MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chein Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

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Knight Piésold
CONSULTING
www.knightpiesold.com

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SOCIAL IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

Executive Summary

The Letpadaung Copper Project (the Project) is located on the largest of four (4) copper deposits in the Salingyi Township area of the Sagaing Region. It is owned by Myanmar Wanbao Mining Copper Limited (MWMCL), Union of Myanmar Economic Holdings Limited (MEHL) and Mining Enterprise 1 (ME-1) and operated by MWMCL. This Environmental and Social Impact Assessment (ESIA) has been prepared to address the effect this project will have within and beyond the Project area and is consistent with a Terms of Reference provided to the Republic of the Union of Myanmar in April 2013.

Under the Production Sharing Contract and its Amendments between the Contract parties, the Government is responsible for all consultation with the community and MEHL is responsible for all elements associated with land acquisition, compensation and resettlement. MWMCL is responsible for the design, operation and closure of the project, as well as completion of this ESIA.

The ESIA has been prepared using the International Finance Corporation's (IFC) standards as a good practice guide to the achievement of sound environmental, social and health outcomes from the Project's implementation.

The document has been developed based on a design approved by MWMCL in November 2012. The project in its broader context consists of:

- An open cut mine from which copper ore and mine waste are extracted;
- A network of crushers which break the ore down to a size suitable for leaching;
- A series of three (3) heap leach pads (HLPs) which will be progressively increased in height, as the optimum leaching period is reached, to a full height of 84 metres (m);
- A solvent extraction and electro-winning plant (SX/EW plant) which is used to extract the copper from the solution from the HLPs and then plate the copper onto electrodes for sale and export.

The estimated mine life is 30 years.

A total of 92,500 tonnes of ore will be mined and placed onto the HLPs daily. This is expected to produce 100,000 tonnes of copper per annum (100ktpa). The stripping ratio in the mine is almost 1:0.99 so it is expect the mining process will also produce almost 30Mtpa of waste rock. This waste rock will be dumped in three (3) areas around the mine during the first 19 years of mine life then placed as backfill into the mined out pit after that time. The waste rock dumps (WRDs) will range in height from 85 m to 150 m in height.

The network of crushers is based around a system of in-pit semi-mobile crushers which is transferred to a mobile stacker for placement onto the HLPs.

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 30 year mine life. Three heap leach pads (HLPs) situated to the south of the crusher complex are proposed for the life of the operation, as shown in Figure 2.1. HLP1 and HLP2 will be utilised initially with HLP3 proposed to be commissioned after 14 years of operation.

The heap leach pad will be constructed with a textured HDPE liner installed over a prepared subgrade. The upper 300 mm of the subgrade will be composed of a compacted clay low-permeability zone with about 5 mm of sand between the top of the clay and the base of the liner to provide an acceptable level of slope stability. The liner will be overlain by 300 mm of cushion material that should be sandy in nature to assure a high interface friction between the liner and cushion. Collection pipes will be installed on top of the cushion layer and arranged in herring bone fashion. The collection pipes will be encased with a sandy gravel layer with a thickness of about 700 mm.

Crushed ore will be spread by conveyor and stacked in cells, the stacked slopes of the heap leach pads are designed with an outer slope of about 37 degrees. Each raise will have a height of about 6 m and every 12 m the subsequent raise will be offset inward 4.5 m, which will create benches on the outer slope thus reducing the global inclination of the heap leach to about 31 degrees. The ultimate height of the heap leach is about 84 m.

The copper is extracted from the ore on the HLPs through a leach process involving the application of a sulfuric acid solution to the surface of heaped ore material which is then allowed to percolate through the ore before being collected in the base of the HLP and diverted to the pregnant liquor solution pond (PLS) for transfer to the SX/EW Plant. In its movement through the ore, the acid dissolves the copper metal in the ore to form a copper laden solution, called the pregnant liquor. This solution is the primary feed for the winning of copper for the production of copper cathode.

After extraction of the copper, the solution is recovered and recycled through the HLPs again to extract further copper for metal production.

A risk assessment was undertaken to determine the potential significant impacts of the Project on the environment within and around the Project site. The assessment was based on the intensity, duration, extent and probability of the impact occurring to determine the unmitigated risk. Based on the availability of management options, the cost of implementation of those options and preparedness to change current practices in this area of work, the mitigated (residual) risk for each impact was determined.

The risks ranged from very low to extreme in the calibration of the methodology.

The following risks were classified as high, very high or extreme unmitigated risks and those in bold text could not be mitigated to a risk of medium or below:

- Construction
  - Contamination of rivers and watercourses;
    - Sediment loads due to erosion of exposed surfaces.
  - Exceedence of health screening guidelines for ground level concentrations of dust;
    - Movement of vehicles and machinery and entrainment from exposed surfaces,
    - **Blasting on site during construction.**
  - Disturbance of noise receptors during the day;
    - Blasting.
  - Disturbance of cultural sites;
    - Site clearance and excavations.
  - Disturbance of view scape;
    - Development of processing plant and other infrastructure,
    - Development of topsoil stockpiles,
    - Construction infrastructure.
  - Resettlement of members of the community;
    - **Persons living within the mining area and the blast exclusion zone are to be relocated to allow for mining to continue.**
  - Reduced access to land for agriculture and traditional livelihood;
    - **Local residents and previous land owners to be excluded from project area.**
  - Increased safety risk to road users;
    - **Construction traffic to and from site,**
    - **Increased traffic due to increased population.**
  - Increase in the spread of communicable disease;

        - Influx of persons into the area (work-seekers and service providers),
        - Increased population density,
        - Greater transient workforce.
    - Change in traditional values and norms;
        - **Greater exposure to transient populations and new technologies.**
- Operations
    - Change in landform and landscape character;
        - **Excavation of open pit,**
        - **Development of dams, HLPs and waste rock dumps.**
    - Soil contamination;
        - **Acid rock drainage (ARD) and metal leaching associated with waste rock dumps,**
        - ARD and metal leaching associated with HLPs.
    - Lowering of groundwater table reducing groundwater supply;
        - Decrease of groundwater level elevation due to pit dewatering.
    - Contamination of groundwater resources;
        - **Seepage from the HLP or waste rock dumps.**
    - Loss of catchment yield;
        - Containment of storm water run-off,
        - Change in creek hydrology.
    - Contamination of rivers and watercourses;
        - Dirty water run-off from plant area, pit, waste rock and HLP area,
    - Exceedence of health screening guidelines for ground level concentrations of dust;
        - Movement of vehicles and machinery and entrainment from exposed surfaces,
        - **Blasting on site for mining,**
        - Wind blown dust from exposed surfaces.

- Exceedence of health screening guidelines for ground level concentrations of sulphuric acid;
    - Acid mist from HLPs.
- Disturbance of noise receptors during the day;
    - Blasting.
- Disturbance of noise receptors at night;
    - Movement of vehicles, machinery and mechanical operation of plant components (e.g. crushers).
- Disturbance to receptors due to blast vibrations;
    - Blasting associated with open pit mining.
- Increased pressure on ecological services;
    - **Increased collection of fuel wood associated with influx of people,**
    - **Bio-ethnology** (loss of traditionally used plants and medicinal resources due to site access restrictions).
- Vegetation clearance and loss of plant productivity;
    - **Influx of persons into the area (work-seekers and service providers) requiring fuel and land.**
- Disturbance of view scape;
    - **Development of pit,**
    - **Development of waste dumps,**
    - **HLP development.**
- Increased safety risk to road users;
    - Operations traffic to and from site,
    - Increased traffic due to increased population.
- Increase in the spread of communicable disease (including HIV/AIDS);
    - Influx of persons into the area (transport operators and service providers).

• Closure
- Soil contamination;

        - **Long term ARD and metal leaching associated with waste rock dumps,**
        - **Long term ARD and metal leaching associated with HLPs.**
- Contamination of groundwater resources;
    - **Seepage from HLPs or waste rock dumps.**
- Contamination of rivers and watercourses;
    - **Dirty water run-off from waste rock dumps and HLPs,**
    - Slope failure of HLP / waste rock dump resulting in exposure of PAF leached ore / mine waste to surface water runoff.
- Disturbance of view scape;
    - Establishment of permanent pit lake,
    - Establishment of permanent waste rock dumps,
    - Establishment of permanent HLP heaps.
- Loss of jobs;
    - **Direct loss of jobs at mine after operations cease,**
    - **Indirect loss of jobs in surrounding area from industries linked to mine and mine employees.**
- Loss of land for agriculture and traditional livelihood;
- Rehabilitated WRDs and HLPs unsuitable for grazing or cultivation of crops due to potential for damage to cover system.

The biophysical environment of the Project area has been studied on several occasions since 1996 when the feasibility of the Sabetaung and Kyisintaung deposits and the Letpadaung deposit were being considered as separate operations. During that time the physical environment in the area has remained almost static in its environmental condition whereas quite marked changes have occurred in the biological environment.

The climate in the area is a summer monsoons with a positive water balance (rainfall – evaporation) only experienced in September and October. The monsoons are carried into the area by winds from the south. The area experiences two other seasons, a cool-dry and a hot-dry, which are dominated by high temperatures, little or no rainfall and northerly winds. The rainfall in the area is about 725 mm with about 2000 mm of evaporation being experienced annually. Winds in the area generally do not exceed 10 m/s and average about 3.5 m/s.

Groundwater in the area is dominated by the Kangon aquifer and the groundwater levels are as shallow as 1.8 m from the surface. The groundwater from this aquifer can be avoided with minor changes to the latter stages of the pit design (after Year 20). But its presence may limit the capacity of water storage ponds and its shallow depth in some areas increases the risk of contamination from surface spillages. Groundwater seepage into the open pit is estimated to be 26 l/s based on investigations undertaken around the pit perimeter.

Surface water is dominated by flows from the Chindwin River when it floods. However, in normal circumstances the Project area is a net, although small, generator of runoff. Studies completed have identified a need to divert flows through the site from the west to maintain community supply to the south of the project area. These flows are estimated to be in the order of 25 m^3/s. Conservation of water supply to the communities downstream of the project is a **moderate** environmental and social risk to the project.

The site will use up to 39,656 m^3/day which will be provide entirely from the Chindwin River during the dry season. Small quantities of water will be available from mine pit water. During the wet season water will be collected on site and stored for use during the dry season.

The soils in the Project area range from rock scree, on the hill slopes, to fine grained soils, on the floodplains of the Chindwin River. The finer grained soils are found in areas which are most suitable for crop production due to their moisture retention and ease of cultivation and the lower slopes of the hills are more suitable for grazing. The upper scree slopes cannot be heavily grazed or cropped due to the high percentage of large stones and the high potential for soil erosion on the slopes.

The ore body itself is made up of a leached overburden cap overlying a hard rock which contains the copper to be won from mining. The leach cap and ore body contain materials that are geochemically reactive when exposed to air and water. The reactivity of the rock generated sulfuric acid in over 70% of samples taken and the balance of the rock samples leached metals under kinetic leach test conditions. These properties make management of ore handling and waste rock dumping critical issues in the environmental management of the operation and the geochemistry of the ore body presents an **extreme** environmental risk to the project.

Vegetation within the project area can be broken down into three (3) classes – the naturally vegetated hills, the cultivated and pastured plains and areas of degraded land (normally thorn bush growing on eroded subsoils). The vegetated hills can be further broken down into four (4) main types of vegetation:

- Low heath in the broad saddle between the hills;
- Low shrubland on the lower slopes where drainage is received from higher slopes;

- Tall shrubland in steeply sided and cooler valleys; and
- Stunted woodland on the hill crests.

Some species growing in the area are used for provision of firewood, traditional medicines and foods and fodder for livestock. Supplementation of areas to foster growth of these areas in areas surrounding the project is being considered by government agencies and MWMCL to offset loss of access to these resources.

A review of historical reports suggests that the loss of natural resources and species in the Project area has occurred over an extended period. A number of timber plantations present at the time of the 1997 Feasibility Study are no longer present and the size of the timber resource (in m^3/ha) and height of the forests are at least 50% less when recent baseline studies were conducted.

The studies did not identify any flora species listed as rare or endangered on international registers.

In addition, studies of the fauna of the Project area suggests that species present only represent a small proportion of the species known from the Monywa district. The studies did not identify any fauna species listed on international registers of rare or endangered fauna, although Eld's Deer (*Panolia eldii*) is known to use the Letpadaung Hills and its foothills as feeding habitat. This species is considered as 'significant' by Myanmar wildlife conservation authorities and the local community. Special local reservation areas are being considered for this species.

At a community level, the loss of natural resources is considered a **high** risk to the community and the Project as it threatens continuation of local culture and may hamper security of the site if people seek to continue to access the site to collect traditional materials.

The need to acquire land to accommodate the Project and relocate people living within the Project site has an **extreme** level of risk associated with it, both for the Project and the communities involved. The communities involved draw their livelihood from agrarian based activities – production of subsistence and cash crops and grazing of animals. The loss of the ability to practice these activities takes away the ability to sustain this livelihood for project-affected-peoples (PAP). This not only include people living on the land, but also people who own land but live outside the areas being acquired for the Project and those people who provide labour to assist in the agrarian based activities and draw an income from them.

MWMCL has offered a minimum of one job per person on the Project for every household that was relocated as a consequence of the project. This offering increases as the size of the affected land involved increases (to a maximum of three jobs). To take up this opportunity most of the PAP within these households will require training and on-the-job skills development to

meet that opportunity to the fullest extent. Given the level of literacy within the community – greater than 50% of people do not have an education and many of those with an education did not go beyond Year 3 at school – the complexity of work, and subsequently the income that each household could expect to earn, will be quite low and possibly result in income per capita still being below the World Bank recognized poverty line. At present, the salary MWMCL provide to unskilled laborers is USD120/month, which is much higher than local mean salary level and that of civil servants in Myanmar government. That salary can be improved will skills development through on-the-job education and training.

In addition, within the communities involved, there are people who draw a living from the land who could not fulfill a role in another industry – the old, the youth, woman who split their home duties with work in the fields and men whose life long experience has been farming using hand tools and animals who actually fear working with machines. Opportunities need to be provided for these people to work directly or indirectly on the Project. The development of cottage industries – sewing, plant propagation, revegetation, for example – need to be considered.

For people who have received compensation, assistance needs to be provided in management and investment of the funds resulting from the compensation. Case studies on other projects suggest this income is quickly dispersed in many cases leaving the PAP in poverty with no means of sustaining themselves or their families. Successful resettlement requires management of the release of funds and education in their management.

A Resettlement Action Plan (RAP) needs to be developed by MEHL (the nominated agent for land acquisition) and endorsed by the Government to ensure the assistance required for the successful resettlement and compensation of the PAP. The RAP should consider short-, medium- and long-term requirements for this success and include a documented grievance mechanism that is developed in consultation with the community and communicated through all the affected communities.

MWMCL has developed a Community and Social Development Plan to make provision for the needs of the community in its strengthening and capacity building. This Plan needs to be supported by all the Project partners and be complemented by Government programs at all levels to maximize its effectiveness. Actions associated with this Plan are already being implemented with some benefits, particularly associated with health issues being evidenced.

In-migration is a **high** risk, particularly during the construction phase of the Project, which requires considerable management. In-migration brings with it issues of disease introduction, increased levels of disposable income, cultural change, vice and crime. MWMCL has put in place policies to assist with management of some of these issues. However, the implementation will require co-operation from local government, local service providers and individuals to

minimize its effect. As a result, consultation with the community is required to highlight these issues and opportunities for reporting of such issues needs to be provided through two-way conversations with the Project managers. Within the site and the staff working on the Project, management can take actions to raise the awareness of staff and control activities to limit the vectors for disease introduction and promote codes of behavior.

The introduction of the economic activity will increase the overall flow of money within the community. This is a **high** risk in both a positive and negative sense depending on the issues involved. This will result in increased demand for goods and services, which has the potential to increase their costs within the community. Monitoring of this effect will be undertaken to ensure an economy does not develop where individuals with a substantial income develop an economy which cannot involve people not engaged in the Project due to the differences in income level. Increased income is also likely to see access to services like mobile phones become highly utilized, particularly among younger persons. With that access, other challenges for the community will arise, including knowledge of the global community, lifestyle opportunities, some of which challenge traditional norms, and entrepreneurship.

Planning for the cessation of mining after the 30-year life of the Project needs to be progressively developed as the certainty of the operation develops. Closure planning also needs to accommodate the early cessation of mining as a result of mineral economics or increased production throughput. Closure planning should engage the community to identify its expectation and also accommodate their desire for use of the Project site after mining. After the works associated with closure are completed, a period of monitoring will be required to demonstrate the long-term sustainability of the closed site and the community affected by the closure.

The loss of livelihood is an **extreme** risk to be considered in the development of the detailed closure plan. Unless alternative industry or another mine was to commence operation which can use the skills gained, it is highly unlikely the direct and indirect employees of the Project would find alternative local employment. If these employees were members of families that had lost land at the commencement of the project, any opportunity to return to a subsistence or cash crop lifestyle will have been foregone.

The cumulative impacts of this Project are closely linked to the nearby S&K mine, other large mining projects in the region (should they develop) and in Myanmar as a whole, development projects undertaken by the Government and aid organizations and cultural changes in the community. The cumulative impacts of the two mines can be managed as there is common ownership between the two Projects. They include environmental issues like dust, noise and vibration as well as activities like land acquisition, community development, education and training, health initiatives and transport management. A significant cumulative impact will occur

when the S&K mine finishes operation in about 15 years into the future. In the face of no alternative work, these staff will increase competition for work at Letpadaung, particularly as many of them will have significant levels of experience in the mining industry. The impact of other mining projects are likely to involve movement of trained national staff between projects which leads to movement of local knowledge, culture and skills, as well as demands for services like transport and mining support.

A series of management plans has been developed to address all risks identified, including moderate and lower risks, with the view of reducing the risk to the lowest level possible. In some instances, such as the geochemical and resettlement risks, the degree or extent of impact makes it difficult to reduce the risk significantly and these risks remain high or extreme. Other risks have limits to the level of control over those risks that is held by MWMCL and the reduction of those risks requires intervention by local, regional or national government to reduce them to the fullest extent possible. The management plans should be fully developed to a system that can be incorporated into an Environmental and Social Management System.

MWMCL will prepare an Environmental and Social Management System at the commencement of construction with a view to having that system functional, compliant with and certified to ISO 14001, the international standard for Environmental Management Systems, within three (3) years of commencement of Project operation. The system will detail all activities required to manage environmental and social issues to the extent possible by MWMCL and include policies, objectives, the legal framework, management criteria, control procedures, training packages, roles and responsibilities, monitoring and reporting and audit and review practices adopted in relation to the Project.

MWMCL will report their performance to relevant government agencies in relation to specific issues on a quarterly basis. A detailed annual report which will include details and analysis of all environmental management on the site will be provided to the Ministry of Environmental Conservation and Forests and the Ministry of Mines on an annual basis. In addition, MWMCL will produce a project Sustainability Report consistent with the elements described in the Global Reporting Initiative for the Project. All reports produced on a quarterly or annual basis will be provided to the public via the Project website. Reports will also be made to the project affected villages on a quarterly basis, at a minimum, describing progress with the project and its community development as well as describing what is planned for the next quarter of the year. Community reports should also describe any complaints or grievances received and how they were resolved. Where items are still outstanding, MWMCL will report on progress being made with them.

The Project can be undertaken with some effects in the Project area which will not have a long term impact on the environment when compared to the benefit the community and the nation

may derive from the Project. However, achievement of this result will require strict adherence to management plans described in this document, recognition that the extreme and high risks exist and continuous, timely and diligent attention to that management.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Myanmar Wanbao Mining Copper Limited (MWMCL or Project Proponent) is developing the Letpadaung Copper Project (the Project) located in the south of Sagaing Region, Myanmar. The Project site is approximately 4.5 km to the south west of Monywa, the largest township of the Region as shown in Figure 1.1.1.

The Letpadaung deposit, on which the Project is based, is the largest of four deposits (Sabetaung, Sabetaung South, Kyisintaung and Letpadaung) in terms of resource in the Monywa area and accounts for 75 % of the resource from all four deposits.

This Environmental and Social Impact Assessment (ESIA) is based on the development of an open-pit copper mining operation at the Letpadaung deposit to support an ore processing capacity of 92,000 tonnes per day (tpd).

The Project will comprise the following major facilities and activities:

- The construction and operation of open-pit mining operations and related infrastructure;
- The construction and operation of crushing and heap leaching facilities, with an average throughput of 92,000 tpd, which may be expanded in the future;
- The construction and operation of a solvent extraction and electrowinning (SX/EW) plant to produce 100,000 tonnes per annum (tpa) of cathode copper;
- The construction and operation of waste rock dumps (WRD);
- The construction and operation of a water abstraction and supply system between the Chindwin River and the Project site; and
- The construction and operation of a power supply system incorporating a 230 kV step-down sub-station, 35 kV sub-station and other various sub-stations.

A workforce total of 2,000 persons will be required for the construction phase of the Project and about 2,500 persons during the operational phase. It is planned that 90 % of the workforce will be sourced from Myanmar with a preference for engagement from within the Salingyi Township area if numbers and skills permit. About 10 % of the workforce will be Chinese nationals or other expatriate staff to provide the high level management of the Project and technical expertise unavailable in the country.

In line with its Health, Safety and Environmental Policy (HSEP), MWMCL is committed to assessing in full the potential economic, environmental, health, safety and social impacts of its operations, and is committed to avoiding, minimising or mitigating negative impacts and enhancing positive impacts wherever possible.

MWMCL expects to meet applicable requirements of Myanmar legislation for natural resource operations, project development and environmental and social impact assessment. Additionally, the Project has been designed to meet current international good practice. This ESIA sets out how the Project will seek to implement international good industry practices including the applicable requirements of the International Finance Corporation (IFC) Performance Standards for Social and Environmental Sustainability (2006).

This draft ESIA will be disclosed to Project stakeholders and the public and will be updated as needed in response to their comments. The ESIA will be used as a reference by international financial institutions seeking to finance the development of the Letpadaung Project in accordance with their environmental and social policies, IFC performance standards, and the Equator Principles for commercial banks.

1.2 PROJECT LOCATION AND SETTING

The Letpadaung Copper Project is located in the south of Sagaing Region, Myanmar. The project is approximately 4.5 km to the south west of Monywa, a regional town located 110 km west of Mandalay, the economic centre of central Myanmar, and 722 km north of Yangon. Travel to Monywa from the project site can be undertaken by road or by river transport. From Monywa, ongoing travel and transport can be undertaken by road, rail and air. The Project site is located around the geographic location 22 º04’ N, 95º05’ E (716100mE, 2443100mN, Zone 46Q) and occupies an area of 32.73 km^2.

The location of these major facilities is shown in Figure 1.2.1.

1.3 SITE AND PROJECT HISTORY

Copper mining and smelting started in the Monywa copper district several centuries ago. The British discovered the mineral wealth of the Salingyi Township in the 1930’s and the Myanmar Geological Department visited and investigated the site in the 1950’s together with a Yugoslavian geological team. This visit resulted in the implementation of an exploration programme. Myanmar Geological Bureau (MGB) and relevant institutions of the United Nations (UN), Japan and Yugoslavia then carried out a series of exploration programmes to follow up on the findings of the initial programme.

Mining Enterprise No 1 (ME-1) of Myanmar and BorInstitute of Yugoslavia signed an agreement in 1978 to jointly develop the Sabetaung and Kyisintaung deposits and a processing plant with a capacity of 8,000 tpd was built in 1984. Production was difficult to maintain and the operation stopped soon afterwards due to low recovery and poor economic benefits.

ME-1 signed a Feasibility Study agreement with Ivanhoe Myanmar Holdings Limited in 1994 to jointly develop the Sabetaung and Kyisintaung deposits. A 1 tpd copper pilot plant was built in 1995 and detailed exploration started. Myanmar Ivanhoe Copper Corporation Limited (MICCL) was formed in 1996. Mining only took place at Sabetaung and Sabetaung South whilst the Kyisintaung and Letpadaung deposits remained untouched. The MICCL operation had a design capacity of 25,000 tpa cathode copper. The plant was put into production in 1998 and the capacity was expanded to 39 kilotonnes per annum (kt/a) in 2004. The mine essentially ceased operating between April 2008 and August 2010, with only sporadic production continuing. Some production was resumed in September 2010 and has increased in scale since that time. It is currently producing about 11,000 tpa of copper cathode.

Wanbao Mining Ltd organised an expert group to visit the Monywa copper mines and investigate the resources and production there in July 2007. The expert group recommended purchase of the Project following the visit.

Wanbao Mining Ltd then organised another expert group to visit the site in December 2008. A review of data relating to previous exploration programmes, feasibility study reports and mine production conditions, and additional testing confirmed the presence of a primary ore body.

Wanbao Mining Ltd reached a draft co-operative development agreement with the Myanmar Government in March 2010 preliminarily acquiring the mining right of the Letpadaung deposit. The formal co-operative development agreement was signed on 3 June 2010. At present MWMCL is in the process of preparing to develop the Letpadaung deposit.

In May 2010 MWMCL selected China Nerin Engineering Co. Ltd. (NERIN) to complete the Feasibility Study, Basic Design and Detail Design for the Project. NERIN completed the Feasibility Study Report for the Myanmar Monywa Letpadaung Copper Project (100 kt/a cathode Cu) in September 2010 and completed the Project Application Report in October 2010. The Basic Design was submitted for review in February 2011 and was approved by MWMCL in May 2011.

A site locality plan showing the relative location of these operations is shown at Figure 1.2.1.

1.4 PROJECT OWNERSHIP

Wanbao Mining Ltd. (Wanbao Mining) was established on 16 March 2005 and is a subsidiary of China North Industries Corporation. Wanbao Mining is a professional mining company approved by the Chinese Government with a registered capital of

RMB 1,3 million. The headquarters is in Beijing and overseas subsidiaries are established to run overseas projects.

Myanmar Wanbao Mining Copper Ltd. (MWMCL) is registered in Myanmar and wholly owned by Hong Kong Wanbao Mining Copper Ltd. which itself is a wholly owned subsidiary of Wanbao Mining Ltd. With a registered capital of USD 10 million, MWMCL is the operational entity to develop the Letpadaung Copper Mine Project.

The Myanmar partner in the Project contributes the mining rights while Wanbao is responsible for Project investment development and management. Both parties will share Project benefits based on the Production Sharing Contract for Letpadaung Copper Mine. The large scale mineral production permit for Letpadaung is currently held by Myanmar Economics Holding Limited (MEHL).

1.5 PRODUCTION SHARING AGREEMENT

The key terms of the Production Sharing Agreement between MWMCL and MEHL are as follows:

- MEHL are responsible for the requisition of land required for the development and operation of the mine and associated infrastructure.
- MEHL are responsible for the removal of former landholders, occupants, or squatters still residing in the land take area.
- Any delay in the completion of the project construction due to the above is not the fault of MWMCL and would constitute grounds for an extension of the contract period.

The responsibility for land requisition rests with the Myanmar Government, represented by MEHL. Wanbao, as the Project Operator, is active in the communities near the Project Area, especially in those affected by land take, and has made broad efforts to establish rapport and improve relations with local communities with a view to winning their support for the mine development.

1.6 EXISTING OPERATIONS AND FACILITIES

Letpadaung is a greenfield mining project and therefore requires extensive investment in plant and infrastructure in addition to development of an open pit and processing facilities. Existing infrastructure is limited to:

- Accommodation camps including laydown areas and workshops located at the foot of the hills northwest of the proposed pit and in the south of the site;
- A small starter pit on the eastern side of Letpadaung Hill;
- Site access roads, along the western and northern boundaries of the future pit,

- A haul road accessing the starter pit from adjacent to the main camp area in the north western corner of the Project area; and
- A haul road access from the Chindwin River and the S&K mine operations

The site layout is shown in Figure 1.4.1.

1.7 DOCUMENT STRUCTURE

This ESIA has been prepared to provide an integrated social and environmental assessment of the Letpadaung Project across all social and environmental media and all phases of the Project. The ESIA draws on a range of project component specific environmental assessments previously prepared for Myanmar approval purposes and a baseline environmental and social investigations undertaken by MWMCL to assist in understanding existing environmental conditions associated with the Project.

The ESIA is structured in twelve sections as follows:

- Section 1 describes the project location, its history, the existing operations and facilities as well as describing the document structure.
- Section 2 describes the administrative setting including government and public administration structures in the project area, applicable legislation, rules and guidelines, good practice guidelines and applicable standards adopted in design.
- Section 3 describes the historic studies in the area including: the 1996 and 1997 feasibility studies; environmental studies undertaken in 2004; and the basic design and associated studies undertaken as part of the project development.
- Section 4 provides a detailed description of the environmental aspects of the Project including atmospheric, surface water, groundwater, geology, geochemistry, seismicity, soils, flora and fauna and the social environment.
- Section 5 presents a project description including a description of the ore body, the construction tasks, site water management, waste management and staff engagement and accommodation.
- Section 6 presents a description of the community consultation methodology, records of meetings held, issues raised and responses by MWMCL.
- Section 7 presents a description of the impacts on the natural environment including a description of the assessment methodology.
- Section 8 describes the Environmental Management Plans for the Project.
- Section 9 describes the Social Management Plans for the Project.
- Section 10 describes the Environmental and Social Monitoring Plans covering the frequency of monitoring for specific management elements as well as the proposed reporting schedules for internal and external review.
- Section 11 presents a list of commitments by MWMCL arising from the ESIA.

- Section 12 presents a conclusion and a series of recommendations arising from the ESIA.

2. ADMINISTRATIVE SETTING

2.1 GOVERNMENT AND PUBLIC ADMINISTRATION STRUCTURES IN THE PROJECT AREA

Myanmar is divided into 21 administrative subdivisions, which include: states (7), regions (7), self-administered zones (5), a union territory, and a self-administered division. The Regions were called Divisions prior to August 2010 and five of them are named after their capital city. The Regions can be described as ethnically predominantly Burman (Bamar), while the States, the Zones and the Division are ethnic minority-dominant. States and Divisions are divided into Districts. These Districts consist of Townships that include towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The Project is located in the south of Sagaing Region 93 km west-northwest of the region's capital city of Sagaing. The immediate Project area is located within the Salingyi Township, 4.7 km southwest of the town of Monywa.[1]

Sagaing Region (formerly Sagaing Division) is an administrative region of Myanmar and is located in the north-western part of the country between latitude 21° 30' North and longitude 94° 97' East. It is bordered by India's Nagaland and Manipur States to the north, Kachin State, Shan State, and Mandalay Region to the east, Mandalay Region and Magway Region to the south, with the Ayeyarwady River forming a greater part of its eastern and also southern boundary, and Chin State and India to the west. The Region has an area of 93,527 km². The population in 2012 was 6,600,000. The urban population was 1,230,000 and rural population was 5,360,000. Sagaing (city) is the capital of the Sagaing Region.

Sagaing Region consists of eight (8) districts divided into 34 townships with 198 wards and villages. The major towns and cities are Sagaing, Monywa, Shwebo, Katha, Kale, Tamu, Mawlaik and Hkamti. The districts are Sagaing, Shwebo, Monywa, Katha, Kale (Kalemyo), Tamu, Mawlaik and Hkamti. The townships include Monywa, Salingyi and Yinmabin (Yin Mar Bin) which are all within or nearby the Project area.[2]

The Project area has affected people in seven (7) villages - tracts and 29 villages (four of which have been resettled).

[1] As described in http://en.wikipedia.org/wiki/Administrative_divisions_of_Burma as cited on 16 September 2013
[2] As cited in http://en.wikipedia.org/wiki/Sagaing_Region on 16 September 2013

2.2 APPLICABLE LEGISLATION, RULES AND GUIDELINES

2.2.1 Legal and Other Requirements

This section reviews the administrative and legal structures set up to protect the environment, as well as ongoing activities by the government and civil society organisations based inside and outside Myanmar that are intended to promote sustainable development and environmental protection.

The Draft Environmental Impact Assessment Rules, which are yet to be enforced states that every project proponent is required to carry out an Environmental Impact Assessment in respect of a proposed project and shall prepare an Environmental Impact Assessment Report detailing every stage of the assessment and its conclusion in a format and timeframe as may be prescribed by the Ministry of Environmental Conservation and Forestry. The project proponent shall prepare an Environmental Management and Monitoring Plan in a format prescribed by the Ministry of Environmental Conservation and Forestry and shall submit it with the Environmental Impact Assessment Report.

2.2.2 Legal Requirements

Legal and approval requirements applicable to the Project related to the environment will be identified by MWMCL.

To meet environmental, legal and other requirements, MWMCL shall:

- Ensure that legal and other obligations are incorporated in the designs, procedures and project controls;
- Communicate legal and other requirements to personnel and contractors accountable for compliance;
- Ensure all relevant legal and other requirements and associated documentation (e.g. licenses, permits, approval applications) are readily available on site to MWMCL personnel, contractors, subcontractors and consultants; and
- Conduct a compliance audit at least annually and ensure there is a process in place to monitor on-going compliance with all legal and other requirements. Where work or construction activities are less than 12-months in duration at least one compliance audit will occur.

2.2.3 National Legislation

The following Myanmar Acts and Rules apply to the Letpadaung Copper Project:

- The Land Acquisition Mines Act (1885);
- The Water Power Act (1927);
- The Forest Law (1992);

- Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law (1994);
- The Protection and Preservation of Cultural Heritage Regions Law (1998);
- The Explosives Act (1887);
- The Explosive Substance Act (1908);
- Myanmar Insurance Law (1993);
- The Factories Act (1951);
- Workmen's Compensation Act (1923);
- Union of Myanmar Public Health Law (1972);
- The Natural Drug Law (1992);
- The Traditional Drug Law (1996);
- The National Food Law (1997);
- Prevention and Control of Communicable Diseases Law (1995);
- Mines Law (1994) and accompanying Mining Rules:
    - Environment Conservation Law (2012)
    - Foreign Investment Law (2012)
- Foreign Investment Rules (2013) by the Ministry of National Planning and Economic Development:
    - Notification No. 1/2013 by Myanmar Investment Commission
    - Environment Conservation Law (2012)
- Guideline to Overview of Labour Laws in Myanmar published by the Ministry of Labour 2004.

2.3 THE ENVIRONMENTAL CONSERVATION LAW 2012 (ECL)

2.3.1 Objectives

The ECL, the landmark law specifically dedicated to address environmental conservation, was enacted:

a) to implement the national environmental policy;
b) to lay down basic principles and provide guidance to systematically integrate environmental conservation matters with the sustainable development works;
c) to build a healthy and clean environment and to conserve natural and cultural heritage for the benefit of current and future generations;
d) to restore the deteriorating and disappearing ecosystem to the fullest extent possible;

e) to enable to manage and implement for the decrease and loss of natural resources and for enabling the benefits of sustainable use;
f) to enable promotion of public awareness and cooperation in the matters of environmental conservation;
g) to enable promotion of international, regional, and bilateral cooperation in the matters of environmental conservation; and
h) To co-operate with the government departments and organisations, international organisations, non-governmental organisations and private individuals on environmental conservation matters.

2.3.2 Current Position

Though the ECL paves the way for the use of EIA and/or SIA in evaluation of issuing a prior permission for prescribed businesses, the prior permission scheme itself is discretionary and there is currently no basis in the law for the Ministry to determine whether or not to issue a permit, and whether to impose environmental compliance conditions on the user. Also, some of the Ministry of Environmental Conservation and Forestry's (MOECAF) broad powers granted under the law require the approval of the Union Government and the Environmental Conservation Council (ECC) but without the clear power and basis of the approval.

There are no regulatory guidelines and rules specified to enable the ECL to be operable in practice: such as setting the environmental quality standards, emission standards, and classes of hazardous waste and substances. In addition, there is a need to cover the non-point sources of pollution that is not discussed in the ECL.

The ECL provides for integration with sectoral policies and co-ordination amongst the Ministries and departments. It is expected that the Environmental Conservation Rules (ECR) of the ECL which is underway would provide regulatory guidelines to implement the ECL.

The maximum monetary fine imposable under the law is only Kyats 2,000,000 or about USD 2,300.

2.3.3 Obligations of Business Owners and Occupiers

The polluter at source has obligations to clean, discharge, dispose, or keep pollutants in accordance with the prescribed standards.

The owner or occupier of business activities, materials or places that are the source of the pollution must install or use an on-site facility or controlling equipment to monitor, control, manage, reduce or eliminate environmental pollution. If this is not possible, it

must be arranged to dispose the wastes in accordance with environmentally sound methods.

The individuals or organisations conducting activities in the industrial zones, or special economic zones or the businesses appointed by the Government ministries have responsibilities to contribute either in cash or in kind and carry out the management of pollutants and environmental conservations, including the treatment of wastes collectively; must give the fees for the usage and expenses incurred in connection with management of environmental conservation by the relevant industrial zones, special economic zones and business organisations; and must comply with the environmental conservation directives published by the relevant industrial zone, special economic zone or the business organisations.

2.3.4 Insurances

The person who has obtained the necessary prior permission to carry out the business concerned must obtain the environmental accident insurance in accordance with the existing laws. Section 77 of the FIL states that "All economic organisation formed under a permit shall affect insurance with any authorised local insurance enterprise in respect of the following types of insurance:

a) machinery insurance;
b) fire insurance;
c) marine insurance;
d) physical injury insurance;
e) natural disaster insurance; and
f) life insurance.

Section 78 provides that in addition, an economic organisation shall acquire other types of insurance prescribed by any existing law based on the category of economic activity.

2.3.5 Prohibitions, Offences and Penalties

No one is allowed to operate a business, worksite, factory, or workshop without the prior permission from the Ministry. The violation of this prohibition constitutes an offence punishable by imprisonment with a term not exceeding 3 years, fines with an amount not smaller than Kyats 100,000 and not greater than Kyats 1,000,000, or both.

No one shall violate any prohibition contained in the rules, notifications, orders, directives and procedures issued under the ECL. The violation of this prohibition constitutes an offence punishable by imprisonment with a term not exceeding 1 year, a monetary fine, or both.

No one shall, without permission of the MOECAF, import, export, produce, store, carry or trade any material which can have an adverse impact on the environment. Any violation of this prohibition will attract a prison term of minimum 3 years and maximum 5 years, a monetary fine of minimum Kyats 100,000 and maximum Kyats 2,000,000, or both.

2.4 FOREIGN INVESTMENT LAW 2012 (FIL)

The Basic Principals of the FIL state that the investment shall be allowed based upon principles including “protection and conservation of the environment”.

The duties of the investor requires the business to be carried out in a manner that does not cause environmental pollution or damage in accord with existing laws in respect of investment business.

2.5 FOREIGN INVESTMENT LAW 2012 (FIL)

The Basic Principals of the FIL state that the investment shall be allowed based upon principles including “protection and conservation of the environment”.

The duties of the investor requires the business to be carried out in a manner that does not cause environmental pollution or damage in accordance with existing laws in respect of the investment business.

2.5.1 Notification No 1 of 2013

The list of Economic Activities under Prohibition includes the installation of a factory that utilises imported wastes, specifically:

- Manufacturing of hazardous material which are not in compliance with the environmental and conservation Law, Rules and Procedures promulgated from time to time;
- Activities which may emit hazardous chemicals, minerals, rays, noise, particles etc., and may cause earth/water/air pollution which affect public health; and
- Exploitation of minerals including gold in the revering and water way.

The list of Economic Activities Permitted with Specific Conditions at No (3) in Notification 1 includes economic activities which require Environmental Impact Assessment. These include exploration and production of minerals, manufacturing of iron, steel and minerals and operation in cultural heritage, archaeological and prominent geographical symbolical sites, amongst others, all require the assessment of Environmental Impact and Social Impact or Environmental Impact without Social Impact to be carried out for the initial study of the environment, prior to the granting of approval to proceed.

Clause 37 of the Rules of the FIL states “In order to scrutinize accepted proposals sector by sector, a Proposal Review Group, composed of high ranking officers from the following departments (including the Environmental Conservation Department), is to be formed to perform preliminary scrutiny”.

Section 47 states that the Commission shall scrutinize investment proposals, including the remarks from the Ministry of Environmental Protection and Forestry on the proposed mitigation measures to reduce the social and environmental impacts of the project.

Notification No 1/2013 of MIC dated 29th January, 2013 includes in the List of Economic Activities requiring Environmental Impact Assessments, the exploration and production of minerals depending upon the scale of business activity, to avoid environmental and social impacts, or to minimise environmental and social impacts. It will be allowed only after the EIA is concluded.

2.6 MINES LAW (1994) (MML) AND ASSOCIATED MINES RULES

The Mines Law (1994) aims to protect the environment from mining operations that may be detrimental to environmental conservation.Section (3) of the Mine Law states the following objectives:

- To carry out for the development of conservation, utilisation and research works of mineral resources; and
- To protect the environmental conservation works that may have detrimental effects due to mining operations.

Under the section referring to the duties of the holder of Permit, it is stated that the holder of permit shall comply with the rules prescribed under this Law in respect of the following matters:

- Making provisions for safety and the prevention of accidents in a mine and their implementation;
- Making and implementation of plans relating to the welfare, health, sanitation and discipline of personnel and workers in a mine;
- Making provisions for the environmental conservation works that may have detrimental effects due to the mining operation;
- Reporting of accidents, loss of life and bodily injury received due to such accidents in the mine; and
- Submission forinspection bythe Chief Inspector and his inspectors.

Rules 69 to 73 govern the rights of utilisation of land and water for mineral production. They include the provision that puts the burden of responsibility of land and water pollution onto the mineral permit holder. It is his responsibility not to pollute.

The holder of a mineral exploration permit or a mineral production permit must backfill or otherwise make safe bore holes, excavations, surface of land damaged during the course of underground mining operations to the satisfaction of the Ministry or the Department. The holder must also establish forest plantations or pay compensation to the Ministry of Forestry (now MOECAF), if trees were cut and cleared for mineral exploration or mineral production within a forest land or in a land area covered with forests.

In disposing of liquids, wastes, tailings and fumes which have resulted from mineral production, the holder of a mineral production permit must undertake laboratory tests as may be necessary for the prevention of pollution of water, air and land in the environment and for the safety of living beings. If toxic materials are found in the waste products, which are harmful to living beings, degradation shall be made by chemical means and systematic disposal shall be made only when it is assured that there is no danger.

The holder of a permit for mineral production within an area under the Ministry's administrative control or which does not lie within the Mineral Reserve Area or Gemstone Tract, shall carry out such production only after co-ordinating and receiving agreement from the individual or organisation having the right of cultivation, right of possession, right of use and occupancy, beneficial enjoyment, right of succession or transfer of the said land.

If the holder of a mineral production permit requires the use of public water for mineral production he shall first and foremost inform the Department of such requirement in accordance with the prescribed manner.

If the Department, after scrutinising the requirement submitted under Section 16 finds that the use of public water is necessary for the holder of a mineral production permit, it shall co-ordinate with the relevant government department(s) and organisation(s) to obtain permission to use water in accordance with the existing law.

Chapter XXI of the Myanmar Mining Rules (MMR) describes "making provisions to prevent detrimental effects due to mining operations on the environmental conservation works". The requirements include:

- Backfilling or making safe bore holes, excavations or surface of the land damaged during the course of underground mining; and

- Undertaking laboratory tests, as necessary, to prevent pollution of water, air and land.

2.7 NATIONAL COMMISSION FOR ENVIRONMENTAL AFFAIRS (CURRENTLY ENVIRONMENTAL CONSERVATION COMMITTEE)

Environmental protection in Myanmar previously came under the authority of the National Commission for Environmental Affairs (NCEA), formed in 1990. Until 2005, the Minister of Foreign Affairs was the chair of NCEA. In 2005, however, the NCEA was transferred under the Ministry of Forestry (MoF), and the Minister of Forestry assumed the role of the NCEA chairperson.

The stated objectives of the now Ministry of Environmental Conservation and Forestry were to set environmental standards, create environmental policies for using natural resources, issue rules and regulations to control pollution, and to create short- and long-term environmental policies which balance environmental needs and development requirements.

The Ministry of Environmental Conservation and Forestry has drafted the Environmental Impact Assessment Rules, which are pending approval by the government, to complement the ECL 2012.

2.8 ENVIRONMENTAL AND SOCIAL POLICIES

A national environmental policy was drafted in 1994. The National Environment Policy is as follows:

"To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources."

The objective of Myanmar's environmental policy is to achieve harmony and balance between its people, its cultural heritage, its environment and its natural resources through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilise its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations.

The development of the environmental policy was followed by the drafting of 'Myanmar Agenda 21' in 1997, which follows a UN framework for a multi-pronged approach to sustainable development. The Myanmar Agenda 21 recognises the need for Environmental Impact Assessments. Myanmar, in its Agenda 21, calls for integrated management of natural resources and provides a blueprint for achieving sustainable development.

The ECL provides more institutional space to regulate environmental quality and conduct EIA's and SIA's for infrastructure and investment projects funded by the government and private sector.

2.9 MYANMAR INVESTMENT COMMISSION (MIC)

The MIC issued a Notification on 30 June 1994 on the Protection of Environment stating that:

1. The Myanmar Investment Commission, at its meeting 8/94 held on 17 June 1994 has resolved that all projects established with the permission of the Commission shall be responsible for the preservation of the environment at and around the area of the project site. The enterprises are entirely responsible that they shall be able to control pollution or air, water and land, and other environmental degradation, and that they keep the project site environmentally friendly.
2. Consequently, it is hereby notified that the treatment plant, industrial waste water treatment plant and other pollution control procedures should be promptly implemented and comply with the sanitary and hygienic rules and regulations set by the relevant authorities.
3. In the future proposals that are to be submitted to the Commission, either under the Union of Myanmar Foreign Investment Law or the Myanmar Citizens Investment Law, shall incorporate the provision in their contracts that they will undertake proper sewage and industrial wastewater treatment systems and other environmental control systems. The system used shall be in accordance with the rules and regulations specified by the respective development committees and local authorities.

2.10 IMPACT ASSESSMENTS IN MYANMAR

One of the most important internationally-accepted environmental protection methods is to conduct an environmental and social impact assessment (ESIA) prior to implementing development projects. An ESIA identifies, predicts, evaluates, and mitigates the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. The ESIA is supposed to

provide appropriate opportunities to inform and involve stakeholders in a project. In the absence of formal regulations and guidelines in Myanmar regarding the scope and content for ESIA, the International Association for Impact Assessment has guidelines on the objectives and principles of an ESIA which should be used to inform this ESIA process.

A social impact assessment (SIA) is a tool used to help understand the potential impacts that a proposed project may have on a community. Social impact assessment should cover:

> *all social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs, and generally cope as members of society' and 'cultural impacts involve changes to the norms, values, and beliefs of individuals that guide and rationalise their cognition of themselves and their societies* (Burge and Vanclay, 1996).

Hence, the SIA enables the project proponent and government to determine effective strategies to help mitigate the negative impacts, and maximise positive impacts, of a project.

2.11 NATIONAL SUSTAINABLE DEVELOPMENT STRATEGY

The National Sustainable Development Strategy (NSDS) is part of a broader programme of the UN Sustainable Development Commission set up after the World Summit on Sustainable Development in 2002. Every country, including Myanmar, that signed Agenda 21 at the Earth Summit in Rio de Janeiro in 1992, agreed to develop an NSDS by 2010 in line with the Millennium Development Goals (MDGs). UNEP provided funding for Myanmar to develop an NSDS. The main aim of the process was to develop an NSDS in line with international standards by meeting the MDGs and ensure that environmental and social impacts are mitigated when implementing development projects. The NCEA took a lead in developing the strategy in consultation with the government and a small number of NGOs. Myanmar's NSDS was published in August 2009.

The three goals described in Myanmar's NSDS are sustainable management of natural resources, integrated economic development and sustainable social development. Specific strategies are outlined under each goal. For example, the goal for Sustainable Management of Natural Resources suggests strategies for forest resource management, sustainable energy production and consumption, biodiversity

conservation, sustainable freshwater resources management, sustainable management of land resources, sustainable management for mineral resources utilisation, and so on.

The NSDS was officially accepted by the Ministry of Planning. In theory, it is a guiding document for government ministries, departments and local authorities, UN organisations, and international and local NGOs. Implementation of the strategy will be assisted by adoption of the ECL and its accompanying regulations and guidelines and the development of sectoral-specific regulations that seek to enhance environmental protection and efficiency of resource use.

The United Nations Environment Program (UNEP) (BEWG, 2011) has stated that there are opportunities to review and further develop the strategy in the future.

2.12 INTERNATIONAL COMMITMENTS

Myanmar has signed a number international treaties related to the environment which may have implications for the Project. These include:

- Plant Protection Agreement for the Asia and Pacific Region; Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer;
- London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer;
- United Nations Framework Convention on Climate Change (UNFCCC); United Nations Convention to Combat Desertification;
- International Civil Aviation Organisation: ANNEX 16 Annex to the Convention on International Civil Aviation Environmental Protection Vol. I, II, Aircraft Noise;
- Vienna Convention for the Protection of Ozone Layer;
- Montreal Protocol on Substances that Deplete the Ozone Layer;
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- Convention on Biological Diversity (CBD); International Tropical Timber Agreement (ITTA);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- ASEAN Agreement on the Conservation of Nature and Natural Resources; Catagena Protocol on Biosafety;
- Kyoto Protocol to the United Nations Framework Convention on Climate Change;

- Ramsar Convention on Wetlands; and
- Copenhagen Amendment to Montreal Protocol on Substances that deplete the Ozone Layer.

2.12.1 United Nations Declaration on the Rights of Indigenous Peoples

Myanmar was one of 144 states that endorsed the United Nations Declaration on the Rights of Indigenous Peoples in September 2007. Article 32 discusses indigenous peoples' right to free and prior informed consent (FPIC):

"States shall consult and co-operate in good faith with the Indigenous Peoples concerned through their own representative institutions in order to obtain Free and Prior Informed Consent prior to approval of any project affecting their land or territories".

Article 10 discusses forcible relocation of indigenous people, and the need for FPIC and Article 26 about land rights are also relevant articles for indigenous peoples in relation to this project. It is good practice to ensure that relocation takes place following the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation and, where possible, with the option of return if that is possible following mining.

The Resettlement Action Plan (RAP) should conform to all relevant international environmental and social conventions ratified by Myanmar.

2.13 ENVIRONMENTAL CONSERVATION DEPARTMENT (ECD)

Environmental Conservation Department (ECD) was established on 11 October, 2012.

The Objectives of ECD are as follows:

1. To implement the National Environment policy.
2. To develop short, medium and long term strategy, policy and planning for the integration of environmental consideration into the sustainable development process.
3. To manage natural resources conservation and sustainable utilisation.
4. To manage the pollution control on water, air and land for environmental sustainability.
5. To cooperate with government organization, civil societies, private and international organizations for the environmental affairs.

2.14 GOOD PRACTICE GUIDELINES

Where no appropriate Myanmar standards are available, standards or guidelines based on International Finance Corporation (IFC) guidelines or other international best practice will be applied to the Project and existing environmental conditions.

The following list of IFC policies, procedures, standards and guidelines is applicable to this Project:

- Policy on Environmental and Social Sustainability (2012);
- IFC Sustainability Framework (2012);
- IFC Performance Standards on Environmental and Social Sustainability (2012);
- Guidance Notes (#1 – 9) on IFC Performance Standards on Environmental and Social Sustainability (2012);
- IFC Environmental Health and Safety General Guidelines, April 30, 2007;
- IFC Environmental Health and Safety Guidelines – Mining, December 10, 2007;
- IFC Operational Policy:
  - OP 4.01 Environmental Assessment, January 1999
  - OP 4.02 Environmental Action Plans, February 2000
  - OP 4.04 Natural Habitats, June 2001
  - OP4.07 Water Resources Management, February 2000
  - OP 4.09 Pest Management, December 1998
  - OP 4.10 Indigenous People, July 2005
  - OP 4.11 Physical Cultural Resources, July 2006
  - OP 4.12 Involuntary Resettlement, December 2001
  - OP 4.20 Gender and Development, March 2003
  - OP 4.36 Forests, November 2002
  - OP 4.37 Safety of Dams, October 2001
  - BP 4.01 Environmental Assessment, January 1999
  - BP 4.02 Environmental Action Plans, February 2000
  - BP 4.04 Natural Habitats, June 2001
  - BP 4.10 Indigenous Peoples, July 2005
  - BP 4.11 Physical Cultural Resources, June 2006
  - BP 4.12 Involuntary Resettlement, December 2001
  - BP 4.20 Gender Development, March 2003
  - BP 4.36 Forests, November 2002
  - BP 4.37 Safety of Dams, October 2001
- Handbook for Preparing a Resettlement Action Plan, 2002;
- A Handbook for Addressing Project-induced In-migration;

- Investing in People – Sustaining Communities Through Improved Business Practice;
- Good Practice Note – Public Infrastructure and Mining, 2010;
- Good Practice Note – Community Development Agreements, 2010;
- Introduction to Health Impact Assessment, 2009;
- Workers Accommodation – Processes and Standards, 2009;
- Strategic Community Investment, June 2010;
- Good Practice Note – Addressing the Social Dimensions of Private Sector Projects, December 2003; and
- Good Practice Note – HIV/AIDS in the Workplace, December 2002.

2.15 APPLICABLE STANDARDS ADOPTED IN DESIGN

The Basic Design document prepared by Nerin describes a number of Chinese guidelines that have been used in the detailed design of the Project. These are described in summary below.

- CECS 102-2002 - Technical Specification for Steel Structure of Light-Weight Buildings with Gabled Frames. The code is formulated to improve the development of light-weight building steel structures with gabled frames and improve design, manufacturing and installation to introduce state-of-the-art technology and make the structures economically feasible, safe and usable, and ensure sound engineering quality.
- CECS 138:2002 - Specification for Structural Design of Reinforced Concrete Water Tank of Water Supply and Sewerage Engineering. The standard describes the construction of concrete water tanks so that they are technically logical, economical, safe, and high quality.
- CECS 200:2006 -Technical Code for Fire Safety of Steel Structure in Buildings. The code aims to prevent and reduce the number of fire-related accidents to protect the safety of humans and assets by adopting economical and logical fire-prevention structural steel design. The code is suitable for new construction expansion or re-design projects.
- CECS24 - Technical Code for Application of Fire Resistant Coating for Steel Structure in Buildings. The code aims to implement fire protection measurements on structures by using fire-resistive coating to protect steel structures and to increase the resistance to heating using a logical, safe, and technically advanced approach.
- GB 50050-2007- Industrial Circulated Cooling Water Treatment Rule. The code aims to implement national water resources saving and environment protection

policies, promote the cyclic utilization of industrial cooling water and sewage reclamation, effectively control and reduce harm caused by re-circulated cooling water, guarantee the recuperation efficiency and service life of implements, decrease water pollution and enable the industrial cycle cooling water treatment to be state-of-art, economical and practical, secure and stable.

- GB 50058-92 - Code for Design of Electric Installations within Explosion and Fire Hazard Atmospheres. The code provides guidelines for installation of electrical work in explosive and fire hazard atmospheres to ensure the safety of humans and assets by adopting logical, economical and safe approaches.
- GB 50201- 94 - Standard for Flood Control. This code is suitable for urban and rural development, mining sites development, power houses, telecommunication infrastructures, places for tourism or of cultural heritage. The code provides guidelines for flash-flooding, rapid snowmelt floods, and rain and rain-induced floods.
- GB 5749-85 - Sanitary Standard for Drinking Water. A standard designed to provide clean and sanitised water for the end users to ensure the safety and health of consumers.
- GB/T14848 - 93: Quality Standard for Groundwater. This standard specifies the classification of groundwater quality, groundwater quality monitoring, evaluation methods and groundwater quality protection. The standard applies to general groundwater, mineral water and brine water.
- GB/T16453.1~16453.6-2008: The Standard on Comprehensive Water and Soil Conservation Treatment.
- GB/T19001－2000－ISO9001:2000. ISO certification for a quality management system.
- GB/T24001－2004－ISO14001:2004. EMS Environmental Management System certification.
- GB/T28001－2001. Occupational Health and Safety Assessment System certification.
- GB13271 - 2001: Emission Standard of Air Pollutants for Coal-Burning Oil-Burning Gas-Fired Boiler. This Standard specifies the permissible effluent concentration of flue dust, SO_2 and nitrogen.
- GB15618 - 1995 - Environmental Quality Standard for Soils. This Standard specifies to the investigations required to assess soils contamination.

- GB16297 – 1996 - Integrated Emission Standard of Air Pollutants. This standard specifies the emission standards of 33 air pollutants and presents various requirements for the implementation of the Standard.
- GB18597-2001 - Standard for Pollution Control on Hazardous Waste Storage. This Standard implements the People's Republic of China law on the Prevention and Control of Environmental Pollution by Solid Wastes, preventing environmental pollution caused by the storage of hazardous wastes and enhancing the supervision and regulation of the storage of hazardous wastes. This Standard stipulates the general requirements for storage of hazardous wastes, including the siting, design, operation, protection and monitoring of storage facilities of hazardous wastes.
- GB18598 - 2001 - Standard for Pollution Control on the Security Landfill Site for Hazardous Wastes. This Standard specifies the environmental protection requirements for hazardous waste landfill sites during their construction and operation, including entrance conditions, site selection, design, construction, operation, and closing and monitoring of the landfill site.
- GB18599-2001 - Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes. This standard specifies the requirements of environmental protection for the storage and disposal site for general industrial solid wastes during the construction and operation phases, including landfill entrance conditions, selection, design, construction, operation, closing and monitoring of the landfill site.
- GB3095 - 1996 - Ambient Air Quality Standard. This Standard specifies the control of air quality including zones delineation, standards, contaminant concentrations, and sampling and methods of analysis.
- GB3096 - 2008 - Environmental Quality Standard for Noise. This Standard specifies environmental noise limits.
- GB3838-2002 - Environmental Quality Standard for Surface Water. This Standard specifies the water quality values, evaluation of water quality and analysis method of water quality. The Standard is applicable to rivers, lakes, canals, channels, reservoirs and other surface water areas with utilisable functions within the People's Republic of China.
- GB4387-1994 - Safety Regulation for Transportation in Plants of Industrial Enterprises. This Standard specifies the safety regulations relating to transportation on internal and external mine roads and on cargo handling.

- GB50011-2010 - Code for Seismic Design of Buildings. This Standard specifies the engineering and building standards for earthquake prevention and disaster reduction.
- GB50013-2006 - Outdoor Water Supply Design Rule. This Standard is formulated to make water supply engineering design conform to national principles, policies, laws and regulations.
- GB50014 - 2006 - Code for Design of Outdoor Wastewater Engineering. This Standard specifies development standards for the design of wastewater engineering in China in order to conform with national laws and specifications, meet the requirements to control the water pollution, improve and protect the environment and improvie the health of people and ensuring their safety.
- GB50015 - 2003 - Water Supply and Drainage Rules for Buildings. This standard is designed to ensure the quality of building water supply and drainage design.
- GB50016-2006 - Code of Design on Building Fire Protection and Prevention. This standard is formulated with a view to preventing and reducing building fire hazards and safeguarding people's life and property.
- GB50040 - 96: Code for Dynamic Machine Foundation Design.
- GB50069 - 2002 - Structural Design Code for Special Structures of Water Supply and Waste Water Engineering. This Standard specifies the national technical and economic policies pertaining to the structural design for water supply and drainage structures.
- GB50151-92 to 02 - Design Codes on Expansion Foam Fire Extinguishing Systems.
- GB50191- 93 - Design Code for Anti - Seismic of Special Structures. This specification has been formulated to lessen the damage to structures caused by earthquakes, to avoid casualties, and to reduce economic losses.
- GB50229-2006 - Fire-Proof Rules for Thermal Power Plant and Substation Design. This Standard is formulated to ensure fire safety in thermal power plant and substation design.
- GB50330 - 2002 - Technical Code for Building Slope Engineering. This Standard is applicable to the design and construction of slopes.
- GB50343 - 2004 - Technical Code for Protection against Lightning of Building Electronic Information System. This standard is formulated with a view to prevent and reduce the damage caused by lightning on electronic information systems and protecting the safety of life and property.

- GB50370 - 2005 - Gas Fire Extinguish System Design Rule. This standard aims to reduce fire hazards by implementing a systematic fire extinguishing design rule.
- GB50421 - 2007 - Code for Waste Dump Design of Non-ferrous Metal Mines. This standard is designed to standardise the technical requirements for waste dump design of nonferrous metal mines. It implements national technical and economic policies, as well as meeting the requirement tosafely stockpiling mine overburden and protecting the environment.
- GB50433 - 2008 - Technical Code on Soil and Water Conservation of Development and Construction Projects. This standard is formulated with a view to standardise the technical requirements for soil and water conservation of development and construction projects. The standard emphasizes the need to reduce negative impacts on ecosystems, as well as prevent soil and water erosion.
- GB50630 - 2010 - Code for Design on Fire Prevention of Nonferrous Metal Engineering.
- GB5085.1 5085.7 - 2007 - Identification Standard for Hazardous Wastes. This standard is formulated for the prevention of environmental pollution caused by hazardous wastes, strengthen the management of hazardous waste, protect the environment and protect human health.
- GB5085.1 - 2007 - Identification Standards for Hazardous Wastes - Identification for Corrosivity.
- GB5085.3 - 2007 - Identification Standards for Hazardous Wastes - Identification for Extraction Toxicity.
- GB5749 - 2006 - Domestic Water Sanitation Standard. This national standard specifies the sanitary requirements for drinking water quality, drinking water source quality, central water supply organization, secondary water supply and health- and safety-related products, together with the water quality monitoring methods and water examination methods. This national standard is applicable to all kinds of central drinking water supply and non-central drinking water supply in both urban and rural regions.
- GB6722-2003 - Blasting Safety Rule. This standard specifies the safety technical requirements and supervisory work requirements of a blasting operation, explosive workings and storage, transportation, processing, inspection and disposal of blasting supplies.
- GB8978 - 1996 - Sewage Discharge Standard: This standard is formulated to carry out: The Environmental Protection Law of the People's Republic of China;

Law of the People's Republic of China on Prevention and Control of Water Pollution; and Marine Environment Protection Law of the People's Republic of China in order to control water pollution, protect the surface water such as rivers, lakes, canals, channels, reservoirs and oceans as well as groundwater, protect human health, maintain the ecological balance, and promote the development of the national economy and urban and rural construction.

- GBJ22 - 87 - Specifications for the Design of Factory and Mine Roads. This standard is formulated to ensure the quality of factory, mine and road designs and ensure that they meet national policies and guidelines.
- JGJ94 - 2008: Technical Code for Building Pile Foundations. The code was established to enable pile foundation engineering and construction to comply with national technical economy policies, and to be safe, workable, state-of-art technology, economically feasible, quality assured and environmentally friendly.
- YSJ019 - 1992 - Code for Design of Non - ferrous Metal Mining.

3. HISTORIC STUDIES IN THE AREA

The following three sections summarise existing reports prepared on the Project which have considered the Project's environmental impact. The information presented in the following sections is extracted from these reports that were prepared between 1997 and 2011. The information is assumed correct at the time of the original reports but may now be out of date.

3.1 1996 S&K ENVIRONMENTAL IMPACT ASSESSMENT[3]

This study was undertaken to describe the existing conditions in and around the S&K project operations. It also highlighted existing environmental effects that were evident from the operations that had been conducted to date and the impact they were having on key environmental areas, such as the Yamar Stream and the Chindwin River.

The description of the existing biophysical and social conditions in the area are relevant to this report (and others following) as they enable an assessment of changes that have been occurring in the Project area over the last 15 - 20 years and highlight some significant existing effects of copper mining in the area which are not only a consequence of the Letpadaung Project but are conditions that have existed in the area for three decades or more.

This assessment indicates that social conditions in the area for populations not involved in mining have not changed much. However, there has been migration into the area and increased pressure on biodiversity. Many features of the natural resources described in the S&K report are no longer present today.

3.1.1 Soils

The S&K report indicated that local soils in areas undisturbed by the mining activities tended to be mildly alkaline, non-saline but low in organic and nutrient content. Supplementation of organic matter, nitrates potassium and phosphorus is required to improve plant growth in the soils.

3.1.2 Climate

AATA described the climate at the site as semi-tropical with monthly average maximum temperatures ranging from 30.9°C in January to 42.5°C in April. Minimal temperatures in the same months range from 10.5°C to 19.4°C respectively.

[3] AATA, 1996; Environmental Assessment – Monywa Copper Project, Volume 1;In Feasibility Study Sabetaung – Kyisintaung Copper Project, Monywa, Union of Myanmar – Volume 5 Appendices , prepared for Ivanhoe Myanmar Holdings Ltd by Mincorp Engineers and Constructors; AATA International Inc., Fort Collins, Colorado USA; March 1996

Rainfall in the area indicated an annual average rainfall of 751 mm with the wettest months being August to October with more than 50% of the annual rainfall received during that time.

Evaporation records suggest a mean annual evaporation of 1,971 mm with monthly evaporation exceeding rainfall in all months except August to October.

The mean maximum wind speed was observed to be 3.66 m/s with speeds to 9.71 m/s. Winds were predominantly from the south in the monsoon period and from the north in the dry season.

Relative humidity (RH) ranged from a low of 30% in April to 86% in August with periods of 100% RH, consistent with temperature and rainfall patterns.

3.1.3 Air Quality

TSP levels were within WHO ambient air quality guidelines, although higher levels were observed near crushing and conveying facilities. Overall observations of all gaseous emissions indicated the Monywa airshed was clean.

3.1.4 Hydrology

The principal streams in the area were the Chindwin River and the Yamar Stream. Most of the mining site laid adjacent to the Chindwin River floodplain (over 12 km wide). The Chindwin catchment area was 106,000 km^2 and the Yamar Stream catchment area was 2,046 km^2. In the project area the 100-year flood level of the Chindwin was 74.6 m and the 10-year flood level was 74.4 m. The flow rate of the Chindwin ranged from the lowest flow rate of 600 m^3/sec to the highest rate of 24,850 m^3/s, in full flood conditions.

3.1.5 Water Quality

The water quality of the Chindwin River was neutral to slightly alkaline with moderate alkalinity, hardness and conductivity. Almost all parameters tested exceeded US EPA water quality criteria both above and below Yamar Stream.

Seasonal variations in water quality were evident with increases in TSS but decreases in TDS, conductivity, hardness and alkalinity.

Some metal parameters (Cr, Cu and Fe) rose with increased flow rates.

3.1.6 Hydrogeology

Both the Kangon Formation and a bedrock aquifer were observed in the area. Samples taken from both aquifers exhibited low quality standards which exceeded US EPA drinking water standards, except from two wells used for drinking water, although some

standards for these wells were also of a poor standard suggesting treatment of the water is required for it to be acceptable for human consumption.

3.1.7 Vegetation

The project area was located in the Dry Belt bioregion of Myanmar. The bioregion was characterised by four (4) forest types:

- The Savannah Forest;
- Than-Dahat Forest (Tectonia hamiltoniana - Terminalia oliveri Forest);
- Sha-Dahat (Acacia - Tectonia hamiltoniana Association) Forest; and
- Sha (Acacia) Thorn Scrub.

Undisturbed land was almost impossible to find in the area due to population pressure and demand for forest resources. The S&K report identified trees up to nine (9) metres in height. Much of the area was considered by the Forest Department as being non-forested due to the prevalence of thorny acacia scrub. Their vegetation classifications were:

- Mixed deciduous forests classified as Dry Upper Mixed Forest; and
- Dry forests classified as Than-Dahat Forests and Thorn Forests.

These forest types were most frequently observed in the Monywa project area.

3.1.8 Wildlife

Habitat conditions in the project area were reported as being poor. Habitat limitations resulted from human population density, loss of original vegetation cover, hunting and other forms of human disturbance.

Wildlife density in the area was assessed to be very low in comparison to the lists of wildlife types developed for the Central Myanmar region.

3.1.9 Socio-Economic Conditions

The S&K operation supported about 7,500 people through direct or indirect employment in a Township (Salingyi) with a population of about 130,000 (in 1996).

The income levels provided by mining companies to locally engaged employees were (and continue to be) the highest available in the project area. Many farmers in the area earned less than $1/day which was the internationally recognised definition of extreme poverty (The World Bank).

Life expectancy within the population is low, aggravated by the lack of trained medical personnel in the area.

Most people in the project area were engaged in farming, with only 2,720 people reported as being employed in industrial pursuits. The key crops produced were wheat, sorghum, green gram, sesame and chickpeas.

Most available water in the area was left untreated from the Chindwin River. Any reticulated water would then only supply about 100 litres per person per day (or about 50% of the requirements specified by the United Nations). Mine water for S&K was sourced from the Chindwin River and used 25 ML/day. No wastewater treatment systems were used in the area for the treatment of sewage.

Electricity was not accessible to all residents. The major fuel source was wood (hence the degradation of the woody vegetation).

Essential services, such as police, fire brigade, medical care, schools and roads were available in limited capacity. Activity was underway at the time of the S&K report to increase the supply of communal services through developmental works.

3.1.10 Summary

This report highlighted the existence of an issue with ARD management in 1996 and the need to rationalise the tailings management on the operation. It also described the influence of the operation on the Yamar Stream. Whilst the report and its findings do not apply directly to the Letpadaung Project, it does highlight some of the broader regional issues and also some of the social and environmental issues likely to require management on the Project.

3.2 1997 FEASIBILITY STUDY

This report[4] was a feasibility study focussing on the key aspects of the Letpadaung Project, in which Section 17 of the report presented an assessment of the environmental and social impacts of the Project. As there was an absence of Myanmar environmental guidelines, the assessment was based on Australian guidelines, and they were considered to be sufficiently specific without being overly prescriptive and hence appropriate for the country context.

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[4] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme Volume 1 - Report Final Draft , Letpadaung Copper Project, Myanmar for Ivanhoe Myanmar Holdings; Report No ME96-056-001; 17 February 1997; In Volume 8, Appendix 10, Feasibility Study Letpadaung Copper project, Monywa, Union of Myanmar commissioned by Ivanhoe Myanmar Holdings; Presented to No1 Mining Enterprise, Ministry of Mines, Government of the Union of Myanmar; Minproc Engineers Limited ACN 008 992 694; March 1997

3.2.1 Physical Environment

The average yearly precipitation and evaporation were 780 mm and 1,876 mm respectively, with a dry season occurring from November to February. There was some anecdotal evidence to suggest the climate was drying, possibly the result of local deforestation and/ or global climate change. The average daily maximum temperature was 37°C.

The wider area's topography comprised typically flat plains with a small number of steep sided and prominent hills present across the landscape. The Letpadaung mine site was located within one of these prominent hills, Letpadaung hill.

In terms of rainfall, central Myanmar was considered temperate; however the vegetation was floristically tropical and similar to that of its neighbouring countries.

The flora on Letpadaung Hill was notably uniform and strongly influenced by human exploitation. The hill crests comprised stunted woodland, the more steeply sloping hill sides and cooler valleys contained tall scrubland and low heath and low scrubland was present toward the base of the hills. The plains were used predominantly for agriculture and contained little natural vegetation with the exception of hedgerows along field boundaries.

Due to the human population, there was limited habitat for fauna in the area and the diversity and density of this fauna was limited. The diversity of bird, reptile and amphibian species was found to be low with bird species being those of agricultural significance (either feeding off the agricultural crops or the insects and pests associated with the crops). Equally few mammalian species were found with only the Dhole (*Cuon alphinus*) being considered vulnerable in the threatened and endangered species list.

The Chindwin River was the main river in the area and was located approximately 2.8 km to the northeast and flows southward. Surface water samples of the river taken a few kilometres upstream recorded the water to be slightly alkaline and of a good quality (better than United States Environmental Protection Agency and Western Australia Environmental Protection Authority water quality criteria).

At the time of writing the report, copper effluent was being discharged into the rivers from the adjacent Sabetaung and Kyisintaung (S&K) mine site. There was no evidence that this effluent was adversely affecting the river systems and this was probably due to the high level of dilution. However, it was recommended that all future discharges received pre-treatment.

A total of 55 species of fish were reported within the Chindwin River and that this fishery was just maintaining itself at sustainable levels. High parasite loads were found in the fish, indicating physiological stress and degradation of the river ecosystem. The high level of parasites were found in fish caught both from the local area but also further upstream, suggesting environmental degradation was affecting a wide area of the river basin.

Groundwater samples that were tested were found to be of low overall quality with high total dissolved solids. There were high levels of trace metals (As, Cr, Cu, Fe and Mn), all of which were higher than drinking water quality.

3.2.2 Social and Economic Environment

Social and economic research that was undertaken for the S&K mine site is germane for the Letpadaung Project. Key information is presented below. .

Myanmar is a culturally diverse nation with approximately 30 % of the population belonging to numerous ethnic minority groups. The majority of the people within the Letpadaung area are from the main cultural group, the Burmans who comprise approximately 70% of the population of Myanmar. The dominant religion is Theravada Buddhism and there are two monasteries very close to the Letpadaung mine. One of these monasteries (Taunguar Monastery) and a stupa will need to be moved to allow development of the Letpadaung mine. No other culturally or archaeologically significant sites will be affected by the mining development with the exception of some WWII lookout points which may have some historic significance.

The local economy is primarily agrarian. Trade and services are the next most significant sectors. The key regional industries are cotton mills, lathe shops, saw mills, noodle plants and cooking oil mills.

The existing S&K mine directly employs approximately 0.5 % of the area's workforce, with more being indirectly employed. One of the negative impacts of the S&K mine is that a cottage industry of backyard smelters has developed that process mine tailings. This has led to health risks for the workers, pollution of the watercourses and an increased demand for fuel wood.

The Letpadaung mine will require the removal of four villages. There is an absence of any discussion on this human impact or the amount of people that will be affected. The only information provided is that it is assumed that the land will be obtained through compulsory purchase and those affected compensated in accordance with Myanmar practice. The mine and associated infrastructure will also lead to a loss of land used for agriculture and for obtaining firewood. Some of this land is more productive and the

area to the south of Letpadaung appears least productive due to its readily drained stony soils. This less productive area is proposed to be used for the waste dumps and heap leach pads. The impact on the local food supply from the loss of agricultural land is not expected to be significant as there appears sufficient production elsewhere in the region to meet demand.

3.2.3 Environmental Impacts

The Letpadaung hill is the only feature in an otherwise flat landscape and the project will be clearly visible from the surrounding villages. The perception gained was that the local people viewed the economic benefits of the scheme as far outweighing the impact it will have on the landscape. Similarly, the operation of the Letpadaung mine will lead to an increase in noise levels in the area, but it is said that people living close to the S&K mine have learnt to accept and live with the noise.

Dust arising from the operations will be controlled as far as possible but there will be some increase when measured against current farming operations. Fibrous tests that have been undertaken on soils found no asbestos form materials to be present.

Rocks exposed by the mining operations contain a high level of sulphur (mean concentration of 1.7 %) and have the propensity to generate acid rock drainage (ARD). This occurs when the sulphur bearing minerals oxidise on exposure to the air and produce acidic by products and liberate trace minerals. This solution can be extremely damaging if discharged to the environment.

To minimise the impacts of ARD it was proposed that surface water infiltration should be minimised and all subsurface water and pit water be collected and either redirected through the heap leach circuit or process plant or sent to evaporation ponds. The heap leach pads were proposed to be provided with double liner systems and leak detection systems and the process plant provided with segregated drainage systems to ensure accidental release was not discharged.

The mine operations will require a supply of process water and the pit will depress the groundwater table locally. Both impacts were considered insignificant as water demand from the Chindwin River is small in comparison to its dry season flow and few local water supply wells are thought to be within the zone of influence of any dewatering.

3.3 2000 DEVELOPMENT PLAN[5]

3.3.1 Climate

This study adjusted the annual average rainfall to 786 mm/yr and the annual pan evaporation to 1,876 mm/yr through adjustment of the historic rainfall events to exclude outlier records from the recordings taken at Monywa and 15 years of data reported in a 1996 report associated with the report at footnote 24. This report identified the following trends:

- Strongly defined wet and dry seasons;
- The wet season occurring within the months April to November;
- The majority of precipitation as intense, short duration (less than five (50 day) storm events during the wet season;
- Mean maximum monthly average temperatures ranging from 27.7°C (December) to 38.7°C (April);
- Mean minimum monthly temperatures ranging from 13.2°C (January) to 25.9°C (July); and
- Rainfall records from 1913 for which a complete record has not been available to date.

3.3.2 Soils and Geology

The report found clay alluvium to 7.5 m overlying a sand alluvium with the water table encountered at 9.5 m in the proposed ponds area.

The interpretation of the soil geology revealed:

- Residual pyroclastic rock soils occur on the surface and at shallow depth near the hills;
- Erosion of the hills has produced clayey, silty, sandy, gravel, cobbles and boulders, which have spread by gravity in scree slopes away from the hills. This forms the obviously steeper areas with about 30% cobbles and boulders on the surface to over a depth of two (2) metres depth;
- It is likely the soils become finer with distance from the hills, although this is not obvious;
- At the abrupt change of slope and about 50 m beyond, the surface soil rapidly reduces in gravel cobble content;
- The flat slopes plain was almost entirely highly plastic clays (probably deposited by the Chindwin River from upstream origins) but drainage outwashes from the

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[5] Knight Piésold, 2000; Development Plan - Leach Pads, Waste Dumps and Water Management for Letpadaung Copper Project Ref 846/1; Ivanhoe Mines Ltd; April 2000

steeper slopes carry sand hundreds of metres out into sandy shallow creeks. These paleo-channels occur throughout the area and to depth and through the clay horizon;

- The clay horizon is dark brown, almost black, slightly moist, highly desiccated (open cracks) to about 1.8 m. Indicator tests show this clay is highly active and effective precautions against swell are required;
- Thereafter, the clay horizon becomes rapidly brown, moist and intact. The clay contained no sand horizon to 7.5 m when excavated;
- In the ponds area, the water table was at 9.5 m. This could be linked to the river or the topographic recharge from upslope, in which case it could rise dramatically after rain.

The valley has been intensively farmed and ploughed to 0.2 m, even in rocky areas, and planted with millet and beans.

3.3.3 Water Balance

Extreme storm water events of 14 to 30 days duration are the most critical for the facility, but the pond sizes (as designed in 1997) will contain all 1 in 100 year events. Shorter duration events can result in peak discharges in pipes and channels. These peak events have been considered in the design of those components.

Even in a wet year, the facility will have a shortfall of water that will require make-up water with a peak requirement of 32,500 m^3/day.

3.3.4 Waste Dump Design

Based on the sampling and testing done to date it has been inferred that up to 70% of the volume of waste may comprise potentially acid forming (PAF) material. The weathered leach cap is expected to have little or no acid generating potential and can be placed to cap the acid forming waste or other non (PAF) uses. More detailed studies into the PAF material and the potential neutralisation of the waste will be required at the final design stage.

Several factors were taken into consideration in selecting a suitable location for waste dumps including:

- Waste dumps to be in close proximity to the pit;
- Avoiding placing waste below the Chindwin River flood limit (74.6 m AMSL);
- Limit the extent of the waste so as not to extend over roads or project boundaries;
- Avoid blocking off the Chindwin River Paleo-channel in the north-east;
- Avoid areas delineated as potential ore reserves; and

- Work around the heap leach operation.

The approaches to control of ARD should be defined at final design stage after further testing of the waste has been conducted.

3.4 2004 ENVIRONMENTAL STUDY[6]

Much of what is presented in the 1997 feasibility report is again presented in this 2004 Environmental Preliminary Impacts Assessment. The following text presents only the additional or revised information and omits information already presented in the section above.

In the absence of defined environmental requirements, this report was based on advisory services provided to the government by the United Nations Economic and Advisory Commission for Asia and the Pacific (UNECAP).

The report similarly concludes that the area has low biodiversity but identifies the presence of numerous venomous snakes and two further vulnerable species: the Hooded Treppie bird and Eld's deer. It states that the presence of these vulnerable species may require further work.

The report highlights the negative impact migrant mine workers can have on the locality but concludes that this has not been a significant issue with the existing S&K mine as the project currently employs a predominantly local workforce.

Information is provided on the positive impacts of selected S&K healthcare services being made available to the wider population.

The report concludes that the key potential environmental impacts are air and noise pollution, hydrocarbons spillages, acid rock drainage and increased road traffic. It concludes that all of these can be adequately mitigated when considered against the benefits that the project can offer.

3.5 2011 BASIC DESIGN STUDY[7]

As with the previous section, this section identifies only the additional or revised information presented in this Basic Design Specification but omits information that has already been presented in the above two sections. The report was primarily based on Chinese environmental standards.

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[6] MICCL, (2004);72E-58 Environmental Preliminary Impacts Assessment for Letpadaung Project Area; Myanmar Ivanhoe Copper Company Ltd.' 13 July 2004

[7] NERIN (2011); Myanmar Monywa Letpadaung Copper Project Basic Design (100kt/a Cathode Copper) Volume 1 Specification for Myanmar Wanbao Mining Copper Ltd; China Nerin Engineering Co. Ltd., June 2011

The report primarily provides quantitative information on the consumption, emission and waste generation of resources, their acceptable range and monitoring and control measures.

Emissions include the generation of dust from transport, mine blasting and ore processing (including conveying and crushing), the emission of sulphuric acid mist from smelting, emissions from a diesel fired boiler and noise emissions. Dust emissions were seen to be primarily controlled through the use of water spraying and/or dust extraction equipment. Noise emissions were seen to be primarily controlled through silencing, acoustic barriers, sound insulation, vibration reduction and regular maintenance. All emissions were said to meet the relevant standards.

Waste generation covers the treatment and disposal of waste water and mine waste solids. All waste water would either be sent to the water conditioning ponds which would feed back to the heap leaching process. Domestic wastewater would be treated prior to discharge to the water conditioning ponds.

Solid waste, comprising waste rock clay mixing slag, would be disposed of according to the requirements of Category I general industrial solid and heap leaching. Slag would be stacked in the heap leaching pad and will meet the requirements for the disposal of Category II general industrial solid.

To further reduce environmental impacts, focus was given to 'cleaner production' which included using the most efficient mine fleet, reducing transportation distances, decreasing the ore loss ratio, using cleaner light diesel oil in the boiler to reduce sulphur dioxide and dust emissions and recycling wastewater back into the production system.

Environmental protection and monitoring would comprise a staff of six and information was provided on the proposed categories and frequency of monitoring. This monitoring focussed on the source of pollutants but not the risk or impact of their dispersal. No mention was given to containment leakage monitoring or the monitoring of the environment beyond the mine.

A short chapter was provided on soil erosion and the proposals for erosion and sediment control. The proposals followed the requirements of Chinese standards and comprised a combination of minimising vegetation clearance, re-vegetating, storing topsoil for reuse, providing erosion and flood protection and providing sediment traps

within drainage channels. Rehabilitation of the site will follow a concpet mine closure[8] plan that has been developed by MWMCL in consultation with Knight Piesold.

3.6 HISTORICAL FIELD SURVEYS

3.6.1 Flora and Fauna

3.6.1.1 Flora

A baseline flora study undertaken by the Botany Department of Yangon University in 2003 identified 80 species of flora in the vicinity of the Project. Shrubs, which comprised 39 of the species identified, are the most predominant vegetation community in this area and the trees greater than 5-10 cm diameter are used as a source of wood by local villagers. The second largest community is trees of which 19 species were identified. The remaining groups differentially encompass 13 species of herbs, 6 species of grass, 2 species of bamboo and one Acacia species. Most of the plants found in this area are xerophytes which are totally adapted to the arid conditions of the project area.

A total of 134 species representing 107 genera and 49 families were listed in the Letpadaung Taung area during the fieldwork associated with the 1997 field studies. The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. (with the highest incident vegetation index (IVI) of 91.93%), the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 38.29%), and *Atalantia monophylla* A. DC. (IVI= 37.87%) is third. The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of the Letpadaung Taung area.

The distribution of scrub and tree species by frequency class in the study area showed that a high percentage of the total number of species was in the lower frequency classes, A and B, whilst a low percentage only was observed for the higher frequency class C, D, and E. This indicates that the forest in the study area is floristically heterogeneous. The value of diversity indices and evenness indices for scrubs and tree species were very low in the study area.

Stem density of ≥10cm was 1,247 m^2/ha and basal area was 3.17 m^2/ha in the study area. Among the 15 sample plot studies, 27 tree species were recorded, and 10 species with only one (1) individual were found and these were considered as unique species. The 3 most abundant species in terms of basal area occupied 71.45% of the

8 Knight Piesold Report, Conceptual Closure Plan, PE701-00022/20 Rev A, September, 2013.

total area, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 37.08%, followed by *Dalbergia paniculata* Roxb. 22.04%, and *Atalantia monophylla* A. DC. with 12.32% of the total basal area. The plant species that were listed and recorded in the recent study were checked against the International Union for the Conservation of Nature (IUCN) Red List of threatened species but are not found on the IUCN Red List.

3.6.1.2 Fauna

A number of fauna surveys were undertaken in the mid-1990's (Muir, 1997) when the proposal to mine Letpadaung was mooted by MICCL. The results of those fauna surveys are described below.

Birds of the Letpadaung Project Area

A total of 18 bird species were recorded during the studies in the 1990s (Table 3.1) (Muir, 1997). The recorded species belong to 11 Families of the Order Passeriformes.

The broad saddles between the hills are inhabited by 7 bird species of 6 Families; 16 bird species were recorded on the lower slopes, 11 species in the steeply sided valley of Letpadaung hill, and 4 species at the hill crest.

Table 3.1: Bird species of the Letpadaung Copper Mine project area

Sr. No.	Family	Scientific name	Common name	Location
1	Ploceidae	Passer montanus	Tree sparrow	I,II
2		Streptopelia chinensis	Spotted dove	I,II,III,IV
3	Pycnonotidae	Pycnonotus cafer	Red vented bulbul	II,III
4		P. blanfordi	Streak eared bulbul	I,II,III
5	Coraciidae	Coracias benghalensis	Indian roller	II
6	Meropidae	Merops orientalis	Green bee-eater	I,II,III
7	Timaliidae	Turdoides gularis	White throated babblers	II
8		Lanius collurioides	Burmese shrike	II,III
9		Accipiter badius	Shikra	III,IV
10	Sturnidae	Acridotheres tristis	Common mynah	II,III
11		Sturnus burmanicus	Vinous breasted starling	II
12	Upupidae	Upupa epops	Hoopoe	II
13		Coracias benghalensis	Indian roller	II,III
14	Turnicidae	Turnix tanki	Yellow-legged buttonquail	II
15	Sylviidae	Orthotomus sutorius	Common tailorbird	I,II,III,IV
16		Orthotomus cuculatus	Mountain tailor bird	I,II,III,IV
17	Falconidae	Francolinus pintadeanus	Chinese francolin	I,III,
18	Turdidae	Saxicola caprata	Pied bush chat	II,III

Note: I = the broad saddle between the hills
II = the lower slopes
III = the steeply-sided valleys
IV = the hill crests

Mammals of the Project Area

The Myanmar hare *Lepus peguensis* was recorded during the survey period and were observed on the flatlands. They have a large movement range between the shrublands and cultivated areas at the base of Letpadaung Hill. According to the interview survey, Eld's deer (Shwethamin) *Cervus eldi thamin* was listed as a frequent visitor to the project area.

Reptilian and Amphibian Species

A total of three reptile species and one amphibian species were recorded during the survey period (Table 3.2). The most common species among them was observed as garden fence lizard *Calotes versicolar*.

Table 3.2: Reptile and amphibian species recorded during the survey period

Sr. No.	Species	Common name	Family	Taxonomic group
1	Calotes versicolor	Garden Fence Lizard	Agamidae	Reptile
2	Mabuya multifasciata	Many-lined Sun Skink	Scincidae	Reptile
3	Ptyas korros	Rat Snake	Colubridae	Reptile
4	Bufo melanostatus	Common Toad	Bufonidae	Amphibian

<u>Butterfly and Odonate Species</u>

Twelve butterfly species were recorded during the survey period (Table 3.3) (Muir, 1997). The most common species among them were *Eurema andersoni* and *Cethosia cyane* species. Most of the butterfly species and higher population size were observed in the lower slope habitat.

Three odonate species, namely *Tholymis tillarga*, *Orthetrum sabina*, and *Macrodiplax cora*, were recorded. Damsal fly species were not observed in the project area during the survey period.

Table 3.3: Butterfly species recorded during the survey period

Sr. No.	Family	Species	Habitat
1	Papilionidae	*Papilio demoleus mylayanus*	I,II,III
2	Papilionidae	*P. castor*	II,III
3	Papilionidae	*P. memnon*	I,II
4	Papilionidae	*C. clydia*	II,III
5	Peridae	*Hebomoia glaucippe*	III,IV
7	Peridae	*Eurema andersoni*	I,II,III,IV
7	Peridae	*Eurema andersoni*	I,II,III,IV
8	Peridae	*Hyarotis adrastus*	I,II,III
9	Peridae	*Pareronia valeria lutescens*	II
10	Peridae	*Catopsilia pomona*	I,II,III,IV
11	Nymphalidae	*Cethosia cyane*	I,II,III
12	Nymphalidae	*Junonia hierta*	I,II,III

4. ENVIRONMENT

4.1 ATMOSPHERIC ENVIRONMENT

4.1.1 Climate

Myanmar experiences a tropical monsoon climate in which there are three distinct seasons:

- A cool-dry season occurs from October to February;
- A hot-dry season occurs from March to May; and
- A hot wet season occurs from June to September.

The mean monthly temperatures presented in Table 4.1 show that temperatures range between a minimum 21.9ºC in January and a maximum of 31ºC in May.

The mean annual rainfall is 773.8 mm which has ranged between a minimum of 411 mm in 1982 and a maximum 1,370 mm in 1973. Mean monthly rainfall (Table 4.2) range from a minimum of 1.9 mm in January and a maximum of 166.4 mm in September.

Pan evaporation shown in Table 4.3 reflects the annual temperature distribution ranging between 121.3 mm in January to 172.7 mm in August. Pan evaporation exceeds precipitation in all months.

Table 4.1: Mean monthly temperatures in the project area (1981 to 2012)

Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
SD	1.9	2.3	2.3	1.4	1.4	1.1	1.2	1.0	0.7	0.7	1.1	1.9
Median	21.9	23.6	28.0	30.9	31.0	30.5	30.8	29.8	29.3	28.1	25.3	22.0

Table 4.2: Mean monthly precipitation in the project area (1961 to 2013)

Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave. # of Rain Days	0	0	1	4	9	9	8	10	11	10	3	1
Mean	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
SD	5.9	14.8	13.7	22.3	69.5	79.4	42.5	80.4	89.1	94.9	44.4	16.9
Median	0.0	0.0	1.0	20.5	94.4	71.5	59.0	103.0	149.5	135.5	12.2	0.0

Table 4.3: Mean monthly pan evaporation in the project area (2000 to 2006)

Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	121.3	149.3	209.5	227.8	216.6	203.1	172.2	172.7	160.2	144.6	124.7	116.5
SD	0.9	12.7	14.4	21.1	23.4	35.9	12.0	26.9	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	209.2	186.9	174.1	172.5	149.7	147.8	129.9	111.8

The prevailing winds during March to October are south-westerly and south-easterly, and during November to February they are northerly. The average wind velocity (2010 to 2012) ranged between 1.0 and 3.2 m/s and the maximum recorded wind velocity was 9.2 m/s.

Details on the derivation of the base climatology can be found in Appendix A – Surface Water Management.

4.1.2 Air Quality (including dust)

Dust is a significant contributor to respiratory infections in communities located near infrastructure works and impacts the life quality of residents. Visual observations conducted at the Letpadaung site suggest that the level of suspended particles in the air is very high as there is an obvious smoke haze early in the morning. Also the end of the dry season saw significant areas of soil laid bare of any vegetation cover after crops had been harvested and straw and fodder depleted by collection or grazing. Land was also laid fallow in preparation for the oncoming planting season. This resulted in observable dust in the atmosphere being generated from the ground surface.

Existing mining operations in the region also contribute to dust being generated. Dust plumes were observed to disperse over surrounding areas after blasting of the open pit mines had taken place.

The general observations were supported by dust monitoring undertaken by Environment Myanmar Cooperative Company Limited (EMC) that took place in the dry and wet seasons in 2013. The results obtained are included in Table 4.4 and Table 4.5.

Table 4.4: Mean ambient air pollutant concentration – dry season

Air Pollutants	Concentrations ($\mu g/m^3$)		WHO guidelines ($\mu g/m^3$) (24 hour average unless specified)
Station	Station 1	Station 2	
PM_{10}	82	82	50
$PM_{2.5}$	58	78	25
SO_2	0.3	0.3	20
NO_2	42	41	200 (1 hour average)
CO	0.4	0.3	NA

Further field sampling around the Project area and beyond was undertaken in the wet season over an extended sampling station network. As expected, these results indicated significantly lower levels of dust.

The air quality data obtained for the wet season are provided in Table 4.5.

Table 4.5: Mean ambient air pollutant concentration – wet season

Parameter ($\mu g/m^3$)	WHO guidelines ($\mu g/m^3$) (24 hour average unless specified)	Station							
		1	2	3	4	5	6	7	8
$PM_{2.5}$	25	6	1.71	2.35	5.63	8.77	2.56	5.21	2.58
PM_{10}	50	8.31	2.67	4.19	10.96	17.71	4.69	10.81	4.35
SO_2	20	2.5	2.4	2.5	2.4	2.5	2.5	2.5	2.5
NO_2	200 (1 hour average)	26.04	24.12	34.75	29.25	22.0	19.7	9.45	13.2
CO	NA	0.33	0.33	0.4	0.4	0.4	0.4	0.4	0.4

The results of the field sampling provided the basis for modelling of potential dust generation at the site and enable both the nuisance and respiratory irritants to be predicted for areas around the site. Based on the results of the modelling, exceedences of health and nuisance levels will be established and a control program developed.

Field monitoring of air quality is being undertaken by MWMCL to develop a fuller background database prior to commencement of the project. This will enable the effect of construction and operations to be observed and managed.

4.1.3 Climate Change

Whilst the 1997 Feasibility Study (Muir, 1997) indicated that there was anecdotal evidence to suggest the climate is drying, possibly the result of local deforestation and/or global climate change, the available climatic data do not support this.

There is no statistically significant wetting/drying trend observable in the Monywa city annual precipitation data (1961 to 2013). Similarly there is no statistically significant heating/cooling in the temperature data (1981 to 2012).

The Monywa city pan evaporation data (2000 to 2013) show a step reduction in the evaporation rate from about 2000 mm (2000 to 2006) to 1,400 mm (2007 to 2012), but having reviewed global lake evaporation data it was considered the lower values over the latter period are the consequence of a change in the method/quality of data collection and not climate change per se.

4.2 SURFACE WATER

The Chindwin River lies approximately 2.8 km northeast of the Letpadaung deposit, with a maximum flow rate of 24,850 m^3/s and an average flow rate of 3,860 m^3/s. The river depth ranges from 1.5 to 10.25 m with an average depth over the year of 5 m. The 20-year flood water level is RL 75.1 m and a 100-year flood water level is RL75.65 m.[9] A water supply from this source could meet the mine requirements.

Water quality in the Chindwin River changes over the course of the year. Table 4.6 presents a series of water quality indicators monitored during various months over the year 2000.

Table 4.6: Water quality monitoring data – Chindwin River (NERIN, 2011)

Month	Temp. (°C)	Total Dissolved Solids (mg/l)	Total Suspended Solids (mg/l)	Total Hardness (mg/l)	Dissolved Oxygen (mg/l)	C_aCO_3 (mg/l)	Sulphate (mg/l)	Ca (mg/l)	Mg (mg/l)
Feb	22.6	146.7	70	90	3.8	107.4	9.2	18.5	10.7
May	34.5	186	11.9	93	-	113	4.8	18.5	11.3
Jun	29	399	1,438	-	4.2	51.6	6.0	21	-
Aug	30.6	98	404	58	3.5	43	2.0	11.6	7
Nov	28.4	79	528	43	3.3	57	10	10.3	4.2
Dec	21	117	190	85	4.6	90	2.4	19.1	9

The table indicates that the indices are generally stable (except salinity and turbidity which increases in the rainy season) and meet the surface water standard of Class IV water (NERIN, 2011), and as such can be used for common industrial purposes. The current water supply for the existing town and mine/mill is taken directly from the Chindwin River. The issue of increased salinity and turbidity in the rainy season may need to be further addressed for future operations. For example process water may need to be sourced from an infiltration gallery or bore field located in the alluvium of the Yamar or Chindwin Rivers.

4.2.1 Water Catchments

An analysis of water catchments was undertaken to determine the local dependence on water flow from within the Project area or through the Project area. The outputs of this analysis are included at Appendix A – Surface Water Management.

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[9] Coffey Partners International Pty Ltd (1997). Letpadaung Copper Project Feasibility Study - Water Management and Environmental Monitoring. Report No. G7024/4-A; February 1997

The analysis identified that runoff, from the Letpadaung hills and through the catchment from the west, supports supply of water to the south of the Project area and to the north-west and north of the Project area. No data was available regarding the volume of water or quality of the water entering these areas.

Currently these catchments provide runoff to three major community dams inside, and beyond the southern boundary, of the site. Catchments draining to the north and north-west provide run-off to a number of small dams which local communities use to supplement dry season water requirements.

Water catchments draining to the east of the site are intercepted by a regional irrigation drain. A detailed analysis of the impact of changes to drainage to the east was not undertaken due to the influence of the drain on catchments between the site and the Chindwin River.

A plan showing the catchments delineated within and around the Project area is shown at Figure 4.2.1.

4.2.2 Baseline Surface Water Quality

For discussion purposes the baseline water chemistry data are compared with the following international and national water quality guidelines:

- WHO Drinking Water Guidelines, (2011)[10].
- The International Finance Corporation (IFC), Environmental Guidelines, (2007)[11].
- The IFC Health and Safety Guidelines, (2004)[12].
- The People's Republic of China Surface Water Quality Standards, (2002)[13]; and
- The People's Republic of China Groundwater Quality Standards (1993)[14].

Using several guidelines allows a comparison with a broader range of parameters. These guidelines are used for a preliminary assessment of water quality only. It is not implied the Project will be required to meet these guideline levels or that these reference levels should be used as the regulatory framework. More detailed assessment of the impact of any discharge from the Project will be required in later

[10] World Health Organisation, 2011; Guidelines for Drinking-Water Quality, 4th Edition; WHO Press, Geneva.
[11] IFC, 2007; Environmental, Health and Safety (EHS) Guidelines, International Finance Corporation, World Bank Group, Washington DC, April 30 2007
[12] Now replaced by reference at Footnote 31
[13] GB3838-2002; Environmental Quality Standard for Surface Water; Ministry of Environmental Protection, The Peoples Republic of China, Bejing
[14] GB/T14848-1993; Quality Standard for Groundwater; Ministry of Environmental Protection, The Peoples Republic of China, Bejing

design stages to assess the impact on receiving environments, where different water quality requirements may be applicable.

The Chindwin River water quality is reported to be fresh, slightly alkaline and soft. Coffey (1997) summarises the Chindwin River quality as:

- Total dissolved solids (TDS) values of 49 mg/L to 123 mg/L (very fresh); and
- pH values between 7.3 and 8.0 (slightly alkaline).

NFMKSDI (2011)[15] summarises the Chindwin River quality as:

- HCO3-Na-Mg dominated;
- A salinity of 500 mg/L (fresh);
- A total hardness of around 160 mg/L (soft);
- A total alkalinity of 300 mg/L (low alkalinity/acid neutralizing capacity); and
- A pH value of around 8 (slightly alkaline).

Surface water sample locations are described as follows:

- LSW-1 North Moe Gyo Byin Drain;
- LSW-2 Yoe Chaung Bridge;
- LSW-3 Kyauk Phyu Dine Dam;
- LSW-4 Kyauk Phyu Dine Drain;
- LSW-5 Ye Dwet Yoe Drain;
- LSW-6 Zi Daw Pond;
- LSW-7 Sede Pond;
- LSW-8 Toe Drain; and
- LSW-9 Tada Gyauk (Shwehlay Village).

The baseline surface water quality results are summarised as follows:

- All samples are pH basic with pH values ranging between 8.2 and 9;
- Dissolved oxygen concentrations range between 12.4 and 99.8 mg/L;
- Seven of the nine samples contain copper above the detection level (0.01 mg/L) but below the adopted guideline value (0.3 mg/L). Four of these have values of 0.01 mg/L and it is possible that the ‘less than sign’ (<) has been omitted in which case only three of the nine samples contain copper above the (0.01 mg/L) detection level;

15 Non Ferrous Metal-Kunming Survey and Design (Institute) Co (NFMKSDIC), 2011 Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma; Prepared for Myanmar Wanbao Mining Copper Limited; April 2011

- Two of the nine samples contain iron above the detection level (0.01 mg/L) but well below the adopted guideline value (1.0 mg/L); and
- The lead concentration is quoted as being "nil' for each sample. The detection level is not provided.

The surface water samples were only analysed for three metals: copper, iron and lead. The analysis suite has been expanded to a suite which includes the IFC Environmental Guidelines (IFC, 2007) as a minimum. First results of this expanded sampling will be available prior to commencement of works in the Project area.

Baseline surface water samples will also be required in the Chindwin River to allow a comparison of river water quality prior to mining. On-going surface water sampling will be required upstream and downstream of any proposed mine water discharge point.

4.3 GROUNDWATER

The aim of this section is to describe the baseline or pre-mining groundwater conditions relating to the Project.

4.3.1 Previous Studies

Previous groundwater related studies are listed as follows:

- WESTEC (October 1994). Hydrological and Geotechnical Scoping Study, Monywa Copper Project. Westec Project No. 94166. Report No. 1063;
- HTL (1996) (in Coffey, 1997). Letpadaung Water Supply and Management Hydrology, Geohydrology and Water Quality Pre-Feasibility. Mincorp Engineers and Constructors for Ivanhoe Myanmar Holdings Ltd;
- Coffey Partners International Pty Ltd (October 1996). Letpadaung Water Management and Environmental Monitoring Study – Phase 1. Report No. G7024/1-Y;
- Coffey Partners International Pty Ltd (February 1997d). Letpadaung Copper Project Feasibility Study - Water Management and Environmental Monitoring. Report No. G7024/4-A;
- Knight Piésold (April 2000). Development Plan Leach Pads, Waste Dumps, and Water Management. KP Ref 846/1;
- Soe Soe Aung (March 2005) Water Management Strategy for Letpadaung; and
- MWMCL (April 2011) Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

In addition baseline water chemistry data and groundwater level data from monitor bores installed around the periphery of the heap leach pads have been reviewed. The results of this monitoring are provided at Appendix B – Groundwater Monitoring Data.

4.3.1.1 Regional Groundwater

The Project is- flanked by a mountainous region to the west and an alluvial plain and the Chindwin River to the east. There are large volumes of groundwater held within the Quaternary alluvial deposits of the Chindwin River and in the underlying fractured rock aquifer. The Quaternary aquifer includes eluvial (slope) deposits at the piedmont and slope edge and the alluvial aquifer of the alluvial plain. The fractured rock aquifer is likely to be more highly developed in the upper weathered zone, and is expected to become less permeable and store less water at depth. Aquifer properties may also be enhanced along fault zones within the bedrock aquifer.

4.3.1.2 Mine Site Groundwater

The main aquifers within the mining area include the Quaternary alluvium aquifer overlying an andesite – dacite fractured rock aquifer summarised as follows:

- The Quaternary aquifer can be subdivided into two aquifers: Quaternary eluvial deposits (IA) forming a poor aquifer, and Quaternary alluvial deposits (IB) that form the primary aquifer of the area.
  - The Quaternary eluvial slope deposits (IA) forms a primary porosity aquifer of limited thickness and extent. The lithology of this aquifer mainly comprises silty clay to gravel breccia and gravelly soil, with a thickness of 0.8 m to 22.6 m (average of 6.6 m). This aquifer is mainly distributed around the isolated peaks in the river valley and stretches to between 100m and 800 m (300 m on average) from the piedmont of Letpadaung. This aquifer is highly permeable, ring infiltration tests indicating permeability coefficients of 0.1 m/d to 7.5 m/d with an average of 3.4 m/d (i.e. high permeability).
  - The Quaternary alluvial (IB) deposits form a primary aquifer that is in hydraulic contact with the Chindwin River. This aquifer comprises river alluvium of medium – fine sand, sand gravel and clay. The upper part is clay, with a thickness of 4 to 6 m; the lower part is a medium to fine sand, sand gravel and cobble gravel, with a thickness of 12.1 to 50.1 m (25.7 m on average). It has high permeability and aquifer storage properties. The permeability ranges between 18.4 m/d and 43.6 m/d, with an average of 23.6 m/d (i.e. very high permeability). On the alluvial plain the depth to groundwater in the dry season ranges between 0.65 m to 19.12 m, with an

average of 4.86 m. Based on the current pit design the main eastern ramp will intersect the high permeability (IB) alluvium that will result in significant groundwater inflows.

- The andesite – dacite rock bedrock forms a fractured rock (or secondary porosity aquifer) with the lithology mainly comprising dacite-andesite, andesite porphyry, ignimbrite and rhyolite. The thickness is estimated to be about 600 to 650 m. This aquifer is widely distributed in the Letpadaung mining area, and will form the main wall of the proposed Letpadaung pit. Based on the weathering degree, permeability and water yield properties, this aquifer is divided into an intensely weathered fissure weak aquifer (IIA), and a moderately weathered fissure weak aquifer (IIB).
  - The intensely weathered fissure weak aquifer (IIA) is mostly covered by Quaternary slope eluvium. The thickness ranges between 25.43 m and 138.05 m, with an average thickness of 66.78 m. The recorded permeability coefficient ranges between 2.9×10^{-4} m/d and 6.7×10^{-2} m/d, with an average of 1.60×10^{-2} m/d (i.e. low permeability).
  - The recorded thickness of the moderately weathered fissure weak aquifer (IIB) ranges between 17.7 m to 620.4 m, with an average of 251.51 m. The recorded permeability value is between 2.8×10^{-4} m/d and 2.4×10^{-3} m/d, with an average of 1.80×10^{-3} m/d (i.e. low permeability).

4.3.2 Groundwater Levels

Groundwater level data are given in MWMCL (2011)[16]. The monitor bore depths and status are summarised in Appendix B. These data together with baseline monitoring data from monitor bores installed around the heap leach pads have been combined to generate groundwater level contours shown on Figure 4.3.1. The groundwater contours shown in Figure 4.3.1 indicate a groundwater flow direction from the mountainous region in the west to the alluvial plain and the Chindwin River to the east. The groundwater contours indicate that groundwater is providing base flow to the Chindwin River.

4.3.3 Hydraulic Connection of the Aquifers

At Letpadaung, the Quaternary eluvium (slope deposits) form a thin aquifer overlying the bedrock, receiving rainfall recharge. The groundwater of this aquifer has a direct hydraulic connection with the groundwater of the underlying intensely weathered

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[16] MWMCL, 2011; Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma; April, 2011

andesite – dacite rock mass fissure weak (IIA) aquifer. On the alluvial plain, a significantly thicker sequence of the Quaternary alluvium aquifer overlies the intensely weathered andesite – dacite rock mass fissure weak (IIA) aquifer that in turn has direct hydraulic connection with the underlying moderately weathered fissure weak (IIB) aquifer.

4.3.4 Groundwater Recharge and Discharge

The two main sources of groundwater recharge in the mining area are direct rainfall, recharge and seasonal river leakage both from the main river channel and from over bank flood events. The groundwater flow direction reflects the general topography and moves from the higher altitude areas west to east, to the lower lying alluvial plain. Groundwater discharge from the area is likely to be via evaporation, and via base flow to the Chindwin River. Pit dewatering will be an additional groundwater discharge mechanism once the Letpadaung pit is excavated below the piezometric surface. As the pit deepens, a cone of depression will develop in the piezometric surface that may impact other groundwater users.

4.3.5 Hydrogeological Characteristics of Faults

Faults that intersect the Letpadaung deposit include the Chindwin Fault, the Monastery Fault and cross connecting faults f1 to f4. These faults are mainly compressional fractures, and are consequently expected to have low hydraulic permeability and storage properties, due to their compressional nature and narrowness.

4.3.6 Pit Dewatering

4.3.6.1 Groundwater Inflows

Groundwater inflow and incident rainfall predictions based on preliminary modelling undertaken by Coffey (1997) and MWMCL (2011) are summarised below.

Coffey (1997) predict groundwater inflows with two different permeability values:

- With an average permeability of 0.01 m/d inflows are predicted to increase from 12 L/s after 5 years to 39 L/s after 25 years; and
- With an average permeability of 0.1 m/d this would increase to 115 L/s to 385 L/s.

MWMCL (2011) predicted groundwater inflows at two pit stages:

- First Pit (-150 m) groundwater inflows of 26 L/s; and
- Final Pit (-350 m) groundwater inflows of 116 L/s with 37.4 L/s coming from the andesite-dacite and 78.8 L/s (two thirds) of the inflow coming from a 430 m stretch of Quaternary sediments at the eastern edge of the pit.

4.3.6.2 Storm Inflows

Coffey (1997) predicted a 10 year annual return interval (ARI) 24-hr storm inflow of 3,850 L/s for the 25 year pit.

NFMKSDI (2011) predicted:

- An average year incident rainfall of 357 L/s; and
- A 20 year ARI storm of 3,428 L/s for the -375 m pit.

This ESIA places greater reliance on the later NFMKSDI (2011) study as it is based on the greatest depth of information resulting from a drilling and testing field campaign. Groundwater inflows are therefore predicted to be between 26 and 116 L/s. A significant proportion of this will be later in the mine development when the main eastern pit ramp intersects the alluvial plain. If the pit was re-shaped to avoid cutting the alluvium this would reduce to 37.4 L/s. Inflow from the alluvium should be intercepted as it enters the pit prior to the water being affected by ARD deeper within the pit.

The above inflow estimates are preliminary based on limited field data and analytical equations based on simplifying assumptions. A numerical groundwater model could be used to improve the inflow predictions and would also model the drawdown cone as it develops with time. Modelling to assess the post-mining pit lake/water recovery levels has also not been undertaken.

4.3.7 Potential Impact of Surface Water on Pit Dewatering

The main surface water features of Letpadaung Project are the Chindwin River and an associated floodway. The Chindwin River is 2.8 km north east of the Project. The river has a catchment area of 106,000 km^2; a channel width of about 800 m and a depth of about 1.5 m to 10.25 m (5 m on average). For the period 1964 to 1987 the river had a mean annual flow of 3,860 m^3/s and a peak recorded flow of 19,503 m^3/sec. The average base flow in the dry months was 800 m^3/sec and the lowest recorded monthly average flow was 571 m^3/sec (Coffey 1997).

A significant floodway of the Chindwin River passes close the eastern side of the Letpadaung Project (Figure 4.2.1). Previous flood level estimates and measurements are summarised as follows.

- Coffey (1997) estimated a 1:100 year flood level of RL74.62 m that would encroach to within about 200m of the planned Letpadaung open pit. A maximum recorded level of RL74.04 m recorded at the Nyauangbigyi Police Station was noted to be close to the predicted value.

- Two flood events occurred in 1995 that resulted in water lapping at the base of the Letpadaung hill which is at about RL76 m (Coffey 1997d).
- Knight Piésold (2000) assumed a Chindwin River flood level of RL78 m based on Coffey's (1997d) reported levels.
- NFMKSDI (2011) noted a maximum flood level of RL74.81 m for the period 1999 to 2010 and a 1:100 year maximum water level of RL75.65 m was estimated.
- The maximum recorded flood level is therefore RL74.81 m and the maximum predicted level was 78 mRL.

In summary, the elevation of the 100-year return flood of the Chindwin River is RL75.65 m, and that of the 20 year return flood is RL75.1 m. The elevation of the topography around the eastern boundary of the final open pit is about RL72 m, and the open pit could therefore be affected by flooding of the Chindwin River. Accordingly, it will be necessary to construct flood prevention measures in this area. Groundwater inflows through the alluvium on the eastern side of the pit, and to a lesser extent through the fractured rock aquifer, will also increase when the Chindwin River is in flood.

4.3.8 Baseline Groundwater Quality

MWMCL (2011) summarised the pre-mining surface water and groundwater quality as follows:

- Surface Water: (Chindwin River): Water chemistry type: HCO3-Na-Mg; salinity: about 500 mg/L; total hardness: about 160 mg/L; total alkalinity: 300 mg/L; pH: about 8.
- Quaternary Aquifer: Water chemistry type: $HCO_3 \cdot SO_4 \cdot Cl$—Ca·Mg·Na; salinity: 390 to 2,350 mg/L; total hardness: 150 to 940 mg/L; total alkalinity: 590 to 780 mg/L; pH: 7.2 to 7.4.
- Andesite-Dacite Rock Fissure Weak Aquifer: Water chemistry type HCO3·SO4·Cl- Ca·Na·Mg; salinity: 960 to 1,878 mg/L; total hardness: 340 to 421 mg/L; total alkalinity: 20 to 144 mg/L; pH: 3.30 to 8.30. Trace metals (As, Cr, Cu, Fe and Mn) occur at higher than guideline values.

Groundwater in the alluvium is shown by Coffey (1997d) to contain brackish to saline (2,600 to 2,700 mg/L TDS), pH neutral, NaCl dominated water near to the mine site and is said to contain fresher water close to the Chindwin River and in association with the floodway. A sharp increase in salinity after pumping at bore LWB01 located at the foot of Letpadaung hill is consistent with a fresh water layer or lens over saline water with the freshwater lens being depleted by pumping. Saline water is also noted as having been pumped from mineral drilling supply bores within the Letpadaung deposit.

During mine dewatering the water quality may also be affected by acid rock drainage (ARD) resulting in low pH and high dissolved metals (Fe and Cu) concentrations in what is likely to be a brackish to saline water. Water quality from the existing Sabetaung is shown by Coffey (1997) to be low pH water of moderately high salinity and high copper concentrations.

The Letpadaung open pit mine water may therefore be of three different types:

- Alluvium Aquifer: Saline (7,000 to 8,000 mg/L TDS), pH neutral, Na-Cl dominated water.
- Volcanics Aquifer: Saline to hyper saline (4,500 to 20,000 mg/L TDS), pH neutral, Na-Cl dominated water from fractured rock aquifers prior to oxidation.
- In-Pit Acid Rock Drainage (ARD): Saline (4,000 mg/L) water in the pit resulting in low pH (pH ~3.2) and high dissolved metals (Fe and Cu) concentrations.

4.3.9 Baseline Groundwater Quality Beneath the Heap Leach Pads

Groundwater levels recorded on 19th December 2011 (beginning of the dry season) beneath Heap Leach Pads 1 and 2 vary between 0.8 and 16.5 metres below ground level (mbgl) with an average depth of 7.2 mbgl. The contoured groundwater levels (Figure 4.3.1) indicate a general movement down from the Letpadaung hill towards the Chindwin River to the east.

Baseline surface water/groundwater chemistry for December 2011 (end of wet season) and February 2013 (end of dry season) collected from surface water sampling points and from monitor bores around the proposed Heap Leach Pads 1 and 2 are included in Appendix B. The baseline surface water quality results are summarised as follows:

- The groundwater samples are neutral to slightly basic ranging between pH 6.9 and 8.7 with an average value of 7.8;
- Total dissolved solids (TDS) concentrations range between fresh to saline, 1,016 mg/L to 19,386 mg/L TDS with an average value of 4,368 mg/L TDS; and
- TDS, hardness, sulphate, lead and manganese values occur above the guideline values.

4.3.10 Recommended Baseline Groundwater Sampling Programme

Additional water sampling is required to establish baseline groundwater quality at additional locations (generally along the down hydraulic gradient the eastern margin of the project) and to determine seasonal variations in baseline water chemistry prior to the commencement of operations at Letpadaung. A database should be established with samples collected via documented procedures with the results assessed and reported on a quarterly basis. A groundwater monitoring network should be

established that could include existing test/monitor bores, existing village wells and possibly nested piezometers or installed in the alluvium and in the weathered bedrock and bedrock strata close to the pit.

The monitor bores should be sampled on a quarterly basis for one year following which the data should be reviewed and formally reported on. The IFC (2007) Environmental, Health and Safety Guidelines for Mining recommended an analysis suite as follows: Total Suspended Solids (TDS); pH; COD mg/L; BOD mg/L; Oil and Grease mg/L; Arsenic mg/L; Cadmium mg/L; Chromium (VI) mg/L; Copper mg/L; Cyanide; Cyanide Free; Cyanide WAD; Iron (total); Lead; Mercury; Nickel; Phenols; Zinc; Temperature.

4.4 GEOLOGY[17]

The Letpadaung Copper Project is located in the Monywa Copper District in Central Myanmar. The Monywa Copper District is located along the north-south trending Inner Volcanic Arc, which within the Central Burma Tectonic Belt and lies between the Eastern Highlands Belt to the east and the Western Ranges Belt to the west.

In general, Letpadaung is overlain by a Holocene alluvial deposit which comprises sand, high plasticity clay, and gravel that is underlain by rocks of Pleistocene Kangon Formation. The Kangon formation is composed of muds and poorly consolidated sands and gravels, which extend about 40 m in depth. The Kangon formation is underlain by the Pliocene to Miocene Magyigon formation which consists of thinly bedded sandstone, siltstone, mudstone, and various pyroclastic units.

The pyroclastic units include:

- Post-mineral andesite porphyry composed of 75 percent plagioclase phenocrysts, 5 – 10 percent euhedral biotite, and minor alkali feldspar with quartz and rarely magnetite.
- Phreatomagmatic breccia zones (diatreme) that consists of angular to rounded fragments of andesite porphyry in a rock flour or fine grained andesite porphyry matrix.
- Andesite porphyry composed of 10 – 30 percent plagioclase feldspar, minor quartz, and rarely alkali feldspar in a pale green to grey aphanitic groundmass.

[17] Mitchell. A.H.G.. Win Myint, Kyi Lynn, Yint Thein Htay, Maw oo, and Thein Zaw (2008) The Monywas Copper Deposits, Myanmar: Chalccite-covellite Veins and Breccia Dykes in Late Miocene Epithermal System. Proceedings of the International Symposia on Geoscience Resources and Environments of Asian Terranes (GREST 2008), 4th IGCP 516, and 5th APSEG: Nov 24-26 2008, Bangkok, Thailand

The Magyigon formation extends about 800 m deep and is underlain by Oligocene Damapala formation, which consists of sandstones that are well-sorted, sub-rounded to rounded and are commonly cemented by clay and carbonates. The Damapala formation extends approximately 300 m deep.

The Letpadaung copper deposit is one of four major copper deposits within the Monywa Copper District which also includes the Kyisintaung, Sabetaung, and Sabetaung South copper deposits. Letpadaung crops out as a cluster of fault bounded hills rising above a generally flat plane. Elevations range from 75 m to 120 m at the base of the hills to 330 m at their summits. Please refer to Figure 1.2.1 for the relative location of the Sabetayng and Kyisintayng (S&K) Mine.

Letpadaung is classified as an Acid-Sulphate or High Sulfidation mineral deposit. These deposits which are formed where reactive, strongly acidic magmatic fluids and gases forcefully migrate vertically and laterally via structures and permeable rocks. The reactive fluids and gases undergo extensive mixing and reaction within wall rocks. Characteristics of the Letpadaung deposits are:

- A zoned alteration sequence that consists of a central residual silica core, surrounded by zones of silica and alunite, then advanced argillic alteration, and finally propylitic/chloritic alteration;
- Wall rock alteration consisting of silica + alunite ± pyrophyllite ± kaolinite ± pyrite; and
- An association with calc-alkalilne volcanism.

The residual silica zone is characterised by the complete leaching and removal of all mineral constituents except quartz. The surrounding silica and alunite is characterised by the pervasive silica replacement of the andesite host rock groundmass and the complete alunitisation of the plagioclase feldspar. The transition between the silica-alunite zone and the zone of advanced argillic alteration is quite sharp. The advanced argillic zone is characterised by hornblende, biotite, and feldspar phenocrysts extensively replaced by kaolinite, alunite, sericite, pyrophyllite, diaspora, and minor pyrite. The zone of chloritic alteration is characterised by weak to strong chloritisation of biotite and hornblende, moderate seritisation of the plagioclase feldspars, and ubiquitous secondary cubic pyrite.

Episodic hydrothermal brecciation is a geologic feature related to mineralization at Letpadaung. Hydrothermal breccia occurs within northwest and northeast trending lozenge shaped breccia dikes that pinch and swell in all directions. The breccia dikes can occur in isolated lenses or in en echelon swarms.

Copper mineralisation is dominated by hypogene chalcocite/digenite, covellite, and supergene chalcocite. The mineralisation is by a 10 to 200 m thick strongly weathered, oxidized leached cap. The leached cap contains no economic copper mineralisation with the exception of a few resistant pods. Below the cap is a zone of intense acid leaching, alunitisation, silicification, and episodic hydrothermal brecciation. Pyrite is ubiquitous and occurs as coarsely crystalline masses in veins, in breccia matrix, vugs and disseminated in groundmass of the host rock.

Andesite porphyry is the most common rock type in the Letpadaung hills and is the most common host rock for copper mineralization in the Monywa Copper District. The andesite has phenocrysts composed of 10 – 30 percent plagioclase feldspar and minor quartz and rare alkali feldspar in aphanitic groundmass.

Pyroclastic rocks are the second most abundant rock type in the Letpadaung hills. Pyroclastic rocks include sub aerial tuff and ejecta, diatreme-related breccias and explosion debris. Volcanclastic siltstones and sandstones overlie small areas within the volcanic section.

In general, Letpadaung is overlain by a Holocene alluvial deposit which comprises sand, high plasticity clay, and gravel that is underlain by rocks of Pleistocene Kangon Formation.

The Kangon formation is composed of muds and poorly consolidated sands and gravels, which extend about 40 m in depth. The Kangon formation is underlain by the Pliocene to Miocene Magyigon formation which consists of thinly bedded sandstone, siltstone, mudstone, and various pyroclastic units.

4.5 RESOURCE OVERVIEW

The deposit contains a currently identified resource of almost 4.5 million tonnes (Mt) of contained copper in the measured and Indicated categories and another 1.4 Mt of contained copper in the Inferred category. Further deposits are expected to be identified along the mineralisation trend, and the known deposits have also not been closed off at depth (i.e. a lower depth to the deposit has not yet been identified). The resource identified within the Letpadaung Licence Area is described in Table 4.7 below.

The Letpadaung deposit is a concealed deposit beneath two mountains and their valley. The deposit is gold-ingot-shaped with a flat top, trending north-west and approximately 2,200 m long and 1,400 m wide and the occurrence is basically horizontal. The ore body has an average thickness of about 140 m, and an average copper grade of 0.37 %.

Table 4.7: Summary of resources calculated in the design

Resource Category	Ore Quantity (kt)	Copper Grade (%)	Metal Quantity (t)
Measured	611,068	0.43	2,621,301
Indicated	528,952	0.35	1,866,164
Inferred	448,142	0.31	1,394,405
Total	1,588,162,000	0.37	5,881,870

4.6 GEOCHEMISTRY

Knight Piésold has conducted an initial geochemical assessment, with samples of waste rock selected and sent to an accredited laboratory for analysis.

One hundred and fifty samples of waste rock were selected for this study, collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

The waste rock, although not all sulphur, was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur that was present as reactive sulfide minerals was still very high, averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are

readily soluble, especially under acidic conditions, although not dependent on the potential acid forming capacity of the waste rock to liberated the metal content.

The combination of potential acid forming capacity and the solubility of metals within the waste rock suggests these properties represent a significant environmental risk once the waste rock is exposed to the environment unless managed carefully.

4.7 SEISMICITY

4.7.1 Regional Tectonics

The convergence of the Indo-Australian and Eurasian plates has caused the orogenic uplift which has formed the Himalaya Mountains. The northward under-thrusting of the Indo-Australian plate beneath Eurasian plate generates numerous earthquakes and consequently makes this area one of the most seismically hazardous regions on Earth. The surface expression of this plate boundary is marked by the foothills of the north-south trending Sulaiman Range in the west, the Indo-Burmese Arc in the east and the east-west trending Himalaya Front in the north of India.

As the Indo-Australian plate moves north, it also rotates in a counter-clockwise direction along the eastern edge. As a result of this movement and rotation, the convergence along the plate's eastern boundary (the Burma-Andaman-Malay region) with Eurasia was at an oblique angle. The transform forces along this subduction zone started the clockwise bending of the Sunda arc in the late Oligocene (ca. 32 Ma). These forces caused further faulting and the Burma and Sunda microplates began to "break off" from the larger Eurasian plate.

After a further series of transform faulting, and the continuing subduction of the India Plate beneath the Burma plate, back-arc spreading caused the formation of the marginal basin and seafloor spreading centre that has formed the Andaman Sea, a process well-underway by the mid-Pliocene (3-4 Ma).

4.7.2 Tectonic Background of Myanmar

Myanmar is located on or near the convergent plate boundary between the north-eastern corner of the Indo-Australian plate and the Eurasian plate. Plate tectonics is a highly theoretic field, and the locations of plate boundaries in Myanmar are only approximately located and the locations vary between expert seismic geologists. Rather than present conflicting theories of plate tectonics in Myanmar, the following are based on information presented by Win Swe, former President of Myanmar Geosciences Society (MGS).

Myanmar is composed of two microplates or blocks, the western block is the Burma plate and to the east is the Shan-Thai block. The Burma plate includes the Western

Ranges and extends into the Bay of Bengal, where the India portion of the Indo-Australian plate subducts beneath the Burma plate. These two blocks separated in the Miocene, 23.03 to 5.332 Ma (million years ago). The composition of two blocks is believed to be of Gowndana origin (Gowndana was a large land mass in the southern hemisphere between 510 – 430 Ma). These blocks are separated by the Sagaing fault, which is a transform fault with right lateral movement in Myanmar and is comparable to the San Andrea fault. The Sagaing fault trends in the north-south direction, and extends to the Andaman Sea, where a south-westward trending oceanic rift (sea-floor spreading) formed the sea and is an extension of the south-east trending Sumatra Fault System.

There are four major physio-tectonic regions in Myanmar, the Eastern Highlands Province is located east of the Sagaing fault on the Shan-Thai block, the Central Myanmar Belt located west of the Sagaing fault is a relatively flat area that has had some instances of quaternary volcanism, the Western Ranges a accretionary wedge lying above the subducting oceanic crust, and the Rakhine Coastal Belt, which may be considered as part of the Western Range, but comprises rocks of the Oligocene epoch (Tertiary period between Eocene and Miocene) and younger mollasse strata. Mollasse are sedimentary deposits that contain materials of marine and continental origins.

4.7.3 Seismicity in Myanmar

The Sagaing Fault is a major strike-slip fault which is located in the central part of Myanmar and potentially within 100 km of the Letpadaung Project. Other major faults in Myanmar comprise the Kabaw and Dauki faults, and shallow earthquakes within this region are predominantly associated with these faults. Deep earthquakes (200km) have also been known to occur in this region, these are thought to be due to the subduction of the eastwards dipping, Indo-Australian plate, though whether subduction is currently active is debated.

Historical records of earthquakes in Myanmar date back to 1429 in Innwa when an earthquake tumbled enclosure walls intended as fire-stops. Of the historical records 15 earthquakes have been recorded in Innwa since 1429 and 11 other records recorded in Bago (Ref. 3). Between 1927 and 1956, six magnitude(M)7.0+ earthquakes occurred near the right-lateral Sagaing Fault, resulting in severe damage in Myanmar including the generation of landslides, liquefaction and the loss of 610 lives. The records also show that at least fifteen M7.0 earthquakes have occurred in Myanmar in the past 100 years.

A search of the USGS database earthquake lists 406 earthquakes that have been recorded between 1973 and 2013, within 200 km of the Letpadaung site including one

M7.0 and M6.8, and 44 events at magnitudes between M5.0 and M5.9. The most recent earthquake was a M4.7 event that occurred on the 20th July 2013, about 70 km south-west from Letpadaung. The closest earthquakes in proximity of the site were a M4.0 event that occurred approximately 3.6 km from the site and a M4.1 that was approximately 9.1 km of the site.

4.7.4 Seismicity of Letpadaung

A preliminary seismic hazard assessment has been performed for the Letpadaung Copper Project. Existing seismic and tectonic information and historical data, including earthquake catalogues and technical publications have been collected and reviewed. Preliminary seismic ground motion parameters for the project area have also been determined.

The computer program EZ-FRISK (Risk Engineering, Inc., 2011) was used to develop a seismic hazard model for Letpadaung. The seismic hazard analysis module available with EZ-FRISK includes a database provided by Risk Engineering Inc. of faults and areal seismic sources pertinent to the study area.

Seismic sources defined in the hazard model include Sagaing Fault, which is the closest fault located approximately 96 km east of Letpadaung. The Sagaing Fault is an active strike-slip fault that separates the Burma plate extending west of the Sagaing Fault to the Bay of Bengal and the Shan-Thai block that contains the Eastern Highlands Belt extending east. Other faults and areal seismic sources defined in the EZ-FRISK seismic source zone and within 500 km of Letpadaung are listed in Table 4.8.

Table 4.8: EZ-FRISK seismic sources zones

Source	Deterministic distance (km)	Fault Magnitude	Mechanism	Site Lies to
Sagaing SE	95.88	7.6	Strike-Slip	West
Kabaw SE	105.57	7.75	Strike-Slip	East
Arakan Trench Arakan Trench	325.66 331.2	7.25 7.5	Reverse Strike-Slip	North North-East
Myanmar Margin	372.98	6.75	Strike-Slip	North-West
Mae Saraing	393.28	6.8	Strike-Slip	North-West
Mae Chan	495.73	7.3	Strike-Slip	North-West

For shallow crustal earthquakes a set of five ground motion attenuation models, known as the Next Generation Attenuation (NGA) relations were used (Earthquake Spectra, 2008). These include the ground motion relationships of Abrahamson and Silva, Boore

and Atkinson, Campbell and Bozorgnia, Chiou and Youngs. These ground motion attenuation relationships are applicable to shallow crustal earthquakes in western North American and similar tectonic regions of the world. The reported peak ground accelerations for shallow crustal earthquakes are average values calculated using the four attenuation relationships (equal weighting). Appropriate NGA attenuation relationships for normal faulting have been used in the probabilistic and deterministic analyses.

Table 4.9 lists the annual return periods for several events, probability of exceedance depending on anticipated mine life, and peak ground accelerations for the Letpadaung Copper Project based on the NGA relations.

Table 4.9: Summary of probabilistic hazard analysis

Return Period (Years)	Probability of Exceedance (%)				Median Peak Ground Acceleration (PGA)
	Design Life = 10 years	Design Life = 15 years	Design Life = 20 years	Design Life = 25 years	
50	18	26	33	39	0.027
100	10	14	18	22	0.043
200	4.9	7	10	12	0.059
500	1.98	3.0	4	5	0.083
1000	1.0	1.5	2	2	0.101
2500	0.40	0.60	1	1	0.124
5000	0.20	0.30	0	0	0.145
10000	0.10	0.15	0.2	0	0.170
20000	0.05	0.07	0.1	0.1	0.199

4.8 SOILS

Surficial deposits in the low-lying areas of Letpadaung consisting of alluvial sands and gravels, and are underlain by residual soils. The residual soils comprise residual silica that results from the weathering and leaching of the andesite porphyry of all minerals, silica-alunite that is characterised by the silica replacement of the andesite host rock and the complete alunitisation of plagioclase feldspar, advanced argillic soils that results from alteration of the hornblende, biotite, and feldspar phenocrysts to clay minerals such as kaolinite.

Test pits excavated on the Letpadaung site identified highly plastic clays, silts, sands, gravels, cobbles and boulders of varying proportions extending to the depths explored. Most of the surficial deposits in low-lying areas have been disturbed and reworked by the historic agricultural use of the lands for generations.

The description of soils in the area included here is taken from Muir (1997). The soils are described in two (2) parts – Letpadaung Hills and the plains surrounding the Letpadaung Hills. These descriptions were confirmed by review of two geotechnical reports undertaken at the site by Knight Piésold (2000) and SWNFKDIC (2011, 2012)[18]-[19]

A soil distribution map is shown at Figure 4.8.1.

4.8.1 Letpadaung Hills

All soils examined in the area comprised deeply weathered profiles, with only minor bedrock being encountered, mainly along the hill crests. Soil sections observed indicated a general soil profile comprising:

- A few centimetres of humus at the surface;
- A deep gradational profile of pink to red-loamy clays with increasing boulder content with depth;
- An underlay of moderately dense weathered rock; and
- Water seepage at the soil rock interface.

Soil surfaces tend to be rough and rocky due to the abundance of large particles (greater than 75 mm in size) in the surface soils. This results in limited evidence of soil erosion and suggests run-off in the area tends to be a sheet flow rather than concentrated in gullies.

Soils on the hills exhibited:

- Uniform structure laterally;
- Good moisture retention characteristics;
- Slow drying when exposed to heat from the sun;
- Low to moderate permeability; and
- High dispersion.

It is expected that the combination of slope and permeability would encourage run-off rather than percolation into the soil. It is also expected that the dispersive nature of the soil would lead to a turbid run-off containing fine soil particles.

[18] SWNFDIC, 2011: Detailed Geotechnical and Hydrogeology Investigation Report for Leach Pads, Storm and Sedimentation Ponds at Letpadaung Copper Mine (100kt/year Cathodic Copper): Southwest Non-ferrous Kunming Design Institute Co. Ltd, August 2011.
[19] SWNFKDIC, 2012: Detailed Geotechnical and Hydrogeology Investigation Report for Waste Rock Dumps and Waste Water Reservoir Dams at Letpadaung Copper Mine (100kt/year Cathodic Copper)" by Southwest Non-ferrous Kunming Design Institute Co. Ltd: February 2012.

Muir (1997) estimated that 10 cm of soil had been lost from the surface of the hills through historic disturbances of fire and firewood collection.

4.8.2 Plains Around The Letpadaung Hills

The soils around the Letpadaung Hills grade from sandy materials close to the hills to fine grained soils near creeks and the Yamar Stream and Chindwin Rivers. Sections of the plains are subject to periodic inundation which influences the consistency of gradation and soil productivity. These soils are frequently loamy and silty in nature. The heavy clays are most often found within 1 km of the Yamar Stream and Chindwin River and represent the best soils for paddy fields.

The undisturbed soils on the plains are near-neutral to slightly alkaline, non-saline and very low in organic matter (based on Muir (1997) results). They are also nutrient and zinc deficient but contain normal levels of copper and manganese.

4.9 FLORA AND FAUNA

4.9.1 Flora

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of the flora and vegetation associations in the project area of the Letpadaung Copper Project The work was undertaken in the period from February 2013 to August 2013 to enable the evaluation of the floristics in the three seasons experienced in the Project area (See Appendix C – Baseline Studies – Flora).

On each occasion the surveys consisted of a series of point quadrats, line transects and wandering transects. Casual observations along roadsides and from tracks were also made in travelling around the study area to ensure all vegetation patterns in the study area were identified. The location of the point quadrats and line transects are shown in Figure 4.9.1.

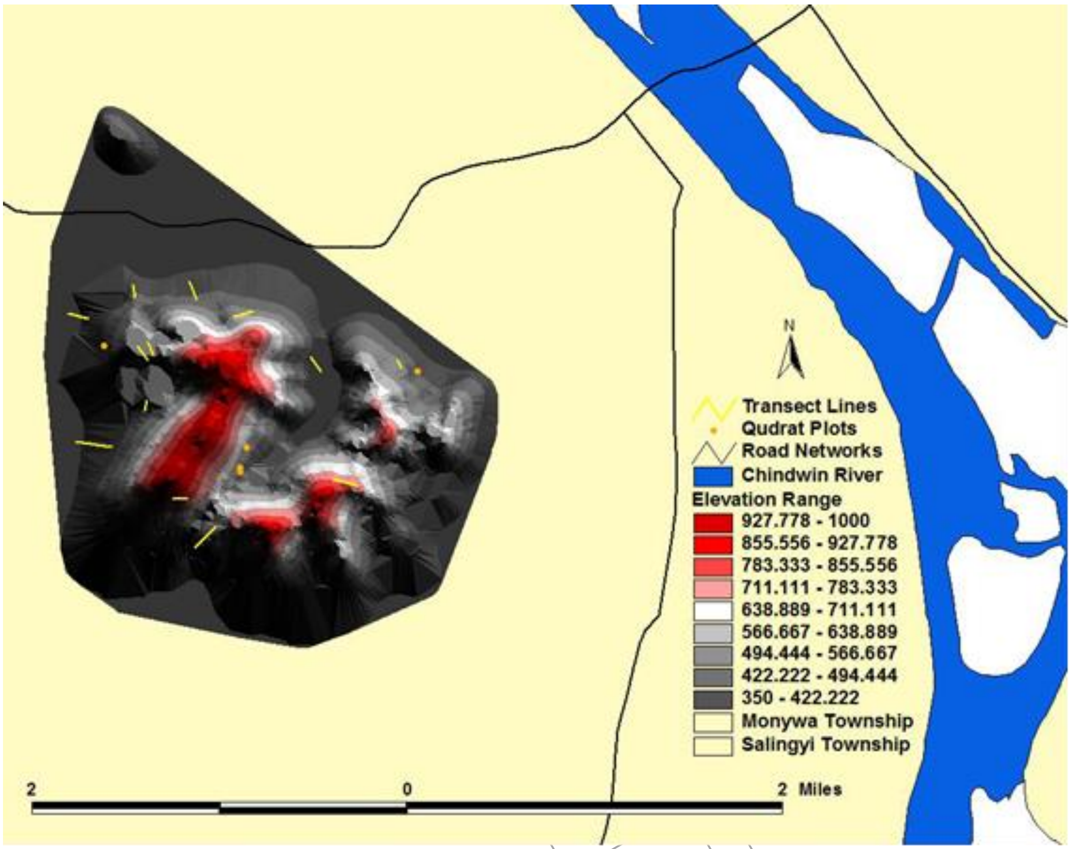

Figure 4.9.1: Location of line transects and point quadrats around Letpadaung Hill.

4.9.1.1 Flora Cool-Dry Season

A total of 90 species representing 71 genera and 38 families were listed in the Letpadaung taung area in the cool-dry season. The tree layer in the study area is dominated by *Azadirachta indica* with the highest IVI of 114.81%, the second most dominant species is an *Acacia sp*. (IVI = 35.43%) and *Dalbergia paniculata* (IVI= 32.45%) is third. The number of species greater than 10% IVI value was seven species. Those species could be considered as an ecological indicator species of the Letpadaung taung area.

Scrub and tree species distribution by frequency classes in study area showed that a high percentage of the total number of species was in lower frequency classes, A and B, while only a low percentage was observed only in higher frequency class C and D. This indicates that the forest of study area is floristically heterogeneous. The value of diversity indices and evenness indices for scrubs and tree species was very low in study area.

Stem density of ≥10cm was 1,630 stems m^2/ha and basal area was 3.74 m^2/ha in the study area. Among the 10 sample plots studies, 16 tree species were recorded and

nine (9) species were found. These cannot be considered to be unique species. The three (3) most abundance species in terms of basal area occupied 82.01% of the total, of which *Azadirachta indica* was the most dominant species in the study area with 45.03%, followed by an *Acacia sp.* with 25.50%, and *Dahlbergia paniculata* with 11.48% of the total basal area.. The plant species that are listed and recorded in the recent study were checked with the IUCN Red List of threatened species, but none were found in the IUCN Red List.

4.9.1.2 Flora Hot-Dry Season

A total of 71 species representing 60 genera and 33 families were listed in the Letpadaung taung area in the hot-dry season. The tree layer in the study area is dominated by *Azadirachta indica* with the highest IVI of 54.47%, the second most dominant species is *Dalbergia paniculata* (IVI = 53.41%) and *Tectonia hamiltoniana* (IVI= 34.65%) is third. The number of species greater than 10% IVI value was eight species. Those species could be considered as an ecological indicator species of the Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that a high percentage of the total number of species was in the lower frequency classes, A and B, while a low percentage was observed in the higher frequency class C only. This indicates that the herb species of the study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species was very low in study area.

Stem density of ≥10cm was 1,311 stems m^2/ha and basal area was 6.22 m^2/ha in the study area. Among the 4 sample plots studies, 14 tree species were recorded. Four (4) species were found only one individual and these were considered to be unique species. The three (3) most abundance species in terms of basal area occupied 63.70% of the total area, of which *Prosopis juliflora* was the most dominant species in the study area with 23.25%, followed by *Azadirachta indica* with (20.79%), and Dalbergia paniculata (19.66% of the total basal area). The plant species that are listed and recorded in the recent study were checked with the IUCN Red List of threatened species, but none were found in the IUCN Red List.

4.9.1.3 Flora Wet Season

A total of 117 species representing 94 genera and 44 families were listed in the Letpadaung taung area in the wet season. The tree layer in the study area is dominated by *Azadirachta indica* with the highest IVI of 66.83%, the second most dominant species is *Dalbergia paniculata* (IVI = 44.22%) and *Prosopis juliflora* (IVI= 31.60%) is third. The number of species greater than 10% IVI value was ten species.

Those species could be considered as an ecological indicator species of the Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that a high percentage of the total number of species was in the lowest frequency classes, A, and while a low percentage was observed only in the higher frequency class C, D, and E. This indicates that the herb species of the study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species was very low in study area.

Stem density of ≥10cm was 1,633 m^2/ha and basal area was 6.76 m^2/ha in the study area. Among the 4 sample plots studies, 16 tree species were recorded, 4 species were found and only one individual, and these were considered to be unique species. The 3 most abundance species in terms of basal area occupied 64.65% of the total, of which *Azadirachta indica* was the most dominant species in the study area with 23.74%, followed by *Prosopis juliflora* (22.45%), and *Dalbergia paniculata* (18.45% of the total basal area). The plant species that are listed and recorded in the recent study were checked with the IUCN Red List of threatened species, but none were found in the IUCN Red List.

4.9.1.4 Flora Seasonal Variability

The highest number of unique species was recorded in the Wet Season with 117 species identified, as shown in Table 4.10. The least was recorded during the Hot-Dry season with only 71 species identified. This shows the seasonal variability of the flora of the Letpadaung hills, with species possibly lying dormant during the dryer seasons and then taking advantage of the wet season.

Table 4.10: Number of unique species, genera and families recorded

Season	Number of Species	Number of Genera	Number of Families
Cool-Dry Season	90	71	38
Hot-Dry Season	71	60	37
Wet Season	117	94	44

4.9.2 Vegetation

The Letpadaung hills themselves have a modified, semi-natural vegetation. Remnants of natural woodland occur on nearby Nachitaung Hill. Remnant natural vegetation also exists on the surrounding plains, which are mostly cultivated with agricultural crops farmed by the local people. Than (*Tectonia hamiltoniana*), Dahat (*Terminalia olivieri*), and Sha (*Acacia catechu*) are dominant species in the project area. A bamboo species

Dendrocalamus strictus, and two shrub species, *Limonia acidissima* and *Harrisonia benettii*, also exist in the project area. Natural vegetation of the flatlands is almost entirely cleared.

A map of the existing vegetation at Letpadaung is provided below at Figure 4.9.2.

In the past, there was a proposal to set aside the Letpadaung Hills as a "protected forest" for the purpose of protecting the area for its value as a firewood supply. Earlier mining proposals have recognised the need for a firewood supply for the surrounding communities given the coincidence of areas where vegetation suitable for firewood and the mineral resources exist within the Salingyi Township.

The modified vegetation of the Letpadaung hills is structurally heath to shrub land and is further divisible into:

- Low heath in the broad saddle between the hills;
- Low shrub land on the lower slopes;
- Tall shrub land in more steeply-sided and cooler valleys; and
- Stunted woodland on the hill crests.

4.9.3 Fauna

Environment Myanmar Cooperative Company Limited (EMC) was appointed by MWMCL to undertake a baseline survey of fauna in the project area. The work was undertaken in February, May and June 2013 to enable the evaluation of the fauna in the three seasons experienced in the Project area. A report on the survey is provided in Appendix D – Baseline Studies – Fauna.

The surveys focused on avifauna, reptiles, amphibians, mammals, butterflies and odonates.

A total of 20 unique species of avifauna were recorded during the surveys, with some species being observed in all of the seasons whilst others were only observed during one or two of the three seasons as shown in Table 4.11.

Table 4.11: Avifauna observed during the Fauna surveys

No.	Scientific name	Common name	Family	IUCN Red List Status	Cool Dry	Hot Dry	Wet
1	*Accipiter badius*	Shikra	Timaliidae	NL	✔	✔	✔
2	*Acridotheres tristis*	Common Myna	Sturnidae	NL	✔	✔	✔
3	*Coracias benghalensis*	Indian Roller	Coraciidae	NL	✔	✔	✔
4	*Elanus caeruleus*	Black-shoulder Kite	Accipitridae	NL	✔	✔	
5	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL	✔	✔	✔
6	*Lanius collurioides*	Burmese Shrike	Timaliidae	NL	✔		
7	*Merops orientalis*	Green Bee-eater	Meropidae	NL	✔	✔	✔
8	*Mirafra microptera*	Burmese Bushlark	Alaudidae	Endemic			✔
9	*Motacilla alba*	White Wagtail	Motacillidae	NL	✔	✔	✔
10	*Orthotomus cuculatus*	Mountain Tailorbird	Sylviidae	NL	✔	✔	✔
11	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL	✔	✔	✔
12	*Passer montanus*	Tree Sparrow	Ploceidae	NL	✔	✔	✔
13	*Pycnonotus blanfordi*	Streak-eared Bulbul	Pycnonotidae	NL			✔
14	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	NL	✔	✔	✔
15	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL	✔	✔	✔
16	*Streptopelia chinensis*	Spotted Dove	Ploceidae	NL	✔	✔	✔
17	*Sturnus burmanicus*	Vinous-breasted Starling	Sturnidae	NL	✔	✔	✔
18	*Turdoides gularis*	White-throated Babbler	Timaliidae	NL	✔	✔	✔
19	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL	✔	✔	✔
20	*Upupa epops*	Hoopoe	Upupidae	NL	✔	✔	✔

NL = Not Listed

A total of 13 species of reptiles and amphibians were recorded during the surveys, with a number of species only being observed during the wet season. The survey included actual first hand observations of individuals as well as anecdotal observations by people.

Table 4.12: Reptiles and Amphibians recorded in the Fauna surveys

No.	Scientific name	Common name	Family	IUCN Red List Status	Cool Dry	Hot Dry	Wet
1	*Bufo melanostatus*	Common Toad	Bufonidae	Lc	✔	✔	
2	*Bungarus fasciatus*	Banded Krait	Elapidae	Lc			✔
3	*Calotes emma*	Tree Lizard	Agamidae	Lc			✔
4	*Calotes versicolor*	Garden Fence Lizard	Agamidae	Lc	✔	✔	✔
5	*Daboia russellii siamensis*	Russell's Viper	Viperidae	Lc			✔
6	*Duttaphrynus melanostictus*	Common Toad	Bufonidae	Lc			✔
7	*Eutropis carinatus*	Common Sun Skink	Scincidae	Lc			✔
8	*Fejervarya l. limnocharis*	Paddy Frog	Dicroglossidae	Lc			✔
9	*Holobatrachus tigerinus*	Indian Bull Frog	Dicroglossidae	Lc			✔
10	*Kaloula pulchra*	Painted Bull Frog	Microhylidae	Lc			✔
11	*Mabuya multifasciata*	Many-lined Sun Skink	Scincidae	Lc	✔	✔	
12	*Polypedates leucomystax*	Common Tree Frog	Rhacophoridae	Lc			✔
13	*Ptyas korros*	Rat Snake	Colubridae	Lc	✔	✔	✔

Lc = Least Concern

A total of six (6) species of mammals were recorded in the Fauna surveys. Individuals were either recorded from direct observation, from the analysis of scat, observation of tracks or from anecdotal evidence provided by the local people. Myanmar Hares and Common Palm Civets were recorded in all seasons whilst all of the other species were recorded in one of the three seasons only.

Table 4.13: Mammal species recorded during the Fauna surveys

No.	Scientific name	Common name	Family	IUCN Status	Cool Dry	Hot Dry	Wet
1	*Callosciurus pygerythrus*	Grey Squirrel	Sciuridae	Lc			✔
2	*Cervus eldi thamin*	Eld's Deer	Cervidae	Endemic / Endangered	✔		
3	*Lepus peguensis*	Myanmar Hare	Leporidae	NL	✔	✔	✔
4	*Muntiacus muntjak*	Barking Deer	Cervidae	NL	✔		
5	*Niviventer fulvscens*	White-belleyed Rat	Muridae	Lc			✔
6	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	NL	✔	✔	✔

NL = Not Listed

Lc = Least Concern

A total of 15 species of Butterfly were recorded during the fauna surveys. Individuals were caught using hand nets with some being photographed and released while others were preserved for use in identification. The largest numbers of species were recorded during the wet season.

Table 4.14: Butterfly species recorded in the Fauna surveys

No.	Species	Family	IUCN Status	Wet	Cool Dry	Hot Dry
1	*Papilio polytes romulus*	Papilionidae	Common	✔		
2	*Papilio demolius*	Papilionidae	Common	✔		
3	*Graphium agamemnon*	Papilionidae	Common		✔	✔
4	*Catopsilia pomona*	Pieridae	Common	✔	✔	✔
5	*Eurema hecabe*	Pieridae	Very Common	✔		
6	*Ixias pyrene verna*	Pieridae	Uncommon	✔		
7	*Ixias marianne*	Pieridae	Very Common		✔	✔
8	*Appias libythea*	Pieridae	Very Common	✔	✔	✔
9	*Danaus limniace*	Danaidae	Uncommon	✔	✔	✔
10	*Danaus chrysippus*	Danaidae	Common	✔	✔	✔
11	*Danaus genutia*	Danaidae	Uncommon	✔		
12	*Junonia hierta*	Nymphalidae	Common	✔		
13	*Junonia almana*	Nymphalidae	Uncommon	✔		
14	*Junonia atlites*	Nymphalidae	Common	✔		
15	*Mycalesis perseidoes*	Satyridae	Common		✔	✔

A total of five (5) Odonate (Dragon Fly) species were recorded during the surveys. The same five species were recorded in the cool-dry, hot-dry and wet seasons. The species are listed in Table 4.15.

Table 4.15: Odonate species recorded during the fauna survey

No.	Species	Common name	Family	IUCN Status
1	*Tholymis tillarga*	Evening Skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green Skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common Glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	Common Flangetail	Gomphidae	Common

4.9.4 Habitat

Muir (1997) found that conditions around Letpadaung provided poor habitat for wildlife, and wildlife diversity and density can be expected to be low. The factors limiting habitat include human population density, conversion of vegetative cover to cropping and firewood collecting. These factors would only have increased the pressure on habitat over time and it is likely that the habitat has continued to degrade.

4.9.5 Aquatic Ecology

The aquatic fauna in the major water ways surrounding the Letpadaung Project site were surveyed during each of the three seasons. A total of seven (7) survey locations were selected. The survey locations consist of locations on the Chindwin River that are upstream, downstream and adjacent to the Letpadaung project site. Additionally upstream and downstream sections of the Yamar Creek were also selected as survey locations as shown in Figure 4.9.3. A copy of the survey findings is included at Appendix E – Baseline Studies – Aquatic Ecology.

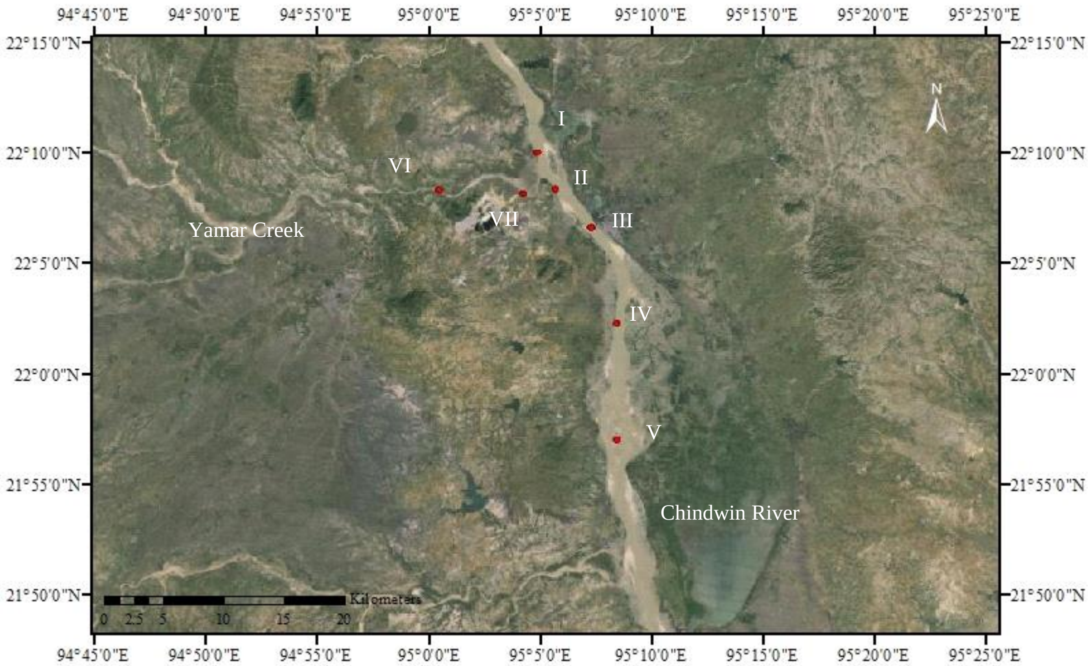

Figure 4.9.3: Survey locations for the Aquatic Fauna survey

The aquatic fauna survey included sampling: fish, zooplankton, phytoplankton, and benthos species.

A total of 21 species of fish were recorded during each of the surveys as shown in Table 4.16, with no species missing from the surveys completed in each season. During the Cool-Dry season, the population of fish was predominated by *Glossogobius giuris* and *Labeo sp*. During both the Hot-Dry season and the Wet season the fish population was predominated by *Glossogobius giuris* and *Chanda ranga*.

Table 4.16: Fish species recorded during all three seasons

No.	Scientific name	Local name	Family	IUCN RedList Status
1	*Puntius chola*	Ngakhonema	Cyprinidae	NL
2	*Chela sardinella*	Yinbaungzar		NL
3	*Cirrhina mrigala*	Ngagyinbyu		NL
4	*Labeo calbasu*	Nganet pyah		NL
5	*Labeo angra*	Ngalu		NL
6	*Labeo rohita*	Ngagyin		NL
7	*Labeo boga*	Ngalu		NL
8	*Esomus altus*	Ngamautort		NL
9	*Rhinomugil corsula*	Ngazinlone	Mugilidae	NL
10	*Lepidocephalus thermalis*	Ngathaledoe	Cobitidae	NL
11	*Mastacembelus armatus*	Ngamwedoegyar	Mastacembelidae	NL
12	*Mastacembelus zebranus*	Ngamwedoebaygyar		NL
13	*Chanda ranga*	Ngazinzat	Channidae	NL
14	*Glossogobius giuris*	Kathaboe	Gobiidae	NL
15	*Mystus aor*	Nga-gyaung	Siluridae	NL
16	*Ompok bimaculatus*	Nganuthan		NL
17	*Silonia silondia*	Ngamyin	Schilbeidae	NL
18	*Mystus cavasius*	Ngazinyaingbyu	Bagridae	NL
19	*Notopterus notopterus*	Ngaphe	Notopteridae	NL
20	*Gudusia variegata*	Ngalabi	Clupeidae	NL
21	*Channa orientalis*	Ngayantgaungdoe	Channidae	NL

NL = Not Listed

A total of 15 zooplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool dry, hot dry and wet seasons (Table 4.17). No significant seasonal variation in the population of zooplankton was found, however some species were not recorded at some of the sampling locations.

Table 4.17: Species composition of Zooplankton in the Chindwin River and Yamar Creek

No.	Species	Phylum	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Astramoeba radiosa*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Spirostomum minus*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Monostyla lunaris*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Monostyla bulla*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
5	*Brachionus diversicornis*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Brachionus havanaensis*	Rotifer	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
7	*Lecane ungulata*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Daphnia sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
9	*Daphnia pulex*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII

No.	Species	Phylum	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
10	*Bosminopsis sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Chydorus sp*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
12	*Cyclops vicinus*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Stenocypris malcolmsoni*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
14	*Eucypris virens*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Entacythere donaldsonensis*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI

A total of 21 phytoplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool dry, hot dry and wet seasons as shown in Table 4.18. No significant seasonal variation in the population of phytoplankton was found, however some species were not recorded at some of the sampling locations.

Table 4.18: Species Composition of Phytoplankton in the Chindwin River and Yamar Creek

No.	Species	Class	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Synedra affinis*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Dinobryon divergens*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Diatoma elongaum*	Bacillariophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Campsopogan caeruleus*	Rhodophyceae	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
5	*Staurastrum leptopus*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Mougeotia nummuloides*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
7	*Spirogyra protecta*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Spirogyra microspora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
9	*Spirogyra cylindrospora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
10	*Spiroyra prolifica*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Spirogyra azygospora*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
12	*Oscillatoria laete-virens*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Oscillatoria subbrevis*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
14	*Lyngbya martensiana*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Lyngbya truncicola*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
16	*Lyngbya contorta*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
17	*Phormidium ambiguum*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
18	*Planktothrix raciborskii*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
19	*Treubaria crassispina*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
20	*Synedra acus var. angustissima*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
21	*Synedra acus var. radians*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII

Five benthos species; *Crocothemis servilia*, *Orthetrum glaucaum*, *Rhyothemis Phyllis*, *Tramea basilaris*, and *Ictinogomphus rapax* were recorded in Chindwin River; all of them are nymphs of dragonfly species. Six benthos species; *Crocothemis servilia*, *Orthetrum glaucaum*, *Rhyothemis Phyllis*, *Tramea basilaris*, *Macrodiplax cora* and *Ictinogomphus rapax* were found in Yamar Creek. Similarly to the survey of the Chindwin River, all of the aforementioned species recorded were dragonfly nymphs.

For all surveyed groups, the results showed that there was no significant difference in species diversity between the upstream and downstream sampling locations. This indicates that in relation to environmental conditions the upstream and downstream sites have relatively similar quality of aquatic habitat.

4.10 SOCIAL ENVIRONMENT

This Section describes the baseline social environment of the local and regional communities surrounding the Letpadaung Copper Mine Project. The baseline was developed from information ascertained from both primary and secondary sources. Due to the lack of official data at the village level, some of the information presented concern the socio-economic and cultural environment reported in secondary sources for Salingyi Township, the administrative unit governing the village-tracts located near the Project site, and Monywa District, the next administrative level up from the township level. Information sourced from interviews, consultations with the villages (See Section 6) and site observations and sampling was extensively used to understand the existing community environment, as well as identifying potential impacts and suggesting the mitigation strategies and measures presented in Section 7.

Absent from the social baseline is a thorough consideration of the social and economic implications of land acquisition on the affected communities. Four (4) villages have already been moved to two (2) new sites located south and south-east of the Project site boundary under the auspices of the Regional authorities and MEHL. Households in an additional 26 villages are in the process of relinquishing their land for the Project activities. A short summary is presented in Section 4.10.4 along with recommendations for moving forward.

Monasteries previously located in the villages have also been relocated to the new sites and a new monastery was constructed outside the new villages (the New Taungyar Monastery Area). More information is required to verify the process undertaken to physically unearth and transfer these cultural resources to the new village locations. This issue is addressed in Section 7.11.1.

Finally, land take will also affect villagers who had previously collected wood and herbs from the Project Area for fuel and medicine. The impacts of the access restrictions to natural resources on the families dependent on these resources require further investigation and possible mitigation. This issue is addressed in Section 4.10.6.

Socio-economic impacts occur throughout the life cycle of the mine, but they are most keenly felt by local residents in the period leading up to construction. Land acquisition and resettlement pose the greatest social challenges to communities and project sponsors. The process of land take occurs prior to construction and can involve the physical and/or economic displacement of entire communities away from their traditional sources of livelihood, from long standing social and family networks and from their places of worship, schools, medical facilities, and markets.

Because of the multiple stresses and livelihood implications resulting from resettlement, the management of resettlement, particularly in its early stages, is a critical factor determining the extent to which adverse impacts are avoided or minimised in both the short and long term. The unintended consequences of a poorly planned or implemented resettlement can be far reaching and result in project delays throughout the life of the mine. The resettlement process undertaken for the Letpadaung Copper Mine Project has been fraught with difficulties and has already resulted in the stoppage of work and scheduling delays.

4.10.1 Methodology

Data was sourced from a number of resources to define and understand the existing social environment documented in this section. From these baseline data, an assessment of the potential impacts, both positive and negative, has been made.

Baseline data sources include:

- Official statistics of Salingyi Township, Monywa District, and Sagaing Region collected from April – December 2012.
- Historical studies prepared for the S&K development, including the 1996 S&K Environmental Assessment and 1997 Feasibility Study conducted by Minproc Engineers, Ltd.
- MEHL.
- Existing MEHL, MWMCL and MYMCL documentation, policies and programs.
- Websites of development agencies and NGOs working in Myanmar.
- Press articles from *Salingyi Township Gazeteer*.
- Community feedback from interviews and consultations.

- Baseline Study - Cultural Heritage Assessment for the Letpadaung Copper Mine Project prepared by MEHL (2013).
- Baseline Study – Social Impact for the Letpadaung Copper Mine Project and analysis of data collected (2013).
- Draft Resettlement Action Plan for the Letpadaung Copper Mine Project prepared by MWMCL (2013).
- Site observations and testing for noise levels, vibrations, and visual amenities.
- EMC Survey of Traffic Conditions.

An important data source was the baseline survey of the socio-economic conditions in the Project area conducted by EMC in May and June 2013. The findings of this baseline study are provided in Appendix F and the survey data sheets are included in Appendix G. The data possess a number of methodological limitations which may affect the integrity of the sample, however the effect of these sampling biases appears to be sufficiently small. While it is assumed that the data are representative of the existing community environment at the Letpadaung Copper Mine, any findings used to direct interventions toward specific villages require confirmation. See Table 4.19 for the population and number of households of the villages included in the social baseline and of the sample.

Table 4.19: Characteristics of the surrounding villages[20] near Letpadaung and the sample

Village Tract	Village Name	Population	# of Households (HH)	# HH in Sample (n)	% of HH
Moegyobyin	North Moegyobyin	638	121	34	28.1
	South Moegyobyin	700	140	48	34.3
	Wardan	634	120	39	32.5
	North Paungga	1200	238	64	26.9
	Central Paungga	628	125	41	32.8
	South Paungga	450	86	27	31.4
Dondaw	Dondaw	1600	315	44	14.0
	Ywartha	384	71	60	84.5
Shwe Pan Khaing	Shwe Pan Khaing	843	166	55	33.1
	Telpinkan	433	82	40	48.8
	Thedawayi	368	73	21	28.8
Taungpalu	Taungpalu	867	163	37	22.7
	Kyawywa	650	131	34	26.0
Phaunggada	South Phaunggada	964	187	44	23.5
	Kyaukpyudaing	547	114	51	44.7
	Zidaw/Sede	530	101	20	19.8
Letpadaung	Shwehlay	265	56	41	73.2
Ywarshay	Ywarshay	1450	275	88	32.0
	Palaung	956	145	84	57.9
	Wetme (new)	350	65	13	20.0
	Kandaw	582	110	25	22.7
Ton	Ledi	562	111	18	16.2
Nyaungbingyi	Nyaungbingyi	1549	291	68	23.4
	Yonebinyoe	728	130	49	37.7
	Mingalargone	187	32	13	40.6
Shwebo	Palaing	439	87	30	34.5
Total		18,504	3,535	1,090	-

Unfortunately there has been a lack of complete data concerning the resettlement carried out to date. MWMCL prepared a draft Resettlement Action Plan (RAP) in outline form which is in need of clarification, updating, analysis and planning. A thorough investigation of the resettlement process to date and any outstanding activities, including corrective measures and mitigation plans, is urgently needed.

[20] The villages of Gondaw and HtanDawGyi were excluded from the analysis as they had too few observations. Wetme is also known as Wet Hmay.

4.10.2 National Demographic and Economic Features

The estimated population of Myanmar in 2004/2005 was 54.3 million, of which 49.7% was male and 50.3% was female (UNDP Country Assessment Report). Myanmar shares borders with Bangladesh and India to the north-west, the People's Republic of China to the northeast, the Lao People's Democratic Republic to the east, and Thailand to the southeast.

In Myanmar, there are 135 recognised ethnic groups residing in seven (7) states and seven (7) divisions. The major ethnic groups are Bamar, Shan, Kayin, Rakhine, Mon, Chin, Kachin and Kayah. The majority of the Myanmar nationals are Bamar and they comprise approximately 70% of the population. The second largest majority are the Shan comprising about 9% of population and the third largest majority are Kayin comprising about 6% of the population.

In view of the topography and natural resources, Myanmar is dependent on agriculture for its economic base. Agriculture is the leading sector in Myanmar's economy, providing about 60% of GDP, 66% of employment, and over 60% in export profits. GDP increased by 7.3% per annum between 1997 and 2003. During that time, mining only contributed 0.5% of GDP.

4.10.3 The Regional and Local Environment of the Project Area

The site of the Letpadaung Copper Mine Project lies within the jurisdiction of the Salingyi Township of Monywa District. Monywa is approximately 7 km north-east of the Project site. Salingyi is approximately 13 km south of the site. Neighbouring townships to Salingyi are Yinmabin Township to the north, Monywa and Chaung-U Townships to the east, Yesagyo and Myaing Townships (both in Magway Division) to the south and Yinmabin and Pale Townships to the west. Average temperatures in Salingyi Township range from 6 ºC to 38 ºC. Average annual rainfall ranges from 25 cm to 76 cm.

Within 5 km of the S&K and Letpadaung Project sites, 26 villages account for a population of approximately 25,000 people. Mine Town is the largest community with appropriately 3,100 people and is continuing to grow (MICCL, 2003). The four (4) villages of Dondaw, Nyaungbingyi, North Paungga, and Ywarshay are the second largest set of villages with populations hovering around 1,500 people. These larger villages provide services to the smaller villages in the area.

Mine Town and eight (8) villages, namely, South, North and Central Paungga, South, North and Central Moegyobyin, Kyawywa, and Taungpalu, are located within eight (8) kilometres of the Letpadaung Project site as shown at Figure 4.10.1. A profile of Mine Town and the villages is, as follows:

Mine Town

Mine Town has a total population of 3,100 people and its infrastructure is significantly more advanced than the villages situated near the mine. Housing includes 145 separate houses, 256 semi-detached houses and a 60-person male dormitory for semi-contract workers. The bulk of the workforce of MYTCL comes from Mine Town, as well as some of the nearby rural communities.

The existing facilities in Mine Town include a high school, a hospital, a recreation centre, a fire station with two (2) fire engines and ten (10) fire brigade personnel, a police station, a number of small stores, and a telecommunications centre. Electricity is supplied to residences and facilities in Mine Town from the Nyaungbingyi Power Station. Treated water is provided in the form of running water to all buildings in Mine Town from Pump Station No 3.

South Paungga Village

This village is located three (3) kilometres from the Project site. It has a population of 450 persons occupying 86 houses. The majority of inhabitants are farmers and they principally grow wheat, peas and beans, sesame, and a small amount of paddy. A main water source for the village is Paungga Dam, which was recently renovated by MWMCL, and irrigates 300 acres of farmed land.

Aside from crop cultivation, the villagers have established sheep and goat farms for trade as well as breeding a few pigs and cows for domestic consumption. Approximately four (4) villagers work at MYTCL, three (3) are contract labourers and one (1) is a permanent employee.

Central Paungga Village

This village is 3.25 km from the project site and has 628 residents and 125 houses. It is one of the few villages in the area with a library and a monastery. The village does not have a primary school and school-going children in the village attend the primary school in North Paungga village.

Due to Central Paungga's close proximity to the Phaungga Dam, paddy farming is more utilised in Central Paungga Village than in North and South Paungga. A scattered toddy plantation exists around Central Phaunga up to the periphery of Phaunga Dam, which is located ½ mile to the west of Central Paungga. These toddy palms are a source of feedstock for animals and the leaves are used as covering materials for houses. The number of MYTCL recruits from this village includes two (2) permanent employees and 60 contract labourers.

North Paungga Village

This village is located four (4) kilometres from the Project site with a population of 1,200 inhabitants occupying 238 houses. The traditional economy is the same as that of South and Central Paungga villages. Sesame and a variety of peas and beans are staple crops for most villagers, while some farmers adopt paddy cultivation from water drawn from Phaunga Dam.

In addition, a number of village women consistently trade items of groceries and vegetables to Mine Town. It has a primary school and two (2) monasteries. Approximately eight (8) permanent staff and about 50 contract employees work for MYTCL.

South Moegyobyin Village

South Moegyobyin is approximately five (5) kilometres south-west of the Project. It has a resident population of 700 occupying 140 houses. The major crops are sesame, maize, peas and beans, and wheat. Paddy cannot be grown due to the scarcity of water in this area. This village has a primary school, a Sub Health Centre and a midwife.

A small dam of approximately 35 ha is located near the village, providing the sole source of water for the purpose of drinking, irrigation and domestic uses. The dam dries up during the dry season, which results in a shortage of available water, not only in this village but also in the adjoining villages of North and Central Moegyobyin.

The south-west part of the village is of archaeological importance. Cultural resources dating back to the antediluvian period were unearthed by the Department of Archaeology at sites just 0.5 km south-west of South Moegyobyin village (MICCL, 2004). Also located in this area is an ancient graveyard dating back to the Pyu civilisation.

North Moegyobyin Village

North Moegyobyin has 638 people living in 121 houses. The village is located approximately five (5) kilometres from the Project site. A primary school operates in the village and the economy and living standards are similar to those of the nearby villages. The number of MYTCL workers originating from the village is 15 contract labourers, which appears to be a higher figure than the number of MYTCL workers coming from Central and South Moegyobyin.

Central Moegyobyin Village

Similar to the North and South villages, the local population in Central Moegyobin village relies heavily on the cultivation of crops. It has a population of 511 and 90 houses situated five (5) kilometres away from the Project site. There is no primary school in Central Moegyobin village and school-going children attend school in South Moegyobyin village.

Kyawywa Village

Kyawywa village is situated adjacent to the Yin Mar Bin Road, 1.5 km from the Project site. The total population is 650 people living in 131 houses. The farmers predominantly grow wheat, peas and beans, garlic, onion, maize and sesame. There is no paddy cultivation in Kyawywa as the majority of the farm plots are located on moorland and the saline content in the groundwater is too high. The high saline content prohibits the groundwater from being a source of drinking water. The residents of Kyawywa get their drinking water from a fresh water well located in the direction of Aungchansi approximately 0.5 km away.

Since Kyawywa village is situated quite close to Nyaungbingyi village and Monywa Town, a number of villagers are self-employed tradesmen doing odd jobs. Eight (8) people are civil servants and six (6) are MICCL and MYTCL permanent employees. The village has a primary school, a monastery and two (2) stupas.

Taungpalu Village

Taungpalu has a population of 867 dwellers and a total of 163 houses. The community infrastructure appears to be better equipped than that found in the nearby villages. Taungpalu village lies next to the Yin Mar Bin Road and just two (2) kilometres away from the Letpadaung site. It has a primary school, a Rural Health Centre and two (2) monasteries. Approximately 14 people from Taungpalu work for MYTCL while the majority cultivate crops.

4.10.4 Land Acquisition and its Effects

A total of 2,746 ha of land take from 30 villages is required for the Letpadaung Copper Mine Project. The four (4) villages of Zidaw, Sede, Kandaw and Wetme, comprising 2,000 inhabitants/220 households, were physically relocated to two (2) sites located south and south-east of the Project lease boundary in 2012. The resettlement was organised by was organised by MEHL and the Regional Government in a process that started in October 2010. Broad community support for resettlement collapsed however in Fall 2013 following NGO agitation demanding better compensation terms for the affected households. The old villages of Sede, Zidaw, Wetme and Kandaw still exist

and populated by the remaining households refusing to move to the new villages. Other households owning land in the Project lease area refuse to relinquish their plots and accept compensation. These dissenting households represent 44% of the households eligible to receive compensation. Currently within the Project lease area early works activities are being carried out alongside working farms with farmers and livestock present.

Two (2) rounds of compensation have been paid to the relocated households in 2011 and 2012, with a third round of back compensation paid in September 2013. Auxiliary compensation was also paid to households affected by the drilling works which took place prior to relocation. Compensation rates were roughly three (3) times higher than the official Government rates.

From the information obtained about the resettlement process underway, the following activities are urgently required to support the affected households and communities displaced by the Project:

- A retrospective Resettlement Action Plan (RAP) based on the current RAP should be prepared in accordance with IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement ;
- Ethnic minority groups and households residing in the Project area should be identified and researched to determine whether they qualify as “indigenous peoples” under IFC Performance Standard 7 on Indigenous Peoples or as a vulnerable group requiring specialised livelihood assistance.
- Livelihood restoration measures need careful examination to ensure that comprehensive and adequate coverage is provided to all relocated households. Livelihood restoration should take into account the needs and capabilities of household members. MWMCL has committed employment to eligible households affected by land take. It is not clear whether an employment placement will be sufficient to meet the subsistence needs of larger families. Specific livelihood restoration measures remain to be identified for the households who are ineligible to work for MWMCL and/or are fully reliant on farming and unable to cope with industrial employment; and
- Resettlement assistance may be required by the affected households in the interim period between relocation and the commencement of employment with MWMCL. Villagers report in the social baseline survey interviews that their ability to feed their families is an immediate concern. The most advisable form of assistance is land clearance and the provision of seeds and other inputs for planting and rice for immediate consumption.

4.10.5 Cultural Heritage

The cultural heritage assessment (CHA) identified a single site as being significant. The site which comprises a Buddhist stupa and associated buildings is regarded as having some historical, religious and cultural importance to the local community. The stupa, as well as being a monument to Buddha, is a shrine to the famous holy monk Ledi Sayadaw. The stupa and attached Thein and Gandaguri buildings is found on the Letpadaung hillslope at the following location: 22^{o} 04' 36.77" latitude; and 95^{o} 05' 36.29" longitude.

4.10.5.1 Historical Background

Maung Tet Khaung, who would later become known as the monk Ledi Sayadaw, was born in 1846 at Saipyin village in Depayin Township. At the age of 15 he started as a samanera novice and took the novice name of Shin Nyanadaza.

According to the historical records Ledi Sayadaw sojourned during Buddhist lent at a hut situated on the hillslopes of Letpadaung Hill for a period of around eight months in the year 1903[21]. In the records the precise location of the hut was not specified but it is surmised to have been in the valley not far from the Kyaw Ywar and Taung Palu villages. The basis of this assertion is that the records indicate that Ledi Sayadaw used to visit to these villages to accept food offerings from local villagers from these communities.

Ledi Sayadaw wrote a thesis over this period, whilst residing in his hut on the Letpadaung hillslopes[22]. In his thesis he mentioned the general location of the hut but did not include any specific geographic reference points. Furthermore no mention is made in the text of the Tawya Valley Stupa, the Thein and Gandagudi buildings, nor the Tawya Kyaung monestary. Considering that Ledi Sayadaw mentions many of his other construction activities in his thesis some have interpreted this to suggest that he may not have been involved in construction of the stupa, monastery, or other associated buildings in their current location. The historical connection between the original temporary monastery (established by Ledi Sayada) and the current stupa site is regarded by some local monks in the areas as contentious[23]

However, in the interview survey, a village elder namely U Pike of Aung Chan Si village reportedly explained that Ledi Sayadaw used to practice meditation in the hut located in the valley of Letpadaung hill as well as in a cave in the Kyaukgyi hill.

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[21] Biography of Ledi Sayadaw.

[22] Kammahttana Depan Thesis.

[23] Recorded converstaions with monks U Kay Lar Tha, U Wa Tha Wa, and U Tha Thana (Abbot of Yesaygyo Way Lu Won monastery.

In summary there is insufficient evidence to confirm the current stupa location as being the original location of the Ledi Sayadaw hut or monastery and so this issue remains contentious.

4.10.5.2 Impacted Cultural Heritage Buildings

The construction and restoration history of the Tawya Valley stupa and associated buildings was provided by U Dhamasara who once resided there. According to his account the Tawya Valley stupa was built during the period of Myanmar kings and the upper portion was destroyed with only the lower portion remaining. In 1964 the stupa was renovated by the locals and over time it has received regular repair and restoration work. According to the stone carved records (on site) the latest repairs were carried out in 2004 by U Ye Aung and Daw Nyunt Nyunt Yi. Dhammasara claims that the stupa Buddha image is an ancient relic that was crafted during the Konboung dynasty (1752 – 1885).

Plate 1: Tawya Valley a stupa and attached buildings)

The stone carved stupa records indicate that the Gandagudi building, situated in the compound, was donated by the community in 1982. The present day Thein building was recently constructed in 2009 by the Howpar villagers.

Plate 2: Buddha image in the Thein building

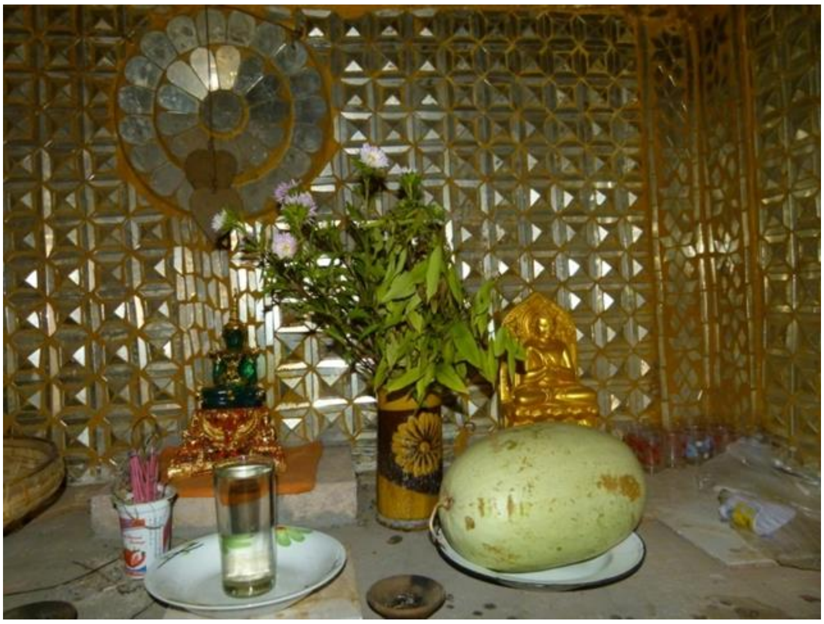

Plate 3: Buddha image in the Gandagudi building

As previously noted there have been several modifications and renovations made to the original stupa over the years including construction of a brick wall. Two boundary pillars in the consecrated area of the stupa are evident. The newest of the pillars is in good condition and quite ornate and the other pillar is ancient, unadorned and in poor condition. The ancient boundary pillar may have been erected in the period that Ledi Sayadaw was in the area but this cannot be confirmed.

Plate 4: Boundary pillars

Plate 5: Thein building plaque

4.10.5.3 Other Structures

There are four (4) other small stupas in the vicinity of Letpadaung hill referred to as the Shwemyintin, Anumyudatpaungkatkyaw, Shwezarli, and Kha stupas. However they are not recognized as having any significant religious, cultural or historical importance by the local community.

4.10.6 Reduced Access to Land and Trees

Local residents and previous land owners will no longer be able to use the land within the site boundary for farming and wood and herb collection important for sustenance and heating. The lower availability of resources requires residents to travel longer distances in search of suitable land, fuel supplies and medicinal plants. The scarcity of

supply may also become a source of conflict among residents and communities. Sustainable use of available land is also required.

A Community Natural Resource Management Plan should be prepared to identify the ways in which residents are impacted by the land access restrictions imposed by the Project and to develop appropriate mitigation measures. Such access restriction plans or frameworks tend to be participatory, involving discussions and negotiations amongst villagers on the use of land and forests in the community, to arrive at a community resource use agreement. The Community Natural Resource Plan would regulate residents' use of neighbouring land and forests as a conservation measure. The Community Natural Resource Plan would also include activities to offset the poverty impacts resulting from the land access restrictions.

In the short term, MWMCL may want to provide alternative fuel sources to those households who are highly dependent on firewood for their sustenance. In the long term, MWMCL and the Regional Government should work toward developing the non-farming sector in Sagaing Region to diversity the income base of residents. This can be achieved through skills training, exposure to other industries, provision of vocational courses in marketing, and long-term investments in education (see Section 4.10.13).

4.10.7 Demographics

Salingyi Township has a population of approximately 190,000 people.[24] The population grew at a rate of 2% per annum since 1995 primarily as a result of in-migration. Approximately 4,000 new identity cards were issued in the Township in 2012, 2.5 times the number issued in 2011. Fertility is slightly above replacement level in Myanmar and in Salingyi Township. The birth rate was 13.10 (per 1000) in Salingyi Township and 17.3 (per 1000) in Myanmar in 2012. Infant mortality is low relative to other Southeast Asian countries with the same economic level; in 2012, it was 6.10 (per 1,000) in Salingyi Township. The maternal mortality rate was also low in the Township, at 2.8 (per 1,000) in 2012.

The majority of the residents in Monywa District, Mine Town and the neighbouring villages are Bamar. A small fraction of the population in the Sagaing Region comprises Chin, Shan and Kayin ethnic groups. Most of the villagers living near the Letpadaung Copper Mine are Bamar and the predominant religion and traditional practices is based

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[24] The population was estimated to be 130,000 in 1995 and had an annual growth rate of 2%. Minproc Engineers Ltd. 1996 Feasibility Study –Sabetaung Kyisintaung Copper Project. Ivanhoe Myanmar Holdings Ltd

on Theravada Buddhism. A meditation centre exists in the vicinity of the Project and one (1) historical stupa is situated within the site boundary.

Salingyi Township is predominately rural with 92% of the population living in a rural area. The Township comprises three (3) urban quarters, 39 village-tracts and 152 villages. The majority of the population (176,000 people or 21,550 households) live in the villages.

Households in the surveyed villages report an average of 5.6 persons which exceeds the national rural average of 4.67.[25] Households typically consist of two (2) parents, one or two (1-2) grandparents, and two or three (2-3) children. Some households have just two (2) adult members while others have as many as 14 members.

The dependency ratio, which is the ratio of dependents to the working age population, is 77% in the villages near the Project site compared to a much lower figure of 44% for the country in 2012[26]. The higher dependency ratio in the Project area suggests that family structure effects may play a greater role in the economic welfare of households in the surveyed villages than in the country as a whole. In general, compared to the national average, households in the surveyed villages have a relatively larger number of young dependents to support.

Table 4.20 presents the dependency ratios for the surveyed villages. Households with more dependents than breadwinners have dependency ratios above 0. The villages with a high proportion of such households are: *Thedawayi, Shwehlay*, and *Ledi*. *Ywartha* and *South Phaunggada* have the lowest dependency ratios.

Another indicator of household welfare is the percentage of households with small children (aged 6 and under) as the presence of young children limit the number of household members available for wage work and may keep older siblings needed for child-minding activities from attending school. Forty percent (40%) of households in the villages have small children. Five (5) villages (*South Moegyobyin, South Paungga, Telpinkan, Ywarshay, Kandaw*) have a high proportion of young families, while four (4)

[25] "Household Income and Expenditure Survey." Central Statistical Organisation. Ministry of National Planning and Economic Development. Retrieved 17 July 2011. Cited from Wikipedia on 7 November 2013.

[26] The World Bank defines dependents as children under 15 years and adults over 64 years, and reports a dependency ratio of 44% for Myanmar in 2012 (http://data.worldbank.org/indicator/SP.POP.DPND. sighted 8 October 2013). **Error! Reference ource not found.** presents the dependency ratio for households by village using a broader definition than that employed by the World Bank. Here dependents are defined as children under 18 years and adults over 60 years. Respondents were asked to report the ages of household members using the broad categories of 0-7, 8-17, 18-59, and 60+, hence the deviation from the World Bank definition.

(*Wardan, Ywartha, South Phaunggada and Mingalargone*) have less than a quarter of households with small children.

Table 4.20: Dependency ratios and the percent of households with small children by village

Village Tract	Village Name	Dependency Ratio (%)	Percent of households with small children
Moegyobyin	North Moegyobyin	79	35.2
	South Moegyobyin	60	56.3
	Wardan	88	23.0
	North Paungga	77	28.1
	Central Paungga	58	29.3
	South Paungga	82	59.3
Dondaw	Dondaw	79	45.5
	Ywartha	41	23.3
Shwe Pan Khaing	Shwe Pan Khaing	75	40.0
	Telpinkan	91	52.5
	Thedawayi	102	42.9
Taungpalu	Taungpalu	72	37.8
	Kyawywa	70	44.1
Paunggada	Phaunggada (South)	53	22.7
	Kyaukpyudaing	72	35.3
	Zidaw/Sede	92	45.0
Letpadaung	Shwehlay	116	43.9
Ywarshay	Ywarshay	65	54.5
	Palaung	88	44.0
	Wetme (new)	67	30.8
	Kandaw	95	52.0
Ton	Ledi	103	50.0
Nyaungbingyi	Nyaungbingyi	65	44.0
	Yonebinyoe	60	32.7
	Mingalargone	94	23.0
Shwebo	Palaing	98	46.7
Average		76	40.2

4.10.8 Main Economic Sectors

Crop production and agricultural trade play an important role in the Salingyi Township and Regional economies (see Table 4.21). The staple crops are peas and beans, corn, oil crops (sesame, sunflower, peas, and groundnut), vegetables and millet. Drought resistant crops, such as the oil crops, grow well in the region which is plagued by irregular rainfall. Cotton and red chili are grown in small quantities.

Table 4.21: Agricultural production in Salingyi Township in 2013

Crop	Number of Hectares (ha) Cultivated
Millet, corn, vegetables and non-edible (e.g. toddy, banana, betel leaves)	19,217
Various types of pea	13,398
Oil crops	13,010
Castor oil plant	7,796
Rice paddy	1,795
Cotton	1,704
Spices (red chili)	209
Total	57,129

In the 2012-13 year, 57,127 ha of cultivable land was utilised in the Salingyi Township (Table 4.22). Over 89 % of that land was used for dry land crop production (farming), about 5.5% was used as paddy, and the rest was used for seasonal farming on riverbanks or gardens. The Salingyi area is a net importer of rice as local rice production can only meet 49% of demand. In contrast, the area produces nearly 5 times the local requirement of vegetable oils and exports about 5,000 tonnes annually.

Table 4.22: Land Use in Salingyi Township, 2012-2013

Land Use	Number of Hectares (ha)
Agricultural land	**45,023**
Farm land	40,295
Paddy field	2,507
Seasonal farm land on the river bank	2,206
Garden	16
Shifting cultivation	0
Reserved forest and protected area	**5,520**
Barren land	**17,501**

After agriculture, manufacturing is the second most important economic sector in Monywa District and in Salingyi Township. Mills and home industry, to a small extent, produce textiles, cotton products, rice noodles, wood and wood products. No manufacturing takes place in Salingyi Township, which does not have a dedicated industrial area.

As expected from the Township data, communities near the Project primarily depend on farming and husbandry (43%) and seasonal farm work (26%) for their livelihood (Figure 4.10.2). Nine-percent (9%) of household's main source of income comes from selling goods and produce. Two-percent (2%) of households have members who work for the Government. Six-percent (6%) of respondents report they have no income sources and are unemployed. The remaining 19% are those households reporting multiple income sources from trade, farming and/or seasonal wage work.

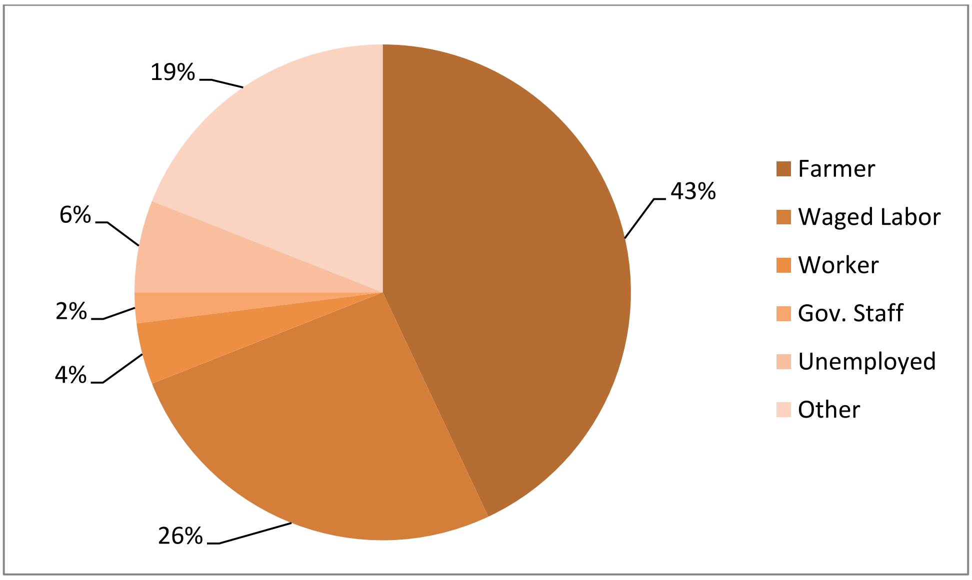

Figure 4.10.2: Livelihood sources among interviewed households.

4.10.9 Public Finance

MWMCL estimates that the Myanmar Government will receive annual revenue from the Letpadaung Copper Mine Project totalling USD 100 million.[27] The revenue will enable the Government to modernise the existing infrastructure in the Country and to build the capacity of the public sector. During the three (3) year construction period, the Project will purchase an estimated USD 70 million worth of construction materials, equipment, labour, and transportation services from local suppliers. During operations, the Project is expected to require USD181 million worth of local goods and services annually. The economic benefit of the Project to the local economy and to the country is therefore anticipated to be large. It is hoped that the Project will stimulate the other economic sectors and increase employment opportunities in all industries.

From 2011 through October 2013, MWMCL spent USD 1.18 million toward 116 community development activities in the nearby villages. The contract volume for the projects still under construction is USD 908,084. These investments include the construction of electricity and water supply facilities to local monasteries; construction of wells and a water purification system; other infrastructural improvements, such as road and bridge upgrading, construction of dams and canals to facilitate irrigation; financing of the mobile health clinic, and various donations toward cultural and education activities throughout the Country and toward earthquake emergency relief in Sagaing Region. Particularly noteworthy is MWMCL's financing of the electricity supply

[27] Report to the Special Commission on Social and Economic Benefits. MWMCL (2013).

facility (USD 37,000) and water supply facility (USD 24,692) in Myaypyinthar monastery. MWMCL spent Ks 72 million (USD 74,076) in road construction and USD 177,000 to repair the Yamar Stream river bank.

An amount of USD 1 million has been preliminarily allocated for FY2014 for community development activities. Salingyi Township generates revenue from various departmental sources. The Township receives most of its departmental revenue from income tax. In 2012, the Internal Revenue Service collected a total of Ks 1,828 (USD 1.88), over double the amount collected in 2011. Most of this revenue came from income tax (55%) and commercial tax (26%). The second highest revenue source came from tender tax collected by the Township Development Committee of the Ministry of Border Affairs. The tender tax collected in 2012 totaled Ks 1067 (USD 1.10), a sharp increase over that collected in 2011, which was just Ks 295 (US 30 cents). The Township's General Administration Department brought in Ks 99.77 (US 10 cents) in 2012, an increase of 38% from 2011, of which two-thirds (2/3's) came from liquor and one-third (1/3's) from land tax. Revenue from the Township's postal and telecommunication services remained stable at Ks 84.2 and Ks 81.3 in 2012 and 2011 respectively (US 9 cents). Finally, the Forestry Department contributed relatively little to the Township's budget, totaling Ks 15.94 in 2012, but it was one-third (1/3) more than had been forecasted.

In the 2012-13 financial year, Salingyi Township generated Ks 79,808 (USD 821) in net gross product and services, significally less than the amount forecasted in the preceding year (just 54%). Gross product revenues constituted most of this revenue (Ks 60,206 in 2012). Trade contributed Ks 14,588 (24%) and services contributed Ks 5014 (8.3%) in 2012.

4.10.10 Communication Facilities

Salingyi Township has two (2) main post offices and one (1) small post office. It also has a telegraph office and a telephone exchange. A GSM tower was constructed in 2012.

4.10.11 Fire Services

The Township has a total of nine (9) fire engines housed in various facilities, i.e. Sulphuric Acid Plant, MEHL, No. 6 Textile Mill, Letpadaung Copper Mine, and in Salingyi Quarter #2 and Kan Kone village. In addition to the firemen who work for the Government, there is a large volunteer fire brigade operating in the quarters and the villages totalling 45 platoons and 1,585 crews. The Government takes active fire prevention measures in the form of daily test runs, training, public education and the

removal of combustibles from the villages in the summer time. Streets are also maintained to ensure passage of the fire engines.

4.10.12 Electrical Power Substations and Transmission Lines

S&K Copper Mine has two (2) electrical power substations, each with a capacity of 10MVA and transmission cable 6.4 km long. No.6 Textile Mill also has an electrical power substation with 10MVA capacity and 16.1 km of cable. The Sulphuric Acid Plant has a substation of much smaller capacity, 1.5MVA, and 5.6 km of cable. The Nyaungbingyi River water electrical pump has a capacity of 7.5 MVA and 4.8 km of cable.

4.10.13 Education

Formal primary education in Sagaing Region faces problems related to universal access, equity, quality, internal and external efficiency and lack of schools. In recent years, substantial improvements have been made in the access to primary education and to its internal efficiency in Salingyi Township. Nevertheless a large proportion of children do not enrol in the first grade and of those who do attend school, a considerable number drop out before reaching the fifth grade (Y5) with generally an insufficient level of education to stay literate. In Salingyi Township, girls are less likely than boys to enrol in school at the age of 5 years.

Statistics indicate that school attendance in Salingyi Township is generally limited to primary education. Just 25% of school-aged children (aged 5 to 17) attend school. Fifty-eight percent (58%) attend primary school (Y1 – Y5), 31% attend middle school (Y6 – Y9) and 11% attend high school (Y10 – Y11). In 2011-12, a total of 92 students matriculated to attend university. Overall, the ratio of teachers to students is 1:24.

Within the Salingyi Township, there are ten (10) high schools, 18 middle schools and 76 primary schools (with an additional 11 functioning as extensions and one (1) functioning as an informal school).

In contrast to the formal educational system, Buddhist monasteries have been the traditional sites for informal primary level and life-long learning in the Region as most villages in the Township have a monastery. Monastic education has been restricted to educating boys and men. Informal education in the region is hampered by a weak infrastructure and delivery system and minimal financial support from the Government.

The findings from the village surveys are broadly aligned with the educational statistics reported for the Township. The majority of respondents (72%) have had primary schooling only, including attendance at a monastic school. Just 10% of respondents

attended middle school and 11% attended high school. Five-percent (5%) attended university. Two-percent (2%) of respondents had no schooling and are illiterate.

Net enrolment rates[28] (NER) for primary and secondary school enrolment are presented in Table 4.23. The NER for the surveyed villages is roughly 20 percentage points lower than for the Region as a whole. The lowest NERs are in the 50% range; they are: *Thedawayi, Shwehlay, Yonebinyoe, and Mingalargone* villages. *Thedawayi* and *Shwehlay* are villages characterised by high dependency ratios and large families. In contrast, some of the villages characterised by low NERs also have low concentrations of small children (*Wardan, North Paungga, Yonebinyoe* and *Mingalargone*). A locational map of the primary and secondary school sites may show a lack of schools near these villages. This should be explored as these villages, with the exception of *Yonebinyoe*, are relatively better-off than other villages in the vicinity.

The main reason for children not attending school is the cost, in the form of direct costs and opportunity costs. When asked what the main reason for their child's (children's) non-school attendance, respondents report that they need their children's labour at home (42%) or they cannot afford to pay for the school fees, school uniform and shoes, and textbooks (54%). Less than 6% of respondents cite poor health, disability or school distance as the main reason for their child's non-school attendance.

[28] The net enrolment rate (NER) in primary education (the ratio of primary school-aged children who are enrolled in primary school to the total population of primary school-aged children) in the Project region, Sagaing Region is 94.1%. There is little difference in boys' and girls' NER. IHCL 2009-2010. Integrated household living conditions survey in Myanmar: MDG Data Report. Ministry of National Planning and Economic Development. Cited in the Baseline Study – Social Impact report, Letpadaung Copper Mine Project, 2013.

Table 4.23: Net enrolment rates by village

Village Tract	Village Name	NER	Percent of households with children
Moegyobyin	North	97	74
	South	83	68
	Wardan	66	77
	North Paungga	61	91
	Central Paungga	92	77
	South Paungga	76	90
Dondaw	Dondaw	94	64
	Ywartha	94	67
Shwe Pan Khaing	Shwe Pan Khaing	62	83
	Telpinkan	80	79
	Thedawayi	50	93
Taungpalu	Taungpalu	80	68
	Kyawywa	62	91
Phaunggada	Phaunggada	92	91
	Kyaukpyudaing	84	80
	Zidaw/Sede	84	77
Letpadaung	Shwehlay	59	62
Ywarshay	Ywarshay	85	80
	Palaung	68	84
	Wetme (new)	94	50
	Kandaw	60	73
Ton	Ledi	68	87
Nyaungbingyi	Nyaungbingyi	61	69
	Yonebinyoe	55	78
	Mingalargone	50	64
Shwebo	Palaing	61	91
Average		**74**	**77**
Sagaing Region		**94**	

Low educational attainment in the villages points to the need for MWMCL to commit to improving the access to education and its quality in its CSR Programme. This should be in the form of a concerted education programme tailored to the schooling needs of

the Township and in collaboration with Local and Regional government. Improving educational access in the *village-tract of Nyaungbingyi* is warranted.

4.10.14 Health

The Salingyi Township Health Department has the responsibility of providing comprehensive health care services in the area of health promotion, disease prevention, treatment and rehabilitation.

In 2012-13, the Township had two (2) government-run hospitals with a total capacity of 41 beds, 26 rural health care centres and six (6) clinics. The hospitals were located in Salingyi town and Kyadet. In total, 5,522 people were treated as in-patients or outpatients at the two (2) hospitals in 2012-13 and an additional 12,026 patients were treated by the 26 health care centres. One of the rural health clinics in Salingyi town delivered services for maternal and child health. None of the hospitals had a dedicated room for childbirth.

In 2012-13, the Township employed 81 medical staff and was seeking to fill 38 positions. The Township has only five credentialed (5) doctors, 12 nurses and four (4) health assistants. Consequently, the ratio of medical personnel to population is extremely low.

The main diseases in Salingyi Township are malaria, diarrhoea-related illnesses, tuberculosis, dysentery and hepatitis. In 2012, there were 366 reported cases of malaria, 847 cases of diarrhoea-related illnesses, 199 cases of tuberculosis resulting in eight (8) deaths, 315 cases of dysentery and 30 cases of hepatitis.

In addition to these public medical facilities, Mine Town has one (1) private hospital and one (1) private clinic. The Mine Town hospital provides medical care to the mine workers and to the communities located near the S&K mine and the Letpadaung Copper Mine. The hospital has 16 beds, an ultrasound facility, x-ray facility and a dental clinic. Four (4) medical doctors, one (1) dentist and six (6) nurses work at the hospital. Data show sharp annual declines in the number of in-patients and out-patients treated starting in 2008. The reason for the lower utilisation among residents is unknown as the mobile clinic began operation in 2012. The Mine Hospital nevertheless was, and continues to be, an important medical provider to the local communities.

Two doctors (2) employed by MWMCL administer to the health care needs of 40 villages near the Project area in a mobile clinic. Every month they travel to these villages on a regular basis and treat patients from their mobile vans which are specifically equipped for this purpose. Figure 4.11.9 shows the presentation of the most common diseases presented by the villagers from January to August 2013. It

includes all of the villages in the social baseline survey with the exception of Mingalargone and Palaing (n=24), and an additional 16 villages,[29] a total of 40 villages.

Viral infections and hypertension are the most commonly presented conditions, followed by arthritis, gastric infections and skin complaints. Respiratory infections, eye and teeth problems, symptoms of vitamin deficiency and female reproductive conditions are presented less often. The total number of presentations is 10,298, averaging roughly 1,287 per month across the 24 surveyed villages.

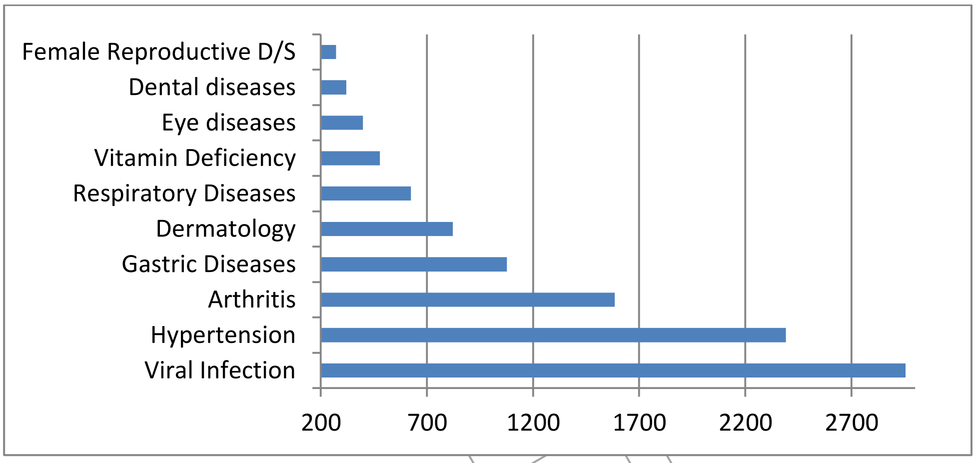

Figure 4.11.9: Common diseases presented in the mobile van visits to the villages

Assuming that there are no repeat visits to the mobile van for the same condition, it is possible to construct a proxy measure for the prevalence of diseases[30] in the villages where population data are available. Seven (7) villages stand out for having much higher presentations (per person) across all the disease categories. They are: *Ywartha, Wardan, Telpinkan, Shwe Pan Khaing, Shwehlay, North Paungga, and North Moegyobyin* (Appendix H – Table 1). *Dondaw, Thedawayi, Palaung, and Taungpalu* also report relatively high presentations of viral infections, hypertension and arthritis. Interestingly, most of these villages are located within the same village tract (*Moegyobyin, Dondaw, and Shwe Pan Khaing*).

Figure 4.11.10 shows the disease prevalence of the three (3) most common diseases presented in the villages (viral infection, hypertension and arthritis). Eighty-three percent (83%) of villagers in *Ywartha* presented viral infections to the mobile van doctors from January to August 2013. This appears to be an exceptional case as the

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[29] They are Aungchansi, Aye Kone, Gondaw, Htan Taw (Ywarshay and YPY), Kangon, Kyae Sar Kya, Central Moe Gyo Pyin, Mya Yeik, Ngar Tae Su, Phaunggada (Central and North), Thar Yar Kone, Ton, and Yaekyipin.

[30] The prevalence of a disease is the proportion of the population that is affected by the disease at a specific time (http://celiacdisease.about.com/od/celiacdiseaseglossary/g/Prevalence.htm sighted 9 October 2013).

next set of villages with relatively high presentations of viral infections presented ½ that proportion, *Wardan* (42%), *Telpinkan* (32%) and *Dondaw* (31%). Still, prevalence estimates are notably high. Hypertension, thought to be the result of a poor diet, reached a high of 28% prevalence in *Telpinkan*, 26% in *Thedawayi* and 20% in *North Paungga*. *Ywartha* presented the highest prevalence of arthritis (25%), followed by *Telpinkan* (16%) and *North Paungga* (15%).

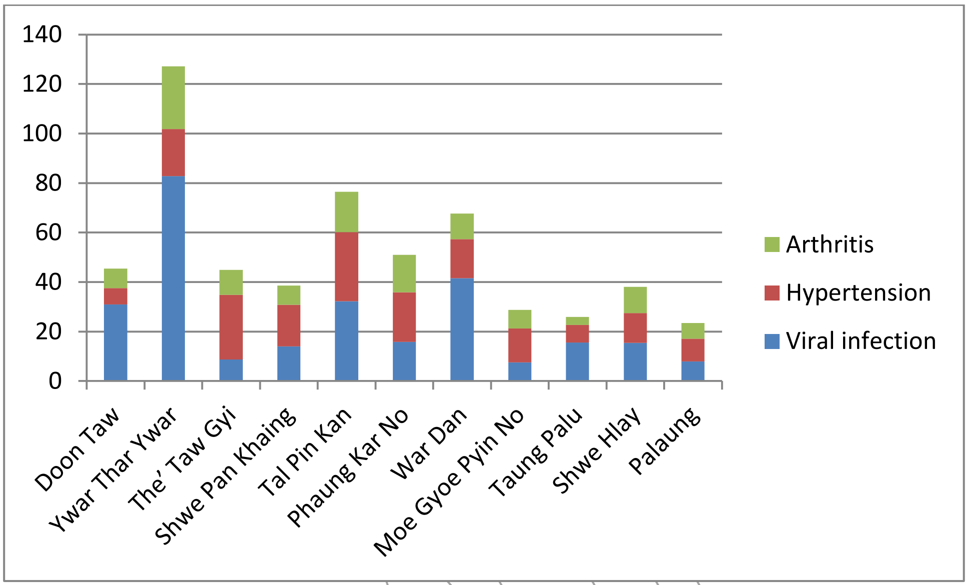

Figure 4.11.10: Disease prevalence in select villages near the Project Area, Jan - Aug 2013

During the next phase of the Project, a Community Health, Safety and Security Plan will be prepared which will address the common ailments identified in the community (refer to Section 9.6 for a summary of the SMP). It will also address the facilities available in the community and the pressure additional population generated by the Project will place on those resources. The plan should make concrete proposals regarding how shortcomings in the current facilities will be addressed by MWMCL. MWMCL has committed to progressively improving the health infrastructure in the villages surrounding the Project in the operational phase (refer to Section 11).

Potential health impacts arising from the Project's industrial activities require management. These have been identified elsewhere in this Report. They include: an increase in accidents and injuries resulting from increased road and river traffic, work place injuries and death, residents' and employees' exposure to hazardous chemicals leading to illness and/or death, an increase in respiratory illnesses associated with lengthy exposure to dust, headaches from exposure to strong light from work carried out at night and noise from blasting and heavy machinery.

Additionally the changes to the landscape, ground water, and surface water may increase the number of disease-carrying organisms. The presence of standing pools of water in the operations phase will attract mosquitos and potentially spread malaria and bilharzia. If left untreated, unclean water can cause invasive skin infections and life-threatening diarrhoea.

The health impacts to workers and communities associated with the Project's industrial works have been addressed in the mitigation measures presented in Section 7. A summary of the water and sanitation infrastructure in the villages and associated recommendations for MWMCL is discussed below.

4.10.15 Electric power

Some of the villages are connected to the electricity network, while others, e.g. South, Central and North Moegyobyin have no access to electricity. However low income prohibits many of the communities supplied with electricity from using it. The villages with access to electricity are: Zidaw/Sede, Kandaw/Wetme, Taungpalu and Kyawywa. Those villages with likely access to electricity are: Palaing, Ywatha and Dondaw. It is assumed that the other villages located near the Project area are not connected to the electricity network.

4.10.16 Water Supply

Household water and drinking water is mainly sourced from the rain-fed weirs and shallow wells. Tube-wells are used to a smaller extent. Some villages like North, Central and South Paungga and North, Central and South Moegyobin depend on water that is captured in the Phaungga weir and in sub-earthen ponds near the villages. There are three (3) weirs located south of the Project site that collect water in the rainy season. Communities use the weirs for crop irrigation, drinking and bathing.

Approximately 11% of households have their own shallow wells, which they use for drinking and bathing in the rainy season. These wells are dry in the summer. Some shallow wells, such as those in Taungpalu, are not used due to local concerns that the water is contaminated with mineral deposits. Consequently, these villagers fetch water from nearby tube-wells, which stay full in the dry season.

The status of the water supply in the villages is not precisely known and more information is needed on the type of infrastructure and its utilisation is needed for all the communities near the Project. The villages whose respondents in the social baseline survey cited the most need for water improvements are*: North Paungga, Mingalargone, Kyawywa, and North Moegyobyin*. The other villages where

approximately 15 to 20% of respondents mentioned water as a village need are: *Kandaw, Taungpalu, South Paugga, Telpinkan and Dondaw.*

4.10.17 Solid waste and waste water system

From a public health perspective, local communities are in need of improved sanitation facilities, e.g. fly-proof toilet systems. Through the provision of the mobile clinic, MWMCL is becoming more knowledgeable about the health status of the communities with a view to upgrade water and sewage systems that differentially impact on residents' health. Continuous health monitoring and efforts to increase public awareness in general hygiene alongside efforts to improve the quality of water and sanitation in the villages will be included in the Community Health, Safety and Security Plan. A related concern is the local propensity to scavenge from solid waste sites, which have both health and safety implications for the waste collectors. The Project waste site will be fenced off and signed to deter the waste collectors from entering it. In addition, the hazards of sorting through rubbish stored at designated dumping sites will be a topic in the Community Health, Safety and Security Plan and public awareness campaigns.

4.10.18 Social Problems Associated with Community Exposure to New Populations

Crime is low in Salingyi Township and generally confined to minor offenses, involving police actions, theft, and disorderly behaviour. From 2007 to 2012, there were six (6) murder convictions and eight (8) rape convictions[31]. There was no gang behaviour, kidnappings, robberies or prostitution prosecuted in the past five (5) years.

Compared to cities, villages situated near the Letpadaung Copper Mine are relatively pristine displaying a strong adherence to traditional values and behaviours associated with Theravada Buddhism. The population is relatively homogeneous, with little or no conflict present apart from the recent tensions associated with resettlement.

The presence of the Project in the Township is expected to have a number of impacts, positive and negative, upon the local communities. The source of the impacts is the exposure of the population to new people, new ideas, and more money. The villages in the Township are likely to undergo social and economic transformations in response to communities' exposure to attitudes and behaviours characteristic of modern urban societies and aided by regular wages earned at the Letpadaung Copper Mine.

Historically, large mining projects have attracted prostitutes due to the large concentration of single male employees who are hired from outside the area (Laite,

[31] Salingyi Township statistics.

2009). Associated with prostitution is the spread of sexually transmitted infections (STI) and HIV/AIDs. The risk of becoming infected with HIV/AIDs or an STI is exacerbated by the presence of large numbers of workers, especially in the construction phase of the project.

Additionally, the communities' exposure to transient populations and new technologies, as they become more accessible from the presence of money, is likely to bring about changes in societal norms and values from traditional approaches to modern approaches. This may produce rifts between the older generation and the younger generation, and between men and women, who may adopt a different set of expectations and values from one another in response to new opportunities arising from employment and/or skills enhancement and almost certainly in response to large amounts of cash available as a result of wages and the lump sum compensation payments.

The changing composition of the villages brought about by the presence of new people may result disrupt existing social structures and create tension and conflict. New arrivals to the villages may not respect the traditional leaders and challenge their authority. Changes in the village social structure may have adverse economic and psychological impacts on the residents who do not support the new regime. It could also disturb the rapport created between the local communities and MWMCL.

The relocation and amalgamation of the four (4) villages into Zidaw/Sede and Kandaw/Wetme is likely to bring about the retirement of two (2) of the four 4) village leaders and a new set of societal hierarchies reflecting the size and composition of the amalgamated villages. It is inevitable that uncertainties arising from amalgamation and its associated effects on leadership structures and patterns of social interaction will produce a certain amount of tension in Zidaw/Sede and Kandaw/Wetme. It is expected that as the residents in the two (2) villages acclimate to their new surroundings and begin employment with MWMCL, any community tension induced by resettlement will attenuate.

4.10.19 Mitigation Measures

A compilation of measures are recommended to offset the social impacts arising from the communities' greater exposure to ideas, people and money.

- As part of the Community Health, Safety and Security Plan, the control of the spread of HIV/AIDS and STIs should be addressed in the training of employees, as well as the risks associated with the use of prostitutes. The concept of "safe sex" should be introduced as part of the employee induction package as well as

in any controls the company may wish to place on staff accessing these services should they become available in the community;

- MWMCL, in collaboration with Government, will conduct an integrated community awareness plan;
- MWMCL will implement an In-Migration Management Plan which shall complement and/or include the following measures:
  - MWMCL will support the village elders in their efforts to control settlement of new arrivals. As noted earlier, the elders have the capacity to restrict opportunistic migration into the area through the use of their powers to refuse settlement and new builds;
  - Additionally, MWMCL has the capacity to control the in-migration of persons seeking employment in the Project area through its preferential employment of local people if their skill set matches that required by MWMCL or its contractors. Application of this requirement by contractors and sub-contractors can be enforced through contract specifications regarding employees;
  - MWMCL can further control long-term migration by only offering single accommodation to those employees who live outside Salingyi Township or Sagaing Region. Whilst this has some limitations with respect to gender balance in the area, it has the advantage of impeding moving whole families into the area and placing a load on public infrastructure and land available for housing. Accommodation camps will strictly enforce a code of conduct.
  - Given mining projects of this nature generally result in job creation ratios of 3 or 4 persons in indirect employment to those in direct employment, it is not unreasonable to expect that 8,000 indirect employment opportunities will be generated as a result of this Project. MWMCL has little opportunity to manage the filling of these positions directly. The development of indirect employment opportunities requires considerable land use planning to enable appropriate location of light industries and additional housing around the Project area. MWMCL can catalyse this process in the definition of local procurement and support service requirements early in the Project life; and
- In response to the potential for changing leadership structures occurring in the villages, MWMCL will liaison with the village elders who have the broad support of their respective communities. Resettlement-induced impacts on traditional leadership structures will be addressed in the RAP. Whilst MWMCL cannot

influence the evolution of societal norms, it can support families in transitioning to a more modern lifestyle through economic-based incentives to raise the standard of living (e.g. employment, skills training and re-training, quality improvements to education) and Company-sponsored public awareness efforts.

4.10.20 Housing Quality and Living Space

Interviewed households residing near the Project area live in detached houses differentiated by the building material and the presence of a roof. Table 4.24 ranks the types of housing present in the villages in order of their quality, with brick houses being the best or most desirable houses and toddy palm houses being the worst or least desirable houses. There is a fairly even distribution of houses in the villages, except for brick houses and one-storey wooden house, which are less common. Fifty-six percent (56%) of the houses are made from plant materials (toddy palm or bamboo), the majority of which do not have a roof.

Table 4.24: Types of housing in the surveyed villages[32]

Type of house	Number	Percent
Brick walls and zinc roof	37	3.7
Two-storey wooden house with zinc roof	211	21.3
One-storey wooden house with zinc roof	94	9.5
Bamboo sheet house with zinc roof	179	18.0
Bamboo sheet house	174	17.5
Toddy palm house	297	29.9
Total	992	100

Houses in the *Ton*[33] and *Dondaw Village-Tracts* have a concentration of houses made with plant materials. Eighty-six (86%) of houses in Ton and 71% in Dondaw are bamboo sheet houses and toddy palm houses. These houses are the least desirable because they provide inadequate shelter against rain and hot weather.

[32] The villages which were relocated at the time of the baseline survey are excluded from this analysis. They are: Kandaw, Wetme and Zidaw/Sede.
[33] The data refer to *Ledi*, the only village represented in the *Ton* Village Tract in the survey.

Table 4.25: A comparison of housing quality in the Village Tracts

Village Tract	Houses with zinc roofs		Houses without zinc roof	
	number	%	number	%
Moegyobyin	113	45.7	134	54.3
Dondaw	31	29.5	74	70.5
Shwe Pan Khaing	55	53.9	47	46.1
Taungpalu	34	58.6	24	41.4
Paunggada	58	76.3	18	23.7
Letpadaung	21	55.3	17	44.7
Ywarshay	69	48.3	74	51.7
Ton	2	14.3	12	85.7
Nyaungbingyi	65	52.4	59	47.6
Shwebo	17	58.6	12	41.4

Note: Chi-square is 51.65 at .05 significance, n=992.

Overcrowding is common in Asia and South-east Asia. Average per capita living space is reputedly 269 m^2 in China, 281 m^2 in South Korea, and 395 m^2 in Japan.[34] Among the villages in the social survey, average per capita living space is estimated to be 251 m^2, roughly eight (8) m^2 less than the average for China.

From Table 4.26, two (2) conclusions can be drawn. First, several villages stand out as having particularly overcrowded housing (less than 200 m^2 per capita). They are: *Dondaw, Shwe Pan Khaing and Taungpalu*.

Second, the distribution of living space per capita is narrow in many of the villages. This means that even the more spacious households are cramped. The villages characterised by a generally low level of per capita living space are: *South Paungga, Dondaw, Shwe Pan Khaing, Telpinkan, Thedawayi, Taungpalu, Kyawywa and Ledi.*

[34](http://heartsofthegods.blogspot.com.au/2006/11/giant-american-houses-another-symptom.html sighted 7 October 2013).

Table 4.26: Per capita living space estimates by village (in m^2)

Village Tract	Village Name	Mean (in m^2)	Standard Error	Minimum (n)	Maximum (n)	N
Moegyobyin	North Moegyobyin	285.4	27.9	125.0	800.0	34
	South Moegyobyin	272.65	17.8	125.0	600.0	45
	Wardan	269.5	21.9	100.0	800.0	39
	North Paungga	245.1	14.5	100.0	600.0	63
	Central Paungga	273.8	28.4	111.1	1000	41
	South Paungga	217.6	20.3	76.9	500.0	27
Dondaw	Dondaw	196.5	16.4	83.3	600.0	44
	Ywartha	232.9	19.3	90.9	1200.0	60
Shwe Pan Khaing	Shwe Pan Khaing	195.7	12.7	83.3	450.0	55
	Telpinkan	234.1	11.0	125.0	360.0	40
	Thedawayi	228.0	29.8	71.4	600.0	21
Taungpalu	Taungpalu	197.7	18.6	90.9	500.0	37
	Kyawywa	203.2	16.1	76.9	500.0	33
Phaunggada	Phaunggada (South)	254.9	20.3	90.9	800.0	44
	Kyaukpyudaing	310.9	21.1	111.1	900.0	51
Letpadaung	Shwehlay	335.4	31.2	111.1	900.0	41
Ywarshay	Ywarshay	270.5	17.7	66.7	1200.0	88
	Palaung	236.2	18.3	83.3	900.0	84
Ton	Ledi	231.8	23.4	76.92	500.0	33
Nyaungbingyi	Nyaungbingyi	269.9	15.2	90.9	600.0	68
	Yonebinyoe	260.1	27.4	83.3	1000.0	49
	Mingalargone	304.3	44.3	142.9	600.0	13
Shwebo	Palaing	223.6	29.3	83.3	900.0	30
All villages		251.1		66.7	1200.0	932

4.10.21 New Villages Constructed for the Relocated Villagers

A total of 441 houses made with wood and iron sheet roofs were constructed in the new villages of Zidaw/Sede and Kandaw/Wetme. MWMCL also built a monastery, pagoda, market, clinic, school, fire station and library to facilitate community development. Residents of Zidaw/Sede and Kandaw/Wetme mentioned in the community consultations that they were not satisfied with the quality of house construction, citing the poor quality wood used. They also mentioned water improvements, most notably, a drainage system as community priorities. MWMCL budgeted Ks 4.9 million (USD 50,360) for house renovations, including the installation of ammeters for electricity, a water supply system, etc. to address residents' housing and infrastructure concerns.

4.10.22 Living Standards

The standard of living is very low in Salingyi Township. The average income is less than USD500/annum (or 500,000 kyats), which is on par with the World Bank definition of extreme poverty.[35] According to the *Salingyi Township Gazetteer*[36], poverty has increased in recent years as a result of low farm yields affected by drought, irregular rainfall, disease, and pest interference. All of these factors combine to bring about low agricultural productivity, especially to crops requiring long growing periods. There has been a shift toward the harvesting of oil crops and other cash crops which take less time to grow, but quick and early ripening varieties require more intensive labour which limits the productive capacity of smaller households. In the past five (5) years, pests have become more invasive as a result of climatic changes and the arrival of new cash crops. Farmers in Salingyi Township attempt to control pests but are often unsuccessful as there is a lack of awareness of pesticide usage, often resulting in its misuse, and chemical fertilizers are expensive.

According to the *Salingyi Township Gazetteer*, environmental shocks have threatened the livelihoods of farmers in the Region with many operating at or near subsistence levels. The most vulnerable farm families are those who do not have relatives from whom they can borrow money or in-kind assistance or whose relatives are in equally dire circumstances.

The Government has implemented the Rural Credit Scheme which allows farmers to borrow money at concessional interest rates, however it is claimed that the amount of credit given is too low and farmers cannot cover their production costs and repay the loan. Farmers with small land holdings are less able to benefit from the Rural Credit Scheme as the amount of credit is given in proportion to the number of acres utilised. Low access to formal credit has given rise to tenure insecurity, as farmers are forced to transfer their land use rights when they borrow money from money lenders. In many instances, they have no means to repay the loan and consequently lose their land.

Reported income in the surveyed villages suggests that the standard of living is lower in the communities near the Project area than in the Township as a whole. The average household earns between Ks 50,000 to 100,000 each month, between USD

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[35] The World Bank defines extreme poverty as persons consuming less than 1.25 USD per day (http://data.worldbank.org/topic/poverty sighted 9 October 2013).
[36] The information from the Gazetteer came from 2012-13, but the precise date of publication is unknown as only an English translation of the article (or cummulation of articles) was available.

52 to 103[37]. Roughly 30% of households report an average monthly income somewhere between USD 10 and 52, or between 33 cents and USD1.70 per day. As this money is spread across an average of six (6) household members, these households can be considered to be extremely poor by the World Bank definition of USD 1.25 per person per day.

Table 4.27: Reported household income among surveyed households

	Number	Percent
10,000 to 49,999 kyats	290	29.3
50,000 to 99,999 kyats	479	48.3
100,000 to 149,999 kyats	155	15.6
150,000 kyats and over	67	6.8

Monthly per capita income is very low in the Project area, ranging from 2,308 kyats (2.38 USD) to 75,000 (77.40 USD). The mean per capita monthly income is 14,914 kyats (15.40 USD) and the median is 12,500 kyats (12.90 USD). These results indicate that individuals living in the villages near the Project area live on less than 50 cents a day on average. An overwhelming 96% of respondents live in extreme poverty, on less than 1.25 USD a day.

When an entire population is deemed poor by an absolute poverty measure, a relative poverty measure is commonly used to distinguish the poor from the non-poor in a community. In this analysis, households reporting a monthly per capita income of less than Ks 6,819 (USD 7.03) are considered to be poor (those housholds with incomes in the bottom income quartile). These 166 households (16.8 %) represent the poorest households in the surveyed villages.

North Moegyobyin, Yonebinyoe and Dondaw have a concentration of the poorest households representing between 30 to 34 % of all households in their respective villages (Table 4.28). Twenty-eight percent (28%) of households are extremely poor in *Kyawywa*. Villages with zero or few households in the bottom income quartile are the four (4) that had been relocated *(Zidaw/Sede, Kandaw, Wetme*) and *Wardan* and *Kyaukpyudaing*

37 http://www.xe.com/currencyconverter/convert/?Amount=150000&From=MMK&To=USD. 9 October 2013. The market exchange rate is Ks 969 to 1 USD.

Table 4.28: Villages with the poorest households

Village Tract	Village Name	Number of the poorest households	Percent	Total N
Moegyobyin	North Moegyobyin	10	30.3	33
	South Moegyobyin	9	20.9	45
	Wardan	1	2.6	39
	North Paungga	4	9.8	63
	Central Paungga	8	24.2	41
	South Paungga	2	8.3	27
Dondaw	Dondaw	13	29.5	44
	Ywartha	9	16.1	60
Shwe Pan Khaing	Shwe Pan Khaing	10	19.6	55
	Telpinkan	35	14.0	40
	Thedawayi	5	23.8	21
Taungpalu	Taungpalu	4	12.1	37
	Kyawywa	7	28.0	33
Paunggada	Phaunggada (South)	4	9.8	44
	Kyaukpyudaing	1	2.2	51
	Zidaw/Sede	0	0.0	19
Letpadaung	Shwehlay	8	20.5	41
Ywarshay	Ywarshay	8	10.0	88
	Palaung	10	12.7	84
	Kandaw	0	0.0	24
	Wetme	0	0.0	12
Ton	Ledi	3	20.0	33
Nyaungbingyi	Nyaungbingyi	13	22.4	68
	Yonebinyoe	15	34.9	49
	Mingalargone	0	0.0	13
Shwebo	Palaing	7	25.0	30

Note: Chi-square is 74.1 at .05 level of significance, n=1071.

4.10.23 Project Impacts on Living Standards

The Project is expected to increase living standards in the Sagaing Region through revenue and employment generation and investments in the community and social infrastructure at the village level. Whilst many of these benefits will have a direct impact on communities, especially on the households with members working at MWMCL and those communities in receipt of new water supply and sanitation systems, electricity, and served by the mobile health clinic, many of the benefits to communities may not reach the poorest and most vulnerable families without targeted assistance. It is recommended that MWMCL identify the poorest families in the community catchment

area with a view to providing them with in-kind and other assistance in times of crisis. The social baseline has alerted MWMCL and its stakeholders to the fact that the villages are extremely poor by international standards and live precariously on the margins of subsistence. It is likely that many Project-affected families will go hungry unless provided with targeted food security measures, such as in-kind resettlement assistance in the period prior to employment at MWMCL.

To improve living standards in the Project communities, access to low-interest microcredit and other financial instruments, such as pooled risk credit arrangements are needed. Low interest credit should be supplemented by capacity building projects to assist farmers in crop diversification, pesticide management and advanced farming techniques to increase productivity. Residents also require new skills to enable them to move away from farm-based employment towards other economic sectors where the income-earning opportunities are greater. They also require life-long skills to help them become more self-sufficient and less vulnerable to economic downturns and environmental shocks.

4.10.24 Multi-dimensional Poverty

The socio-economic baseline results presented in this Section indicate that some of the villages and village-tracts near the Project Area are poor across multiple dimensions. Households in a subset of the surveyed villages experience one or more combinations of poverty, including low income, lack of modern sanitation facilities, inadequate water supply or electricity supply, inadequate housing conditions, etc.

It is often the case that a household's attributes, the educational status of its main wage earners, its sources of livelihood, its family structure, can influence the type of poverty the household experiences. Families with high numbers of young children, for instance, may have difficulty feeding themselves because child care responsibilities restrict the number of members available for wage work. Poverty, caused and/or exacerbated by the presence of young children in the household, prohibits older school-aged siblings from attending school as they are needed for wage work or child care, farm work and other household duties.

Among the 24 villages represented in the baseline, *Dondaw* stands out as having the highest number of poverty dimensions factors relative to the other villages in the study (Table 4.29)[38]. Dondaw is poor across four (4) dimensions: compared to the other

[38] As the majority of villages do not appear to have electricity, while an important requirement in modern daily life, its absence in a village does not differentiate the households in that village from other households in other villages.

communities, its residents are impoverished, face severe water supply constraints, and live in crowded conditions in houses that do not provide shelter against the elements.

After Dondaw, the next set of villages that can be classified as poor across three (3) dimensions when compared to the other villages in the study is: *North Moegyobin, Kwawya, South Paungga, Telpinkan and Thedawayi.* They are poor in the following ways:

- North Moegyobin residents have no direct assess to water and they are impoverished and often in ill health;
- Like Dondaw, residents of Kwawya are poor, live in crowded housing and have an inadequate supply of water;
- South Paungga residents lack available water, live in crowded housing, and have a large presence of young families;
- Telpinkan village is characterised by a concentration of young families, cramped housing conditions and poor health (and possibly, nutrition) status; and
- Thedawayi village has a high dependency burden, low school attendance and crowded housing conditions.

Finally, the following seven (7) villages have two (2) dimensions of poverty compared to the other villages the study. They are: *Ledi, Mingalargone, North Paungga, South Moegyobyin, Shwe Pan Khaing, Shwehlay and Yonebinyoe.*

- Ledi residents have too few breadwinners relative to dependents and live in cramped conditions;
- Mingalargone residents has inadequate water provision and the lowest school enrolment amongst all the villages;
- North Paungga residents lack adequate water provision and have low health status;
- South Moegyobyin has a preponderance of young families and low access to water;
- Similar to Telpinkan, which is located in the same village-tract, Shwe Pan Khaing residents have poor health/nutritional status and live in crowded conditions;
- Similar to Thedawayi village, which is located in the same village-tract, Shwehlay village has a high dependency burden and low school attendance; and

- Yonebinyoe residents are (income) poor and like Mingalargone, roughly ½ of its school-aged children do not attend school.

Table 4.29: Dimensions of poverty in the surrounding villages.

	High dependency ratio	Young families	Low school attendance	Poor health	Lack of water	Crowded housing	Low income	Houses with inadequate shelter
Dondaw					x	x	x	x
Kyawywa					x	x	x	
Ledi	x					x		
Mingalargon			x		x			
N Moegyobin				x	x		x	
N Paungga				x	x			
S Moegyobin		x			x			
S Paungga		x			x	x		
Shwe Pan Khaing				x		x		
Shwehlay	x		x					
Taungpalu					x	x		
Telpinkan		x		x		x		
Thedawayi	x		x			x		
Yonebinyoe			x				x	

From the analysis, one may conclude that the standard of living broadly defined is the lowest in the *village-tracts of Dondaw, Moegyobyin and Shwe Pan Khaing.* These village-tracts have a relatively higher incidence of poor and extremely poor households, are poorly equipped with basic infrastructure, and have a concentration of houses that do not provide adequate shelter and are severely overcrowded. It is possible that these factors contribute to the high number of disease presentations (relative to population) in these village-tracts.

Also of concern is the *village-tract of Nyaungbingyi,* which has the lowest net primary school enrolment rates in the surveyed villages near the Project site. One-half of school-aged children only attend school in Mingalargone and Yonebinyoe.

4.10.25 The Poorest Villages

Households can be characterised by the depth of poverty they experience. The villages found in the social baseline as having the most severe poverty outcomes are summarised below.[39]

39 Dependency ratios are the highest in Shwehlay, Ledi and Thedawayi villages. The working members of these families are apt to experience significant stress in providing for all of its members. While the standard of living is by no means high in these villages, high dependency ratios have not appeared to impact on these households' poverty status. Similarly, South Paugga has a relatively high percentage of families with young children (59%, which does not seem to have any poverty impacts.

- The poorest households, as measured by reported income, are located in North *Moegyobyin village, Yonebinyoe village and Dondaw village.* These households are possibly living below subsistence; and
- Households in *Dondaw* village have the worst housing conditions. Lack of adequate shelter and overcrowding may contribute to the exceptionally low health status among village residents.

The information presented in this Section and in the preceding Section can be used to target a portion of the Project-sponsored community investments as part of its Corporate and Social Responsibility Programme. As mentioned in Section 4.10.3, a thorough examination of the critically poor households is required and can be included in a poverty profile that is based on more rigorous data collection.

4.10.26 Social Impacts from Closure

The closure of the Letpadaung Copper Mine will likely have adverse employment and environmental impacts on local communities. It is difficult to anticipate all of the social impacts to occur in 30 years' time and unfortunately most of the mitigation measures proposed today to manage mine closure impacts are inadequate. The closure of a mine invariably results in the loss of jobs to workers and to local suppliers of goods and support services. Upon closure, towns where the mine was the largest employer or the only employer empty overnight as residents leave in search of better opportunities. The remaining residents are left to cope on their own with little or no access to local services, e.g. jobs, stores, schools, libraries, etc.

Given the often devastating impacts on households and communities occurring at mine closure, it is recommended that the Letpadaung Copper Mine develop an exit strategy in conjunction with the Mine Closure Plan early on, in the operational phase. The exit strategy should endeavour to raise the development of Salingyi Township and villages to a level of self-sufficiency, whereby the transition from mine to non-mine work is facilitated amongst former Mine employees and residents who wish to remain in the local vicinity, and whereby the transfer of Mine employees to other mines still operating in the area is supported. In this way, the villages in the Township would continue to function well after the Letpadaung Copper Mine closes.

Training programmes and other capacity-building programmes sponsored by MWMCL and the Government during the 30 years of Mine operation should be developed in conjunction with the Mine Closure Plan. MWMCL's responsibility for maintaining the community and social infrastructure in the villages needs to be gradually phased out in the operations phase and turned over to the communities and Local Government. This

will help ensure that the investments will be sustained long after the Letpadaung Mine closes. Finally, efforts to develop the governance capacity of local government are required in the operational phase to facilitate and maximise the potential for business development and job creation, and to provide government with the tools to effectively govern after mine decommissioning.

In the mine closure planning process, it may be the case that some of the land areas used for the Project will require specific attention. There is the possibility that the rehabilitated WRD and HLPs will be unsuitable for grazing and other uses by the local community as a result of damage the capping system by people and livestock. A recommendation made from the social baseline study was to revegetate the water shed areas, such as *Khamauk-taung, Kyadwin-taung, Hninsi-taung and Phowuntaung* among others and turn them into protected areas.

In development of the Mine Closure Plan, the local community shall be consulted to agree to a suitable end land use for the landforms situated within the current site. The Mine Closure Plan will take into account these community agreements and a cost provision will be made for implementing the end land use rehabilitations.

4.10.27 Noise

Ten (10) noise stations were sampled during the dry and wet seasons of 2013, whose locations are shown at Figure 4.10.3. Noise equivalent values have been determined per period (daytime and night-time). Consequently, during the dry season, noise levels for the daytime period varied between 41.3 and 46.6 dB(A), while they varied between 41.5 and 46.3 dB(A) for the night-time period. It is important to point out that, except for the value determined for Station 3 during the night-time period, the remaining recorded values do not exceed international noise standards established by the IFC (2007).

On the other hand, values exceeding IFC standards were recorded during the wet season. These values range from 59.9 to 85.5 dB (A) during the daytime period, and from 66.7 to 74.6 dB(A) during the night-time period. These results are likely the result of rain incident on roofs and surrounding structures as well as the increased activity within the villages associated with the planting of crops and collection of seasonal plant materials.

The criterion considered for assessing the results obtained at sampling stations close to vehicle traffic and built-up areas was the one established by the OECD (Organisation for Economic Cooperation and Development). This standard considers a value below 65 dB(A) to be an acceptable noise level for the daytime period, and a value below 55 dB(A) to be acceptable for the night-time period.

Furthermore, the samplings also provided measurement results for meteorological parameters, which are shown in Table 4.30.

Table 4.30: Meteorological conditions during noise quality sampling

Season (2013)	Station	Parameters			
		Temperature ºC	Relative humidity (%)	Wind speed (m/s)	Wind direction
Dry	1	29-31	41-63	2.5-3.3	167 (S)
	2	29-31	40-64	2.6-3.5	178 (S)
	3	26-42	41-63	2.5-3.4	158 (S)
	4	25-42	41-63	2.4-3.8	169 (S)
	5	26-45	41-60	2.8-3.9	175 (S)
	6	23-40	40-61	2.3-3.5	164 (S)
	7	23-38	40-65	2.3-3.5	165 (S)
	8	23-37	40-68	2.3-3.5	172 (S)
	9	23-41	40-66	2.5-3.6	164 (S)
	10	24-41	41-67	2.6-3.8	172 (S)
Wet	1	29.9-30.4	36-93	0.5-3.3	177 (S)
	2	30.4-31.1	40-91	0.6-3.5	174 (S)
	3	34.8-41.7	41-83	0.5-3.4	168 (S)
	4	34.8-41.9	41-83	0.4-3.8	175 (S)
	5	34.8-42.4	41-90	0.8-3.9	176 (S)
	6	35.8-44.6	40-81	0.3-3.5	168 (S)
	7	37.6-39.4	40-85	0.3-3.5	167 (S)
	8	35.3-37.8	40-90	0.3-3.5	173 (S)
	9	35.1-36.9	40-96	0.5-3.6	166 (S)
	10	37.4-41	41-87	0.6-3.8	177 (S)

Source: Data provided by EMC

From a community health perspective, noise associated with mining operations (as with other noise sources) is known to disturb areas around the source of noise generation. It is particularly significant where noise disturbance is associated with schools, hospitals, places of worship and nearby households. Noise disturbance is most intrusive at night when people are sleeping and background noise levels are low.

A common standard is that any increase in noise levels which is 3dB(A) above the existing background level is likely to disturb people at the receptor point whilst the background noise level varies dependent on the time of day that it occurs. Typically noise levels in town areas are likely to be 60-65 dB(A) during the day and 45-50 dB(A) during the night. In rural settings the levels may be 5-10 dB(A) less depending on season.

There is no current background noise data available to determine how significant the noise generated by the mining, crushing, stacking and processing is likely to be and

what management actions will be necessary to make it acceptable. In the next phase of the project, background noise levels will be determined by field sampling and modelling will be conducted to determine the areas where noise disturbance levels will exceed accepted levels based on a range of global guidelines.

A noise management plan will then be incorporated into the ESIA if required.

4.10.28 Vibration

The background vibration levels at Letpadaung were recorded for dry season and wet season comparison as shown in Table 4.31 and Table 4.32. The locations selected were ten villages located around the boundary of the Letpadaung site.

Table 4.31: Vibration levels recorded during the Hot-Dry Seasons

Vibration (mm/s)	Mean	MAX	MIN
Station 1	0.371	1.4	0
Station 2	0.510	3	0.1
Station 3	1.383	4.8	0.4
Station 4	0.298	0.8	0.1
Station 5	0.229	1.2	0.1
Station 6	0.958	4.5	0.2
Station 7	0.360	1.5	0
Station 8	0.329	1.4	0.1
Station 9	0.279	1.3	0.1
Station 10	0.233	1.1	0.1

Table 4.32: Vibration levels recorded during the Wet Season

Vibration (mm/s)	Mean	MAX	MIN
Station 1	0.360	1.5	0
Station 2	0.515	3	0.1
Station 3	1.410	5.9	0.4
Station 4	0.294	0.7	0.1
Station 5	0.225	1.2	0.1
Station 6	0.990	4.5	0.2
Station 7	0.373	1.5	0
Station 8	0.338	1.5	0.1
Station 9	0.271	1.2	0.1
Station 10	0.223	1.2	0.1

The mean vibration levels recorded are all below a recommended peak particle velocity (PPV) of 5 mm/sec. However, three maximum PPV readings approached that value and one reading exceeded the recommended maximum value. These values were recorded over the period of a blast being completed at the Kysintaung Mine at the S&K operation.

Values exceeding a PPV of 2 mm/sec are known to elicit a response from humans sensitive to vibration and it is likely that persons in the vicinity of Letpadaung would respond to the peak readings observed here.

4.10.29 Mitigation of Potentially Adverse Noise and Vibration Impacts

Proposed mitigation measures to protect sensitive receptors from noise and vibration include:

- Schedule waste dumping away from sensitive receptors during night-time operations;
- Limit the extent of other noisy activities, as far as possible, during night-time operations;
- Monitoring of noise levels near sensitive receptors;
- Install acoustic barriers to reduce noise in sensitive areas;
- Management of blasting (timing/magnitude); and
- Notification of receptors regarding blast times.

4.10.30 Visual Amenity

Letpadaung Hill is a series of hills on the flood plain of the Chindwin River that rise about 300 m above the surrounding lowlands. The hills provide a viewscape from them which covers the surrounding villages and town including across the River to Monywa some 4 km to the east. From the hills many stupa are visible on the surrounding hills and activities on the plains below can be observed.

On the plains the hills are a prominent landmark and a feature within the overall landscape. Their rise above the plain provides a relief from the constrained viewscape created by the flatness of the plain. The vegetation and slopes on the hill also provide a visual diversity that is not generally accommodated by other local visual opportunities due to their scale and diversity of steepness amongst the slopes.

The valley running through the hills is not typical of the surrounding hills and, as a consequence, these hills provide a visually unique experience in this area.

Any adverse impacts to the visual amenity will be mitigated by the following activities:

- Construction area and mine site to be kept tidy;
- Clearing of vegetation around the site will be minimised;
- Revegetation of disturbed areas will be carried out progressively and as soon as practicable; and
- Landscape planting strategy will be adopted to identify appropriate revegetation to act as a visual barrier.

4.10.31 Traffic and Transport

The current level of heavy vehicles using the local road network appears quite low. It is envisaged that during construction and operation up to 20 heavy vehicle movements may occur on a daily basis to carry loads from barge landings on the Yamar Stream during the wet season and the Chindwin River at Pakokku during the dry seasons.

It is also proposed that convoys of vehicles will bring supplies of explosives to site from China at least twice yearly.

EMC has undertaken a survey of the traffic at the key intersections expected to be impacted from the Letpadaung Copper project for Myanmar Wanbao Mining Copper Limited. The survey was undertaken in three campaigns over the period from September 2012 until late June 2013 to enable the influence of season to be established with respect to traffic volumes and traffic types.

The survey was undertaken at 11 fixed locations and included recording not only the total traffic volume, but divided the traffic into 5 types: Heavy Truck, Light Truck, Passenger Bus, Passenger Car or Motorcycle. The results are shown in Table 4.33.

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Table 4.33: Survey data

Sr. No.	Survey Location Name	Season		
		Cool-Dry (Oct-Feb)	Hot-dry (Mar-May)	Wet (Jun-Sep)
1	Mine haul road intersection	2035	3925	1587
2	Road intersection1 (Salingyi)	323	343	277
3	Road intersection2 (Salingyi)	359	396	354
4	Road intersection (Kyadet)	936	1036	502
5	Road intersection (Lingadaw)	961	826	716
6	Road intersection (Yesago)	2583	2583	2301
7	Fuel landing point (Pakokku)	3098	2164	4979
8	Highway intersection (fuel landing point)	8958	8509	3961
9	Highway intersection (Pakokku Bridge)	6952	6328	6334
10	Let Pan Chay Paw (Pakokku)	2641	2832	1922
11	Barge landing site on Chindwin River	1917	2339	1053

The potential for adverse traffic-related impacts is high in the construction and operational phases of the Project. SMPs have been developed for the management of road traffic and river traffic (Section 9.7.1 and Section 9.7.2).

5. PROJECT DESCRIPTION

This section describes the various aspects of construction and operation of the Letpadaung copper mining project. A simplified flowchart of the mining and processing sequence is shown at Figure 5.0.1. The construction phase will focus on the development of the facilities to enable mining and processing to be carried out successfully.

5.1 DESCRIPTION OF THE ORE BODY

The Letpadaung deposit is a concealed deposit beneath two hills and their valley. The deposit is gold-ingot-shaped and essentially horizontal with a flat top, trending north-west and approximately 2,200 m long and 1,400 m wide. The average thickness of the orebody is about 140 m and the average copper grade is 0.37 %.

There is a 10-200 m thick leaching zone between the ore body and the surface. Under the leaching zone is a layer of secondary enrichment zone at the thickness of several metres to dozens of metres which is the high grade ore section and concentrated in the valley between two hill tops. Beneath the secondary enrichment zone is a mixed belt composed of primary and secondary sulphide, silicate and sulphate minerals. Further downward is a primary zone consisting of andesite porphyry and dacite porphyry. There is no clear boundary between each pair of zones.

Due to secondary leaching of the deposit, part of the secondary ores under the leaching cap contains mud. Categorisation is made based on clay content:

- High clay ores (clay content >15%) account for three (3) %;
- Medium clay ores (clay content between 10% and 15%) account for four (4) %; and
- Low clay ores (clay content 0%-10%) account for 93%.

Generally speaking, clay content is not high and far lower than that of the Sabetaung deposit.

5.2 CONSTRUCTION

Construction works for Letpadaung will be split into five (5) sections to phase the works accordingly. Works are to run partially concurrently and generally split to construct and install specific infrastructure for ore production and mine operation. The works are in addition to the works undertaken by the Mining Contractor in stripping of the Letpadaung Pit and removal of waste rock overburden to the designated waste rock dump areas.

Table 5.1: Construction phases

Outline Tasks	Duration

<u>Mine Infrastructure</u>
• 33 kV and 10 kV substations
• Semi Portable Crusher
• Conveyors
• Intermediate Ore Stack
• Fresher Water Supply
• Associated Infrastructure including,
  - Office buildings
  - Warehouses
  - Fuelling Station
  - Road Works
	466 days

<u>Heap Leach Pads and Infrastructure</u> • Heap Leach Pad #1 (HLP1)Blocks 1 – 10 • Heap Leach Pad #2 (HLP2) Blocks 1 – 10 • Solution Pond for HLP1 and channel for blocks 1 – 10 • Solution Pond for HLP2 and channel for blocks 1 – 10 • Raffinate Pond • Pregnant leach Solution Pond • Flood Storage Pond • Heap Leach Pad 33 kV Substation • Associated Road Works	691 days
<u>Plant Site and Infrastructure</u> • SX – EW Plant • Solvent oil Warehouse • Sulphuric Acid Storage • Diesel Generator • Cooling Tower • Air Compression Station • Boiler House • Metallurgical Office and Laboratory • Associated Piping and power supply • Crushing Plant	420 days
<u>Power Supply</u> • 230 KV Step-sown substation • 230 kV overhead power lines • 33 kV and 10 kV Substations • 33 kV and 10 kV overhead power lines	228 days
<u>Wastewater Treatment</u> • Wastewater treatment pond North • Wastewater treatment pond South	300 days

Construction works are due to commence in October 2013 with the completion of each section phased to allow for mine operations to commence in early 2015. Construction works are estimated to be complete in Quarter 4 2015.

5.3 CONSTRUCTION TASKS

As described in Section 5.2, the construction works will be split into 5 sections to phase and construct the works accordingly. These works will be undertaken partly concurrently by separate contractors in order to construct key infrastructure required to ensure the mine in operational by Quarter 4 2015. An overview of the key construction zones is provided in Figure 5.3.1 and described in further detail in the following sections.

5.3.1 Mine Infrastructure

These works are primarily associated with the initial infrastructure required for the ore processing works including power supply, portable crushers, conveyors, water supply, office facilities and road works.

5.3.1.1 Mine Site

The construction works for the mine site are intended to commence in October 2013 with an estimated duration of 435 days.

The major works included are the excavation and earthworks associated with the semi-portable crushing station and foundations as well as the crushing equipment itself, foundations and structural works for primary belt conveyor systems. Also included is the construction of structural pads only for the 33 kV substations and 10 kV distribution room.

5.3.1.2 Belt Conveyor System for Heap Leach Pads

These works include all civil, structural, mechanical and electrical works involved in five number belt conveyors servicing the heap leach pads (HLPs). The works for each conveyor will be undertaken concurrently, commencing in early 2014 with an estimated duration of 235 days.

5.3.1.3 Stacking Conveyor Systems for Heap Leach Pads

The works comprise the civil, structural, mechanical and electrical works for installing the mobile stacking conveyors and portable belt conveyors for both HLPs #1 and #2. The works for HLP1 are planned to commence in Quarter 2 2014 approximately 10 weeks before HLP2, with a total construction duration for the two systems of approximately 191 days.

5.3.1.4 Auxiliary Facilities

Also included within the mine infrastructure works are numerous auxiliary works associated with the ore processing. These include civil, structural and installation works for maintenance facilities, the fuelling station, metals warehouse and a diesel generator. Also included is the fresh water supply system as well as the construction

and surfacing of the main access road from the western site boundary to the ore processing site. Construction works associated with these auxiliary facilities are expected to commence in October 2013 with a duration of 350 days.

Construction equipment involved in these activities would vary depending on the tasks involved. However, the civil works equipment would include a fleet of at least 4 medium sized excavators (greater than 24T), 2 large bulldozers, numerous earthmoving trucks as well as graders, rollers and water carts for levelling and compacting. Some cranage will also be required for the structural elements.

Details of the construction personnel and materials are provided in Sections 5.4 and 5.7 respectively.

The mine infrastructure works are expected to be completed in Quarter 4 2014 which includes the commissioning of the whole system.

5.3.2 Heap Leach Pads and Infrastructure

These works incorporate the construction of the eastern blocks of HLP1 and HLP2 as well as the solution pond and associated channel for the constructed HLP blocks. Also included is the construction of the roads associated with the HLPs, raffinate pond, pregnant solution pond and flood pond for HLP1 and HLP2 as well as the civil works for the 33 kV substation associated with these works.

5.3.2.1 HLP1 and HLP2

The construction of the numerous aspects of the eastern blocks (Blocks 1 to 10) of HLP1 and HLP2 will involve bulk earthworks and detailed construction of various earthworks layers to creating a suitable heap leach pad, as well as the associated works for the channels and solution ponds for each pad. The works, following the recovery and storage of vegetation, topsoil and sub-soil, can be summarised as follows:

- Bulk earthworks (cut and fill) to engineer the existing ground to provide the required pad with surface slopes to enable gravity flow of leachate from the HLPs to the solution channels;
- Import, placement and compaction of a low permeability clay layer above the pad to reduce the potential for fluid ingress to the natural environment;
- Bulk earthworks for the solution ponds, foundation preparation and placement of low permeability clay layer;
- Installation of a synthetic smooth geomembrane (HDPE) above the clay layer for heap leach pads and pond;

- Import and placement of a fine grained soil (sand) protective layer over the membrane on the pads;
- Placement of an underdrainage network of pipes, enveloped in gravel together with a drainage layer of selected gravel over the heap leach pad protective layer;
- Placement of mine rock over the underdrainage layer;
- Installation of W-drains solution channels for constructed heap leach pad blocks; and
- Fencing of ponds.

The works will be phased with works associated with each of the construction stages described above undertaken in the following order:

1. HLP1 Blocks 1 and 2
2. HLP2 Blocks 1 and 2
3. HLP1 Blocks 3, 4 and 5.
4. HLP1 Blocks 6 to 10, and, HLP2 Blocks 3, 4 and 5
5. HLP2 Blocks 6 to 10.

The works to the solution ponds and solution channels will be undertaken in conjunction with the works to the pads as indicated above.

Works to the first area will commence in October 2013 with a total duration for the whole works of approximately 686 days.

5.3.2.2 Road Construction

This work involves the construction of the access roads both to and around HLP1 and HLP2. The works involve the vegetation and growth medium recovery along the road alignments and the construction of the road pavement and associated surface seal.

Works will commence for the roads in October 2013 with a total duration of 350 days. The works will be phased so that the road pavement is complete in Quarter 2 2014 to allow for construction access prior to the completion of the sealing works in Quarter 4 2014.

5.3.2.3 Raffinate and Pregnant Leach Solution Pond

The works for the raffinate pond and pregnant leach solution (PLS) pond involve similar works to that of solution ponds described with the heap leach pads above. The works, following the recovery of vegetation and growth medium, can be summarised as follows:

- Bulk excavation works and embankment construction to form the pond shapes;

- Trenching and installation of groundwater drainage system to collect and discharge groundwater flows below the ponds;
- Import, placement and compaction of a low permeability clay layer to reduce the potential for fluid ingress to the natural environment;
- Installation of a two layer synthetic smooth geomembrane (HDPE) above the clay layer for both ponds;
- Installation of monitoring equipment and piping etc.; and
- Fencing of the ponds.

The construction of each pond should require a duration of approximately 140 days with works commencing in early 2014.

5.3.2.4 Heap leach Storm Water Pond

The construction of the heap leach storm water pond will be undertaken in sections to provide adequate storage as the works progress. The works involved, following the recovery and storage of vegetation and growth medium, are summarised below:

- Bulk excavation works and embankment construction to form the pond shape;
- Trenching and installation of groundwater drainage system to collect and discharge groundwater flows below the pond;
- Import, placement and compaction of a low permeability clay layer to reduce the potential for fluid ingress to the natural environment;
- Installation of a synthetic smooth geomembrane (HDPE) above the clay layer; and
- Installation of monitor wells and fencing.

Construction works will commence in early 2014 with the pond split into four (4) sections. The works will be phased so that the first section is completed in Quarter 3 2014 with the final section completed in Quarter 3 2015.

5.3.2.5 Auxiliary Facilities

Also included within the HLP and infrastructure works is the construction of structural pads only for the 33 kV substations associated with the HLP area. These works will commence in October 2013 and are due for completion in March 2014.

The majority of the tasks required for the construction of the HLPs and associated infrastructure require similar equipment. As the majority of these tasks will be completed in parallel it will require a larger fleet of equipment. As this is also the largest area of works it is envisaged that a fleet of at least 8 medium to large sized excavators, 8 large bulldozers, up to 50 earthmoving trucks as well as graders, rollers and water carts for levelling and compacting.

Details of the construction personnel and materials are provided in Sections 5.4 and 5.7 respectively.

The HLP and infrastructure works are expected to be completed in Quarter 3 2015.

5.3.3 Plant Site and Infrastructure

Works in this section include the construction and install of the solvent extraction and electrowinning (SX-EW) plant as well as the associated infrastructure and auxiliary features. Also included in these works are the civil works for the step-down Substation and the construction and install of the crushing plant.

5.3.3.1 SX-EW Plant

The construction works for SX-EW plant are intended to commence in October 2013 with an estimated duration of 420 days.

The major works included are the excavation and earthworks to provide the construction pad. Works also include the construction of the foundation structures and the install of all structural equipment as well as the construction of cranes to facilitate the work.

5.3.3.2 Auxiliary Facilities

These works include the civil, structural and mechanical works associated with the support facilities for the SX-EW Plant. Included are the works for the following facilities:

- Solvent oil and sulphuric acid storage;
- Diesel generator station;
- Cooling tower ;
- Air compressor station;
- Fire station;
- 33 kV substation and 10 kV distribution room;
- Boiler Room;
- Metallurgical laboratory and offices; and
- Associated pipe networks and power supply.

Works to construct and install the above facilities are expected to commence in November 2013 with a construction duration of approximately 1 year.

5.3.3.3 Step-down Substation

Construction of the 230 kV step-down substation includes the civil works for the structural pads for all aspects of the substation as well as the construction of the structural elements such as the switch room building, control room and guard house. Also included is the works for water and electricity supply to the substation.

These works are due to commence in October 2013 with a duration of approximately 170 days.

5.3.3.4 Crushing Plant

Works include the civil, structural and mechanical works to install the main crushing plant. This installation includes detailed civil works including foundations for all structural components as well as the formation of underground works for the belt conveyor. Also included is the installation and test of all the crusher components.

Works to the crusher are envisaged to commence in October 2013 with completion due in Quarter 1 2014.

The works associated with the SX-EW Plant require less earthmoving and ground preparation than other sections and therefore it is envisaged that the construction equipment demand will be less. The equipment fleet demand will likely require 2 medium sized excavators, 2 bulldozers, 10 to 12 earthmoving trucks and 1 or 2 sets of levelling and compaction equipment comprising of graders, rollers and water carts. The installation of the numerous structural elements will require intensive cranage with fixed cranes constructed on site.

Details of the construction personnel and materials are provided in Sections 5.4 and 5.7 respectively.

The works associated with the SX-EW plant are expected to be completed in Quarter 4 2014.

5.3.4 Power Supply

The works associated with this section are the install of equipment for the substations installed under previous sections, the upgrade of existing installations and the installation of overhead power lines to support the site.

5.3.4.1 230 kV Step-Down Substation

This works involve the installation and testing of the equipment associated with the 230 kV step down substation. Works are due to commence following the completion of the civil and structural elements in Quarter 1 2014 with a duration of approximately 135 days.

5.3.4.2 Substation Upgrade

This section includes works to upgrade the existing 230 kV Nyaungpingyi substation to allow for extra capacity and provide linkage to the new 230 kV overhead line to the Letpadaung substation. Works are scheduled to commence in November 2013 and should be completed in January 2014.

5.3.4.3 230 kV Overhead Line

Construction of a new 230 kV overhead line is required between the existing Nyaungpingyi substation and the newly constructed step-down substation at the Letpadaung plant site. The construction will include the civil works and construction of the towers as well as the installation of the power lines. These works should commence in December 2013 with an estimated duration of approximately 3 months.

5.3.4.4 Substations and Distribution Rooms

This work will include the equipment installation for the 33 kV substations and 10 kV distribution rooms constructed in other sections. The work elements include the substations for the plant site, open pit, heap leach pads and the mine site. The works to each substation will commence as the civil works in other sections are completed, in general they will commence in December 2013 with a duration of approximately 110 days.

5.3.4.5 33 kV and 10 kV Overhead Lines

These works include the civil, structural and electrical works associated with installing both 33 kV and 10 kV overhead lines to facilitate power supply to the whole project. Works are due to commence in November 2013 with a 6 month duration.

The power supply works will require little in the way of heavy construction equipment as the major works involve equipment installation. However some equipment will be required for the clearing the power line corridor and installing the towers. It is envisaged that the small fleet of construction equipment will comprise of up to 2 bull dozers and small excavators, along with possibly 1 or 2 earthmoving trucks if required.

Details of the construction personnel and materials are provided in Sections 5.4 and 5.7 respectively.

The power supply works, including linkage and test of the whole systems, are expected to be completed in Quarter 2 2014.

5.3.5 Wastewater Pond

The works associated with this section are the construction of the wastewater pond (WWP). These works will be phased to construct the pond in two sections, north and south, and mainly involve the bulk earthworks to excavate the pond and create the embankments. The works, following the recovery and storage of vegetation and growth medium, can be summarised as follows:

- Excavation to form the pond shape and, where applicable, haul and compact to create the bulk fill embankment;

- Import, placement and compaction of a low permeability clay layer in the pond basin and to the bulk fill embankment; and
- Fencing.

The works to the north pond will be undertaken first and are due to commence in November 2013 with a duration of 200 days to complete construction. Following the completion of the north pond, works to the south pond will commence in Quarter 2 2014 with a construction duration of 100 days.

The construction equipment required for the construction of both the north and south WWPs will be a fleet of at least 4 medium to large sized excavators, 2 large bulldozers, numerous earthmoving trucks as well as graders, rollers and water carts for levelling and compaction.

Details of the construction personnel and materials are provided in Sections 5.4 and 5.7 respectively.

The construction of both the northern and southern WWPs are expected to be completed in Quarter 3 2014.

5.4 CONSTRUCTION WORKFORCE

The construction workforce for each of the sections described above will reflect the quantity of work required as well as the complexity of the works. The workforce will be made up of a mix of local and expatriate employees and numbers will be ramped up over the initial period of the project with the intention that full manpower is employed by week 12 of the works. Table 5.2 below summarises the anticipated manpower for each section of the works.

Table 5.2: Construction workforce

Construction Section	Total Manpower Requirements
Mine Infrastructure	300 persons
Heap Leach Pad and Infrastructure	380 persons
Plant Site and Infrastructure	140 persons
Power Supply	60 persons
Wastewater Ponds	160 persons

5.5 CONSTRUCTION SERVICES

To facilitate the works, numerous services will be provided, these are summarised in the sections below.

5.5.1 Transport

The provision of transportation will be provided by the EPCM Contractor for use by the individual contractors. This will include trucks for moving freight and construction materials from the river port on the Chindwin River during the wet season to the site on an existing dedicated haul road. Dry season transportation will be via the river port at Pakoku then the road network to the site, a distance of about 70 km. Bus transportation will be provided for workers from the construction accommodation camp to the construction site.

5.5.2 Basic Raw Materials

Basic raw materials will be supplied by the EPCM Contractor for use by the individual contractors. These materials will include the following;

- Diesel fuel and fuel trucks for construction equipment; and
- Fine grained soil (sand) for leach pads and associated infrastructure construction.

5.5.3 Concrete Supply

The supply of concrete and concrete aggregates will be provided by the EPCM Contractor for use by the individual construction contractors. Concrete will be produced on an onsite batching plant operated by a concrete subcontractor. Coarse aggregates for the production of concrete will be won from nearby operating quarries.

5.6 HOURS OF OPERATION

Construction activities will be based on a 5 day week with a 8 hour working day.

5.7 CONSTRUCTION MATERIALS

5.7.1 Earthwork Materials

Where possible, earthworks material will be won from excavation on site in a cut to fill operation. It is intended that all bulk earthwork operations such as the creation of ‘plateaus’ for the construction of the HLPs and the levelling of the ground for the construction mine and plant site infrastructure pads will be constructed as a cut to fill operation. Any unsuitable material identified during this operation will be removed and stockpiled and any shortfall material will be won locally, either from surplus material from other operations such as pond excavation, or through the establishment of local borrow pits.

Fine grained soil material for placement above the HDPE liners will be sourced from a locally identified borrow area within the site which is within the footprint of waste rco dump 1 (WRD1) .

Low permeability clay material, for placement on the HLPs and ponds, will be sourced from a locally identified borrow area within the site which is within the footprint of the Storm Water Pond, Waste Water Pond and Intermediate Solution Pond.

5.7.2 Construction Water

Construction water for compaction, dust suppression and other uses will be supplied from the existing Chindwin River pumping station at Kyaukmyet. To facilitate this supply, a new pipeline will be constructed to service the Project site.

Where possible waste water generated from site, through surface water runoff, will be collected in the WWPs and treated. Where water quality allows this will be used for construction purposes.

5.8 CONSTRUCTION ACCOMMODATION

Accommodation for construction personnel will be provided in a dedicated construction camp in the north-west corner of the site. As present there are two options considered for the layout of the accommodation camps:

- Option 1 – 100 accommodation units which will house up to 400 personnel; and
- Option 2 – 210 accommodation units which will house between 420 and 840 personnel.

Accommodation is provided for expatriate and local personnel. Therefore, depending on the make-up of the construction personnel, the final accommodation camp requirements will be derived.

5.9 MINING

The Letpadaung copper deposit is located approximately 7 km southeast of the existing Sabetaung mine (Figure 1.2.1). The deposit trends to the northwest and is approximately 2200 m long and 1400 m wide and is basically horizontal. Average thickness of the ore body is about 140 m with an average copper grade of 0.37%. Overlying the ore body is a highly weathered and oxidised leach cap varying in thickness between 10 m and 200 m. This material is essentially waste as it contains little economic copper mineralisation. The geochemical properties of this zone are not well understood.

The estimated resource for the deposit is 1,600 million tonnes (Mt) averaging 0.37% copper.

Letpadaung has a mineable reserve of approximately 954 Mt at an average grade of 0.43% copper with 946 Mt of waste resulting in a waste to ore ratio of 0.99:1. It is

proposed to mine at a production rate of approximately 30 Mt /annum, resulting in a mine life of around 33 years.

5.9.1 Mining Method

The Letpadaung deposit comprises two large hills and the valley between (Figure 5.9.1). It is planned to mine the open pit in two sections. Section I has a mine life of 19 years and Section 2 will be mined for an additional 13 years, resulting in one large pit over the life of the project, as shown in Figure 5.9.1. The total excavation area of the open pit will be 325.0 ha with Section I being 207.0 ha and Section 2 118.0 ha The final pit dimensions will be 2700 m long by 1900 m wide by 450 m deep. A diagram showing the Year 30 pit shell is provided at Figure 5.9.2.

Mining will be conducted using conventional open pit, truck and shovel methods. Initial development of the pit will require the stripping topsoil and vegetation from the initial mining area. The topsoil and vegetation will be stockpiled in safe areas and used for progressive rehabilitation of disturbed areas. The weathered overburden layer above the ore zone will then be stripped and trucked to the waste rock dump (WRD) providing access to the ore.

Mining will utilise a fleet of five 22 m^3 hydraulic shovels and twenty four 186 m^3 electric drive dump trucks. In addition there will be sundry front end loaders, bulldozers and excavators used. Ore will be trucked directly to a primary mobile crusher for sizing. Low grade ore will be trucked to low grade ore stockpiles, as shown in Figure 5.9.1.

A production rate of approximately 30 Mtpa (92Kt/day) has been adopted for the Project utilising 330 days/a, with three, 8 hour shifts/day.

5.9.2 Drilling and Blasting

Drilling and blasting will be required to break up rock formations. A combination of ANFO (ammonium nitrate and fuel oil) and emulsion explosive will be used at the site. An explosives preparation area and explosives magazine is located on the west of, and adjacent to, WRD 3 as shown in Figure 5.9.1.

The magazine comprises an enclosed area adjacent to the southern perimeter of the open pit. The area will incorporate a production division and magazine division, located at least 33 m from each other. The magazine facility will occupy an area of about 5 ha.

The production division will incorporate 3 ammonium nitrate warehouses in a hazardous building compound. Each warehouse stores 600 t of explosive, for a total storage of 1,800 t.

The hazardous building compound includes No. 1 and No. 2 explosive initiator magazines. The No. 1 magazine has a Class 1.1 in hazard rating, containing a calculated 14 t of explosive. The No. 2 magazine has a Class 1.1 hazard rating and is planned to store 0.02 t of explosive.

5.9.3 Haul Roads

Mined ore will be hauled by truck to the semi-portable crushing stations in the pit and waste rock is hauled to WRDs located adjacent to the pit, as shown in Figure 5.9.1. The haul roads will be 26 m in width to allow safe passage of the large mining equipment. The roads will be graded regularly by graders and sprayed by water trucks, as needed, to reduce dust emissions.

5.9.4 Mine Water Management

5.9.4.1 Groundwater Management

The groundwater contours indicate pre-mining groundwater flows are from the southwest towards the north-east and the Chindwin River. Mining below the groundwater table will result in a localised steepening and reversal of the groundwater flow direction towards the Letpadaung pit. Based on the current pit design, the main eastern ramp in Stage II will intersect the high permeability Quaternary alluvium which will result in higher groundwater inflows to the pit and a steepening and reversal of the groundwater flow direction towards the pit that will extend under the south of WRD 1, WRD 2 and WRD 3.

MWMCL (April 2011) predicted groundwater inflows at two pit stages:

- Stage I Pit (<150 m) groundwater inflows of 26 L/s.
- Stage II Pit (<350 m) groundwater inflows of 116 L/s with 37.4 L/s coming from the andesite-dacite and 78.8 L/s (two thirds) of the inflow coming from a 430 m stretch of Quaternary alluvium at the eastern edge of the pit.

Groundwater inflows are therefore predicted to be between 26 and 116 L/s. A significant proportion of this flow will be later in the mine development when the main eastern pit ramp of the Stage II pit intersects the alluvial plain. If the pit was re-shaped to avoid cutting the alluvium this would reduce to 37.4 L/s. Inflow from the alluvium should be intercepted as it enters the pit prior to the water being affected by Acid Rock Drainage (ARD) deeper within the pit.

The above inflow estimates are preliminary based on limited field data and analytical equations based on simplifying assumptions. A numerical groundwater model could be developed to improve the inflow predictions and would also model the drawdown cone

as it develops with time. Modelling to assess the post-mining pit lake/water recovery levels has also not been undertaken.

Groundwater inflow to the pit will be collected by in-pit sumps. The water from the sumps will be either pumped to one of the waste water ponds or used for dust control, depending upon the water quality.

5.9.4.2 Surface Water Management

The main area for control is located south of the open pit. Due to the influence of rainfall runoff around the open pit, an interception trench will be set at the upper part of each area to convey rainwater out of the area. The rainwater of each area will be discharged centrally after being collected.

Since the WRDs are adjacent to the open pit, the upstream catchment will be taken away by the runoff interception trench. Only the rainwater of the WRD itself will be considered, thus the flood interception trench may be built at the corner of each bench on the waste dump to intercept rainwater within the waste dump. Rainfall runoff from WRD1 will be discharged centrally to the waste water pond in the south-east. The clean water component will be discharged into the stormwater collection pond to the east of the mine site.

5.9.4.3 Structures for Flood Control and Discharge

Flood structures will consist of the following:

- Interception trenches around each main area, open pit and waste dump;
- Seepage and runoff control at the base of each waste dump; and
- Flood protection berm at the east edge of the mine site to prevent the flooding of Chindwin River from eroding the mine site.
- Development of a Resettlement Action Framework to be used in the event villages located near Chindwin River need to be relocated due to flood activity.

5.9.5 Waste Rock Dumps

The amount of waste rock within the mining boundary is about 946 Mt, of which 256 Mt will be mined from the 20th year of production and disposed of through in-pit dumping. The balance of the waste rock will be dumped outside the open pit and amounts to 690 Mt.

There will be three WRDs associated with the Project to store the estimated 30 Mtpa of waste generated. The WRDs are located on the alluvial plain of the Chindwin River to the northeast (WRD 1), the west (WRD 2) and the southeast (WRD 3) of the pit, as

shown in Figure 5.9.1. The Stage I pit will also be used as a site for waste backfilling once mining has finished in this section.

Knight Piésold was commissioned by the proponent undertake preliminary design of the above-surface WRDs for the Project (Appendix I – Preliminary Waste Dump Design). The following information is derived from this study.

WRDs 1, 2 and 3 overlie Quaternary alluvial deposits that comprise medium to fine sand, sand, gravel and clay. The upper layer is clay, with a thickness of 4 to 6 m; below which is a medium to fine sand, sandy gravel and cobble gravel, with a thickness of 12 to 50 m (25.7 m on average).). On the alluvial plain, the depth to groundwater in the dry season ranges between 0.65 m to 19.12 m, with an average of 4.86 m. The upper Quaternary clay layer has the potential to form a low permeability base and hydraulically isolate and protect the alluvial aquifer from contaminated seepage emanating from the WRDs.

Waste will be transported by truck from the pit to the appropriate WRD and selectively placed according to its potential for generation of acid or metal leachates as set out in Sections 5.9.6 and 5.9.7.

The principal objective of the WRD design is to provide waste rock storage while ensuring protection of the environment during operations, closure and completion of the Project. The WRD design has taken the following requirements into account:

- Permanent and secure storage of all waste rock within engineered facilities.
- Waste dump placement and development scheduling to minimize equipment requirements, achieve stable slopes at closure and minimize closure measures.
- Control of drainage and runoff from the waste dumps during operations to the maximum practical extent.
- Collection of sediment from the waste dumps to the maximum practical extent.
- Treatment (if required) and discharge of excess drainage and runoff from the waste dumps.
- Monitoring for all aspects of the waste dumps to the maximum practical extent to ensure performance goals are achieved and design objectives are met.

The WRDs will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H.

5.9.6 Waste Rock Geochemistry

The Project geology is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap of highly weathered material is present above the main

ore zone of between 10 and 200 m thick. Previous geochemical investigations at the Project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold was commissioned by the proponent to conduct a geochemical assessment of the waste material (Appendix J – Geochemical Study). The following is a summation of this study.

The study selected 150 samples of waste rock which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth, Western Australia for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment of acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulphur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

Overall, approximately 71% of the samples were found to be potentially acid forming (PAF) with only 29% of the samples found to be non-acid forming (NAF). There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming. The presence and management of PAF materials is an extreme risk to the environment.

The multi-element analysis indicated the majority of the waste rock to be highly enriched with metals, and that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material. Management of waste rock to reduce the potential for leaching of metals from the rock is a very high risk to the environment and water use in areas in and around the mine site.

Additional characterisation of the waste rock at the project will be required prior to bulk mining to refine the design of the WRDs and the management for acid generation and metal leaching.

It is proposed that a proportion of waste rock will be placed as backfill into the Stage I pit. There are unique ARD management challenges associated with in-pit waste rock disposal. This is discussed further in Section 5.9.9.

5.9.7 Acid Mine Drainage and Metal Leaching Management

Acid rock drainage (ARD) is caused by the exposure of PAF material to air and moisture through the mining process. Once exposed sulphur bearing minerals may oxidise to produce acidic by-products and liberate trace metals.

Testing will need to be conducted on grade control or blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones and allow selective handling of each of these wastes so they can be placed in specific areas of the waste dump.

The waste rock will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all WRD areas to prevent contaminant seepage into the soil.
- Placement of a layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps to act as a buffer between the PAF waste and the foundation material at the base of the dump.
- Full encapsulation of all waste with a suitable compacted soil liner to reduce oxygenation and water intrusion into the waste material.
- Cover of the WRD soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material to prevent the soil liner from desiccating or eroding.
- Water management structures around all waste dump areas to collect potentially contaminated waters.
- Specialised in pit mine waste disposal to ensure that pit lake water quality is acceptable and that it is hydraulically contained.

Further details of water management and in pit mine waste disposal can be found in Sections 5.18 and 5.9.9 respectively.

In addition, the PAF waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height which can be compacted by truck movement to minimise oxidation of the material.

- Installation of interim covers reduces oxygenation and water intrusion into the waste material, the frequency of which is still to be determined.
- Instrumentation and monitoring of the quality of the construction and the performance of the encapsulation system will be required to confirm that the design intent is being achieved and sulphide oxidation has been reduced to acceptable levels.

Further discussion on the management of materials that are PAF and/or metal leaching are described in Section 8.3.

5.9.8 Low Grade Ore

Copper-containing low grade ore amount to approximately 99,375 kt. Depending on market conditions at the time, the low grade ore may be processed, so the copper-containing low grade ore will be segregated from the high grade ore within designated areas of the HLPs.

5.9.9 In-Pit Mine Waste Disposal

It is proposed to place a portion of the waste rock within the Stage 1 pit. As this waste will be exposed for a number of years, acid generation and metal leaching will occur. Therefore, the seepage will need to be collected and either treated prior to release or pumped to the leach pad for use in the process circuit to prevent outflows from the pit to groundwater. Once the waste has been placed to within 10 m of the estimated post-mining groundwater level, deposition must cease and the pit allowed to fill with water. Once the waste is fully submerged, acid generation will cease. Therefore, options to accelerate the pit filling should be considered. However, the pit cannot be allowed to fill to a level of the estimated post-mining groundwater level, otherwise outflow from the pit lake to groundwater could occur.

During pit filling, the water will require lime dosing to raise the pH. This should also result in a significant proportion of the metals precipitating, particularly if the pH is raised to around pH 10 or 11. Once the groundwater has rebounded, the pH can then be allowed to drop to almost pH 7circum neutral levels, as the metals should not be re-mobilised unless the pit lake becomes acidic.

Appropriate mitigation controls will be required if the pit lake water quality is predicted to be poor, and the water balance model indicates that outflows to off-site groundwater or surface water resources will likely occur.

5.10 CRUSHING CIRCUIT

Mined ore is subject to primary crushing prior to heap leaching.

The crushing circuit will comprise:

- A semi-portable crushing station in the pit;
- A primary crushing product stockpile;
- A screening plant;
- A qualified crushed ore stockyard;
- A sub-station; and
- A transfer station.

The crushing area will occupy 13.5 ha.

The Semi-portable crushing station is located within the open pit to reduce truck haulage distance.

The crushing system will be arranged along the existing passage between the two hills in the shape of an "L" so as to optimise land and earthworks volume.

5.10.1 Primary Crushing

A semi-portable crushing station established in the pit is used for primary crushing. Mined ore is hauled by trucks and fed into the semi-portable crushing station and the crushed ore is delivered by 2 belt feeders to the main belt conveyors which then convey the ores to the primary crushing product stockpile for storage and further crushing.

5.10.2 Screening

Ore from the primary crushing product stockpile is fed by the bottom vibrating feeder and heavy apron feeder to belt conveyors which deliver the ore to the vibrating screen for screening. Ten (10) 3.6 m × 7.5 m circular vibrating screens are used for screening. The oversize is transported by belt conveyors to the primary crushing plant for resizing. The crushed ore is carried by belt conveyors to the screening plant together with the primary crushing products. The undersize is the final product (particle size 50～0 mm) which is delivered by belt conveyors to the final crushing product stockpile for storage and then carried by belt conveyors to the heap leach pad for stacking.

5.10.3 Power Supply

The power supply system is composed of a 230 kV step-down substation connected to the national electricity grid, a 35 kV sub-station and other various sub-stations. The 230 kV step-down substation will be located to the east of the SX-EW plant, and to the south of the administration area. The 35 kV substation will be located on the southern slope of the crushing area. The facility occupies an area of 1.1 ha.

5.11 HEAP LEACH OPERATION

Extraction of the copper from the host ore will utilise a process known as heap leaching. In this process the ore is stockpiled on a pad and an acid solution is percolated through the ore, leaching the copper from the ore as it passes through. The resultant solution (pregnant leach solution), containing the copper compound, is collected in a pond for further processing in a plant equipped for solvent extraction and electro-winning of the extract to produce high grade copper sheets.

5.11.1 Method of Operation

Three heap leach pads (HLPs) situated to the south of the crusher complex are proposed to be built for the life of the operation, as shown in Figure 1.4.1. HLP1 and HLP2 will be utilised initially with HLP3 proposed to be commissioned after 14 years of operation.

HLP1 and HLP2 will each consist of 15 heap cells, with each cell covering an area of 300 m x 770 m. HLP1 covers an area of 3.465 km^2 and HLP2 covers an area of 3.460 km^2. Crushed ore will be transported to each cell by conveyor and stacked by mobile stackers to a raise height of 6 m. Cells will be developed sequentially, first HLP 1 then moving to HLP2. A total of 14 raises will occur on each HLP such that the final height of each pad will be 84 metres with a final slope of 26 degrees.

The base of the pad comprises an engineered HDPE lined foundation onto which a drainage layer and pipe work collection network is installed. Division of the cells will be achieved using independent drainpipe systems exiting the leach pad in individual outlet pipes into a solution collection channel or pipe running the length of the pad.

The copper loaded solution (pregnant leach solution, (PLS)) is collected at the base of each cell by a network of drainage pipes embedded in the base of the heap and the solution flows by gravity to a system of ponds. The outlet pipes may be throttled to direct solution flow either into a PLS pond, intermediate leach solution (ILS) pond or the single stormwater pond. The pipes carrying solution with the highest copper content will report to the PLS pond whilst lower concentration solution (as defined by the operators) will report to the ILS pond or the stormwater pond. Clean rainfall from unirrigated areas or overflow from the pad will report to the stormwater pond via the channel, thereby maximising copper concentration in the PLS pond by reducing potential dilution.

Once the copper is removed in the solvent extraction process the barren solution (raffinate) is recycled back into the irrigation delivery system, via the raffinate pond, to

be re-used in the leaching process. Acid will be added to the ILS or raffinate as needed to ensure the pH is at the required level.

The leaching process to remove most of the copper from the heap takes approximately 400 days made up of the following cycles:

- 40 days first cycle (from ILS – reports to the PLS);
- 180 days second cycle (from ILS – reports to the ILS); and
- 180 days last cycle (from raffinate – reports to the ILS).

Once this cycle is completed a new 6 m stockpile of ore will be placed on the exhausted heap and the process repeated. It is envisaged that there will be 14 cycles for each cell.

The parameters used in the design of the heap leach are set out below in Table 5.11.1.

Table 5.3: Design parameters of heap leaching

Usable Particle Size P95 (mm)	Daily Ore Processing Capacity (kt/d)	Usable ore grade (%)	Irrigation Strength ($l/m^2 \cdot h$)	Heap Leaching PH Value	Lift Height (m)	Heap Leaching Period (d)	Leaching Rate (%)	Grade of Copper in Pregnant Solution (g/l)
50	92	0.42	9	1.4~1.8	6	400	81	4.0

5.11.2 Leaching Circuit Solution Management

Three solutions are present in the leaching process comprising ILS for leaching, the PLS containing the leached copper and the raffinate solution which has had the copper removed. The solutions are contained in lined ponds located in the open space between each of the heap leach pads 1 and 2. Thus there is one ILS pond (60.0 m×470.0 m×3.0 m), one raffinate pond (60.0 m×130.0 m×3.0 m) and one PLS pond (60.0 m×245.0 m×3.0 m) for each heap leach pad. The location of the ponds is shown on Figure 5.11.1. Additional ponds will be constructed when the third heap leach pad is built 14 years after the commencement of the operation.

5.11.3 Drainage and Runoff Control

Stormwater runoff from the HLPs will be directed to a storm water pond (SWP) to the east of the HLP's (Figure 1.4.1). The SWP comprises a square HDPE lined facility (subdivided into four cells) as the main storage of excess water for the HLP, process ponds and plant site during rain events. The pond will be constructed to prevent seepage of the water which will contain elevated levels of metals from the heap and acidic runoff water. Anti-seepage measures will include a compacted clay layer for the

base and sides of the pond, an HDPE liner and provision of monitoring wells to detect any seepage.

The water from the SWP will be used as make-up water for the heap leaching operation and the process plant.

5.12 SOLVENT EXTRACTION AND ELECTROWINNING

The next stage of processing involves solvent extraction (SX) and electrowinning (EW) to produce the final copper cathode product.

The PLS from the leaching process is pumped to a solution storage tank in the SX plant where it is contacted with an organic solvent, referred to as the extractant, in the solvent extraction stage. Here the copper is extracted away from the aqueous phase leaving behind most of the impurities that were in the pregnant solution. Since the copper ion is exchanged for the hydrogen ion, the aqueous phase is returned to its original acidity as the raffinate solution and recycled to the leaching step of the process. The copper bearing organic phase is then stripped of its copper by contacting it with a strongly acidified aqueous solution. The copper-bearing solution is advanced to the EW stage of the process while the barren organic phase is returned to the extraction stage of the process. In the EW stage of the process the copper is reduced electrochemically from copper sulphate in solution to a metallic copper cathode.

After the cathode cycle, the cathode copper is lifted by crane into the cathode stripping section for removal of copper sulphate on the surface and stripping of cathode copper sheet. The design capacity of the SX/EW plant at Letpadaung is 100 kt/a.

Electro-won copper cathodes are as pure as, or purer, than electro-refined cathodes from the smelting process. Cathode copper purity is above 99.9%.

5.13 WATER STORAGE AND USES

For Project operation, water is required for the following uses:

- Heap leaching;
- Dust suppression (for mining and crushing);
- Emergency fire fighting;
- Camp;
- Process cooling; and
- Sewage system.

In broad terms water will be sourced from on-site run-off, open pit dewater, and the Chindwin River. Water quality requirements vary according to its proposed use, as detailed below in.

Table 5.4: Proposed project water quality requirements according to use

Water Quality	Water Use	Potential Source(s)
Untreated raw water	heap leaching and dust suppression	on-site run-off, open pit dewater, and Chindwin River
Treated water (industrial use)	emergency fire fighting, process cooling, and sewage system	on-site run-off, open pit dewater, and Chindwin River
Purified water (potable)	camp	Chindwin River

Water used for process is not expected to require any form of treatment prior to use. Water used for emergency fire fighting, process cooling, and sewage system operation will require a basic level of treatment to remove the suspended solids. Potable water for the camp will be abstracted from the Chindwin prior to filtration and chlorine disinfection.

Preliminary water quality baseline data from the Chindwin indicates that it is suitable for all of the above uses with the appropriate treatment. With regard to its industrial usage on site, the Chindwin River water quality data indicates that it is suitable for use following sedimentation and filtration (as total suspended solids values vary from 70 mg/L to 1438 mg/L over a typical year).

Water storage infrastructure available on site will include the following:

- Wastewater pond (4,730,000 m^3 capacity);
- Stormwater pond (4,000,000 m^3 capacity);
- Waste water collection pond;
- Heap leach pad solution ponds;
- Sediment control dams (150,000 m^3 estimated combined capacity); and
- Sundry process storage tanks.

In terms of heap leach water recycle the options are as follows (in order of decreasing priority): SWP; WWP; and the Chindwin River.

The WWP is the largest storage on the site with several potential sources reporting to it as follows: runoff from WRDs; open pit dewater; discharge from the cooling towers; discharge from air compressors; runoff from the crushing area; and wastewater from the camp sewerage treatment plant.

Water abstracted from the Chindwin River has various uses and will be pumped to various storages around site. Dedicated head tanks (with capacity of up to 2,500 m^3) will be established for heap leaching and dust suppression. These tanks will receive

water pumped directly from the Chindwin. Water for industrial use will also be abstracted from the Chindwin, and after treatment will be stored in the metallurgical head tank (capacity of 2,500 m^3) prior to distribution to local process ponds. Potable water, taken from the Chindwin River, will be stored in a 100 m^3 capacity stainless steel tank, after passing through the water purification plant.

5.14 REAGENT USE

The main reagents used in the heap leach and SX/EW process are listed below.

Table 5.5: Reagents used in ore processing

Description	Unit	Qty.
Sulfuric Acid	t/a	30,350
Extractant	t/a	450
Solvent naphtha 260#	m^3/a	4500
Active clay	t/a	400
Flux oil	t/a	4,500
Cobalt sulphate	t/a	75
Guar gum	t/a	30

5.15 HAZARDOUS MATERIALS HANDLING AND STORAGE

The main hazardous materials used at the project are listed in Table 5.6.

Table 5.6: Hazardous materials used for the Letpadaung Project

Description	Unit	Qty.
Sulfuric Acid	t/a	30,350
Diesel	t/a	22,650,000
Extractant	t/a	450
Solvent naphtha 260#	m^3/a	4,500
Flux oil	t/a	4,500
Cobalt sulphate	t/a	75
Engine oil	t/a	1466.8
Granular ammonium nitrate	t/a	9,024
Powder ammonium nitrate	t/a	2,560
Explosion initiation devices	ea/a	42,386

5.15.1 Hazardous Substances Storage

- Storage areas will be designed to adequately and safely store a sufficient quantity of substances required for the project;

- The storage area will be properly designed to contain and prevent contamination of the environment, particularly soil and groundwater;
- Floor, curbing, walls and roofs will be designed to adequately contain spills and protect the storage area from weather where necessary;
- Spill kits, protective equipment, and other necessary equipment will be in the storage area or approximate to the storage area to clean and mitigate spills;
- Fire prevention systems will be designed to be appropriate and adequate to the material being stored;
- Only containers that are in good condition will be used;
- Incompatible (e.g., bases and acids) materials will not be stored in the same containment area and will be stored in safe manner and distance to prevent accidents;
- To provide a safe work area, walls, dykes, berms, or separate facilities of other means will separate incompatible materials;
- Drums, containers, and storage areas will be properly labelled, marked and secured;
- Material safety data sheets (MSDS) for each material will be stored on a database and placards containing the MSDS will be placed in the storage containment area for each material stored;
- Sufficient storage space between containers will be allowed for safe access and handling of containers;
- No smoking or electronic devices such as hand phones or hand-held radios will be allowed in storage areas; and
- Fire prevention and management practices will be developed specific to the materials being stored.

5.15.2 Explosives Storage and Handling

- All blasting activity will be performed by a specialist contractor who will be responsible for blasting design, explosives calculations, delivering blasting agents to the blast-holes, placing powder or emulsion in the holes, charging the holes, placing detonators and boosters, filling the holes with stemming material and tie-in patterns;
- The blasting contractor will supply the explosives, boosters and detonators, transport them to site and store term, until required for blasting, in the explosive magazines. The contractor will also supply mixing and delivery trucks;
- Explosive magazines will be constructed away from receptors at designated limits in accordance with Myanmar legislation; and
- A plan will be produced of explosives storage locations.

5.16 NON - HAZARDOUS MATERIALS HANDLING AND STORAGE

A range of non-hazardous materials will be used on the Project ranging from industrial materials such as pipes and conveyor belts to domestic materials such as food and bedding.

Most of the industrial materials will be stored in the warehouse and maintenance area to the southwest of the pit. The domestic materials will be stored in the accommodation area located approximately 3km to the north-west of the Letpadaung mine area.

5.17 TRANSPORT

Transport methods will include road, river, sea and air transportation. The majority of materials will be shipped to the port of Pathein in the Irrawaddy Delta and will then be transported via river barge to the Letpadaung site. During the wet season the depth of flow in the Chindwin River (a tributary of the Irrawaddy that flows past Letpadaung) is adequate to allow barge access to a landing adjacent to the site. Over the dry season, river levels are such that barges can generally only venture as far upstream as the town of Pakokku. Thus, at this time of the year it will be necessary to transport materials via road between Pakokku and the Project site. The current plans are to use and upgrade the existing barge jetty and load-out facilities at Pakokku and Letpadaung.

It is estimated that approximately 50,000 tonnes of general freight and fuel will be delivered to the site each year. This equates to about 3 barge movements per month, or 4,500 tonnes of material. Based on a 20 tonne payload per truck, this freight mass will require 225 truck movements per month or 24 truck movements per weekday. In addition, there is expected to be 100,000 tonnes of product freighted by road to Pathein port per year. This equates to 28 truck movements per day of 30 tonnes payload. Thus, at the mine site, there is likely to be 52 truck movements to/from the site daily for movement of product, fuel and general freight.

5.17.1 Hazardous Material Transport

The main hazardous materials transported to the site are explosives, diesel fuel and sulphuric acid.

- Explosives – transported by road from China using the border crossing at the town of Muse. These materials will be transported in convoys that will deliver supplies monthly and are likely to comprise 50 – 100 vehicles per convoy;
- Diesel fuel – transported by barge to Letpadaung or Pakokku, then by truck to site. Approximately 1 barge/week; and
- Sulfuric acid - transported by barge to Letpadaung or Pakokku, then by truck to site. Approximately 1-2 barge(s)/week.

5.17.2 Non - Hazardous Material Transport

Non-hazardous materials will be transported by barge to Letpadaung or Pakokku, then by truck to site. The volume of material will require approximately 15 barges/year.

The final copper cathode product will be transported by road from Letpadaung to Yangon for shipping to customers.

5.18 SITE WATER MANAGEMENT

5.18.1 Water Balance and Supply

The Letpadaung Project has been designed to contain site runoff for storm events up to and including that for a 1 in 100 year return interval. Process water for heap leaching will be recycled, in a closed loop system, with make-up water sourced from open pit dewater, site surface water runoff, and the Chindwin River (over the dry season).

A site water balance, incorporating water inputs and losses from the system, was completed for average, wet and dry conditions. Under average climate conditions, the leach pad water balance is shown to be in net water deficit for approximately 6 months of the year. During this time, due to the ongoing loss occurring on the leach pad, the SWP and WWP remain empty with any shortfall made up from the Chindwin River. The annual raw water requirement (for an average year) equates to around 6 Mm^3/year.

Under dry climatic conditions, the annual rainfall is reduced, thereby increasing reliance on external water sources during and after the wet season. The annual raw water requirement increases, under these circumstances, to around 9 Mm^3/year.

The existing SWP and WWP are suitable for containing 1 in 100 year recurrence interval storm events, with storage capacities of 4 Mm^3 and 4.8 Mm^3 respectively.

Use of HLP make-up water should be prioritised so that on-site, low pH water sources are used first. Make-up water may be taken from three potential sources, in order of decreasing priority, as follows: SWP; WWP; and the Chindwin River.

The estimated water consumption for an average year is given in Table 5.7.

Table 5.7: Estimated water consumption (average year)

Area	Consumption (Mm^3 per annum)
Crushing and heap leaching	4.56
Mining operations / dust suppression	0.44
Electrowinning and extraction	0.30
Boiler and air compressor	0.04
Contingency	0.68
Camp domestic (potable)	0.11
Total	6.13

5.18.2 On Site Water Storage Ponds

Water for heap leaching will be supplied from site run-off (harvested in the SWP and WWP) and the open pit. Water for mining and dust suppression will be taken from the WWP. Where supply from the ponds is not sufficient to meet process and mining requirements, make-up water will be abstracted from the Chindwin River. Capacities for the WWP and SWP are 4.8 Mm^3 and 4.0 Mm^3 respectively.

5.18.3 Potable Water

Potable water for the camp will be abstracted from the Chindwin River using a floating barge mounted pump that will allow water to be conveyed around the site to local storages, via a pipeline network. Water for camp usage will be stored in a 100 m^3 capacity stainless steel tank, after passing through a water purification plant (involving a process of filtration and chlorine disinfection). The majority of the camp potable water will ultimately be transferred to the WWP as domestic sewage wastewater / grey-water.

5.18.4 River Diversion

To divert clean water from the upstream, undisturbed, catchment (east of the project area) the South Diversion Channel will be built along the western edge of HLP 1 and HLP 2 (as shown on Figure 5.18.1). The channel diverts runoff south and then west around the southwest edge of the Letpadaung site and back into its original catchment. This will minimise impacts on downstream users and ecosystems. The channel will be designed for a minimum 1 in 100 year flood event and will comprise a 1.5 km long open channel with a cut depth of up to 12 m.

5.18.5 Flood Protection

The eastern edge of the Project area sits on a flood plain for the Chindwin River. To protect this part of the site (and in particular to avoid flooding of the open pit) an earthfill flood protection bund will be constructed along the eastern boundary, and northeast and southeast corners of the site. The bund will be constructed to a level above that of

the 1 in 100 year flood. The alignment of flood protection bund is shown on Figure 5.18.1.

5.18.6 Storm Water Management

The following principles are applied in the surface water management of the site:

- Identification of watershed catchments influenced by the proposed mine development;
- Reduction of hydrologic flow impacts of the development by maintaining pre-mining watershed catchment flow routing wherever possible;
- Classification of watershed catchments as either undisturbed (clean water) or disturbed (dirty water); and
- Separation and segregation of clean water and dirty water (so as to reduce handling requirements).

Surface water flowing within or adjacent to the site is classified in terms of quality according to the following categories: clean; sediment laden; contact (potentially acidic or enriched with metals); and process.

To reduce the environmental risks associated with storm water management on the site the following will be implemented:

- Progressive rehabilitation of WRDs (effectively encapsulating the mine waste). Runoff from rehabilitated surfaces will generate sediment but would be otherwise clean.
- Contact water (runoff from ore stockpiles) to be directed to the WWP and tested to assess its requirement for treatment prior to release.
- Segregation of different water quality streams to allow maximum potential discharge of water meeting release standards.

No contaminated water will be discharged from the site for events up to 1 in 100 year recurrence intervals. Infrastructure that will be in place to ensure that this is the case includes the following:

- Diversion of clean water (from upstream undisturbed catchments) around the site via the South Diversion Channel.
- Perimeter diversion channels around WRDs to direct sediment laden runoff to the WWP northern cell.
- Perimeter diversion channels around low grade ore and ore reserve stockpiles to direct contact runoff to the WWP southern cell.

- The WWP will be operated as two cells with the northern cell used to contain sediment laden water and the southern cell used to contain contact water (that may require special treatment prior to release).
- Perimeter diversion channels around the heap leach pads to divert surface runoff to the SWP.
- Sediment control dams (SCDs) will be installed downstream from any disturbed catchments that report to offsite waterways, particularly along the northern boundary of the site.

To facilitate operation of the system the more environmentally problematic, low grade ore and ore reserve, stockpiles will be consolidated in the northern half of the HLP3 area. This location will allow the contact water from these stockpiles to be directed relatively easily to the south WWP cell. A plan showing the layout of the surface water infrastructure described above is presented in Figure 5.18.1.

5.18.7 Raw Water Supply

Raw water for the site will be abstracted from the Chindwin River, over the dry season, using a floating barge mounted pump. The water will be pumped to a number of storage tanks around the site via a pipeline network. Dedicated head tanks (with capacity of up to 2,500 m^3) will be established for heap leaching and dust suppression. These tanks will receive water pumped directly from the Chindwin. River water for industrial purposes will require primary treatment (to remove suspended solids) prior to being stored in the metallurgical head tank. Potable water, taken from the Chindwin River, will be stored in a 100 m^3 capacity stainless steel tank, after passing through the water purification plant.

5.19 SITE WASTE MANAGEMENT

5.19.1 Non-Hazardous Waste

Non-hazardous waste management aims to ensure the effective collection, storage, management and disposal of non-hazardous industrial and domestic waste during operation of the Project. For the purposes of this exercise, industrial waste includes inert bulk wastes other than mining wastes, and domestic waste is defined as kitchen, biological, and general camp waste.

5.19.1.1 Waste Disposal and Reuse Philosophy

The Project will employ the waste hierarchy approach whereby the first aim will be to reduce the amount of waste generated through design, use of approved suppliers for materials, contract arrangements, minimisation of over-ordering etc. Under the waste

management hierarchy, management options will be evaluated in the following sequence to minimise the amount of waste generated for final disposal.

Reuse

As far as practicable, wastes will be reused. Recycle: There are currently no recycling facilities in Myanmar. Materials or goods that are waste but cannot be reused can often be recycled i.e. paper, wood, metal, plastic, and glass; this recycling may occur on the site, in the immediate communities or in the region.

Segregation

Segregation of inert, hazardous and non-hazardous wastes will be carried out. Segregation of materials such as wood, metal, plastic and inert materials should be the initial targets as this may provide benefits such as cost savings for waste disposal and benefits to the community.

Recovery

If neither reuse nor recycling can be carried out, materials should be considered for recovery as a last resort.

Disposal

Where none of the above is practicable the waste can be sent for disposal at controlled on-site disposal location.

5.19.1.2 Non-Hazardous Wastes Produced by the Project

Typical non-hazardous wastes that will be generated are listed below:

Domestic Wastes

- Food waste (i.e., any food remains or wastes that have been in direct contact with food such as containers, napkins, wrappers);
- Paper and cardboard;
- Some plastics; and
- General camp and office wastes such as used office supplies, liners.

Inert Bulk Waste

- Conveyor belts, tyres;
- Crusher and chute liners, screen elements;
- Motors, v-belts;
- Piping and fittings;
- Reinforcing bars;

- Building and bulk debris, cladding, carpeting, drywall, light bulbs (except in the case of mercury vapour/low energy bulbs. These must be disposed of as per hazardous waste requirements), broken glass, insulation and timber; and
- Scrap metals.

5.19.1.3 Waste Disposal

Solid wastes will be segregated at source prior to being transported to the waste storage area on hard-standing with controlled access. The site will be installed with an apron and appropriate perimeter drainage. Areas used for loading and unloading will also have suitable drainage structures, spill containment and other control equipment. Suitable protection from rainfall and sunlight will be provided.

Purpose designed and built landfill cells will be prepared. Landfill cells will be designed to prevent the inflow of rainfall runoff from upslope areas and will be lined with a compacted soil layer. Once a cell is full, it will be covered with a low permeability compacted soil capping. The capping will be constructed to shed stormwater.

Domestic sewage and grey water treated effluent will be discharged to the WWP during operations.

5.19.2 Hazardous Waste

Hazardous waste management aims to ensure the effective storage, management and disposal of all hazardous materials used at the Project.

Hazardous materials include but are not limited to:

- Hydrocarbons;
- Solvents;
- Explosives;
- Acids; and
- Any other solid or liquid toxic chemical.

5.19.2.1 Disposal of Liquid Hazardous Waste

Liquid waste procedures apply to solvents and reagents, waste oils, solvents or greases from maintenance or workshop areas:

- Any spills of oils, grease, solvents or other hazardous materials in the maintenance areas, fuel storage areas or loading/unloading areas will be cleaned up using absorbent materials and placed in bins, not washed;
- Waste oils and solvents will be stored in separate drums on bunded pallets, on paved areas equipped with secondary containment and protected from the weather; drums will be clearly labelled with their contents;

- Waste oils will not be stored for extended periods in underground sumps; tanks and sumps will be emptied and inspected regularly for any signs of cracks or holes. The findings of the inspection will be recorded; any cracks or holes will be repaired, and any repairs conducted will be recorded;
- As far as possible, waste oils will be reused;
- If waste oil is not of suitable quality for onsite use, it will be collected by a licensed contractor for offsite recycling; copies of contractor licenses will be retained onsite. If recycling is not possible it will be burnt;
- Spill clean-up and fire extinguishing equipment will be available in the storage area, and personnel will be trained in its use; and
- There will be no onsite disposal of waste oils and solvents direct to the soil surface or storm water collection system.

5.20 ACCOMMODATION

The Project will provide jobs for approximately 2,500 people at the peak of the Project operations.

The accommodation village will be located adjacent to the reserved area of S&K mine, approximately 3 km to the north-west of the Letpadaung mine area, near to the local arterial highway and mine access. The new accommodation village will become an extension of Mine Town which houses the bulk of the S&K mine workforce (Figure 5.20.1).

The existing Mine Town has a total population of 3,100 people and its infrastructure is significantly more advanced than other places near the mine. Housing includes 145 separate houses, 256 semi-detached houses and a 60-person male dormitory for semi-contract workers. The expanded mine town development will require construction of 444 new houses to accommodate a mixture of expatriate and local staff. Four different house types have been developed varying from three bedroom to one bedroom architectural designs. In addition to the dwellings described above new amenities and facilities will be constructed to improve the quality of life of the Mine Town residents. New amenities will include:

- Sports facilities including golf driving range, soccer pitch, volleyball, tennis, and basketball courts;
- A small hotel with dining room, café, laundry, gymnasium, games rooms, and cable TV;
- An Olympic size swimming pool;
- A supermarket; and

- An administration building and visitors car park;

A new 10kV overhead power line and substation will be constructed to augment the existing Mine Town electrical infrastructure. Water will be pumped from the mine and will pass through a water purification plant before being stored in a tank on an elevated part of the Mine Town site (promoting flow under gravity). Each new house will be fitted with a solar hot water system. Mine Town sewage will be treated in a dedicated wastewater treatment plant to a level that will allow treated water to be used for watering of gardens and lawn.

5.21 MINE CLOSURE

Letpadaung's short term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active:
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment – including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;

- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment;
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;
- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

The conceptual closure plan in Appendix L allows integration with the design concepts and ensures that the design and operation of the site are compatible with the closure plan. After commissioning a detailed closure plan will be developed.

An outline closure land-use plan has been developed for the site. On closure the open pit will remain as a void with a permanent pit lake. The remaining areas will be rehabilitated to one of four land-use categories, namely:

i. Scrub/grazing;
ii. Agriculture;
iii. Pond or wetland areas; or

iv. Landfill.

Progressive rehabilitation will be undertaken wherever possible. All equipment and infrastructure will be removed from site unless there is a beneficial use to the community such as buildings or roads.

Due to the potential for long-term environmental pollution, both the WRDs and HLPs are to be covered with low or very low permeability capping systems to reduce infiltration.

Surface water run-off and leachate from WRDs and HLPs will be controlled via a surface water management system that separates clean from potentially contaminated water, provides settling areas to reduce suspended load prior to discharge, and allows treatment of water which doesn't reach the necessary standards before release from site.

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

If it is possible to reuse a waste, either onsite or for a different application in the local community, then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that two landfills will be constructed on the site so that wastes are contained within the site boundary. One facility will accept inert/non-hazardous waste whilst the other will be a hazardous waste landfill.

As the closure plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

Closure costs will be developed concurrent with the closure plan and financial provision will be made to ensure that adequate funds are available for final closure.

6. COMMUNITY CONSULTATION

6.1 INTRODUCTION

The Letpadaung Project has voluntarily undertaken to prepare an ESIA consistent with the good international practice. According to the World Bank/International Finance Corporation (WB/IFC) Performance Standard 1, stakeholder engagement is an ongoing process in the project lifecycle to "disclose project-related information and consult with local communities on matters that directly affect them."[40] For public consultation to be effective, communities must be knowledgeable about planned project activities and their potential impacts and given ample opportunities to express their concerns about project matters so that these concerns can be addressed through the Project's design and implementation arrangements. Instrumental in the process is a two-way and timely exchange of information between Project representatives and affected communities in which both parties are free to communicate without fear of reprisal. Public consultation also plays a role in ensuring that all affected persons, regardless of their social status, are given equal opportunities to express their concerns and receive a proportional share of the project's benefits even if it means Project planners make special arrangements to accommodate a person's circumstances and needs. When preparing the scoping study and Terms of Reference for this ESIA it was apparent that the concept of free, prior and informed consent in relation to this Project would not be achievable due to historical events associated with the Project and, more broadly, in Myanmar as a nation.

6.2 STAKEHOLDER CONSULTATION REGARDING LAND COMPENSATION

Ministry of Mines received an application for issuing of Farm Land Nationalization Act (39) (La Na -39) for utilization of farm lands for the mining purpose (No.1 Mining Enterprise) on 18 January 2001 with reference No. 5/41-5(130)/Oo 6 from Sagaing Division Peace and Development Council. No.1 Mining Enterprise handed over La Na (39) to the Myanmar Economic Holdings Limited (MEHL) on 5th March 2010. According to La Na (39), the total area (7867.78) acre include the following-

a) Registered permanent farm land - 4826.70 Acres
b) Temporary farm land - 230.80 Acres
c) Other land (Including mountain area, road and other infrastructure) - 2810.28 Acres
d) Total - 7867.78 Acre

[40] International Finance Corporation. Performance Standard 1. Assessment and Management of Environmental and Social Risks and Impacts. January 2012.

Communication with the community regarding the Project had commenced as early as 2003, when the Myanmar Ivanhoe Copper Company Ltd. (MICCL) commenced collection of land information and land compensation as well as shifting the Taung Gyar Pagoda in preparation for development of the Project site. However, these activities were disbanded as the activities of MICCL focussed on the development of the S&K Project. It is unclear if community consultation occurred as part of the feasibility study and initial Environmental Impact Assessment process by Muir in 1997.

According to the contract between MWMCL and the Republic of the Union of Myanmar, the Government and its agencies were responsible for undertaking the public consultation associated with this Project. It is understood that discussions with the community regarding land acquisition and resettlement commenced as early as 2010, although there is no documented evidence of the content of that consultation, the issues raised or their resolution. MEHL undertook investigation of the current status of the land in 2010 with assistance from the local government and the local Settlement and Land Record Department. On 12 October 2010 they made a submission to regional authorities to set up two (2) land compensation committees to lead the land compensation process. One committee was formed of representatives from Regional authorities and the second from local authorities and village heads of the affected areas.

The Salingyi Township authority set about checking and recording the condition of farmland on the ground. The teams identified that the area of farmland had increased to 5487 acres in the ten (10) years since the original submission in 2001.

The committees made representation to government to increase the rates normally paid for land, including land that had been farmed without authority and this approval was granted. Compensation was also paid for the land for the resettlement villages. The initial compensation determination was completed on 20 August 2011.

Anecdotal evidence suggests there was at least some consultation regarding resettlement of the villages and the selection of the sites for the new villages. Indeed it appears land was offered in two (2) locations some distance from the Project area but this was not accepted by the villagers and the two (2) resettlement villages that have been developed were agreed in consultation with the villagers to be relocated.

There is also some evidence that the land compensation and resettlement negotiations have resulted in reconsideration of the land valuation process on at least two (2) occasions which has resulted in deputations presenting this case to the agents of the Government.

The first occurred after the finalisation of the first round of land compensation in August 2011 in regard to unregistered farmland. It was agreed to compensate for this land, a process which was completed on 6 November 2012. The land compensation was based on the current market value of the three (3) years production from the land plus the value of any trees on the land.

On 3 August 2012, MEHL was granted a 60 year land grant over the Project area by the Ministry of Home Affairs.

Ultimately, many landholders did not accept the compensation offered and this has lead to subsequent protests and actions to limit access to the land by MWMCL. The most significant of these culminated in dispersion of the protest on 29 November 2012 and there have been many smaller protests since that time. The failure to resolve the land compensation issue to date has clouded any consultation with the community regarding this ESIA or discussions regarding the project status, including the commencement of early construction works.

6.3 SPECIAL INVESTIGATION COMMISSION

Following the protests that culminated on 29 November, the Government appointed a Special Investigation Commission (SIC) chaired by Daw Aung San Suu Kyi. This Commission conducted investigations in the period from January 2013 to March 2013 before delivering its report to the Parliament in March 2014. During this period all other consultation with the community was stopped at the request of the Government. As a result, the Scoping Study and Terms of Reference prepared to enable this ESIA were not developed in consultation with the community as their development coincided with the work of the SIC.

The SIC's findings were developed after significant community consultation. During the operation of the SIC, no additional consultation was able to be carried out. As a result, no community consultation was undertaken during the scoping study which lead to the preparation of the terms of Reference for this ESIA.

In September 2013, in response to the SIC's findings, another round of compensation was paid to the households that lost their land. The rate of compensation was between 3 to 3.7 times the legal requirement. Approximately 56% of the compensation capital has been claimed by the villagers.

The Project sponsors are taking action to regain the trust of the communities by making concessions aligned with villagers' expectations, including back compensation payments to households affected by land take and re-evaluating decisions related to cultural property. MWMCL also changed its compensation criteria with respect to the

provision of jobs to affected households in response to information learned from the community consultations. Whereas previously one (1) job was to be allocated to each affected household regardless of the amount of land taken for the Project, the new criteria take the amount of land eligible for compensation into account. Wanbao will provide between one (1) to three (3) jobs per household based on the amount of acreage lost. These arrangements were approved by the Government in July 2013, in Phase 1 of the CSD Programme summarised below.

From a risk management perspective alone, it is strongly recommended that MWMCL develop the retrospective Resettlement Action Plan in line with IFC Performance Standard 5 and make corrective actions to protect communities and their assets from their exposure to the construction activities. A second effort at damage control would be for the Company to separate the compensation and livelihood restoration measures, including infrastructure works to be carried out in the new villages, from its broader philanthropic CSR Programme of community investments and communicate this distinction to the main community stakeholders. This will demarcate the social and community infrastructure investments associated with impact mitigation from those associated with the Company's philanthropic endeavours and good will.

6.4 CONSULTATION ASSOCIATED WITH ESIA PREPARATION

As mentioned previously, consultation during the preparation of the ESIA has been hindered by the ongoing disputation regarding land compensation and resettlement. As a consequence, the community has not been able to be informed of the undertaking of the ESIA and the field work associated with it. The ESIA has been developed with very little representative feedback from the community on the issues it considers are significant to the Project or on the management of those issues. This has resulted in:

- Staff collecting field data being asked to leave land within the Project area;
- Site reference markers being removed making inter-seasonal variations difficult to monitor;
- Permanent monitoring points being rendered useless through vandalism;
- The inability to leave monitoring equipment in the field for extended periods as good practice baseline definition requires; and
- The inability to involve the community in the data collection process in a representative manner.

In a normal community consultation process, the baseline data gained would be discussed with the community and their comments received and considered in its

interpretation. This process could not be undertaken as the community was not receptive to such presentations.

The Project construction commenced before the development of the ESIA and as a result, stakeholder engagement with affected communities was less rigorous than the WB/IFC model. Free, prior and informed consent about the construction activities did not take place in the communities, and resulted in local tensions and protests that continue to undermine broad community support for the Letpadaung Project and create a rift between those persons and communities who support the Project and those who do not. The situation deteriorated with the commencement of the Early Works in November 2013 and remains problematic.

6.5 METHODOLOGY

MWMCL recognised the need to fill the gap in information being presented to the community. It also recognised the benefit of using local village representatives to communicate, within their communities, the progress and plans being made by MWMCL in preparing for the Project development in a manner approaching good practice.

Stakeholder engagement officially commenced on March 28, 2013 with a launching ceremony hosted by the Environmental Systems and Operational Development Manager and the Public Relations Manager with the newly contracted CSD leaders in attendance. This was followed by a week-long training workshop of the newly appointed CSD leaders representing villages near the Project site. Training consisted of brainstorming exercises in which the CSD leaders shared with the group the main problems and concerns facing the villages they represented, later consolidated into one list; conducted community mapping; and gained familiarity with the World Bank/ICMM/ESMAP Community Development Toolkit. The Community Development Toolkit was adopted as the reference standard and guidance for the upcoming village consultations. A second round of training was conducted by the Public Relations Manager and the newly hired CSD Team Project Manager in late April. On April 24, MWMCL’s Managing Director sent a letter to the Sagaing Regional authorities and to MEHL officially informing them of the CSD Program and requesting their approval which was readily given. MWMCL subsequently approved the CSD programme.

To date, the Project has carried out consultations in two (2) phases, the planned activities of which were side-tracked by either Project delays or civil disobedience in some of the affected villages. The refusal of villages to participate in the community engagement activities and the general atmosphere of discord influenced the venue for

consultation, the type of consultation technique used, and the amount of time spent obtaining information. In many instances, the quality of the stakeholder engagement methods utilised was compromised in response to the uncertainty posed by access restrictions to some of the villages (as a result of barred entry or the potential threat of physical harm by the protesters). That the CSD Team was able to obtain the volume of information it did is commendable and demonstrates the tenaciousness of the CSD Leaders to carry out their mandate.

Phase 1 Consultations

The intended purpose of the Phase 1 consultations (May – August 2013) was to ascertain village stakeholders knowledge base about the planned Project activities, demonstrate MWMCL's commitment to continuous stakeholder dialogue (through the implementation of a forthcoming Public Disclosure and Consultation Plan (PDCP), and discuss locations of the Early Works Project activities and potential impacts and collect feedback.

As the Early Works were rescheduled for October 2013, the CSD Team quickly changed the focus of the consultations toward corporate social responsibility and community development planning. They then developed an implementation schedule for Phase 1 activities, which involved:

(i.) public awareness raising;
(ii.) identification of community needs;
(iii.) implementation of Complaint Response Mechanism in the villages and training of the CSD leaders on the CRM;
(iv.) information gathering for media promotion;
(v.) estimates of employment vacancies in the construction period; and
(vi.) detailed proposal of the community and social development infrastructure to be financed in the villages in FY2014.

These activities, among others, formed the Draft PDCP. All of the activities in the implementation schedule were completed.

In line with good practice, the CSD Team identified the primary stakeholders with whom they would regularly consult. These primary stakeholders would be directly affected by the Project activities and were defined to be the 12 villages bordering the leased area and the 4 villages to be relocated. However, as it became known in the villages that the primary stakeholders would receive Project-related benefits from the CSD Programme, there was high demand to expand the group of primary stakeholders to include an additional 18 villages considered to be indirectly affected by the Project.

The resulting group of primary stakeholders are the following 34 villages listed in Table 6.1 (33 with Zidaw and Sede merged into one village). It should be noted that data that was gathered for Palaing, Mingalargone, and Yonebinyoe but is not included in the consultation summary for the period of May to August 2013.

Table 6.1: List of villages defined as primary stakeholders and status of first round of consultations, May 2013

	Village	Status
	4 relocated villages:	R=Refused E= Engaged NE=Not Engaged
1	Zidaw/Sede	Old – R New - E
2	Kandaw	E
3	Wetme	Old – R New - E
	12 villages bordering the leased area:	
4	Moegyobyin (North)	E
5	Moegyobyin (South)	E
6	Moegyobyin (Central)	R
7	Wardan	E
8	Paungga (North)	E
9	Paungga (South)	E
10	Paungga (Central)	E
11	Dondaw	E
12	Ywatha	E
13	Gondaw	E
14	Kan Kone	E
15	Shwe Pan Khaing	E
	18 additional villages:	
16	Thedawayi	E
17	Yay Kyi Pin	E
18	Telpinkan	E
19	Phaung Kadar (South)	E
20	Kyaukpyudaing	E
21	Kyawywa	E
22	Taungpalu	E
23	Shwehlay	E
24	Ywarshay	NE
25	Ton Ywathit	R
26	Taw Kyaung	R
26	Aleywa	R

	Village	Status
27	Ledi	E
28	Yonebinyoe	E
29	HtanDawGyi	NE
30	Palaing	NE
31	Palaung	E
32	Nyaungbingyi	NE
33	Mingalargone	NE

Following protocol, the CSD Team sent a letter to each Village Administrator requesting approval for the CSD Team to speak to the villagers in a public forum in which they would present the Draft PCDP and the draft questionnaire proposed for the socio-economic baseline data collection.[41] Six (6) of the 26 villages (24%) refused engagement (see Table 6.2.1).

In light of the volatile situation, the CSD Team could not present the PCDP in a public forum, but instead, made separate visits to the receptive villages where discussions were dominated by outstanding issues. Most of the villagers wanted to know the status of commitments made earlier by MWML regarding job placements, provision or upgrading of community infrastructure, and land compensation. Their daily reports provide the basis of information for the summary of issues raised and their resolution presented in the next section. An example of the meeting minutes for Kyawywa village is presented in the Table 6.6.5 at the end of this report.

In the first round of consultations, the CSD Team obtained agreement from most of the villagers to conduct interviews with willing households for the socio-economic baseline data collection (with Gondaw and Kan Kone declining). This was to take place the week of May 11, 2013. On May 11th, after being alerted to a strike demonstration organized by student protesters, the CSD Team decided to cancel/postpone the interviews in those villages located near the strike action, totalling six villages and another, Moegyobyin (North), where the household interviews were interrupted by the protesters.

After the fieldwork data collection, in June 2013, a second round of consultations followed in which MWMCL answered questions about the status of the villages' CSD requests and heard grievances expressed by the villagers. These complaints were recorded in a database which was updated to include the actions taken by Project staff

[41] At the time the letter was sent out, there were 26 primary stakeholders.

to investigate the complaint and seek resolution. The findings of the community consultations were communicated to Wanbao management who responded by making two (2) important commitments to the communities. As mentioned previously, one was the increase in the number of job opportunities available to households affected by land take. The second was a long-term financial commitment to support the communities for the life of the Project.

Wanbao, MEHL and Mining Enterprise 1 are apportioning 2% of their respective net profit from the Project for CSR activities once the Project is in full operation. Before then,the Project partners have committed USD 1 million annually toward community development activities. These financial commitments to the communities are specified in the Amendment to the Production Sharing Contract which was signed by the three (3) parties in July 2013.

Phase 2 Consultations

The objectives of the Phase 2 consultations were two-fold; first, to inform the villages about the modified Early Works activities and schedule and obtain their perceptions of the potential impacts of the planned works on their communities; and second, to gain community input into the proposed CESMS and ESIA impact and mitigation measures to be included in the EMPs and SMPs.

Phase 2 consultations commenced in late September 2013 with an issues identification exercise conducted by the CSD Team Leaders in their respective villages. The CSD Team was able to compile a list of environmental-related issues which will be used to tailor the EMPs and Environmental Control Procedures as appropriate in future consultations with the villages and to inform the planning of the Safety and Environmental Awareness Programme. As a deadline of September 30th for eligible households to accept financial compensation in return for their land, as presented in their compensation offer, was approaching, the discussions were overwhelmed by village requests for an extension to this deadline, requests to postpone the Early Works until after the harvest, and requests for the MWMCL to protect the villagers' livestock from Project construction activities. Households were encouraged to agree to the land compensation terms by the deadline by the CSD Team as well as being presented with an updated 12-week Construction schedule and map.

Although information did come out of the consultations in Phase 2, the process of stakeholder engagement was less than satisfactory. The disclosure of the Early Works activities to the villages should have occurred much earlier, as it had been planned as early as April 2013, with more time allowed for digestion of the material, conferment

with Project technical staff on specific issues, and opportunities for villagers to express their concerns, receive feedback from the Project on specific grievances/queries, and make the necessary adjustments to their daily regime to manage any impositions/impacts from the construction activities (ideally with assistance from the Project). It would also have allowed for agreements to be made regarding deferment of planting of crops in the wet season.

The first blasting took place on October 9th, barely a week after the September 30th deadline and the disclosure of the Construction Schedule. The short notice given by the Company may have been perceived by the communities to be a forewarning of the upcoming construction works rather than a genuine effort to obtain informed feedback and broad consent.

After presenting the Construction Schedule in their respective villages, the CSD Team instructed the villagers to write down their concerns and drop them in the CRM box in the village. Only five (5) pieces of paper were received. This is not an unexpected outcome given the mood of the community and its focus on resolution of land compensation. The desire of MWMCL management to consult directly with the affected communities, particularly those who strongly opposed the Project, was hindered by refusal of entry into those communities and the lack of authority afforded to the company within the Product Sharing Contract to take on such a process. Even more worrisome is that it also creates the perception that the Company does not care about the well-being of the local people. This is damaging for the Company's reputation and may seriously put at risk not only the Company's "social license" to operate but its actual ability to operate.

6.6 OUTPUTS FROM THE VILLAGE CONSULTATIONS

A total of 6 outputs were produced as a result of the Phase 1 consultations:

- Issues identification and priority ranking of village needs;
- Financing proposal for FY2014 CSD Programme and subsequent financial commitments;
- Data collection for the socio-economic baseline analysis and report;
- Effectiveness Evaluation Record;
- Public Consultation and Disclosure Plan (PCDP); and
- Complaint Response Mechanism (CRM).

A major outcome of the Phase 1 consultations was a list of priorities identified by the villages, a ranking of the top three priorities (also done with village participation) and concrete follow-on actions to be taken by the Company corresponding to each priority.

The Requirement List for six villages is presented in Table 6.6.1 at the end of this report. This list is continually being updated together with the actions taken or proposed and justifications for decisions made.

The activities undertaken to identify practical and realistic community infrastructure projects in the designated villages led to the development of a financing proposal for the FY2014 (See Table 6.6.2 in the Tables Section at the end of this report). It should be noted that the Table does not contain all the villages and requires updating for the villages listed.

The proposed activities and budget for the FY2014 CSD Program is subject to the approval of MWMCL's Managing Director and the Sagaing Regional Government. An amount of USD 1 million has been preliminarily allocated for FY2014.

The third output from the Phase 1 consultations was the collection of information required for the socio-economic baseline data analysis, the results of which are presented in Section 4.11.

The fourth output was the implementation of a process to evaluate the effectiveness of the Public Consultation and Disclosure Plan (PCDP). It involves the completion of an Effectiveness Evaluation Record (EER) pertaining to a set period of time by the CSD Project Manager. The EER for the Phase 1 consultations was signed and approved on September 30, 2013 and is presented Table 6.6.3 at the end of this report.

While monitoring and evaluation of the public consultation activities is important and an integral part of the ESIA process, additional M&E tools need to be developed to supplement the EER. The EER also needs refinement in the area of indicator development. As is currently the case, the indicator defining achievement of the three conceptual goals related to the principles of free and informed participation is completion of the activity in the PCDP. This means that an activity is considered to be successful if it was completed or largely completed. The EER for Phase 1 was rated "largely achieved" because most of the activities were completed. While it is true that outputs were generated as a result of the public consultations, this in itself says nothing about the quality of the consultative process as perceived by independent evaluators.

The fifth output, the PCDP is problematic because there was little consultation on the Plan and the driver of the PCDP is Company management and Government and not the CSD Team in collaboration with the villages. It is doubtful the PCDP has broad based support and will likely need modification in line with the SMPs regulating stakeholder engagement and public consultation.

The sixth and final output of the Phase 1 consultations is the Complaint Response Mechanism (CRM) which serves as the chief mechanism for local persons and communities to express concerns about Project-related activities in an anonymous and confidential manner. A box for the collection of concerns has been placed in each of the 33 villages. The CRM needs to be developed further in terms of role definition, organizational responsibility, staffing, resourcing and training. Above all, it has to function as a true and effective mechanism for the fair and transparent consideration and redress of concerns and be perceived as such.

The main output from the Phase 2 consultations to date is the Issues Analysis matrix, which was based on the environmental-related issues raised in the village consultations in September and October 2013. From the Issues Analysis matrix, the MWMCL Village Environmental Awareness Program will be developed. (Table 6.6.4 for the Issues Analysis at the end of this report). The status of this report is not known.

6.7 ISSUES RAISED AND RESOLUTION

It appears that the CSD Team and Project community personnel are knowledgeable about the needs and priorities of the communities they visited in their consultations. These needs and priorities have informed the CSD Programme for 2014.

A less satisfactory outcome of the consultations is the lack of information collected on community concerns regarding the Early Works and the other Project activities required in the construction phase. The situation is made even more complex by the current stalemate between MEHL and the remaining 44% of land users yet to sign the compensation agreement and tensions resulting from the close proximity of the farmlands to the Early Works. A resolution is urgently needed to remedy the land acquisition issues and to improve and normalise broader Company-community relations. it is recommended, MWMCL should hire a team of dedicated and qualified Myanmar-based community mobilisers to lead the community engagement activities. This team should be skilled in appropriate public consultation techniques and just as importantly, trusted and accepted by the local communities. The team must be regarded as being fair and impartial and respectful of local traditions and opinions.

7. ENVIRONMENTAL AND SOCIAL IMPACT ANALYSIS

7.1 INTRODUCTION

The project will inevitably bring negative effects, particularly given that it occupies land currently used by others and that it makes permanent changes to that land in the development of the Project. MWMCL has undertaken to mitigate impacts to the maximum practical extent and to ensure no person in the area will be worse-off because of the Project implementation.

The Project will provide economic and social benefit to the local community and to the national economy. The Letpadaung area population is mainly comprised of subsistence farmers and the Project will bring opportunities for employment and developments in social, economic and health infrastructure.

7.2 ASSESSMENT METHODOLOGY

The impact assessment has been undertaken based on a risk-based approach using the consequence of the impact, its probability and its severity. The resultant risk matrix is included at Table 7.2.1 attached. These criteria are defined as follows:

1. Impact Significance

The significance of the impact is a product of the consequence and the probability that the impact will occur (impact significance = consequence x probability).

2. Consequence

The consequence of the impact is based on the severity of the impact and the extent over which it occurs [consequence = (severity +extent)/2]

3. Severity

The severity of the impact is the sum of its intensity and duration (severity = [intensity + duration]/2))

Where the consequence of an event is not known or cannot be determined, the “precautionary principle” has been adhered to and the worst-case scenario assumed.

Each criterion is given a rating (see Table 7.2.2 and Table 7.2.).

Table 7.2.2: Severity

INTENSITY = MAGNITUDE OF IMPACT	Rating
Insignificant: impact is of a very low magnitude	1
Low: impact is of low magnitude	2
Medium: impact is of medium magnitude	3
High: impact is of high magnitude	4
Very high: impact is of highest order possible	5
DURATION = HOW LONG THE IMPACT LASTS	**Rating**
Very short-term: impact lasts for a very short time (less than a month)	1
Short-term: impact lasts for a short time (months but less than a year)	2
Medium-term: impact lasts for the for more than a year but less than the life of operation.	3
Long-term: impact occurs over the operational life of the mine	4
Residual: impact is permanent (remains after closure)	5
EXTENT = SPATIAL SCOPE OF IMPACT	**Rating**
Limited: impact affects the immediate site only	1
Small: impact affects immediate site and surrounds	2
Medium: impact affects the entire project area	3
Large: impact affects an area greater than the site (including neighbouring areas).	4
Very Large: impact affects an area larger than the site and neighbouring areas.	5
Medium-term: impact lasts for the for more than a year but less than the life of operation.	3
Long-term: impact occurs over the operational life of the mine	4
Residual: impact is permanent (remains after closure)	5

Table 7.2.3: Probability

PROBABILITY = LIKELIHOOD THAT THE IMPACT WILL OCCUR	Rating
Highly unlikely: the impact is highly unlikely to occur	0.2
Unlikely: the impact is unlikely to occur	0.4
Possible: the impact could possibly occur	0.6
Probable: the impact will probably occur	0.8
Definite: the impact will occur	1

Table 7.2.4: Impact Significance

Negative Impacts		
≤1	Very low	Impact is negligible. No mitigation required.
>1≤2	Low	Impact is of a low order. Mitigation could be considered to reduce impacts. But does not affect environmental acceptability.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts. Mitigation should be implemented to reduce impacts.
>3≤4	High	Impact is substantial. Mitigation is required to lower impacts to acceptable levels.
>4≤5	Very High	Impact is of the highest order possible. Mitigation is required to lower impacts to acceptable levels. Potential Fatal Flaw.
Positive Impacts		
≤1	Very low	Impact is negligible.
>1≤2	Low	Impact is of a low order.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts.
>3≤4	High	Impact is substantial.
>4≤5	Very High	Impact is of the highest order possible.

Mitigation measures for all significant impacts have been identified as part of the impact assessment. The impacts have been ranked before and after the implementation of the mitigation measures. Consideration has also been given to the confidence level that can be placed on the successful implementation of the mitigation level by MWMCL:

- High Confidence: mitigation measure easy and inexpensive to implement;
- Medium Confidence: mitigation measure expensive or difficult to implement; and
- Low Confidence: mitigation measure expensive and difficult to implement.

The significance of the impact is given without and with mitigation. Consideration is given to the mitigation confidence when determining the potential to reduce the impact significance. If the mitigation confidence is low the impact is unlikely to be reduced and this is reflected in the assessment of the significance with mitigation. If the mitigation confidence is high the impact significance is reduced. If the confidence significance is moderate the impact significance may change based upon experience that the measure can be implemented.

7.3 AIR QUALITY

The Project will give rise to atmospheric emissions during the construction, operation and closure phases of the project. The key sources of such emissions are given in Table 7.1.

Table 7.1: Key sources of air quality emissions

Pollutant	Activity
Particulates	Earthmoving for construction of roads
	Land clearing activities such as dozing and scraping of vegetation and topsoil
	Vehicles and construction equipment activity on the unpaved roads during construction and operations
	Drilling and blasting of waste rock and ore
	Tipping of material onto dumps and stockpiles
	Conveyor transfer points
	Erosion from exposed WRDs, stockpiles and HLPs
	Primary and secondary crushing
Gases and particles	Emissions from vehicles
	Acid mist from HLPs

Air quality dispersion modelling was undertaken by Knight Piésold Pty. Ltd in September 2013 (Appendix K) for the project's construction and operation phases, taking into account the influence of changes caused by the dry and wet season (mainly wind speed and direction variations due to monsoon influence).

Considering the Project's extractive characteristics, dust emissions (PM_{10} and $PM_{2.5}$) have been inventoried. Of these emissions, PM_{10} was selected for modelling emission dispersion, given that it is seen as an air quality impact indicator for extractive open pit mining activities was considered the most relevant characteristic to be managed.

7.3.1 Construction Phase

During the construction phase, activities related to drilling and blasting, earthworks (topsoil removal, excavations and land grading), loading and unloading of materials by trucks, and light and heavy vehicle traffic on paved and unpaved roads will take place.

Table 7.2 shows the modelled PM_{10} concentration at sensitive receptors adjacent to the Letpadaung Project for the construction phase. Figure 4.10.4 shows the location of the receptors.

Table 7.2: Impact analysis of PM_{10} concentration – Construction phase

Receptor	Impacts of PM_{10} (µg/m^3)		Background concentration of PM_{10} (µg/m^3)(1)		Total PM_{10} (µg/m^3)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	1.5	13.3	11.3	14.3	12.8	27.6
Station 2	0.3	11.4	7.7	12.65	8	24.05
Station 3	2.2	21.4	7.8	11.4	10	32.8
Station 4	0.4	12.8	14.3	17.6	14.7	30.4
Station 5	0.2	3.7	20.0	22.3	20.2	26
Station 6	0.2	5.1	7.1	9.5	7.3	14.6
Station 7	0.1	1.8	15.0	19.2	15.1	21
Station 8	0.1	1.9	7.4	10.4	7.5	12.3
Monywa	0.2	11.9	-	-	-	-

Prepared by Knight Piésold

Notes:

(1) Results from air quality sampling

(2) Maximum 24 hour average concentrations

The modelled values are well below the IFC standard for PM_{10} concentrations which is 20µg/m^3 (annual mean) and 50µg/m^3 (24-hour mean).

7.3.2 Operations Phase

During the operation phase, activities related to drilling and blasting, earthmoving, material loading and unloading, heavy vehicle traffic on paved roads between the pit and the WRDs (haul roads), wind erosion of stockpiles at WRDs, unloading at semi-mobile crushers, materials crushing, ore handling, ore transfer to heap leach piles (HLPs), and vehicle traffic along paved roads will take place.

Table 7.3 shows the modelled PM_{10} concentration at sensitive receptors adjacent to the Letpadaung Project for the operations phase.

Table 7.3: Impact analysis of PM_{10} concentration – Operations phase

Receptor	Impacts of PM_{10} (µg/m^3)		Background concentration of PM_{10} (µg/m^3)$^{(1)}$		Total PM_{10} (µg/m^3)	
	Annual	24 hours$^{(2)}$	Annual	24 hours$^{(2)}$	Annual	24 hours$^{(2)}$
Station 1	2.3	33.3	11.3	14.3	13.6	47.6
Station 2	1.2	15.6	7.7	12.65	8.9	28.3
Station 3	2.7	29.3	7.8	11.4	10.5	40.7
Station 4	1.0	14.4	14.3	17.6	15.3	32.0
Station 5	0.8	19.2	20.0	22.3	20.8	41.5
Station 6	0.4	10.3	7.1	9.5	7.5	19.8
Station 7	0.1	6.6	15.0	19.2	15.1	25.8
Station 8	0.2	6.1	7.4	10.4	7.6	16.5
Monywa	0.3	6.1	-	-	-	-

Prepared by Knight Piésold

Notes:

(1) Results from air quality sampling

(2) Maximum 24 hour average concentrations

The modelled values are well below the IFC standard for PM_{10} concentrations which are 20µg/m^3 (annual mean) and 50µg/m^3 (24-hour mean).

Gaseous emissions from diesel equipment and light vehicles are expected to be low for both construction and operations. However, acid mist from the acid irrigation solution used on HLPs is considered to be an area of concern and requires careful monitoring and management.

7.3.3 Mitigation Measures

For the purposes of the air quality dispersion modelling, it was assumed that mitigation measures will be implemented including wet suppression of dust at ore handling points, haul roads and at crushers

Proposed mitigation measures to protect air quality include:

- Water sprays and chemical suppressants will be utilised to control dust on haul roads and access roads;
- A dust management plan will be prepared for the both the construction and operations phase;
- Blasting will take account of weather conditions, particularly wind direction;
- Planting of vegetative buffer zones to mitigate windblown dust;
- The use of drippers for dispersion of acid onto the surface of the HLPs;

- Adjustment of application rates to ensure no pooling of acid leach solution on the surface of the HLP;
- Adjustment of pumping pressure to ensure HLP drippers do not emit jets of solution;
- Minimum set back from HLPs of 350 m for villages;
- Consideration of wind direction and strength during operation of HLP irrigation system; and
- Checking of all irrigation pipework on HLPs to ensure no leakages.

7.4 NOISE AND VIBRATION

A noise and vibration survey was undertaken at the site and modelling was undertaken by Knight Piésold Pty. Ltd in September 2013 (Appendix K), taking into account the influence of changes caused by the dry and wet season.

7.4.1 Baseline Survey

For the purpose of characterizing the environmental baseline conditions of the Letpadaung Project, 10 noise stations were sampled during the dry and wet seasons of 2013, whose locations are shown in Figure 4.10.3. During the dry season, noise levels for the daytime period varied between 41.3 and 46.6 dB(A), while they varied between 41.5 and 46.3 dB(A) for the night-time period. It is important to point out that, except for the value determined for Station 3 during the night-time period, the remaining recorded values do not exceed international noise standards of 45 dB(A) night-time and 55 dB(A) for daytime, established by the IFC (2007).

On the other hand, values exceeding IFC standards were recorded during the wet season. These values range from 59.9 to 85.5 dB (A) during the daytime period, and from 66.7 to 74.6 dB(A) during the night-time period.

The criterion considered for assessing the results obtained at sampling stations close to vehicle traffic and built-up areas was the one established by the OECD (Organisation for Economic Cooperation and Development). This standard considers a value below 65 dB(A) to be an acceptable noise level for the daytime period, and a value below 55 dB(A) to be acceptable for the night-time period.

Noise and vibration modelling was undertaken for daytime and night-time to determine the level of impact on sensitive receptors adjacent to the Project.

7.4.2 Daytime Results

Table 7.4 outlines the results of noise modelling for the prediction of daytime noise impacts at sensitive locations adjacent to the Project.

Table 7.4: Assessment of noise modelling results for operation phase - Daytime

Location	Predicted Noise Contribution dB(A) (1)	Background noise dB(A)(2)		Total noise dB(A)(3)		Standard dB(A)
		Dry season	Wet season	Dry season	Wet season	
Station 1	53.2	42.2	67.5	53.5	67.6	65 (4)
Station 2	51.7	42.8	72.9	52.2	73.0	65 (4)
Station 3	48.4	44.7	59.9	50.0	60.2	55 (5)
Station 4	16.5	46.6	66.5	46.6	66.5	55 (5)
Station 5	52.1	43.9	75.4	52.7	75.4	65 (4)
Station 6	16.5	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	43.2	42.2	67.9	45.7	67.9	55 (5)
Station 9	Not perceptible	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Prepared by Knight Piésold

(1) Results from noise modelling using SoundPLAN v. 7.2

(2) Results from noise quality sampling for environmental baseline.

(3) Total noise = background noise + predicted noise level.

(4) Acceptable standard for Leq < 65 dB(A) according to OECD.

(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

7.4.3 Night-time Results

Table 7.5 outlines the results of noise modelling for the prediction of night-time noise impacts at sensitive locations adjacent to the Project.

Table 7.5: Assessment of noise modelling results for operation phase – Night-time

Location	Predicted Noise Contribution dB(A) (1)	Background noise dB(A) (2)		Total noise dB(A) (3)		Standard dB(A)
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	45	46.3	67.9	48.7	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	28.5	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	Not perceptible	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Prepared by Knight Piésold

(1) Results from noise modelling using SoundPLAN v. 7.2

(2) Results from noise quality sampling for environmental baseline.

(3) Total noise = background noise + predicted noise level.

(4) Acceptable standard for Leq < 55 dB(A) according to OECD.

(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

The largest increases of noise were observed for station 1, 2 and 5, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Vibration levels from blasting were modelled and ranged from 0.2629 mm/s at the nearest receptor approximately 2.5 km from the blast area to 0.0032 mm/s at a receptor 9.5 km from the blast area. IFC does not have a standard for vibration associated with community health. The ANZEC (1990) guidelines[42] for ground vibration suggests the adoption of a standard of 5 mm/s for 95% of all blasts with no blast to exceed 10 mm/s.

7.4.4 Mitigation Measures

The noise impacts of the project have been predicted without the presence of acoustic barriers. The WRDs to the east, west and south of the pit can be utilised as acoustic barriers.

42 Australian and New Zealand Environment Council (ANZEC). Technical basis for Guidelines to Minimise Annoyance Due to Blast Overpressure and Ground Vibration. September 1990.

Proposed mitigation measures to protect sensitive receptors from noise and vibration include:

- Schedule waste dumping away from sensitive receptors during night-time operations;
- Limit the extent of other noisy activities, as far as possible, during night-time operations;
- Monitoring of noise levels near sensitive receptors;
- Install acoustic barriers to reduce noise in sensitive areas;
- Management of blasting (timing/size); and
- Notification of receptors regarding blast times.

7.5 GROUNDWATER

7.5.1 Groundwater Supply

It is expected that the groundwater ingress into the mining open pit will be significant and is estimated at between 26 and 116 litres/second[43]. A significant proportion of this flow will be later in the mine development when the main eastern pit ramp of the Stage 2 pit intersects the alluvial plain. If the pit was re-shaped to avoid cutting the alluvium this would reduce to 37.4 L/s. Inflow from the alluvium should be intercepted as it enters the pit prior to the water being affected by ARD deeper within the pit.

It is likely that the change in the groundwater flow into the open pit could affect community groundwater wells.

7.5.1.1 Mitigation Measures

Proposed mitigation measures to prevent contamination of groundwater supply include:

- Monitoring bores to be established in the community, in order to monitor change in water levels at water supply points;
- Monitor water levels on a quarterly basis; and
- Identify potential alternative water sources if local wells are significantly impacted.

7.5.2 Groundwater Contamination

Mining and processing activities will generate acidic solutions that can contaminate groundwater. In particular the heap leaching process and WRDs are significant potential sources of groundwater contamination. Other sources of contamination are

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[43] NFMKSDI, 2011

hazardous chemicals such as hydrocarbons and chemical reagents, and waste material.

Geochemical sampling was undertaken in 2013 to evaluate the chemical composition of the waste rock that will be produced during the mining process and the potential for ARD. The primary conclusions from the geochemical study (Knight Piesold, August 2013 Appendix J) are:

- The waste rock samples were primary composed of quartz, clay minerals with a relatively high amorphous content. The main sulfide mineral in the waste samples was pyrite with trace chalcopyrite;
- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents;
- The Net Acid Generation test resulted in 96 samples producing acidic conditions, with the number of samples producing acid increasing with depth;
- Overall, 29% of the waste samples can considered as NAF, with the remaining 71% considered PAF. Of the NAF material identified, almost all of the material leached metals when contacted with water;
- The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metal leaching from both the PAF and NAF material; and
- Based on the results of the testing, active management of the potentially acid generating materials will be required.

The acid and metals generation arising from waste rock is an extreme environmental risk to groundwater in the Project area.

7.5.2.1 Mitigation Measures

Proposed mitigation measures to prevent groundwater contamination include:

- Full compliance with EMP's, particularly those for groundwater contamination, acid rock drainage, metal leaching and waste dumps;
- Monitor groundwater quality in the proximity of potential pollution sources;
- Compacted clay liner with HDPE liner for the HLPs and any ore stockpiles to further reduce the risk of contamination from these sources;
- Seepage management systems for stockpiles and HLPs;
- Compacted clay liner for the WRDs to further reduce the risk of contamination from this source;

- Establish material availability for liners and capping material for WRDs;
- All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater;
- Monitor groundwater quality in the proximity of potential pollution sources;
- Facilities engineered to good international practice for the protection of groundwater are to be constructed on site for the disposal of general waste/hazardous waste;
- Bio-remediation facility to be implemented for hydrocarbon contaminated soils; and
- Temporary waste storage facilities to be engineered to prevent seepage of contaminants from such sites.

7.6 SURFACE WATER

Surface water issues arise from commencement of construction through the life of the project and beyond closure.

7.6.1 Loss of Catchment Yield

Downstream of the Project, surface water flowing to dams from local creeks is used primarily for subsistence agriculture, domestic purposes and livestock watering. The loss in yield associated with the Project will result from the containment of run-off from dirty areas and changes to surface hydrology.

7.6.1.1 Mitigation Measures

Proposed mitigation measures to prevent loss of catchment yield include:

- Reserve determination for the downstream users to be conducted and water supply to the catchment to be managed to ensure that the water requirements are met; and
- Installation of alternative water supplies.

7.6.2 Water Quality

Water will be collected or harvested from the following areas:

- Open pit in the form of groundwater ingress and rainfall from the pit area itself;
- Run-off and seepage from the WRDs and stockpiles;
- Run-off from the HLPs; and
- Run-off from hardstand areas around the processing plant and workshops.

Run-off from the WRDs and stockpile areas and the pit water can be expected to have a low pH, high level of soluble metals and high suspended solid content. The acid and

metals generation arising from waste rock is an extreme environmental risk to surface water in the Project area and the water potentially discharged from the Project area.

All potentially contaminated waters will be harvested and pumped to the WWPs for use as process water during the operation phase of the Project. However, beyond closure these waters need to be contained within their respective structures and sealed in a manner that does not allow seepage from the containment. Failure to heed this requirement, from commencement of construction of these facilities, will leave a residual risk and legacy beyond closure of the operation.

Other potential surface water contaminant sources include spillages of hydrocarbons and chemicals from workshops and storage areas, spillage of chemicals from the process plant and leakage from pipes. Measures will be put in place to contain such spillages and prevent them from entering into any natural run-off area.

7.6.2.1 Mitigation Measures

Proposed mitigation measures to protect water quality include:

- Proper classification of waste rock prior to mining to enable location of the rock in appropriately prepared containment structures;
- Diversion of clean water around potential contaminant sources including the pit, WRDs, plant area and HLPs;
- The containment of water collected from areas with potential contaminants (including suspended solids) including the open pit, the WRDs, the pit area, HLPs, process plant and the workshops. This water is to be re-used;
- All diversion and containment measures are to be designed to accommodate the 1 in 100 year peak flow event and dirty water management measures are to be designed to have a risk of spill of 1% or less in any 1 year;
- All chemicals, reagents, hydrocarbons (fuel, greases, and oils) are to be stored in bunded areas, sized to contain spills;
- Oil interceptors and sediment traps will be installed and maintained to ensure any discharge to the environment carries a low sediment load;
- Storm water management drains and ponds will be maintained and kept clean in order to ensure that the capacity of such systems is not compromised during the life of the operations;
- Correct design of HLPs to reduce risk of slope failure; and
- Development of procedures to clean up uncontrolled release of HLP materials.

7.7 GEOCHEMISTRY

Geochemical sampling was undertaken by Knight Piesold in August 2013 (Appendix J) to evaluate the chemical composition of the material that will be produced during the mining process for heap leaching and waste. The primary conclusions from the geochemical study are:

- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents;
- The Net Acid Generation test resulted in 96 of 150 samples producing acidic conditions, with the number of samples indicating acid increasing with depth;
- Overall, 29% of the waste samples can considered as NAF, with the remaining 71% considered PAF. Of the NAF material identified, almost all of the material leached metals when contacted with water;
- The multi-element analysis indicated the majority of the material to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metal leaching from both the PAF and NAF material; and
- Based on the results of the testing, active management of the potentially acid generating materials will be required.

7.7.1 Open Pit

The open pit will generate ARD during operation and post closure. Rock exposed in the pit walls has the potential to produce low-pH and/or metal-contaminated run-off water once it is exposed.

7.7.1.1 Mitigation Measures

Mitigation measures for the control of ARD and metal leaching in the open pit include:

- During operations, run-off from the in-pit waste dump and more generally from within the pit area, will be collected and pumped to the WWPs for use in processing;
- Specialised in pit mine waste disposal to ensure that pit water quality is acceptable and that it is hydraulically contained;
- On closure the pit will be flooded and water levels managed such that the waste rock and rock within the pit walls that has the potential to produce acid or leach metals remains submerged in perpetuity;
- Water levels will also be maintained at a level lower than the surrounding groundwater table to reduce seepage of contaminated water from the pit lake

into groundwater, thus finished waste rock levels in the pit should not exceed three (3) metres below that level in the pit; and

- After closure, pit water shall be monitored quarterly and results compared to IFC standards quoted in Section 8.2.2 – Surface Water and 8.2.5 – Groundwater Contamination.

The water quality of the pit water will continue to degrade with the addition of acid and metaliferous leachate. However, if it is contained within the pit and does not seep into groundwater or surface water, the environmental impacts are not highly significant.

7.7.2 Heap Leach

The HLPs will be operated throughout the life of the mine with low-pH and high metal concentration leachate managed through the SW/EX plant. ARD and metals leaching are not issues during the operational phase.

From closure, the drawdown of the HLPs and any ongoing infiltration/ percolation will generate ARD and metal-rich leachate for many years.

7.7.2.1 Mitigation Measures

- All leachate produced by the HLPs will be collected and passed through the SX/EW plant and treated to render it acceptable for release to the environment;
- At closure, the HLPs will be capped with a very low permeability soil or geosynthetic cover system to reduce water ingress;
- Passive seepage management systems for stockpiles and HLPs;
- Connection of seepage management system to surface water management system;
- Monitor groundwater quality in the proximity of the HLPs; and
- Adoption of closure batter slopes for long term stability.

7.7.3 Waste Rock

Approximately 946 Mt of waste rock lies within the mining boundary, of which 256 Mt will be mined from the 20th year of production and disposed of through in-pit dumping. The balance of 690 Mt of waste rock will be dumped outside the open pit in three WRDs.

Testing will need to be conducted on grade control and blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones and allow selective handling of each of these wastes so they can be placed in specific areas of the waste dump.

7.7.3.1 Mitigation Measures

The waste rock will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Mining practices are established which allow definition of the PAF and NAF waste in the field and allow for selective mining and placement of the material;
- Preparation of the foundations below all WRD areas to prevent contaminant seepage into the soil;
- Placement of a layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps to act as a buffer between the PAF waste and the foundation material at the base of the dump;
- All PAF waste is placed in lifts of no greater than 6.25 m in height to eliminate segregation of the waste which could lead to accelerated acid generation;
- All waste be encapsulated during operations with an engineered cover comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The encapsulation material will need to be covered by benign waste or borrow material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the cover;
- Borrow areas for the encapsulation material be identified and samples of the proposed cover material be collected for geotechnical testing to allow detailed design of the cover system;
- Geotechnical testing be conducted during construction of the cover system to ensure that the cover system is constructed to the design specification;
- Geochemical monitoring of the cover system, comprising oxygen sampling points and thermistors, be conducted to allow the performance of the cover system to be verified during operations;
- A water management system be designed and constructed to prevent clean water from entering the waste dump area and to collect potentially contaminated water and direct this to a suitably designed water storage facility;
- Ongoing monitoring of the waste dump, encapsulation layer, cover system and drainage water will be required post closure until the integrity of the structure can be certain; and
- Should the drainage waters be found to be of an unacceptable quality, they will either need to be treated prior to release or contained.

It may be possible to direct seepage waters to the open pits on closure; however, this would require detailed hydrological, hydrogeological and geochemical modelling to

determine whether off-site downstream groundwater or surface water resources would be impacted. The management of waste rock to minimise ARD and metal leaching is a crucial component of the Project and failure to do it adequately will seriously damage the environmental credibility of the Project.

7.8 SOILS

The soil groups within the Letpadaung area as described in Section 4.8 are of key importance when considering the impacts on soil and soil conservation. Two soil groups exist in the area:

- Letpadaung Hills - comprised deeply weathered profiles, with only minor bedrock being encountered, mainly along the hill crests; and
- Plains Around the Letpadaung Hills - the soils around the Letpadaung Hills grade from sandy materials close to the hills to fine grained soils near creeks and the Chindwin River. The undisturbed soils on the plains are near-neutral to slightly alkaline, non-saline and very low in organic matter (based on Muir (1997) results). They are also nutrient and zinc deficient but contain normal levels of copper and manganese.

The key impacts on soils and possible mitigation measures associated with the proposed mining activities include:

7.8.1 Sterilisation of Soil Resources

The development of infrastructure required for the Project will result in the sterilisation of soils within the footprint areas. Key activities that will impact on soils are the preparation of areas for the development of the open pit, waste rock dumps, heap leach pads, stockpile and loading areas, development of haul and site roads, founding excavations for the processing plant infrastructure, construction of buildings and the excavation of material for water storage ponds.

7.8.1.1 Mitigation Measures

All utilisable soil is to be stripped from footprint areas prior to construction or development and stockpiled as berms or low profile dumps of no more than six (6) metres high. Soil stripped from areas that will require rehabilitation at the end of the construction phase will be placed in berms adjacent to areas that will require rehabilitation. Soils will be separated in accordance with a soil utilisation plan and stockpile locations and volumes noted. Stockpiling of soils in close proximity to areas where the soil is required for rehabilitation limits the handling of such soils and reuse of the soil in the appropriate areas.

7.8.2 Soil Contamination

Mining activities include the storage and handling of hazardous chemicals including hydrocarbons and chemical reagents. Spillage or leakage of these materials may make soils unsuitable for vegetation establishment. Containment measures (e.g. bunds and impervious materials) are to be put in place where such materials are stored or handled during the construction and operational phases to prevent the release of such chemicals into the soil environment.

7.8.2.1 Mitigation Measures

Proposed mitigation measures to prevent soil contamination include:

- All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater;
- Monitor groundwater quality in the proximity of potential pollution sources;
- Low permeability compacted soil /liner for WRDs and HLPs;
- Collection of contaminated run-off;
- Effective in-pit waste delineation plan;
- Application of mine waste management plan to reduce ingress of water and air in order to prevent ARD;
- Immediate clean up of spillage;
- Maintenance of plant infrastructure to prevent leaks and spills; and
- Design and placement of long term cover over WRDs.

7.8.3 Soil Erosion

Exposed soil surfaces are prone to erosion by wind and storm water run-off. Long-term stockpiles established for the operational and closure phases of the Project are to be provided with storm water diversion measures. Soil stockpiles are to be restricted in height to avoid compaction and damage to seed banks.

7.8.3.1 Mitigation Measures

Proposed mitigation measures to prevent soil erosion include:

- Long-term stockpiles are to be progressively re-vegetated to allow for stability of surfaces;
- Stockpiles not to exceed six (6) metres in height;
- Storm water to be diverted around long-terms stockpile areas; and
- Development of an erosion and sediment control plan.

7.9 BIODIVERSITY

Much of the area to be disturbed by the Project has been drastically transformed through long periods of agriculture and fuel wood removal. The composition of the

aquatic environment shows modest levels of organic pollution but there are no severe anthropogenic impacts.

The Project does not pose any fatal flaws in relation to biodiversity as there does not appear to be any conflicts with international conventions, treaties, protocols or national legislation related to biodiversity. However, impacts are to be reduced by ensuring that sensitive areas are avoided where practicable and appropriate levels of environmental management are exercised.

7.9.1 Loss of Habitat

Most of the native woodland on the Letpadaung Hills has been removed for firewood. However, small remnant woodland exists that can be protected and rehabilitated. The remnant areas of vegetation offsite are proposed to be established as 'conservation' reserves. There are also proposals to enhance the quality of the vegetation in these and other areas around the Project area such that a total of 320 ha of vegetation will be retained in the 'reserved' areas and a further 160 ha of border plantings will be established around the site.

As part of the early works for the Project it is proposed to fence some areas of remnant vegetation and plant additional tree and shrub species (Figure 7.9.1). In addition there will be planting and management of buffer areas around the site boundary and within the site.

7.9.2 Loss of Aquatic Life

The following consequences of the proposed development are likely to have an impact on aquatic life.

7.9.2.1 Change in Water Quality

Any changes in water quality can affect sensitive aquatic invertebrates. Accidental spills of pollutants could enter streams either directly or through surface water run-off. Such impacts on water quality will be of short duration especially on fish and aquatic invertebrates.

Vegetation clearance and mine pre-stripping may mobilise large quantities of sediment that may enter in to the surface water environment, particularly during rainfall events even though extensive silt traps will be installed. The increased turbidity in the river is expected to have a minimal impact as a result of the short-duration and also the existing clay-sandy soils that occur in the Project area that already provide a large sediment load.

The ecological implications of pollutants seeping from waste storage sites such as the WRDs are difficult to define but they could be significant. Seepage and runoff water from the WRDs are expected to be acidic and mobilisation of metals is thus likely.

The release of domestic wastewater into natural systems tends to elevate the nutrient levels as does nitrate residue that originates from blasting. All wastewater generated in the Project will be treated through sewerage treatment to minimise eutrophication of surface waters and impact on aquatic life.

Mitigation measures for surface water quality are outlined in Section 7.6.2.1.

7.9.3 Loss of Ecological Services

The development and operation of the mine will result in loss of firewood resources of the Letpadaung Hills and loss of some species of flora used for traditional food and medicines. The increased population associated with the mine could also result in added pressure on existing supplies of these resources.

It is proposed to prepare a natural resources management plan to outline measures to develop new or alternative sources of fuel and traditional food/firewood.

7.9.4 Proliferation of Alien Vegetation

Disturbed areas are usually colonised naturally by invasive, pioneer plants. Should these pioneers be alien invasive species, the disturbed areas become nodes of seed production for these unwanted plants. These species tend to replace indigenous species and reduce habitat diversity. The long-term impacts are the loss of both plant and animal diversity.

7.9.5 Proliferation of Disease Causing Species

Mining activities are likely to increase the prevalence of pest species. Of particular concern is the increase in the species that result in malaria and other mosquito borne diseases. These diseases are promoted by an increase in the presence of standing water that will result due to the implementation of the mining infrastructure.

7.9.6 Loss of Plant Productivity

High levels of dust fallout results in reduced plant production as a result of clogging stomata in the leaves. The impact is likely to be most prevalent in close proximity to dust sources (i.e. within the Project area). Since the habitat is transformed, the impact is not considered to be of significance.

7.9.7 Mitigation Measures

Proposed biodiversity mitigation measures are generally discussed in preceding sections relating to water quality, soils, water quality and air quality. Specific additional measures include:

- Preparation of a weed management plan;
- Tree planting; and
- Preparation of a community health and safety management plan that includes measures to combat mosquito borne diseases.

7.10 TOPOGRAPHY

The development of the Project will result in a permanent impact on the topography. Key contributors to changes in the landscape character include:

- Excavation of the open pit to a depth of 450 m;
- Development of water storage ponds;
- Development of the waste rock dumps (125 m to 150 m high); and
- Development of the heap leach stacks (80 m high).

The backfilling of the Section 1 pit is proposed but not Section 2. Mine planning will investigate the backfilling of Section 2 or flooding of the pit to produce a lake. Site rehabilitation at closure will reduce and mitigate topographical impacts by contouring to resemble the surrounding landscape.

7.11 CULTURAL HERITAGE

Cultural heritage impacts occur predominantly in the construction phase, because land clearance and other intrusive activities are required to prepare the site and build Project facilities. The Cultural Heritage Baseline Study has already identified the stupa situated in the valley of Letpadaung Taung as having religious, historical and cultural significance to local communities, and two monasteries are known to be situated in the Project footprint. In the operations phase, development of the open pit, waste rock dumps, soil stockpiles, dams and HLPs may also disturb cultural sites, but the likelihood of encountering any chance finds or hidden archaeological sites is very low as the Project area would have been cleared and surveyed in the construction phase.

7.11.1 Mitigation Measures

Proposed mitigation measures to minimise disturbance to the cultural sites at the site are:

- A site survey has been conducted to accurately map and identify all cultural sites prior to the commencement of construction activities;

- Sites will be relocated in accordance with legislative requirements and in consultation with community stakeholders;
- A Phase II survey will be undertaken for the excavation and documentation of all sites to be disturbed; and
- Only sites in Project footprint areas are to be disturbed, sites located outside the footprint are to be mapped, demarcated and protected.

7.12 SOCIO-ECONOMIC IMPACTS

The activities required to build and operate the mine are likely to impact local residents and Company personnel both positively and negatively. The more frequent the exposure of a person or group to a Project activity, the higher the likelihood the person or group will be affected by the activity. Communities and residents living near the Project boundary are therefore more likely to be adversely affected by many Project activities. The impact assessment does not take into account the cumulative effects of Project activities on affected persons and groups, but it is an important aspect to bear in mind.

7.12.1 Resettlement

The four (4) communities to be relocated from within the Project site are potentially highly impacted by the Project activities in the construction phase because the loss of land can threaten their ability to survive if replacement measures are not put in place, especially in the transitional period. The loss of land by members of the community who live outside the Project Area can also significantly impact their livelihood and ability to survive if they do not have alternative sources of food or income.

7.12.1.1 Mitigation Measures

The Project proposes the following mitigation measures to support relocated persons, households and communities and those who have had their land acquired:

- A retrospective Resettlement Action Plan (and associated Grievance Mechanism) will be developed in consultation with affected communities in line with good practice (The Plan includes management of resettlement issues through the closure phase);
- Entitled relocated households will receive compensation at the market replacement value of the land acquired; and
- Every eligible relocated household will receive a minimum of one (1) job placement at MWMCL. The Company will provide other assistance to those families who do not meet the eligibility criteria for employment and/or fully reliant on farming.

7.12.2 Reduced Access to Land for Agriculture and Traditional Livelihoods

Local residents and previous land owners will no longer be able to use the land within the site boundary for farming and wood and herb collection important for sustenance and heating. The lower availability of resources requires residents to travel longer distances in search of suitable land, fuel supplies and medicinal plants. The scarcity of supply may also become a source of conflict among residents and communities.

7.12.2.1 Mitigation Measures

The Project proposes the following mitigation measures:

- Development of a Community Natural Resource Management Plan;
- Development of the non-farming sector; and
- Provision of alternative fuel sources.

7.12.3 Disruption of Leadership Structures and Associated Community Tension

The relocation of the four communities will affect the size and composition of the communities, with amalgamation of Zidaw/Sede and Wetme/Kandaw, and the integration of those households refusing to move into their respective communities at the new sites. Such changes may produce community tensions as traditional leadership structures are modified in response to the new environment. Migrant populations may also result in disruption of existing social structures with persons from outside areas not respecting the traditional leadership structures of the community.

7.12.3.1 Mitigation Measures

The Project proposes the following mitigation measures:

- Leadership structures will be addressed in the RAP using appropriate community consultation; and
- MWMCL will support the new leadership structures that have the broad support of the communities.

7.12.4 Influx of Persons into the Area

Persons from outside Saigaing Region will be attracted to the area in the hope of receiving employment at the Project. The immigration of persons into the area places pressure on social structures, land availability, housing, social amenities (schools, clinics, water supply), natural resources (water and wood) and thus has an indirect negative impact on the Project. Migration influx needs to be curtailed and managed. Currently persons aspiring to take up residence in a village require approval from the Village Administrator.

7.12.4.1 Mitigation Measures

The Project proposes the following mitigation measures:

- The Company will support local leadership in managing migration influx;
- Preference for employment places will be given to local persons;
- There will be no ad hoc hiring on site;
- The Company will communicate its employment policies widely to discourage potential job seekers; and
- The Company will provide camp accommodation and transport for persons hired from outside the local area.

7.12.5 Increased Safety Risk to Road Users

Traffic to and from the Letpadaung Copper Mine will travel on paved and unpaved roads from Pakoku, Salingyi, Kyadet, Lingadaw, Monywa, and Yesago to an access road linked to the site. The access route passes through villages, including schools and markets. Livestock also cross the road.

Construction and operational traffic for the Project and increased population will substantially increase the number of heavy trucks and cars along the access road and this will pose a risk to current road users.

7.12.5.1 Mitigation Measures

The Project proposes the following mitigation measures to be implemented in all phases of the Project:

- The access route to the site will be upgraded in accordance with the Project proposal;
- A traffic safety awareness program will be put in place for communities situated along the access road;
- Warning signage will be placed along the route;
- Fencing will be erected adjacent to the schools along the route from Pakoku and exit/entry points will be clearly demarcated;
- Training of transport drivers;
- Use of safe and serviced vehicles only;
- Promotion of road safety;
- Drug and alcohol testing of drivers; and
- Restricted working hours for drivers and adequate rest breaks.

7.12.6 Increase in Social Problems Resulting from Exposure to New People

The influx of persons into the area including those employed at the mine may be expected to increase the proliferation of social ills. Of concern is the increase in the incidence of disease. Increased interaction between persons can enhance the spread of communicable diseases especially sexually transmitted infections (STI), including

HIV and AIDS. Incidences of malaria and tuberculosis can also expect to increase should there be an increase in population density.

This will be exacerbated by the presence of large numbers of workers, especially during the construction phase of the Project. The circulation of money encourages the occurrence of commercial sex workers further increasing the risk of the spread of disease. The presence of money also can lead to increased occurrence of alcohol abuse.

Other social ills associated with the influx of persons include an increase in the incidence of crime also encouraged by the presence of money. The nature of the criminal activities may change and become more sophisticated, placing pressure on local policing services.

The exposure of communities to transient populations and new technologies, as they become more accessible from the presence of money, may bring about changes in societal norms and values from traditional approaches to more modern approaches. This may produce rifts between the older generation and the younger generation and between men and women who may adopt a different set of expectations and values from each other in response to new opportunities arising from employment and/or skills enhancement and almost certainly in response to large amounts of cash available as a result of lump sum compensation payments and wages.

Over time, it is possible that the presence of money circulating in the local and regional economy, as a result of population increase and employment at the mine, has the unintended effect of driving up the cost of goods and services. This may in turn widen the gap between the rich (those employed at the mine) and the poor (everyone else).

7.12.6.1 Mitigation Measures

The Project proposes the following mitigation measures to be employed in all three project phases:

- The RAP will address a sustainable mechanism for delivering cash benefits (or their equivalent) to the local communities in a manner which will least disrupt the local economy and encourage household saving and investment;
- MWMCL will support local policing structures, as appropriate;
- The Company will develop and enforce an STI Educational Policy on all contract workers;
- MWMCL, in collaboration with government, will conduct an integrated community awareness plan;
- MWMCL will implement the In-Migration Management Plan;

- MWMCL will continue to support local health centres and will supply free condoms;
- Sanitation facilities will be provided and upgraded in the local communities;
- Accommodation camps will strictly enforce a code of conduct; and
- MWMCL will commit to the development of industry and micro-finance initiatives in the non-mining sectors so as to lessen economic inequality and reduce poverty.

7.12.7 Increase in Workplace Injuries

The incidence of workplace injuries and death is likely to be higher in the construction phase as a result of the relatively large number of unskilled workers and contractors required for land clearance and the building of Project facilities. Workplace injuries and deaths are a concern in Myanmar in light of ubiquitous acceptance of practices considered in the west as being "risky," and the absence of legislation and safety codes and their enforcement. As a result, mitigation measures are required in all phases of the Project.

7.12.7.1 Mitigation Measures

The Project proposes the following mitigation measures to reduce the incidence of workplace injuries and death:

- All employees and contractors will receive induction training;
- Training on safety will be tailored to meet the linguistic and educational needs of the workers;
- For certain occupation and tasks, hours will be restricted to reduce fatigue; and
- An Occupational Health and Safety Management System will be developed and implemented.

7.12.8 Proliferation of Disease Causing Species

The presence of standing water in the operations phase will attract mosquitoes and thereby contribute to the spread of malaria and bilharzia. Measures to limit the spread of malaria and bilharzia include the management of standing water, prohibitions on swimming, mosquito nets and repellent and public awareness programs will be implemented during operations.

7.12.9 Increased Safety Risks

Project activities in the operational phase may increase the safety risk to workers and local populations in close proximity to the waste dumps due to fly rock from blasting, HLP/WRD rockfalls or land slips, explosion of hazardous/flammable materials and bush fire. These risks continue to be germane in the closure phase along with the increased

safety risk arising from the collapse of the pit's walls and from local people and livestock falling into the pit.

7.12.10 Mitigation Measures for the Increased Safety Risks

The Project proposes the following measures to mitigate against safety risk due to:

Fly rock from blasting

- Enforcement of the blast exclusion zone;
- Blast design; and
- Blast warning system.

HLP/WRD rockfalls or land slips

- Slope monitoring
- Safety setbacks from roads and villages;
- Exclusion of non-essential personnel and the general public;
- Batter slopes designed with acceptable factors of safety;
- Monitoring and inspection of waste rock dumps; and
- Adoption of closure batter slopes for increased stability.

Explosion of hazardous / flammable materials

- Construction of blast walls and bunding;
- Internal fire suppression systems;
- Separation distances for the explosives magazine; and
- Segregation of incompatible hazardous materials.

Bush fire

- Installation of fire suppression systems on items of large equipment
- Monitoring of tyre temperatures to guard against tyre fires
- Public awareness campaigns; and
- Strict enforcement of OHSM policies and procedures.

Pit

- Restrict access through the installation of 2 m bund wall around the full pit perimeter outside the area of potential future instability; and
- Install warning signs.

7.12.11 Loss of Employment at Closure

The decommissioning of the mine will have a direct impact on employees and contractors who will certainly lose their jobs and an indirect impact on the suppliers of goods and services in the support economy, particularly small businesses fully

dependent on supply orders from the mine. The closure of the mine, if not managed properly, may contract the local economy and plunge local people into poverty. Mitigation measures to absorb mine workers into other industrial sectors will be employed. These along with the regional and local capacity developed by the Company's training programs and infrastructure investments will hopefully provide alternative income-earning opportunities that will offset the loss of employment with the mine.

7.12.11.1 Mitigation

The Mine Closure Plan shall include consideration of activities which will develop alternative economic opportunities progressively through the mine life to reduce dependence on the mine-induced economy at a local level.

7.12.12 Reduced Access to Land for Agriculture and Traditional Livelihoods at Closure

There is the possibility that the rehabilitated WRD and HLPs will be unsuitable for grazing and other uses by the local community as a result of damage to the capping system from people and livestock.

7.12.12.1 Mitigation

In development of the Mine Closure Plan, the local community shall be consulted to agree a suitable end land use for the various landforms within the site and the design of the closure plan will take into account the agreements with the community and a cost provision will be made to account for those end land uses.

7.12.13 Socio-economic Benefits

The Project will have an economic benefit for the local population. MWMCL is committed to the employment of local persons and will give preference to eligible households who were relocated or lost land as a result of Project activities. The community will benefit from the presence of the mine, especially in the operational phase when local workers will gradually replace ex-patriate workers. MWMCL plans to develop and diversify the local skill base away from farming through the provision of training programs, demonstration projects, and microfinance.

Employment on the Project site will have an indirect injection of money into the local economy, with persons working on the Project spending some of their wages in the local area. This in turn will encourage business activities supplying goods to such persons.

There will also be a need to provide goods and services to the Project and local entrepreneurs will position themselves to meet this demand. MWMCL will adopt a strategy to foster growth in local businesses through the use of training, microfinance

and other commonly used mechanisms to develop a support economy. This will facilitate the volume of local procurement and improve access to markets.

In the construction phase, the new villages will be equipped with improved community infrastructure (a communal drinking point and proper sanitation facilities). All locals will benefit from the upgrading of roads and the upgrading of the bridge over Yamar Stream. The mobile health clinic will continue to service the villages and additional health clinics are to be built, staffed and equipped to increase the local population's access to basic health care.

In the operational and closure phases, the Project partners will continue to improve the provision and quality of medical services in the surrounding communities by scaling up its financial investment. The infrastructure in the new villages will be maintained and upgraded. Community and social infrastructure will continue to be built and maintained from the sub-projects and grants financed by the Corporate Social Responsibility Program. Much will depend on the joint commitment of the Project partners and the governments to improve local housing standards and continue to develop the infrastructure in the Sagaing Region from the Project proceeds.

Economic benefits to the regional economy will depend on the ability of local and regional businesses to provide a sufficiently high volume of goods and services to the Project. Efforts to develop the governance capacity of local government are anticipated in this phase to facilitate and maximise the potential for business development and job creation, and to provide Government with the tools to effectively govern after decommissioning.

8. ENVIRONMENTAL MANAGEMENT PLANS

This section provides a series of outline Environmental Management Plans (EMPs) that are based on the findings of an impact analysis using a risk-based methodology for determination of significance, as described in Section 7 – Impact Analysis. The EMPs also address issues raised in the Community Consultation and reported in Section 6.

The EMPs are designed to lead the development of an Environmental and Social Monitoring Plan (see Section 10) and for expansion into the EMPs within the Environmental and Social Management System for the Letpadaung Copper Project.

The EMPs draw on recognized industry standards wherever possible, in the absence of specific environmental quality standards in Myanmar.

8.1 AIR QUALITY

The EMPs relating to air quality address the ambient air quality, dust as a specific element within the total suspended solids (TSP), acid mist and greenhouse gases through consideration of energy efficiency. Elements transmitted through the air, such as noise and vibration, that have specific human environmental concerns are addressed in the social management plans (SMPs).

<table>
<tr><td>Section: 8.1</td><td>Title: Air Quality</td></tr>
<tr><td>Date: 7 October 2013</td><td>Sub-title: Ambient Air Quality</td></tr>
<tr><td>Purpose</td><td>This EMP relates principally to the control of fugitive emissions from heap leach pads, plant, equipment, vehicles and dust. Potential impacts associated with gaseous emissions include vegetation stress, nuisance impacts associated with odour and irritants, health impacts to the community and on-site personnel, visual impacts and community perception.</td></tr>
<tr><td>Timing</td><td>Ambient air quality will be monitored continuously over the construction, operations and closure phases of the project</td></tr>
<tr><td>Location</td><td>Two permanent air quality monitoring stations are located on the Letpadaung site – one on the southern boundary near the village of Kyauk Phyu Daung and one on the north boundary at the construction camp site. These locations take into account the prevailing wind directions in the dry seasons and wet season and will enable ambient air quality entering and leaving the site at any particular time to be monitored.</td></tr>
<tr><td>Action</td><td>The air quality monitoring stations shall be used to undertake continuous monitoring of SO_2, NO_2, CO and TSP. These parameters will be downloaded on a weekly basis.
Following receipt of a complaint regarding air quality, MWMCL staff will download the recordings hourly for a period of 50 hrs then daily for the following 10 days to determine the validity of the complaint.
Where the potential source of the complaint lies outside the collection zone of the monitoring stations, portable monitors shall be positioned to enable downwind samples to be taken at heights of 1, 3 and 5 m above the ground surface for a period of 1 hour sequentially for a period of 9 hours, to determine the likely emission source associated with the complaint. Wind direction measurements and intensity shall be taken at the same time.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td><table>
<tr><td>Emission</td><td>Standard ($\mu g/m^3$)</td></tr>
<tr><td>TSP[44]</td><td>150 (Annual mean)
300 (24-hour mean)</td></tr>
<tr><td>NO_2[45]</td><td>40 (annual mean)
200 (1-hour mean)</td></tr>
<tr><td>SO_2[46]</td><td>20 (24-hour mean)
500 (10 minute mean)</td></tr>
<tr><td>Ozone (O_3)[47]</td><td>100 (8-hour mean)</td></tr>
</table></td></tr>
</table>

[44] EU standard
[45] WHO standard
[46] WHO standard
[47] IFC standard

Reporting	Weekly	MWMCL Management Team
	Quarterly	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes		

8.1.1 Dust

Section: 8.1.1	Title: Air Quality
Date: 9 October 2013	Sub-title: Dust
Purpose	This EMP relates principally to the control of fugitive dust emissions from the site. Potential impacts associated with dust emissions include vegetation stress, nuisance impacts associated with the soiling action of deposited dust within local communities, health impacts to the community and on-site personnel, visual impacts and community perception.
Timing	Air quality will be controlled and monitored for dust continuously over the construction, operations and closure phases of the project
Locations	Seven permanent dust monitoring stations are located on the Letpadaung site at the following locations: on the western boundary near the village of Moe Goe Pyn South; at the southeast corner of the site adjacent to the SX/EW plant; at the northeast corner of the site near the village of Tan Daw; on the northern boundary near the village of Kyaw; on the north-western boundary near the village of Phaunga South; on the eastern boundary near the village of Shwehlay; and at the northeast corner near the construction camp site. These locations take into account the prevailing wind directions in the dry seasons and wet season.
Actions	<u>Controls</u> General dust control measures during mining/production operations may include: use of dust collection systems for bulk materials unloading; use of dust control devices for crushing operations; minimisation of land disturbance; use of dust suppression measures (wetting work areas, roads, stockpiles and equipment; minimizing drop distances; and using dust hoods and shields). To limit dust emissions from topsoil stockpiles the following procedures will be adopted: • Stockpiles configured to minimise windblown dust; • Conditioning and seeding with native grasses; and • Use of vegetation screening. The following procedures will be adopted to limit dust emissions from access roads and cleared areas: • 50 kph maximum speed limit on site; • Vehicles to follow specific access routes and use designated turning areas; • Heavy vehicles leaving the site to be fitted with appropriate covers; unsealed roads to be watered at regular intervals; • Use of vegetation screening. Dusty work areas such as crushers, conveyors, hoppers and transfer points will be designed to avoid the generation of fugitive dust through careful siting and water spray equipment. <u>Monitoring</u> The air quality monitoring stations comprise the following equipment: 150 ±10mm diameter glass funnel; stand for gauge; glass bottle (minimum volume 1 litre); rubber stopper; and filtration apparatus.

	This equipment shall be used to undertake continuous monitoring of TSP, PM_{10}, and $PM_{2.5}$. These parameters will be downloaded on a weekly basis. Following receipt of a complaint regarding dust, MWMCL staff will download the recordings hourly for a period of 50 hrs then daily for the following 10 days to determine the validity of the complaint. Where the potential source of the complaint lies outside the collection zone of the monitoring stations, portable monitors shall be positioned to enable downwind samples to be taken at heights of 1, 3 and 5 m above the ground surface for a period of 1 hour sequentially for a period of 9 hours, to determine the likely emission source associated with the complaint. Wind direction measurements and intensity shall be taken at the same time.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Compliance Limits	Parameter: Limit (µg/m^3) TSP[48]: 150 (Annual mean); 300 (24-hour mean) PM_{10}[49]: 20 (annual mean); 50 (24-hour mean) $PM_{2.5}$[50]: 10 (annual mean); 25 (24-hour mean)
Reporting	Weekly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes	

Compliance Limits:

Parameter	Limit (µg/m^3)
TSP[48]	150 (Annual mean) 300 (24-hour mean)
PM_{10}[49]	20 (annual mean) 50 (24-hour mean)
$PM_{2.5}$[50]	10 (annual mean) 25 (24-hour mean)

Reporting:

Weekly	MWMCL Management Team
Quarterly	Department of Environmental Conservation (DEC)
Annually	DEC and Department of Mines

[48] EU standard
[49] IFC standard
[50] IFC standard

8.1.2 Acid Mist

Section: 8.1.3	Title: Air Quality
Date: 9 October 2013	Sub-title: Acid Mist
Purpose	This EMP relates principally to the control of emissions of acid mist within and from the site. Potential impacts associated with gaseous emissions include vegetation stress, health impacts to the community and on-site personnel, visual impacts and community perception.
Timing	Acid mist generation should be measured continuously when acid is being added to heap leach pads and in and around the SX/EW plant during its operation.
Locations	<u>Monitoring</u> One permanent monitoring station is to be located on the Letpadaung site at the southeast corner of the site adjacent to the SX/EW plant. Additional monitoring should be undertaken, using portable monitors, along the southern and western boundaries of the site in the vicinity of areas of the HLP being irrigated. Monitoring inside the site should also be undertaken downwind of the areas of the HLPs being irrigated. These locations take into account the prevailing wind directions in the dry seasons and wet season. They will enable acid mist entering and leaving the site, particularly near sensitive receptors, to be monitored at any particular time.
Action	<u>Management</u> Distribution of solution onto HLPs shall be undertaken using drippers to avoid dispersion of acid mist through the movement of wind or equipment in the vicinity of areas with solution pooled on the surface or leached into the waste. <u>Controls</u> General acid mist control measures during mining/production activities may include: • Adjustment of application rates to ensure no pooling of acid leach solution on the surface of the leach pad; • Adjustment of pumping pressure to ensure drippers do not emit jets of solution; • Checking of all irrigation pipework to ensure no leakages; and Maintenance of pumping pressures to 80% of maximum design pressure of lowest strength pipework in the irrigation network <u>Monitoring</u> Following receipt of a complaint regarding dust, MWMCL staff will download the recordings hourly for a period of 50 hrs then daily for the following 10 days to determine the validity of the complaint. Where the potential source of the complaint lies outside the collection zone of the monitoring stations, portable monitors shall be positioned to enable downwind samples to be taken at heights of 1, 3 and 5 m above the ground surface for a period of 1 hour sequentially for a period of 9 hours, to determine the likely emission source associated with the complaint. Wind direction measurements and intensity shall be taken at the same time. Sampling may be performed by collection of sulphuric acid on a cellulose membrane filter and then analysis conducted using a

<table>
<tr><td></td><td>recognised laboratory technique to determine the level of sulphuric acid present. Alternatively detector tubes certified by OISH under 42CFR Part 84 can be used for direct reading of the acid level in the atmosphere.[51]</td></tr>
<tr><td>Responsibility</td><td>Processing Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation (DEC); Department of Labour</td></tr>
<tr><td>Compliance Limits</td><td><table><tr><td>Parameter</td><td>Limit ($\mu g/m^3$)[52]</td></tr><tr><td>Acid Mist (workplace)</td><td>1 mg H_2SO_4/m^3 air (8 hr shift)</td></tr><tr><td>Acid Mist (public)</td><td>0.1mg/m^3 per incident [53]</td></tr></table></td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Labour</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

[51] Cited in http://www.cdc.gov/niosh/docs/81-123/pdfs/0577.pdf on 11/10/2013.
[52] Cited in http://ntp.niehs.nih.gov/ntp/roc/twelfth/profiles/StrongInorganicAcidMists.pdf on 10/10/2013
[53] Cited in https://www.osha.gov/dts/chemicalsampling/data/CH_268700.html on 10/10/2013

8.1.3 Energy Efficiency

Section: 8.1.3	Title: Air Quality
Date: 10 October 2013	Sub-title: Energy Efficiency
Purpose	This EMP relates to the management of energy efficiency for the project. Energy costs can constitute as much as 15% of total mining and mineral processing input costs. Potential impacts associated with poor energy efficiency include higher operational costs and higher levels of greenhouse gases emissions.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the project.
Location	Energy efficiency management will take place throughout the project site.
Action	An energy assessment will be undertaken to determine the opportunity for energy savings. The study will include: • the energy profile of the site (where is most energy used and where are the most significant opportunities likely to be?); • the depth of the resource and the equipment used; • the mining or extraction method; • crushing strategy proposed; and • energy efficiency in materials movement and processing.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations	The Myanmar Environmental Conservation Law (ECL) (March 2012).
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

8.2 WATER

This section addresses issues related to surface water and groundwater and seeks to provide guidance on the management of surface water quality and quantity as well as the use and control of groundwater volumes and quantity. Specific recommendations for monitoring are specified.

8.2.1 Water Usage

Section: 8.2.1	Title: Water
Date: 8 October 2013	Sub-title: Water Usage
Purpose	This EMP relates principally to the management and efficient use of water in operation of the mine. The mine will use large quantities of water mostly in heap leaching, but also in mining, crushing, dust suppression and electrowinning. Most of the water in the system is lost through evaporation. Reduction in surface water availability due to mine operation may impact on the following: health of downstream habitats and ecosystems; viability of downstream businesses and agricultural enterprises; and community perception. Consequently water use on the site needs to be monitored to ensure that it is used efficiently.
Timing	Climatic data and water usage on the site will be monitored continuously over the construction, operations and closure phases of the project.
Locations	Water flows to, from and around the site will be measured and recorded. This will include measurement of the following (on a daily basis): • Raw water abstracted from the Chindwin River; • Water pumped to the WWP; • Water overflowing from the WWP; • Water flowing to the SWP; • HLP irrigation water pumped from the solution ponds and the SWP; • Groundwater pumped from dewatering wells; and • Surface water pumped from the pit. The following climatic data will be recorded from the two weather stations on site: temperature; relative humidity; wind speed; wind direction; precipitation; daily solar radiation; pressure; and pan evaporation.
Actions	<u>Controls</u> Efficient water usage will be promoted on site for all phases of the mine development and operation. This will be achieved by ongoing measurement and recording of water usage and flows around the site. These data will then be used as updated inputs for the water balance model to identify losses from the system and opportunities for improved water use efficiency. A general policy of maximising reuse of on-site water sources and minimising abstraction of raw water from the Chindwin River will be applied. <u>Monitoring</u> Flow meters will be fitted to pipelines onsite and will be used to measure water abstracted from the Chindwin River and water pumped between major infrastructure and ponds. Water overflow from the WWP will be measured using a v-notch weir.
Responsibility	Processing Department
Authority	Department of Environmental Conservation
Regulation	External limits regarding water usage will be applied for the following: • Maximum daily quantity of water abstracted from the Chindwin

	River – 35,000 m^3/day. • Annual quantity of water abstracted from the Chindwin River – 5,350,000 m^3/yr.	
Reporting	Monthly	MWMCL Management Team
	Quarterly	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes: Subject to abstraction licence being obtained.		

8.2.2 Surface Water

Section: 8.2.2	Title: Water
Date: 8 October 2013	Sub-title: Surface Water
Purpose	This EMP relates principally to the management of surface water flow through, around, and from the site both in terms of quality and quantity. Changes to the surface water flows, associated with the mine site, may impact on the following: health of the community; health of downstream habitats and ecosystems; viability of downstream businesses and agricultural enterprises; and community perception.
Timing	Surface water flows (quality and quality) will be monitored continuously over the construction, operations and closure phases of the project. The collection of data over periods of flooding is particularly important.
Locations	Seven permanent surface water monitoring stations are located on the Letpadaung site at the following sites: just upstream of the south diversion channel inlet; just downstream of the south diversion channel outlet; the irrigation channel at the upstream (southeast) corner; the irrigation channel at the downstream (northeast) corner; the spillway overflow for the waste water pond (north); the northwest project boundary (Phaunga South); and the Chindwin River. These locations account for stream flow directions and enable upstream and downstream flows and water quality at any particular time to be monitored.
Actions	<u>Management</u> Recommended practices to manage impacts associated with changes to hydrologic flow include: • Maintaining pre-mining watershed catchment flow routing wherever possible. • Ensuring that adequate flood modelling is performed so that changes to hydrologic flows have negligible downstream impact. Where downstream impacts are identified measures will be implemented to mitigate these or some form of compensation will be awarded. • Evaluation of the impacts of flooding after each event will be made with appropriate changes to management practices and procedures. Compensation (by way of alternative supply) where diversion of streams impacts on the livelihood and quality of life of water users surrounding the site. <u>Controls</u> Recommended practices to manage impacts to water quality include: • The quality and quantity of mine waste water will be managed and if necessary treated to meet effluent discharge limits. • Discharges to surface water will not result in contaminant concentrations in excess of local ambient water quality criteria outside an established mixing zone. • Oil and grease traps will be installed and maintained at refuelling facilities, workshops, parking areas, fuel storage depots, and containment areas.

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<tr><td></td><td>

Sanitary wastewater will be managed via septic or surface treatment and discharge systems.
Disturbed areas and waste rock dumps will be progressively rehabilitated to reduce sediment loads in surface runoff.
Runoff from watershed catchments shall be designated clean or dirty and clean water shall be segregated from dirty runoff so as to reduce handling requirements.
Dirty or contaminated water will be stored in appropriately sized and designed containment ponds. No contaminated water will be discharged from the site for events up to 1 in 100 year recurrence interval.

<u>Monitoring</u>
Surface water flow will be measured using a v-notch weir at each of the monitoring stations. Surface water quality will be measured in the field and samples will also be taken for laboratory testing. The following field equipment will be required: EC/TDS/pH/BOD meter; surface flow meter; water sampling gear, and GPS. Field measurements will be taken monthly, and during periods of flooding, and will include flow rate, water level, pH, electrical conductivity, temperature, and turbidity.
Laboratory testing of samples will be performed monthly and will include oil and grease, phosphates, sulphates, chlorides, phenols, COD, BOD_5, TDS, TSS, and metals.
</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulation</td><td>IFC (mining sector)[54] compliance limits will apply for all measured parameters with the exception of TSS. For TSS the greater of the following values will apply: within 10% of the receiving water body background value; or 50mg/L. These will apply to any water being released from the site.</td></tr>
<tr><td>Reporting</td><td>
<table>
<tr><td>Monthly</td><td>MWMCL Management Team</td></tr>
<tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr>
<tr><td>Annually</td><td>DEC and Department of Mines</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Notes: Myanmar compliance standards should replace the regulation specified when they are promulgated.</td></tr>
</table>

[54] As cited at http://www.ifc.org/wps/wcm/connect/1f4dc28048855af4879cd76a6515bb18/Final%2B-%2BMining.pdf?MOD=AJPERES&id=1323153264157 on 10/10/2013

8.2.3 Groundwater Usage and Drawdown

Section: 8.2.3	Title: Water
Date: 8 October 2013	Sub-title: Groundwater Usage and Drawdown
Purpose	This EMP relates principally to the control of groundwater usage and drawdown. Groundwater abstraction rates (usage) are recorded for use as an input to the mine water balance; and to understand pit inflow control measures and potential drawdown effects. Groundwater levels are recorded for the management of inflow control measures; as an input to the pit slope stability analysis; to understand groundwater flow directions (and as a consequence the direction a groundwater contamination plume will travel); and to understand the drawdown of the piezometric surface around the pit to understand potential social and environmental impacts.
Timing	Groundwater usage and drawdown will be monitored over the construction, operations and closure phases of the project. Groundwater abstraction rates are recorded on a weekly or daily basis. Baseline groundwater level data are required to establish the pre-mining conditions. Operational phase groundwater levels are required to assess mining impacts.
Location	Recommended groundwater monitoring locations are included on Figure 4.3.1. The monitor bore locations have been selected to monitor groundwater levels and, as a consequence, groundwater flow directions, and to monitor possible drawdowns in the piezometric surface. The proposed bores are for environmental and social monitoring and are not intended to be used for detailed pit wall stability analysis.
Action	Management Groundwater abstraction shall only be undertaken to enable open pit mining to be undertaken in a safe and efficient manner. Groundwater abstraction shall not be undertaken as a means of securing water supply. Controls Groundwater levels and flows recorded in monitoring bores shall be recorded and inserted into a groundwater model, on a quarterly basis to determine the extent of drawdown. Monitoring Groundwater usage is recorded using accumulating flow gauges on each bore head works. Groundwater level monitoring is monitored manually using an electronic dipper or via the installation of electronic loggers. Monitoring bores constructed to recognised standards are required for the manual dipping and the installation of loggers. Water bores/wells in villages surrounding the Project site shall be monitored to check water levels and collect water samples annually to identify any changes in quality/quantity of water resources.
Responsibility	Mining Department
Authority	Department of Environmental Conservation

Regulations	Regulation The monitoring of groundwater usage and drawdown will aim to meet with requirements of the following laws, policies, and guidelines: • The Myanmar Environmental Conservation Law (ECL) (March 2012); • Myanmar's Rules of the Conservation of Water Resources and Rivers Law (2013); • IFC Sustainability Framework[55] • OP4.07 Water Resources Management, February 2000[56] • Guideline GB/T14848 - 93: Quality Standard for Groundwater.[57] • Guideline GB/T16453.1~16453.6-2008: The Standard on Comprehensive Water and Soil Conservation Treatment.[48]
Reporting	Weekly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes	

[55] As cited at http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework on 8/10/2013

[56] As cited at http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20064755~pagePK:64141683~piPK:64141620~theSitePK:502184,00.html on 8/10/2013

[57] Standard of the People’s Republic of China

8.2.4 Discharge to Groundwater

Section: 8.2.4	Title: Water
Date: 8 October 2013	Sub-title: Discharge to Groundwater
Purpose	This EMP relates principally to discharges to groundwater. Discharge to groundwater is monitored to prevent groundwater contamination and to detect and manage potential off site social and environmental impacts.
Timing	Discharge to groundwater will be monitored continuously over the construction, operations and closure phases of the Project. Baseline groundwater chemistry data are required to establish pre-mining, and receiving groundwater chemistry characteristics. Operational phase discharge water and receiving water quality are required to assess mining impacts.
Location	Discharge water should be sampled at the point of discharge and at up-gradients and down gradient monitor bores. The discharge point and associated bore locations will be determined in the mine construction phase.
Action	<u>Management</u> Action will be taken during construction to ensure all locations, where materials are placed/stored with the potential to contaminate groundwater, are adequately lined such that production of any leachate/fluid/reacted material with the potential to contaminate groundwater will not permeate into the groundwater. <u>Controls</u> • All hazardous goods storages will be formed with an impermeable base. • All WRDs containing materials with potential to produce acid or leach metals are encapsulated within the facility. • All HLPs are lined with a compacted clay liner covered with a HDPE liner and leachate collection facilities. • All ore storage occurs in areas with constructed lining as per HLP facilities. <u>Monitoring</u> Discharge flow rates should be recorded using an in-line accumulating flow gauge. Discharge water quality should be monitored at the point if discharge. Groundwater level and quality monitoring is undertaken in dedicated groundwater monitor bores. Monitor bores constructed to recognised standards are required.
Responsibility	Mining and Processing Departments
Authority	Department of Environmental Conservation
Regulations	The management of discharge to groundwater will aim to meet with requirements of the following laws, policies, and guidelines: • The Myanmar Environmental Conservation Law (ECL) (March 2012); • Myanmar's Rules of the Conservation of Water Resources and Rivers Law (2013); • IFC Operational Policies: • OP4.07 Water Resources Management, February 2000. • Guideline GB/T14848 - 93: Quality Standard for Groundwater.

	• Guideline GB/T16453.1~16453.6-2008: The Standard on Comprehensive Water and Soil Conservation Treatment.	
Reporting	Quarterly	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes: For Regulation references see footnotes in Section 8.2.3		

8.2.5 Groundwater Contamination

Section: 8.2.5	Title: Water
Date: 8 October 2013	Sub-title: Groundwater Contamination
Purpose	This EMP relates principally to the monitoring of groundwater contamination. Groundwater quality is recorded to understand the effectiveness of containment measures and to detect and manage potential off site social and environmental impacts.
Timing	Groundwater quality will be monitored during the construction, operations and closure phases of the Project. Baseline groundwater chemistry data are required to establish pre-mining conditions. Operational phase groundwater chemistry is required to assess mining impacts. Groundwater should be sampled and tested on a quarterly basis.
Location	Recommended groundwater sample locations are included on Figure 4.3.1. The bore locations have been selected to monitor the impacts of potential contaminant sources. The proposed bores are for environmental and social monitoring and are not intended to be used for detailed pit wall stability analysis.
Action	Groundwater is sampled using an electro submersible pump using a set procedure using monitor bores constructed to a specific design. Monitor bores constructed to recognised standards are required for the manual dipping and the installation of loggers. Monitor bores are often destroyed by mobile plant particularly during the construction phase and of bore availability/replacement bores need to be managed.
Responsibility	Safety and Environment Department.
Authority	Department of Environmental Conservation
Regulations	The monitoring of groundwater quality and drawdown will aim to meet with requirements of the following laws, policies, and guidelines: • The Myanmar Environmental Conservation Law (ECL) (March 2012); • Myanmar's Rules of the Conservation of Water Resources and Rivers Law (2013); • IFC Operational Policies: • OP4.07 Water Resources Management, February 2000 • Guideline GB/T14848 - 93: Quality Standard for Groundwater. • Guideline GB/T16453.1~16453.6-2008: The Standard on Comprehensive Water and Soil Conservation Treatment.
Reporting	Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes: For Regulation references see footnotes in Section 8.2.3	

8.3 SOIL AND WASTE ROCK

Soil and rock fall into two (2) categories: materials that can be utilized and materials that will be stored as waste. This section describes both types of material and their management, particularly as acid forming and metal leaching waste is predicted to be an extremely sensitive management issue and the supply of benign materials within the Project site is limited and the demand for those materials is very high in construction, operation and closure. Insufficient benign material will lead to a requirement to source materials outside the Project area as it is currently defined.

8.3.1 Construction Materials

Section: 8.3.1	Title: Soil and Rock
Date: 9 October 2013	Sub-title: Construction Materials
Purpose	The purpose of this management plan is to identify a process of defining the supply and extraction of basic raw materials (soil and rock) required to enable progressive closure and rehabilitation of areas, such as WRDs and complete closure of the site. It aims to ensure material use is planned and managed in such a way that materials suitable for these purposes are not disposed to waste and are reserved for this purpose.
Timing	This plan shall be implemented prior to the commencement of construction and be continually implemented over the life of the mine until finalisation of closure and return of the land to the community
Location	The plan applies to all activities across the Project area and into the surrounding environment.
Action	1. Undertake investigations to establish the properties and quantities of soil and rock with the characteristics to provide suitable materials for: • Providing a compacted impermeable base for WRDs and (HLPs and landfills; • Capping of WRDs, HLPs at closure and closed landfills; • Developing store and release covers where required; • Providing periodic covers for waste landfills; • Supply of benign rock for construction of drains, drop structures, and weirs; • Supply of benign rock for abandonment bund walls and protection bunds around the final and operating crest of the open pit, respectively. 2. Maintain an inventory of available materials, their location and volume. 3. Clearly mark all areas where materials are stored to identify their purpose. 4. Prepare a materials balance for the site and periodically update the balance sheet to ensure the quantities of material are known and utilisation of the material and

	additions to stockpiles are recorded. 5. Plan, operate and rehabilitate borrow pits according to a known standard for basic raw materials.[58,59]
Responsibility	Mining Department
Authority	Department of Mining, Department of Environmental Conservation
Regulations	
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes: Management of topsoil and waste rock are described in separate EMPs.	

[58] CSI, 2011; Guidelines on Quarry Rehabilitation; Cement Sustainability Initiative, World Business Council for Sustainable Development; August 2011.
[59] DEC, 2008; Guidelines for Management and Operation of Basic Raw Materials; Department of Environment and Conservation, Government of Western Australia; August, 2008.

8.3.2 Topsoil Removal and Storage

Section: 8.3.2	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Topsoil Stripping and Stockpiling
Purpose	This EMP relates to the management of the stripping and stockpiling of topsoil on the site. Upon closure of the mining operation the intent is to rehabilitate disturbed areas including the WRDs, and HLPs. A critical aspect of the rehabilitation of these areas involves placement of previously stripped topsoil on rehabilitation surfaces prior to revegetation. Consequently the existing in situ topsoil and subsoil on site is a valuable resource that must be carefully conserved and stockpiled for future use. If topsoil stripping and stockpiling is not properly managed it may not be possible to meet the project closure commitments. This may impact on return of environmental bond monies, the company reputation, and its ability to do business in Myanmar in the future.
Timing	Topsoil stripping, stockpiling and re-spreading for rehabilitation will be monitored continuously over the construction, operations and closure phases of the project. In addition changes in topsoil conditions will be monitored to ensure that they do not undergo any adverse changes over the life of the project. It will require establishing representative sampling locations to assess the potential effects of acid deposition, fugitive dust emissions and the mobilization of metals / elements through changes in soil chemistry during construction and mine operations. Sampling of topsoil from rehabilitated areas and trial plots will be performed annually.
Locations	Topsoil monitoring locations will vary according to construction and rehabilitation activities around the site. These will be planned in advance and indicated on the topsoil inventory and plan. Samples of the topsoil will also be taken from test pits around the site.
Actions	<u>Management</u> All disturbed areas will: • Have permits approved prior to any surface disturbance being undertaken. • Two layers of soil (topsoil150 mm and subsoil250 mm-400mm) removed and stockpiled for reclamation and use during rehabilitation of disturbed and closed facilities. • Stockpiles will be a maximum height of 6 m. All stockpiles will be clearly marked and only reclaimed with approval from the Safety and Environment Department. <u>Controls</u> Recommended topsoil conservation control strategies include: • Use of Clearing Permits that require inclusion of the proposed clearing areas, stockpile locations, estimated volume, and the recovery method. • Development of a formal soil conservation and land use monitoring plan. • Planting of appropriate trees and vegetation will be promoted to provide shelter from the wind as well as reduce dust and soil erosion. • Seeding of topsoil stockpiles with natural leguminous shrubs

<table>
<tr><td></td><td>and plants to regenerate nutrients within the stockpiles.
• Inclusion of leguminous shrub and plant species in the mix of species used in land rehabilitation works and buffer plantings around the site.
<u>Monitoring</u>
Monitoring will be conducted with test pits located up and down gradient (and up and down wind) from mine facilities at designated control points. The suite of analyses for the monitoring programme for soil chemistry will include: pH; anion exchange capacity; electrical conductivity; metals; and toluene-extractable organics. The suite of analyses for the monitoring programme for soil structure will include: clay fraction; particle size distribution; water retention; and permeability.
Sampling frequency and parameters analysed will be reassessed based on results from air quality and surface water monitoring results but are likely to be more frequent during the rainy season, to correspond with rains. Monitoring shall comprise inspecting, recording and reporting of the following: quantities of topsoil removed; storage locations and quantities; the type of topsoil; and storage procedures and methods. This data will be used to develop a topsoil inventory and plan for the site that will be maintained over the life of the project.</td></tr>
<tr><td>Responsibility</td><td>Mining and Engineering Departments</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>Compliance limits for topsoil loss from rehabilitated areas, stockpiles and trial plots will not be applied but this information will be used to refine and improve topsoil management, and rehabilitation practices.</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes</td></tr>
</table>

8.3.3 Erosion and Sediment Control

Section: 8.3.3	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Erosion and Sediment Control
Purpose	This EMP relates principally to the management of erosion and sediment control on the site. Disturbance of catchments and placement of waste rock dumps, and topsoil / ore stockpiles will lead to increased erosion that, if not managed properly, could result in elevated sediment loads in downstream rivers and waterways. Increased sediment loads in waterways may impact on river flow, boat access, the health of downstream habitats and ecosystems, the viability of downstream businesses and agricultural enterprises, and community perception towards the Project.
Timing	Surface water flows and total suspended solids (TSS) will be monitored continuously over the construction, operations and closure phases of the Project. Collection of data over periods of flooding is particularly important. Sampling and testing of the different soils, ore, and waste rock materials around the site will also be required. Initially this will be done to establish baseline data and then will be continued as new materials are disturbed with progressive development of the mine. Sampling of topsoil from rehabilitated areas and trial plots will also be performed annually.
Locations	Seven permanent surface water monitoring stations are located on the Letpadaung site at the following sites: just upstream of the south diversion channel inlet; just downstream of the south diversion channel outlet; the irrigation channel at the upstream (southeast) corner; the irrigation channel at the downstream (northeast) corner; the spillway overflow for the waste water pond (north); the northwest project boundary (Phaunga South); and the Chindwin River. These locations account for stream flow directions and enable upstream and downstream flows and suspended solids at any particular time to be monitored. Samples of the different soils, ore, and waste rock materials will be taken from test pits and excavations around the site.
Actions	<u>Management</u> Prior to each wet season, a campaign to close and rehabilitate disturbed areas no longer required for construction and operations will be undertaken to reduce the area available for erosion and generation of sediments. New ground disturbing activities will be limited immediately prior to and during the wet season. <u>Controls</u> Recommended erosion prevention and control strategies include: • Establishing riparian setback zones. • Reducing exposure of sediment-generating materials to wind or water (e.g. proper placement of soil and rock piles). • Reducing or preventing off-site sediment transport (e.g. use of settlement ponds, silt fences). • Timely implementation of an appropriate combination of

	contouring techniques, terracing, slope reduction /minimization, runoff velocity limitation and appropriate drainage installations to reduce erosion in both active and inactive areas. • Final grading of disturbed areas, including preparation of overburden before application of the final layers of growth medium, will be along the contour as far as can be achieved in a safe and practical manner. • Revegetation of reclaimed areas including seeding will be performed immediately following application of the growth medium to avoid erosion. • Access and haul roads will have gradients to limit erosion, and road drainage systems will be provided. • Stormwater drains, ditches, and stream channels will be protected against erosion through a combination of adequate dimensions, slope limitation techniques, and use of rip-rap. Temporary drainage installations will be designed for an annual recurrence interval (ARI) of at least a 10- year, while permanent drainage installations will be designed for a 100-year ARI. Consideration of the intended life of diversion structures, as well as the recurrence interval of any structures that drain into them, will be taken into account when the above intervals are defined. • Drainage structures will also have "low flow" channels for smaller frequent storms. • Surface drainage from disturbed areas, including areas that have been graded, seeded, or planted, will be treated for sediment removal. Stormwater settling facilities will be designed and maintained according to internationally accepted good engineering practices, including provisions for capturing of debris and floating matter. Sediment control facilities will be designed and operated to comply with TSS discharge limits. <u>Monitoring</u> Surface water flow will be measured using a vee-notch weir at each of the monitoring stations. Surface water turbidity will be measured in the field and samples will also be taken for laboratory testing to determine TSS. The following field water sampling equipment will be required: TDS /BOD meter; surface flow meter; water sampling gear, and GPS. Field water quality measurements will be taken monthly, and during periods of flooding, and will include flow rate, water level, and turbidity. Laboratory TSS testing of water samples will be performed monthly as part of the surface water sampling. Monitoring will be conducted with test pits located up and down gradient (and up and down wind) from mine facilities at designated control points. The suite of analyses for the monitoring programme for soil chemistry will include pH; anion exchange capacity; electrical conductivity; metals; and toluene-extractable organics. The suite of analyses for the monitoring programme will for soil structure will include: clay fraction (<0.002 mm); particle size distribution; water retention; permeability; and total suspended solids. Sampling frequency and parameters analysed will be reassessed

<table>
<tr><td></td><td>based on results from air quality and surface water monitoring results but are likely to be more frequent during the rainy season, to correspond with rains. Erosion monitoring shall comprise inspecting, recording and reporting of the following: quantities of vegetation removed, storage locations, quantities and type of topsoil and overburden, storage procedures and methods used, areas prone to erosion, evidence of erosion, depth of remaining in situ topsoil, condition of access roads, condition of cleared areas, condition of perimeter drains and associated settlement ponds, compliance with applicable regulatory and corporate requirements.</td></tr>
<tr><td>Responsibility</td><td>Mining and Engineering Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>Beyond the agreed mixing zone of the receiving water body for TSS the greater of the following values will apply: within 10% of the receiving water body background value; or 50mg/L.
Compliance limits for topsoil loss from rehabilitated areas and trial plots will not be applied but this information will be used to refine and improve rehabilitation practices and closure designs.</td></tr>
<tr><td>Reporting</td><td><table>
<tr><td>Monthly</td><td>MWMCL Management Team</td></tr>
<tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr>
<tr><td>Annually</td><td>DEC and Department of Mines</td></tr>
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<tr><td colspan="2">Notes</td></tr>
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8.3.4 Acid Rock Drainage and Metals Leaching - WRD

Section: 8.3.4	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Acid Rock Drainage and Metals Leaching – Waste Rock Dumps
Purpose	This EMP relates to the reduction of acid generation and metals leaching from waste rock placed within the WRDs. Potential impacts associated with acid drainage and metals leaching include contamination of surface and groundwater with potential loss of habitat, flora and fauna.
Timing	Waste rock will be produced throughout the mine life. Waste rock will be placed in the WRDs from Year 1 to approximately year 20 with waste after that disposed of in-pit (see separate EMP). Encapsulation of the waste will be continuous throughout the construction of the WRDs.
Location	The three WRDs will be located around the open pit within the site boundary.
Action	All waste rock shall be classified as benign, metal leaching or acid forming before excavation from the open pit. The waste encapsulation will be undertaken to meet the following objectives: • Reduce oxygen ingress; • Reduce water ingress; • Protect shallow groundwater; and • Protect surface water. Waste rock will be progressively placed within cells that are lined and capped with low permeability fill within the WRDs as shown in figures 8.3.1 to 8.3.4. On completion the WRDs will be capped with a 'store and release' cover to reduce water ingress as shown in Figure 8.3.5. Any contaminated seepage will be collected and passed through appropriate active or passive treatment systems to render it acceptable for release to the environment.
Responsibility	Mining Department
Authority	Department of Environmental Conservation
Regulations	• Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009; • British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia; • Australian Government, Department of Industry, Tourism and Resources (February 2007). Managing Acid and Metalliferous Drainage.
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental

		Conservation (DEC)
	Annually	DEC and Department of Mines
Notes:		

8.3.5 Acid Rock Drainage and Metals Leaching – HLP

Section: 8.3.5	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Acid Rock Drainage and Metals Leaching – Heap Leach Pads
Purpose	This EMP relates to the reduction of acid generation and metals leaching from ore placed within the HLPs. Potential impacts associated with acid drainage and metals leaching include contamination of surface and groundwater with potential loss of habitat, flora and fauna.
Timing	The HLPs will be operated throughout the life of the mine with low-pH and high metal concentration leachate managed through the copper recovery plant. ARD and metals leaching are not issues during operation of the HLPs. On closure the drawdown of the HLPs and any ongoing infiltration/ percolation will generate ARD and metal-rich leachate for many years.
Location	The three HLPs will be located in the southwest segment of the site.
Action	The ore encapsulation will be undertaken to meet the following objectives: • Reduce oxygen ingress. • Reduce water ingress. • Protect shallow groundwater. • Protect surface water. On completion the HLPs will be capped with a very low permeability soil or geosynthetic cover system to reduce water ingress. All leachate produced by the HLPs will be collected and passed through the SX/EW plant and treated to render it acceptable for release to the environment.
Responsibility	Processing Department
Authority	Department of Environmental Conservation
Regulations	• Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009; • British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia; • Australian Government, Department of Industry, Tourism and Resources (February 2007). Managing Acid and Metalliferous Drainage.
Reporting	Monthly – MWMCL Management Team Quarterly – Department of Environmental Conservation (DEC) Annually – DEC and Department of Mines
Notes:	

8.3.6 Acid Rock Drainage and Metals Leaching – In Pit

Section: 8.3.6	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Acid Rock Drainage and Metals Leaching – In Pit
Purpose	This EMP relates to the reduction of acid generation and metals leaching from waste rock placed within the open pit and also exposed rock in the pit walls. Potential impacts associated with acid drainage and metals leaching include contamination of surface and groundwater with potential loss of habitat, flora and fauna.
Timing	Waste rock will be produced throughout the mine life. Waste will be placed in the surface WRDs from Year 1 to 20 approximately (see separate EMP) with waste after that disposed of in-pit. Encapsulation of the waste will be continuous throughout the placement of the waste rock in the pit void. Rock exposed in the pit walls has the potential to produce low-pH and/or metal-contaminated run-off water once it is exposed.
Location	Open Pit.
Action	The waste rock encapsulation will be undertaken to meet the following objectives: • Reduce oxygen ingress. • Reduce water ingress. • Protect shallow groundwater. • Protect surface water. Waste rock will be progressively placed within cells in the open pit void that are lined and capped with low permeability fill. During operations, run-off from the in-pit waste dump and more generally from within the pit area, will be collected and pumped to the WWP for use in the process or treatment prior to release. On closure, the pit will be flooded and water levels managed such that the waste rock and rock within the pit walls that has the potential to produce acid or leach metals remains submerged in perpetuity. Water levels will also be maintained at a level lower than the surrounding groundwater table to reduce seepage of contaminated water from the pit lake into groundwater, thus finished waste rock levels in the pit should not exceed that level in the pit. After closure, pit water shall be monitored quarterly and results compared to IFC standards quoted in Section 8.2.2 – Surface Water and 8.2.5 – Groundwater Contamination
Responsibility	Mining Department
Authority	Department of Environmental Conservation
Regulations	• Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009; • British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia; • Australian Government, Department of Industry, Tourism and

	Resources (February 2007). Managing Acid and Metalliferous Drainage.	
Reporting	Monthly	MWMCL Management Team
	Quarterly	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes:		

8.3.7 Waste Rock Dumps

Section: 8.3.7	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Waste Rock Dumps
Purpose	This EMP relates to the construction and operation of the WRDs. Potential impacts associated with the WRDs include poor air quality (dust generation), contamination of surface water and groundwater with potential loss of habitat, flora and fauna.
Timing	Waste rock will be produced throughout the mine life. Waste will be placed in the WRDs from Year 1 to approximately Year 20 with waste after that disposed of in-pit. Construction of the waste dumps will be continuous throughout the mine life.
Location	The three WRDs will be located around the open pit within the site boundary.
Action	The WRD design and operation will take the following requirements into account: • Permanent and secure storage of all waste rock within engineered facilities (see separate EMP for Acid Rock Drainage and Metals Leaching); • Waste dump placement and development scheduling to minimize equipment requirements, achieve stable slopes at closure and reduce closure measures; • Control of drainage and runoff from the waste dumps during operations to the maximum practical extent; • Collection of sediment from the waste dumps to the maximum practical extent; • Treatment (if required) and discharge of excess drainage and runoff from the waste dumps; and • Monitoring for all aspects of the waste dumps to the maximum practical extent to ensure performance goals are achieved and design objectives are met.
Responsibility	Mining Department
Authority	Department of Environmental Conservation
Regulations	• Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009; • British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia; • Australian Government, Department of Industry, Tourism and Resources (February 2007). Managing Acid and Metalliferous Drainage. • Code for Waste Dump Design of Nonferrous Metal Mines (2007). National Standard of the People's Republic of China, GB 504421-2007. Implemented 01 October 2007.
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC)

		Annually	DEC and Department of Mines
Notes:			

8.3.8 Rehabilitation of Developed Landforms

Section: 8.3.8	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Rehabilitation of Developed Landforms
Purpose	This EMP relates to the rehabilitation of developed landforms at the project site. Potential impacts associated with rehabilitation include erosion by wind and water and ultimately contamination, if the rehabilitation is unsuccessful.
Timing	Rehabilitation will be undertaken progressively over the construction, operations and closure phases of the Project as landforms become available for rehabilitation.
Location	Developed land at the Project site including open pits, WRDs, HLPs and stockpile areas.
Action	The rehabilitation programme will be done to meet the following objectives: • All developed landforms that are temporary structure, such as topsoil/subsoil stockpiles and drainage bunds, shall be revegetated with leguminous local plants to maintain the soil nutrition and improve their value for rehabilitation of disturbed areas; • All developed landforms will be rehabilitated to a standard that achieves a safe, stable landform which supports self-sustaining native vegetation, is free draining and non-polluting and visually compatible with the surrounding landscape; • To ensure that environmental rehabilitation achieves an acceptable standard compatible with the intended land use and consistent with the conditions of approvals and other requirements; • Progressively rehabilitate disturbed areas as they become available; and • Rehabilitation meets completion criteria. Monitoring should be carried out using the Landscape Function Analysis technique[60].
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations	• Environment Conservation Law (2012); • Mine Rehabilitation Guideline- Leading Practice Sustainable Development Program for the Mining Industry (Government of Australia, 2006)
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

[60] CSIRO 2004. Landscape Function Analysis: Procedures for monitoring and assessing landscapes. Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO). February 2004.

8.3.9 Rehabilitation of Disturbed Areas

Section: 8.3.9	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Rehabilitation of Disturbed Areas
Purpose	This EMP relates to the rehabilitation of disturbed land at the Project site. Potential impacts associated with rehabilitation include erosion by wind and water if the rehabilitation is unsuccessful.
Timing	Rehabilitation will be undertaken progressively over the construction, operations and closure phases of the Project as disturbed land becomes available.
Location	Disturbed land at the Project site including plant areas, workshop areas and roads.
Action	The rehabilitation programme will be done to meet the following objectives: • All disturbed areas rehabilitated to a standard that achieves a safe, stable landform which supports self-sustaining native vegetation, is free draining and non-polluting and is visually compatible with the surrounding landscape; • To ensure that environmental rehabilitation achieves an acceptable standard compatible with the intended land use and is consistent with the conditions of approvals and other requirements; • Progressively rehabilitate disturbed areas as they become available; and • Rehabilitation meets completion criteria. All monitoring shall be carried out using the Landscape Function Analysis technique (CSIRO, 2004).
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations	• Environment Conservation Law (2012); • Mine Rehabilitation Guideline- Leading Practice Sustainable Development Program for the Mining Industry (Government of Australia, 2006)
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

8.3.10 Ore Handling and Placement

Section: 8.3.10	Title: Soil and Waste Rock
Date: 8 October 2013	Sub-title: Ore Handling and Placement
Purpose	This EMP relates to the management of ore handling and placement at the Project site. Potential impacts associated with these activities include dust and noise generation and contaminated runoff from stockpiles.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the Project.
Location	Ore handling and placement will be carried out in the crushing circuit, stockpile areas and on the HLPs.
Action	The management programme will include: • Water will be used on the haul roads and in the crushing circuit to minimise dust generation. Contaminated water will be collected and recycled for use as process water; • Ore stockpile areas will be compacted and properly drained to prevent leachate from contaminating groundwater. Any leachate will be directed to the waste water pond for reuse; and • The HLPs will be compacted, covered with a plastic liner and drainage to prevent any loss of leached solution from the heaps.
Responsibility	Mining and Processing Departments
Authority	Department of Environmental Conservation
Regulations	• Environment Conservation Law (2012); • Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Dust emission limits as per Air Quality EMP; • Noise limits as per Noise EMP.
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

8.4 VEGETATION AND FAUNA

Whilst the vegetation and fauna on the site may be considered depauperate, the general loss of natural vegetation in the region and on the Project site requires the conservation of that remaining as a source for revegetation and recolonisation of the site as it is rehabilitated and then closed at the end of mine life.

This section describes EMPs to limit the threat to the existing resources with less focus on conservation and offsetting for loss of vegetation and habitat.

8.4.1 Weed Hygiene and Control

<table>
<tr><td>Section: 8.4.1</td><td>Title: Vegetation and Fauna</td></tr>
<tr><td>Date: 8 October 2013</td><td>Sub-title: Weed Hygiene and Control</td></tr>
<tr><td>Purpose</td><td>This EMP relates to the management of weeds at the Project site. Potential impacts associated weeds include invasion of native vegetation and degradation of rehabilitated areas.</td></tr>
<tr><td>Timing</td><td>Management will be undertaken continuously over the construction, operations and closure phases of the Project.</td></tr>
<tr><td>Location</td><td>Weed hygiene and control will take place throughout the Project site.</td></tr>
<tr><td>Action</td><td>The management programme will include:
Delineation of areas of significant flora or remnant vegetation on the site;
Identification of known locations of rare or protected flora and known locations of weeds will be clearly shown on site database;
Prevent the introduction and spread of weeds into the Project area through vehicle, plant and equipment inspection and cleaning;
Maintain the abundance, diversity, geographic distribution and productivity of native flora and ecosystems; and
Ensure there is no unauthorised vehicle traffic outside of the Project disturbance area.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>Weed hygiene and control of weed growth will aim to meet the requirements of the following laws and guidelines:
The Myanmar Environmental Conservation Law (ECL) (March 2012);
Department of Mines and Energy (DME) (2012). Weed Management on Mine Sites- Advisory Note. Northern Territory Government, NT.</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

8.4.2 Fire

<table>
<tr><td>Section: 8.4.2</td><td colspan="2">Title: Vegetation and Fauna</td></tr>
<tr><td>Date: 9 October 2013</td><td colspan="2">Sub-title: Fire</td></tr>
<tr><td>Purpose</td><td colspan="2">This EMP relates to the management of fire at the Project site. Potential impacts associated with fire include risk to site personnel and nearby villagers, damage to plant and equipment and damage to vegetation.</td></tr>
<tr><td>Timing</td><td colspan="2">Management will be undertaken continuously during the construction, operations and closure phases of the Project.</td></tr>
<tr><td>Location</td><td colspan="2">Fire management will take place throughout the Project site.</td></tr>
<tr><td>Action</td><td colspan="2">The management programme will aim to:
• Prevent fire as a result of construction and operation activities;
• Ensure no uncontrolled fires are started as a direct result of the Project activities; and
• Minimise the impact of any fires that do occur.</td></tr>
<tr><td>Responsibility</td><td colspan="2">Safety and Environment Department</td></tr>
<tr><td>Authority</td><td colspan="2">Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td colspan="2">Fire management will aim to meet the requirements of the following laws and guidelines:
• The Myanmar Environmental Conservation Law (ECL) (March 2012);
• Mining Regulations of the Union of Myanmar (1996)
• Safety Regulation for Metal and Non-metal Mines, (GB16423-2006);[61]
• Code of Design on Building Fire Protection and Prevention, (GB50016-2006); [62]
• Code for Design of Electrical Installation for Explosive and Fire Hazardous Atmospheres (GB50058-92); [63]
• Code for Design and Construction of Automobile Gasoline and Gas Filling Station (GB50156-2002). [64]</td></tr>
<tr><td rowspan="3">Reporting</td><td>Monthly</td><td>MWMCL Management Team</td></tr>
<tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr>
<tr><td>Annually</td><td>DEC and Department of Mines</td></tr>
<tr><td colspan="3">Notes:</td></tr>
</table>

[61] Standard of the Peoples Republic of China
[62] Standard of the Peoples Republic of China
[63] Standard of the Peoples Republic of China
[64] Standard of the Peoples Republic of China

8.4.3 Fauna Identification and Handling

Section: 8.4.3	Title: Vegetation and Fauna
Date: 10 October 2013	Sub-title: Fauna Identification and Handling
Purpose	This EMP relates to the identification and handling of fauna at, and around, the Project site. Fauna identification is a specialist occupation and should only be undertaken by personnel with the necessary skills. Potential impacts associated with fauna identification and handling are injury to fauna and injury to personnel.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the Project.
Location	Fauna identification and handling will take place throughout the Project site and its surrounds.
Action	The management programme will aim to: • Minimise stress, injury and death to vertebrate fauna; • Maximise consistency of data collection; • Provide guidance to relevant personnel on fauna identification and handling; • Provide guidance to qualified field staff on fauna handling[65]and decisions for treatment or euthanasia; and • Ensure compliance with relevant legislation, policies and permits.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations	The fauna identification and handling EMP will aim to meet the requirements of the following laws and guidelines: • Environmental Conservation Law (ECL) (March 2012). • Protection of Wildlife and Protected Areas Law (1994)
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

8.5 INDUSTRIAL WASTE MANAGEMENT

The site is expected to generate both hazardous and non-hazardous wastes. The EMPs make allowance for the options of processing of waste on or off site, as it is expected local capacity to process either class of material is limited.

[65] DEC, 2009; Standard Operating Procedure for Hand Capture of Wildlife; Department of Environment and Conservation, Government of Western Australia; June, 2009

8.5.1 Non-Hazardous Waste Management

<table>
<tr><td>Section: 8.5.1</td><td>Title: Industrial Waste Management</td></tr>
<tr><td>Date: 9 October 2013</td><td>Sub-title: Non-hazardous Waste Management</td></tr>
<tr><td>Purpose</td><td>This EMP relates to the management non-hazardous waste material at the Project site. Potential impacts associated with non-hazardous waste include pollution of water resources, danger to people and fauna and unsightly nature of rubbish.</td></tr>
<tr><td>Timing</td><td>Management will be undertaken continuously over the construction, operations and closure phases of the Project.</td></tr>
<tr><td>Location</td><td>Non-hazardous waste management will take place throughout the Project site.</td></tr>
<tr><td>Action</td><td>The Project will employ the waste hierarchy approach whereby the first aim will be to reduce the amount of waste generated through design, use of approved suppliers for materials, contract arrangements, minimisation of over-ordering etc.
Under the waste management hierarchy, management options will be evaluated in the sequence of re-use, segregation and recovery to minimise the amount of waste generated for final disposal.
A landfill will be constructed as an engineered cell within the WRD.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>Non-hazardous waste management will aim to meet the requirements of the following laws and guidelines:
• Myanmar Environmental Conservation Law (ECL) (March 2012);
• Mining Regulations of the Union of Myanmar (1996)
• IFC Performance Standard 3. Resource Efficiency and Pollution Prevention. (IFC, 2012).</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

8.5.2 Hazardous Waste Management

<table>
<tr><td>Section: 8.5.2</td><td>Title: Industrial Waste Management</td></tr>
<tr><td>Date: 9 October 2013</td><td>Sub-title: Hazardous Waste Management</td></tr>
<tr><td>Purpose</td><td>This EMP relates to the management hazardous waste material at the Project site. Potential impacts associated with hazardous waste include danger to mine personnel, pollution of water and soil, risk to villagers and risk to flora and fauna.</td></tr>
<tr><td>Timing</td><td>Management will be undertaken continuously over the construction, operations and closure phases of the Project.</td></tr>
<tr><td>Location</td><td>Hazardous waste management will be undertaken in those areas where hazardous waste is generated such as the process plant, fuel farm, maintenance area and explosives area.</td></tr>
<tr><td>Action</td><td>Hazardous waste from the project will be managed as follows;
Recycled – waste such as waste oil can be recycled;
Removed from site by a licensed contractor;
Disposed of on-site by burying in a secure, lined, engineered cell and marked as contaminated land.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>Hazardous waste management will aim to meet the requirements of the following laws and guidelines:
The Myanmar Environmental Conservation Law (ECL) (March 2012);
Mining Regulations of the Union of Myanmar (1996)
IFC Performance Standard 3. Resource Efficiency and Pollution Prevention. (IFC, 2012).</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

8.5.3 Sewage and Wastewater

Section: 8.5.3	Title: Industrial Waste Management
Date: 10 October 2013	Sub-title: Sewage and Domestic Wastewater
Purpose	This EMP relates to the management of sewage and domestic wastewater at the Project site. Potential impacts associated with sewage and wastewater includes risk to health of mine personnel, pollution of water resources and risk to fauna.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the Project.
Location	The main sources of sewage and domestic wastewater are the accommodation camp and the process plant.
Action	Sewage and domestic wastewater from the project will be managed as follows: • Segregation of wastewater streams to ensure compatibility with selected treatments option (e.g. septic system which can only accept domestic sewage); • Segregation and pre-treatment of effluents containing oil and grease (e.g. use of a grease trap) prior to discharge into sewer systems; • If sewage from the industrial facility is to be discharged to surface water, treatment to meet international or local standards for sanitary wastewater discharges; • If the sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable international or local standards for sanitary wastewater discharges is required; • Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long-term sustainability of water and land resources; and • Monitoring at point of discharge. The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations	Discharge water quality parameters.

Pollutant	Guideline Value	Units
pH	6 – 9	pH
BOD	30	mg/l
COD	125	mg/l
Total Nitrogen	10	mg/l
Total Phosphorus	2	mg/l
Oil and Grease	10	mg/l
Total Suspended Solids	50	mg/l
Total Coliform Bacteria	400	MPN[1] / 100 ml

Reporting	Monthly	MWMCL Management Team
	Quarterly	Department of Environmental Conservation (DEC)
	Annually	DEC and Ministry of Health
Notes: [1] MPN = Most Probable Number		

8.6 CONCEPTUAL CLOSURE

This EMP is based on the Conceptual Closure Plan (Appendix H) and draws its contents and recommendations from it.

Section: 8.6	Title: Mine Closure
Date: 8 October 2013	
Purpose	This EMP relates to the management of mine closure and the Mine Closure Plan. Potential impacts associated with poor management of the closure process include a lack of materials for capping and rehabilitation, erosion and instability where progressive rehabilitation has not taken place and long-term environmental liabilities due to the presence of contaminated waste materials and/or loss of usable land.
Timing	The development schedule for the Mine Closure Plan will consist of the following stages: • The Conceptual Closure Plan will be prepared during the design stage (this report). This will allow integration with the design concepts and ensure that the design and operation of the site are compatible with the closure plan. • After commissioning the Detailed Closure Plan will be developed which incorporates the following: - A closure plan for each specific area / type of facility and structure on site. - Rehabilitation completion standards for approval with the regulators. - Testing program for assessment of short term and long term physical and chemical stability of waste dump and heap leach materials. - Rehabilitation trials to assess the viability of the closure concept plan. - Progressive rehabilitation plans for areas of the site which are no longer required for the ongoing operation. • During mine operation the closure plan will be updated every five years based on the results of the testwork programme and the changes in the operation and mine planning. • A minimum of five years before closure of the mine, a Final Closure Plan will be developed and approved with the regulators.
Location	The Mine Closure Plan applies to the whole site.
Action	Develop the closure design and the Mine Closure Plan in line with the above-defined schedule. This will include: • Ongoing design of the final land use and engineering development of the site. • Integration of the closure design into operational design to reduce works on closure and promote progressive rehabilitation. • Consultation with the local population to determine preferred final land use options; • Consultation with government to establish final land use parameters; • Rehabilitation trials to assess most appropriate resoiling and

	revegetation strategies for each key area on the site. • Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes. Monitoring of the progress of the Mine Closure Plan should be undertaken on an annual basis with revision of the plan every three (3) years.
Responsibility	Environmental Department
Authority	Department of Environmental Conservation
Regulations	• Environmental Conservation Law (2012), • Foreign Investment Law (2012), • Rules and Notification by Myanmar Investment Commission (2013), • Rules of the Conservation of Water Resources and Rivers Law (2013), • Land Acquisition Act • Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007; • Code for Waste Dump Design of Nonferrous Metal Mines (2007). National Standard of the People's Republic of China, GB 504421-2007. Implemented 01 October 2007 • European Commission Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities (January 2009) • Guidelines for Preparing Mine Closure Plans, produced by the Government of Western Australia (June 2011)
Reporting	Monthly: MWMCL Management Team Quarterly: Department of Environmental Conservation (DEC) Annually: DEC and Department of Mines
Notes:	

9. SOCIAL MANAGEMENT PLANS

9.1 NOISE

Section: 9.1	Title: Noise
Date: 10 October 2013	
Purpose	This SMP relates to the control of noise from the Project. Potential impacts associated with noise include health impacts to site personnel and nuisance to the community.
Timing	Noise emissions will be monitored over the construction, operations and closure phases of the Project.
Location	Noise monitoring shall be conducted using a digital sound level meter. Six noise monitoring stations are located on the Letpadaung site at the following locations: on the western boundary near the village of Moe Gyp Pyn South; at the southeast corner of the site adjacent to the SX/EW plant; north of the site near the village of Aungchans; on the northern boundary near the village of Kyaw; on the eastern boundary near the village of Shwehlay; and at the northeast corner near the construction camp site. These locations take into account the location of sensitive noise receptors such as villages and the accommodation area.
Action	Background noise levels around the site have been monitored and show a large variation between the dry season and the wet season. Modelling has also been carried out which shows that noise levels from the operation can be kept within 3dB of background levels at nearby noise sensitive premises with proper management. Noise monitoring should be carried out on an annual basis and more frequently if complaints occur from particular noise sensitive premises. In the event that public complaints arise, steps should be taken to investigate the root cause without delay and remedial action should be taken to correct any deficiency. General noise control measures during mining/production operations may include: • Comply with established noise limits; a 100 m wide buffer along the property perimeter will be considered; • Provide an air inlet silencer and exhaust silencers for combustion engines and other units; • Utilise sound insulation on equipment and sound barriers around stationary equipment; • Avoid trucking operations during night-time; • Select vehicles with minimum noise output including tyre noise, exhaust and compressor/fan noise; • Conduct noise survey at the property line and at the location of critical receptors when the Project attains full production capacity and annually thereafter during daytime and night-time hours to confirm compliance; and • Overpressure arising from blasting activities shall be monitored and recorded to assure compliance and respond to community complaints regarding blast noise.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation

<table>
<tr><td rowspan="5">Regulations and Compliance</td><td colspan="3">Blasting overpressure shall not exceed a sound power level of 115 dB(A) for 95% of all blasts and no blast shall exceed 120 dB(A) (ANZEC, 1990).
The following table shows maximum allowable noise emission levels adopted by IFC (2007). Noise levels should not exceed these levels, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.</td></tr>
<tr><td></td><td colspan="2">One Hour L_{Aeq} (dBA)</td></tr>
<tr><td>Receptor</td><td>Daytime
0700 – 2200 (hrs)</td><td>Night-time
2200 – 0700(hrs)</td></tr>
<tr><td>Residential, Institutional, Educational</td><td>55</td><td>45</td></tr>
<tr><td>Industrial, Commercial</td><td>70</td><td>70</td></tr>
<tr><td rowspan="3">Reporting</td><td>Monthly</td><td colspan="2">MWMCL Management Team</td></tr>
<tr><td>Annually</td><td colspan="2">Department of Environmental Conservation (DEC)</td></tr>
<tr><td>Annually</td><td colspan="2">DEC and Department of Mines</td></tr>
<tr><td colspan="4">Notes:</td></tr>
</table>

9.2 VIBRATION

Section: 9.2	Title: Vibration
Date: 16 October 2013	
Purpose	This SMP relates to the control of vibration from the Project. Potential impacts associated with vibration include damage to buildings and nuisance to the community.
Timing	Vibration will be monitored continuously over the construction, operations and closure phases of the Project.
Location	Vibration monitoring will be conducted at the same location as for noise monitoring. Six monitoring stations are located on the Letpadaung site at the following locations: on the western boundary near the village of Moe Goe Pyn South; at the southeast corner of the site adjacent to the SX/EW plant; north of the site near the village of Aungchans; on the northern boundary near the village of Kyaw; on the eastern boundary near the village of Shwehlay; and at the northeast corner near the construction camp site. These locations take into account the location of sensitive receptors such as villages and the accommodation area.
Action	The primary source of vibration from the operational phase will be blasting in the pit. Background vibration levels at dwelling locations around the site have been measured to determine existing levels of vibration prior to operations. Modelling has also been carried out which shows that vibration levels from operational activities, particularly blasting, is within the levels set by the German standard used for acceptable vibration levels for protection of structures (DIN 4150-3).[66] Monitoring should be conducted to ensure that the blasting program is able to comply with the prescribed standard. This will enable changes to be made to the blasting methods if it is found that the levels do not comply. Monitoring should be done over a sufficient number of blasts to show consistent results, usually a minimum of five. General vibration control measures during mining/production operations may include: • Only blast during daytime hours; • Do not blast at the same time as nearby mines; • Monitor blasts and revise blast design, as required; • Limit ground-borne vibration and minimize air over pressure by taking care in unusual situations e.g. corners and geological considerations in blast; • Adequate stemming of holes; • Use of down-hole initiation with short delay detonators; this improves fragmentation whilst at the same time minimises ground vibration which is directly related to Maximum Instantaneous Charge (MIC) and not to the total charge in the blast; • Ensure the correct blasting ratio is obtained (the blasting ratio is a measure of the amount of work expected per unit volume of explosives i.e. tonnes/kg);

[66] DIN 4150-3 (1999-02) Structural vibration - Effects of vibration on structures

<table>
<tr><td></td><td>

- Notify nearest residences (if present) prior to the blast;
- Eliminate exposed detonating cord and secondary blasting;
- Restrict blasts to favourable weather conditions (wind and temperature gradient);
- Use hole spacing to ensure that the explosive force is just sufficient to break the ore to the required size; and
- Perform blasting in depressed pits.

</td></tr>
<tr><td>Regulations and Compliance</td><td>IFC does not have a standard for vibration associated with community health. The ANZEC guideline for ground vibration suggests the adoption of a standard of 5 mm/s for 95% of all blasts with no blast to exceed 10mm/s.
The following table shows allowable vibration levels using the German standard DIN 4150-3 designed to protect structural integrity of buildings.
<table>
<tr><td>Type of Structure</td><td>Guideline values for velocity in mm/s, of vibration in horizontal plane of highest floor, at all frequencies</td></tr>
<tr><td>Buildings used for commercial purposes, industrial buildings, and buildings of similar design</td><td>10</td></tr>
<tr><td>Dwellings and buildings of similar design and/or occupancy</td><td>5</td></tr>
<tr><td>Structures that, because of their particular sensitivity to vibration, cannot be classified under the classifications above and are of great intrinsic value (e.g. listed buildings under preservation order or traditional structures)</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Reporting</td><td>
<table>
<tr><td>Monthly</td><td>MWMCL Management Team</td></tr>
<tr><td>Annually</td><td>Department of Environmental Conservation (DEC)</td></tr>
<tr><td>Annually</td><td>DEC and Department of Mines</td></tr>
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<tr><td colspan="2">Notes:</td></tr>
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9.3 BLASTING AND EXPLOSIVES

<table>
<tr><td>Section: 9.3</td><td>Title: Blasting and Explosives</td></tr>
<tr><td>Date: 16 October 2013</td><td></td></tr>
<tr><td>Purpose</td><td>This SMP relates to the control of blasting and explosives use from the Project. Potential impacts associated with blasting include risk from flyrock to people and animals and nuisance to the community form dust, noise and vibration. The management of dust, noise and vibration have been set out in separate management plans.</td></tr>
<tr><td>Timing</td><td>Blasting and explosives use will be managed over the construction, operations and closure phases of the Project.</td></tr>
<tr><td>Location</td><td>The explosives magazines will be located in purpose built structures to the south of the pit adjacent to WRD3. Blasting will take place in the open pits during the life of the operation.</td></tr>
<tr><td>Action</td><td>In order to minimise effects to local communities, domestic livestock and wildlife as a result of blasting activities, the following provisions will be undertaken;
• MWMCL will obtain approval from the relevant local authorities for the transportation, storage and use of explosives;
• Shot-firers and other personnel using explosives must be licensed and appropriately trained for their duties;
• Times for blasting will be selected when the community is least sensitive to blasting impacts (e.g. day time hours);
• The local population shall be warned well in advance with dates and times of blasting (they must be allowed the opportunity to move livestock and prepare in advance);
• Warning signs and security staff must be put into place to ensure the safety of the local population during blasting;
• An audible pre-warning shall be given immediately before each blast or series of blasts; and
• Approved blasting practices shall be followed at all times.</td></tr>
<tr><td>Responsibility</td><td>Mining Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations and Compliance</td><td>• Environment Conservation Law (2012);
• Mining Regulations of the Union of Myanmar (1996);
• Dust emission limits as per Air Quality EMP;
• Vibration limits as per vibration SMP;
• Noise limits as per Noise SMP.</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Annually</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

9.4 VISUAL AMENITY

Section: 9.4	Title: Visual Amenity	
Date: 16 October 2013		
Purpose	This SMP relates to the management of visual amenity of the Project. Potential impacts associated with changes to visual amenity include loss of viewscape and loss of cultural amenity.	
Timing	Visual amenity will be considered during design, operation and closure of the Project.	
Location	The mining operation will be visible from all the surrounding villages as the Letpadaung hills are the only prominent feature in an otherwise flat landscape.	
Action	• Construction area and mine site to be kept tidy; • Clearing of vegetation around the site to be minimised; • Revegetation of disturbed areas will be carried out progressively and as soon as practicable; • Landscape planting strategy to identify appropriate revegetation to act as a visual barrier.	
Responsibility	Safety and Environment Department	
Authority	Department of Environmental Conservation	
Regulations and Compliance	• Environment Conservation Law (2012); • Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007;	
Reporting	Monthly	MWMCL Management Team
	Annually	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes:		

9.5 CULTURAL HERITAGE

Section: 9.5	Title: Cultural Heritage
Date: 18 October 2013	
Purpose	The Cultural Heritage Management Plan (CHMP) is designed to ensure that the Project has minimal impact on cultural resources through the identification of sites and chance finds; consultation with cultural heritage authorities and local populations; and appropriate measures to protect the cultural resources, including Project design modifications and excavation and relocation. Cultural resources refer to archaeological/cultural sites, chance finds unearthed during construction, and sites which hold traditional and cultural significance to local populations, including minority subgroups.
Timing	Cultural heritage impacts occur predominately in the construction phase, because land clearance and other intrusive activities are required to prepare the site and build Project facilities. Although construction is phased, the facility footprint will be determined in the first year.
Location	Irrespective of exact location, cultural heritage management shall apply to sites which require protection from disturbance or destruction as a result of Project activities.
Actions	• A management plan will be prepared for the removal of the Villey Tawya Stupa and agreed with the Ministry of Religious Affairs. The Ministry shall undertake removal of all items of significance from the site and place them in a new or reconstructed pagoda for future worship and adoration. • The Project Manager shall ensure that the procedures in the CHMP are recognised, adopted and applied by Project staff and Project contractors prior to the commencement of construction works. Construction personnel will be trained to ensure proper management of construction activities around cultural heritage sites and to follow established procedures for handling chance finds. • In cooperation with the CSD Manager, the Project Manager will consult with archaeologists familiar with the area and local communities to understand the significance of the cultural resource and culturally acceptable actions to protect it from Project activities. • The Project footprint shall be surveyed and cleared of archaeological/cultural sites prior to intrusive construction works. • Chance finds and/or disturbance to cultural heritage sites will be reported to the CSD Manager within 24 hours. • Site specific protection/retrieval plans will be developed for each known site potentially impacted by Project activities. • Scouting investigations and expert consultations to identify any additional sites potentially impacted by the Project will be undertaken early in construction. • Subsurface evaluative testing will be conducted at potentially threatened sites prior to construction activities to determine if buried cultural deposits are present. • All testing and collection will be done under an approved plan

	and conducted by experienced archaeologists/work teams recognised by the National Museum of Myanmar. • Scientific and cultural analysis and interpretation of the archaeological data collected during mitigation will be undertaken as soon as possible, and coordinated by the Community and Social Development Department. • The Community and Social Development Department shall maintain an inventory of all archaeological monitoring activities and cultural heritage management documentation arising on site and shall transmit any necessary documentation to the Environmental Department and the National Museum. • The Project Manager shall report to the CSD Manager on the implementation of the CHMP in the construction phase. Monitoring procedures include “watching briefs” conducted at sites, erection and maintenance of demarcation fencing around sites, careful siting of access routes or facilities, induction training to Project staff and contractors, cultural heritage complaints and actions taken, and causes of damage to or disruption of, cultural heritage properties and actions taken. • The CSD Manager will conduct routine inspections of site activities in consultation with the Project Manager to assess the potential for chance finds at work sites and any other cultural heritage issue that may arise. He will also inspect sites where chance finds were unearthed to ensure that the correct control procedures and engagement activities were performed.
Responsibility	MWMCL Project Manager
Authority	MWMCL Managing Director
Regulations and Compliance	IFC Performance Standard 8, Cultural Heritage, 2012.
Reporting/Audits	Monthly: MWMCL CSD Manager Annually: MWMCL Project General Manager
Notes:	

9.6 COMMUNITY HEALTH, SAFETY AND SECURITY

Section: 9.6	Title: Community Health, Safety and Security
Date: 22 October 2013	
Purpose	This SMP is designed to ensure that the Letpadaung Project protects the health, safety and security of people and communities within the vicinity of the mine site and along the transport route to the port of Pakokku.
Timing	Management will be undertaken over the construction, operations and closure phases of the Project.
Location	The plan will apply to the mine and its environs and transport route to the port of Pakokku.
Action	The International Finance Corporation (IFC) Performance Standards for Social and Environmental Sustainability set out a range of recommendations with regard to community health, safety and security in Performance Standard 4. MWMCL will comply with requirements of IFC Performance Standard 4 that are relevant to the Letpadaung Project. A range of community health, safety and security procedures have been developed to ensure the protection of local people, their properties, assets and livestock from activities associated with the Project. These are outlined below. Community Safety • Implement an Alcohol and Substance Abuse Policy which clearly sets out the requirements and rules related to alcohol use during “on-duty” and “off-duty” hours (there will be a zero tolerance to drunkenness during “on-duty” hours); • Drug and alcohol testing will be carried out in accordance with the Alcohol and Substance Abuse Policy and the programme will reinforce the requirements of the policy; • The Code of Conduct will contain rules and regulations related to illegal activities, including crimes and violence and other expectations of the workforce; • At induction all MWMCL employees, Contractor personnel and subcontractors will be instructed on the requirements of the Code of Conduct prior to their commencing work; • The Project will implement disciplinary procedures related to its workforce and any illegal conduct by Project personnel; • Entertainment and sports facilities shall be provided at construction camps to encourage workers to remain within the camp boundaries during leisure time; • Measures to ensure community safety from transportation of goods and services for the Project are outlined in the Transport SMP (9.7.1); • Measures to ensure community safety from blasting activities at the Project are outlined in the Blasting and Explosives SMP(9.3); • A high security fence will be erected around ‘high risk’ mine facilities including the mill and crusher areas; • A manned security gate and personnel identification system will be implemented by MWMCL in the absence of other reasonable measures to control site access; • All site activities will be clearly demarcated where fencing is not

	required to ensure that they are safe, visible and illuminated; • Where roads or other access routes cross site activity areas, MWMCL will be responsible for providing and maintaining safe diversions, temporary bridges, traffic controls, barricades, signs and warning lights as required; • Stock proof fencing will be erected in areas of danger for livestock and the Community Relations Team will decide on the areas to be fenced with relevant communities and livestock owners; • Watchmen should be employed to survey the Project construction sites and night-time vehicle storage areas and they will also discourage public infringement onto all Project sites; • Measures to manage the inflow of people seeking employment at the Project are outlined in the Human Resources, Training and Employment SMP (9.9.3). <u>Community Health and Wellbeing</u> • Employees will undertake a fitness to work assessment and baseline medical assessment on joining; • The health programme will include medical examination and immunisations (if required) of employees and main contractors on a regular basis; • Training will be provided to all staff, both national and expatriate, and will include awareness-raising on health considerations, including sexually transmitted diseases (STDs); • Health awareness training for workers will be conducted at induction and then periodically throughout construction and operations; • Health awareness materials will be provided in the appropriate language and disseminated through the meeting houses, Storefront Information Centres and local schools; • Medical facilities will be provided to all workers and their families at the site and there will be a dedicated ambulance service for the Project; • Medical staff from the Project may support government staff to conduct health awareness, health checks and other in-kind support services within local communities from time to time; • In the course of time, MWMCL may help to fund community inoculation programmes. <u>Community Health and Safety Awareness and Support</u> • MWMCL shall conduct a Community Health Assessment within the Project-affected villages; this will be a key piece of work and will serve to inform any health awareness and support programmes implemented by MWMCL; • Awareness-raising education and outreach events will be facilitated by MWMCL on health issues, particularly communicable diseases, including HIV/AIDS for communities close to the mine site; • MWMCL will work with local Health Departments and administrators to help them implement the Community Health Awareness Programme; • MWMCL will work with local Police Departments and administrators to help them implement a traffic awareness programme; • The Traffic Awareness Programme will inform affected communities of the potential hazards that could be encountered

from increased or altered traffic patterns and volumes on the roads used by Project-related vehicles.

Security and the Use of Force

- MWMCL will adhere to local laws as well as international standards on law enforcement in securing its operations, particularly those that relate to the use of force;
- MWMCL will carry out risk assessments in relation to security issues at each of its Project sites;
- Each MWMCL site will develop a Security Plan in order to prevent or mitigate any threats identified in its risk assessment. The Security Plan will determine how personnel will be deployed at the Project sites;
- The objective of the Security Plan will be to ensure that security is deployed in a way that respects and protects human dignity and human rights, avoids creating conflict and addresses security threats in as peaceful a way as possible;
- MWMCL will therefore seek to ensure that force is a last resort and is used in a way that minimizes damage and injury, and respects and preserves human life;
- MWMCL will only use armed guards where the above risk assessment determines that this is the only way to mitigate the risks identified or where it is required by law;
- Force should only be used for preventive and defensive purposes in proportion to the nature and extent of the threat;
- Firearms will only be used in accordance with the above principles and where human life is at risk and less extreme measures are not sufficient;
- In every instance in which a firearm is discharged, a report should be made promptly to MWMCL's central office;
- Security personnel must ensure that medical aid is given to anybody injured in any incident at the earliest possible moment;
- A community complaints process will be in place to allow the local community to express concerns about the security arrangements and acts of MWMCL security personnel;
- MWMCL will investigate any credible allegations of unlawful or abusive acts of its security personnel, take action to prevent recurrence, and report unlawful and abusive acts to public authorities when appropriate;
- Where MWMCL uses public or government security services to protect its operations, they must guarantee that existing international guidelines and standards for the use of force are respected;
- MWMCL will conduct due diligence on security providers to avoid retaining the services of any group or individual that has previously been responsible for violations of human rights or humanitarian law;
- MWMCL will provide training regarding the use of force (and where applicable, firearms) and appropriate conduct toward workers and the local community and monitor to ensure that security personnel abide by this standard.

Emergency Response

- Measures to manage community safety in the event of an emergency related to the Project are outlined in the Emergency Response SMP (9.10).

<table>
<tr><td>Responsibility</td><td>Environment/ Community Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation and Department of Mines</td></tr>
<tr><td>Regulations and Compliance</td><td>Environment Conservation Law (2012).
IFC Performance Standards for Social and Environmental Sustainability; Performance Standard #4. January 2012</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>MWMCL Management Team</td></tr><tr><td>Annually</td><td>Department of Environmental Conservation and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

9.7 TRANSPORT

9.7.1 Road Transport

Section: 9.7.1	Title: Transport
Date: 21 October 2013	Sub-title: Road Transport
Purpose	This SMP relates principally to the road transport of materials and supplies to the site together with copper cathode and waste generated from the Project site. The predominant mode of transport will be via barge along the Irrawaddy River. However, over the dry season, river levels are such that barges can generally only venture as far upstream as the town of Pakokku. At this time of the year it will be necessary to transport materials via road between the Project and Pakokku. Explosives will be transported to the site by truck from China (crossing the border at the town of Muse). Potential road transport impacts include animal road kills, driver and public safety concerns, safety issues related to transportation along the route, and environmental risks due to spillage of hazardous materials. Road transport routes are shown in Figure 9.7.1.
Timing	Road transport of materials to and from site will occur over the construction and operation phases of the Project.
Location	Road transport monitoring and management for the Project will be conducted as follows: • Between the Project and Pakokku, over the dry season, for transport of general materials and copper cathode. • Between Muse and the Project, all year round, for haulage of explosives.
Action	Quality and condition of access roads, the number, frequency and size of trucks transporting materials to and from site, truck maintenance and mechanical inspection records, as well as any transport related incidents or accidents will be recorded and monitored. Related SMPs / EMPs that are applicable include those for noise, hydrocarbons, dust, air quality, community health and safety, emergency preparedness and response, and occupational health and safety. General measures to mitigate / manage road transport related impacts associated with mine construction and operation include: • Drivers and mechanics will be trained to ensure safe operation, maintenance, repair and material handling. • Vehicle transport will be limited to day light hours, as much as possible. • Truck traffic will be planned, where possible, to avoid passing through towns during busy pedestrian periods (e.g. market days and school start / finish). • At least one vehicle in each transportation convoy will be equipped with a suitable VHF radio for routine and emergency communications. • All drivers will be trained in safe handling of hydrocarbons /

<table>
<tr><td></td><td>hazardous materials and EMSC emergency response procedures.
Spill response equipment will be kept and maintained on trucks.
Mine trucks will have a speed limit set for travel through villages where there are no posted speed limits.
MWMCL will sponsor a Traffic Awareness Programme for affected villages to reduce the risk of accident.
Access roads to site will be upgraded for safety and signage.
Fencing and pedestrian crossings adjacent to schools.
Drug and alcohol testing of drivers.
Enforcement of safe working hours with adequate rest breaks for drivers.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>IFC Environmental Health and Safety Guidelines for Mining will be used as a guide for various aspects of transportation associated with the project site.</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>Environmental Manager</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes</td></tr>
</table>

9.7.2 River Transport

Section: 9.7.2	Title: Transport
Date: 21 October 2013	Sub-title: River Transport
Purpose	This SMP relates principally to the river transport of materials, supplies and copper cathode to and from the site. The destination of materials from the Project will be the port at Pathein in the Irrawaddy delta of Myanmar. The majority of materials, destined for site, will be shipped to the Port of Pathein and will then be transported via river barge to the Letpadaung site. Copper cathode and back-haul transport will follow the same route and the copper will be shipped from Pathein to China. The predominant mode of transport will be via barge along the Irrawaddy River. During the wet season the depth of flow in the Chindwin River (a tributary of the Irrawaddy that flows past Letpadaung) is adequate to allow barge access to a landing adjacent to site. However, over the dry season, river levels are such that barges can generally only venture as far upstream as the town of Pakokku. At this time of the year it will be necessary to transport materials via road between the Project and Pakokku. Transport of goods via barge is commonplace along the Irrawaddy and Chindwin Rivers so additional barge traffic associated with the Project is not expected to have significant impact. Potential river transport impacts include safety issues related to working over water, and environmental risks due to spillage of hazardous materials. River transport routes are shown in Figure 9.7.1.
Timing	Transport of materials to and from site will occur over the construction and operation phases of the Project.
Location	River transport monitoring and management for the Project will be conducted between the Project and the port of Pathein for transport of general materials and copper cathode.
Action	The number, frequency and size of barges transporting materials to and from site, barge condition, maintenance and mechanical inspection records, as well as any transport related incidents or accidents will be recorded and monitored. Related SMPs / EMPs that are applicable include those for hydrocarbons, surface water, emergency preparedness and response, and occupational health and safety. General measures to mitigate / manage river transport related impacts associated with mine construction and operation include: • Barge operators and mechanics will be trained to ensure safe operation, maintenance, repair and material handling. • Barge loading and unloading will be limited to day light hours, as much as possible. • Barges will be equipped with a suitable VHF radio for routine and emergency communications. • Barge operators will be trained in safe handling of hydrocarbons / hazardous materials and EMSC emergency response procedures. • Spill response equipment will be kept and maintained on barges and load out facilities.

<table>
<tr><td></td><td>Drug and alcohol testing of barge operators.
Enforcement of safe working hours with adequate rest breaks for barge operators.</td></tr>
<tr><td>Responsibility</td><td>Safety and Environment Department</td></tr>
<tr><td>Authority</td><td>Department of Environmental Conservation</td></tr>
<tr><td>Regulations</td><td>A Field Guide to Fuel Handling, Transportation and Storage (British Colombia Ministry of Water, Land and Air Protection) will be used as general guide for managing potential river transport impacts.</td></tr>
<tr><td>Reporting</td><td><table><tr><td>Monthly</td><td>Environmental Manager</td></tr><tr><td>Quarterly</td><td>Department of Environmental Conservation (DEC)</td></tr><tr><td>Annually</td><td>DEC and Department of Mines</td></tr></table></td></tr>
<tr><td colspan="2">Notes</td></tr>
</table>

9.8 LAND USE AND RESETTLEMENT

9.8.1 Future Land Use

Section: 9.8.1	Title: Land Use and Resettlement
Date: 16 October 2013	Sub-title: Future Land Use
Purpose	This SMP relates to planning of a future land use for the site prior to closure of mining operations.
Timing	Discussions will take place with the community and government departments to develop options for future land use during the course of operations such that a future land use plan can be put into effect at closure.
Location	The plan will cover the extent of the mining operation and leased area as well as those adjacent areas that experience change as a result of the Project.
Action	In order to develop a conceptual future land use plan, a number of consultations and studies will be undertaken during the mine operations phase to refine the plan. These are likely to include: • Identification of potential future land uses and land suitable for those purposes; • Consultation with the local population to determine preferred final land use options; • Consultation with government to establish final land use parameters; • Rehabilitation trials to assess most appropriate rehabilitation; • Revegetation strategies for each key area on the site; • Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes and • Development of a strategic local and regional plan to address the likely changes in land use and economic development in the area during and after the Project life.
Responsibility	Community Relations/Environment Department
Authority	Department of Environmental Conservation/Department of Mines/Department of Regional Development/Salingyi Township Planning Department
Regulations and Compliance	• Environment Conservation Law (2012); • Mining Regulations of the Union of Myanmar (1996); • IFC (2012). Performance Standards for Social and Environmental Sustainability.
Reporting	Monthly: MWMCL Management Team Annually: Department of Environmental Conservation (DEC) and Department of Mines
Notes:	

9.8.2 Resettlement Action Plan

A resettlement action plan is included at Appendix M.

9.9 COMMUNITY ENGAGEMENT

9.9.1 Community and Social Development

Section: 9.9.1	Title: Community and Social Development
Date: 18 October 2013	
Purpose	The community and social development plan (CSDP) is an action plan that sets out the roles and responsibilities of the Project towards designated communities considered to be affected by the Project, and the consultation approach and activities and capacity building measures to be implemented in these communities. Known direct impacts include relocation of communities and cultural resources, the provision of employment and training to targeted communities, upgrading and provision of medical facilities, inconveniences caused by Project activities (dust, noise, etc.). Consultations to obtain local input into Project design and in proposed mitigation measures are planned for the project phases. Monitoring, reporting, and budgeting of the CSD activities are also summarised. The management of the impacts on the communities are detailed in separate SMPs and EMPs. The CSDP complements the Stakeholder Engagement Management Plan.
Timing	Consultation with the communities takes place in all Project phases; the highest volume is in the construction phase when public disclosure about the Project activities and any foreseeable impacts takes place, and the solicitation of concerns on these activities and impacts is also ascertained and reported back to MWMCL for consideration in design and implementation arrangements.
Location	Community consultations predominately take place in the designated villages.
Actions	• MWMCL will develop new criteria to reselect project-affected communities for engagement; emphasis will be made on those particularly adversely affected by the Project activities, the number of which will be kept to a manageable number (maximum of 15). • MWMCL will adopt a consultation strategy, tailored for the specific Project activity, for all activities requiring information disclosure and/or no-objection from the target communities (TCs) for all phases of the Project. A brief action plan shall be made for each consultation. The strategy will distinguish between consultations about the Project activities and associated impacts and consultations about community social development based on MWMCL's philanthropy, which should be viewed as a separate group of activities altogether. • Regarding MWMCL's philanthropic strategy, the process for determining community priorities and deciding which priorities to fund will be elaborated therein. Community grants shall be made on an annual basis and shall require communities to contribute labour as partial payment towards the grant. In the case of infrastructure, MWMCL will train designated individuals

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<tr><td></td><td colspan="2">from the recipient village(s) how to maintain the infrastructure. Monitoring of the maintenance requirements will be conducted on a regular basis, and any neglect of the infrastructure will result in the exclusion of the village from future financing.

In order to fulfill the Corporate Social Responsibility (CSR), MWMCL is willing to implement the Community and Social Development Plan by providing cash, materials and/or free engineering construction, the value of which shall be approximately 1 million USD per year before the Letpadaung Project is in full operation.
Once the Letpadaung Project is in full operation, the Parties concerned (ME(1), MEHL & MWMCL) agree to allocate (2%) of their respective net profit from the Letpadaung Project according to their respective audited annual financial report for the CSR activities, which should be discussed and allocated in the nearest JMC meeting.
MWMCL will adopt engagement protocols that set out behavioural expectations for the consultative team(s) to adhere. These include: respecting local social and cultural practices, communicating in a culturally sensitive manner, adopting appropriate dress, using simple language and diagrams for ease of comprehension consistent with the capacity of the community, etc.
MWMCL will ensure that there is adequate staff resources and funding for all CSD activities. MWMCL will hire professional CSD staff to serve on the CSD Team which will be managed by the CSD Team Project Manager. Key roles of the CSD personnel will be developed with experience and skill requirements for each position specified. The CSD Team will recruit liaison officers from the TCs to help them implement the CSD activities. The CSD Team Project Manager will coordinate CSD activities with the External Affairs Coordinator responsible for stakeholder engagement implementation.
MWMCL managers and personnel working with the TCs (including media) shall be provided with training in social development/media relations as required.
Monitoring of key performance indicators shall take place on a regular basis. The Community Relations Manager will report monthly on CSD activities, and the MWMCL Project General Manager will conduct quarterly audits.
</td></tr>
<tr><td>Responsibility</td><td colspan="2">MWMCL CSD Committee</td></tr>
<tr><td>Authority</td><td colspan="2">MWMCL Managing Director</td></tr>
<tr><td>Regulations and Compliance</td><td colspan="2">IFC Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts.</td></tr>
<tr><td>Reporting</td><td>Monthly</td><td>MWMCL Community Relations Manager</td></tr>
<tr><td rowspan="2">Audits</td><td>Annually</td><td>MWMCL Project General Manager</td></tr>
<tr><td>Annually</td><td>MWMCL CSD Committee</td></tr>
<tr><td colspan="3">Notes:</td></tr>
</table>

9.9.2 Stakeholder Engagement

Section: 9.9.2	Title: Stakeholder Engagement
Date: 18 October 2013	
Purpose	The purpose of the SEMP is to set out the principles underlying, the processes for, and timing of, systematic and coordinated stakeholder engagement with Project stakeholders. The overall objectives of stakeholder engagement are to disclose information about the Project on a rolling basis and to learn how Project activities are viewed by the main stakeholders so that their concerns can be addressed in project design and implementation. In the construction phase particularly, the emphasis of stakeholder engagement is on informing, and gaining general consensus, from local communities about the nature and timing of the construction activities and on the resultant foreseeable social, health and environmental impacts and associated mitigation measures. The key tools for engaging local communities are the Community and Social Development Plan (CSDP) and the complimentary Resettlement Action Plan (RAP), Cultural Heritage Management Plan (CHMP) and the Natural Resources Management Plan (NRMP). Specified actions in these plans will be coordinated with the SEMP.
Timing	Consultation with stakeholders takes place in all Project phases. In the construction phase, the volume of consultations and topics for discussion is high and mainly concerns local communities' receptivity toward planned Project activities.
Location	Varies by stakeholder group and purpose of the consultation (interviews, meeting, focus groups, workshops, presentations, etc.)
Actions	• MWMCL shall adhere to the principle of free, prior and informed consent to the greatest extent possible (see note). In instances where it is not possible to obtain general consensus, MWMCL will pursue options that are congruent with international good practice. • MWMCL will identify the Project's primary and secondary stakeholder groups and the issues on which they shall be consulted. Likely primary stakeholders are: Sagaing Division Government and relevant land, cadastre, roads authorities; Project management and employees; Project Implementation Committee, Project-affected persons; community leaders; target communities; local business and community groups and NGOs; and suppliers. • MWMCL will construct a list of all the key consultations to be carried out in each phase of the Project, indicating the stakeholder group(s), purpose and issues to be addressed, timing with respect to Project activity, method of engagement, and venue for the consultation, and responsible party. All engagements shall be coordinated so as to maximise active stakeholder participation and receptivity. The actual hosting and planning of the consultation will reside with the relevant responsible party (e.g. the CSD team for village consultations). • MWMCL will establish stakeholder engagement procedures/protocols applicable to any consultation with non-

	Project persons and groups to guide the Project Management Team and Project contractors/subcontractors. Specific communication protocols shall be established for dealing with the media and NGOs. • MWMCL shall maintain a master database of all consultations, specifying the outcome(s) and any resultant management actions and follow-up activities. • MWMCL shall establish a Grievance Mechanism to process stakeholder complaints, take any corrective actions, and inform the complainant of the outcome. • MWMCL will ensure that there is adequate staff resources and funding for all stakeholder engagement activities. MWMCL will hire a dedicated External Affairs Coordinator responsible for implementing the Project's Stakeholder Engagement Program who will report to the Deputy General Manager and work alongside the Public Relations Officer. The External Affairs Coordinator shall be a qualified Myanmar national with no immediate associations in Sagaing Division. S/he will be trained in MWMCL communication protocols for dealing with the media and NGOs. • Performance indicators measuring the effectiveness of stakeholder engagement shall be tracked and assessed at regular intervals.
Responsibility	MWMCL Deputy General Manager
Authority	MWMCL Managing Director
Regulations and Compliance	IFC Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts.
Reporting	Monthly: MWMCL External Affairs Coordinator Annually: MWMCL Project General Manager
Audits	Annually: MWMCL CSD Committee
Notes: Project construction was commenced prior to the commencement of the ESIA and stakeholder engagement and, as a result, the principle of free, prior and informed consent (FPIC) was not adopted.	

9.9.3 Human Resources, Engagement and Training

Section: 9.9.3	Title: Human Resources, Training and Employment
Date: 22 October 2013	
Purpose	The Human Resources (HR), Training and Employment Management Plan is designed to ensure that local employment is maximised and enhanced through effective, fair and transparent procedures for recruitment, employment and training of personnel. This Plan complements the Company's Recruitment and Training Arrangement Guidelines. Approximately 2000 workers will be required for the construction of the mine and ancillary facilities, and 1500 for the peak of the operational phase. Currently Myanmar Yang Tse Copper Ltd employs 1,831 personnel who come from villages located in Salingyi, Yin Mar Bin, Pale, and Monywa Townships, of which 555 are permanent staff. Eligible persons and households who are affected by resettlement will be given employment as compensation for loss of income resulting from displacement or land take. This Plan specifies the eligibility rules regarding the hiring of personnel from these households in the construction phase.
Timing	HR management is required at all phases of the Project, and is particularly demanding in the construction phase, where manpower (and associated training) requirements for the Project activities peak. Preferential employment of persons from the affected households will take place early in the construction phase.
Location	The vast majority of personnel will be based at the Project site, living in nearby villages or in accommodation housing. Some expatriate contractors will have fly in, fly out arrangements.
Action	The main elements of the Plan are: 1) Local preference: Expatriates will only be brought in as (a) skilled and experienced operators for specific mining and processing plant and machinery, not available in-country; (b) skilled and experienced mine trained supervisors in mining, processing and engineering; and (c) high level mining industry professionals. 2) Experienced Myanmar nationals with transferable skills will be identified and retrained to the standards required for an international mining project. 3) Most expat labour will be gradually replaced by local labour in the operational phase. 4) All employees and relevant contractors will be trained for the requirements of the position they are holding, including specialised training where applicable, e.g. chance finds procedures. 5) Recruitment procedures will be transparent, public and open to all and shall be publicised in advance, including distribution of information to affected communities and regional stakeholders. Priority will be given to applicants entitled to compensation (see below). 6) Efforts to control against migration influx of job seekers in to the Project area will take place through proactive policies

	and procedures. 7) Employment conditions will meet national laws and international standards. There shall be no discrimination on the basis of religion, ethnicity, gender, and age. Employment conditions, including recruitment policies and procedures, wages and salaries, overtime hours, leave, social security and training are specified in the Company's Recruitment and Training Arrangement Guidelines. 8) Principles of Preferential Employment to Eligible Affected Persons/Households. • Applicants must be from households that are legally registered and entitled for compensation by the land requisition process of the Project. • The applicant must pass the medical check-up arranged by the Company, aged between 18 to 60, and agree to accept the Company's Recruitment and Training Arrangement Guidelines, and abide by Company regulations. • For the four relocated villages: The Company will provide one job to each household that was relocated to a new site. • For the 26 affected villages: Households that lost less than 5 acres and all of its land will be allocated one job. Households that lost between 5 to 10 acres will be allocated one job. Households that lost between 10 to 20 acres will be allocated 2 jobs. Household that lost more than 20 acres will be allocated 3 jobs. • All the certified full-time graduates in the affected villages will be recruited as on-the-job trainees and become the employees of Wanbao after trained by the Company for five months and proven to be qualified. • Regarding those households with members who are not capable of working for the Company or those who don't meet the above criteria but fully rely on farming in the Project area for their livelihoods, the Company will provide specialised assistance on a case by case basis under the advice and assistance of the Regional Government.
Responsibility	Human Resources Department
Authority	Ministry of Labour, Employment and Social Security
Regulations and Compliance	• Recruitment and Training Arrangement Guidelines for Myanmar Wanbao Mining Copper Limited (2013). • The Labour Organisation Law, (2011). • The Settlement of Labour Dispute Law, (2012). • The Minimum Wage Law (Draft), (2012). • Employment and Training Act, (1950). • Leave and Holiday Act, (1951).
Reporting	Monthly: MWMCL Management Team Annually: Ministry of Labour, Employment and Social Security

9.10 EMERGENCY RESPONSE

Section: 9.10	Title: Emergency Response
Date: 17 October 2013	
Purpose	This SMP relates to the management of emergency response. The plan will provide information to assist and inform all personnel on site so that they can respond to any site emergencies that have the potential to adversely affect the natural environment and/or the safety of personnel.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the Project.
Location	The plan will apply throughout the Project site.
Action	The Emergency Response Plan allows for the fact that emergency events can occur and develop rapidly, requiring personnel to act without waiting for further guidance. The following shall be considered in the implementation of any emergency response: • Health or epidemic alert; • Liaison with the local health authorities; • Equipment requirements to assist in an emergency situation; • Training requirements; • Personnel needs – resources; • Public interface; • Environmental impact; • Social impact; and • Reputation of stakeholders and the Project. On discovery of an incident, the On-Scene Coordinator will undertake an initial assessment of the emergency and collect the following key information: • The nature of the incident; • What hazards are involved; • Who is in charge; • Location of the incident; • The physical situation; • Type of substances involved; and • Injuries to people. Following completion of the initial assessment, the On-Scene Coordinator shall consult with the General Manager or his designate to identify the need to notify government agencies for advice or assistance.
Responsibility	Safety and Environment Department
Authority	Department of Environmental Conservation
Regulations and Compliance	• Environment Conservation Law (2012); • Mining Regulations of the Union of Myanmar (1996); • Environmental, Health and Safety General Guidelines: Community Health and Safety, IFC/World Bank Group, 10th December 2007.

Reporting	Monthly	MWMCL Management Team
	Annually	Department of Environmental Conservation (DEC)
	Annually	DEC and Department of Mines
Notes:		

9.11 HEALTH

Section: 9.11	Title: Accommodation
Date: 17 October 2013	
Purpose	This SMP relates to the management of accommodation for the Project. The Accommodation Management Plan is designed to ensure that appropriate standards are adopted for the accommodation provided by the Letpadaung Project, for employees and contractors of MWMCL.
Timing	Management will be undertaken continuously over the construction, operations and closure phases of the Project.
Location	The plan will apply to those areas designated for accommodation of construction and operational personnel.
Action	The following standards apply to the accommodation facilities: 1. Accommodation and sanitary facilities: • Not more than eight workers accommodated in the same room, with separate beds for each worker, partitions to ensure privacy and a minimum distance of one metre between beds; • Not more than one worker per five square metre (surface) and one worker per ten cubic metre (volume); • 100 litres of water per worker per day are available on average for personal hygiene purposes. This water is drinking water quality unless explicitly marked otherwise; • One hand wash sink per ten persons; • One toilet per ten persons; • One urinal per fifteen persons; • One shower per ten persons; • Regular cleaning of sanitary facilities and regular washing of bed linen; • Separate storage provided for work boots and Personal Protective Equipment (PPE). 2. Gender: separate sleeping areas and separate sanitary facilities are provided for men and women; 3. Comfort, culture and recreation: • Facilities for the storage of workers' personal belongings are provided; • Facilities are provided for observance of religion as defined in consultation with workers' representatives; • Television and internet are provided in dedicated facilities allowing inexpensive phone calls. 4. Safety: • Both natural and artificial lighting are provided and maintained in living facilities. Emergency lighting is provided; • Extinguishers are provided and fire emergency procedures are in place, with trained Fire Wardens in each accommodation block.

Responsibility	Environment/Community Department
Authority	Department of Mines
Regulations and Compliance	• Workers' Accommodation: Processes and Standards, IFC/EBRD, August 2009.
Reporting	Monthly — MWMCL Management Team Annually — Department of Mines
Notes:	

10. ENVIRONMENTAL AND SOCIAL MONITORING PLAN

10.1 INTRODUCTION

Monitoring is a key tool to ensure that impact mitigation plans are working effectively and to assess compliance against regulatory requirements and other agreed performance standards. Monitoring is also used to identify areas of non-compliance and/or poor performance and to assess the effectiveness of measure to improve performance. Monitoring enables mitigation and management measures to be adjusted to respond to inevitable changing conditions and the unexpected.

Mitigation and management of a project before it is constructed depend on assessment of potential impacts and public and government concerns expressed through consultation and the approval process. It is almost impossible to fully and accurately predict all environmental impacts which might arise from a project at this early stage. Even the best impact assessment may fail to identify and mitigate all negative impacts which a project could have on the natural and social environment. In addition, no project is implemented in a static environment. Other changes in other conditions could lead to negative environmental impacts arising from a project which it would have been impossible to predict at the time of assessment. For these reasons, monitoring and evaluation of a project's environmental impact following approval and implementation is an important part of the overall project cycle.

General procedures regarding monitoring are included in each of the individual environmental and social management plans. Specific information pertaining to monitoring type, frequency, and locations is included herein.

10.1 AIR QUALITY

Monitoring of changes in ambient air quality will be done to ensure that air quality in the area does not undergo any adverse changes over the life of the Project. It will require establishing representative sampling locations to assess the potential effects of fugitive emissions during construction and mine operations.

An air quality risk assessment plan shall be prepared which will:

- Identify zones (or areas) of different severity levels with respect to their vulnerability to potential impacts of air emissions;
- Help identify emissions or sources of greatest risk to beneficial uses of the environment;
- Provide for assessment of the environmental and health impacts of air emissions and establishment of air quality management priorities; and

- Serve as a basis for selecting locations for dust and gaseous emission monitoring and for establishing mitigation measures.
- An air quality emergency mitigation plan shall also be prepared which will:
- Outline procedures for coordinating activities with local authorities and local health institutions to develop an Emergency Abatement plan;
- Specify arrangements and procedures for having local communities report adverse health effects experienced as a result of release of dust and gaseous emissions into the environment; and
- Establish air pollution alert procedures and protocols; implementation strategy for an emergency abatement plan if the concentration of air quality indicator is predicted to exceed the standard limit.

The significant contributors to air quality impacts from the Project are dust and acid mist.

10.1.1 Dust

Seven permanent dust monitoring stations are located on the Letpadaung site at the following locations: on the western boundary near the village of Moe Gyp Pyn South; at the southeast corner of the site adjacent to the SX/EW plant; at the northeast corner of the site near the village of Tan Daw; on the northern boundary near the village of Kyaw; on the north-western boundary near the village of Phaunga South; on the eastern boundary near the village of Shwehlay; and at the northeast corner near the construction camp site (Figure 4.10.4). These locations take into account the prevailing wind directions in the dry seasons and wet season.

There will be continuous monitoring of TSP, PM10, and PM2.5. These parameters will be downloaded on a weekly basis.

Table 10.1: Dust sampling requirements

Parameter	Sampling Frequency	Sampling Duration
TSP	Weekly	24 hrs
PM_{10}	Weekly	24 hrs
$PM_{2.5}$	Weekly	24 hrs

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a weekly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;

- Planned activities during the next reporting period; and
- Any other issues of concern.

10.2.2 Acid Mist

Acid mist generation should be measured continuously when acid is being added to heap leach pads and in and around the SX/EW plant during its operation

Two permanent monitoring stations are to be located on the Letpadaung site at the southeast corner of the site adjacent to the SX/EW plant and further to the west adjacent to HLP 2. Additional monitoring should be undertaken, using portable monitors, along the southern and western boundaries of the site in the vicinity of areas of the HLP being irrigated. Monitoring inside the site should also be undertaken downwind of the areas of the HLPs being irrigated. These locations take into account the prevailing wind directions in the dry seasons and wet season. They will enable acid mist entering and leaving the site, particularly near sensitive receptors, to be monitored at any particular time.

Where the potential source of the complaint lies outside the collection zone of the monitoring stations, portable monitors shall be positioned to enable downwind samples to be taken at heights of 1, 3 and 5 m above the ground surface for a period of 1 hour sequentially for a period of 9 hours, to determine the likely emission source associated with the complaint. Wind direction measurements and intensity shall be taken at the same time.

Sampling may be performed by collection of sulphuric acid on a cellulose membrane filter and then analysis conducted using a recognised laboratory technique to determine the level of sulphuric acid present. Alternatively detector tubes certified by OISH under 42CFR Part 84 can be used for direct reading of the acid level in the atmosphere.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a weekly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern

10.1.2 Greenhouse Gas

The monitoring of greenhouse gas (GHG) emissions is becoming a standard requirement under international good practice. MWMCL will conduct annual monitoring of GHG emissions. It is likely that GHG monitoring during operations will involve inventories being developed using mass balance, stoichiometric calculations and internationally accepted „factors". Key data that will be collected on a semi-continuous basis to support the inventory will include:

- Diesel consumption by mining vehicles;
- Explosives use;
- Extent of electricity import and export;
- Power generation/fuel type (emissions);
- Incineration (emissions);
- Employee road and air miles;
- Road miles by HGVs importing plant; and
- Road miles by HGVs exporting concentrate.

This data will be used to prepare an annual GHG emissions inventory and to track emissions over the course of Project development.

10.2 WATER

Surface and groundwater resources will be monitored during the life of the operation.

10.2.1 Water Usage

Water flows to, from and around the site will be measured and recorded. This will include measurement on a daily basis of the following:

- Raw water abstracted from the Chindwin River;
- Water pumped to the WWP;
- Water overflowing from the WWP;
- Water flowing to the SWP;
- HLP irrigation water pumped from the solution ponds and the SWP;
- Groundwater pumped from dewatering wells; and
- Surface water pumped from the pit.

The following climatic data will be recorded from the two weather stations on site:

Table 10.2: Climate parameters to be recorded at site weather stations

Parameter	Sampling Frequency
Temperature (^{o}C)	Twice daily (minimum and maximum)
Relative humidity (%)	Daily
Wind speed (m/s)	Every 1 to 3 hrs
Wind direction (deg.)	Every 1 to 3 hrs
Precipitation (mm)	As frequently as possible (use electronic tipping bucket)
Daily solar radiation (Wh/m^2)	Daily
Pressure (mb)	Daily
Pan evaporation (mm)	Daily

Flow meters will be fitted to pipelines onsite and will be used to measure water abstracted from the Chindwin River and water pumped between major infrastructure and ponds. Water overflow from the WWP will be measured using a v-notch weir.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.2.2 Surface Water Quality and Quantity

Seven permanent surface water monitoring stations are located on the Letpadaung site at the following sites (Figure 10.3.1):

- Just upstream of the south diversion channel inlet;
- Just downstream of the south diversion channel outlet;
- The irrigation channel at the upstream (southeast) corner; the irrigation channel at the downstream (northeast) corner;
- The spillway overflow for the WWP (north);
- The northwest Project boundary (Phaunga South); and
- The Chindwin River.

These locations account for stream flow directions and enable upstream and downstream flows and water quality at any particular time to be monitored.

Surface water flow will be measured using a v-notch weir at each of the monitoring stations. Surface water quality will be measured in the field and samples will also be

taken for laboratory testing. The following field equipment will be required: EC/TDS/pH/BOD meter; surface flow meter; water sampling gear, and GPS.

Field measurements will be taken monthly, and during periods of flooding.

Table 10.3: Surface water quality sampling requirements

Parameter	Sampling Frequency
Flow rate	Monthly
Water level	Monthly
pH	Monthly
Electrical conductivity	Monthly
Temperature	Monthly
Turbidity	Monthly

Laboratory testing of samples will be performed monthly and will include oil and grease, phosphates, sulphates, chlorides, phenols, COD, BOD_5, TDS, TSS, and metals.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.2.3 Groundwater

Groundwater quantity and quality will be measured both on and off the site. A detailed groundwater level and quality monitoring network will be established over the region to monitor the impacts of production from water wells and from pit dewatering activities (Figure 10.3.1). The monitoring will include points in the shallow alluvial aquifers used by the local populace and in the deeper bedrock aquifers. The exact location of monitoring will depend on the location of the production water wells. Monitoring will commence before mining starts and will continue post mining. Water quality samples will be collected monthly throughout the life of the mine. Automated water level monitoring will be established to collect data on a regular basis to observe long term trends. Monitoring bore construction details are shown in Figure 10.2.1.

The development of a groundwater monitoring plan will involve:

- Collection of climate data as outlined in Table 10.2.1;

- Development of a numerical model to obtain a long-term prediction of the effects due to groundwater withdrawal/dewatering;
- The effect of groundwater withdrawal/dewatering and its implications for other environmental resources, including habitat diversity, surface water, vegetation and soil saturation;
- An inventory of all groundwater users, identifying any potential conflicts and proposed resolutions; and
- Inspection of groundwater wells.

Sampling of groundwater monitoring bores will be undertaken covering the following parameters:

Table 10.2.3: Groundwater quality sampling requirements

Parameter	Sampling Frequency
Water level	Monthly
pH	Monthly
Electrical conductivity	Monthly
Temperature	Monthly

Laboratory testing of samples will be performed monthly and will include alkalinity, nitrates, phosphates, sulphates, chlorides, COD, TDS, TSS, metals, and initially, total coliform bacteria.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.3 SOIL AND WASTE ROCK

10.3.1 Topsoil

Topsoil stripping, stockpiling and re-spreading for rehabilitation will be monitored continuously over the construction, operations and closure phases of the project. In addition changes in topsoil conditions will be monitored to ensure that they do not undergo any adverse changes over the life of the project. It will require establishing representative sampling locations to assess the potential effects of acid deposition, fugitive dust emissions and the mobilization of metals / elements through changes in

soil chemistry during construction and mine operations. Sampling of topsoil from rehabilitated areas and trial plots will be performed annually.

Monitoring will be conducted with test pits located up and down gradient (and up and down wind) from mine facilities at designated control points. The suite of analyses for the monitoring programme for soil chemistry will include:

- pH;
- anion exchange capacity;
- electrical conductivity;
- metals; and
- toluene-extractable organics.

The suite of analyses for the monitoring programme for soil structure will include:

- clay fraction;
- particle size distribution;
- water retention; and
- permeability.

Sampling frequency and parameters analysed will be reassessed based on results from air quality and surface water monitoring results but are likely to be more frequent during the rainy season, to correspond with rains. Monitoring shall comprise inspecting, recording and reporting of the following: quantities of topsoil removed; storage locations and quantities; the type of topsoil; and storage procedures and methods. This data will be used to develop a topsoil inventory and plan for the site that will be maintained over the life of the project.

The MWMCL Mining Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.3.2 Waste Rock Dumps

The main performance concern for the WRDs will be maintenance of the water management facilities. During mining operations, runoff collection ditches and ponds will be inspected after every major rain event, and maintenance carried out as necessary.

Physical stability of WRD slopes shall be assessed by regular pickups of survey pins installed at critical locations on dump batter slopes.

Acid rock drainage and metal leaching from waste rock and seepage will be monitored on a monthly basis during operations and continue post mining. A field assessment of waste rock net acid production potential shall be made on a flitch by flitch basis using the hydrogen peroxide oxidation method. In addition, the need for treatment of ARD drainage will be assessed from water quality samples collected during the operations and closure phases. The physical stability of WRDs and the water diversion system will be monitored annually by an independent geotechnical engineer and a report prepared for MWMCL which will be forwarded to the relevant government regulatory body. Weekly visual inspections of these facilities will be conducted by mine personnel and observations logged for inspection by the independent geotechnical engineer, and government regulators upon request. In addition, visual inspections will be done after every major rain and earthquake event.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.3.3 Erosion and Sediment Control

Sampling and testing of the different soils, ore, and waste rock materials around the site will be required. Initially this will be done to establish baseline data and then will be continued as new materials are disturbed with progressive development of the mine.

Monitoring will be conducted with test pits located up and down gradient (and up and down wind) from mine facilities at designated control points. The suite of analyses for the monitoring programme for soil chemistry will include pH; anion exchange capacity; electrical conductivity; metals; and toluene-extractable organics. The suite of analyses for the monitoring programme for soil structure will include: clay fraction (<0.002 mm); particle size distribution; water retention; permeability; and total suspended solids. Surface water turbidity will be measured in the field and samples will also be taken for laboratory testing to determine TSS.

Sampling frequency and parameters analysed will be reassessed based on results from air quality and surface water monitoring results but are likely to be more frequent

during the rainy season, to correspond with rains. Erosion monitoring shall comprise inspecting, recording and reporting of the following: quantities of vegetation removed, storage locations, quantities and type of topsoil and overburden, storage procedures and methods used, areas prone to erosion, evidence of erosion, depth of remaining in situ topsoil, condition of access roads, condition of cleared areas, condition of perimeter drains and associated settlement ponds, compliance with applicable regulatory and corporate requirements.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.3.4 Rehabilitation

Landscape Function Analysis (LFA) is a monitoring procedure developed by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO). It provides a rapid, reliable, and easily applied method for assessing and monitoring landscape restoration or rehabilitation projects.

It uses visible indicators of plants, litter and soil surface condition that gauge how effectively a landscape is infiltrating water, cycling nutrients and keeping the soil stable, healthy and productive.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern

10.4 VEGETATION AND FAUNA

10.4.1 Weed Hygiene and Control

Monitoring of weed hygiene shall be as follows:

- Inspection for evidence of invasive flora shall be performed on a monthly basis; and

- The type of invasive flora, its extent, herbicide treatment, and location shall be recorded in a database and layout plan or uploaded onto a GIS database.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern

10.4.2 Fire

Monitoring of fire shall be as follows:

- Fires within and around the Project footprint shall be reported immediately as well as the likely cause and the circumstances; and
- House-keeping and vehicle inspections (as part of general site inspections) shall be undertaken and documented. Any areas of concern or non-compliances shall be recorded.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern

10.4.3 Fauna

The Environment Manager will maintain updated records on the following:

- Wildlife mortalities (e.g., from air strikes, vehicle strikes, shooting, other sources);
- Wildlife monitoring - weekly site inspections and wildlife counts. This will include the numbers and location of:
  - Large mammals;
  - Birds (including migratory birds);
  - Reptiles (watercourses and ponds);

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.5 INDUSTRIAL WASTE MANAGEMENT

10.5.1 Non-hazardous Waste Management

The MWMCL Construction Manager shall record on a monthly basis the following:

- Construction of waste storage facilities;
- Use of recycling facilities;
- Vermin and litter control; and
- Status of wastes inventory.

The MWMCL Environment Manager shall prepare and update the Waste Inventory as the mine develops.

Inspection records will comprise the following:

- Designated waste storage locations marked on a plan;
- Each waste storage area will be numbered to facilitate inspections;
- Any spills, leaks, poor containment, lack of labelling or other issues will be recorded and reported to the relevant department for corrective action; and
- Corrective actions will be documented on completion.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.5.2 Hazardous Materials Management

All hazardous materials will be subject to strict inventory control from the time they enter the site. The MWMCL Supply Department will maintain an inventory of all hazardous substances purchased, delivered, stored and used at the mine site. This inventory will be updated on a monthly basis. Logs will be kept as required for

inspection by the regulatory agencies. The MWMCL Construction Manager will conduct routine inspections of all hazardous substances storage areas, and worksite areas to look for spills, leaks, overflows and compliance with the procedures. Where necessary, corrective actions will be recommended. The MWMCL Environmental Manager will monitor all activities to do with explosives use and storage. The MWMCL Supply Department will collect and maintain records on hazardous substances in consultation with the construction manager, for the following:

- Reconciled bulk inventory;
- Weekly use summaries;
- Weekly reconciliation for each storage area;
- Overfill alarm tests;
- Pressure tests (if applicable);
- Inspections and maintenance checks of storage tank system, piping and delivery system;
- Any alteration to the system;
- Reports of leaks or losses;
- Reports of spill responses; and
- Records of training.

10.5.3 Sewage and Wastewater

Down gradient monitoring wells will be installed 50 m from the outer perimeter of the leach field at three sites on each of the distal sides of the field from the septic tanks Shallow groundwater quality will be monitored when present on a monthly basis for parameters including:

- Faecal bacteria;
- Phosphates;
- Nitrates;
- BOD;
- Metals;
- Oil and grease (largely removed by grease traps where required); and
- Total suspended solids.

Should an increasing trend in any of the parameters become apparent, monitoring will be increased to weekly until the source of the increase is determined and management actions result in a decrease in the subject pollutant.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.6 CONCEPTUAL CLOSURE

Closure and post-closure monitoring will document the progress of the closure and reclamation effort. The elements of these monitoring programs will include:

- Inspection of the physical conditions (e.g., for evidence of erosion and landslides) at the end of the initial rainy season post-closure;
- Inspection of the plantings after the first year post-closure;
- After two years, evaluation of the effectiveness of the reclamation effort (e.g., number and type of plant species, plant heights, productivity);
- Demonstration that water quality objectives are met; and
- Assessment of the adequacy and performance of drainage structures and sediment control systems.

10.7 NOISE AND VIBRATION

Monitoring of changes in noise and vibration levels within the operational areas will be done to ensure that levels do not increase significantly over the life of the Project and do not breach thresholds limits.

Six noise monitoring stations are located on the Letpadaung site at the following locations: on the western boundary near the village of Moe Gyp Pyn South; at the southeast corner of the site adjacent to the SX/EW plant; north of the site near the village of Aungchans; on the northern boundary near the village of Kyaw; on the eastern boundary near the village of Shwehlay; and at the northeast corner near the construction camp site (Figure 4.10.3). These locations take into account the location of sensitive noise receptors such as villages and the accommodation area.

Any complaints from the community should be documented and managed through to resolution. In the event that public complaints arise, steps should be taken to investigate the root cause without delay and remedial action should be taken to correct the deficiency. Actions should ensure that similar incidents do not recur and should be reported as part of the performance reporting process.

The monitoring programme will:

- Provide clearly regulatory requirements and corporate standards for environmental performance pertaining to noise and vibration control;
- Form the link between operations, safety and environmental programs;
- Provide monitoring results that will be regularly reviewed to ensure the noise and vibration management systems are operating as designed;
- Identify the reporting requirements to document and communicate the monitoring results; and
- Ensure that all environment, health and safety (EH&S) risks are addressed.

The ambient noise monitoring program during both, the construction and operation stages should include one full day (day and night) measurements semi-annually (during wet and dry seasons) to determine noise parameters such as the equivalent continuous noise level (Leq) in decibels (dBA), the A-weighted sound pressure level that is exceeded for 10%, 50% and 90% of the time over which a given sound is measured (L10, L50 and L90) and frequency noise analysis.

A five day vibration and air blast monitoring programme should be undertaken to ensure the desired vibration (ppv not greater than 5 mm/s and 115dB(A) at Sensitive Sites) can be achieved and, if not, blast techniques amended to achieve that result.

The following items are to be included in a noise and vibration monitoring report:

- The type of monitoring test conducted (that is, the construction stage or operation);
- The noise and vibration limits (daytime & night time) for the facility;
- Description of the nearest affected receivers;
- The monitoring locations;
- The noise and vibration instrumentation used;
- The weather conditions during noise survey;
- The time and duration of monitoring, including dates;
- The results of noise and vibration monitoring at each monitoring location; and
- A statement outlining the Project's compliance or non-compliance with the limit; and
- Where noise and vibration exceedances are found; the reason for non-compliance should be stated; and the strategies to be used to manage the noise and vibration exceedance.

The MWMCL Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.8 CULTURAL HERITAGE

Cultural heritage monitoring procedures shall be as follows:

The Mining Manager shall report on a monthly basis to the Community Relations Manager on the implementation of the Management Plan during the operations phase, including:

- "Watching briefs" participated in at specific areas/construction sites;
- The erection and maintenance of demarcation fencing around sites;
- The protection of sites by careful siting of access routes or facilities;
- Induction training including cultural heritage awareness given to staff and planned training;
- Cultural heritage-related complaints and actions taken; and
- Cases of damage to, or disruption of, cultural heritage properties and actions taken.

The Community Relations Manager will conduct routine inspections of site activities in consultation with the Project Manager to assess the potential for chance finds at work sites and any other cultural heritage issues that may arise.

The Community Relations Manager will conduct an inspection of any cultural heritage field activities and documentation that are implemented as a result of a chance find or other event that results in archaeological field work. The inspection shall include:

- Details of all work specifications prepared and implemented;
- Monitoring/"watching briefs" conducted at specific construction and other sites;
- Consultation with local communities related to cultural resources;
- Communication and cooperation with the Construction Department and the National Museum;
- Review of how the Cultural Heritage Database is being maintained;
- Information dissemination regarding cultural heritage;

- Performance of the Construction Department in managing cultural resources at specific construction sites;
- Cultural heritage-related complaints and actions taken; and
- Cases of damage to, or disruption of, cultural heritage properties and actions taken.

The MWMCL Community Relations Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.9 COMMUNITY HEALTH SAFETY AND SECURITY

It is important to monitor activities at the mine site, as well as those that occur off-site, including transportation of supplies and concentrate to and from Letpadaung, to ensure that local and regional communities are protected. Community Health and Safety Monitoring Procedures shall be as follows:

Designated personnel shall report on a monthly basis to the MWMCL Community Relations Manager on the implementation of the Management Plan including:

- Workforce conduct within the community;
- Any instances of workforce non-compliance with Project rules and regulations;
- Condition of access roads and dust suppression activities;
- Security arrangement;
- Employee Personal Health Programme;
- Implementation of the substance and alcohol abuse policy; and
- Time lost to illness or disease by workers.

MWMCL Community Relations Manager shall inspect the condition of areas of activity at the site on a monthly basis and shall maintain appropriate records. The inspection shall include:

- Safety practices in areas that could impact communities;
- Spot checks of vehicles entering/exiting nearby local communities;
- Spot checks to indicate that workers and communities are aware of health issues, the Code of Conduct and other Project rules;
- Conditions of roads and other areas prone to dust;

- Health and safety inductions;
- Record for the Personal Health Programme;
- Records for the Drug and Alcohol Testing Programme;
- Lost time incident statistics; and
- Records related to education event to raise health and safety awareness in communities.

The MWMCL Community Relations Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.10 TRANSPORT

The designated manager shall report on a monthly basis to the Environment Manager on the implementation of the Management Plan during both the construction and operations phase, including:

- Quality of access roads; and
- Number and size of trucks used

The Environment Manager shall inspect the condition of areas on monthly basis and shall maintain appropriate records. The inspection shall include:

- Road conditions along the preferred truck routes;
- Driver / barge operator orientation;
- Driver / barge operator updates;
- Maintenance and mechanical inspection of trucks / barges; and
- Compliance with applicable regulatory and corporate requirements.

In addition, all trucks / barges shall be inspected for essential systems prior to each trip. The Environment Manager shall be responsible for record-keeping.

The MWMCL Community Relations Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period;

- Any other issues of concern.

10.11 STAKEHOLDER ENGAGEMENT

The Community Development Officer (CSD) shall report on a monthly basis to the Community Relations Manager, including on:

- Engagement activities;
- Level of participation by different stakeholder groups (e.g. women);
- Comments from, and feedback provided to, stakeholders;
- Commitments made to local communities by the Project;
- Disclosure materials disseminated: types, frequency, and location;
- Community attitudes and perceptions;
- Community complaints and their resolution;
- Community relations staff, their duties/activities and staff changes;
- Committees, groups and partnership activities related to engagement; and
- Project website.

The stakeholder engagement process will be used to measure the effectiveness of Letpadaung activities within the community and to track changes in the relationship between the Project and its host communities over the life of the project. MWMCL will conduct regular consultation with local communities and governments and will make known any complaints regarding the project. Monitoring will be conducted to ensure that MWMCL is achieving the actions defined in the stakeholder engagement program as well as to monitor community perceptions and attitudes. MWMCL will use the stakeholder database and tracking system that contains records for all engagement activities for the project to establish a monitoring program.

10.12 COMMUNITY AND SOCIAL DEVELOPMENT

The CSD shall monitor the implementation of the community Development program and report to the Community Relations Manager on at least a quarterly basis, including:

- Reporting of village consultation prior to projects approval;
- Reporting of any incidents or accidents;
- New or improved infrastructure developments funded;
- Reporting completion of projects and acceptance by communities;
- Reporting of feedback from communities; and
- Training, skills development and capacity building provided including the number of sessions held and number of people trained;
- The number of awareness raising materials distributed to target stakeholders;
- Public attitudes to community development initiatives; and

- Performance of the community group and implementing partners.

The Community Relations Manager shall inspect community assistance projects and documentation on a quarterly basis and shall maintain appropriate records. The inspection shall include:

- Records of community assistance activities/meetings/events;
- Records of funds disbursed;
- Feedback from local communities related to projects implemented;
- Records of training given to communities;
- Condition and operation of specific projects (e.g. for infrastructure projects);
- Status of projects already implemented;
- Review of projects being planned;
- Spot checks on the activities of the Community Action Group; and
- Review of progress and performance of implementing partners or operators.

The MWMCL Community Relations Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period; and
- Any other issues of concern.

10.13 HUMAN RESOURCES, TRAINING AND EMPLOYMENT

It is important to monitor employment and training to ensure that employment targets are met and the efforts to enhance local and national skills and employment opportunities are maximised. Human resources, employment and training monitoring procedures shall be as follows.

The Human Resources Manager shall maintain records on the following:

- Recruitment conducted;
- Recruitment and employment targets;
- How the Employment Database is being maintained;
- Training conducted/given to staff and planned;
- Interviews and random selection processes;
- Job descriptions and selection criteria;
- Information dissemination regarding employment, including vacancy announcements;

- Operation of recruitment offices;
- Equities and inequities in recruitment process (e.g. gender, ethnicity, age);
- Employee grievances and actions taken;
- Cases of corruption and disciplinary actions taken; and
- Working conditions and related issue.

The Human Resources Manager shall inspect recruitment offices and MWMCL / Contractor documentation on a monthly basis and shall maintain appropriate records. The inspection shall include:

- Records of recruitment processes;
- Records of employees hired;
- Records of hours worked;
- Records of wages paid;
- Records of National Service Demobilisation Certificates;
- Records of grievances and of disciplinary actions taken;
- Condition of workers on site and worker camp areas;
- Records of training given to staff;
- Condition and operation of recruitment offices;
- Other spot checks of relevant practices and documentation; and
- Compliance with applicable regulatory and corporate requirements.

10.14 EMERGENCY RESPONSE

A key part of preparedness for emergencies is to ensure that all preparations and emergency equipment are in place and functioning as intended. There are two aspects to this:

- routine site inspections; and
- training updates.

The Mining Manager shall report on a monthly basis to the Environment Manager on the implementation of the Management Plan including:

- Training undertaken (numbers of staff, courses etc);
- PPE quantities and locations;

The Environment Manager shall inspect the Project on a monthly basis and shall maintain appropriate records. The inspection shall include:

- Training;
- PPE;
- Site conditions;

- Observations of management practices;
- Rehearsals and exercises; and
- Compliance with applicable regulatory and corporate requirements.

The Environment Manager shall prepare and update the Emergency Response Plan on a periodic basis.

The Environment Manager will be responsible for record-keeping. Regular reporting will be undertaken via a monthly report that will be prepared and submitted to the MWMCL management team. Reporting will include:

- A summary of activities undertaken during the reporting period;
- Any material deviations or non-compliances to the Management Plan;
- Planned activities during the next reporting period;
- Any other issues of concern.

10.15 ANNUAL REPORTING

A key element in maintaining an overall understanding of the sustainability of the Project is the development of an annual report which describes all facets of the Project activities and provides the metrics to support the description provided.

MWMCL will prepare an annual report which addresses the sustainability reporting requirements of the Global Reporting Initiative (GRI). The report will address all the elements of the Initiative guidelines and the metric to demonstrate its performance consistent with the GRI intent.

MWMCL will make the report available for public review and comment and also communicate the findings through its community consultation with project-affected villages.

11. LIST OF COMMITMENTS

A consolidated summary list of environmental and social commitments that MWMCL will be expected to adopt in order to manage and mitigate potential impacts associated with the project development is provided below in Table 11.1.

Table 11.1: Project key commitments

Commitment Source	Commitment
ESIA Executive Summary	MWMCL will develop a ISO14001 compliant and certified EMS within 2 years of commencing operations.
ESIA Section 5.17	Upgrade existing barge jetty and load-out facilities at Pakokku and Letpadaung
ESIA Section 5.18.6 and 5.21	MWMCL will undertake progressive rehabilitation of Waste Rock Dumps (WRD) and other disturbed areas as they become available to a standard that achieves a safe, stable landform which supports self-sustaining native vegetation, is free draining and non-pol
ESIA Section 8.1	Continuous monitoring of air quality at two permanent monitoring stations as well as temporary mobile monitoring when complaints are made. MWMCL shall ensure that air quality complies with the standards set out in the Air Quality EMP.
ESIA Section 8.1.1	Dust Emissions from the site will meet IFC ambient air quality standards at receptor locations.
ESIA Section 8.1.2	Acid mist emissions will meet the following standards; a)Workplace - 1 mg H_2SO_4/m^3 air (8 hr shift); b)Public - $0.1 mg/m^3$ per incident.
ESIA Section 8.1.3	MWMCL will complete an energy assessment in order to determine the opportunities for energy savings.
ESIA Section 8.2.3	MWMCL will monitor groundwater level, quality, and extraction during the life of the Project.
ESIA Section 5.18.6	No contaminated water will be discharged from the site for events up to 1 in 100 year recurrence intervals
ESIA Section 8.2.2	An alternative water supply will be provided to users where their existing supply has been impacted by the Project.
ESIA Section 8.2.4	MWMCL will not allow contaminants to permeate into the groundwater through the use of adequate foundation lining in the HLPs, ore stockpiles, waste rock dumps and temporary storage facilities.
	Storage of hazardous materials shall be on an impermeable base and bunded to contain spillage.
ESIA Section 8.3.2	Topsoil and subsoil shall be stripped to an adequate depth and correctly stored for use in rehabilitation. Topsoil and subsoil stockpiles shall consist of a layer of topsoil on top of a layer of subsoil. The maximum thickness of each layer shall be 3m.
ESIA Section 8.3.4	MWMCL shall complete a materials balance study to determine the quantity of PAF and NAF material on the site.
	MWMCL shall classify all waste rock as either benign, metal leaching or acid forming prior to its excavation. Waste rock will be progressively placed within cells that are lined and capped with low permeability fill within the WRDs. On completion the WRD
ESIA Section 8.3.6	On closure the pit will be flooded and water levels managed such that the waste rock and rock within the pit walls that has the potential to produce acid or leach metals remains submerged in perpetuity. Water levels will also be maintained at a level low
ESIA Section 9.3	MWMCL will obtain approval from the relevant local authorities for the transportation, storage and use of explosives;
SWM Report	MWMCL shall operate the Storm Water Pond (SWP) and the Waste Water Pond (WWP) as specified in the Surface Water Management report. That is stormwater from the Heap Leach Pads (HLP) shall be stored in the stormwater pond. The ponds will be built such as th
SWM Report	No contaminated water will be discharged from the site for events up to 1 in 100 year recurrence intervals. Sediment laden water released from the site must comply with IFC standards, with TSS levels within 10% of the receiving water body background value
ESIA Section 9.1	Noise emissions shall conform to IFC (2007) standards for noise sensitive premises.
	Blasting overpressure shall not exceed a sound power level of 115 dB(A) for 95% of all blasts and no blast shall exceed 120 dB(A).
	Vibration levels from blasting at sensitive receptors shall not exceed a standard of 5mm/s for 95% of all blasts with no blast to exceed 10mm/s.

Table 11.2 Cont'd: Project key commitments

ESIA Section 10.15	MWMCL will prepare an annual report which addresses the sustainability reporting requirements of the Global Reporting Initiative (GRI). The report will address all the elements of the Initiative guidelines and the metric to demonstrate its performance co
	MWMCL will make the annual report available for public review and comment and also communicate the findings through its community consultation with project-affected villages.
ESIA Section 9.9.1	**Development of a Corporate Responsibility Management Plan to guide the planning and implementation of the Company's philanthropic activities in the local community. Specific actions to be included in this plan are:** MWMCL will set up a steering committee to allocate the 2% respective contributions of net profit from MEHL, Wanbao and ME1 for community social development in the form of community sub-projects/grants. The Steering Committee will consist of key represent From the overall parameters set by the Steering Committee, MWMCL will develop an operational project cycle for the subprojects. This will involve the following 4 phases: (i.) preparation and planning, (ii.) decision-making and approval, (iii.) implementa MWMCL will set up a new department responsible for implementing the program, "Corporate Social Responsibility (CSR)". This department will hire a local project manager with experience managing projects in Myanmar communities and the appropriate staff dedi
	MWMCL will change the remit of the CSD Department. The new remit of the CSD Department will be to manage the consultations of communities directly affected by the Project activities, so as to safeguard communities and their assets from harm and obtain l Recruit a CSD Team Project Manager with professional experience implementing community programs in Myanmar and who is a Myanmar national. Replace the contracted CSD Team members with a small team of professional dedicated staff of Myanmar nationals with experience implementing community programs in Myanmar. The former CSD Team members can act as liaisons with the villages and assist in CSD Develop roles and responsibilities for the CSD Team in relation to its mandate with respect to the communities and the Company. The CSD Team should not have to deliver messages from Company management/personnel as it would significantly damage the rapport Establish criteria for selecting the villages at the highest risk of being adversely impacted by the Project activities. Apply the criteria for identifying the primary village stakeholders who will be consulted on all Project-related activities and for e Develop a Consultation Plan for the construction phase with stakeholder group(s), timing and consultation method(s) specified for each Project activity/impact. Develop an internal plan for coordinating the consultations sufficiently early to obtain inform Adopt engagement protocols that set out the behavioural expectations for the CSD Team and visitors to adhere. These protocols should follow good practice in accordance with village norms and culture. Develop monitoring indicators that look at impact, such as measures of community satisfaction with the consultative process, rather than inputs used.
ESIA Section 9.9.2	**Stakeholder Engagement**
	MWMCL will hire a local External Affairs Coordinator responsible for implementing the Project's Stakeholder Engagement Program and dedicated staff to carry out all but the village consultations. All staff shall be Myanmar nationals with at least a univers
	MWMCL will train staff working on CSR, CSD and public relations/social media in MWMCL's communication protocols for dealing with questions from the media and NGOs.
	MWMCL will set out the principles for stakeholder engagement it will adopt in accordance with good practice.
ESIA Section 9	MWMCL will develop an organizational structure for the newly established CSR Department, the CSD Department, Stakeholder Engagement Program, External Affairs, Public Relations for the CESMS.

Table 11.3 Cont'd: Project key commitments

ESIA Section 9	MWMCL will develop an organizational structure for the newly established CSR Department, the CSD Department, Stakeholder Engagement Program, External Affairs, Public Relations for the CESMS.
ESIA Sections 4.10.5 and 9.5	**Cultural Heritage**
	Determine the boundaries of the Project footprint.
	Survey and relocate archaeological/cultural sites prior to intrusive construction works.
	Relocation of cemeteries and gravesites will be in accordance with legislative requirements and in consultation with descendants and Tribal authorities.
	A Phase II survey will be conducted for the excavation and documentation of all archaeological sites to be disturbed as a result of construction or operations
	Construction personnel will be trained to ensure proper management of construction activities around cultural heritage sites and to follow established procedures for handling chance finds.
ESIA Section 9.9.3	**Human Resources, Training, and Employment**
	Preference for jobs will go to eligible Project-affected households/persons in accordance with the amount of land taken from the household in the 26 affected villages. MWMCL will allocate a minimum of one job to each household that was relocated to the n
	MWMCL will provide a suitable form of livelihood assistance for those affected households fully reliant on farming in the Project area who are not capable of working for the Company or don't meet the eligibility criteria.
	MWMCL will recruit all certified full-time graduates in the affected villages as on-the-job trainees. These graduates will become employed by Wanbao after trained for five months and proven to be qualified.
	Experienced Myanmar nationals with transferable skills will be identified and retrained to the standards required for an international mining project.
	All employees and relevant contractors will be trained for the requirements of the position they are holding, including specialised training indicated in an EMP/SMP.
	Working conditions will meet international standards, to which the Republic of the Union of Myanmar is a signatory, and national standards.
	MWMCL will adopt recruitment procedures that are fair, transparent, public and open to all. These procedures will be advertised in advance, especially in the affected communities and local area overall.
ESIA Section 4.10.6	MWMCL will develop a Community Natural Resources Management Plan to compensate for restricted access to medicinal plants and other botanic resources in the Project area.
ESIA Section 9.9.6	MWMCL will comply with the requirements of IFC Performance Standard 4 with respect to community health, safety and security.
ESIA Section 4.10.4	MWMCL will develop a Resettlement Action Plan aligned with IFC Performance Standards 5, 6, and 7.
	MWMCL will develop a Grievance Mechanism that quickly and fairly addresses complaints related to resettlement, compensation and livelihood restoration.
	MWMCL will provide compensation to entitled households commensurate with the market value of land. It shall not pay compensation amounts in gross excess of current land prices.
ESIA Section 4.10.23	MWMCL will restore or improve livelihoods of relocated households through employment, training, and other assistance. It will provide transitional assistance (cash or in-kind) to relocated households in the interim period between relocation and three mon
ESIA Section 9.9.3	For those relocated households whose members are physically incapable of working for the Company or do not meet the Company's employment criteria or are fully reliant on farming, the Company will provide tangible assistance, including monetary support, up
ESIA Section 7.12.6	MWMCL will support local structures to retain/reinforce traditional values and cultural systems should they be eroding and causing intergenerational and/or family tension as a result of information diffusion and opportunities directly or indirectly result

Table 11.4 Cont'd: Project key commitments

ESIA Section 7.12.6	MWMCL will control migration influx by restricting employment to local persons and supporting local structures to manage in-migration.
ESIA Section 4.10.20	MWMCL will design the accommodation village in an appropriate town planning layout and incorporating local architectural styles.
	Sanitation, water, electricity, fuel supply infrastructure in villages will be maintained and upgraded.
	Housing conditions will be improved in the villages
ESIA Section 9.9.3	MWMCL will promote local employment by gradually replacing ex-pat personnel with locals and adopt training programs to facilitate this process
ESIA Table 7.2.1(a): Construction Phase Risk Matrix	MWMCL will progressively upgrade roads and road intersections
ESIA Section 4.10.26	MWMCL will work with government to identify alternative industries capable of absorbing mine site employees who will lose their jobs upon mine closure
ESIA Section 4.10.13	MWMCL will continue to support the provision of progressively higher quality medical care through its usual efforts and additional ones to upgrade clinics to hospital standard facilities, recruit more doctors and reduce the travel distance for basic medic
ESIA Table 7.2.1(a): Construction Phase Risk Matrix	MWMCL shall landscape and revegetate landforms back to their original character.
	MWMCL shall increase agricultural productivity of farm land around the site perimeter.
	All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into soil or groundwater.
	MWMCL will develop and implement a soil management plan.
	Waste disposal will take place off-site until general and hazardous waste sites are developed.
	MWMCL will not allow effluents to be released. Effluents are to be contained and treated.
	MWMCL will construct drainage areas, sediment control dams and use source control BMPs to mitigate against erosion.
	MWMCL will conduct additional flood modelling of the Chindwin River.
	MWMCL will resettle any dwellings significantly at risk of flooding.
	MWMCL will prepare a Resettlement Action Framework for areas potentially requiring relocation of households.
	MWMCL will take measures to reduce concentrations of dust in accordance with a Dust Management Plan which MWMCL will develop.
	MWMCL will use low sulphur fuel and monitor fuel usage and engine performance to limit greenhouse gas emissions.
	MWMCL will reduce noise disturbances by installing noise buffers in critical areas and around the perimeter, relocating noise receptors, notifying the public on blast times, limiting construction activities to daytime hours except when night time work is
	MWMCL will demarcate and protect the balance of primary woodland within the proposed mining area and prepare a Reforestation Plan.
	MWMCL will implement reforestation projects with district authorities.
	MWMCL will plant buffer areas in and around the site boundary and reserve remnant vegetation in surrounding areas. Any buffer area destroyed by fire will be rehabilitated.
	MWMCL will relocate all rare or endemic species found.
	MWMCL will implement measures to curtail the loss of wood and other natural resources.
	MWMCL will clean vehicles and inspect containers prior to entering the site to limit the spread of invasive weeds and pest species.
	MWMCL will rehabilitate construction areas after implementation.
	MWMCL will take measures to minimise light disturbances.
	MWMCL will take measures to minimise the safety risks associated with increased traffic, such as upgrading of the access route to the site, warning signage along the access road, and fencing around schools. It will also promote road safety through awarene
	MWMCL will support local policing structures and programs to limit prostitution near the site.
	MWMCL will develop and implement a Sexually Transmitted Infections Education Policy for employees and contractors, with specific controls enforced in accommodation camps.
	MWMCL will develop in conjunction with government an integrated community STI awareness campaign.
	MWMCL will support local health centres prevent the spread of communicable diseases.
	MWMCL will develop and strictly enforce an Occupational Health Management System.
	MWMCL will monitor near misses, workplace injuries and deaths associated with Project activities, including road transport and seek to lower the incidence of harmful outcomes through training, restricted working hours for requiring deep concentration, and
	MWMCL will give preference to local service providers and suppliers of goods.
	MWMCL will support microfinance initiatives and other means to promote local procurement opportunities, improve access to markets, and develop the non-mining sector.
	MWMCL will maintain the infrastructure built at the resettled villages.
	MWMCL will train and recruit medical staff to the project area through the provision of scholarships and provide medical supplies and equipment.

Table 11.5 Cont'd: Project key commitments

ESIA Table 7.2.1(b): Operational Phase Risk Matrix	MWMCL will construct the SX/EW Plant on a structurally sound, impermeable concrete base which will be regularly maintained to prevent leaks and cleaned after spills.
	Any contaminated residue removed from the solution, stormwater and wastewater ponds will be disposed of so as to minimise risk of soil contamination.
	MWMCL will develop and implement procedures to clean up uncontrolled release of HLP materials.
	Facilities engineered to good international practice for the protection of groundwater are to be constructed on site for the disposal of general waste, hazardous waste.
	Bio-remediation facility to be implemented for hydrocarbon contaminated soils.
	Water supply reserve to downstream creek users will be determined and supplemented with alternative water supplies if necessary.
	Pollution control dams will be put in place and engineered as per project proposal.
	Surface Water Management Plan to be implemented.
	MWMCL will use HLP dripper irrigation and monitor wind direction during operation of the irrigation system to minimise sulphur acid concentrations in the ambient air.
	MWMCL will enforce measures to prevent the spread of malaria and bilharzia resulting from mosquitos and other pests.
	MWMCL will establish multiple controls to reduce the safety risk due to fly rock, WRD rock falls and land slips, explosion of hazardous materials, and bush fire.
	MWMCL will support the improvement of farming practices to increase agricultural productivity to offset higher costs of living associated with a mining development.
ESIA Table 7.2.1(c): Closure Phase Risk Matrix	Care will be taken during decommissioning to prevent the release of contaminants and manage contaminated water and sediment.
	Monitoring boreholes are to be established in communities to monitor change in water levels at water supply points. MWMCL will monitor water levels on a quarterly basis and identify potential alternative water sources if local wells are significantly impa
	MWMCL will develop and implement a Care and Maintenance Plan for the management of seepage from HLP or waste rock material into the groundwater. It will also minimise the catchment area of the pit and maintain a pit lake elevation at a suitable depth to m
	MWMCL will decommission ponds and release of storm water to environment where quality is within suitable limits.
	MWMCL will develop and implement a Care and Maintenance Plan for the management of dirty water run-off from the plant area, pit, waste rock and HLP area and will install a passive water treatment wetland system. MWMCL will identify the ponds to be used o
	MWMCL will develop and implement a Care and Maintenance Plan to manage potential contamination resulting from slope failure of HLPs.
	MWMCL will erect a fence around the project site to restrict access to revegetated areas.

12. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the development of the Letpadaung Copper Project will not have a significant impact on the environment provided the management measures described in this document are implemented.

The following are considered to be key impacts associated with the Project.

12.1 ACID ROCK DRAINAGE

The acid and metals generation arising from waste rock is an extreme environmental risk to surface and groundwater in the Project area and the water potentially discharged from the Project area. Although the largest volume of this material is stored in WRDs, waste rock will also be placed in the pit. The ore in the HLPs is also acid generating and metal leaching creating a significant management issue post closure.

Unless appropriate management measures, as outlined in the EMPs in Section 8, are implemented ARD could become a fatal flaw in the environmental acceptability of the Project.

Failure to heed these requirements, from commencement of construction through operation and closure of these facilities, will leave a residual risk and legacy beyond closure of the operation.

12.2 RESETTLEMENT

Four villages within the Project lease area have been relocated to two sites prior to the commencement of construction. The Government and MEHL organised the resettlement following a consultative process with the relevant stakeholders and the participation of affected households in site selection. Broad community support for resettlement collapsed however in 2012 following NGO agitation demanding better compensation terms for the affected households. This resulted in the relocation of cooperative households only numbering 220 houses. The old villages of Sede, Zidaw, Wetme and Kandaw still exist and its residents continue to refuse to move. Other households owning land in the Project lease area refuse to relinquish it and accept compensation. Currently within the Project lease area early works activities are being carried out alongside working farms with farmers and livestock present.

The stand-off between the protesting villagers and MWMCL requires an immediate solution. A number of issues require clarification and possibly remediation. A process of identifying areas of contention and finding workable and practicable solutions is urgently required. Such a process should be undertaken within a larger process to complete the Resettlement Action Plan (RAP). The RAP should be retrospective in

nature, making corrective actions if necessary and follow good practice approaches consistent with the requirements specified in IFC Performance Standard 5.

An important feature of the RAP is the development of mitigation measures to restore/improve the livelihoods of households physically and/or economically displaced as a result of the Project. Some of these mitigation measures are incorporated in the Letpadaung Copper Mine Project, including provision of jobs at the mine, training for the acquisition and/or retention of skills, and microfinance initiatives to build local capacity especially in the non-farm sectors. Other measures remain to be developed, such as the identification of long-term income earning opportunities to those affected households who are incapable of working at the mine or do not meet the employment criteria. The proposed Community Natural Resource Management Plan is also an important mitigation measure to restore/improve living standards among those households who depend on the land in the Project area but no longer have access to it.

The ESIA also highlighted the necessity to develop a Resettlement Action Framework (RAF) as a planning device to be used in the event that households situated in the flood plain adjacent to the Chindwin River need to be relocated as a result of possible flooding. IFC Performance Standard 5 requires a RAF for sub-projects / project components whose activities may displace populations economically or physically in the future.

12.3 SOCIAL LICENSE TO OPERATE

The discord in the communities surrounding the Project area underlies the need for MWMCL to regain the trust of the villagers and the Company's "social license to operate." The first step in this process is for MWMCL to re-establish control of the consultation agenda. It can only do this through the willing and active participation of the villages. MWMCL needs the villagers to listen to the messages it wishes to convey, most importantly to safeguard them against potential harm posed by high risk Project activities, as well as to obtain their views on Project activities so that their concerns can be effectively addressed either through a discussion of the issues or by subsequently implementing tangible measures. Currently MWMCL is shut out from initiating dialogue with the dissenting villages.

To re-establish its leadership role in the consultative process, MWMCL must start with a "clean slate". For this to happen, it needs to resolve all outstanding issues expediently and fairly using processes and institutions trusted by the communities. It also needs to rebrand the CSD Programme following the recommendations in the SMPs on Public Consultation and Stakeholder Engagement. Critical in the rebranding

is the separation of consultation to ameliorate adverse impacts resulting from Project activities from consultation activities required (and the process overall) for delivering community and social infrastructure in the local area. New departments reflecting these two separate processes need to be developed and staffed with knowledgeable professionals who are accepted by those villages who will take part in the consultation programs.

Rebranding alone is insufficient to rebuild rapport with the communities; it must be followed by repeated demonstrations of MWMCL's commitment to improve the quality of life in the stakeholder communities and the local area in general. Establishing genuine and effective processes to enable community members to participate in the Project and take advantage of the proposed trainings and other opportunities to better position themselves and their children in the market place is fundamental to building and maintaining trust and rapport.

12.4 CORPORATE SOCIAL RESPONSIBILITY

A number of policy choices need to be made by Wanbao in conjunction with Regional and Local Government.

First, living standards in Myanmar are among the lowest in the world; indeed, 96% of the households interviewed for the socio-baseline subsist on less than $1.25 per day – that is, they are "extremely poor" in absolute terms. It would be entirely warranted for MWMCL to seek to improve the standard of living of all of the villages designated for investment.

Second, the socio-economic baseline identified communities who are poor in relative terms. They are the poorest of the poor. Some of the communities have a concentration of households who are relatively worse off with respect to (reported) income, while other members live in cramped housing conditions or in housing made of leaves and bamboo which provide inadequate shelter against the elements. Some communities have large concentrations of children who do not attend school regularly, if at all, because there are no primary or secondary schools in the local vicinity for schooling to be practical.

MWMCL may want to target investments to reduce poverty, increase school attendance, and improve health access and health status in those communities who have the most to gain from the intervention. This is a means-tested approach that directs investment and assistance to the most vulnerable members of society. Before adopting this approach, MWMCL would need to confirm the findings of the socio-

economic baseline analysis in consultation with the appropriate regional and local agencies.

Third, regardless of the strategy employed to direct the financing of community social development subprojects and grants, it is imperative that the funds are used as intended and that the decision-making processes for allocating the investments are publically disclosed and conducted in a fair, transparent, and auditable manner.

Fourth, good practice dictates that community investments be sustainable over time. Communities are more likely to maintain donated infrastructure when it is desired by the community, when communities are involved in the planning decisions of the infrastructure, and when community members are trained in the infrastructure's operation and/or maintenance and its monitoring. It is highly recommended that MWMCL's CSR Program incorporates mechanisms to facilitate active and informed participation of the recipient communities.

Fifth, high return investments in community infrastructure are difficult to achieve under the most favourable conditions. Experience has shown that the carte blanche injection of money into a community brings little social return and more often than not, the money is squandered to fulfil short-term needs and desires and/or diverted for unknown purposes. For investments to be sustainable:

- They must be grounded in evidence-based research; and
- Build the capacity of community members and local government to gain competency in running the activity/maintaining the infrastructure.

It is recommended that MWMCL utilise experienced national personnel and technical assistance to design and implement its CSR Plan in a professional and auditable manner.

Lastly, the success of the proposed Mine Closure Plan will ultimately depend on MWMCL's provision of capacity-building opportunities in the operational phase of the mine and the uptake of these opportunities by local residents. At mine decommissioning, the level of development in the local area should have progressively improved to a point where local government, local businesses and individual members of society are able to position themselves in the market place so that the economic, community and social developments brought about by the Letpadaung Copper Mine Project continue to function and contribute to the improved living standards of the local population.

12.5 PROTECTION OF WATER RESOURCES

Communities surrounding the Project rely on streams and community wells as the primary water sources in the area. It is thus essential that these resources be protected. Management measures to prevent the contamination of these resources are essential. Aside from waste rock, there are other potentially significant sources of pollution from the Project, such as hydrocarbons and chemical reagents used in processing. Therefore, run-off from areas where these materials are used, stored or disposed of should be contained and prevented from entering into the environment. This is also important to contain the sediment loads, detrimental to aquatic life, within the Project site. The monitoring of the impact of dewatering on the resources within community wells is also required and actions will need to be implemented to ensure that no member of the community is left without water.

12.6 NOISE AND VIBRATION

Construction and operation of the Project will result in the generation of noise and vibration. There are a number of villages close to the boundary of the Project area that are likely to be impacted by noise and vibration to a level of nuisance even with management. However, these should be events of short duration such as blasting.

The operation of vehicles and machinery, particularly at night, has the potential to be disruptive if not well managed. Management measures described in the document should prevent undue interference with people's amenity.

12.7 AIR QUALITY

Construction and operation of the Project has the potential to impact air quality. Clearing of the site and provision of exposed surfaces will result in dust if not properly managed. The acid irrigation of the HLPs can lead to acid mist which has the potential, depending upon weather conditions, to cross the boundary of the Project area and impact the community.

A range of management measures have been developed to prevent or minimise air quality impacts and if these are properly implemented impacts are unlikely.

12.8 INFLUX OF PERSONS

It is anticipated that the development of the Project will result in the immigration of persons to the area and this will need to be managed. Key to the reduction in immigration of people is the implementation of a stringent recruitment policy, particularly during the construction phase of the project, and close liaison with Village Administrators to ensure there is control on settlement of in-migrants into the

community. No persons are to be recruited on site and preference is to be given to existing members of community. A skills audit is to be undertaken and a register compiled of persons who have skills that could be used by the Project. This should be compiled as a matter of urgency and the recruitment policy communicated with the general public.

The surrounding communities are to be sensitised to the risks associated with the influx of persons. MWMCL is to implement a Community Awareness Plan that addresses such issues. In addition the influx of persons will place a strain on available resources and thus needs to be minimised.

MWMCL is to give support to local community leaders in the management of the influx of persons into the area. It is important that the integrity of the traditional structures is maintained. MWMCL is to take positive action to mitigate the negative social impacts including AIDS awareness programmes, service capacity building and ongoing and extensive community consultation.

TABLES

Table 6.6.1: Requirement List of Local Villages

Sr No	Village Name	Requirements	Priority			Action Plan	Remarks
			1	2	3		
1	Palaung	1)Job opportunity	1			To explain job opportunity is1st priority for 4 relocated villages and 2nd priority for poor and nearest villages to minesite. When we start construction phase and operation phase, Myanmar Wanbao and supplier can hire more employee but degree holders have more priority.	
		2)Library Building		2		Plan to calculate cost for construction and company will review and support.	
		3)Clinic			*	Not urgent due to mobile medical team is providing medical treatment to local villages weekly and also one country hospital is under construction for local villages.	
		4)Computer Training Class			*	Should attend in the computer training class that is conducting in Wet Mhay/KanTaw(new) village. In the next step, we will arrange more training for villagers.	
		5)Electricity for monastery	1			To calculate estimated cost and submit to the company for reviewing and supporting.	
		6)Water tube well and purification unit		2		Will put it in next year CSD plan and will discuss local government how to do.	
2	ShweHlay	1)Electricity	1			To install power line and distribute lighting for all roads and community buildings (such as monastery & school), for every households should be arranged by themselves.	
		2) Library Building		2		Plan to calculate cost for construction and company will review and support.	
		3)Firefighting truck			*	No need because the village is located between the 2 new villages which are available for fire trucks whenever they need.	
		4) Job opportunity	1			To explain job opportunity is1st priority for 4 relocated villages and 2nd priority for poor & nearest villages to mine site. When we start construction phase and operation phase, Myanmar Wanbao and supplier can hire more employee but degree holders have more priority.	

Sr No	Village Name	Requirements	Priority			Action Plan	Remarks
			1	2	3		
		5)Cemetery compound	1			Will check with engineering department that place is included or not in company's construction plan.	
		6)Water purification unit		2		Put it in next year CSD plan.	
		7) Cleaning for play ground		2		Will assist to do levelling the playground when we start construction of playground in Wet Mhay/ KanTaw (new) village.	
3	Lae Ti	1)Electricity	1			(a) To install power line and distribute lighting for all roads and community buildings (such as monastery and school), for every households should be arranged by their self. (b) Will provide Diesel (15gal/month) for road light lighting until electricity available.	
		2) Library Building		2		Plan to calculate cost for construction and company will review and support.	
		3) Construction for primary school		2		No need to do urgently and will discuss to put in next year CSD plan.	
		4) Job opportunity	1			To explain job opportunity is1st priority for 4 relocated villages and 2nd priority for poor & nearest villages to mine site. When we start construction phase and operation phase, Myanmar Wanbao and supplier can hire more employee but degree holders have more priority.	
		5)Animal husbandry (chicken)	1			Will discuss with local government how to provide the need.	
		6)Scholarship for 3 university students	1			To submit detail facts of these 3 university students.	
		7) to offer job for one male degree holder (BA-economic)				To submit detail facts and application form.	
4	PhaungKa Tar	1)(a)ceiling for traditional Medicine clinic (b)Ceiling for meeting room	1			Will provide fan(2)Nos. Will provide fan(2)Nos.	
		2) (a)Roof repairing for Administrator's office (b) to construct toile		2		To estimate detail cost for reviewing and supporting.(will provide cash) To estimate detail cost for reviewing and supporting.(will provide	

Sr No	Village Name	Requirements	Priority			Action Plan	Remarks
			1	2	3		
						cash)	
		3)Refrigerator for traditional medicine clinic			3	Not urgently. (if possible, will donate used one)	
		4)Job opportunity for degree holders (a) BE(Mechanical) (1) person (b) BSc (Botanical) (1) person (c) Electrical Installation (experienced man) (1) person (d) others degree holder (3) person	 1 1 	 2 2		 To submit detail facts and application form. To submit detail facts and application form. To submit detail facts and application form. To submit detail facts and application form.	
5	Wardann	1) Job opportunity (a) For degree holders	1			To collect degree holders list and will pay a priority when job opportunity appear. To submit detail facts and application form to company via CSD member.	
		2) Electricity	1			Responsible of local government and need to take a time hopefully for complete in this year.	
		3) Drinking and domestic used water	1			Still construction for water line to the village from water source at mine town.	
		4) Library		2		Plan to calculate cost for construction and company will review and support.	
		6) Land compensation for SK extension cell line area.	1			Will do urgently for to get suitable compensation for their crops according to the standard compensation rate under the supervision of local government.	
		7) provision Diesel for their road lighting	1			To provide required diesel 2 gal/ day for road lighting and required lighting cable &temporary pole until electricity available in the village.	
6	Tel Pin Kan	1) Job opportunity (a) For degree holders	1			To collect degree holders list and will pay a priority when job opportunity appear. To submit detail facts and application form to company via CSD member.	
		2) Electricity	1			Electricity installation is mainly responsible for local government and need to take a time and hopefully for complete in this year.	

Sr No	Village Name	Requirements	Priority			Action Plan	Remarks
			1	2	3		
		3) Drinking water	1			Will install submersible pump with solar system on the Dam and to install water distribution pipe for each household.	
		4) Road repairing in the village	1			Will start road repairing in the village in next week and will finish within 3 weeks.	

Table 6.6.2: Proposal for community social development

Proposal for Community Social Development of Local villages (FY2014)

S/N	Vilage Name	Books & furniture	Medical Service(☆Mine Town Hospital& Mobile Team)	Electricity (☆ Power Lines to the villages, instead of every household)	Drinking Water	Road Repairing	Playground	Kindergartens	School Repairing	TOTAL
1	Shwe Pann Khaing	650,000	As we signed a service agreement with Yangong International Clinic (YIC), we paid 16,800 dollars every month for medical service charge of the doctors and nurse. And the average expense for madicine cost about 5,000 dollars per month. The service charge and medicine cost(21,800 dollars per monthe and 261,600 dollars for one year) include Mine Town Hospital and Mobile Medical Teams. The mobile medical service is totally free for local villagers. According to our monthly record in Mine Town Hospital, we treated more than one thousand villagers for free and only less than 20 company employees every month.	Long distance to install						650,000
2	Ywar Thar Ywar	650,000								650,000
3	Gone Taw	650,000								650,000
4	Doon Taw	650,000								650,000
5	War Dan	650,000		111,300,000	20,160,000	14,150,000				146,260,000
6	Tal Pin Kan	650,000		83,670,000	37,670,000	14,810,000				136,800,000
7	Kan Kone	650,000							40,000,000	40,650,000
8	Phaung Kar (North)	650,000								650,000
9	Phaung Kar (Middle)	650,000								650,000
10	Phaung Kar (South)	650,000								650,000
11	Moe Kyo Pyin(North)	650,000			72,840,000	1,930,000				75,420,000
12	Moe Kyo Pyin(Middle)	650,000								650,000
13	Moe Kyo Pyin(South)	650,000								650,000
14	Yey Kyi Pin	650,000		Long distance to install						650,000
15	The' Taw Gyi	650,000		Long distance to install						650,000
16	Taung Pa Lu	650,000							30,000,000	30,650,000
17	Kyaw Ywar	650,000							8,880,000	9,530,000
18	Nyaung Pin Gyi	650,000							30,000,000	30,650,000
19	Ywar Shay	650,000								650,000
20	Pal Laung	650,000								650,000
21	Wet Hmay (new)	650,000					11,850,000	65,500,000		78,000,000
22	Kan Daw (New)	650,000								650,000
23	Sei Te' (New)	650,000								650,000
24	Zee Taw (New)	650,000						65,500,000		66,150,000
25	Ton/YwarThit	650,000								650,000
26	Taw Kyaung	650,000								650,000
27	A Lel Taw/ Lae Ti	650,000		20,520,000						21,170,000
28	Phaung Kadar	650,000								650,000
29	Kyauk Phyu Dine	650,000		61,950,000						62,600,000
30	Shwe Hlay	650,000		60,200,000						60,850,000
	TOTAL Cost (Kyats)	19500000	222,360,000	337640000	130,670,000	30,890,000	11,850,000	131,000,000	108,880,000	992,790,000
	TOTAL Cost (FEC)	22,941	261,600	397,224	153,729	36,341	13,941	154,118	128,094	1,167,988

Table 6.6.3: Effective Evaluation Record

PCDP Effectiveness Evaluation Record				
EVALUATION CRITERIA AND RESULTS				
Title: Phase 1 Public Consultation and Disclosure Plan				
Date: 30 September 2013				
Goal Statements: • adequate and timely information is provided to project-affected stakeholders; • these stakeholders are given sufficient opportunity to voice their opinions and concerns; and • these concerns influence the ESIA process and project decisions.				
	Evidence used	**Progress**	**Comments**	**Rating**
Activity 1 Select CSD from each village and provide training for smooth communication between affected villages and company.	Altogether an updated from 16 to 22 CSD have been recruited for 22 villages as contract Employees.	Completed	Due to the instable situation, the CSD selection was not done via mass meetings with the villagers.	4
Consultation and information sharing in placed between the company and the villagers.	Grievance Process is developed. Community Consultation Summary Table. Consultation Meeting minutes Performa.	Completed as per phase 1 plan.	Provided information to the villages should be implemented as much as possible according to the plan.	2
Activity 2 Conduct Village Situation Analysis Questionnaire data collection in the surrounding villages	Hard copy collected questionnaires are kept in file and computerized.	Completed in 16 villages but the 6 villages which did not allow doing questionnaire were left out.		2
Output 2 The villages' social information are collected for the ESIA and kept as village information for further social development activities.	Collected questionnaires are filed and sent to EMC for baseline data entry.	70% completed against the plan since some of the villages did not allow the team to go in.		2

Activity 3 Consult to the affected villages regarding early work constructions of Letpadaung project	Meeting Minutes Performa. Pamphlets Photo records Community info Centre Established	Completed in 16 villages but the 6 villages which not allowed the consultation team were left out. However, the pamphlets were distributed to those 6 villages.	The villagers were more interested in the job opportunity and social development. Apart from few people who concern about environmental impact.	2
Output 3 CSD team ensured the project affected villages are consulted about early work constructions of Letpadaung project.	Grievance Log Villages' request summary table Pamphlets Photos Meeting Minutes Performa.	70% completed against plan		2

Achieving Goals

Targeted Goals were for the most part achieved in regards to Public Engagement. Intervention from the Government and Wanbao management to focus on CSR activities to ease the tensions between MWMCL and the communities, and to build trust with the communities became the prime directive. Early Works were postponed and consultation with Government Agencies and the Implementation Committee were conducted for future planning.

Action (if required): The computerized data should be shared to the project after entering the data in Yangon. A Data-base has been created and now requires input. The consulted community requests (the neediest things) should be prioritized to be addressed in coming year CSD plan.

A Phase-2 Consultation Planning will commence October 1st.

Lessons Learned:

- PCDP structure and contents: Any of the project activities related to the village should be consulted with CSD team to be more effective support for the community. In order to minimize the confusion in the community, the information channel should be clearly identified and maintained. The role of CSD should be clarified so that the CSD team will be a meaningful resource both to the company and community.

- Consultation methods/stakeholder: The PCDP could not conduct the workshop due to the complex situation. A coordination meeting should be done with higher level Government administration on regular basis, sharing information about PCDP.

- Integration of consultations with ESIA process and Project activities: This activity need to be strengthened within the company department for mutual understanding and supporting each other.

Staff responsible for review: Daw Myat Htwe Mon CSD Project Manager	Date September 30th 2013
Senior Manager approval: Glenn R. Wallis Environmental Systems & Operational Development Manager	Date: September 30th 2013

Rating key

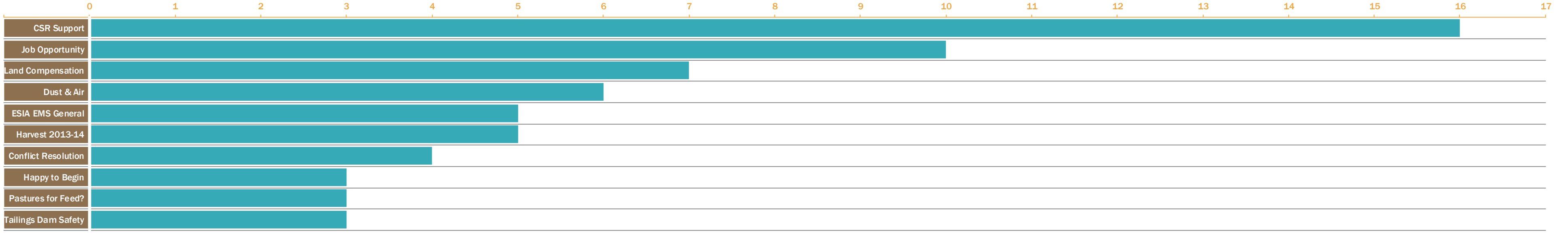
1 = Completely achieved
2 = Largely achieved
3 = Partially achieved
4 = Achieved to a very limited extent
5 = Not realised
X = Too early to judge extent of achievement

Table 6.6.4: Issue Analysis

Summary | Inventory

Letpadaung Village Region Issue Analysis

Top 10 Village Issues



Village Count of Issues

Type	Count
Acid Mist	1
Blasting Standards	0
Conflict Resolution	4
CSR Support	16
Dust & Air	6
ESIA EMS General	5
Fencing for Safety	1
Harvest 2013-14	5
Job Opportunity	10
Land Compensation	7
Pastures for Feed?	3
Public Roads	2
Rehabilitation	1
Surface Water	2
Tailings Dam Safety	3
Vibration	1
Grand Total	67

Table 6.6.5: Example of Meeting Minutes

Meeting Minutes Proforma - Table

Date of Meeting	15 May 2013	
Venue for Meeting	School Compound, Kyawywa village	
Consultation Phase	Phase 1	
Meeting Reference	Meeting Report and photos	
Goal and Objectives	Community consultation	
Subject	Early construction work of Wanbao mining project, the objective of CSD and household questionnaire data collection	
Materials Used	Pamphlets and Questionnaire	
Materials Circulated	Format Pamphlets	Circulation Individual distribution
Meeting Organizer(s)	Name	Affiliation and Position
Meeting Facilitator(s)	Daw Myat Htwe Mon and CSD members CSD Team	CSD Project Manager and CTS team
Recorder	Daw Mya Mya Moe	CSD Supervisor
Method(s) of Record	Note Taking and photo taking	
Technical Expert(s)		
Independent Observer		
Interpreter		
Letpadaung Project Representative(s)	Mr. Glenn R Wallis	Environmental Systems and Operational Development Manager
Agenda	- CSD Introduction - Information Provision about early construction and job opportunity - Household questionnaire Data Collection - Question and Answer session for villagers' concern and queries	

Questions Raised

Number	Topic	Details of Question	Raised By Whom	Response Provided	By Whom

Comments / Proposals / Recommendations put forward

Number	Topic	Details	Proposed By Whom	Response Provided	By Whom
The villagers asked for job opportunity. Some farmers want to use some lands as their animals' pasture. And some villagers want know more how the project will impact on their environment and how the company will protect.					

Information Provided

Number	Topic	Details	Provided By Whom	Response Provided	By Whom

Actions Agreed

Number	Topic	Details of Action Agreed	Actionee	Milestone

Summary of Level of Stakeholder Interest / Concern and Stance towards Project by Issue

Stakeholder Organization - Individual or Category	Topic	Level of Stakeholder Interest - Concern (High, Medium, Low)	Comments

Attendees List

Date of Meeting	15th May 2013
Venue for Meeting	School Compound, Kyawywa village
Consultation Phase	Phase 1
Meeting Reference	Daily report

Name of Organization	Name of Individual	Position of Individual in Org.	Contact Details: Address	Contact Details: Tel. Number	Contact Details: Email	Signature	Key Area of Interest of Organization /Individual
Unable to get the signature of meeting attendees due to the sensitivity in Letpadaung Project Area. However, photos were taken as the record of this meeting for anytime reference.							

Summary of Community Consultation (May – August 2013)

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
1	Shwehlay	LPD	Job opportunities for landless people				3 recruited - in WB	% of on job training opportunity will be given to graduates
			Job opportunities for land lost people					1 employee for 10acre lost, 2 employee for 20 acre lost and 3 employee for above 20Acre opportunity will be given when the company start in Oct.
			Land Compensation amount is low					
			Levelling the football ground with the machines	Yes			100% completed	
			Village road earth filling for preventing flood		No			The village is geographically flooded every year so that need to have further discussion with government
			Elderly care support		No			Considering but not yet taken into action
			Electricity	Yes			35% completed	
2	Don Taw	SK	The renovated road quality is poor		No			No action taken
			To test water level and quality			Pending		No action taken
			To support water scarcity as the water level is getting deeper due to the mine pits	Yes			One water purification system is provided	But the water is not enough and asked for another assistance
			To access Mine Hospital for minor health cases		No			No consideration
			SK job opportunities have bias	Yes			Explained to the villagers if they have any specifice information, they can bring it up to the CSD and HR.	

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
			Transparency on job employment and give priority to the poor	Yes			Unskilled labor are chosen by the village head	
			Periodically environmental impact assessment should be conducted					
			U Mya Aung's land compensation		No			Still negotaiting
			Water pipeline for farmlands arrigation		No			Not yet started
			School bus for children		No			Not possible
			To support money for land purchaing to construct village health center		No			Not possible
			Job opportunity	Yes			3 in WB, 4 in sino, 75 in sk	Out of 75, 65 are casual labor
3	Kyaut Phyu Taing	LPD	Electricity	Yes			60% accomplished	
			Library	Yes				Will be provided in Mid August
			Job opportunity for landless and land lost people	Yes			1 in WB, 1 in Sino	1 employee for 10acre lost, 2 employee for 20 acre lost and 3 employee for above 20Acre opportunity will be given when the company start in Oct.
			Land Compensation amount is low					
			School benches and supplies		No			Not included in this year CSR plan
4	Leiti	LPD	Village road renovation	Yes			100% completed	
			Education support	Yes			3 high school students provided	
			Electricity	Yes			50% completed	

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
5	Kyaw village	LPD	Job opportunity				7 in WB, 6 in Sino, 9 in Norbenco, 11 in Ytse	
			Education support			Pending		But there is a plan to provide education support
			Drinking water	Yes			Plan 14 Sep - 16 Oct	
			School Construction	Yes			100% completed	
7,8,9,10	Relocated 4 villages	LPD	Job opportunity 2 HH per family at least		No			But recruited one house per family
			Complaint on ladders	Yes				The list was sent to Htoo Comp. to renovate
			Complaint on houses' quality	Yes				The list was sent to Htoo Comp. to renovate
			The public electricity bill should be paid by the Gov. or company			Pending		Not yet confirmed
			To provide salary for water pumper and maintenance			Pending		Not yet taken action
			To provide village sign board			Pending		Public Relation Center is opened in Zitaw Seite village to address all the pendings in new relocated villages
			To provide vocational training to unskilled labor or uneducated people who only knows working in the farm			Pending		
			To create job opportunity by operating factories and small enterprises			Pending		
			To provide incentives for other village development committee members who are formed by the Government			Pending		
			To provide relocation cost			Pending		
			To support house moving cost (transport)			Pending		

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
			To provide compounds in new village for those who own more than one compound			Pending		
			To provide extension rooms for the family member of 3 and 4	Yes				Approved by Government to take action but not yet starte
			To renovate the drains with concrete as it can be eroased by heavy rain			Pending		
			To renovate the lamp-posts bottoms as they are erosed by the rain and as they are closed to the drain.	Yes			12 lamp-posts completed but the rest are on going	
			Complaint to some CSDs	Yes			No specific complaints	
			Pastures and spaces to keep the animals			Pending		
			Elederly land lost people who cannot work in the company			Pending		
			To think of the families who do not have workers as per the land lost job opportunity.			Pending		Not yet consider
			To consider Education support for the families			Pending		Plan to do educational support
			To specify the Zitaw-Seite village boundry line			Pending		
			To recruit the ECCD teachers from the village - not from outside (Early Child Care Development)			Pending		
			To solve the land for Cemetry (Zitaw-Seite)			Pending		

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
11	Phaung Katar (N)	LPD	To provide CSD		No			1 CSD is provided for Phaung Katar (N) and (S)
			Books and chairs for library			Pending		Considering but not yet taken into action
			Job opportunity	Yes			2 in WB, 6 in Norbenco	
			Complaint to Phaung Katar (S) CSD	Yes			The villagers are welcomed to raise up if there is any specific factors	
12	Ywar Thar	SK	Road Renovation	Yes			100% completed	
			Retaining wall	Yes			100% completed	
			Library			Pending		
			Job opportunity				61 in SK	out of 61, 43 are casual labor
			Dust and betel leave issues	Yes			Ongoing	
13	Moegyobyin (N)	LPD	Classroom extension			Pending		Not included in this year CSR plan
			Tube well for drinking water			Pending		Government responsible
			Library			Pending		
			Pond renovation for animals' drinking water			Pending		Not included in this year CSR plan
			Electricity			Pending		Not included in this year CSR plan
			Clinic renovation					
			Job opportunity				22 in SK, 5 in WB, 1 in Sino, 1 in NoB, 2 in Norinco	
			Education support			Pending		There is a plan to provide education support
14	Ton Ywar Ma	LPD	Plastic chairs 20 numbers by village head			Pending		If the villagers accept the company come and donate in the village
			To recruit CSD by village head			Pending		If the villagers accept the company

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
								to cooperate
15	Kangon	SK	Land compensation for the land occupied by over 20 yrs ago		No			
			Water supplies	Yes			Set up water purification and tube well	But not yet found good water quality within the village
			School buildings	Yes			25% completed	
			Job opportunity	Yes			42 in Wb, 25 in Sino, 20 in Norbenco, 4 in Norinco, 4 in 8MCC	
			To do EIA and SIA	Yes			On the process	
			Hospital	Yes			Tendering process	
			Provide vocational training to school drop out youth		No			No consideration for this so far
16	Taungpalu	LPD	Education support			Pending		There is a plan to provide education support
			Job opportunity				1 in WB, 2 in Sino, 1 in Norbenco	
			Electricity	Yes			100% completed	
17	Moegyobyin (S)	LPD	Drinking water supplies	Yes			Plan to start in Aug	Government responsibility
			To upgrade Primary school to Middle school			Pending		Government responsibility
			Electricity			Pending		Not included in this year CSR plan
			Job opportunity			Pending		Coming up job opportunity will fulfill this request
18	Shwe Pan Khaing	SK	Concrete bridge on the village connection road			Pending		Submitted to Regeional government for approval.
			Monastery renovation			Pending		
			Job Opportunity	Yes			30 no. recruited	
			Electricity		No			Far distance

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
			To complete the road renovation	Yes			100% completed	
			School benches and supplies			Pending		Not included in this year CSR plan
			To support the village social group			Pending		Not included in this year CSR plan
			To increase wages for daily wages workers		No			According to the market price
			Land resettlement assistance	Yes			Land measurement and amount calculation is finished but not yet provided	
19	Paungga (S)	LPD	To provide CSD	Yes			Recruited on 16 Aug	
			Drinking water supplies			Pending		Not included in this year CSR plan
			School Construction	Yes				Government's responsibility
			Job opportunity for landless and land lost people	Yes			152 no. recruited in SK, WB and Sino for Paungga (S) (N) (M)	Coming up job opportunity and on job training will fulfill this request in Oct
			To donate some construction items for monastery renovation		No			Not included in this year CSR plan
20	Wadan	SK	To complete the road renovation, removing the tailings	Yes			100% completed	
			Job opportunity (employment to be transparent)	Yes			Given the chance to raise up any doubt throug suggestion box or in person	
			Electricity	Yes			35% completed	
			Drinking water supplies	Yes			100% completed	
			School compound cleaning with machines	Yes			100% completed	
			Lamp-post quality complaint (the contactor)	Yes			The villagers are asked not to accept if the quality is not good	

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
			Land resettlement assistance	Yes			Land measurement and amount calculation is finished but not yet provided	
21	Palung	LPD	Library	Yes			Tendering process and plan to start in mid Aug	
			Job opportunity	Yes			2 casual labor in WB	Coming up job opportunity and on job training will fulfill this request in Oct
			Electricity supplies for monastery	Yes			100% completed	
			School Construction	Yes				Government's responsibility
			To give awareness training on Enviromental Impact and the mine project's implementation			Pending		No action taken
22	Teipinkan	SK	Library fencing			Pending		Not included in this year CSR plan
			Drinking water supplies	Yes			80% completed	
			Complaint to CSD member	Yes			Cleared	
			Job opportunity	Yes			27 recruited	
			Land measurement and compensation for SK project extension	Yes			Land measurement and amount calculation is finished but not yet provided	
24	Thedawgyi	SK	Library	Yes			Tendering process and plan to start in mid Aug	
			Job opportunity	Yes			3 no. recruited	
			School supplies			Pending		Not included in this year CSR plan
			To complete road renovation	Yes			100% completed	

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
25	Yaykyibin	SK	Library			Pending		Not included in this year CSR plan
			School building construction	Yes			Tendering process but plan to start in Sep	
			Mobile medical care	Yes			3 weeks per month provided	
			Land resettlement assistance	Yes			Land measurement and amount calculation is finished but not yet provided	
			Road Renovation			Pending		Not included in this year CSR plan
			Job opportunity	Yes			60 people recruited	
			Dust and Betel leave, pasture and other crops	Yes			Betel leave issue is under process	SE dept. should do assessment on pastures and other crops
26	Gon Taw	SK	School fencing			Pending		Not included in this year CSR plan but should not be by brick
			School earth filling	Yes			Plan to start in Oct	
			Arrigation for farming	Yes				Government's responsibility
			Job opportunity	Yes			56 people recurited	Coming up job opportunity and on job training will fulfill this request in Oct
			Cement for monastery	Yes			200 bags of cement donated	
27	Paungga (M)	LPD	2 water cart during monastery construction		No			Due to road accessibilitey, it was not helped
			Library			Pending		Not included in this year CSR plan
			Bridge			Pending		Not included in this year CSR plan
			Job opportunity	Yes			152 no. recruited in SK, WB and Sino for Paungga (S) (N) (M)	Coming up job opportunity and on job training will fulfill this request in Oct
			Road Renovation (village to	Yes			Plan to start on 19 Aug	

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
			Paungga dam)					
28	Paungga (N)	LPD	Road Renovation (village to cemetry)	Yes			Plan to start on 19 Aug	
			Cement for monastery	Yes			40 bags of cement donated	
			Job opportunity for uneducated people	Yes			152 no. recruited in SK, WB and Sino for Paungga (S) (N) (M)	Coming up job opportunity and on job training will fulfill this request in Oct
			Education support			Pending		There is a plan to provide education support
29	Taw Kyaung	LPD	No consultation so far due to villagers' unacceptance					
30	Ton Ywar Ma	LPD	No consultation so far due to villagers' unacceptance					
31	Moegyobyin (M)	LPD	Complaint about the land measurement and the toddy palm trees counting by the land department and by the authorities					The villagers do not accept the company to do consultation
			No consultation with mass meeting due to villagers' unacceptance					The villagers do not accept the company to do consultation
32	Ywarshay	LPD	Library			Pending		Not included in this year CSR plan
			School Compound earth filling	Yes			Completed	
			School benches and supplies		No			Not included in this year CSR plan
33	Htan Taw (Nyaungbingyi)	LPD	One CSD for Htan Taw village			Pending		Considering but not yet taken into action

Sr. No.	Village Name	Area	Consultation Minutes	Addressed			Progress	Remark
				Yes	No	Pending		
34	HtanDawGyi (YinMarPin)	SK	BEHS school building painting	Yes			Donated	
			Mobile medical care for the whole day since there are over 100 patients want to get the treatment. Half day medical service only cover round about 50 patients			Pending		Considering but not yet taken into action
35	Zitaw, Seitei (old village)	LPD	To release the arrested 3 people					informed to management team
			To withdraw the section 144					
			To take action the responsible person of giving command to use the bomb to crackdown the protests.					
			Imlementation committee should come and negotiate the villagers					
36	Ton Ywathit	LPD	No consultation so far due to villagers' unacceptance					

Table 7.2.1(a): Construction Phase Environmental and Social Risk Matrix

ENVIRONMENTAL IMPACT	ASPECT	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
CONSTRUCTION PHASE												
TOPOGRAPHY												
Change in landform and landscape character	(1) Excavations for the South Diversion Channel and other water management works.	2	5	3.5	2	2.8	1.0	2.8	Medium	Low	(1) Revegetate and provide crossing point for local people. (2) Flatten side slopes.	Low
	(2) Development of platforms for plant and infrastructure construction	3	4	3.5	1	2.3	1.0	2.3	Medium	Low	(1) Platforms will be landscaped and revegetated to original landform at the end of the project.	
	(3) Excavation for and establishment of pollution control dams.	1	4	2.5	2	2.3	1.0	2.3	Medium	Low	(1) Revegetate side slope.	
	(4) Development of flood protection bund	2	4	3.0	2	2.5	1.0	2.5	Low	Medium	(1) Revegetate side slope.	
SOILS												
Sterilisation of soil resources	(1) Development of mine infrastructure including plant, roads, stockpile platforms, waste rock dumps, heap leach pads, dams and buildings.	4	4	4.0	2	3.0	1.0	3.0	Low	Medium	(1) Stripping and stockpiling of soil resources prior to construction	Medium
	(2) Loss of agricultural land	3	5	4.0	3	3.5	1.0	3.5	High	Medium	(1) Increase of agricultural productivity of surounding farm land.	
Soil contamination	(1) Leakage or spillage of hazardous chemicals including hydrocarbons.	4	3	3.5	1	2.3	0.8	1.8	High	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into soil or groundwater.	
Loss of soil resources	(1) Wind and storm water erosion of stockpiles and exposed soil surfaces.	2	4	3.0	3	3.0	1.0	3.0	High	Low	(1) Long-term stockpiles are to be progressively re-vegetated to allow for stability of surfaces. (2) Stockpiles not to exceed 4.5 m in height. (3) Storm water to be diverted around long-terms stockpile areas. (4) Erosion and sediment control plan.	
	(2) Mismanagement of soil recovery	3	5	4.0	3	3.5	0.8	2.8	Medium	Medium	(1) Development and implimentation of a soil management plan.	
GROUNDWATER												
Contamination of groundwater resources	(1) Inappropriate disposal of hazardous and general waste during construction.	2	3	2.5	2	2.3	0.6	1.4	Low	Low	(1) Facilities for the temporary storage of general and hazardous waste will be provided that prevent run-off or seepage into the environment. (2) Waste disposal to take place off-site at available facilities until such a time that the general and hazardous waste sites are developed.	Low
	(2) Leakage or spillage of hazardous chemicals including hydrocarbons.	2	4	3.0	2	2.5	0.4	1.0	Medium	Very Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater.	
SURFACE WATER (HYDROLOGY AND RIVERS)												
Contamination of rivers and watercourses	(1) Release of effluent and contaminants into the environment.	4	3	3.5	4	3.8	0.6	2.3	High	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into water courses. (2) No effluent is to be released into the environment (3) Effluent is to be contained and treated (e.g. sewage treatment plant prior to release).	Medium
	(2) Sediment loads due to erosion of exposed surfaces.	3	4	3.5	4	3.8	1.0	3.8	Medium	Medium	(1) Drainage areas will be constructed with protective features to mitigate erosion. (2) Use of source control BMPs (3) Construction of Sediment Control Dams	
Increase of flood frequency and severity	(1) Construction of flood protection bund resulting in a bottle neck of the Chindwin River.	4	4	4.0	4	4.0	0.2	0.8	Low	Very Low	(1) Additional flood modelling. (2) Resettlement of significantly at risk village dwellings.	

ENVIRONMENTAL IMPACT	ASPECT	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
AIR QUALITY												
Exceedance of health screening guidelines for ground level concentrations of dust	(1) Movement of vehicles and machinery and entrainment from exposed surfaces.	3	4	3.5	4	3.8	1.0	3.8	Medium	Medium	(1) Surface wetting of construction roads. (2) Minimisation of the exposed surfaces to that necessary for development. (3) Dust management plan.	Medium
	(1) Quarrying and crushing of agregate	3	3	3.0	4	3.5	0.8	2.8	Medium	Medium	(1) shrouds over equipment. (2) Dampening of stockpiles (3) Covers on trucks transporting materials to site.	
	(1) Blasting on site during construction	4	2	3.0	4	3.5	1.0	3.5	Low	High	(1) Management of blasting according to weather conditions.	
	(1) Wind blown dust from exposed surfaces	2	4	3.0	4	3.5	1.0	3.5	High	Medium	(1) Progressive clearing and grubbing of working areas. (2) Planting of vegetation buffer zones.	
Exceedance of health screening guidelines for ground level concentrations of SO2, NO2, NO3, DPM and CO.	(1) Exhaust emissions (2) Diesel generators	1	3	2.0	4	3.0	0.2	0.6		Very Low	(1) Options for lowering exhaust emissions should be considered.	
Green House Gas emissions	(1) Use of fuel on site by various equipment	1	5	3.0	3	3.0	1.0	3.0	Medium	Medium	(1) Low Sulphur Fuel (2) High efficiency motors and engines (3) Monitoring fuel usage and engine performance	
NOISE & VIBRATION												
Disturbance of noise receptors during the day	(1) Movement of machinery and vehicles	2	3	2.5	3	2.8	1.0	2.8	Medium	Medium	(1) Noise buffer in critical areas and around perimeter. (2) Control working hours (3) Relocation of receptors (4) Monitoring of noise levels near sensitive receptors.	Medium
	(1) Blasting	4	3	3.5	4	3.8	1.0	3.8	Medium	High	(1) Management of blasting (timing/size) (2) Notification of receptors regarding blast times. (3) Monitoring of noise levels near sensitive receptors.	
Disturbance of noise receptors at night	(1) Movement of vehicles, machinery and mechanical operation of plant components e.g. crushers	3	3	3.0	4	3.5	0.2	0.7		Very Low	(1) Limit the construction activities as night to that which is absolutely necessary to complete the project within schedule. (2) Monitoring of noise levels near sensitive receptors.	
Disturbance to receptors due to blast vibrations	(1) Blasting	3	3	3.0	3	3.0	1.0	3.0	Medium	Medium	(1) Management of blasting (timing/size) (2) Notification of receptors regarding blast times. (3) Monitoring of vibration levels near sensitive receptors.	

ENVIRONMENTAL IMPACT	ASPECT	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
BIODIVERSITY												
Loss of habitat	(1) Land clearing	3	4	3.5	2	2.8	1.0	2.8	Medium	Low	(1) Balance of Primary Woodland within the proposed mining area is to be demarcated and protected from damage. (2) Reforestation plan for balance of primary woodland. (3) Planting of buffer areas around the site boundary and within the site. (4) Identification and reservation of remenant vegetation in the surounding areas.	Medium
	(1) Fire Damage	2	3	2.5	3	2.8	0.2	0.6		Very Low	(1) Installation of fire suppression systems on itmes of large equipment. (2) Monitoring of tire temperatures to guard against tire fires. (3) Public awareness campaigns. (4) Strict enforecment of OHSM policies and procedures.	
Loss of natural vegetation	(1) Land clearing	3	4	3.5	2	2.8	1.0	2.8	Medium	Medium	(1) Revegitation and planting of buffer zones.	
	(1) Fire Damage	2	3	2.5	3	2.8	0.2	0.6		Very Low		
Loss of Rare or Endemic species	(1) Habitat loss (2) Biogeographical isolation (3) Road kill	1	4	2.5	4	3.3	0.6	2.0	Medium	Low	(1) Relocation if found.	
Increased pressure on ecological services	(1) Increased collection of fuel wood associated with influx of people. (2) Loss of current fuel wood sources and impact translocation. (3) Disruption of livelihood activities resulting from resettlement.	3	4	3.5	4	3.8	0.8	3.0	High	Low	(1) MWMCL will implement measures to reduce influx of work seekers into the area. (2) MWMCL together with district authorities will implement reforestation projects. (3) Development of alternative fuel sources.	
Spread of invasive weeds and pest species	(1) Movement of machinery and vehicles spreading seeds.	2	3	2.5	3	2.8	0.8	2.2	Low	Medium	(1) Vehicle clean downs prior to entering the site	
	(1) Importation of materials	2	4	3.0	2	2.5	0.8	2.0	Low	Low	(1) Inspection of containers prior to entry of site	
CULTURAL HERITAGE												
Disturbance of cemeteries and grave sites	(1) Site clearance and excavations	2	4	3.0	3	3.0	0.2	0.6		Very Low	(1) Site survey to be undertaken to accurately map and identify all burial sites prior to construction (2) Relocation of sites in accordance with legislative requirements and in consultation with descendants and Tribal Authorities.	Low
Disturbance of archaeological sites	(1) Site clearance and excavations	1	4	2.5	2	2.3	0.2	0.5		Very Low	(1) Site survey to be undertaken to map all sites prior to construction. (2) Phase II survey for the excavation and documentation of all sites to be disturbed. (3) Only sites in footprint areas to be disturbed, remaining sites to be mapped, demarcated and protected.	
Disturbance of cultural sites	(1) Site clearance and excavations	5	5	5.0	4	4.5	1.0	4.5	High	Medium	(1) Dismantling and relocating cultural site or moving entire site including vegetation.	
VISUAL												
Disturbance of view scape	(1) Development of processing plant and other infrastructure (2) Development of topsoil stockpiles (3) Construction infrastructure.	3	4	3.5	4	3.8	1.0	3.8		Medium	(1) Rehabilitation of construction areas at end of the implementation phase.	Medium
Light and nightglow	(1) Lighting masts	1	4	2.5	2	2.3	1.0	2.3	High	Low	(1) Minimise use of high lighting masts (2) Direct lights towards areas of work. (3) Lights to be provided with hoods to reduce light spill.	

ENVIRONMENTAL IMPACT	ASPECT	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
SOCIO-ECONOMICS												
NEGATIVE IMPACTS												
Resettlement of members of the community	(1) Persons living within the mining area and the blast exclusion zone are to be relocated to allow for mining to continue.	5	5	5.0	4	4.5	1.0	4.5	High	High	(1) Development of Resettlement Action Plan (RAP) and associated greivance mechanism. (2) Fair compensation for entitled households. (3) MWMCL to be actively involved in compensation and resettlement process to ensure company social responsibility objectives are met.	High
Reduced access to land for agriculture and traditional livelihood	(1) Local residents and previous land owners to be excluded from project area.	5	4	4.5	3	3.8	1.0	3.8	Medium	High	(1) A community natural resource management plan will be developed. (Additional SMP or EMP required) (2) Development of alternative (non agricultural) industries. (3) Provision of alternative fuel sources.	
Disruption of leadership structures and associated community tension	(1) Resettlement of communities.	3	3	3.0	4	3.5	0.6	2.1	Medium	Low	(1) Leadership structures are to be agreed with consultation with local communities. (2) Leadership structures to be addressed in the RAP	
Influx of persons into the area	(1) Job seekers and persons attracted to economic benefits	2	3	2.5	4	3.3	0.8	2.6	High	Low	(1) Support local leadership in managing influx of persons. (2) Preference to be given to local community in employment. (3) MWMCL to provide camp accommodation and transport for persons from outside the immediate area. (4) Employment strategy to be clearly communicated by MWMCL and persons discouraged from moving to the area.	
Increased safety risk to road users	(1) Construction traffic to and from site. (2) Increased traffic due to increased population	4	3	3.5	5	4.3	1.0	4.3	Low	High	(1) Access route to the site will be upgraded in accordance with project proposal. (2) Traffic safety awareness programme to be put in place for communities along the access road. (3) Warning signage to be put in place along the route. (4) Fencing to be put in place adjacent to schools along the route from Pakoku and exit/entry points are to be clearly demarcated. (5) Transport driver training (6) Use of only safe and serviced vehicles (7) Promotion of road safety (8) Drug and alcohol testing of drivers. (9) Restricted working hours for drivers and adequate rest breaks	
Increase in the spread of communicable disease (including HIV/AIDS)	(1) Influx of persons into the area (work-seekers and service providers) (2) Increased population density. (3) Greater transient workforce.	3	4	3.5	5	4.3	0.8	3.4	Medium	Medium	(1) MWMCL to develop a Sexually Transmitted Infections Education Policy and to enforce this on all contract workers. (2) An integrated community awareness plan (in collaboration with government) on to be put in place prior to construction. (3) Implement measures to discourage influx of persons into the area. (4) MWMCL to provide support to local health centres. (5) Provision of free condoms (6) Sanitation (7) Management of accommodation camps	
Increase in crime (including theft and prostitution)	(1) Influx of persons and increase in financial resources	2	4	3.0	4	3.5	0.8	2.8	Medium	Low	(1) MWMCL to provide support to local policing structures, as appropriate. (2) Implement measures to prevent influx of persons into the area. (3) Enforcement of a code of conduct in accommodation camps.	
Increase in workplace injuries	(1) Employment of unskilled workers. (2) Cultural of disregard for safety. (3) Inadequate local safety codes. (4) Language issues.	3	3	3.0	2	2.5	1.0	2.5	Medium	Low	(1) Training (Safety and language) (2) Strong supervision (3) Development of an occupational health and safety management system. (4) Resticted working hours to reduce fatigue.	
Change in tranditional values and norms	(1) Greater exposure to transient populations and new technologies.	4	5	4.5	3	3.8	1.0	3.8	Low	High		

ENVIRONMENTAL IMPACT	ASPECT	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
POSITIVE IMPACTS												
Economic benefits to local community	(1) Employment of local persons	4	3	3.5	4	3.8	0.6	2.3	Low	Low Positive	(1) Preference to be given to local persons for employment. (2) Local skill base to be developed (training programmes).	**Moderate Positive**
	(2) Local procurement	2	3	2.5	4	3.3	0.6	2.0	High	ModerateP ositive	(1) Preference will be given to local services providers and suppliers of goods. (2) Training and advice (microfinance will also be investigated.)	
	(3) Improved access to markets	2	4	3.0	2	2.5	0.6	1.5	High	ModerateP ositive	(1) Provision of training to develop skills	
Improved infrastructure (Sanitation, Electricty, Water, Fuel supply)	(1) New villages equipped with communal drinking water point	3	4	3.5	2	2.8	1	2.8	Low	ModerateP ositive	(1) Maintenance of infrastructure.	
	(2) New villages equipped with proper sanitation facilities	3	4	3.5	2	2.8	1	2.8	Low	ModerateP ositive	(1) Maintenance of infrastructure.	
Improved housing conditions	(1) Provision of new villages built with modern materials	3	4	3.5	2	2.8	1	2.8	Low	ModerateP ositive	(1) Maintenance of infrastructure.	
Improved Road Infrastructure	(1) Upgrading roads. (2) Upgrading bridge over Yama Creek	3	3	3.0	3	3.0	0.6	1.8	Medium	Low Positive	(1) Maintenance of infrastructure.	
Improved Provision of Medical Services	(1) Construction of new clinics in surounding area. (2) Additional medical staff.	3	4	3.5	3	3.3	0.8	2.6	Medium	Moderate Positive	(1) Community and social development program will be continued. (2) Training and recruitment of medical staff to the project area. (3) Provision of medical supplies and equipment.	

Table 7.2.1(b): Operational Phase Environmental and Social Risk Matrix

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance			Mitigation Measures	Overall Significance
								Without Mitigation	Mitigation Confidence	With Mitigation		
OPERATIONAL PHASE												
TOPOGRAPHY												
Change in landform and landscape character	(1) Excavation of open pit	5	5	5.0	3	4.0	1.0	4	Low	High	(1) Mine planning to include investigation into the backfilling of waste rock or flooding of the pit to produce a lake. (2) Designing the pit to reduce visual impact from a regional perspective.	High
	(2) Development of dams, HLPs and waste rock dumps	4	5	4.5	4	4.3	1.0	4.25	Low	Very High	(1) Progressive rehabilitation of waste rock dumps, including adoption of closure slopes and revegetation. (2) Vegetation screens around HLPs and dams.	
	(3) Operations accommodation village.	1	5	3.0	1	2.0	1.0	2	Medium	Low	(1) Vegetation screening. (2) Height limit on structures within village. (3) Incorporation of typical architecture for the area. (4) Appropriate town planning/layout.	
SOILS												
Sterilisation of soil resources	(1) Development of open-pit, waste rock dumps and HLPs.	4	4	4.0	2	3.0	1.0	3	Low	Medium	(1) Utilisable soil is to be stripped and stockpiled prior to development.	High
Soil contamination	(1) Leakage or spillage of hazardous chemicals including hydrocarbons	4	4	4.0	1	2.5	1.0	2.5	High	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater. (2) Monitor groundwater quality in the proximity of potential pollution sources.	
	(2) Acid rock drainage (ARD) and metal leaching associated with waste rock dumps	5	5	5.0	4	4.5	1.0	4.5	Low	High*	(1) Low permeability compacted soil liner. (2) Effective in-pit waste identification. (3) Application of mine waste management plan to reduce ingress of water and air in order to prevent ARD. (4) Adoption of pit back fill. (5) Design and placement of long term cover. *Current unmitigated impact significance is still High. If all mitigation measures are followed this impact could be reduced.	
	(3) ARD and metal leaching associated with HLPs	5	5	5.0	4	4.5	0.8	3.6	Medium	Medium	(1) Low permeability compacted soil and HDPE liner under HLPs. (2) Seepage management systems for HLPs. (3) Connection of seepage management system to surface water management system. (4) Monitor groundwater quality in the proximity of HLPs.	
	(4) SX/EW Plant	4	4	4.0	2	3.0	0.6	1.8	Medium	Low	(1) Construct plant on a structurally sound, impermeable concrete base. (2) Continual maintenance of concrete to maintain impermeable base. (3) Immediate clean up of spillage. (4) Maintenance of plant infrastructure to prevent leaks and spills.	
	(5) Solution ponds, stormwater ponds and waste water ponds.	4	4	4.0	3	3.5	0.8	2.8	Medium	Medium	(1) Low permeability liners. (2) Management of contaminated residue removed from ponds. (3) Hydraulic design of ponds to contain overflow from upstream ponds.	
	(6) Slope failure of HLP leading to an uncontrolled release of leached ore	4	4	4.0	2	3.0	0.6	1.8	Medium	Low	(1) Correct closure design of HLPs to reduce risk of slope failure. (2) Ongoing monitoring and maintenance of HLP batter slopes. (3) Development of procedures to clean up spilt leached ore.	
Loss of soil resources	(1) Wind and storm water erosion of stockpiles and exposed soil surfaces	1	4	2.5	2	2.3	0.8	1.8	High	Low	(1) Long-term stockpiles are to be progressively re-vegetated to allow for stability of surfaces. (2) Stockpiles not to exceed 4.5 m in height. (3) Storm water to be diverted around long-terms stockpile areas. (4) Implementation of erosion and sediment control plan.	

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
GROUNDWATER												
Lowering of groundwater table reducing groundwater supply	(1) Decrease of groundwater level elevation due to pit dewatering	3	4	3.5	4	3.8	1.0	3.75	Medium	Medium	(1) Monitoring boreholes to be established in the community, in order to monitor change in groundwater level. (2) Monitoring of water levels on a quarterly basis. (3) Identification of potential alternative water sources if local wells are significantly impacted.	High
Contamination of groundwater resources	(1) Seepage from the HLP or waste rockdumps	5	5	5.0	4	4.5	1.0	4.5	Low	High*	(1) Full compliance with EMPs. (2) Monitoring of groundwater quality in the proximity of potential pollution sources. (3) Compacted clay liner with HDPE liner for the HLPs. (4) Seepage management systems for HLPs. (5) Compacted clay liner for the WRDs. (6)Confirm material availability for liners and closure cover systems. *Current unmitigated impact significance is still High. If all mitigation measures are followed this impact could be reduced.	
	(3) Spillage and seepage of hazardous chemicals (including hydrocarbons) from operational and storage sites	3	4	3.5	3	3.3	0.4	1.3	Medium	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater. (2) Monitor groundwater quality in the proximity of potential pollution sources.	
	(4) Inappropriate disposal of hazardous and general waste produced during operation	3	5	4.0	3	3.5	0.8	2.8	Medium	Low	(1) Facilities engineered to best international practice for the protection of groundwater are to be constructed on site for the disposal of general waste, hazardous waste. (2) Bio-remediation facility to be implemented for hydrocarbon contaminated soils. (3) Temporary waste storage facilities to be engineered to prevent seepage of contaminants from such sites.	
SURFACE WATER (HYDROLOGY AND RIVERS)												
Loss of catchment yield	(1) Containment of storm water run-off (2) Change in creek hydrology	3	4	3.5	3	3.3	1.0	3.25	Medium	Medium	(1) Reserve determination for the downstream users to be determined and water supply to the catchment to be managed to ensure that the water requirements are met. (2) Installation of alternative water supplies.	High
Contamination of rivers and watercourses	(1) Dirty water run-off from plant area, pit, waste rock and HLP area	5	4	4.5	5	4.8	1.0	4.75	Low	High*	(1) Dirty water containment measures e.g. pollution control dams to be put in place and engineered as per project proposal. (2) Surface Water Management Plan to be implemented *Current unmitigated impact significance is still High. If all mitigation measures are followed this impact could be reduced.	
	(2) Slope failure of HLP / waste rock dump resulting in exposure of PAF leached ore / mine waste to surface water runoff.	5	3	4.0	3	3.5	0.6	2.1	Medium	Low	(1) Correct design of HLPs / waste rock dumps to reduce risk of slope failure. (2) Monitoring and maintenance of HLP / waste rock dump batter slopes. (3) Development of procedures to clean up spilt leached ore. (4) Adoption of closure batter slopes for long term stability and erosion resistance.	
AIR QUALITY												
Exceedance of health screening guidelines for ground level concentrations of dust	(1) Movement of vehicles and machinery and entrainment from exposed surfaces	3	4	3.5	4	3.8	1.0	3.75	Medium	Medium	(1) Regular spraying of haul roads. (2) Implementation of dust management plan.	Medium
	(1) Blasting on site for mining.	4	2	3.0	4	3.5	1.0	3.5	Low	High	(1) Management of blasting according to weather conditions. (2) Implementation of dust management plan.	
	(1) Wind blown dust from exposed surfaces	2	4	3.0	4	3.5	1.0	3.5	High	Medium	(1) Planting of vegetation buffer zones. (2) Implementation of dust management plan.	
Exceedance of health screening guidelines for ground level concentrations of SO2, NO2, NO3, DPM and CO.	(1) Exhaust emissions (2) Diesel generators	1	3	2.0	4	3.0	0.2	0.6		Very Low	(1) Options for lowering exhaust emissions should be considered.	

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
Production of Green House Gases	(1) Use of fuel on site by various equipment (2) On-site backup power generation (3) Off-site power generation	1	5	3.0	3	3.0	1.0	3	Medium	Medium	(1) Use of low sulphur fuel. (2) Use of high efficiency motors and engines. (3) Monitoring fuel usage and engine performance. (4) Use of renewable energy (e.g. hydro-power).	
Exceedence of health screening guidelines for ground level concentrations of sulphuric acid	(1) Acid mist from HLPs	4	4	4.0	4	4.0	0.8	3.2	Medium	Medium	(1) Use of HLP dripper irrigation (2) Minimum set back from HLPs for villages (3) Consideration of wind direction and strength during operation of irrigation system.	
NOISE & VIBRATION												
Disturbance of noise receptors during the day	(1) Movement of machinery and vehicles	3	4	3.5	4	3.8	1.0	3.75	Medium	Medium	(1) Use of noise buffers in critical areas and around perimeter. (2) Control of working hours. (3) Relocation of receptors. (4) Monitoring of noise levels near sensitive receptors.	High
	(1) Blasting	4	4	4.0	4	4.0	1.0	4	Medium	High	(1) Management of blasting (timing/size). (2) Notification of receptors regarding blast times. (3) Monitoring of noise levels near sensitive receptors.	
Disturbance of noise receptors at night	(1) Movement of vehicles, machinery and mechanical operation of plant components (e.g. crushers)	4	4	4.0	4	4.0	1.0	4.0	Low	High	(1) Limit the operational activities as night to that which is absolutely necessary to complete the project within schedule. (2) Limit the operational activities spacially at night to reduce noise disturbance of receptors. (3) Monitoring of noise levels near sensitive receptors.	
Disturbance to receptors due to blast vibrations	(1) Blasting associated with open pit mining	4	4	4.0	4	4.0	1.0	4.0	Medium	Medium	(1) Management of blasting (timing/size) (2) Notification of receptors regarding blast times. (3) Monitoring of vibration levels near sensitive receptors.	
BIODIVERSITY												
Loss of habitat	(1) Development of infrastructure and the pit	3	4	3.5	2	2.8	1.0	2.75	Medium	Low	(1) Balance of primary woodland within the proposed mining area is to be demarcated and protected from damage. (2) Implementation of reforestation plan for balance of primary woodland. (3) Planting and management of vegetation buffer areas around the site boundary and within the site.	Medium
	(1) Fire damage	2	4	3.0	3	3.0	0.2	0.6		Very Low	(1) Installation of fire suppression systems on large equipment. (2) Monitoring of tyre temperatures to guard against tyre fires. (3) Public awareness campaigns. (4) Strict enforcement of OHSM policies and procedures.	
Loss of aquatic life	(1) Change in water quality	4	5	4.5	4	4.3	0.6	2.55	Medium	Medium	(1) Implement measures for the protection of water quality and the separation of clean and dirty water. (2) Implementation of the Surface Water Management Plan.	
	(2) Change in flow regimes	2	5	3.5	3	3.3	0.6	1.95	Medium	Low	(1) Ecological reserve determination to be undertaken for the catchments downstream of the site.	
Increased pressure on ecological services	(1) Increased collection of fuel wood associated with influx of people	3	4	3.5	4	3.8	1.0	3.8	Low	High	(1) Implement measure to reduce influx of work seekers into the area. (2) MWMCL together with district authorities to implement re forestation projects. (3) Development of alternative fuel sources. (4) Development of a natural resource management plan.	
	(1) Bio-ethnology (loss of traditionally used plants and medicinal resources due to site access restrictions)	3	4	3.5	4	3.8	1.0	3.8	Low	High	(1) Finding and managing alternative sources of plants and herbs for foor and medicine. (2) Developing alternative sources.	

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
Spread of invasive weeds and pest species	(1) Movement of machinery and vehicles spreading seeds	2	4	3.0	3	3.0	0.8	2.4	Low	Medium	(1) Vehicle clean downs prior to entering the site. (2) Alien invasive species management programme to be implemented.	
	(1) Importation of materials	2	4	3.0	2	2.5	0.8	2	Low	Low	(1) Inspection of containers prior to entry of site. (2) Alien invasive species management programme to be implemented.	
Vegetation clearance and loss of plant productivity	(1) Influx of persons into the area (work-seekers and service providers) requiring fuel and land	3	4	3.5	4	3.8	1.0	3.75	Low	High	(1) Sensitive habitats in the mining area to be protected from disturbance by surrounding communities. (2) MWMCL will implement measures to reduce influx of work seekers into the area. (3) MWMCL together with district authorities will implement reforestation projects. (4) Development of alternative fuel sources.	
	(2) Die back of vegetation due to dust fallout	2	4	3.0	4	3.5	0.6	2.1	Medium	Medium	(1) Implementation of the Dust Management Plan.	
Disturbance to rare or endemic fauna	(1) Traffic (road kill) (2) Noise	1	4	2.5	4	3.3	0.6	1.95	Low	Low	(1) Relocation of fauna if found on site.	
CULTURAL HERITAGE												
Disturbance of cemeteries and grave sites	(1) Development of open pit, waste rock dumps, soil stockpiles, dams and HLPs	2	4	3.0	3	3.0	0.1	0.3	High	Very Low	(1) Site survey to be undertaken to accurately map and identify all burial sites prior to disturbance of any area. (2) Relocation of sites in accordance with legislative requirements and in consultation with descendants and Tribal Authorities. (3) Only sites in footprint areas to be disturbed, remaining sites to be mapped, demarcated and protected.	Low
Disturbance of archaeological sites	(1) Development of open pit, waste rock dumps, soil stockpiles, dams and HLPs	1	4	2.5	2	2.3	0.1	0.2	Medium	Very Low	(1) Site survey to be undertaken to map all sites prior to disturbance of any area. (2) Phase II survey for the excavation and documentation of all sites to be disturbed. (3) Only sites in footprint areas to be disturbed, remaining sites to be mapped, demarcated and protected.	
Disturbance of cultural sites	(1) Development of open pit, waste rock dumps, soil stockpiles, dams and HLPs	3	4	3.5	2	2.8	1.0	2.75	High	Medium	(1) Negotiate relocation requirements with the regulator and the community.	
VISUAL												
Disturbance of view scape	(1) Development of pit (2) Development of waste dumps. (3) HLP development	4	5	4.5	4	4.3	1.0	4.25	Medium	High	(1) Progressive rehabilitation of inactive areas of waste rock dumps and stockpiles. (2) Planting of vegetation buffers to screen infrastructure.	Medium
Light and nightglow	(1) Lighting masts	1	4	2.5	2	2.3	1.0	2.25	Medium	Medium	(1) Minimise use of high lighting masts (2) Direct lights towards areas of work. (3) Lights to be provided with hoods to reduce light spill.	
SOCIO-ECONOMICS												
NEGATIVE IMPACTS												
Influx of persons into the area	(1) Job seekers and persons attracted to economic benefits	1	4	2.5	4	3.3	0.8	2.6	High	Low	(1) Support local leadership in managing influx of persons. (2) Preference to be given to local community in employment. (3) MWMCL to provide housing and transport for persons from outside the immediate area. (4) Employment strategy to be clearly communicated by MWMCL and persons discouraged from moving to the area.	
Increased safety risk to road users	(1) Operations traffic to and from site (2) Increased traffic due to increased population	3	4	3.5	5	4.3	1.0	4.25	Low	High	(1) Access route to the site will be upgraded in accordance with project proposal. (2) Traffic safety awareness programme to be put in place for communities along the access road. (3) Warning signage to be put in place along the route. (4) Fencing to be put in place adjacent to schools along the route from Pakoku and exit/entry points are to be clearly demarcated. (5) Transport driver training (6) Use of only safe and serviced vehicles (7) Promotion of road safety (8) Drug and alcohol testing of drivers. (9) Restricted working hours for drivers and adequate rest breaks	

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance			Mitigation Measures	Overall Significance
								Without Mitigation	Mitigation Confidence	With Mitigation		
Increase in the spread of communicable disease (including HIV/AIDS)	(1) Influx of persons into the area (work-seekers and service providers)	2	4	3.0	5	4.0	0.8	3.2	Medium	Medium	(1) MWMCL to develop a Sexually Transmitted Infections Education Policy and to enforce this on all contract workers. (2) An integrated community awareness plan (in collaboration with government) on to be put in place prior to construction. (3) Implement measures to discourage influx of persons into the area. (4) MWMCL to provide support to local health centres. (5) Provision of free condoms (6) Sanitation (7) Management of accommodation camps	Medium
Proliferation of disease causing species e.g. malaria and bilharzia	(1) Standing water	3	4	3.5	4	3.8	0.8	3	Medium	Low	(1) Standing water will be managed and minimised and treated to avoid mosquitoes. (2)No swimming to be allowed within mine dams including the clean water dam. (3) Malaria prevention measures to be implemented at mine residences. (4) Community education on the spread of diseases such as malaria and bilharzia. (5) Investigation of natural pest species controls. (6) Provision of mosquito nets and repellant.	
Increase in crime (including theft and prostitution)	(1) Influx of persons and increase in financial resources	2	4	3.0	4	3.5	0.5	1.75	Low	Low	(1) MWMCL to provide support to local policing structures, as appropriate. (2) Implement measures to prevent influx of persons into the area. (3) Enforcement of a code of conduct in accommodation camps and villages.	
Increased safety risk due to fly rock from blasting	(1) Mining - blasting of hard rock for the pit	4	3	3.5	2	2.8	0.4	1.1	High	Low	(1) Enforcement of the blast exclusion zone. (2) Proper blast design. (3) Use of blast warning system.	
Increased safety risk due to WRD rockfalls or land slips	(1) Slope instability (2) Inappropriate dumping practises. (3) Proximity of villages and the public to the WRDs (4) Proximity of site facilities to waste dumps	4	5	4.5	2	3.3	0.4	1.3	High	Very Low	(1) Safety set backs from roads and villages. (2) Exclusion of non essential personel and the general public. (3) Batter slopes designed with acceptable factors of safety. (4) Monitoring and inspection of waste rock dumps.	
Increased safety risk due to explosion of hazardous / flammable materials	(1) SX/EW Plant (2) Explosives magazines (3) Fuel Storage	4	4	4.0	4	4.0	0.4	1.6	High	Low	(1) Construction of blast walls and bunding. (2) Internal fire suppression systems. (3) Separation distances for the explosives magazine. (4) Segregation of incompatible hazardous materials.	
Increased safety risk due to bush fire	(1) Vehicles and machinery (2) Cigarette butts (3) Vehicle tyre fires	3	4	3.5	4	3.8	0.2	0.75		Very Low	(1) Installation of fire suppression systems on large equipment. (2) Monitoring of tyre temperatures to guard against tyre fires. (3) Public awareness campaigns. (4) Strict enforcement of OHSM policies and procedures.	
Economic inequality due to comparative high wage of locals employed at the mine	(1) Cost of local goods and services increase	2	4	3.0	4	3.5	0.8	2.8	Low	Medium	(1) Micro financing for non mine personnel. (2) Development of new industries in the area outside of the mine. (3) Improvement of farming practises to increase productivity.	

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
POSITIVE IMPACTS												
Economic benefits to local community	(1) Employment of local persons	3	4	3.5	4	3.8	0.8	3.0	Medium	Moderate Positive	(1) Preference to be given to local persons for employment. (2) Local skill base to be developed (training programmes). (3) Management commitment to promote locals with long term view of replacing ex-pats with locals.	Low Positive
	(2) Local procurement	1	4	2.5	4	3.3	0.6	2.0	Medium	Low Positive	(1) Preference given to local services providers and suppliers of goods. (2) Training and advice (and microfinancing to be investigated).	
	(3) Improved access to markets	3	5	4.0	2	3.0	0.6	1.8	Low	Low Positive	(1) Provision of training to develop skills	
Improved infrastructure (Sanitation, Electricty, Water, Fuel supply)	(1) Infrastucture of villages maintained and upgraded	3	4	3.5	3	3.3	0.6	2.0	Low	Low Positive	(1) Maintenance of infrastructure by MWMCL. (2) Commitment of management and government to the continuous development of the regions infrastructure.	
Improved housing conditions	(1) Upgrade of existing village housing (2) Improved income.	3	4	3.5	2	2.8	0.2	0.6	Low	Very Low Positive	(1) Commitment of management and government to the improvement of local housing standards. (2) Assistance with financial management and housing aid.	
Improved Road Infrastructure	(1) Upgrade of roads and intersections	3	4	3.5	4	3.8	0.8	3.0	Medium	Moderate Positive	(1) Upgrading of roads to dual lane. (2) Improving road intersections to accommodate heavy traffic. (3) Commitment of government to progressive upgrading of road network.	
Improved Provision of Medical Services	(1) Construction of additional clinics in surounding area. (2) Continued hiring of trained medical professionals.	3	5	4.0	3	3.5	0.8	2.8	Medium	Moderate Positive	(1) Community and social development program to be continued. (2) Training and recruitment of medical staff to the project area through the provision of scholarships. (3) Provision of medical supplies and equipment. (4) Upgrading clinic(s) to hospital standard facility. (5) Improve ratio of doctors to population and reducing travel distance for basic medical services. (6) Provision of pre and post natal services and family planning services. (7) Provision of nutritional advice.	
Benefit to regional economy	(1) Purchase of goods and services in the Monywa regional centres	1	5	3.0	4	3.5	0.2	0.7	Low	Very Low Positive	(1) Preference to be given to local services providers and suppliers of goods, where practicable. (2) Develop governance capacity within local government institutions.	
Benefit to the national economy	(1) In accordance with agreement with national government	1	4	2.5	5	3.8	0.6	2.3	Medium	Moderate Positive	(1) In accordance with Development Agreement	
Benefit to the local community due to improved education and training opportunities	(1) Employment and skills training (2) Building of new schools (3) Local employment opportunities associated with CSD programs and local industry	2	4	3.0	3	3.0	0.6	1.8	Low	Very Low Positive	(1) Follow commitments to employment, local supply and CSD plan.	

Table 7.2.1(c): Closure Phase Environmental and Social Risk Matrix

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	Mitigation Measures	Overall Significance
CLOSURE PHASE												
TOPOGRAPHY												
Change in landform and landscape character	(1) Establishment of permanent pit lake	3	5	4.0	3	3.5	1.0	3.5	Medium	Medium	(1) Vegetation screens and bunds around pit. (3) Maintenance and management of rehabilitated and revegetated areas.	Medium
	(2) Establishment of permanent dams, and revegetated heaps and waste rock dumps dumps	3	5	4.0	3	3.5	1.0	3.5	Medium	Medium	(1) Rehabilitation of HLPs and WRDs prior to closure. (2) Vegetation screens around HLPs and dams. (3) Maintenance and management of rehabilitated and revegetated areas.	
SOILS												
Soil contamination	(1) Leakage or spillage of hazardous chemicals including hydrocarbons during closure phase	3	3	3.0	1	2.0	1.0	2	High	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater. (2) Monitor groundwater quality in the proximity of potential pollution sources.	High
	(2) Long term Acid rock drainage (ARD) and metal leaching associated with waste rock dumps	4	5	4.5	3	3.8	1.0	3.75	Low	High*	(1) Monitoring and maintenance of long term cover system. (2) Restrict access to revegetated WRDs and manage post closure land usage to prevent erosion damage to the cover due to clearing or over grazing. *Current mitigated impact significance is still High. If all mitigation measures are followed impact could be lowered.	
	(3) Long term ARD and metal leaching associated with HLPs.	4	5	4.5	3	3.8	1.0	3.75	Medium	High*	(1) Monitoring and maintenance of long term cover system. (2) Restrict access to revegetated WRDs and manage post closure land usage to prevent erosion damage to the cover due to clearing or over grazing. *Current mitigated impact significance is still High. If all mitigation measures are followed impact could be lowered.	
	(4) SX/EW Plant	4	4	4.0	2	3.0	0.6	1.8	Medium	Low	(1) Care taken during decomissioning to prevent any spills or release of contaminants.	
	(5) Solution ponds, stormwater ponds and waste water ponds.	4	4	4.0	3	3.5	0.8	2.8	Medium	Medium	(1) Careful decommisioning and management of contaminated water and sediment.	
	(6) Slope failure of HLP leading to an uncontrolled release of leached ore.	4	4	4.0	2	3.0	0.6	1.8	Medium	Low	(1) Correct closure design of HLPs to reduce risk of slope failure. (2) Ongoing monitoring and maintenance of HLP batter slopes. (3) Development of procedures to clean up spilt leached ore. (3) Adoption of closure batter slopes for long term stability.	
GROUNDWATER												
Contamination of groundwater resources	(1) Seepage from HLPs or waste rock dumps	3	5	4.0	4	4.0	1.0	4	Low	High*	(1) Full compliance with EMPS. (2) Placement of an appropriate cover system to reduce infiltration into the HLPs and WRDs and provide a growth medium suitable for rehabilitation. (3) Flushing of HLPs with freshwater in order to reduce amount of free acid in the heaps. (4) Post-Closure Care and Maintenance Plan to be developed and implemented. *Current mitigated impact significance is still High. If all mitigation measures are followed impact could be lowered.	
	(2) Leakage or spillage of hazardous chemicals including hydrocarbons during closure phase	3	3	3.0	2	2.5	0.8	2	Medium	Low	(1) All hazardous chemicals are to be stored and handled in facilities that are engineered to prevent spillage or seepage of contaminants into groundwater. (2) Monitor groundwater quality in the proximity of potential pollution sources.	
	(3) Seepage of contaminated water from the pit lake	5	5	5.0	4	4.5	0.6	2.7	Low	Medium	(1) Minimise catchment area of the pit. (2) Maintain pit lake elevation below that of adjacent aquifers to ensure that pit is maintained as a groundwater sink.	

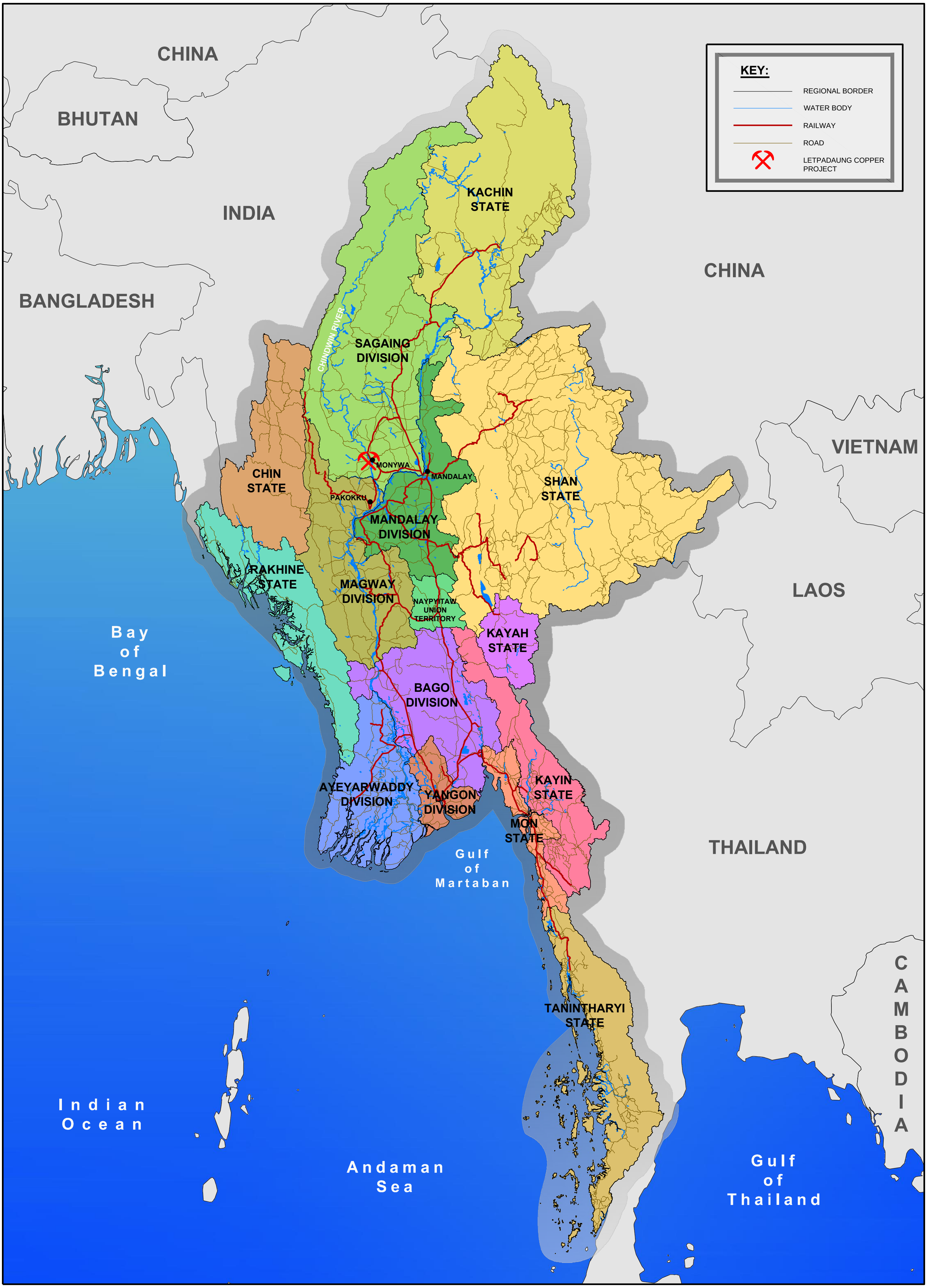
SURFACE WATER (HYDROLOGY AND RIVERS)												
Loss of catchment yield	(1) Containment of storm water run-off (2) Change in creek hydrology	2	3	2.5	3	2.8	1.0	2.75	Medium	Medium	(1) Reserve determination for the downstream users to be determined and water supply to the catchment to be managed to ensure that the water requirements are met. (2) Installation of alternative water supplies. (3) Decomissioning of ponds and release of stormwater to environment where quality is within suitable limits. (4) Hand over of ponds for agricultural use when water quality is acceptable.	High
Contamination of rivers and watercourses	(1) Dirty water run-off from waste rock dumps and HLPs	2	3	2.5	4	3.3	1.0	3.25	Low	High*	(1) Maintenance of sediment control ponds after closure to detain runoff long enough for sediment to fall from suspnesion prior to release. (2) Installation of passive water treatment wetland system to deal with low pH seepage. (3) Post-Closure Care and Maintenance Plan to be developed and implemented. *Current mitigated impact significance is still High. If all mitigation measures are followed impact could be lowered.	
	(2) Slope failure of HLP / waste rock dump resulting in exposure of PAF leached ore / mine waste to surface water runoff.	5	5	5.0	3	4.0	0.8	3.2	Medium	Medium	(1) Correct design of HLPs / waste rock dumps to reduce risk of slope failure. (2) Ongoing monitoring and maintenance of HLP / waste rock dump batter slopes. (3) Development of procedures to clean up spilt leached ore. (4) Adoption of closure batter slopes for long term stability and erosion resistance. (5) Post-Closure Care and Maintenance Plan to be developed and implemented. *Current mitigated impact significance is still High. If all mitigation measures are followed impact could be lowered.	
AIR QUALITY												
Exceedance of health screening guidelines for ground level concentrations of dust	(1) Movement of vehicles and machinery and entrainment from exposed surfaces during closure phase	2	3	2.5	4	3.3	0.8	2.6	Medium	Low	(1) Surface wetting of haul roads. (2) Dust management plan.	Low
	(1) Wind blown dust from exposed surfaces	2	3	2.5	4	3.3	0.8	2.6	High	Low	(1) Continued management of vegetation buffer zones. (2) Dust management plan.	
Exceedance of health screening guidelines for ground level concentrations of SO2, NO2, NO3, DPM and CO.	(1) Exhaust emissions during closure phase	1	3	2.0	4	3.0	0.2	0.6		Very Low	(1) Options for lowering exhaust emissions should be considered.	
Production of Green House Gases	(1) Use of fuel on site by various equipment during closure phase (2) On-site backup power generation (3) Off-site power generation	1	2	1.5	2	1.8	1.0	1.75	Medium	Low	(1) Use of low sulphur fuel. (2) Use of high efficiency motors and engines. (3) Monitoring fuel usage and engine performance.	

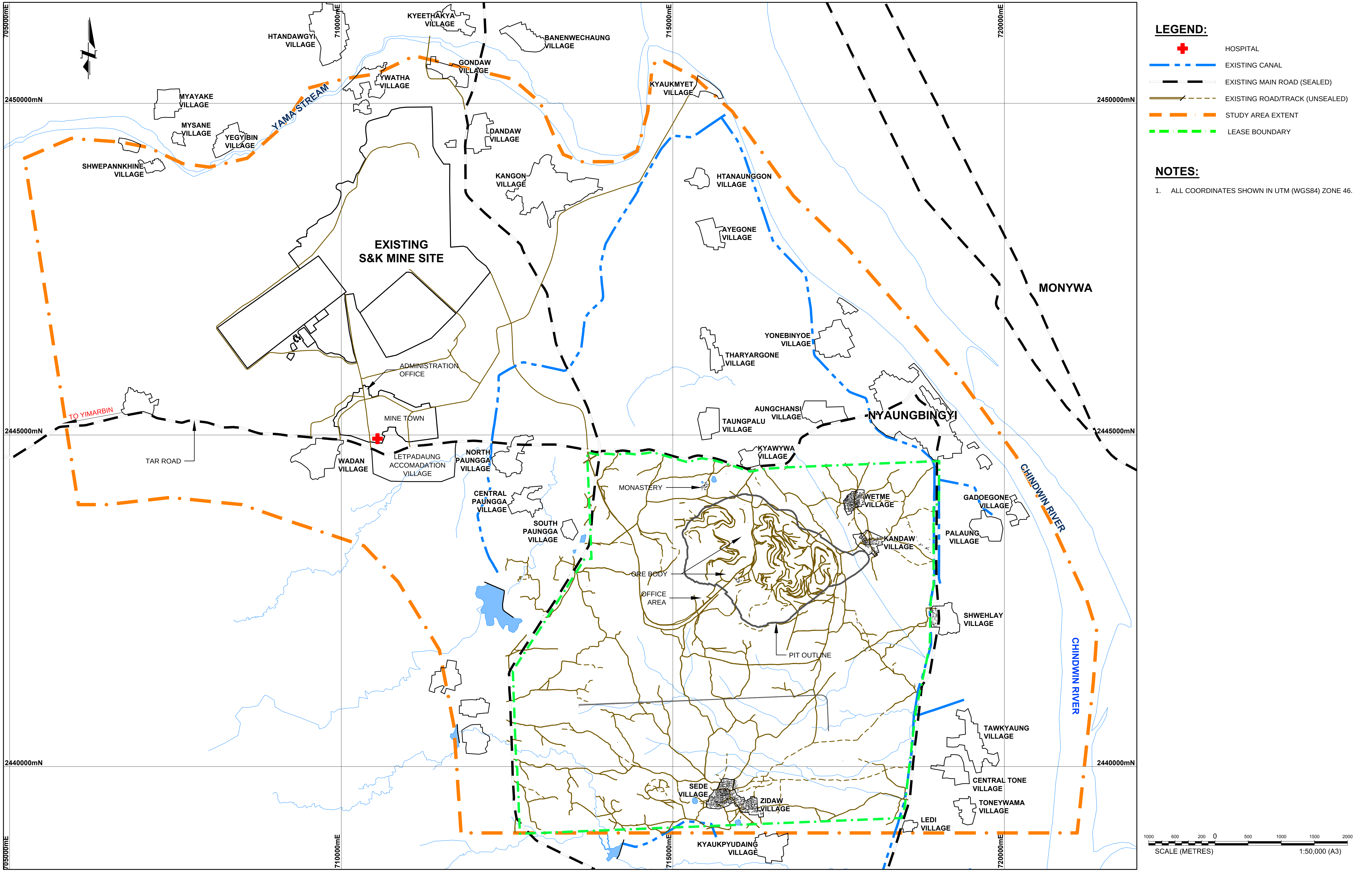
NOISE & VIBRATION													
Disturbance of noise receptors during the day	(1) Movement of machinery and vehicles during closure phase	1	3	2.0	4	3.0	1.0	3	Medium	Low	(1) Construction of noise buffers in critical areas and around site perimeter. (2) Control working hours. (3) Relocation of receptors. (4) Monitoring of noise levels near sensitive receptors.	Low
BIODIVERSITY													
Loss of habitat	(1) Fire damage to forested and rehabilitated areas during closure phase	2	3	2.5	3	2.8	0.2	0.55		Very Low	(1) Installation of fire suppression systems on large equipment. (2) Monitoring of tyre temperatures to guard against tyre fires. (3) Public awareness campaigns. (4) Strict enforecment of OHSM policies and procedures.	Low
Loss of aquatic life	(1) Change in water quality	4	5	4.5	4	4.3	0.6	2.55	Medium	Medium	(1) Implement measures for the protection of water quality and the separation of clean and dirty water. (2) Installation of passive water treatment options such as wetlands to treat runoff.	
	(2) Change in flow regimes	2	5	3.5	3	3.3	0.6	1.95	Medium	Low	(1) Ecological reserve determination to be undertaken for the catchments downstream of the site.	
Increased pressure on ecological services	(1) Bio-Ethnology (loss of traditionally used natural food and medicinal resources)	2	4	3.0	4	3.5	0.8	2.8	Low	Medium	(1) Revegetation of rehabilitated areas of the site with traditional plants and medicinal herbs.	
Spread of invasive weeds and pest species	(1) Movement of machinery and vehicles spreading seeds during closure phase	1	3	2.0	3	2.5	0.8	2	Low	Low	(1) Vehicle clean downs prior to entering the site (2) Alien invasive species management programme to be implemented	
	(1) Importation of materials during closure phase	1	3	2.0	2	2.0	0.8	1.6	Low	Low	(1) Inspection of containers prior to entry of site (2) Alien invasive species management programme to be implemented	
Development of protected vegetation areas	(1) Establishment of forested and revegetated parts of project area	1	4	2.5	2	2.3	0.8	1.8	Low	Very Low Positive	(1) Development of forestry management plans to prevent over utilisation of revegetated areas, particularly excessive harvesting of firewood.	
VISUAL													
Disturbance of view scape	(1) Establishment of permanent pit lake (2) Establishment of permanent waste rock dumps (3) Establishment of permanent HLP heaps	2	5	3.5	4	3.8	1.0	3.75	Medium	Medium	(1) Progressive rehabilitation of inactive areas of waste rock dumps. (2) Rehabilitation of HLP heaps at closure. (3) Planting of vegetation buffers to screen infrastructure.	Medium

SOCIO-ECONOMICS												
NEGATIVE IMPACTS												
Loss of jobs	(1) Direct loss of jobs at mine after operations cease (2) Indirect loss of jobs in surrounding area from industries linked to mine and mine employees	3	5	4.0	3	3.5	1.0	3.5	Medium	High	(1) Development of alternate industries capable of absorbing mine site employees.	Medium
Proliferation of Disease Causing Species e.g. malaria and bilharzia	(1) Standing water (2) Passive water treatment wetlands	3	4	3.5	4	3.8	0.8	3	Medium	Low	(1) Standing water will be managed and minimised and treated to avoid mosquitoes. (2) No swimming to be allowed within mine dams including the clean water dam. (3) Malaria prevention measures to be implemented at mine residences. (4) Community education on the spread of water borne diseases such as malaria and bilharzia. (5) Investigation of natural pest species controls. (6) Mosquito nets and repellant.	
Increased safety risk due to WRD rockfalls or land slips	(1) Slope instability (2) Proximity of villages and the public to the waste dumps	4	5	4.5	2	3.3	0.4	1.3	High	Very Low	(1) Safety set backs from roads and villages (2) Exclusion of non essential personel and the general public. (3) Batter slopes designed with acceptable factors of safety. (4) Monitoring and inspection of waste rock dumps. (5) Adoption of closure batter slopes for increased stability.	
Increased safety risk due to pit lake	(1) Local people and livestock could fall into the pit. (2) Pit wall instabillity	3	5	4.0	2	3.0	0.4	1.2		Low	(1) Restrict access through the installation of a 2 m bund wall around the full pit perimeter outside the area of potential future instability. (2) Installation of warning signs.	
Increased safety risk due to bush fire	(1) Vehicle and machinery use during closure phase (2) Cigarette butts (3) Tyre fires	3	4	3.5	4	3.8	0.2	0.75		Very Low	(1) Installation of fire suppression systems on itmes of large equipment. (2) Monitoring of tire temperatures to guard against tire fires. (3) Public awareness campaigns. (4) Strict enforecment of OHSM policies and procedures.	
Loss of land for agriculture and traditional livelihood	(1) Rehabilitated WRDs and HLPs unsuitable for grazing or cultivation of crops due to potential for damage to cover system	2	5	3.5	3	3.3	1.0	3.25	Low	Medium	(1) Slackening of closure slopes. (2) Installation of a more robust capping system. (3) In development of the mine closure plan, the local community shall be consulted to agree a suitable end land use for the various landforms within the site and the design of the closure plan will take into account the agreements with the community and a cost provision will be made to account for those end land uses.	

POSITIVE IMPACTS												
Economic benefits to local community	(1) Employment of local persons during closure phase	1	3	2.0	2	2.0	0.8	1.6	Medium	Low Positive	(1) Preference to be given to local persons for employment. (2) Local skill base to be developed (training programmes).	**Very Low Positive**
	(2) Local procurement of materials and services required during mine closure.	1	3	2.0	4	3.0	0.6	1.8	Medium	Low Positive	(1) Preference will be given to local services providers and suppliers of goods. (2) Training and advice (microfinance will also be investigated.)	
	(3) Improved access to markets	1	4	2.5	2	2.3	0.6	1.4	Low	Very Low Positive	(1) Provision of training to develop skills	
	(4) Development of sustainable alternative industries to maintain local economy after mine closure	1	5	3.0	4	3.5	0.5	1.8	Low	Very Low Positive	(1) Consultation with local community to identify potential alternative industries and businesses. (2) Development of alternative industries and businesses prior to closure with MWMCL sponsorship of education and training.	
Improved infrastructure (Sanitation, Electricty, Water, Fuel supply)	(1) Ongoing maintenance of village infrastucture	2	5	3.5	3	3.3	0.6	2.0	Low	Very Low Positive	(1) Maintenance of infrastructure by district shire. (2) Maintenance of the regional infrastructure to be included in mine closure plan.	
Improved housing conditions	(1) Maintenance of existing village housing. (2) Improved income.	2	5	3.5	2	2.8	0.2	0.6	Low	Very Low Positive	(1) Commitment of management and government to the long term maintenance of local housing standards. (2) Maintenance of local housing to be included in mine closure plan.	
Improved Road Infrastructure	(1) Ongoing maintenance of roads and intersections	2	5	3.5	4	3.8	0.4	1.5	Low	Very Low Positive	(1) Upgrading roads to dual lane roads. (2) Improving road intersections to accommodate heavy traffic. (3) Commitment of government to progressive upgrading of road network.	
Improved Provision of Medical Services	(1) Maintenance of local medical clinics	2	5	3.5	3	3.3	0.4	1.3	Low	Very Low Positive	(1) Commitment of management and government to the long term maintenance of local medical clinics and hospitals. (2) Maintenance of local medical clinics and hospitals to be included in mine closure plan.	

FIGURES


KEY:
REGIONAL BORDER
WATER BODY
RAILWAY
ROAD
LETPADAUNG COPPER PROJECT
CHINA
BHUTAN
INDIA
BANGLADESH
CHINA
VIETNAM
LAOS
THAILAND
CAMBODIA
KACHIN STATE
SAGAING DIVISION
CHINDWIN RIVER
CHIN STATE
MONYWA
MANDALAY
PAKOKKU
SHAN STATE
MANDALAY DIVISION
RAKHINE STATE
MAGWAY DIVISION
NAYPYITAW UNION TERRITORY
KAYAH STATE
BAGO DIVISION
AYEYARWADDY DIVISION
YANGON DIVISION
KAYIN STATE
MON STATE
TANINTHARYI STATE
Bay of Bengal
Gulf of Martaban
Indian Ocean
Andaman Sea
Gulf of Thailand



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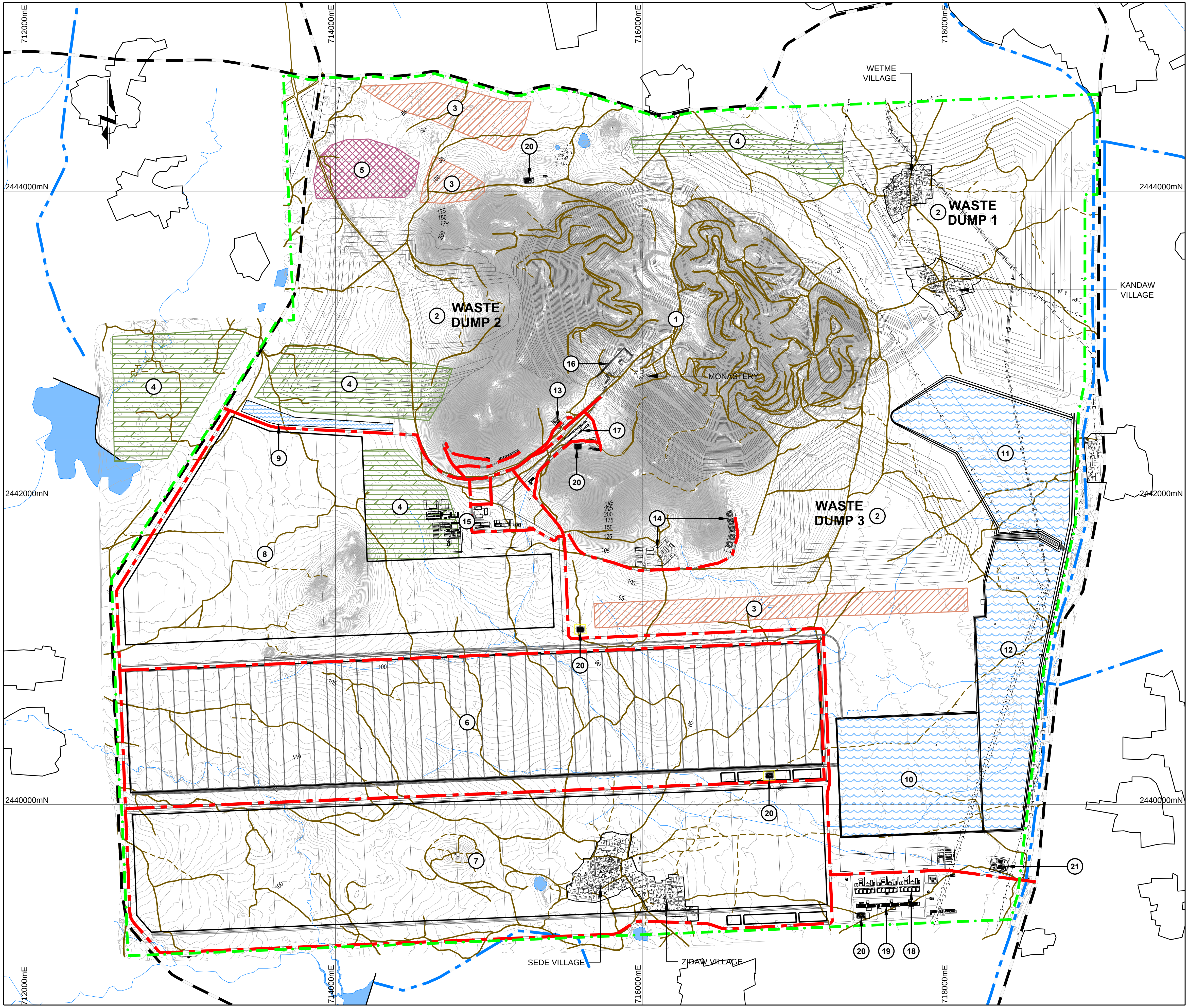
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
PROJECT LOCALITY PLAN

Ref: PE701-00022/13
Figure 1.2.1



LEGEND:

- EXISTING POWER LINE
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LETPADAUNG PROJECT LEASE BOUNDARY
- SITE ROAD ALIGNMENT

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 1m CONTOUR INTERVALS SHOWN.

KEY:

1. PIT
2. WASTE DUMP
3. TOPSOIL STOCKPILE
4. LOW GRADE ORE STOCKPILE
5. RESERVE ORE STOCKPILE
6. HEAP LEACH PAD No.1
7. HEAP LEACH PAD No.2
8. HEAP LEACH PAD No.3
9. WASTE WATER COLLECTION POND
10. HEAP LEACH STORM WATER POND
11. WASTE WATER RESERVOIR (NORTH)
12. WASTE WATER RESERVOIR (SOUTH)
13. FUEL STATION
14. EXPLOSIVES AREA
15. OFFICES/ WAREHOUSES/ MAINTENANCE AREA
16. MOBILE CRUSHER FOR QUARRY
17. CONVEYOR FOUNDATIONS
18. EXTRACTION PLANT
19. ELECTROWINNING PLANT
20. 33Kv SUB STATION
21. 230kV SUB STATION

500 300 100 0 250 500 750 1000
SCALE (METRES) 1:25,000 (A3)

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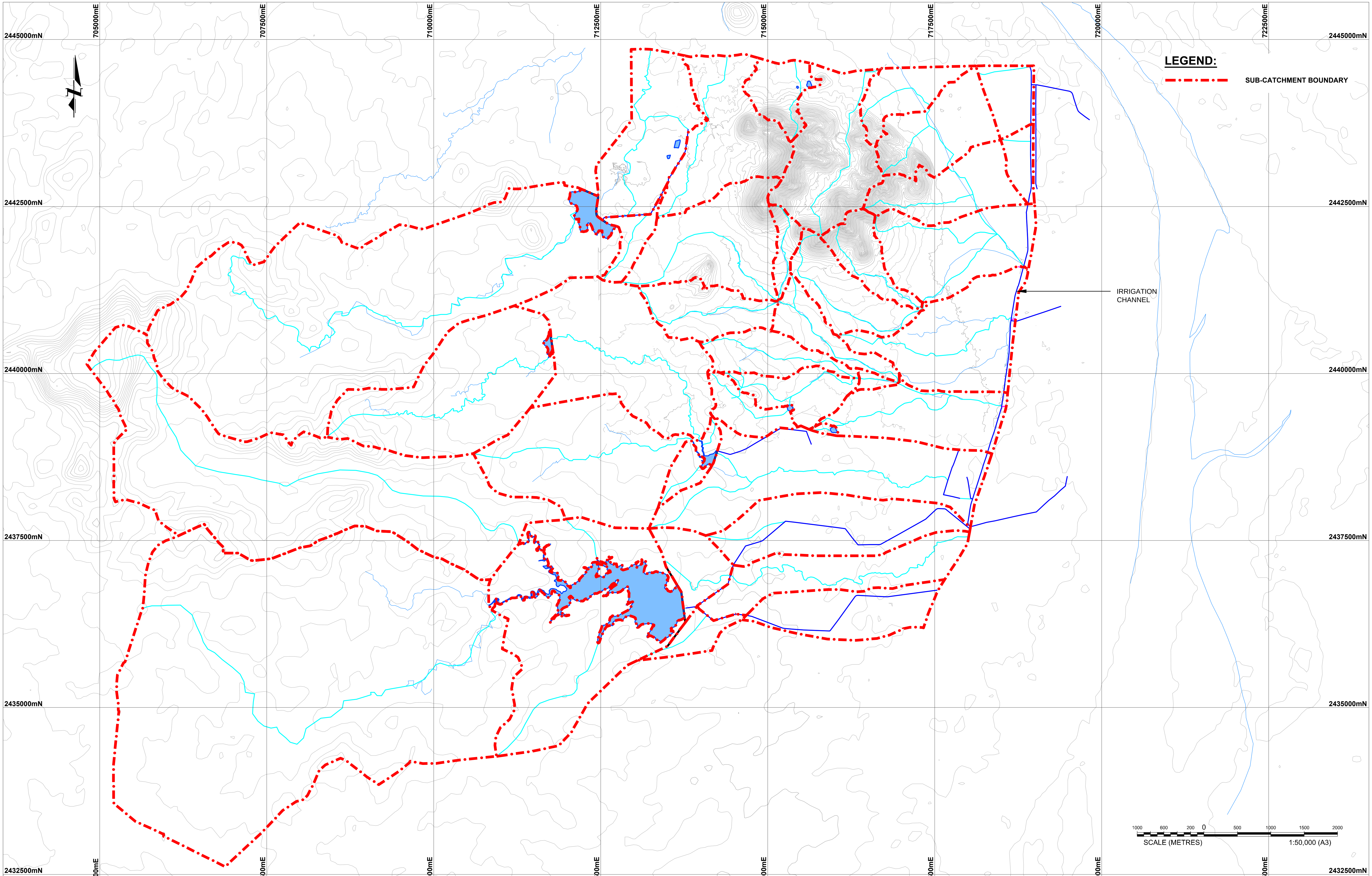
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
SITE GENERAL ARRANGEMENT

Ref: PE701-00022/13
Figure 1.4.1



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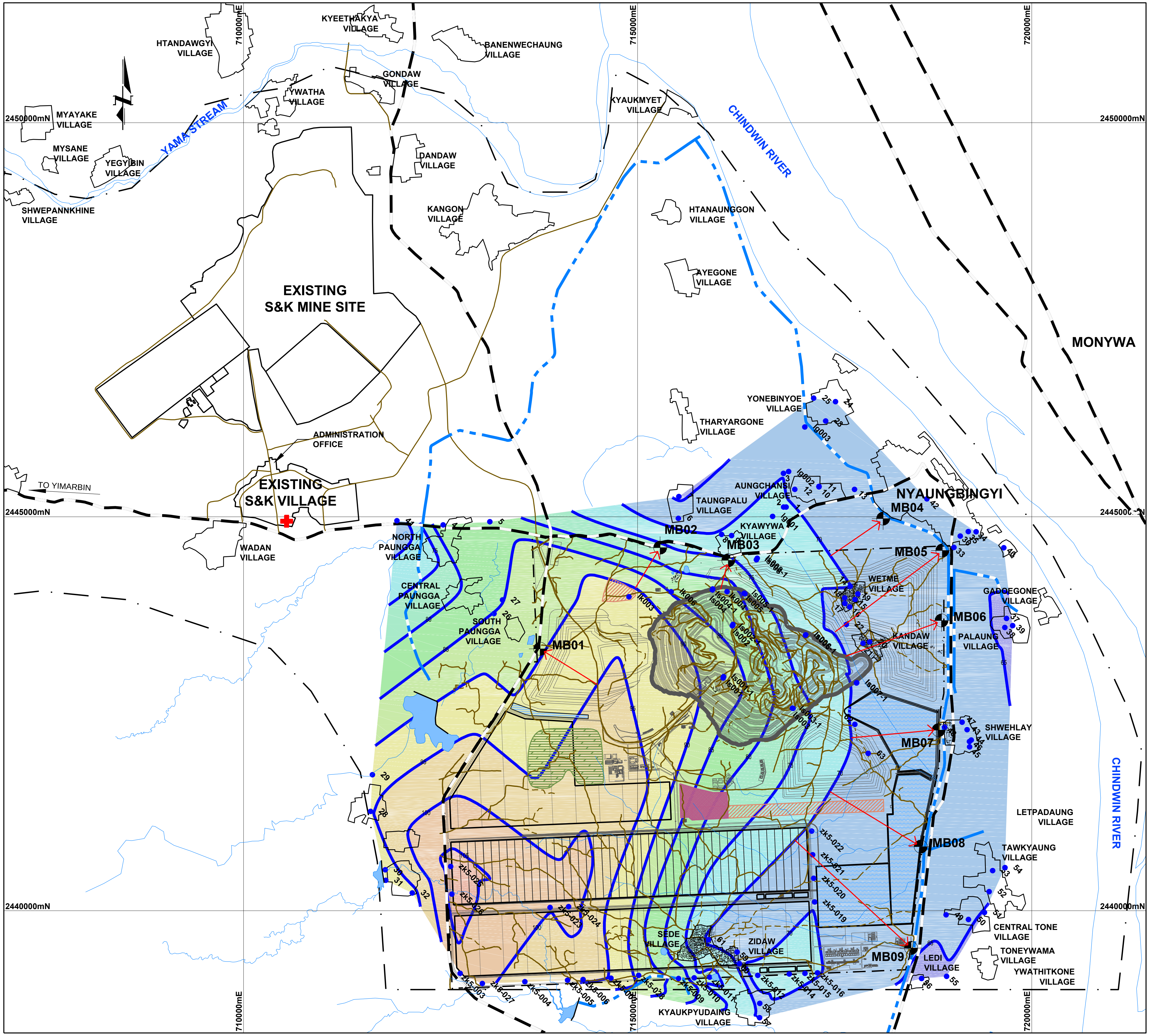
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
CATCHMENT DELINEATION - EXISTING CONDITIONS

Ref: PE701-00022/13
Figure 4.2.1



LEGEND:

- HOSPITAL
- EXISTING CANAL
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- STUDY AREA EXTENT
- PROJECT AREA BOUNDARY
- BOREHOLE LOCATION
- GROUND WATER CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION
- MONITORING BORE LOCATION

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 1m CONTOUR INTERVALS SHOWN.

LEVELS TABLE

COLOUR CODE	DEPTH (FROM)	DEPTH (TO)
	60	65
	65	70
	70	75
	75	80
	80	85
	85	90
	90	95
	95	100
	100	105
	105	110

AQUIFER THICKNESS

BORE I.D.	EASTING	NORTHING	ELEVATION	AI	Col	HW	MW	SW
Ig001	716710.7	2445004	71.97		19.42		30.82	
Ig002	716914.7	2445572	69.42		32.1		17.71	
Ig003	717119.8	2446137	67.17		50.09		2.06	
Ik002			-	0.8			171.29	
Ik003	714888.7	2443982	93.41	1.6			148.35	
Ik004	716132.9	2444049	82.84	3.55		110.6	36.13	
Ik005			-	15		35.05	100.21	
Ik006	715424.4	2444047	84.82	4.75		65.91	150.26	
Is001	716082.9	2442952	88.31	3.34		55.51	401.5	
Is001-1	716088.2	2442970	89.1	6.45		60.25	33.85	
Is002	716200.5	2443615	83.13	4.6		45.54	598.46	21.9
Is002-1	716207.7	2443633	83.75	4.3		50.66	45.84	
Is003	716962.7	2442570	77.12	4.55		136.15	309.84	
Is003-1	716971.6	2442567	77.07	3.85		96.73		
Is004	715947.6	2444070	82.57	15.9		4.31	130.29	
Is004-1	715952.7	2444083	82.41	17.32		4.78	78.1	
Is005	716359.5	2444021	79.21	6.97		13.52	132.55	
Is005-1	716351.7	2444029	78.96	3.52		19.68	77.17	
Is006	717127.9	2443494	70.71	12.16		138.05		
Is006-1	717132	2443502	70.4	22.62		77.95		
Is007	717777.1	2442890	69.74		25.44	25.43		
Is007-1	717779.2	2442894	69.95		27.09	23.61		
Is008	716505.6	2444452	71.14		13.8	36.93		
Is008-1	716515.8	2444471	71.36		12.7	38.06		

SCALE (METRES) 1:50,000 (A3)

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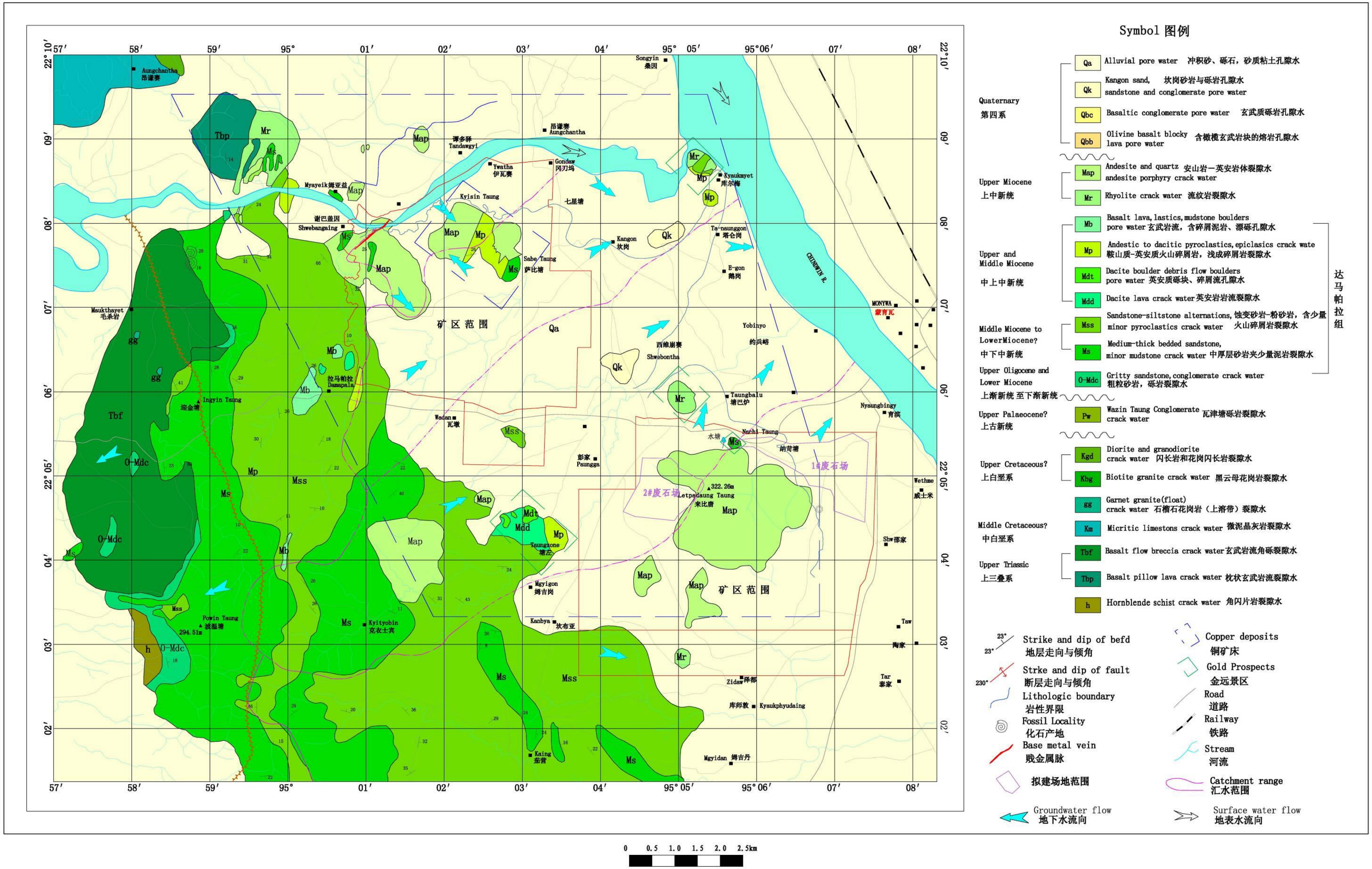
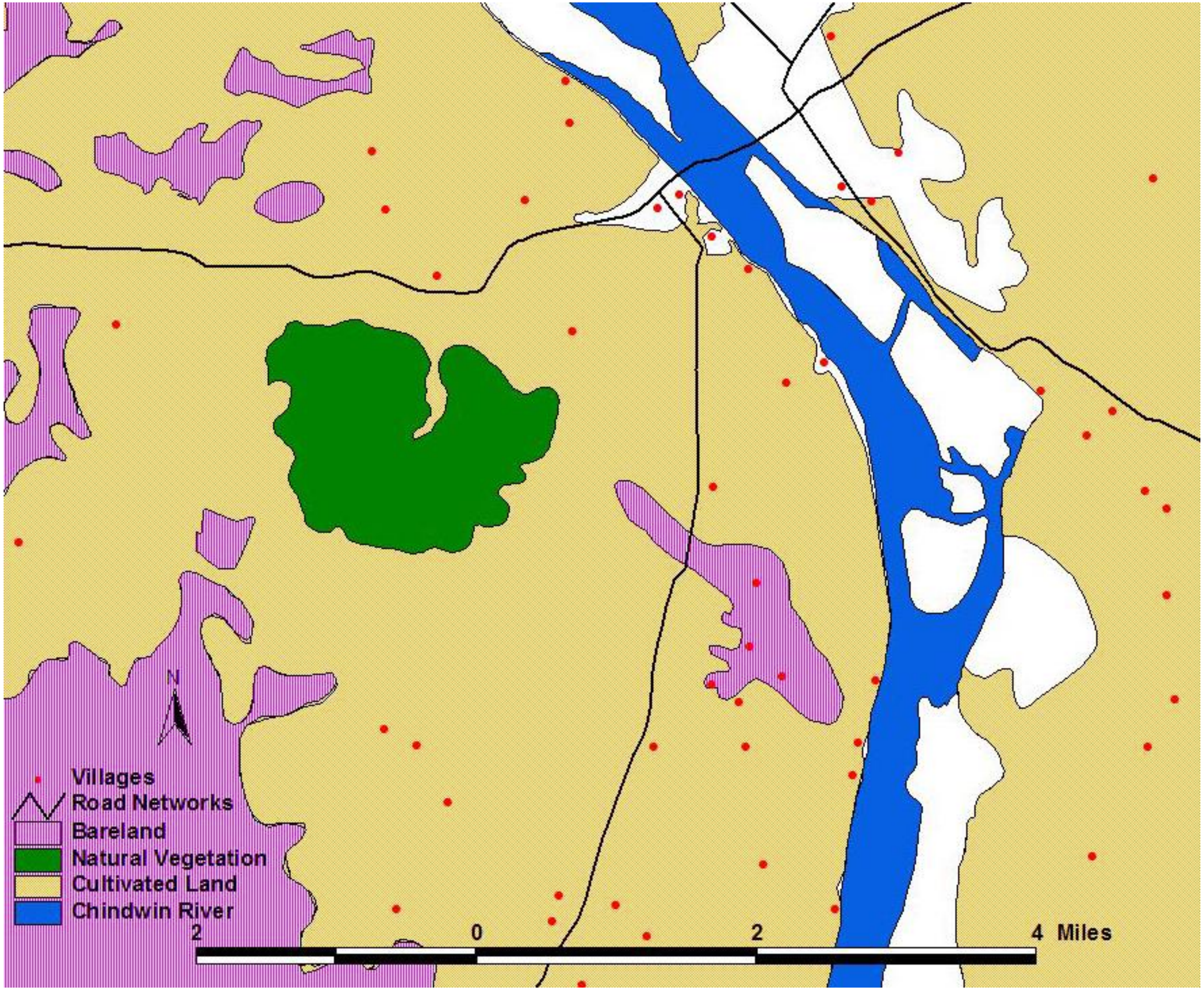
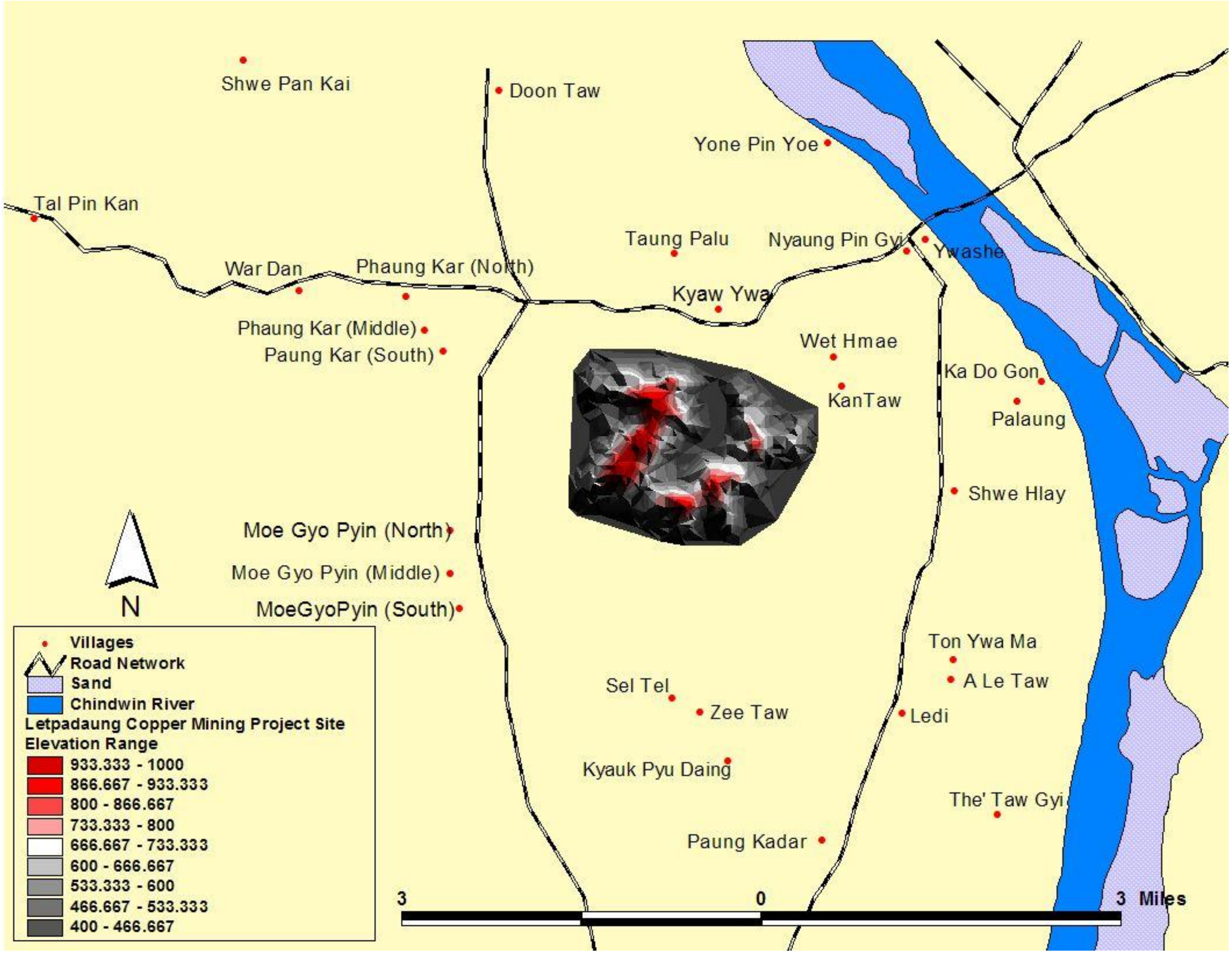
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
GROUNDWATER CONTOURS

Ref: PE701-00022/13
Figure 4.3.1



Symbol 图例
Qa Alluvial pore water 冲积砂、砾石，砂质粘土孔隙水
Qk Kangon sand, sandstone and conglomerate pore water 坎岗砂岩与砾岩孔隙水
Qbc Basaltic conglomerate pore water 玄武质砾岩孔隙水
Qbb Olivine basalt blocky lava pore water 含橄榄玄武岩块的熔岩孔隙水
Map Andesite and quartz andesite porphyry crack water 安山岩一英安岩体裂隙水
Mr Rhyolite crack water 流纹岩裂隙水
Mb Basalt lava, lastics, mudstone boulders pore water 玄武岩流，含碎屑泥岩、漂砾孔隙水
Mp Andestic to dacitic pyroclastics, epiclasics crack wate 鞍山质-英安质火山碎屑岩，浅成碎屑岩裂隙水
Mdt Dacite boulder debris flow boulders pore water 英安质砾块、碎屑流孔隙水
Mdd Dacite lava crack water 英安岩岩流裂隙水
Mss Sandstone-siltstone alternations, 蚀变砂岩-粉砂岩，含少量 minor pyroclastics crack water 火山碎屑岩裂隙水
Ms Medium-thick bedded sandstone, minor mudstone crack water 中厚层砂岩夹少量泥岩裂隙水
O-Mdc Gritty sandstone, conglomerate crack water 粗粒砂岩，砾岩裂隙水
Pw Wazin Taung Conglomerate crack water 瓦津塘砾岩裂隙水
Kgd Diorite and granodiorite crack water 闪长岩和花岗闪长岩裂隙水
Kbg Biotite granite crack water 黑云母花岗岩裂隙水
gg Garnet granite(float) crack water 石榴石花岗岩（上溶带）裂隙水
Km Micritic limestons crack water 微泥晶灰岩裂隙水
Tbf Basalt flow breccia crack water 玄武岩流角砾岩裂隙水
Tbp Basalt pillow lava crack water 枕状玄武岩流裂隙水
h Hornblende schist crack water 角闪片岩裂隙水
Quaternary 第四系
Upper Miocene 上中新统
Upper and Middle Miocene 中上中新统
Middle Miocene to LowerMiocene? 中下中新统
Upper Oligocene and Lower Miocene 上渐新统至下渐新统
Upper Palaeocene? 上古新统
Upper Cretaceous? 上白垩系
Middle Cretaceous? 中白垩系
Upper Triassic 上三叠系
达马帕拉组
Strike and dip of befd 地层走向与倾角
Strke and dip of fault 断层走向与倾角
Lithologic boundary 岩性界限
Fossil Locality 化石产地
Base metal vein 贱金属脉
拟建场地范围
Copper deposits 铜矿床
Gold Prospects 金远景区
Road 道路
Railway 铁路
Stream 河流
Catchment range 汇水范围
Groundwater flow 地下水流向
Surface water flow 地表水流向
矿区范围
1#废石场
2#废石场
Letpadaung Taung 来比唐
322.26m
MONYWA 蒙育瓦
CHINDWIN R.
0 0.5 1.0 1.5 2.0 2.5km


N
Villages
Road Networks
Bareland
Natural Vegetation
Cultivated Land
Chindwin River
2
0
2
4 Miles


Shwe Pan Kai
Doon Taw
Yone Pin Yoe
Tal Pin Kan
Taung Palu
Nyaung Pin Gyi
Ywashe
War Dan
Phaung Kar (North)
Kyaw Ywa
Phaung Kar (Middle)
Paung Kar (South)
Wet Hmae
Ka Do Gon
KanTaw
Palaung
Shwe Hlay
Moe Gyo Pyin (North)
Moe Gyo Pyin (Middle)
MoeGyoPyin (South)
N
Ton Ywa Ma
A Le Taw
Sel Tel
Zee Taw
Ledi
Kyauk Pyu Daing
The' Taw Gyi
Paung Kadar
Villages
Road Network
Sand
Chindwin River
Letpadaung Copper Mining Project Site
Elevation Range
933.333 - 1000
866.667 - 933.333
800 - 866.667
733.333 - 800
666.667 - 733.333
600 - 666.667
533.333 - 600
466.667 - 533.333
400 - 466.667
3
0
3 Miles

7
6
Kyaukka Rd
Monywa
Kadogon In
Damapala
1
2
5
3
Monywa-Mandalay Hwy
10
8
4
9

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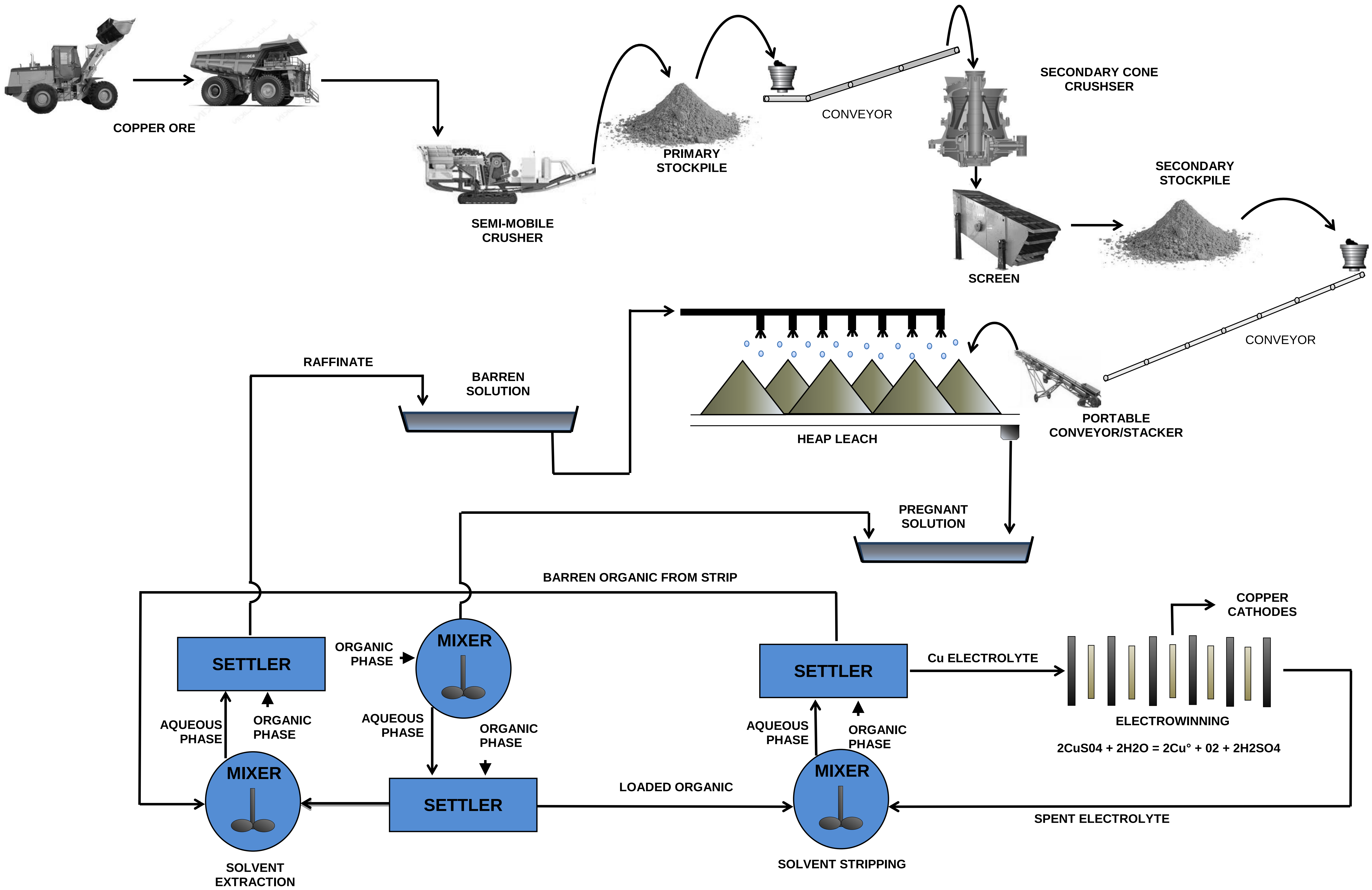
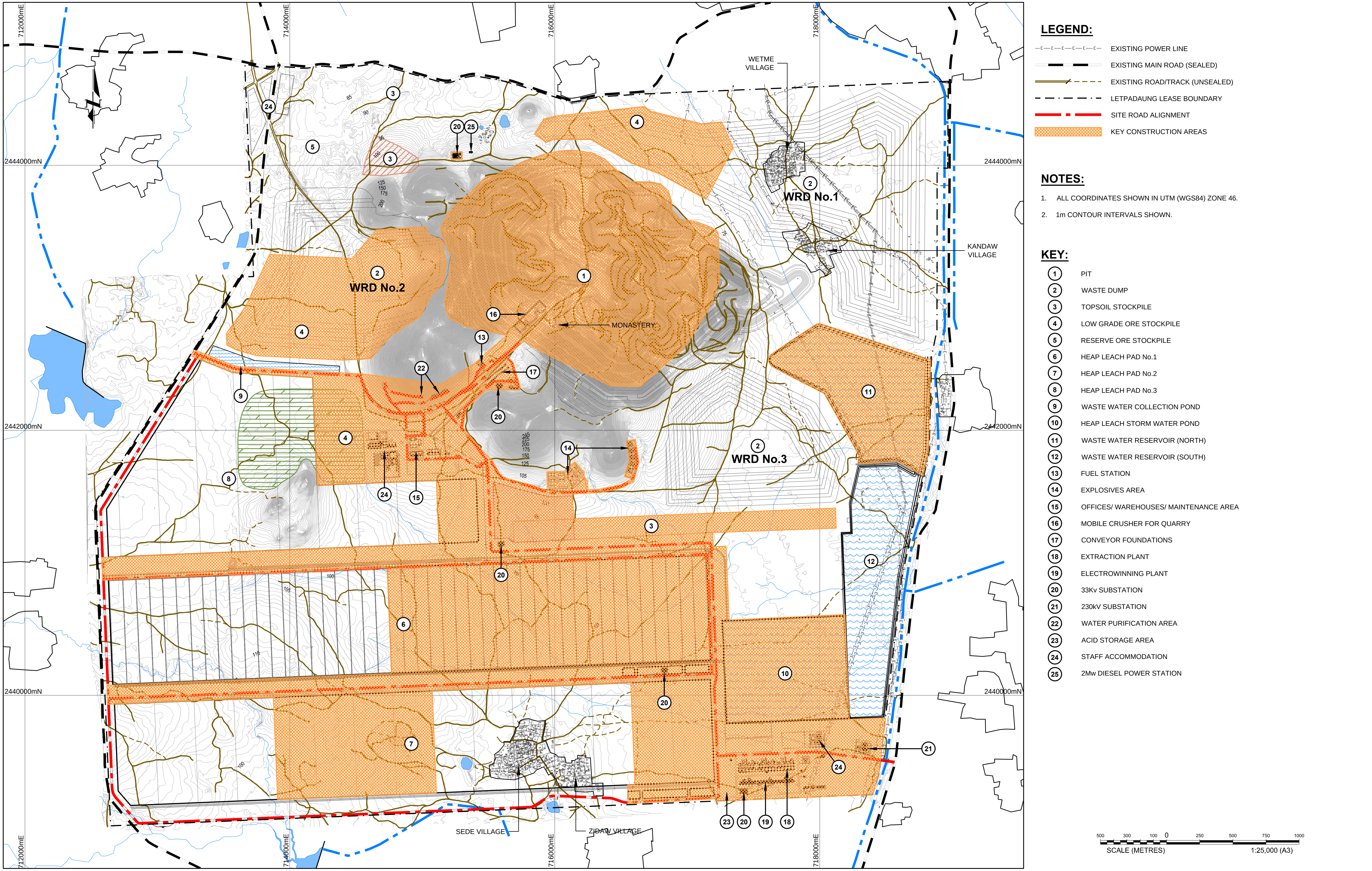
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
BASELINE DUST STATION LOCATIONS

Ref: PE701-00022/13
Figure 4.10.4


COPPER ORE
SEMI-MOBILE CRUSHER
PRIMARY STOCKPILE
CONVEYOR
SECONDARY CONE CRUSHSER
SCREEN
SECONDARY STOCKPILE
CONVEYOR
PORTABLE CONVEYOR/STACKER
HEAP LEACH
RAFFINATE
BARREN SOLUTION
PREGNANT SOLUTION
BARREN ORGANIC FROM STRIP
SETTLER
ORGANIC PHASE
MIXER
AQUEOUS PHASE
ORGANIC PHASE
AQUEOUS PHASE
ORGANIC PHASE
MIXER
SETTLER
SOLVENT EXTRACTION
LOADED ORGANIC
SETTLER
AQUEOUS PHASE
ORGANIC PHASE
MIXER
SOLVENT STRIPPING
Cu ELECTROLYTE
COPPER CATHODES
ELECTROWINNING
2CuS04 + 2H2O = 2Cu° + 02 + 2H2SO4
SPENT ELECTROLYTE



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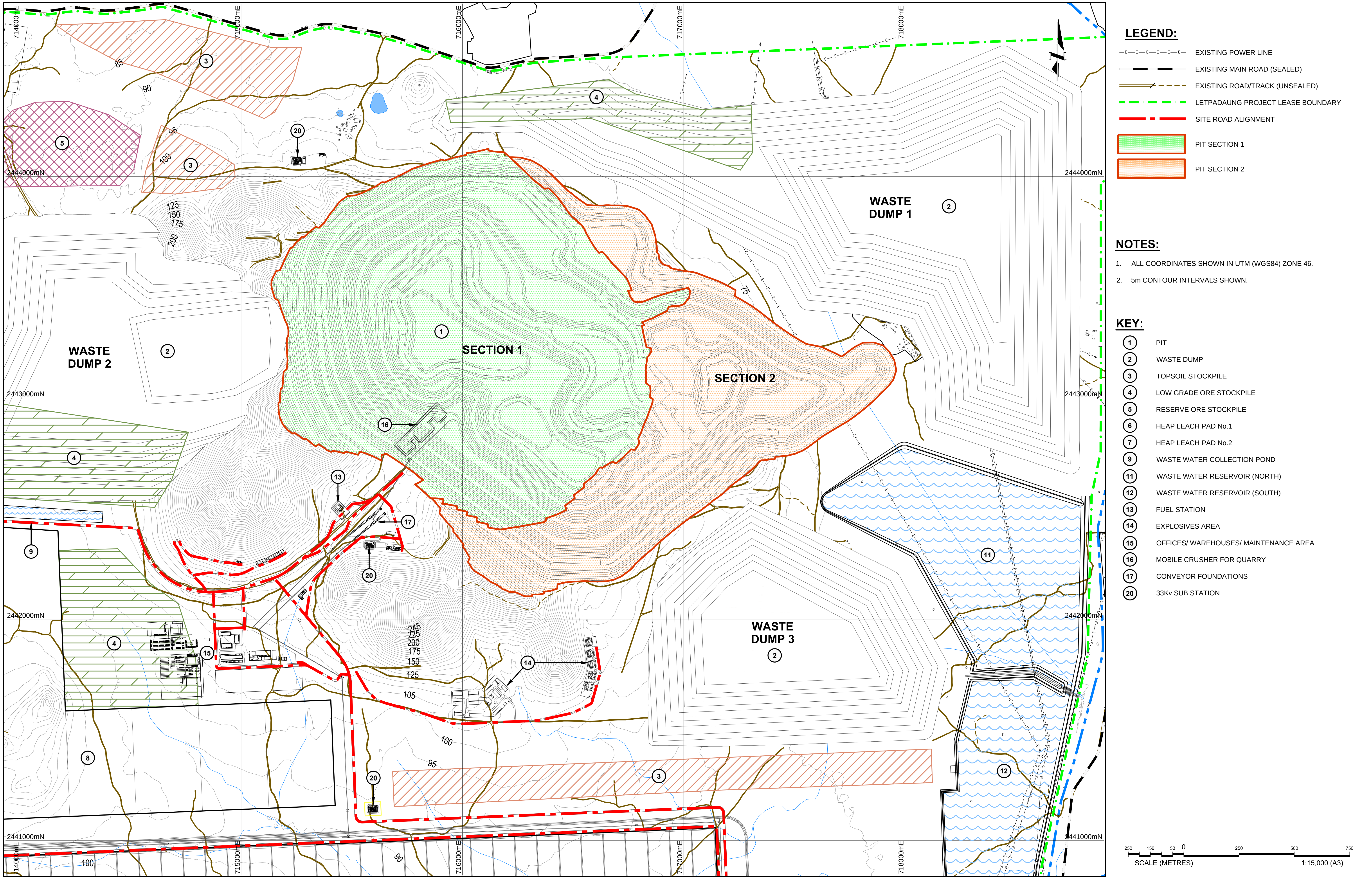
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
KEY CONSTRUCTION AREAS

Ref: PE701-00022/13
Figure 5.3.1



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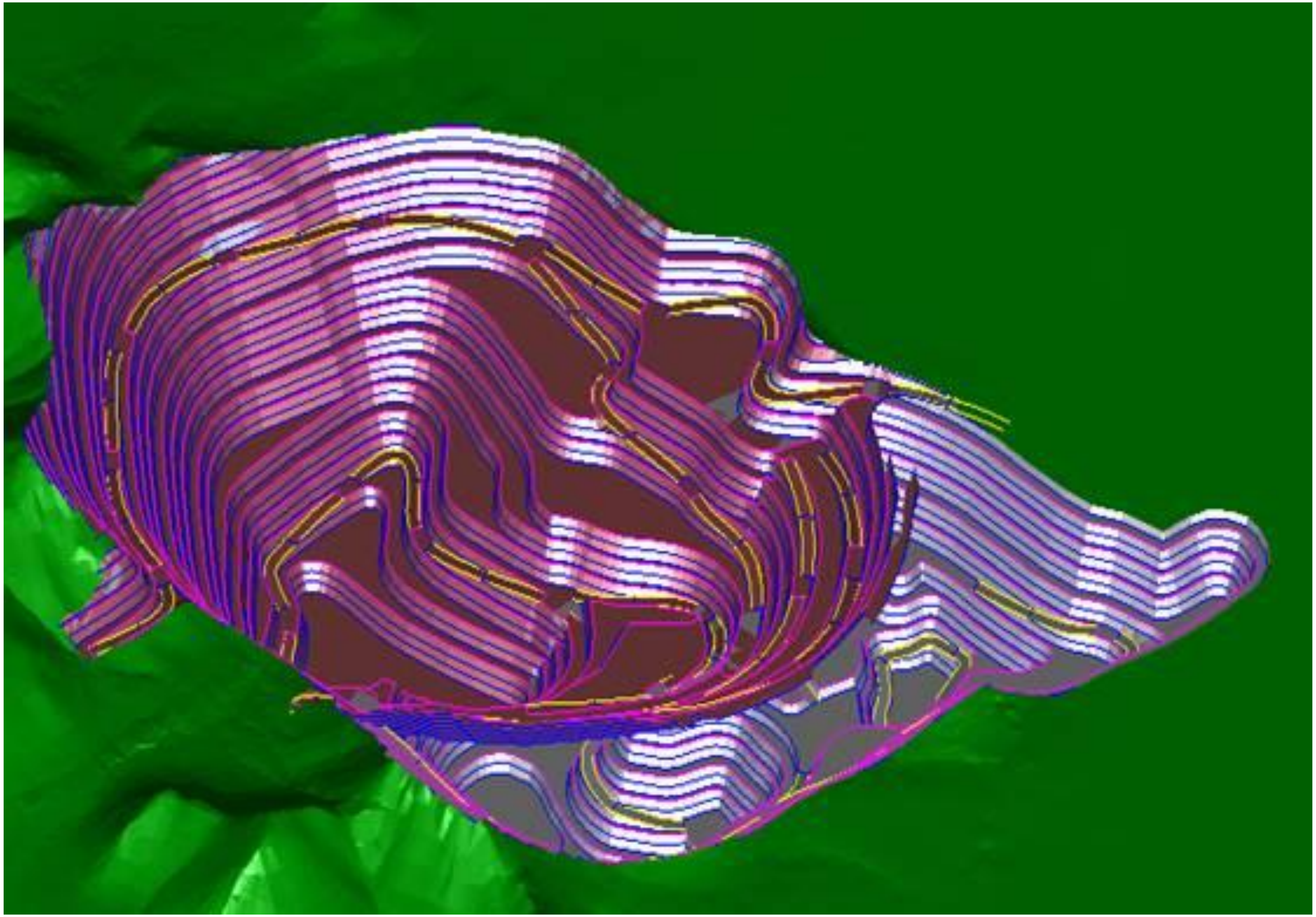
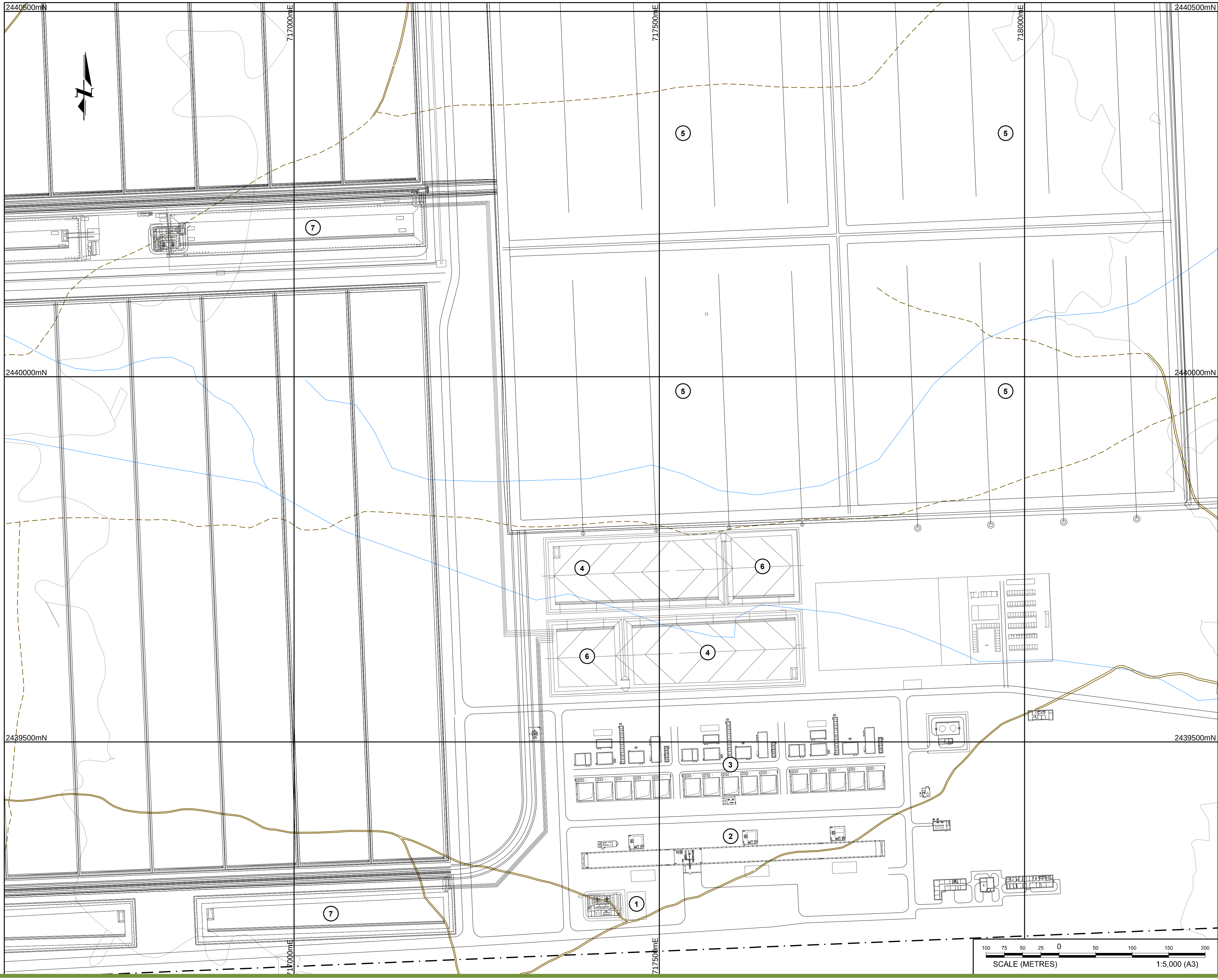
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
PIT AND WASTE DUMPS

Ref: PE701-00022/13
Figure 5.9.1



YEAR 30 SHELL

Figure 5.9.2



LEGEND:

WATER COURSE

EXISTING ROAD/TRACK (UNSEALED)

LEASE BOUNDARY

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 5m CONTOUR INTERVALS SHOWN.

KEY:

1. 33kv SUB-STATION
2. ELECTROWINNING PLANT
3. EXTRACTION PLANT
4. PREGNANT LEACH SOLUTION POND
5. STORM WATER POND
6. RAFINATE POND
7. INTERMEDIATE LEACH SOLUTION POND

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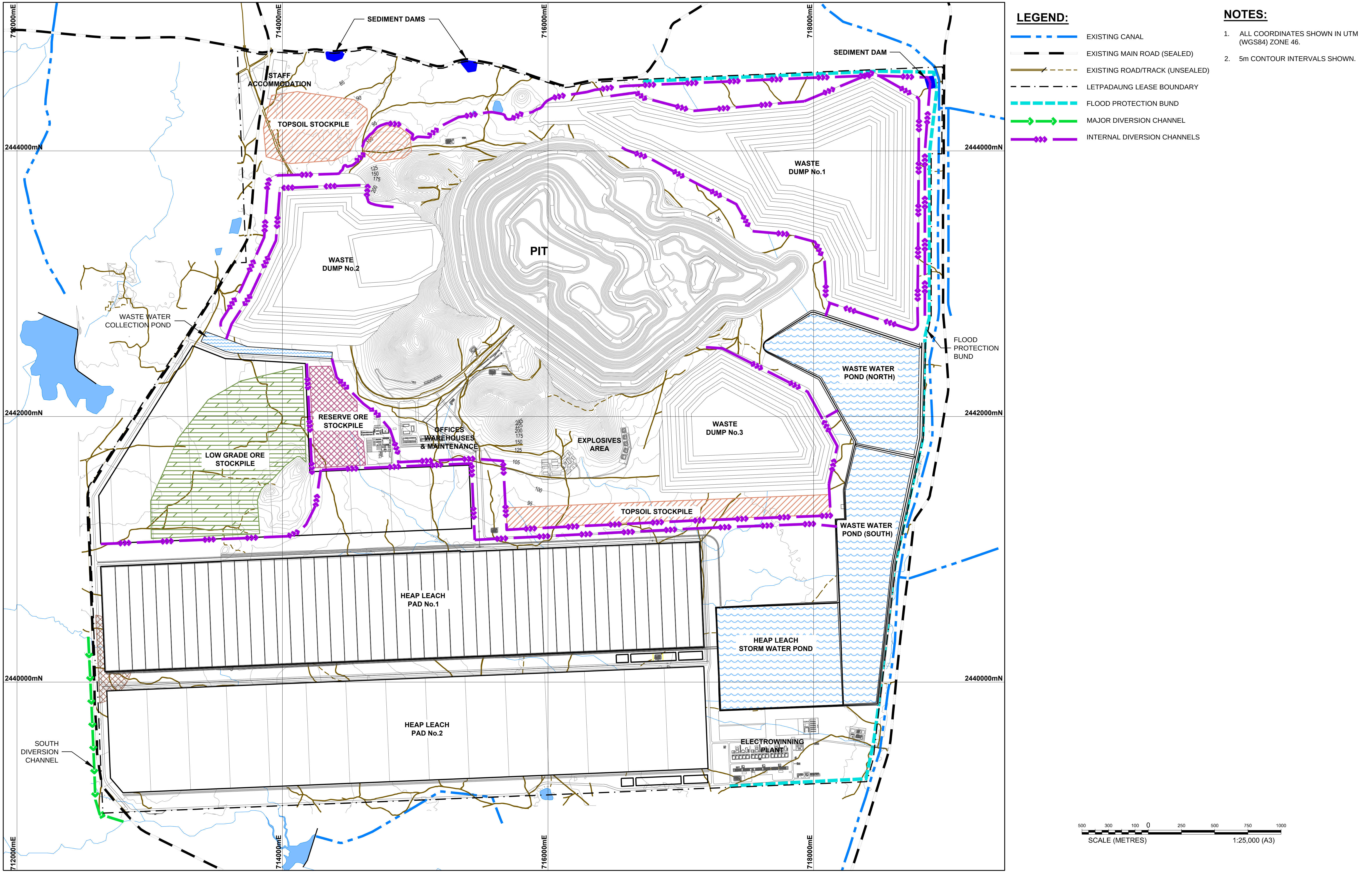
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
HEAP LEACH PAD PONDS

Ref: PE701-00022/13
Figure 5.11.1



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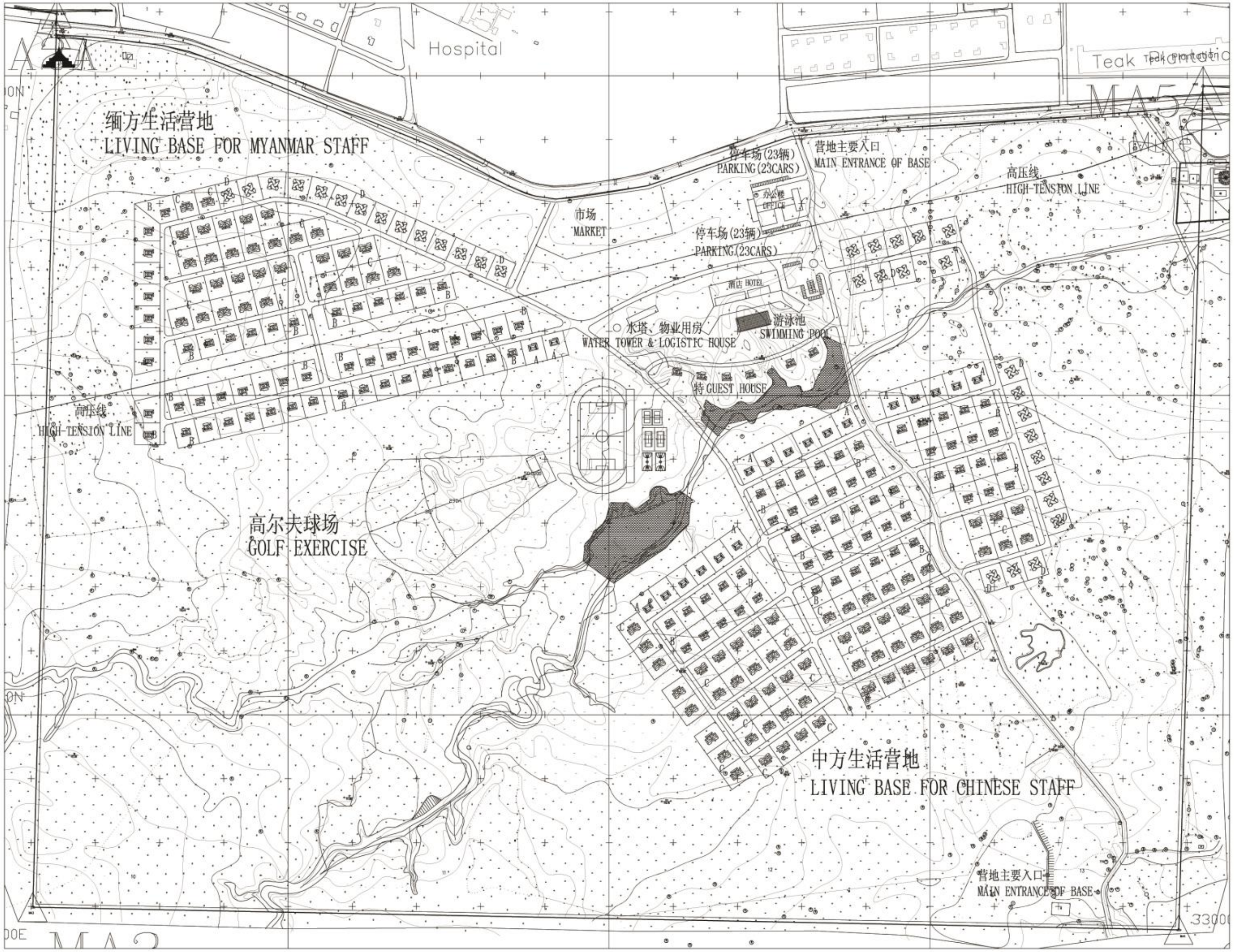
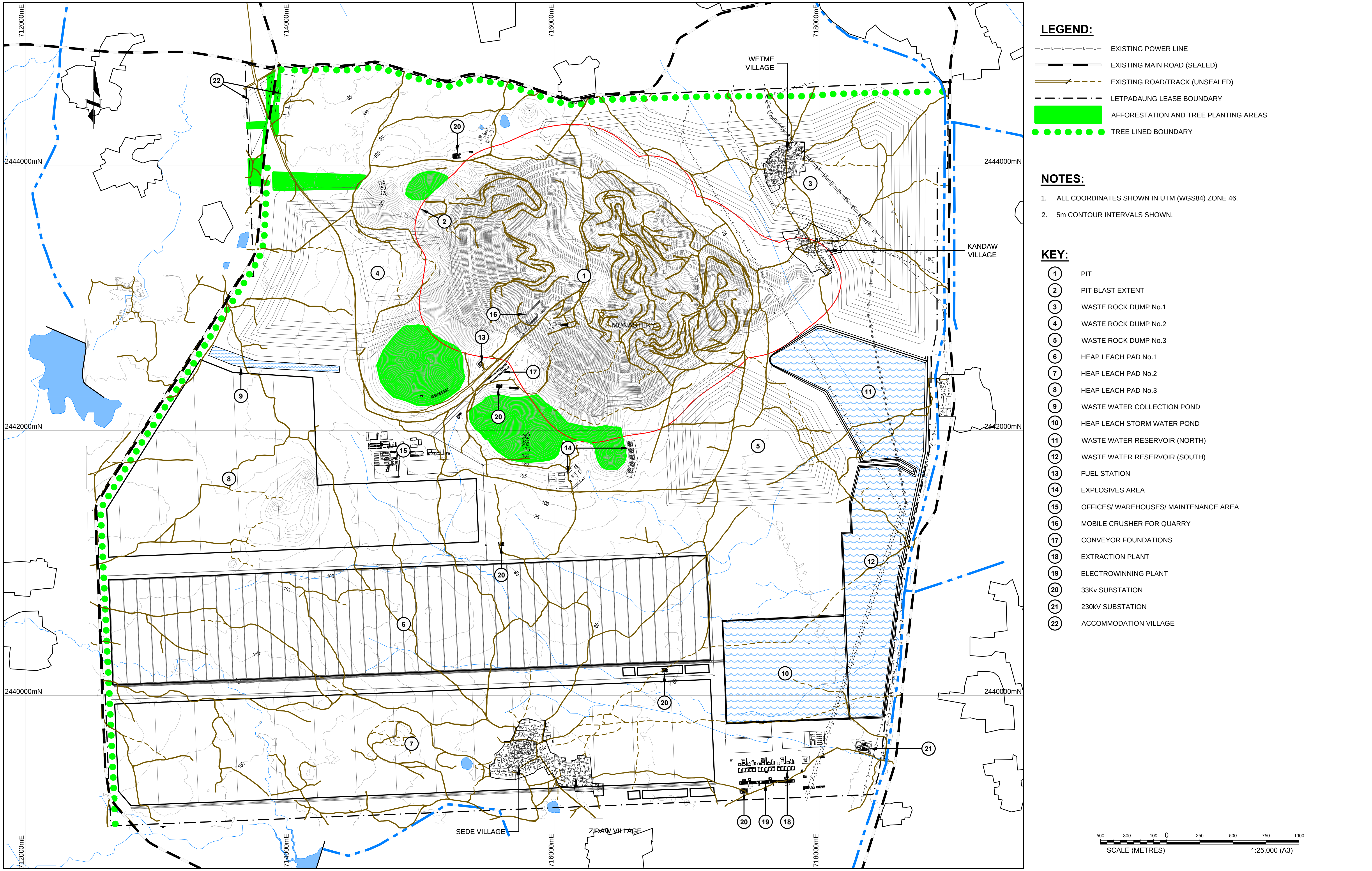
LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
SITE WATER MANAGEMENT PLAN

Ref: PE701-00022/13
Figure 5.18.1


Hospital
Teak Plantation
缅方生活营地
LIVING BASE FOR MYANMAR STAFF
停车场(23辆)
PARKING(23CARS)
营地主要入口
MAIN ENTRANCE OF BASE
高压线
HIGH-TENSION LINE
市场
MARKET
办公楼
OFFICE
停车场(23辆)
PARKING(23CARS)
酒店 HOTEL
水塔、物业用房
WATER TOWER & LOGISTIC HOUSE
游泳池
SWIMMING POOL
GUEST HOUSE
高压线
HIGH-TENSION LINE
高尔夫球场
GOLF EXERCISE
中方生活营地
LIVING BASE FOR CHINESE STAFF
营地主要入口
MAIN ENTRANCE OF BASE



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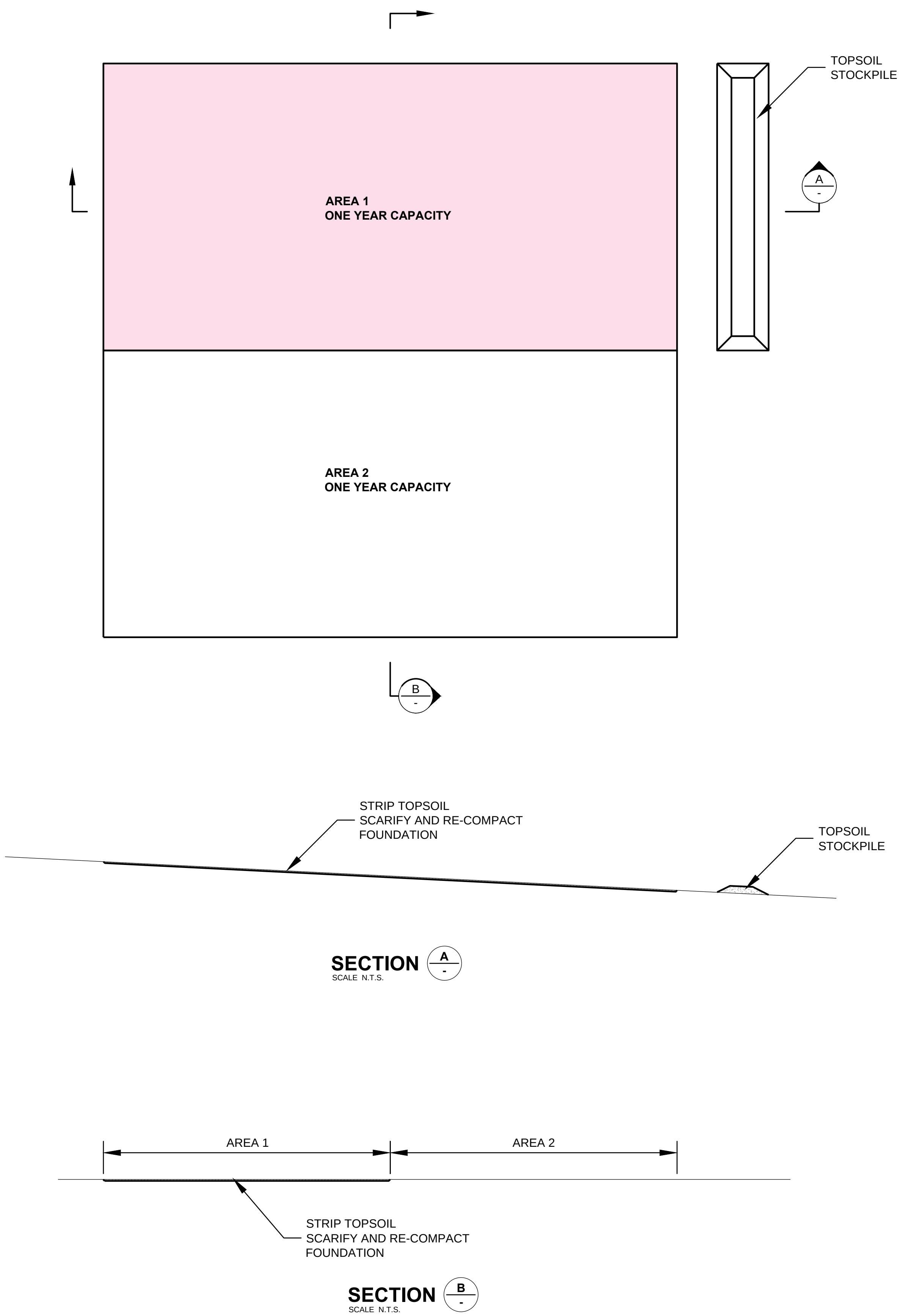
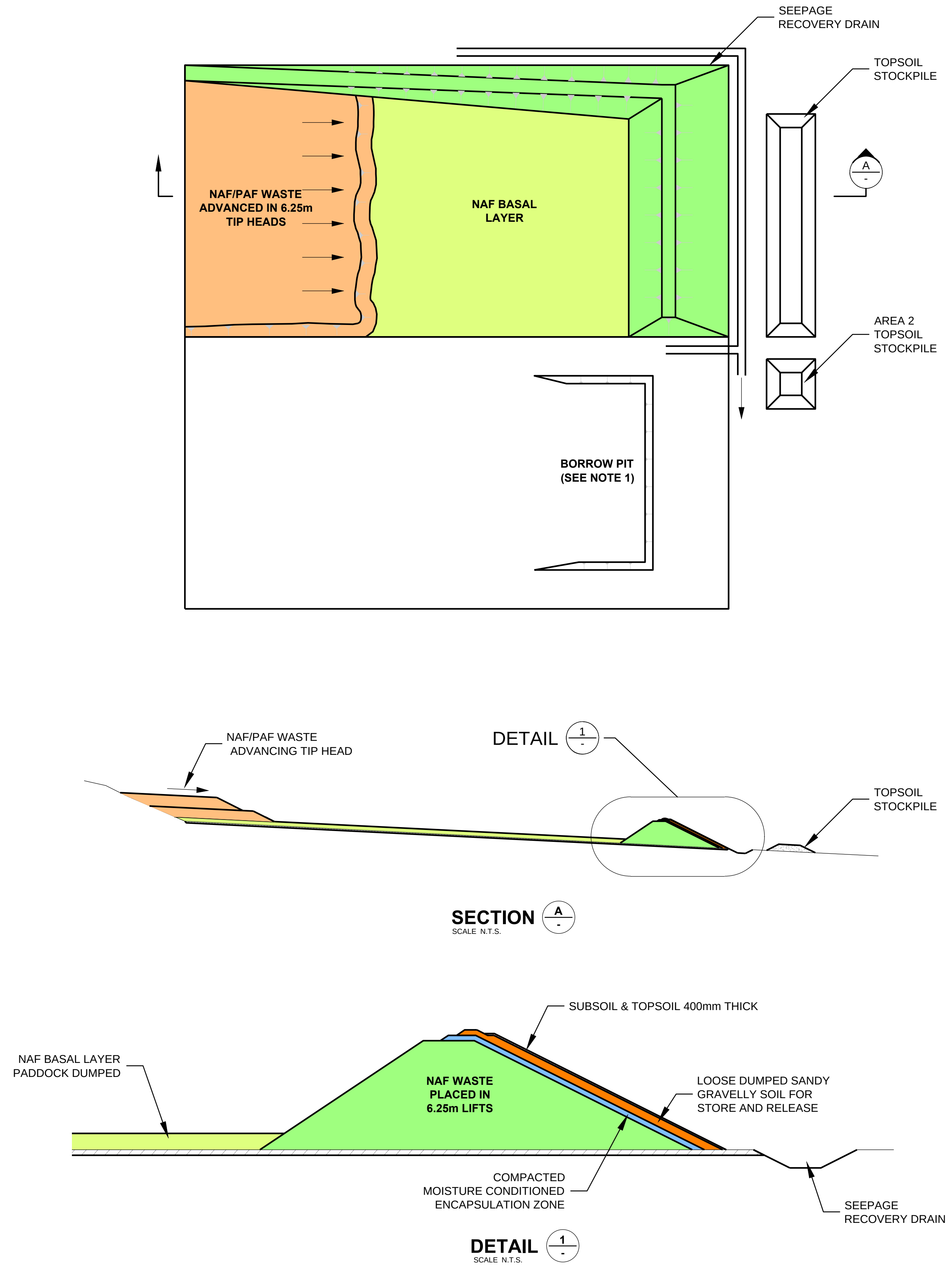
LETPADAUNG PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
AFFORESTATION AND TREE PLANTING EXTENTS

Ref: PE701-00022/13
Figure 7.9.1

STEP 1:



STEP 2:



NOTE:

1. BORROW PIT IN NEXT WASTE DUMP AREA TO SUPPLY ENCAPSULATION MATERIAL AND STORE AND RELEASE ZONE.
2. LOCAL OUTER BATTER SLOPE ANGLES TO BE CONFIRMED.

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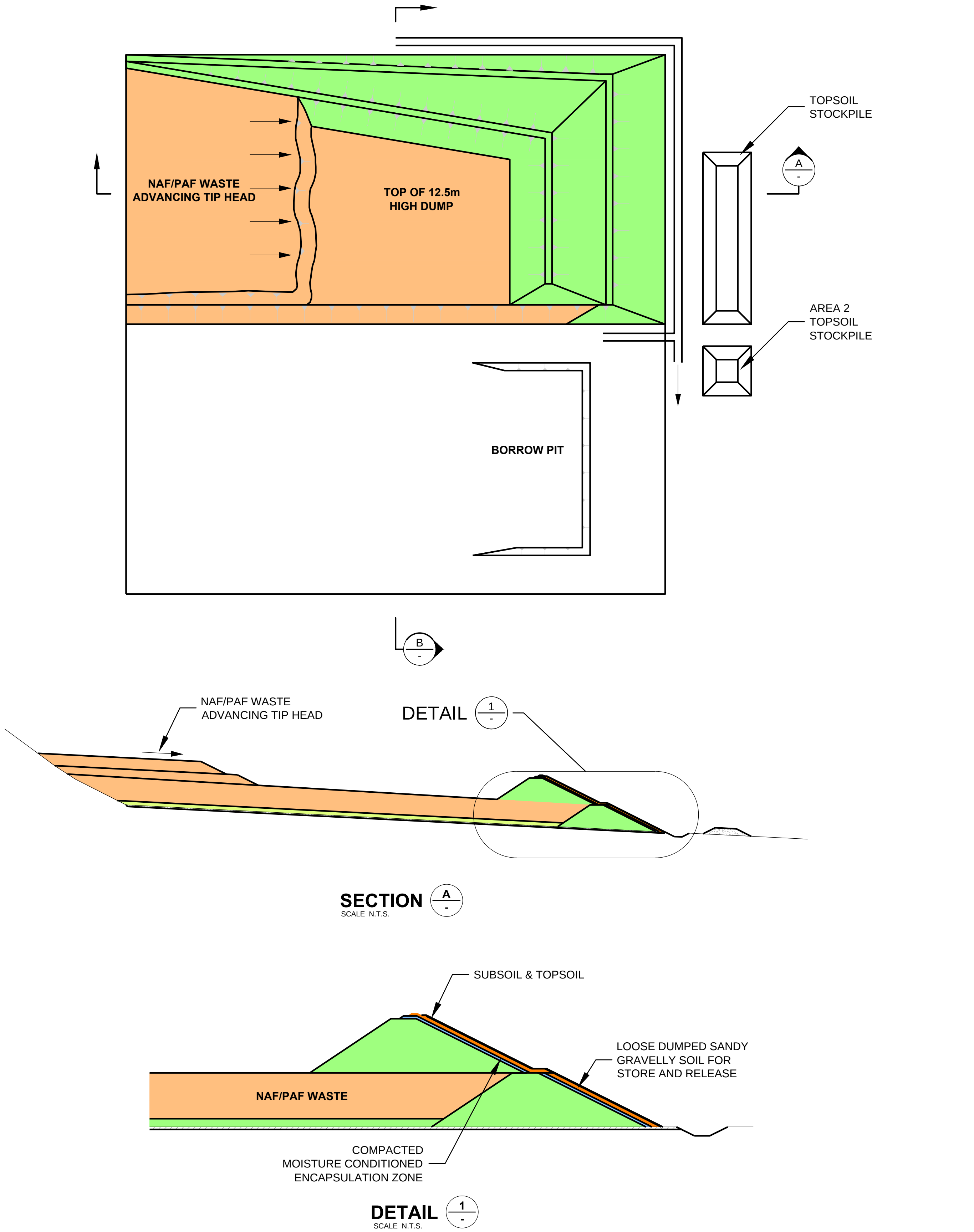
LETPADAUNG PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
MINE WASTE MANAGEMENT STRATEGY (STEPS 1 & 2)

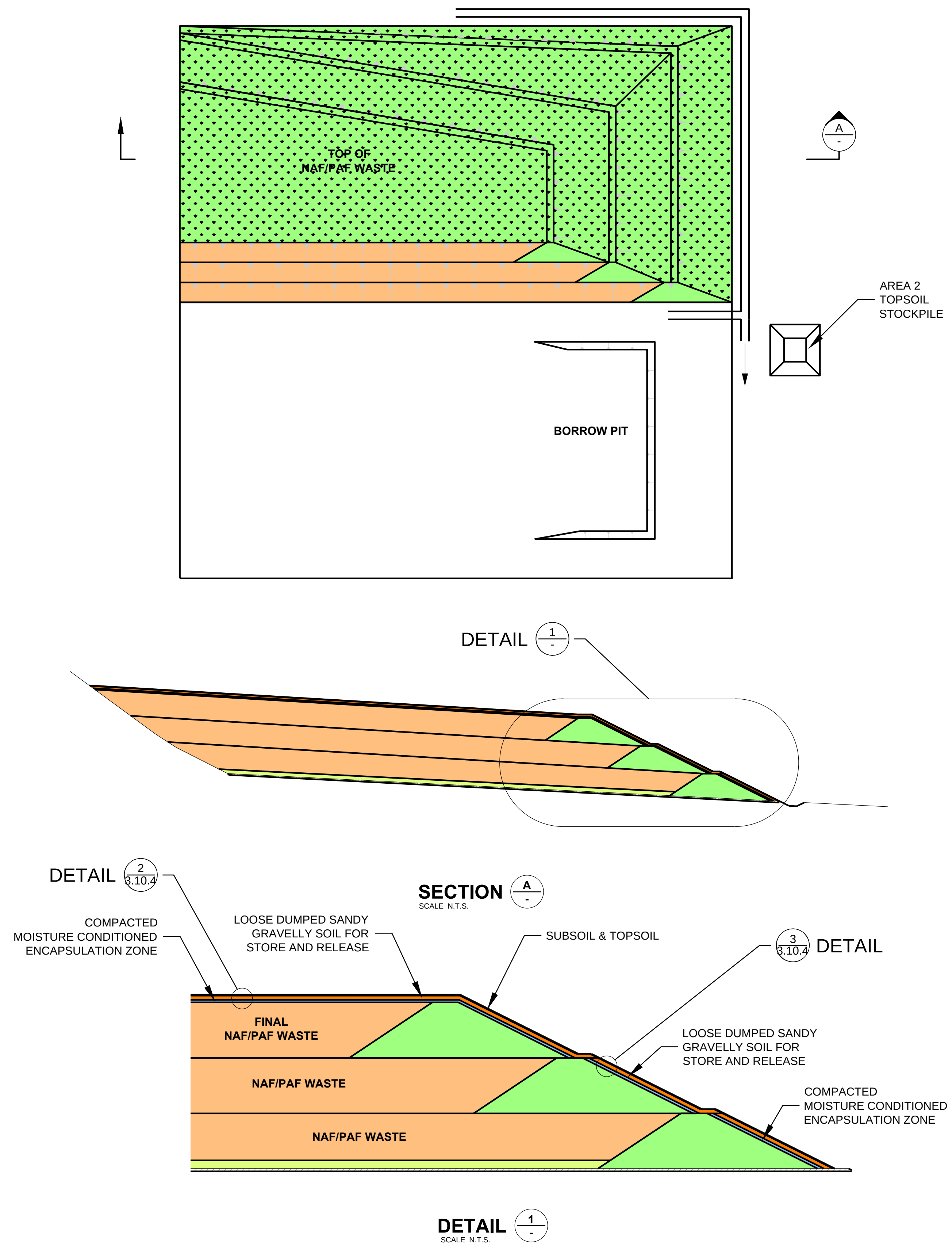
Ref: PE701-00022/13
Figure 8.3.1

STEP 3:



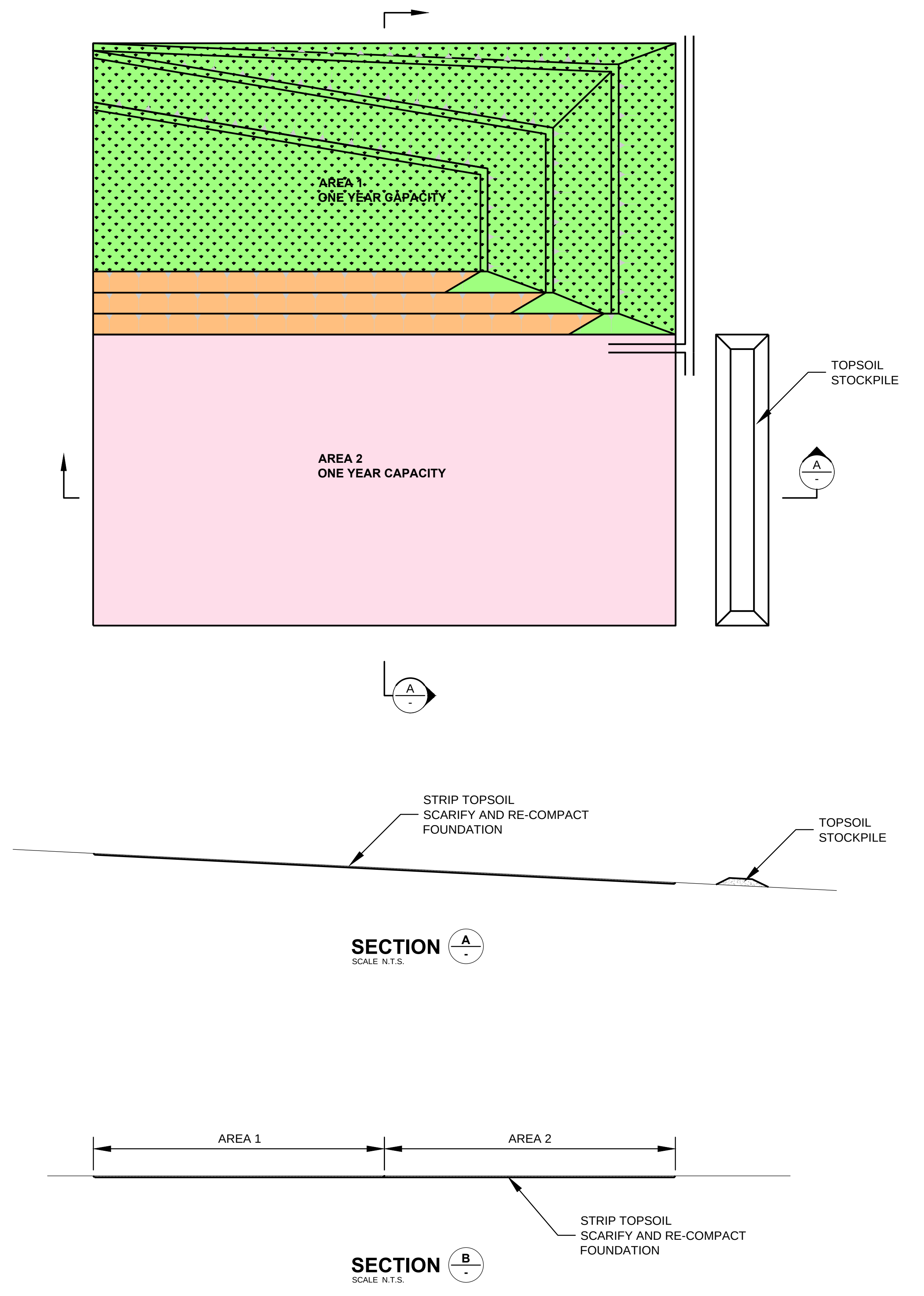
NAF/PAF WASTE
ADVANCING TIP HEAD
TOP OF 12.5m
HIGH DUMP
TOPSOIL
STOCKPILE
A
AREA 2
TOPSOIL
STOCKPILE
BORROW PIT
B
NAF/PAF WASTE
ADVANCING TIP HEAD
DETAIL 1
SECTION A
SCALE N.T.S.
SUBSOIL & TOPSOIL
LOOSE DUMPED SANDY
GRAVELLY SOIL FOR
STORE AND RELEASE
NAF/PAF WASTE
COMPACTED
MOISTURE CONDITIONED
ENCAPSULATION ZONE
DETAIL 1
SCALE N.T.S.

STEP 4:

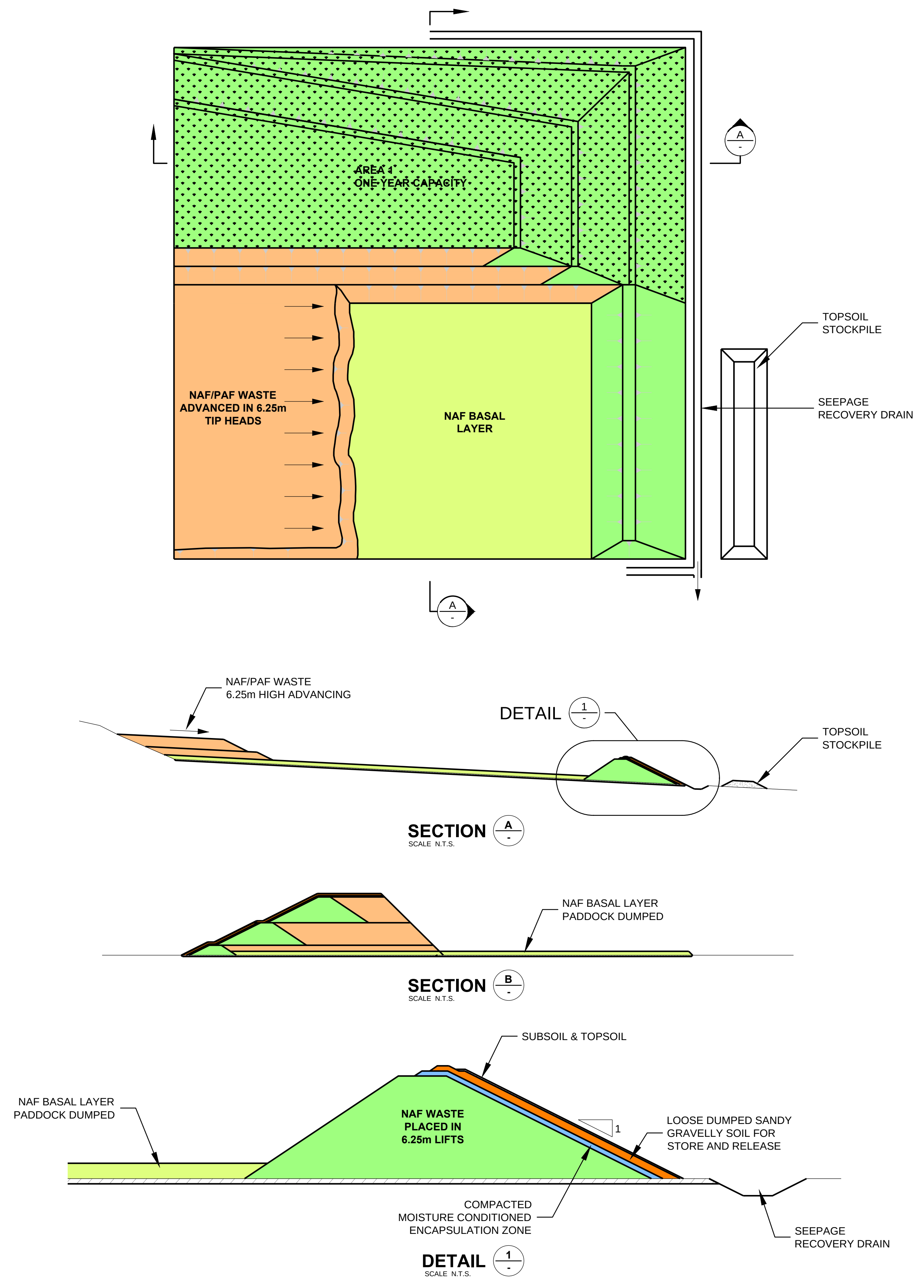


TOP OF
NAF/PAF WASTE
A
AREA 2
TOPSOIL
STOCKPILE
BORROW PIT
DETAIL 1
DETAIL 2 3.10.4
SECTION A
SCALE N.T.S.
COMPACTED
MOISTURE CONDITIONED
ENCAPSULATION ZONE
LOOSE DUMPED SANDY
GRAVELLY SOIL FOR
STORE AND RELEASE
SUBSOIL & TOPSOIL
3 3.10.4 DETAIL
FINAL
NAF/PAF WASTE
NAF/PAF WASTE
NAF/PAF WASTE
LOOSE DUMPED SANDY
GRAVELLY SOIL FOR
STORE AND RELEASE
COMPACTED
MOISTURE CONDITIONED
ENCAPSULATION ZONE
DETAIL 1
SCALE N.T.S.

STEP 5:



STEP 6:



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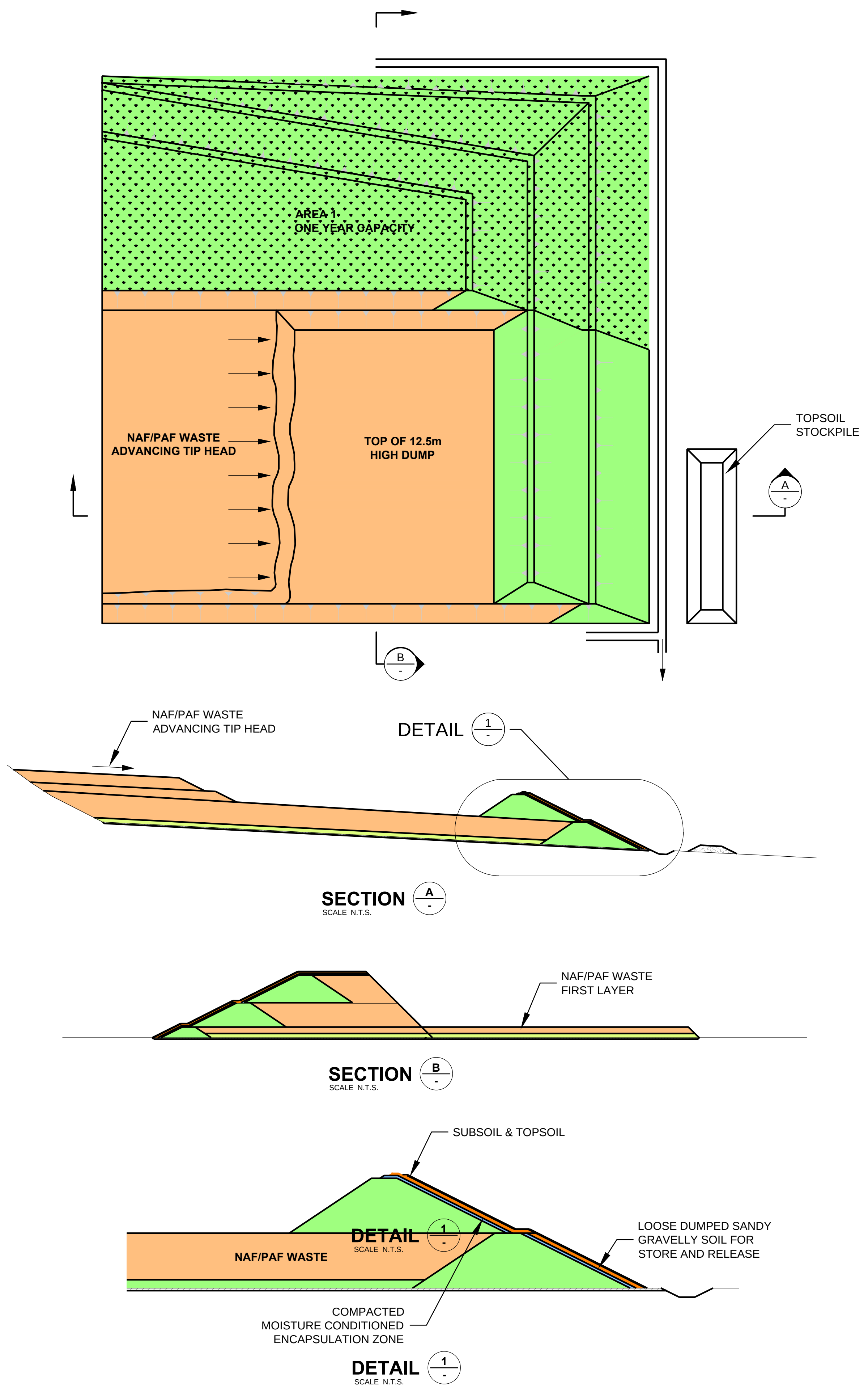
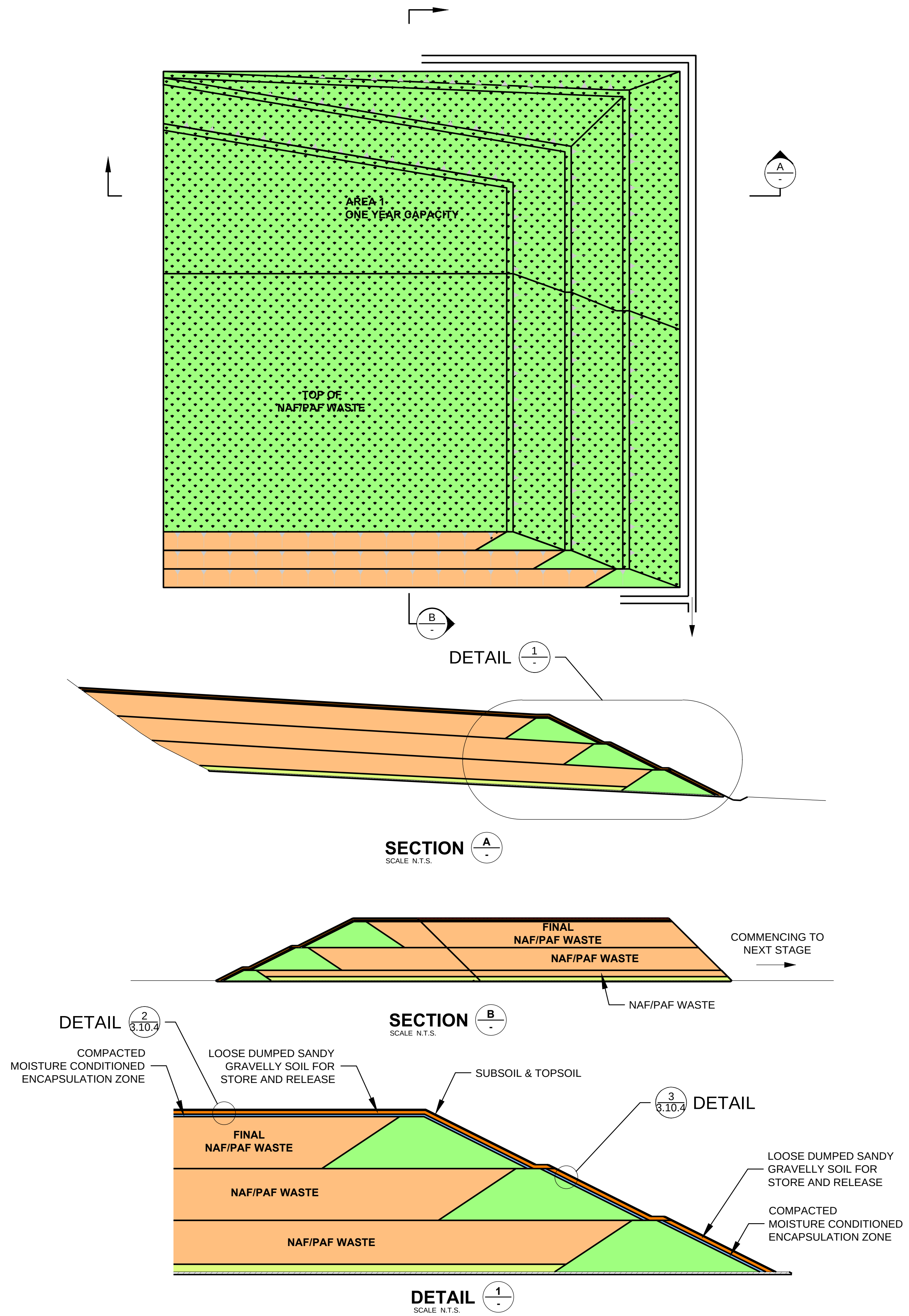
LETPADAUNG PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
MINE WASTE MANAGEMENT STRATEGY (STEPS 5 & 6)

Ref: PE701-00022/13
Figure 8.3.3

STEP 7:



STEP 8:



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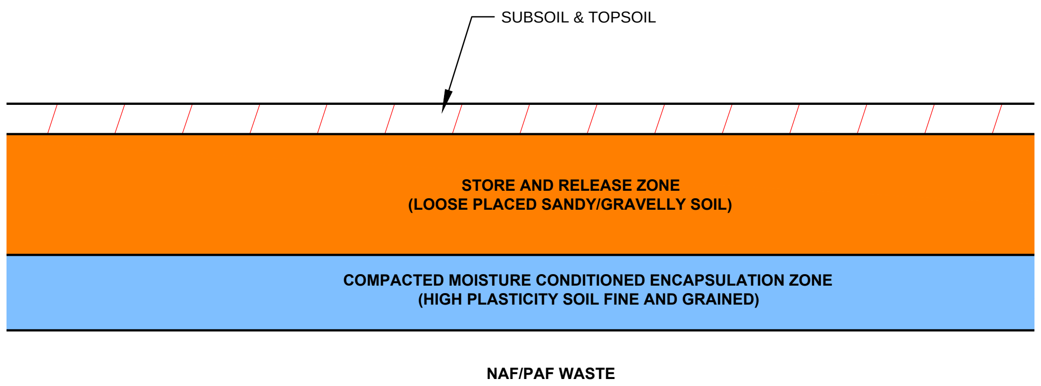
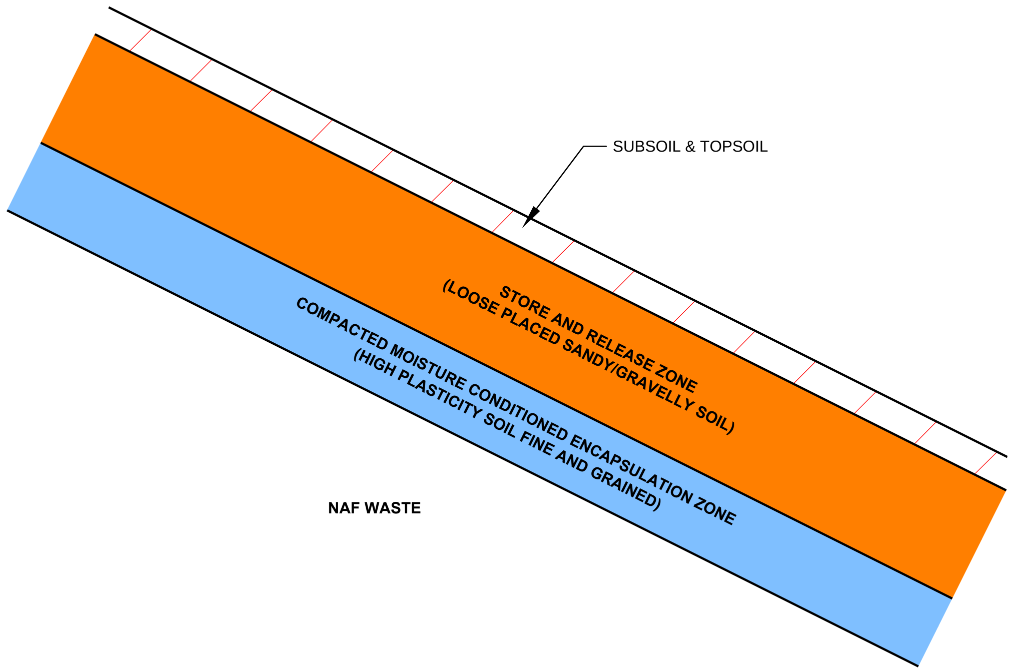
LETPADAUNG PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
MINE WASTE MANAGEMENT STRATEGY (STEPS 7 & 8)

Ref: PE701-00022/13
Figure 8.3.4



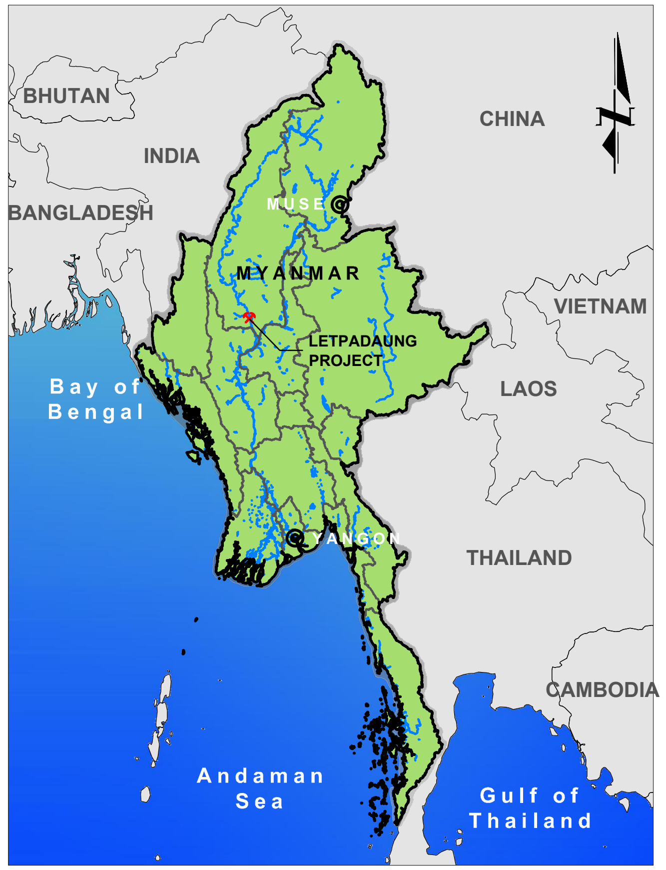
DETAIL 2/3.10.2 2/3.10.3 WRD CLOSURE COVER SYSTEM FOR TOP OF DUMP
SCALE 1:100



DETAIL 3/3.10.2 3/3.10.3 WRD CLOSURE COVER SYSTEM FOR DUMP BATTER SLOPES
SCALE 1:100

LEGEND:

- CITIES
- MAJOR HIGHWAY
- RAILWAY
- AIRPORT
- BARGE ROUTE (WET/DRY SEASON)
- BARGE ROUTE (DRY SEASON)
- ROAD (DRY SEASON)
- ROAD (EXPLOSIVE ROUTE)



TRANSPORT SUMMARY PLAN

DESCRIPTION	DESTINATIONS	TRANSPORT MODE
PEOPLE		
LOCALS	VILLAGE <--->MINE	BY BUS
EXPATS	MANDALAY <--->MINE	BY BUS
	HOME <--->MINE	BY AIR
MATERIALS/COPPER		
DRY SEASON	PATHEIN <--->MINE	BY RIVER BARGE
	PAKOKKA <--->MINE	BY TRUCK
	PATHEIN <--->CHINA	BY SHIP
WET SEASON	PATHEIN <--->MINE	BY RIVER BARGE
	PATHEIN <--->CHINA	BY SHIP
EXPLOSIVES	CHINA <---> MINE (VIA MUSE)	BY TRUCK

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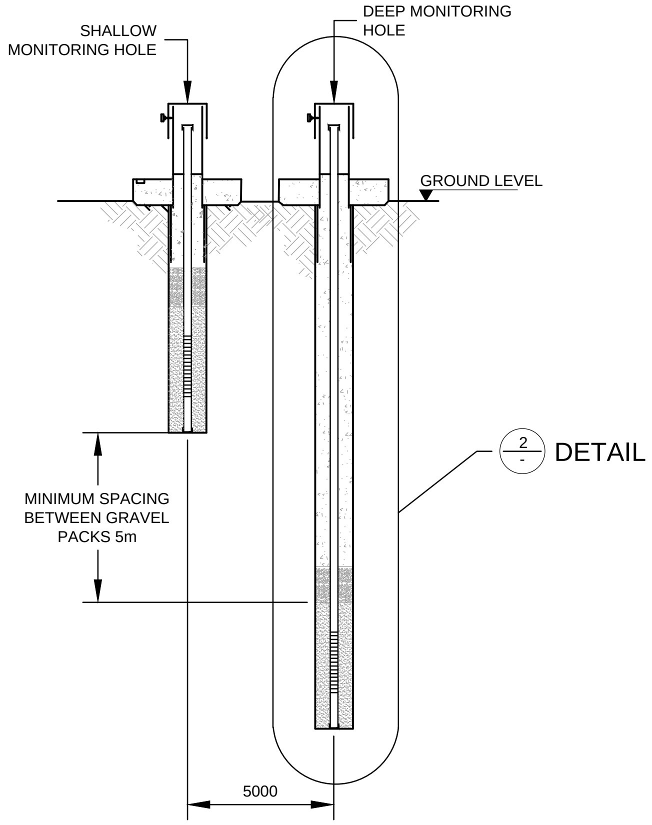
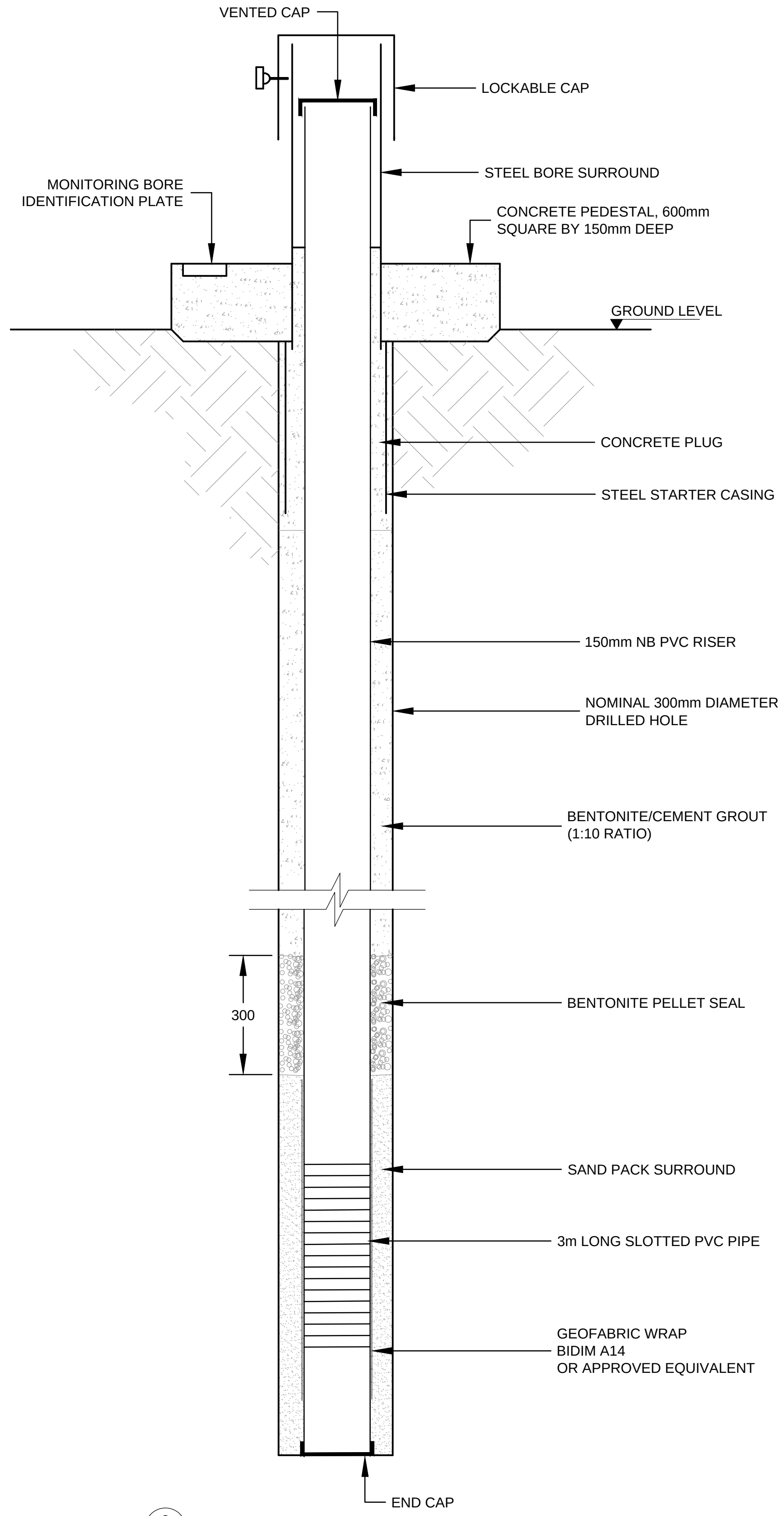
LETPADAUNG PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
LETPADAUNG TRANSPORT MANAGEMENT

Ref: PE701-00022/13
Figure 9.7.1



MONITORING BORE STATIONS

SCALE N.T.S.

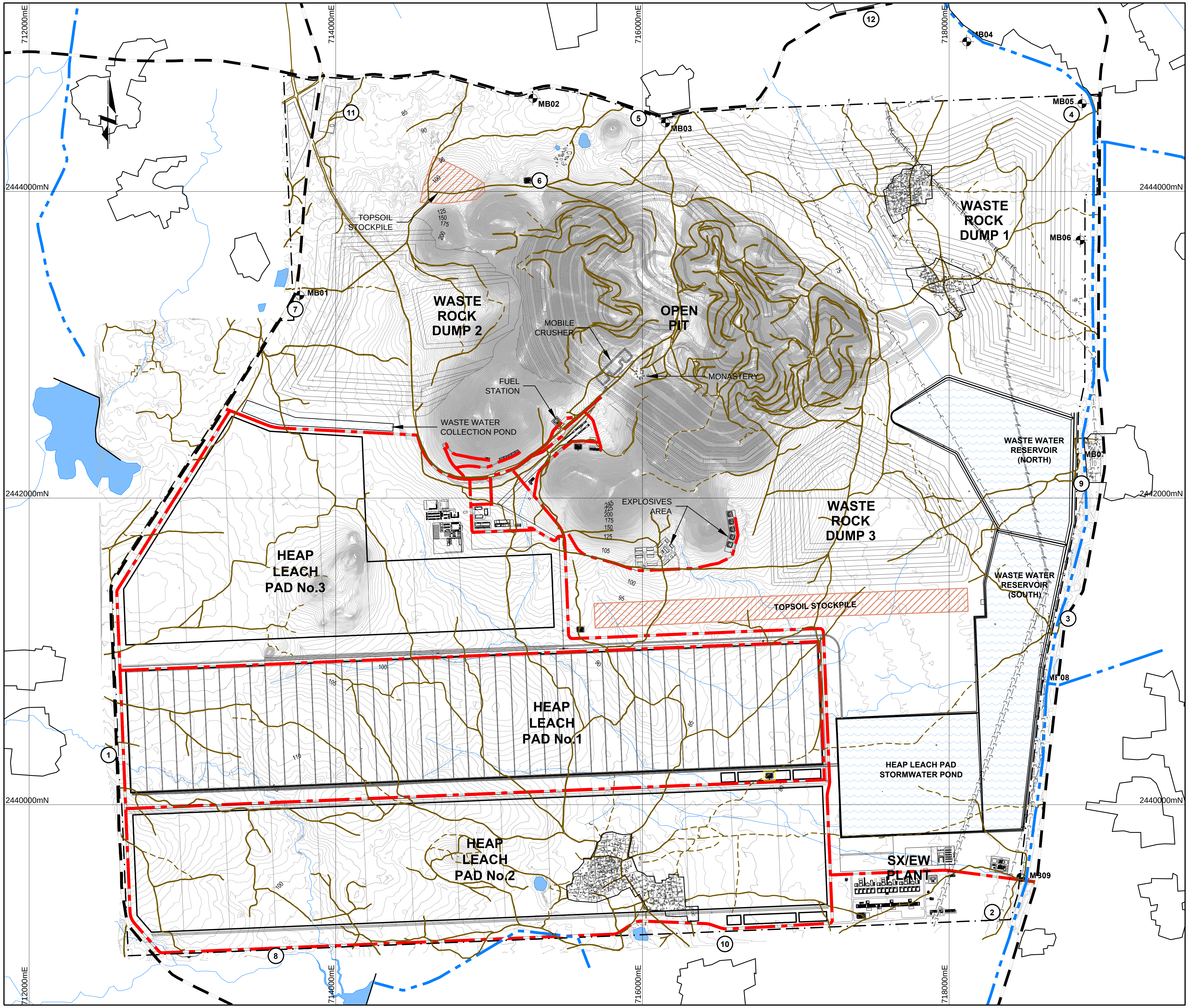


DETAIL (2/-) **MONITORING BORE INSTALLATION DETAIL**

SCALE N.T.S

NOTES:

1. DEPTH OF MONITORING BORES TO BE DETERMINED ON SITE. (APPROXIMATELY 10m AND 20m)
2. BOREHOLE DRILLING TO BE SUPERVISED BY ENGINEER FOR GEOLOGICAL LOGGING.
3. INSTRUMENTATION LOCATIONS TO BE DETERMINED BY THE ENGINEER ON SITE.



LEGEND:

- EXISTING VILLAGE EXTENT
- EXISTING POWER LINE
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LETPADAUNG LEASE BOUNDARY
- SITE ROAD ALIGNMENT
- TOPSOIL STOCKPILE
- V MONITORING BORE LOCATION GROUNDWATER

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 1m CONTOUR INTERVALS SHOWN.

MONITORING POINTS:

1. MOE GYP PYN SOUTH
2. SX/EW PLANT
3. CLEAN WATER OUTLET
4. TAN DAW
5. KYAW
6. OPEN PIT MINE HV SUBSTATION
7. PHAUNGA SOUTH
8. GRID POINT 40/14
9. SHWEHLAY
10. KYAUK PHYU DAUNG
11. CONSTRUCTION CAMP
12. AUNG CHAN SI

SUMMARY OF MONITORING PLAN

MONITORING POINT	MONITORED PARAMETER						
	DUST	AMBIENT AIR QUALITY	NOISE & VIBRATION	SURFACE WATER QUALITY	SURFACE WATER FLOW	WEATHER STATION	ACID MIST
1	X		X	X	X		
2	X		X	X	X	X	
3							
4	X		X	X	X		
5	X		X				
6						X	
7	X		X	X	X		
8				X	X		X
9	X		X	X	X		
10		X					X
11	X	X					
12			X				

500 300 100 0 250 500 750 1000
SCALE (METRES) 1:25,000 (A3)

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LETPADAUNG COPPER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
MONITORING PLAN

Ref: PE701-00022/13
Figure 10.3.1

APPENDIX A

Surface Water Management

APPENDIX B

Groundwater Monitoring Data

APPENDIX C

Baseline Studies – Flora

Prepared by EMC

APPENDIX D

Baseline Studies - Fauna

Knight Piésold CONSULTING

APPENDIX E

Baseline Studies – Aquatic Ecology

Knight Piésold CONSULTING

APPENDIX F

Baseline Study – Socio Economic

Prepared by EMC

Knight Piésold CONSULTING

APPENDIX G

Socio Economic Survey Data Sheets

To Be Provided by EMC

APPENDIX H

Health Table

APPENDIX I

Preliminary Waste Dump Design

APPENDIX J

Geochemical Study

APPENDIX K

Air Quality, Noise and Vibration Modeling

APPENDIX L

Conceptual Closure Plan

APPENDIX M

Resettlement Action Plan

Prepared by MWMCL

APPENDIX A

Surface Water Management

Knight Piésold
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MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT

SURFACE WATER MANAGEMENT PLAN

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

Knight Piésold
CONSULTING
www.knightpiesold.com

PE701-00022/18
Rev B
October 9, 2013

DOCUMENT CONTROL PAGE

MYANMAR WANBAO MINING COPPER LTD (MWMCL)

LETPADAUNG COPPER PROJECT

SURFACE WATER MANAGEMENT PLAN

KP Job No. PE701-00022/18

CONTRACT

DOCUMENT INFORMATION

REV	DESCRIPTION	PREPARED	REVIEW	KNIGHT PIESOLD APPROVAL	DATE
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B	Issued with additional figures	JR/DSS	PLV	DJTM	

DOCUMENT DISTRIBUTION

REV	DESTINATION	HARD COPY	ELECTRONIC COPY
A	MWMCL, MONYWA SITE OFFICE, SALINGYI TOWNSHIP SAGAING REGION	0	1

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EXECUTIVE SUMMARY

General

The Letpadaung Copper Project is located in the south of the Sagaing Division, Myanmar, approximately 730 km north of Yangon.

Myanmar Wanbao Mining Copper Limited (MWMCL) are contemplating developing the project, which will comprise an open pit copper mine and processing facilities including the following:

- A crushing circuit and heap leaching operation (comprising three heap leach pads);
- A solvent extraction and electrowinning (SX/EW) plant;
- Three associated waste rock dumps (WRDs);
- Process and stormwater ponds;
- On site accommodation villages; and
- Associated access roads and typical mine support infrastructure.

The site is characterised by flat alluvial plains punctuated by steep sided hills up to 300 m high. The site on occasions experiences high intensity rainfall events, particularly during the wet season.

An important aspect of the project design process concerns surface water management so as to understand and, if necessary, mitigate downstream social and environmental impacts associated with development of the project, from early works through to closure.

Development of the mine will involve disturbance of existing watershed catchments both in terms of hydrologic flows and in terms of water quality. Excavation of the open pit and establishment of WRDs and heap leach pads (HLPs) will result in rainfall runoff from the effected catchments being diverted into adjacent sub-catchments and catchments.

Disturbance of the catchments will result in soil erosion, that if not managed properly, could result in elevated sediment loads in downstream rivers and waterways. The mine waste and ore has the potential to generate acid and will generally be enriched with metals. Surface water runoff from the WRDs, low grade ore stockpiles, and HLPs will need to be stored, tested (and treated if not meeting the relevant release criteria potentially) before release to downstream river systems.

The surface water management concept design was undertaken by MWMCL. Knight Piésold were engaged to review the potential environmental impacts and outcomes of the design. This report provides a general, high level description of the hydrologic and water quality impacts associated with the development as well as recommendations to improve management of surface water on the project site.

The hydrologic run-off flows and volumes for the surface water management structures were assessed using a 100 year annual return interval (ARI) design storm. Two different duration design storms were considered as follows:

- Long duration (48 hours); and
- Short duration (6 hours).

For the water balance modelling and pond sizing wet conditions ranging from 1 day to yearly durations were used

Climatology

Average annual rainfall is in the order of 774 mm with the majority of the rain falling in the months of April through to November. Annual average lake evaporation is estimated at 1412 mm.

For Letpadaung it is clear that in the wet season, particularly during September and October, there will be a build up of water in the various storage ponds across the site. For the rest of the year, areas such as the HLPs, which are continuously wetted (thus acting as an evaporative surface) will operate with a moderate to large water deficit.

For storm runoff and waste rock dump collection ponds the transition from water surplus to deficit would be likely to be only for the peak dry season (February to April). It is estimated that for the overall site the large shortfall from the heap leach pad water balance is likely to result in an overall site deficit. Adequate water storage and careful management of available water resources will therefore be critical to successful operation of the mine.

Hydrologic Flow Impacts

The core principles of good surface water management practice are as follows:

- Identify watershed catchments influenced by the proposed development;
- Reduce hydrologic flow impacts of the development by maintaining pre-mining watershed catchment flow routing wherever possible;
- Classify watershed catchments as either undisturbed (clean water) or disturbed (dirty water); and

- Separate and segregate clean water and dirty water (so as to reduce handling requirements).

In order to divert clean water from the upstream, undisturbed, catchment (east of the project area) the South Diversion Channel will be built along the western edge of HLP 1 and HLP 2. The channel diverts runoff south and then west around the southwest edge of the Letpadaung site and back into its original catchment. This will minimise impacts on downstream users and ecosystems.

- Hydrologic modelling of the project catchment was completed allowing comparison of pre-mining and post-mining hydrologic flows. The impact of the operational mine on pre-mining hydrologic flows is summarised as follows:
- The volume of clean runoff water reporting to the community water dams south of the proposed Heap Leach Pad No. 2 is expected to be reduced significantly.
- During operations, runoff from a large proportion of the northern part of the site is directed to the WWP which would in turn overflow (when full) into the irrigation canal, running along the eastern boundary of the site. Prior to development of the mine this runoff would have reported directly to the irrigation canal. If the WWP is operated in accordance with the design the volume of surface water from the northern area of the site flowing into the irrigation canal decreases by around 60-80%.
- The overall impact to runoff volume reporting east to the Chindwin River, from the Letpadaung site, is expected to decrease due to the exclusion and rerouting of runoff. Assuming the WWP is operated in accordance with the design concepts, the runoff reporting to the Chindwin River is expected to decrease by roughly 28%.
- The overall impact of runoff volume reporting north, to the Yama Stream, from the Letpadaung site is expected to decrease by around 18% due to the exclusion and rerouting of runoff.

HLP Water Balance

A site water balance, incorporating water inputs and losses from the system, was completed for average, wet and dry conditions. The main purpose of the exercise was to check sizing of ponds and design allowances for system water make-up.

Under average climate conditions, the leach pad water balance is shown to be in net water deficit for approximately 6 months of the year. During this time, due to the ongoing loss occurring on the leach pad, the SWP and WWP remain empty and all shortfall will need to be made up from the Chindwin River. The annual requirement equates to around 6 Mm^3/year which is similar to the figure quoted in the China Nerin

Engineering Basic Design report. Both ponds are adequately sized for average conditions.

Under dry climatic conditions, the annual rainfall is reduced by 45%, thereby increasing the reliance on external water sources during and after the wet season. The peak requirement in the dry season remains unchanged as it is based on a zero rainfall period of operation. However, the annual requirement from external sources increases to around 9 Mm^3/year.

Under average climatic conditions and expected operation parameters, the SWP is unlikely to overflow. It is maintained as the primary source of makeup water on site. The peak makeup water requirement is not influenced by rainfall conditions as it occurs continuously throughout the dry season. The annual makeup water requirement however is highly dependent on rainfall and dripper loss with ore absorption losses being less significant. Contingency for greater make-up water requirements should be made until system dripper losses have been measured.

The existing SWP size is suitable for containing 1 or 2 day, 1 in 100 year ARI storm events. Longer durations than this will begin to accumulate water at a higher rate than evaporation and absorption losses combined. To reduce the likelihood of SWP outflow, its capacity will need to be increased. It is recommended that the SWP storage capacity be increased to at least 4 Mm^3 in order to contain longer duration rainfall events. This can be achieved by excavating the basin of the SWP deeper while maintaining the same area.

Under average climatic conditions the WWP will store a peak volume of about 1.42 Mm^3. A long duration storm event (48 hour; 100 year ARI) will require 3.31 Mm^3. On this basis it is recommended that the WWP capacity be increased to 4.8 Mm3 from the current 4.64 Mm^3 capacity.

Use of HLP make-up water should be prioritised so that on-site, low pH water sources are used first. Make-up water may be taken from three potential sources, in order of decreasing priority, as follows: HLP stormwater pond; WWP; and the Chindwin River.

Stormwater reporting to the SWP should be re-used for irrigation of the HLPs as soon as possible.

Runoff Water Quality

Surface water flowing within or adjacent to the site should be classified in terms of quality according to the following categories: clean; sediment laden; contact (potentially acidic or enriched with metals); and process.

Runoff from stockpiles and disturbed areas of the site is directed to the WWP. Runoff water is a combination of sediment laden and contact water. Most of the suspended solids will naturally fall out of suspension in the WWP, limiting the requirement for specialised water treatment prior to release, from a suspended solids perspective. Of greater concern is the issue of managing the potentially acidic, metal enriched contact water (running off the ore stockpiles). Mixing of the various runoff water classes, within the WWP, will lead to an approximate eight-fold dilution of the contact water. Dilution will improve the contact water quality but, depending on its constituents dilution alone is unlikely to be sufficient to preclude the need for water treatment prior to release.

To reduce the environmental risks associated with rainfall runoff on the site the following is required:

- WRDs need to be rehabilitated progressively (effectively encapsulating the mine waste). Runoff from rehabilitated surfaces will be sediment laden but would be otherwise clean.
- Contact water (runoff from ore stockpiles) must be directed to the WWP and tested to assess its requirement for treatment prior to release.
- The different water quality streams should be segregated to allow maximum potential discharge of water meeting release standards.

To accurately evaluate contact water quality it is recommended that further sampling and testing of mine waste and ore material be undertaken. This in turn will allow a more rigorous, quantitative assessment of site runoff water quality and potential water treatment solutions.

Hydrological and Sediment Load Baseline Monitoring

The models used are based on a number of assumptions that need to be confirmed in the field. As such it is recommended that rain gauges and flow meters be installed on major drainage paths to monitor rainfall and runoff. Furthermore, baseline sediment load monitoring along major drainage paths should be undertaken for a range of seasonal flows.

Sediment Control and Modelling

SCDs should be installed downstream from any disturbed catchments that report to off site waterways, particularly along the northern boundary of the site. (The original Nerin concept design did not include SCDs, assuming that sediment laden runoff generated along the northern boundary could be released directly in to adjacent waterways). The northeast corner of the site represents a topographic low and as such WRD runoff will report to this spot. Consequently this corner will effectively operate as an SCD with the flood protection bund acting as a dam wall. Water accumulating in this dam will have to be either pumped to the Waste Water Pond (WWP) or discharged to downstream waterways (depending on water quality).

SCD and WWP sizes should be refined after more rigorous sediment modelling has been undertaken.

Improvements to Site Surface Water Management

Where ever possible the different surface water quality streams should be segregated from one another. In particular sediment laden water should be separated out from the contact water (running off the ore stockpiles or geochemically problematic mine waste) so as to reduce the quantity of poor quality water that may require treatment. This would best be achieved by operating the existing division of WWP as two ponds with the northern pond used to contain sediment laden water and the southern pond used to contain contact water (that may require special treatment prior to release).

To facilitate operation of the system it is recommended that the more environmentally problematic, low grade ore and ore reserve, stockpiles be consolidated in the northern half of HLP3. This location will allow the contact water from these stockpiles to be directed relatively easily to the south WWP cell.

Timing for construction of ECDs and diversion channels needs to be reconciled with the latest mining plan. In particular this will determine which structures are required early in the project and which can be deferred.

1. INTRODUCTION

The Letpadaung Copper Project is located in the south of the Sagaing Division, Myanmar, approximately 730 km north of Yangon.

Myanmar Wanbao Mining Copper Limited (MWMCL) are contemplating developing the project, which will comprise an open pit copper mine and processing facilities including the following:

- A crushing circuit and heap leaching operation (comprising three heap leach pads), with an average throughput of 92,000 tonnes per day and potential for expansion;
- A solvent extraction and electrowinning (SX/EW) plant to produce 100,000 tonnes per annum of cathode copper;
- Three associated waste rock dumps (WRDs);
- On site accommodation villages; and
- Associated access roads and typical mine support infrastructure.

The Project layout showing the location of key infrastructure items is shown on Figure 1.1.

The site is characterised by flat alluvial plains punctuated by steep sided hills up to 300 m high. The site on occasions experiences high intensity rainfall events, particularly during the wet season. Average annual rainfall is in the order of 774 mm with the majority of the rain falling in the months of April through to November.

An important aspect of the project design process concerns surface water management so as to understand and, if necessary, mitigate downstream social and environmental impacts associated with development of the project, from early works through to closure.

Development of the mine will involve disturbance of existing watershed catchments both in terms of hydrologic flows and in terms of water quality. Excavation of the open pit and establishment of WRDs and heap leach pads (HLPs) will result in rainfall runoff from the effected catchments being diverted into adjacent sub-catchments and catchments.

Disturbance of the catchments will result in soil erosion, that if not managed properly, could result in elevated sediment loads in downstream rivers and waterways. The mine waste and ore has the potential to generate acid and will be enriched with metals. Surface water runoff from the WRDs, low grade ore stockpiles, and HLPs will need to be stored, tested (and treated if unable to meet release criteria) before release to the

downstream river system. On this basis the potential impact of the mine development in terms of surface water quality needs to be modelled.

The core principles of good surface water management practice are as follows:

- Identify watershed catchments influenced by the proposed development;
- Reduce hydrologic flow impacts of the development by maintaining pre-mining watershed catchment flow routing wherever possible;
- Classify watershed catchments as either undisturbed (clean water) or disturbed (contact water); and
- Separate and segregate clean water and contact water (so as to reduce handling requirements).

The surface water management concept design was undertaken by MWMCL. Knight Piésold were engaged to review the potential environmental impacts and outcomes of the design. This report provides a general, high level description of the hydrologic and water quality impacts associated with the development as well as recommendations to improve management of surface water on the project site, in accordance with the aforementioned principles.

1.1 SCOPE OF WORK

Consistent with the scope of work it was agreed that the following outputs would be generated from the of the site water management assessment:

- A baseline climate analysis including discussion of potential climate change impacts;
- Definition of water inputs and outputs for each classification of water under normal, extreme dry and extreme wet climatic conditions;
- A description of the current hydrologic flows before the project is implemented and changes that will occur progressively as it is implemented with definition of the impact of the changes;
- An estimate of the potential water quality levels in ponds and discharge zones across the site (for each water classification) and an assessment of the requirements for treatment.
- A discussion of options to mitigate impacts of water use on the site, changes in hydrologic flows, changes in water quality, volumes to be released from the site and management recommendations.

Small scale sediment control structures are described in the “Erosion and Sediment Control Guidelines” report (Ref.1) and are therefore not discussed herein. However, Sediment Control Dams are discussed briefly in Section 6.0.

1.2 DESIGN OBJECTIVES

An important aspect of the project will be the management of surface water runoff in order to achieve the following objectives:

- Mitigate the risk of contamination of nearby waterways due to runoff from heap leach pads, waste rock dumps, the plant site, and other site infrastructure.
- Control soil erosion and subsequent re-deposition, thereby reducing adverse impacts to downstream environments for all aspects of the project, from initial development through to closure.

The contamination management objectives are as follows:

- Identify and separate benign mine waste from mine waste that is potentially contaminated with: heavy metals; or potentially acid forming (PAF) sulphide minerals.
- Direct potentially contaminated surface runoff (contact water) to stormwater retention ponds which will in turn report to a polishing pond (and treatment as necessary) before release to the environment.
- Identification of undisturbed catchments to allow segregation of freshwater from contact water.

The erosion and sediment control objectives are as follows:

- Reduce sediment loadings within runoff reporting from impacted project areas to the downstream environment by implementing practical and cost-effective solutions for both short and long-term erosion and sediment control.
- Fully integrate the erosion and sediment control measures with the project development and operations.
- Reduce maintenance costs for the project infrastructure arising from inadequate surface water management.
- Provide long-term post-mining surface water management, including erosion and sediment control measures, for the establishment of stabilised and protected final reclaimed surfaces that require low maintenance.
- Comply with environmental discharge limits with respect to total suspended solids.

The incorporation of surface water management methods throughout the project life can substantially reduce the volume of eroded sediment produced and the volume transported to the downstream environment. Properly implemented, it will also lead to lower infrastructure maintenance costs (i.e. prevention of sedimentation or washout of drainage ditches, roads, culverts, etc.) as well as reduced capital and maintenance

costs for reclamation of impacted project areas (i.e. prevention of slope erosion, sedimentation or washout of surface water diversion and control structures, etc.).

1.3 DESIGN CRITERIA

1.3.1 Selection of Design Annual Recurrance Interval (ARI)

For design purposes the ARI should vary depending on importance of structure, cost of repair and consequences of failure. The operational life of a structure should also be considered when assigning a design ARI. Probability of exceedance over the operational life of a structure varies with its design life according to the following equation:

$$\text{Return Exceedence} = 1 - (1 - AEP)^{\text{Operational Life}}$$

AEP represents the Annual Exceedance Probability (AEP = 1 / ARI). It is assumed that the operational life of all structures is equal to the project life of 31 years. Application of the above equation demonstrates that the longer the operational life of the structure the greater the probability of exceedance over this period of time for a given ARI. An indication of return exceedance, over the project life, for a given annual return interval is shown in Table 1.3.1.

Table 1.3.1: Variation of return exceedance with ARI (for 31 year operation life)

ARI	Return Exceedance
20 years	80%
50 years	47%
100 years	27%

An ARI of 100 years has been conservatively adopted for the analysis herein.

1.3.2 Design Storms

The hydrologic run-off flows and volumes for the surface water management structures were assessed using a 100 year annual return interval (ARI) design storm. Two different duration design storms were considered as follows:

- Long duration (48 hours); and
- Short duration (6 hours).

The total storm depths of these two design storms were taken from the site Intensity / Duration / Frequency (IDF) curve. The Rainfall Ratio Method was used to extrapolate results to durations both less than and greater than 24 hours. The total storm depths were then temporally distributed using hyetograph patterns derived from historic data.

Further detail concerning the derivation of both the site IDF curves and hyetograph patterns is provided in Section 2.

The above design criteria were applied when reviewing hydrologic flows / volumes for the following structures:

- Ditches and diversion channels.
- WRD stormwater and environmental retention ponds.

Leach pad water balances are typically influenced by both short term high intensity events for small process pond overflows and long term wet season build up of runoff volumes in stormwater ponds. As a result, a range of additional durations have been modelled for the HLPs as outlined below.

1.3.3 Climatic Modelling for HLPs

As the water balance model was conducted on a daily basis, average and extreme rainfall patterns were scaled from historical rainfall patterns. Historical rainfall was obtained from nearby climate stations.

The following conditions were examined for the HLP water balance scenarios:

- Average rainfall conditions;
- Storm events of 1, 2, 3, 4, 7, 14 and 30 days;
- Wet season events of 60, 90, 120 and 180 days;
- Annual events of 1 and 2 year wet and dry cycles.

All wet event scenarios were based on an ARI of 100 years. Details of the assumptions and design criteria applied for the HLP related climate modelling are described in Section 4.

1.3.4 Runoff Coefficients

The SCS Curve Number Method, as described in the US Department of Agriculture Technical Note (Ref. 2) was used for the surface water management models. Each individual catchment was assigned a curve number which was done by breaking the catchment areas into definable area types. For the existing conditions (pre-mining) model, catchments were defined as consisting of a mixture of the three area types as described in Table 1.3.2. The proportion of each area type making up the catchment was estimated. The curve number for individual catchments was calculated as a weighted average of curve numbers, according to area types, and their catchment proportions.

Table 1.3.2: Curve numbers for the existing conditions model

Area Type:	Natural Vegetation	Farmland	Water Pond
Cover Description:	Brush	Pasture	N/A
Soil Type:	C	C	N/A
Hydrologic condition:	Good	Fair	N/A
SCS CN for AMC II:	65	79	98

For the planned conditions (operations phase) model, curve numbers were calculated using the same methodology as above, assuming five area types, as detailed in Table 1.3.3.

Table 1.3.3: Curve numbers for the planned conditions model

Area Type:	Natural Vegetation	Farmland	Developed / Disturbed Areas	Leach Pad	Water Pond
Cover Description:	Brush	Pasture	Newly graded areas (no vegetation)	Newly graded areas (no vegetation)	N/A
Soil Type:	C	C	C	A	N/A
Hydrologic condition:	Good	Fair	N/A	N/A	N/A
SCS CN for AMC II:	65	79	91	77	98

For all of the Area Types, excluding the Leach Pads and Water Ponds, soil type "C" was adopted. This is because the soils of the Letpadaung Project site were assumed to have low infiltration rates. The HLPs were assigned soil type "A", as the leached ore heaps are assumed to have low runoff potential and high infiltration rates. Soil types are as defined in *Design Hydrology and Sedimentology for Small Catchments* (Ref 3).

The Antecedent Moisture Condition (AMC) of the catchments was assumed to be AMC III. This assumes that the soils are already thoroughly wetted which is expected to be the case during the wet season. The AMC III curve number is calculated from the AMC II curve number using the following equation:

2. CLIMATOLOGY

2.1 GENERAL

A complete baseline design climatology study was completed by KP (and is attached as Appendix A). This study defines the preliminary hydrologic basis for on-going and future design work. The following sub-sections outline key results from this report.

2.2 DATA SOURCES

Four different sources of historic climate data were used to derive baseline design climate estimates:

- Daily historic data spanning the period (1961-2013) from the Monywa Township climate station, located 5.6 km northeast of Letpadaung Hill, was employed for deriving precipitation estimates.
- Monthly historic pan evaporation data spanning the period (2000-2013) from the Yangtse climate station, located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kysintaung (S&K) operations site was employed for deriving evaporation estimates.
- Daily temperature data spanning the period (1981-2012) from the World Meteorological Organization (WMO) climate station number 48037, located 4.7 km northeast of Letpadaung Hill was used for determining temperature normals.
- Hourly wind speed, wind direction and precipitation data spanning the period (2010-2012) derived from the MM5 (5th generation Mesoscale Model) and SAMSON hourly surface meteorological datasets at a sampling location 0.9 km northwest of Letpadaung Hill was used for characterization of prevailing wind normals and in developing precipitation temporal distributions.

2.3 PRECIPITATION

2.3.1 Monthly Pattern

The historic precipitation dataset outlined in Section 2.2 was aggregated on annual and monthly time scales and used to compute sampling statistics to define normal precipitation patterns at Letpadaung Hill. The resulting normal pattern of monthly precipitation is reproduced in Table 2.3.1.

Table 2.3.1: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0
Feb	3	0	15	0	102	0
Mar	5	1	14	0	96	1
Apr	26	21	22	0	100	4
May	102	94	70	12	386	9
Jun	100	72	79	0	342	9
Jul	67	59	43	2	182	8
Aug	121	103	80	0	356	10
Sep	166	150	89	47	496	11
Oct	142	136	95	15	513	10
Nov	33	12	44	0	186	3
Dec	6	0	17	0	85	1

*1 Incomplete data from 1995 (Jan – Jun), 1999 (Jan – Apr) and 2013 (Jun – Dec) were excluded from this analysis.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for eight months, from April through the end of November. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

2.3.2 Design Rainfall Totals

Frequency analysis was performed on daily precipitation data with EasyFit Professional 5.4 software (Ref. 4) in order to determine the best-fitting probability distribution for use in estimating extreme short-duration design storms totals at the project site. After the design totals were augmented to account for potential straddling errors caused by the use of fixed 24 hour periods (Ref 5), the Rainfall Ratio method (Ref. 6) was used with tabulated fitting coefficients appropriate to the Letpadaung site to derive the Intensity / Frequency / Duration (IDF) relationship describing design rainfall. The resulting IDF curve is reproduced in Table 2.3.2

Table 2.3.2: Letpadaung intensity / frequency / duration results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm*1							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16
18 h	5	6	7	8	9	10	10	11
24 h*2	4	5	6	6	7	8	8	9
48 h*3	2	3	3	4	5	5	6	6
72 h*4	2	2	3	3	4	4	5	6

*1 Intensity values are shown rounded to the nearest mm/h.

*2 Intensity values for 24 hour duration storms have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref 5).

*3 Intensity values for 48 hour duration storms have been augmented 6.7% (Ref 5).

*4 Intensity values for 72 hour duration storms have been augmented 4.4% (Ref 5).

2.3.3 Design Temporal Distributions

Site temporal patterns (hyetographs) of precipitation were derived from hourly precipitation data included with the wind sampling dataset for storm durations ranging between 2 and 45 hours. The resulting hyetographs from a subset of storms considered (durations between 2 and 9 hours) are reproduced in Table 2.3.3.

Table 2.3.3: Letpadaung hyetograph results for 2 through 9 hour storms

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	55.3%	22.9%	15.3%	6.6%	8.1%	6.7%	0.9%	3.8%
2	100.0%	77.0%	56.2%	37.2%	24.3%	19.0%	4.7%	13.7%
3		100.0%	90.1%	67.8%	45.3%	43.0%	15.6%	34.9%
4			100.0%	93.7%	76.5%	70.1%	51.5%	63.4%
5				100.0%	97.1%	88.5%	73.8%	81.3%
6					100.0%	98.4%	88.3%	88.9%
7						100.0%	97.5%	93.7%
8							100.0%	97.8%
9								100.0%

2.3.4 Trend Analysis

Precipitation trend analysis was performed on the full historic dataset. The results of this analysis show that there is no statistically significant trend observable in annual precipitation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future precipitation cycles due to observed climate change. Details of this analysis are provided in Appendix A.

2.3.5 Water Balance Scenarios

Frequency analysis was performed on 15 candidate water balance cycle durations to estimate the statistical likelihood of experiencing extremely “Wet” or “Dry” years at the Letpadaung site and the corresponding design totals. The durations considered include:

- Long duration cycles of 1, 2, 3, 4 and 5 years and
- Short duration cycles of 2, 3, 4, 7, 14, 30, 60, 90, 120 and 180 days.

The wettest (or wettest and driest in the case of the 1 year duration precipitation cycle) historical records of continuous rainfall were converted to a series of cumulative daily percentages for use in apportioning water balance cycle design totals to daily amounts. A summary of these results is shown in Table 2.4.

Table 2.3.4: Letpadaung water balance scenario summary

Scenario	100-yr ARI Total Depth (mm)	500-yr ARI Total Depth (mm)	Temporal Pattern Based on Historic Period
5 Year Wet	5,479	5,839	1973 – 1979
4 Year Wet	4,630	5,083	1973 – 1976
3 Year Wet	3,644	4,083	1975 – 1977
2 Year Wet	2,544	2,844	2010 – 2011
1 Year Wet	1,555	1,902	1973
1 Year Dry	424	383	1982
180 Day Wet	1,437	1,767	25/05/1973 – 20/11/1973
120 Day Wet	1,067	1,272	2/07/2010 – 29/10/2010
90 Day Wet	921	1,101	30/07/1965 –27/10/1965
60 Day Wet	740	865	29/08/1965 – 27/10/1965
30 Day Wet	520	596	29/09/2010 – 28/10/2010
14 Day Wet	440	563	9/05/2007 – 22/05/2007
7 Day Wet[*1]	343	447	9/05/2007 – 15/05/2007
4 Day Wet[*2]	308	410	1/06/1984 – 4/06/1984
3 Day Wet[*3]	298	401	1/06/1984 – 3/06/1984
2 Day Wet[*4]	214	249	2/06/1984 – 3/06/1984

*1 Scenario totals for 7 day duration cycles have been augmented 1.8% to account for potential straddling errors in sampling (Ref. 5).

*2 Scenario totals for 4 day duration cycles have been augmented 3.4% (Ref. 5).

*3 Scenario totals for 3 day duration cycles have been augmented 4.4% (Ref. 5).

*4 Scenario totals for 2 day duration cycles have been augmented 6.7% (Ref. 5).

Details of all 32 derived water balance scenarios are provided in Appendix A.

2.4 EVAPORATION

2.4.1 Monthly Pattern

The historic evaporation dataset outlined in Section 2.2 was aggregated on annual and monthly time scales and used to compute sampling statistics to define normal evaporation patterns at Letpadaung Hill. The resulting normal pattern of monthly evaporation is reproduced in Table 2.4.1

Table 2.4.1: Monthly pan evaporation statistics – Yangtse climate station (2000-2006)

Month*1	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)
Jan	123	121	5	119	134
Feb	149	151	13	130	166
Mar	210	213	14	188	224
Apr	228	236	21	191	248
May	202	205	43	118	256
Jun	203	187	36	165	270
Jul	172	174	12	153	187
Aug	184	175	38	133	248
Sep	160	150	27	128	208
Oct	145	148	27	102	184
Nov	125	130	17	102	146
Dec	117	112	12	98	131

*1 All computed pan evaporation statistics are measured in (mm).

Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to the calculated annual average pan evaporation (2,017 mm).

2.4.2 Trend Analysis

Trend analysis was performed on the full historic dataset of pan evaporation. The results of this analysis showed an unexplained downshift of nearly 600 mm in annual average pan evaporation between 2006 and 2007. As a shift of this magnitude is highly unusual, further investigation was performed in an attempt to explain the variation.

The results of this additional investigation, detailed in Appendix A, led KP to exclude the historic period (2007-2012) of pan evaporation from consideration. Accordingly

only data from the historic period (2000-2006) was used for forming the design data values provided in Table 2.5.

Inspection of this reduced dataset shows no statistically significant trend observable in annual pan evaporation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future pan evaporation due to observed climate change. Details of this analysis are provided in Appendix A.

2.4.3 Comparison of Precipitation and Evaporation

Average monthly values of precipitation (taken from Section 2.3.1) and pan evaporation (taken from Section 2.4.1) were compared to determine if the site is expected to run under annual water surplus or deficit conditions. The comparison is provided in Table 2.4.2.

Table 2.4.2: Comparision of monthly average precipitation and evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake[*1] Evaporation (mm)	Precip. minus Lake Evap. (mm)
Jan	2	123	86	-84
Feb	3	149	105	-101
Mar	5	210	147	-142
Apr	26	228	160	-134
May	102	202	142	-40
Jun	100	203	142	-42
Jul	67	172	121	-54
Aug	121	184	129	-7
Sep	166	160	112	54
Oct	142	145	101	50
Nov	33	125	87	-55
Dec	6	117	82	-75
Totals	773	2,017	1,412	-639

*1 Assumed pan coefficient = 0.7.

Additional details concerning the comparison of precipitation to pan evaporation are given in Appendix A.

The comparison between precipitation and evaporation can be used to indicate general trends in water build up or reduction on the site as follows:

- If precipitation is higher than evaporation, a water surplus usually results.
- If evaporation is larger than precipitation, the water surplus – deficit relationship is controlled by the ratio of runoff catchment area to evaporation surface area. This

scenario requires site specific modelling to draw any meaningful conclusions with regards to the site water balance.

For Letpadaung it is clear that in the wet season, particularly during September and October, there will be a build up of water in the various storage ponds across the site. For the rest of the year, areas such as the HLPs, which are continuously wetted (thus acting as an evaporative surface) will operate with a moderate to large water deficit.

For storm runoff and waste rock dump collection ponds the transition from water surplus to deficit would be likely to be only for the peak dry season (February to April). It is estimated that for the overall site the large shortfall from the heap leach pad water balance is likely to result in an overall site deficit. Adequate water storage and careful management of available water resources will be critical for the mining operations at Letpadaung.

2.5 TEMPERATURE

2.5.1 Monthly Patterns

The historic temperature dataset outlined in Section 2.2 was aggregated on annual and monthly time scales and used to compute sampling statistics to define normal temperature patterns at Letpadaung Hill. The resulting normal pattern of monthly average temperature is reproduced in Table 2.5.1.

Table 2.5.1: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month*1	Average	Median	Std. Dev.	Min.	Max.
Jan	21.9	21.9	1.9	18.4	28.0
Feb	24.0	23.6	2.3	21.1	32.9
Mar	28.1	28.0	2.3	23.1	35.5
Apr	30.9	30.9	1.4	25.9	33.1
May	31.0	31.0	1.4	28.1	33.8
Jun	30.6	30.5	1.1	27.8	32.9
Jul	30.5	30.8	1.2	26.8	32.5
Aug	29.9	29.8	1.0	28.4	32.1
Sep	29.3	29.3	0.7	27.8	30.4
Oct	28.0	28.	0.7	26.5	29.8
Nov	25.1	25.3	1.1	23.0	27.6
Dec	22.2	22.0	1.9	18.4	28.0

*1 All computed temperature statistics are measured in (℃).

Monthly temperature ranges were also analysed through the computation of monthly averages on daily temperature maxima and minima. The results of this computation are reproduced as Table 2.5.2.

Table 2.5.2: Monthly temperature ranges – WMO 48037 station (1981-2012)

Month[*1]	Max. (℃)	Average (℃)	Min. (℃)
Jan	28.5	21.9	15.4
Feb	31.6	24.0	16.9
Mar	36.0	28.1	20.5
Apr	38.4	30.9	24.0
May	36.8	31.0	25.5
Jun	35.4	30.6	26.0
Jul	35.5	30.5	26.1
Aug	34.3	29.9	25.7
Sep	33.4	29.3	25.3
Oct	32.5	28.0	23.8
Nov	30.4	25.1	19.9
Dec	28.0	22.2	16.4

Temperatures are fairly consistent during the six warm months of the year: April through September, when the average value is 30.4℃. The other four "shoulder" months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January, when the average temperature is 22.1℃, Minimum temperature generally occurs in January (15.4℃) and the maximum in April (38.4℃).

2.5.2 Trend Analysis

Temperature trend analysis was performed on the full historic dataset. The results of this analysis show that there is no statistically significant trend observable in annual values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future temperature due to observed climate change. Details of this analysis are provided in Appendix A.

2.6 WIND

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average speed of 3.0 m/s, with a maximum speed of 9.2 m/s. These correspond to Beaufort scale readings of 2 "light breeze" to 5 "fresh breeze". The direction the wind blows from tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available data indicates that high wind storms are unlikely at the Letpadaung site. The Letpadaung wind rose plot, including all daily measurements are included in Appendix A.

Seasonal variability was also considered. The dataset was divided into the Wet (May through October) and Dry (November through April) Seasons. Wind rose plots were produced for each season. During the Wet Season, winds generally blow along the North / South cardinal directions, with the preponderance of statistical data suggesting

that winds blow from the South (180°) to South by Southeast (157.5°). In the Dry Season, the wind blows predominantly from the North (0°) to North by Northwest (337.5°). Letpadaung Wet Season and Dry Season wind rose plots are included in Appendix A.

3. SURFACE WATER MANAGEMENT IMPACT ASSESSMENT

3.1 GENERAL

The Letpadaung Surface Water Management Impact Assessment aims to quantify the impact of the planned development at the Letpadaung project site on surface water runoff resulting from selected design rainfalls. In the context of the report, this section deals with the likely impacts of the development on the quantity and timing of runoff flows from the site. Water quality impacts are discussed in Section 5. Management and design of the HLP surface water infrastructure is discussed in Section 6.

The impact assessment was made through the construction and subsequent use of two site-wide rainfall / runoff models that were constructed using HEC-HMS software (Ref. 7), one model corresponding to existing (pre-mining) conditions and the other to planned future (operational) conditions. The existing catchments are provided in Figure 3.1 while the revised catchment configurations after construction of the mine are shown in Figure 3.2. Results were tabulated at key locations common to both models and used for purposes of comparison.

The following sub-sections provide details regarding modelling methods and assumptions, results of the simulations, and various considerations and recommendations for future surface water planning and design (based on the modelling results).

3.2 MODELLING METHODOLOGY AND ASSUMPTIONS

The approach for estimating runoff to various locations in the Letpadaung catchment (both for existing and planned future conditions) was to simulate runoff from the total area using a rainfall / runoff model constructed using HEC-HMS software (Ref. 7). By simulating the runoff hydrographs resulting from rainfall on each sub-catchment (or basin) reporting to and from the Letpadaung project area and routing them (combining hydrographs as necessary) throughout the natural and man-made sections of the overall drainage network, it was possible to determine peak runoff flow rate, time to peak runoff and total volume of runoff which reports to (or past) selected locations throughout the site. These results form the quantitative basis for impact assessment.

Background assumptions and methods employed in the Letpadaung HEC-HMS models for existing and planned future conditions are discussed in more detail in Appendix B.

Unless otherwise stated, the various water ponds in the Letpadaung hydrologic models were simulated assuming all ponds were full. Furthermore, since the majority of the design inputs for the water ponds were assumed, pond attenuation results are

indicative only. Precipitation was estimated using the SCS Curve Number Method, as described in Section 1.3.

Two potential 100 year ARI design storms, one of long duration (48 hours) and one of short duration (6 hours) were estimated for use as hydrologic inputs to the models. The total storm depths were then temporally distributed using the hyetograph patterns that were derived from historic data.

The operational model was run under two initial pond conditions for the Waste Water Pond. The two initial pond conditions are full and empty, where the pond was assumed to be either filled to the spillway invert level or completely empty. This was done due to uncertainty as to the typical pond volume. The scenario with the full pond provides the most conservative assumption for the sizing of outflows from the Waste Water Pond. The scenario with the empty pond provides the most conservative assumption for the estimation of the reduction of run off from the site (and potential impact on downstream users or the environment).

3.3 DESCRIPTION OF SURFACE WATER MANAGEMENT STRUCTURES

3.3.1 Overview

The surface water management structures for the site (excluding those associated with the HLPs) comprise the following:

- The South Diversion Channel.
- The Waste Water Pond (WWP).
- The Flood Protection Bund.
- Sundry minor diversion channels conveying runoff from WRDs and ore stockpiles to the WWP.
- Sundary minor retention ponds and silt traps used as temporary on site storage between their sub-catchments and the WWP.

These structures are shown on Figure 1.1 and briefly described below.

3.3.2 South Diversion Channel

The undisturbed catchment to the southwest of the Letpadaung project area drains to a river which currently flows through the area planned for construction of HLP 1 and HLP 2. In the early stages of planning the option of diverting runoff from this catchment through the middle of the site was contemplated. In light of the environmental, operational, construction, and commercial risks MWMCL decided to evaluate an alternative to this concept. In consultation with KP it was agreed that the South Diversion Channel would be built along the western edge of HLP 1 and HLP 2, in order

to divert runoff south and then west around the southwest edge of the Letpadaung site and back into its original catchment, draining to the existing water pond (WP-EX-002/WP-PL-002). In order to accomplish this, the channel could be located either immediately adjacent to the current southern and western lease boundaries (which would require additional property acquisition), or the western boundary of HLP 1 and HLP 2 could be moved slightly east in order to allow for construction of the diversion on currently owned land. There are several significant advantages associated with the South Diversion Channel option as follows:

- Runoff would be maintained in its natural catchment, thereby minimising impacts on downstream users and ecosystems.
- Construction of this option may be easily converted to a permanent surface water management system that is suitable for closure conditions. (The current Nerin-designed western diversion would only be temporary, requiring redesign and replacement at mine closure.)
- Use of this option provides a conveniently located source of clean construction material that could be borrowed during excavation of the channel.

3.3.3 Waste Water Pond (WWP)

The Waste Water Pond (WWP) is located on the eastern project boundary, with the flood protection bund acting as the eastern embankment. The WWP collects water from a number of on site sources, with the main one listed as follows:

- Runoff from WRDs;
- Open pit dewater;
- Runoff from low grade ore stockpiles;
- Runoff from reserve ore stockpiles; and
- Runoff from topsoil stockpiles.

Additional, minor sources include:

- Treated effluent from the site sewerage treatment plant; and
- Discharge from on-site cooling towers and compressors.

3.3.4 Flood Protection Bund

The purpose of the flood protection bund, along the eastern boundary of the project, is to mitigate the risk of flooding from the Chindwin River. The flood protection bund was designed by others and is outside of the scope of this report. Though outside the scope of this report, there are concerns regarding the potential impact of the flood protection bund. The main concern being that the bund could act as a bottleneck, concentrating

the flow of the Chindwin during periods of flooding. This may increase the frequency and severity of flooding of the villages located between the site and the Chindwin River. Further flood modelling and analysis is warranted to better understand the risks associated with the proposed flood protection bund.

3.3.5 Minor Internal Diversion Channels

A network of diversion channels extends around the site to ensure that contact water from stockpiles and runoff from disturbed catchments is conveyed to the WWP.

3.3.6 Minor Retention Ponds and Silt Traps

Sundry minor retention ponds and silt traps are distributed around the site for temporary storage before release to the downstream environment or before pumping to the WWP. These would include the silt traps along the northern boundary of the site and the waste water collection pond, immediately south of WRD 2.

3.4 RESULTS OF MODELLING

3.4.1 Comparison of Hydrologic Flows

The pre-mining and operational rainfall / runoff models were run and the detailed results are provided in Appendix B. A summary of the primary impacts is provided below.

The following parameters were estimated, for pre-mining and operational conditions, at key locations on and around the Letpadaung site:

- Drainage area;
- Peak runoff rate; and
- Total runoff volume.

Comparison of the above parameters was done to gauge the impact of the development on the downstream environment, primarily in terms of total runoff quantity. With respect to hydrologic flows, the main impacts associated with the mine development are detailed below.

- The volume of clean runoff water reporting to the large water pond located immediately southwest of proposed Heap Leach Pad No. 2 (WP-EX-002/WP-PL-002) is expected to be reduced by 21% under both long- and short-duration storms. This is a direct result of either the removal or diversion of runoff from the pre-mining catchment area.
- The volume of clean runoff water reporting to the small water pond located immediately southeast of proposed Heap Leach Pad No. 2 (WP-EX-004/WP-PL-003)

is expected to be reduced by up to to 47% as a result of removal of original catchment.

- During operations, runoff from a large proportion of the northern part of the site will be directed to the WWP which in turn overflows (when full) into the irrigation canal, running along the eastern boundary of the site. Prior to development of the mine this runoff would have reported directly to the irrigation canal. The impact of the WWP on hydrologic flows varies according to whether the WWP is assumed to be full or empty. If empty, most of the runoff is stored and the volume of runoff passing comparison points CP-EX-033/CP-PL-025 and CP-EX-20/CP-PL-023 decreases by around 80% and 90% respectively.
- In the pre-mining catchment configuration rainfall runoff enters the irrigation channel at a number of points along its length. After the mine is constructed all of these catchments are directed into the WWP and overflow from the WWP enters the irrigation channel at one location (CP-EX-033/CP-PL-025). As a result if the WWP is full at the commencement of the storm the volume of run off reporting to CP-EX-033/CP-PL-025 is expected to increase by around 84%. At a control point south of the relevant catchments (CP-EX-020/CP-PL-23) the flow decreases by 18%. It should be noted that under average conditions the WWP (even in the peak of the wet season) is less than 30% full.
- The volume of runoff water reporting to the northeast corner of the Letpadaung property (CP-EX-044/CP-PL-065) is expected to increase by up to 176% as a result of planned stormwater diversions along the north edge of the mine site. This result was expected as the catchment area which reports to this location will increase by around 1 km^2 under operational conditions. As this area is a topographical low point this corner of the site will effectively operate as an SCD with the flood protection bund acting as a dam wall. Water accumulating in this dam has to be either pumped to the WWP or discharged to the downstream irrigation canal (depending on water quality).
- In the event of release of water into the downstream irrigation canal, design flows reporting to the canal are likely to increase. The irrigation canal design should be checked to ensure that it has adequate capacity to accept such a flow increase.
- The overall impact to runoff volume reporting east to the Chindwin River, from the Letpadaung site, is expected to decrease due to the exclusion and rerouting of contact water runoff. Assuming the WWP is empty, the runoff reporting to the Chindwin River is expected to decrease by roughly 28%.

- Similarly, the overall impact of runoff volume reporting north to the Yama Stream from the Letpadaung site is expected to decrease by around 18% due to the exclusion and rerouting of contact water runoff.

Details of outputs from the hydrologic models are provided in Appendix B.

3.4.2 Diversion Channel Sizing

Results of the operational hydrologic model for the short-duration design storm (100 year ARI, 6 hour duration) were reviewed to provide preliminary runoff flow rates for the design of selected diversion channels onsite as indicated in Table 3.4.1.

Table 3.4.1: Preliminary diversion channel design flows

Sub-Catchment	Peak Inlet Design Flow (m^3/s)	Peak Outlet Design Flow (m^3/s)
South Diversion Channel	26	26
Contact water diversion from HLP 1 (DC-PL-032)	51	51
Contact water diversion from HLP 2 (DC-PL-031)	51	51
Contact water diversion through center of site (DC-PL-042, DC-PL-041, … DC-PL-034)	6	49
Contact water diversion along the southern edge of the northeast waste dump (DC-PL-046)	23	23
Clean water diversion along the northern edge of the mine site (DC-PL-059, DC-PL-058, … DC-PL-052)	2	16

Design flow rates listed are to be considered preliminary due to the assumed geometric and topographic configuration of the storm water conveyance system. Appropriate sizing of the storm water conveyance system should be performed and the model results updated prior to final design. Details of outputs from the hydrologic models are provided in Appendix B.

4. HEAP LEACH PAD WATER BALANCE MODEL

4.1 GENERAL

A water balance model incorporating the leach pads, process water ponds and stormwater pond was developed. The model was used to assess the water build-up during wet periods and to quantify the make-up water required during dry periods each year. The heap leaching process involves the management of a large volume of acidic solution, and considerations of water balance are of considerable importance to the successful operation of the facility. The modelling parameters used were predominantly based on information provided in the Basic Design report (Ref 8) and are shown schematically in Figure 4.1 (with units of m^3/day). To illustrate the processing details a flowchart is shown on Figure 4.2. The water balance, conducted by KP, included a full year of operation and additional modelling for extreme climatic conditions and sensitivity of critical parameters. The model was based on a daily time step using a series of historical rainfall input patterns to model the resulting fluctuations in various process ponds, the stormwater pond and raw water makeup requirements.

On average, the site has about 774 mm of rainfall annually and an annual pan evaporation of 2,017 mm. This indicates that an overall annual water shortfall is expected. The majority of the rain however occurs over a 6 month period, coinciding with the lower evaporation months, resulting in a distinct water positive period for a number of months before returning to a shortfall for the remainder of the year. Hence, longer duration wet seasons tend to be more critical for maximum pond volumes than short term storm events. A range of events with durations from 1 day to 1 year have been modelled in the water balance. For the purposes of the water management, the heap leach facility has been designed to contain all run-off resulting from a 1 in 100 year return interval event. No allowance has been made for treatment and release of excess water in the model.

4.2 WATER BALANCE MODEL

The modelling of the water balance was set up using the EXTEND simulation software package. EXTEND allows construction of a dynamic model of the water management system that can include multiple operational controls, limits and links between various system parts.

In order to provide information for the input and output data, the model was set up linked to an EXCEL spreadsheet. The EXCEL spreadsheet contains the relevant input and output data for each model run. A layout of the Extend model is shown in Figure 4.3.

4.3 MODEL COMPONENTS

The following section discusses the individual model components as standalone modules which each have modelled inputs/inflows and calculated outputs/outflows. Components are then duplicated and linked within the EXTEND model to examine the combined effect of all components acting together.

4.3.1 Heap Leach Pad

Each Heap Leach Pad (HLP) comprises a defined area onto which crushed ore is continuously stacked over the course of the mine life. The surface of the freshly stacked ore is irrigated with acid solution through a network of drippers for a predetermined period of about 400 days. Copper is progressively extracted from the crushed ore until the return of copper concentrate ceases to be economic. After this period, a subsequent lift (approximately 6 m high) is stacked on top of the pad to allow additional ore to be irrigated on the same pad. The process is repeated until the pad size becomes too small for further stacking or irrigation.

The base of the pad comprises an engineered HDPE lined foundation onto which a drainage layer and pipework collection network is installed. The pad is divided into a number of discrete cells which have been defined by both stacking and irrigation requirements, and topography. Division of the cells will be achieved using independent drainpipe systems exiting the leach pad in individual outlet pipes into a solution collection channel or pipe running the length of the pad. The outlet pipes may be throttled to direct solution flow either into a Pregnant Liquor Solution (PLS) pond, Intermediate Liquor Solution (ILS) pond or the single stormwater pond. The pipes carrying solution with the highest copper content will report to the PLS pond whilst lower concentration solution (as defined by the operators) will report to the ILS pond or the stormwater pond. Clean rainfall from unirrigated areas or overflow from the pad will report to the stormwater pond via the channel, thereby maximising copper concentration in the PLS pond by reducing potential dilution.

The model allows for the following inputs into the HLP:

- Direct rainfall on the HLP surface;
- Direct irrigation on the HLP surface area designated for leaching.

Outputs from the HLP included:

- Evaporation losses from the irrigation system to the atmosphere as a percentage of irrigation application rate;
- Evaporation losses from the wetted irrigation area;

- Permanent moisture content loss of water retained in the ore at the water retention moisture limit. This is determined as being the difference between the stacked ore moisture content and the remaining moisture content after irrigation which can no longer drain due to gravity. The short term loss during irrigation at the operating moisture limit has been ignored as water is progressively both lost and returned to the system as areas progressively commence and cease irrigation; and
- Water exiting the solution collection system at the base of the pad to be directed to the designated solution ponds.

The model utilises the required cycle time, stacking rate, stacking lift height and stacked density to determine the required irrigation area. The required irrigation area was divided into 3 zones based on the duration of irrigation each cell has experienced. On this basis, the freshly stacked ore will generate liquor solution of the highest copper concentration and should report to the PLS pond for maximum process plant efficiency. As the duration of irrigation continues and concentrations reduce, liquor solution will be directed to the ILS pond. Barren solution after the process plant copper extraction and with the highest acid concentration will be discharged on to the irrigation area nearing the completion of irrigation.

4.3.2 Process Plant

The process plant has a complex water balance which includes various pumping systems, storage tanks and losses. The plant balance was completed by China Nerin Engineering (Ref 8) and is assumed to be self balancing. Therefore, the plant has been simplified greatly for the purposes of the HLP water balance. The process plant has been modelled as a single component which extracts water from the PLS pond and discharges the solution back into the Raffinate pond after copper extraction and pH adjustments for re-irrigation has been completed. The process plant also requires a minimum daily quantity of fresh water. In addition, the plant has a continuous water loss from evaporative cooling towers and dust suppression.

4.3.3 Process Water Ponds

A number of process water ponds are located adjacent to each HLP to collect and store the leached solution before being pumped to either the process plant or back to the top of the pad for further irrigation. The designated process ponds in the system are the Pregnant Liquor Solution (PLS) pond, Intermediate Liquor Solution (ILS) pond and the Raffinate pond. All process water ponds comprise a rectangular HDPE lined facility excavated below natural ground. Any internal division within a pond for a presettler section has been ignored. The model allowed for the following inputs into each pond:

- Rainfall runoff from the direct pond surface;
- Rainfall runoff from the direct lined area of the pond;
- HLP outflow from leachate collection system directed to the designated pond based on copper concentration;
- Spillway discharge from the upstream process water ponds (i.e. each PLS pond will discharge into the following ILS pond then to the Raffinate pond); and
- Process plant discharge of barren solution into the Raffinate pond.

Outputs from each pond included:

- Evaporation losses from the free water surface;
- Seepage losses;
- Water returned to the process plant from the PLS pond for processing;
- Water returned to the HLP irrigation circuit; and
- Water discharged via the spillway.

The model utilises stage storages to determine the increase in surface area of the ponds resulting from changes to the volume of water stored in the system. A maximum capacity was assigned to each pond to calculate the potential spillway level trigger before spilling water.

4.3.4 Stormwater Pond

The Storm Water Pond (SWP) comprises a single square HDPE lined facility as the main storage of excess water for the HLP, process ponds and plant site during rain events. The SWP then progressively supplies the makeup water requirements for irrigation of the HLP as well as general evaporation losses. The model allows for the following inputs into the SWP:

- Rainfall runoff from the SWP pond surface;
- Rainfall runoff from the direct lined catchment area of 72 Ha; and
- Spillway discharge from the Raffinate ponds.

Outputs from the SWP included:

- Evaporation losses from the free water surface;
- Seepage losses;
- Water returned to the process plant as make-up water;
- Water used as irrigation make-up water; and
- Water discharged via the SWP spillway.

The model utilises the stage storage to determine the increase in water area resulting from changes to the volume of water stored in the system. A maximum capacity was assigned to the facility to calculate the potential spillway level trigger before releasing water. As part of the modelling, the spillway capacity was also artificially increased to determine what pond capacity was required to contain the design storm event runoff.

4.3.5 Waste Water Pond

The Waste Water Pond (WWP) is located downstream of the SWP and collects water from a number of on site sources. As the HLP is designed as a no release system with no SWP water overflow, the WWP was only modelled as a source of makeup water for the system. The design capacity is based on the site water balance modelling from short duration storm events.

4.3.6 River Makeup

The Chindwin River is the projects source of all year round fresh water and any process water makeup as required. The model assumed the river can supply an unlimited quantity of water for make up once all other site sources have been exhausted.

4.3.7 Waste Rock Dump 1 and Open Pit

Waste Rock Dump 1 and the Open Pit have been simplified to be modelled as contributing rainfall areas to the WWP volume.

4.4 BLOCK MODEL

A block model layout of the EXTEND model is shown in Figure 4.4 showing the cycle of water around the HLP and ponds. The flowsheet for the facility is described as follows starting at the irrigation of new ore:

- The Fresh Stacked Ore leach area comprises those cells currently being leached producing the highest copper grade, with drainage reporting to the PLS pond. The area is approximimely equivalent to 40 days of irrigation;
- The volume in the PLS pond is monitored by the operators to ensure that the pond level remains between the defined minimum and maximum operating level to provide a constant supply to the process plant. In cases of sudden extreme rainfall the pond would overflow to the ILS pond;
- The Proces Plant (SX/EW) takes a constant flow from the PLS pond of up to 81,294.5 m3/day, strips the copper from the pregnant solution and discharges barren solution to the Raffinate pond;

- The Raffinate pond collects treated solution from the Process Plant, overflow from the PLS and ILS pond and may also require make-up water pumped from the SWP to supliment the required irrigation rate;
- The Raffinate pond is used to irrigate the area of the pad which has had the longest period of irrigation and is nearing completion. The returned solution is directed to the ILS pond. The area is approximely equivalent to 180 days of irrigation;
- The ILS pond is used to irrigate the area of the pad which has an intermediate copper concentration reporting out of the pad and also the freshly stacked ore area. The intermediate leaching area reports back to the ILS pond to be reirrigated again. The area is approximely equivalent to 180 days of irrigation;
- The non-leaching area is the balance of the leach pad area which is not under leach or is currently being stacked and which cannot be diverted. The area may produce solution with very low reagent and copper content or sediment. This can be sent to any pond but has been assumed to report to the SWP;
- The process plant sources water from either the SWP (and WWP) or Chindwin River to ensure there is adequate irrigation volume to account for irrigation area and plant evaporation losses; and
- Each section of the pad or ponds in the model receives daily rainfall on its area which is included in the runoff from the pad or accumlation within the ponds. Water losses from the ponds are in proportion to the evaporation rate and free water pan factor. The model automatically calculates the daily volume of solution in the ponds and any overflow volumes.

The Basic Design report (Ref. 8) indicated each pad would consist of one PLS pond, three ILS ponds, three Raffinate ponds, and a single SWP for the project. The duplicated ILS and Raffinate ponds are spaced along the alignment of the southern toe channel while the PLS is located at the south east corner of each pad. For the purposes of modelling, it was assumed only one PLS pond, one ILS pond and one Raffinate pond was required for each pad on the basis that the additional ILS and Raffinate ponds are only operational when certain areas of the pad are being irrigated. The influence of the additional ponds will be extremely minor for stormwater and makeup calculations, but would assist in water control of solution concentrations during operations.

4.5 DESIGN CRITERIA

The design criteria used in the water balance modelling are taken from the Basic Design report (Ref 8) with additional climatic parameters and sensitivity determined by KP. Key criteria used in the model are discussed below.

4.5.1 Climatic Parameters

Leach pad water balances are typically influenced by both short term high intensity events for small process pond overflows and long term wet season build up of runoff volumes in stormwater ponds. As a result, a range of climatic extremes have been modelled.

Climatic parameters used for the model were determined from the Baseline Design Climatology assessment conducted by KP (Appendix A). As the water balance model was conducted on a daily basis, average and extreme rainfall patterns were scaled from historical rainfall patterns. Historical rainfall was obtained from Monywa Township climate station, located 5.6 km northeast of Letpadaung Hill, and evaporation data from Yangtse climate station, 7.6 km northwest at the S&K operations site. Daily precipitation analysis was conducted on the Monywa climate station and is presented in Appendix A.

The following conditions were examined for the water balance scenarios:

- Average rainfall conditions;
- Less than 30 day storm events of 1, 2, 3, 4, 7, 14 and 30 days;
- Wet season events of 60, 90, 120 and 180 days;
- Annual events of 1 and 2 year wet and dry cycles.

All extreme conditions were modelled assuming a 100 year ARI. The nominal rainfall sequences are provided in Table 4.5.1.

Table 4.5.1: Water balance rainfall scenarios

Scenario	100-yr ARI Total Depth (mm)	Temporal Pattern Based on
Average	774	2006
2 Year Wet	2,544	2010 – 2011
1 Year Wet	1,555	1973
1 Year Dry	424	1982
180 Day Wet	1,437	25/05/1973 – 20/11/1973
120 Day Wet	1,067	2/07/2010 – 29/10/2010
90 Day Wet	921	30/07/1965 –27/10/1965
60 Day Wet	740	29/08/1965 – 27/10/1965
30 Day Wet	520	29/09/2010 – 28/10/2010
14 Day Wet	440	9/05/2007 – 22/05/2007
7 Day Wet	343	9/05/2007 – 15/05/2007
4 Day Wet	308	1/06/1984 – 4/06/1984
3 Day Wet	298	1/06/1984 – 3/06/1984
2 Day Wet	214	2/06/1984 – 3/06/1984
1 Day Wet	159	-

Monthly pan evaporation rates were converted to daily by dividing the monthly values by day per month. The values used in the modelling are provided in Table 4.5.2.

Table 4.5.2: Monthly pan evaporation

Month*1	Average
Jan	123
Feb	149
Mar	210
Apr	228
May	202
Jun	203
Jul	172
Aug	184
Sep	160
Oct	145
Nov	125
Dec	117
Total	2017

4.5.2 Heap Leach Pad

The ore production and stacking parameters for the project are as follows:

- Ore processing capacity 92,000 kt/day;
- Total ore processing 954 Mt;
- Ore density 2.55 t/m^3;
- Days of Operation 330 d/year;
- Life of Operation 33 years;
- Stacking height of 6 m and 37° slopes
- Internal benches of 4.5 m for an overall slope at closure of 26°;
- Stacking density 1.6 t/m^3;
- Stacking moisture content 5%;

The leaching parameters for the project are as follows:

- Irrigation leaching rate 9 L / h / m^2;
- Leaching total period of 400 days made up of the following cycles:
  - 40 days first cycle (from ILS – reports to the PLS)
  - 180 days second cycle (from ILS – reports to the ILS)
  - 180 days last cycle (from Raffinate – reports to the ILS)
- Retained ore moisture content of 9% (predicted by KP and sensitivity conducted);
- Loss from Dripper irrigation of 4% (predicted by KP and sensitivity conducted);

Based on the stacking rate and cycle time the following irrigation area and application rate for the water balance was calculated:

92,000t/day / 1.6 t/m^3 / 6 m lifts x 400 days = 3,833,333 m^2 of irrigation area

3,833,333 m^2 x 9l/h/m^2 x 24 hours / 1000 = 828,000m^3 / day of irrigation.

A review of the proposed stacking plan of the three leach pad cells was conducted. The main results are summarised in tables Table 4.5.3 and Table 4.5.4. A cycle of 460 days was allowed for to include setting up of irrigation, irrigation, rinsing and removal of irrigation systems.

Table 4.5.3: Leach pads HLP1 and HLP2 geometry

Layer Number	Area Base (m^2)	Area Top (m^2)	Stacking Height (m)	Volume (m^3)	Ore (t)	Placement (days)
Layer 1	3,465,000	3,381,331	6	20,538,994	32,862,390	357
Layer 2	3,334,269	3,251,394	6	19,756,989	31,611,182	344
Layer 3	3,204,780	3,122,699	6	18,982,439	30,371,902	330
Layer 4	3,076,534	2,995,247	6	18,215,343	29,144,549	317
Layer 5	2,949,530	2,869,037	6	17,455,702	27,929,124	304
Layer 6	2,823,769	2,744,070	6	16,703,517	26,725,627	290
Layer 7	2,699,250	2,620,345	6	15,958,786	25,534,057	278
Layer 8	2,575,974	2,497,862	6	15,221,509	24,354,415	265
Layer 9	2,453,940	2,376,622	6	14,491,688	23,186,700	252
Layer 10	2,333,149	2,256,625	6	13,769,321	22,030,914	239
Layer 11	2,213,600	2,137,870	6	13,054,409	20,887,055	227
Layer 12	2,095,294	2,020,357	6	12,346,952	19,755,123	215
Layer 13	1,978,230	1,904,087	6	11,646,950	18,635,120	203
Layer 14	1,862,408	1,789,059	6	10,954,402	17,527,044	191
Total				219,097,001	350,555,202	3812

Table 4.5.4: Leach pad HLP3 geometry

Layer Number	Area Base (m^2)	Area Top (m^2)	Stacking Height (m)	Volume (m^3)	Ore (t)	Placement (days)
Layer 1	2,394,579	2,312,580	6	14,121,477	22,594,363	246
Layer 2	2,277,700	2,196,925	6	13,423,875	21,478,200	233
Layer 3	2,162,570	2,083,018	6	12,736,764	20,378,822	222
Layer 4	2,049,187	1,970,856	6	12,060,129	19,296,206	210
Layer 5	1,937,552	1,970,859	6	11,725,230	18,760,369	204
Layer 6	1,937,552	1,860,447	6	11,393,996	18,230,393	198
Layer 7	1,827,664	1,751,783	6	10,738,342	17,181,348	187
Layer 8	1,719,525	1,644,867	6	10,093,176	16,149,081	176
Layer 9	1,613,133	1,539,699	6	9,458,496	15,133,594	164
Layer 10	1,508,489	1,436,279	6	8,834,304	14,134,886	154
Layer 11	1,405,593	1,334,606	6	8,220,598	13,152,956	143
Layer 12	1,304,445	1,234,681	6	7,617,379	12,187,806	132
Layer 13	1,205,045	1,136,504	6	7,024,646	11,239,434	122
Layer 14	1,107,392	1,040,075	6	6,442,401	10,307,841	112
Total				143,890,813	230,225,299	2503

Based on the developed stacking plan HLP1 and HLP2 will operate until approximately the end of Year 12 when HLP3 is required to commence operation to compensate for the reducing area on the two initial leaching areas.

4.5.3 Process Plant

The process plant flows have been simplified into a single minimum raw water makeup and PLS return rate into the plant. The plant is then balanced to discharge water to the Raffinate pond and WWP while losing a set amount from cooling towers. The simplified parameters are shown in Figure 4.5. Additional make up above the minimum raw water (predominately loss at the HLP) is made up of input from either SWP, WWP or Chindwin River and is part of the model output results.

The process plant is modelled to operate at 330 days per year by the inclusion of a random daily availability number to turn off all pumped flows in the system. All gravity flows and rainfall will continue during these times. The process plant is designed to source up to 81,294.5 m^3/day from the PLS ponds or equivalent to a leaching area of 376,363 m^2 at 9L/h/m^2.

4.5.4 Process Water Ponds

Three types of process water ponds are modelled. The dimensions and parameters of each pond as it is modelled are described below.

PLS Pond

- 60 m wide x 245 m long x 3 m deep;
- Side slopes of 2H:1V;
- Total Capacity = 35,000 m3;
- HDPE lined.

ILS Pond

- 60 m wide x 470 m long x 3 m deep
- Side slopes of 2H:1V;
- Total Capacity = 70,000 m3;
- HDPE lined.

Raffinate Pond

- 60 m wide x 130 m long x 3 m deep
- Side slopes of 2H:1V;
- Total Capacity = 18,000 m3;
- HDPE lined.

SWP

- Plan area of 636,000 m2;
- Side slopes of 2H:1V;
- Total Capacity = 2,224,000 m3;
- HDPE lined.

WWP

- Plan area of 1,558,000 m2;
- Side slopes of 2H:1V;
- Total Capacity = 4,645,000 m3;
- Soil lined.

For all ponds an evaporation pan factor of 0.7 was used to adjust from pan evaporation to equivalent pond evaporation. The size of the SWP was increased from that above as part of the modelling results in order to contain the volume of a 1 in 100 year wet r climatic event.

4.5.5 Waste Rock Dump 1 and Open Pit

For the purpose of the modelling, the contributing catchment from WRD1 and the Open Pit reported to the WWP on a daily basis. This water is to provide makeup water before relying on the Chindwin River as the final source of makeup. From the Basic Design report, the following areas were used:

- WRD1 Runoff Area = 252 Ha;
- Open Pit Catchment Area = 207 Ha;

During operation, more areas around the site may report to the WWP for containment than modelled. This will either reduce the overall annual demand from the Chindwin River or may alternatively require release of excess water in the wet season. A run off coefficient of 0.7 was used to determine runoff quantities.

4.6 RESULTS OF MODELLING

The leach pad water balance model was run for various scenarios using the design parameters discussed above. Each modelling run tracked daily pond volumes, discharges and levels and accumulated site shortfalls over a year long period. The following models were run:

- Average climatic conditions to determine typical expected operating results;

- Dry conditions (1 in 100 year annual) to determine potential extreme shortfall quantities above those under average conditions;
- Dry and average conditions with a sensitivity analysis on the Dripper loss and ore absoption quantity on the makeup requirements;
- Wet conditions (1 in 100 year storm events up to annual wet years) to determine potential extreme pond volumes or spillways flows through the system;
- Sensitivity analysis on the Dripper loss and ore absoption quantity under wet conditions on the pond volumes;
- Recommendations for modifications to the system.

Outputs from the above modelling runs are discussed in the sections that follow

4.6.1 Average Climatic Conditions

Average climatic conditions were modelled by selecting the year of historical daily rainfall record which most closely matched the total annual average of the precipitation data set. The daily pattern was then scaled to equal the average annual rainfall.

Under average conditions, the leach pad water balance is shown to be in net water deficit for approximately 6 months of the year. During this time, due to the ongoing loss occurring on the leach pad, the SWP and WWP remain empty and all shortfall will need to be made up from the Chindwin River. The PLS and Raffinate ponds are generally expected to be empty during this period as reclaim back to the plant has a greater capacity than discharge out from the pad during low rainfall events. The ILS pond was found to be continually discharging to the Raffinate pond based on a larger irrigation area reporting to the ILS pond. This is not considered an issue and would be controlled during operation based on directing each cell to the appropriate pond based on copper concentrate.

The annual shortfall requirement equates to 5.96 Mm^3/year and closely resembles the rate determined in the Basic Design document (Ref. 8) of 16,800 m^3/day if averaged over the entire year. For ease of reference the site water balance inputs and outputs are summarised in Figure 4.1 which is taken from the Basic Design report (Ref. 8). The makeup water requirement during this period has a maximum rate of 40,740 m^3/day, which also closely resembles the maximum make up of 39,696 m^3/day (shown on Figure 4.1) if both the SWP and WWP return flows are reduced to zero.

During periods of higher rainfall, the SWP and WWP begin to accumulate water as rainfall runoff exceeds evaporation losses and no additional external makeup water is required. The SWP peaks at a volume of about 620,000 m^3 while the WWP peaks at a volume of about 1.4 Mm^3 based on the assumed catchment areas (WRD 1 and Open

pit only). The pond volumes and make-up water return are shown on Figure 4.6. The two ponds are adequately sized for average conditions.

4.6.2 Dry Climatic Conditions

Under dry climatic conditions, the annual rainfall is reduced by 45%, thereby increasing the reliance on external water sources during and after the wet season. The peak requirement in the dry season remains unchanged as it is based on an effective zero rainfall period of operation. As a result however, the annual requirement from external sources increases to 9.29 Mm^3/year. Figure 4.7 shows the reduced SWP and WWP volumes under this condition and the increased periods of full make up requirement.

4.6.3 Dripper Loss and Ore Absorption Sensitivity

As a result of the large irrigation flows and high throughput, a sensitivity modelling run varying the high loss parameters was conducted to assess the impact on makeup water. The dripper loss percentage was adjusted from the design rate of 4% loss to both 6% and 8% while independently, the ore absorption was increased from a 5% increase in ore moisture content to 10% and 15% increase in ore moisture content. Average and dry conditions were run for all cases. A summary of all model runs is presented in Table 4.6.1.

Table 4.6.1: River makeup requirements – sensitivity to ore absorption and dripper loss

Dripper Loss (%)	Ore Absorption (%)	Climate	River Makeup (Mm^3/year)
4	5	Average	5.96
		Dry	9.29
	10	Average	7.07
		Dry	10.65
	15	Average	8.81
		Dry	12.68
6	5	Average	11.18
		Dry	14.40
	10	Average	12.09
		Dry	16.70
	15	Average	13.95
		Dry	17.68
8	5	Average	16.32
		Dry	20.08
	10	Average	18.61
		Dry	21.01
	15	Average	19.27
		Dry	23.21

The results indicate the selection and operation of the irrigation system will have a significant impact on the water loss and resulting makeup requirements. The cost or limitations of makeup water from the river in the dry season is not assessed but will need to be confirmed prior to operation.

The ore absorption is a less sensitive parameter and will be under less control by the operators or designers of the HLP and more governed by ore type and particle size. Ore absorption losses are best calibrated with a site water balance during operation.

4.6.4 Wet Climatic Conditions

The water balance model was run for 100 year ARI wet conditions with durations ranging from 1 day events through to 1 year events. As it was found that longer duration events generated larger pond volumes, the SWP capacity was increased to determine storm storage requirements. A summary of the SWP volumes for multiple events in presented in Table 4.6.2 and shown against time in Figure 4.8. The SWP's volume peak towards the end of the wet season and then take several months to return to minimum from the ongoing water losses within the system. During this time, no makeup is required from the river (except minimum raw water). All events resulted in the SWP volume returning to minimum prior to the next wet season indicating there will be no cumulative effects between multiple years.

Table 4.6.2: Wet SWP volume results

Climatic Condition	Maximum SWP Volume (m^3)
Average	620,000
1 Day Wet	1,477,000
2 Day Wet	1,839,000
3 Day Wet	2,609,000
4 Day Wet	2,709,000
7 Day Wet	2,636,000
14 Day Wet	3,392,000
30 Day Wet	3,599,000
60 Day Wet	3,821,000
90 Day Wet	4,546,000
120 Day Wet	5,070,000
180 Day Wet	5,401,000
1 Year Wet	5,509,000

As the SWP capacity is currently 2.2 Mm^3, a 1 or 2 day event can be fully contained. In order to contain longer events, KP suggests increasing the SWP capacity (by excavation of the SWP basin) to increase the pond capacity to approximately 4.0 Mm^3, while maintaining the same footprint and approximate liner area. For events longer than 60 days, it is envisaged that water storage capacity in the WWP will be available.

For the wet conditions modelling, a sensitivity analysis was also conducted on the ore absorption and dripper loss for selected scenarios. The results for the same wet climatic conditions are in Table 4.6.3. As the percentage losses increase, the shorter duration storm event become more critical due to the increase in the long term losses.

Table 4.6.3: Wet SWP sensitivity to dripper and ore absorption losses

Climatic Condition	Maximum SWP Volume (m^3)		
	Dripper– 4% Ore – 5%	Dripper – 6% Ore – 10%	Dripper – 8% Ore – 15%
Average	620,000	575,000	560,000
1 Day Wet	1,477,000	1,302,000	1,287,000
2 Day Wet	1,839,000	1,745,000	1,692,000
3 Day Wet	2,609,000	2,419,000	2,437,000
4 Day Wet	2,709,000	2,423,000	2,360,000
7 Day Wet	2,636,000	2,453,000	2,479,000
14 Day Wet	3,392,000	3,094,000	2,795,000
30 Day Wet	3,599,000	3,319,000	2,912,000
60 Day Wet	3,821,000	2,506,000	1,506,000
90 Day Wet	4,546,000	3,140,000	2,137,000
120 Day Wet	5,070,000	2,902,000	2,397,000
180 Day Wet	5,401,000	2,300,000	1,278,000
1 Year Wet	5,509,000	2,818,000	1,367,000

The recommended increase to 4.0 Mm^3 would cover up to a 90 day event for these higher loss scenarios.

4.7 CONCLUSIONS

Under average climatic conditions and expected operation parameters, the SWP is unlikely to overflow. It will be maintained as the primary source of makeup water on site. The peak makeup water requirement is not influenced by rainfall conditions as it occurs continuously throughout the dry season when rainfall is effectively zero. The annual makeup water requirement however is highly dependent on rainfall and dripper loss with ore absorption losses being less critical. As there is currently no known restrictions on the amount of water that can be sourced from the Chindwin River, higher water losses or dry events were not considered critical provided the pump system is sized for the peak condition.

The existing SWP size is suitable for containing 1 or 2 day, 1 in 100 year ARI storm events. Longer durations than this will begin to accumulate water at a higher rate than evaporation and absorption losses combined. To reduce the likelihood of SWP outflow, its capacity will need to be increased. KP recommend the SWP design is increased to above 4.0 Mm^3 in order to contain longer duration rainfall events. This can be achieved by excavating the basin of the SWP deeper while maintaining the same footprint area.

5. WATER QUALITY

5.1 GENERAL

A high level water quality assessment has been conducted for the site based on measured catchment areas, water flows from the modelling and assumptions regarding dilution. Limited water quality information was available in terms of baseline data or projected waste rock dump and HLP runoff. On this basis a quantitative evaluation of site runoff water quality was not possible. To assist preliminary design a simple assessment, based on catchment size and the type of use within each area, has been conducted.

5.2 WATER QUALITY DEFINITIONS

Site runoff was classified in terms of quality according to expected land usage. For the purposes of this report the following four runoff water quality categories were applied:

- Category 1: Clean water – this would consist of runoff water from the surrounding watershed catchment that has had no contact with the site (or runoff from the project site). The pit dewatering may be included in this category if it meets World Health Organisation drinking water standards. Otherwise it would need to be classified as a lower standard water type. Direct rainfall onto ponds will dilute any existing pond water;
- Category 2: Clean water containing sediment – this would include sediment laden surface water runoff from disturbed areas of the site (including topsoil stockpiles). It excludes potentially contaminated contact water. After sediment removal this water could be released to the environment;
- Category 3: Contact water – water which has been in contact with ore or PAF waste that is potentially acidic and / or enriched with dissolved metals. This water would need to be contained, tested and if necessary treated prior to release to the external environment; and
- Category 4: Process water – This would be acidic water, containing soluble metals, associated with the heap leaching process. This water should be contained and recycled to the process, to minimise the risk of release to the environment.

For the purpose of the dilution assessment, it was assumed that the Category 1 and 2 water will evenly dilute Category 3 water if mixed. It is recommended however that poor quality water be separated for as long as possible, from clean water, using internal divider walls to compartmentalise ponds.

5.3 DESIGNATED SUBCATCHMENT AREAS

The various sub-catchment areas, defined in the site water model, were assigned a ratio for each of the three water quality categories based on assumptions pertaining to land usage extents. Only the HLP area was assigned a Category 4 classification. Subcatchment areas and runoff water quality categories are summarised in Table 5.3.1.

Table 5.3.1: Site sub-catchment areas and water quality designation

Sub-Catchment	Area (km^2)	Category 1	Category 2	Category 3	Category 4
BA-PL-021	0.03094	0	0.85	0.15	0
BA-PL-022	0.07116	0	0.85	0.15	0
BA-PL-023	0.09257	0	0.85	0.15	0
BA-PL-024	0.21727	0	0.85	0.15	0
BA-PL-025	0.79950	0	0.85	0.15	0
BA-PL-028	0.09586	0	0.85	0.15	0
BA-PL-029	0.43793	0	0.85	0.15	0
BA-PL-030	1.0583	0	0.85	0.15	0
BA-PL-032	0.631	0.5	0	0.5	0
BA-PL-035	0.493	1.0	0	0	0
WP-PL-005/006P	1.461	1.0	0	0	0
BA-PL-036	0.783	0.2	0.8	0	0
BA-PL-037	0.623	0.1	0.9	0	0
BA-PL-038	0.820	0.75	0.25	0	0
BA-PL-039	0.496	0.65	0.35	0	0
BA-PL-040	0.116	0.9	0.1	0	0
BA-PL-041	1.077	0.4	0.35	0.25	0
BA-PL-042	0.459	0.05	0.8	0.15	0
BA-PL-043	0.543	0	0.55	0.45	0
WP-PL-008P	0.100	1.0	0	0	0
BA-PL-044	0.594	0.3	0.5	0.2	0
BA-PL-045	1.824	0.25	0.65	0.1	0
BA-PL-046	0.378	0.7	0.3	0	0
BA-PL-047	0.752	0	1.0	0	0
BA-PL-048	0.387	0	0.55	0.45	0
BA-PL-033	4.380	0	0	0	1
BA-PL-034	4.428	0	0	0	1
WP-PL-007P	0.717	1.0	0	0	0
BA-PL-050	0.191	0.9	0.1	0	0
BA-PL-051	0.116	0.9	0.1	0	0
BA-PL-052	0.461	0.9	0.1	0	0
BA-PL-053	0.138	0.9	0.1	0	0
BA-PL-054	0.281	0.8	0.2	0	0
BA-PL-055	0.187	0.8	0.2	0	0
BA-PL-056	0.161	0	10	0	0

A pictorial representation of site sub-catchments and relative rainfall runoff quality is shown on Figure 5.1.

5.4 RESULTS

5.4.1 Overview

With respect to rainfall run-off on site, and its impact on water quality, there are two aspects to this that were considered in the analysis, as follows:

- Site surface water runoff quality and its management.
- Heap leach pad surface water runoff and its management.

The results of this are discussed in the sections that follow.

5.4.2 Surface Water Management

The majority of surface water runoff from site reports to the WWP. Some small catchments for Category 1 and 2 runoff (located on the northern boundary) are managed by perimeter sediment dams which can either discharge water off site directly or return water to the site via a pumped system. These sediment dams have not been reviewed and are assumed to be sized appropriately (allowing for plan area and dead sediment storage) for the required particle size removal for a given ARI peak inflow. On this basis, for all intents and purposes the quality of the surface water run-off from the site depends on how effectively the WWP operates.

The WWP pond has a reporting catchment area of 13.2 km^2, not including pit flows. The 6 hour and 48 hour, 100 year ARI, events were run on the initial condition of the WWP being empty, to estimate minimum required pond volumes. The resulting pond runoff volumes were 1.78 Mm^3 and 3.31 Mm^3 respectively. The heap leach water balance indicates under average climatic conditions a peak volume in the WWP of 1.42 Mm^3. This at the peak of the wet season in order to store the average climatic condition wet pond plus the 48 hour storm event a capacity of 4.73 Mm^3 is required. Thus it is recommended that the WWP be increased in capacity to 4.8 Mm3 by deepening the base of the pond.

Based on Category 1 and 2 water diluting Category 3 water, an approximate eight fold dilution is possible, with the current layout, prior to discharge. This assumes perfect mixing of the runoff in the WWP. A summary of flow volumes is shown in Table 5.4.1.

Table 5.4.1: Runoff quantities reporting to WWP

	Runoff Quantities		
	Category 1	Category 2	Category 3
6 Hour Event	638,000 m^3	926,000 m^3	223,000 m^3
48 Hour Event	1,101,000 m^3	1,627,000 m^3	390,000 m^3
Runoff Proportions	36%	52%	12%

The Nerin configuration of water flows into the WWP indicates the majority of the site surface runoff will report to the northern pond before flowing southwards to the southern part of the pond, through a channel or pipe connecting the two. Therefore, the northern pond should be subdivided into cells to promote even mixing and sediment drop out. Individual ponds can be tested for water quality and specific active treatment applied and directed south or directly released. Any Category 1 pumped water flows (i.e. the clean pit water or other site sediment dams) should then be directed to the southern pond where the final spillway to the environment should be located. The northern pond (cell of lowest water quality) should be prioritised as the primary make up water source (after the SWP). KP recommends an adjustment to the configuration as outlined in Section 5.5.

5.4.3 HLP Water Balance

The HLP pad system consists of numerous solution ponds, leach pad area and a stormwater pond. During normal operation with no rain, the copper concentrate in the process ponds will operate as follows (according to the daily manipulation of the HLP launders by the operators):

PLS at the grade of 4.0g/L is pumped to SX system while that under such grade is returned to irrigation process. The leach solution or rainwater at copper grade in the range of 1～3g/L shall be led to ILS pond and those at copper grade lower than 1g/L will be discharged to the flood pond.

The HLP irrigation is expected to operate at a pH range of 1.4 – 1.8. Therefore, with regards to SWP water quality, it was assumed that any pad runoff or process pond overflow was Category 4 and any direct rainfall on the SWP was Category 1. As water is returned to the process plant for makeup, it will be returned at the diluted rate for that day based on the inflows and outflows. Evaporation from the pond will slightly increase the concentration of the SWP.

The HLP water balance was run for average and 1 in 100 year ARI Wet Year conditions and the above water quality assessment was conducted by assigning pad irrigation as a unit value of 1 and direct rain as a unit value of 0. The water in the SWP was tracked for concentration based on water inflow from the pads or ponds and water outflow as evaporation or makeup water. The plot of expected water concentration based on a unit value of 1 is shown in Figure 5.2.

The results indicate that the rainfall, either average or wet, has only a minor impact on the quality of the SWP water relative to the irrigation water quality. This is due to the rainfall being relatively low compared to the irrigation rate, therefore providing little in

the way of dilution. However it is enough additional water to cause the process water ponds to overflow into the SWP during rain events. By comparison, the 100 year ARI wet year rainfall, of 1,555 mm, is insignificant given the irrigation rate of 9 L / h / m^2 is equivalent to 216 mm of rainfall falling on the pad every day.. Therefore the water treatment design for the SWP should assume that runoff water has little to no dilution due to rainfall and water quality would be similar to that being discharged from the base of the pad.

5.5 RECOMMENDATIONS

KP has conducted a high level review of site water management system and has identified possible improvements. The system could operate more effectively by adopting an alternative layout that involves segregating site rainfall runoff according to its quality as follows:

- Installing a divider wall in the WWP so as to create a north cell and a south cell.
- Category 1 and Category 2 runoff would be directed to the WWP north cell.
- Category 3 runoff would be directed to the WWP south cell.

The southern pond would then be prioritised as the primary make up water source (after the SWP). The north and south cells would be hydraulically separated, with a weir between them. A spillway would then be located on the northern pond (flood protection bund wall) that would, when required, release water to the environment. This alternative layout has a number of benefits which include:

- The northern WWP would generally only contain Category 1 and 2 water and would act as a sediment pond, treating the Category 2 water. This water could then be used for dust control around the site without the risk of further contamination.
- If the southern WWP cell weir overflowed, it would spill into the northern WWP cell where it would most likely be contained.
- If both the northern and southern WWP cells overflowed, the Category 3 water from the southern cell would be diluted in the northern cell before being released to the environment.

To facilitate operation of the system described above it is recommended that the more environmentally problematic, low grade ore and ore reserve, stockpiles be consolidated in one location. KP have nominated the northern half of HLP3 for this purpose as this location will allow the contact water from these stockpiles to be directed relatively easily to the south WWP cell. Considering that HLP3 is not developed until much later in the life of the operation it is assumed that this can be accommodated from an operational

and construction perspective. It should be noted that in order to develop a system that largely flows under gravity it will be necessary, in some instances, to place internal diversion channels (both for contact and sediment laden water) on engineered fill or WRD benches.

A schematic figure illustrating the above system is presented in Figure 5.3.

6. SEDIMENT CONTROL

6.1 GENERAL

Surface water run-off from cleared areas and WRDs is likely to be laden with suspended solids. If sediment laden run-off reports directly to waterways it has the potential to impact on riverine ecosystems and downstream users. To mitigate these environmental and social risks it is important that strategies and systems are in place to reduce soil erosion and contain sediment laden water on site until it is suitable for release. A typical approach to erosion and sediment control involves a combination of source management and downstream management (at the property boundary).

Source management requires progressive rehabilitation combined with strategic placement of small scale structures such as diversion ditches, brushwood barriers, geotextile silt fences, rock check dams, level spreaders, and sediment traps. If implemented properly on site their use will improve the effectiveness of the larger scale engineered sediment control structures (and in some instances may eliminate their necessity). Further details of sediment source control practices and the associated small scale structures are provided in the Erosion and Sediment Control Guidelines (Ref. 1).

In addition to source control it is proposed that a number of sediment control dams (SCDs) are to be located at strategic locations around the site. SCDs are utilised to contain uncontaminated, sediment laden water for a period of time to allow the sediment to drop out of suspension.

Environmentally it is important to achieve a level of total suspended solids (TSS) similar to the quality of the water moving through the area prior to disturbance. The TSS of the Chindwin river varies seasonally, with values as low as 11 mg/L in the dry season and as high as 1400 mg/L in the wet season. As the SCDs will most likely only operate in the wet season, it is not expected to be difficult to reduce the TSS to a levels comparable to that of local waterways.

6.2 DESIGN PHILOSOPHY

Sediment generation is influenced by the terrain, rainfall, soil type, and vegetation cover. Each of these factors interact in a complex way that can be approximately modelled in accordance with the revised universal soil loss equation (RUSLE). Generation of a sediment model, for impacted sub-catchments, would require detailed baseline data concerning soil and waste rock erosion susceptibility and is beyond the scope of this report. However SCDs may be approximately sized according to typical catchment areas and terrain. For present purposes a typical SCD embankment height

of 5 m may be adopted across the project site. Based on experience with similar terrain in southeast Asia this assumption is considered to be reasonable for preliminary design.

It is envisaged that SCDs will be constructed progressively, as required, throughout the life of the mine. Therefore, it is recommended that the waste dump footprints should be cleared and developed progressively over several years. In addition, small scale sediment control structures will be constructed within each waste dump stage footprint. These intermediate structures will then be buried by successive stages of waste dump development.

Vegetation is an effective form of erosion control as it filters and uses water. Vegetation will act as a sediment filter, with sediment sizes >0.02 mm being trapped by relatively short (5 - 10 m) widths of filter strip. Therefore, where possible, vegetation strips within the waste dump footprint should be retained that will be progressively buried by mine waste. This reflects current experience in southeast Asia where the existing vegetation forms very effective silt barriers.

SCDs are required downstream from any catchments where construction or mining activities are likely to lead to elevated levels of sediment in runoff reporting to local waterways. It can be expected that three SCDs will be required along the northern boundary of the Letpadaung project. The proposed SCD locations are shown on Figure 1.1.

A typical SCD comprises a small homogeneous earthfill embankment structure approximately 5 m in height. It is designed to impound enough water for a sufficient period of time to allow settlement of suspended solids.

The SCD is equipped with two discharge structures: a floating offtake arrangement for draining water from the surface of the dam under normal conditions; and an overflow spillway for flows in excess of the containment capacity. The floating offtake system comprises a length of flexible hose pipe connected to a small pontoon at the upstream end and a discharge pipe (passing through the dam wall) at the other end, The pontoon sits on the surface of the SCD pond so that the mouth of the pipe sits just below the pond surface, allowing the cleanest water to be abstracted from the dam. The discharge pipe would comprise an HDPE conduit with a gate valve on the downstream end that would be manually opened to allow release of water from the dam, when TSS levels are similar to that of downstream receiving waters.

7. CONCLUSIONS AND RECOMMENDATIONS

GENERAL

Additional investigation, monitoring and analysis are required before proceeding to detailed design of the Letpadaung project surface water management systems. A brief summary of future work required for the detailed design phase is described below.

7.1 HYDROLOGICAL AND SEDIMENT LOAD BASELINE MONITORING

The models used are based on a number of assumptions that should be confirmed in the field. As such it is recommended that rain gauges and flow meters be installed on major drainage paths to monitor rainfall and runoff. Furthermore, baseline sediment load monitoring along major drainage paths should be undertaken for a range of seasonal flows.

In terms of sediment management and monitoring, a sediment control plan needs to be developed to mitigate the impacts of existing and future farming and non-mining activities in upstream catchments outside of the mine site development area.

7.2 SEDIMENT CONTROL AND MODELLING

SCDs should be installed downstream from any disturbed catchments that report to off site waterways, particularly along the northern boundary of the site. The northeast corner of the site represents a topographic low and as such WRD runoff will report to this spot. Consequently this corner will effectively operate as an SCD with the flood protection bund acting as a dam wall. Water accumulating in this dam will have to be either pumped to the Waste Water Pond (WWP) or discharged to downstream waterways (depending on water quality).

SCD and WWP sizes should be refined after more rigorous sediment modelling has been undertaken. This will allow individual SCD and WWP basin volumes, extents and embankment heights to be confirmed.

7.3 WASTE MATERIAL GEOCHEMISTRY

Mine waste material has been assessed in the KP Report on Mine Waste Geochemistry (Ref 9). This report recommended further sampling and testing of waste and ore material to assess the leachate chemistry from the potentially acid forming and heavy metal enriched materials. A better understanding of the mine waste and ore geochemistry will allow a more rigorous, quantitative assessment of site rainfall runoff water quality. This will in turn allow an assessment of potential water treatment requirements.

7.4 CONSTRUCTION TIMING

Timing for construction of ECDs and diversion channels needs to be reconciled with the latest mining plan. In particular this will determine which structures are required early in the project and which can be deferred.

7.5 HEAP LEACH PAD WATER MANAGEMENT

Use of HLP make-up water should be prioritised so that on-site, low pH water sources are used first. Make-up water may be taken from three potential sources, in order of decreasing priority, as follows: HLP stormwater pond; WWP; and the Chindwin River.

Stormwater reporting to the SWP should be re-used for irrigation of the HLPs as soon as possible. A larger SWP is required to store run-off from extreme events. The SWP should be subdivided into cells. One cell should be capable of storing one day's process water drawdown (i.e. approximately 800,000 m^3). The WWP capacity should also be increased to 4.8 Mm^3.

7.6 SITE SURFACE WATER MANAGEMENT

Surface water flowing within or adjacent to the site should be classified in terms of quality according to the following categories: clean; sediment laden; contact (potentially acidic or enriched with metals); and process.

Where ever possible the different surface water quality streams should be segregated from one another. In particular sediment laden water should be separated out from the contact water (running of the ore stockpiles or geochemically problematic mine waste) so as to reduce the quantity of poor quality water that may require treatment. This would best be achieved by dividing the WWP into two ponds with the northern pond used to contain sediment laden water and the southern pond used to contain contact water (that may require special treatment prior to release).

To facilitate operation of the system it is recommended that the more environmentally problematic, low grade ore and ore reserve, stockpiles be consolidated in the northern half of HLP3. This location will allow the contact water from these stockpiles to be directed relatively easily to the south WWP cell.

8. REFERENCES

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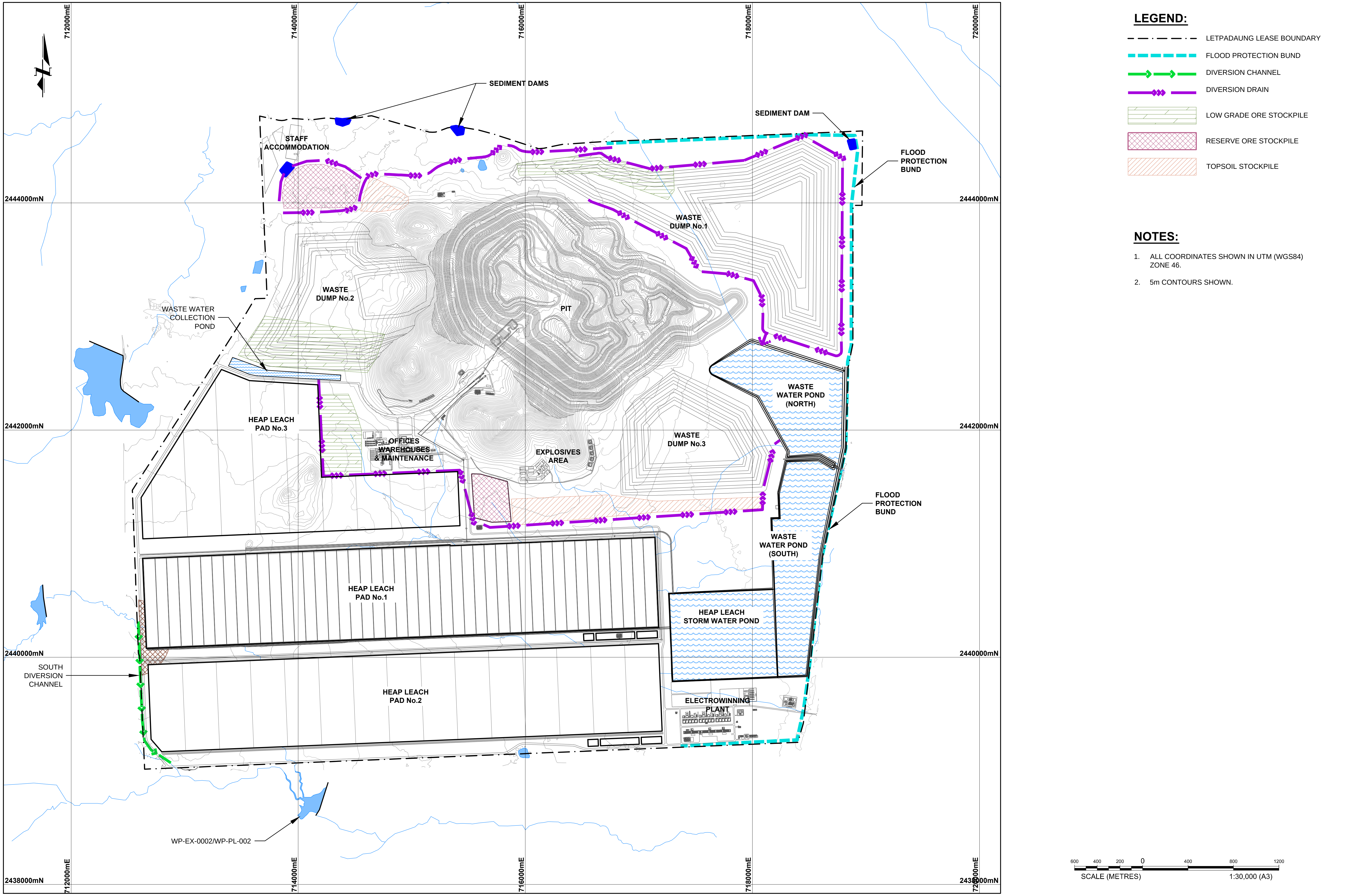
FIGURES



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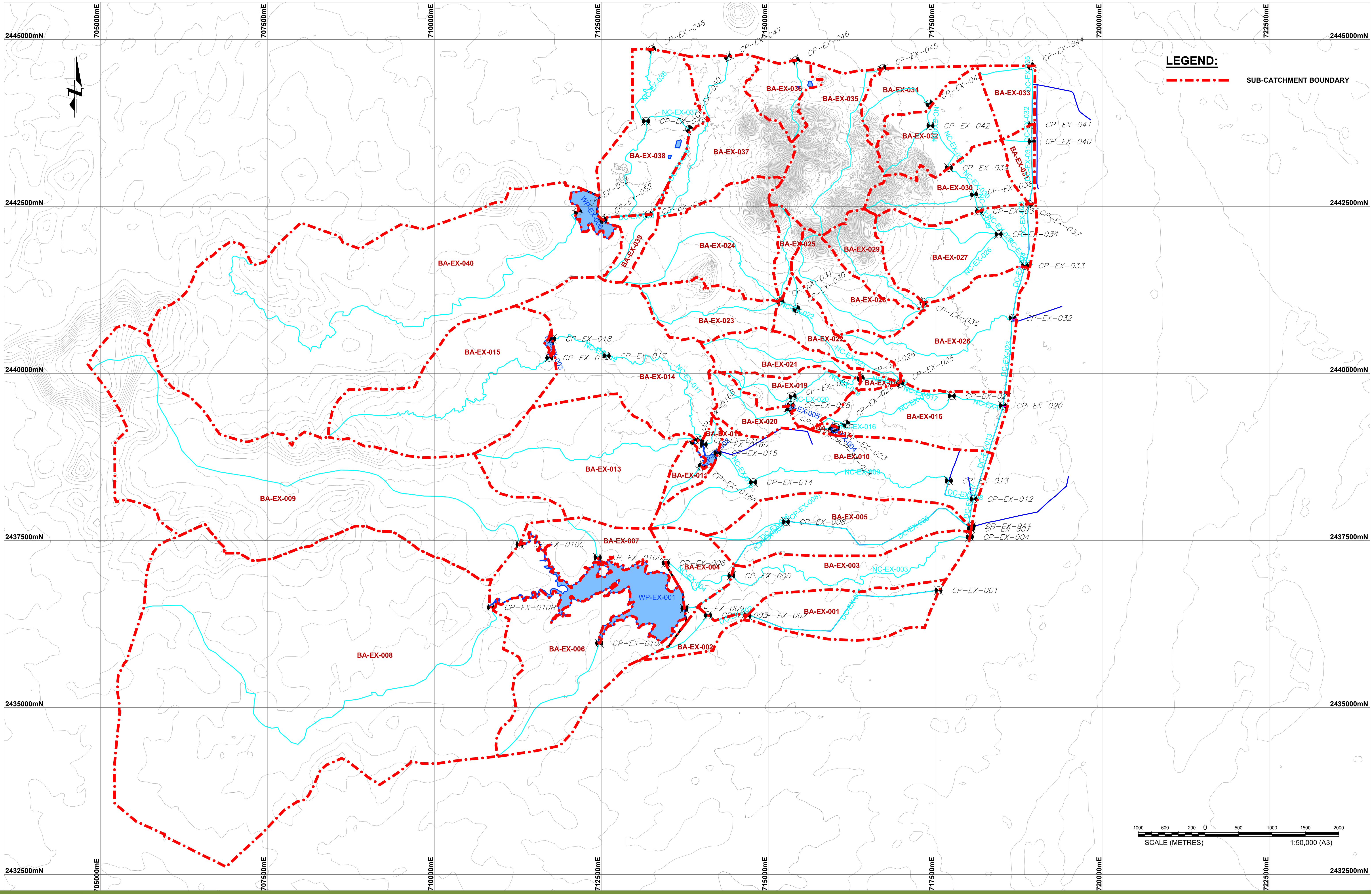
LETPADAUNG PROJECT
SURFACE WATER MANAGEMENT
GENERAL ARRANGEMENT

Ref: PE701-00022/18
Figure 1.1



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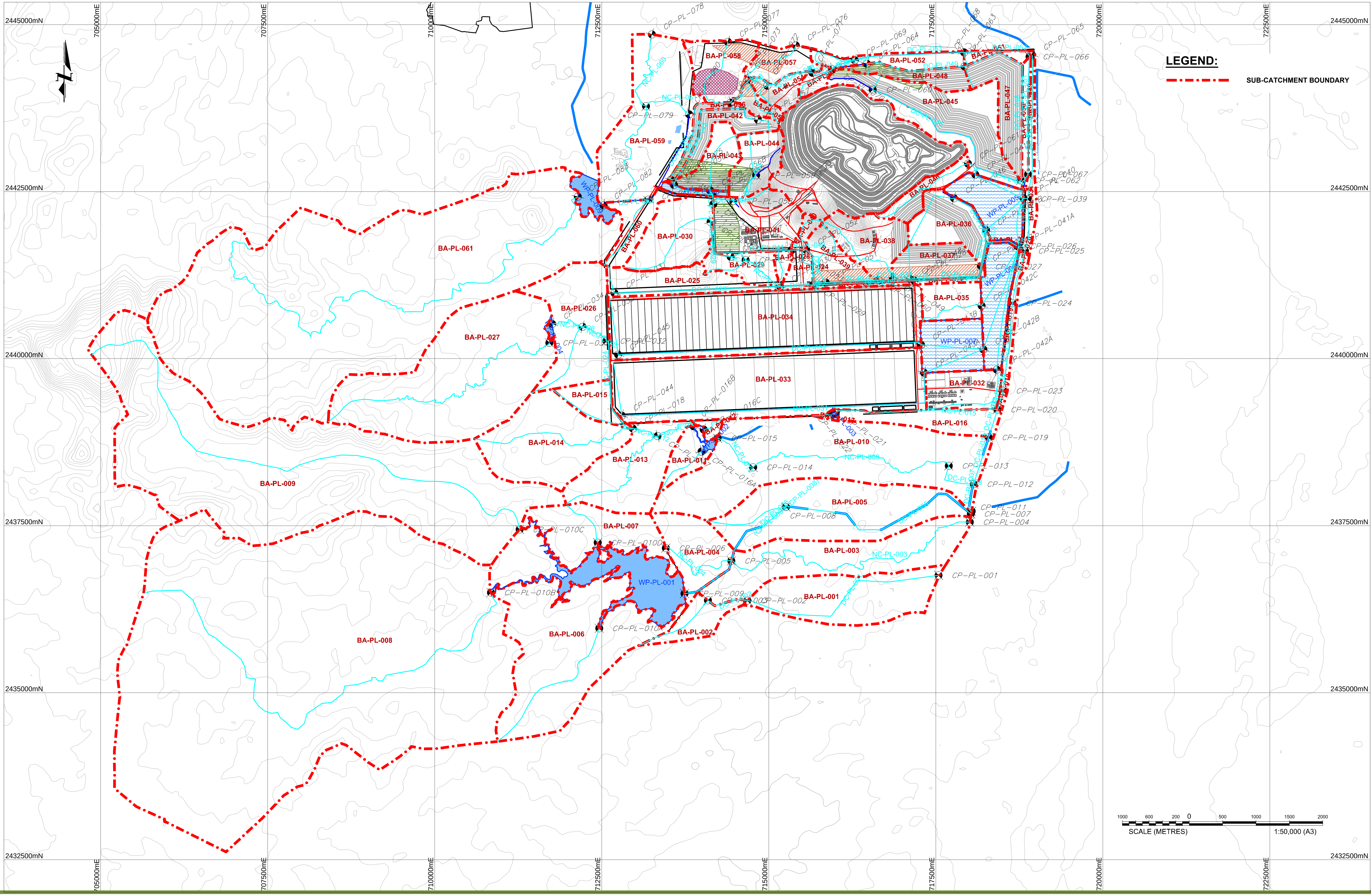
LETPADAUNG COPPER PROJECT
SURFACE WATER MANAGEMENT PLAN
CATCHMENT DELINEATION - EXISTING CONDITIONS

Ref: PE701-00022/18
Figure 3.1



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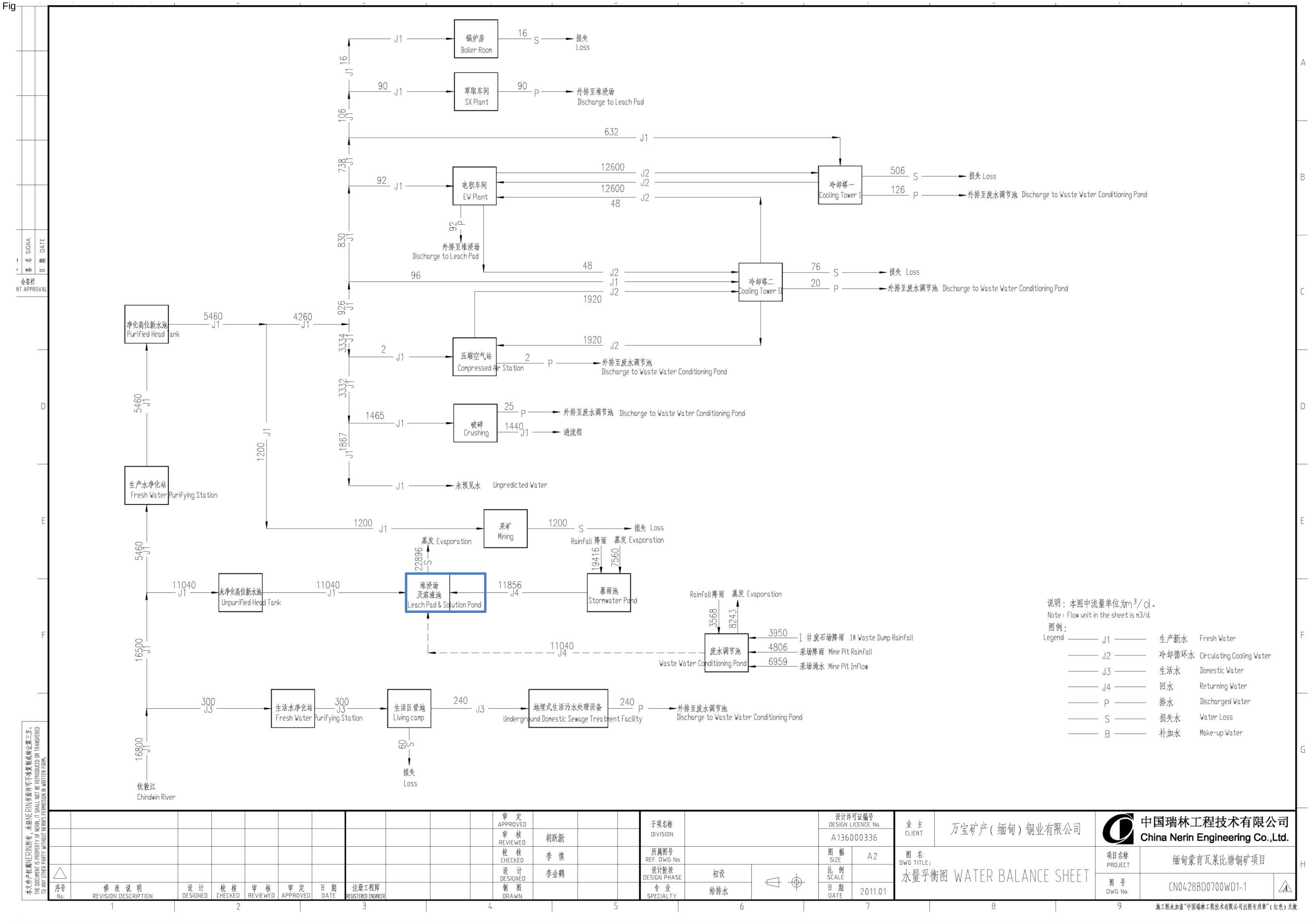
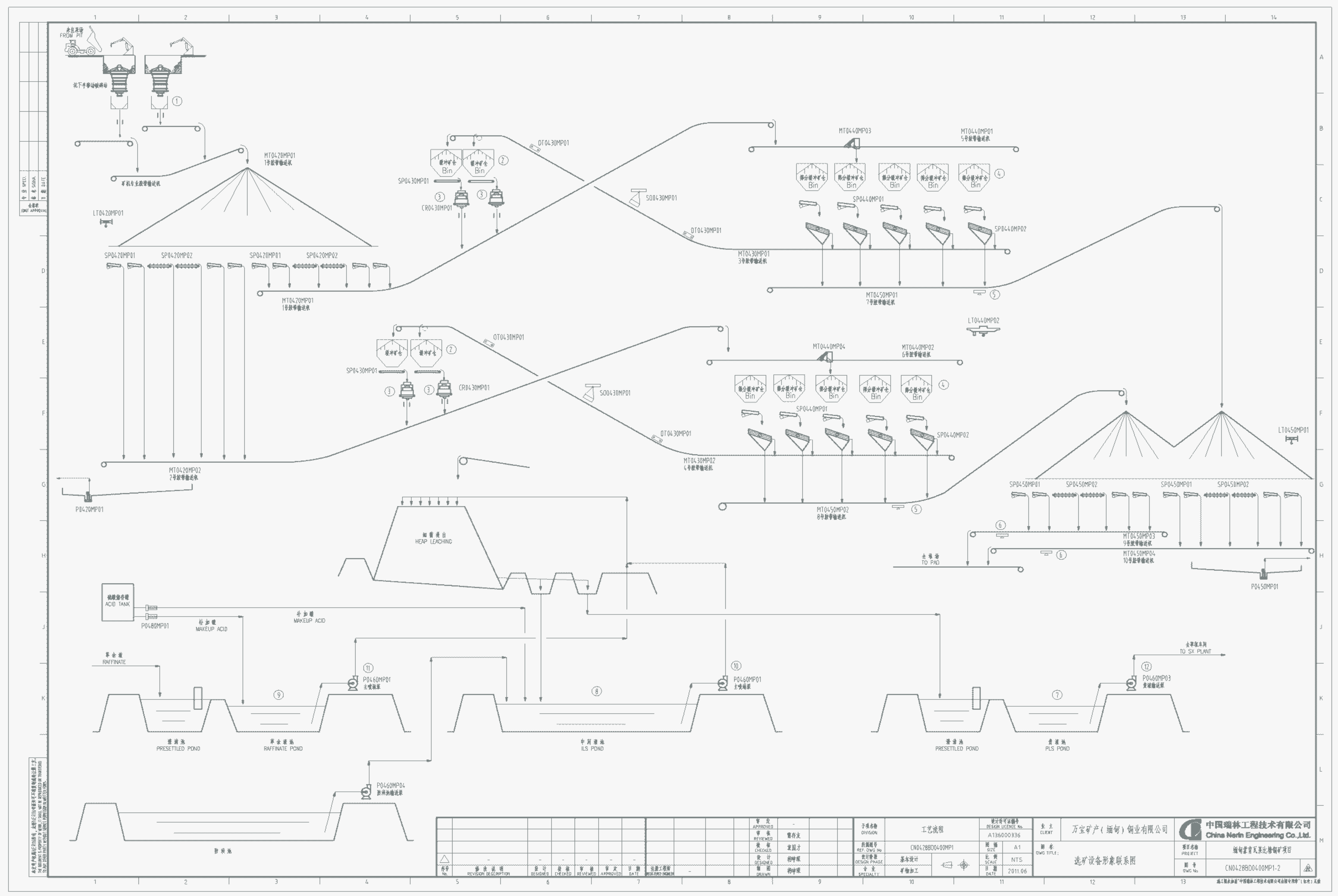
LETPADAUNG COPPER PROJECT
SURFACE WATER MANAGEMENT PLAN
CATCHMENT DELINEATION - PLANNED CONDITIONS

Ref: PE701-00022/18
Figure 3.2

Fig



锅炉房
Boiler Room
损失
Loss
萃取车间
SX Plant
外排至堆浸场
Discharge to Leach Pad
电积车间
EW Plant
冷却塔一
Cooling Tower I
损失 Loss
外排至废水调节池 Discharge to Waste Water Conditioning Pond
外排至堆浸场
Discharge to Leach Pad
冷却塔二
Cooling Tower II
损失 Loss
外排至废水调节池 Discharge to Waste Water Conditioning Pond
净化高位新水池
Purified Head Tank
压缩空气站
Compressed Air Station
外排至废水调节池
Discharge to Waste Water Conditioning Pond
破碎
Crushing
外排至废水调节池 Discharge to Waste Water Conditioning Pond
进流程
未预见水 Unpredicted Water
生产水净化站
Fresh Water Purifying Station
采矿
Mining
损失 Loss
蒸发 Evaporation
Rainfall 降雨
蒸发 Evaporation
未净化高位新水池
Unpurified Head Tank
堆浸场
及溶液池
Leach Pad & Solution Pond
暴雨池
Stormwater Pond
Rainfall 降雨
蒸发 Evaporation
1 # 废石场降雨 1# Waste Dump Rainfall
采场降雨 Mine Pit Rainfall
采场涌水 Mine Pit Inflow
废水调节池
Waste Water Conditioning Pond
生活水净化站
Fresh Water Purifying Station
生活区营地
Living camp
地埋式生活污水处理设备
Underground Domestic Sewage Treatment Facility
外排至废水调节池
Discharge to Waste Water Conditioning Pond
损失
Loss
依敦江
Chindwin River
说明：本图中流量单位为m³/d。
Note：Flow unit in the sheet is m3/d.
图例：
Legend
J1 生产新水 Fresh Water
J2 冷却循环水 Circulating Cooling Water
J3 生活水 Domestic Water
J4 回水 Returning Water
P 排水 Discharged Water
S 损失水 Water Loss
B 补加水 Make-up Water
审定 APPROVED
审核 REVIEWED 胡跃新
校核 CHECKED 李慎
设计 DESIGNED 李金鹤
制图 DRAWN
子项名称 DIVISION
所属图号 REF. DWG No.
设计阶段 DESIGN PHASE 初设
专业 SPECIALTY 给排水
设计许可证编号 DESIGN LICENCE No. A136000336
图幅 SIZE A2
比例 SCALE
日期 DATE 2011.01
业主 CLIENT 万宝矿产(缅甸)铜业有限公司
图名 DWG TITLE: 水量平衡图 WATER BALANCE SHEET
中国瑞林工程技术有限公司
China Nerin Engineering Co.,Ltd.
项目名称 PROJECT 缅甸蒙育瓦莱比塘铜矿项目
图号 DWG No. CN0428BD0700WD1-1
序号 No.
修改说明 REVISION DESCRIPTION
设计 DESIGNED
校核 CHECKED
审核 REVIEWED
审定 APPROVED
日期 DATE
注册工程师 REGISTERED ENGINEER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Bin
HEAP LEACHING
ACID TANK
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MAKEUP ACID
RAFFINATE
TO PAD
TO SX PLANT
P0460MP01
P0460MP03
P0460MP04
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RAFFINATE POND
ILS POND
PLS POND
万宝矿产（缅甸）铜业有限公司
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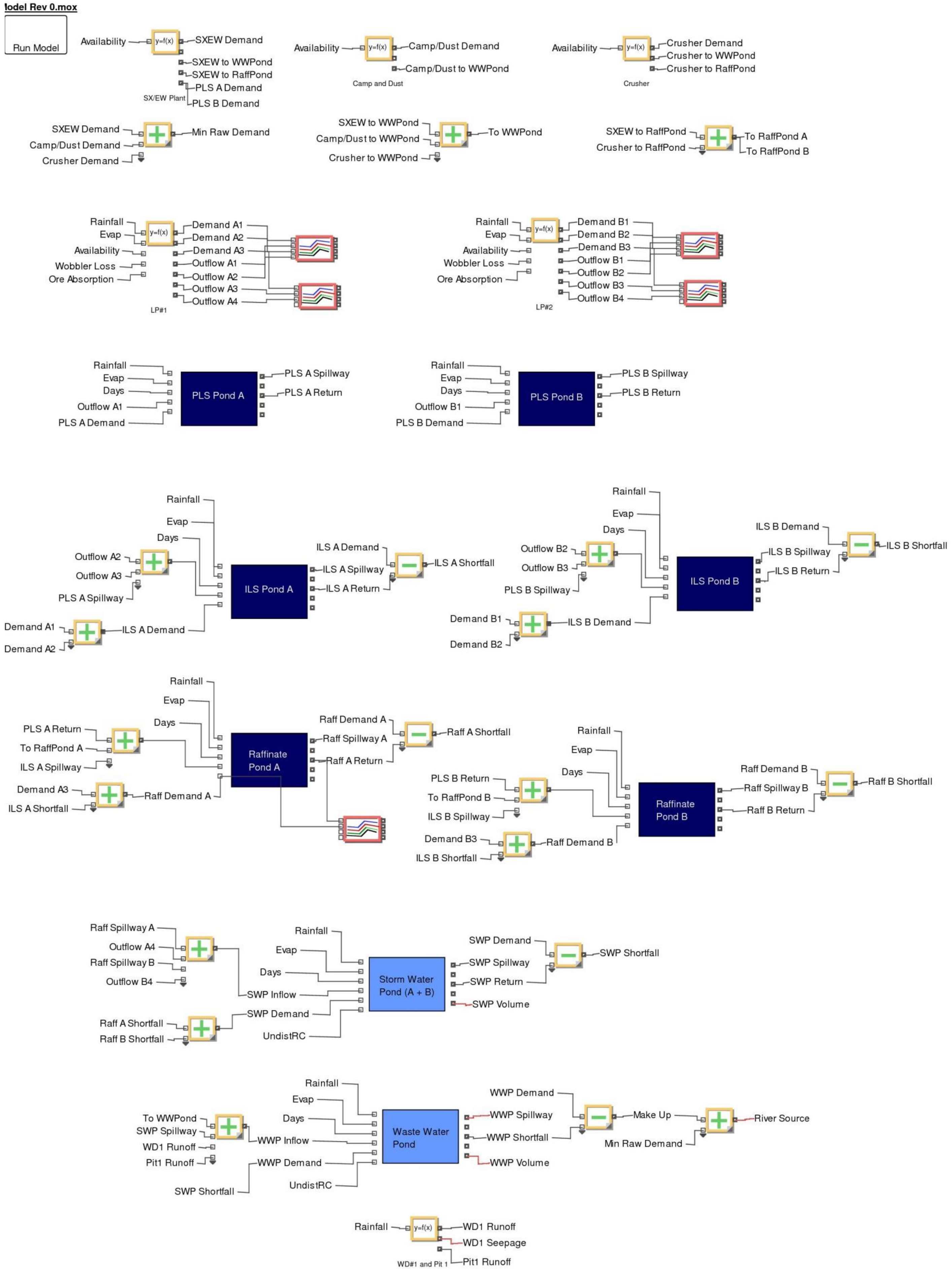
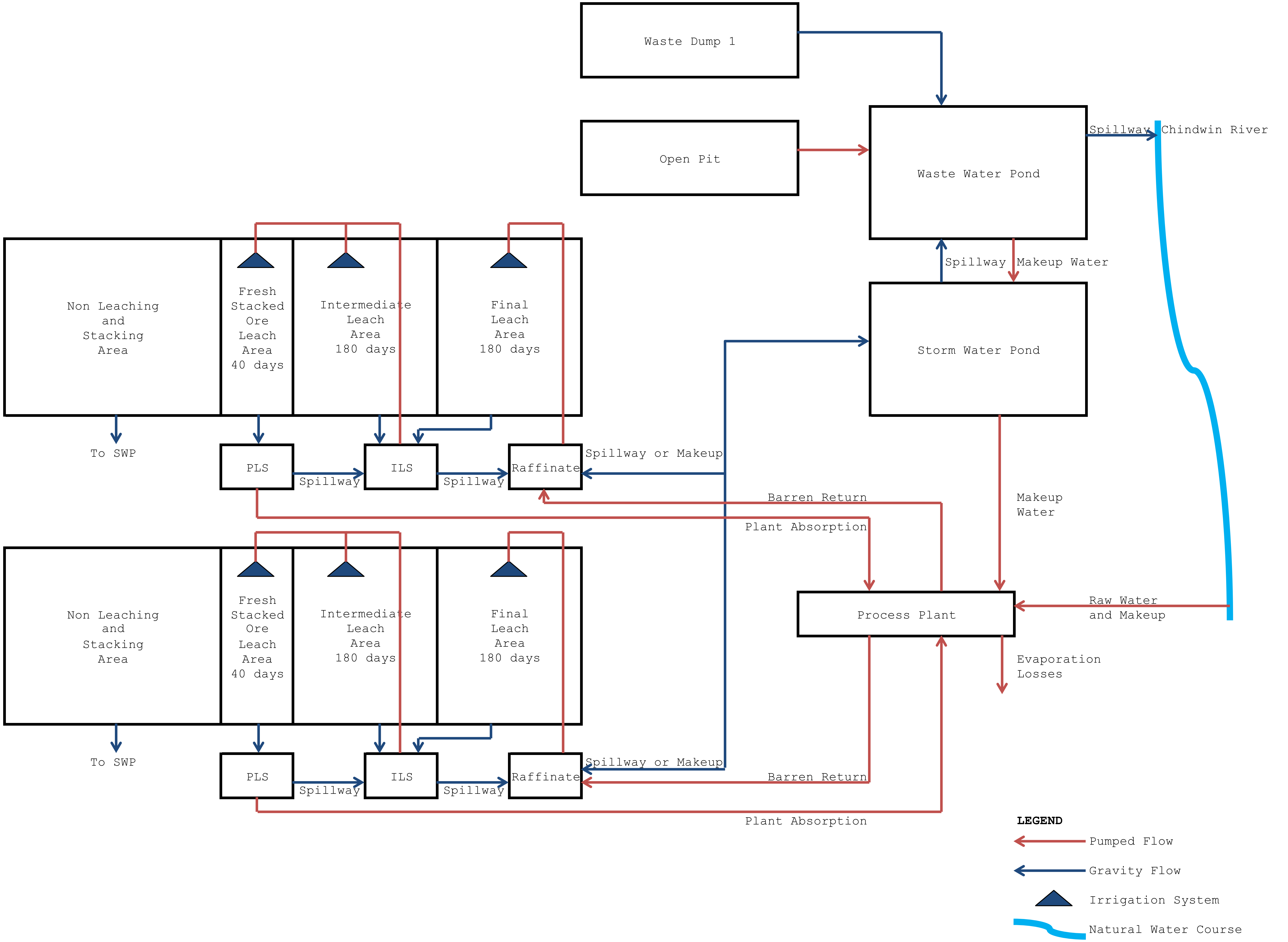
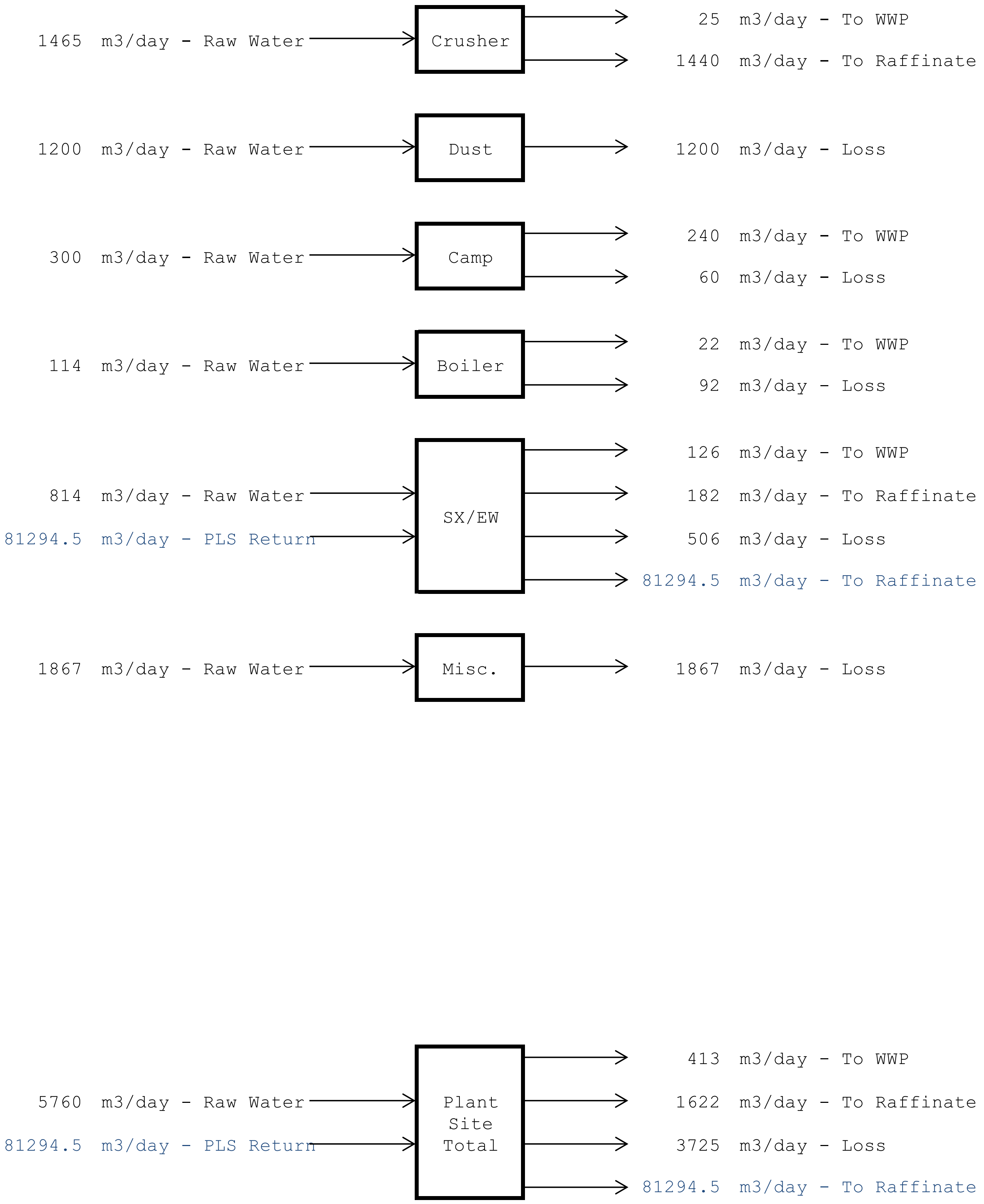
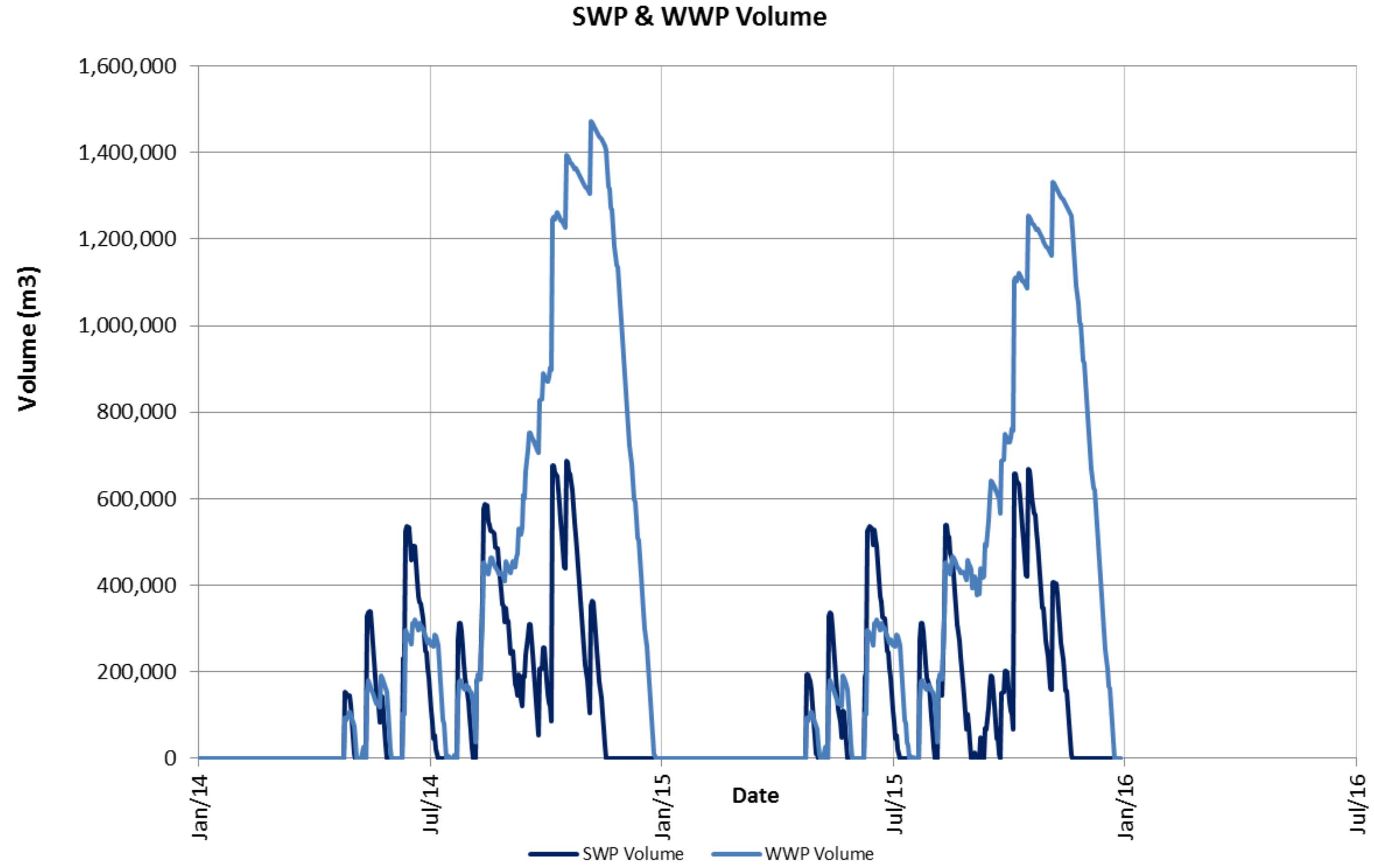
中国瑞林工程技术有限公司
China Nerin Engineering Co.,Ltd.

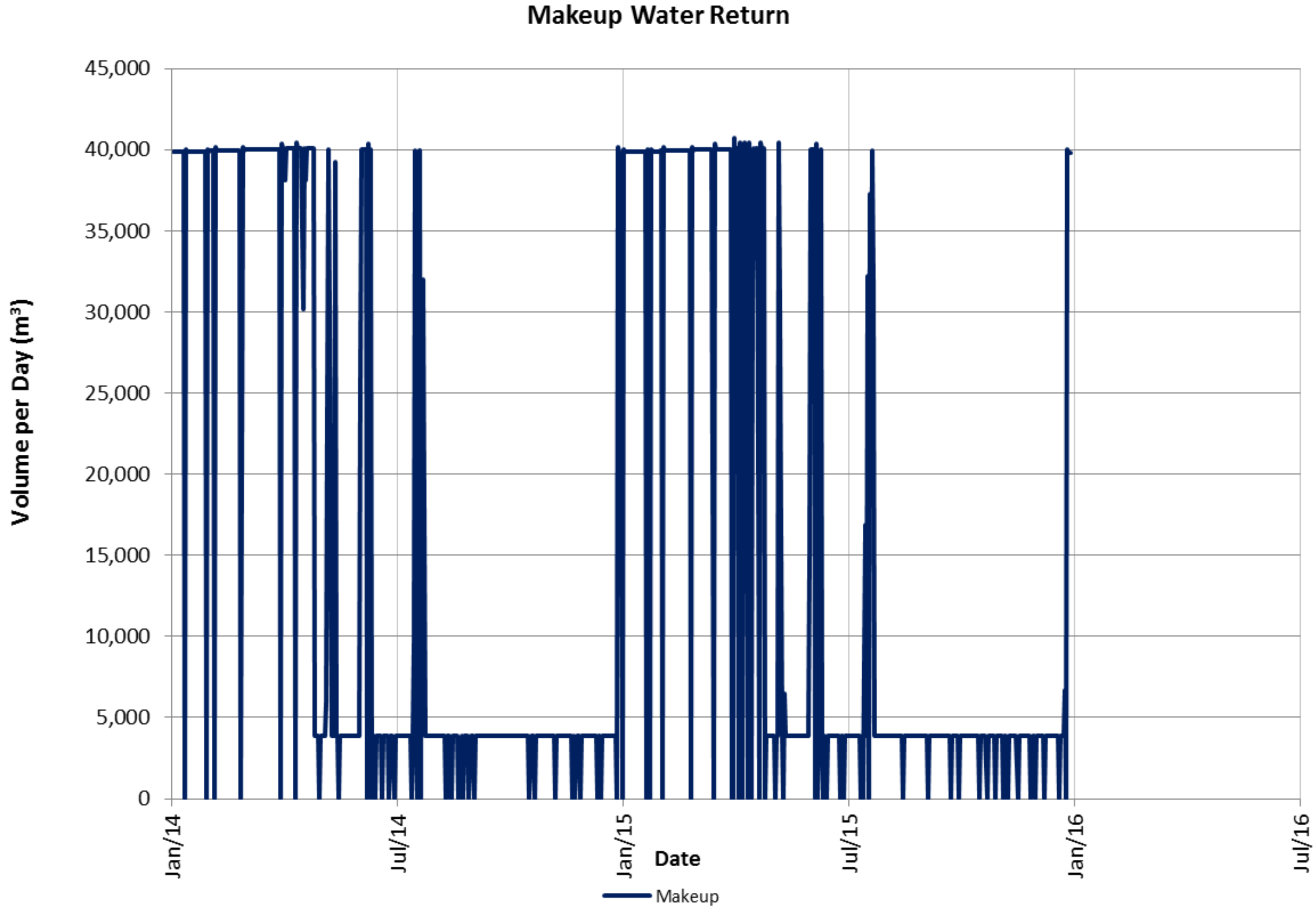

lodel Rev 0.mox
Run Model
Availability
SXEW Demand
SXEW to WWPond
SXEW to RaffPond
PLS A Demand
PLS B Demand
SX/EW Plant
Camp/Dust Demand
Camp/Dust to WWPond
Camp and Dust
Crusher Demand
Crusher to WWPond
Crusher to RaffPond
Crusher
Min Raw Demand
To WWPond
To RaffPond A
To RaffPond B
Rainfall
Evap
Wobbler Loss
Ore Absorption
Demand A1
Demand A2
Demand A3
Outflow A1
Outflow A2
Outflow A3
Outflow A4
LP#1
Demand B1
Demand B2
Demand B3
Outflow B1
Outflow B2
Outflow B3
Outflow B4
LP#2
Days
PLS Pond A
PLS A Spillway
PLS A Return
PLS Pond B
PLS B Spillway
PLS B Return
ILS A Demand
ILS A Spillway
ILS A Return
ILS A Shortfall
ILS Pond A
ILS B Demand
ILS B Spillway
ILS B Return
ILS B Shortfall
ILS Pond B
Raff Demand A
Raff Spillway A
Raff A Return
Raff A Shortfall
Raffinate Pond A
ILS A Shortfall
Raff Demand B
Raff Spillway B
Raff B Return
Raff B Shortfall
Raffinate Pond B
ILS B Shortfall
Raff A Shortfall
Raff B Shortfall
SWP Inflow
SWP Demand
UndistRC
Storm Water Pond (A + B)
SWP Spillway
SWP Return
SWP Volume
SWP Shortfall
WD1 Runoff
Pit1 Runoff
WWP Inflow
WWP Demand
Waste Water Pond
WWP Spillway
WWP Shortfall
WWP Volume
Make Up
River Source
WD1 Seepage
WD#1 and Pit 1


Waste Dump 1
Open Pit
Waste Water Pond
Spillway
Chindwin River
Spillway
Makeup Water
Storm Water Pond
Non Leaching and Stacking Area
Fresh Stacked Ore Leach Area 40 days
Intermediate Leach Area 180 days
Final Leach Area 180 days
To SWP
PLS
ILS
Raffinate
Spillway
Spillway
Spillway or Makeup
Barren Return
Plant Absorption
Makeup Water
Process Plant
Raw Water and Makeup
Evaporation Losses
Non Leaching and Stacking Area
Fresh Stacked Ore Leach Area 40 days
Intermediate Leach Area 180 days
Final Leach Area 180 days
To SWP
PLS
ILS
Raffinate
Spillway
Spillway
Spillway or Makeup
Barren Return
Plant Absorption
LEGEND
Pumped Flow
Gravity Flow
Irrigation System
Natural Water Course



Figures obtained from DRG No CN0428BD0700WD1-1 (Figure 4.1.1)


SWP & WWP Volume
Volume (m3)
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Jan/14
Jul/14
Jan/15
Jul/15
Jan/16
Jul/16
Date
SWP Volume
WWP Volume


Makeup Water Return
Volume per Day (m³)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
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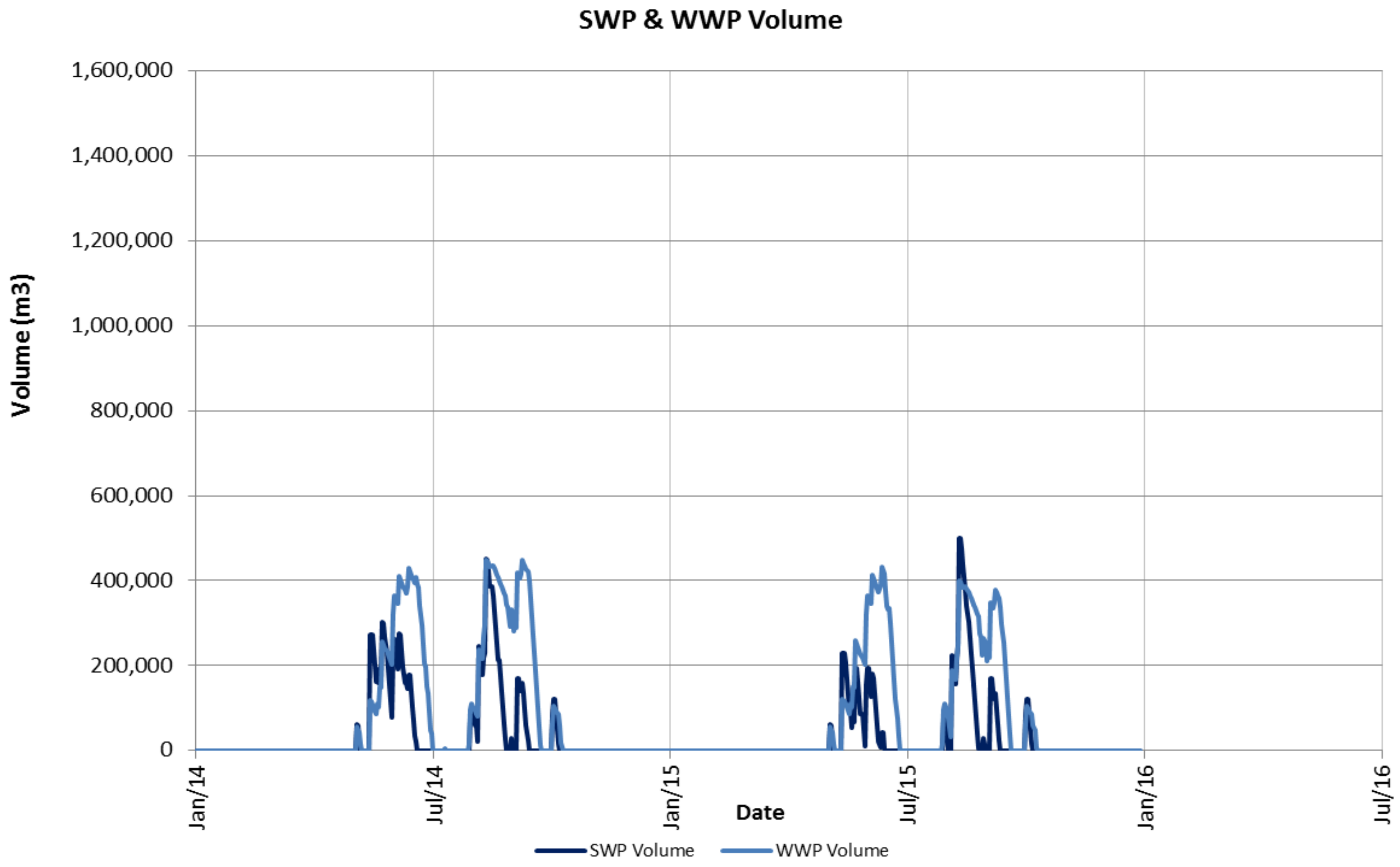
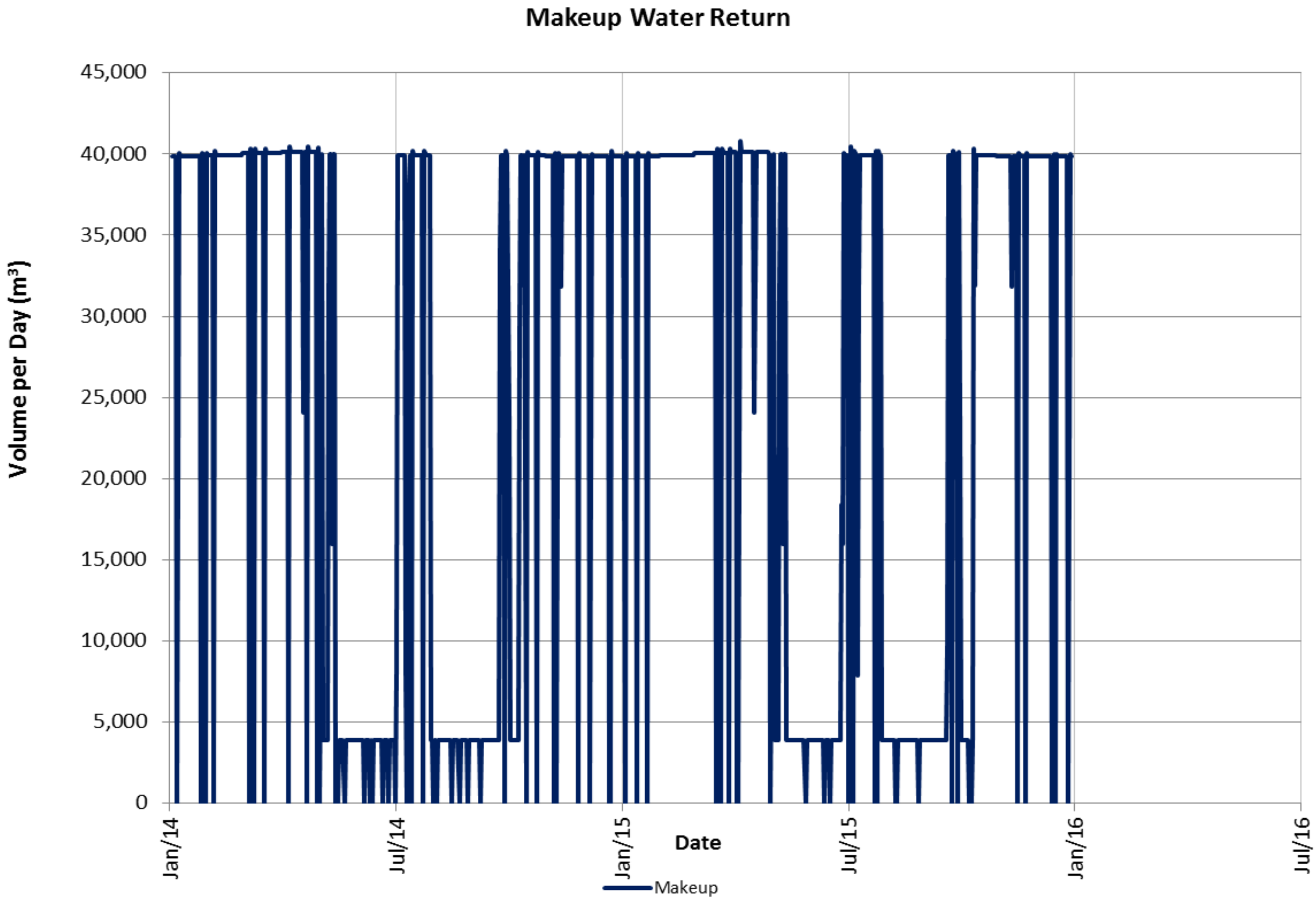
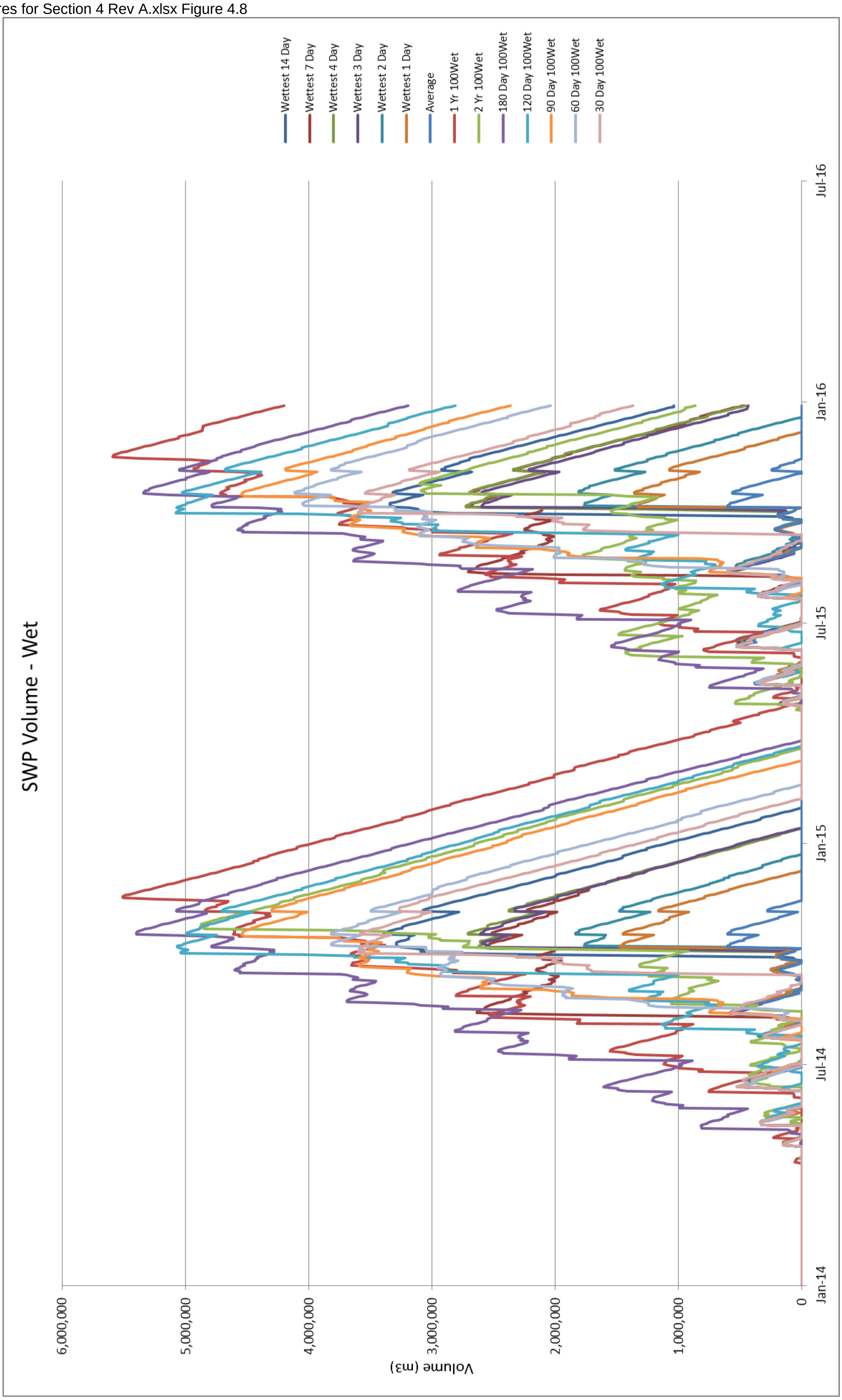
Jul/14
Jan/15
Jul/15
Jan/16
Jul/16
Date
Makeup

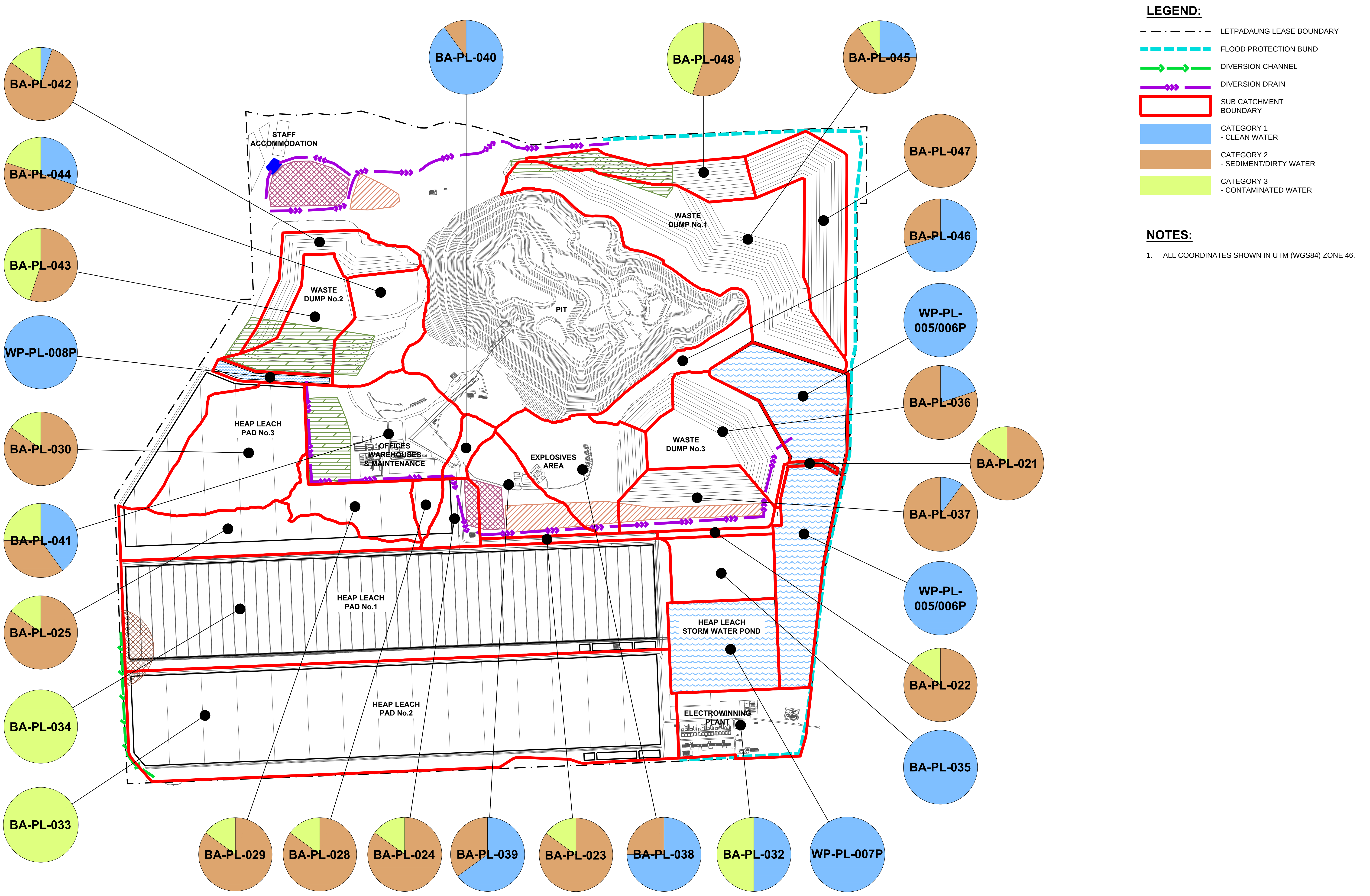


SWP & WWP Volume
Volume (m3)
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Jan/14
Jul/14
Jan/15
Jul/15
Jan/16
Jul/16
Date
SWP Volume
WWP Volume



Makeup Water Return
Volume per Day (m³)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Jan/14
Jul/14
Jan/15
Jul/15
Jan/16
Jul/16
Date
Makeup


SWP Volume - Wet
Volume (m3)
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Wettest 14 Day
Wettest 7 Day
Wettest 4 Day
Wettest 3 Day
Wettest 2 Day
Wettest 1 Day
Average
1 Yr 100Wet
2 Yr 100Wet
180 Day 100Wet
120 Day 100Wet
90 Day 100Wet
60 Day 100Wet
30 Day 100Wet



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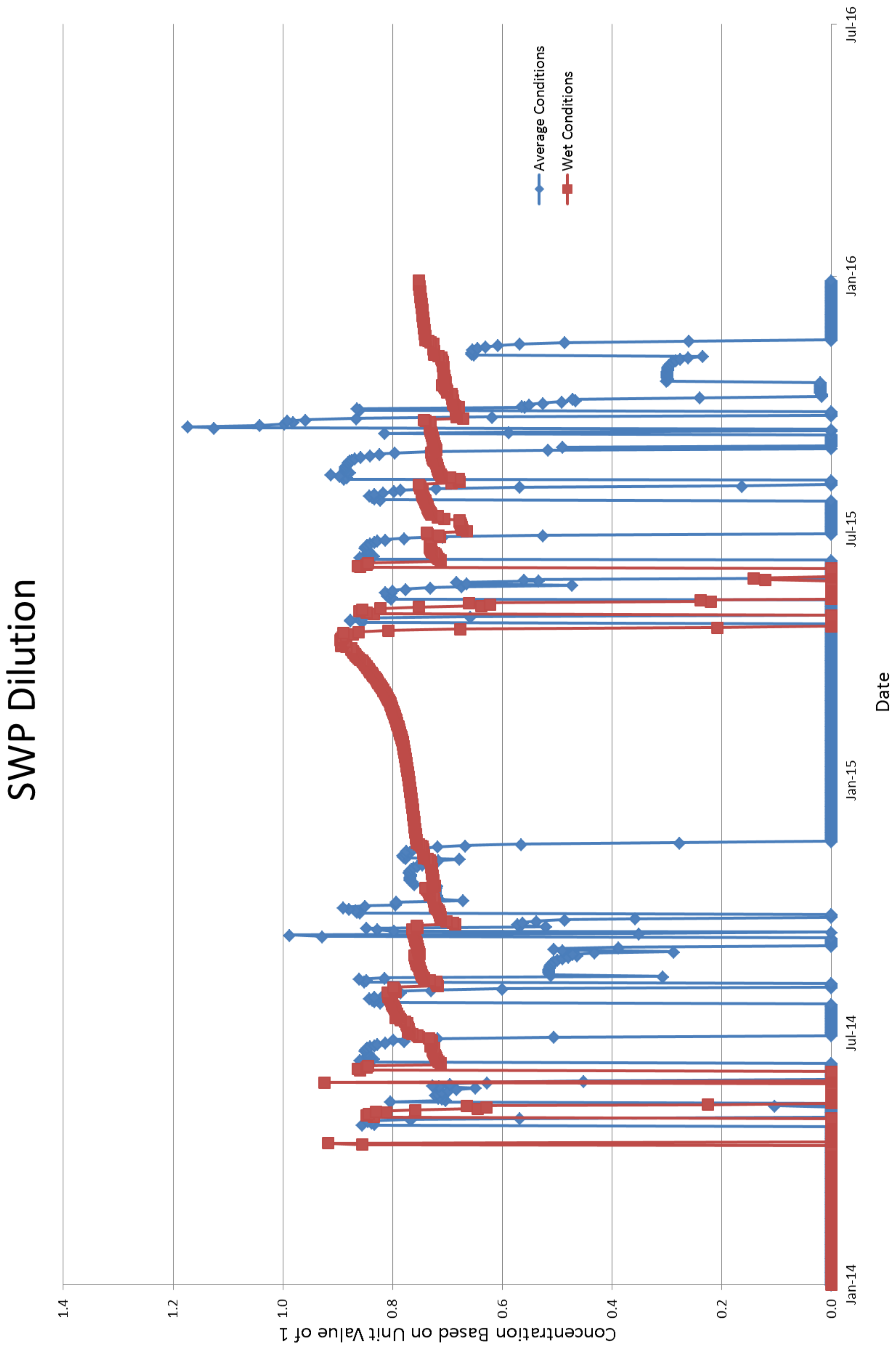
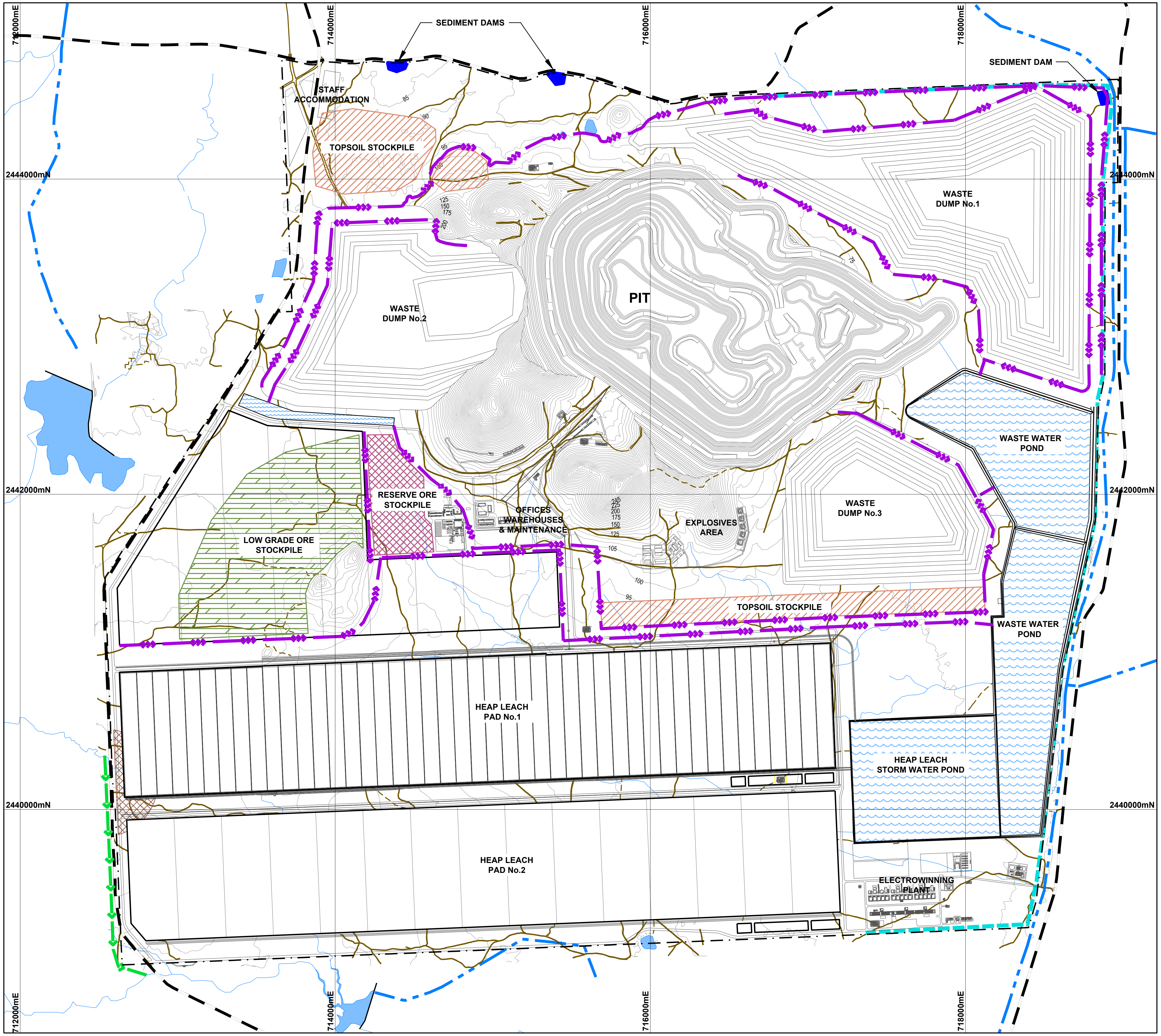
LETPADAUNG PROJECT
SURFACE WATER MANAGEMENT
SITE SUB-CATCHMENT WATER QUALITY DESIGNATION

Ref: PE701-00022/18
Figure 5.1



SWP Dilution
Average Conditions
Wet Conditions
Concentration Based on Unit Value of 1
Date
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16



LEGEND:

- EXISTING CANAL
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LETPADAUNG LEASE BOUNDARY
- FLOOD PROTECTION BUND
- MAJOR DIVERSION CHANNEL
- INTERNAL DIVERSION CHANNELS

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 5m CONTOUR INTERVALS SHOWN.

Knight Piésold CONSULTING

LETPADAUNG PROJECT
SURFACE WATER MANAGEMENT
RECOMMENDED SITE LAYOUT

Ref: PE701-00022-18
Figure 5.3

APPENDIX A

Basic Climatology Study

Knight Piésold CONSULTING

MEMORANDUM

To:	**MYANMAR WANBAO MINING COPPER LTD (MWMCL)**	**Date:**	17th September 2013
Attn:	Glenn Wallis	**Our Ref:**	PE13-00838
		KP File Ref.:	**PE701-22/4-A bl M13017**
cc:		**From:**	Brett Loney

RE: LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY

Please find herein baseline design climatology that has been developed for the Letpadaung project site in Myanmar. The investigation and calculations discussed herein provide the preliminary hydrologic basis for on-going and future design work.

1. DATA SOURCES

Historic climate data from four separate locations were used in deriving baseline design climate estimates. The stations, illustrated on Figure 1.1, are:

- Monywa Township climate station, which is located 5.6 kilometres (km) northeast of Letpadaung Hill. At the time this memorandum was written, Knight Piésold (KP) was unable to confirm the precise location and elevation of this monitoring station; accordingly the location shown in Figure 1.1 was assumed to be within the city of Monywa. Daily precipitation data from this station provided by Myanmar Wanbao Mining Copper Ltd. (MWMCL) cover the period (1961–2013).
- Yangtse climate station, which is located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kyisintaung (S&K) operations site. Monthly pan evaporation data from this station which was previously collected by KP whilst working on the (S&K) project and subsequently extended by MWMCL cover the period (2000-2013).
- World Meteorological Organization (WMO) climate station number 48037, which is located 4.7 km northeast of Letpadaung Hill. Although the location shown on Figure 1.1 accurately depicts WMO records, KP suspects that the actual location of this station is somewhere nearby and not on a sandbar in the Chindwin River as shown. Daily temperature data from this station was sourced by KP from the Research Data Archive (RDA) at the National Center for Atmospheric Research (NCAR), Computational and Information Systems Laboratory (CISL) in Boulder, Colorado USA. The daily temperature data span the period (1981-2012).
- The Wind Rose sampling point, which is located 0.9 km northwest of Letpadaung Hill; this location was used by Lakes Environmental Consultants (LEC) as a sampling point for extracting processed surface and upper air meteorological data from the results of the MM5 (5th generation Mesoscale Model) and SAMSON hourly surface meteorological datasets. More information about these datasets may be reviewed online at:
  - MM5, refer to http://www.mmm.ucar.edu/mm5/mm5-home.html and
  - SAMSON, refer to http://www.webmet.com/MetGuide/Samson.html.

  Hourly wind speed, wind direction and precipitation data from this source span the period (2010-2012).

2. PRECIPITATION ANALYSIS

Precipitation data from the Monywa Township and Wind Rose sampling point datasets were reduced into a standardised format and then analysed on annual, monthly, and daily time scales as appropriate. Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes. Daily data is used to derive design storms for sizing water conveyance infrastructure: spillways, channels, etc. The following sections detail the various analyses conducted and the results achieved.

2.1 ANNUAL PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias from distorting the results. Sampling statistics were computed on these annual sums to provide a broad overview of the variability of annual precipitation in the region surrounding the project site, as given in Table 2.1.

Table 2.1: Annual precipitation statistics – Monywa Township (1961-2013)

Selected Statistic	Statistic[*1] Value
Average number of rain days	65
Average (mm)	774
Median (mm)	727
Std. Deviation (mm)	230
Minimum (mm)	411
Maximum (mm)	1,370
25th Percentile (mm)	610
75th Percentile (mm)	894
Count (yr)	50
Distance to site (km)	5.6

*1 Incomplete data from 1995, 1999 and 2013 were excluded from this analysis.

The sample statistics for annual precipitation at this site were also depicted graphically, as a “box and whisker” plot to illustrate the variability of annual precipitation, as shown on Figure 2.1. For each year shown, the “box and whisker” plot is read as follows:

- Top of each “box” indicates the 75th percentile annual precipitation;
- Central line within each “box” indicates the median (or 50th percentile) annual precipitation;
- Bottom of each “box” indicates the 25th percentile annual precipitation;
- Red diamond inside each “box” indicates the average annual precipitation;
- The “whiskers”, each of length 1.5 times the inter-quartile range (which is the 75th minus the 25th percentile values) indicate the range of expected readings above and below each “box”. Values above and below the “whiskers” are considered to be outliers; and
- Individual yearly outlier values are indicated as blue crosses with values adjacent.

Details of the annual precipitation analysis are given in Attachment 2.1.

2.2 MONTHLY PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township dataset were summed in a manner similar to that described in Section 2.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). As described in Section 2.1, data exclusions were made to prevent sampling bias. Sampling statistics were computed on the values to describe the variability of monthly precipitation at the project site, as given in Table 2.2.

Table 2.2: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	25th Pct. (mm)	75th Pct. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0	0	0
Feb	3	0	15	0	102	0	0	0
Mar	5	1	14	0	96	0	5	1
Apr	26	21	22	0	100	9	38	4
May	102	94	70	12	386	54	141	9
Jun	100	72	79	0	342	42	129	9
Jul	67	59	43	2	182	34	83	8
Aug	121	103	80	0	356	64	172	10
Sep	166	150	89	47	496	99	212	11
Oct	142	136	95	15	513	83	180	10
Nov	33	12	44	0	186	0	45	3
Dec	6	0	17	0	85	0	2	1

*1 Incomplete data from 1995 (January – June), 1999 (January – April) and 2013 (June – December) were excluded from this analysis.

The sample statistics for monthly precipitation from the Monywa Township dataset were also depicted as a “box and whisker” plot to illustrate the variability of monthly precipitation at the project site, as shown on Figure 2.2. September is the wettest month of the year onsite and the primary wet season starts (on average) about the beginning of April and finishes at the end of November. Accordingly, the wet season typically lasts 8 months out of each year, with the remaining 4 months experiencing negligible rainfall. Details of the monthly precipitation analysis are given in Attachment 2.2.

2.3 DAILY PRECIPITATION ANALYSIS

KP performed frequency analysis on daily precipitation data (from the Monywa dataset) to estimate the statistical likelihood of experiencing extreme short-duration storms at the project site. A large number of different probability distributions, e.g.: Log-Pearson 3, Generalised Extreme Value (GEV), Generalised Logistic, Wakeby, Burr, etc. were fitted to the annual maxima of the daily precipitation data using EasyFit Professional 5.4 software (Ref. 1).

Three of the best fits were selected for comparison, as shown on Figure 2.3. Based on the comparison, and to maintain compatibility with other *n* day duration frequency analyses, discussed in Section 2.6, KP selected the GEV fit for use at the Letpadaung site. The results of the GEV fit to historic precipitation records are given in Table 2.3 and details of the daily precipitation frequency analysis are given in Attachment 2.3.

KP notes that frequency is generally expressed as Average Recurrence Interval (ARI), measured in years.

Table 2.3: Extreme daily (24-h) design precipitation

Annual Exceedance Probability (AEP)*1	Annual Recurrence Interval (ARI) (yr)	24-h Duration Precipitation	
		Uncorrected Depth (mm)	Corrected*2 Depth (mm)
0.001	1,000	194	222
0.002	500	184	211
0.005	200	170	195
0.010	100	159	182
0.020	50	147	168
0.050	20	131	149
0.100	10	117	134
0.200	5	102	117
0.500	2	79	90

*1 AEP calculated using the Weibull probability plotting formulation.

*2 Values have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

KP utilised the daily design precipitation information in Table 2.3 to derive Intensity / Duration / Frequency (IDF) curves for short duration storms. The rainfall ratio method as given in (Ref. 3) was employed for this purpose. By using tabulated fitting coefficients from (Ref. 4) for the most similar (in climate) listed location (Phnom Penh, Cambodia) and correction factors for 24, 48 and 72 hour duration storms taken from (Ref. 2); KP obtained estimates for the Letpadaung project site, as given in Table 2.4 and illustrated on Figure 2.4.

(KP notes that the world maximum intensity / duration envelope, taken from (Ref. 5) is shown on Figure 2.4 for purposes of comparison.)

Table 2.4: Letpadaung intensity / duration / frequency results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm[*1]							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16
18 h	5	6	7	8	9	10	10	11
24 h[*2]	4	5	6	6	7	8	8	9
48 h[*3]	2	3	3	4	5	5	6	6
72 h[*4]	2	2	3	3	4	4	5	6

*1 Intensity values are shown rounded to the nearest mm/h.

*2 Intensity values for 24 hour duration storms have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

*3 Intensity values for 48 hour duration storms have been augmented 6.7% (Ref. 2).

*4 Intensity values for 72 hour duration storms have been augmented 4.4% (Ref. 2).

Details of the IDF curve analysis are given in Attachment 2.4.

2.4 TEMPORAL DISTRIBUTION OF PRECIPITATION

KP analysed the hourly precipitation data from the Wind Rose sampling point dataset (2010-2012) to determine the temporal distributions (i.e. hyetographs) of short-duration storms to be used with the IDF results from Section 2.3 in rainfall-runoff modelling. For candidate storm durations ranging from 2 to 45 hours (the longest storm identified in the historic dataset was 45 hours), the hyetograph analysis entailed the following steps:

- Delineate all storms of *n* duration (where *n* is the candidate duration, measured in integer hours).
- Convert hourly readings within each delineated storm of *n* duration to a cumulative percentage basis; this puts the *n* hour storms on a dimensionless basis.
- Select all *n* hour dimensionless storms with total precipitation equal to or exceeding the 85th percentile of all *n* hour storms; which restricts derived hyetal patterns to those associated with heavy rainfall. Then, compute averages for every hour within the selected subset of *n* hour storms. The results of these computations are the dimensionless design hyetographs to be used in rainfall-runoff modelling.

The results of the analysis for a subset of the storms considered (durations ranging between 2 and 9 hours) are given in Table 2.5, with a typical hyetograph (for 4 hour storms) shown on Figure 2.5. Complete results of the Letpadaung hyetograph analysis (i.e. tabulated patterns for all 24 derived durations with corresponding hyetographs) are given in Attachment 2.5.

Table 2.5: Letpadaung hyetograph results for 2 through 9 hour storms

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	55.3%	22.9%	15.3%	6.6%	8.1%	6.7%	0.9%	3.8%
2	100.0%	77.0%	56.2%	37.2%	24.3%	19.0%	4.7%	13.7%
3		100.0%	90.1%	67.8%	45.3%	43.0%	15.6%	34.9%
4			100.0%	93.7%	76.5%	70.1%	51.5%	63.4%
5				100.0%	97.1%	88.5%	73.8%	81.3%
6					100.0%	98.4%	88.3%	88.9%
7						100.0%	97.5%	93.7%
8							100.0%	97.8%
9								100.0%

KP notes that hyetographs for intermediate durations may be estimated via interpolation, after the bounding storms have been put on a dimensionless temporal basis. Storm hyetographs for durations outside of the range given in Attachment 2.5 may be assumed as follows:

- Durations less than 2 hours should employ the 2 hour duration hyetograph, after scaling to the smaller duration;
- Durations in the range (45 h ≤ *n* ≤ 72 h) should employ the 45 hour duration hyetograph, after scaling to the larger duration; and
- Durations greater than 72 hours should not employ the derived hyetographs. Additional studies are required to estimate design hyetographs for long duration continuous storms.

2.5 PRECIPITATION TREND ANALYSIS

KP performed trend analysis on annual precipitation totals from the Monywa Township dataset (1961-2013) in order to ascertain potential impacts of trends in precipitation on planned site development. The results of this analysis, illustrated on Figure 2.6, show that there is no statistically significant trend observable in annual precipitation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future precipitation cycles due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 2.6.

2.6 WATER BALANCE SCENARIOS

KP performed frequency analysis on precipitation values for 15 candidate water balance cycle durations to estimate the statistical likelihood of experiencing extremely “Wet” or “Dry” years at the Letpadaung site. The durations considered include:

- Long duration cycles of 1, 2, 3, 4 and 5 years and
- Short duration cycles of 2, 3, 4, 7, 14, 30, 60, 90, 120 and 180 days.

Exceedance and non-exceedance probabilities were assigned to the *n* (year or day) totals of daily precipitation values, by sorting the values in descending (for the “Wet” series) and ascending (for the “Dry” series) order. The requisite frequency analyses were then conducted in a manner similar to that described in Section 2.3.

For each of the candidate water balance cycle durations, the three best fitting probability distributions were selected for comparison. Based on the comparison, the probability

distribution which fits Monywa Township (1961-2013) historical data best for all considered durations is the Generalised Extreme Value (GEV) distribution. Details of the water balance scenario frequency analysis are given in Attachment 2.7.

In order to apportion the statistically-computed climate cycle precipitation totals to daily time series for use in water balance modelling, the wettest (or wettest and driest, in the case of the 1 year duration cycle) *n* (year or day) continuous records of historical rainfall in the Monywa Township (1963-2013) dataset were identified and converted to series of cumulative daily percentages (of total observed rainfall). These series were then multiplied by the 100 and 500 year ARI depths (for each duration *n*) to derive 32 daily water balance scenarios, which are detailed in Attachment 2.8. A summary of the derived scenarios is given in Table 2.6.

Table 2.6: Letpadaung water balance scenario summary

Scenario	100-yr ARI Total Depth (mm)	500-yr ARI Total Depth (mm)	Temporal Pattern Based on
5 Year Wet	5,479	5,839	1973 – 1979
4 Year Wet	4,630	5,083	1973 – 1976
3 Year Wet	3,644	4,083	1975 – 1977
2 Year Wet	2,544	2,844	2010 – 2011
1 Year Wet	1,555	1,902	1973
1 Year Dry	424	383	1982
180 Day Wet	1,437	1,767	25/05/1973 – 20/11/1973
120 Day Wet	1,067	1,272	2/07/2010 – 29/10/2010
90 Day Wet	921	1,101	30/07/1965 –27/10/1965
60 Day Wet	740	865	29/08/1965 – 27/10/1965
30 Day Wet	520	596	29/09/2010 – 28/10/2010
14 Day Wet	440	563	9/05/2007 – 22/05/2007
7 Day Wet*1	343	447	9/05/2007 – 15/05/2007
4 Day Wet*2	308	410	1/06/1984 – 4/06/1984
3 Day Wet*3	298	401	1/06/1984 – 3/06/1984
2 Day Wet*4	214	249	2/06/1984 – 3/06/1984

*1 Scenario totals for 7 day duration cycles have been augmented 1.8% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily design storm estimates (Ref. 2).

*2 Scenario totals for 4 day duration cycles have been augmented 3.4% (Ref. 2).

*3 Scenario totals for 3 day duration cycles have been augmented 4.4% (Ref. 2).

*4 Scenario totals for 2 day duration cycles have been augmented 6.7% (Ref. 2).

3. EVAPORATION ANALYSIS

Pan evaporation data from the Yangtse climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate. Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes.

Pan evaporation values may be used to estimate evaporation from natural water bodies (lakes, ponds, etc.). Evaporation from a natural body of water is usually at a lower rate because the body of water does not have metal sides that get hot with the sun. Also, while

light penetration in a pan is essentially uniform, light penetration in natural bodies of water decreases with depth. Accordingly, lake evaporation can be estimated by multiplying pan evaporation by a coefficient, which may be assumed as 0.7 in lieu of experimentally calibrated results.

The following sections detail the various analyses conducted and the results achieved.

3.1 ANNUAL EVAPORATION ANALYSIS

Monthly pan evaporation records from the Yangtse climate station were summed to produce annual totals for the entire period of available record. Recorded data from 2007 and onwards was excluded from consideration because the evaporation trend analysis, discussed in Section 3.3, revealed an unexplained shift in recorded values between 2006 and 2007. If the full dataset were to be used “as is”, spurious analysis results are likely.

Sampling statistics were computed on these annual sums from the reduced dataset (2000-2006) to provide a broad overview of the typical variability of annual pan evaporation in the region surrounding the project site, as given in Table 3.1.

Table 3.1: Annual pan evaporation statistics – Yangtse climate station (2000-2006)

Selected Statistic	Statistic Value
Average (mm)	2,017
Median (mm)	2,051
Std. Deviation (mm)	75
Minimum (mm)	1,922
Maximum (mm)	2,109
25th Percentile (mm)	1,951
75th Percentile (mm)	2,067
Count (yr)	7
Distance to site (km)	7.6

The sample statistics for annual precipitation at this site were also depicted graphically, as a “box and whisker” plot, as shown on Figure 3.1. Details of the annual pan evaporation analysis are given in Attachment 3.1.

3.2 MONTHLY EVAPORATION ANALYSIS

Monthly pan evaporation from the Yangtse climate station was employed in this analysis. As discussed in Section 3.1, recorded data from 2007 and onwards was excluded from consideration. Sampling statistics were computed on these values to describe the variability of monthly pan evaporation at the project site, as given in Table 3.2.

Table 3.2: Monthly pan evaporation statistics – Yangtse climate station (2000-2006)

Month[*1]	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	123	121	5	119	134	121	122
Feb	149	151	13	130	166	141	158
Mar	210	213	14	188	224	201	220
Apr	228	236	21	191	248	218	242
May	202	205	43	118	256	197	223
Jun	203	187	36	165	270	181	219
Jul	172	174	12	153	187	166	180
Aug	184	175	38	133	248	167	198
Sep	160	150	27	128	208	145	173
Oct	145	148	27	102	184	132	157
Nov	125	130	17	102	146	111	137
Dec	117	112	12	98	131	110	127

*1 All computed pan evaporation statistics are measured in (mm).

The sample statistics for monthly pan evaporation were also depicted as a “box and whisker” plot, as shown on Figure 3.2. A cyclical pattern was observed, with the greatest pan evaporation occurring in April and the smallest in December. Details of the monthly pan evaporation analysis are given in Attachment 3.2.

3.3 EVAPORATION TREND ANALYSIS

KP performed trend analysis on annual pan evaporation totals from the Yangtse climate station dataset (2000-2013) in order to ascertain potential impacts of trends in pan evaporation on planned site development. The results of this analysis, illustrated on Figure 3.3, show a statistically significant negative trend. However, further inspection of the data showed an unexplained downshift of nearly 600 mm in annual average pan evaporation between 2006 and 2007.

A shift this large is highly unusual, if not impossible, in nature. Therefore, an attempt was made to try and find an explanation for this behaviour. As no records of a sudden shift in pan evaporation of this magnitude were found for this period in Myanmar, KP efforts shifted to trying to determine which sub-period in the provided historical dataset, either (2000-2006) or (2007-2012) was most likely.

A contour map of iso-lines of equal lake evaporation for Myanmar was obtained from (Ref. 6). This map, reproduced as Figure 3.4, shows that annual average lake evaporation at Monywa City is approximately 1,600 mm/yr, which converts to an equivalent 2,300 mm/yr after application of a 0.7 pan coefficient, which is considerably closer to the average annual evaporation of the first sub-period rather than the second. Based on this observation, KP selected the (2000-2006) period for estimating site pan evaporation values. The data from the second (2007-2012) period was excluded from further consideration.

Focusing on the (2000-2006) period, there is no statistically significant trend observable in annual pan evaporation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future pan evaporation due to observed climate change.

Details of the pan evaporation trend analysis are given in Attachment 3.3.

3.4 COMPARISON OF PRECIPITATION & EVAPORATION

Average monthly values of precipitation (taken from Section 2.2) and pan evaporation (taken from Section 3.2) were compared to determine if the Letpadaung site is expected to run with a surplus of water from precipitation or if an annual deficit is expected. The results of this comparison are summarised in Table 3.3 and illustrated on Figure 3.5.

Table 3.3: Comparison of monthly average precipitation & evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake[*1] Evaporation (mm)	Precip. minus Lake Evap. (mm)
Jan	2	123	86	-84
Feb	3	149	105	-101
Mar	5	210	147	-142
Apr	26	228	160	-134
May	102	202	142	-40
Jun	100	203	142	-42
Jul	67	172	121	-54
Aug	121	184	129	-7
Sep	166	160	112	54
Oct	142	145	101	50
Nov	33	125	87	-55
Dec	6	117	82	-75
Totals	773	2,017	1,412	-639

*1 Assumed pan coefficient = 0.7.

As Table 3.3 clearly shows, the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Additional details of this comparison are provided in Attachment 3.4.

4. TEMPERATURE ANALYSIS

Average daily temperature data from the WMO 48037 climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate. The following sections detail the various analyses conducted and the results achieved.

4.1 ANNUAL TEMPERATURE ANALYSIS

Daily average temperature records from the WMO 48037 climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias. Sampling statistics were computed on these annual sums, as given in Table 4.1.

Table 4.1: Annual average temperature statistics – WMO 48037 station (1981-2012)

Selected Statistic	Statistic*1 Value
Average (℃)	27.8
Median (℃)	27.8
Std. Deviation (℃)	0.8
Minimum (℃)	26.1
Maximum (℃)	29.7
25th Percentile (℃)	27.2
75th Percentile (℃)	28.2
Count (yr)	25
Distance to site (km)	4.7

*1 Incomplete data from 1981, 1986-1989, 1992 and 2012 were excluded from this analysis.

The sample statistics for annual average precipitation at this site were also depicted graphically, as a "box and whisker" plot, as shown on Figure 4.1.

Details of the annual average temperature analysis are given in Attachment 4.1.

4.2 MONTHLY TEMPERATURE ANALYSIS

Daily temperature records from the WMO 48037 dataset were summed in a manner similar to that described in Section 4.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). This was done to prevent sampling bias. Sampling statistics were computed on these values, as given in Table 4.2.

Table 4.2: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month*1	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	21.9	21.9	1.9	18.4	28.0	21.2	22.5
Feb	24.0	23.6	2.3	21.1	32.9	23.0	24.8
Mar	28.1	28.0	2.3	23.1	35.5	27.0	29.2
Apr	30.9	30.9	1.4	25.9	33.1	30.3	31.7
May	31.0	31.0	1.4	28.1	33.8	30.4	31.7
Jun	30.6	30.5	1.1	27.8	32.9	29.9	31.3
Jul	30.5	30.8	1.2	26.8	32.5	30.1	31.3
Aug	29.9	29.8	1.0	28.4	32.1	29.2	30.6
Sep	29.3	29.3	0.7	27.8	30.4	28.8	29.8
Oct	28.0	28.	0.7	26.5	29.8	27.6	28.4
Nov	25.1	25.3	1.1	23.0	27.6	24.4	25.8
Dec	22.2	22.0	1.9	18.4	28.0	21.3	22.9

*1 All computed temperature statistics are measured in (℃).

The sample statistics for monthly average temperature from the WMO 48037 dataset were also depicted as a "box and whisker" plot, as shown on Figure 4.2. The hottest month (on average) each year is May, with a cyclical pattern shown. Details of the monthly average temperature analysis are given in Attachment 4.2.

Monthly ranges in temperature were also analysed by computing monthly averages on daily temperature maxima and minima. The results of this analysis are given in Table 4.3 and are illustrated on Figure 4.3.

Table 4.3: Monthly temperature ranges – WMO 48037 station (1981-2012)

Month*1	Max.	Average	Min.
Jan	28.5	21.9	15.4
Feb	31.6	24.0	16.9
Mar	36.0	28.1	20.5
Apr	38.4	30.9	24.0
May	36.8	31.0	25.5
Jun	35.4	30.6	26.0
Jul	35.5	30.5	26.1
Aug	34.3	29.9	25.7
Sep	33.4	29.3	25.3
Oct	32.5	28.0	23.8
Nov	30.4	25.1	19.9
Dec	28.0	22.2	16.4

*1 All computed temperature statistics are measured in (°C).

Temperatures are fairly consistent for six months of the year: April through September. The other four “shoulder” months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January. Details of the monthly temperature range analysis are given in Attachment 4.3.

4.3 TEMPERATURE TREND ANALYSIS

KP performed trend analysis on annual average temperature totals from the WMO 48037 dataset (1981-2012) in order to ascertain potential impacts of trends in temperature on planned site development. The results of this analysis, illustrated on Figure 4.4, show that there is no statistically significant trend observable in annual average temperature values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future temperature due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 4.4.

5. WIND ROSE ANALYSIS

Wind speed and direction data from the Wind Rose sampling point dataset were analysed using WindRose Pro 3.01 software (Ref. 7). Hourly data spanning the historic period (2010-2012) were used as inputs to the program to produce wind rose plots. Each concentric circle on a wind rose plot represents a different frequency, starting at zero in the center and increasing as the circles move outwards. The direction of each “spoke” indicates the cardinal direction that winds are blowing *from* over the historic period analysed. Additionally, the colours of portions of each spoke indicate the speed with which the wind blows from in a particular direction.

The hourly wind data were used to prepare nine wind rose plots, as follows:

- All wind measurements are shown on Figure 5.1;
- Wind measurements for the period (00:00 – 03:00) are shown on Figure 5.2;
- Wind measurements for the period (03:00 – 06:00) are shown on Figure 5.3;
- Wind measurements for the period (06:00 – 09:00) are shown on Figure 5.4;

- Wind measurements for the period (09:00 – 12:00) are shown on Figure 5.5;
- Wind measurements for the period (12:00 – 15:00) are shown on Figure 5.6;
- Wind measurements for the period (15:00 – 18:00) are shown on Figure 5.7;
- Wind measurements for the period (18:00 – 21:00) are shown on Figure 5.8;
- Wind measurements for the period (21:00 – 00:00) are shown on Figure 5.9;
- Wind measurements for the Wet Season are shown on Figure 5.10; and
- Wind measurements for the Dry Season are shown on Figure 5.11.

Wind rose data may be used for noise and dust analysis as well as for siting airstrips and for calculating fetch lengths for wave run-up calculations that are used in pond / dam sizing.

Details of the wind rose analysis are given in Attachment 5.1. The two years of available data indicate that at Letpadaung, winds blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s which, on the Beaufort scale is classified as 2 "light breeze". Maximum recorded wind speed during this period is 9.2 m/s, which corresponds to 5 "fresh breeze" on the Beaufort scale.

The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Generally speaking, the data does not indicate that high wind storms are likely at this site.

Seasonal variability was also considered. The dataset was divided into the Wet (May through October) and Dry (November through April) Seasons. Wind rose plots were produced for each season. During the Wet Season, winds generally blow along the North / South cardinal directions, with the preponderance of statistical data suggesting that winds blow from the South (180°) to South by Southeast (157.5°). In the Dry Season, the wind blows predominantly from the North (0°) to North by Northwest (337.5°). Letpadaung Wet Season and Dry Season wind rose plots are shown in figures 5.10 and 5.11.

6. SUMMARY / CONCLUSIONS

Historic data from four different locations were analysed to derive design values associated with climate parameters of interest: precipitation, evaporation, temperature and wind. The specific design values associated with each climate parameter that have been addressed in this memorandum are listed below.

Precipitation parameters:

- Typical variability of annual precipitation and average number of rain days;
- Typical variability of monthly precipitation and average number of rain days;
- Intensity / Duration / Frequency (IDF) curves for short-duration extreme rainfall events;
- Temporal distributions (i.e. hyetographs) of short-duration precipitation to be used with the IDF curves in rainfall-runoff modelling. Design hyetographs were derived for storm durations ranging from 2 to 45 hours;
- Trend analysis of annual precipitation totals, for ascertaining potential impacts of climate trends on site development; and
- Daily precipitation amounts for 32 climate scenarios (15 durations x 2 storm frequencies for each duration, with the 1 year scenario considered for both Wet and Dry cycles) to be used with water balance modelling, as follows:
  - 500 year Annual Recurrence Interval (ARI), 5 year duration Wet cycle;
  - 100 year ARI, 5 year duration Wet cycle;
  - 500 year ARI, 4 year duration Wet cycle;
  - 100 year ARI, 4 year duration Wet cycle;
  - 500 year ARI, 3 year duration Wet cycle;
  - 100 year ARI, 3 year duration Wet cycle;
  - 500 year ARI, 2 year duration Wet cycle;

- 100 year ARI, 2 year duration Wet cycle;
- 500 year ARI, 1 year duration Wet cycle;
- 100 year ARI, 1 year duration Wet cycle;
- 500 year ARI, 1 year duration Dry cycle;
- 100 year ARI, 1 year duration Dry cycle;
- 500 year ARI, 180 day duration Wet cycle;
- 100 year ARI, 180 day duration Wet cycle;
- 500 year ARI, 120 day duration Wet cycle;
- 100 year ARI, 120 day duration Wet cycle;
- 500 year ARI, 90 day duration Wet cycle;
- 100 year ARI, 90 day duration Wet cycle;
- 500 year ARI, 60 day duration Wet cycle;
- 100 year ARI, 60 day duration Wet cycle;
- 500 year ARI, 30 day duration Wet cycle;
- 100 year ARI, 30 day duration Wet cycle;
- 500 year ARI, 14 day duration Wet cycle;
- 100 year ARI, 14 day duration Wet cycle;
- 500 year ARI, 7 day duration Wet cycle;
- 100 year ARI, 7 day duration Wet cycle;
- 500 year ARI, 4 day duration Wet cycle;
- 100 year ARI, 4 day duration Wet cycle;
- 500 year ARI, 3 day duration Wet cycle;
- 100 year ARI, 3 day duration Wet cycle;
- 500 year ARI, 2 day duration Wet cycle; and
- 100 year ARI, 2 day duration Wet cycle.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for eight months, from April through the end of November. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

Evaporation parameters:

- Typical variability of annual evaporation;
- Typical variability of monthly evaporation; and
- Trend analysis of annual evaporation totals, for ascertaining potential impacts of climate trends on site development.

Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to calculated annual average pan evaporation (2,017 mm). A comparison of precipitation and lake evaporation indicates that the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Adequate water storage and careful management of available water resources will be critical to successful mining operations at Letpadaung.

Temperature parameters:

- Typical variability of annual mean temperature;
- Typical variability of monthly mean temperature, as well as the range of monthly mean temperature between maximum and minimum; and
- Trend analysis of annual temperature averages, for ascertaining potential impacts of climate trends on site development.

Temperatures are fairly consistent during the six warm months of the year: April through September, when the average value is 30.4℃. The o ther four “shoulder” months exhibit a cyclical transition from the warm period to the coldest two months of the year: December

and January, when the average temperature is 22.1°C. Minimum temperature generally occurs in January (15.4°C) and the maximum in April (38.4°C).

Wind parameters:

- Typical variability of wind speed and direction on daily and eight sub-daily time periods (each of 3 hours duration), which are illustrated graphically through the use of wind rose plots.

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s, with a maximum of is 9.2 m/s. These correspond to Beaufort scale readings of 2 "light breeze" to 5 "fresh breeze". The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available wind data indicates that high wind storms are unlikely at the Letpadaung site.

We trust that these results are sufficient for any preliminary design computations.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

TODD LEWIS
Lead Engineer, Hydrology and Hydraulics

BRETT LONEY
Manager Environmental Services

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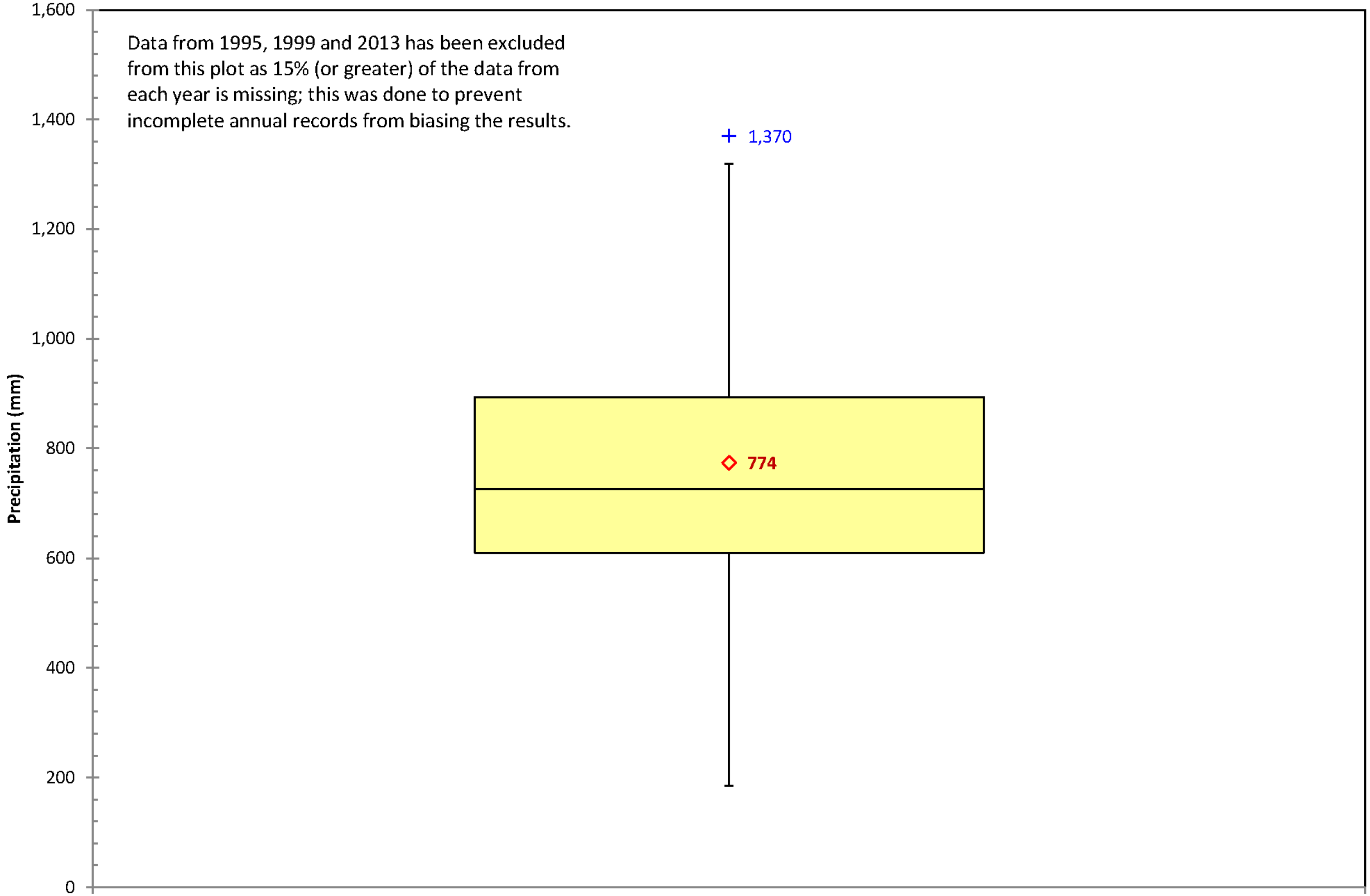
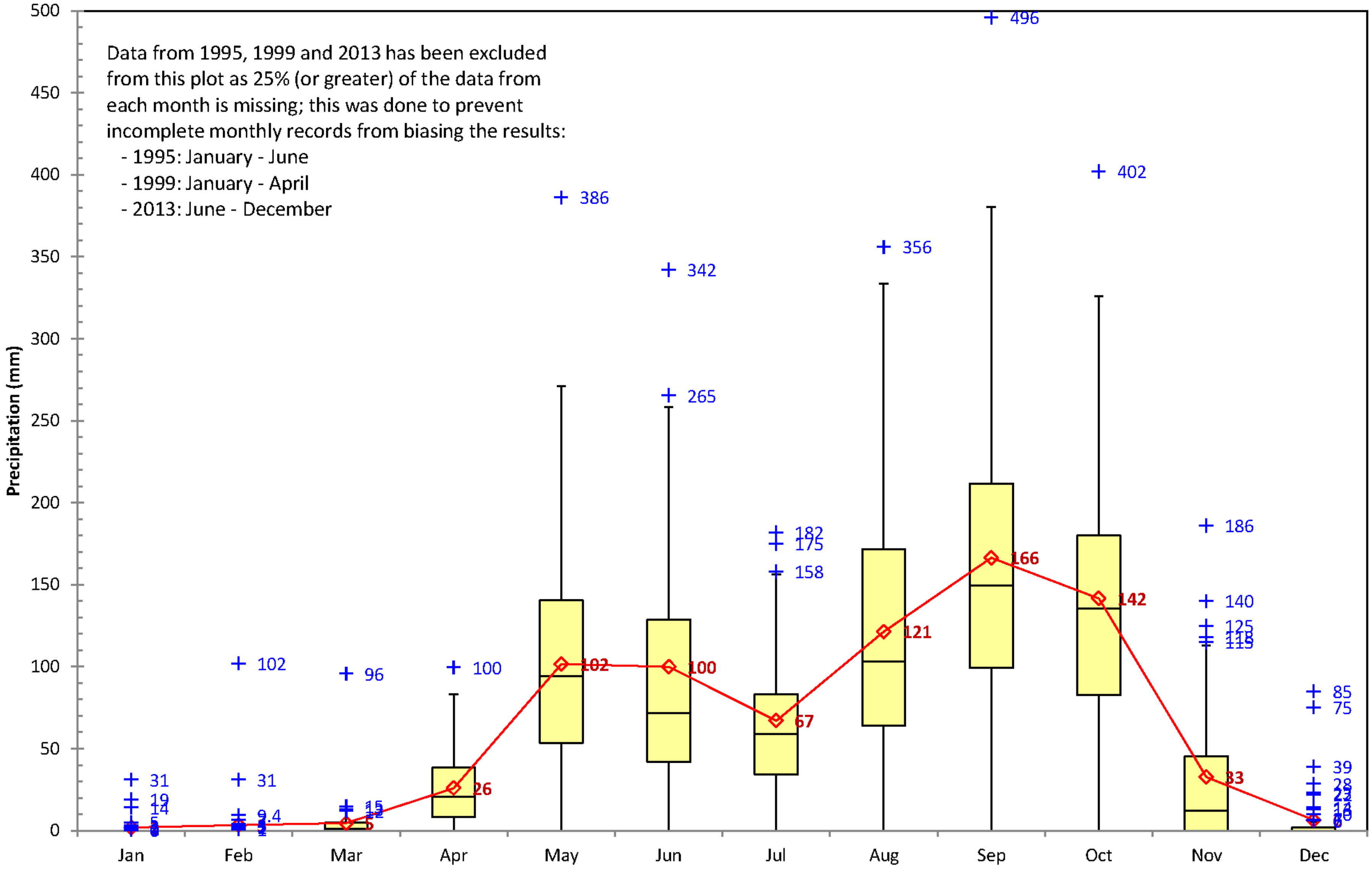
FIGURES

LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
LETPADAUNG PROJECT SITE WITH NEARBY CLIMATE STATIONS

Ref: PE701-00022 M13017
Figure 1.1



1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)
Data from 1995, 1999 and 2013 has been excluded from this plot as 15% (or greater) of the data from each year is missing; this was done to prevent incomplete annual records from biasing the results.
1,370
774



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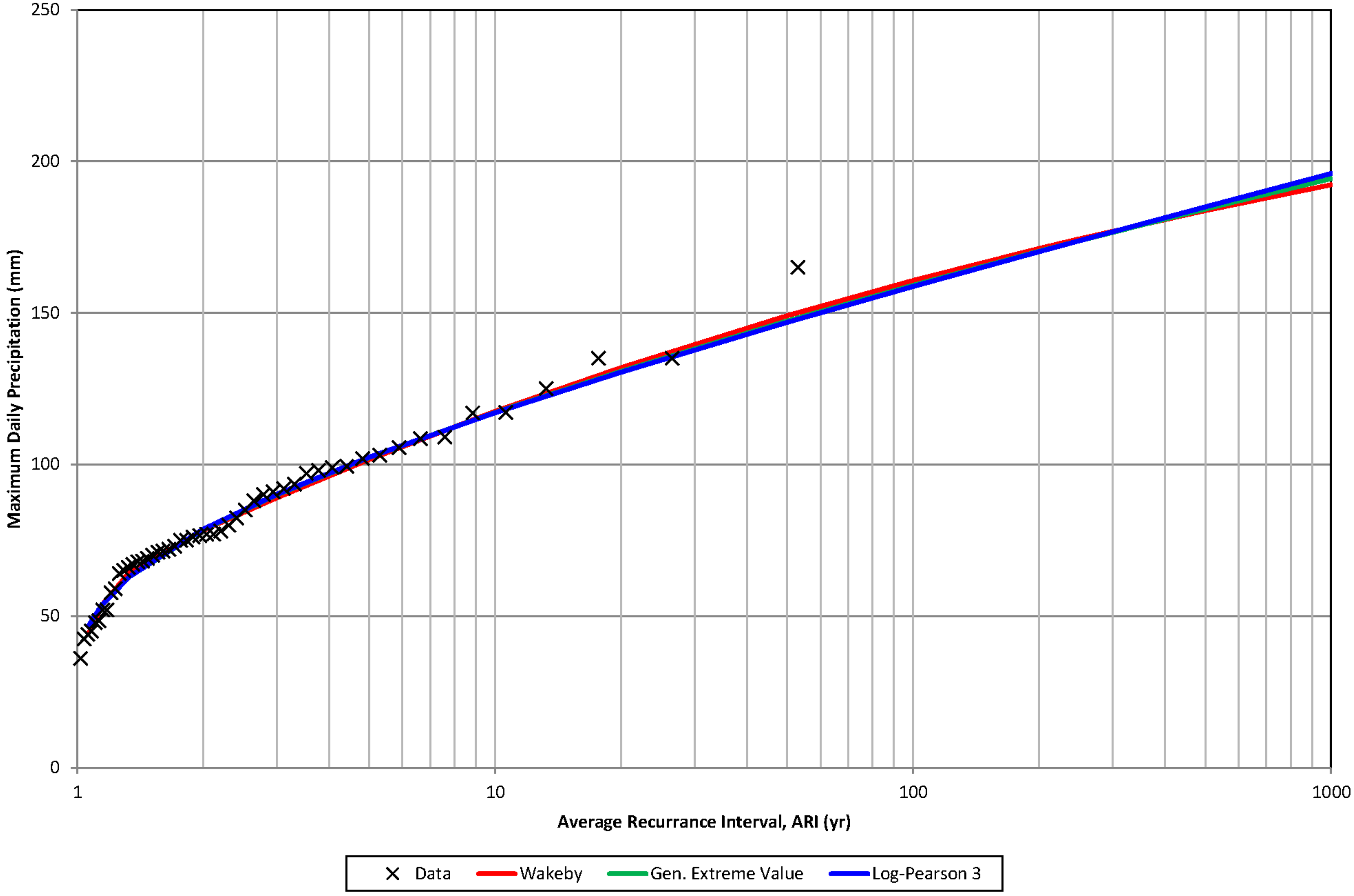
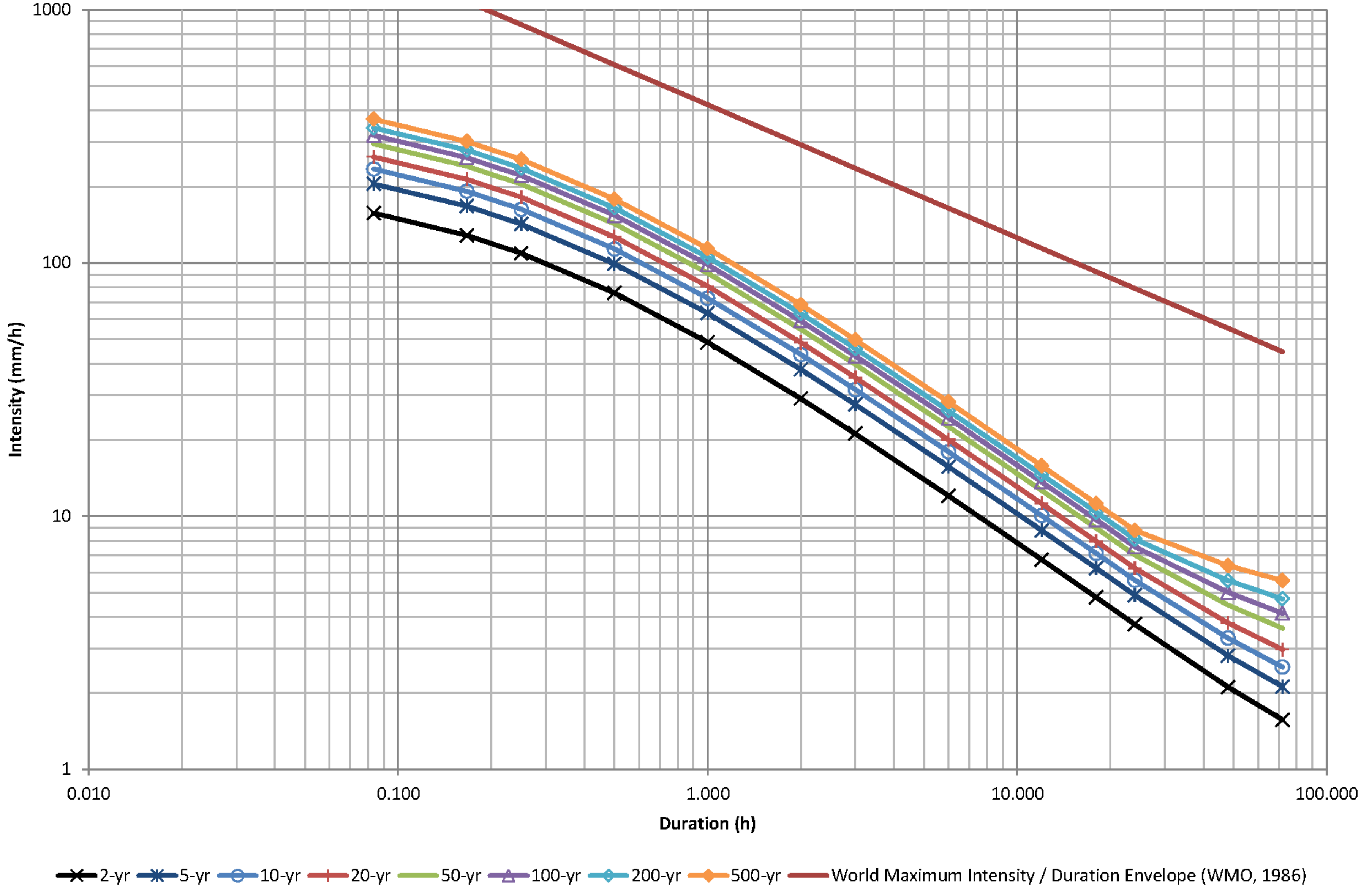
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PRECIPITATION MONTHLY SAMPLE STATISTICS
MONYWA TOWNSHIP (1961-2013)

Ref: PE701-00022 M13017
Figure 2.2



250
200
150
100
50
0
Maximum Daily Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3



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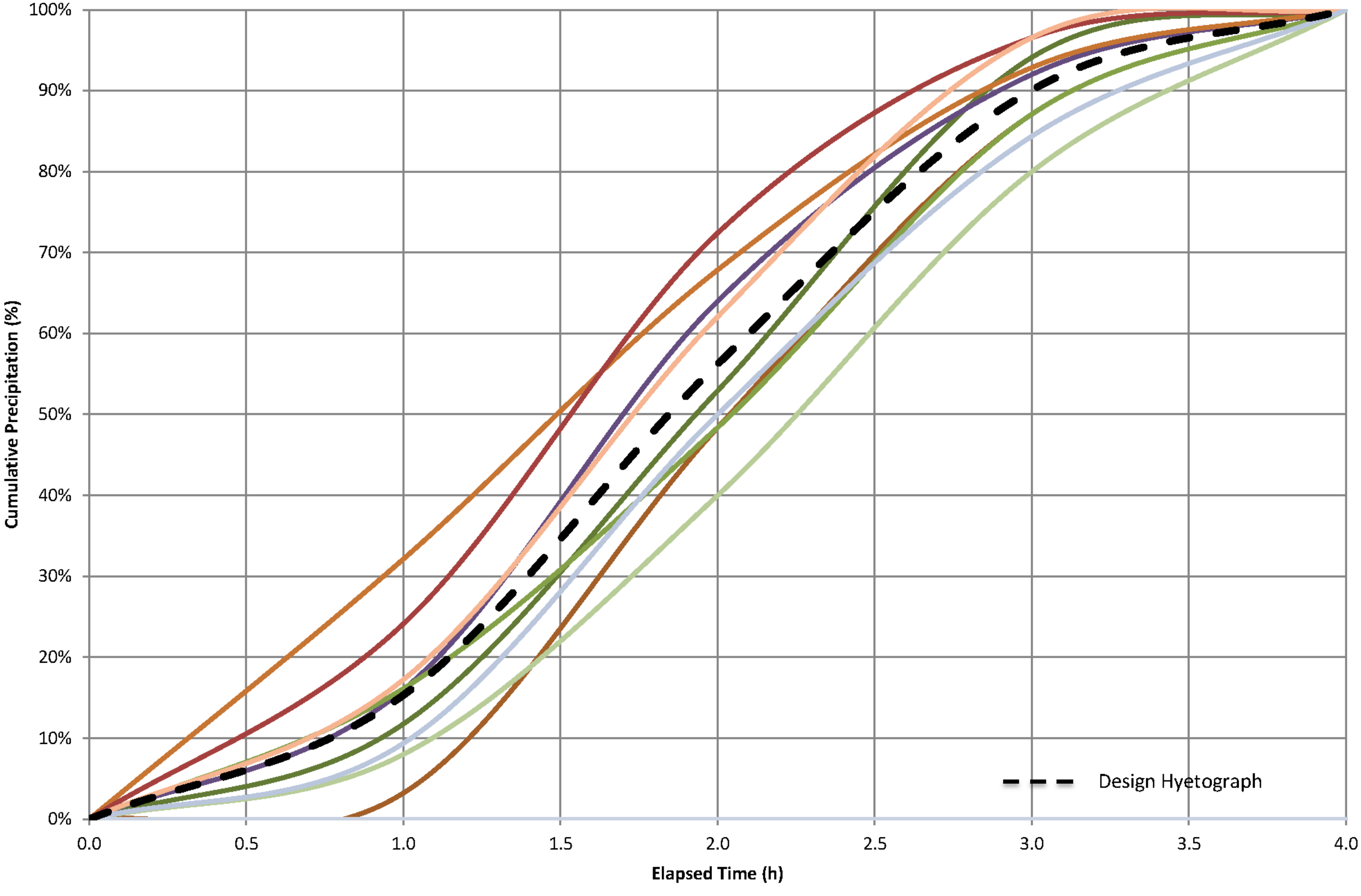
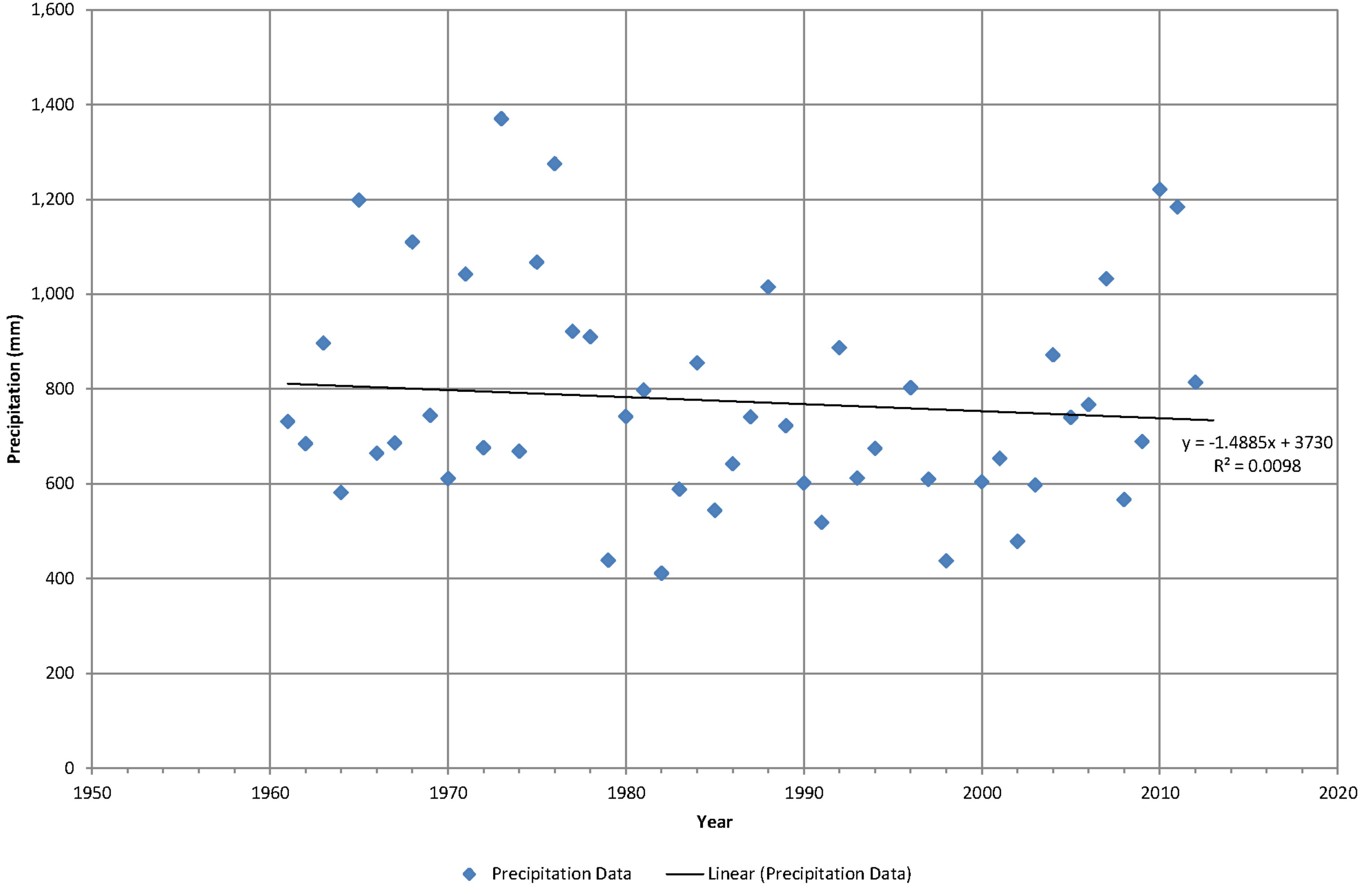
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PRECIPITATION INTENSITY / DURATION / FREQUENCY RESULTS
MONYWA TOWNSHIP (1961-2013)

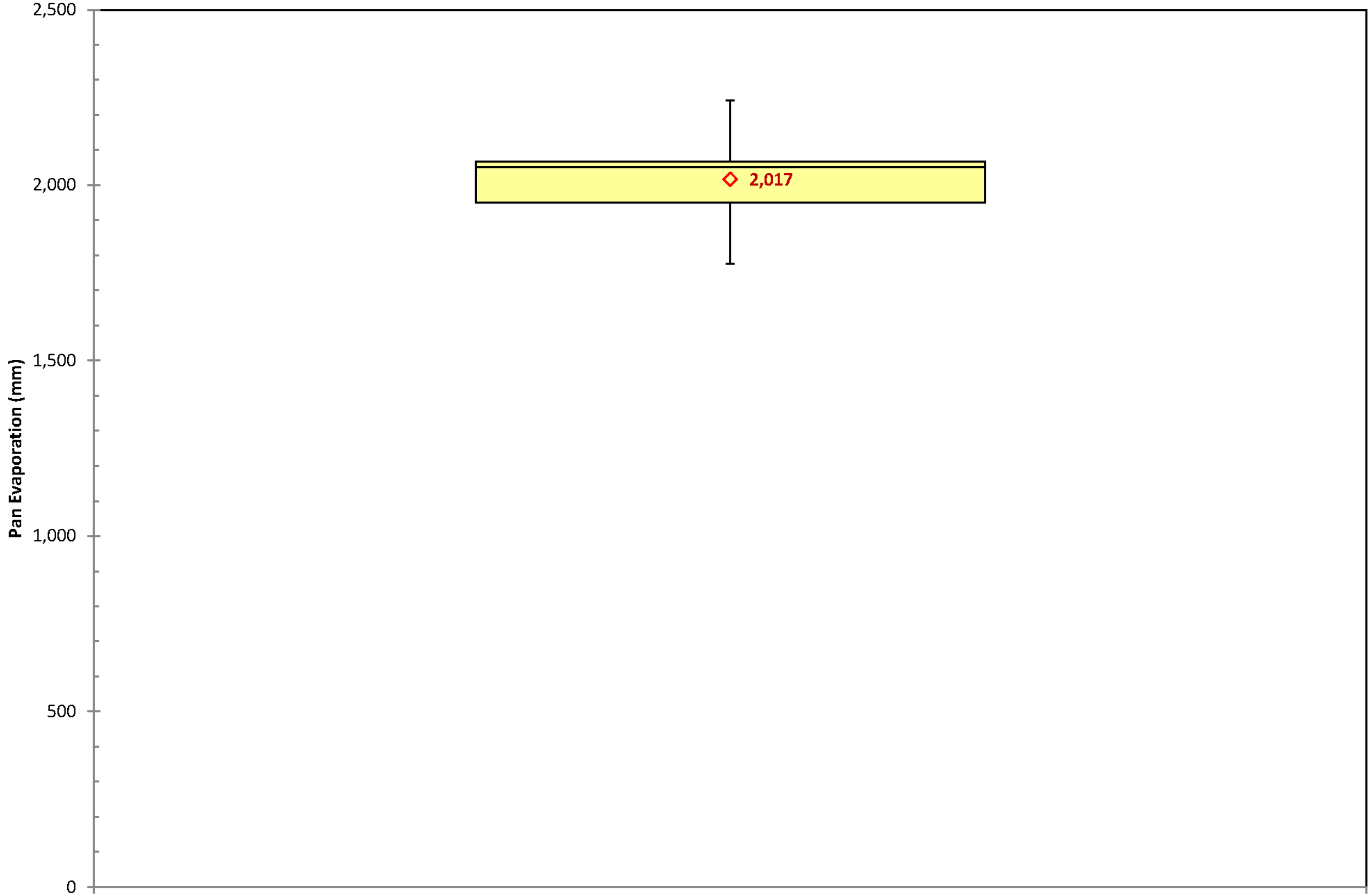
Ref: PE701-00022 M13017
Figure 2.4



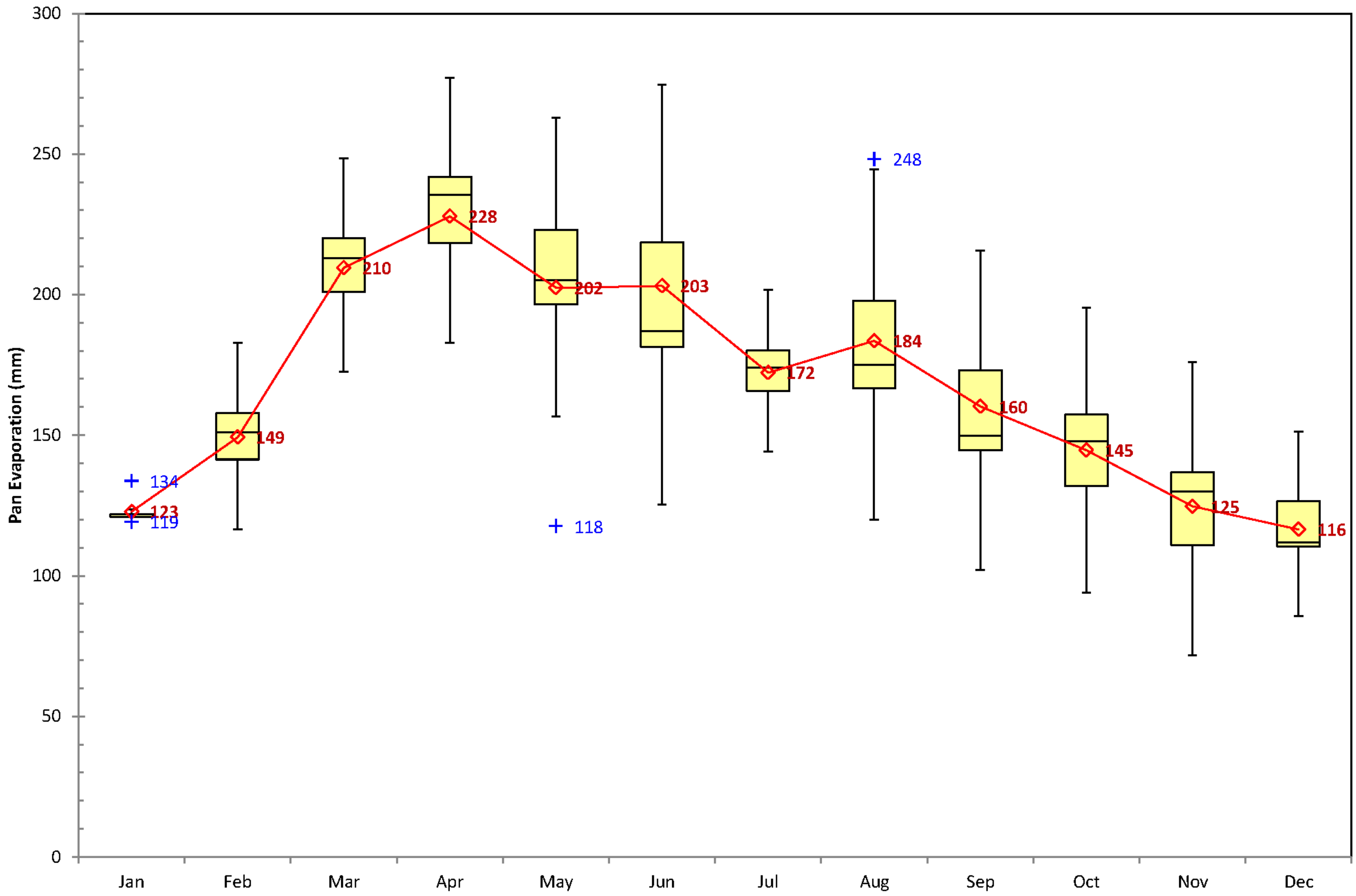
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Elapsed Time (h)
Design Hyetograph



1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)
1950
1960
1970
1980
1990
2000
2010
2020
Year
y = -1.4885x + 3730
R² = 0.0098
Precipitation Data
Linear (Precipitation Data)

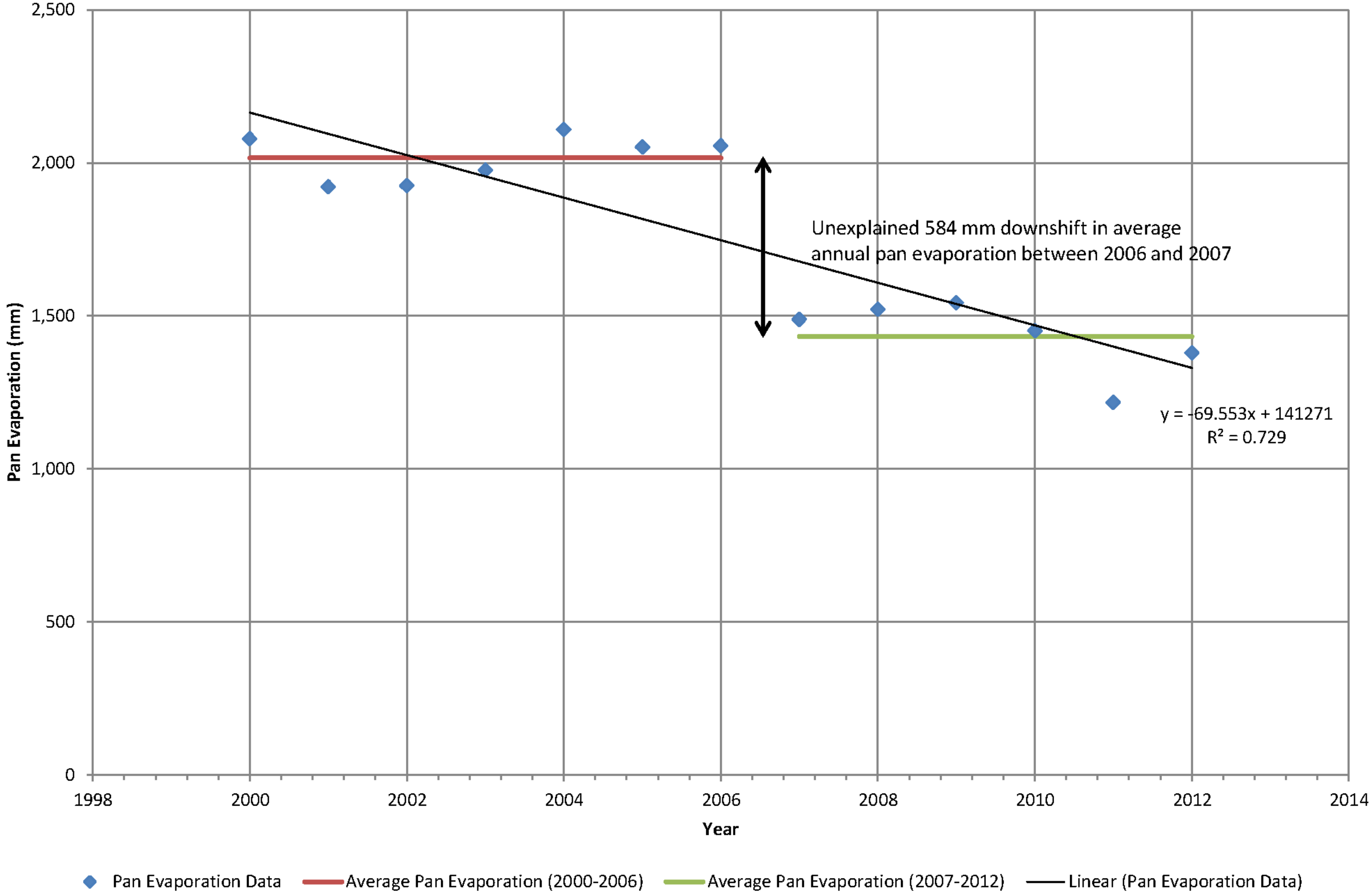


2,500
2,000
1,500
1,000
500
0
Pan Evaporation (mm)
2,017

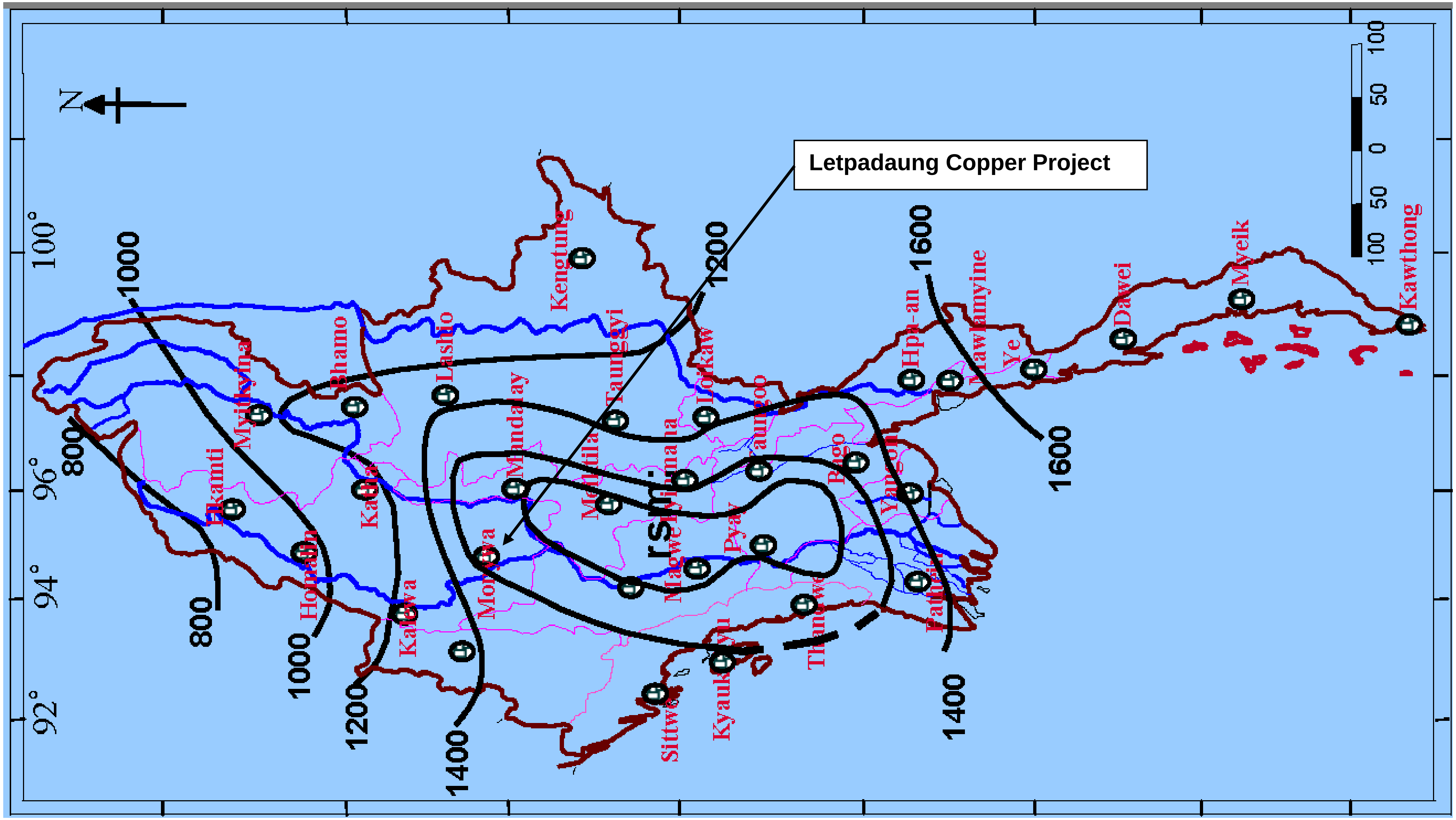


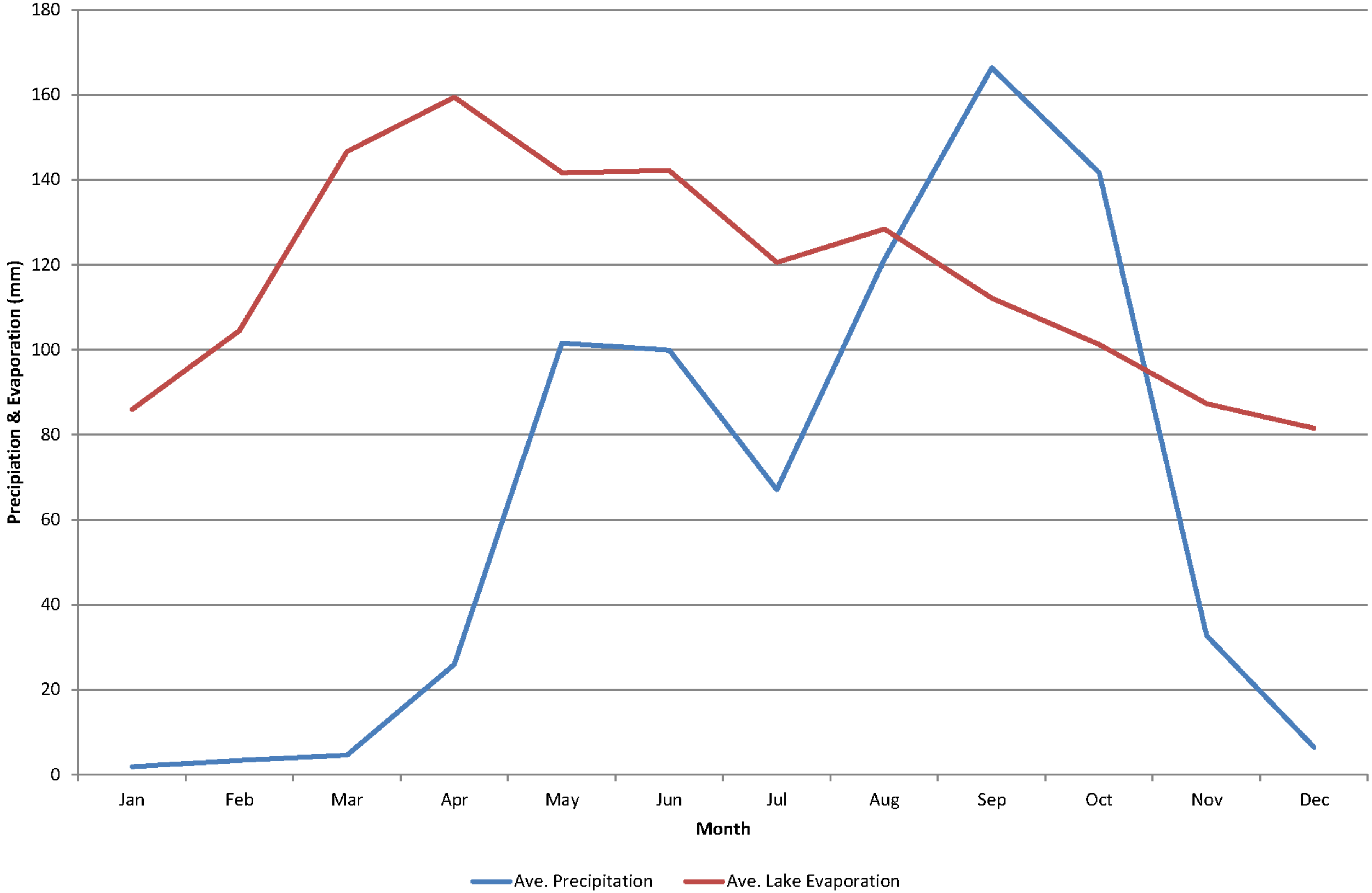
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
134
123
119
149
210
228
202
118
203
172
248
184
160
145
125
116

Figure 3.2

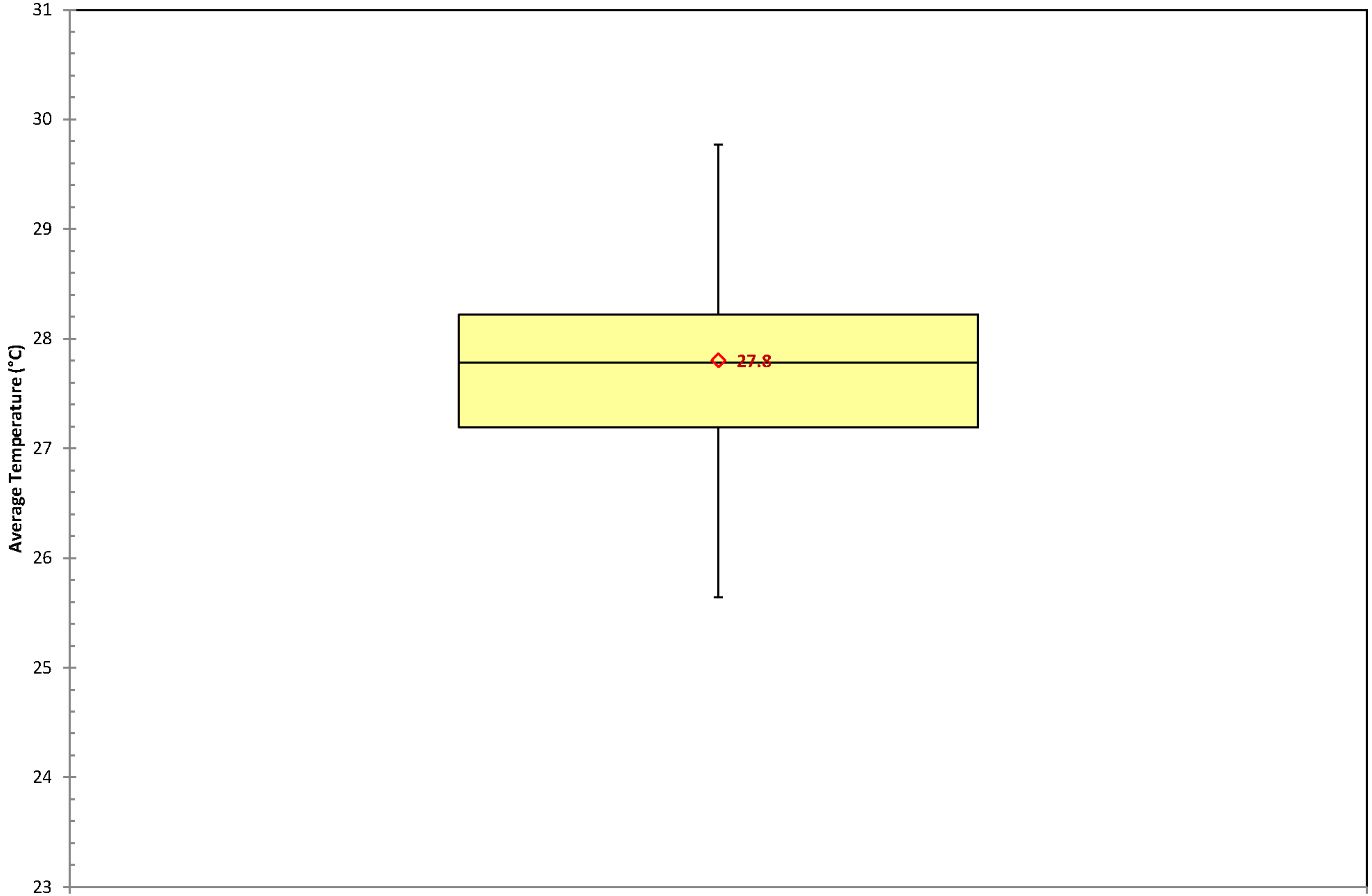


2,500
2,000
1,500
1,000
500
0
Pan Evaporation (mm)
1998
2000
2002
2004
2006
2008
2010
2012
2014
Year
Unexplained 584 mm downshift in average annual pan evaporation between 2006 and 2007
y = -69.553x + 141271
R² = 0.729
Pan Evaporation Data
Average Pan Evaporation (2000-2006)
Average Pan Evaporation (2007-2012)
Linear (Pan Evaporation Data)


Letpadaung Copper Project
N
100 50 0 50 100
800
1000
1200
1400
1600
100°
96°
94°
92°



180
160
140
120
100
80
60
40
20
0
Precipiation & Evaporation (mm)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Ave. Precipitation
Ave. Lake Evaporation



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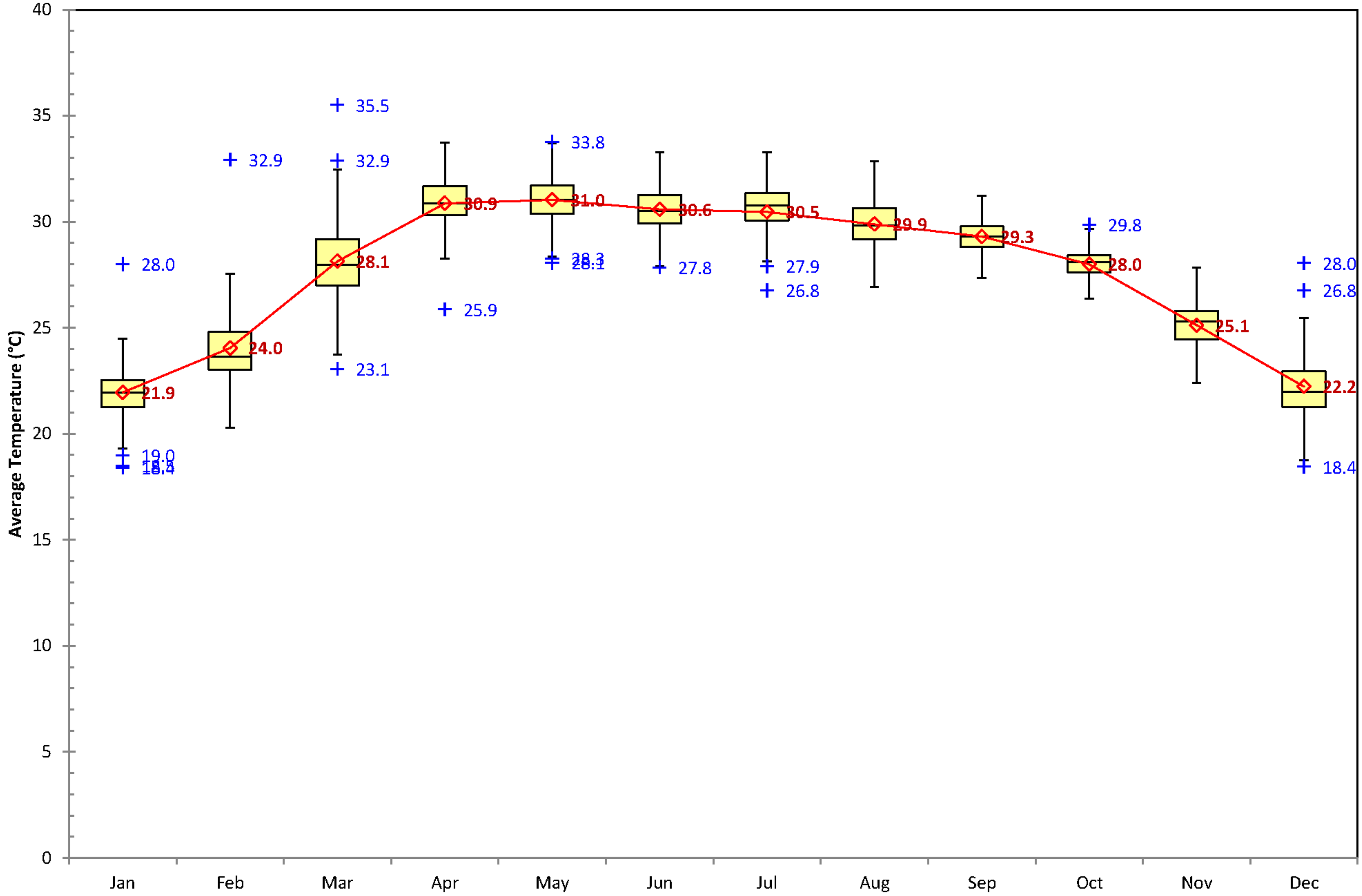
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
AVERAGE TEMPERATURE ANNUAL SAMPLE STATISTICS
WMO 48037 CLIMATE STATION (1981-2012)

Ref: PE701-00022 M13017
Figure 4.1



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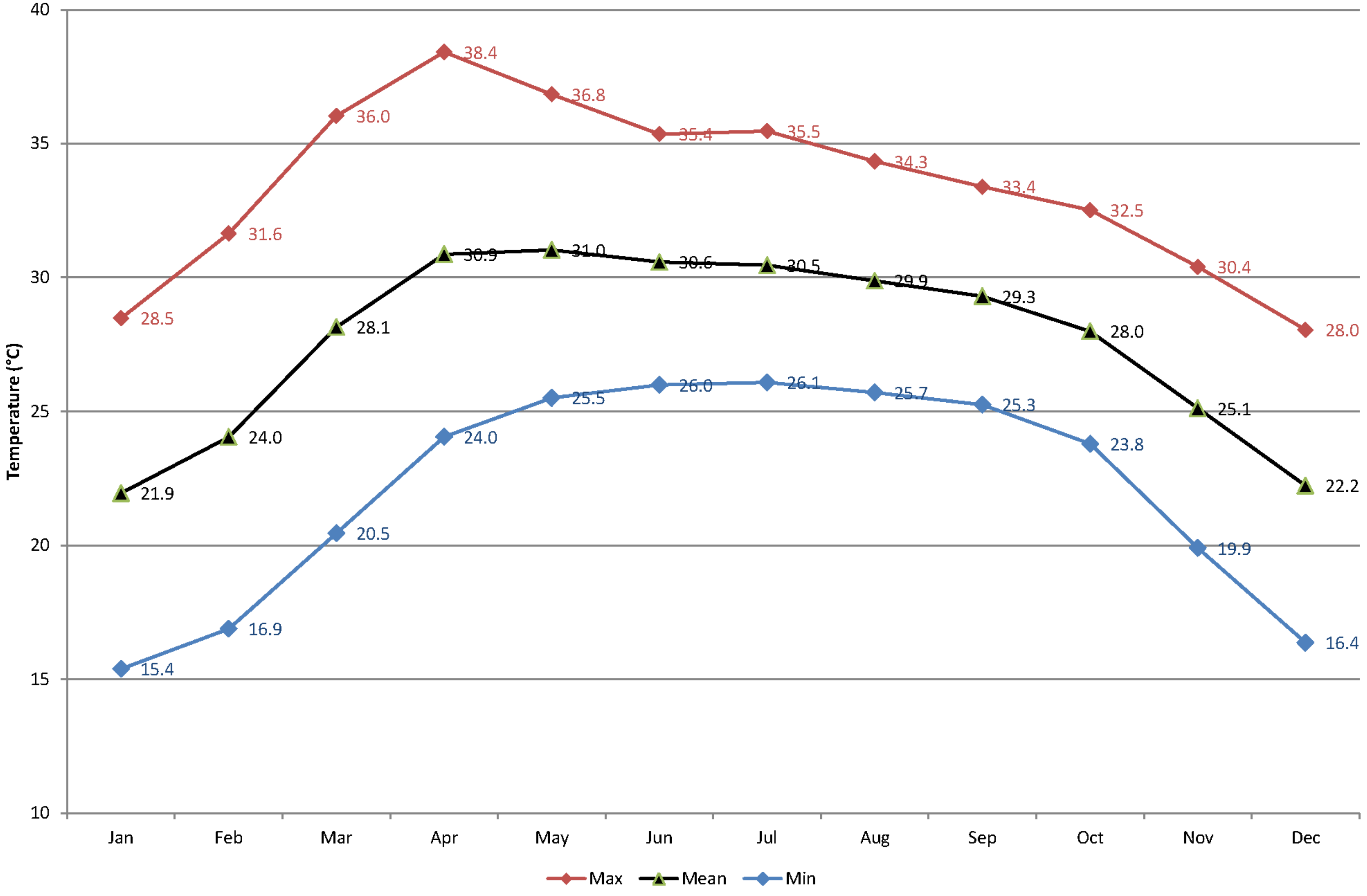
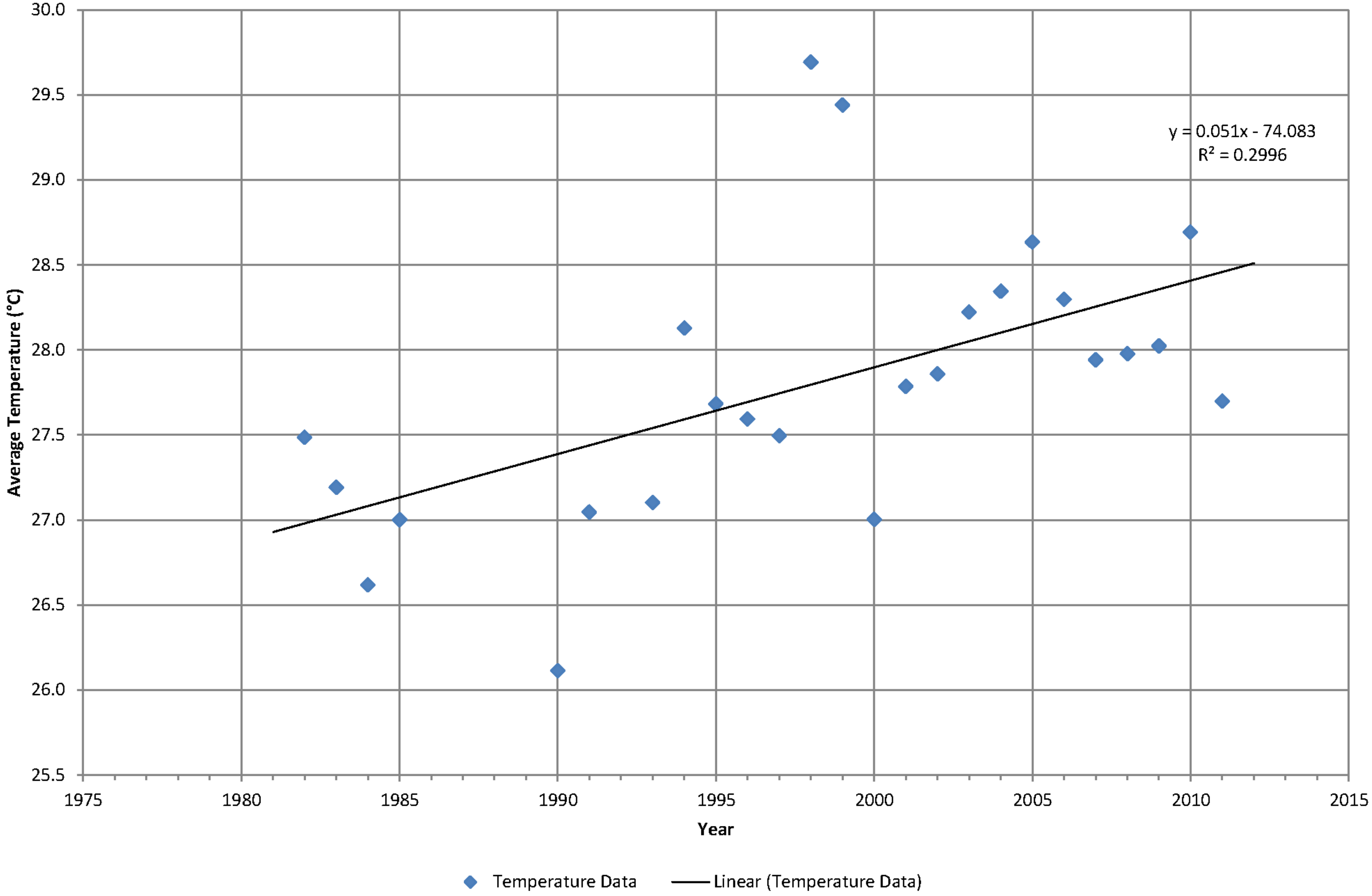
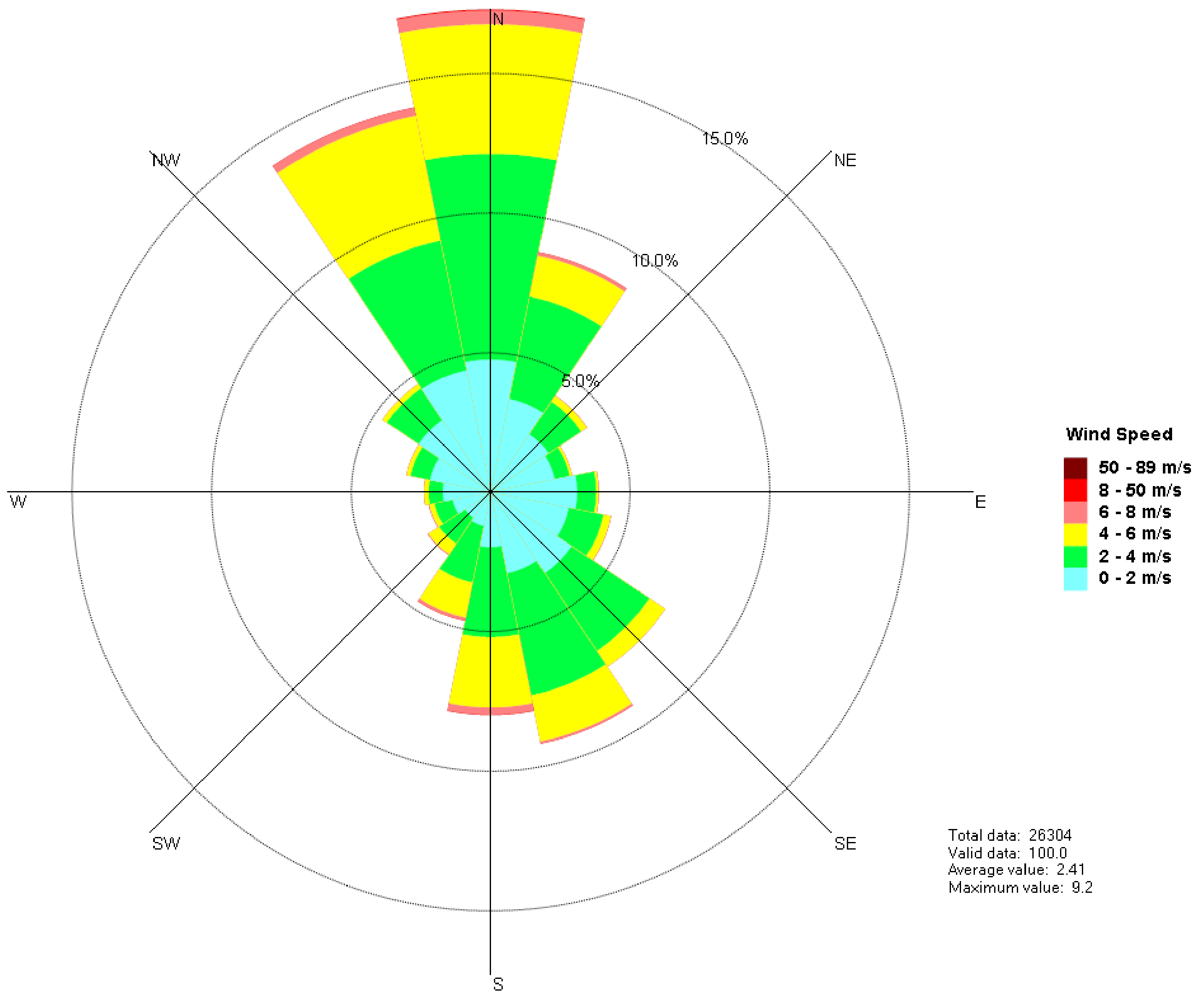
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
AVERAGE TEMPERATURE MONTHLY SAMPLE STATISTICS
WMO 48037 CLIMATE STATION (1981-2012)

Ref: PE701-00022 M13017
Figure 4.2

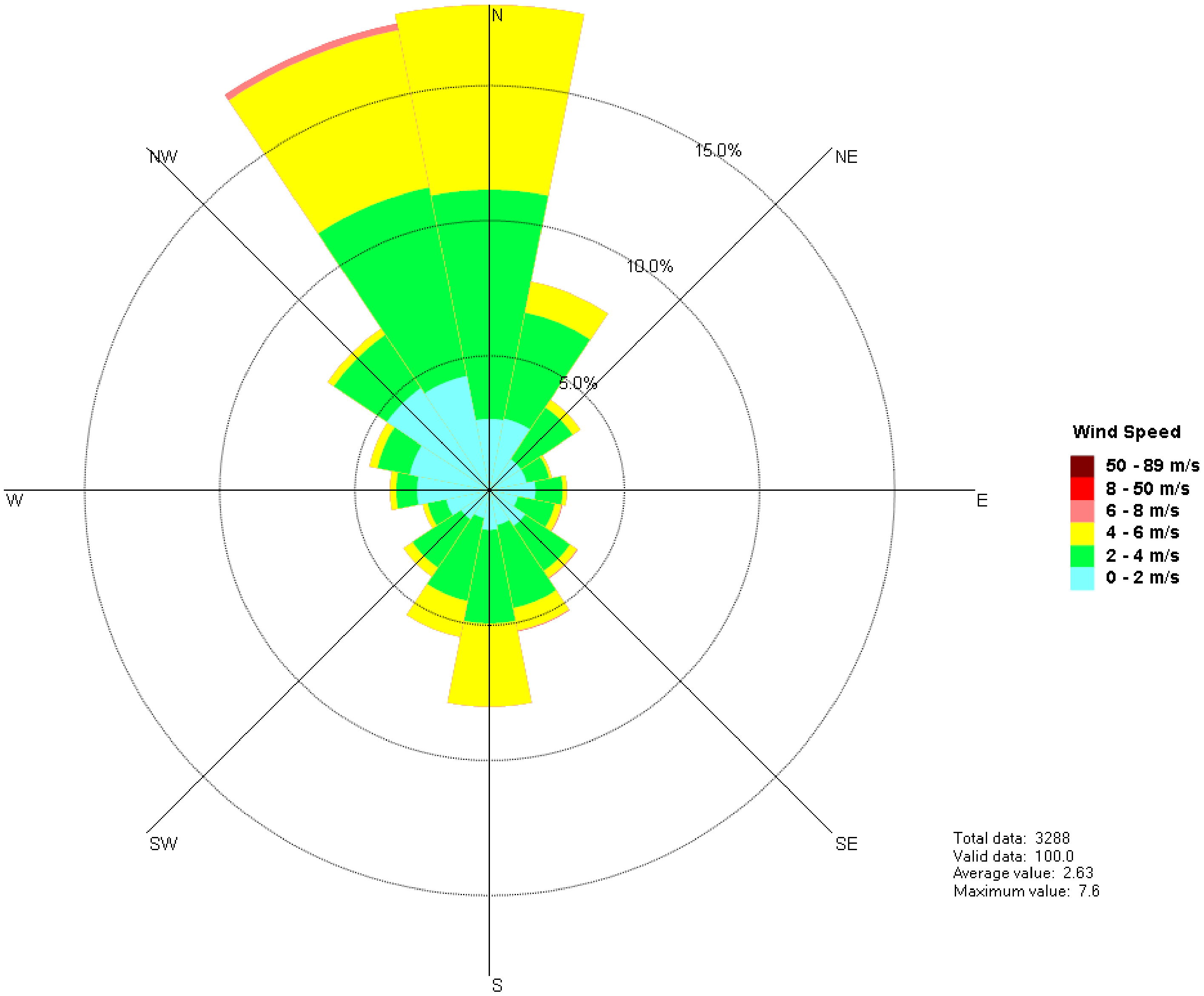


Temperature (°C)
40
35
30
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
28.5
31.6
36.0
38.4
36.8
35.4
35.5
34.3
33.4
32.5
30.4
28.0
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
15.4
16.9
20.5
24.0
25.5
26.0
26.1
25.7
25.3
23.8
19.9
16.4
Max
Mean
Min

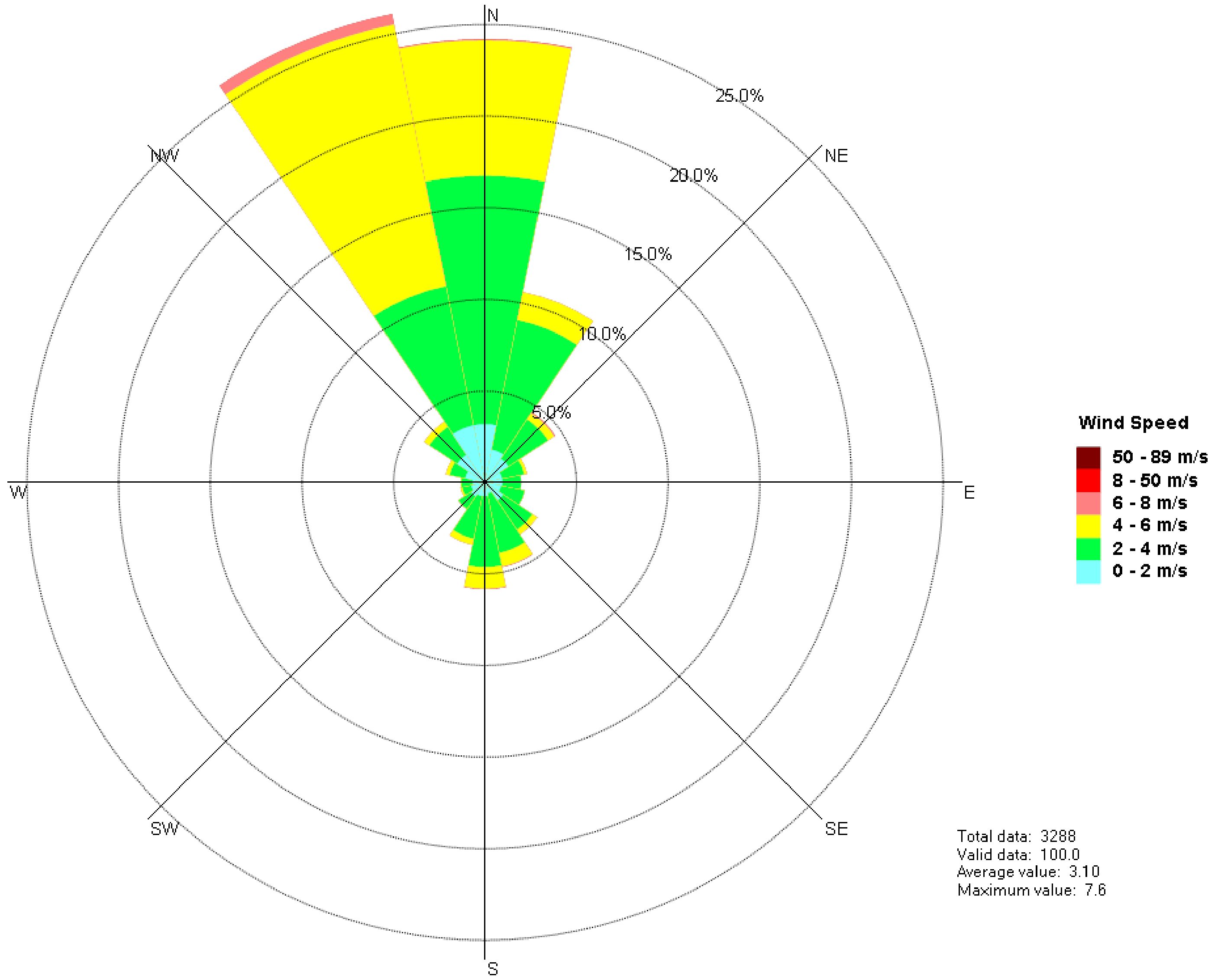

30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
Average Temperature (°C)
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
y = 0.051x - 74.083
R² = 0.2996
Temperature Data
Linear (Temperature Data)

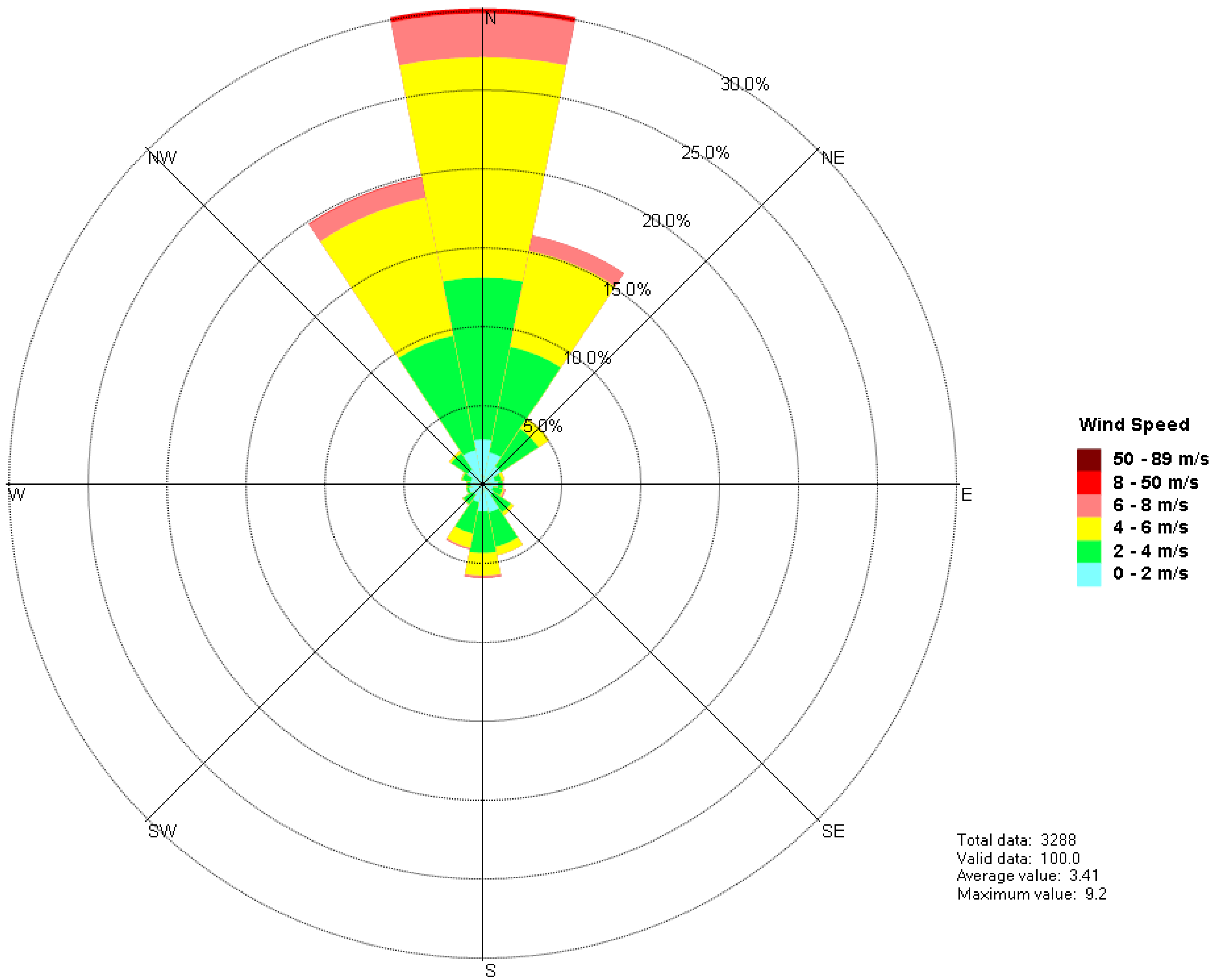


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 26304
Valid data: 100.0
Average value: 2.41
Maximum value: 9.2

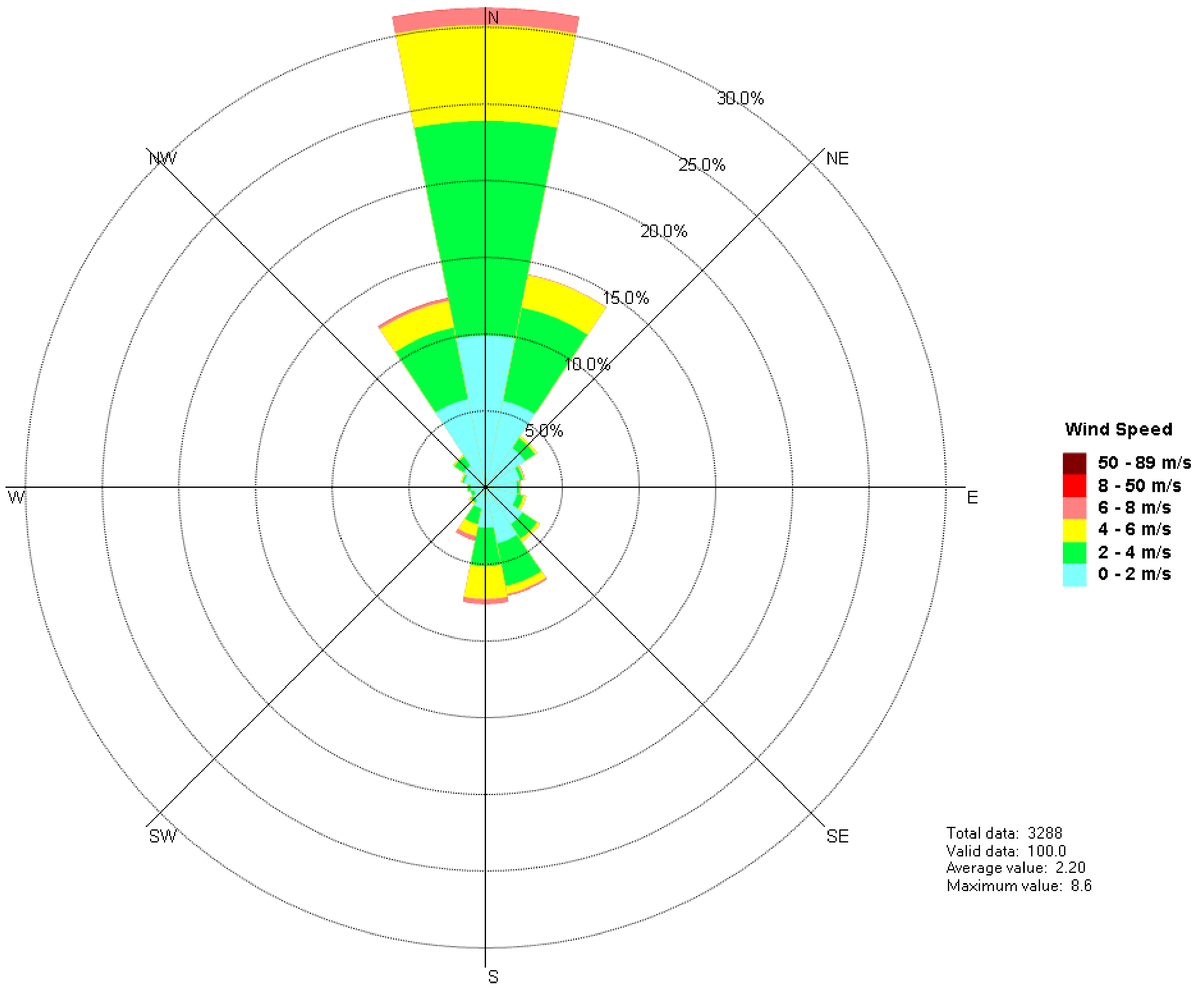


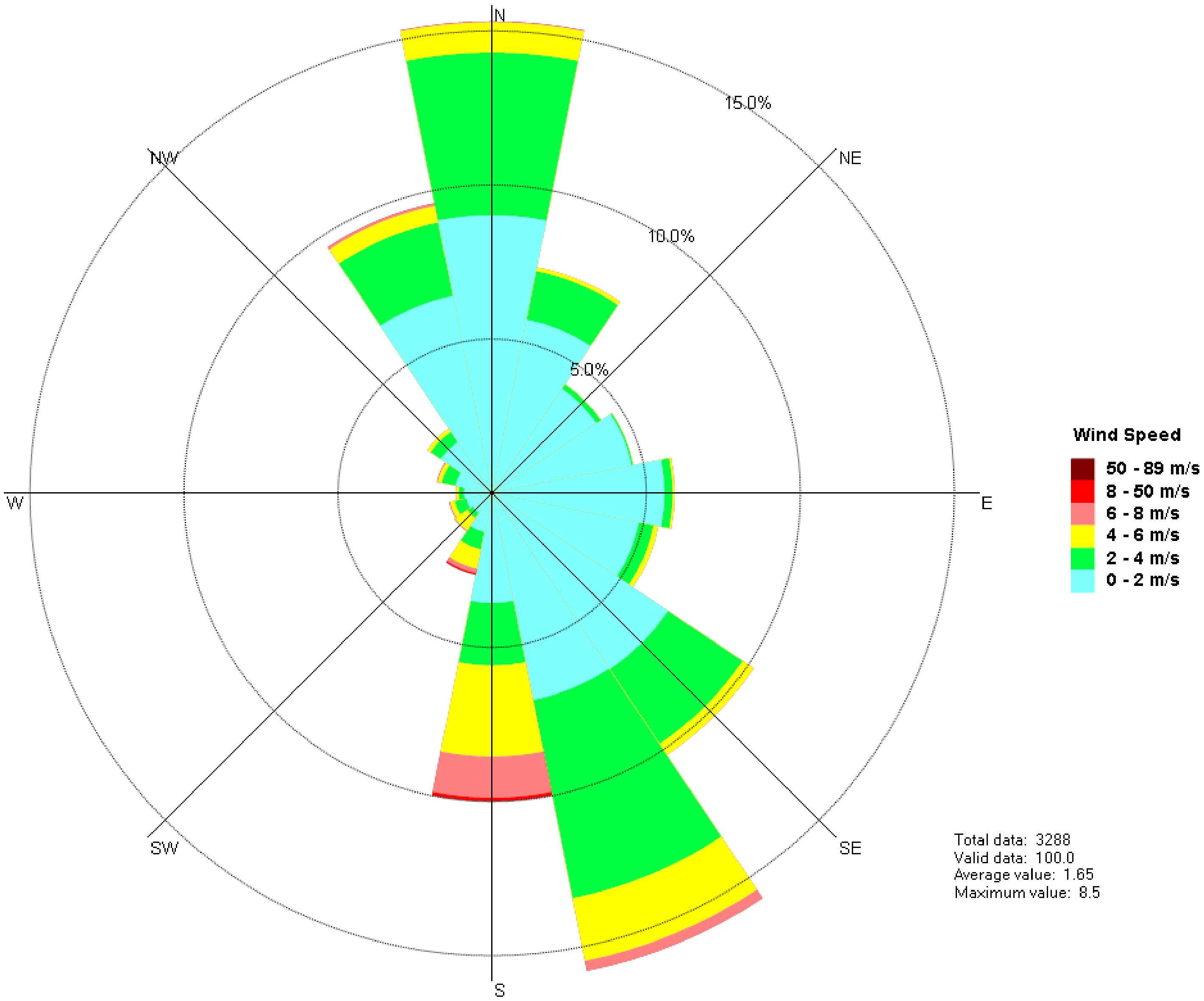
N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.63
Maximum value: 7.6


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
20.0%
25.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 3.10
Maximum value: 7.6

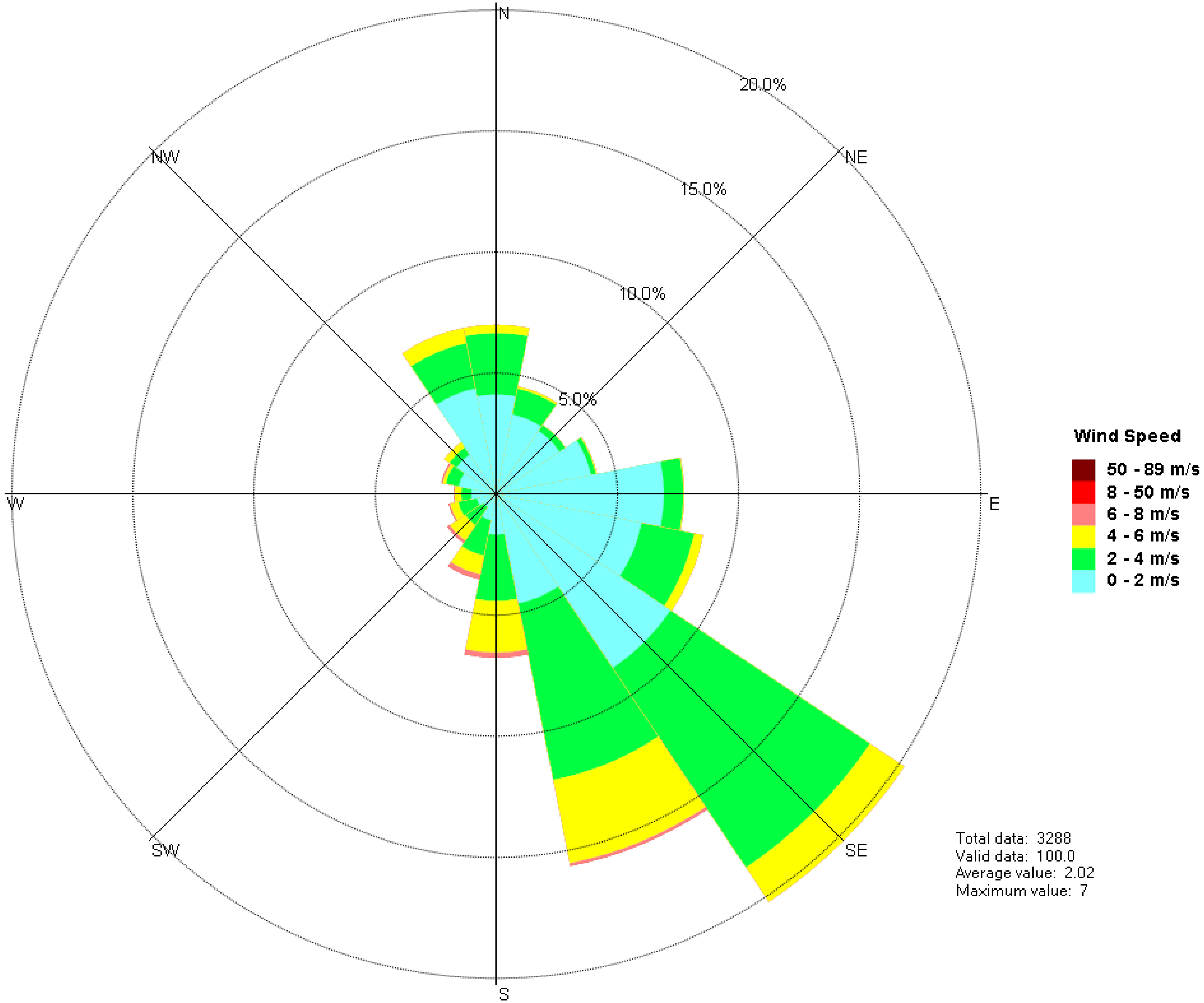


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 3.41
Maximum value: 9.2


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.20
Maximum value: 8.6

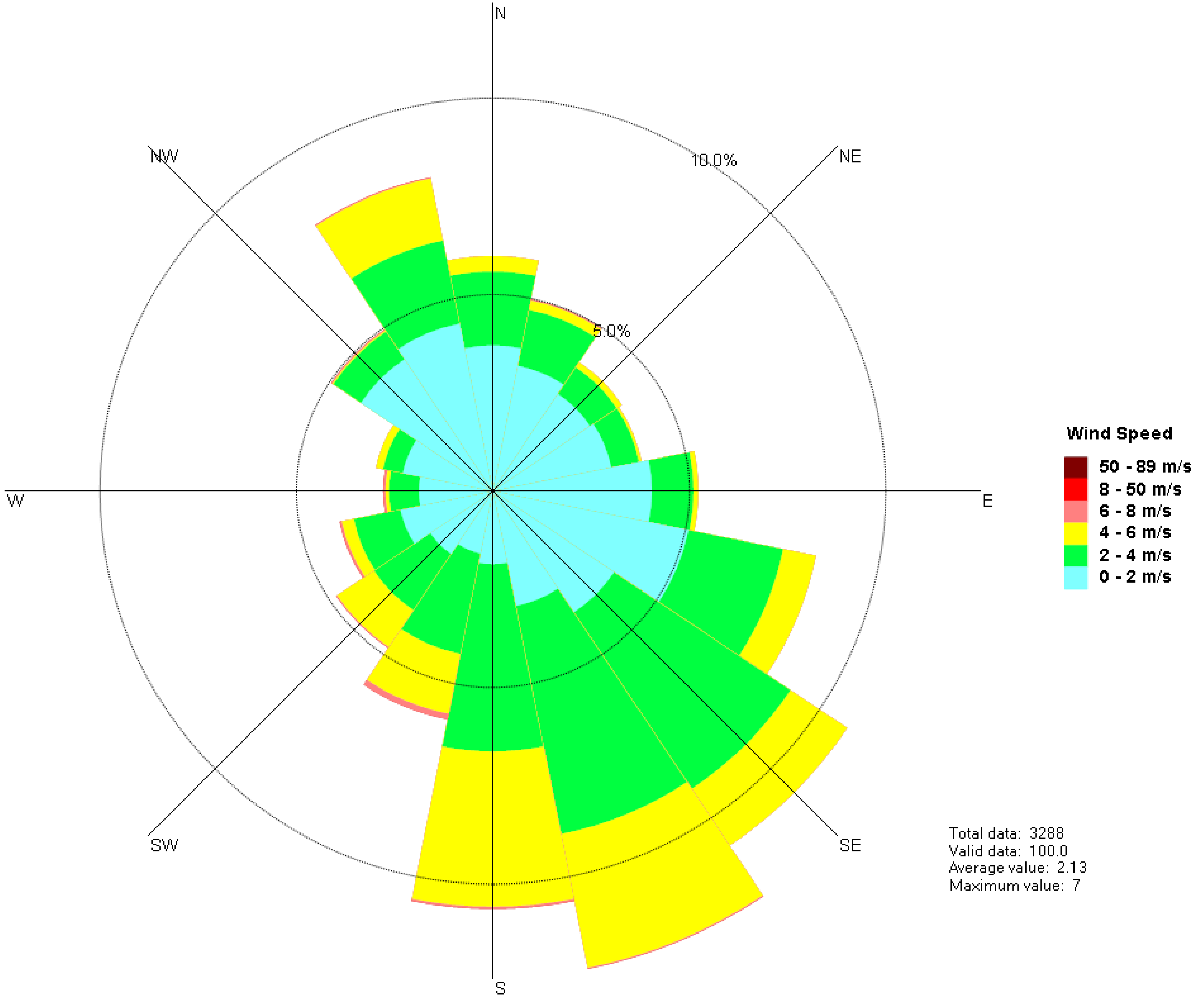


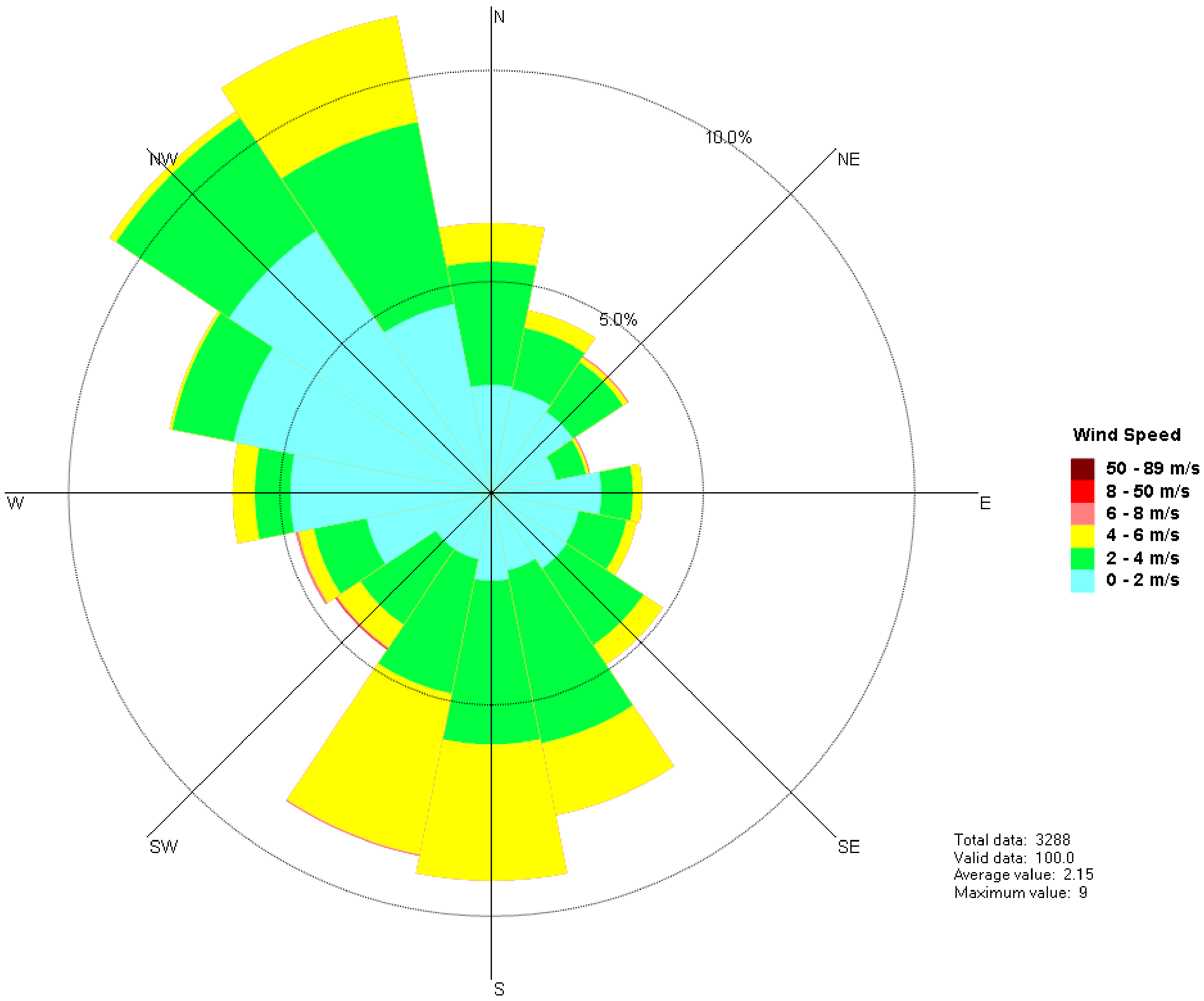
N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 1.65
Maximum value: 8.5



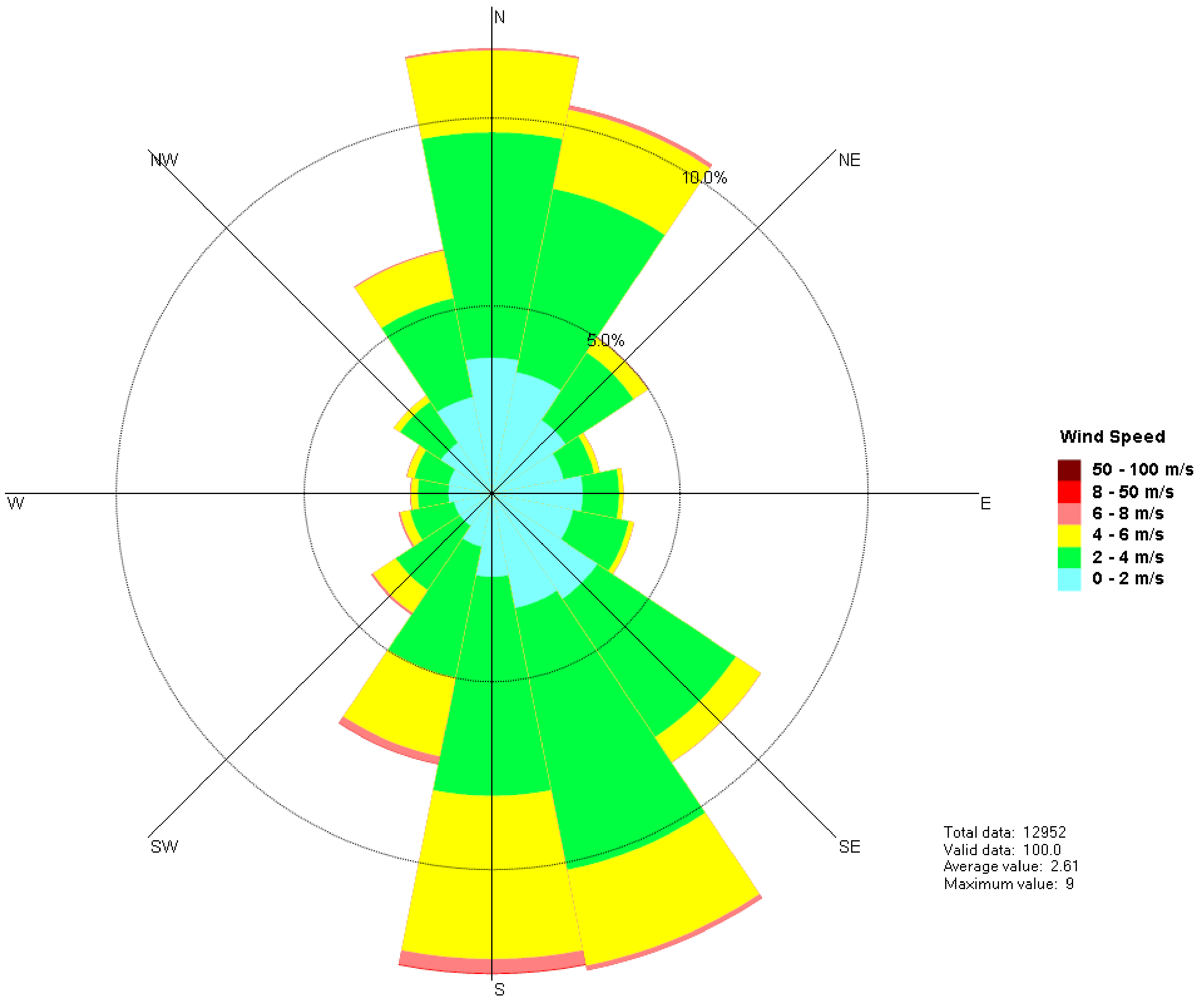
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS – (15:00 – 18:00)
WIND ROSE DATASET (2010-2012)

Figure 5.7


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.13
Maximum value: 7



N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.15
Maximum value: 9



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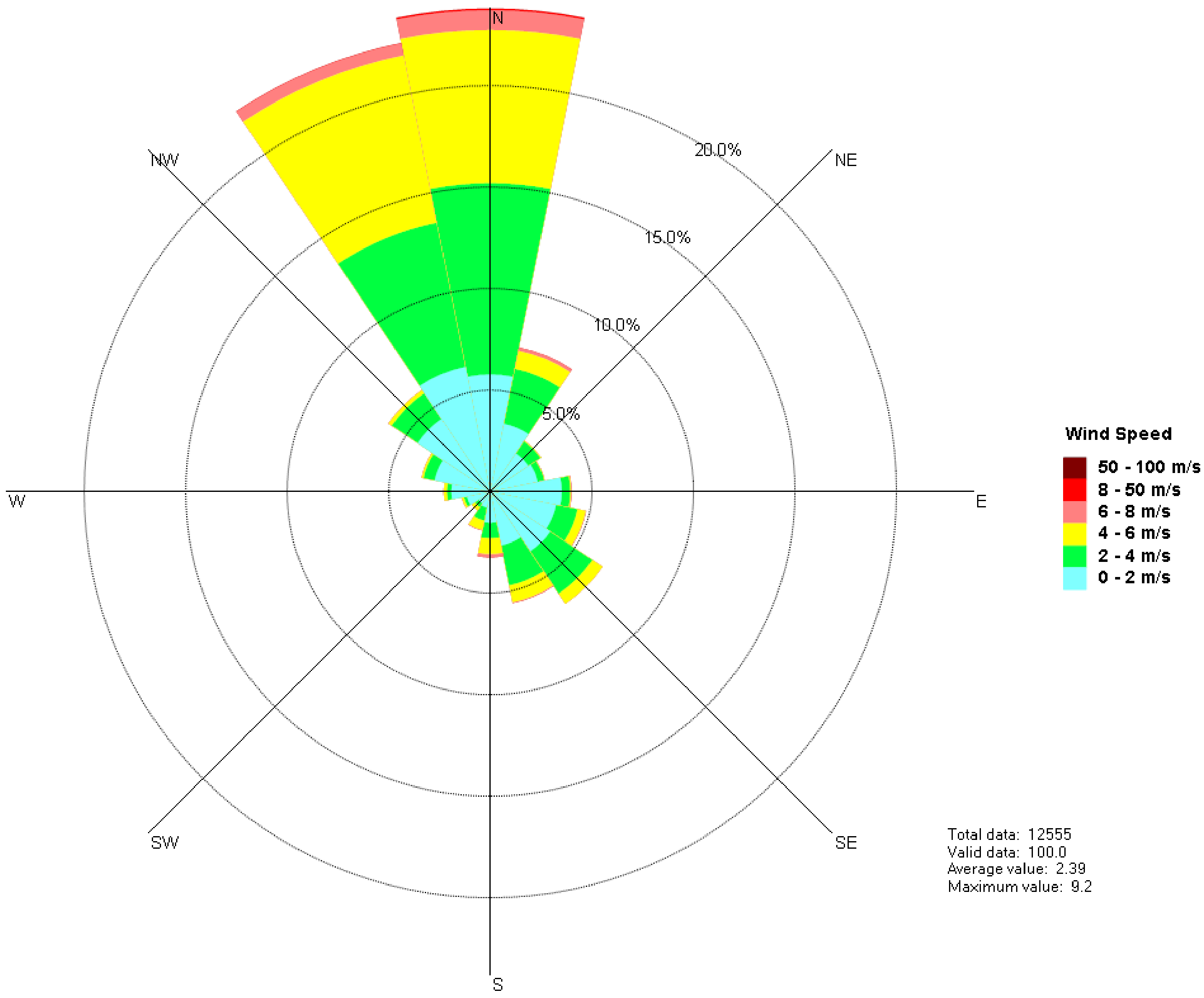
LETPADAUNG – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS (2010-2012): WET SEASON (MAY – OCT) MEASUREMENTS
LETPADAUNG MM5 MESOSCALE MODEL DATASET

Ref: PE701-00022 M13017
Figure 5.10


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
20.0%
Wind Speed
50 - 100 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 12555
Valid data: 100.0
Average value: 2.39
Maximum value: 9.2

ATTACHMENT 2.1

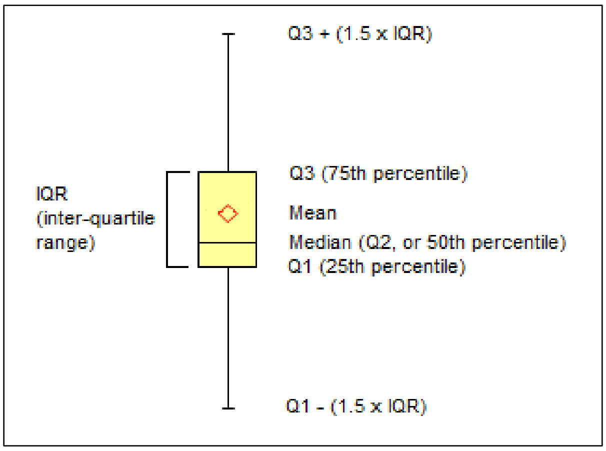
Annual Precipitation Analysis

Annual Precipitation Data: Monywa Township (1961-2013)

Year	Precip. (mm)	Rain Days
1961	731.0	61
1962	684.0	53
1963	896.0	63
1964	581.0	50
1965	1,198.0	91
1966	664.0	60
1967	686.0	67
1968	1,110.0	66
1969	744.0	50
1970	611.0	66
1971	1,042.0	62
1972	676.0	55
1973	1,370.0	99
1974	668.0	61
1975	1,067.0	73
1976	1,275.0	86
1977	921.0	70
1978	910.0	76
1979	438.0	38
1980	742.0	52
1981	797.0	67
1982	411.0	44
1983	588.0	59
1984	855.0	55
1985	544.0	57
1986	642.0	50
1987	741.0	58
1988	1,015.0	62
1989	722.0	49
1990	601.0	50
1991	518.0	55
1992	887.0	68
1993	612.0	60
1994	674.6	58
1995	Exclude	Exclude
1996	802.4	101
1997	609.6	75
1998	437.2	61
1999	Exclude	Exclude
2000	604.2	77
2001	653.3	80
2002	478.2	82
2003	597.4	63
2004	871.6	76
2005	739.9	77
2006	766.8	88
2007	1,032.5	73
2008	566.2	48
2009	689.2	51
2010	1,220.9	64
2011	1,184.2	81
2012	813.7	54
2013	Exclude	Exclude

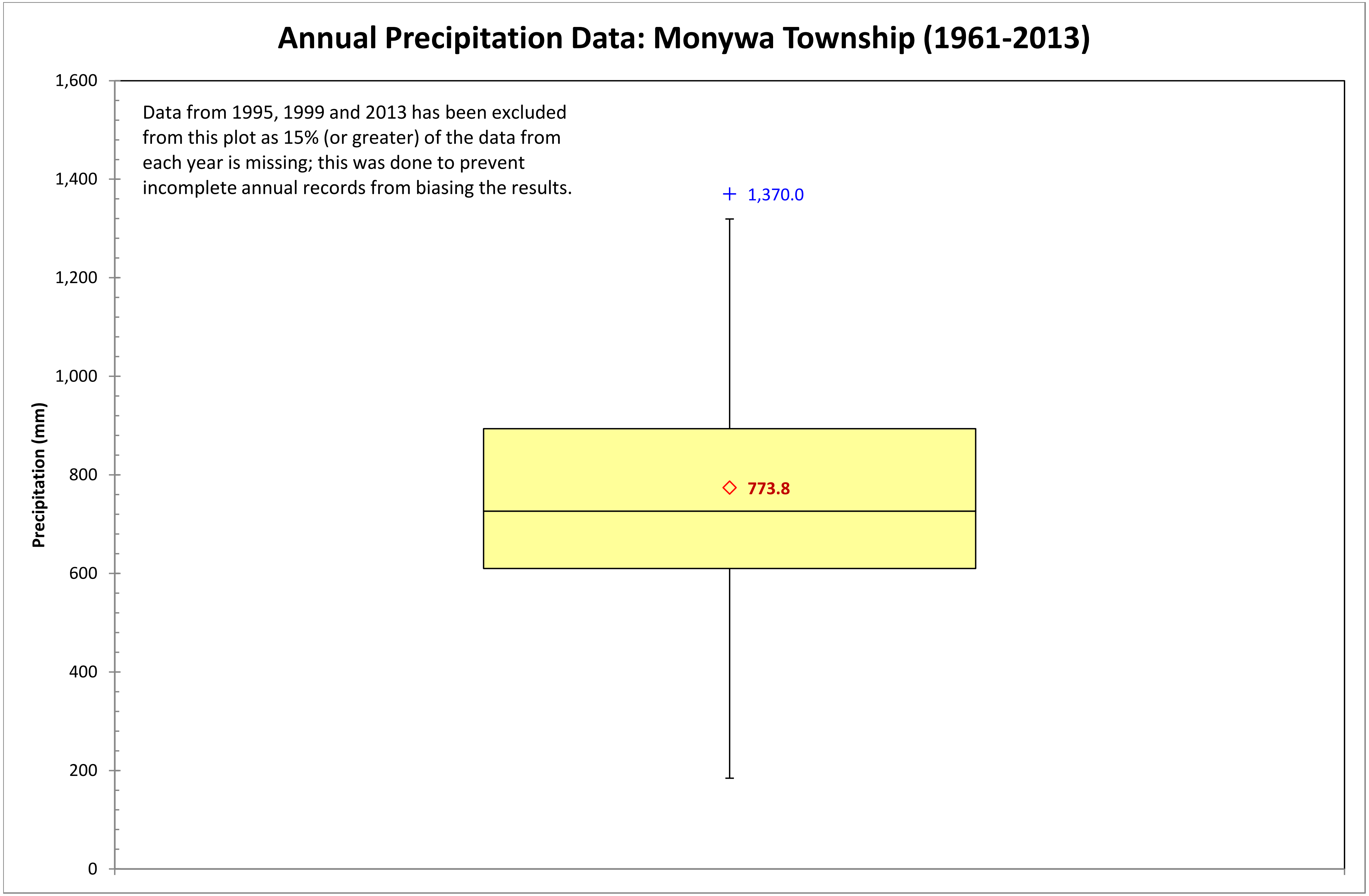
Stat	Precip. (mm)
Mean	773.8
SD	230.0
Median	726.5
Q1	610.0
Q3	893.8
Minimum	411.0
Maximum	1,370.0
Count	50
Ext Max	1,319.4
Ext Min	184.3
25th Pct	610.0
50th Pct	116.5
75th Pct	167.3
1.5 * IQR	425.7

Stat	Rain Days
Mean	64.8



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Precipitation Data: Monywa Township (1961-2013)
Data from 1995, 1999 and 2013 has been excluded from this plot as 15% (or greater) of the data from each year is missing; this was done to prevent incomplete annual records from biasing the results.
1,370.0
773.8
Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0

ATTACHMENT 2.2

Monthly Precipitation Analysis

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Precipitation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	0.0	0.0	12.0	60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962	1.0	4.0	0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0	2.0	1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965	5.0	0.0	0.0	2.0	79.0	50.0	69.0	166.0	496.0	236.0	10.0	85.0
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	10.0
1967	19.0	0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968	14.0	3.0	1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	22.0
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0	356.0	64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0	186.0	1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975	31.0	0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0	102.0	13.0	8.0	178.0	193.0	60.0	74.0	124.0	402.0	115.0	6.0
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0	182.0	140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0	158.0	70.0	70.0	28.0	0.0	39.0
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0	13.0	32.0	139.0	243.0	31.0	92.0	47.0	82.0	118.0	0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0	140.0	14.0
1984	0.0	0.0	0.0	83.0	59.0	342.0	80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987	3.0	31.0	1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0	175.0	125.0	63.0	180.0	125.0	0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992	1.0	4.0	0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	23.0
1993	0.0	3.0	2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0	2.0	5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0	2.8	95.8	32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	75.2
1997	0.0	0.8	5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0	14.7	9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0	6.6	7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002	2.3	0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005	0.3	0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	28.4
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0	9.4	0.0	48.3	386.2	60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008	19.0	0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8	512.5	0.0	13.0
2011	0.0	0.0	5.5	99.5	88.5	265.4	85.4	235.2	95.2	303.0	0.0	6.5
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

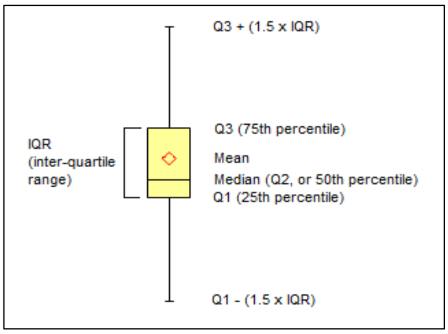
Precipitation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave. # of Rain Days	0	0	1	4	9	9	8	10	11	10	3	1
Mean	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
SD	5.9	14.8	13.7	22.3	69.5	79.4	42.5	80.4	89.1	94.9	44.4	16.9
Median	0.0	0.0	1.0	20.5	94.4	71.5	59.0	103.0	149.5	135.5	12.2	0.0
Q1	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
Q3	0.0	0.0	4.8	38.4	140.5	128.5	83.3	171.8	211.7	180.0	45.3	2.1
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	31.0	102.0	95.8	99.5	386.2	342.0	182.0	356.0	496.0	512.5	186.0	85.0
Count	51	51	51	51	52	51	52	52	52	52	52	52
Ext Max	0.0	0.0	12.0	83.1	271.0	258.3	156.5	333.8	380.4	326.1	113.1	5.3
Ext Min	0.0	0.0	-7.2	-36.3	-77.0	-87.8	-38.9	-98.0	-69.5	-63.5	-67.9	-3.2
25th Pct	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
50th Pct	0.0	0.0	1.0	12.0	40.9	29.5	24.6	39.1	50.3	52.9	12.2	0.0
75th Pct	0.0	0.0	3.8	17.9	46.1	57.0	24.3	68.8	62.1	44.5	33.0	2.1
1.5 * IQR	0.0	0.0	7.2	44.8	130.5	129.8	73.3	161.9	168.7	146.1	67.9	3.2

Note: N/D = No Data Available, N/A = Not Applicable.

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013)
(Analysis Format | Outliers Removed)

Precipitation Data (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1961	0.0	0.0		60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962			0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0		1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965		0.0	0.0	2.0	79.0	50.0	69.0	166.0		236.0	10.0	
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	
1967		0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968			1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0		64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0		1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975		0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0			8.0	178.0	193.0	60.0	74.0	124.0			
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0		140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0		70.0	70.0	28.0	0.0	
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0		32.0	139.0	243.0	31.0	92.0	47.0	82.0		0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0		
1984	0.0	0.0	0.0	83.0	59.0		80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987			1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0		125.0	63.0	180.0		0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992			0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	
1993	0.0		2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0		5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0			32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	
1997	0.0		5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0		9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0		7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002		0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005		0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0		0.0	48.3		60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008		0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8		0.0	
2011	0.0	0.0	5.5		88.5		85.4	235.2	95.2	303.0	0.0	
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

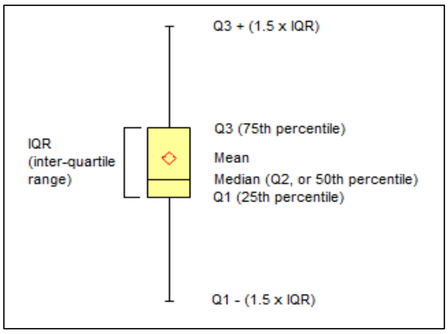
Precipitation Data Summary Statistics (mm)												
Stat.	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rain Days	0.3	0.4	1.0	3.8	9.0	8.6	7.7	10.0	11.3	9.5	2.7	1.0
Mean	0.0	0.0	1.8	24.5	96.0	91.6	60.6	116.7	159.9	129.0	21.6	0.3
SD	0.0	0.0	2.9	19.8	57.3	68.6	34.5	73.9	76.6	70.8	28.4	0.7
Median	0.0	0.0	0.0	20.2	92.8	67.0	54.5	98.0	148.1	125.8	9.7	0.0
Q1	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
Q3	0.0	0.0	2.9	35.8	139.5	116.0	80.3	171.2	211.0	176.8	37.3	0.0
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	0.0	0.0	11.0	83.0	263.0	248.0	134.0	315.0	378.0	303.0	107.0	3.0
Count	41	39	46	50	51	49	49	51	51	50	47	41
Ext Max	0.0	0.0	7.2	77.0	270.8	228.5	149.6	333.2	379.9	318.6	93.2	0.0
Ext Min	0.0	0.0	-4.3	-33.0	-79.3	-71.5	-35.4	-98.7	-70.5	-59.6	-55.9	0.0
25th Pct	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
50th Pct	0.0	0.0	0.0	11.9	40.8	26.0	20.5	34.7	49.7	43.6	9.7	0.0
75th Pct	0.0	0.0	2.9	15.6	46.7	49.0	25.8	73.2	62.9	50.9	27.6	0.0
1.5 * IQR	0.0	0.0	4.3	41.3	131.3	112.5	69.4	161.9	168.9	141.8	55.9	0.0

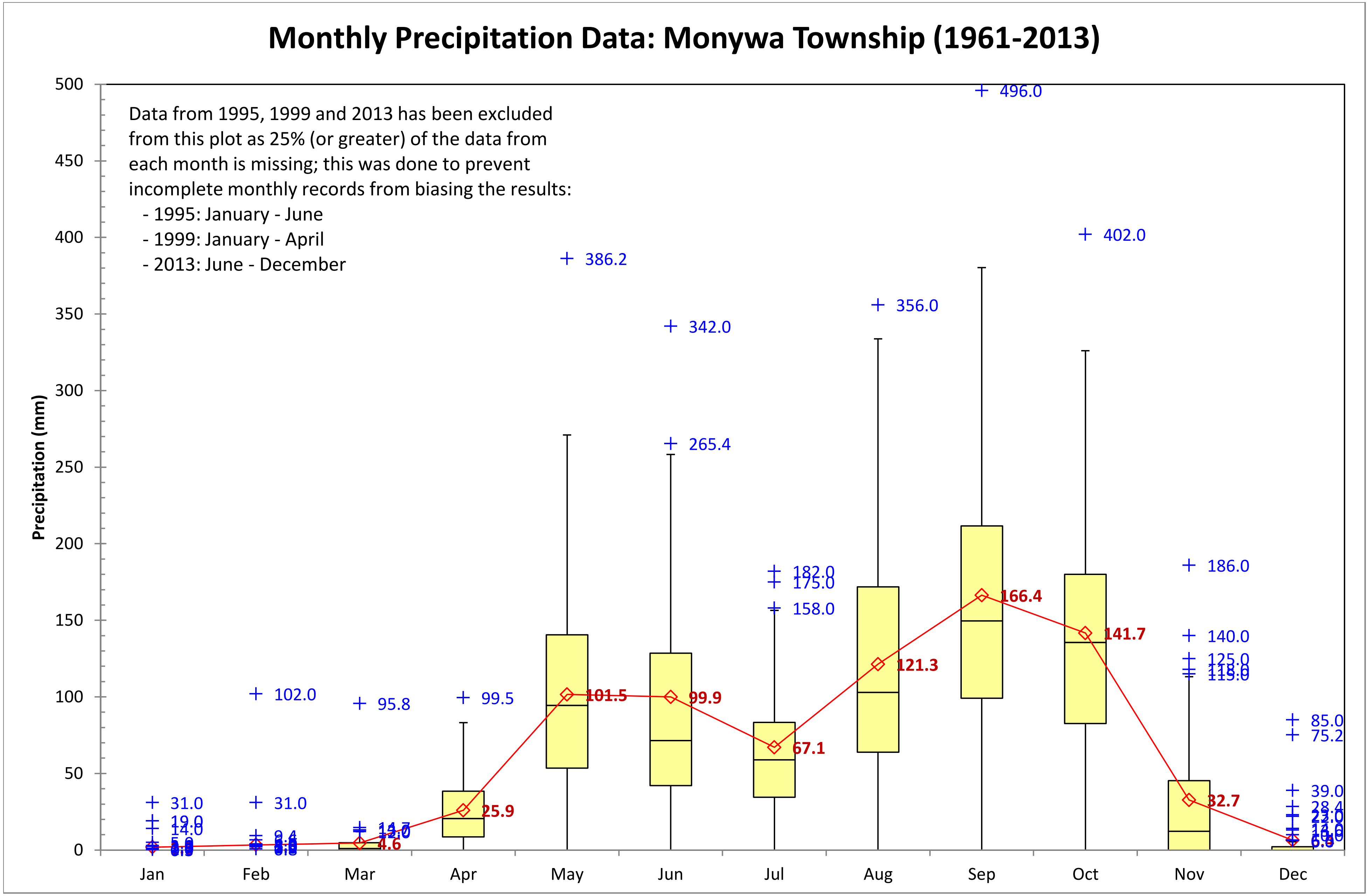
Note: N/D = No Data Available, N/A = Not Applicable.

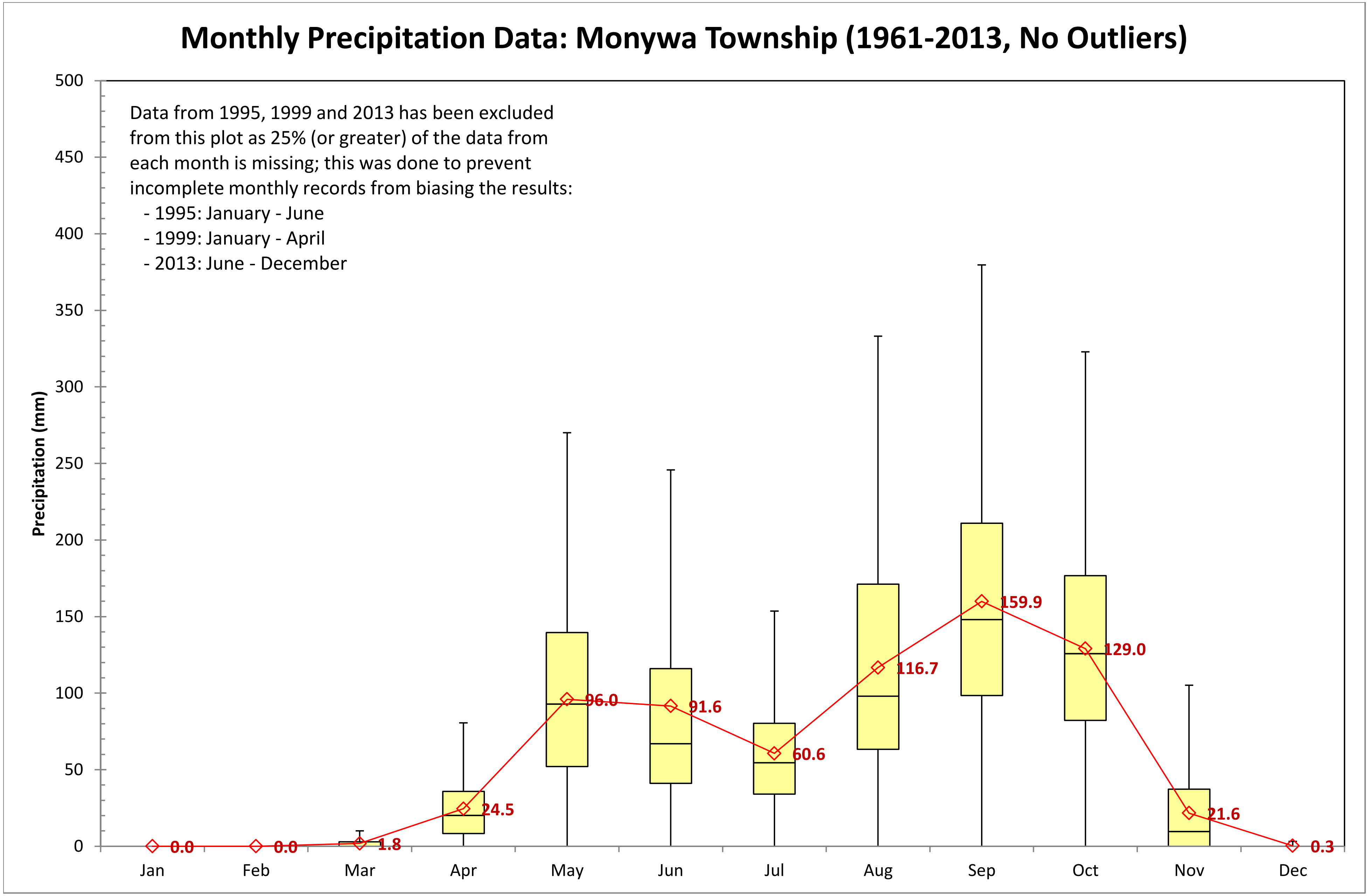
Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013)
(Analysis Format | Outliers Removed)

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers




Monthly Precipitation Data: Monywa Township (1961-2013)
Precipitation (mm)
Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
500
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
31.0
19.0
14.0
102.0
31.0
95.8
4.6
99.5
25.9
386.2
101.5
342.0
265.4
99.9
182.0
175.0
158.0
67.1
356.0
121.3
496.0
166.4
402.0
141.7
186.0
140.0
125.0
32.7
85.0
75.2
39.0
28.4



Monthly Precipitation Data: Monywa Township (1961-2013, No Outliers)
Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
0.0
0.0
1.8
24.5
96.0
91.6
60.6
116.7
159.9
129.0
21.6
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

ATTACHMENT 2.3

Daily Precipitation Frequency Analysis

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

Max Daily Data		Rank	Weibull	ARI	Ranked
Year	Precip. (mm)	(highest to lowest) m	Exceedance Probability p	(yrs)	Precip (mm)
1961	77.0	1	0.019	53.00	165.0
1962	59.0	2	0.038	26.50	135.0
1963	76.0	3	0.057	17.67	135.0
1964	98.0	4	0.075	13.25	125.0
1965	90.0	5	0.094	10.60	117.1
1966	75.0	6	0.113	8.83	117.0
1967	125.0	7	0.132	7.57	109.0
1968	109.0	8	0.151	6.63	108.5
1969	73.0	9	0.170	5.89	105.5
1970	65.0	10	0.189	5.30	103.0
1971	92.0	11	0.208	4.82	102.0
1972	71.0	12	0.226	4.42	99.3
1973	103.0	13	0.245	4.08	99.0
1974	85.0	14	0.264	3.79	98.0
1975	69.0	15	0.283	3.53	97.0
1976	102.0	16	0.302	3.31	93.5
1977	72.0	17	0.321	3.12	92.0
1978	70.0	18	0.340	2.94	91.0
1979	99.0	19	0.358	2.79	90.0
1980	52.0	20	0.377	2.65	88.0
1981	97.0	21	0.396	2.52	85.0
1982	36.0	22	0.415	2.41	82.3
1983	80.0	23	0.434	2.30	80.0
1984	135.0	24	0.453	2.21	78.0
1985	52.0	25	0.472	2.12	77.0
1986	78.0	26	0.491	2.04	77.0
1987	91.0	27	0.509	1.96	76.5
1988	117.0	28	0.528	1.89	76.0
1989	64.0	29	0.547	1.83	75.0
1990	75.0	30	0.566	1.77	75.0
1991	45.0	31	0.585	1.71	73.0
1992	88.0	32	0.604	1.66	72.0
1993	66.0	33	0.623	1.61	71.4
1994	117.1	34	0.642	1.56	71.0
1995	68.1	35	0.660	1.51	70.0
1996	57.7	36	0.679	1.47	69.0
1997	47.7	37	0.698	1.43	68.1
1998	48.4	38	0.717	1.39	67.8
1999	82.3	39	0.736	1.36	67.0
2000	67.8	40	0.755	1.33	66.0
2001	76.5	41	0.774	1.29	65.0
2002	43.9	42	0.792	1.26	64.0
2003	93.5	43	0.811	1.23	59.0
2004	99.3	44	0.830	1.20	57.7
2005	71.4	45	0.849	1.18	52.0
2006	77.0	46	0.868	1.15	52.0
2007	105.5	47	0.887	1.13	48.4
2008	42.4	48	0.906	1.10	47.7
2009	67.0	49	0.925	1.08	45.0
2010	108.5	50	0.943	1.06	43.9
2011	165.0	51	0.962	1.04	42.4
2012	135.0	52	0.981	1.02	36.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Pearson 5 (3P)	2	5	10
Pearson 6	6	6	36
Gen. Logistic	12	3	36
Burr	18	2	36
Pearson 6 (4P)	5	10	50
Log-Logistic (3P)	4	14	56
Gumbel Max	3	26	78
Gen. Extreme Value	13	7	91
Log-Pearson 3	11	13	143

Three fits were selected for comparison:

1) **Wakeby** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Note that these predictions should be multiplied by **1.143** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

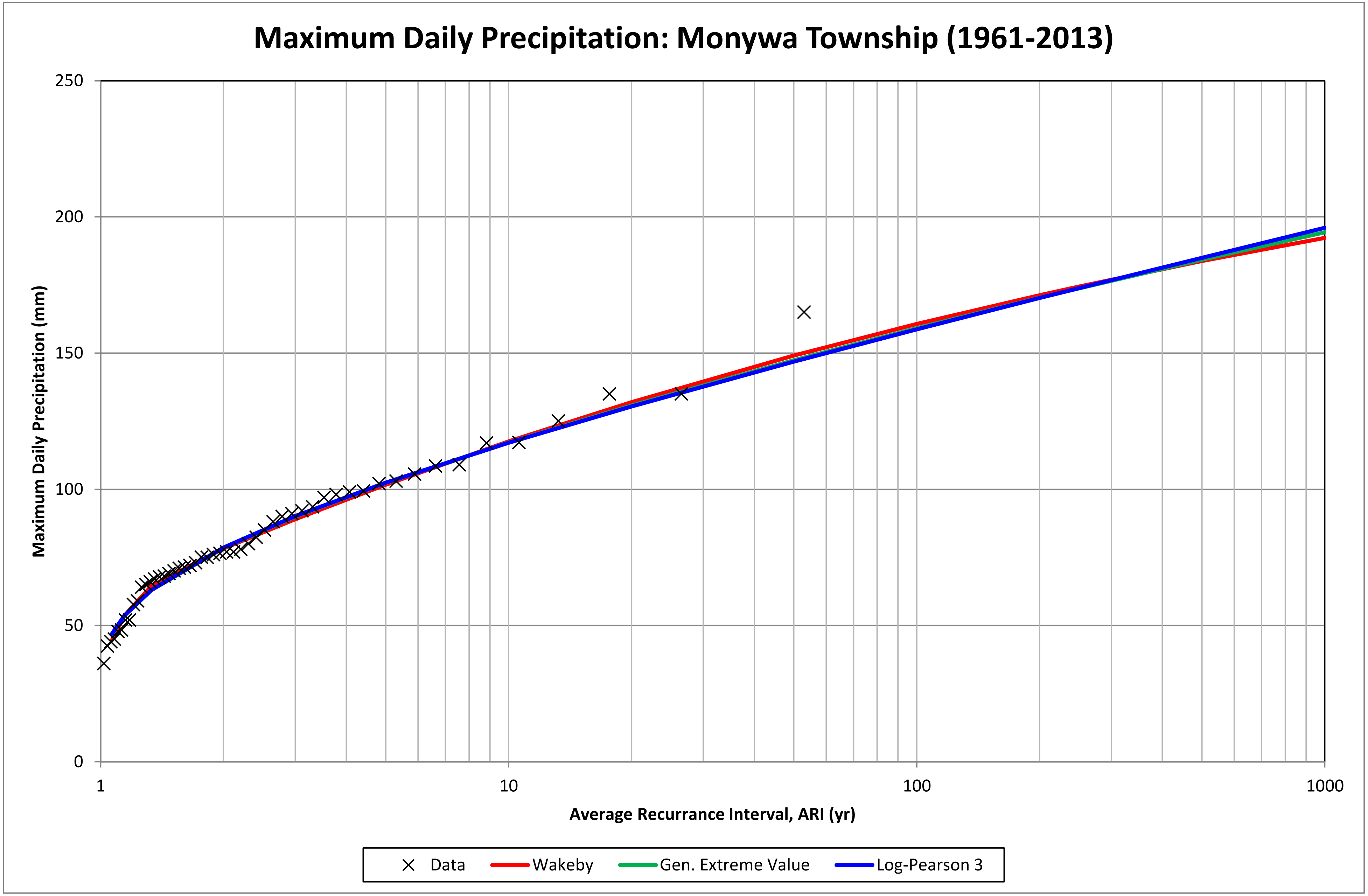
Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

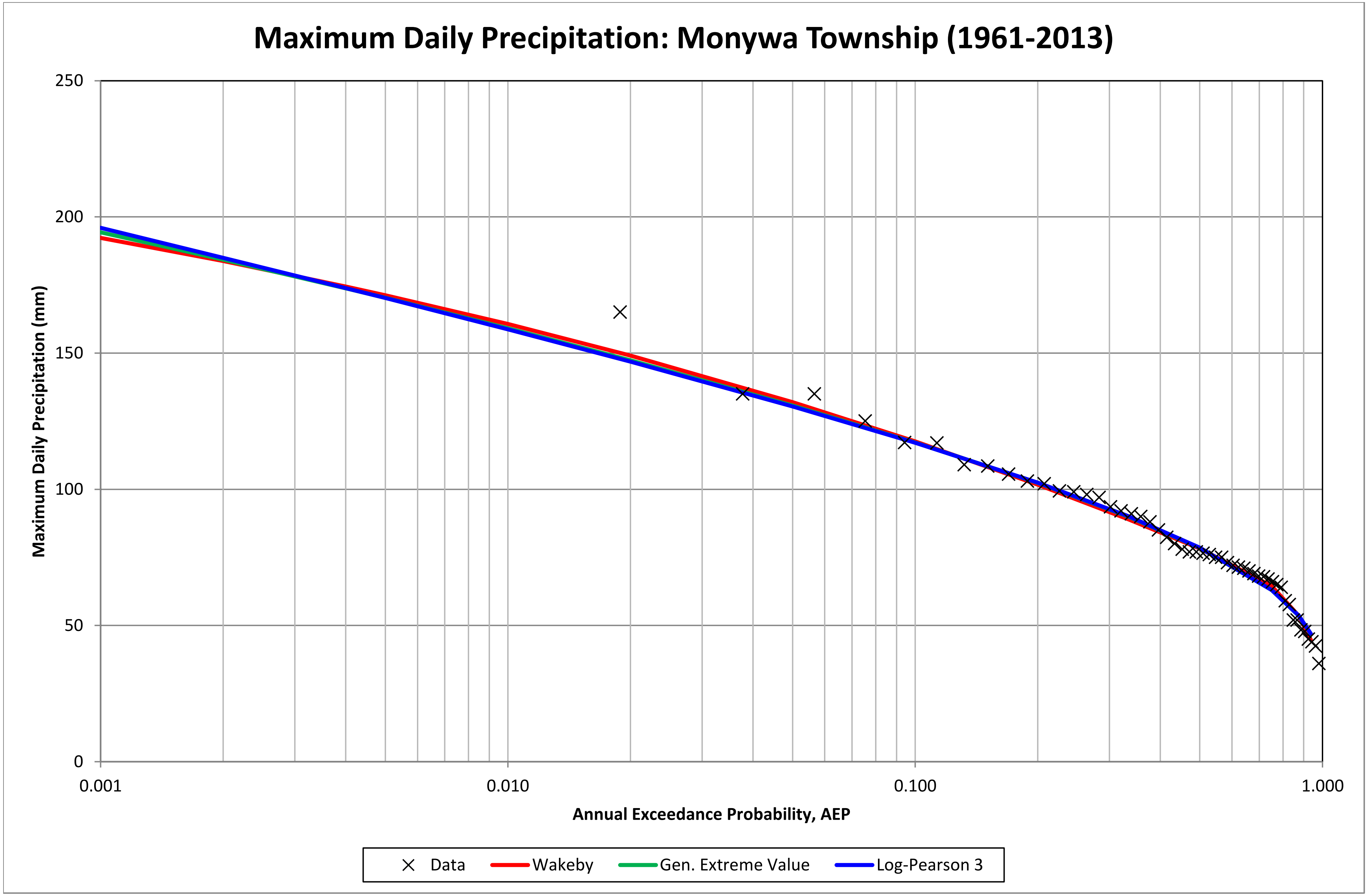
2013 was excluded from this analysis as a significant portion of data from the wet season was missing.

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent short-term storm precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	221.90042	k =	-0.06676115	α =	148.2847421
			β =	8.2130851	σ =	22.3984849	β =	-0.0264996
			γ =	29.8116959	μ =	70.39076611	γ =	8.285147763
			δ =	-0.1356425				
			ξ =	31.5886933				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	192.3	N/A	194.3	26.53	196.0	26.44
0.998	0.002	500	183.8	N/A	184.3	26.53	185.0	26.44
0.996	0.004	250	174.5	N/A	173.8	26.53	173.9	26.44
0.995	0.005	200	171.3	N/A	170.3	26.53	170.2	26.44
0.990	0.010	100	160.7	N/A	159.1	26.53	158.7	26.44
0.980	0.020	50	149.1	N/A	147.3	26.53	146.9	26.44
0.950	0.050	20	132.0	N/A	130.7	26.53	130.4	26.44
0.900	0.100	10	117.6	N/A	117.2	26.53	117.1	26.44
0.800	0.200	5	101.7	N/A	102.4	26.53	102.5	26.44
0.667	0.333	3	89.0	N/A	90.0	26.53	90.2	26.44
0.500	0.500	2.0	78.2	N/A	78.5	26.53	78.6	26.44
0.250	0.750	1.3	64.5	N/A	63.0	26.53	63.0	26.44
0.125	0.875	1.1	53.5	N/A	53.6	26.53	53.6	26.44
0.063	0.937	1.1	44.7	N/A	46.8	26.53	47.0	26.44
Kolmogorov Smirnov (Statistic, Rank)			0.06197	1	0.07306	13	0.07296	11
Anderson Darling (Statistic, Rank)			0.16639	1	0.22384	7	0.22713	13


Maximum Daily Precipitation: Monywa Township (1961-2013)
Maximum Daily Precipitation (mm)
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3



Maximum Daily Precipitation: Monywa Township (1961-2013)
250
200
150
100
50
0
Maximum Daily Precipitation (mm)
0.001
0.010
0.100
1.000
Annual Exceedance Probability, AEP
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.4

Precipitation IDF Curve Analysis

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

IDF curves for the **Letpadaung Copper** project are derived using the Rainfall Ratio method discussed in Chapter 4 of "Highway and Urban Hydrology in the Tropics", 1984, L.H. Watkins and D. Fiddes - London, Great Britain - Pentech Press, Ltd.

Twenty-four hour duration precipitation intensities for various average recurrence interval (ARI) events are used along with empirically-derived coefficients from Table 4.6 of (Watkins & Fiddes, 1984) to construct IDF curves. The fundamental equations used with this technique are:

$I_t = a / (b + t)^n$ and $RR_t = (I_t \cdot t) / (I_{24} \cdot 24)$

where:

I_t = precipitation intensity for a t-hour duration storm (mm/h) RR_t = rainfall ratio for a t-hour duration storm (mm/mm)

t = precipitation duration (h)

a, b and n = fitting coefficients

by substituting the first expression into the second, the fitting coefficient "a" is eliminated, leaving:

$RR_t = (t / 24) * ((b + 24) / (b + t))^n$

The basic approach then, is using a list of twenty-four hour duration intensities (depth / 24 hours) for various ARI periods and fitting coefficients "b" and "n" selected from Table 4.6 of (Watkins & Fiddes, 1984):

1) Compute the corresponding rainfall ratio (RR_t) for a select duration (t) using the third relationship and then
2) Solve the second relationship for I_t as follows: $I_t = (RR_t * I_{24} * 24) / t$

In this case, the value for Phnom Penh, Cambodia were applied, as given in "Best Practise Guidelines for Flood Risk Assessment", Mekong River Commission, December 2009.

This process is completed for all of the various ARI's and periods selected to construct an IDF curve using the following five-step process.
First, the I_{24} values for the each of the selected ARI's are tabulated:

Annual Exceedance Probability	Average Recurrance Interval (yr)	24-hr Precip. (mm)	24-hr Precip. Factored (mm)	24-hr Intensity I_{24} (mm/h)
50.0%	2	78.5	89.7	3.7
20.0%	5	102.4	117.0	4.9
10.0%	10	117.2	134.0	5.6
5.0%	20	130.7	149.4	6.2
2.0%	50	147.3	168.4	7.0
1.0%	100	159.1	181.9	7.6
0.5%	200	170.3	194.7	8.1
0.2%	500	184.3	210.7	8.8

Second, the fitting coefficient "b" is selected from the aforementioned reference for Phnom Penh, Cambodia: **b =** 0.23

Third, the fitting coefficient "n" is selected from the aforementioned reference for Phnom Penh, Cambodia: **n =** 0.86

Fourth, rainfall ratios (RR_t) and the intensities (I_t) which follow the range of selected durations (t) are computed and tabulated:

Note: IDF and DDF values for 48 and 72 hour storm events were calculated using frequency analysis. Storm depths for 24, 48 and 72 hour events were factored following "Ratio of true to fixed-interval maximum rainfall", ASCE Journal of the Hydraulics Division: Weiss, 1964.

Duration	24	48	72
Factor	1.143	1.067	1.044

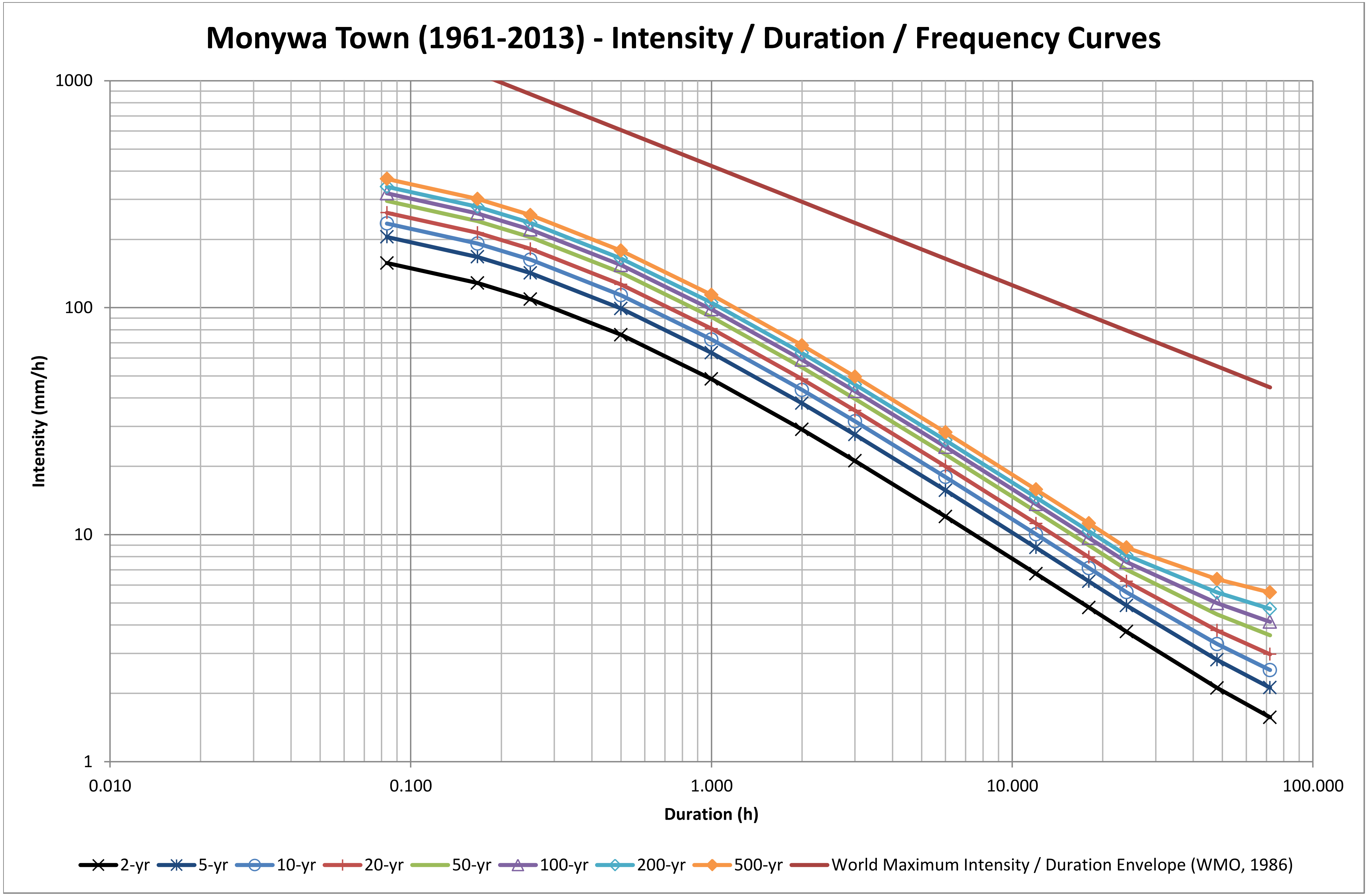
Precipitation Duration t (min)	(h)	Rainfall Ratio RR_t (mm/mm)	Precipitation Intensity (I_t) for given AEP (%) or ARI (1 in _ year) Storm (mm/h)								
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
			I_{24} (mm/h)	3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
5	0.083	0.146		157.3	205.1	234.8	261.9	295.2	318.8	341.2	369.3
10	0.167	0.239		128.4	167.4	191.7	213.9	241.0	260.3	278.6	301.5
15	0.25	0.304		109.0	142.1	162.7	181.5	204.6	220.9	236.5	255.9
30	0.50	0.423		76.0	99.1	113.5	126.6	142.6	154.0	164.9	178.4
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		29.1	37.9	43.4	48.4	54.6	59.0	63.1	68.3
180	3	0.707		21.2	27.6	31.6	35.2	39.7	42.9	45.9	49.7
360	6	0.804		12.0	15.7	17.9	20.0	22.6	24.4	26.1	28.2
720	12	0.900		6.7	8.8	10.0	11.2	12.6	13.6	14.6	15.8
1080	18	0.958		4.8	6.2	7.1	8.0	9.0	9.7	10.4	11.2
1440	24	1.000		3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
2880	48			2.1	2.8	3.3	3.8	4.5	5.0	5.6	6.4
4320	72			1.6	2.1	2.5	3.0	3.6	4.1	4.7	5.6

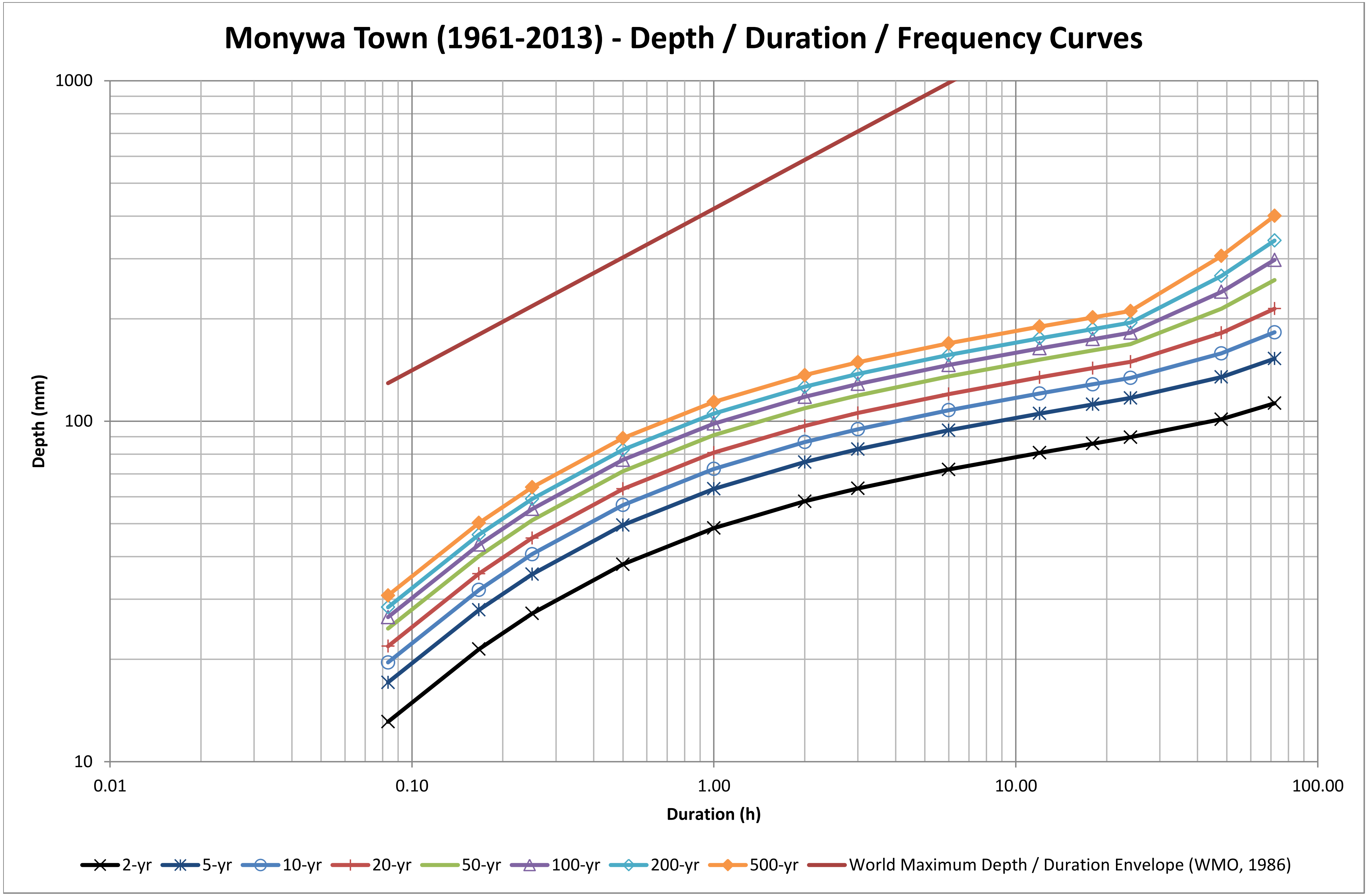
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining Copper Ltd. | Letpadaung Copper Project	Made by AB	Job No. PE701-00022
		Checked TML	Date 24/06/2013
	Basic Climatology	Approved	

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

Also tabulate the total storm depths:

Precipitation Duration t		Rainfall Ratio RR_t	Precipitation Depth (d_t) for given AEP (%) or ARI (1 in _ year) Storm (mm)								
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
(min)	(h)	(mm/mm)	d_{24} (mm)	89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
5	0.083	0.146		13.1	17.1	19.6	21.8	24.6	26.6	28.4	30.8
10	0.167	0.239		21.4	27.9	32.0	35.6	40.2	43.4	46.4	50.2
15	0.25	0.304		27.2	35.5	40.7	45.4	51.1	55.2	59.1	64.0
30	0.50	0.423		38.0	49.5	56.7	63.3	71.3	77.0	82.4	89.2
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		58.2	75.9	86.8	96.9	109.2	117.9	126.2	136.6
180	3	0.707		63.5	82.7	94.7	105.7	119.1	128.6	137.7	149.0
360	6	0.804		72.1	94.1	107.7	120.1	135.4	146.2	156.5	169.4
720	12	0.900		80.8	105.3	120.6	134.5	151.6	163.7	175.2	189.6
1080	18	0.958		86.0	112.1	128.3	143.1	161.3	174.2	186.5	201.8
1440	24	1.000		89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
2880	48			101.3	134.8	158.2	181.7	214.0	239.8	267.0	305.7
4320	72			112.9	152.6	182.4	214.0	259.6	297.7	339.4	400.7


Monywa Town (1961-2013) - Intensity / Duration / Frequency Curves
1000
100
10
1
Intensity (mm/h)
0.010
0.100
1.000
10.000
100.000
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Intensity / Duration Envelope (WMO, 1986)


Monywa Town (1961-2013) - Depth / Duration / Frequency Curves
1000
100
10
Depth (mm)
0.01
0.10
1.00
10.00
100.00
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Depth / Duration Envelope (WMO, 1986)

ATTACHMENT 2.5

Precipitation Hyetograph Analysis

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

2 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	55.3%
2	100.0%

3 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	22.9%
2	77.0%
3	100.0%

4 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	15.3%
2	56.2%
3	90.1%
4	100.0%

5 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	6.6%
2	37.2%
3	67.8%
4	93.7%
5	100.0%

6 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	8.1%
2	24.3%
3	45.3%
4	76.5%
5	97.1%
6	100.0%

7 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	6.7%
2	19.0%
3	43.0%
4	70.1%
5	88.5%
6	98.4%
7	100.0%

8 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	4.7%
3	15.6%
4	51.5%
5	73.8%
6	88.3%
7	97.5%
8	100.0%

9 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	3.8%
2	13.7%
3	34.9%
4	63.4%
5	81.3%
6	88.9%
7	93.7%
8	97.8%
9	100.0%

10 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.4%
2	3.3%
3	7.9%
4	13.6%
5	21.5%
6	45.0%
7	71.5%
8	83.1%
9	97.5%
10	100.0%

11 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.8%
2	4.8%
3	12.3%
4	22.4%
5	37.3%
6	52.2%
7	66.2%
8	79.8%
9	91.2%
10	98.2%
11	100.0%

12 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.1%
2	4.5%
3	9.0%
4	13.5%
5	18.0%
6	23.6%
7	30.3%
8	42.7%
9	61.8%
10	84.3%
11	96.6%
12	100.0%

13 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	2.8%
2	6.6%
3	11.3%
4	17.9%
5	23.6%
6	32.1%
7	47.2%
8	66.0%
9	84.9%
10	93.4%
11	97.2%
12	99.1%
13	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

14 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	3.0%
2	8.7%
3	13.1%
4	15.4%
5	17.3%
6	20.6%
7	27.6%
8	39.9%
9	55.6%
10	67.8%
11	80.8%
12	92.6%
13	98.8%
14	100.0%

15 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.0%
2	15.1%
3	30.2%
4	41.3%
5	50.0%
6	57.1%
7	63.5%
8	71.4%
9	81.0%
10	88.1%
11	91.3%
12	94.4%
13	97.6%
14	99.2%
15	100.0%

16 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	5.7%
3	12.3%
4	16.0%
5	20.8%
6	34.9%
7	45.3%
8	50.9%
9	62.3%
10	68.9%
11	72.6%
12	74.5%
13	80.2%
14	89.6%
15	97.2%
16	100.0%

18 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	6.2%
3	10.6%
4	14.2%
5	22.1%
6	28.3%
7	34.5%
8	40.7%
9	46.0%
10	52.2%
11	61.1%
12	65.5%
13	70.8%
14	78.8%
15	86.7%
16	95.6%
17	99.1%
18	100.0%

19 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.3%
2	11.4%
3	21.4%
4	31.4%
5	41.4%
6	48.6%
7	58.6%
8	70.0%
9	80.0%
10	85.7%
11	88.6%
12	90.0%
13	91.4%
14	92.9%
15	94.3%
16	95.7%
17	97.1%
18	98.6%
19	100.0%

20 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.7%
2	3.3%
3	5.0%
4	7.5%
5	13.3%
6	22.5%
7	30.0%
8	37.5%
9	41.7%
10	43.3%
11	44.2%
12	51.7%
13	60.0%
14	68.3%
15	75.8%
16	83.3%
17	90.8%
18	95.8%
19	99.2%
20	100.0%

21 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.4%
2	4.3%
3	7.1%
4	11.4%
5	17.1%
6	21.4%
7	25.7%
8	30.0%
9	34.3%
10	37.1%
11	41.4%
12	47.1%
13	52.9%
14	60.0%
15	68.6%
16	77.1%
17	84.3%
18	90.0%
19	95.7%
20	98.6%
21	100.0%

23 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.4%
2	0.8%
3	3.5%
4	6.2%
5	8.1%
6	10.8%
7	15.1%
8	22.4%
9	31.7%
10	40.2%
11	47.5%
12	51.7%
13	53.3%
14	54.4%
15	56.0%
16	57.5%
17	59.8%
18	66.4%
19	79.9%
20	91.5%
21	97.3%
22	99.6%
23	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

27 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	2.1%
2	6.7%
3	23.5%
4	52.5%
5	58.1%
6	59.5%
7	60.1%
8	60.4%
9	61.0%
10	62.5%
11	64.8%
12	67.2%
13	69.5%
14	72.1%
15	74.5%
16	76.2%
17	77.4%
18	78.0%
19	78.3%
20	78.9%
21	83.3%
22	89.7%
23	95.0%
24	97.9%
25	99.1%
26	99.7%
27	100.0%

30 Hour

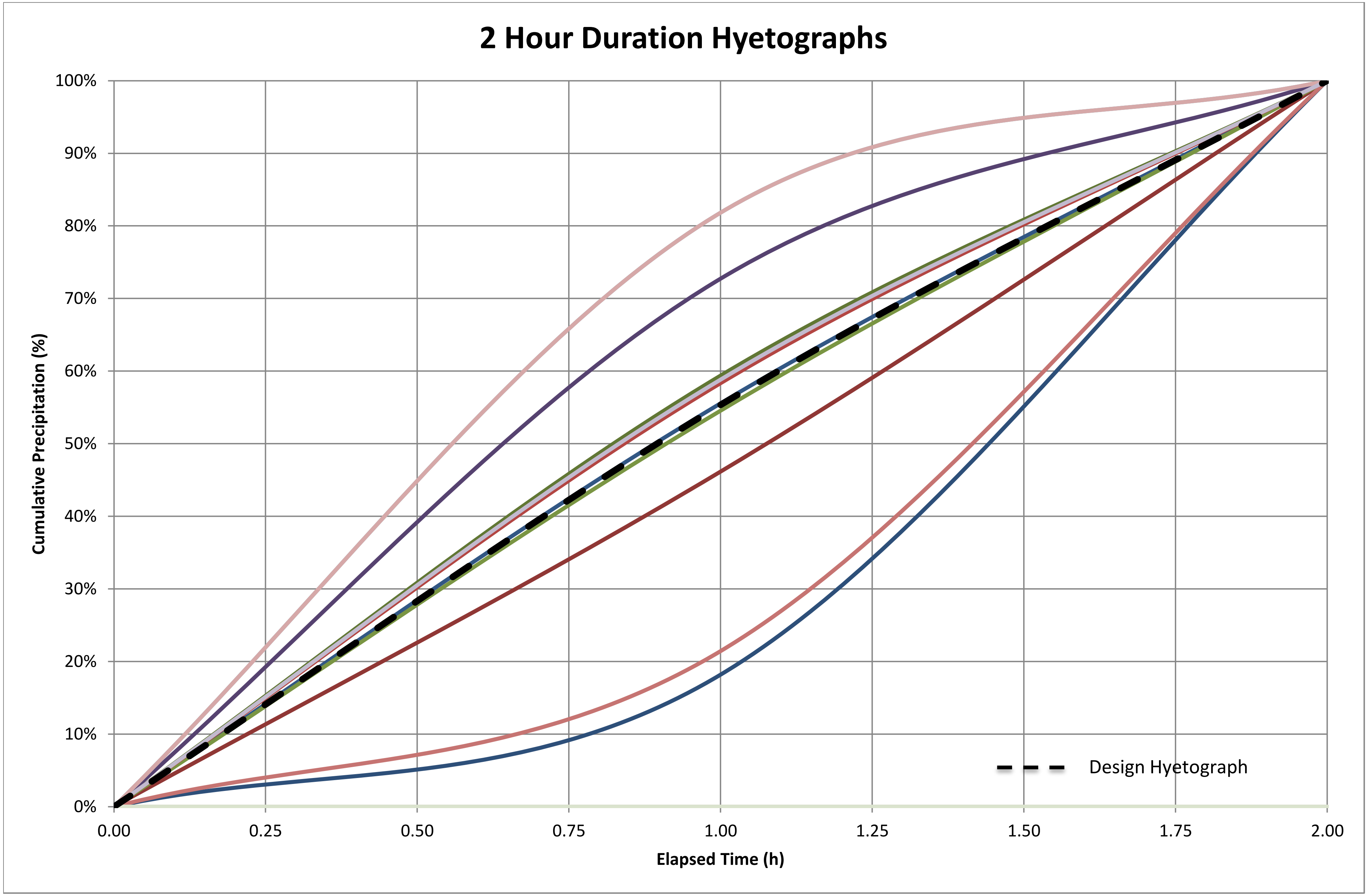
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.1%
2	3.7%
3	7.0%
4	11.2%
5	16.0%
6	20.3%
7	24.1%
8	27.3%
9	29.9%
10	31.6%
11	32.6%
12	33.2%
13	33.7%
14	35.3%
15	38.0%
16	41.2%
17	44.4%
18	48.7%
19	56.7%
20	67.9%
21	73.3%
22	74.9%
23	75.9%
24	77.0%
25	79.1%
26	82.4%
27	85.6%
28	89.3%
29	94.7%
30	100.0%

44 Hour

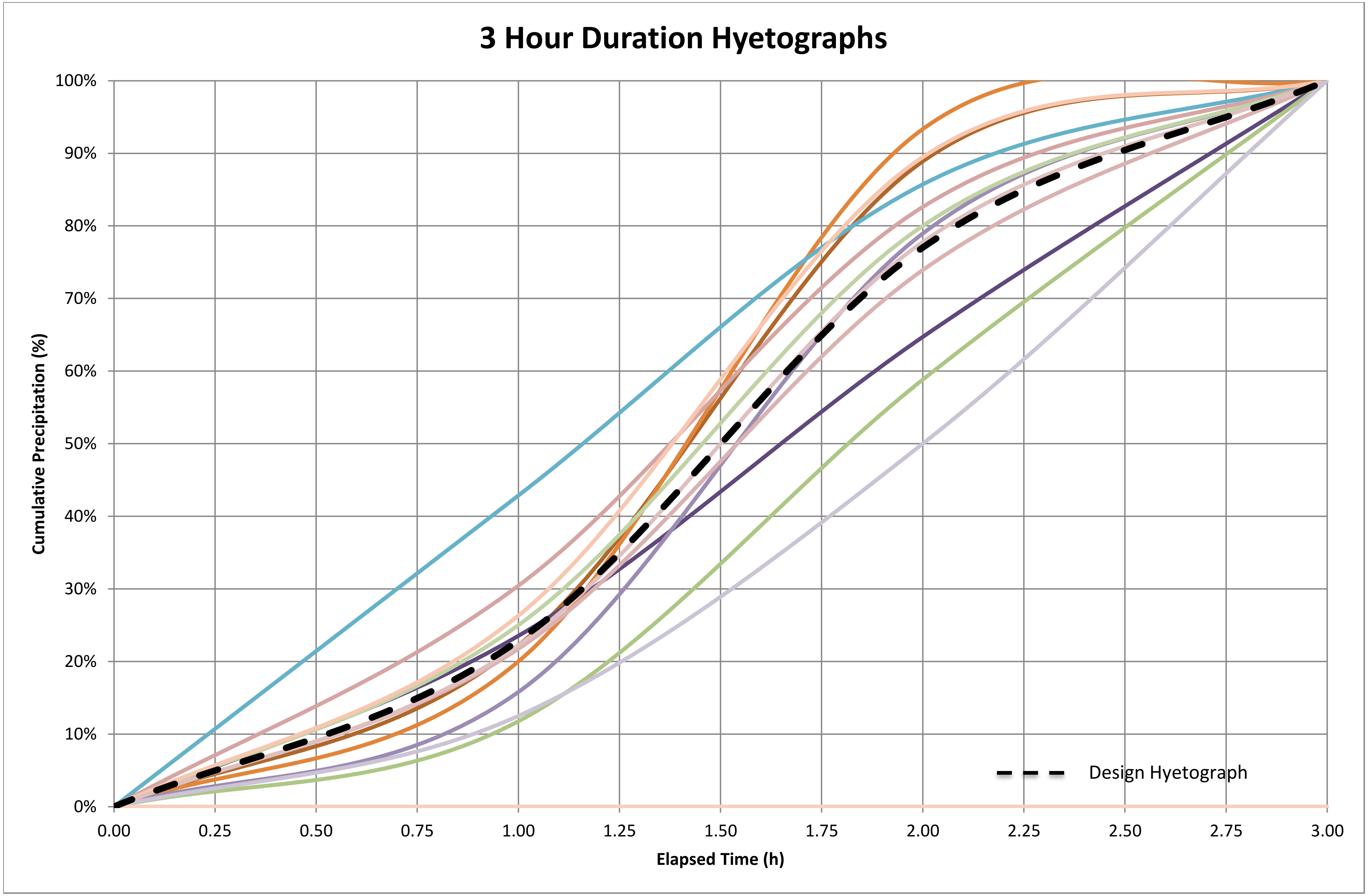
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.0%
3	2.9%
4	4.5%
5	6.2%
6	7.9%
7	10.5%
8	14.0%
9	18.4%
10	23.6%
11	24.7%
12	26.5%
13	29.0%
14	31.4%
15	35.4%
16	40.6%
17	43.9%
18	45.9%
19	47.9%
20	49.8%
21	51.8%
22	53.1%
23	53.6%
24	53.8%
25	54.0%
26	54.1%
27	54.2%
28	54.7%
29	56.7%
30	61.8%
31	68.9%
32	74.9%
33	79.2%
34	82.6%
35	85.6%
36	88.7%
37	91.2%
38	93.1%
39	94.7%
40	96.5%
41	98.0%
42	99.1%
43	99.9%
44	100.0%

45 Hour

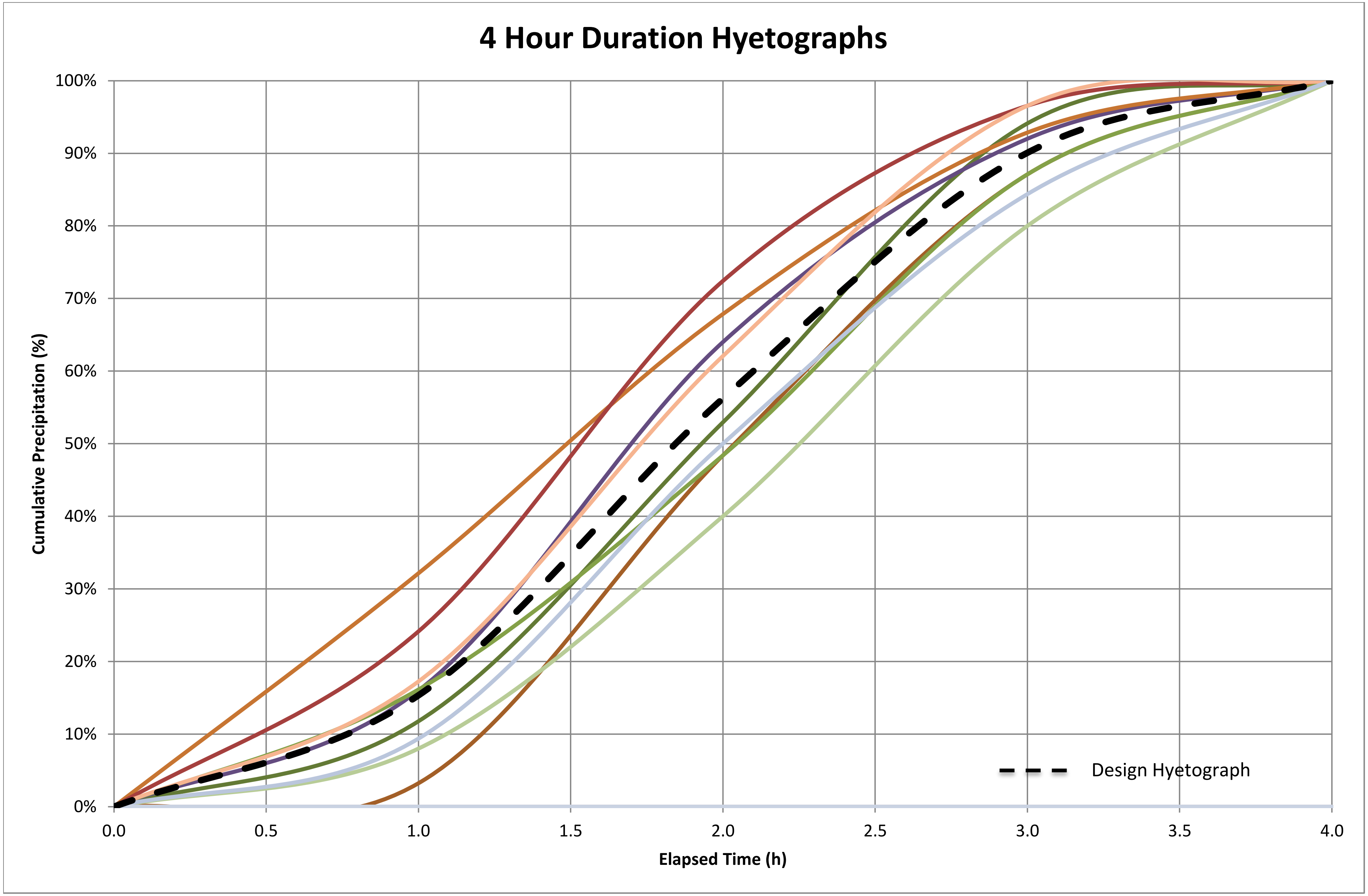
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.5%
3	5.4%
4	10.2%
5	14.8%
6	20.0%
7	25.2%
8	30.2%
9	35.4%
10	40.3%
11	42.0%
12	43.4%
13	45.2%
14	46.9%
15	48.9%
16	50.5%
17	51.4%
18	51.9%
19	52.5%
20	52.7%
21	52.8%
22	53.0%
23	53.1%
24	53.2%
25	53.5%
26	55.5%
27	60.0%
28	65.6%
29	70.1%
30	73.4%
31	76.3%
32	78.9%
33	81.7%
34	84.8%
35	88.3%
36	91.7%
37	93.0%
38	93.2%
39	93.4%
40	94.0%
41	95.1%
42	96.4%
43	98.0%
44	99.5%
45	100.0%

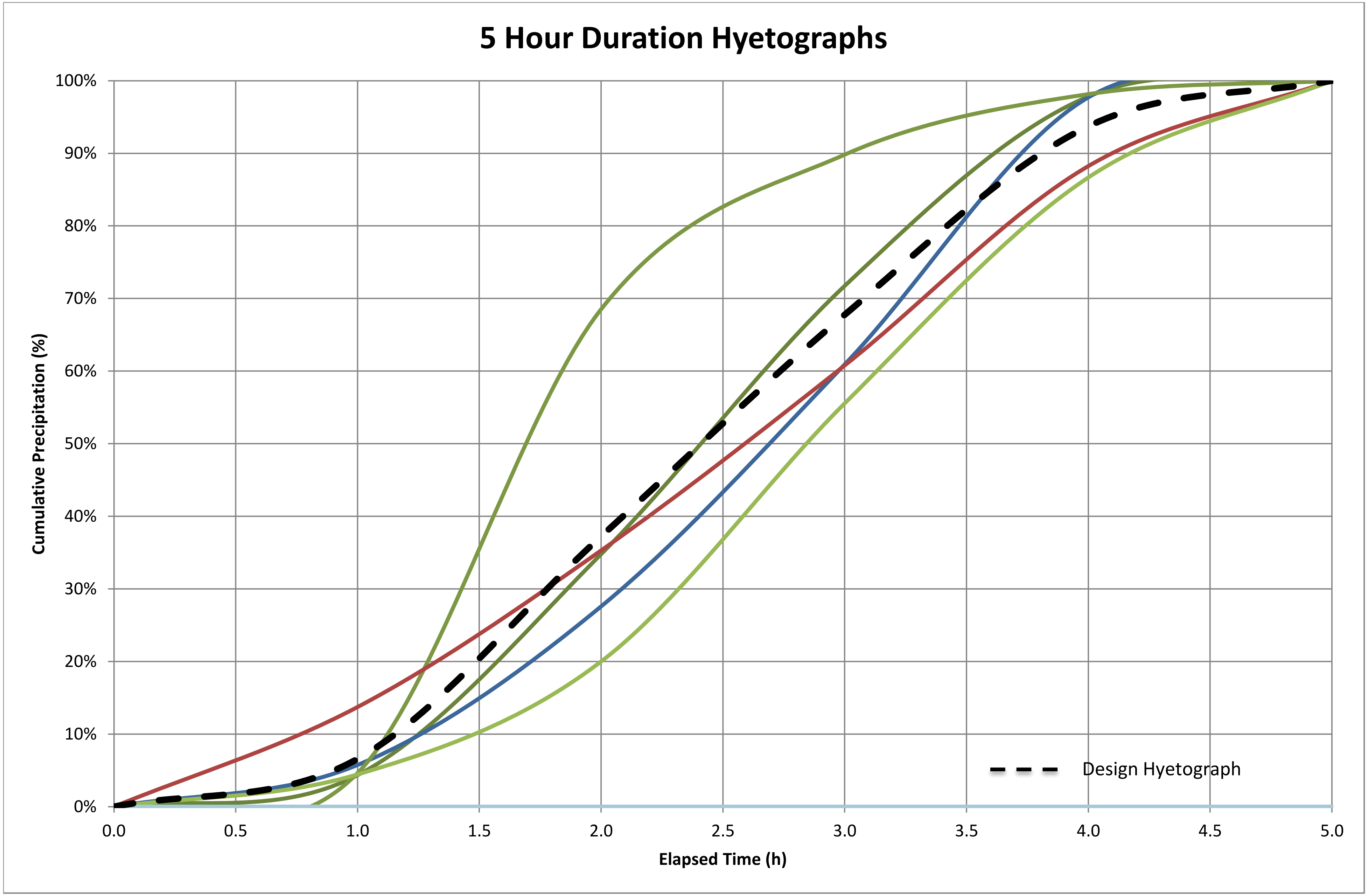


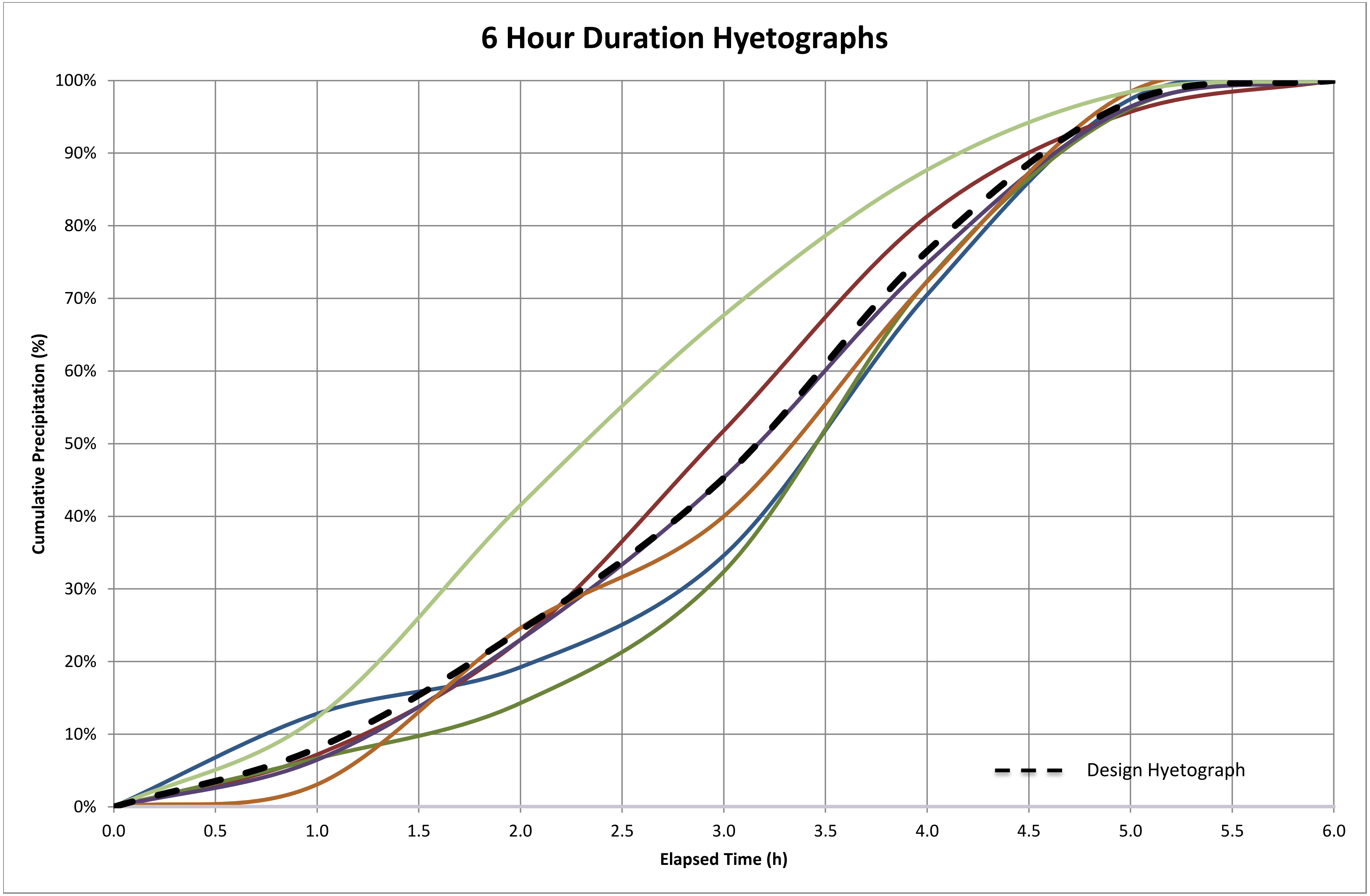
2 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Elapsed Time (h)
Design Hyetograph



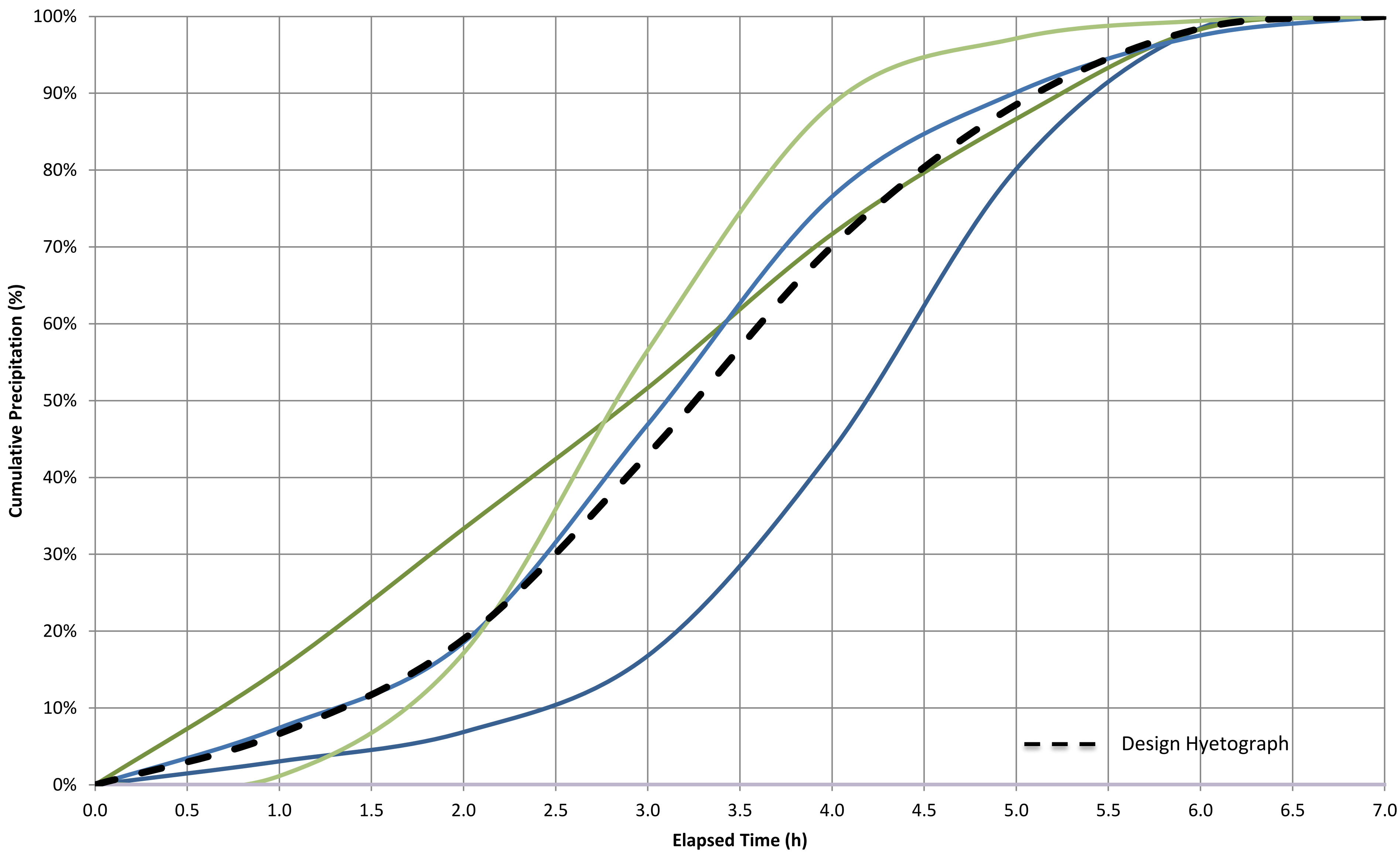
3 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
Elapsed Time (h)
Design Hyetograph

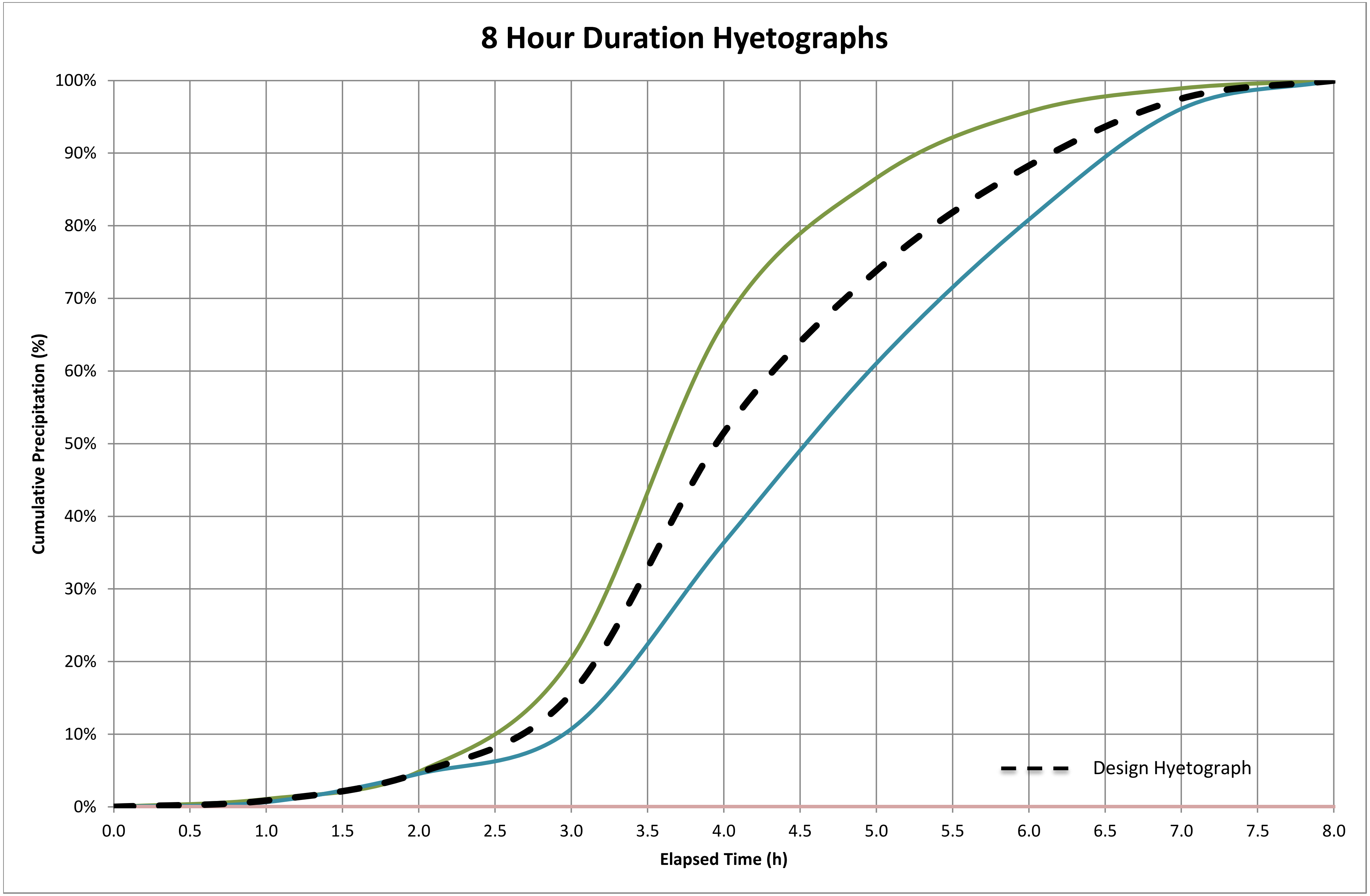

4 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Elapsed Time (h)
Design Hyetograph

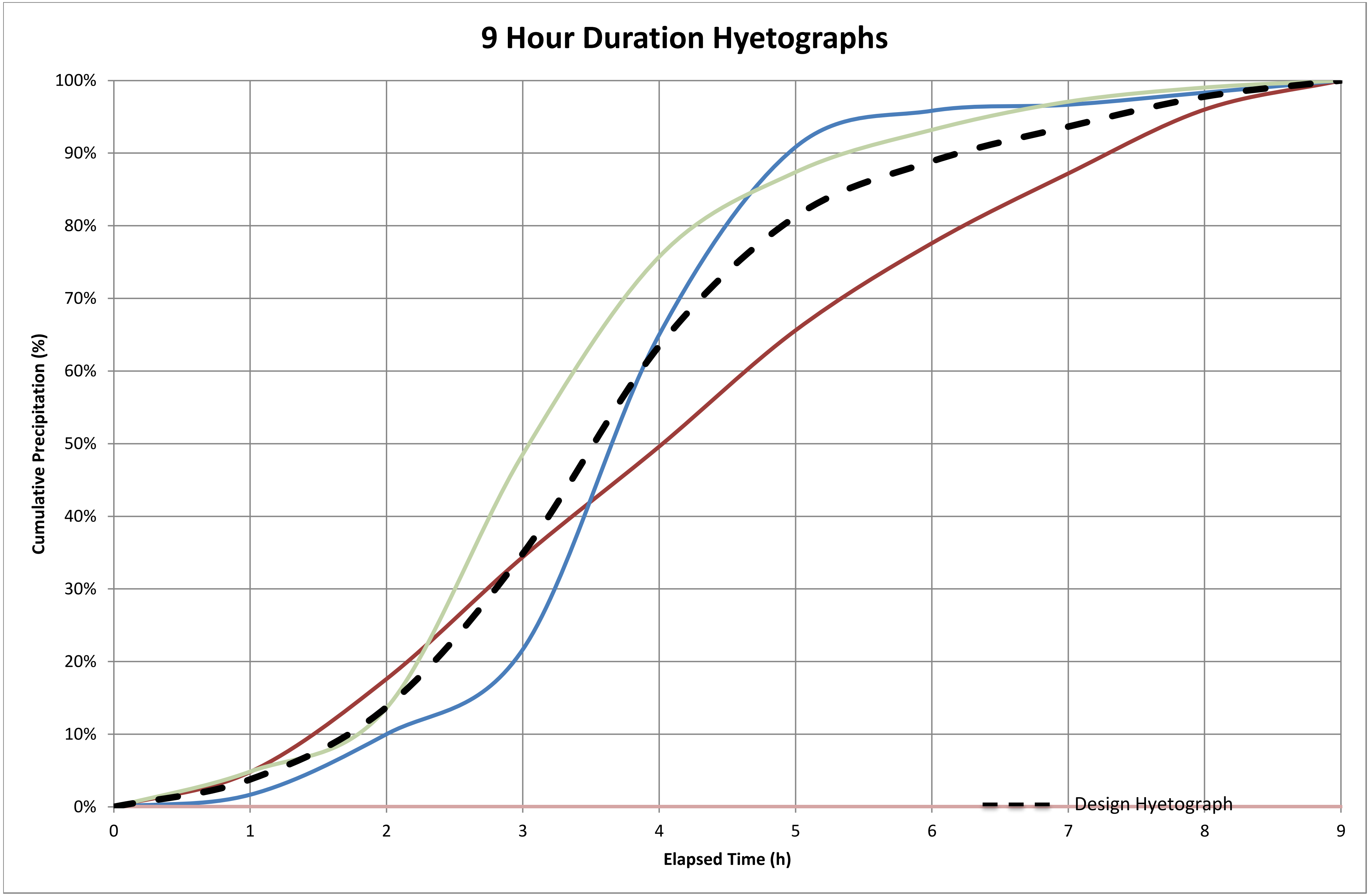

5 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Elapsed Time (h)
Design Hyetograph


6 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Elapsed Time (h)
Design Hyetograph

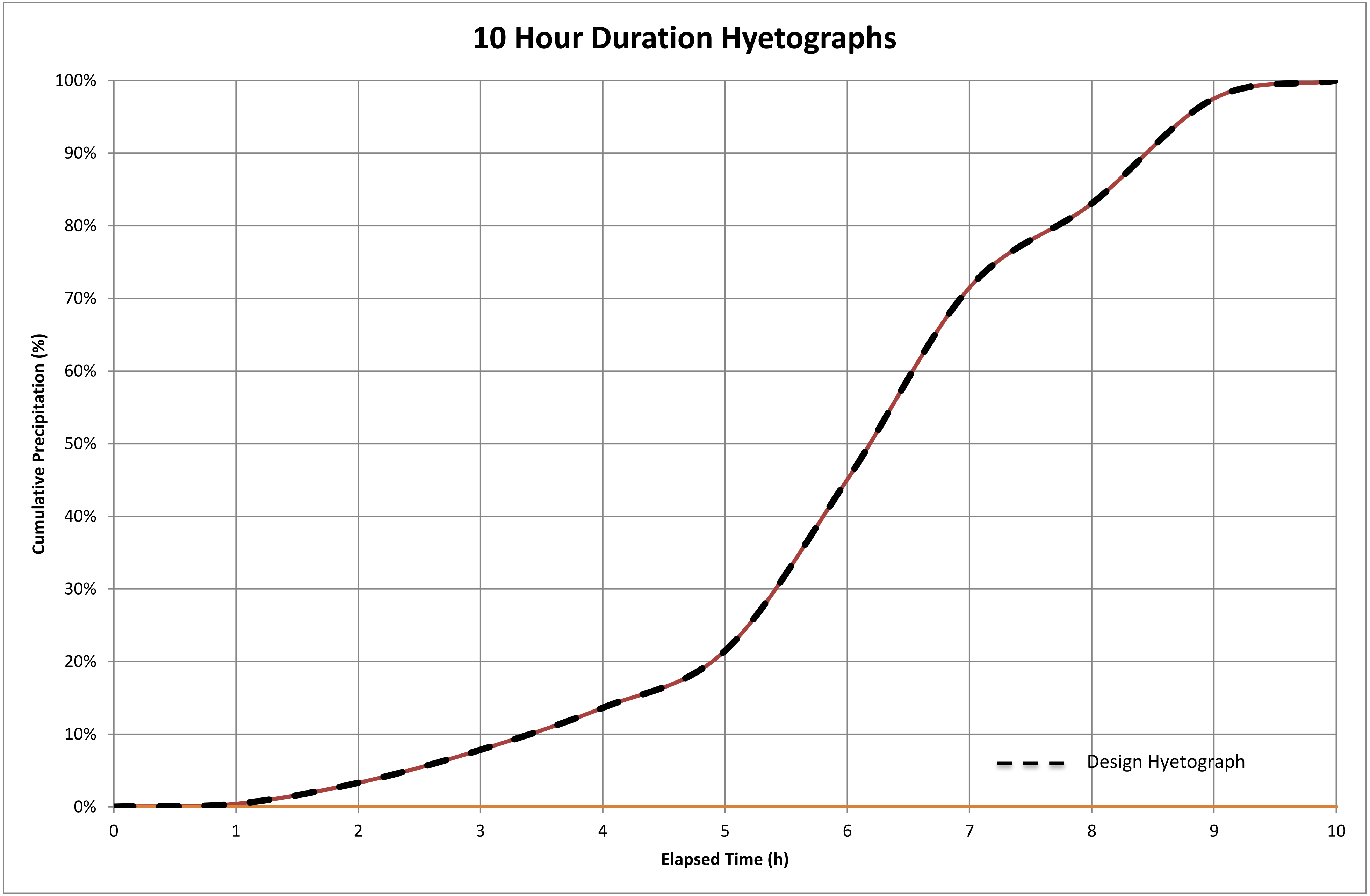
7 Hour Duration Hyetographs

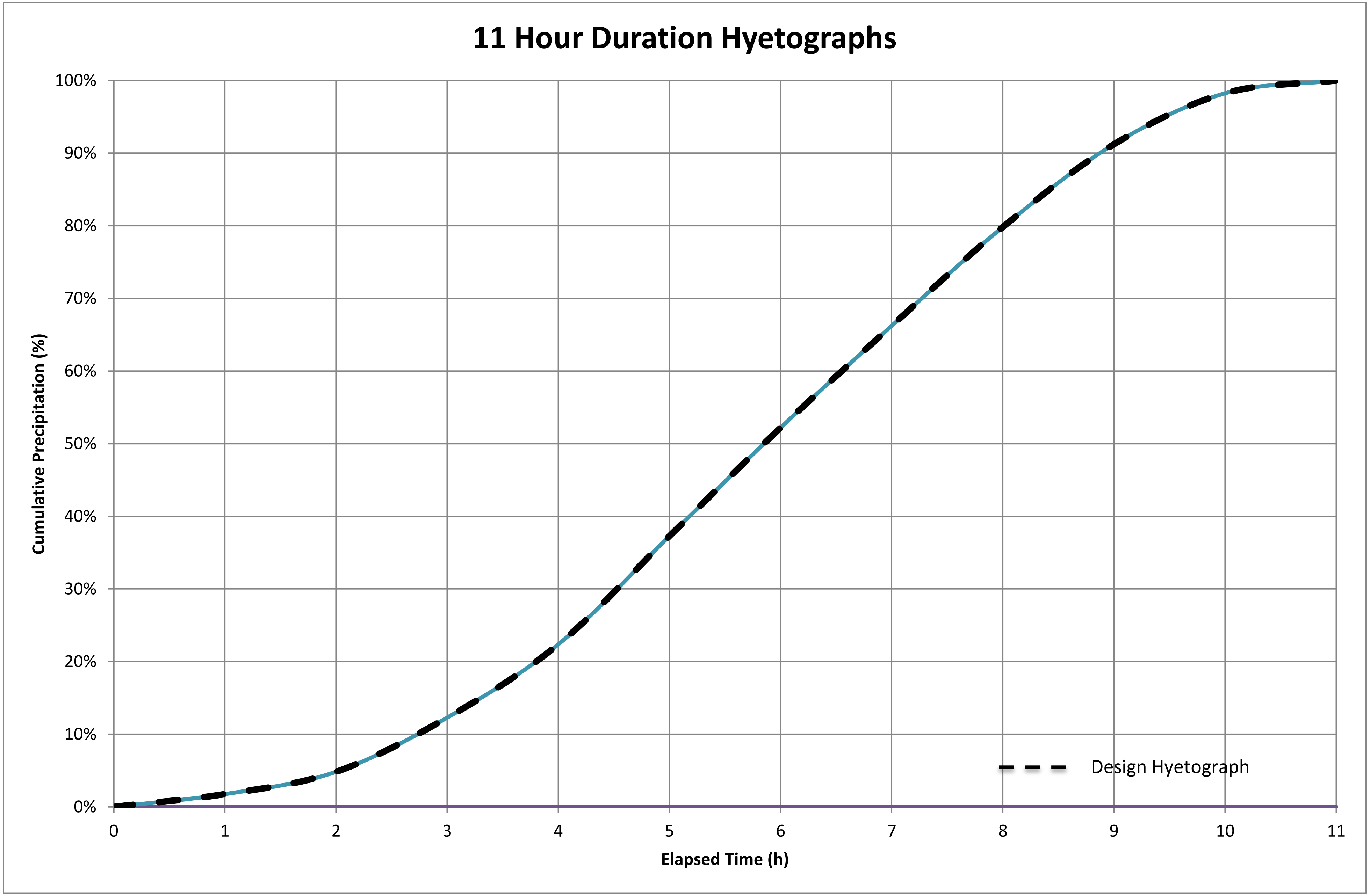


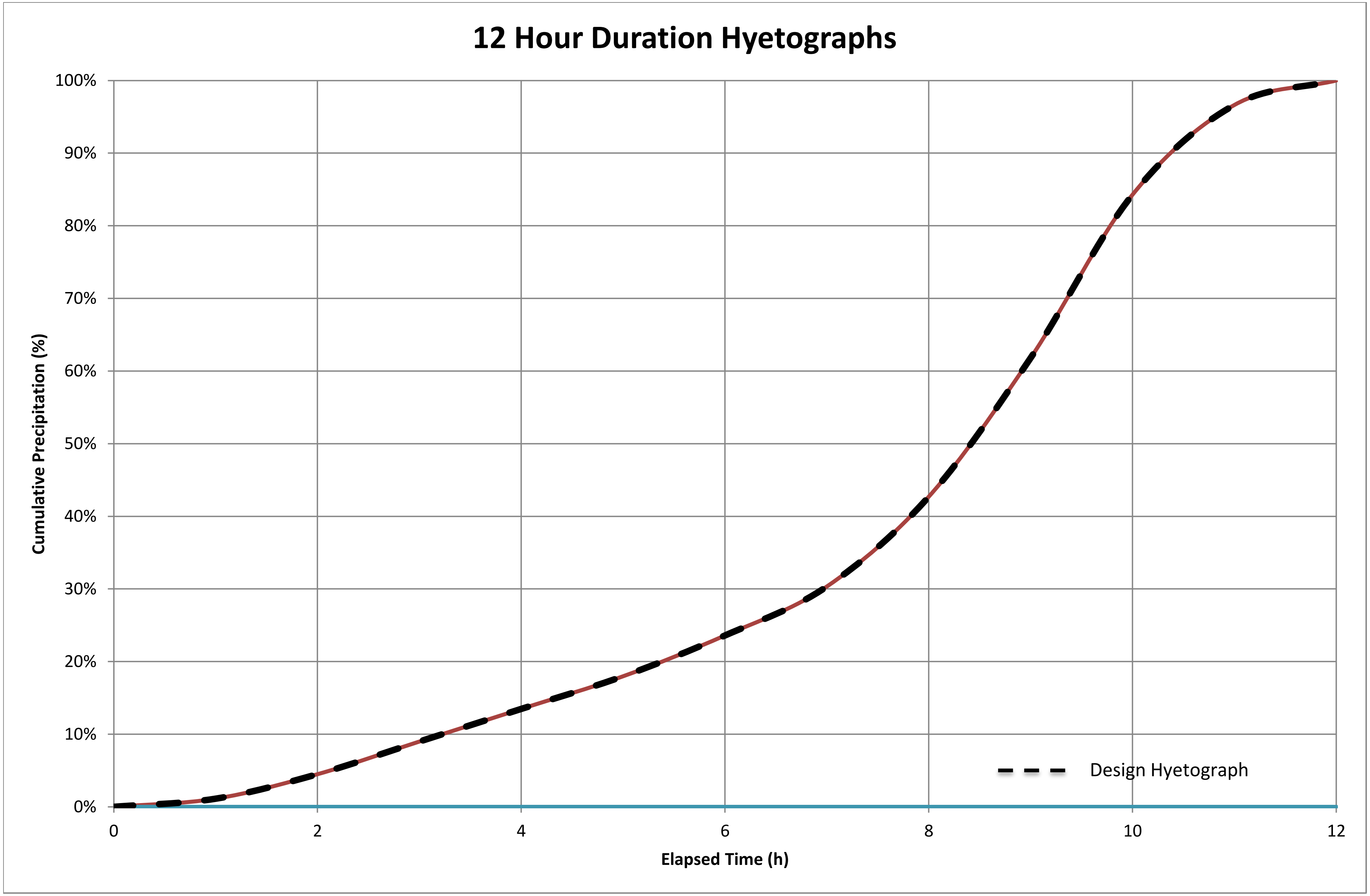

8 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Elapsed Time (h)
Design Hyetograph



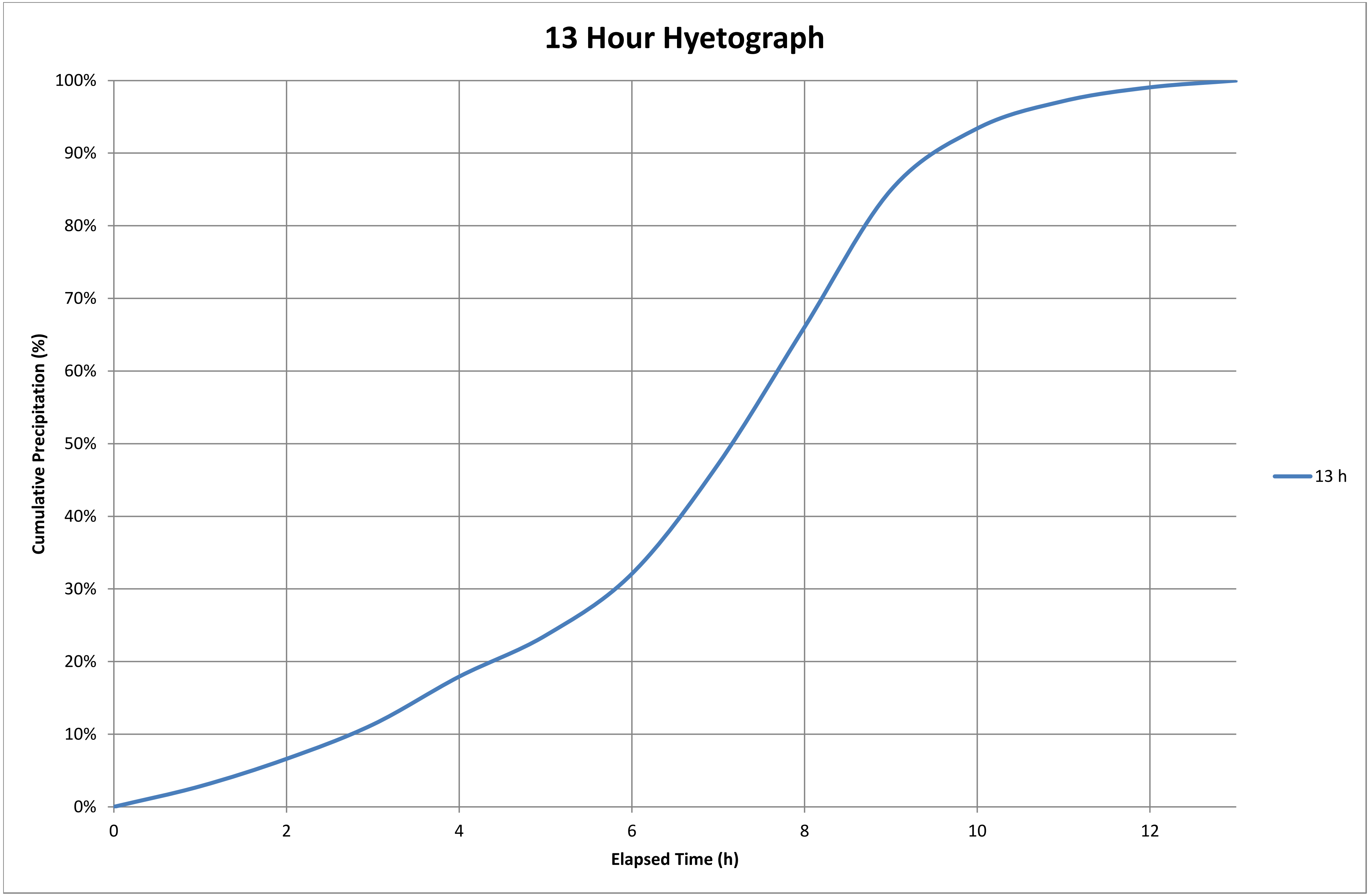
9 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
Elapsed Time (h)
Design Hyetograph

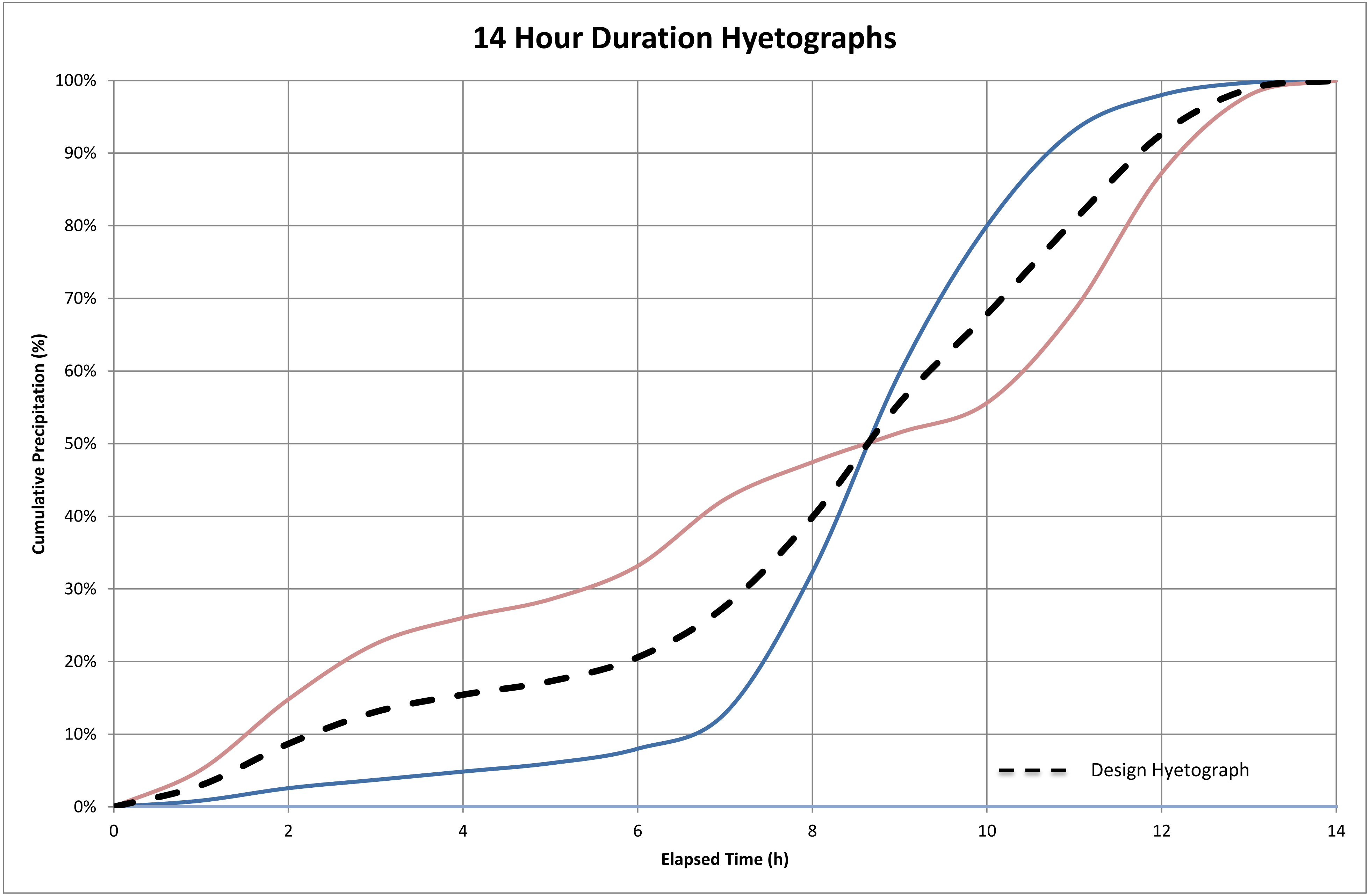

10 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
Elapsed Time (h)
Design Hyetograph

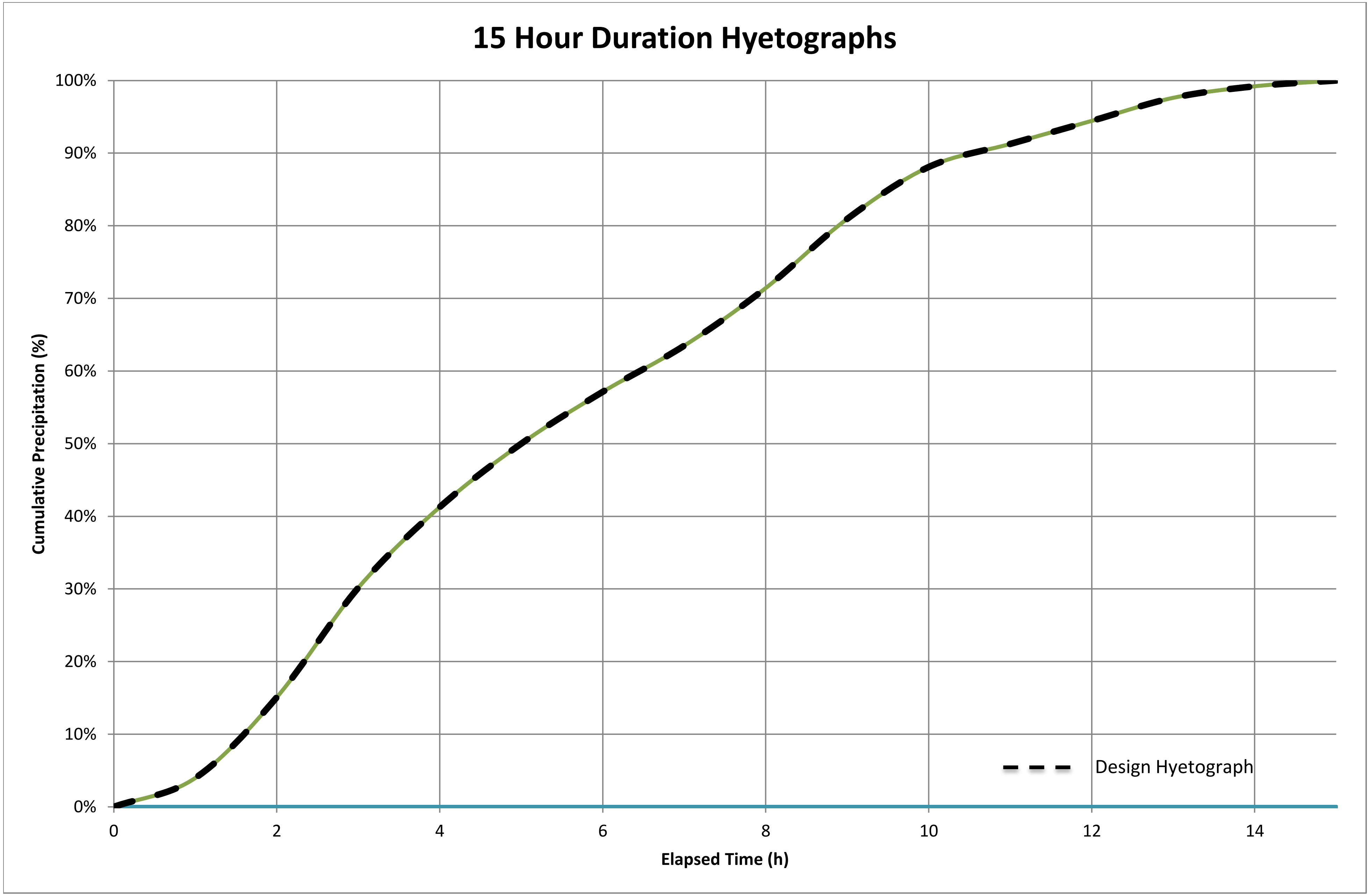

11 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
11
Elapsed Time (h)
Design Hyetograph

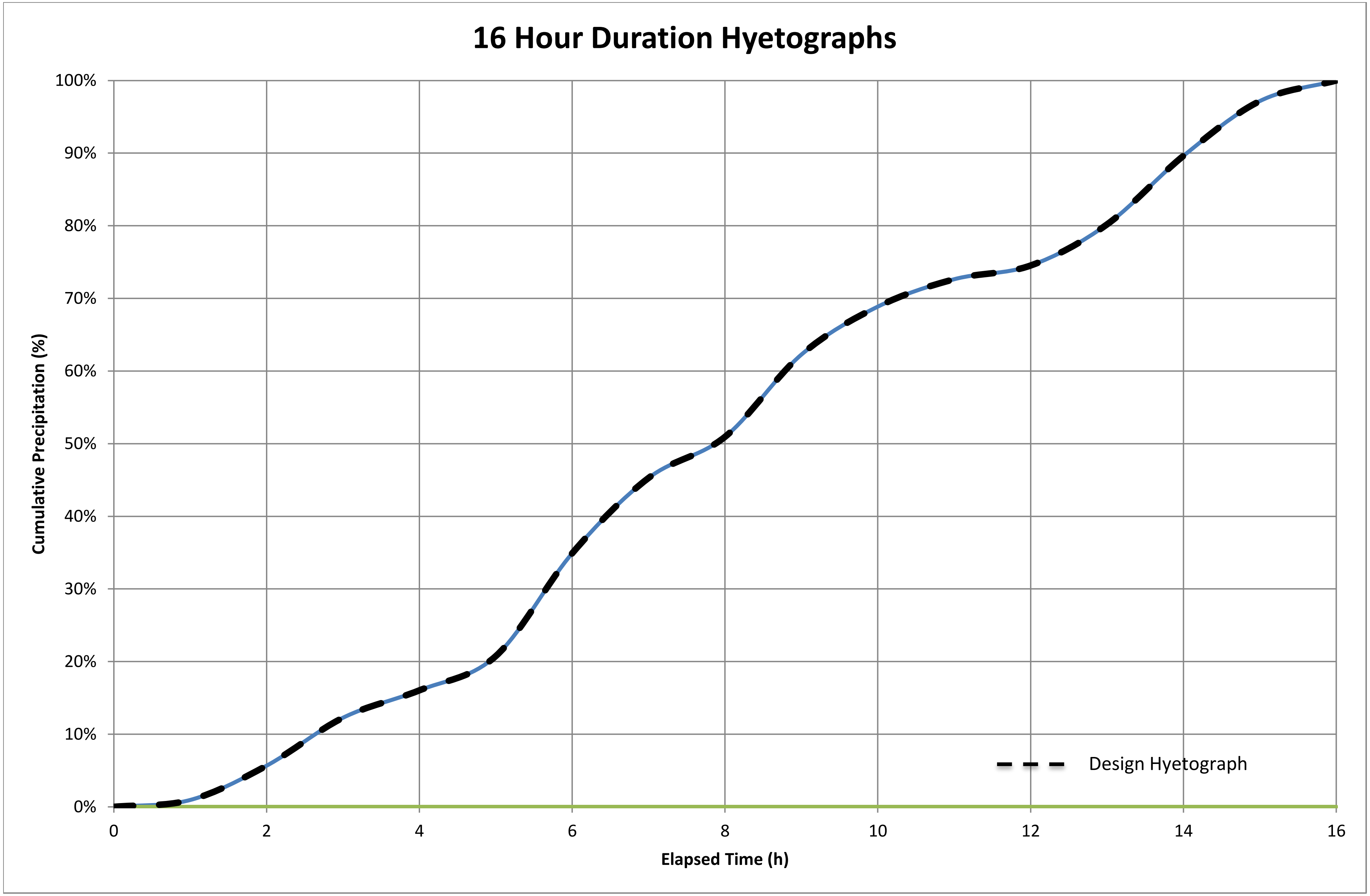


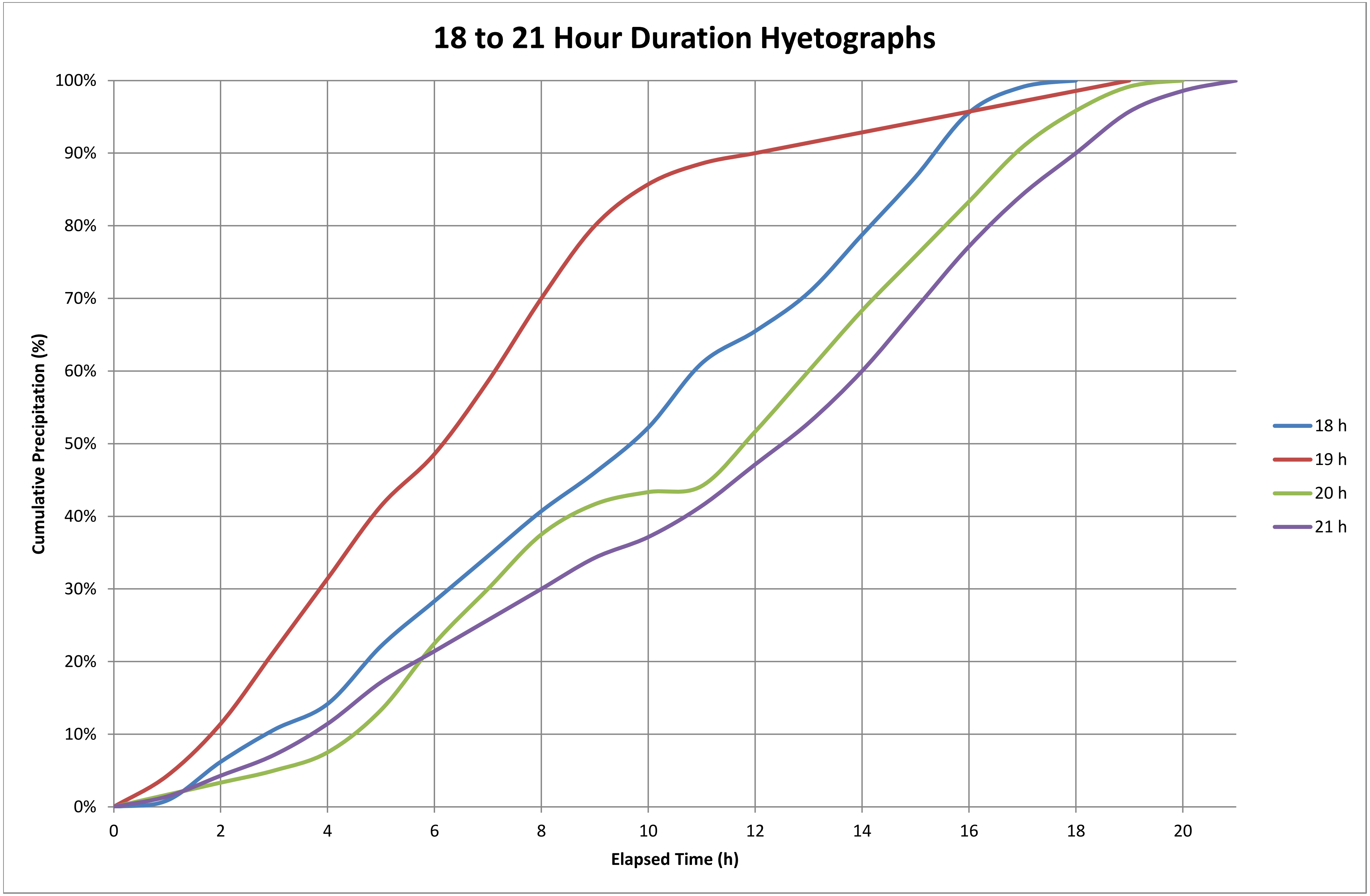
12 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
Elapsed Time (h)
Design Hyetograph


13 Hour Hyetograph
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
Elapsed Time (h)
13 h

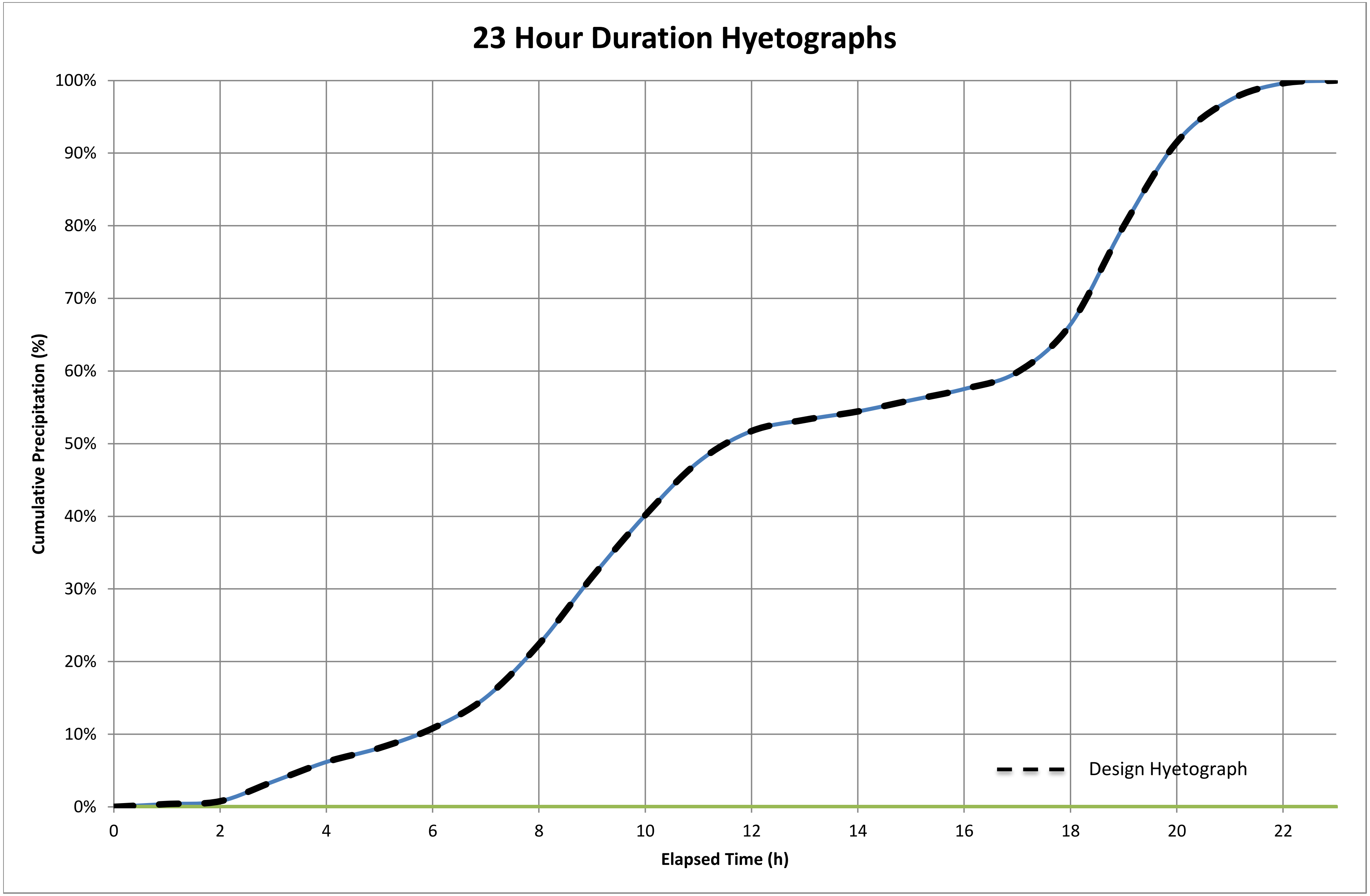

14 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph


15 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph

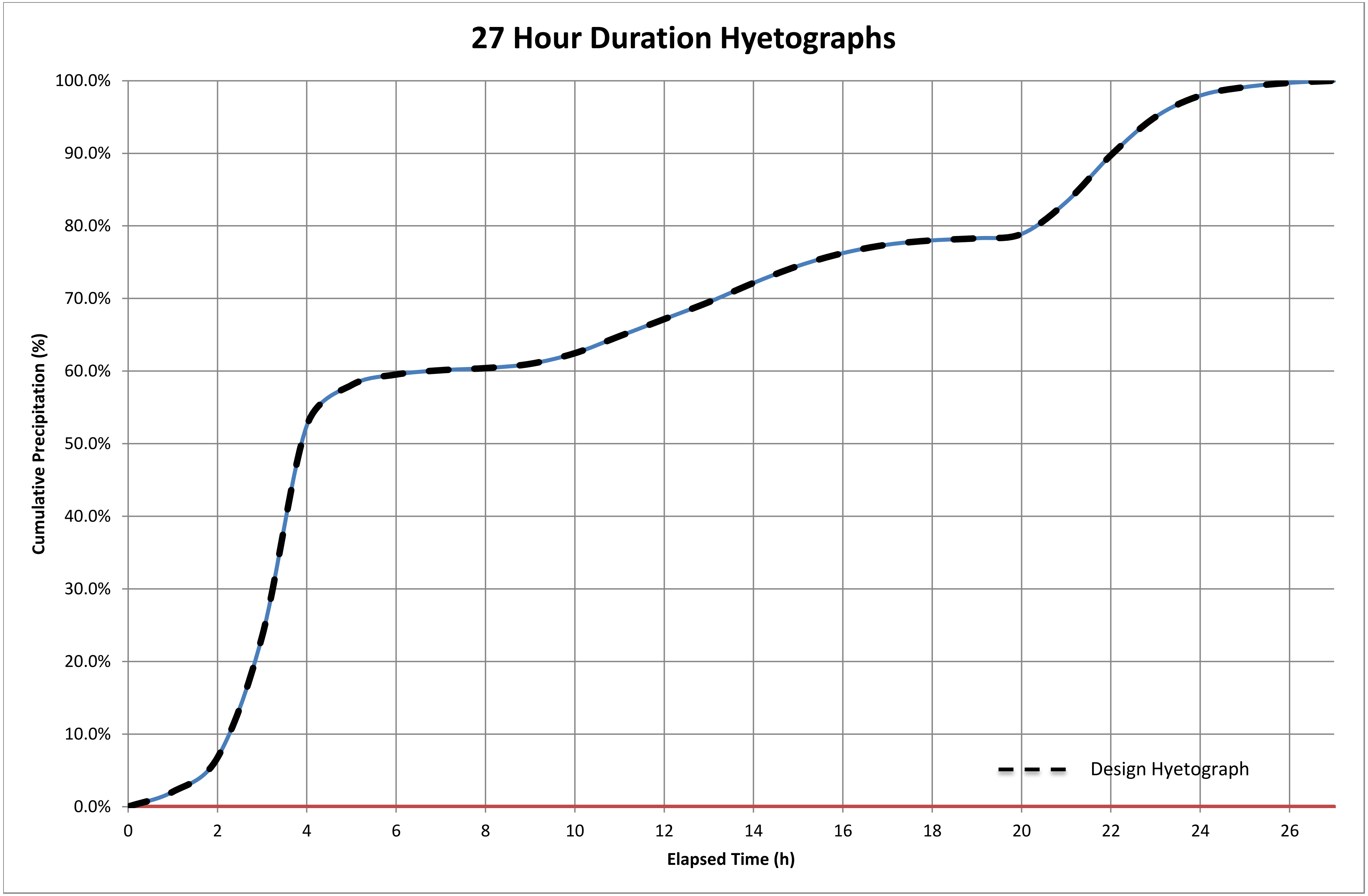

16 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
Elapsed Time (h)
Design Hyetograph

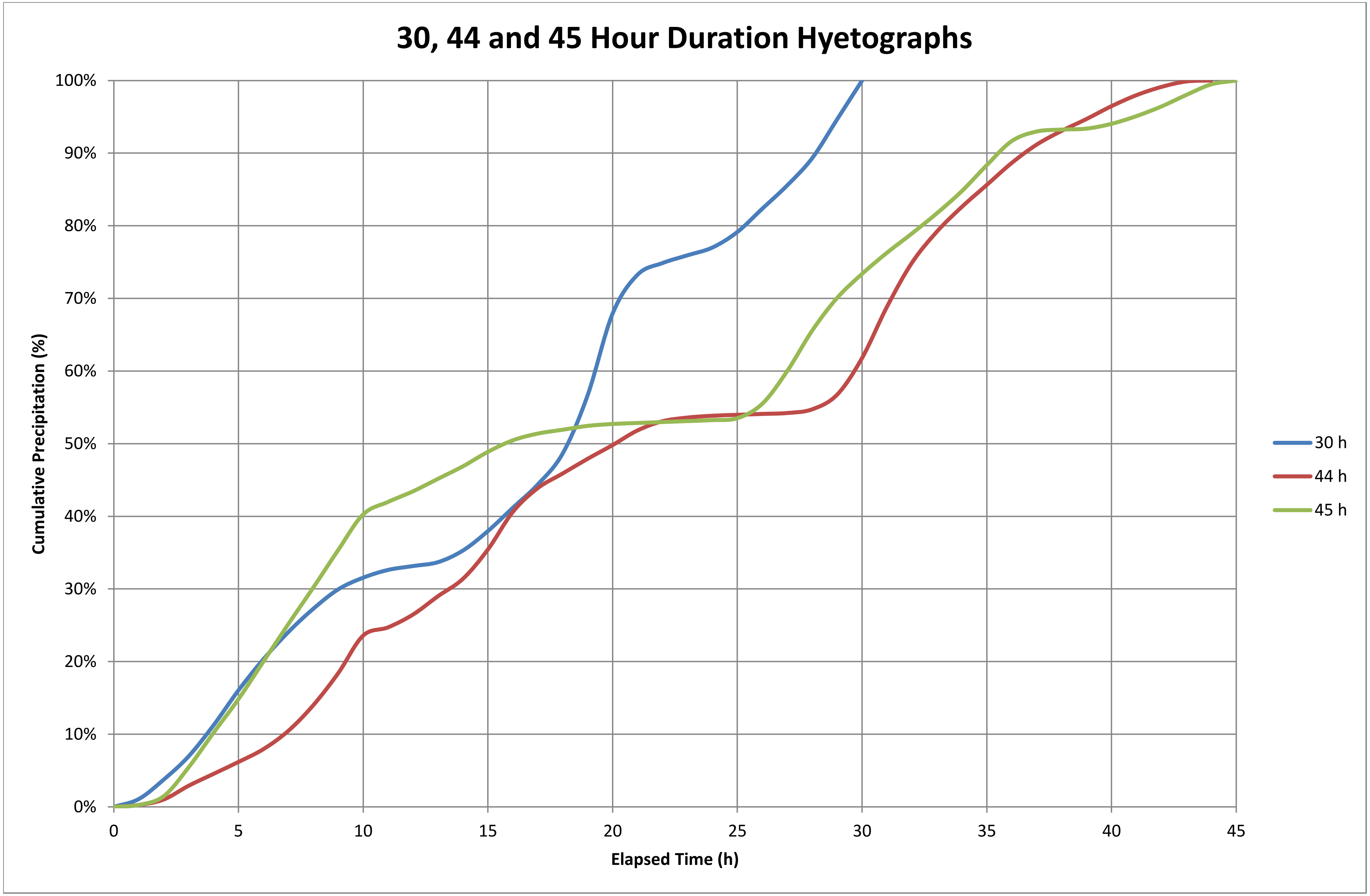


18 to 21 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
Elapsed Time (h)
18 h
19 h
20 h
21 h



23 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
22
Elapsed Time (h)
Design Hyetograph


27 Hour Duration Hyetographs
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Elapsed Time (h)
Design Hyetograph

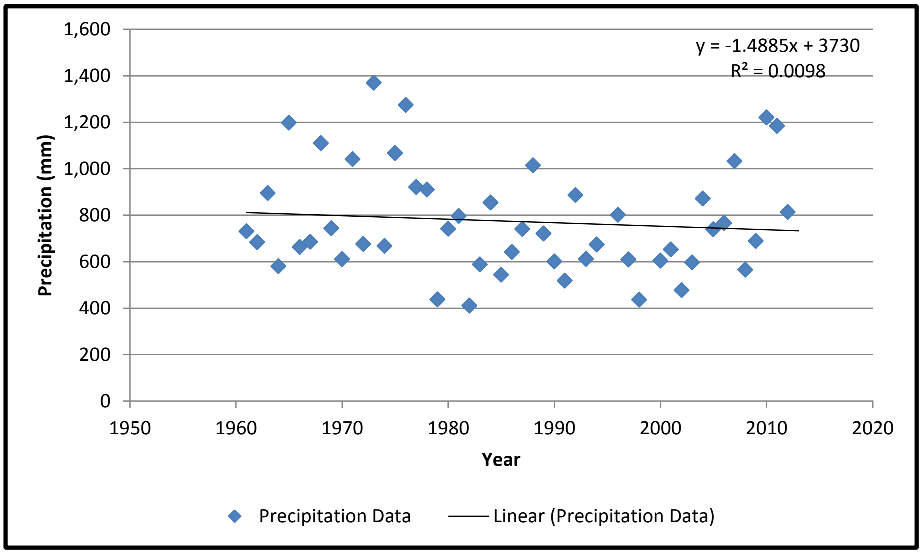

30, 44 and 45 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
Elapsed Time (h)
30 h
44 h
45 h

ATTACHMENT 2.6

Precipitation Trend Analysis

Climatic Trend Analysis: Monywa Township Precipitation (1961-2013)

Year	Precip (mm)
1961	731
1962	684
1963	896
1964	581
1965	1,198
1966	664
1967	686
1968	1,110
1969	744
1970	611
1971	1,042
1972	676
1973	1,370
1974	668
1975	1,067
1976	1,275
1977	921
1978	910
1979	438
1980	742
1981	797
1982	411
1983	588
1984	855
1985	544
1986	642
1987	741
1988	1,015
1989	722
1990	601
1991	518
1992	887
1993	612
1994	675
1995	Exclude
1996	802
1997	610
1998	437
1999	Exclude
2000	604
2001	653
2002	478
2003	597
2004	872
2005	740
2006	767
2007	1,032
2008	566
2009	689
2010	1,221
2011	1,184
2012	814
2013	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual precipitation values at this site.

ATTACHMENT 2.7

Water Balance Scenario Frequency Analysis

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 39

5 Year Data		Rank	Weibull	ARI	Ranked
Years	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**5 yr Wet Precip (mm)**
1961 - 1965	4090.0	1	0.025	40.00	5301.0
1962 - 1966	4023.0	2	0.050	20.00	5056.0
1963 - 1967	4025.0	3	0.075	13.33	4841.0
1964 - 1968	4239.0	4	0.100	10.00	4823.0
1965 - 1969	4402.0	5	0.125	8.00	4693.0
1966 - 1970	3815.0	6	0.150	6.67	4611.0
1967 - 1971	4193.0	7	0.175	5.71	4474.2
1968 - 1972	4183.0	8	0.200	5.00	4443.0
1969 - 1973	4443.0	9	0.225	4.44	4402.0
1970 - 1974	4367.0	10	0.250	4.00	4367.0
1971 - 1975	4823.0	11	0.275	3.64	4286.0
1972 - 1976	5056.0	12	0.300	3.33	4275.6
1973 - 1977	5301.0	13	0.325	3.08	4239.0
1974 - 1978	4841.0	14	0.350	2.86	4193.0
1975 - 1979	4611.0	15	0.375	2.67	4183.0
1976 - 1980	4286.0	16	0.400	2.50	4090.0
1977 - 1981	3808.0	17	0.425	2.35	4025.0
1978 - 1982	3298.0	18	0.450	2.22	4023.0
1979 - 1983	2976.0	19	0.475	2.11	4008.1
1980 - 1984	3393.0	20	0.500	2.00	3976.9
1981 - 1985	3195.0	21	0.525	1.90	3815.0
1982 - 1986	3040.0	22	0.550	1.82	3808.0
1983 - 1987	3370.0	23	0.575	1.74	3797.0
1984 - 1988	3797.0	24	0.600	1.67	3794.6
1985 - 1989	3664.0	25	0.625	1.60	3743.0
1986 - 1990	3721.0	26	0.650	1.54	3721.0
1987 - 1991	3597.0	27	0.675	1.48	3664.0
1988 - 1992	3743.0	28	0.700	1.43	3597.0
1989 - 1993	3340.0	29	0.725	1.38	3453.9
1990 - 1994	3292.6	30	0.750	1.33	3393.0
1991 - 1995	Exclude	31	0.775	1.29	3370.0
1992 - 1996	Exclude	32	0.800	1.25	3340.4
1993 - 1997	Exclude	33	0.825	1.21	3340.0
1994 - 1998	Exclude	34	0.850	1.18	3298.0
1995 - 1999	Exclude	35	0.875	1.14	3292.6
1996 - 2000	Exclude	36	0.900	1.11	3204.7
1997 - 2001	Exclude	37	0.925	1.08	3195.0
1998 - 2002	Exclude	38	0.950	1.05	3040.0
1999 - 2003	Exclude	39	0.975	1.03	2976.0
2000 - 2004	3204.7				
2001 - 2005	3340.4				
2002 - 2006	3453.9				
2003 - 2007	4008.1				
2004 - 2008	3976.9				
2005 - 2009	3794.6				
2006 - 2010	4275.6				
2007 - 2011	4693.0				
2008 - 2012	4474.2				
2009 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Wakeby	1	1	1
Johnson SB	3	2	6
Gen. Extreme Value	6	3	18
Error	5	5	25
Nakagami	9	4	36
Weibull (3P)	8	7	56
Rayleigh (2P)	7	10	70
Beta	2	41	82
Gamma	15	6	90
Log-Pearson 3	18	9	162

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

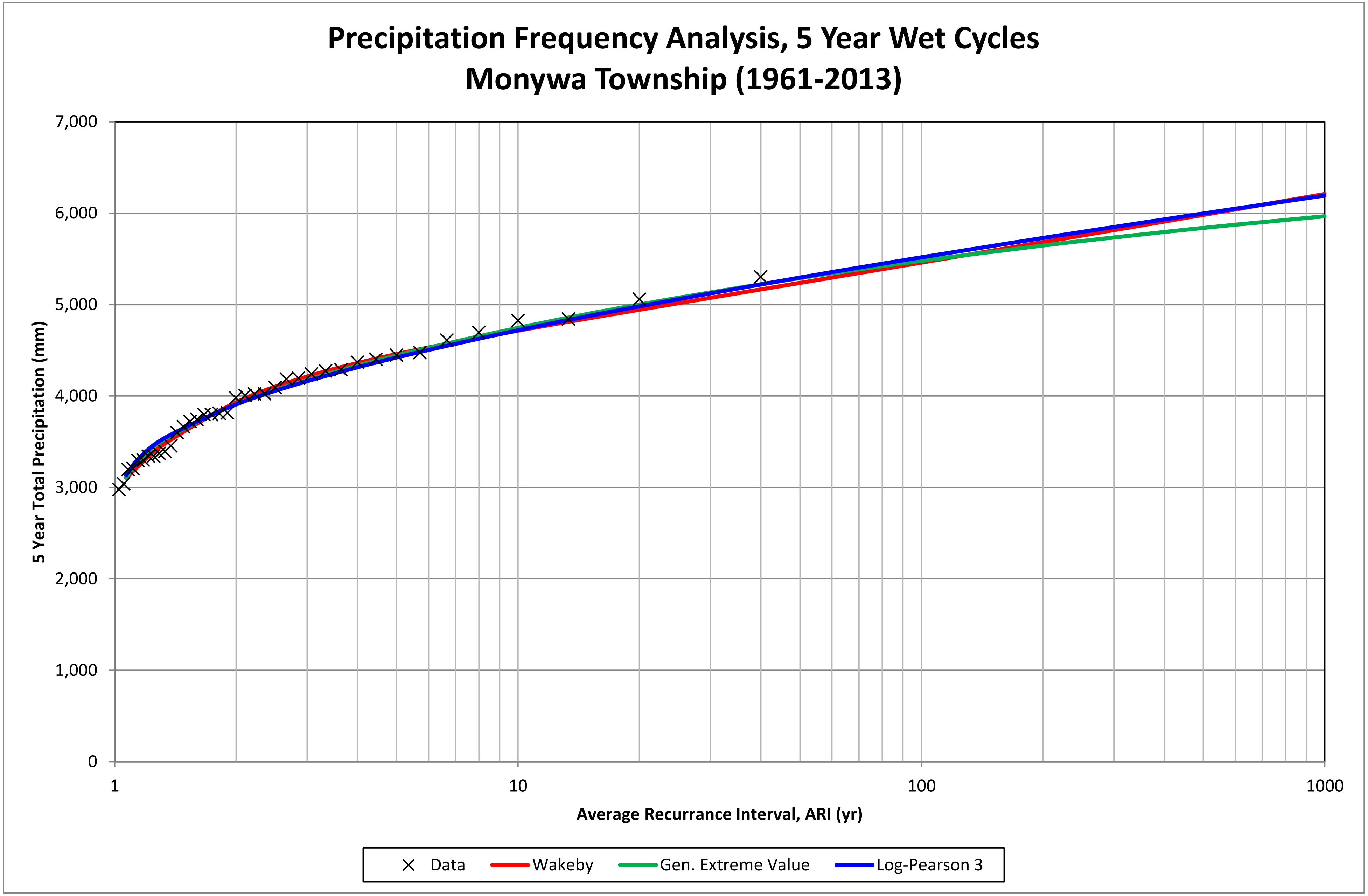
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 5 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 5 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	1911.522	k =	-0.16718292	α =	2422.254636
			β =	1.802226	σ =	549.6462521	β =	0.002964861
			γ =	302.7783	μ =	3714.507579	γ =	1.090119469
			δ =	0.012517				
			ξ =	2963.906				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	6209.2	N/A	5966.2	592.61	6192.9	581.77
0.998	0.002	500	5981.3	N/A	5838.8	592.61	5996.6	581.77
0.996	0.004	250	5755.4	N/A	5695.6	592.61	5794.8	581.77
0.995	0.005	200	5683.1	N/A	5645.8	592.61	5728.4	581.77
0.990	0.010	100	5459.6	N/A	5478.5	592.61	5517.0	581.77
0.980	0.020	50	5237.6	N/A	5289.9	592.61	5295.5	581.77
0.950	0.050	20	4944.0	N/A	5001.3	592.61	4981.4	581.77
0.900	0.100	10	4715.1	N/A	4745.4	592.61	4719.2	581.77
0.800	0.200	5	4458.5	N/A	4443.7	592.61	4421.7	581.77
0.667	0.333	3	4213.6	N/A	4175.6	592.61	4162.8	581.77
0.500	0.500	2.0	3931.2	N/A	3909.9	592.61	3908.0	581.77
0.250	0.750	1.3	3480.3	N/A	3530.0	592.61	3543.3	581.77
0.125	0.875	1.14	3231.2	N/A	3286.5	592.61	3308.5	581.77
0.063	0.937	1.07	3101.0	N/A	3105.2	592.61	3133.3	581.77
Kolmogorov Smirnov (Statistic, Rank)			0.0563	1	0.0822	6	0.0916	18
Anderson Darling (Statistic, Rank)			0.1431	1	0.2045	3	0.2438	9



Precipitation Frequency Analysis, 5 Year Wet Cycles
Monywa Township (1961-2013)
5 Year Total Precipitation (mm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 41

4 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	4 yr Wet Precip (mm)
1961 - 1964	2892.0	1	0.024	42.00	4380.0
1962 - 1965	3359.0	2	0.048	21.00	4173.0
1963 - 1966	3339.0	3	0.071	14.00	3931.0
1964 - 1967	3129.0	4	0.095	10.50	3908.0
1965 - 1968	3658.0	5	0.119	8.40	3781.0
1966 - 1969	3204.0	6	0.143	7.00	3756.0
1967 - 1970	3151.0	7	0.167	6.00	3699.0
1968 - 1971	3507.0	8	0.190	5.25	3660.5
1969 - 1972	3073.0	9	0.214	4.67	3658.0
1970 - 1973	3699.0	10	0.238	4.20	3544.0
1971 - 1974	3756.0	11	0.262	3.82	3508.8
1972 - 1975	3781.0	12	0.286	3.50	3507.0
1973 - 1976	4380.0	13	0.310	3.23	3410.7
1974 - 1977	3931.0	14	0.333	3.00	3359.0
1975 - 1978	4173.0	15	0.357	2.80	3339.0
1976 - 1979	3544.0	16	0.381	2.63	3204.0
1977 - 1980	3011.0	17	0.405	2.47	3151.0
1978 - 1981	2887.0	18	0.429	2.33	3129.0
1979 - 1982	2388.0	19	0.452	2.21	3120.0
1980 - 1983	2538.0	20	0.476	2.10	3105.4
1981 - 1984	2651.0	21	0.500	2.00	3079.0
1982 - 1985	2398.0	22	0.524	1.91	3073.0
1983 - 1986	2629.0	23	0.548	1.83	3054.7
1984 - 1987	2782.0	24	0.571	1.75	3011.0
1985 - 1988	2942.0	25	0.595	1.68	2975.7
1986 - 1989	3120.0	26	0.619	1.62	2942.0
1987 - 1990	3079.0	27	0.643	1.56	2892.0
1988 - 1991	2856.0	28	0.667	1.50	2887.0
1989 - 1992	2728.0	29	0.690	1.45	2856.0
1990 - 1993	2618.0	30	0.714	1.40	2782.0
1991 - 1994	2691.6	31	0.738	1.35	2728.0
1992 - 1995	Exclude	32	0.762	1.31	2691.6
1993 - 1996	Exclude	33	0.786	1.27	2687.1
1994 - 1997	Exclude	34	0.810	1.24	2651.0
1995 - 1998	Exclude	35	0.833	1.20	2629.0
1996 - 1999	Exclude	36	0.857	1.17	2618.0
1997 - 2000	Exclude	37	0.881	1.14	2600.5
1998 - 2001	Exclude	38	0.905	1.11	2538.0
1999 - 2002	Exclude	39	0.929	1.08	2398.0
2000 - 2003	2333.2	40	0.952	1.05	2388.0
2001 - 2004	2600.5				
2002 - 2005	2687.1				
2003 - 2006	2975.7				
2004 - 2007	3410.7				
2005 - 2008	3105.4				
2006 - 2009	3054.7				
2007 - 2010	3508.8				
2008 - 2011	3660.5				
2009 - 2012	3908.0				
2010 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	2	2
Johnson SB	3	1	3
Gen. Extreme Value	4	4	16
Weibull (3P)	6	3	18
Rayleigh (2P)	10	6	60
Gamma (3P)	12	5	60
Log-Pearson 3	8	9	72
Erlang (3P)	7	11	77
Fatigue Life (3P)	13	7	91
Gen. Pareto	2	51	102

Three fits were selected for comparison:
1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

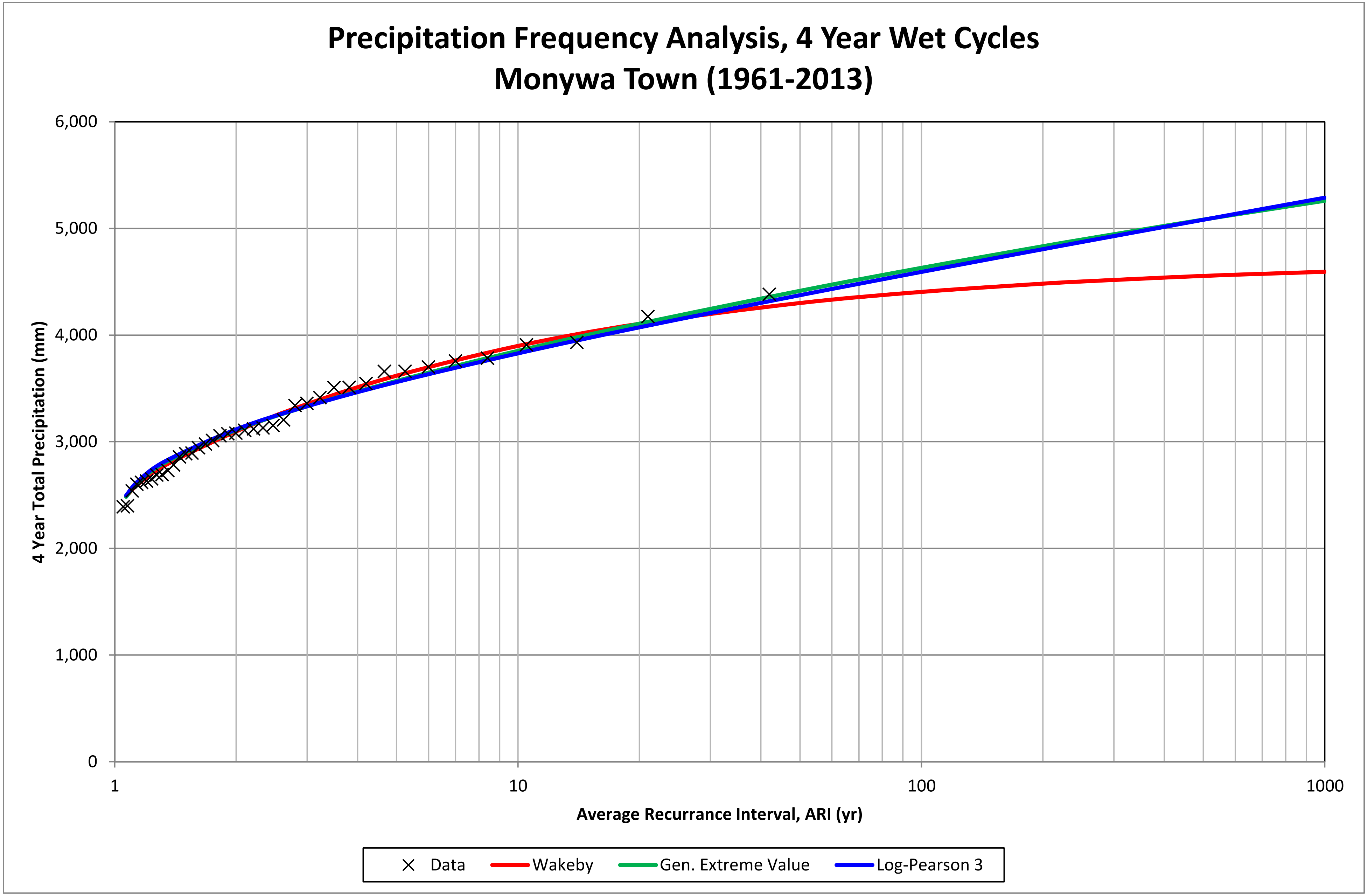
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 4 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	2021.286	k =	-0.083376416	α =	84.55063094
			β =	9.582717	σ =	439.7441449	β =	0.016726578
			γ =	927.1087	μ =	2950.042696	γ =	6.635654783
			δ =	-0.42826				
			ξ =	2330.035				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4593.4	N/A	5259.1	511.81	5287.9	499.12
0.998	0.002	500	4554.6	N/A	5082.6	511.81	5081.2	499.12
0.996	0.004	250	4502.3	N/A	4895.4	511.81	4872.7	499.12
0.995	0.005	200	4481.9	N/A	4832.7	511.81	4804.9	499.12
0.990	0.010	100	4404.5	N/A	4630.2	511.81	4592.1	499.12
0.980	0.020	50	4300.4	N/A	4414.7	511.81	4373.9	499.12
0.950	0.050	20	4105.7	N/A	4107.0	511.81	4072.6	499.12
0.900	0.100	10	3898.2	N/A	3852.3	511.81	3828.5	499.12
0.800	0.200	5	3619.2	N/A	3570.1	511.81	3559.8	499.12
0.667	0.333	3	3354.0	N/A	3332.9	511.81	3332.9	499.12
0.500	0.500	2.0	3096.7	N/A	3108.8	511.81	3116.1	499.12
0.250	0.750	1.3	2778.5	N/A	2804.4	511.81	2816.8	499.12
0.125	0.875	1.14	2602.6	N/A	2618.1	511.81	2631.0	499.12
0.063	0.937	1.07	2487.4	N/A	2483.4	511.81	2495.9	499.12
Kolmogorov Smirnov (Statistic, Rank)			0.0616	1	0.0693	4	0.0733	8
Anderson Darling (Statistic, Rank)			0.1472	2	0.2029	4	0.2365	9



Precipitation Frequency Analysis, 4 Year Wet Cycles
Monywa Town (1961-2013)
6,000
5,000
4,000
3,000
2,000
1,000
0
4 Year Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 44

3 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	3 yr Wet Precip (mm)
1961 - 1963	2311.0	1	0.022	45.00	3263.0
1962 - 1964	2161.0	2	0.044	22.50	3218.8
1963 - 1965	2675.0	3	0.067	15.00	3106.0
1964 - 1966	2443.0	4	0.089	11.25	3105.0
1965 - 1967	2548.0	5	0.111	9.00	3094.3
1966 - 1968	2460.0	6	0.133	7.50	3088.0
1967 - 1969	2540.0	7	0.156	6.43	3010.0
1968 - 1970	2465.0	8	0.178	5.63	2714.0
1969 - 1971	2397.0	9	0.200	5.00	2675.0
1970 - 1972	2329.0	10	0.222	4.50	2548.0
1971 - 1973	3088.0	11	0.244	4.09	2540.0
1972 - 1974	2714.0	12	0.267	3.75	2539.2
1973 - 1975	3105.0	13	0.289	3.46	2478.0
1974 - 1976	3010.0	14	0.311	3.21	2476.3
1975 - 1977	3263.0	15	0.333	3.00	2465.0
1976 - 1978	3106.0	16	0.356	2.81	2460.0
1977 - 1979	2269.0	17	0.378	2.65	2443.0
1978 - 1980	2090.0	18	0.400	2.50	2398.0
1979 - 1981	1977.0	19	0.422	2.37	2397.0
1980 - 1982	1950.0	20	0.444	2.25	2378.3
1981 - 1983	1796.0	21	0.467	2.14	2365.5
1982 - 1984	1854.0	22	0.489	2.05	2338.0
1983 - 1985	1987.0	23	0.511	1.96	2329.0
1984 - 1986	2041.0	24	0.533	1.88	2311.0
1985 - 1987	1927.0	25	0.556	1.80	2287.9
1986 - 1988	2398.0	26	0.578	1.73	2269.0
1987 - 1989	2478.0	27	0.600	1.67	2208.9
1988 - 1990	2338.0	28	0.622	1.61	2173.6
1989 - 1991	1841.0	29	0.644	1.55	2161.0
1990 - 1992	2006.0	30	0.667	1.50	2090.0
1991 - 1993	2017.0	31	0.689	1.45	2041.0
1992 - 1994	2173.6	32	0.711	1.41	2017.0
1993 - 1995	Exclude	33	0.733	1.36	2006.0
1994 - 1996	Exclude	34	0.756	1.32	1987.0
1995 - 1997	Exclude	35	0.778	1.29	1977.0
1996 - 1998	1849.3	36	0.800	1.25	1950.0
1997 - 1999	Exclude	37	0.822	1.22	1947.2
1998 - 2000	Exclude	38	0.844	1.18	1927.0
1999 - 2001	Exclude	39	0.867	1.15	1854.0
2000 - 2002	1735.8	40	0.889	1.13	1849.3
2001 - 2003	1728.9	41	0.911	1.10	1841.0
2002 - 2004	1947.2	42	0.933	1.07	1796.0
2003 - 2005	2208.9	43	0.956	1.05	1735.8
2004 - 2006	2378.3	44	0.978	1.02	1728.9
2005 - 2007	2539.2				
2006 - 2008	2365.5				
2007 - 2009	2287.9				
2008 - 2010	2476.3				
2009 - 2011	3094.3				
2010 - 2012	3218.8				
2011 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	2	3	6
Pearson 5 (3P)	1	10	10
Wakeby	16	1	16
Frechet (3P)	3	11	33
Weibull (3P)	9	4	36
Johnson SB	22	2	44
Log-Pearson 3	5	9	45
Log-Logistic (3P)	4	12	48
Lognormal (3P)	7	8	56
Inv. Gaussian (3P)	10	6	60

Three fits were selected for comparison:

1) **Pearson 5** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

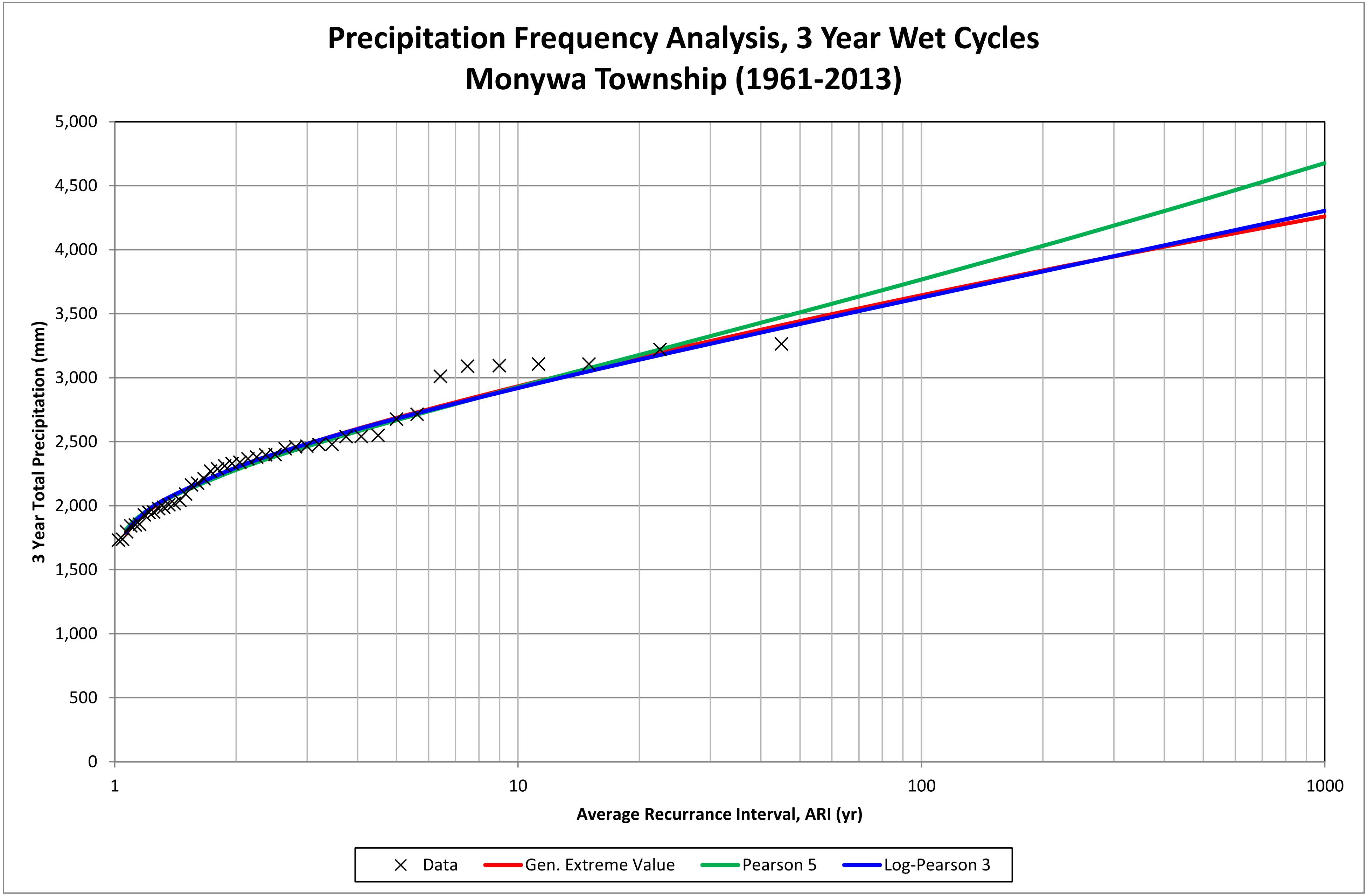
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 3 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Pearson 5		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.05346	α =	13.63980555	α =	46.42243888
			σ =	363.1438	β =	19090.81617	β =	0.025855566
			μ =	2162.971	γ =	845.7300296	γ =	6.548325006
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4260.3	436.49	4676.7	442.70	4304.0	429.50
0.998	0.002	500	4082.9	436.49	4391.5	442.70	4099.6	429.50
0.996	0.004	250	3898.7	436.49	4116.7	442.70	3896.0	429.50
0.995	0.005	200	3837.9	436.49	4030.3	442.70	3830.4	429.50
0.990	0.010	100	3643.9	436.49	3767.1	442.70	3626.4	429.50
0.980	0.020	50	3441.9	436.49	3510.8	442.70	3420.3	429.50
0.950	0.050	20	3160.3	436.49	3178.4	442.70	3141.0	429.50
0.900	0.100	10	2932.9	436.49	2927.1	442.70	2919.5	429.50
0.800	0.200	5	2686.4	436.49	2668.2	442.70	2680.6	429.50
0.667	0.333	3	2483.4	436.49	2463.9	442.70	2483.3	429.50
0.500	0.500	2.0	2294.8	436.49	2280.3	442.70	2298.5	429.50
0.250	0.750	1.3	2043.3	436.49	2045.1	442.70	2049.9	429.50
0.125	0.875	1.14	1891.8	436.49	1909.5	442.70	1899.7	429.50
0.063	0.937	1.07	1783.5	436.49	1815.7	442.70	1792.5	429.50
Kolmogorov Smirnov (Statistic, Rank)			0.0806	2	0.0794	1	0.0834	5
Anderson Darling (Statistic, Rank)			0.4176	3	0.4473	10	0.4428	9



Precipitation Frequency Analysis, 3 Year Wet Cycles
Monywa Township (1961-2013)
3 Year Total Precipitation (mm)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Pearson 5
Log-Pearson 3

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 47

2 Year Data		Rank	Weibull	ARI	Ranked
Years	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**2 yr Wet Precip (mm)**
1961 - 1962	1415.0	1	0.021	48.00	2405.1
1962 - 1963	1580.0	2	0.042	24.00	2342.0
1963 - 1964	1477.0	3	0.063	16.00	2196.0
1964 - 1965	1779.0	4	0.083	12.00	2046.0
1965 - 1966	1862.0	5	0.104	9.60	2038.0
1966 - 1967	1350.0	6	0.125	8.00	1997.9
1967 - 1968	1796.0	7	0.146	6.86	1910.1
1968 - 1969	1854.0	8	0.167	6.00	1862.0
1969 - 1970	1355.0	9	0.188	5.33	1854.0
1970 - 1971	1653.0	10	0.208	4.80	1831.0
1971 - 1972	1718.0	11	0.229	4.36	1799.3
1972 - 1973	2046.0	12	0.250	4.00	1796.0
1973 - 1974	2038.0	13	0.271	3.69	1779.0
1974 - 1975	1735.0	14	0.292	3.43	1756.0
1975 - 1976	2342.0	15	0.313	3.20	1737.0
1976 - 1977	2196.0	16	0.333	3.00	1735.0
1977 - 1978	1831.0	17	0.354	2.82	1718.0
1978 - 1979	1348.0	18	0.375	2.67	1653.0
1979 - 1980	1180.0	19	0.396	2.53	1611.5
1980 - 1981	1539.0	20	0.417	2.40	1598.7
1981 - 1982	1208.0	21	0.438	2.29	1580.0
1982 - 1983	999.0	22	0.458	2.18	1539.0
1983 - 1984	1443.0	23	0.479	2.09	1506.7
1984 - 1985	1399.0	24	0.500	2.00	1499.0
1985 - 1986	1186.0	25	0.521	1.92	1477.0
1986 - 1987	1383.0	26	0.542	1.85	1469.0
1987 - 1988	1756.0	27	0.563	1.78	1443.0
1988 - 1989	1737.0	28	0.583	1.71	1415.0
1989 - 1990	1323.0	29	0.604	1.66	1412.0
1990 - 1991	1119.0	30	0.625	1.60	1405.0
1991 - 1992	1405.0	31	0.646	1.55	1399.0
1992 - 1993	1499.0	32	0.667	1.50	1383.0
1993 - 1994	1286.6	33	0.688	1.45	1355.0
1994 - 1995	Exclude	34	0.708	1.41	1350.0
1995 - 1996	Exclude	35	0.729	1.37	1348.0
1996 - 1997	1412.0	36	0.750	1.33	1323.0
1997 - 1998	1046.9	37	0.771	1.30	1286.6
1998 - 1999	Exclude	38	0.792	1.26	1257.5
1999 - 2000	Exclude	39	0.813	1.23	1255.4
2000 - 2001	1257.5	40	0.833	1.20	1208.0
2001 - 2002	1131.5	41	0.854	1.17	1186.0
2002 - 2003	1075.6	42	0.875	1.14	1180.0
2003 - 2004	1469.0	43	0.896	1.12	1131.5
2004 - 2005	1611.5	44	0.917	1.09	1119.0
2005 - 2006	1506.7	45	0.938	1.07	1075.6
2006 - 2007	1799.3	46	0.958	1.04	1046.9
2007 - 2008	1598.7	47	0.979	1.02	999.0
2008 - 2009	1255.4				
2009 - 2010	1910.1				
2010 - 2011	2405.1				
2011 - 2012	1997.9				
2012 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Gen. Gamma (4P)	1	8	8
Rice	2	29	58
Johnson SB	3	1	3
Triangular	4	43	172
Beta	5	41	205
Wakeby	6	2	12
Rayleigh (2P)	7	5	35
Gamma	8	19	152
Gen. Extreme Value	10	4	40
Log-Pearson 3	16	6	96

Three fits were selected for comparison:

1) **Gen. Gamma (4P)** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

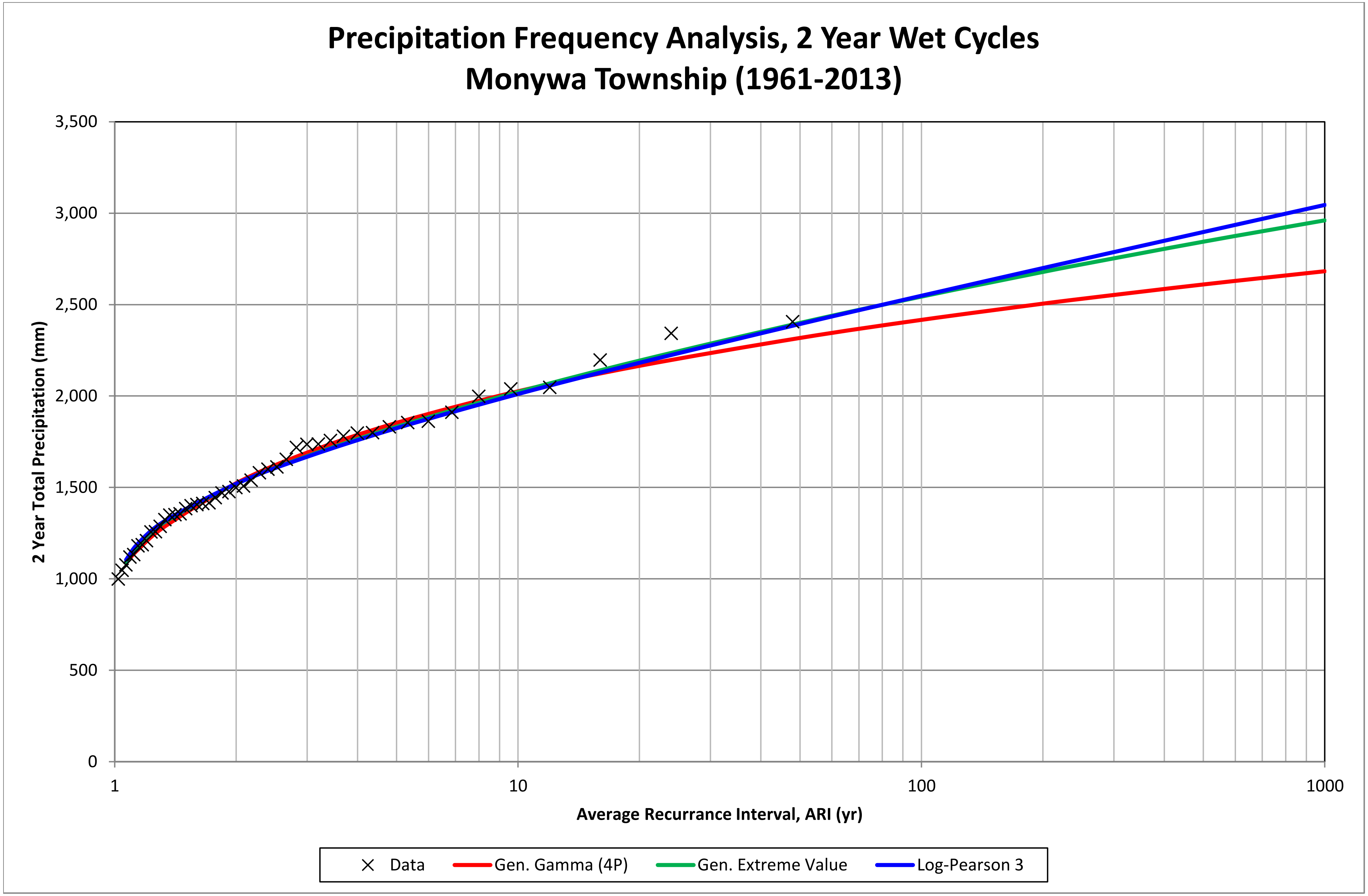
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 2 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	3.002649	k =	-0.087925417	α =	422.6834021
			α =	0.416684	σ =	299.2902393	β =	0.010413888
			β =	982.5662	μ =	1411.245461	γ =	2.928064568
			γ =	991.0833				
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2682.4	338.35	2960.7	346.72	3045.0	341.68
0.998	0.002	500	2610.1	338.35	2844.1	346.72	2896.9	341.68
0.996	0.004	250	2531.8	338.35	2720.0	346.72	2747.9	341.68
0.995	0.005	200	2505.0	338.35	2678.4	346.72	2699.6	341.68
0.990	0.010	100	2416.4	338.35	2543.6	346.72	2548.3	341.68
0.980	0.020	50	2317.5	338.35	2399.8	346.72	2393.8	341.68
0.950	0.050	20	2165.2	338.35	2193.6	346.72	2181.6	341.68
0.900	0.100	10	2025.9	338.35	2022.3	346.72	2010.9	341.68
0.800	0.200	5	1853.3	338.35	1831.8	346.72	1824.3	341.68
0.667	0.333	3	1690.8	338.35	1671.3	346.72	1668.0	341.68
0.500	0.500	2.0	1522.9	338.35	1519.2	346.72	1519.9	341.68
0.250	0.750	1.3	1287.6	338.35	1312.1	346.72	1317.6	341.68
0.125	0.875	1.14	1160.6	338.35	1184.9	346.72	1193.6	341.68
0.063	0.937	1.07	1089.0	338.35	1092.9	346.72	1104.3	341.68
Kolmogorov Smirnov (Statistic, Rank)			0.0580	1	0.0723	10	0.0765	16
Anderson Darling (Statistic, Rank)			0.1597	8	0.1427	4	0.1586	6



Precipitation Frequency Analysis, 2 Year Wet Cycles
Monywa Township (1961-2013)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2 Year Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 50

Annual Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**1 yr Wet Precip (mm)**
1961	731.0	1	0.020	51.00	1370.0
1962	684.0	2	0.039	25.50	1275.0
1963	896.0	3	0.059	17.00	1220.9
1964	581.0	4	0.078	12.75	1198.0
1965	1198.0	5	0.098	10.20	1184.2
1966	664.0	6	0.118	8.50	1110.0
1967	686.0	7	0.137	7.29	1067.0
1968	1110.0	8	0.157	6.38	1042.0
1969	744.0	9	0.176	5.67	1032.5
1970	611.0	10	0.196	5.10	1015.0
1971	1042.0	11	0.216	4.64	921.0
1972	676.0	12	0.235	4.25	910.0
1973	1370.0	13	0.255	3.92	896.0
1974	668.0	14	0.275	3.64	887.0
1975	1067.0	15	0.294	3.40	871.6
1976	1275.0	16	0.314	3.19	855.0
1977	921.0	17	0.333	3.00	813.7
1978	910.0	18	0.353	2.83	802.4
1979	438.0	19	0.373	2.68	797.0
1980	742.0	20	0.392	2.55	766.8
1981	797.0	21	0.412	2.43	744.0
1982	411.0	22	0.431	2.32	742.0
1983	588.0	23	0.451	2.22	741.0
1984	855.0	24	0.471	2.13	739.9
1985	544.0	25	0.490	2.04	731.0
1986	642.0	26	0.510	1.96	722.0
1987	741.0	27	0.529	1.89	689.2
1988	1015.0	28	0.549	1.82	686.0
1989	722.0	29	0.569	1.76	684.0
1990	601.0	30	0.588	1.70	676.0
1991	518.0	31	0.608	1.65	674.6
1992	887.0	32	0.627	1.59	668.0
1993	612.0	33	0.647	1.55	664.0
1994	674.6	34	0.667	1.50	653.3
1995	Exclude	35	0.686	1.46	642.0
1996	802.4	36	0.706	1.42	612.0
1997	609.6	37	0.725	1.38	611.0
1998	437.2	38	0.745	1.34	609.6
1999	Exclude	39	0.765	1.31	604.2
2000	604.2	40	0.784	1.28	601.0
2001	653.3	41	0.804	1.24	597.4
2002	478.2	42	0.824	1.21	588.0
2003	597.4	43	0.843	1.19	581.0
2004	871.6	44	0.863	1.16	566.2
2005	739.9	45	0.882	1.13	544.0
2006	766.8	46	0.902	1.11	518.0
2007	1032.5	47	0.922	1.09	478.2
2008	566.2	48	0.941	1.06	438.0
2009	689.2	49	0.961	1.04	437.2
2010	1220.9	50	0.980	1.02	411.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

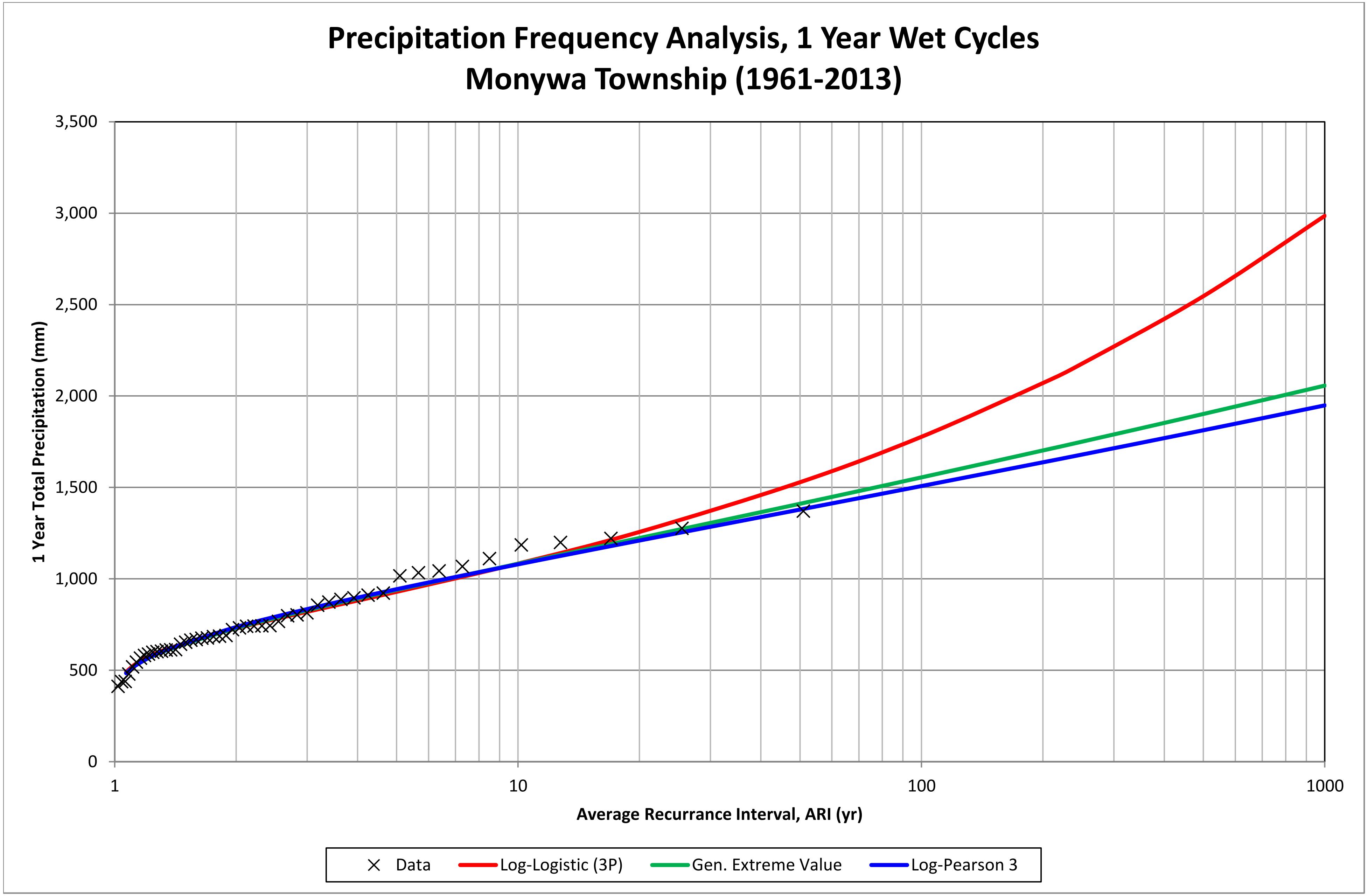
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2985.2	282.20	2056.9	240.34	1948.7	234.14
0.998	0.002	500	2546.0	282.20	1901.8	240.34	1812.7	234.14
0.996	0.004	250	2176.7	282.20	1750.2	240.34	1679.6	234.14
0.995	0.005	200	2070.8	282.20	1702.1	240.34	1637.3	234.14
0.990	0.010	100	1776.7	282.20	1554.9	240.34	1507.4	234.14
0.980	0.020	50	1528.5	282.20	1410.6	240.34	1379.0	234.14
0.950	0.050	20	1256.6	282.20	1223.3	240.34	1209.7	234.14
0.900	0.100	10	1083.5	282.20	1082.6	240.34	1079.5	234.14
0.800	0.200	5	929.1	282.20	939.5	240.34	943.4	234.14
0.667	0.333	3	820.3	282.20	828.5	240.34	834.7	234.14
0.500	0.500	2.0	728.4	282.20	730.3	240.34	736.1	234.14
0.250	0.750	1.3	612.3	282.20	606.2	240.34	608.8	234.14
0.125	0.875	1.14	542.4	282.20	535.0	240.34	535.0	234.14
0.063	0.937	1.07	491.5	282.20	485.6	240.34	483.9	234.14
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11


Precipitation Frequency Analysis, 1 Year Wet Cycles
Monywa Township (1961-2013)
1 Year Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 50

Annual Data Year	Annual Data Precip (mm)	Rank (lowest to highest) m	Weibull Exceedance Probability p	ARI (yr)	Ranked 1 yr Dry Precip (mm)
1961	731.0	1	0.020	51.00	411.0
1962	684.0	2	0.039	25.50	437.2
1963	896.0	3	0.059	17.00	438.0
1964	581.0	4	0.078	12.75	478.2
1965	1198.0	5	0.098	10.20	518.0
1966	664.0	6	0.118	8.50	544.0
1967	686.0	7	0.137	7.29	566.2
1968	1110.0	8	0.157	6.38	581.0
1969	744.0	9	0.176	5.67	588.0
1970	611.0	10	0.196	5.10	597.4
1971	1042.0	11	0.216	4.64	601.0
1972	676.0	12	0.235	4.25	604.2
1973	1370.0	13	0.255	3.92	609.6
1974	668.0	14	0.275	3.64	611.0
1975	1067.0	15	0.294	3.40	612.0
1976	1275.0	16	0.314	3.19	642.0
1977	921.0	17	0.333	3.00	653.3
1978	910.0	18	0.353	2.83	664.0
1979	438.0	19	0.373	2.68	668.0
1980	742.0	20	0.392	2.55	674.6
1981	797.0	21	0.412	2.43	676.0
1982	411.0	22	0.431	2.32	684.0
1983	588.0	23	0.451	2.22	686.0
1984	855.0	24	0.471	2.13	689.2
1985	544.0	25	0.490	2.04	722.0
1986	642.0	26	0.510	1.96	731.0
1987	741.0	27	0.529	1.89	739.9
1988	1015.0	28	0.549	1.82	741.0
1989	722.0	29	0.569	1.76	742.0
1990	601.0	30	0.588	1.70	744.0
1991	518.0	31	0.608	1.65	766.8
1992	887.0	32	0.627	1.59	797.0
1993	612.0	33	0.647	1.55	802.4
1994	674.6	34	0.667	1.50	813.7
1995	Exclude	35	0.686	1.46	855.0
1996	802.4	36	0.706	1.42	871.6
1997	609.6	37	0.725	1.38	887.0
1998	437.2	38	0.745	1.34	896.0
1999	Exclude	39	0.765	1.31	910.0
2000	604.2	40	0.784	1.28	921.0
2001	653.3	41	0.804	1.24	1015.0
2002	478.2	42	0.824	1.21	1032.5
2003	597.4	43	0.843	1.19	1042.0
2004	871.6	44	0.863	1.16	1067.0
2005	739.9	45	0.882	1.13	1110.0
2006	766.8	46	0.902	1.11	1184.2
2007	1032.5	47	0.922	1.09	1198.0
2008	566.2	48	0.941	1.06	1220.9
2009	689.2	49	0.961	1.04	1275.0
2010	1220.9	50	0.980	1.02	1370.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

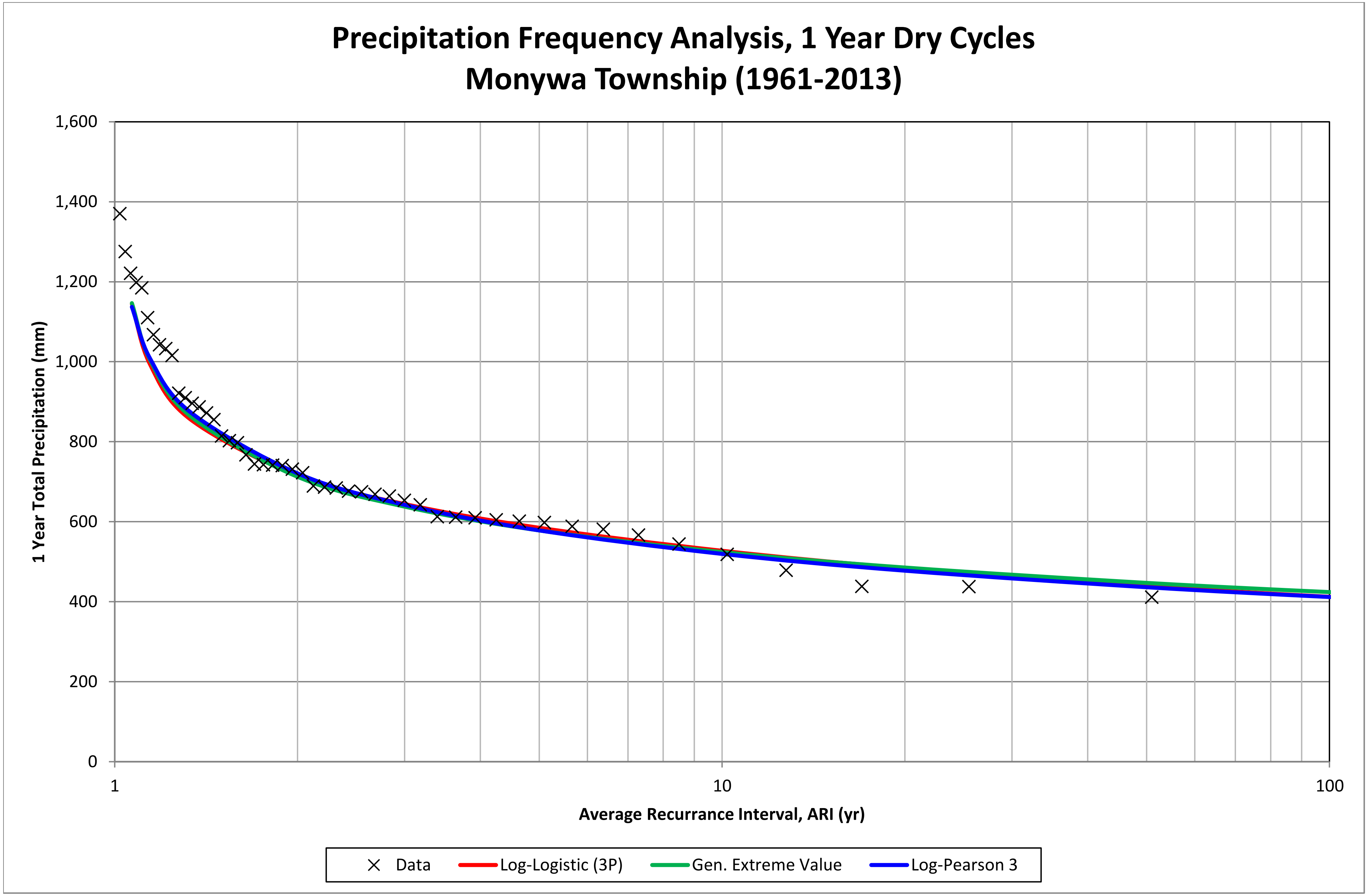
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent dry-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.001	0.999	1000	351.1	259.33	368.2	233.54	354.0	224.66
0.002	0.998	500	365.9	259.33	382.6	233.54	368.6	224.66
0.004	0.996	250	383.5	259.33	398.8	233.54	385.3	224.66
0.005	0.995	200	389.9	259.33	404.5	233.54	391.3	224.66
0.010	0.990	100	412.3	259.33	424.0	233.54	411.8	224.66
0.020	0.980	50	439.1	259.33	447.0	233.54	436.3	224.66
0.050	0.950	20	483.8	259.33	485.4	233.54	477.6	224.66
0.100	0.900	10	527.3	259.33	524.1	233.54	519.6	224.66
0.200	0.800	5	584.8	259.33	578.3	233.54	578.3	224.66
0.333	0.667	3	644.1	259.33	637.7	233.54	642.1	224.66
0.500	0.500	2.0	714.9	259.33	712.5	233.54	720.9	224.66
0.750	0.250	1.3	855.7	259.33	863.4	233.54	873.5	224.66
0.875	0.125	1.14	994.2	259.33	1005.0	233.54	1008.6	224.66
0.937	0.063	1.07	1144.8	259.33	1146.5	233.54	1137.1	224.66
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11



Precipitation Frequency Analysis, 1 Year Dry Cycles
Monywa Township (1961-2013)
1,600
1,400
1,200
1,000
800
600
400
200
0
1 Year Total Precipitation (mm)
1
10
100
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

180 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	180 d Wet Precip (mm)
1961	653.0	1	0.019	53.00	1288.0
1962	678.0	2	0.038	26.50	1180.9
1963	837.0	3	0.057	17.67	1139.7
1964	565.0	4	0.075	13.25	1098.0
1965	1098.0	5	0.094	10.60	1046.0
1966	628.0	6	0.113	8.83	1024.0
1967	640.0	7	0.132	7.57	994.0
1968	1024.0	8	0.151	6.63	971.8
1969	713.0	9	0.170	5.89	965.0
1970	560.0	10	0.189	5.30	903.0
1971	965.0	11	0.208	4.82	901.0
1972	600.0	12	0.226	4.42	864.5
1973	1288.0	13	0.245	4.08	863.0
1974	614.0	14	0.264	3.79	851.0
1975	994.0	15	0.283	3.53	837.0
1976	1046.0	16	0.302	3.31	821.0
1977	863.0	17	0.321	3.12	753.7
1978	903.0	18	0.340	2.94	724.2
1979	415.0	19	0.358	2.79	720.0
1980	702.0	20	0.377	2.65	715.2
1981	650.0	21	0.396	2.52	713.0
1982	410.0	22	0.415	2.41	702.0
1983	545.0	23	0.434	2.30	678.0
1984	821.0	24	0.453	2.21	673.6
1985	459.0	25	0.472	2.12	665.0
1986	614.0	26	0.491	2.04	653.0
1987	645.0	27	0.509	1.96	650.0
1988	901.0	28	0.528	1.89	645.7
1989	720.0	29	0.547	1.83	645.0
1990	572.0	30	0.566	1.77	640.0
1991	472.0	31	0.585	1.71	637.8
1992	851.0	32	0.604	1.66	628.0
1993	573.0	33	0.623	1.61	616.5
1994	637.8	34	0.642	1.56	614.0
1995	531.1	35	0.660	1.51	614.0
1996	616.5	36	0.679	1.47	602.3
1997	602.3	37	0.698	1.43	600.0
1998	413.1	38	0.717	1.39	576.3
1999	715.2	39	0.736	1.36	573.0
2000	556.8	40	0.755	1.33	572.0
2001	645.7	41	0.774	1.29	565.0
2002	454.4	42	0.792	1.26	560.0
2003	576.3	43	0.811	1.23	556.8
2004	864.5	44	0.830	1.20	545.0
2005	673.6	45	0.849	1.18	531.1
2006	724.2	46	0.868	1.15	514.9
2007	971.8	47	0.887	1.13	472.0
2008	514.9	48	0.906	1.10	459.0
2009	665.0	49	0.925	1.08	454.4
2010	1180.9	50	0.943	1.06	415.0
2011	1139.7	51	0.962	1.04	413.1
2012	753.7	52	0.981	1.02	410.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	1	3	3
Gen. Extreme Value	3	1	3
Burr	2	2	4
Lognormal (3P)	7	4	28
Pearson 6 (4P)	5	6	30
Pearson 5 (3P)	6	5	30
Frechet (3P)	8	9	72
Log-Logistic	4	19	76
Inv. Gaussian (3P)	11	7	77
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

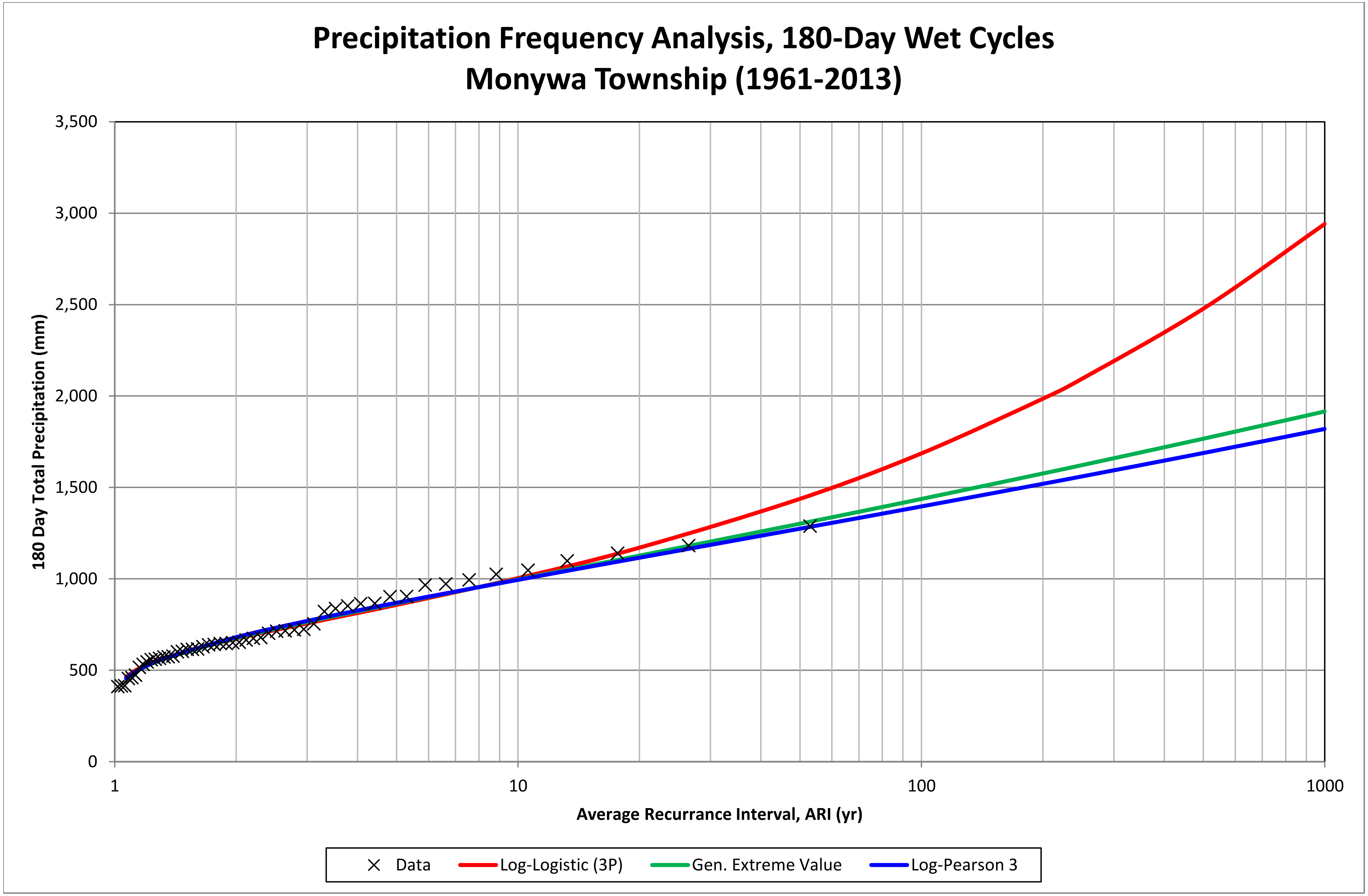
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 180 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α =	3.636479	k =	0.043959129	α =	63.28937577
			β =	399.3156	σ =	160.9920019	β =	0.03539472
			γ =	273.2777	μ =	616.2480698	γ =	4.294614079
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2941.2	270.39	1915.6	219.52	1819.9	213.97
0.998	0.002	500	2477.6	270.39	1766.5	219.52	1688.2	213.97
0.996	0.004	250	2094.0	270.39	1621.9	219.52	1560.2	213.97
0.995	0.005	200	1985.2	270.39	1576.2	219.52	1519.7	213.97
0.990	0.010	100	1686.1	270.39	1437.0	219.52	1395.9	213.97
0.980	0.020	50	1437.7	270.39	1301.5	219.52	1274.4	213.97
0.950	0.050	20	1170.6	270.39	1127.0	219.52	1115.6	213.97
0.900	0.100	10	1004.0	270.39	997.1	219.52	994.6	213.97
0.800	0.200	5	857.9	270.39	865.9	219.52	869.2	213.97
0.667	0.333	3	756.6	270.39	764.7	219.52	769.9	213.97
0.500	0.500	2.0	672.6	270.39	675.7	219.52	680.6	213.97
0.250	0.750	1.3	568.5	270.39	564.0	219.52	566.2	213.97
0.125	0.875	1.14	507.1	270.39	500.3	219.52	500.4	213.97
0.063	0.937	1.07	463.3	270.39	456.1	219.52	455.1	213.97
Kolmogorov Smirnov (Statistic, Rank)			0.0671	1	0.0764	2	0.0863	17
Anderson Darling (Statistic, Rank)			0.3558	2	0.3565	3	0.3842	10


Precipitation Frequency Analysis, 180-Day Wet Cycles
Monywa Township (1961-2013)
180 Day Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

120 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	120 d Wet Precip (mm)
1961	493.0	1	0.019	53.00	980.9
1962	466.0	2	0.038	26.50	977.0
1963	641.0	3	0.057	17.67	928.0
1964	384.0	4	0.075	13.25	802.0
1965	977.0	5	0.094	10.60	781.0
1966	432.0	6	0.113	8.83	754.2
1967	456.0	7	0.132	7.57	718.0
1968	695.0	8	0.151	6.63	717.0
1969	551.0	9	0.170	5.89	712.8
1970	420.0	10	0.189	5.30	703.0
1971	802.0	11	0.208	4.82	695.0
1972	497.0	12	0.226	4.42	673.0
1973	928.0	13	0.245	4.08	654.0
1974	423.0	14	0.264	3.79	653.0
1975	703.0	15	0.283	3.53	641.0
1976	717.0	16	0.302	3.31	640.0
1977	781.0	17	0.321	3.12	636.2
1978	718.0	18	0.340	2.94	632.7
1979	375.0	19	0.358	2.79	597.9
1980	558.0	20	0.377	2.65	589.8
1981	520.0	21	0.396	2.52	577.0
1982	351.0	22	0.415	2.41	558.0
1983	523.0	23	0.434	2.30	551.0
1984	653.0	24	0.453	2.21	544.3
1985	316.0	25	0.472	2.12	537.0
1986	577.0	26	0.491	2.04	532.9
1987	537.0	27	0.509	1.96	531.4
1988	640.0	28	0.528	1.89	523.0
1989	654.0	29	0.547	1.83	520.0
1990	488.0	30	0.566	1.77	505.5
1991	372.0	31	0.585	1.71	497.0
1992	673.0	32	0.604	1.66	496.6
1993	416.0	33	0.623	1.61	493.0
1994	589.8	34	0.642	1.56	488.0
1995	496.6	35	0.660	1.51	466.0
1996	532.9	36	0.679	1.47	465.1
1997	465.1	37	0.698	1.43	456.0
1998	388.7	38	0.717	1.39	452.0
1999	597.9	39	0.736	1.36	432.0
2000	405.1	40	0.755	1.33	431.1
2001	505.5	41	0.774	1.29	423.0
2002	383.2	42	0.792	1.26	420.0
2003	431.1	43	0.811	1.23	416.0
2004	712.8	44	0.830	1.20	405.1
2005	531.4	45	0.849	1.18	388.7
2006	544.3	46	0.868	1.15	384.0
2007	632.7	47	0.887	1.13	383.2
2008	340.1	48	0.906	1.10	375.0
2009	452.0	49	0.925	1.08	372.0
2010	980.9	50	0.943	1.06	351.0
2011	754.2	51	0.962	1.04	340.1
2012	636.2	52	0.981	1.02	316.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Gamma (4P)	1	3	3
Weibull (3P)	5	1	5
Johnson SB	3	2	6
Inv. Gaussian	6	10	60
Gamma (3P)	16	4	64
Gen. Extreme Value	14	5	70
Triangular	2	41	82
Log-Pearson 3	15	8	120
Fatigue Life (3P)	21	6	126
Fatigue Life	8	18	144

Three fits were selected for comparison:

1) **Gen. Gamma (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

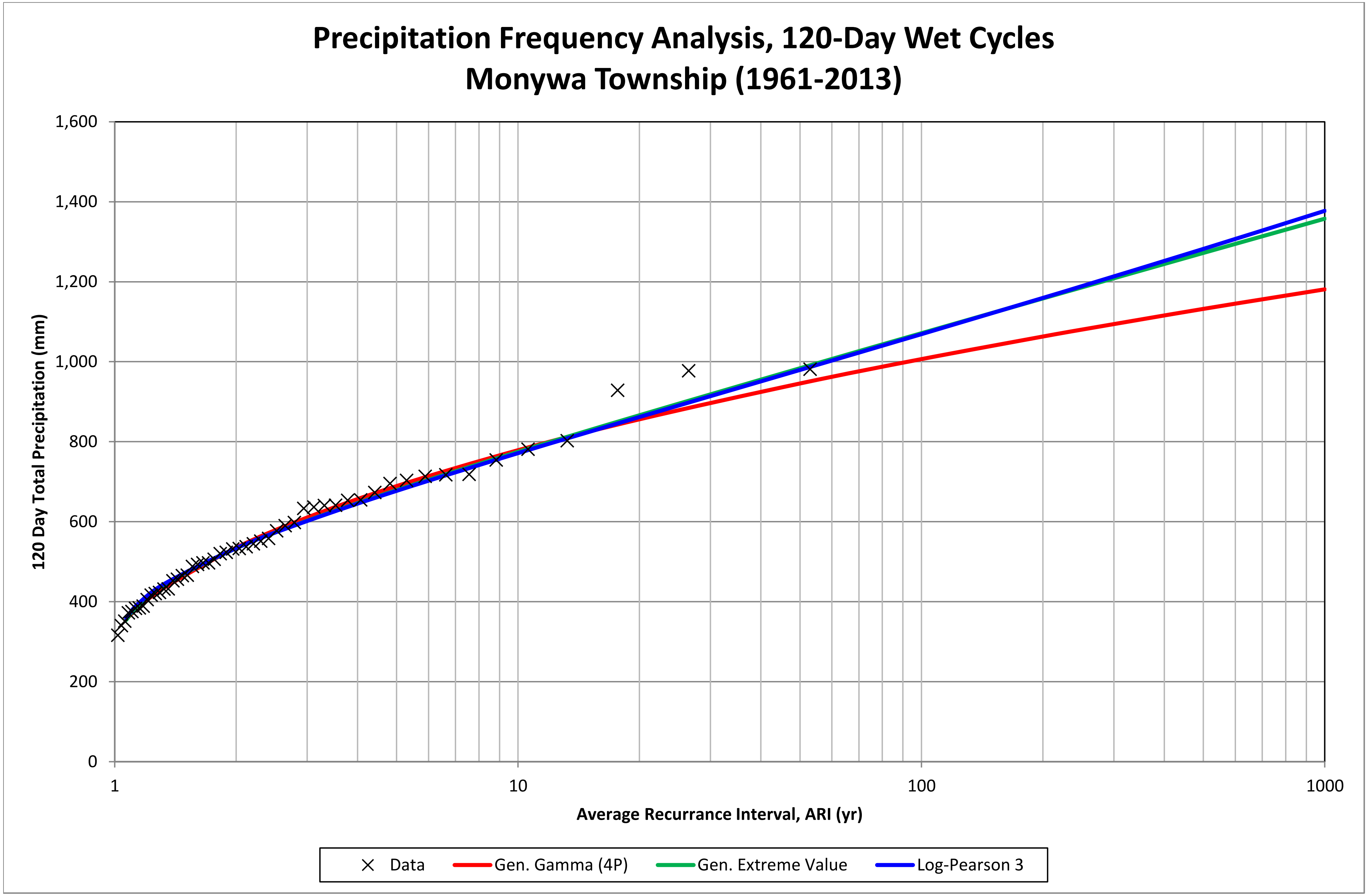
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 120 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	$k =$	2.014351	$k =$	-0.007127425	$\alpha =$	79.44577123
			$\alpha =$	0.680568	$\sigma =$	129.2860825	$\beta =$	0.030828944
			$\beta =$	357.1653	$\mu =$	486.2314488	$\gamma =$	3.840998652
			$\gamma =$	311.3739				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1181.0	137.96	1357.6	164.29	1377.3	162.20
0.998	0.002	500	1132.1	137.96	1272.0	164.29	1282.0	162.20
0.996	0.004	250	1080.3	137.96	1186.0	164.29	1189.0	162.20
0.995	0.005	200	1063.0	137.96	1158.1	164.29	1159.5	162.20
0.990	0.010	100	1006.5	137.96	1071.3	164.29	1068.9	162.20
0.980	0.020	50	945.6	137.96	983.7	164.29	979.5	162.20
0.950	0.050	20	856.1	137.96	866.2	164.29	861.8	162.20
0.900	0.100	10	778.8	137.96	774.9	164.29	771.5	162.20
0.800	0.200	5	689.2	137.96	679.1	164.29	677.2	162.20
0.667	0.333	3	610.6	137.96	602.7	164.29	602.0	162.20
0.500	0.500	2.0	535.0	137.96	533.6	164.29	533.8	162.20
0.250	0.750	1.3	436.5	137.96	444.0	164.29	445.7	162.20
0.125	0.875	1.14	385.1	137.96	391.3	164.29	394.7	162.20
0.063	0.937	1.07	355.8	137.96	354.3	164.29	359.3	162.20
Kolmogorov Smirnov (Statistic, Rank)			0.0550	1	0.0719	14	0.0740	15
Anderson Darling (Statistic, Rank)			0.1466	3	0.1704	5	0.1777	8



Precipitation Frequency Analysis, 120-Day Wet Cycles
Monywa Township (1961-2013)
1,600
1,400
1,200
1,000
800
600
400
200
0
120 Day Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

90 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	90 d Wet Precip (mm)
1961	420.0	1	0.019	53.00	899.0
1962	370.0	2	0.038	26.50	864.8
1963	590.0	3	0.057	17.67	738.0
1964	348.0	4	0.075	13.25	718.0
1965	899.0	5	0.094	10.60	683.0
1966	346.0	6	0.113	8.83	654.4
1967	377.0	7	0.132	7.57	605.0
1968	557.0	8	0.151	6.63	596.7
1969	416.0	9	0.170	5.89	594.0
1970	385.0	10	0.189	5.30	590.0
1971	533.0	11	0.208	4.82	585.0
1972	450.0	12	0.226	4.42	561.0
1973	718.0	13	0.245	4.08	557.0
1974	368.0	14	0.264	3.79	555.0
1975	605.0	15	0.283	3.53	536.0
1976	683.0	16	0.302	3.31	533.0
1977	738.0	17	0.321	3.12	517.0
1978	561.0	18	0.340	2.94	515.6
1979	298.0	19	0.358	2.79	503.0
1980	440.0	20	0.377	2.65	503.0
1981	473.0	21	0.396	2.52	486.9
1982	254.0	22	0.415	2.41	473.0
1983	466.0	23	0.434	2.30	470.7
1984	555.0	24	0.453	2.21	466.0
1985	266.0	25	0.472	2.12	465.9
1986	517.0	26	0.491	2.04	465.6
1987	503.0	27	0.509	1.96	463.6
1988	536.0	28	0.528	1.89	460.5
1989	585.0	29	0.547	1.83	450.0
1990	442.0	30	0.566	1.77	445.8
1991	354.0	31	0.585	1.71	443.5
1992	594.0	32	0.604	1.66	442.0
1993	347.0	33	0.623	1.61	440.0
1994	486.9	34	0.642	1.56	420.0
1995	460.5	35	0.660	1.51	416.0
1996	470.7	36	0.679	1.47	396.5
1997	445.8	37	0.698	1.43	394.0
1998	363.0	38	0.717	1.39	385.0
1999	515.6	39	0.736	1.36	380.0
2000	380.0	40	0.755	1.33	377.0
2001	463.6	41	0.774	1.29	370.0
2002	349.5	42	0.792	1.26	368.0
2003	396.5	43	0.811	1.23	363.0
2004	465.9	44	0.830	1.20	354.0
2005	443.5	45	0.849	1.18	349.5
2006	465.6	46	0.868	1.15	348.0
2007	503.0	47	0.887	1.13	347.0
2008	311.6	48	0.906	1.10	346.0
2009	394.0	49	0.925	1.08	311.6
2010	864.8	50	0.943	1.06	298.0
2011	654.4	51	0.962	1.04	266.0
2012	596.7	52	0.981	1.02	254.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	1	1	1
Log-Logistic (3P)	4	2	8
Burr	2	8	16
Log-Gamma	3	13	39
Pearson 5 (3P)	9	5	45
Frechet (3P)	16	3	48
Pearson 6 (4P)	10	6	60
Gumbel Max	18	4	72
Log-Pearson 3	15	10	150
Gen. Extreme Value	22	9	198

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

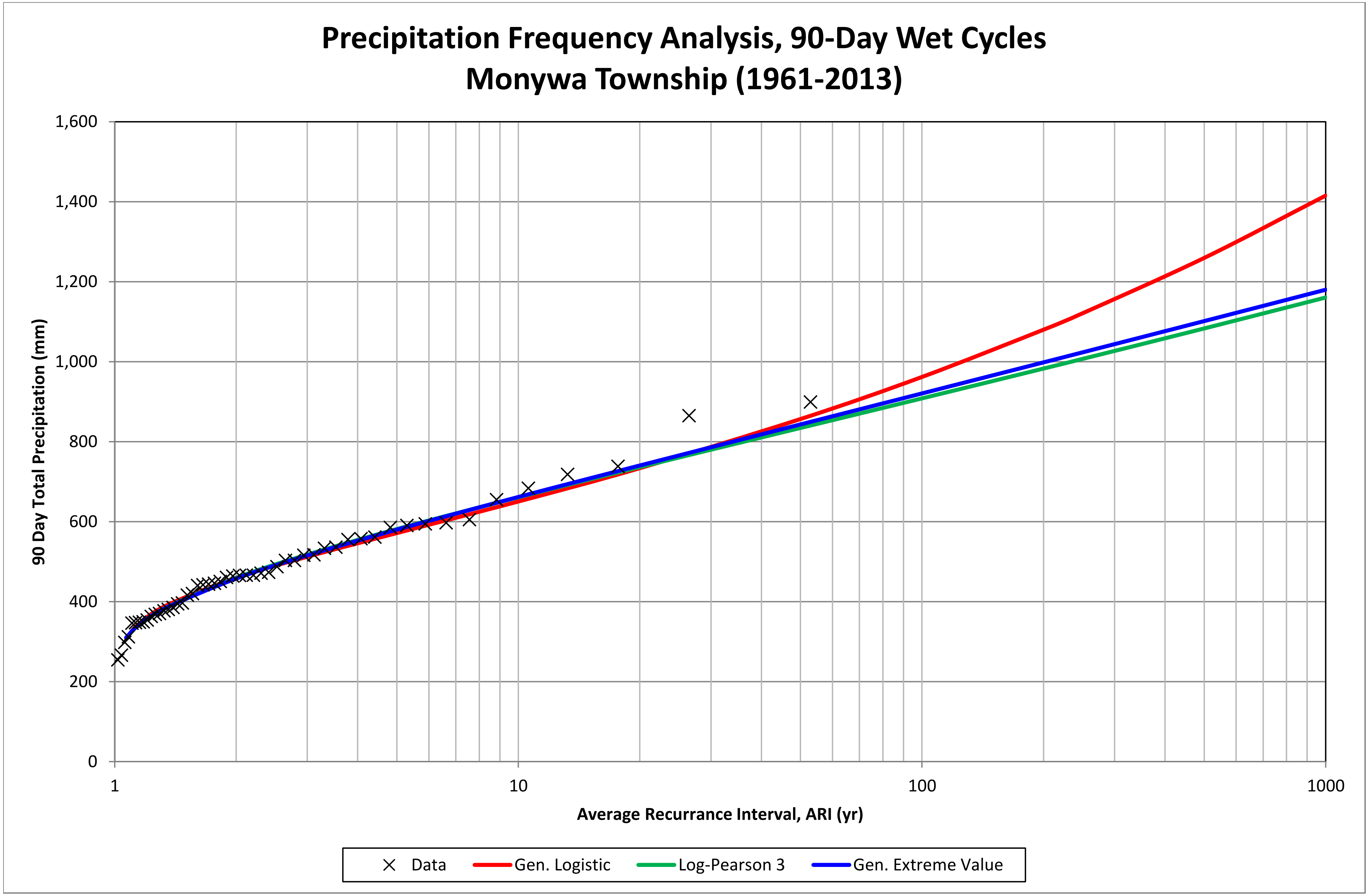
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 90 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α =	0.175342	α =	107.5755695	k =	0.008412194
			β =	71.06012	β =	0.026267129	σ =	107.0507724
			ξ =	460.0164	γ =	3.313707262	μ =	418.5725416
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1415.2	N/A	1160.5	137.46	1179.9	138.84
0.998	0.002	500	1259.3	N/A	1083.0	137.46	1101.4	138.84
0.996	0.004	250	1121.1	N/A	1007.0	137.46	1023.4	138.84
0.995	0.005	200	1080.0	N/A	982.8	137.46	998.3	138.84
0.990	0.010	100	961.9	N/A	908.3	137.46	920.7	138.84
0.980	0.020	50	856.6	N/A	834.4	137.46	843.2	138.84
0.950	0.050	20	733.9	N/A	736.5	137.46	740.5	138.84
0.900	0.100	10	650.5	N/A	661.0	137.46	661.8	138.84
0.800	0.200	5	571.5	N/A	581.6	137.46	580.2	138.84
0.667	0.333	3	512.5	N/A	517.8	137.46	515.7	138.84
0.500	0.500	2.0	460.0	N/A	459.7	137.46	457.9	138.84
0.250	0.750	1.3	389.0	N/A	384.2	137.46	383.7	138.84
0.125	0.875	1.14	342.9	N/A	340.1	137.46	340.4	138.84
0.063	0.937	1.07	307.2	N/A	309.5	137.46	310.2	138.84
Kolmogorov Smirnov (Statistic, Rank)			0.0629	1	0.0702	15	0.0756	22
Anderson Darling (Statistic, Rank)			0.1745	1	0.1825	10	0.1820	9



Precipitation Frequency Analysis, 90-Day Wet Cycles
Monywa Township (1961-2013)
90 Day Total Precipitation (mm)
0
200
400
600
800
1,000
1,200
1,400
1,600
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

60 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	60 d Wet Precip (mm)
1961	352.0	1	0.019	53.00	749.0
1962	286.0	2	0.038	26.50	666.3
1963	506.0	3	0.057	17.67	643.0
1964	314.0	4	0.075	13.25	574.0
1965	749.0	5	0.094	10.60	556.7
1966	315.0	6	0.113	8.83	522.0
1967	323.0	7	0.132	7.57	506.0
1968	476.0	8	0.151	6.63	498.0
1969	383.0	9	0.170	5.89	481.0
1970	282.0	10	0.189	5.30	476.0
1971	423.0	11	0.208	4.82	474.6
1972	420.0	12	0.226	4.42	473.0
1973	522.0	13	0.245	4.08	456.2
1974	303.0	14	0.264	3.79	447.0
1975	498.0	15	0.283	3.53	443.0
1976	574.0	16	0.302	3.31	442.0
1977	643.0	17	0.321	3.12	441.7
1978	402.0	18	0.340	2.94	428.0
1979	251.0	19	0.358	2.79	423.0
1980	343.0	20	0.377	2.65	420.0
1981	382.0	21	0.396	2.52	414.1
1982	187.0	22	0.415	2.41	413.0
1983	447.0	23	0.434	2.30	402.0
1984	481.0	24	0.453	2.21	388.4
1985	194.0	25	0.472	2.12	386.8
1986	413.0	26	0.491	2.04	383.5
1987	442.0	27	0.509	1.96	383.0
1988	428.0	28	0.528	1.89	382.0
1989	473.0	29	0.547	1.83	352.8
1990	335.0	30	0.566	1.77	352.0
1991	301.0	31	0.585	1.71	347.2
1992	443.0	32	0.604	1.66	347.2
1993	335.0	33	0.623	1.61	343.0
1994	352.8	34	0.642	1.56	339.8
1995	347.2	35	0.660	1.51	335.0
1996	388.4	36	0.679	1.47	335.0
1997	300.7	37	0.698	1.43	323.6
1998	282.0	38	0.717	1.39	323.0
1999	441.7	39	0.736	1.36	315.0
2000	339.8	40	0.755	1.33	314.0
2001	313.5	41	0.774	1.29	313.5
2002	299.7	42	0.792	1.26	303.0
2003	347.2	43	0.811	1.23	301.0
2004	414.1	44	0.830	1.20	300.7
2005	386.8	45	0.849	1.18	299.7
2006	323.6	46	0.868	1.15	286.0
2007	474.6	47	0.887	1.13	282.0
2008	238.5	48	0.906	1.10	282.0
2009	383.5	49	0.925	1.08	251.0
2010	666.3	50	0.943	1.06	238.5
2011	456.2	51	0.962	1.04	194.0
2012	556.7	52	0.981	1.02	187.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	2	4	8
Gumbel Max	1	5	5
Log-Logistic (3P)	22	1	22
Lognormal	3	8	24
Gen. Logistic	20	6	120
Pearson 5 (3P)	12	7	84
Log-Gamma	5	2	10
Fatigue Life	6	9	54
Burr	24	3	72
Log-Pearson 3	10	10	100

Three fits were selected for comparison:

1) **Gumbel Max** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

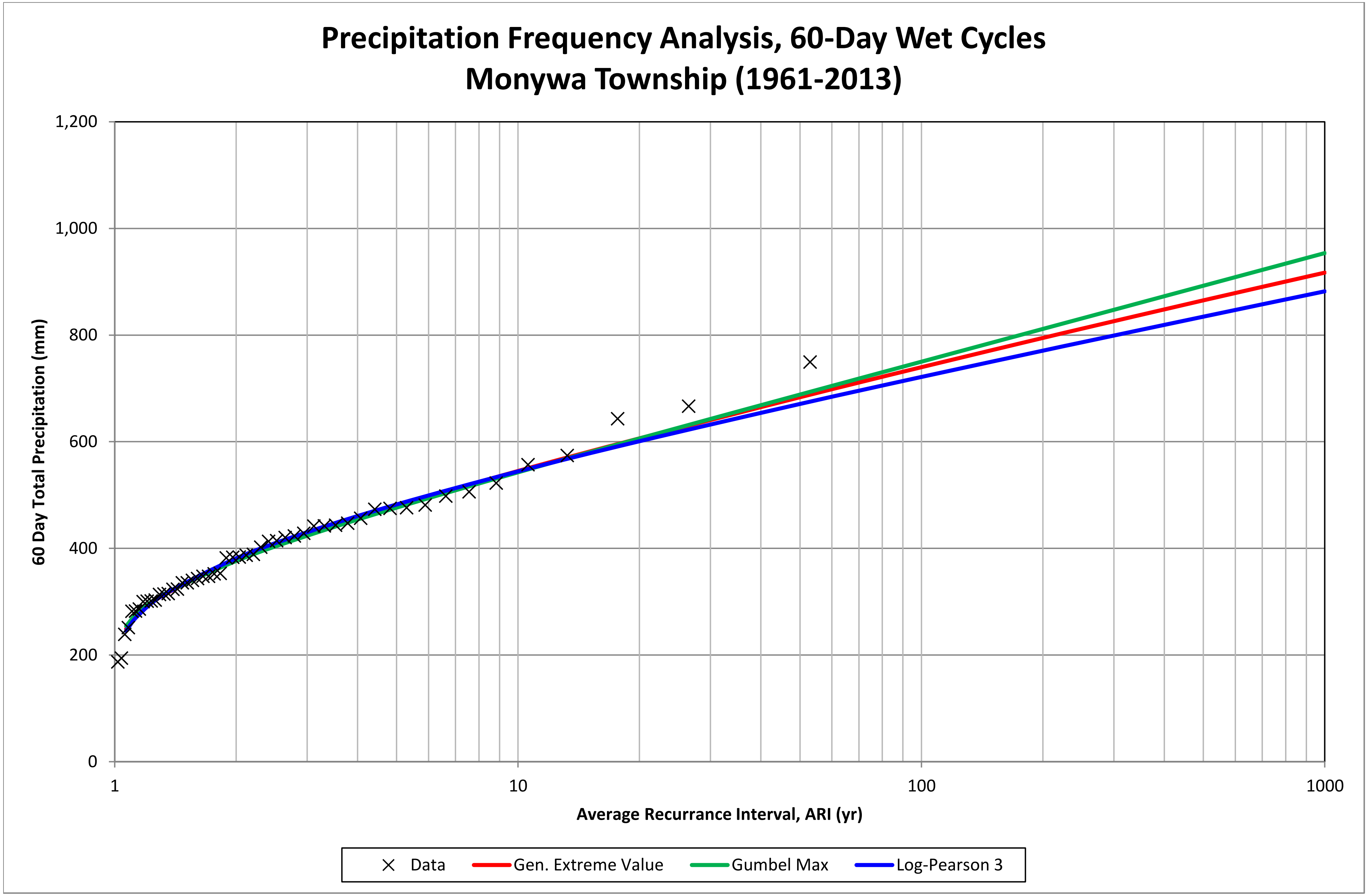
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 60 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Gumbel Max		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.03209	σ =	88.26703134	α =	671.7214009
			σ =	92.41894	μ =	344.0374253	β =	-0.01090416
			μ =	344.491			γ =	13.26444653
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	917.0	113.87	953.7	113.21	882.0	112.70
0.998	0.002	500	865.1	113.87	892.5	113.21	834.5	112.70
0.996	0.004	250	812.0	113.87	831.2	113.21	786.4	112.70
0.995	0.005	200	794.6	113.87	811.5	113.21	770.7	112.70
0.990	0.010	100	739.7	113.87	750.1	113.21	721.4	112.70
0.980	0.020	50	683.4	113.87	688.4	113.21	670.8	112.70
0.950	0.050	20	606.3	113.87	606.2	113.21	600.9	112.70
0.900	0.100	10	545.1	113.87	542.7	113.21	544.4	112.70
0.800	0.200	5	479.8	113.87	476.4	113.21	482.4	112.70
0.667	0.333	3	426.8	113.87	423.8	113.21	430.4	112.70
0.500	0.500	2.0	378.2	113.87	376.4	113.21	381.3	112.70
0.250	0.750	1.3	314.1	113.87	315.2	113.21	314.6	112.70
0.125	0.875	1.14	276.0	113.87	279.4	113.21	274.2	112.70
0.063	0.937	1.07	249.0	113.87	254.3	113.21	245.4	112.70
Kolmogorov Smirnov (Statistic, Rank)			0.0650	2	0.0603	1	0.0694	10
Anderson Darling (Statistic, Rank)			0.2320	6	0.2507	14	0.2444	10



Precipitation Frequency Analysis, 60-Day Wet Cycles
Monywa Township (1961-2013)
60 Day Total Precipitation (mm)
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Gumbel Max
Log-Pearson 3

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

30 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**30 d Wet Precip (mm)**
1961	259.0	1	0.019	53.00	518.0
1962	194.0	2	0.038	26.50	496.0
1963	342.0	3	0.057	17.67	415.0
1964	205.0	4	0.075	13.25	394.2
1965	496.0	5	0.094	10.60	388.0
1966	232.0	6	0.113	8.83	372.0
1967	223.0	7	0.132	7.57	365.0
1968	320.0	8	0.151	6.63	357.0
1969	230.0	9	0.170	5.89	353.2
1970	229.0	10	0.189	5.30	351.0
1971	298.0	11	0.208	4.82	347.0
1972	357.0	12	0.226	4.42	342.0
1973	312.0	13	0.245	4.08	340.0
1974	240.0	14	0.264	3.79	334.0
1975	347.0	15	0.283	3.53	321.0
1976	415.0	16	0.302	3.31	320.0
1977	365.0	17	0.321	3.12	312.0
1978	272.0	18	0.340	2.94	306.0
1979	178.0	19	0.358	2.79	301.0
1980	222.0	20	0.377	2.65	298.0
1981	340.0	21	0.396	2.52	294.9
1982	142.0	22	0.415	2.41	292.0
1983	306.0	23	0.434	2.30	285.2
1984	372.0	24	0.453	2.21	272.0
1985	127.0	25	0.472	2.12	272.0
1986	239.0	26	0.491	2.04	269.0
1987	334.0	27	0.509	1.96	261.1
1988	292.0	28	0.528	1.89	259.0
1989	321.0	29	0.547	1.83	252.0
1990	240.0	30	0.566	1.77	242.0
1991	172.0	31	0.585	1.71	240.0
1992	227.0	32	0.604	1.66	240.0
1993	242.0	33	0.623	1.61	239.0
1994	272.0	34	0.642	1.56	232.0
1995	230.9	35	0.660	1.51	230.9
1996	269.0	36	0.679	1.47	230.0
1997	188.7	37	0.698	1.43	229.0
1998	195.1	38	0.717	1.39	227.0
1999	294.9	39	0.736	1.36	223.0
2000	261.1	40	0.755	1.33	222.0
2001	180.9	41	0.774	1.29	217.2
2002	171.0	42	0.792	1.26	205.0
2003	301.0	43	0.811	1.23	195.1
2004	351.0	44	0.830	1.20	194.0
2005	285.2	45	0.849	1.18	188.7
2006	217.2	46	0.868	1.15	180.9
2007	394.2	47	0.887	1.13	178.7
2008	178.7	48	0.906	1.10	178.0
2009	252.0	49	0.925	1.08	172.0
2010	518.0	50	0.943	1.06	171.0
2011	353.2	51	0.962	1.04	142.0
2012	388.0	52	0.981	1.02	127.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Johnson SB	11	1	11
Log-Gamma	1	19	19
Fatigue Life	3	11	33
Log-Pearson 3	17	2	34
Gamma (3P)	10	4	40
Frechet (3P)	2	20	40
Gen. Extreme Value	16	3	48
Gen. Gamma (4P)	12	5	60
Lognormal	5	14	70
Rayleigh (2P)	4	18	72

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

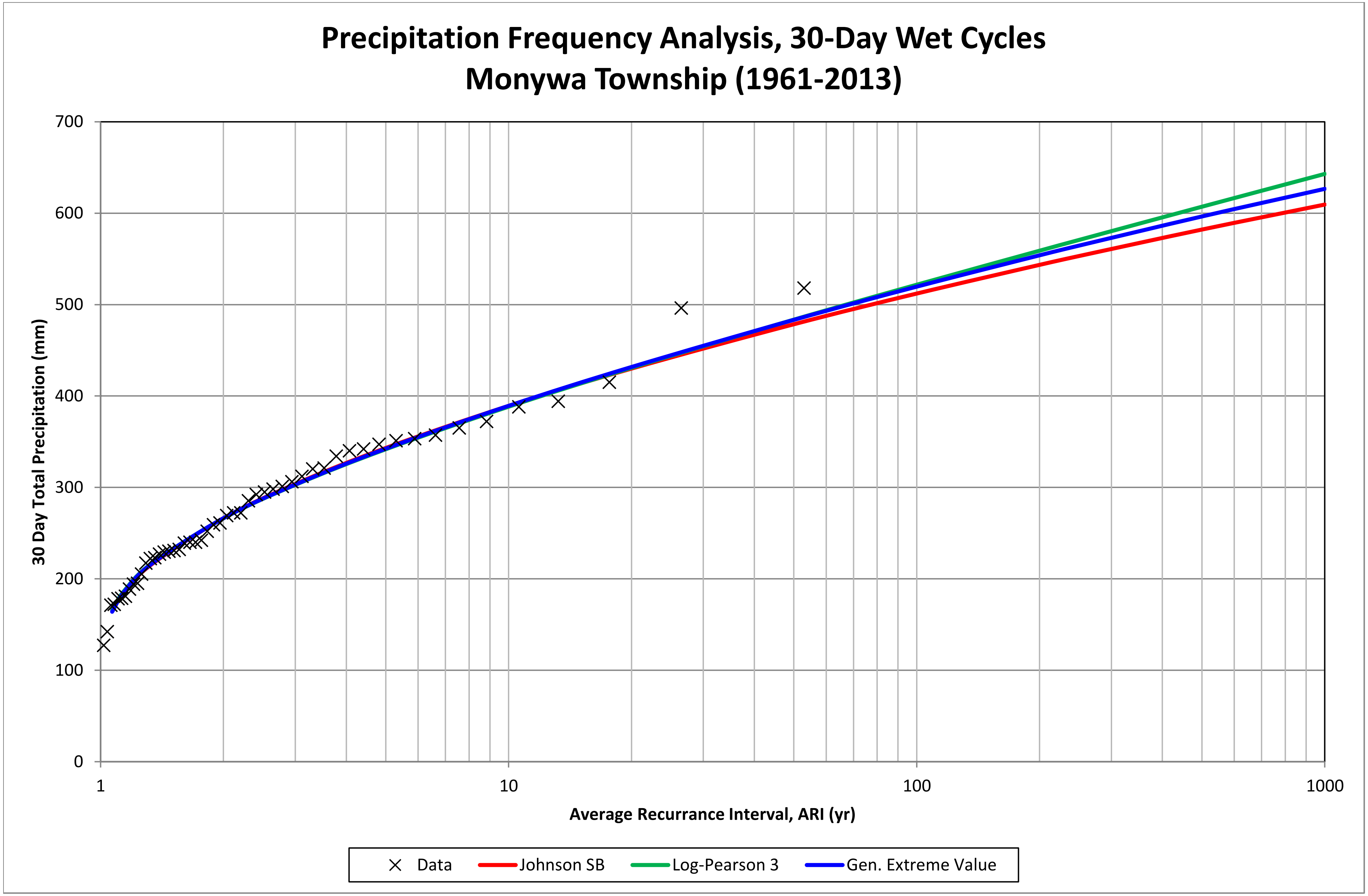
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 30 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Johnson SB		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	γ =	3.1891087	α =	373.2489569	k =	-0.07695247
			δ =	2.282648	β =	-0.015596338	σ =	72.10509295
			λ =	1179.23	γ =	11.40050618	μ =	240.2813801
			ξ =	32.561480				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	609.4	N/A	643.0	84.04	626.6	84.48
0.998	0.002	500	582.1	N/A	607.1	84.04	596.4	84.48
0.996	0.004	250	553.1	N/A	570.7	84.04	564.5	84.48
0.995	0.005	200	543.4	N/A	558.9	84.04	553.9	84.48
0.990	0.010	100	512.1	N/A	521.7	84.04	519.6	84.48
0.980	0.020	50	478.5	N/A	483.6	84.04	483.3	84.48
0.950	0.050	20	430.0	N/A	430.9	84.04	431.7	84.48
0.900	0.100	10	389.2	N/A	388.3	84.04	389.3	84.48
0.800	0.200	5	343.2	N/A	341.8	84.04	342.4	84.48
0.667	0.333	3	303.8	N/A	302.9	84.04	303.2	84.48
0.500	0.500	2.0	266.4	N/A	266.2	84.04	266.3	84.48
0.250	0.750	1.3	215.9	N/A	216.8	84.04	216.4	84.48
0.125	0.875	1.14	185.8	N/A	187.0	84.04	186.0	84.48
0.063	0.937	1.07	165.0	N/A	165.9	84.04	164.0	84.48
Kolmogorov Smirnov (Statistic, Rank)			0.0638	11	0.0660	17	0.0657	16
Anderson Darling (Statistic, Rank)			0.1768	1	0.1804	2	0.1808	3


Precipitation Frequency Analysis, 30-Day Wet Cycles
Monywa Township (1961-2013)
30 Day Total Precipitation (mm)
0
100
200
300
400
500
600
700
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Johnson SB
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

14 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	14 d Wet Precip (mm)
1961	169.0	1	0.019	53.00	365.9
1962	145.0	2	0.038	26.50	359.0
1963	270.0	3	0.057	17.67	338.0
1964	166.0	4	0.075	13.25	333.0
1965	297.0	5	0.094	10.60	324.5
1966	171.0	6	0.113	8.83	297.0
1967	153.0	7	0.132	7.57	285.0
1968	245.0	8	0.151	6.63	280.0
1969	167.0	9	0.170	5.89	270.0
1970	173.0	10	0.189	5.30	247.0
1971	227.0	11	0.208	4.82	245.0
1972	280.0	12	0.226	4.42	244.0
1973	210.0	13	0.245	4.08	235.0
1974	193.0	14	0.264	3.79	230.0
1975	221.0	15	0.283	3.53	227.0
1976	359.0	16	0.302	3.31	224.5
1977	197.0	17	0.321	3.12	221.0
1978	199.0	18	0.340	2.94	210.0
1979	133.0	19	0.358	2.79	203.5
1980	146.0	20	0.377	2.65	203.0
1981	203.0	21	0.396	2.52	199.0
1982	118.0	22	0.415	2.41	197.9
1983	244.0	23	0.434	2.30	197.0
1984	338.0	24	0.453	2.21	193.0
1985	93.0	25	0.472	2.12	182.0
1986	182.0	26	0.491	2.04	173.0
1987	230.0	27	0.509	1.96	172.5
1988	235.0	28	0.528	1.89	171.0
1989	247.0	29	0.547	1.83	169.0
1990	139.0	30	0.566	1.77	168.4
1991	115.0	31	0.585	1.71	168.1
1992	164.0	32	0.604	1.66	167.0
1993	161.0	33	0.623	1.61	166.0
1994	154.9	34	0.642	1.56	164.0
1995	149.9	35	0.660	1.51	161.0
1996	172.5	36	0.679	1.47	155.7
1997	132.3	37	0.698	1.43	154.9
1998	168.1	38	0.717	1.39	153.5
1999	203.5	39	0.736	1.36	153.0
2000	141.5	40	0.755	1.33	149.9
2001	155.7	41	0.774	1.29	146.0
2002	112.2	42	0.792	1.26	145.0
2003	197.9	43	0.811	1.23	141.5
2004	333.0	44	0.830	1.20	139.7
2005	168.4	45	0.849	1.18	139.0
2006	139.7	46	0.868	1.15	133.0
2007	365.9	47	0.887	1.13	132.3
2008	121.5	48	0.906	1.10	121.5
2009	153.5	49	0.925	1.08	118.0
2010	285.0	50	0.943	1.06	115.0
2011	224.5	51	0.962	1.04	112.2
2012	324.5	52	0.981	1.02	93.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	10	1	10
Log-Logistic (3P)	1	16	16
Wakeby	12	2	24
Pearson 5 (3P)	11	3	33
Frechet	9	4	36
Pearson 6 (4P)	2	25	50
Lognormal (3P)	8	7	56
Burr	13	5	65
Erlang (3P)	6	14	84
Log-Pearson 3	16	9	144

Three fits were selected for comparison:
1) **Log-Logistic (3P)** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

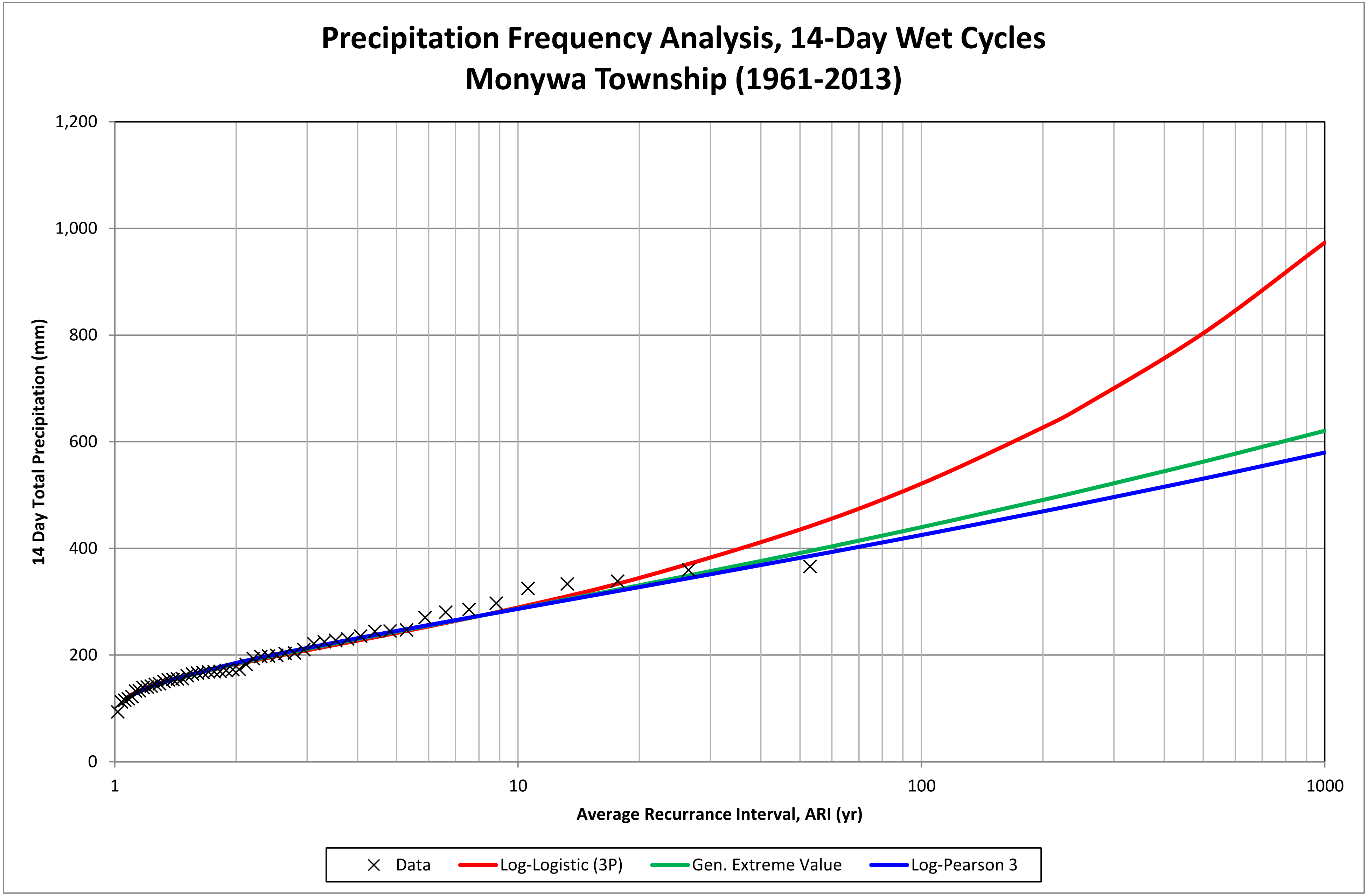
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 14 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Log-Logistic (3P)		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.079888	α =	3.342476125	α =	51.89373803
			σ =	49.38084	β =	114.6736834	β =	0.044826575
			μ =	165.2531	γ =	67.8774572	γ =	2.909563599
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	620.4	71.22	973.3	90.18	579.7	69.03
0.998	0.002	500	562.6	71.22	803.5	90.18	530.8	69.03
0.996	0.004	250	507.8	71.22	665.4	90.18	484.0	69.03
0.995	0.005	200	490.8	71.22	626.6	90.18	469.4	69.03
0.990	0.010	100	439.8	71.22	521.3	90.18	425.0	69.03
0.980	0.020	50	391.3	71.22	435.3	90.18	382.2	69.03
0.950	0.050	20	330.8	71.22	344.6	90.18	327.4	69.03
0.900	0.100	10	287.0	71.22	289.2	90.18	286.6	69.03
0.800	0.200	5	243.9	71.22	241.5	90.18	245.3	69.03
0.667	0.333	3	211.5	71.22	209.0	90.18	213.3	69.03
0.500	0.500	2.0	183.6	71.22	182.6	90.18	185.1	69.03
0.250	0.750	1.3	149.3	71.22	150.4	90.18	150.0	69.03
0.125	0.875	1.14	130.1	71.22	131.9	90.18	130.4	69.03
0.063	0.937	1.07	117.0	71.22	119.0	90.18	117.1	69.03
Kolmogorov Smirnov (Statistic, Rank)			0.0942	8	0.0914	7	0.1032	19
Anderson Darling (Statistic, Rank)			0.2409	1	0.2425	2	0.2683	10



Precipitation Frequency Analysis, 14-Day Wet Cycles
Monywa Township (1961-2013)
14 Day Total Precipitation (mm)
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

7 Day Data Year	Precip (mm)	Rank (highest to lowest) m	Weibull Exceedance Probability p	ARI (yr)	Ranked 7 d Wet Precip (mm)
1961	122.0	1	0.019	53.00	319.4
1962	116.0	2	0.038	26.50	309.0
1963	165.0	3	0.057	17.67	232.7
1964	141.0	4	0.075	13.25	225.5
1965	178.0	5	0.094	10.60	221.0
1966	141.0	6	0.113	8.83	212.0
1967	144.0	7	0.132	7.57	208.0
1968	203.0	8	0.151	6.63	206.5
1969	112.0	9	0.170	5.89	203.0
1970	96.0	10	0.189	5.30	186.0
1971	159.0	11	0.208	4.82	183.0
1972	162.0	12	0.226	4.42	178.0
1973	183.0	13	0.245	4.08	174.0
1974	186.0	14	0.264	3.79	173.0
1975	166.0	15	0.283	3.53	172.0
1976	221.0	16	0.302	3.31	166.0
1977	150.0	17	0.321	3.12	165.0
1978	131.0	18	0.340	2.94	162.0
1979	119.0	19	0.358	2.79	159.0
1980	109.0	20	0.377	2.65	157.0
1981	132.0	21	0.396	2.52	150.0
1982	89.0	22	0.415	2.41	149.4
1983	174.0	23	0.434	2.30	145.0
1984	309.0	24	0.453	2.21	144.0
1985	92.0	25	0.472	2.12	141.7
1986	172.0	26	0.491	2.04	141.0
1987	157.0	27	0.509	1.96	141.0
1988	208.0	28	0.528	1.89	132.0
1989	212.0	29	0.547	1.83	131.0
1990	98.0	30	0.566	1.77	129.5
1991	108.0	31	0.585	1.71	128.5
1992	145.0	32	0.604	1.66	125.2
1993	118.0	33	0.623	1.61	122.0
1994	120.1	34	0.642	1.56	120.1
1995	132.3	35	0.660	1.51	119.0
1996	128.5	36	0.679	1.47	118.0
1997	91.9	37	0.698	1.43	116.0
1998	100.3	38	0.717	1.39	115.5
1999	141.7	39	0.736	1.36	112.0
2000	125.2	40	0.755	1.33	109.0
2001	107.4	41	0.774	1.29	108.0
2002	99.0	42	0.792	1.26	107.4
2003	149.4	43	0.811	1.23	100.6
2004	232.7	44	0.830	1.20	100.3
2005	129.5	45	0.849	1.18	99.0
2006	100.6	46	0.868	1.15	98.0
2007	319.4	47	0.887	1.13	96.0
2008	84.9	48	0.906	1.10	92.0
2009	115.5	49	0.925	1.08	91.9
2010	225.5	50	0.943	1.06	89.0
2011	173.0	51	0.962	1.04	84.9
2012	206.5	52	0.981	1.02	80.8
2013	Exclude				

EasyFit 5.3 Professional Fit Results: Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Weibull (3P)	2	3	6
Johnson SB	5	2	10
Phased Bi-Weibull	3	6	18
Gen. Extreme Value	4	7	28
Gamma (3P)	7	4	28
Log-Pearson 3	6	5	30
Lognormal (3P)	12	10	120
Inv. Gaussian (3P)	14	9	126
Gen. Logistic	8	16	128

Three fits were selected for comparison:
1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

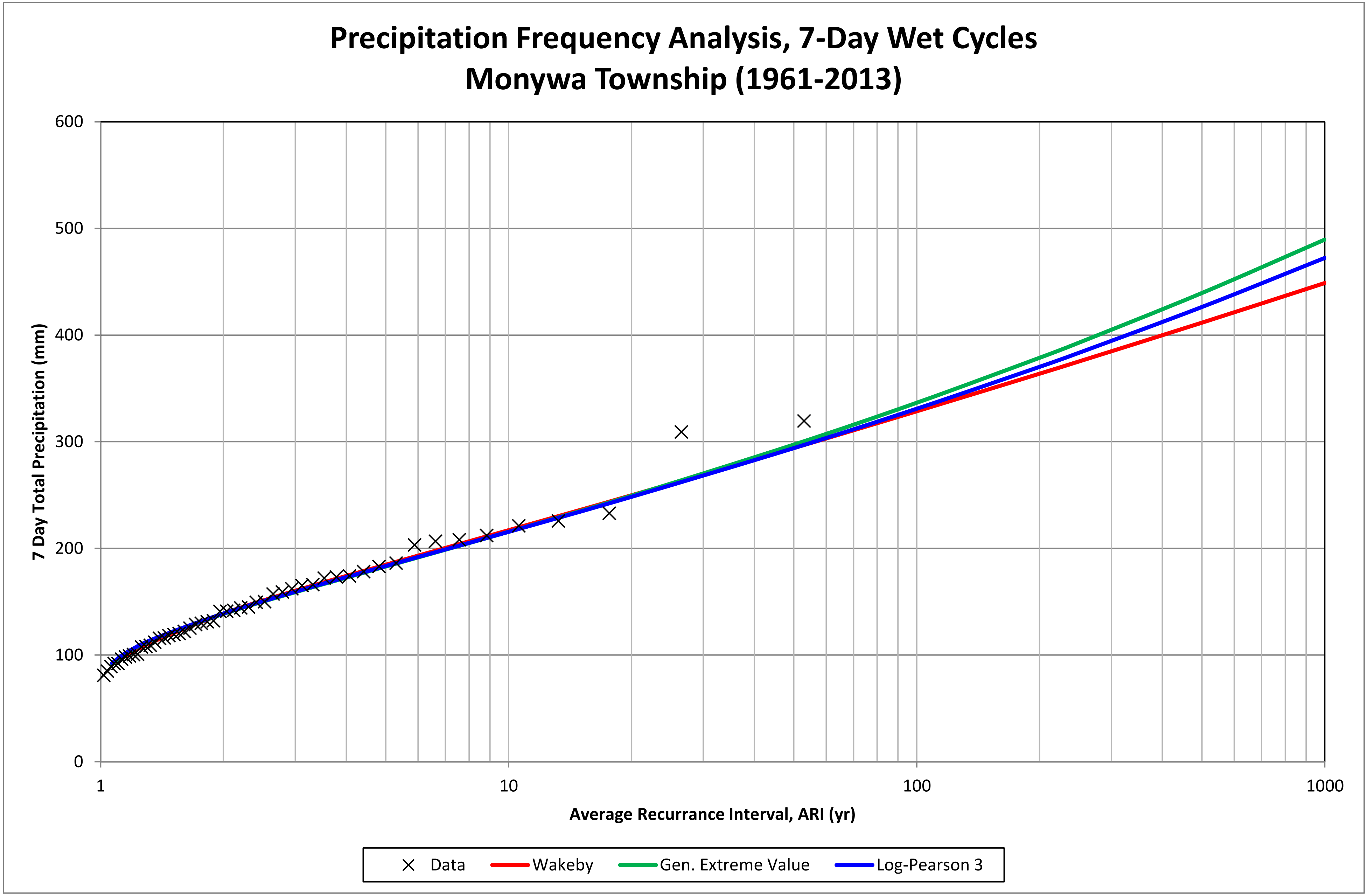
Note that these predictions should be multiplied by **1.018** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 7 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	73.72227	k =	0.108755469	α =	14.5565948
			β =	2.488256	σ =	35.37236791	β =	0.08155159
			γ =	43.14648	μ =	125.3784974	γ =	3.773859131
			δ =	0.033106				
			ξ =	84.27241				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	448.8	N/A	489.5	53.60	472.3	52.50
0.998	0.002	500	411.6	N/A	439.4	53.60	426.3	52.50
0.996	0.004	250	375.3	N/A	392.9	53.60	383.4	52.50
0.995	0.005	200	363.8	N/A	378.7	53.60	370.2	52.50
0.990	0.010	100	328.5	N/A	336.5	53.60	330.9	52.50
0.980	0.020	50	294.1	N/A	297.3	53.60	294.0	52.50
0.950	0.050	20	249.8	N/A	249.4	53.60	248.3	52.50
0.900	0.100	10	217.0	N/A	215.6	53.60	215.5	52.50
0.800	0.200	5	184.7	N/A	183.0	53.60	183.4	52.50
0.667	0.333	3	160.3	N/A	159.0	53.60	159.4	52.50
0.500	0.500	2.0	138.9	N/A	138.6	53.60	138.9	52.50
0.250	0.750	1.3	111.9	N/A	114.0	53.60	114.3	52.50
0.125	0.875	1.14	98.4	N/A	100.5	53.60	101.1	52.50
0.063	0.937	1.07	91.5	N/A	91.3	53.60	92.3	52.50
Kolmogorov Smirnov (Statistic, Rank)			0.0392	1	0.0473	4	0.0520	6
Anderson Darling (Statistic, Rank)			0.1049	1	0.1532	7	0.1465	5



Precipitation Frequency Analysis, 7-Day Wet Cycles
Monywa Township (1961-2013)
7 Day Total Precipitation (mm)
600
500
400
300
200
100
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

4 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	4 d Wet Precip (mm)
1961	96.0	1	0.019	53.00	294.0
1962	116.0	2	0.038	26.50	288.0
1963	128.0	3	0.057	17.67	216.0
1964	109.0	4	0.075	13.25	204.0
1965	152.0	5	0.094	10.60	190.0
1966	141.0	6	0.113	8.83	174.0
1967	144.0	7	0.132	7.57	168.0
1968	168.0	8	0.151	6.63	158.0
1969	108.0	9	0.170	5.89	154.0
1970	96.0	10	0.189	5.30	153.0
1971	158.0	11	0.208	4.82	152.0
1972	125.0	12	0.226	4.42	147.6
1973	124.0	13	0.245	4.08	145.0
1974	154.0	14	0.264	3.79	144.0
1975	145.0	15	0.283	3.53	143.0
1976	128.0	16	0.302	3.31	141.7
1977	127.0	17	0.321	3.12	141.0
1978	85.0	18	0.340	2.94	139.0
1979	112.0	19	0.358	2.79	128.8
1980	97.0	20	0.377	2.65	128.0
1981	108.0	21	0.396	2.52	128.0
1982	55.0	22	0.415	2.41	127.0
1983	108.0	23	0.434	2.30	125.0
1984	294.0	24	0.453	2.21	124.0
1985	72.0	25	0.472	2.12	119.1
1986	143.0	26	0.491	2.04	116.0
1987	114.0	27	0.509	1.96	115.5
1988	153.0	28	0.528	1.89	114.0
1989	174.0	29	0.547	1.83	112.0
1990	87.0	30	0.566	1.77	109.0
1991	107.0	31	0.585	1.71	108.0
1992	106.0	32	0.604	1.66	108.0
1993	90.0	33	0.623	1.61	108.0
1994	119.1	34	0.642	1.56	107.0
1995	87.1	35	0.660	1.51	106.0
1996	95.8	36	0.679	1.47	97.0
1997	73.9	37	0.698	1.43	96.3
1998	96.3	38	0.717	1.39	96.0
1999	141.7	39	0.736	1.36	96.0
2000	72.1	40	0.755	1.33	95.8
2001	90.2	41	0.774	1.29	90.2
2002	87.6	42	0.792	1.26	90.0
2003	147.6	43	0.811	1.23	87.6
2004	204.0	44	0.830	1.20	87.1
2005	128.8	45	0.849	1.18	87.0
2006	86.6	46	0.868	1.15	86.6
2007	288.0	47	0.887	1.13	85.0
2008	69.6	48	0.906	1.10	73.9
2009	115.5	49	0.925	1.08	72.1
2010	216.0	50	0.943	1.06	72.0
2011	139.0	51	0.962	1.04	69.6
2012	190.0	52	0.981	1.02	55.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Dagum (4P)	1	6	6
Gen. Logistic	7	1	7
Burr (4P)	3	3	9
Frechet (3P)	2	7	14
Log-Logistic (3P)	10	2	20
Dagum	9	4	36
Pearson 6	4	11	44
Pearson 5 (3P)	6	9	54
Gen. Extreme Value	14	8	112
Log-Pearson 3	13	14	182

Three fits were selected for comparison:

1) **Dagum (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

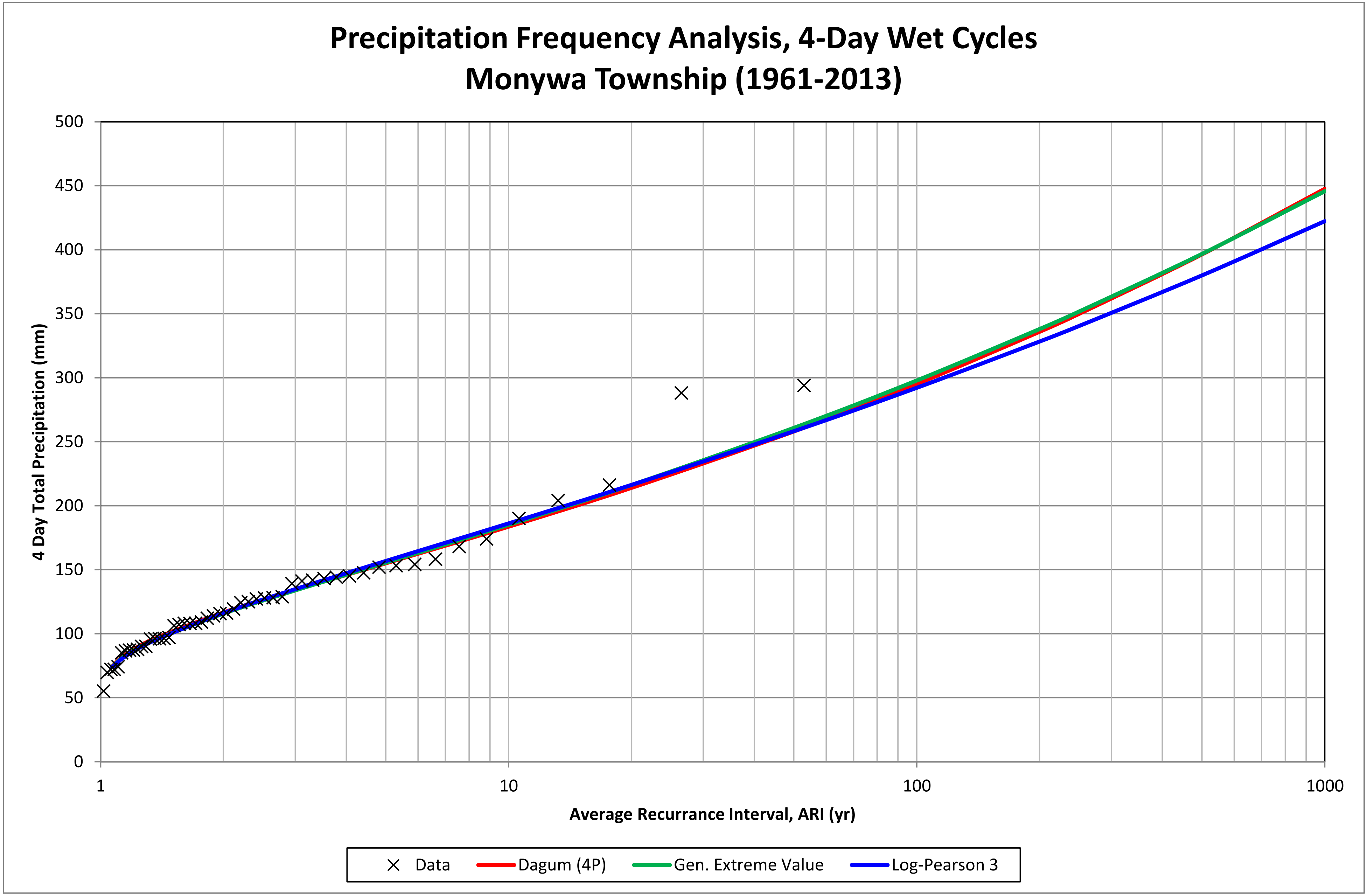
Note that these predictions should be multiplied by **1.034** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods. The correction factor for 4 day durations was linearly interpolated from values given in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Dagum (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	5.96752	k =	0.124568917	α =	19.47467782
			α =	6.967524	σ =	31.19983548	β =	0.076595668
			β =	155.2871	μ =	104.0418997	γ =	3.288776571
			γ =	-93.1777				
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	447.6	48.07	445.7	48.66	422.3	48.01
0.998	0.002	500	396.3	48.07	396.7	48.66	379.9	48.01
0.996	0.004	250	349.9	48.07	351.7	48.66	340.4	48.01
0.995	0.005	200	335.9	48.07	338.0	48.66	328.3	48.01
0.990	0.010	100	295.1	48.07	297.8	48.66	292.1	48.01
0.980	0.020	50	258.0	48.07	260.8	48.66	258.2	48.01
0.950	0.050	20	214.0	48.07	216.2	48.66	216.3	48.01
0.900	0.100	10	183.6	48.07	185.1	48.66	186.2	48.01
0.800	0.200	5	155.0	48.07	155.5	48.66	156.8	48.01
0.667	0.333	3	134.2	48.07	133.9	48.66	134.9	48.01
0.500	0.500	2.0	116.6	48.07	115.7	48.66	116.2	48.01
0.250	0.750	1.3	95.1	48.07	94.1	48.66	93.8	48.01
0.125	0.875	1.14	82.9	48.07	82.2	48.66	81.7	48.01
0.063	0.937	1.07	74.4	48.07	74.2	48.66	73.8	48.01
Kolmogorov Smirnov (Statistic, Rank)			0.0547	1	0.0639	14	0.0630	13
Anderson Darling (Statistic, Rank)			0.1956	6	0.2235	8	0.2428	14


Precipitation Frequency Analysis, 4-Day Wet Cycles
Monywa Township (1961-2013)
4 Day Total Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Dagum (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

3 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	3 d Wet Precip (mm)
1961	92.0	1	0.019	53.00	279.0
1962	116.0	2	0.038	26.50	265.0
1963	123.0	3	0.057	17.67	216.0
1964	104.0	4	0.075	13.25	195.3
1965	137.0	5	0.094	10.60	185.5
1966	139.0	6	0.113	8.83	165.0
1967	144.0	7	0.132	7.57	160.0
1968	165.0	8	0.151	6.63	144.0
1969	106.0	9	0.170	5.89	142.0
1970	88.0	10	0.189	5.30	141.0
1971	134.0	11	0.208	4.82	140.5
1972	107.0	12	0.226	4.42	139.0
1973	111.0	13	0.245	4.08	137.0
1974	129.0	14	0.264	3.79	135.0
1975	141.0	15	0.283	3.53	134.0
1976	120.0	16	0.302	3.31	130.0
1977	127.0	17	0.321	3.12	129.0
1978	79.0	18	0.340	2.94	128.8
1979	112.0	19	0.358	2.79	127.0
1980	97.0	20	0.377	2.65	123.0
1981	99.0	21	0.396	2.52	120.0
1982	54.0	22	0.415	2.41	119.1
1983	99.0	23	0.434	2.30	116.0
1984	279.0	24	0.453	2.21	114.0
1985	70.0	25	0.472	2.12	112.0
1986	142.0	26	0.491	2.04	112.0
1987	114.0	27	0.509	1.96	111.0
1988	130.0	28	0.528	1.89	107.0
1989	160.0	29	0.547	1.83	106.0
1990	75.0	30	0.566	1.77	106.0
1991	79.0	31	0.585	1.71	104.0
1992	106.0	32	0.604	1.66	99.0
1993	87.0	33	0.623	1.61	99.0
1994	119.1	34	0.642	1.56	97.0
1995	83.6	35	0.660	1.51	95.8
1996	95.8	36	0.679	1.47	92.0
1997	65.3	37	0.698	1.43	90.2
1998	82.5	38	0.717	1.39	88.0
1999	82.6	39	0.736	1.36	87.1
2000	68.1	40	0.755	1.33	87.0
2001	90.2	41	0.774	1.29	83.6
2002	87.1	42	0.792	1.26	82.8
2003	140.5	43	0.811	1.23	82.6
2004	195.3	44	0.830	1.20	82.5
2005	128.8	45	0.849	1.18	79.0
2006	82.8	46	0.868	1.15	79.0
2007	265.0	47	0.887	1.13	75.0
2008	68.1	48	0.906	1.10	70.0
2009	112.0	49	0.925	1.08	68.1
2010	216.0	50	0.943	1.06	68.1
2011	135.0	51	0.962	1.04	65.3
2012	185.5	52	0.981	1.02	54.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	4	1	4
Log-Logistic (3P)	5	2	10
Burr	2	9	18
Dagum (4P)	7	3	21
Dagum	6	5	30
Frechet (3P)	8	4	32
Log-Logistic	3	13	39
Wakeby	1	45	45
Gen. Extreme Value	9	6	54
Log-Pearson 3	13	11	143

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

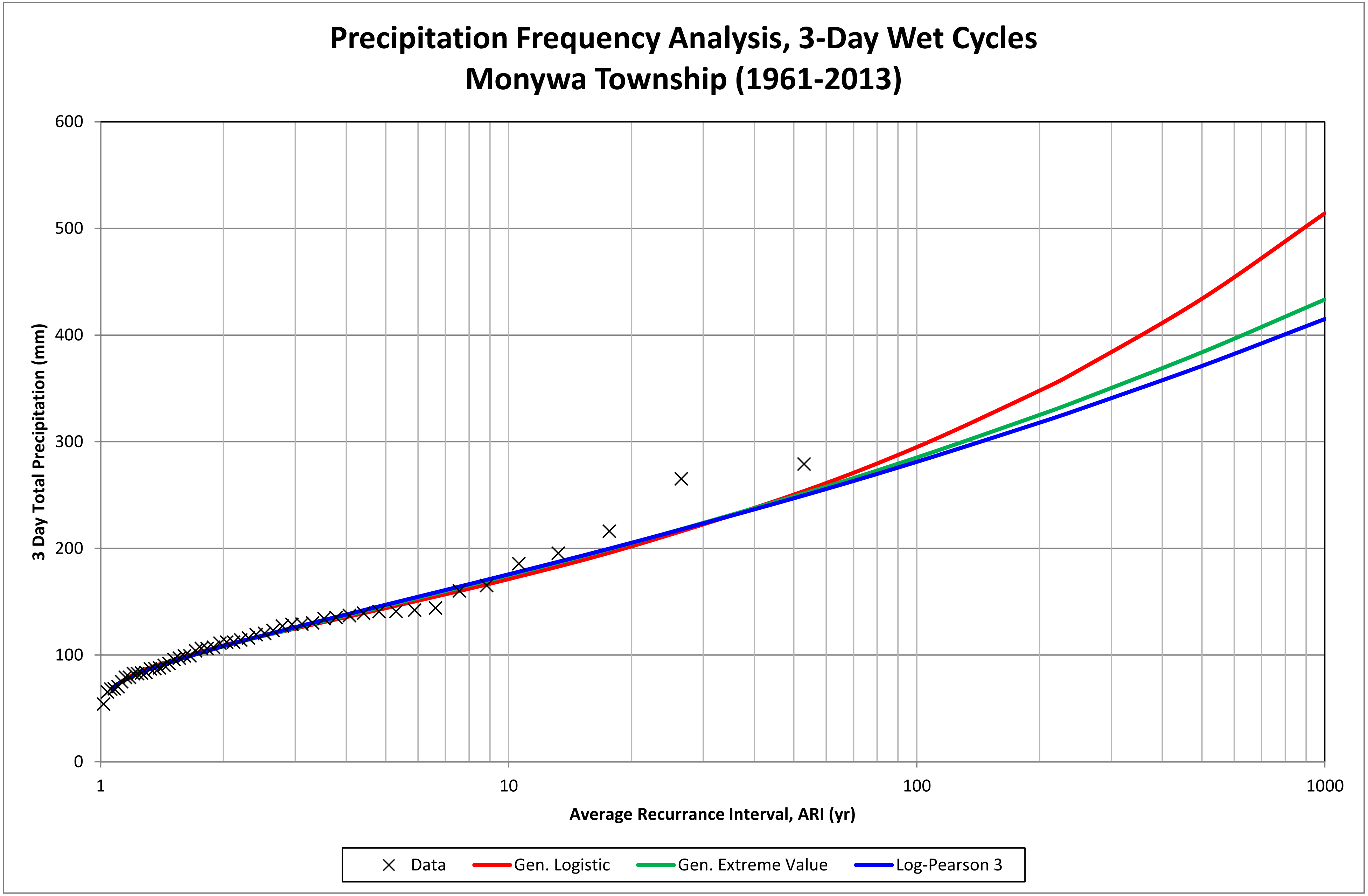
Note that these predictions should be multiplied by **1.044** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.259058	k =	0.134098497	α =	15.06559838
			σ =	21.05745	σ =	29.56566364	β =	0.088278212
			μ =	108.9025	μ =	97.07074459	γ =	3.384985514
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	514.1	N/A	433.3	46.96	415.0	46.38
0.998	0.002	500	434.0	N/A	383.9	46.96	371.0	46.38
0.996	0.004	250	367.1	N/A	338.8	46.96	330.3	46.38
0.995	0.005	200	347.9	N/A	325.1	46.96	317.9	46.38
0.990	0.010	100	294.9	N/A	285.2	46.96	281.1	46.38
0.980	0.020	50	250.4	N/A	248.6	46.96	247.0	46.38
0.950	0.050	20	201.9	N/A	204.9	46.96	205.2	46.38
0.900	0.100	10	171.2	N/A	174.7	46.96	175.7	46.38
0.800	0.200	5	144.0	N/A	146.2	46.96	147.2	46.38
0.667	0.333	3	124.9	N/A	125.5	46.96	126.1	46.38
0.500	0.500	2.0	108.9	N/A	108.2	46.96	108.4	46.38
0.250	0.750	1.3	88.8	N/A	87.6	46.96	87.4	46.38
0.125	0.875	1.14	76.7	N/A	76.5	46.96	76.3	46.38
0.063	0.937	1.07	68.0	N/A	69.0	46.96	69.0	46.38
Kolmogorov Smirnov (Statistic, Rank)			0.0655	4	0.0765	9	0.0814	13
Anderson Darling (Statistic, Rank)			0.1778	1	0.1925	6	0.2033	11


Precipitation Frequency Analysis, 3-Day Wet Cycles
Monywa Township (1961-2013)
600
500
400
300
200
100
0
3 Day Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

2 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**2 d Wet Precip (mm)**
1961	92.0	1	0.019	53.00	204.0
1962	95.0	2	0.038	26.50	197.8
1963	90.0	3	0.057	17.67	183.5
1964	104.0	4	0.075	13.25	164.0
1965	114.0	5	0.094	10.60	144.3
1966	75.0	6	0.113	8.83	139.0
1967	139.0	7	0.132	7.57	128.8
1968	122.0	8	0.151	6.63	124.0
1969	104.0	9	0.170	5.89	124.0
1970	78.0	10	0.189	5.30	123.0
1971	109.0	11	0.208	4.82	122.0
1972	98.0	12	0.226	4.42	122.0
1973	104.0	13	0.245	4.08	120.7
1974	105.0	14	0.264	3.79	119.1
1975	123.0	15	0.283	3.53	117.0
1976	102.0	16	0.302	3.31	114.0
1977	124.0	17	0.321	3.12	113.0
1978	76.0	18	0.340	2.94	109.0
1979	106.0	19	0.358	2.79	107.0
1980	77.0	20	0.377	2.65	106.0
1981	97.0	21	0.396	2.52	105.0
1982	41.0	22	0.415	2.41	105.0
1983	99.0	23	0.434	2.30	104.0
1984	204.0	24	0.453	2.21	104.0
1985	63.0	25	0.472	2.12	104.0
1986	107.0	26	0.491	2.04	103.0
1987	113.0	27	0.509	1.96	102.0
1988	117.0	28	0.528	1.89	99.0
1989	122.0	29	0.547	1.83	98.0
1990	75.0	30	0.566	1.77	97.0
1991	73.0	31	0.585	1.71	95.3
1992	105.0	32	0.604	1.66	95.0
1993	87.0	33	0.623	1.61	92.0
1994	119.1	34	0.642	1.56	90.0
1995	70.6	35	0.660	1.51	89.2
1996	95.3	36	0.679	1.47	87.0
1997	57.9	37	0.698	1.43	82.3
1998	67.8	38	0.717	1.39	79.5
1999	82.3	39	0.736	1.36	78.0
2000	68.1	40	0.755	1.33	77.0
2001	89.2	41	0.774	1.29	76.0
2002	52.1	42	0.792	1.26	75.0
2003	120.7	43	0.811	1.23	75.0
2004	144.3	44	0.830	1.20	73.0
2005	128.8	45	0.849	1.18	70.6
2006	79.5	46	0.868	1.15	68.1
2007	197.8	47	0.887	1.13	67.8
2008	42.5	48	0.906	1.10	63.0
2009	103.0	49	0.925	1.08	57.9
2010	164.0	50	0.943	1.06	52.1
2011	124.0	51	0.962	1.04	42.5
2012	183.5	52	0.981	1.02	41.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Wakeby	1	1	1
Log-Logistic (3P)	2	3	6
Gen. Logistic	4	2	8
Burr	3	4	12
Pearson 5 (3P)	16	5	80
Gumbel Max	6	15	90
Pearson 6 (4P)	15	6	90
Gen. Extreme Value	14	8	112
Cauchy	5	26	130
Log-Pearson 3	27	14	378

Three fits were selected for comparison:
1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

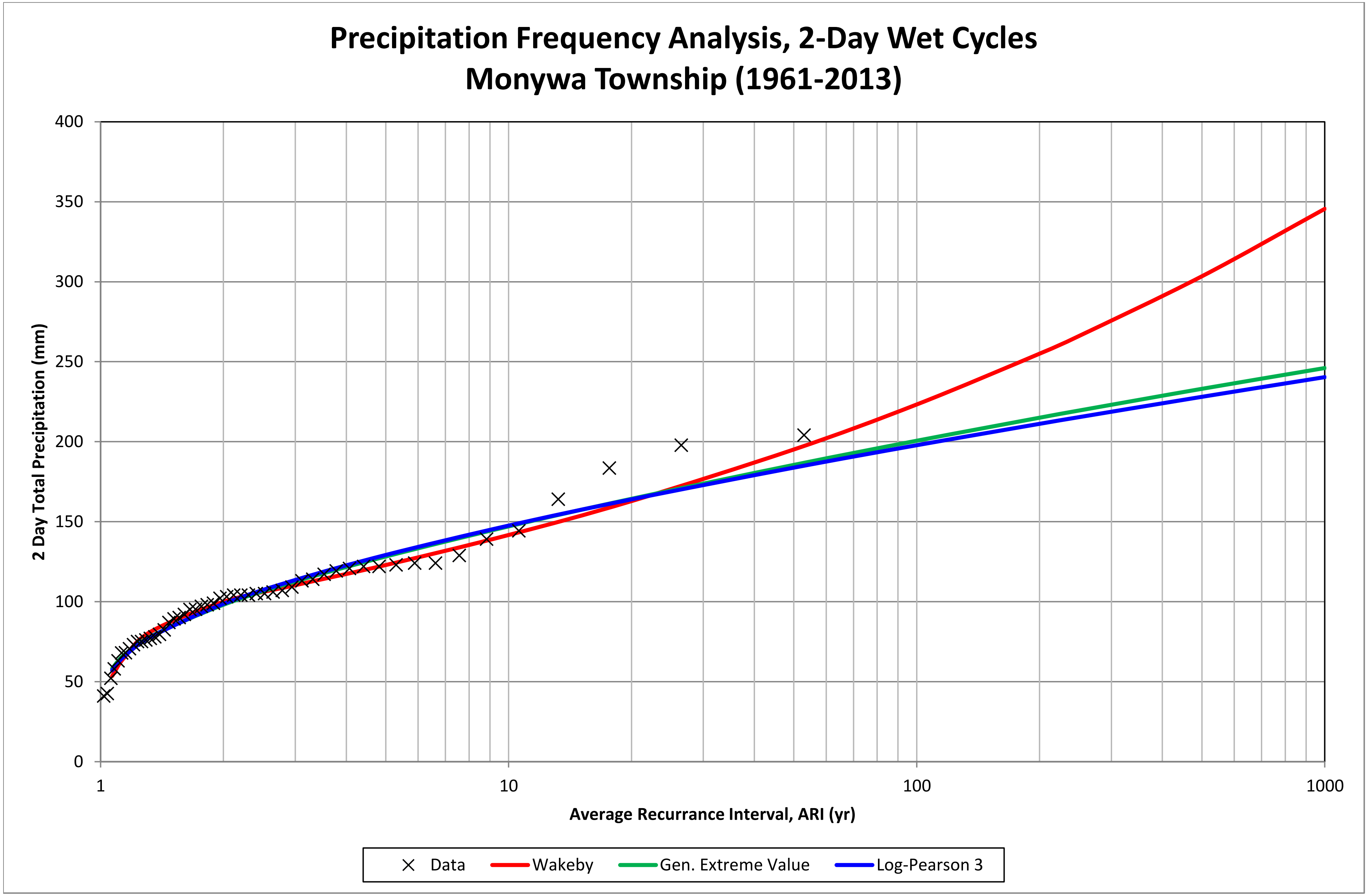
Note that these predictions should be multiplied by **1.067** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	245.3084	k =	-0.062569239	α =	53.52555281
			β =	5.045338	σ =	28.20174054	β =	-0.0457566
			γ =	19.16715	μ =	87.88256944	γ =	7.02549131
			δ =	0.175864				
			ξ =	38.67424				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	345.6	N/A	246.0	33.56	240.4	33.72
0.998	0.002	500	303.4	N/A	233.1	33.56	228.1	33.72
0.996	0.004	250	266.1	N/A	219.5	33.56	215.4	33.72
0.995	0.005	200	255.0	N/A	215.0	33.56	211.2	33.72
0.990	0.010	100	223.3	N/A	200.6	33.56	197.8	33.72
0.980	0.020	50	195.2	N/A	185.5	33.56	183.8	33.72
0.950	0.050	20	162.9	N/A	164.3	33.56	164.0	33.72
0.900	0.100	10	141.7	N/A	147.1	33.56	147.6	33.72
0.800	0.200	5	122.9	N/A	128.3	33.56	129.2	33.72
0.667	0.333	3	110.4	N/A	112.7	33.56	113.6	33.72
0.500	0.500	2.0	100.0	N/A	98.1	33.56	98.7	33.72
0.250	0.750	1.3	81.6	N/A	78.6	33.56	78.2	33.72
0.125	0.875	1.14	65.1	N/A	66.8	33.56	65.9	33.72
0.063	0.937	1.07	53.5	N/A	58.3	33.56	57.1	33.72
Kolmogorov Smirnov (Statistic, Rank)			0.0577	1	0.0968	14	0.1047	27
Anderson Darling (Statistic, Rank)			0.2143	1	0.4281	8	0.4728	14



Precipitation Frequency Analysis, 2-Day Wet Cycles
Monywa Township (1961-2013)
2 Day Total Precipitation (mm)
400
350
300
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.8

Water Balance Scenarios

Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining Copper Ltd. | Letpadaung Copper Project	Made by: AB	Job No. PE701-00022/04
	Basic Climatology	Checked: TML	Date: 24/06/2013
		Approved:	Version No. 2.2

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.1	0.0	0.0
11	0.0	0.0	28.9	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	105.4	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.3	0.0	0.0
11	0.0	0.0	30.8	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	112.3	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.2	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.4	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0	0.0
82	0.0	3.1	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0	4.1
93	0.0	4.1	0.0	0.0	3.1
94	0.0	0.0	0.0	0.0	1.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.1	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.1	8.3
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	16.5	0.0	0.0	0.0	6.2
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.0
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.2
110	0.0	0.0	0.0	4.1	0.0
111	0.0	0.0	8.3	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.0
114	0.0	0.0	0.0	0.0	0.0
115	3.1	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.0	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	34.1	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.0	0.0
125	0.0	0.0	11.4	0.0	0.0
126	0.0	0.0	0.0	0.0	5.2
127	0.0	0.0	0.0	0.0	2.1
128	0.0	0.0	0.0	1.0	0.0
129	1.0	0.0	0.0	0.0	0.0
130	6.2	0.0	0.0	42.4	0.0
131	8.3	1.0	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.1
133	0.0	0.0	0.0	47.5	6.2
134	0.0	0.0	11.4	0.0	2.1
135	0.0	0.0	0.0	15.5	0.0
136	2.1	0.0	0.0	0.0	0.0
137	0.0	0.0	27.9	3.1	0.0
138	1.0	7.2	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.0
140	6.2	0.0	0.0	0.0	0.0
141	0.0	0.0	8.3	40.3	0.0
142	0.0	12.4	0.0	0.0	0.0
143	2.1	0.0	0.0	6.2	0.0
144	1.0	20.7	11.4	0.0	0.0
145	6.2	87.8	13.4	14.5	10.3
146	1.0	6.2	50.6	12.4	4.1
147	1.0	24.8	19.6	0.0	0.0
148	9.3	40.3	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	14.3	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.2	0.0	0.0	0.0
82	0.0	3.3	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.2	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.2	0.0	4.4
93	0.0	4.4	0.0	0.0	3.3
94	0.0	0.0	0.0	0.0	1.1
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.4	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.3	8.8
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	17.6	0.0	0.0	0.0	6.6
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.1
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.5
110	0.0	0.0	0.0	4.4	0.0
111	0.0	0.0	8.8	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.1
114	0.0	0.0	0.0	0.0	0.0
115	3.3	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	36.3	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1	0.0
125	0.0	0.0	12.1	0.0	0.0
126	0.0	0.0	0.0	0.0	5.5
127	0.0	0.0	0.0	0.0	2.2
128	0.0	0.0	0.0	1.1	0.0
129	1.1	0.0	0.0	0.0	0.0
130	6.6	0.0	0.0	45.2	0.0
131	8.8	1.1	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.3
133	0.0	0.0	0.0	50.7	6.6
134	0.0	0.0	12.1	0.0	2.2
135	0.0	0.0	0.0	16.5	0.0
136	2.2	0.0	0.0	0.0	0.0
137	0.0	0.0	29.7	3.3	0.0
138	1.1	7.7	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.1
140	6.6	0.0	0.0	0.0	0.0
141	0.0	0.0	8.8	43.0	0.0
142	0.0	13.2	0.0	0.0	0.0
143	2.2	0.0	0.0	6.6	0.0
144	1.1	22.0	12.1	0.0	0.0
145	6.6	93.6	14.3	15.4	11.0
146	1.1	6.6	54.0	13.2	4.4
147	1.1	26.4	20.9	0.0	0.0
148	9.9	43.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
149	0.0	0.0	9.3	0.0	0.0
150	0.0	0.0	0.0	0.0	2.1
151	0.0	0.0	18.6	0.0	0.0
152	7.2	0.0	0.0	0.0	25.8
153	0.0	0.0	0.0	2.1	0.0
154	0.0	0.0	1.0	58.9	0.0
155	5.2	0.0	14.5	25.8	0.0
156	0.0	0.0	4.1	5.2	0.0
157	16.5	0.0	14.5	0.0	0.0
158	4.1	0.0	0.0	0.0	0.0
159	6.2	0.0	0.0	0.0	0.0
160	8.3	0.0	0.0	2.1	0.0
161	79.6	1.0	0.0	24.8	0.0
162	4.1	0.0	0.0	6.2	0.0
163	0.0	16.5	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.1
165	0.0	0.0	0.0	0.0	0.0
166	4.1	26.9	0.0	7.2	1.0
167	1.0	4.1	0.0	0.0	0.0
168	0.0	0.0	26.9	1.0	0.0
169	1.0	0.0	26.9	18.6	0.0
170	0.0	0.0	18.6	0.0	0.0
171	0.0	0.0	14.5	0.0	0.0
172	6.2	0.0	1.0	19.6	0.0
173	0.0	0.0	0.0	1.0	0.0
174	0.0	6.2	0.0	0.0	3.1
175	0.0	2.1	0.0	22.7	7.2
176	2.1	9.3	0.0	2.1	14.5
177	1.0	0.0	8.3	0.0	1.0
178	68.2	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1	0.0
180	0.0	0.0	0.0	0.0	0.0
181	25.8	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	17.6	0.0	0.0	23.8	0.0
184	10.3	0.0	0.0	0.0	1.0
185	0.0	0.0	0.0	0.0	0.0
186	5.2	0.0	0.0	0.0	0.0
187	6.2	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.0	0.0
190	1.0	0.0	0.0	0.0	0.0
191	4.1	0.0	0.0	0.0	0.0
192	48.6	0.0	0.0	0.0	0.0
193	14.5	0.0	0.0	0.0	0.0
194	1.0	0.0	0.0	0.0	0.0
195	21.7	0.0	0.0	0.0	22.7
196	0.0	0.0	20.7	0.0	2.1
197	0.0	0.0	0.0	0.0	1.0
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.0	0.0	0.0	0.0
200	0.0	10.3	0.0	0.0	1.0
201	1.0	0.0	0.0	0.0	0.0
202	0.0	0.0	12.4	0.0	0.0
203	0.0	0.0	0.0	0.0	13.4
204	0.0	4.1	0.0	0.0	1.0
205	0.0	0.0	1.0	0.0	3.1
206	0.0	0.0	0.0	31.0	0.0
207	0.0	0.0	0.0	1.0	0.0
208	1.0	3.1	0.0	0.0	0.0
209	0.0	10.3	3.1	0.0	0.0
210	0.0	6.2	10.3	3.1	0.0
211	2.1	0.0	0.0	0.0	0.0
212	4.1	0.0	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1	0.0
214	8.3	0.0	1.0	0.0	0.0
215	3.1	0.0	49.6	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	106.4	0.0	0.0	2.1	0.0
219	1.0	0.0	3.1	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.1	0.0	0.0	0.0	0.0
222	30.0	0.0	3.1	2.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
149	0.0	0.0	9.9	0.0	0.0
150	0.0	0.0	0.0	0.0	2.2
151	0.0	0.0	19.8	0.0	0.0
152	7.7	0.0	0.0	0.0	27.5
153	0.0	0.0	0.0	2.2	0.0
154	0.0	0.0	1.1	62.8	0.0
155	5.5	0.0	15.4	27.5	0.0
156	0.0	0.0	4.4	5.5	0.0
157	17.6	0.0	15.4	0.0	0.0
158	4.4	0.0	0.0	0.0	0.0
159	6.6	0.0	0.0	0.0	0.0
160	8.8	0.0	0.0	2.2	0.0
161	84.8	1.1	0.0	26.4	0.0
162	4.4	0.0	0.0	6.6	0.0
163	0.0	17.6	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.2
165	0.0	0.0	0.0	0.0	0.0
166	4.4	28.6	0.0	7.7	1.1
167	1.1	4.4	0.0	0.0	0.0
168	0.0	0.0	28.6	1.1	0.0
169	1.1	0.0	28.6	19.8	0.0
170	0.0	0.0	19.8	0.0	0.0
171	0.0	0.0	15.4	0.0	0.0
172	6.6	0.0	1.1	20.9	0.0
173	0.0	0.0	0.0	1.1	0.0
174	0.0	6.6	0.0	0.0	3.3
175	0.0	2.2	0.0	24.2	7.7
176	2.2	9.9	0.0	2.2	15.4
177	1.1	0.0	8.8	0.0	1.1
178	72.7	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.2	0.0
180	0.0	0.0	0.0	0.0	0.0
181	27.5	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	18.7	0.0	0.0	25.3	0.0
184	11.0	0.0	0.0	0.0	1.1
185	0.0	0.0	0.0	0.0	0.0
186	5.5	0.0	0.0	0.0	0.0
187	6.6	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1	0.0
190	1.1	0.0	0.0	0.0	0.0
191	4.4	0.0	0.0	0.0	0.0
192	51.8	0.0	0.0	0.0	0.0
193	15.4	0.0	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0	0.0
195	23.1	0.0	0.0	0.0	24.2
196	0.0	0.0	22.0	0.0	2.2
197	0.0	0.0	0.0	0.0	1.1
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0	0.0
200	0.0	11.0	0.0	0.0	1.1
201	1.1	0.0	0.0	0.0	0.0
202	0.0	0.0	13.2	0.0	0.0
203	0.0	0.0	0.0	0.0	14.3
204	0.0	4.4	0.0	0.0	1.1
205	0.0	0.0	1.1	0.0	3.3
206	0.0	0.0	0.0	33.0	0.0
207	0.0	0.0	0.0	1.1	0.0
208	1.1	3.3	0.0	0.0	0.0
209	0.0	11.0	3.3	0.0	0.0
210	0.0	6.6	11.0	3.3	0.0
211	2.2	0.0	0.0	0.0	0.0
212	4.4	0.0	0.0	0.0	0.0
213	0.0	2.2	0.0	2.2	0.0
214	8.8	0.0	1.1	0.0	0.0
215	3.3	0.0	52.9	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	113.4	0.0	0.0	2.2	0.0
219	1.1	0.0	3.3	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.3	0.0	0.0	0.0	0.0
222	31.9	0.0	3.3	2.2	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
223	48.6	71.3	5.2	0.0	0.0
224	0.0	3.1	0.0	0.0	0.0
225	12.4	2.1	0.0	0.0	0.0
226	0.0	0.0	0.0	1.0	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.1	31.0	0.0	0.0
229	0.0	1.0	0.0	1.0	0.0
230	0.0	3.1	0.0	0.0	16.5
231	0.0	0.0	1.0	0.0	33.1
232	1.0	0.0	3.1	0.0	53.7
233	0.0	0.0	6.2	11.4	19.6
234	14.5	0.0	1.0	0.0	12.4
235	0.0	0.0	0.0	0.0	3.1
236	9.3	11.4	0.0	0.0	16.5
237	6.2	0.0	18.6	0.0	0.0
238	0.0	0.0	0.0	1.0	23.8
239	2.1	0.0	12.4	8.3	0.0
240	0.0	0.0	50.6	0.0	0.0
241	72.3	0.0	0.0	0.0	0.0
242	0.0	0.0	6.2	14.5	3.1
243	0.0	0.0	1.0	24.8	21.7
244	0.0	0.0	2.1	10.3	14.5
245	0.0	0.0	2.1	0.0	22.7
246	0.0	0.0	0.0	5.2	0.0
247	0.0	0.0	0.0	1.0	0.0
248	0.0	0.0	0.0	0.0	4.1
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.1	0.0	0.0	47.5
251	0.0	28.9	2.1	0.0	16.5
252	0.0	0.0	13.4	0.0	9.3
253	2.1	0.0	27.9	0.0	1.0
254	0.0	0.0	11.4	0.0	36.2
255	0.0	0.0	0.0	0.0	14.5
256	0.0	0.0	0.0	15.5	0.0
257	0.0	0.0	0.0	6.2	0.0
258	0.0	0.0	9.3	6.2	4.1
259	0.0	4.1	0.0	20.7	3.1
260	70.3	2.1	0.0	2.1	0.0
261	0.0	2.1	0.0	33.1	0.0
262	0.0	15.5	0.0	1.0	0.0
263	34.1	1.0	4.1	0.0	0.0
264	11.4	14.5	18.6	0.0	53.7
265	34.1	0.0	55.8	0.0	74.4
266	30.0	0.0	71.3	0.0	3.1
267	0.0	0.0	0.0	0.0	0.0
268	3.1	0.0	18.6	0.0	0.0
269	0.0	0.0	3.1	19.6	0.0
270	0.0	26.9	0.0	4.1	0.0
271	0.0	62.0	0.0	0.0	0.0
272	3.1	44.4	0.0	0.0	23.8
273	9.3	0.0	0.0	12.4	1.0
274	16.5	0.0	0.0	1.0	0.0
275	11.4	11.4	0.0	0.0	0.0
276	0.0	0.0	56.8	2.1	0.0
277	0.0	0.0	0.0	4.1	0.0
278	0.0	0.0	1.0	0.0	0.0
279	0.0	0.0	37.2	0.0	0.0
280	0.0	0.0	8.3	0.0	0.0
281	0.0	0.0	19.6	0.0	0.0
282	0.0	0.0	15.5	0.0	38.2
283	0.0	0.0	0.0	0.0	5.2
284	28.9	0.0	0.0	1.0	66.1
285	0.0	0.0	0.0	26.9	7.2
286	0.0	0.0	0.0	45.5	1.0
287	13.4	1.0	0.0	51.7	13.4
288	11.4	0.0	2.1	5.2	0.0
289	12.4	0.0	6.2	2.1	0.0
290	90.9	0.0	0.0	24.8	0.0
291	0.0	0.0	0.0	20.7	0.0
292	12.4	0.0	7.2	78.5	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.0	0.0	0.0	0.0	5.2
295	5.2	0.0	0.0	53.7	7.2
296	0.0	0.0	0.0	3.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
223	51.8	76.0	5.5	0.0	0.0
224	0.0	3.3	0.0	0.0	0.0
225	13.2	2.2	0.0	0.0	0.0
226	0.0	0.0	0.0	1.1	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.4	33.0	0.0	0.0
229	0.0	1.1	0.0	1.1	0.0
230	0.0	3.3	0.0	0.0	17.6
231	0.0	0.0	1.1	0.0	35.2
232	1.1	0.0	3.3	0.0	57.3
233	0.0	0.0	6.6	12.1	20.9
234	15.4	0.0	1.1	0.0	13.2
235	0.0	0.0	0.0	0.0	3.3
236	9.9	12.1	0.0	0.0	17.6
237	6.6	0.0	19.8	0.0	0.0
238	0.0	0.0	0.0	1.1	25.3
239	2.2	0.0	13.2	8.8	0.0
240	0.0	0.0	54.0	0.0	0.0
241	77.1	0.0	0.0	0.0	0.0
242	0.0	0.0	6.6	15.4	3.3
243	0.0	0.0	1.1	26.4	23.1
244	0.0	0.0	2.2	11.0	15.4
245	0.0	0.0	2.2	0.0	24.2
246	0.0	0.0	0.0	5.5	0.0
247	0.0	0.0	0.0	1.1	0.0
248	0.0	0.0	0.0	0.0	4.4
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.4	0.0	0.0	50.7
251	0.0	30.8	2.2	0.0	17.6
252	0.0	0.0	14.3	0.0	9.9
253	2.2	0.0	29.7	0.0	1.1
254	0.0	0.0	12.1	0.0	38.6
255	0.0	0.0	0.0	0.0	15.4
256	0.0	0.0	0.0	16.5	0.0
257	0.0	0.0	0.0	6.6	0.0
258	0.0	0.0	9.9	6.6	4.4
259	0.0	4.4	0.0	22.0	3.3
260	74.9	2.2	0.0	2.2	0.0
261	0.0	2.2	0.0	35.2	0.0
262	0.0	16.5	0.0	1.1	0.0
263	36.3	1.1	4.4	0.0	0.0
264	12.1	15.4	19.8	0.0	57.3
265	36.3	0.0	59.5	0.0	79.3
266	31.9	0.0	76.0	0.0	3.3
267	0.0	0.0	0.0	0.0	0.0
268	3.3	0.0	19.8	0.0	0.0
269	0.0	0.0	3.3	20.9	0.0
270	0.0	28.6	0.0	4.4	0.0
271	0.0	66.1	0.0	0.0	0.0
272	3.3	47.4	0.0	0.0	25.3
273	9.9	0.0	0.0	13.2	1.1
274	17.6	0.0	0.0	1.1	0.0
275	12.1	12.1	0.0	0.0	0.0
276	0.0	0.0	60.6	2.2	0.0
277	0.0	0.0	0.0	4.4	0.0
278	0.0	0.0	1.1	0.0	0.0
279	0.0	0.0	39.7	0.0	0.0
280	0.0	0.0	8.8	0.0	0.0
281	0.0	0.0	20.9	0.0	0.0
282	0.0	0.0	16.5	0.0	40.8
283	0.0	0.0	0.0	0.0	5.5
284	30.8	0.0	0.0	1.1	70.5
285	0.0	0.0	0.0	28.6	7.7
286	0.0	0.0	0.0	48.5	1.1
287	14.3	1.1	0.0	55.1	14.3
288	12.1	0.0	2.2	5.5	0.0
289	13.2	0.0	6.6	2.2	0.0
290	96.9	0.0	0.0	26.4	0.0
291	0.0	0.0	0.0	22.0	0.0
292	13.2	0.0	7.7	83.7	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0	5.5
295	5.5	0.0	0.0	57.3	7.7
296	0.0	0.0	0.0	3.3	0.0

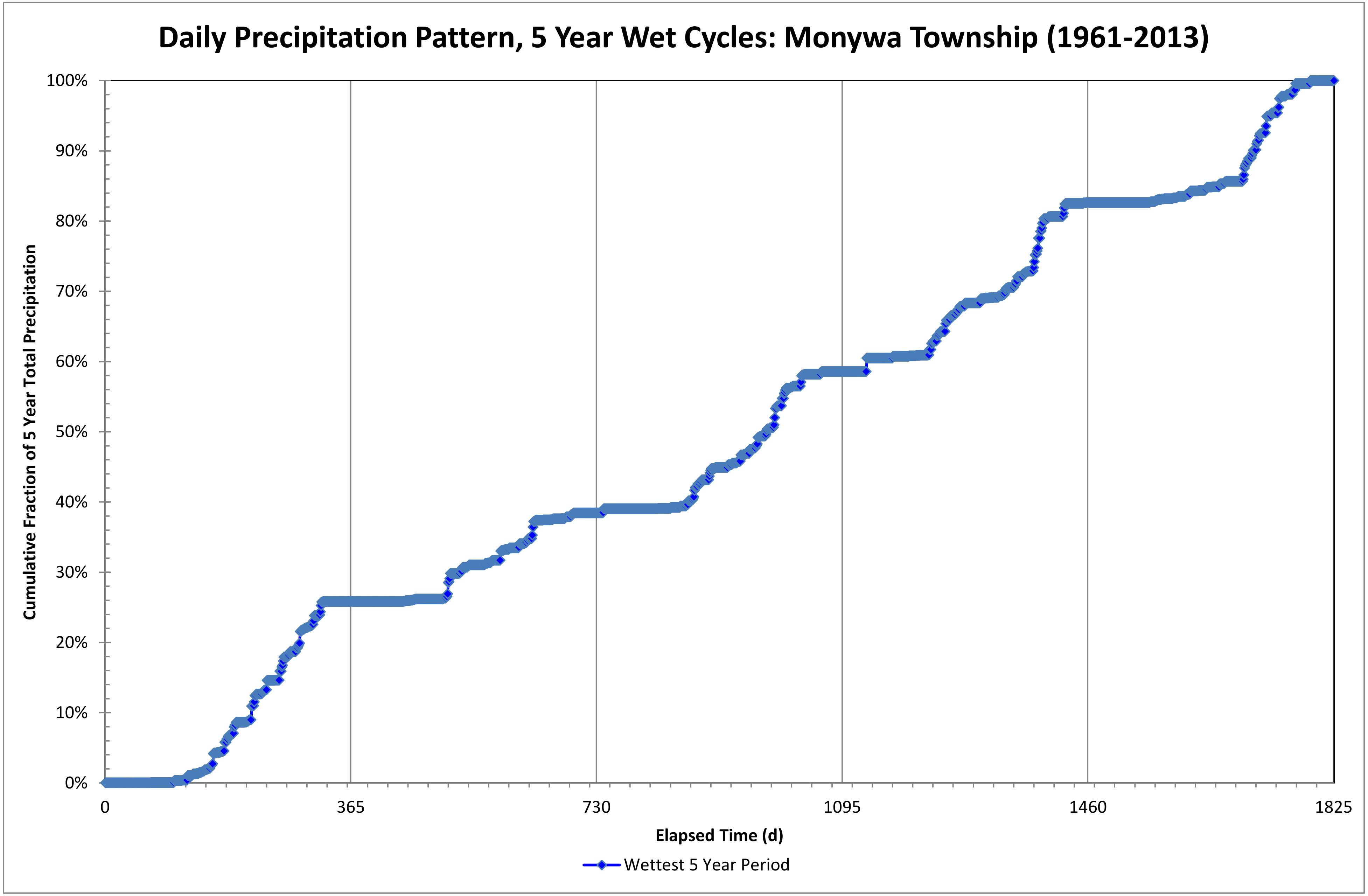
Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
297	7.2	2.1	0.0	21.7	2.1
298	2.1	0.0	0.0	37.2	0.0
299	1.0	0.0	0.0	6.2	0.0
300	1.0	0.0	0.0	31.0	0.0
301	2.1	6.2	0.0	0.0	0.0
302	2.1	0.0	0.0	0.0	0.0
303	7.2	0.0	0.0	0.0	0.0
304	0.0	1.0	32.0	0.0	33.1
305	0.0	0.0	48.6	0.0	0.0
306	2.1	0.0	6.2	2.1	0.0
307	1.0	0.0	1.0	12.4	0.0
308	10.3	0.0	0.0	0.0	50.6
309	0.0	0.0	4.1	3.1	0.0
310	28.9	0.0	0.0	0.0	0.0
311	39.3	0.0	0.0	0.0	0.0
312	1.0	0.0	0.0	0.0	0.0
313	0.0	1.0	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.1	6.2	0.0	0.0	0.0
320	24.8	5.2	0.0	0.0	0.0
321	49.6	3.1	0.0	0.0	0.0
322	26.9	0.0	0.0	0.0	0.0
323	1.0	0.0	0.0	0.0	0.0
324	3.1	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	16.5	0.0	0.0	0.0
329	0.0	0.0	0.0	23.8	0.0
330	0.0	4.1	0.0	41.3	22.7
331	0.0	6.2	0.0	30.0	0.0
332	0.0	2.1	0.0	6.2	0.0
333	0.0	1.0	0.0	0.0	0.0
334	0.0	0.0	18.6	0.0	0.0
335	0.0	0.0	3.1	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.0	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.1	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.0	0.0
363	0.0	0.0	0.0	1.0	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
297	7.7	2.2	0.0	23.1	2.2
298	2.2	0.0	0.0	39.7	0.0
299	1.1	0.0	0.0	6.6	0.0
300	1.1	0.0	0.0	33.0	0.0
301	2.2	6.6	0.0	0.0	0.0
302	2.2	0.0	0.0	0.0	0.0
303	7.7	0.0	0.0	0.0	0.0
304	0.0	1.1	34.1	0.0	35.2
305	0.0	0.0	51.8	0.0	0.0
306	2.2	0.0	6.6	2.2	0.0
307	1.1	0.0	1.1	13.2	0.0
308	11.0	0.0	0.0	0.0	54.0
309	0.0	0.0	4.4	3.3	0.0
310	30.8	0.0	0.0	0.0	0.0
311	41.9	0.0	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.4	6.6	0.0	0.0	0.0
320	26.4	5.5	0.0	0.0	0.0
321	52.9	3.3	0.0	0.0	0.0
322	28.6	0.0	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0	0.0
324	3.3	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	17.6	0.0	0.0	0.0
329	0.0	0.0	0.0	25.3	0.0
330	0.0	4.4	0.0	44.1	24.2
331	0.0	6.6	0.0	31.9	0.0
332	0.0	2.2	0.0	6.6	0.0
333	0.0	1.1	0.0	0.0	0.0
334	0.0	0.0	19.8	0.0	0.0
335	0.0	0.0	3.3	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.4	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1	0.0
363	0.0	0.0	0.0	1.1	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	



Daily Precipitation Pattern, 5 Year Wet Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 5 Year Total Precipitation
0
365
730
1095
1460
1825
Elapsed Time (d)
Wettest 5 Year Period

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.2	0.0
11	0.0	0.0	29.6	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	107.8
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.5	0.0
11	0.0	0.0	32.5	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	118.4
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.3	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.7
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0
82	0.0	3.2	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0
93	0.0	4.2	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.2	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.2
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	16.9	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.2
111	0.0	0.0	8.5	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.2	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	34.9	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1
125	0.0	0.0	11.6	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.1
129	1.1	0.0	0.0	0.0
130	6.3	0.0	0.0	43.3
131	8.5	1.1	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	48.6
134	0.0	0.0	11.6	0.0
135	0.0	0.0	0.0	15.9
136	2.1	0.0	0.0	0.0
137	0.0	0.0	28.5	3.2
138	1.1	7.4	0.0	0.0
139	0.0	0.0	0.0	0.0
140	6.3	0.0	0.0	0.0
141	0.0	0.0	8.5	41.2
142	0.0	12.7	0.0	0.0
143	2.1	0.0	0.0	6.3
144	1.1	21.1	11.6	0.0
145	6.3	89.9	13.7	14.8
146	1.1	6.3	51.8	12.7
147	1.1	25.4	20.1	0.0
148	9.5	41.2	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	15.1
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.2	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.3	0.0	0.0
82	0.0	3.5	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.2	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.3	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.3	0.0
93	0.0	4.6	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.6	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.5
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	18.6	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.6
111	0.0	0.0	9.3	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.5	0.0	0.0	0.0
116	0.0	0.0	0.0	1.2
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	38.3	0.0	0.0	0.0
124	0.0	0.0	0.0	1.2
125	0.0	0.0	12.8	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.2
129	1.2	0.0	0.0	0.0
130	7.0	0.0	0.0	47.6
131	9.3	1.2	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	53.4
134	0.0	0.0	12.8	0.0
135	0.0	0.0	0.0	17.4
136	2.3	0.0	0.0	0.0
137	0.0	0.0	31.3	3.5
138	1.2	8.1	0.0	0.0
139	0.0	0.0	0.0	0.0
140	7.0	0.0	0.0	0.0
141	0.0	0.0	9.3	45.3
142	0.0	13.9	0.0	0.0
143	2.3	0.0	0.0	7.0
144	1.2	23.2	12.8	0.0
145	7.0	98.6	15.1	16.2
146	1.2	7.0	56.9	13.9
147	1.2	27.8	22.0	0.0
148	10.4	45.3	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
149	0.0	0.0	9.5	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	19.0	0.0
152	7.4	0.0	0.0	0.0
153	0.0	0.0	0.0	2.1
154	0.0	0.0	1.1	60.3
155	5.3	0.0	14.8	26.4
156	0.0	0.0	4.2	5.3
157	16.9	0.0	14.8	0.0
158	4.2	0.0	0.0	0.0
159	6.3	0.0	0.0	0.0
160	8.5	0.0	0.0	2.1
161	81.4	1.1	0.0	25.4
162	4.2	0.0	0.0	6.3
163	0.0	16.9	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.2	27.5	0.0	7.4
167	1.1	4.2	0.0	0.0
168	0.0	0.0	27.5	1.1
169	1.1	0.0	27.5	19.0
170	0.0	0.0	19.0	0.0
171	0.0	0.0	14.8	0.0
172	6.3	0.0	1.1	20.1
173	0.0	0.0	0.0	1.1
174	0.0	6.3	0.0	0.0
175	0.0	2.1	0.0	23.3
176	2.1	9.5	0.0	2.1
177	1.1	0.0	8.5	0.0
178	69.8	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1
180	0.0	0.0	0.0	0.0
181	26.4	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	18.0	0.0	0.0	24.3
184	10.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.3	0.0	0.0	0.0
187	6.3	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1
190	1.1	0.0	0.0	0.0
191	4.2	0.0	0.0	0.0
192	49.7	0.0	0.0	0.0
193	14.8	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0
195	22.2	0.0	0.0	0.0
196	0.0	0.0	21.1	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0
200	0.0	10.6	0.0	0.0
201	1.1	0.0	0.0	0.0
202	0.0	0.0	12.7	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.2	0.0	0.0
205	0.0	0.0	1.1	0.0
206	0.0	0.0	0.0	31.7
207	0.0	0.0	0.0	1.1
208	1.1	3.2	0.0	0.0
209	0.0	10.6	3.2	0.0
210	0.0	6.3	10.6	3.2
211	2.1	0.0	0.0	0.0
212	4.2	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1
214	8.5	0.0	1.1	0.0
215	3.2	0.0	50.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	108.9	0.0	0.0	2.1
219	1.1	0.0	3.2	0.0
220	0.0	0.0	0.0	0.0
221	3.2	0.0	0.0	0.0
222	30.7	0.0	3.2	2.1

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
149	0.0	0.0	10.4	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	20.9	0.0
152	8.1	0.0	0.0	0.0
153	0.0	0.0	0.0	2.3
154	0.0	0.0	1.2	66.1
155	5.8	0.0	16.2	29.0
156	0.0	0.0	4.6	5.8
157	18.6	0.0	16.2	0.0
158	4.6	0.0	0.0	0.0
159	7.0	0.0	0.0	0.0
160	9.3	0.0	0.0	2.3
161	89.4	1.2	0.0	27.8
162	4.6	0.0	0.0	7.0
163	0.0	18.6	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.6	30.2	0.0	8.1
167	1.2	4.6	0.0	0.0
168	0.0	0.0	30.2	1.2
169	1.2	0.0	30.2	20.9
170	0.0	0.0	20.9	0.0
171	0.0	0.0	16.2	0.0
172	7.0	0.0	1.2	22.0
173	0.0	0.0	0.0	1.2
174	0.0	7.0	0.0	0.0
175	0.0	2.3	0.0	25.5
176	2.3	10.4	0.0	2.3
177	1.2	0.0	9.3	0.0
178	76.6	0.0	0.0	0.0
179	0.0	0.0	0.0	2.3
180	0.0	0.0	0.0	0.0
181	29.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	19.7	0.0	0.0	26.7
184	11.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.8	0.0	0.0	0.0
187	7.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.2
190	1.2	0.0	0.0	0.0
191	4.6	0.0	0.0	0.0
192	54.5	0.0	0.0	0.0
193	16.2	0.0	0.0	0.0
194	1.2	0.0	0.0	0.0
195	24.4	0.0	0.0	0.0
196	0.0	0.0	23.2	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.2	0.0	0.0
200	0.0	11.6	0.0	0.0
201	1.2	0.0	0.0	0.0
202	0.0	0.0	13.9	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.6	0.0	0.0
205	0.0	0.0	1.2	0.0
206	0.0	0.0	0.0	34.8
207	0.0	0.0	0.0	1.2
208	1.2	3.5	0.0	0.0
209	0.0	11.6	3.5	0.0
210	0.0	7.0	11.6	3.5
211	2.3	0.0	0.0	0.0
212	4.6	0.0	0.0	0.0
213	0.0	2.3	0.0	2.3
214	9.3	0.0	1.2	0.0
215	3.5	0.0	55.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	119.5	0.0	0.0	2.3
219	1.2	0.0	3.5	0.0
220	0.0	0.0	0.0	0.0
221	3.5	0.0	0.0	0.0
222	33.7	0.0	3.5	2.3

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
223	49.7	72.9	5.3	0.0
224	0.0	3.2	0.0	0.0
225	12.7	2.1	0.0	0.0
226	0.0	0.0	0.0	1.1
227	0.0	0.0	0.0	0.0
228	0.0	4.2	31.7	0.0
229	0.0	1.1	0.0	1.1
230	0.0	3.2	0.0	0.0
231	0.0	0.0	1.1	0.0
232	1.1	0.0	3.2	0.0
233	0.0	0.0	6.3	11.6
234	14.8	0.0	1.1	0.0
235	0.0	0.0	0.0	0.0
236	9.5	11.6	0.0	0.0
237	6.3	0.0	19.0	0.0
238	0.0	0.0	0.0	1.1
239	2.1	0.0	12.7	8.5
240	0.0	0.0	51.8	0.0
241	74.0	0.0	0.0	0.0
242	0.0	0.0	6.3	14.8
243	0.0	0.0	1.1	25.4
244	0.0	0.0	2.1	10.6
245	0.0	0.0	2.1	0.0
246	0.0	0.0	0.0	5.3
247	0.0	0.0	0.0	1.1
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.2	0.0	0.0
251	0.0	29.6	2.1	0.0
252	0.0	0.0	13.7	0.0
253	2.1	0.0	28.5	0.0
254	0.0	0.0	11.6	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	15.9
257	0.0	0.0	0.0	6.3
258	0.0	0.0	9.5	6.3
259	0.0	4.2	0.0	21.1
260	71.9	2.1	0.0	2.1
261	0.0	2.1	0.0	33.8
262	0.0	15.9	0.0	1.1
263	34.9	1.1	4.2	0.0
264	11.6	14.8	19.0	0.0
265	34.9	0.0	57.1	0.0
266	30.7	0.0	72.9	0.0
267	0.0	0.0	0.0	0.0
268	3.2	0.0	19.0	0.0
269	0.0	0.0	3.2	20.1
270	0.0	27.5	0.0	4.2
271	0.0	63.4	0.0	0.0
272	3.2	45.5	0.0	0.0
273	9.5	0.0	0.0	12.7
274	16.9	0.0	0.0	1.1
275	11.6	11.6	0.0	0.0
276	0.0	0.0	58.1	2.1
277	0.0	0.0	0.0	4.2
278	0.0	0.0	1.1	0.0
279	0.0	0.0	38.1	0.0
280	0.0	0.0	8.5	0.0
281	0.0	0.0	20.1	0.0
282	0.0	0.0	15.9	0.0
283	0.0	0.0	0.0	0.0
284	29.6	0.0	0.0	1.1
285	0.0	0.0	0.0	27.5
286	0.0	0.0	0.0	46.5
287	13.7	1.1	0.0	52.9
288	11.6	0.0	2.1	5.3
289	12.7	0.0	6.3	2.1
290	93.0	0.0	0.0	25.4
291	0.0	0.0	0.0	21.1
292	12.7	0.0	7.4	80.3
293	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0
295	5.3	0.0	0.0	55.0
296	0.0	0.0	0.0	3.2

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
223	54.5	80.1	5.8	0.0
224	0.0	3.5	0.0	0.0
225	13.9	2.3	0.0	0.0
226	0.0	0.0	0.0	1.2
227	0.0	0.0	0.0	0.0
228	0.0	4.6	34.8	0.0
229	0.0	1.2	0.0	1.2
230	0.0	3.5	0.0	0.0
231	0.0	0.0	1.2	0.0
232	1.2	0.0	3.5	0.0
233	0.0	0.0	7.0	12.8
234	16.2	0.0	1.2	0.0
235	0.0	0.0	0.0	0.0
236	10.4	12.8	0.0	0.0
237	7.0	0.0	20.9	0.0
238	0.0	0.0	0.0	1.2
239	2.3	0.0	13.9	9.3
240	0.0	0.0	56.9	0.0
241	81.2	0.0	0.0	0.0
242	0.0	0.0	7.0	16.2
243	0.0	0.0	1.2	27.8
244	0.0	0.0	2.3	11.6
245	0.0	0.0	2.3	0.0
246	0.0	0.0	0.0	5.8
247	0.0	0.0	0.0	1.2
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.6	0.0	0.0
251	0.0	32.5	2.3	0.0
252	0.0	0.0	15.1	0.0
253	2.3	0.0	31.3	0.0
254	0.0	0.0	12.8	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	17.4
257	0.0	0.0	0.0	7.0
258	0.0	0.0	10.4	7.0
259	0.0	4.6	0.0	23.2
260	78.9	2.3	0.0	2.3
261	0.0	2.3	0.0	37.1
262	0.0	17.4	0.0	1.2
263	38.3	1.2	4.6	0.0
264	12.8	16.2	20.9	0.0
265	38.3	0.0	62.7	0.0
266	33.7	0.0	80.1	0.0
267	0.0	0.0	0.0	0.0
268	3.5	0.0	20.9	0.0
269	0.0	0.0	3.5	22.0
270	0.0	30.2	0.0	4.6
271	0.0	69.6	0.0	0.0
272	3.5	49.9	0.0	0.0
273	10.4	0.0	0.0	13.9
274	18.6	0.0	0.0	1.2
275	12.8	12.8	0.0	0.0
276	0.0	0.0	63.8	2.3
277	0.0	0.0	0.0	4.6
278	0.0	0.0	1.2	0.0
279	0.0	0.0	41.8	0.0
280	0.0	0.0	9.3	0.0
281	0.0	0.0	22.0	0.0
282	0.0	0.0	17.4	0.0
283	0.0	0.0	0.0	0.0
284	32.5	0.0	0.0	1.2
285	0.0	0.0	0.0	30.2
286	0.0	0.0	0.0	51.1
287	15.1	1.2	0.0	58.0
288	12.8	0.0	2.3	5.8
289	13.9	0.0	7.0	2.3
290	102.1	0.0	0.0	27.8
291	0.0	0.0	0.0	23.2
292	13.9	0.0	8.1	88.2
293	0.0	0.0	0.0	0.0
294	1.2	0.0	0.0	0.0
295	5.8	0.0	0.0	60.3
296	0.0	0.0	0.0	3.5

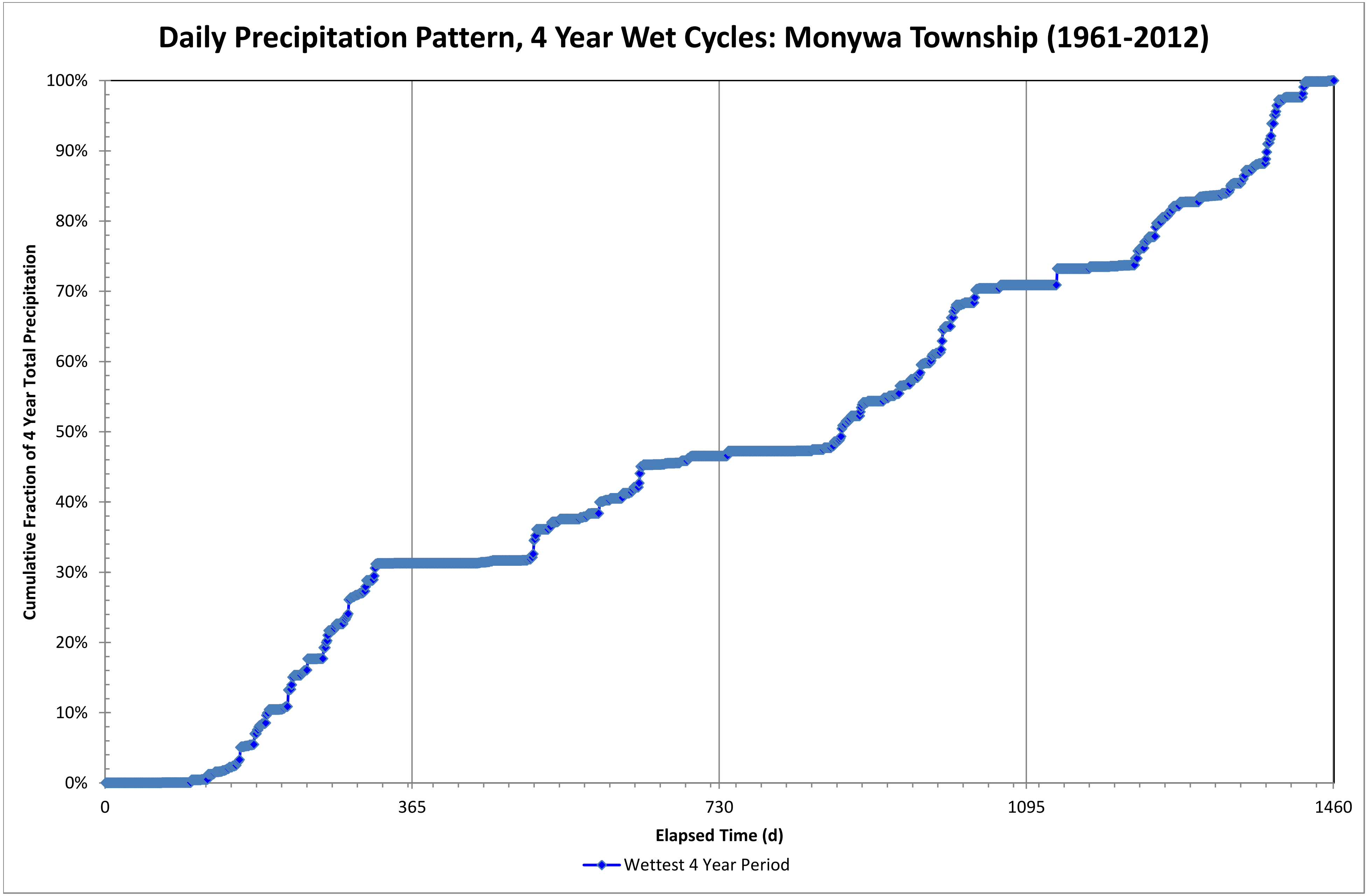
Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
297	7.4	2.1	0.0	22.2
298	2.1	0.0	0.0	38.1
299	1.1	0.0	0.0	6.3
300	1.1	0.0	0.0	31.7
301	2.1	6.3	0.0	0.0
302	2.1	0.0	0.0	0.0
303	7.4	0.0	0.0	0.0
304	0.0	1.1	32.8	0.0
305	0.0	0.0	49.7	0.0
306	2.1	0.0	6.3	2.1
307	1.1	0.0	1.1	12.7
308	10.6	0.0	0.0	0.0
309	0.0	0.0	4.2	3.2
310	29.6	0.0	0.0	0.0
311	40.2	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.2	6.3	0.0	0.0
320	25.4	5.3	0.0	0.0
321	50.7	3.2	0.0	0.0
322	27.5	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0
324	3.2	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	16.9	0.0	0.0
329	0.0	0.0	0.0	24.3
330	0.0	4.2	0.0	42.3
331	0.0	6.3	0.0	30.7
332	0.0	2.1	0.0	6.3
333	0.0	1.1	0.0	0.0
334	0.0	0.0	19.0	0.0
335	0.0	0.0	3.2	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.2
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1
363	0.0	0.0	0.0	1.1
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
297	8.1	2.3	0.0	24.4
298	2.3	0.0	0.0	41.8
299	1.2	0.0	0.0	7.0
300	1.2	0.0	0.0	34.8
301	2.3	7.0	0.0	0.0
302	2.3	0.0	0.0	0.0
303	8.1	0.0	0.0	0.0
304	0.0	1.2	36.0	0.0
305	0.0	0.0	54.5	0.0
306	2.3	0.0	7.0	2.3
307	1.2	0.0	1.2	13.9
308	11.6	0.0	0.0	0.0
309	0.0	0.0	4.6	3.5
310	32.5	0.0	0.0	0.0
311	44.1	0.0	0.0	0.0
312	1.2	0.0	0.0	0.0
313	0.0	1.2	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.6	7.0	0.0	0.0
320	27.8	5.8	0.0	0.0
321	55.7	3.5	0.0	0.0
322	30.2	0.0	0.0	0.0
323	1.2	0.0	0.0	0.0
324	3.5	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	18.6	0.0	0.0
329	0.0	0.0	0.0	26.7
330	0.0	4.6	0.0	46.4
331	0.0	7.0	0.0	33.7
332	0.0	2.3	0.0	7.0
333	0.0	1.2	0.0	0.0
334	0.0	0.0	20.9	0.0
335	0.0	0.0	3.5	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.2	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.6
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.2
363	0.0	0.0	0.0	1.2
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0



Daily Precipitation Pattern, 4 Year Wet Cycles: Monywa Township (1961-2012)
Cumulative Fraction of 4 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
1460
Elapsed Time (d)
Wettest 4 Year Period

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	3.2
10	3.4	0.0	29.6
11	31.3	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	113.9	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	3.8	0.0	0.0
11	35.0	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	127.6	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
75	0.0	0.0	0.0
76	0.0	14.5	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	2.1
92	2.2	0.0	0.0
93	0.0	0.0	0.0
94	0.0	0.0	0.0
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.4	0.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	0.0
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	0.0
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	0.0
110	0.0	4.5	8.5
111	8.9	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	0.0
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.1	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.1	11.6
125	12.3	0.0	0.0
126	0.0	0.0	0.0
127	0.0	0.0	0.0
128	0.0	1.1	0.0
129	0.0	0.0	0.0
130	0.0	45.8	0.0
131	0.0	0.0	0.0
132	0.0	0.0	0.0
133	0.0	51.4	11.6
134	12.3	0.0	0.0
135	0.0	16.8	0.0
136	0.0	0.0	28.5
137	30.2	3.4	0.0
138	0.0	0.0	0.0
139	0.0	0.0	0.0
140	0.0	0.0	8.5
141	8.9	43.6	0.0
142	0.0	0.0	0.0
143	0.0	6.7	11.6
144	12.3	0.0	13.7
145	14.5	15.6	51.8
146	54.7	13.4	20.1
147	21.2	0.0	0.0
148	0.0	0.0	9.5

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
75	0.0	0.0	0.0
76	0.0	16.3	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	0.0
92	2.5	0.0	5.0
93	0.0	0.0	3.8
94	0.0	0.0	1.3
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.8	10.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	7.5
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	1.3
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	6.3
110	0.0	5.0	0.0
111	10.0	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	1.3
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.3	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.3	0.0
125	13.8	0.0	0.0
126	0.0	0.0	6.3
127	0.0	0.0	2.5
128	0.0	1.3	0.0
129	0.0	0.0	0.0
130	0.0	51.3	0.0
131	0.0	0.0	0.0
132	0.0	0.0	3.8
133	0.0	57.6	7.5
134	13.8	0.0	2.5
135	0.0	18.8	0.0
136	0.0	0.0	0.0
137	33.8	3.8	0.0
138	0.0	0.0	0.0
139	0.0	0.0	1.3
140	0.0	0.0	0.0
141	10.0	48.8	0.0
142	0.0	0.0	0.0
143	0.0	7.5	0.0
144	13.8	0.0	0.0
145	16.3	17.5	12.5
146	61.3	15.0	5.0
147	23.8	0.0	0.0
148	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
149	10.1	0.0	0.0
150	0.0	0.0	19.0
151	20.1	0.0	0.0
152	0.0	0.0	0.0
153	0.0	2.2	1.1
154	1.1	63.7	14.8
155	15.6	27.9	4.2
156	4.5	5.6	14.8
157	15.6	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.2	0.0
161	0.0	26.8	0.0
162	0.0	6.7	0.0
163	0.0	0.0	0.0
164	0.0	0.0	0.0
165	0.0	0.0	0.0
166	0.0	7.8	0.0
167	0.0	0.0	27.5
168	29.0	1.1	27.5
169	29.0	20.1	19.0
170	20.1	0.0	14.8
171	15.6	0.0	1.1
172	1.1	21.2	0.0
173	0.0	1.1	0.0
174	0.0	0.0	0.0
175	0.0	24.6	0.0
176	0.0	2.2	8.5
177	8.9	0.0	0.0
178	0.0	0.0	0.0
179	0.0	2.2	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	25.7	0.0
184	0.0	0.0	0.0
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.1	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	21.1
196	22.3	0.0	0.0
197	0.0	0.0	0.0
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	0.0
201	0.0	0.0	12.7
202	13.4	0.0	0.0
203	0.0	0.0	0.0
204	0.0	0.0	1.1
205	1.1	0.0	0.0
206	0.0	33.5	0.0
207	0.0	1.1	0.0
208	0.0	0.0	3.2
209	3.4	0.0	10.6
210	11.2	3.4	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.2	1.1
214	1.1	0.0	50.7
215	53.6	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.2	3.2
219	3.4	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	3.2
222	3.4	2.2	5.3

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
149	11.3	0.0	0.0
150	0.0	0.0	2.5
151	22.5	0.0	0.0
152	0.0	0.0	31.3
153	0.0	2.5	0.0
154	1.3	71.3	0.0
155	17.5	31.3	0.0
156	5.0	6.3	0.0
157	17.5	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.5	0.0
161	0.0	30.0	0.0
162	0.0	7.5	0.0
163	0.0	0.0	0.0
164	0.0	0.0	2.5
165	0.0	0.0	0.0
166	0.0	8.8	1.3
167	0.0	0.0	0.0
168	32.5	1.3	0.0
169	32.5	22.5	0.0
170	22.5	0.0	0.0
171	17.5	0.0	0.0
172	1.3	23.8	0.0
173	0.0	1.3	0.0
174	0.0	0.0	3.8
175	0.0	27.5	8.8
176	0.0	2.5	17.5
177	10.0	0.0	1.3
178	0.0	0.0	0.0
179	0.0	2.5	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	28.8	0.0
184	0.0	0.0	1.3
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.3	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	27.5
196	25.0	0.0	2.5
197	0.0	0.0	1.3
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	1.3
201	0.0	0.0	0.0
202	15.0	0.0	0.0
203	0.0	0.0	16.3
204	0.0	0.0	1.3
205	1.3	0.0	3.8
206	0.0	37.5	0.0
207	0.0	1.3	0.0
208	0.0	0.0	0.0
209	3.8	0.0	0.0
210	12.5	3.8	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.5	0.0
214	1.3	0.0	0.0
215	60.1	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.5	0.0
219	3.8	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	0.0
222	3.8	2.5	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
223	5.6	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.1	0.0
227	0.0	0.0	31.7
228	33.5	0.0	0.0
229	0.0	1.1	0.0
230	0.0	0.0	1.1
231	1.1	0.0	3.2
232	3.4	0.0	6.3
233	6.7	12.3	1.1
234	1.1	0.0	0.0
235	0.0	0.0	0.0
236	0.0	0.0	19.0
237	20.1	0.0	0.0
238	0.0	1.1	12.7
239	13.4	8.9	51.8
240	54.7	0.0	0.0
241	0.0	0.0	6.3
242	6.7	15.6	1.1
243	1.1	26.8	2.1
244	2.2	11.2	2.1
245	2.2	0.0	0.0
246	0.0	5.6	0.0
247	0.0	1.1	0.0
248	0.0	0.0	0.0
249	0.0	0.0	0.0
250	0.0	0.0	2.1
251	2.2	0.0	13.7
252	14.5	0.0	28.5
253	30.2	0.0	11.6
254	12.3	0.0	0.0
255	0.0	0.0	0.0
256	0.0	16.8	0.0
257	0.0	6.7	9.5
258	10.1	6.7	0.0
259	0.0	22.3	0.0
260	0.0	2.2	0.0
261	0.0	35.7	0.0
262	0.0	1.1	4.2
263	4.5	0.0	19.0
264	20.1	0.0	57.1
265	60.3	0.0	72.9
266	77.1	0.0	0.0
267	0.0	0.0	19.0
268	20.1	0.0	3.2
269	3.4	21.2	0.0
270	0.0	4.5	0.0
271	0.0	0.0	0.0
272	0.0	0.0	0.0
273	0.0	13.4	0.0
274	0.0	1.1	0.0
275	0.0	0.0	58.1
276	61.4	2.2	0.0
277	0.0	4.5	1.1
278	1.1	0.0	38.1
279	40.2	0.0	8.5
280	8.9	0.0	20.1
281	21.2	0.0	15.9
282	16.8	0.0	0.0
283	0.0	0.0	0.0
284	0.0	1.1	0.0
285	0.0	29.0	0.0
286	0.0	49.1	0.0
287	0.0	55.8	2.1
288	2.2	5.6	6.3
289	6.7	2.2	0.0
290	0.0	26.8	0.0
291	0.0	22.3	7.4
292	7.8	84.9	0.0
293	0.0	0.0	0.0
294	0.0	0.0	0.0
295	0.0	58.1	0.0
296	0.0	3.4	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
223	6.3	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.3	0.0
227	0.0	0.0	0.0
228	37.5	0.0	0.0
229	0.0	1.3	0.0
230	0.0	0.0	20.0
231	1.3	0.0	40.0
232	3.8	0.0	65.1
233	7.5	13.8	23.8
234	1.3	0.0	15.0
235	0.0	0.0	3.8
236	0.0	0.0	20.0
237	22.5	0.0	0.0
238	0.0	1.3	28.8
239	15.0	10.0	0.0
240	61.3	0.0	0.0
241	0.0	0.0	0.0
242	7.5	17.5	3.8
243	1.3	30.0	26.3
244	2.5	12.5	17.5
245	2.5	0.0	27.5
246	0.0	6.3	0.0
247	0.0	1.3	0.0
248	0.0	0.0	5.0
249	0.0	0.0	0.0
250	0.0	0.0	57.6
251	2.5	0.0	20.0
252	16.3	0.0	11.3
253	33.8	0.0	1.3
254	13.8	0.0	43.8
255	0.0	0.0	17.5
256	0.0	18.8	0.0
257	0.0	7.5	0.0
258	11.3	7.5	5.0
259	0.0	25.0	3.8
260	0.0	2.5	0.0
261	0.0	40.0	0.0
262	0.0	1.3	0.0
263	5.0	0.0	0.0
264	22.5	0.0	65.1
265	67.6	0.0	90.1
266	86.3	0.0	3.8
267	0.0	0.0	0.0
268	22.5	0.0	0.0
269	3.8	23.8	0.0
270	0.0	5.0	0.0
271	0.0	0.0	0.0
272	0.0	0.0	28.8
273	0.0	15.0	1.3
274	0.0	1.3	0.0
275	0.0	0.0	0.0
276	68.8	2.5	0.0
277	0.0	5.0	0.0
278	1.3	0.0	0.0
279	45.0	0.0	0.0
280	10.0	0.0	0.0
281	23.8	0.0	0.0
282	18.8	0.0	46.3
283	0.0	0.0	6.3
284	0.0	1.3	80.1
285	0.0	32.5	8.8
286	0.0	55.1	1.3
287	0.0	62.6	16.3
288	2.5	6.3	0.0
289	7.5	2.5	0.0
290	0.0	30.0	0.0
291	0.0	25.0	0.0
292	8.8	95.1	0.0
293	0.0	0.0	0.0
294	0.0	0.0	6.3
295	0.0	65.1	8.8
296	0.0	3.8	0.0

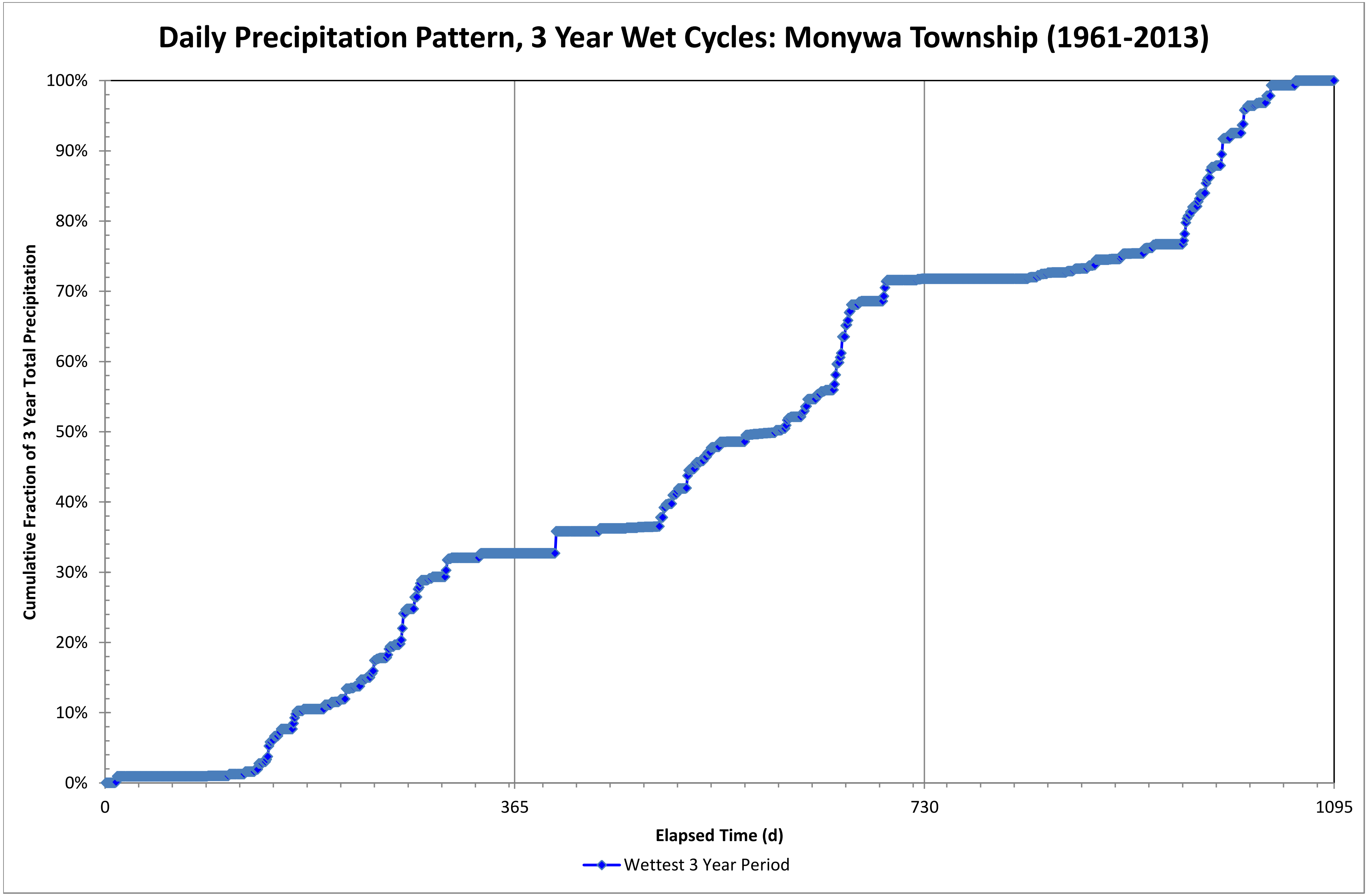
Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
297	0.0	23.5	0.0
298	0.0	40.2	0.0
299	0.0	6.7	0.0
300	0.0	33.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	32.8
304	34.6	0.0	49.7
305	52.5	0.0	6.3
306	6.7	2.2	1.1
307	1.1	13.4	0.0
308	0.0	0.0	4.2
309	4.5	3.4	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	25.7	0.0
330	0.0	44.7	0.0
331	0.0	32.4	0.0
332	0.0	6.7	0.0
333	0.0	0.0	19.0
334	20.1	0.0	3.2
335	3.4	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	4.5	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.1	0.0
363	0.0	1.1	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
297	0.0	26.3	2.5
298	0.0	45.0	0.0
299	0.0	7.5	0.0
300	0.0	37.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	0.0
304	38.8	0.0	40.0
305	58.8	0.0	0.0
306	7.5	2.5	0.0
307	1.3	15.0	0.0
308	0.0	0.0	61.3
309	5.0	3.8	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	28.8	0.0
330	0.0	50.1	27.5
331	0.0	36.3	0.0
332	0.0	7.5	0.0
333	0.0	0.0	0.0
334	22.5	0.0	0.0
335	3.8	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	5.0	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.3	0.0
363	0.0	1.3	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	


Daily Precipitation Pattern, 3 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 3 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
Elapsed Time (d)
Wettest 3 Year Period

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	3.7
87	0.0	0.0
88	3.2	1.6
89	0.0	0.5
90	6.3	0.0
91	0.0	0.0
92	0.0	1.6
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	10.6	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	15.9
114	0.0	1.1
115	4.2	0.0
116	0.0	0.0
117	0.0	8.5
118	4.2	73.0
119	0.0	2.1
120	0.0	3.2
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	7.9
125	0.0	0.0
126	8.5	5.9
127	0.0	0.0
128	0.0	0.5
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	21.7	5.3
137	0.0	12.2
138	0.0	1.1
139	0.0	0.0
140	1.1	0.0
141	44.4	9.0
142	0.0	0.0
143	0.0	7.9
144	12.2	12.2
145	0.0	0.0
146	0.0	0.0
147	0.0	11.0
148	0.0	5.8

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	4.1
87	0.0	0.0
88	3.5	1.8
89	0.0	0.6
90	7.1	0.0
91	0.0	0.0
92	0.0	1.8
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	11.8	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	17.7
114	0.0	1.2
115	4.7	0.0
116	0.0	0.0
117	0.0	9.5
118	4.7	81.6
119	0.0	2.4
120	0.0	3.5
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	8.9
125	0.0	0.0
126	9.5	6.6
127	0.0	0.0
128	0.0	0.6
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	24.2	5.9
137	0.0	13.6
138	0.0	1.2
139	0.0	0.0
140	1.2	0.0
141	49.7	10.1
142	0.0	0.0
143	0.0	8.9
144	13.6	13.6
145	0.0	0.0
146	0.0	0.0
147	0.0	12.3
148	0.0	6.5

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
149	0.0	14.8
150	0.0	0.0
151	0.0	0.0
152	0.0	48.6
153	0.0	0.0
154	0.0	3.2
155	4.2	0.0
156	0.0	0.0
157	0.0	105.8
158	0.0	25.4
159	0.0	11.6
160	0.0	4.2
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	9.0
166	41.2	0.0
167	3.2	0.5
168	20.1	2.1
169	12.2	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	7.4	0.0
175	28.6	69.7
176	1.6	0.5
177	0.0	0.0
178	0.0	0.0
179	4.2	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	29.3	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.6
192	0.0	0.0
193	0.0	0.7
194	0.0	0.0
195	0.0	0.0
196	0.0	29.1
197	5.9	0.0
198	20.6	0.0
199	9.8	0.0
200	2.6	0.0
201	8.5	3.9
202	34.9	0.0
203	0.0	0.0
204	0.0	1.1
205	0.0	4.2
206	0.0	0.5
207	5.3	0.5
208	0.0	0.0
209	0.0	46.5
210	5.8	0.0
211	1.1	0.0
212	15.3	2.1
213	0.0	20.6
214	0.0	0.0
215	0.0	0.0
216	13.2	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	8.1
220	0.0	4.8
221	0.0	41.2
222	0.0	2.6

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
149	0.0	16.6
150	0.0	0.0
151	0.0	0.0
152	0.0	54.4
153	0.0	0.0
154	0.0	3.5
155	4.7	0.0
156	0.0	0.0
157	0.0	118.3
158	0.0	28.4
159	0.0	13.0
160	0.0	4.7
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	10.1
166	46.1	0.0
167	3.5	0.6
168	22.5	2.4
169	13.6	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	8.3	0.0
175	31.9	77.9
176	1.8	0.6
177	0.0	0.0
178	0.0	0.0
179	4.7	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	32.8	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.8
192	0.0	0.0
193	0.0	0.8
194	0.0	0.0
195	0.0	0.0
196	0.0	32.5
197	6.6	0.0
198	23.1	0.0
199	11.0	0.0
200	3.0	0.0
201	9.5	4.4
202	39.0	0.0
203	0.0	0.0
204	0.0	1.2
205	0.0	4.7
206	0.0	0.6
207	5.9	0.6
208	0.0	0.0
209	0.0	52.0
210	6.5	0.0
211	1.2	0.0
212	17.1	2.4
213	0.0	23.1
214	0.0	0.0
215	0.0	0.0
216	14.8	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	9.1
220	0.0	5.3
221	0.0	46.1
222	0.0	3.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
223	4.2	36.0
224	2.6	9.0
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	25.4
229	47.6	2.6
230	18.5	0.0
231	0.0	3.7
232	0.0	0.5
233	0.0	0.0
234	89.9	0.0
235	0.0	0.0
236	7.4	27.5
237	10.0	1.1
238	0.0	42.8
239	0.0	13.2
240	0.0	9.5
241	2.1	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	9.0	0.0
247	9.3	3.7
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	4.8
253	0.0	0.0
254	20.1	0.0
255	0.0	0.0
256	1.6	15.9
257	68.2	4.2
258	0.0	0.0
259	0.0	0.0
260	2.1	0.0
261	0.0	0.0
262	0.0	0.0
263	9.0	14.8
264	0.0	1.1
265	35.4	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	21.7
272	6.9	3.9
273	0.0	30.7
274	0.0	14.8
275	0.0	10.6
276	0.0	14.3
277	0.0	6.9
278	0.0	3.7
279	83.6	0.0
280	89.9	0.0
281	55.0	0.0
282	0.0	0.0
283	1.6	0.0
284	2.1	0.0
285	6.3	0.0
286	5.3	0.0
287	37.0	0.0
288	0.0	2.1
289	20.6	0.0
290	0.0	38.1
291	0.0	22.7
292	0.0	174.5
293	55.5	0.0
294	0.0	0.0
295	54.5	0.0
296	114.7	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
223	4.7	40.2
224	3.0	10.1
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	28.4
229	53.2	3.0
230	20.7	0.0
231	0.0	4.1
232	0.0	0.6
233	0.0	0.0
234	100.5	0.0
235	0.0	0.0
236	8.3	30.7
237	11.2	1.2
238	0.0	47.9
239	0.0	14.8
240	0.0	10.6
241	2.4	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	10.1	0.0
247	10.4	4.1
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	5.3
253	0.0	0.0
254	22.5	0.0
255	0.0	0.0
256	1.8	17.7
257	76.3	4.7
258	0.0	0.0
259	0.0	0.0
260	2.4	0.0
261	0.0	0.0
262	0.0	0.0
263	10.1	16.6
264	0.0	1.2
265	39.6	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	24.2
272	7.7	4.4
273	0.0	34.3
274	0.0	16.6
275	0.0	11.8
276	0.0	16.0
277	0.0	7.7
278	0.0	4.1
279	93.4	0.0
280	100.5	0.0
281	61.5	0.0
282	0.0	0.0
283	1.8	0.0
284	2.4	0.0
285	7.1	0.0
286	5.9	0.0
287	41.4	0.0
288	0.0	2.4
289	23.1	0.0
290	0.0	42.6
291	0.0	25.4
292	0.0	195.1
293	62.1	0.0
294	0.0	0.0
295	60.9	0.0
296	128.3	0.0

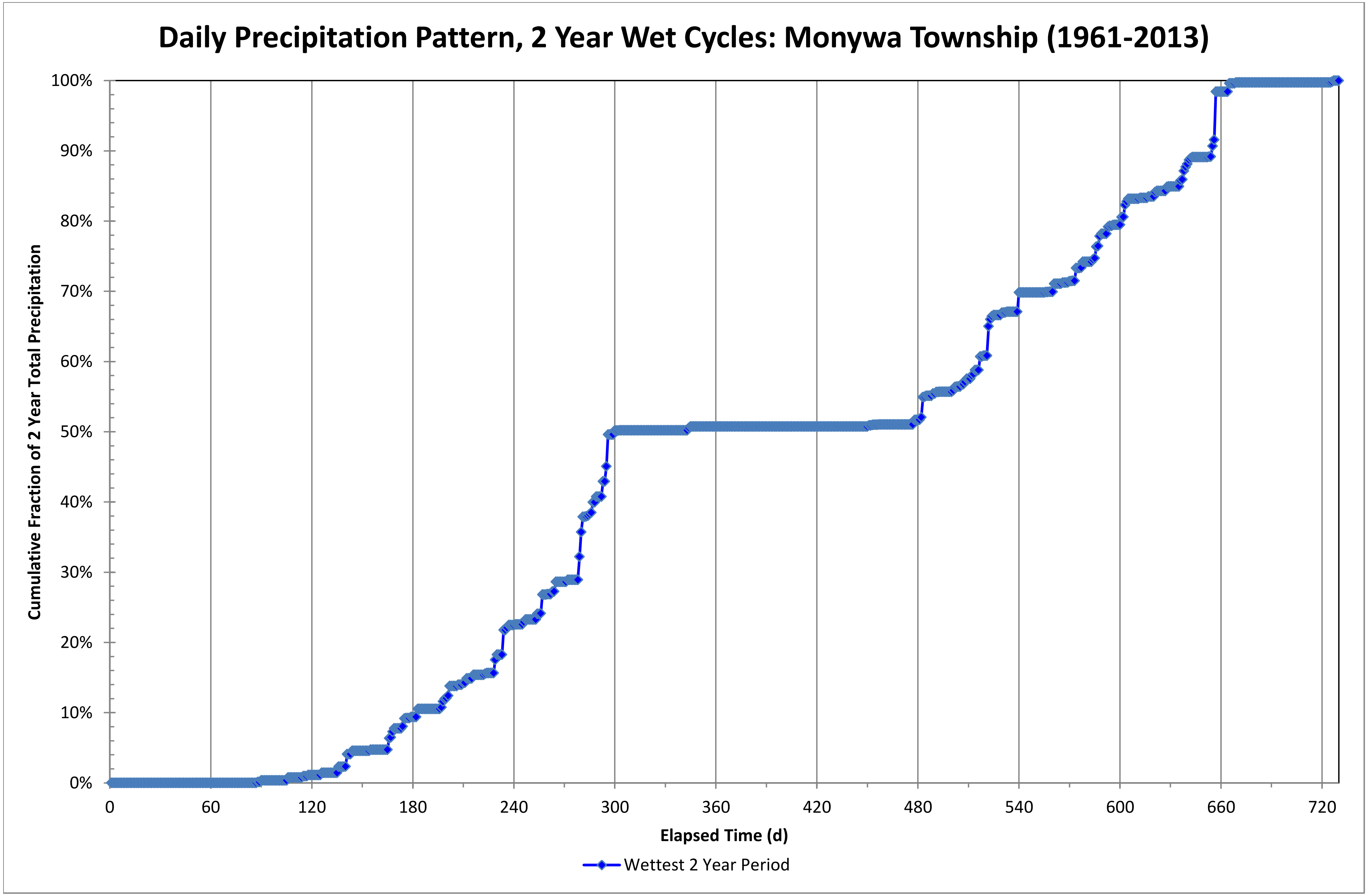
Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	14.8	29.6
301	0.0	0.0
302	0.0	0.0
303	1.1	0.0
304	0.0	3.2
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	8.5	0.0
345	5.3	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	2.6
362	0.0	4.2
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	16.6	33.1
301	0.0	0.0
302	0.0	0.0
303	1.2	0.0
304	0.0	3.5
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	9.5	0.0
345	5.9	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	3.0
362	0.0	4.7
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0



Daily Precipitation Pattern, 2 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 2 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
60
120
180
240
300
360
420
480
540
600
660
720
Elapsed Time (d)
Wettest 2 Year Period

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)		Wet, 500 year ARI (mm)		Dry, 100 year ARI (mm)		Dry, 500 year ARI (mm)	
Total	1554.9	Total	1901.8	Total	424.0	Total	382.6
Day	Year 1	Day	Year 1	Day	Year 1	Day	Year 1
1	0.0	1	0.0	1	0.0	1	0.0
2	0.0	2	0.0	2	0.0	2	0.0
3	0.0	3	0.0	3	0.0	3	0.0
4	0.0	4	0.0	4	0.0	4	0.0
5	0.0	5	0.0	5	0.0	5	0.0
6	0.0	6	0.0	6	0.0	6	0.0
7	0.0	7	0.0	7	0.0	7	0.0
8	0.0	8	0.0	8	0.0	8	0.0
9	0.0	9	0.0	9	0.0	9	0.0
10	0.0	10	0.0	10	0.0	10	0.0
11	0.0	11	0.0	11	0.0	11	0.0
12	0.0	12	0.0	12	0.0	12	0.0
13	0.0	13	0.0	13	0.0	13	0.0
14	0.0	14	0.0	14	0.0	14	0.0
15	0.0	15	0.0	15	0.0	15	0.0
16	0.0	16	0.0	16	0.0	16	0.0
17	0.0	17	0.0	17	0.0	17	0.0
18	0.0	18	0.0	18	0.0	18	0.0
19	0.0	19	0.0	19	0.0	19	0.0
20	0.0	20	0.0	20	0.0	20	0.0
21	0.0	21	0.0	21	0.0	21	0.0
22	0.0	22	0.0	22	0.0	22	0.0
23	0.0	23	0.0	23	0.0	23	0.0
24	0.0	24	0.0	24	0.0	24	0.0
25	0.0	25	0.0	25	0.0	25	0.0
26	0.0	26	0.0	26	0.0	26	0.0
27	0.0	27	0.0	27	0.0	27	0.0
28	0.0	28	0.0	28	0.0	28	0.0
29	0.0	29	0.0	29	0.0	29	0.0
30	0.0	30	0.0	30	0.0	30	0.0
31	0.0	31	0.0	31	0.0	31	0.0
32	0.0	32	0.0	32	0.0	32	0.0
33	0.0	33	0.0	33	0.0	33	0.0
34	0.0	34	0.0	34	0.0	34	0.0
35	0.0	35	0.0	35	0.0	35	0.0
36	0.0	36	0.0	36	0.0	36	0.0
37	0.0	37	0.0	37	0.0	37	0.0
38	0.0	38	0.0	38	0.0	38	0.0
39	0.0	39	0.0	39	0.0	39	0.0
40	0.0	40	0.0	40	0.0	40	0.0
41	0.0	41	0.0	41	0.0	41	0.0
42	0.0	42	0.0	42	0.0	42	0.0
43	0.0	43	0.0	43	0.0	43	0.0
44	0.0	44	0.0	44	0.0	44	0.0
45	0.0	45	0.0	45	0.0	45	0.0
46	0.0	46	0.0	46	0.0	46	0.0
47	0.0	47	0.0	47	0.0	47	0.0
48	0.0	48	0.0	48	0.0	48	0.0
49	0.0	49	0.0	49	0.0	49	0.0
50	0.0	50	0.0	50	0.0	50	0.0
51	0.0	51	0.0	51	0.0	51	0.0
52	0.0	52	0.0	52	0.0	52	0.0
53	0.0	53	0.0	53	0.0	53	0.0
54	0.0	54	0.0	54	0.0	54	0.0
55	0.0	55	0.0	55	0.0	55	0.0
56	0.0	56	0.0	56	0.0	56	0.0
57	0.0	57	0.0	57	0.0	57	0.0
58	0.0	58	0.0	58	0.0	58	0.0
59	0.0	59	0.0	59	0.0	59	0.0
60	0.0	60	0.0	60	0.0	60	0.0
61	0.0	61	0.0	61	0.0	61	0.0
62	0.0	62	0.0	62	0.0	62	0.0
63	0.0	63	0.0	63	0.0	63	0.0
64	0.0	64	0.0	64	0.0	64	0.0
65	0.0	65	0.0	65	0.0	65	0.0
66	0.0	66	0.0	66	0.0	66	0.0
67	0.0	67	0.0	67	0.0	67	0.0
68	2.3	68	2.8	68	0.0	68	0.0
69	0.0	69	0.0	69	0.0	69	0.0
70	0.0	70	0.0	70	0.0	70	0.0
71	0.0	71	0.0	71	0.0	71	0.0
72	0.0	72	0.0	72	0.0	72	0.0
73	0.0	73	0.0	73	0.0	73	0.0
74	0.0	74	0.0	74	0.0	74	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	**Year 1**
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	18.2
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	0.0
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	3.4
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	37.5
124	0.0
125	0.0
126	0.0
127	0.0
128	0.0
129	1.1
130	6.8
131	9.1
132	0.0
133	0.0
134	0.0
135	0.0
136	2.3
137	0.0
138	1.1
139	0.0
140	6.8
141	0.0
142	0.0
143	2.3
144	1.1
145	6.8
146	1.1
147	1.1
148	10.2

Wet, 500 year ARI (mm)

Total	1901.8
Day	**Year 1**
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	22.2
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	0.0
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	4.2
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	45.8
124	0.0
125	0.0
126	0.0
127	0.0
128	0.0
129	1.4
130	8.3
131	11.1
132	0.0
133	0.0
134	0.0
135	0.0
136	2.8
137	0.0
138	1.4
139	0.0
140	8.3
141	0.0
142	0.0
143	2.8
144	1.4
145	8.3
146	1.4
147	1.4
148	12.5

Dry, 100 year ARI (mm)

Total	424.0
Day	**Year 1**
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	0.0
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	2.1
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	0.0
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	4.1
124	0.0
125	17.5
126	0.0
127	0.0
128	0.0
129	0.0
130	0.0
131	0.0
132	3.1
133	0.0
134	0.0
135	37.1
136	1.0
137	0.0
138	0.0
139	0.0
140	0.0
141	7.2
142	0.0
143	12.4
144	1.0
145	25.8
146	0.0
147	0.0
148	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	**Year 1**
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	0.0
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	1.9
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	0.0
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	3.7
124	0.0
125	15.8
126	0.0
127	0.0
128	0.0
129	0.0
130	0.0
131	0.0
132	2.8
133	0.0
134	0.0
135	33.5
136	0.9
137	0.0
138	0.0
139	0.0
140	0.0
141	6.5
142	0.0
143	11.2
144	0.9
145	23.3
146	0.0
147	0.0
148	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)		Wet, 500 year ARI (mm)		Dry, 100 year ARI (mm)		Dry, 500 year ARI (mm)	
Total	1554.9	**Total**	1901.8	**Total**	424.0	**Total**	382.6
Day	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**
149	0.0	149	0.0	149	0.0	149	0.0
150	0.0	150	0.0	150	0.0	150	0.0
151	0.0	151	0.0	151	0.0	151	0.0
152	7.9	152	9.7	152	0.0	152	0.0
153	0.0	153	0.0	153	27.9	153	25.1
154	0.0	154	0.0	154	11.3	154	10.2
155	5.7	155	6.9	155	1.0	155	0.9
156	0.0	156	0.0	156	0.0	156	0.0
157	18.2	157	22.2	157	0.0	157	0.0
158	4.5	158	5.6	158	16.5	158	14.9
159	6.8	159	8.3	159	0.0	159	0.0
160	9.1	160	11.1	160	0.0	160	0.0
161	87.4	161	106.9	161	0.0	161	0.0
162	4.5	162	5.6	162	0.0	162	0.0
163	0.0	163	0.0	163	0.0	163	0.0
164	0.0	164	0.0	164	5.2	164	4.7
165	0.0	165	0.0	165	11.3	165	10.2
166	4.5	166	5.6	166	0.0	166	0.0
167	1.1	167	1.4	167	0.0	167	0.0
168	0.0	168	0.0	168	0.0	168	0.0
169	1.1	169	1.4	169	1.0	169	0.9
170	0.0	170	0.0	170	0.0	170	0.0
171	0.0	171	0.0	171	5.2	171	4.7
172	6.8	172	8.3	172	1.0	172	0.9
173	0.0	173	0.0	173	0.0	173	0.0
174	0.0	174	0.0	174	0.0	174	0.0
175	0.0	175	0.0	175	0.0	175	0.0
176	2.3	176	2.8	176	0.0	176	0.0
177	1.1	177	1.4	177	0.0	177	0.0
178	74.9	178	91.6	178	0.0	178	0.0
179	0.0	179	0.0	179	0.0	179	0.0
180	0.0	180	0.0	180	3.1	180	2.8
181	28.4	181	34.7	181	0.0	181	0.0
182	0.0	182	0.0	182	0.0	182	0.0
183	19.3	183	23.6	183	0.0	183	0.0
184	11.3	184	13.9	184	0.0	184	0.0
185	0.0	185	0.0	185	0.0	185	0.0
186	5.7	186	6.9	186	0.0	186	0.0
187	6.8	187	8.3	187	0.0	187	0.0
188	0.0	188	0.0	188	0.0	188	0.0
189	0.0	189	0.0	189	0.0	189	0.0
190	1.1	190	1.4	190	0.0	190	0.0
191	4.5	191	5.6	191	0.0	191	0.0
192	53.3	192	65.2	192	4.1	192	3.7
193	15.9	193	19.4	193	1.0	193	0.9
194	1.1	194	1.4	194	0.0	194	0.0
195	23.8	195	29.2	195	0.0	195	0.0
196	0.0	196	0.0	196	0.0	196	0.0
197	0.0	197	0.0	197	0.0	197	0.0
198	0.0	198	0.0	198	0.0	198	0.0
199	0.0	199	0.0	199	0.0	199	0.0
200	0.0	200	0.0	200	0.0	200	0.0
201	1.1	201	1.4	201	0.0	201	0.0
202	0.0	202	0.0	202	0.0	202	0.0
203	0.0	203	0.0	203	0.0	203	0.0
204	0.0	204	0.0	204	0.0	204	0.0
205	0.0	205	0.0	205	0.0	205	0.0
206	0.0	206	0.0	206	0.0	206	0.0
207	0.0	207	0.0	207	0.0	207	0.0
208	1.1	208	1.4	208	0.0	208	0.0
209	0.0	209	0.0	209	0.0	209	0.0
210	0.0	210	0.0	210	0.0	210	0.0
211	2.3	211	2.8	211	0.0	211	0.0
212	4.5	212	5.6	212	6.2	212	5.6
213	0.0	213	0.0	213	19.6	213	17.7
214	9.1	214	11.1	214	4.1	214	3.7
215	3.4	215	4.2	215	0.0	215	0.0
216	0.0	216	0.0	216	0.0	216	0.0
217	0.0	217	0.0	217	0.0	217	0.0
218	116.9	218	143.0	218	0.0	218	0.0
219	1.1	219	1.4	219	36.1	219	32.6
220	0.0	220	0.0	220	0.0	220	0.0
221	3.4	221	4.2	221	0.0	221	0.0
222	32.9	222	40.3	222	0.0	222	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	**Year 1**
223	53.3
224	0.0
225	13.6
226	0.0
227	0.0
228	0.0
229	0.0
230	0.0
231	0.0
232	1.1
233	0.0
234	15.9
235	0.0
236	10.2
237	6.8
238	0.0
239	2.3
240	0.0
241	79.4
242	0.0
243	0.0
244	0.0
245	0.0
246	0.0
247	0.0
248	0.0
249	0.0
250	0.0
251	0.0
252	0.0
253	2.3
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	77.2
261	0.0
262	0.0
263	37.5
264	12.5
265	37.5
266	32.9
267	0.0
268	3.4
269	0.0
270	0.0
271	0.0
272	3.4
273	10.2
274	18.2
275	12.5
276	0.0
277	0.0
278	0.0
279	0.0
280	0.0
281	0.0
282	0.0
283	0.0
284	31.8
285	0.0
286	0.0
287	14.8
288	12.5
289	13.6
290	99.9
291	0.0
292	13.6
293	0.0
294	1.1
295	5.7
296	0.0

Wet, 500 year ARI (mm)

Total	1901.8
Day	**Year 1**
223	65.2
224	0.0
225	16.7
226	0.0
227	0.0
228	0.0
229	0.0
230	0.0
231	0.0
232	1.4
233	0.0
234	19.4
235	0.0
236	12.5
237	8.3
238	0.0
239	2.8
240	0.0
241	97.2
242	0.0
243	0.0
244	0.0
245	0.0
246	0.0
247	0.0
248	0.0
249	0.0
250	0.0
251	0.0
252	0.0
253	2.8
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	94.4
261	0.0
262	0.0
263	45.8
264	15.3
265	45.8
266	40.3
267	0.0
268	4.2
269	0.0
270	0.0
271	0.0
272	4.2
273	12.5
274	22.2
275	15.3
276	0.0
277	0.0
278	0.0
279	0.0
280	0.0
281	0.0
282	0.0
283	0.0
284	38.9
285	0.0
286	0.0
287	18.0
288	15.3
289	16.7
290	122.2
291	0.0
292	16.7
293	0.0
294	1.4
295	6.9
296	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	**Year 1**
223	13.4
224	7.2
225	35.1
226	1.0
227	0.0
228	0.0
229	2.1
230	2.1
231	0.0
232	0.0
233	0.0
234	0.0
235	0.0
236	0.0
237	0.0
238	0.0
239	0.0
240	0.0
241	0.0
242	0.0
243	0.0
244	10.3
245	0.0
246	0.0
247	7.2
248	2.1
249	29.9
250	0.0
251	0.0
252	4.1
253	8.3
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	0.0
261	0.0
262	0.0
263	0.0
264	0.0
265	0.0
266	0.0
267	0.0
268	0.0
269	0.0
270	0.0
271	0.0
272	0.0
273	0.0
274	0.0
275	2.1
276	19.6
277	10.3
278	0.0
279	0.0
280	0.0
281	1.0
282	0.0
283	0.0
284	0.0
285	0.0
286	0.0
287	1.0
288	0.0
289	0.0
290	0.0
291	0.0
292	0.0
293	0.0
294	0.0
295	0.0
296	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	**Year 1**
223	12.1
224	6.5
225	31.6
226	0.9
227	0.0
228	0.0
229	1.9
230	1.9
231	0.0
232	0.0
233	0.0
234	0.0
235	0.0
236	0.0
237	0.0
238	0.0
239	0.0
240	0.0
241	0.0
242	0.0
243	0.0
244	9.3
245	0.0
246	0.0
247	6.5
248	1.9
249	27.0
250	0.0
251	0.0
252	3.7
253	7.4
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	0.0
261	0.0
262	0.0
263	0.0
264	0.0
265	0.0
266	0.0
267	0.0
268	0.0
269	0.0
270	0.0
271	0.0
272	0.0
273	0.0
274	0.0
275	1.9
276	17.7
277	9.3
278	0.0
279	0.0
280	0.0
281	0.9
282	0.0
283	0.0
284	0.0
285	0.0
286	0.0
287	0.9
288	0.0
289	0.0
290	0.0
291	0.0
292	0.0
293	0.0
294	0.0
295	0.0
296	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	**Year 1**
297	7.9
298	2.3
299	1.1
300	1.1
301	2.3
302	2.3
303	7.9
304	0.0
305	0.0
306	2.3
307	1.1
308	11.3
309	0.0
310	31.8
311	43.1
312	1.1
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	4.5
320	27.2
321	54.5
322	29.5
323	1.1
324	3.4
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.1
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Wet, 500 year ARI (mm)

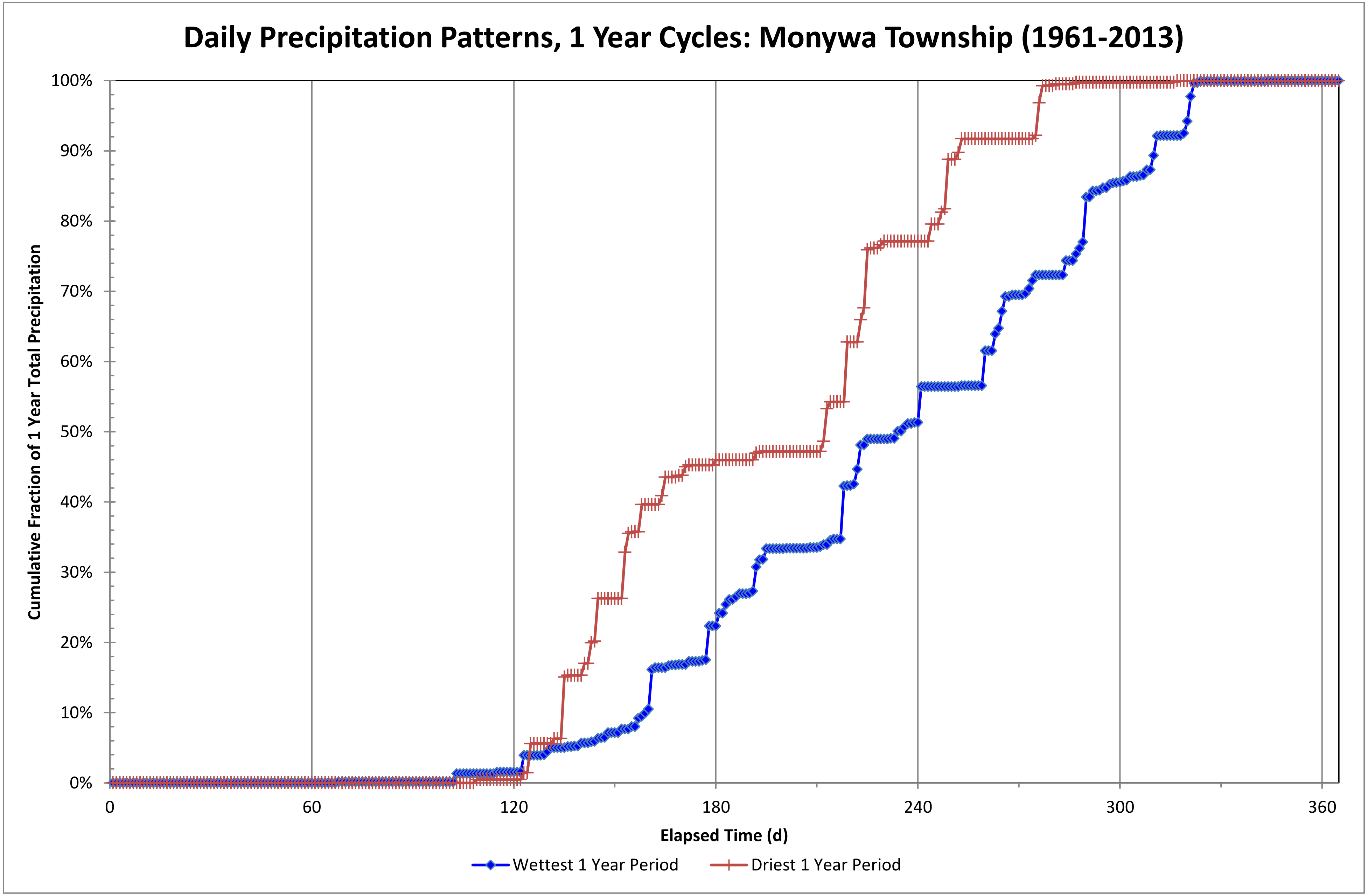
Total	1901.8
Day	**Year 1**
297	9.7
298	2.8
299	1.4
300	1.4
301	2.8
302	2.8
303	9.7
304	0.0
305	0.0
306	2.8
307	1.4
308	13.9
309	0.0
310	38.9
311	52.8
312	1.4
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	5.6
320	33.3
321	66.6
322	36.1
323	1.4
324	4.2
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.4
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	**Year 1**
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	1.0
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	**Year 1**
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	0.9
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0



Daily Precipitation Patterns, 1 Year Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 1 Year Total Precipitation
0
60
120
180
240
300
360
Elapsed Time (d)
Wettest 1 Year Period
Driest 1 Year Period

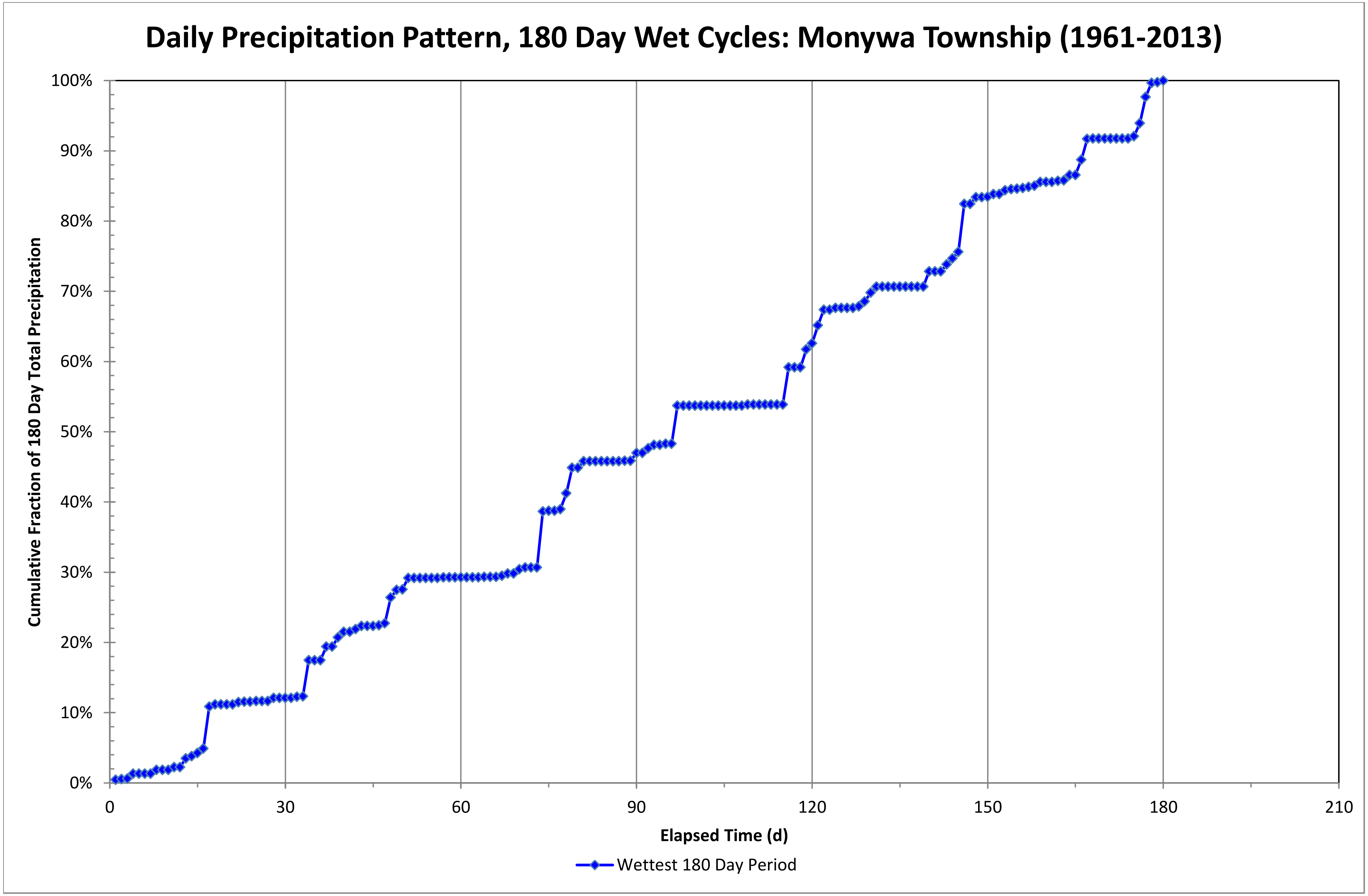
Precipitation, 180 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	174.1	254.4	300.1
Day	**Day +0**	**Day +60**	**Day +120**
1	6.7	0.0	36.8
2	1.1	0.0	32.4
3	1.1	0.0	0.0
4	10.0	1.1	3.3
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.2	0.0
8	7.8	4.5	3.3
9	0.0	0.0	10.0
10	0.0	8.9	17.9
11	5.6	3.3	12.3
12	0.0	0.0	0.0
13	17.9	0.0	0.0
14	4.5	114.9	0.0
15	6.7	1.1	0.0
16	8.9	0.0	0.0
17	85.9	3.3	0.0
18	4.5	32.4	0.0
19	0.0	52.4	0.0
20	0.0	0.0	31.2
21	0.0	13.4	0.0
22	4.5	0.0	0.0
23	1.1	0.0	14.5
24	0.0	0.0	12.3
25	1.1	0.0	13.4
26	0.0	0.0	98.2
27	0.0	0.0	0.0
28	6.7	1.1	13.4
29	0.0	0.0	0.0
30	0.0	15.6	1.1
31	0.0	0.0	5.6
32	2.2	10.0	0.0
33	1.1	6.7	7.8
34	73.6	0.0	2.2
35	0.0	2.2	1.1
36	0.0	0.0	1.1
37	27.9	78.1	2.2
38	0.0	0.0	2.2
39	19.0	0.0	7.8
40	11.2	0.0	0.0
41	0.0	0.0	0.0
42	5.6	0.0	2.2
43	6.7	0.0	1.1
44	0.0	0.0	11.2
45	0.0	0.0	0.0
46	1.1	0.0	31.2
47	4.5	0.0	42.4
48	52.4	0.0	1.1
49	15.6	2.2	0.0
50	1.1	0.0	0.0
51	23.4	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	4.5
56	0.0	75.9	26.8
57	1.1	0.0	53.6
58	0.0	0.0	29.0
59	0.0	36.8	1.1
60	0.0	12.3	3.3

500 year ARI (mm)

Total	214.0	312.7	368.9
Day	**Day +0**	**Day +60**	**Day +120**
1	8.2	0.0	45.3
2	1.4	0.0	39.8
3	1.4	0.0	0.0
4	12.3	1.4	4.1
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.7	0.0
8	9.6	5.5	4.1
9	0.0	0.0	12.3
10	0.0	11.0	21.9
11	6.9	4.1	15.1
12	0.0	0.0	0.0
13	21.9	0.0	0.0
14	5.5	141.3	0.0
15	8.2	1.4	0.0
16	11.0	0.0	0.0
17	105.6	4.1	0.0
18	5.5	39.8	0.0
19	0.0	64.5	0.0
20	0.0	0.0	38.4
21	0.0	16.5	0.0
22	5.5	0.0	0.0
23	1.4	0.0	17.8
24	0.0	0.0	15.1
25	1.4	0.0	16.5
26	0.0	0.0	120.7
27	0.0	0.0	0.0
28	8.2	1.4	16.5
29	0.0	0.0	0.0
30	0.0	19.2	1.4
31	0.0	0.0	6.9
32	2.7	12.3	0.0
33	1.4	8.2	9.6
34	90.5	0.0	2.7
35	0.0	2.7	1.4
36	0.0	0.0	1.4
37	34.3	96.0	2.7
38	0.0	0.0	2.7
39	23.3	0.0	9.6
40	13.7	0.0	0.0
41	0.0	0.0	0.0
42	6.9	0.0	2.7
43	8.2	0.0	1.4
44	0.0	0.0	13.7
45	0.0	0.0	0.0
46	1.4	0.0	38.4
47	5.5	0.0	52.1
48	64.5	0.0	1.4
49	19.2	2.7	0.0
50	1.4	0.0	0.0
51	28.8	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	5.5
56	0.0	93.3	32.9
57	1.4	0.0	65.8
58	0.0	0.0	35.7
59	0.0	45.3	1.4
60	0.0	15.1	4.1


Daily Precipitation Pattern, 180 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 180 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
30
60
90
120
150
180
210
Elapsed Time (d)
Wettest 180 Day Period

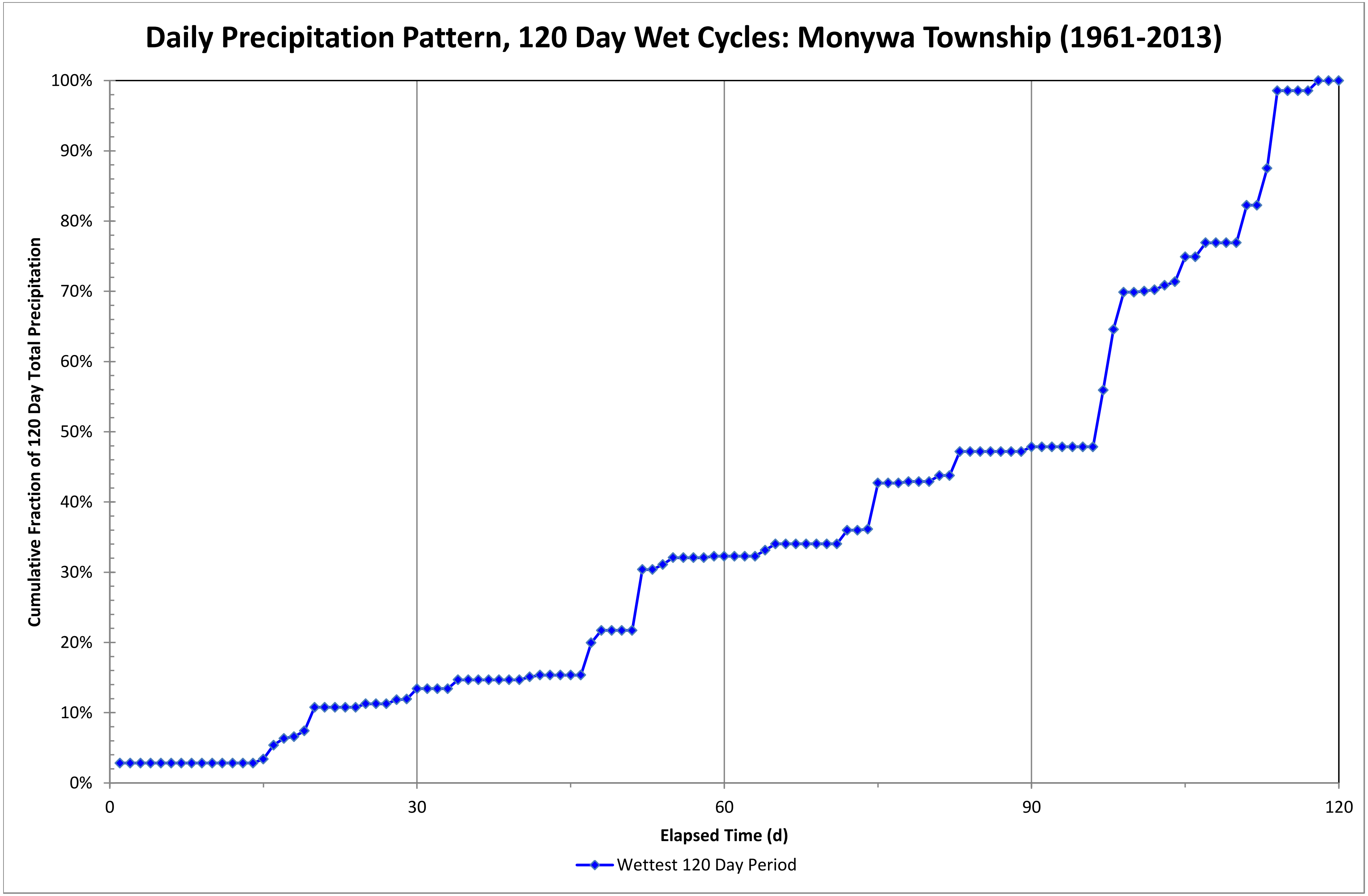
Precipitation, 120 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	143.7	166.9
Day	**Day +0**	**Day +60**
1	30.3	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	9.3
5	0.0	9.6
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	20.8
13	0.0	0.0
14	0.0	1.6
15	6.1	70.4
16	21.3	0.0
17	10.2	0.0
18	2.7	2.2
19	8.7	0.0
20	36.0	0.0
21	0.0	9.3
22	0.0	0.0
23	0.0	36.6
24	0.0	0.0
25	5.5	0.0
26	0.0	0.0
27	0.0	0.0
28	6.0	0.0
29	1.1	0.0
30	15.8	7.1
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	13.7	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	86.3
38	0.0	92.8
39	0.0	56.8
40	0.0	0.0
41	4.4	1.6
42	2.7	2.2
43	0.0	6.6
44	0.0	5.5
45	0.0	38.2
46	0.0	0.0
47	49.1	21.3
48	19.1	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	57.3
52	92.8	0.0
53	0.0	56.2
54	7.6	118.5
55	10.4	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	15.3
59	2.2	0.0
60	0.0	0.0

500 year ARI (mm)

Total	170.7	198.2
Day	**Day +0**	**Day +60**
1	35.9	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	11.0
5	0.0	11.4
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	24.6
13	0.0	0.0
14	0.0	1.9
15	7.3	83.6
16	25.3	0.0
17	12.1	0.0
18	3.2	2.6
19	10.4	0.0
20	42.8	0.0
21	0.0	11.0
22	0.0	0.0
23	0.0	43.4
24	0.0	0.0
25	6.5	0.0
26	0.0	0.0
27	0.0	0.0
28	7.1	0.0
29	1.3	0.0
30	18.8	8.4
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	16.2	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	102.4
38	0.0	110.2
39	0.0	67.4
40	0.0	0.0
41	5.2	1.9
42	3.2	2.6
43	0.0	7.8
44	0.0	6.5
45	0.0	45.4
46	0.0	0.0
47	58.4	25.3
48	22.7	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	68.1
52	110.2	0.0
53	0.0	66.8
54	9.1	140.7
55	12.3	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	18.2
59	2.6	0.0
60	0.0	0.0


Daily Precipitation Pattern, 120 Day Wet Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 120 Day Total Precipitation
0
30
60
90
120
Elapsed Time (d)
Wettest 120 Day Period

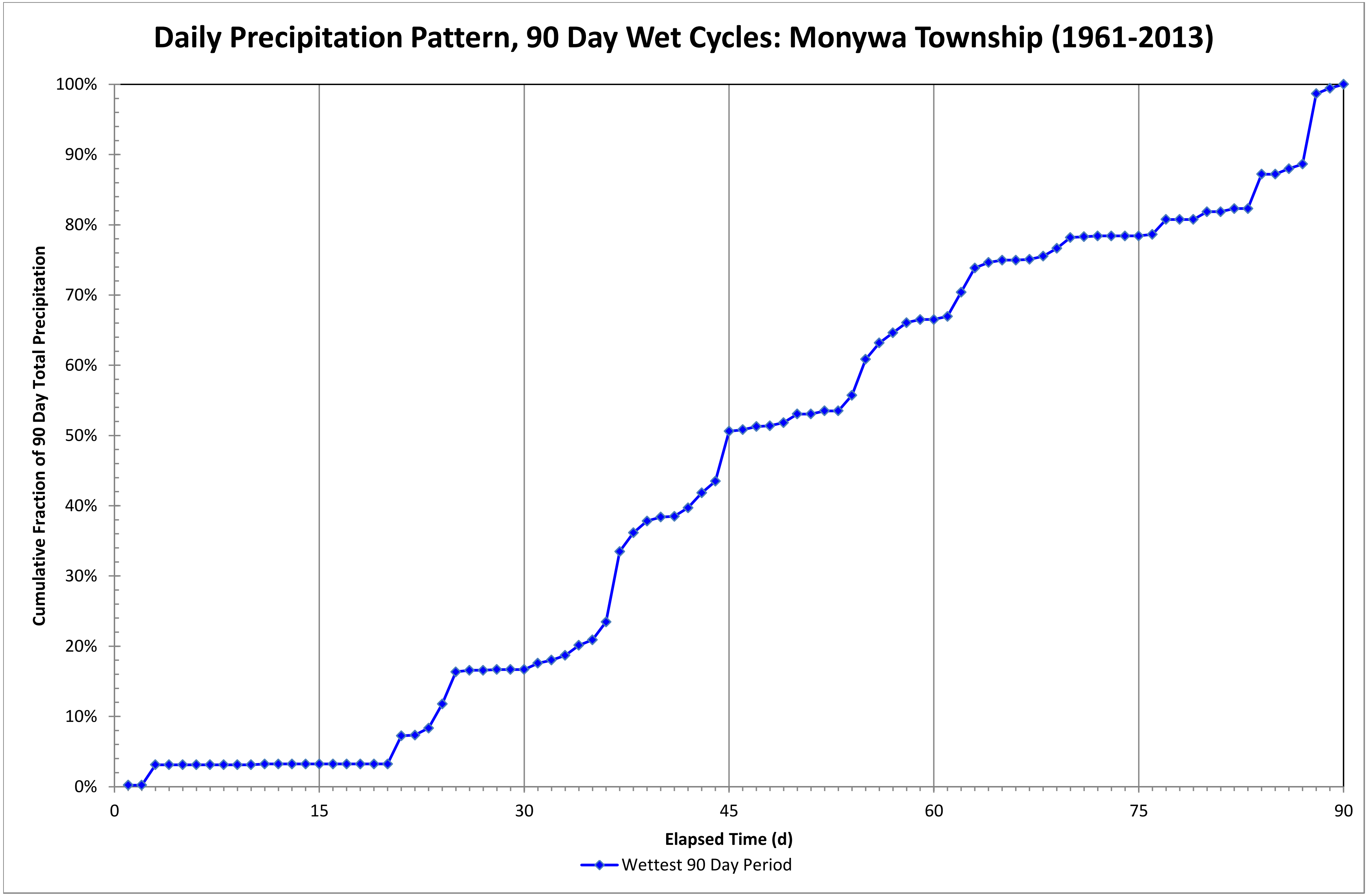
Precipitation, 90 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	153.6	458.8	308.3
Day	**Day +0**	**Day +30**	**Day +60**
1	2.0	8.2	4.1
2	0.0	4.1	31.7
3	26.6	6.1	31.7
4	0.0	13.3	7.2
5	0.0	7.2	3.1
6	0.0	23.6	0.0
7	0.0	92.2	1.0
8	0.0	24.6	4.1
9	0.0	15.4	10.2
10	0.0	5.1	14.3
11	1.0	1.0	1.0
12	0.0	11.3	1.0
13	0.0	19.5	0.0
14	0.0	15.4	0.0
15	0.0	65.5	0.0
16	0.0	2.0	2.0
17	0.0	4.1	19.5
18	0.0	1.0	0.0
19	0.0	4.1	0.0
20	0.0	11.3	10.2
21	36.9	0.0	0.0
22	1.0	4.1	4.1
23	9.2	0.0	0.0
24	31.7	20.5	45.1
25	42.0	47.1	0.0
26	2.0	21.5	7.2
27	0.0	13.3	6.1
28	1.0	13.3	92.2
29	0.0	4.1	7.2
30	0.0	0.0	5.1

500 year ARI (mm)

Total	183.8	548.9	368.8
Day	**Day +0**	**Day +30**	**Day +60**
1	2.5	9.8	4.9
2	0.0	4.9	38.0
3	31.9	7.4	38.0
4	0.0	15.9	8.6
5	0.0	8.6	3.7
6	0.0	28.2	0.0
7	0.0	110.3	1.2
8	0.0	29.4	4.9
9	0.0	18.4	12.3
10	0.0	6.1	17.2
11	1.2	1.2	1.2
12	0.0	13.5	1.2
13	0.0	23.3	0.0
14	0.0	18.4	0.0
15	0.0	78.4	0.0
16	0.0	2.5	2.5
17	0.0	4.9	23.3
18	0.0	1.2	0.0
19	0.0	4.9	0.0
20	0.0	13.5	12.3
21	44.1	0.0	0.0
22	1.2	4.9	4.9
23	11.0	0.0	0.0
24	38.0	24.5	53.9
25	50.2	56.4	0.0
26	2.5	25.7	8.6
27	0.0	15.9	7.4
28	1.2	15.9	110.3
29	0.0	4.9	8.6
30	0.0	0.0	6.1



Daily Precipitation Pattern, 90 Day Wet Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 90 Day Total Precipitation
0
15
30
45
60
75
90
Elapsed Time (d)
Wettest 90 Day Period

Precipitation, 60 Day Wet Cycles: Monywa Township (1961-2013)

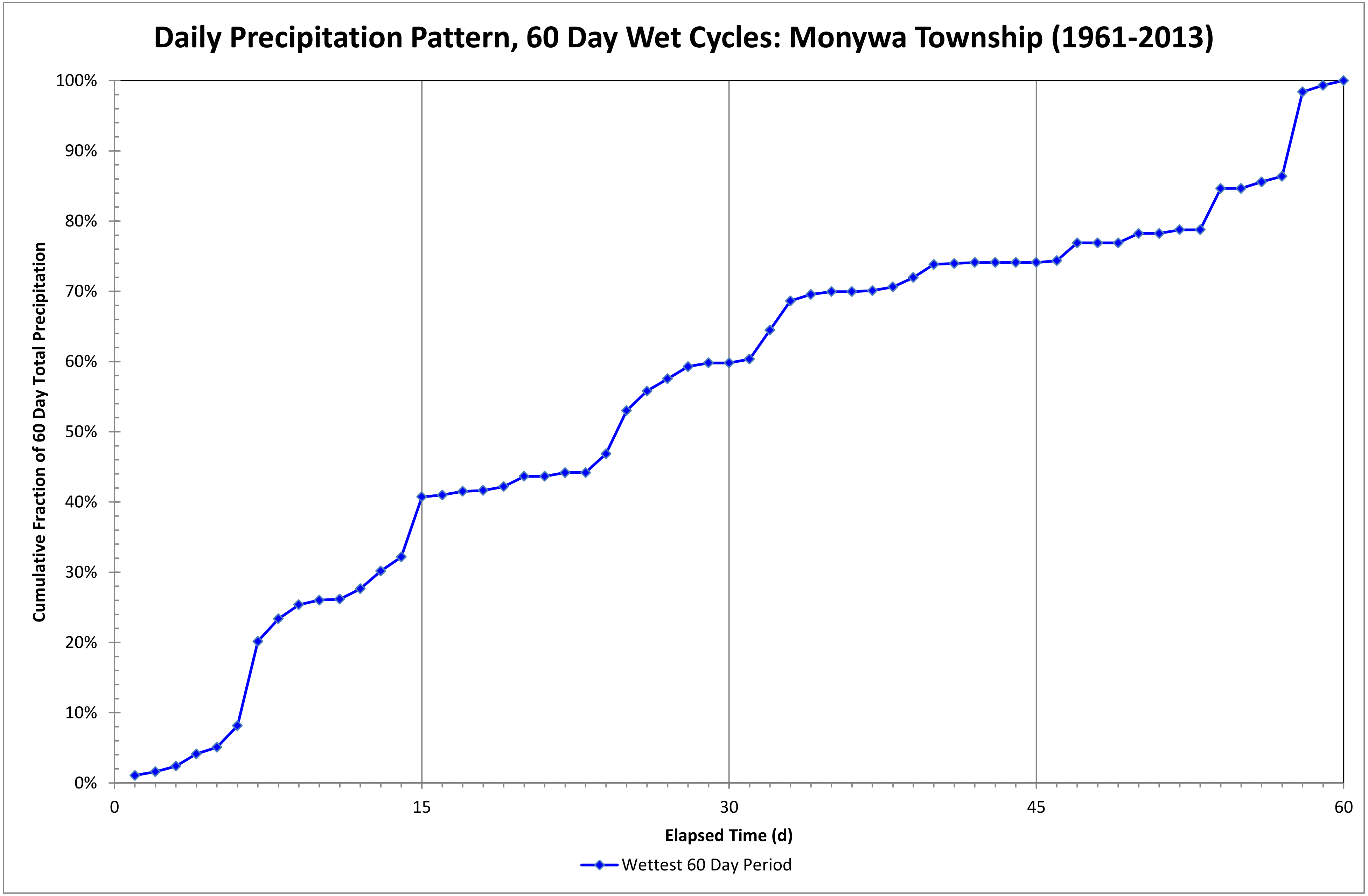
100 year ARI (mm)

Total	442.5	297.3
Day	**Day +0**	**Day +30**
1	7.9	4.0
2	4.0	30.6
3	5.9	30.6
4	12.8	6.9
5	6.9	3.0
6	22.7	0.0
7	88.9	1.0
8	23.7	4.0
9	14.8	9.9
10	4.9	13.8
11	1.0	1.0
12	10.9	1.0
13	18.8	0.0
14	14.8	0.0
15	63.2	0.0
16	2.0	2.0
17	4.0	18.8
18	1.0	0.0
19	4.0	0.0
20	10.9	9.9
21	0.0	0.0
22	4.0	4.0
23	0.0	0.0
24	19.8	43.5
25	45.4	0.0
26	20.7	6.9
27	12.8	5.9
28	12.8	88.9
29	4.0	6.9
30	0.0	4.9

500 year ARI (mm)

Total	517.4	347.7
Day	**Day +0**	**Day +30**
1	9.2	4.6
2	4.6	35.8
3	6.9	35.8
4	15.0	8.1
5	8.1	3.5
6	26.6	0.0
7	104.0	1.2
8	27.7	4.6
9	17.3	11.6
10	5.8	16.2
11	1.2	1.2
12	12.7	1.2
13	21.9	0.0
14	17.3	0.0
15	73.9	0.0
16	2.3	2.3
17	4.6	21.9
18	1.2	0.0
19	4.6	0.0
20	12.7	11.6
21	0.0	0.0
22	4.6	4.6
23	0.0	0.0
24	23.1	50.8
25	53.1	0.0
26	24.3	8.1
27	15.0	6.9
28	15.0	104.0
29	4.6	8.1
30	0.0	5.8

`



Daily Precipitation Pattern, 60 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 60 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
45
60
Elapsed Time (d)
Wettest 60 Day Period

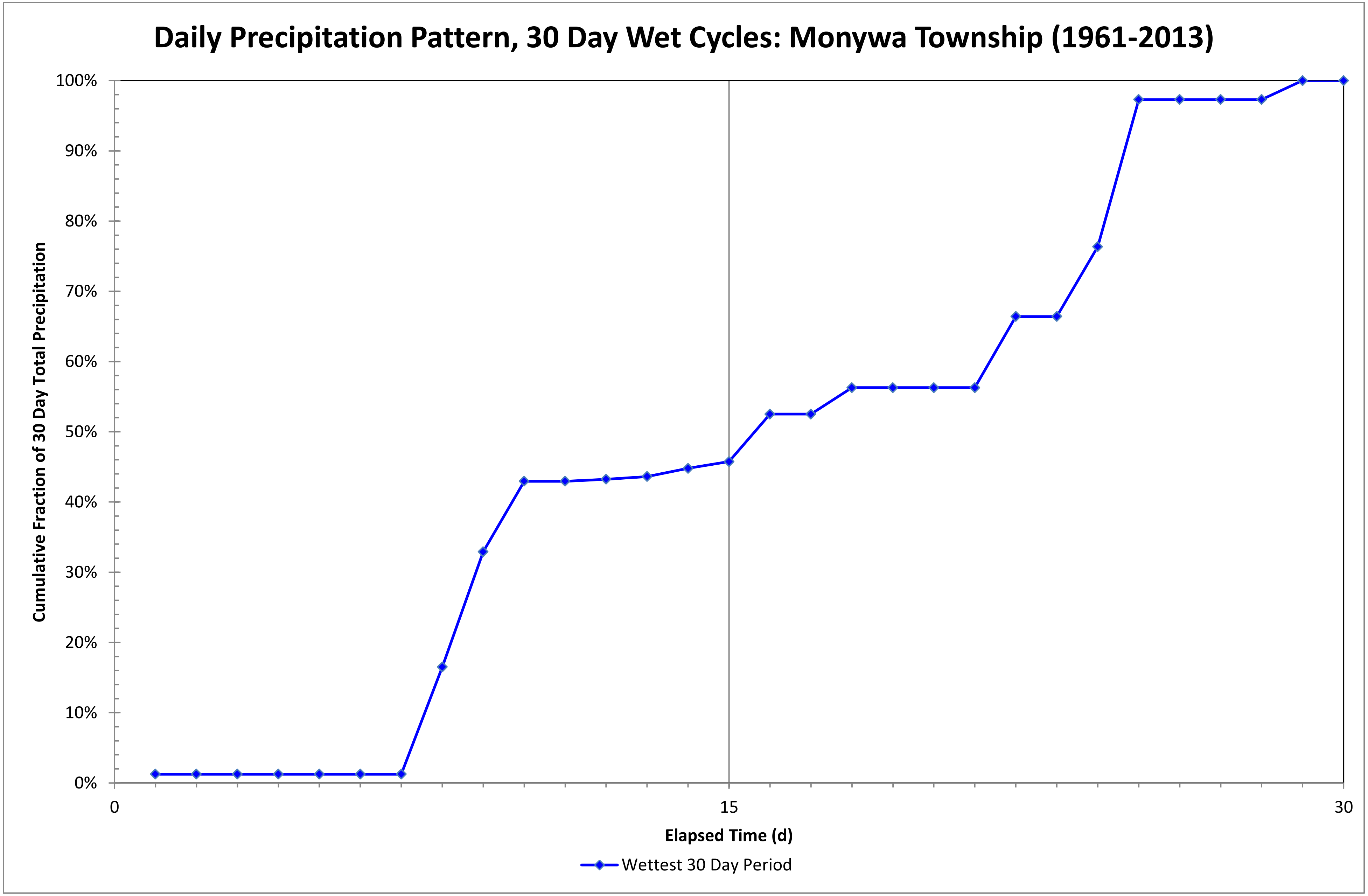
Precipitation, 30 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	519.6
Day	**Day +0**
1	6.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	79.2
9	85.3
10	52.2
11	0.0
12	1.5
13	2.0
14	6.0
15	5.0
16	35.1
17	0.0
18	19.6
19	0.0
20	0.0
21	0.0
22	52.7
23	0.0
24	51.7
25	108.8
26	0.0
27	0.0
28	0.0
29	14.0
30	0.0

500 year ARI (mm)

Total	596.4
Day	**Day +0**
1	7.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	91.0
9	97.9
10	59.9
11	0.0
12	1.7
13	2.3
14	6.9
15	5.8
16	40.3
17	0.0
18	22.5
19	0.0
20	0.0
21	0.0
22	60.4
23	0.0
24	59.3
25	124.9
26	0.0
27	0.0
28	0.0
29	16.1
30	0.0



Daily Precipitation Pattern, 30 Day Wet Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 30 Day Total Precipitation
0
15
30
Elapsed Time (d)
Wettest 30 Day Period

Precipitation, < 30 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	439.8
Day	**Day +0**
1	17.2
2	5.8
3	14.8
4	110.9
5	126.8
6	80.8
7	27.6
8	0.0
9	0.0
10	17.4
11	19.8
12	10.2
13	3.0
14	5.4

500 year ARI (mm)

Total	562.6
Day	**Day +0**
1	22.0
2	7.4
3	18.9
4	141.9
5	162.2
6	103.3
7	35.4
8	0.0
9	0.0
10	22.3
11	25.4
12	13.1
13	3.8
14	6.9

100 year ARI (mm)

Total	342.6
Day	**Day +0**
1	15.3
2	5.1
3	13.2
4	99.0
5	113.2
6	72.1
7	24.7

500 year ARI (mm)

Total	447.3
Day	**Day +0**
1	20.0
2	6.7
3	17.2
4	129.3
5	147.8
6	94.1
7	32.2

100 year ARI (mm)

Total	307.9
Day	**Day +0**
1	78.5
2	72.3
3	141.4
4	15.7

500 year ARI (mm)

Total	410.1
Day	**Day +0**
1	104.6
2	96.3
3	188.3
4	20.9

100 year ARI (mm)

Total	297.7
Day	**Day +0**
1	80.0
2	73.6
3	144.1

500 year ARI (mm)

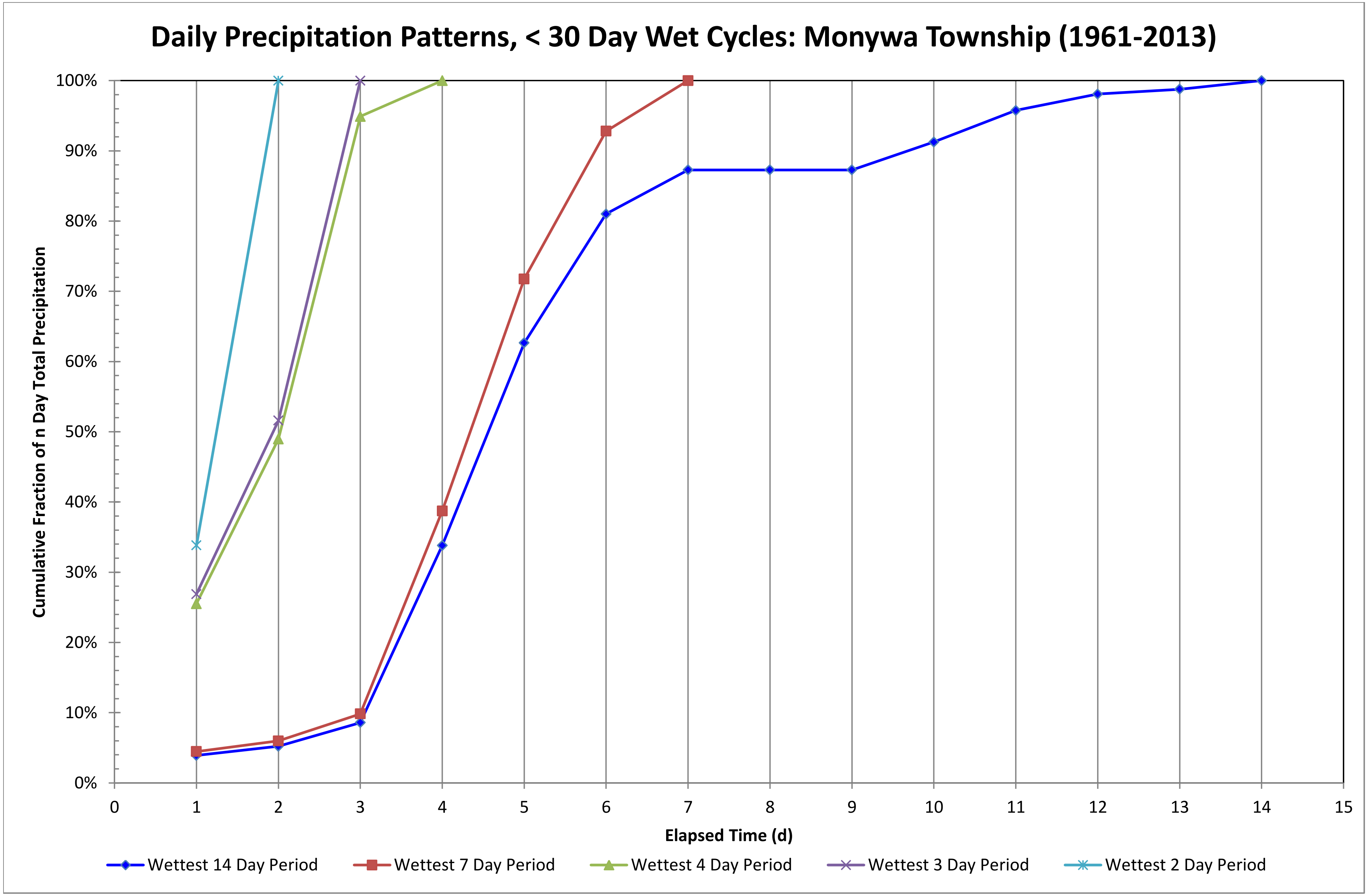
Total	400.7
Day	**Day +0**
1	107.7
2	99.1
3	193.9

100 year ARI (mm)

Total	214.1
Day	**Day +0**
1	72.4
2	141.7

500 year ARI (mm)

Total	248.7
Day	**Day +0**
1	84.1
2	164.6



Daily Precipitation Patterns, < 30 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of n Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Elapsed Time (d)
Wettest 14 Day Period
Wettest 7 Day Period
Wettest 4 Day Period
Wettest 3 Day Period
Wettest 2 Day Period

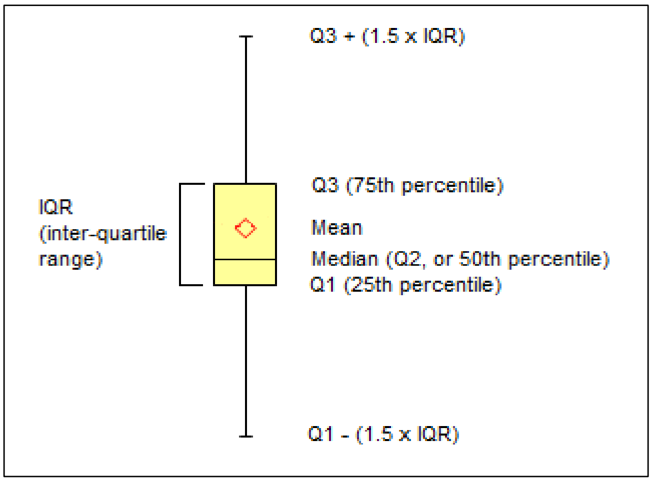
ATTACHMENT 3.1

Annual Pan Evaporation Analysis

Pan Evaporation Data, Annual Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

Year	Evap. (mm)
2000	2,078.3
2001	1,921.7
2002	1,925.4
2003	1,975.8
2004	2,108.6
2005	2,051.4
2006	2,055.8
2007	Exclude
2008	Exclude
2009	Exclude
2010	Exclude
2011	Exclude
2012	Exclude
2013	Exclude

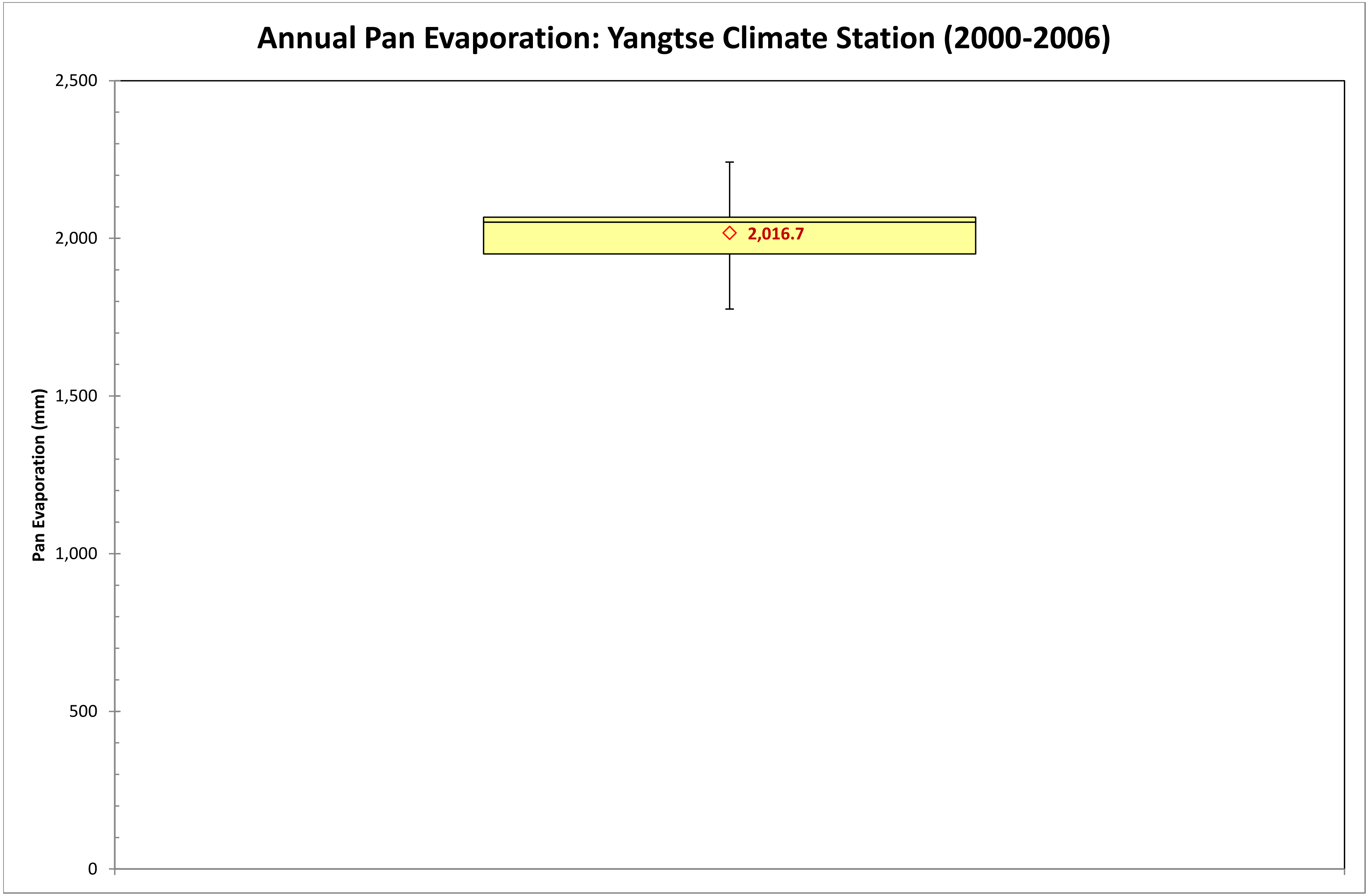
Stat	Evap. (mm)
Mean	2,016.7
SD	75.3
Median	2,051.4
Q1	1,950.6
Q3	2,067.0
Minimum	1,921.7
Maximum	2,108.6
Count	7
Ext Max	2,241.7
Ext Min	1,775.9
25th Pct	1,950.6
50th Pct	100.8
75th Pct	15.7
1.5 * IQR	174.7



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation. For more discussion on this issue, refer to the climate trend analysis worksheet.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
2,500
2,000
1,500
1,000
500
0
2,016.7

ATTACHMENT 3.2

Monthly Pan Evaporation Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining Copper Ltd. | Letpadaung Copper Project	Made by AB	Job No. PE701-00022/04
	Basic Climatology	Checked TML	Date 20/06/2013
		Approved	Version No. 2.1

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

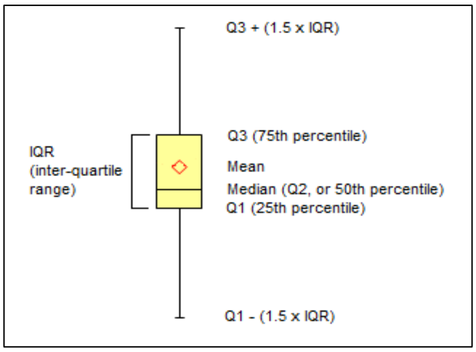
Pan Evaporation Data (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2000	133.7	154.2	218.7	240.0	117.6	211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1	248.2	149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006	119.2	142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
SD	4.9	12.7	14.4	21.1	43.1	35.9	12.0	37.6	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	205.0	186.9	174.1	175.0	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
Q3	122.0	158.0	220.0	241.8	223.0	218.7	180.1	197.8	173.0	157.3	136.9	126.7
Minimum	119.2	129.6	187.5	191.2	117.6	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	133.7	165.6	224.4	247.8	255.5	269.8	187.3	248.2	208.2	183.9	145.5	131.2
Count	7	7	7	7	7	7	7	7	7	7	7	7
Ext Max	123.7	182.8	248.6	277.2	262.8	274.7	201.8	244.4	215.6	195.3	175.9	151.3
Ext Min	119.2	116.5	172.4	182.9	156.6	125.4	144.1	120.1	102.1	94.0	71.7	85.7
25^{th} Pct	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
50^{th} Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	8.3	5.1	15.9	19.1	1.5
75^{th} Pct	1.1	6.9	7.1	6.3	18.0	31.8	6.0	22.8	23.3	9.5	7.0	14.9
1.5 * IQR	1.7	24.9	28.5	35.4	39.8	56.0	21.6	46.6	42.6	38.0	39.1	24.6

Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013)
(Analysis Format | Outliers Removed)

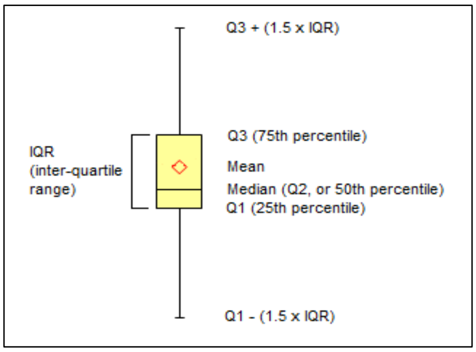
Pan Evaporation Data (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2000		154.2	218.7	240.0		211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1		149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006		142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	121.3	149.3	209.5	227.8	216.6	203.1	172.2	172.7	160.2	144.6	124.7	116.5
SD	0.9	12.7	14.4	21.1	23.4	35.9	12.0	26.9	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	209.2	186.9	174.1	172.5	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
Q3	121.0	158.0	220.0	241.8	227.8	218.7	180.1	178.5	173.0	157.3	136.9	126.7
Minimum	120.9	129.6	187.5	191.2	193.7	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	123.0	165.6	224.4	247.8	255.5	269.8	187.3	215.9	208.2	183.9	145.5	131.2
Count	5	7	7	7	6	7	7	6	7	7	7	7
Ext Max	121.2	182.8	248.6	277.2	268.6	274.7	201.8	198.6	215.6	195.3	175.9	151.3
Ext Min	120.8	116.5	172.4	182.9	159.9	125.4	144.1	145.0	102.1	94.0	71.7	85.7
25th Pct	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
50th Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	7.3	5.1	15.9	19.1	1.5
75th Pct	0.1	6.9	7.1	6.3	18.6	31.8	6.0	6.1	23.3	9.5	7.0	14.9
1.5 * IQR	0.1	24.9	28.5	35.4	40.7	56.0	21.6	20.1	42.6	38.0	39.1	24.6

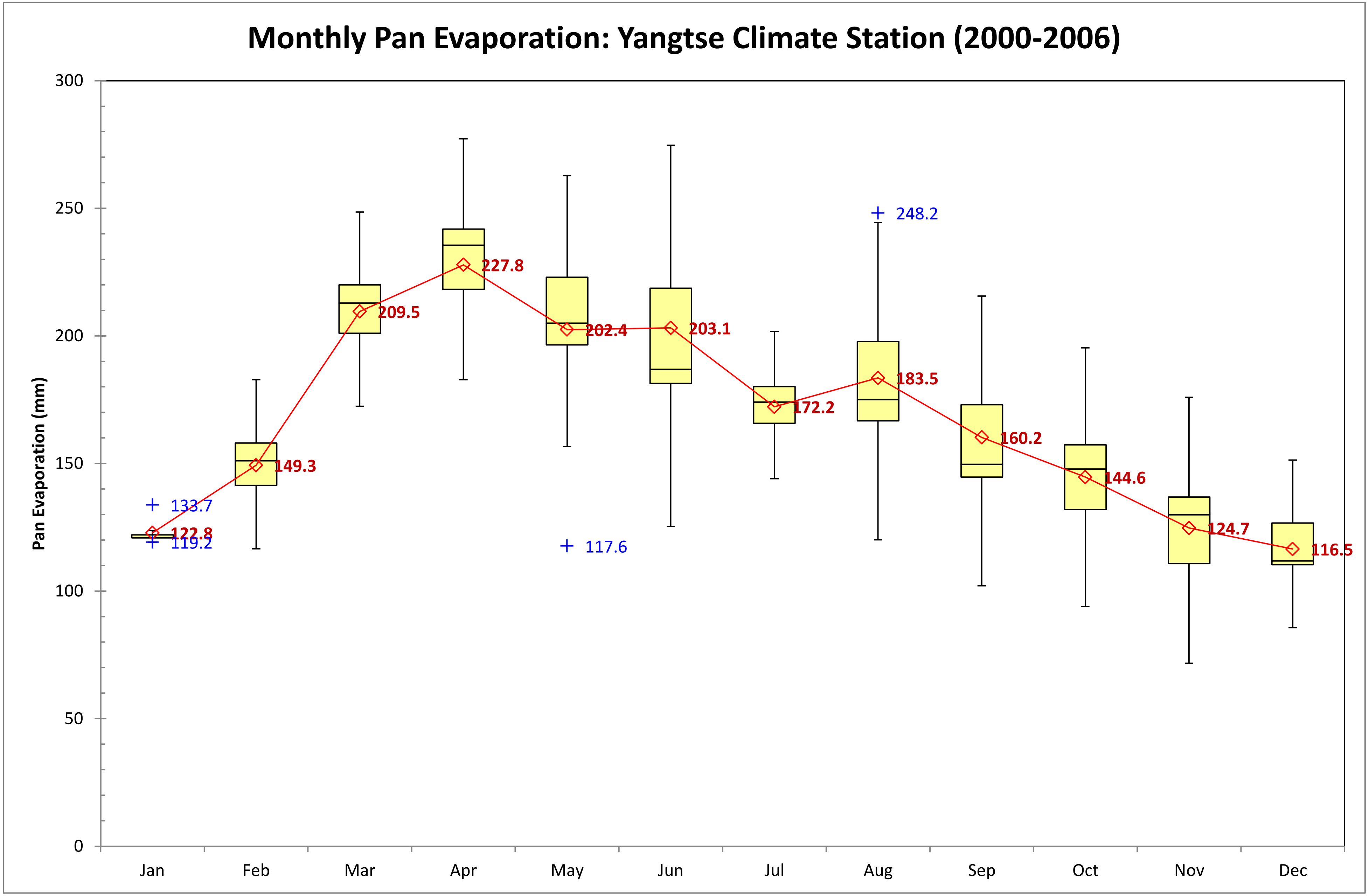
Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

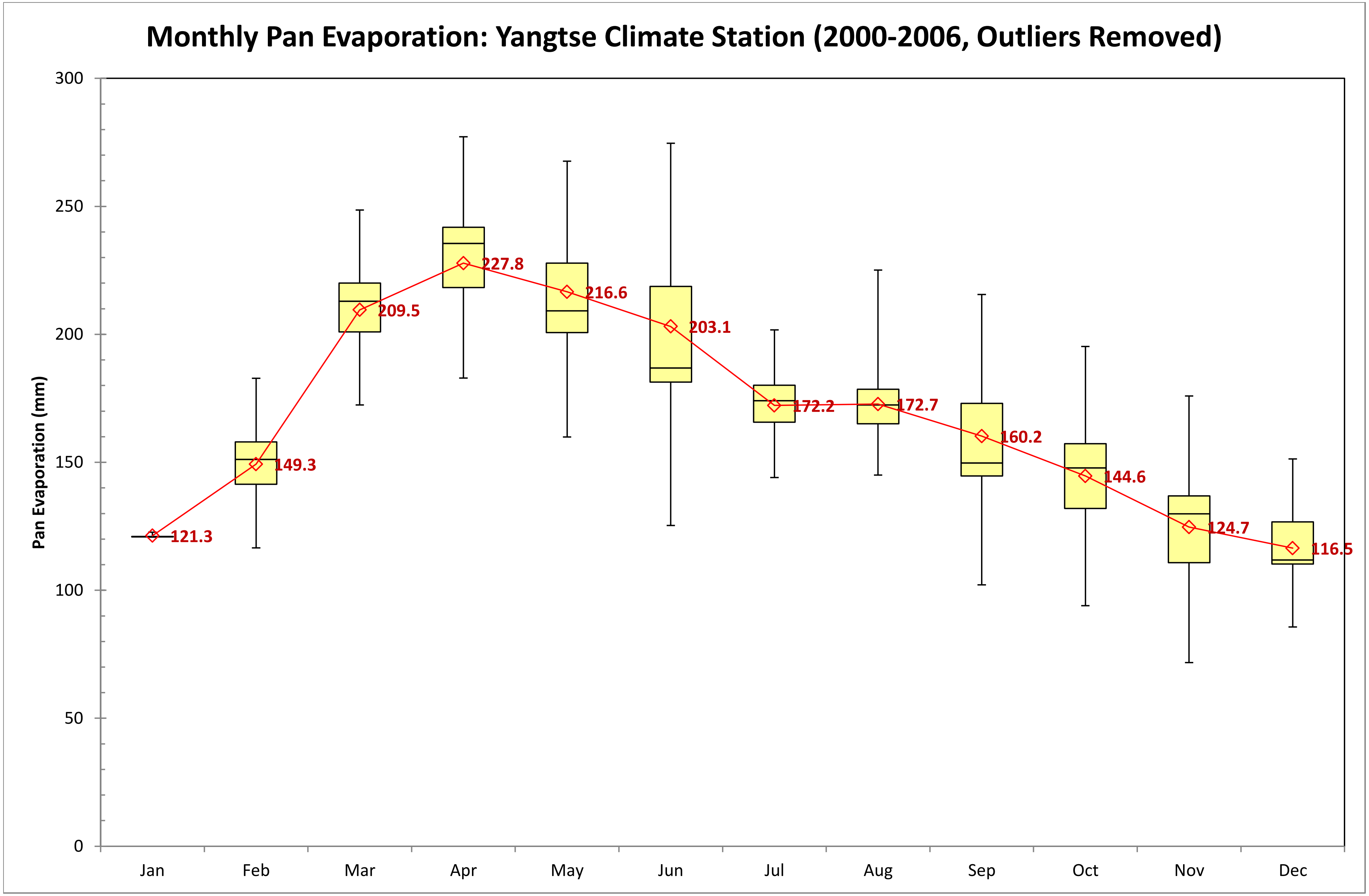
Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.



Monthly Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
133.7
122.8
119.2
149.3
209.5
227.8
202.4
117.6
203.1
172.2
248.2
183.5
160.2
144.6
124.7
116.5



Monthly Pan Evaporation: Yangtse Climate Station (2000-2006, Outliers Removed)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
121.3
149.3
209.5
227.8
216.6
203.1
172.2
172.7
160.2
144.6
124.7
116.5

ATTACHMENT 3.3

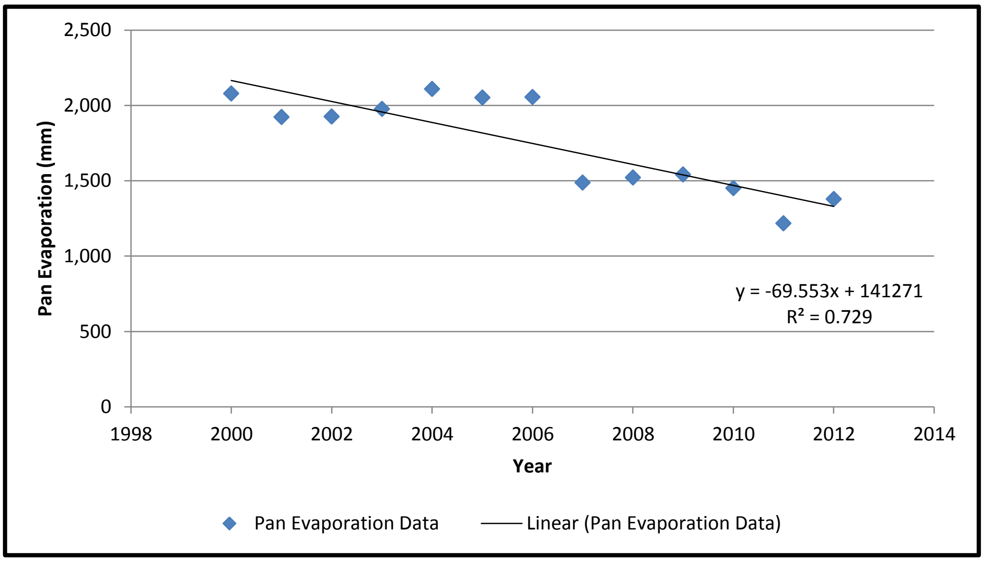
Pan Evaporation Trend Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 25/06/2013
	Basic Climatology	Approved	

Climatic Trend Analysis: Monywa Township Pan Evaporation (2000-2013)

Year	Evap (mm)
2000	2,078
2001	1,922
2002	1,925
2003	1,976
2004	2,109
2005	2,051
2006	2,056
2007	1,488
2008	1,521
2009	1,542
2010	1,451
2011	1,217
2012	1,379
2013	Exclude

Period	Ave. Pan Evap. (mm)
2000-2006	2,017
2007-2012	1,433
2000-2012	1,747



Even though a statistically significant negative trend is shown on the above graph, KP questions its validity. From the dramatic shift in annual pan evaporation occurring from 2007 and onwards (~ 600 mm/yr less), the only conclusion we can draw is that either there was a problem with the instrumentation or that the data was from another site. At this time, there is no satisfactory answer to this question and as a result, pan evaporation data from 2007 and onwards is to be excluded from climate analysis.

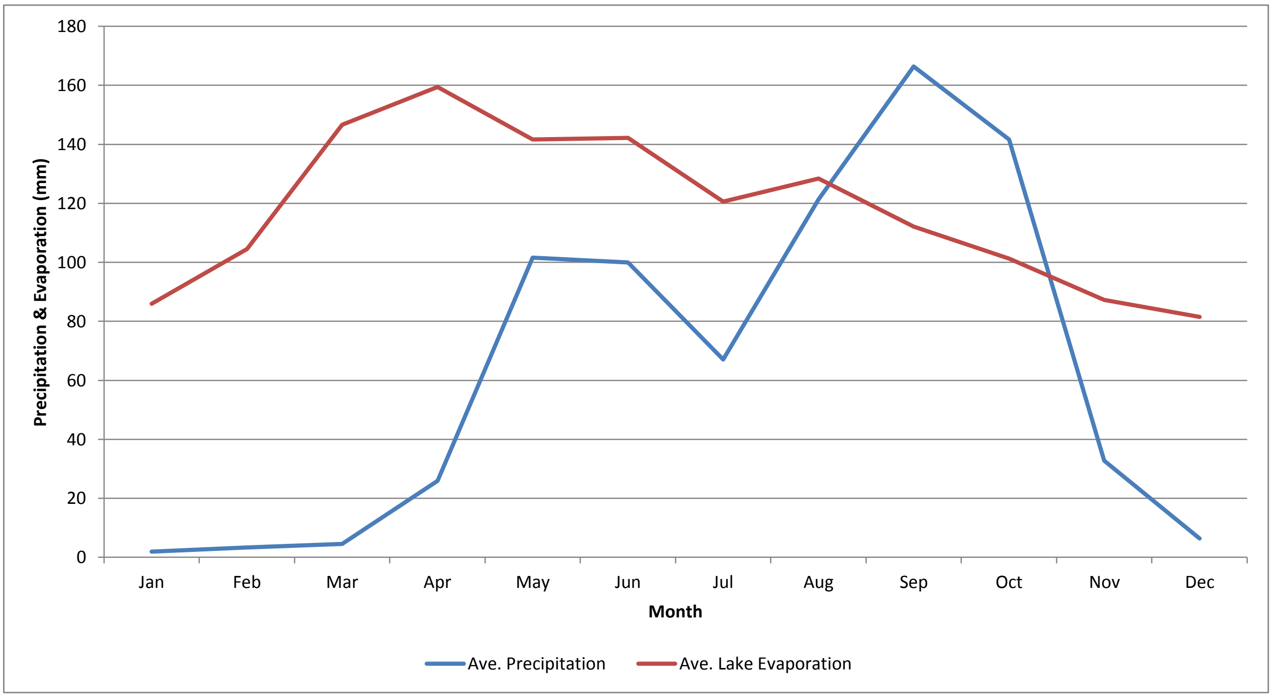
ATTACHMENT 3.4

Comparison of Monthly Average
Precipitation & Evaporation

Comparison of Average Monthly Precipitation and Lake Evaporation

Comparison Data (mm)												
Variable	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Ave. Precipitation	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
Ave. Pan Evaporation	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
Ave. Lake Evaporation	86.0	104.5	146.7	159.5	141.7	142.2	120.5	128.5	112.1	101.2	87.3	81.6
Precipitation minus Lake Evaporation	-84.1	-101.2	-142.1	-133.5	-40.1	-42.2	-53.5	-7.2	54.2	40.4	-54.6	-75.1

Pan Coefficient = 0.7 **Net Annual Precipiation minus Lake Evaporation =** -638.9 **mm**



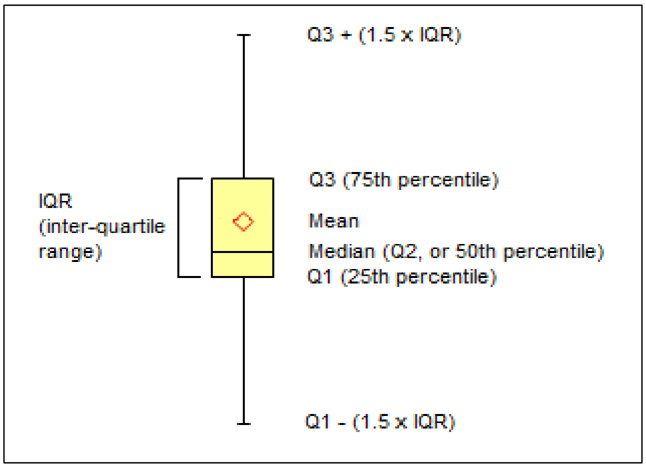
ATTACHMENT 4.1

Annual Average Temperature Analysis

Temperature Data, Annual Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

Year	Ave. Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude

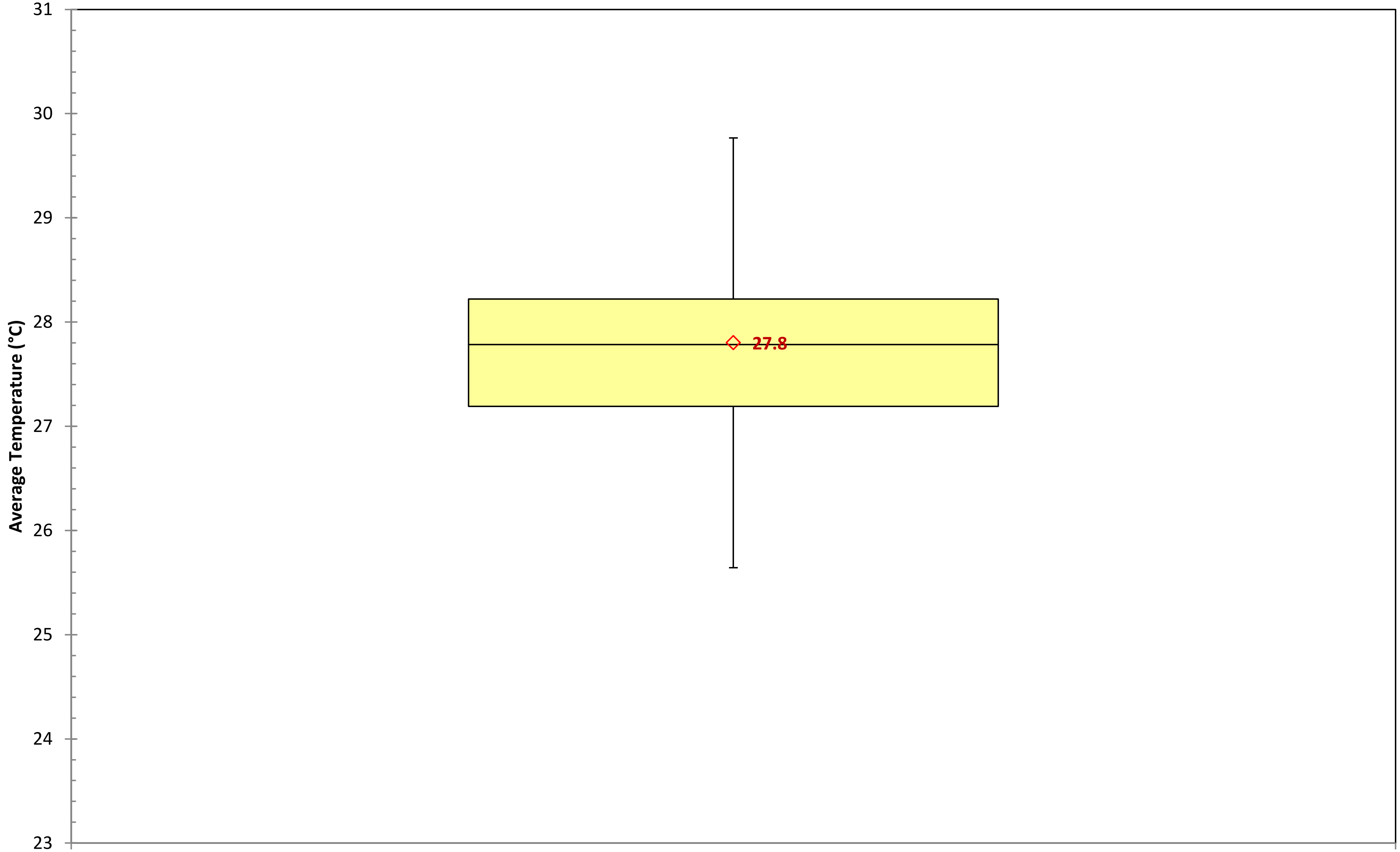
Stat	Ave. Temp (°C)
Mean	27.8
SD	0.8
Median	27.8
Q1	27.2
Q3	28.2
Minimum	26.1
Maximum	29.7
Count	25
Ext Max	29.8
Ext Min	25.6
25^{th} Pct	27.2
50^{th} Pct	0.6
75^{th} Pct	0.4
1.5 * IQR	1.5



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers

Annual Average Temperature: WMO 48037 Climate Station (1981-2012)



ATTACHMENT 4.2

Monthly Average Temperature Analysis

Temperature Data, Monthly Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

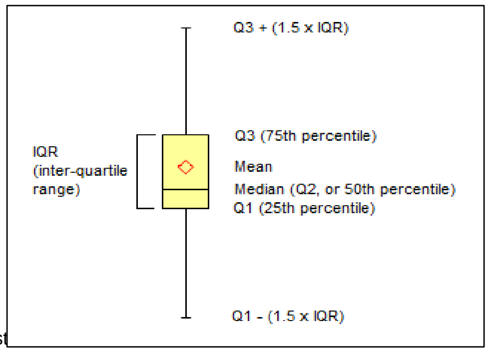
Average Temperature Data (°C)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	23.0	21.5
1982	21.4	23.4	26.3	30.5	31.4	29.9	31.4	29.9	30.3	28.2	25.8	21.3
1983	18.4	21.5	27.2	31.3	32.7	31.2	31.4	29.6	30.1	28.0	23.7	21.1
1984	20.2	23.0	26.9	30.6	30.6	29.4	29.5	29.3	28.0	26.5	23.4	22.0
1985	22.5	22.3	28.7	31.1	30.6	30.1	26.8	29.2	30.4	26.7	23.8	21.9
1986	21.1	23.2	27.6	31.6	32.3	31.1	30.1	28.9	28.8	26.8	N/D	N/D
1987	N/D	21.9	23.1	30.9	28.1	N/D	N/D	29.0	28.9	28.1	24.8	22.7
1988	21.2	N/D	N/D	N/D	30.4	27.8	28.7	28.4	N/D	N/D	N/D	N/D
1989	N/D	N/D	24.8	N/D	31.0	29.3	27.9	28.6	28.2	27.0	23.7	19.9
1990	21.6	21.1	25.8	25.9	28.3	29.0	29.0	30.1	27.8	28.4	25.4	21.2
1991	20.4	23.8	29.5	30.1	30.4	30.6	30.0	29.4	29.3	27.7	23.4	20.1
1992	18.5	21.3	25.9	30.7	31.7	N/D	N/D	29.3	29.8	27.0	23.9	18.4
1993	19.0	22.2	27.8	29.5	30.5	30.7	30.7	29.8	29.1	27.9	25.0	23.1
1994	23.4	23.1	27.2	31.8	32.5	31.9	31.2	32.1	29.7	27.6	25.6	21.4
1995	21.9	25.0	27.4	30.9	31.4	31.9	30.4	29.9	28.8	28.6	25.3	20.7
1996	21.6	23.9	27.4	30.3	31.4	29.3	30.1	28.6	28.6	27.5	25.7	26.8
1997	20.7	23.2	26.6	29.3	33.4	30.5	30.8	29.2	28.4	28.1	26.0	23.8
1998	24.3	24.2	35.5	30.3	31.3	32.9	31.4	31.4	29.7	29.8	27.6	28.0
1999	28.0	32.9	32.9	33.1	29.5	31.8	31.3	30.0	30.3	28.3	24.8	20.4
2000	22.5	22.8	26.5	30.2	29.2	29.9	30.1	31.0	28.6	27.6	24.4	21.3
2001	21.3	24.8	28.0	32.1	29.9	30.1	30.6	29.5	30.4	28.2	25.3	23.3
2002	23.0	25.9	28.9	31.8	30.6	31.2	29.8	28.7	29.2	28.0	24.6	22.6
2003	21.9	24.5	28.0	32.8	29.9	30.3	31.7	30.9	29.7	29.0	26.3	23.8
2004	22.5	24.5	29.5	30.8	33.8	29.9	30.3	31.4	28.9	28.4	27.2	22.9
2005	23.2	27.1	30.4	28.8	32.9	32.0	31.4	30.9	28.9	29.1	25.8	23.1
2006	23.5	25.6	29.3	31.6	31.1	31.2	31.1	30.0	29.0	28.5	26.5	22.0
2007	22.4	23.3	28.8	31.6	30.5	31.4	31.0	30.3	29.5	28.1	25.5	22.9
2008	22.1	23.4	29.5	32.3	30.1	30.5	30.8	30.8	30.3	28.1	24.9	22.9
2009	23.5	26.1	28.1	31.5	31.6	30.2	31.3	30.2	29.4	27.8	25.4	21.3
2010	21.8	24.5	30.9	32.4	33.1	31.9	32.5	30.8	29.8	28.6	26.3	21.8
2011	22.4	23.6	28.1	30.6	31.1	30.2	31.4	29.2	29.8	27.9	25.4	22.5
2012	22.3	25.3	27.9	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D

Average Temperature Data Summary Statistics (°C)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
SD	1.9	2.3	2.3	1.4	1.4	1.1	1.2	1.0	0.7	0.7	1.1	1.9
Median	21.9	23.6	28.0	30.9	31.0	30.5	30.8	29.8	29.3	28.1	25.3	22.0
Q1	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
Q3	22.5	24.8	29.2	31.7	31.7	31.3	31.3	30.6	29.8	28.4	25.8	22.9
Minimum	18.4	21.1	23.1	25.9	28.1	27.8	26.8	28.4	27.8	26.5	23.0	18.4
Maximum	28.0	32.9	35.5	33.1	33.8	32.9	32.5	32.1	30.4	29.8	27.6	28.0
Count	29	29	30	28	30	28	28	30	29	29	29	29
Ext Max	24.5	27.5	32.5	33.7	33.7	33.3	33.3	32.9	31.2	29.7	27.8	25.5
Ext Min	19.3	20.3	23.7	28.2	28.4	27.9	28.1	26.9	27.4	26.4	22.4	18.7
25th Pct	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
50th Pct	0.7	0.6	1.0	0.6	0.7	0.6	0.7	0.7	0.5	0.5	0.9	0.7
75th Pct	0.6	1.2	1.2	0.8	0.7	0.8	0.6	0.8	0.5	0.3	0.5	1.0
1.5 * IQR	1.9	2.7	3.3	2.1	2.0	2.0	1.9	2.2	1.5	1.2	2.0	2.5

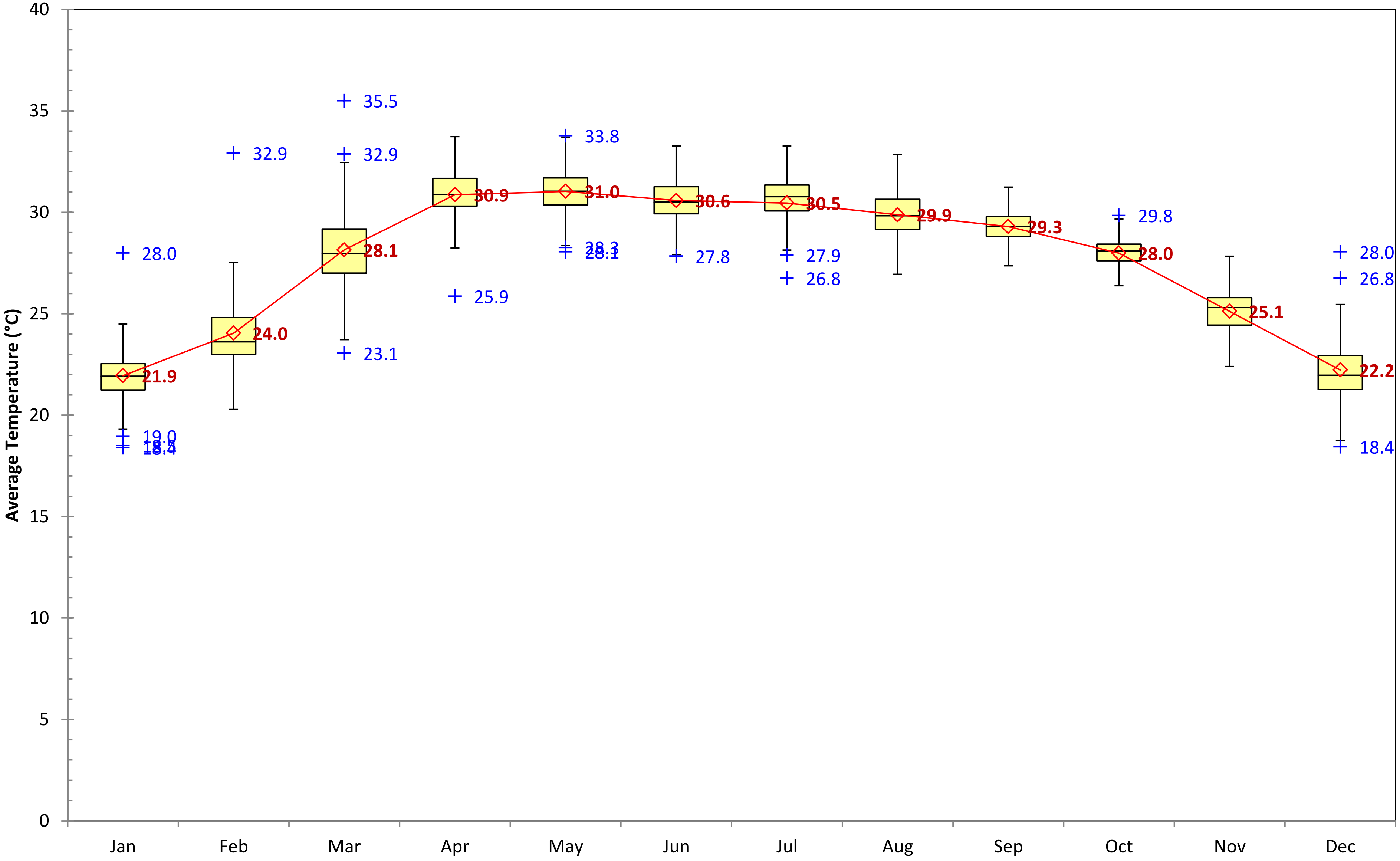
Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statist



Monthly Average Temperature: WMO 48037 Climate Station (1981-2012)



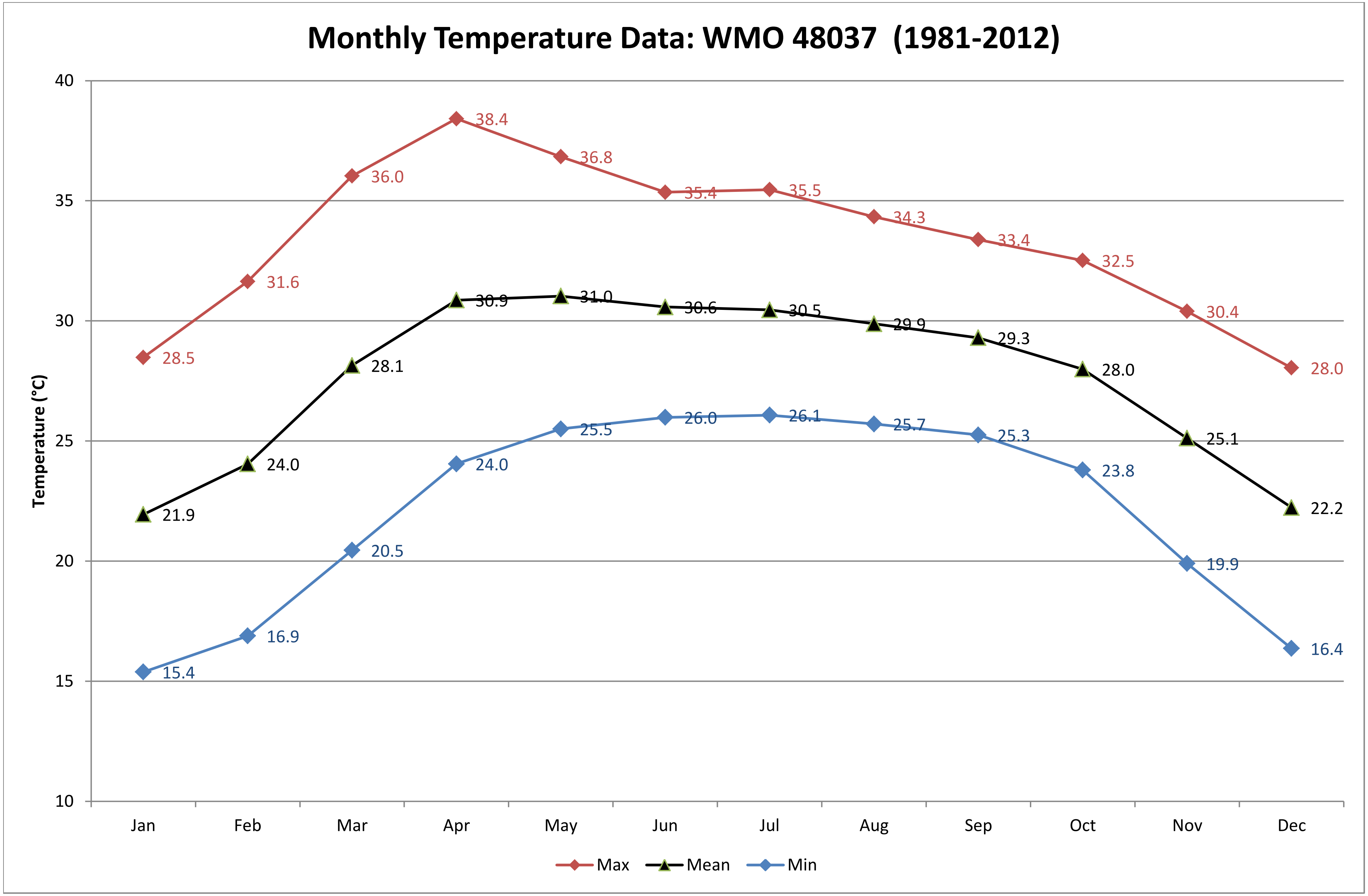
ATTACHMENT 4.3

Monthly Temperature Range Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 21/06/2013
	Basic Climatology	Approved	Sheet No.

Monthly Temperature Analysis: WMO 48037 (1981-2012)

Temperature Summary Statistics (°C)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Max	28.5	31.6	36.0	38.4	36.8	35.4	35.5	34.3	33.4	32.5	30.4	28.0
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
Min	15.4	16.9	20.5	24.0	25.5	26.0	26.1	25.7	25.3	23.8	19.9	16.4



Monthly Temperature Data: WMO 48037 (1981-2012)
Temperature (°C)
40
35
30
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
28.5
31.6
36.0
38.4
36.8
35.4
35.5
34.3
33.4
32.5
30.4
28.0
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
15.4
16.9
20.5
24.0
25.5
26.0
26.1
25.7
25.3
23.8
19.9
16.4
Max
Mean
Min

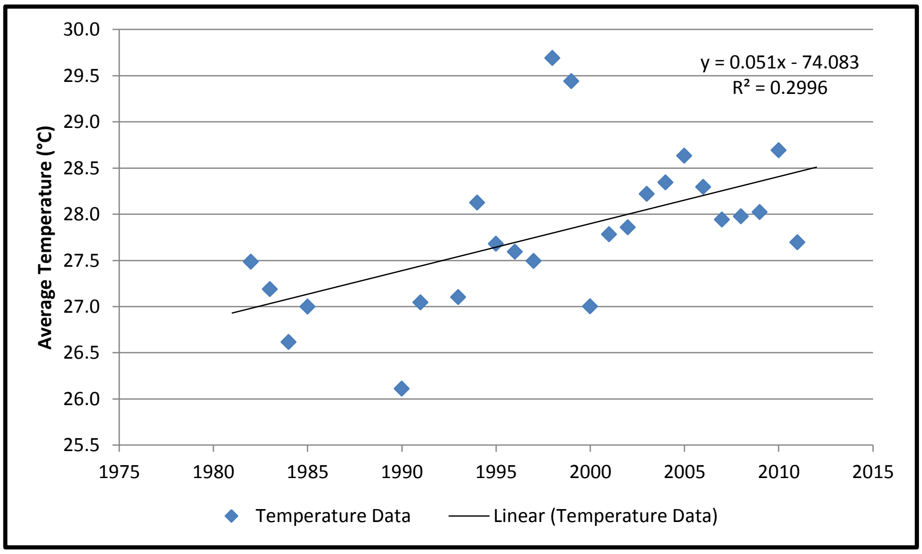
ATTACHMENT 4.4

Temperature Trend Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 25/06/2013
	Basic Climatology	Approved	

Climatic Trend Analysis: WMO 48037 Average Temperature (1981-2012)

Year	Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual average temperature values at this site.

ATTACHMENT 5.1

Wind Rose Analysis

Wind Rose Analysis Results (All Values): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 26,304 **Number of Valid Points:** 26,304 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.90	2.40	3.70	5.10	9.20

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	17.29	0.000	3.015	9.200
22.5	8.76	0.000	2.481	7.400
45.0	4.16	0.000	1.660	7.400
67.5	2.98	0.000	1.047	6.700
90.0	3.87	0.000	1.045	7.300
112.5	4.40	0.000	1.612	6.300
135.0	7.52	0.000	2.141	6.200
157.5	9.18	0.000	2.656	7.600
180.0	7.98	0.000	3.185	8.500
202.5	4.70	0.000	2.997	8.300
225.0	2.71	0.000	2.333	9.000
247.5	2.26	0.000	1.601	7.100
270.0	2.39	0.000	1.354	7.000
292.5	3.09	0.000	1.370	6.700
315.0	4.66	0.000	1.550	6.800
337.5	14.05	0.000	2.961	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	11,172	42.473	0	26,304	100
2 - 4	9,826	37.356	2	15,132	57.527
4 - 6	4,884	18.568	4	5,306	20.172
6 - 8	400	1.521	6	422	1.604
8 - 50	22	0.084	8	22	0.084
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 00:00 to 03:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.20	1.30	2.90	3.90	4.60	7.60

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	17.97	0.000	3.294	5.400
22.5	7.88	0.000	2.608	5.600
45.0	4.05	0.000	2.386	5.300
67.5	2.34	0.000	1.700	4.900
90.0	2.86	0.100	1.723	5.400
112.5	2.74	0.000	2.263	6.000
135.0	3.92	0.100	2.332	6.200
157.5	5.32	0.000	2.825	6.600
180.0	8.00	0.000	3.275	5.600
202.5	5.54	0.000	3.082	5.000
225.0	3.83	0.000	2.329	4.800
247.5	2.52	0.000	1.440	4.500
270.0	3.68	0.000	1.347	4.400
292.5	4.53	0.000	1.602	5.500
315.0	7.21	0.000	1.708	5.000
337.5	17.61	0.000	3.075	7.600
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	**Counts**	**Frequency (%)**	**Exceeding**		
			Values > (m/s)	**Counts**	**Frequency (%)**
>0 - 2	1,111	33.79	0	3,288	100
2 - 4	1,452	44.161	2	2,177	66.21
4 - 6	714	21.715	4	725	22.05
6 - 8	11	0.335	6	11	0.335
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 03:00 to 06:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.40	2.30	3.40	4.00	4.90	7.60

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	24.18	0.000	3.381	6.600
22.5	10.58	0.100	2.971	5.500
45.0	4.59	0.100	2.530	6.400
67.5	2.34	0.000	2.174	4.900
90.0	1.98	0.000	1.908	3.800
112.5	2.22	0.000	2.156	3.800
135.0	3.44	0.000	2.471	4.900
157.5	4.71	0.000	3.098	7.600
180.0	5.81	0.100	3.228	7.600
202.5	3.47	0.000	2.687	4.500
225.0	1.76	0.000	1.817	3.900
247.5	1.37	0.000	1.540	4.500
270.0	1.34	0.000	1.809	4.100
292.5	2.19	0.000	2.089	5.500
315.0	3.98	0.000	2.198	5.100
337.5	26.03	0.000	3.815	7.100
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	692	21.046	0	3,288	100
2 - 4	1,675	50.943	2	2,596	78.954
4 - 6	896	27.251	4	921	28.011
6 - 8	25	0.76	6	25	0.76
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 06:00 to 09:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.40	2.30	3.50	4.60	6.10	9.20

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	30.17	0.000	4.112	9.200
22.5	16.09	0.000	3.674	7.400
45.0	5.05	0.000	2.655	5.500
67.5	1.40	0.000	2.022	4.900
90.0	1.31	0.000	1.460	7.300
112.5	1.46	0.000	2.354	6.300
135.0	2.37	0.000	2.205	4.700
157.5	4.56	0.000	2.319	5.700
180.0	5.93	0.000	2.973	6.700
202.5	4.17	0.100	2.889	6.800
225.0	1.55	0.000	1.863	4.000
247.5	1.06	0.100	1.426	3.800
270.0	1.03	0.100	1.229	4.600
292.5	1.40	0.000	1.861	4.400
315.0	2.59	0.000	2.042	4.900
337.5	19.86	0.000	3.887	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	679	20.651	0	3,288	100
2 - 4	1,319	40.116	2	2,609	79.349
4 - 6	1,099	33.425	4	1,290	39.234
6 - 8	178	5.414	6	191	5.809
8 - 50	13	0.395	8	13	0.395
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 09:00 to 12:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.70	2.10	3.40	5.20	8.60

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	31.27	0.000	2.813	8.600
22.5	14.14	0.000	2.300	6.500
45.0	4.05	0.000	1.077	5.800
67.5	2.62	0.000	0.765	6.700
90.0	2.31	0.000	0.736	7.100
112.5	2.71	0.000	1.281	5.600
135.0	4.26	0.000	1.354	5.700
157.5	7.18	0.000	2.002	7.400
180.0	7.57	0.000	2.861	7.800
202.5	3.50	0.000	2.720	7.700
225.0	1.34	0.000	1.161	5.100
247.5	1.00	0.000	1.012	3.800
270.0	1.22	0.000	0.893	5.200
292.5	1.64	0.000	0.661	4.600
315.0	2.59	0.000	1.408	5.200
337.5	12.62	0.000	2.273	8.000
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	1,559	47.415	0	3,288	100
2 - 4	1,185	36.04	2	1,729	52.585
4 - 6	472	14.355	4	544	16.545
6 - 8	70	2.129	6	72	2.19
8 - 50	2	0.061	8	2	0.061
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 12:00 to 15:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.00	0.20	1.20	2.60	5.00	8.50

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	15.33	0.000	1.768	6.000
22.5	7.48	0.000	1.181	4.700
45.0	4.26	0.000	0.425	3.300
67.5	4.68	0.000	0.203	2.400
90.0	5.93	0.000	0.411	4.500
112.5	5.51	0.000	0.728	5.500
135.0	10.22	0.000	1.469	5.500
157.5	15.82	0.000	2.317	6.700
180.0	10.01	0.000	3.297	8.500
202.5	2.71	0.000	2.581	8.300
225.0	1.49	0.000	2.418	6.500
247.5	1.43	0.000	1.638	6.200
270.0	1.19	0.000	1.249	5.600
292.5	1.83	0.000	1.565	6.400
315.0	2.52	0.000	1.083	5.600
337.5	9.61	0.000	1.577	6.700
Sum:	100.00			

Wind speed bin statistics					
Bin	Counts	Frequency	Exceeding		
(m/s)		(%)	Values > (m/s)	Counts	Frequency (%)
>0 - 2	2,130	64.781	0	3,288	100
2 - 4	792	24.088	2	1,158	35.219
4 - 6	293	8.911	4	366	11.131
6 - 8	67	2.038	6	73	2.22
8 - 50	6	0.182	8	6	0.182
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 15:00 to 18:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.70	1.80	3.10	4.70	7.00

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	7.00	0.000	1.830	5.300
22.5	4.53	0.000	1.410	5.000
45.0	3.44	0.000	0.867	3.400
67.5	4.23	0.000	0.630	4.000
90.0	7.76	0.000	0.808	4.100
112.5	8.70	0.100	1.522	5.800
135.0	20.26	0.000	2.281	5.500
157.5	15.66	0.100	2.797	6.600
180.0	6.75	0.000	3.191	7.000
202.5	3.59	0.000	2.914	7.000
225.0	2.43	0.000	3.099	6.900
247.5	2.01	0.000	2.464	6.900
270.0	1.76	0.000	1.995	6.400
292.5	2.31	0.000	1.403	6.700
315.0	2.59	0.000	1.351	5.300
337.5	7.00	0.000	1.837	5.700
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	1,778	54.075	0	3,288	100
2 - 4	1,110	33.759	2	1,510	45.925
4 - 6	373	11.344	4	400	12.165
6 - 8	27	0.821	6	27	0.821
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 18:00 to 21:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.00	0.50	2.00	3.60	4.80	7.00

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	5.99	0.000	1.550	4.600
22.5	4.99	0.000	1.399	6.800
45.0	3.95	0.000	1.217	5.000
67.5	3.86	0.000	1.030	4.800
90.0	5.23	0.000	1.226	5.600
112.5	8.39	0.000	1.866	5.200
135.0	10.86	0.000	2.585	5.800
157.5	12.41	0.000	3.027	6.200
180.0	10.65	0.000	3.359	6.300
202.5	5.93	0.000	3.003	6.300
225.0	4.81	0.000	2.452	6.700
247.5	3.98	0.000	1.595	6.600
270.0	2.80	0.000	1.386	7.000
292.5	3.04	0.000	1.055	5.500
315.0	4.96	0.000	1.013	6.800
337.5	8.15	0.000	2.057	6.200
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
			Values >	**Counts**	**Frequency**
(m/s)		**(%)**	**(m/s)**		**(%)**
>0 - 2	1,619	49.24	0	3,288	100
2 - 4	1,131	34.398	2	1,669	50.76
4 - 6	522	15.876	4	538	16.363
6 - 8	16	0.487	6	16	0.487
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 21:00 to 00:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.10	0.70	2.00	3.50	4.60	9.00

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	6.39	0.000	2.322	5.000
22.5	4.41	0.000	1.839	4.800
45.0	3.89	0.000	1.698	7.400
67.5	2.37	0.000	1.468	6.500
90.0	3.56	0.000	1.377	5.100
112.5	3.50	0.000	1.707	5.200
135.0	4.87	0.000	2.244	5.700
157.5	7.76	0.000	2.892	5.100
180.0	9.16	0.000	3.157	5.400
202.5	8.73	0.000	3.389	6.500
225.0	4.44	0.000	2.483	9.000
247.5	4.71	0.000	1.496	7.100
270.0	6.11	0.000	1.192	5.500
292.5	7.76	0.000	1.160	4.500
315.0	10.86	0.000	1.526	4.900
337.5	11.50	0.000	2.493	5.700
Sum:	100.00			

Wind speed bin statistics					
Bin	Counts	Frequency	Exceeding		
(m/s)		(%)	Values > (m/s)	Counts	Frequency (%)
>0 - 2	1,604	48.783	0	3,288	100
2 - 4	1,162	35.341	2	1,684	51.217
4 - 6	515	15.663	4	522	15.876
6 - 8	6	0.182	6	7	0.213
8 - 50	1	0.03	8	1	0.03
50 - 89	0	0.000	50	0	0.000

ATTACHMENT 5.2

Wind Rose Analysis – Seasonal Variability

Wind Rose Analysis Results (All Values from Wet Season): Wind Rose Dataset (2010-2012)

The "Wet Season" was assumed to span from May to October.
Analysis performed using WindRose Pro 3.1 software.

Number of points: 13,248 **Number of Valid Points:** 12,952 **Number of excuded samples:** 296

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.10	0.20	1.40	2.80	3.70	4.90	9.00

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	11.84	0.100	2.732	7.300
22.5	10.53	0.100	2.711	6.800
45.0	5.01	0.100	2.072	7.400
67.5	2.92	0.100	1.436	6.500
90.0	3.50	0.100	1.380	5.600
112.5	3.86	0.100	1.765	6.000
135.0	8.60	0.100	2.310	6.200
157.5	12.93	0.100	2.899	7.600
180.0	12.79	0.100	3.406	8.500
202.5	7.34	0.100	3.250	8.300
225.0	3.87	0.100	2.829	9.000
247.5	2.54	0.100	2.371	7.100
270.0	2.19	0.100	2.015	7.000
292.5	2.32	0.100	2.028	6.700
315.0	3.14	0.100	1.941	5.600
337.5	6.62	0.100	2.508	6.800
Sum:	100.00			

Wind speed bin statistics			
Bin (m/s)	Counts	Frequency (%)	Comment
0	296	2.23	Excluded
>0	12,952	97.77	Analysed
N/D	0	0.00	Excluded

Wind speed bin statistics					
Bin	Counts	Frequency	Exceeding		
(m/s)		(%)	Values > (m/s)	Counts	Frequency (%)
>0 - 2	4,475	34.551	0	12,952	100
2 - 4	6,015	46.441	2	8,477	65.449
4 - 6	2,313	17.858	4	2,462	19.009
6 - 8	142	1.096	6	149	1.15
8 - 50	7	0.054	8	7	0.054
>50	0	0.000	50	0	0.000

Wind Rose Analysis Results (All Values from Dry Season): Wind Rose Dataset (2010-2012)

The "Dry Season" was assumed to span from November to April.
Analysis performed using WindRose Pro 3.1 software.

Number of points: 13,056 **Number of Valid Points:** 12,377 **Number of excuded samples:** 679

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.10	0.10	0.80	2.20	3.90	5.30	9.20

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	23.82	0.100	3.223	9.200
22.5	7.25	0.100	2.275	7.400
45.0	3.03	0.100	1.247	4.700
67.5	2.73	0.100	0.817	6.700
90.0	4.01	0.100	0.873	7.300
112.5	4.83	0.100	1.630	6.300
135.0	6.65	0.100	2.019	5.500
157.5	5.60	0.100	2.229	6.600
180.0	3.24	0.100	2.585	7.300
202.5	1.96	0.100	2.512	6.300
225.0	1.12	0.100	1.744	5.700
247.5	1.44	0.100	0.952	6.000
270.0	2.31	0.100	0.970	5.500
292.5	3.46	0.100	1.157	6.400
315.0	6.04	0.100	1.476	6.800
337.5	22.53	0.100	3.155	8.100
Sum:	100.00			

Wind speed bin statistics			
Bin (m/s)	**Counts**	**Frequency (%)**	**Comment**
0	679	5.20	Excluded
>0	12,555	96.16	Analysed
N/D	0	0.00	Excluded

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
			Values >	**Counts**	**Frequency**
(m/s)		**(%)**	**(m/s)**		**(%)**
>0 - 2	5,817	46.332	0	12,555	100
2 - 4	3,861	30.753	2	6,738	53.668
4 - 6	2,604	20.741	4	2,877	22.915
6 - 8	258	2.055	6	273	2.174
8 - 50	15	0.119	8	15	0.119
50 - 89	0	0.000	50	0	0.000

APPENDIX B

Site Wide Rainfall/Runoff Modelling

APPENDIX B

Surface Water Management

B.1 – Model Development

B.2 – Sub-Catchment Input Parameters

B.3 – HEC-HMS Water Pond Input

B.4 – HEC-HMS Channel Topography

B.5 – HEC-HMS Hyetograph Input

B.6 – Simulation Results – Comparison at Selected Locations

B.7 – Simulation Results – Summary Table at Control Points

B.8 – Simulation Results – Time Series Plots at Control Points

B.9 – Simulation Results – Time Series Plots at Water Ponds

B.10 – Catchment Model Schematics

1. METHODS AND ASSUMPTIONS FOR MODEL DEELOPMENT

The selected approach for estimating runoff to various locations in the Letpadaung catchment (both for existing and planned future conditions) was to simulate runoff from the total area using a rainfall / runoff model constructed using HEC-HMS software (Ref. 1). By simulating the runoff hydrographs resulting from rainfall on each sub-catchment (or basin) reporting to and from the Letpadaung project area and routing them (combining hydrographs as necessary) throughout the natural and man-made sections of the overall drainage network, it was possible to determine peak runoff flow rate, time to peak runoff and total volume of runoff which reports to (or past) selected locations throughout the site. These results form the quantitative basis for impact assessment.

1.1 MODEL NOMENCLATURE

All hydrologic features on the Letpadaung site are assigned an alphanumeric "feature code" for purposes of uniquely identifying each feature within the framework of the Letpadaung HEC-HMS rainfall / runoff models as follows:

"AA-BB-NNN"

where:

- AA denotes a two character "structure code" for the type of hydrologic feature described. The structure codes used for these models are:
  - BA indicates a sub-catchment (or basin) area which generates runoff in response to direct rainfall;
  - CP indicates a control point, where various runoff information is reported;
  - DC indicates a diversion (man-made) channel which conveys runoff from one location to another;
  - NC indicates a natural channel which conveys runoff from one location to another; and
  - WP indicates a water pond, which both stores and discharges water simultaneously, depending on the elevation of water within it.
- BB denotes a two character "stage code" for the time at which the feature is to be considered. The stage codes used in these models are:
  - EX indicates exsting conditions and

- PL indicates planned future conditions. Specifically, the future condition assumed for assessment is assumed to be after Heap Leach Pad (HLP) No. 2 construction is complete, but before commencement of construction on HLP 3. Following current development plans, this is roughly 10 years after commencement of mining operations at the Letpadaug site.

- NNN denotes a three digit “feature number”, which increases sequentially from 1 and is padded with zeros (e.g. 001, 002, etc.). The feature number indicates the specific feature for a given structure type and time at which the feature is considered.
- Three exceptions exist to the above nomenclature rules:
  - Water ponds may have more the one runoff reporting node where water flows into said pond. Control points fitting this description (i.e. more than one inflow point into a water pond) are indicated by appending a single letter (in ascending order, by inflow point) to the feature code of the selected control point (e.g. CP-EX-016A, CP-EX-016B, etc.)
  - The surface area of water ponds which receives direct rainfall is indicated by appending the letter “P” to the feature code of that water pond (e.g. WP-EX-001P, WP-PL-005P, etc.). Locations matching this description are a special subset of the control point classification.
  - Cross sections used to describe the geometry of a conveyance pathway, either a diversion channel (DC) or natural channel (NC) are indicated by prefixing the letters “XS-” to the feature code of the channel which the given cross section belongs to (e.g. XS-DC-EX-008, XS-NC-PL-011, etc.)

A feature code is merely the combination of specific values of structure code, stage code and feature number, separated by hyphens “-” and subject to the three naming exceptions given above.

1.2 CATCHMENT DELINATION AND MODEL SKELETONIZATION

The total existing (EX) Letpadaung catchment area is 110.2 square kilometres (km^2) and the total planned (PL) Letpadaung catchment area is 106.1 km^2, after subtraction of the developed pit area which does not generate runoff to the exterior of the mine

site. These catchments were sub-delineated into basins using AutoCAD Civil 3D 2013 (Ref. 2) as follows:

- The EX model catchment sub-delineation is shown on Figure 3.1. This catchment is comprised of the following hydrologic features:
  - 40 basins;
  - 39 channels (14 man-made diversions and 25 natural water courses) with associated cross sections;
  - 59 control points;
  - 2 sinks (Chindwin River and Yama Stream); and
  - 6 water ponds.
- The PL model catchment sub-delineation is shown on Figure 3.2. This catchment is comprised of the following hydrologic features:
  - 61 basins;
  - 63 channels (50 man-made diversions and 13 natural water courses) with associated cross sections;
  - 93 control points;
  - 2 sinks (Chindwin River and Yama Stream); and
  - 9 water ponds.

The AutoCAD electronic catchment maps were converted into simplified routing diagrams as part of the HEC-HMS model construction. These resulting catchment model schematics are shown in Appendix B.10 for EX and PL models, respectively.

1.3 SUB-CATCHMENT PARAMETERS

The delineated basins and water pond surfaces define the area which generates runoff in response to rainfall in the HEC-HMS surface water management (SWM) models. Generation of runoff from rainfall in the HEC-HMS SWM models employs three primary hydrologic methods:

- Precipitation excess was estimated using the SCS Curve Number Method as described in (Ref. 3). With the SCS Curve Number Method, generation of excess precipitation from a given area is defined through the use of a "curve number" (CN) which ranges between 0 and 100. (KP notes that CN = 0 means no excess is generated in response to rainfall, while CN = 100 means

that all rainfall is treated as excess precipitation, i.e. no losses occur.) CN is adjusted based upon antecedent moisture conditions (AMC).

- Transformation of excess precipitation to runoff was accomplished using the SCS Unit Hydrograph Method as described (Ref. 4). With the SCS Unit Hydrograph Method, the transformation of excess precipitation to runoff hydrographs is governed by CN and by lag time (t_L) for each basin. Formulae for estimating lag time are given in (Ref. 3).
- Baseflow (i.e. the groundwater component of runoff) is not considered in the Letpadaung EX and PL SWM models. Generally speaking, the baseflow response to individual storms is smaller in magnitude and delayed in time. Consequently, KP excluded consideration of baseflow from storm water modelling.

A summary of the primary basin parameters for the Letpadaung EX and PL SWM models are given in tables 1.1 and 1.2, respectively.

Table 1.1: Basin hydrologic parameter summary: EX SWM model

Sub-Catchment	Reports to Location	Area (km^2)	CN*	t_L (min)	Antecedent Moisture Condition
BA-EX-001	CP-EX-001	1.76	89.6	161	III
BA-EX-002	CP-EX-003	0.44	89.6	75	III
BA-EX-003	CP-EX-004	2.22	89.2	334	III
BA-EX-004	CP-EX-005	0.91	88	69	III
BA-EX-005	CP-EX-007	2.72	89.6	203	III
WP-EX-001P	WP-EX-001	1.11	98	4	III
BA-EX-006	CP-EX-010A	3.67	89.6	149	III
BA-EX-007	CP-EX-010D	1.35	89.6	25	III
BA-EX-008	CP-EX-010B	21.29	88.8	330	III
BA-EX-009	CP-EX-010C	10.54	87.6	204	III
BA-EX-010	CP-EX-011	4.51	88.4	241	III
WP-EX-002P	WP-EX-002	0.06	98	4	III
BA-EX-011	CP-EX-016A	0.33	89.2	33	III
BA-EX-012	CP-EX-016D	0.11	89.6	37	III
BA-EX-013	CP-EX-016B	4.09	89.6	134	III
BA-EX-014	CP-EX-016C	4.16	89.6	212	III
WP-EX-003P	WP-EX-003	0.02	98	4	III
BA-EX-015	CP-EX-019	4.51	88.8	147	III
BA-EX-016	CP-EX-020	1.99	89.6	125	III
WP-EX-004P	WP-EX-004	0.01	98	4	III
BA-EX-017	CP-EX-024	0.05	89.6	21	III
BA-EX-018	CP-EX-025	0.12	89.6	59	III
BA-EX-019	CP-EX-026	0.98	88.8	108	III
WP-EX-005P	WP-EX-005	0.02	98	4	III
BA-EX-020	CP-EX-029	0.66	89.2	65	III
BA-EX-021	CP-EX-026	1.03	89.6	101	III
BA-EX-022	CP-EX-025	0.9	89.6	124	III

Table 1.1 Cont'd: Basin hydrologicparameter summary: EX model

Sub-Catchment	Reports to Location	Area (km^2)	CN*	t_L (min)	Antecedent Moisture Condition
BA-EX-023	CP-EX-031	1.28	89.2	115	III
BA-EX-024	CP-EX-031	2.71	87.6	171	III
BA-EX-025	CP-EX-031	0.36	87.6	24	III
BA-EX-026	CP-EX-032	2.82	89.6	176	III
BA-EX-027	CP-EX-033	2.44	88.8	41	III
BA-EX-028	CP-EX-035	1.37	88.4	58	III
BA-EX-029	CP-EX-035	0.85	88	34	III
BA-EX-030	CP-EX-036	2.03	88	27	III
BA-EX-031	CP-EX-037	0.39	89.6	85	III
BA-EX-032	CP-EX-039	1.78	88	26	III
BA-EX-033	CP-EX-044	0.69	89.6	135	III
BA-EX-034	CP-EX-043	0.87	88.8	28	III
BA-EX-035	CP-EX-045	2.64	83.3	68	III
BA-EX-036	CP-EX-046	0.79	87.2	18	III
BA-EX-037	CP-EX-047	2.6	88	155	III
BA-EX-038	CP-EX-048	2.45	89.6	190	III
BA-EX-039	CP-EX-051	0.45	89.6	62	III
WP-EX-006P	WP-EX-006	0.24	98	4	III
BA-EX-040	CP-EX-053	13.95	88	350	III

* SCS curve numbers for Antecedent Moisture Condition III derived using relationships from (Ref. 5).

Table 1.2: Basin hydrologic parameter summary: PL SWM model

Sub-Catchment	Reports to Location	Area (km^2)	CN*	t_L (min)	Antecedent Moisture Condition
BA-PL-001	CP-PL-001	1.76	89.6	161	III
BA-PL-002	CP-PL-003	0.44	89.6	75	III
BA-PL-003	CP-PL-004	2.22	89.2	334	III
BA-PL-004	CP-PL-005	0.91	88	69	III
BA-PL-005	CP-PL-007	2.72	89.6	203	III
WP-PL-001P	CP-PL-009	1.11	98	4	III
BA-PL-006	CP-PL-010A	3.67	89.6	149	III
BA-PL-007	CP-PL-010D	1.35	89.6	25	III
BA-PL-008	CP-PL-010B	21.29	88.8	330	III
BA-PL-009	CP-PL-010C	10.54	87.6	204	III
BA-PL-010	CP-PL-013	4.48	89.1	167	III
WP-PL-002P	CP-PL-015	0.06	98	4	III
BA-PL-011	CP-PL-016A	0.33	89.2	33	III
BA-PL-012	CP-PL-016C	0.08	89.6	36	III
BA-PL-013	CP-PL-017	1.45	88.4	90	III
BA-PL-014	CP-PL-018	2.01	88.8	99	III
BA-PL-015	CP-PL-018	0.4	89.6	58	III
BA-PL-016	CP-PL-020	0.66	89.6	162	III
WP-PL-003P	CP-PL-021	0.01	98	4	III
BA-PL-017	CP-PL-022	0.02	89.6	18	III
BA-PL-018	CP-PL-020	0.03	89.6	8	III
BA-PL-019	CP-PL-023	0.16	896	9	III
BA-PL-020	CP-PL-024	0.1	89.6	9	III
BA-PL-021	CP-PL-025	0.03	95.9	3	III

Table 1.2 Cont'd: Basin hydrologic parameter summary: PL SWM model

Sub-Catchment	Reports to Location	Area (km^2)	CN*	t_L (min)	Antecedent Moisture Condition
BA-PL-022	CP-PL-027	0.07	95.9	6	III
BA-PL-023	CP-PL-028	0.09	95.9	6	III
BA-PL-024	CP-PL-030	0.22	89.6	28	III
BA-PL-025	CP-PL-031	0.8	89.2	27	III
BA-PL-026	CP-PL-032	1.66	90.6	62	III
WP-PL-004P	CP-PL-034	0.02	98	4	III
BA-PL-027	CP-PL-035	4.51	88.8	148	III
BA-PL-028	CP-PL-030	0.1	89.6	20	III
BA-PL-029	CP-PL-030	0.44	89.2	38	III
BA-PL-030	CP-PL-038	1.06	89.2	88	III
BA-PL-031	CP-PL-025	0.17	91.3	15	III
WP-PL-005P / WP-PL-006P	CP-PL-040	1.46	98	4	III
WP-PL-007P	CP-PL-042B	0.72	98	4	III
BA-PL-032	CP-PL-042A	0.63	98.9	103	III
BA-PL-033	CP-PL-044	4.38	88.5	14	III
BA-PL-034	CP-PL-045	4.43	88.5	14	III
BA-PL-035	CP-PL-042C	0.49	95.9	54	III
BA-PL-036	CP-PL-046	0.78	95.9	11	III
BA-PL-037	CP-PL-048	0.62	95.9	4	III
BA-PL-038	CP-PL-049	0.82	89.1	22	III
BA-PL-039	CP-PL-051	0.5	92.6	12	III
BA-PL-040	CP-PL-052	0.12	86	10	III
BA-PL-041	CP-PL-058	1.08	93.3	5	III
WP-PL-008P	CP-PL-055	0.1	98	4	III
BA-PL-042	CP-PL-057	0.46	95.9	3	III
BA-PL-043	CP-PL-056B	0.54	95.9	9	III
BA-PL-044	CP-PL-059	0.59	95.9	7	III
BA-PL-045	CP-PL-060	1.82	95.9	2	III
BA-PL-046	CP-PL-061	0.38	92.6	37	III
BA-PL-047	CP-PL-063	0.75	95.9	2	III
BA-PL-048	CP-PL-064	0.39	95.9	1	III
BA-PL-049	CP-PL-065	1.18	95.9	4	III
BA-PL-050	CP-PL-067	0.19	95.9	11	III
BA-PL-051	CP-PL-068	0.12	95.9	41	III
BA-PL-052	CP-PL-069	0.46	95.9	14	III
BA-PL-053	CP-PL-070	0.14	92.6	11	III
BA-PL-054	CP-PL-072	0.28	88.3	5	III
BA-PL-055	CP-PL-073	0.19	84.4	14	III
BA-PL-056	CP-PL-074	0.16	95.9	1	III
BA-PL-057	CP-PL-076	0.43	94.1	28	III
BA-PL-058	CP-PL-077	0.76	95.9	39	III
BA-PL-059	CP-PL-078	2.52	90.3	186	III
BA-PL-060	CP-PL-081	0.49	89.6	62	III
WP-PL-009P	CP-PL-082	0.24	98	4	III
BA-PL-061	CP-PL-083	13.95	88.8	350	III

* SCS curve numbers for Antecedent Moisture Condition III derived using relationships from (Ref. 5).

Additional details pertaining to the estimation and assignment of sub-catchment modelling parameters are given in Appendix B.2.

1.4 WATER POND PARAMETERS

The various water ponds in the Letpadaung EX and PL SWM models were simulated using level pool routing methodology with two functional relationships that were developed for each water pond:

- Water pond outflow (discharge) as a function of water surface elevation (stage); in each instance, a functional relationship was calculated using the broad-crested weir equation with tabulated coefficients taken from (Ref. 6) and spillway dimensions which were either inferred from Google Earth satellite photography or assumed because as-built dimensions for the water ponds were not available at the time of this study.
- Water pond volume (storage) as a function water surface elevation (stage); in each instance, a functional relationship was developed using available topographic mapping with Rift TD software (Ref. 7).

The two functional relationships were tabulated and then graphed for all 15 of the water ponds in the Letpadaung EX and PL SWM models. The rating tables and the corresponding rating curves are given in Appendix B.3.

KP notes that when the simulations were performed, all ponds were assumed to be full to the assumed invert elevations of their corresponding spillways. Further, since the majority of the design inputs for the water ponds were assumed, pond attenuation results are indicative only.

1.5 CHANNEL PARAMETERS

Runoff routing was performed in the Letpadaung EX and PL SWM HEC-HMS models using the Muskingum Cunge Method (Ref. 5). This method employs 8-point approximations of internal channel cross sections, typical Manning's hydraulic roughness (n) coefficients taken from (Ref. 8), average ground slopes, and channel lengths to estimate attenuation effects on the passing flood wave.

For the various natural channels (NC) in the EX and PL SWM models, typical cross section topography was extracted from available site topography and approximated using 8 points for each channel. For the man-made channels (DC), dimensions were either inferred from Google Earth satellite photography or assumed because as-built dimensions were not available at the time of this study. Tables and graphs of the

assumed 8-point cross sectional topography for all 102 channel reaches used in the EX and PL SWM models are given in Appendix B.4.

1.6 DESIGN STORMS

Two potential 100 year ARI design storms, one of long (48 hours) and one of short (6 hours) duration were estimated for use as hydrologic inputs to the EX and PL SWM models. The total storm depths of these two design storms were taken from the site Intensity / Duration / Frequency (IDF) curve, which was developed through usage of EasyFit 5.4 software (Ref. 9) for frequency analysis on historic annual rainfall maxima and subsequent application of the Rainfall Ratio Method, as discussed in (Ref. 10) to extrapolate results to durations both less than and greater than 24 hours. The total storm depths were then temporally distributed using the hyetograph patterns that were derived from historic data.

The results of these computations are tabulated and illustrated in Appendix B.5.

2. REFERENCES

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Surface Water Existing (EX) Conditions: Estimation of loss parameters for modelling

The peak flow rate resulting from the selected design storm under existing conditions is estimated. The following methods were employed for this effort:

Runoff Estimation Method = SCS Curve Number
Time of Concentration Estimation Method = SCS Lag Method
Hydrograph Routing Method = SCS TR-20
Assumed Storm Hyetograph Distribution = Design Hyetographs

The soil class for the entire Letpadaung project site under existing conditions was assumed to be "C", loamy clay soil.

Catchments were then divided between either "Pasture - Fair" or "Brush - Good" as per Table 2.2c from *"Urban Hydrology for Small Watersheds"* .
Where a catchment was composed of a mixture of the two cover types, the curve number was calculated using an area weighted average.

Cover Description:	Brush	Pasture
Soil Type:	C	C
Hydrologic condition:	Good	Fair
SCS CN for AMC II:	65	79

Basic catchment data was then compiled for use with the above methods:

Catchment ID	Catchment Reports to Point	Catchment Area (ha)	Catchment Composite SCS CN for Antecedent Moisture Condition (AMC)			Hydraulic Length (m)	Catchment Ave. Slope (m/m)	Antecedent Moisture Condition
			AMC I	AMC II	AMC III			
BA-EX-001	CP-EX-001	175.9166	61.2	79.0	89.6	3,170.0	0.006	III
BA-EX-002	CP-EX-003	44.2642	61.2	79.0	89.6	1,910.4	0.013	III
BA-EX-003	CP-EX-004	222.0805	60.2	78.3	89.2	4,885.0	0.003	III
BA-EX-004	CP-EX-005	90.6424	57.4	76.2	88.0	1,383.7	0.011	III
BA-EX-005	CP-EX-007	272.2658	61.2	79.0	89.6	4,416.4	0.007	III
WP-EX-001P	WP-EX-001	110.5155	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-006	CP-EX-010A	366.8125	61.2	79.0	89.6	2,452.5	0.005	III
BA-EX-007	CP-EX-010D	134.5052	61.2	79.0	89.6	790.6	0.028	III
BA-EX-008	CP-EX-010B	2,128.6787	59.3	77.6	88.8	7,685.5	0.007	III
BA-EX-009	CP-EX-010C	1,054.1859	56.4	75.5	87.6	8,204.5	0.022	III
BA-EX-010	CP-EX-011	451.2104	58.3	76.9	88.4	5,214.9	0.007	III
WP-EX-002P	WP-EX-002	5.5452	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-011	CP-EX-016A	33.2129	60.2	78.3	89.2	924.2	0.022	III
BA-EX-012	CP-EX-016D	10.8962	61.2	79.0	89.6	593.6	0.008	III
BA-EX-013	CP-EX-016B	409.4391	61.2	79.0	89.6	3,758.2	0.012	III
BA-EX-014	CP-EX-016C	415.7292	61.2	79.0	89.6	3,991.2	0.005	III
WP-EX-003P	WP-EX-003	2.4404	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-015	CP-EX-019	451.2576	59.3	77.6	88.8	4,931.1	0.017	III
BA-EX-016	CP-EX-020	199.0365	61.2	79.0	89.6	2,447.1	0.007	III
WP-EX-004P	WP-EX-004	0.6419	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-017	CP-EX-024	4.6547	61.2	79.0	89.6	333.0	0.011	III
BA-EX-018	CP-EX-025	11.8689	61.2	79.0	89.6	602.4	0.003	III
BA-EX-019	CP-EX-026	97.6495	59.3	77.6	88.8	2,601.5	0.011	III
WP-EX-005P	WP-EX-005	1.5380	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-020	CP-EX-029	65.8895	60.2	78.3	89.2	1,485.6	0.012	III
BA-EX-021	CP-EX-026	102.7839	61.2	79.0	89.6	2,635.6	0.012	III
BA-EX-022	CP-EX-025	89.8874	61.2	79.0	89.6	2,654.4	0.008	III
BA-EX-023	CP-EX-031	128.2843	60.2	78.3	89.2	2,618.3	0.010	III
BA-EX-024	CP-EX-031	270.5781	56.4	75.5	87.6	3,381.9	0.008	III
BA-EX-025	CP-EX-031	36.3773	56.4	75.5	87.6	1,774.1	0.134	III
BA-EX-026	CP-EX-032	281.5133	61.2	79.0	89.6	3,262.0	0.006	III
BA-EX-027	CP-EX-033	243.5105	59.3	77.6	88.8	2,262.5	0.062	III
BA-EX-028	CP-EX-035	137.3354	58.3	76.9	88.4	3,309.2	0.060	III
BA-EX-029	CP-EX-035	84.7190	57.4	76.2	88.0	2,271.2	0.100	III
BA-EX-030	CP-EX-036	203.3458	57.4	76.2	88.0	1,811.3	0.108	III

Surface Water Existing (EX) Conditions: Estimation of loss parameters for modelling

BA-EX-031	CP-EX-037	39.3618	61.2	79.0	89.6	451.7	0.001	III
BA-EX-032	CP-EX-039	178.1041	57.4	76.2	88.0	1,928.2	0.131	III
BA-EX-033	CP-EX-044	69.1503	61.2	79.0	89.6	804.0	0.001	III
BA-EX-034	CP-EX-043	87.3353	59.3	77.6	88.8	1,394.0	0.062	III
BA-EX-035	CP-EX-045	263.7901	47.7	68.5	83.3	3,151.5	0.064	III
BA-EX-036	CP-EX-046	78.5387	55.5	74.8	87.2	1,362.1	0.170	III
BA-EX-037	CP-EX-047	259.8394	57.4	76.2	88.0	3,108.1	0.008	III
BA-EX-038	CP-EX-048	244.9021	61.2	79.0	89.6	3,341.9	0.005	III
BA-EX-039	CP-EX-051	45.4595	61.2	79.0	89.6	1,234.9	0.009	III
WP-EX-006P	WP-EX-006	23.6015	95.4	98.0	98.0	#N/A	#N/A	III
BA-EX-040	CP-EX-053	1,395.4265	57.4	76.2	88.0	9,194.3	0.009	III

The following equations are used to estimate the Time of Concentration expected for each given catchment (SCS Lag Method):

$T_c = T_L / 0.6$ $\qquad$ $T_L = ((L^{0.8}) \cdot ((S+1)^{0.7})) / (1{,}900 \cdot (Y^{0.5}))$ $\qquad$ $S = (1{,}000 / CN) - 10$

where:

T_c = time of concentration (hr);

T_L = lag time (hr);

L = hydraulic length of watershed (ft);

S = maximum soil water retention (in) - note this is taken at AMC II conditions;

CN = area-weighted SCS curve number (at AMC II conditions); and

Y = average catchment slope (%).

Catchment times of concentration are estimated as:

Catchment ID	Catchment Reports to Point	Hyd. Length L (ft)	AMC II CN	Max Ret. S (in)	Ave. Slope Y (%)	Lag Time T_L (h)	Time of Concentration T_c (h)	Time of Concentration T_c (min)
BA-EX-001	CP-EX-001	10,400	79.0	2.7	0.6	2.69	4.5	268.6
BA-EX-002	CP-EX-003	6,268	79.0	2.7	1.3	1.24	2.1	124.4
BA-EX-003	CP-EX-004	16,027	78.3	2.8	0.3	5.56	9.3	556.0
BA-EX-004	CP-EX-005	4,540	76.2	3.1	1.1	1.15	1.9	114.8
BA-EX-005	CP-EX-007	14,490	79.0	2.7	0.7	3.38	5.6	337.6
WP-EX-001P	WP-EX-001	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-006	CP-EX-010A	8,046	79.0	2.7	0.5	2.48	4.1	248.4
BA-EX-007	CP-EX-010D	2,594	79.0	2.7	2.8	0.42	0.7	42.1
BA-EX-008	CP-EX-010B	25,215	77.6	2.9	0.7	5.50	9.2	549.7
BA-EX-009	CP-EX-010C	26,918	75.5	3.2	2.2	3.40	5.7	340.2
BA-EX-010	CP-EX-011	17,109	76.9	3.0	0.7	4.02	6.7	401.9
WP-EX-002P	WP-EX-002	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-011	CP-EX-016A	3,032	78.3	2.8	2.2	0.55	0.9	55.3
BA-EX-012	CP-EX-016D	1,948	79.0	2.7	0.8	0.61	1.0	60.9
BA-EX-013	CP-EX-016B	12,330	79.0	2.7	1.2	2.23	3.7	223.5
BA-EX-014	CP-EX-016C	13,094	79.0	2.7	0.5	3.54	5.9	353.7
WP-EX-003P	WP-EX-003	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-015	CP-EX-019	16,178	77.6	2.9	1.7	2.44	4.1	244.4
BA-EX-016	CP-EX-020	8,028	79.0	2.7	0.7	2.08	3.5	208.1
WP-EX-004P	WP-EX-004	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-017	CP-EX-024	1,092	79.0	2.7	1.1	0.34	0.6	34.3
BA-EX-018	CP-EX-025	1,976	79.0	2.7	0.3	0.98	1.6	98.1
BA-EX-019	CP-EX-026	8,535	77.6	2.9	1.1	1.80	3.0	180.0
WP-EX-005P	WP-EX-005	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-020	CP-EX-029	4,874	78.3	2.8	1.2	1.08	1.8	108.0
BA-EX-021	CP-EX-026	8,647	79.0	2.7	1.2	1.68	2.8	168.4
BA-EX-022	CP-EX-025	8,709	79.0	2.7	0.8	2.07	3.5	207.2
BA-EX-023	CP-EX-031	8,590	78.3	2.8	1.0	1.91	3.2	191.4
BA-EX-024	CP-EX-031	11,096	75.5	3.2	0.8	2.84	4.7	284.4
BA-EX-025	CP-EX-031	5,821	75.5	3.2	13.4	0.41	0.7	40.7

Surface Water Existing (EX) Conditions: Estimation of loss parameters for modelling

BA-EX-026	CP-EX-032	10,702	79.0	2.7	0.6	2.94	4.9	293.9
BA-EX-027	CP-EX-033	7,423	77.6	2.9	6.2	0.68	1.1	68.3
BA-EX-028	CP-EX-035	10,857	76.9	3.0	6.0	0.96	1.6	95.9
BA-EX-029	CP-EX-035	7,451	76.2	3.1	10.0	0.56	0.9	56.3
BA-EX-030	CP-EX-036	5,942	76.2	3.1	10.8	0.45	0.8	45.2
BA-EX-031	CP-EX-037	1,482	79.0	2.7	0.1	1.42	2.4	142.0
BA-EX-032	CP-EX-039	6,326	76.2	3.1	13.1	0.43	0.7	43.1
BA-EX-033	CP-EX-044	2,638	79.0	2.7	0.1	2.25	3.8	225.2
BA-EX-034	CP-EX-043	4,573	77.6	2.9	6.2	0.46	0.8	46.5
BA-EX-035	CP-EX-045	10,340	68.5	4.6	6.4	1.13	1.9	112.7
BA-EX-036	CP-EX-046	4,469	74.8	3.4	17.0	0.30	0.5	29.9
BA-EX-037	CP-EX-047	10,197	76.2	3.1	0.8	2.58	4.3	258.3
BA-EX-038	CP-EX-048	10,964	79.0	2.7	0.5	3.17	5.3	316.8
BA-EX-039	CP-EX-051	4,051	79.0	2.7	0.9	1.04	1.7	104.0
WP-EX-006P	WP-EX-006	#N/A	98.0	0.2	#N/A	0.06	0.1	6.0
BA-EX-040	CP-EX-053	30,165	76.2	3.1	0.9	5.83	9.7	583.1

(Note: a minimum 6 minute time of concentration was assumed for all water pool areas: WP-EX-001P, WP-EX-002P, etc.)

With the sub-catchment times of concentration estimated, a hydrologic model for the study area was prepared. HEC-HMS software was used for this effort and the following additional assumptions were made:

Antecedent Moisture Condition = AMC III

Design Storms = 100-yr, 6-h

100-yr, 48-h

Surface Water Planned (PL) Conditions: Estimation of loss parameters for modelling

The peak flow rate resulting from the selected design storm under planned conditions is estimated. The following methods were employed for this effort:

Runoff Estimation Method = SCS Curve Number
Time of Concentration Estimation Method = SCS Lag Method
Hydrograph Routing Method = SCS TR-20
Assumed Storm Hyetograph Distribution = Design Hyetographs

The soil class for the entire Letpadaung project site, under planned conditions was assumed to be "C", loamy clay soil.

Catchments were then divided between either "Pasture - Fair" or "Brush - Good" as per Table 2.2c from *"Urban Hydrology for Small Watersheds"* . Where a catchment was composed of a mixture of the two cover types, the curve number was calculated using an area weighted average.

Cover Description:	Natural Vegetation	Farmland	Developed Areas	Leach Pad	Water Pond
Cover Description:	Brush	Pasture	Newly graded areas (no vegetation)	Newly graded areas (no vegetation)	N/A
Soil Type:	C	C	C	A	N/A
Hydrologic condition:	Good	Fair	N/A	N/A	N/A
SCS CN for AMC II:	65	79	91	77	98

Basic catchment data was then compiled for use with the above methods:

Catchment ID	**Catchment Reports to Point**	**Catchment Area (ha)**	**Catchment Composite SCS CN for Antecedent Moisture Condition (AMC)**			**Hydraulic Length (m)**	**Catchment Ave. Slope (m/m)**	**Antecedent Moisture Condition**
			AMC I	**AMC II**	**AMC III**			
BA-PL-001	CP-PL-001	175.9166	61.2	79.0	89.6	3,170.0	0.006	III
BA-PL-002	CP-PL-003	44.2642	61.2	79.0	89.6	1,910.4	0.013	III
BA-PL-003	CP-PL-004	222.0805	60.2	78.3	89.2	4,885.0	0.003	III
BA-PL-004	CP-PL-005	90.6424	57.4	76.2	88.0	1,383.7	0.011	III
BA-PL-005	CP-PL-007	272.2658	61.2	79.0	89.6	4,416.4	0.007	III
WP-PL-001P	CP-PL-009	110.5155	95.4	98.0	98.0	N/A	N/A	III
BA-PL-006	CP-PL-010A	366.8125	61.2	79.0	89.6	2,452.5	0.005	III
BA-PL-007	CP-PL-010D	134.5052	61.2	79.0	89.6	790.6	0.028	III
BA-PL-008	CP-PL-010B	2,128.6787	59.3	77.6	88.8	7,685.5	0.007	III
BA-PL-009	CP-PL-010C	1,054.1859	56.4	75.5	87.6	8,204.5	0.022	III
BA-PL-010	CP-PL-013	447.6518	60.0	78.1	89.1	4,119.4	0.009	III
WP-PL-002P	CP-PL-015	5.5452	95.4	98.0	98.0	N/A	N/A	III
BA-PL-011	CP-PL-016A	33.2129	60.2	78.3	89.2	924.2	0.022	III
BA-PL-012	CP-PL-016C	8.4539	61.2	79.0	89.6	367.3	0.004	III
BA-PL-013	CP-PL-017	145.4770	58.3	76.9	88.4	2,383.1	0.015	III
BA-PL-014	CP-PL-018	201.2272	59.3	77.6	88.8	2,693.1	0.014	III
BA-PL-015	CP-PL-018	39.7289	61.2	79.0	89.6	1,370.2	0.013	III
BA-PL-016	CP-PL-020	65.5815	61.2	79.0	89.6	2,434.1	0.004	III
WP-PL-003P	CP-PL-021	0.6419	95.4	98.0	98.0	N/A	N/A	III
BA-PL-017	CP-PL-022	2.1624	61.2	79.0	89.6	284.5	0.011	III
BA-PL-018	CP-PL-020	2.8674	61.2	79.0	89.6	69.0	0.005	III
BA-PL-019	CP-PL-023	15.6214	61.2	79.0	89.6	71.7	0.005	III
BA-PL-020	CP-PL-024	9.5835	61.2	79.0	89.6	77.6	0.005	III
BA-PL-021	CP-PL-026	3.0936	80.9	91.0	95.9	30.0	0.005	III
BA-PL-022	CP-PL-027	7.1155	80.9	91.0	95.9	70.0	0.005	III
BA-PL-023	CP-PL-028	9.2567	80.9	91.0	95.9	70.0	0.005	III
BA-PL-024	CP-PL-030	21.7268	61.2	79.0	89.6	641.5	0.016	III
BA-PL-025	CP-PL-031	79.9501	60.2	78.3	89.2	450.7	0.010	III
BA-PL-026	CP-PL-032	166.0356	63.9	80.8	90.6	1,352.5	0.010	III
WP-PL-004P	CP-PL-034	2.4404	95.4	98.0	98.0	N/A	N/A	III
BA-PL-027	CP-PL-035	451.2576	59.3	77.6	88.8	4,931.1	0.017	III
BA-PL-028	CP-PL-030	9.5861	61.2	79.0	89.6	557.1	0.025	III
BA-PL-029	CP-PL-030	43.7933	60.2	78.3	89.2	1,392.2	0.032	III

Surface Water Planned (PL) Conditions: Estimation of loss parameters for modelling

BA-PL-030	CP-PL-038	105.8290	60.2	78.3	89.2	1,737.2	0.008	III
BA-PL-031	CP-PL-025	17.2394	65.7	82.0	91.3	153.2	0.005	III
WP-PL-005/006P	CP-PL-040	146.0679	95.4	98.0	98.0	N/A	N/A	III
WP-PL-007P	CP-PL-042B	71.6789	95.4	98.0	98.0	N/A	N/A	III
BA-PL-032	CP-PL-042A	63.1434	80.9	91.0	95.9	1,498.4	0.002	III
BA-PL-033	CP-PL-044	438.0285	58.4	77.0	88.5	795.2	0.106	III
BA-PL-034	CP-PL-045	442.8296	58.4	77.0	88.5	818.8	0.103	III
BA-PL-035	CP-PL-042C	49.3441	80.9	91.0	95.9	1,014.7	0.004	III
BA-PL-036	CP-PL-046	78.3403	80.9	91.0	95.9	1,145.3	0.111	III
BA-PL-037	CP-PL-048	62.3393	80.9	91.0	95.9	511.9	0.235	III
BA-PL-038	CP-PL-049	82.0277	59.8	78.0	89.1	1,573.8	0.123	III
BA-PL-039	CP-PL-051	49.5972	69.6	84.5	92.6	1,167.8	0.158	III
BA-PL-040	CP-PL-052	11.6139	52.9	72.8	86.0	738.2	0.233	III
BA-PL-041	CP-PL-058	107.6777	71.7	85.8	93.3	625.3	0.334	III
WP-PL-008P	CP-PL-055	10.0232	95.4	98.0	98.0	N/A	N/A	III
BA-PL-042	CP-PL-057	45.8602	80.9	91.0	95.9	308.0	0.227	III
BA-PL-043	CP-PL-056B	54.2571	80.9	91.0	95.9	1,004.9	0.144	III
BA-PL-044	CP-PL-059	59.3838	80.9	91.0	95.9	634.2	0.118	III
BA-PL-045	CP-PL-060	182.3637	80.9	91.0	95.9	240.2	0.283	III
BA-PL-046	CP-PL-061	37.7778	69.6	84.5	92.6	1,741.3	0.032	III
BA-PL-047	CP-PL-063	75.1868	80.9	91.0	95.9	358.8	0.421	III
BA-PL-048	CP-PL-064	38.6927	80.9	91.0	95.9	159.2	0.459	III
BA-PL-049	CP-PL-065	17.7913	80.9	91.0	95.9	46.3	0.005	III
BA-PL-050	CP-PL-067	19.1014	80.9	91.0	95.9	153.8	0.005	III
BA-PL-051	CP-PL-068	11.5504	80.9	91.0	95.9	844.0	0.005	III
BA-PL-052	CP-PL-069	46.0531	80.9	91.0	95.9	841.1	0.045	III
BA-PL-053	CP-PL-070	13.7832	69.6	84.5	92.6	719.9	0.090	III
BA-PL-054	CP-PL-072	28.0652	58.0	76.7	88.3	433.4	0.300	III
BA-PL-055	CP-PL-073	18.6877	49.7	70.2	84.4	890.6	0.184	III
BA-PL-056	CP-PL-074	16.1208	80.9	91.0	95.9	74.3	0.605	III
BA-PL-057	CP-PL-076	43.3901	74.4	87.4	94.1	975.2	0.017	III
BA-PL-058	CP-PL-077	76.4254	80.9	91.0	95.9	1,249.8	0.010	III
BA-PL-059	CP-PL-078	251.7544	63.0	80.2	90.3	3,341.9	0.005	III
BA-PL-060	CP-PL-081	48.9104	61.2	79.0	89.6	1,234.9	0.009	III
WP-PL-009P	CP-PL-082	23.6015	95.4	98.0	98.0	N/A	N/A	III
BA-PL-061	CP-PL-083	1,395.4265	57.4	76.2	88.0	9,194.3	0.009	III

The following equations are used to estimate the Time of Concentration expected for each given catchment (SCS Lag Method):

$T_c = T_L / 0.6$ $\qquad$ $T_L = ((L^{0.8}) \cdot ((S+1)^{0.7})) / (1,900 \cdot (Y^{0.5}))$ $\qquad$ $S = (1,000 / CN) - 10$

where:

T_c = time of concentration (hr);
T_L = lag time (hr);
L = hydraulic length of watershed (ft);
S = maximum soil water retention (in) - note this is taken at AMC II conditions;
CN = area-weighted SCS curve number (at AMC II conditions); and
Y = average catchment slope (%).

Catchment times of concentration are estimated as:

Catchment ID	Catchment Reports to Point	Hyd. Length L (ft)	AMC II CN	Max Ret. S (in)	Ave. Slope Y (%)	Lag Time T_L (hr)	Time of Concentration T_c (hr)	(min)
BA-PL-001	CP-PL-001	10,400	79.0	2.7	0.6	2.69	4.5	268.6
BA-PL-002	CP-PL-003	6,268	79.0	2.7	1.3	1.24	2.1	124.4
BA-PL-003	CP-PL-004	16,027	78.3	2.8	0.3	5.56	9.3	556.0
BA-PL-004	CP-PL-005	4,540	76.2	3.1	1.1	1.15	1.9	114.8
BA-PL-005	CP-PL-007	14,490	79.0	2.7	0.7	3.38	5.6	337.6

Surface Water Planned (PL) Conditions: Estimation of loss parameters for modelling

WP-PL-001P	CP-PL-009	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-006	CP-PL-010A	8,046	79.0	2.7	0.5	2.48	4.1	248.4
BA-PL-007	CP-PL-010D	2,594	79.0	2.7	2.8	0.42	0.7	42.1
BA-PL-008	CP-PL-010B	25,215	77.6	2.9	0.7	5.50	9.2	549.7
BA-PL-009	CP-PL-010C	26,918	75.5	3.2	2.2	3.40	5.7	340.2
BA-PL-010	CP-PL-013	13,515	78.1	2.8	0.9	2.78	4.6	277.9
WP-PL-002P	CP-PL-015	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-011	CP-PL-016A	3,032	78.3	2.8	2.2	0.55	0.9	55.3
BA-PL-012	CP-PL-016C	1,205	79.0	2.7	0.4	0.60	1.0	59.5
BA-PL-013	CP-PL-017	7,818	76.9	3.0	1.5	1.49	2.5	149.3
BA-PL-014	CP-PL-018	8,836	77.6	2.9	1.4	1.66	2.8	165.6
BA-PL-015	CP-PL-018	4,496	79.0	2.7	1.3	0.97	1.6	96.5
BA-PL-016	CP-PL-020	7,986	79.0	2.7	0.4	2.70	4.5	269.5
WP-PL-003P	CP-PL-021	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-017	CP-PL-022	933	79.0	2.7	1.1	0.30	0.5	30.2
BA-PL-018	CP-PL-020	226	79.0	2.7	0.5	0.14	0.2	14.1
BA-PL-019	CP-PL-023	235	79.0	2.7	0.5	0.15	0.2	14.6
BA-PL-020	CP-PL-024	255	79.0	2.7	0.5	0.16	0.3	15.5
BA-PL-021	CP-PL-026	98	91.0	1.0	0.5	0.05	0.1	6.0
BA-PL-022	CP-PL-027	230	91.0	1.0	0.5	0.09	0.2	9.3
BA-PL-023	CP-PL-028	230	91.0	1.0	0.5	0.09	0.2	9.3
BA-PL-024	CP-PL-030	2,105	79.0	2.7	1.6	0.46	0.8	46.5
BA-PL-025	CP-PL-031	1,479	78.3	2.8	1.0	0.46	0.8	45.8
BA-PL-026	CP-PL-032	4,437	80.8	2.4	1.0	1.04	1.7	104.1
WP-PL-004P	CP-PL-034	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-027	CP-PL-035	16,178	77.6	2.9	1.7	2.46	4.1	245.8
BA-PL-028	CP-PL-030	1,828	79.0	2.7	2.5	0.33	0.6	33.5
BA-PL-029	CP-PL-030	4,568	78.3	2.8	3.2	0.63	1.1	63.5
BA-PL-030	CP-PL-038	5,700	78.3	2.8	0.8	1.46	2.4	146.2
BA-PL-031	CP-PL-025	503	82.0	2.2	0.5	0.24	0.4	24.3
WP-PL-005/006P	CP-PL-040	N/A	98.0	0.2	N/A	0.06	0.1	6.0
WP-PL-007P	CP-PL-042B	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-032	CP-PL-042A	4,916	91.0	1.0	0.2	1.71	2.8	170.9
BA-PL-033	CP-PL-044	2,609	77.0	3.0	10.6	0.23	0.4	23.1
BA-PL-034	CP-PL-045	2,686	77.0	3.0	10.3	0.24	0.4	24.0
BA-PL-035	CP-PL-042C	3,329	91.0	1.0	0.4	0.89	1.5	89.2
BA-PL-036	CP-PL-046	3,758	91.0	1.0	11.1	0.19	0.3	18.5
BA-PL-037	CP-PL-048	1,680	91.0	1.0	23.5	0.07	0.1	6.7
BA-PL-038	CP-PL-049	5,163	78.0	2.8	12.3	0.36	0.6	35.9
BA-PL-039	CP-PL-051	3,831	84.5	1.8	15.8	0.20	0.3	20.2
BA-PL-040	CP-PL-052	2,422	72.8	3.7	23.3	0.17	0.3	16.5
BA-PL-041	CP-PL-058	2,052	85.8	1.7	33.4	0.08	0.1	8.0
WP-PL-008P	CP-PL-055	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-042	CP-PL-057	1,011	91.0	1.0	22.7	0.05	0.1	6.0
BA-PL-043	CP-PL-056B	3,297	91.0	1.0	14.4	0.15	0.2	14.6
BA-PL-044	CP-PL-059	2,081	91.0	1.0	11.8	0.11	0.2	11.2
BA-PL-045	CP-PL-060	788	91.0	1.0	28.3	0.03	0.1	6.0
BA-PL-046	CP-PL-061	5,713	84.5	1.8	3.2	0.62	1.0	62.2
BA-PL-047	CP-PL-063	1,177	91.0	1.0	42.1	0.04	0.1	6.0
BA-PL-048	CP-PL-064	522	91.0	1.0	45.9	0.02	0.1	6.0
BA-PL-049	CP-PL-065	152	91.0	1.0	0.5	0.07	0.1	6.7
BA-PL-050	CP-PL-067	505	91.0	1.0	0.5	0.18	0.3	17.5
BA-PL-051	CP-PL-068	2,769	91.0	1.0	0.5	0.68	1.1	68.3
BA-PL-052	CP-PL-069	2,760	91.0	1.0	4.5	0.23	0.4	22.8
BA-PL-053	CP-PL-070	2,362	84.5	1.8	9.0	0.18	0.3	18.2
BA-PL-054	CP-PL-072	1,422	76.7	3.0	30.0	0.08	0.1	8.5
BA-PL-055	CP-PL-073	2,922	70.2	4.2	18.4	0.23	0.4	23.2

Surface Water Planned (PL) Conditions: Estimation of loss parameters for modelling

BA-PL-056	CP-PL-074	244	91.0	1.0	60.5	0.01	0.1	6.0
BA-PL-057	CP-PL-076	3,199	87.4	1.4	1.7	0.47	0.8	47.4
BA-PL-058	CP-PL-077	4,100	91.0	1.0	1.0	0.65	1.1	64.9
BA-PL-059	CP-PL-078	10,964	80.2	2.5	0.5	3.10	5.2	309.9
BA-PL-060	CP-PL-081	4,051	79.0	2.7	0.9	1.04	1.7	104.0
WP-PL-009P	CP-PL-082	N/A	98.0	0.2	N/A	0.06	0.1	6.0
BA-PL-061	CP-PL-083	30,165	76.2	3.1	0.9	5.83	9.7	583.1

(Note: a minimum 6 minute time of concentration was assumed for all water pool areas: WP-PL-001P, WP-PL-002P, etc.)

With the sub-catchment times of concentration estimated, a hydrologic model for the study area was prepared. HEC-HMS software was used for this effort and the following additional assumptions were made:

Antecedent Moisture Condition = AMC III

Design Storms = 100-yr, 6-h
100-yr, 48-h

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m	Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m	Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
103.0	0	0	#N/A	0.0	#N/A	#N/A	0.0
103.1	18,844	1,677	#N/A	0.0	#N/A	#N/A	0.0
103.2	22,962	3,768	#N/A	0.0	#N/A	#N/A	0.0
103.3	27,042	6,268	#N/A	0.0	#N/A	#N/A	0.0
103.4	31,085	9,175	#N/A	0.0	#N/A	#N/A	0.0
103.5	35,091	12,484	#N/A	0.0	#N/A	#N/A	0.0
103.6	39,058	16,192	#N/A	0.0	#N/A	#N/A	0.0
103.7	42,989	20,294	#N/A	0.0	#N/A	#N/A	0.0
103.8	46,881	24,788	#N/A	0.0	#N/A	#N/A	0.0
103.9	50,736	29,669	#N/A	0.0	#N/A	#N/A	0.0
104.0	54,519	34,933	#N/A	0.0	#N/A	#N/A	0.0
104.1	67,628	41,464	#N/A	0.0	#N/A	#N/A	0.0
104.2	72,442	48,466	#N/A	0.0	#N/A	#N/A	0.0
104.3	77,476	55,960	#N/A	0.0	#N/A	#N/A	0.0
104.4	82,718	63,968	#N/A	0.0	#N/A	#N/A	0.0
104.5	88,160	72,510	#N/A	0.0	#N/A	#N/A	0.0
104.6	93,801	81,607	#N/A	0.0	#N/A	#N/A	0.0
104.7	99,642	91,277	#N/A	0.0	#N/A	#N/A	0.0
104.8	105,683	101,542	#N/A	0.0	#N/A	#N/A	0.0
104.9	111,923	112,420	#N/A	0.0	#N/A	#N/A	0.0
105.0	118,368	123,933	#N/A	0.0	#N/A	#N/A	0.0
105.1	133,673	136,908	#N/A	0.0	#N/A	#N/A	0.0
105.2	141,633	150,673	#N/A	0.0	#N/A	#N/A	0.0
105.3	149,738	165,240	#N/A	0.0	#N/A	#N/A	0.0
105.4	157,989	180,625	#N/A	0.0	#N/A	#N/A	0.0
105.5	166,385	196,843	#N/A	0.0	#N/A	#N/A	0.0
105.6	174,927	213,907	#N/A	0.0	#N/A	#N/A	0.0
105.7	183,623	231,833	#N/A	0.0	#N/A	#N/A	0.0
105.8	192,478	250,637	#N/A	0.0	#N/A	#N/A	0.0
105.9	201,494	270,334	#N/A	0.0	#N/A	#N/A	0.0
106.0	210,670	290,941	#N/A	0.0	#N/A	#N/A	0.0
106.1	219,765	312,487	#N/A	0.0	#N/A	#N/A	0.0
106.2	228,409	334,895	#N/A	0.0	#N/A	#N/A	0.0
106.3	237,095	358,170	#N/A	0.0	#N/A	#N/A	0.0
106.4	245,823	382,316	#N/A	0.0	#N/A	#N/A	0.0
106.5	254,597	407,336	#N/A	0.0	#N/A	#N/A	0.0
106.6	263,423	433,237	#N/A	0.0	#N/A	#N/A	0.0
106.7	272,300	460,023	#N/A	0.0	#N/A	#N/A	0.0
106.8	281,230	487,699	#N/A	0.0	#N/A	#N/A	0.0
106.9	290,211	516,270	#N/A	0.0	#N/A	#N/A	0.0
107.0	299,243	545,743	#N/A	0.0	#N/A	#N/A	0.0
107.1	308,849	576,160	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m	Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m	Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
107.2	318,267	607,515	#N/A	0.0	#N/A	#N/A	0.0
107.3	327,766	639,816	#N/A	0.0	#N/A	#N/A	0.0
107.4	337,348	673,071	#N/A	0.0	#N/A	#N/A	0.0
107.5	347,011	707,288	#N/A	0.0	#N/A	#N/A	0.0
107.6	356,752	742,476	#N/A	0.0	#N/A	#N/A	0.0
107.7	366,572	778,641	#N/A	0.0	#N/A	#N/A	0.0
107.8	376,470	815,793	#N/A	0.0	#N/A	#N/A	0.0
107.9	386,446	853,938	#N/A	0.0	#N/A	#N/A	0.0
108.0	396,500	893,085	#N/A	0.0	#N/A	#N/A	0.0
108.1	416,267	934,313	#N/A	0.0	#N/A	#N/A	0.0
108.2	424,227	976,338	#N/A	0.0	#N/A	#N/A	0.0
108.3	432,184	1,019,159	#N/A	0.0	#N/A	#N/A	0.0
108.4	440,134	1,062,775	#N/A	0.0	#N/A	#N/A	0.0
108.5	448,078	1,107,185	#N/A	0.0	#N/A	#N/A	0.0
108.6	456,016	1,152,390	#N/A	0.0	#N/A	#N/A	0.0
108.7	463,948	1,198,388	#N/A	0.0	#N/A	#N/A	0.0
108.8	471,874	1,245,179	#N/A	0.0	#N/A	#N/A	0.0
108.9	479,795	1,292,763	#N/A	0.0	#N/A	#N/A	0.0
109.0	487,711	1,341,138	#N/A	0.0	#N/A	#N/A	0.0
109.1	499,121	1,390,644	#N/A	0.0	#N/A	#N/A	0.0
109.2	507,216	1,440,961	#N/A	0.0	#N/A	#N/A	0.0
109.3	515,268	1,492,085	#N/A	0.0	#N/A	#N/A	0.0
109.4	523,277	1,544,013	#N/A	0.0	#N/A	#N/A	0.0
109.5	531,243	1,596,739	#N/A	0.0	#N/A	#N/A	0.0
109.6	539,165	1,650,260	#N/A	0.0	#N/A	#N/A	0.0
109.7	547,045	1,704,571	#N/A	0.0	#N/A	#N/A	0.0
109.8	554,882	1,759,668	#N/A	0.0	#N/A	#N/A	0.0
109.9	562,677	1,815,546	#N/A	0.0	#N/A	#N/A	0.0
110.0	570,430	1,872,202	#N/A	0.0	#N/A	#N/A	0.0
110.1	579,682	1,929,725	#N/A	0.0	#N/A	#N/A	0.0
110.2	588,947	1,988,153	#N/A	0.0	#N/A	#N/A	0.0
110.3	598,641	2,047,528	#N/A	0.0	#N/A	#N/A	0.0
110.4	608,766	2,107,895	#N/A	0.0	#N/A	#N/A	0.0
110.5	619,321	2,169,296	#N/A	0.0	#N/A	#N/A	0.0
110.6	630,300	2,231,773	#N/A	0.0	#N/A	#N/A	0.0
110.7	641,699	2,295,370	#N/A	0.0	#N/A	#N/A	0.0
110.8	653,517	2,360,127	#N/A	0.0	#N/A	#N/A	0.0
110.9	665,754	2,426,087	#N/A	0.0	#N/A	#N/A	0.0
111.0	678,439	2,493,293	#N/A	0.0	#N/A	#N/A	0.0
111.1	700,936	2,562,582	#N/A	0.0	#N/A	#N/A	0.0
111.2	716,957	2,633,477	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m		Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
111.3	732,889	2,705,970	#N/A	0.0	#N/A	#N/A	0.0
111.4	748,733	2,780,052	#N/A	0.0	#N/A	#N/A	0.0
111.5	764,490	2,855,714	#N/A	0.0	#N/A	#N/A	0.0
111.6	780,161	2,932,947	#N/A	0.0	#N/A	#N/A	0.0
111.7	795,751	3,011,743	#N/A	0.0	#N/A	#N/A	0.0
111.8	811,261	3,092,095	#N/A	0.0	#N/A	#N/A	0.0
111.9	826,692	3,173,993	#N/A	0.0	#N/A	#N/A	0.0
112.0	842,047	3,257,431	#N/A	0.0	#N/A	#N/A	0.0
112.1	866,642	3,343,247	#N/A	0.0	#N/A	#N/A	0.0
112.2	883,641	3,430,760	#N/A	0.0	#N/A	#N/A	0.0
112.3	900,682	3,519,976	#N/A	0.0	#N/A	#N/A	0.0
112.4	917,754	3,610,898	#N/A	0.0	#N/A	#N/A	0.0
112.5	934,856	3,703,528	#N/A	0.0	#N/A	#N/A	0.0
112.6	951,988	3,797,870	#N/A	0.0	#N/A	#N/A	0.0
112.7	969,163	3,893,927	#N/A	0.0	#N/A	#N/A	0.0
112.8	986,394	3,991,704	#N/A	0.0	#N/A	#N/A	0.0
112.9	1,003,681	4,091,208	#N/A	0.0	#N/A	#N/A	0.0
113.0	1,021,024	4,192,443	#N/A	0.0	#N/A	#N/A	0.0
113.1	1,043,183	4,295,805	#N/A	0.0	#N/A	#N/A	0.0
113.2	1,061,974	4,401,066	#N/A	0.0	#N/A	#N/A	0.0
113.3	1,080,373	4,508,187	#N/A	0.0	#N/A	#N/A	0.0
113.4	1,098,472	4,617,130	#N/A	0.0	#N/A	#N/A	0.0
113.5	1,116,472	4,727,878	#N/A	0.0	#N/A	#N/A	0.0
113.6	1,134,379	4,840,421	#N/A	0.0	#N/A	#N/A	0.0
113.7	1,151,985	4,954,743	#N/A	0.0	#N/A	#N/A	0.0
113.8	1,169,344	5,070,811	#N/A	0.0	#N/A	#N/A	0.0
113.9	1,186,501	5,188,605	#N/A	0.0	#N/A	#N/A	0.0
114.0	1,203,688	5,308,110	#N/A	0.0	#N/A	#N/A	0.0
114.1	1,234,448	5,430,671	#N/A	0.0	#N/A	#N/A	0.0
114.2	1,252,103	5,554,999	#N/A	0.0	#N/A	#N/A	0.0
114.3	1,269,744	5,681,091	#N/A	0.0	#N/A	#N/A	0.0
114.4	1,287,367	5,808,947	#N/A	0.0	#N/A	#N/A	0.0
114.5	1,304,966	5,938,564	#N/A	0.0	#N/A	#N/A	0.0
114.6	1,322,507	6,069,938	#N/A	0.0	#N/A	#N/A	0.0
114.7	1,339,959	6,203,063	#N/A	0.0	#N/A	#N/A	0.0
114.8	1,357,316	6,337,926	#N/A	0.0	#N/A	#N/A	0.0
114.9	1,374,695	6,474,527	#N/A	0.0	#N/A	#N/A	0.0
115.0	1,392,101	6,612,866	#N/A	0.0	#N/A	#N/A	0.0
115.1	1,448,887	6,756,472	#N/A	0.0	#N/A	#N/A	0.0
115.2	1,474,672	6,902,649	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m	Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m	Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
115.3	1,500,607	7,051,411	#N/A	0.0	#N/A	#N/A	0.0
115.4	1,526,692	7,202,775	#N/A	0.0	#N/A	#N/A	0.0
115.5	1,552,931	7,356,755	#N/A	0.0	#N/A	#N/A	0.0
115.6	1,579,327	7,513,366	#N/A	0.0	#N/A	#N/A	0.0
115.7	1,605,879	7,672,625	#N/A	0.0	#N/A	#N/A	0.0
115.8	1,632,591	7,834,548	#N/A	0.0	#N/A	#N/A	0.0
115.9	1,659,468	7,999,149	#N/A	0.0	#N/A	#N/A	0.0
116.0	1,686,516	8,166,447	#N/A	0.0	#N/A	#N/A	0.0
116.1	1,725,666	8,337,505	1.490	0.2	#N/A	#N/A	0.2
116.2	1,755,791	8,511,578	1.490	0.7	#N/A	#N/A	0.7
116.3	1,785,869	8,688,662	1.450	1.2	#N/A	#N/A	1.2
116.4	1,815,891	8,868,750	1.460	1.8	#N/A	#N/A	1.8
116.5	1,845,839	9,051,837	1.450	2.6	#N/A	#N/A	2.6
116.6	1,875,711	9,237,916	1.450	3.4	#N/A	#N/A	3.4
116.7	1,905,508	9,426,977	1.450	4.2	#N/A	#N/A	4.2
116.8	1,935,229	9,619,015	1.450	5.2	#N/A	#N/A	5.2
116.9	1,964,845	9,814,020	1.450	6.2	#N/A	#N/A	6.2
117.0	1,994,242	10,011,976	1.450	7.3	#N/A	#N/A	7.3
117.1	2,029,941	10,213,456	1.450	8.4	#N/A	#N/A	8.4
117.2	2,060,345	10,417,969	1.450	9.5	#N/A	#N/A	9.5
117.3	2,090,902	10,625,530	1.450	10.7	#N/A	#N/A	10.7
117.4	2,121,575	10,836,153	1.450	12.0	#N/A	#N/A	12.0
117.5	2,152,347	11,049,849	1.450	13.3	#N/A	#N/A	13.3
117.6	2,183,217	11,266,626	1.450	14.7	#N/A	#N/A	14.7
117.7	2,214,185	11,486,495	1.450	16.1	#N/A	#N/A	16.1
117.8	2,245,243	11,709,466	1.450	17.5	#N/A	#N/A	17.5
117.9	2,276,369	11,935,546	1.450	19.0	#N/A	#N/A	19.0
118.0	2,307,561	12,164,742	1.450	20.5	#N/A	#N/A	20.5
118.5	2,463,523	13,310,722	1.450	28.7	#N/A	#N/A	28.7
119.0	2,619,485	14,456,702	1.450	37.7	#N/A	#N/A	37.7
119.5	2,775,446	15,602,682	1.450	47.5	#N/A	#N/A	47.5
120.0	2,931,408	16,748,662	1.450	58.0	#N/A	#N/A	58.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-002

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	10.0	m	Dam crest length is:	#N/A	m
Assume spillway crest breadth is:	>4.5	m	Dam crest breadth is:	5.0	m
Assume spillway invert elevation is:	99.0	m	Dam crest invert elevation is:	101.0	m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
98.1	0	0	#N/A	0.0	#N/A	#N/A	0.0
98.2	1,639	84	#N/A	0.0	#N/A	#N/A	0.0
98.3	3,697	344	#N/A	0.0	#N/A	#N/A	0.0
98.4	6,403	845	#N/A	0.0	#N/A	#N/A	0.0
98.5	9,535	1,638	#N/A	0.0	#N/A	#N/A	0.0
98.6	18,037	3,063	#N/A	0.0	#N/A	#N/A	0.0
98.7	27,273	5,305	#N/A	0.0	#N/A	#N/A	0.0
98.8	34,242	8,373	#N/A	0.0	#N/A	#N/A	0.0
98.9	42,587	12,213	#N/A	0.0	#N/A	#N/A	0.0
99.0	50,234	16,868	#N/A	0.0	#N/A	#N/A	0.0
99.1	56,839	22,225	1.490	0.5	#N/A	#N/A	0.5
99.2	63,405	28,235	1.490	1.3	#N/A	#N/A	1.3
99.3	70,343	34,918	1.450	2.4	#N/A	#N/A	2.4
99.4	77,420	42,303	1.460	3.7	#N/A	#N/A	3.7
99.5	84,269	50,386	1.450	5.1	#N/A	#N/A	5.1
99.6	91,194	59,159	1.450	6.7	#N/A	#N/A	6.7
99.7	97,897	68,617	1.450	8.5	#N/A	#N/A	8.5
99.8	104,308	78,729	1.450	10.4	#N/A	#N/A	10.4
99.9	112,914	89,573	1.450	12.4	#N/A	#N/A	12.4
100.0	123,069	101,379	1.450	14.5	#N/A	#N/A	14.5
100.1	133,890	114,217	1.450	16.7	#N/A	#N/A	16.7
100.2	145,510	128,183	1.450	19.1	#N/A	#N/A	19.1
100.3	157,636	143,337	1.450	21.5	#N/A	#N/A	21.5
100.4	170,334	159,731	1.450	24.0	#N/A	#N/A	24.0
100.5	183,952	177,436	1.450	26.6	#N/A	#N/A	26.6
100.6	200,227	196,613	1.450	29.3	#N/A	#N/A	29.3
100.7	220,360	217,627	1.450	32.1	#N/A	#N/A	32.1
100.8	240,430	240,699	1.450	35.0	#N/A	#N/A	35.0
100.9	257,509	265,665	1.450	38.0	#N/A	#N/A	38.0
101.0	271,272	291,416	1.450	41.0	#N/A	#N/A	41.0
101.5	340,084	420,171	1.450	57.3	#N/A	#N/A	57.3
102.0	408,897	548,925	1.450	75.3	#N/A	#N/A	75.3
102.5	477,710	677,680	1.450	94.9	#N/A	#N/A	94.9
103.0	546,522	806,435	1.450	116.0	#N/A	#N/A	116.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-003

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	117.0 m		Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
115.4	0	0	#N/A	0.0	#N/A	#N/A	0.0
115.4	23	1	#N/A	0.0	#N/A	#N/A	0.0
115.5	527	21	#N/A	0.0	#N/A	#N/A	0.0
115.6	1,793	133	#N/A	0.0	#N/A	#N/A	0.0
115.7	3,246	384	#N/A	0.0	#N/A	#N/A	0.0
115.8	4,771	785	#N/A	0.0	#N/A	#N/A	0.0
115.9	6,375	1,341	#N/A	0.0	#N/A	#N/A	0.0
116.0	8,068	2,063	#N/A	0.0	#N/A	#N/A	0.0
116.1	9,850	2,958	#N/A	0.0	#N/A	#N/A	0.0
116.2	11,722	4,036	#N/A	0.0	#N/A	#N/A	0.0
116.3	13,683	5,305	#N/A	0.0	#N/A	#N/A	0.0
116.4	15,733	6,775	#N/A	0.0	#N/A	#N/A	0.0
116.5	17,872	8,455	#N/A	0.0	#N/A	#N/A	0.0
116.6	20,104	10,353	#N/A	0.0	#N/A	#N/A	0.0
116.7	22,487	12,480	#N/A	0.0	#N/A	#N/A	0.0
116.8	25,216	14,862	#N/A	0.0	#N/A	#N/A	0.0
116.9	28,235	17,534	#N/A	0.0	#N/A	#N/A	0.0
117.0	31,170	20,505	#N/A	0.0	#N/A	#N/A	0.0
117.1	33,983	23,763	1.490	0.2	#N/A	#N/A	0.2
117.2	37,075	27,312	1.490	0.7	#N/A	#N/A	0.7
117.3	40,743	31,198	1.450	1.2	#N/A	#N/A	1.2
117.4	45,007	35,480	1.460	1.8	#N/A	#N/A	1.8
117.5	49,819	40,217	1.450	2.6	#N/A	#N/A	2.6
117.6	56,461	45,514	1.450	3.4	#N/A	#N/A	3.4
117.7	63,484	51,513	1.450	4.2	#N/A	#N/A	4.2
117.8	70,395	58,207	1.450	5.2	#N/A	#N/A	5.2
117.9	77,221	65,589	1.450	6.2	#N/A	#N/A	6.2
118.0	83,919	73,632	1.450	7.3	#N/A	#N/A	7.3
118.1	90,518	82,007	1.450	8.4	#N/A	#N/A	8.4
118.2	97,116	90,383	1.450	9.5	#N/A	#N/A	9.5
118.3	103,714	98,758	1.450	10.7	#N/A	#N/A	10.7
118.4	110,313	107,134	1.450	12.0	#N/A	#N/A	12.0
118.5	116,911	115,509	1.450	13.3	#N/A	#N/A	13.3
118.6	123,510	123,884	1.450	14.7	#N/A	#N/A	14.7
118.7	130,108	132,260	1.450	16.1	#N/A	#N/A	16.1
118.8	136,707	140,635	1.450	17.5	#N/A	#N/A	17.5
118.9	143,305	149,011	1.450	19.0	#N/A	#N/A	19.0
119.0	149,903	157,386	1.450	20.5	#N/A	#N/A	20.5
119.5	182,895	199,263	1.450	28.7	#N/A	#N/A	28.7
120.0	215,888	241,140	1.450	37.7	#N/A	#N/A	37.7
120.5	248,880	283,018	1.450	47.5	#N/A	#N/A	47.5
121.0	281,872	324,895	1.450	58.0	#N/A	#N/A	58.0

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-004

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	2.0 m	Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	92.5 m	Dam crest invert elevation is:	93.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
91.0	4,200	0	#N/A	0.0	#N/A	#N/A	0.0
91.1	4,303	425	#N/A	0.0	#N/A	#N/A	0.0
91.2	4,409	861	#N/A	0.0	#N/A	#N/A	0.0
91.3	4,590	1,311	#N/A	0.0	#N/A	#N/A	0.0
91.4	4,720	1,776	#N/A	0.0	#N/A	#N/A	0.0
91.5	4,850	2,255	#N/A	0.0	#N/A	#N/A	0.0
91.6	4,980	2,746	#N/A	0.0	#N/A	#N/A	0.0
91.7	5,110	3,251	#N/A	0.0	#N/A	#N/A	0.0
91.8	5,240	3,768	#N/A	0.0	#N/A	#N/A	0.0
91.9	5,370	4,299	#N/A	0.0	#N/A	#N/A	0.0
92.0	5,500	4,842	#N/A	0.0	#N/A	#N/A	0.0
92.1	5,630	5,399	#N/A	0.0	#N/A	#N/A	0.0
92.2	5,760	5,968	#N/A	0.0	#N/A	#N/A	0.0
92.3	5,890	6,551	#N/A	0.0	#N/A	#N/A	0.0
92.4	6,020	7,146	#N/A	0.0	#N/A	#N/A	0.0
92.5	6,150	7,755	#N/A	0.0	#N/A	#N/A	0.0
92.6	6,280	8,376	1.490	0.1	#N/A	#N/A	0.1
92.7	6,410	9,011	1.490	0.3	#N/A	#N/A	0.3
92.8	6,540	9,658	1.450	0.5	#N/A	#N/A	0.5
92.9	6,670	10,319	1.460	0.7	#N/A	#N/A	0.7
93.0	6,800	10,992	1.450	1.0	#N/A	#N/A	1.0
93.1	6,930	11,666	1.450	1.3	#N/A	#N/A	1.3
93.2	7,060	12,339	1.450	1.7	#N/A	#N/A	1.7
93.3	7,190	13,013	1.450	2.1	#N/A	#N/A	2.1
93.4	7,320	13,686	1.450	2.5	#N/A	#N/A	2.5
93.5	7,450	14,360	1.450	2.9	#N/A	#N/A	2.9
93.6	7,580	15,033	1.450	3.3	#N/A	#N/A	3.3
93.7	7,710	15,707	1.450	3.8	#N/A	#N/A	3.8
93.8	7,840	16,380	1.450	4.3	#N/A	#N/A	4.3
93.9	7,970	17,054	1.450	4.8	#N/A	#N/A	4.8
94.0	8,100	17,727	1.450	5.3	#N/A	#N/A	5.3
94.1	8,230	18,401	1.450	5.9	#N/A	#N/A	5.9
94.2	8,360	19,074	1.450	6.4	#N/A	#N/A	6.4
94.3	8,490	19,748	1.450	7.0	#N/A	#N/A	7.0
94.4	8,620	20,421	1.450	7.6	#N/A	#N/A	7.6
94.5	8,750	21,095	1.450	8.2	#N/A	#N/A	8.2

Surface Water Existing (EX) Conditions: Rating tables for WP-EX-005

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	2.0 m	Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	93.5 m	Dam crest invert elevation is:	94.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
91.0	970	0	#N/A	0.0	#N/A	#N/A	0.0
91.1	1,103	104	#N/A	0.0	#N/A	#N/A	0.0
91.2	1,237	221	#N/A	0.0	#N/A	#N/A	0.0
91.3	1,370	351	#N/A	0.0	#N/A	#N/A	0.0
91.4	1,504	495	#N/A	0.0	#N/A	#N/A	0.0
91.5	1,637	652	#N/A	0.0	#N/A	#N/A	0.0
91.6	1,771	822	#N/A	0.0	#N/A	#N/A	0.0
91.7	1,904	1,006	#N/A	0.0	#N/A	#N/A	0.0
91.8	2,038	1,203	#N/A	0.0	#N/A	#N/A	0.0
91.9	2,171	1,414	#N/A	0.0	#N/A	#N/A	0.0
92.0	2,305	1,637	#N/A	0.0	#N/A	#N/A	0.0
92.1	2,438	1,875	#N/A	0.0	#N/A	#N/A	0.0
92.2	2,572	2,125	#N/A	0.0	#N/A	#N/A	0.0
92.3	2,705	2,389	#N/A	0.0	#N/A	#N/A	0.0
92.4	2,839	2,666	#N/A	0.0	#N/A	#N/A	0.0
92.5	2,972	2,957	#N/A	0.0	#N/A	#N/A	0.0
92.6	3,106	3,261	#N/A	0.0	#N/A	#N/A	0.0
92.7	3,239	3,578	#N/A	0.0	#N/A	#N/A	0.0
92.8	3,373	3,909	#N/A	0.0	#N/A	#N/A	0.0
92.9	3,506	4,253	#N/A	0.0	#N/A	#N/A	0.0
93.0	3,800	4,610	#N/A	0.0	#N/A	#N/A	0.0
93.1	4,263	5,013	#N/A	0.0	#N/A	#N/A	0.0
93.2	4,726	5,463	#N/A	0.0	#N/A	#N/A	0.0
93.3	5,189	5,958	#N/A	0.0	#N/A	#N/A	0.0
93.4	5,652	6,500	#N/A	0.0	#N/A	#N/A	0.0
93.5	6,116	7,089	#N/A	0.0	#N/A	#N/A	0.0
93.6	6,579	7,724	1.490	0.1	#N/A	#N/A	0.1
93.7	7,042	8,405	1.490	0.3	#N/A	#N/A	0.3
93.8	7,505	9,132	1.450	0.5	#N/A	#N/A	0.5
93.9	7,968	9,906	1.460	0.7	#N/A	#N/A	0.7
94.0	8,432	10,726	1.450	1.0	#N/A	#N/A	1.0
94.1	8,895	11,546	1.450	1.3	#N/A	#N/A	1.3
94.2	9,358	12,366	1.450	1.7	#N/A	#N/A	1.7
94.3	9,821	13,186	1.450	2.1	#N/A	#N/A	2.1
94.4	10,284	14,006	1.450	2.5	#N/A	#N/A	2.5
94.5	10,748	14,826	1.450	2.9	#N/A	#N/A	2.9
94.6	11,211	15,646	1.450	3.3	#N/A	#N/A	3.3
94.7	11,674	16,466	1.450	3.8	#N/A	#N/A	3.8
94.8	12,137	17,286	1.450	4.3	#N/A	#N/A	4.3
94.9	12,600	18,106	1.450	4.8	#N/A	#N/A	4.8
95.0	13,064	18,926	1.450	5.3	#N/A	#N/A	5.3
95.1	13,527	19,746	1.450	5.9	#N/A	#N/A	5.9
95.2	13,990	20,566	1.450	6.4	#N/A	#N/A	6.4
95.3	14,453	21,386	1.450	7.0	#N/A	#N/A	7.0
95.4	14,916	22,206	1.450	7.6	#N/A	#N/A	7.6
95.5	15,380	23,026	1.450	8.2	#N/A	#N/A	8.2

Surface Water Existing Conditions: (EX) Rating tables for WP-EX-006

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m	Dam crest length is:	960.9 m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	109.0 m	Dam crest invert elevation is:	111.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
106.7	0	0	#N/A	0.0	#N/A	#N/A	0.0
106.8	46	2	#N/A	0.0	#N/A	#N/A	0.0
106.9	215	13	#N/A	0.0	#N/A	#N/A	0.0
107.0	538	50	#N/A	0.0	#N/A	#N/A	0.0
107.1	999	125	#N/A	0.0	#N/A	#N/A	0.0
107.2	1,565	253	#N/A	0.0	#N/A	#N/A	0.0
107.3	2,270	443	#N/A	0.0	#N/A	#N/A	0.0
107.4	3,089	710	#N/A	0.0	#N/A	#N/A	0.0
107.5	3,950	1,062	#N/A	0.0	#N/A	#N/A	0.0
107.6	4,823	1,501	#N/A	0.0	#N/A	#N/A	0.0
107.7	5,755	2,029	#N/A	0.0	#N/A	#N/A	0.0
107.8	6,799	2,655	#N/A	0.0	#N/A	#N/A	0.0
107.9	7,972	3,392	#N/A	0.0	#N/A	#N/A	0.0
108.0	9,276	4,254	#N/A	0.0	#N/A	#N/A	0.0
108.1	10,719	5,252	#N/A	0.0	#N/A	#N/A	0.0
108.2	12,325	6,403	#N/A	0.0	#N/A	#N/A	0.0
108.3	14,114	7,723	#N/A	0.0	#N/A	#N/A	0.0
108.4	16,091	9,232	#N/A	0.0	#N/A	#N/A	0.0
108.5	18,274	10,948	#N/A	0.0	#N/A	#N/A	0.0
108.6	20,674	12,894	#N/A	0.0	#N/A	#N/A	0.0
108.7	23,474	15,096	#N/A	0.0	#N/A	#N/A	0.0
108.8	26,914	17,609	#N/A	0.0	#N/A	#N/A	0.0
108.9	31,061	20,502	#N/A	0.0	#N/A	#N/A	0.0
109.0	35,832	23,841	#N/A	0.0	#N/A	#N/A	0.0
109.1	41,175	27,687	1.490	0.0	#N/A	#N/A	0.0
109.2	46,989	32,092	1.490	0.2	#N/A	#N/A	0.2
109.3	53,375	37,102	1.450	0.2	#N/A	#N/A	0.2
109.4	60,661	42,798	1.460	0.7	#N/A	#N/A	0.7
109.5	68,339	49,247	1.450	1.2	#N/A	#N/A	1.2
109.6	76,043	56,465	2.450	3.1	#N/A	#N/A	3.1
109.7	84,086	64,466	3.450	6.1	#N/A	#N/A	6.1
109.8	92,808	73,304	4.450	10.3	#N/A	#N/A	10.3
109.9	102,652	83,063	5.450	16.0	#N/A	#N/A	16.0
110.0	114,020	93,877	6.450	23.1	#N/A	#N/A	23.1
110.1	127,166	105,921	7.450	31.8	#N/A	#N/A	31.8
110.2	142,916	119,394	8.450	42.3	#N/A	#N/A	42.3
110.3	161,883	134,605	9.450	54.5	#N/A	#N/A	54.5
110.4	183,670	151,851	10.450	68.7	#N/A	#N/A	68.7
110.5	210,151	171,475	11.450	84.9	#N/A	#N/A	84.9
110.6	238,209	193,888	12.450	103.1	#N/A	#N/A	103.1
110.7	264,615	219,056	13.450	123.5	#N/A	#N/A	123.5
110.8	288,006	246,713	14.450	146.2	#N/A	#N/A	146.2
110.9	309,183	276,614	15.450	171.2	#N/A	#N/A	171.2
111.0	327,266	308,261	16.450	198.6	#N/A	#N/A	198.6

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m		Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
103.0	0	0	#N/A	0.0	#N/A	#N/A	0.0
103.1	18,844	1,677	#N/A	0.0	#N/A	#N/A	0.0
103.2	22,962	3,768	#N/A	0.0	#N/A	#N/A	0.0
103.3	27,042	6,268	#N/A	0.0	#N/A	#N/A	0.0
103.4	31,085	9,175	#N/A	0.0	#N/A	#N/A	0.0
103.5	35,091	12,484	#N/A	0.0	#N/A	#N/A	0.0
103.6	39,058	16,192	#N/A	0.0	#N/A	#N/A	0.0
103.7	42,989	20,294	#N/A	0.0	#N/A	#N/A	0.0
103.8	46,881	24,788	#N/A	0.0	#N/A	#N/A	0.0
103.9	50,736	29,669	#N/A	0.0	#N/A	#N/A	0.0
104.0	54,519	34,933	#N/A	0.0	#N/A	#N/A	0.0
104.1	67,628	41,464	#N/A	0.0	#N/A	#N/A	0.0
104.2	72,442	48,466	#N/A	0.0	#N/A	#N/A	0.0
104.3	77,476	55,960	#N/A	0.0	#N/A	#N/A	0.0
104.4	82,718	63,968	#N/A	0.0	#N/A	#N/A	0.0
104.5	88,160	72,510	#N/A	0.0	#N/A	#N/A	0.0
104.6	93,801	81,607	#N/A	0.0	#N/A	#N/A	0.0
104.7	99,642	91,277	#N/A	0.0	#N/A	#N/A	0.0
104.8	105,683	101,542	#N/A	0.0	#N/A	#N/A	0.0
104.9	111,923	112,420	#N/A	0.0	#N/A	#N/A	0.0
105.0	118,368	123,933	#N/A	0.0	#N/A	#N/A	0.0
105.1	133,673	136,908	#N/A	0.0	#N/A	#N/A	0.0
105.2	141,633	150,673	#N/A	0.0	#N/A	#N/A	0.0
105.3	149,738	165,240	#N/A	0.0	#N/A	#N/A	0.0
105.4	157,989	180,625	#N/A	0.0	#N/A	#N/A	0.0
105.5	166,385	196,843	#N/A	0.0	#N/A	#N/A	0.0
105.6	174,927	213,907	#N/A	0.0	#N/A	#N/A	0.0
105.7	183,623	231,833	#N/A	0.0	#N/A	#N/A	0.0
105.8	192,478	250,637	#N/A	0.0	#N/A	#N/A	0.0
105.9	201,494	270,334	#N/A	0.0	#N/A	#N/A	0.0
106.0	210,670	290,941	#N/A	0.0	#N/A	#N/A	0.0
106.1	219,765	312,487	#N/A	0.0	#N/A	#N/A	0.0
106.2	228,409	334,895	#N/A	0.0	#N/A	#N/A	0.0
106.3	237,095	358,170	#N/A	0.0	#N/A	#N/A	0.0
106.4	245,823	382,316	#N/A	0.0	#N/A	#N/A	0.0
106.5	254,597	407,336	#N/A	0.0	#N/A	#N/A	0.0
106.6	263,423	433,237	#N/A	0.0	#N/A	#N/A	0.0
106.7	272,300	460,023	#N/A	0.0	#N/A	#N/A	0.0
106.8	281,230	487,699	#N/A	0.0	#N/A	#N/A	0.0
106.9	290,211	516,270	#N/A	0.0	#N/A	#N/A	0.0
107.0	299,243	545,743	#N/A	0.0	#N/A	#N/A	0.0
107.1	308,849	576,160	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-001

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	116.0 m		Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
107.2	318,267	607,515	#N/A	0.0	#N/A	#N/A	0.0
107.3	327,766	639,816	#N/A	0.0	#N/A	#N/A	0.0
107.4	337,348	673,071	#N/A	0.0	#N/A	#N/A	0.0
107.5	347,011	707,288	#N/A	0.0	#N/A	#N/A	0.0
107.6	356,752	742,476	#N/A	0.0	#N/A	#N/A	0.0
107.7	366,572	778,641	#N/A	0.0	#N/A	#N/A	0.0
107.8	376,470	815,793	#N/A	0.0	#N/A	#N/A	0.0
107.9	386,446	853,938	#N/A	0.0	#N/A	#N/A	0.0
108.0	396,500	893,085	#N/A	0.0	#N/A	#N/A	0.0
108.1	416,267	934,313	#N/A	0.0	#N/A	#N/A	0.0
108.2	424,227	976,338	#N/A	0.0	#N/A	#N/A	0.0
108.3	432,184	1,019,159	#N/A	0.0	#N/A	#N/A	0.0
108.4	440,134	1,062,775	#N/A	0.0	#N/A	#N/A	0.0
108.5	448,078	1,107,185	#N/A	0.0	#N/A	#N/A	0.0
108.6	456,016	1,152,390	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-002

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control (Q = C * L * $H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	10.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	99.0 m		Dam crest invert elevation is:	101.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
98.1	0	0	#N/A	0.0	#N/A	#N/A	0.0
98.2	1,639	84	#N/A	0.0	#N/A	#N/A	0.0
98.3	3,697	344	#N/A	0.0	#N/A	#N/A	0.0
98.4	6,403	845	#N/A	0.0	#N/A	#N/A	0.0
98.5	9,535	1,638	#N/A	0.0	#N/A	#N/A	0.0
98.6	18,037	3,063	#N/A	0.0	#N/A	#N/A	0.0
98.7	27,273	5,305	#N/A	0.0	#N/A	#N/A	0.0
98.8	34,242	8,373	#N/A	0.0	#N/A	#N/A	0.0
98.9	42,587	12,213	#N/A	0.0	#N/A	#N/A	0.0
99.0	50,234	16,868	#N/A	0.0	#N/A	#N/A	0.0
99.1	56,839	22,225	1.490	0.5	#N/A	#N/A	0.5
99.2	63,405	28,235	1.490	1.3	#N/A	#N/A	1.3
99.3	70,343	34,918	1.450	2.4	#N/A	#N/A	2.4
99.4	77,420	42,303	1.460	3.7	#N/A	#N/A	3.7
99.5	84,269	50,386	1.450	5.1	#N/A	#N/A	5.1
99.6	91,194	59,159	1.450	6.7	#N/A	#N/A	6.7
99.7	97,897	68,617	1.450	8.5	#N/A	#N/A	8.5
99.8	104,308	78,729	1.450	10.4	#N/A	#N/A	10.4
99.9	112,914	89,573	1.450	12.4	#N/A	#N/A	12.4
100.0	123,069	101,379	1.450	14.5	#N/A	#N/A	14.5
100.1	133,890	114,217	1.450	16.7	#N/A	#N/A	16.7
100.2	145,510	128,183	1.450	19.1	#N/A	#N/A	19.1
100.3	157,636	143,337	1.450	21.5	#N/A	#N/A	21.5
100.4	170,334	159,731	1.450	24.0	#N/A	#N/A	24.0
100.5	183,952	177,436	1.450	26.6	#N/A	#N/A	26.6
100.6	200,227	196,613	1.450	29.3	#N/A	#N/A	29.3
100.7	220,360	217,627	1.450	32.1	#N/A	#N/A	32.1
100.8	240,430	240,699	1.450	35.0	#N/A	#N/A	35.0
100.9	257,509	265,665	1.450	38.0	#N/A	#N/A	38.0
101.0	271,272	291,416	1.450	41.0	#N/A	#N/A	41.0
101.5	340,084	420,171	1.450	57.3	#N/A	#N/A	57.3
102.0	408,897	548,925	1.450	75.3	#N/A	#N/A	75.3
102.5	477,710	677,680	1.450	94.9	#N/A	#N/A	94.9
103.0	546,522	806,435	1.450	116.0	#N/A	#N/A	116.0

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-003

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	2.0 m		Dam crest length is:	#N/A m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	92.5 m		Dam crest invert elevation is:	93.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
91.0	4,200	0	#N/A	0.0	#N/A	#N/A	0.0
91.1	4,303	425	#N/A	0.0	#N/A	#N/A	0.0
91.2	4,409	861	#N/A	0.0	#N/A	#N/A	0.0
91.3	4,590	1,311	#N/A	0.0	#N/A	#N/A	0.0
91.4	4,720	1,776	#N/A	0.0	#N/A	#N/A	0.0
91.5	4,850	2,255	#N/A	0.0	#N/A	#N/A	0.0
91.6	4,980	2,746	#N/A	0.0	#N/A	#N/A	0.0
91.7	5,110	3,251	#N/A	0.0	#N/A	#N/A	0.0
91.8	5,240	3,768	#N/A	0.0	#N/A	#N/A	0.0
91.9	5,370	4,299	#N/A	0.0	#N/A	#N/A	0.0
92.0	5,500	4,842	#N/A	0.0	#N/A	#N/A	0.0
92.1	5,630	5,399	#N/A	0.0	#N/A	#N/A	0.0
92.2	5,760	5,968	#N/A	0.0	#N/A	#N/A	0.0
92.3	5,890	6,551	#N/A	0.0	#N/A	#N/A	0.0
92.4	6,020	7,146	#N/A	0.0	#N/A	#N/A	0.0
92.5	6,150	7,755	#N/A	0.0	#N/A	#N/A	0.0
92.6	6,280	8,376	1.490	0.1	#N/A	#N/A	0.1
92.7	6,410	9,011	1.490	0.3	#N/A	#N/A	0.3
92.8	6,540	9,658	1.450	0.5	#N/A	#N/A	0.5
92.9	6,670	10,319	1.460	0.7	#N/A	#N/A	0.7
93.0	6,800	10,992	1.450	1.0	#N/A	#N/A	1.0
93.1	6,930	11,666	1.450	1.3	#N/A	#N/A	1.3
93.2	7,060	12,339	1.450	1.7	#N/A	#N/A	1.7
93.3	7,190	13,013	1.450	2.1	#N/A	#N/A	2.1
93.4	7,320	13,686	1.450	2.5	#N/A	#N/A	2.5
93.5	7,450	14,360	1.450	2.9	#N/A	#N/A	2.9
93.6	7,580	15,033	1.450	3.3	#N/A	#N/A	3.3
93.7	7,710	15,707	1.450	3.8	#N/A	#N/A	3.8
93.8	7,840	16,380	1.450	4.3	#N/A	#N/A	4.3
93.9	7,970	17,054	1.450	4.8	#N/A	#N/A	4.8
94.0	8,100	17,727	1.450	5.3	#N/A	#N/A	5.3
94.1	8,230	18,401	1.450	5.9	#N/A	#N/A	5.9
94.2	8,360	19,074	1.450	6.4	#N/A	#N/A	6.4
94.3	8,490	19,748	1.450	7.0	#N/A	#N/A	7.0
94.4	8,620	20,421	1.450	7.6	#N/A	#N/A	7.6
94.5	8,750	21,095	1.450	8.2	#N/A	#N/A	8.2

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-004

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m	Dam crest length is:	1487.6 m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	117.0 m	Dam crest invert elevation is:	118.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
115.4	0	0	#N/A	0.0	#N/A	#N/A	0.0
115.5	527	21	#N/A	0.0	#N/A	#N/A	0.0
115.6	1,793	133	#N/A	0.0	#N/A	#N/A	0.0
115.7	3,246	384	#N/A	0.0	#N/A	#N/A	0.0
115.8	4,771	785	#N/A	0.0	#N/A	#N/A	0.0
115.9	6,375	1,341	#N/A	0.0	#N/A	#N/A	0.0
116.0	8,068	2,063	#N/A	0.0	#N/A	#N/A	0.0
116.1	9,850	2,958	#N/A	0.0	#N/A	#N/A	0.0
116.2	11,722	4,036	#N/A	0.0	#N/A	#N/A	0.0
116.3	13,683	5,305	#N/A	0.0	#N/A	#N/A	0.0
116.4	15,733	6,775	#N/A	0.0	#N/A	#N/A	0.0
116.5	17,872	8,455	#N/A	0.0	#N/A	#N/A	0.0
116.6	20,104	10,353	#N/A	0.0	#N/A	#N/A	0.0
116.7	22,487	12,480	#N/A	0.0	#N/A	#N/A	0.0
116.8	25,216	14,862	#N/A	0.0	#N/A	#N/A	0.0
116.9	28,235	17,534	#N/A	0.0	#N/A	#N/A	0.0
117.0	31,170	20,505	#N/A	0.0	#N/A	#N/A	0.0
117.1	33,983	23,763	1.490	0.2	#N/A	#N/A	0.2
117.2	37,075	27,312	1.490	0.7	#N/A	#N/A	0.7
117.3	40,743	31,198	1.450	1.2	#N/A	#N/A	1.2
117.4	45,007	35,480	1.460	1.8	#N/A	#N/A	1.8
117.5	49,819	40,217	1.450	2.6	#N/A	#N/A	2.6
117.6	56,461	45,514	1.450	3.4	#N/A	#N/A	3.4
117.7	63,484	51,513	1.450	4.2	#N/A	#N/A	4.2
117.8	70,395	58,207	1.450	5.2	#N/A	#N/A	5.2
117.9	77,221	65,589	1.450	6.2	#N/A	#N/A	6.2
118.0	83,919	73,632	1.450	7.3	#N/A	#N/A	7.3
118.1	90,518	82,007	1.450	8.4	#N/A	#N/A	8.4
118.2	97,116	90,383	1.450	9.5	#N/A	#N/A	9.5
118.3	103,714	98,758	1.450	10.7	#N/A	#N/A	10.7
118.4	110,313	107,134	1.450	12.0	#N/A	#N/A	12.0
118.5	116,911	115,509	1.450	13.3	#N/A	#N/A	13.3
118.6	123,510	123,884	1.450	14.7	#N/A	#N/A	14.7
118.7	130,108	132,260	1.450	16.1	#N/A	#N/A	16.1
118.8	136,707	140,635	1.450	17.5	#N/A	#N/A	17.5
118.9	143,305	149,011	1.450	19.0	#N/A	#N/A	19.0
119.0	149,903	157,386	1.450	20.5	#N/A	#N/A	20.5
119.5	182,895	199,263	1.450	28.7	#N/A	#N/A	28.7
120.0	215,888	241,140	1.450	37.7	#N/A	#N/A	37.7
120.5	248,880	283,018	1.450	47.5	#N/A	#N/A	47.5
121.0	281,872	324,895	1.450	58.0	#N/A	#N/A	58.0

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-005 / WP-PL-006

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	25.0 m	Dam crest length is:	3713.1 m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	3.0 m
Assume spillway invert elevation is:	74.5 m	Dam crest invert elevation is:	75.5 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
71.3	0	0	#N/A	0.0	#N/A	#N/A	0.0
71.4	1,359,729	135,872	#N/A	0.0	#N/A	#N/A	0.0
71.5	1,361,755	271,946	#N/A	0.0	#N/A	#N/A	0.0
71.6	1,363,782	408,223	#N/A	0.0	#N/A	#N/A	0.0
71.7	1,365,810	544,702	#N/A	0.0	#N/A	#N/A	0.0
71.8	1,367,839	681,385	#N/A	0.0	#N/A	#N/A	0.0
71.9	1,369,869	818,270	#N/A	0.0	#N/A	#N/A	0.0
72.0	1,371,899	955,359	#N/A	0.0	#N/A	#N/A	0.0
72.1	1,373,931	1,092,650	#N/A	0.0	#N/A	#N/A	0.0
72.1	1,375,964	1,230,145	#N/A	0.0	#N/A	#N/A	0.0
72.2	1,377,997	1,367,843	#N/A	0.0	#N/A	#N/A	0.0
72.3	1,380,032	1,505,744	#N/A	0.0	#N/A	#N/A	0.0
72.4	1,382,067	1,643,849	#N/A	0.0	#N/A	#N/A	0.0
72.5	1,384,103	1,782,158	#N/A	0.0	#N/A	#N/A	0.0
72.6	1,386,140	1,920,670	#N/A	0.0	#N/A	#N/A	0.0
72.7	1,388,178	2,059,386	#N/A	0.0	#N/A	#N/A	0.0
72.8	1,390,218	2,198,306	#N/A	0.0	#N/A	#N/A	0.0
72.9	1,392,257	2,337,429	#N/A	0.0	#N/A	#N/A	0.0
73.0	1,394,298	2,476,757	#N/A	0.0	#N/A	#N/A	0.0
73.1	1,396,340	2,616,289	#N/A	0.0	#N/A	#N/A	0.0
73.2	1,398,383	2,756,025	#N/A	0.0	#N/A	#N/A	0.0
73.3	1,400,427	2,895,966	#N/A	0.0	#N/A	#N/A	0.0
73.4	1,402,471	3,036,110	#N/A	0.0	#N/A	#N/A	0.0
73.5	1,404,517	3,176,460	#N/A	0.0	#N/A	#N/A	0.0
73.6	1,406,563	3,317,014	#N/A	0.0	#N/A	#N/A	0.0
73.7	1,408,610	3,457,772	#N/A	0.0	#N/A	#N/A	0.0
73.8	1,410,659	3,598,736	#N/A	0.0	#N/A	#N/A	0.0
73.9	1,412,708	3,739,904	#N/A	0.0	#N/A	#N/A	0.0
74.0	1,414,758	3,881,277	#N/A	0.0	#N/A	#N/A	0.0
74.1	1,416,809	4,022,856	#N/A	0.0	#N/A	#N/A	0.0
74.2	1,418,861	4,164,639	#N/A	0.0	#N/A	#N/A	0.0
74.3	1,420,914	4,306,628	#N/A	0.0	#N/A	#N/A	0.0
74.4	1,422,967	4,448,822	#N/A	0.0	#N/A	#N/A	0.0
74.5	1,423,995	4,519,996	#N/A	0.0	#N/A	#N/A	0.0
74.6	1,426,049	4,662,344	1.490	1.2	#N/A	#N/A	1.2
74.7	1,429,230	4,876,038	1.490	3.3	#N/A	#N/A	3.3
74.8	1,432,412	5,089,731	1.450	6.0	#N/A	#N/A	6.0
74.9	1,435,593	5,303,425	1.460	9.2	#N/A	#N/A	9.2
75.0	1,438,774	5,517,119	1.450	12.8	#N/A	#N/A	12.8
75.1	1,441,955	5,730,812	1.450	16.8	#N/A	#N/A	16.8
75.2	1,445,137	5,944,506	1.450	21.2	#N/A	#N/A	21.2
75.3	1,448,318	6,158,199	1.450	25.9	#N/A	#N/A	25.9
75.4	1,451,499	6,371,893	1.450	31.0	#N/A	#N/A	31.0
75.5	1,454,680	6,585,586	1.450	36.2	#N/A	#N/A	36.2

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-007

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations. Initial pond volume of approximately 620,000 m3 is assumed as per water balance model results.

Assume spillway crest length is:	50.0 m		Dam crest length is:	3398.7 m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	77.5 m		Dam crest invert elevation is:	78.5 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
72.5	0	0	#N/A	0.0	#N/A	#N/A	0.0
72.6	12,514	3,129	#N/A	0.0	#N/A	#N/A	0.0
72.7	25,029	6,257	#N/A	0.0	#N/A	#N/A	0.0
72.8	37,543	9,386	#N/A	0.0	#N/A	#N/A	0.0
72.9	50,057	12,514	#N/A	0.0	#N/A	#N/A	0.0
73.0	62,572	15,643	#N/A	0.0	#N/A	#N/A	0.0
73.1	75,170	25,050	#N/A	0.0	#N/A	#N/A	0.0
73.2	87,769	34,457	#N/A	0.0	#N/A	#N/A	0.0
73.3	100,367	43,863	#N/A	0.0	#N/A	#N/A	0.0
73.4	112,965	53,270	#N/A	0.0	#N/A	#N/A	0.0
73.5	125,564	62,677	#N/A	0.0	#N/A	#N/A	0.0
73.6	138,246	78,404	#N/A	0.0	#N/A	#N/A	0.0
73.7	150,929	94,131	#N/A	0.0	#N/A	#N/A	0.0
73.8	163,611	109,858	#N/A	0.0	#N/A	#N/A	0.0
73.9	176,294	125,585	#N/A	0.0	#N/A	#N/A	0.0
74.0	188,976	141,312	#N/A	0.0	#N/A	#N/A	0.0
74.1	201,743	163,401	#N/A	0.0	#N/A	#N/A	0.0
74.2	214,509	185,490	#N/A	0.0	#N/A	#N/A	0.0
74.3	227,276	207,580	#N/A	0.0	#N/A	#N/A	0.0
74.4	240,042	229,669	#N/A	0.0	#N/A	#N/A	0.0
74.5	252,809	251,758	#N/A	0.0	#N/A	#N/A	0.0
74.6	265,659	280,252	#N/A	0.0	#N/A	#N/A	0.0
74.7	278,510	308,745	#N/A	0.0	#N/A	#N/A	0.0
74.8	291,360	337,239	#N/A	0.0	#N/A	#N/A	0.0
74.9	304,211	365,732	#N/A	0.0	#N/A	#N/A	0.0
75.0	317,061	394,226	#N/A	0.0	#N/A	#N/A	0.0
75.1	329,996	429,166	#N/A	0.0	#N/A	#N/A	0.0
75.2	342,931	464,105	#N/A	0.0	#N/A	#N/A	0.0
75.3	355,865	499,045	#N/A	0.0	#N/A	#N/A	0.0
75.4	368,800	533,985	#N/A	0.0	#N/A	#N/A	0.0
75.5	381,734	568,925	#N/A	0.0	#N/A	#N/A	0.0
75.6	394,753	610,353	#N/A	0.0	#N/A	#N/A	0.0
75.7	407,772	651,781	#N/A	0.0	#N/A	#N/A	0.0
75.8	420,790	693,209	#N/A	0.0	#N/A	#N/A	0.0
75.9	433,809	734,637	#N/A	0.0	#N/A	#N/A	0.0
76.0	446,828	776,065	#N/A	0.0	#N/A	#N/A	0.0
76.1	459,930	824,024	#N/A	0.0	#N/A	#N/A	0.0
76.2	473,033	871,982	#N/A	0.0	#N/A	#N/A	0.0
76.3	486,136	919,941	#N/A	0.0	#N/A	#N/A	0.0
76.4	499,238	967,899	#N/A	0.0	#N/A	#N/A	0.0
76.5	512,341	1,015,857	#N/A	0.0	#N/A	#N/A	0.0
76.6	525,528	1,070,388	#N/A	0.0	#N/A	#N/A	0.0

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-007

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations. Initial pond volume of approximately 620,000 m3 is assumed as per water balance model results.

Assume spillway crest length is:	50.0 m		Dam crest length is:	3398.7 m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	77.5 m		Dam crest invert elevation is:	78.5 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
76.7	538,715	1,124,919	#N/A	0.0	#N/A	#N/A	0.0
76.8	551,901	1,179,450	#N/A	0.0	#N/A	#N/A	0.0
76.9	565,088	1,233,981	#N/A	0.0	#N/A	#N/A	0.0
77.0	578,275	1,288,511	#N/A	0.0	#N/A	#N/A	0.0
77.1	591,546	1,349,657	#N/A	0.0	#N/A	#N/A	0.0
77.2	604,816	1,410,802	#N/A	0.0	#N/A	#N/A	0.0
77.3	618,087	1,471,947	#N/A	0.0	#N/A	#N/A	0.0
77.4	631,358	1,533,092	#N/A	0.0	#N/A	#N/A	0.0
77.5	644,629	1,594,237	#N/A	0.0	#N/A	#N/A	0.0
77.6	657,983	1,662,039	#N/A	0.0	#N/A	#N/A	0.0
77.7	671,338	1,729,840	#N/A	0.0	#N/A	#N/A	0.0
77.8	684,693	1,797,642	#N/A	0.0	#N/A	#N/A	0.0
77.9	698,048	1,865,443	#N/A	0.0	#N/A	#N/A	0.0
78.0	711,403	1,933,245	#N/A	0.0	#N/A	#N/A	0.0
78.1	712,251	2,004,597	#N/A	0.0	#N/A	#N/A	0.0
78.2	713,099	2,075,950	#N/A	0.0	#N/A	#N/A	0.0
78.3	713,948	2,147,302	#N/A	0.0	#N/A	#N/A	0.0
78.4	714,796	2,218,654	#N/A	0.0	#N/A	#N/A	0.0
78.5	715,644	2,290,007	#N/A	0.0	#N/A	#N/A	0.0
78.6	716,492	2,361,359	1.490	2.4	#N/A	#N/A	2.4
78.7	717,341	2,432,711	1.490	6.7	#N/A	#N/A	6.7
78.8	718,189	2,504,064	1.450	11.9	#N/A	#N/A	11.9
78.9	719,037	2,575,416	1.460	18.5	#N/A	#N/A	18.5
79.0	719,885	2,646,768	1.450	25.6	#N/A	#N/A	25.6
79.1	720,734	2,718,121	1.450	33.7	#N/A	#N/A	33.7
79.2	721,582	2,789,473	1.450	42.5	#N/A	#N/A	42.5
79.3	722,430	2,860,825	1.450	51.9	#N/A	#N/A	51.9
79.4	723,278	2,932,178	1.450	61.9	#N/A	#N/A	61.9
79.5	724,127	3,003,530	1.450	72.5	#N/A	#N/A	72.5

Surface Water Planned (PL) Conditions: Rating tables for WP-PL-008

The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

Assume spillway crest length is:	5.0 m		Dam crest length is:	2230.2 m
Assume spillway crest breadth is:	>4.5 m		Dam crest breadth is:	3.0 m
Assume spillway invert elevation is:	107.0 m		Dam crest invert elevation is:	108.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
104.0	0	0	#N/A	0.0	#N/A	#N/A	0.0
104.1	10,023	5,012	#N/A	0.0	#N/A	#N/A	0.0
104.2	20,046	10,023	#N/A	0.0	#N/A	#N/A	0.0
104.3	30,070	15,035	#N/A	0.0	#N/A	#N/A	0.0
104.4	40,093	20,046	#N/A	0.0	#N/A	#N/A	0.0
104.5	50,116	25,058	#N/A	0.0	#N/A	#N/A	0.0
104.6	60,139	30,070	#N/A	0.0	#N/A	#N/A	0.0
104.7	70,162	35,081	#N/A	0.0	#N/A	#N/A	0.0
104.8	80,186	40,093	#N/A	0.0	#N/A	#N/A	0.0
104.9	90,209	45,104	#N/A	0.0	#N/A	#N/A	0.0
105.0	100,232	50,116	#N/A	0.0	#N/A	#N/A	0.0
105.1	100,232	61,253	#N/A	0.0	#N/A	#N/A	0.0
105.2	100,232	72,390	#N/A	0.0	#N/A	#N/A	0.0
105.3	100,232	83,527	#N/A	0.0	#N/A	#N/A	0.0
105.4	100,232	94,663	#N/A	0.0	#N/A	#N/A	0.0
105.5	100,232	105,800	#N/A	0.0	#N/A	#N/A	0.0
105.6	100,232	116,937	#N/A	0.0	#N/A	#N/A	0.0
105.7	100,232	128,074	#N/A	0.0	#N/A	#N/A	0.0
105.8	100,232	139,211	#N/A	0.0	#N/A	#N/A	0.0
105.9	100,232	150,348	#N/A	0.0	#N/A	#N/A	0.0
106.0	100,232	161,485	#N/A	0.0	#N/A	#N/A	0.0
106.1	100,232	172,622	#N/A	0.0	#N/A	#N/A	0.0
106.2	100,232	183,758	#N/A	0.0	#N/A	#N/A	0.0
106.3	100,232	194,895	#N/A	0.0	#N/A	#N/A	0.0
106.4	100,232	206,032	#N/A	0.0	#N/A	#N/A	0.0
106.5	100,232	217,169	#N/A	0.0	#N/A	#N/A	0.0
106.6	100,232	228,306	#N/A	0.0	#N/A	#N/A	0.0
106.7	100,232	239,443	#N/A	0.0	#N/A	#N/A	0.0
106.8	100,232	250,580	#N/A	0.0	#N/A	#N/A	0.0
106.9	100,232	261,717	#N/A	0.0	#N/A	#N/A	0.0
107.0	100,232	272,853	#N/A	0.0	#N/A	#N/A	0.0
107.1	100,232	283,990	1.490	0.2	#N/A	#N/A	0.2
107.2	100,232	295,127	1.490	0.7	#N/A	#N/A	0.7
107.3	100,232	306,264	1.450	1.2	#N/A	#N/A	1.2
107.4	100,232	317,401	1.460	1.8	#N/A	#N/A	1.8
107.5	100,232	328,538	1.450	2.6	#N/A	#N/A	2.6
107.6	100,232	339,675	1.450	3.4	#N/A	#N/A	3.4
107.7	100,232	350,812	1.450	4.2	#N/A	#N/A	4.2
107.8	100,232	361,949	1.450	5.2	#N/A	#N/A	5.2
107.9	100,232	373,085	1.450	6.2	#N/A	#N/A	6.2
108.0	100,232	384,222	1.450	7.3	#N/A	#N/A	7.3

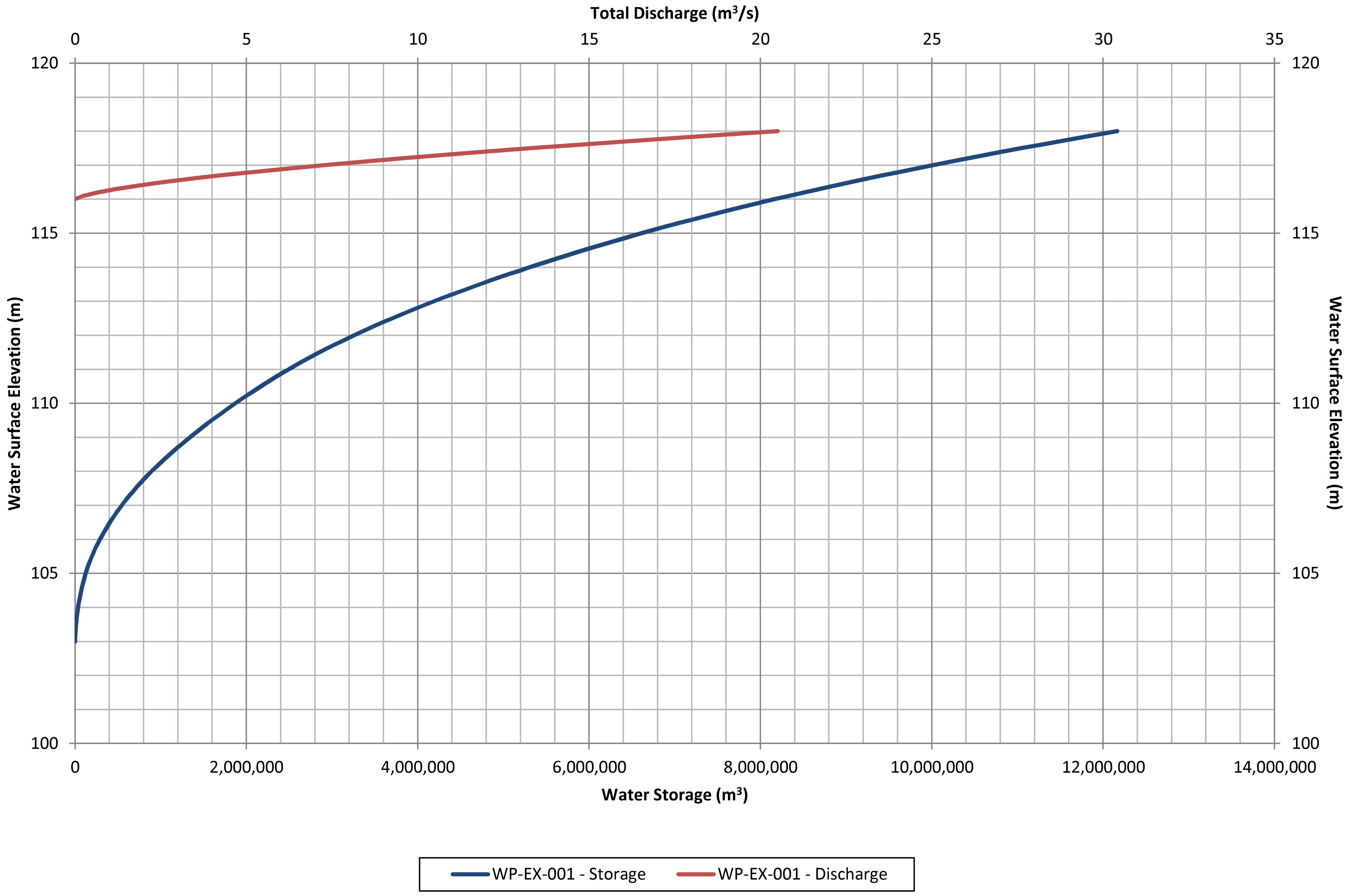
Surface Water Planned (PL) Conditions: Rating tables for WP-PL-009

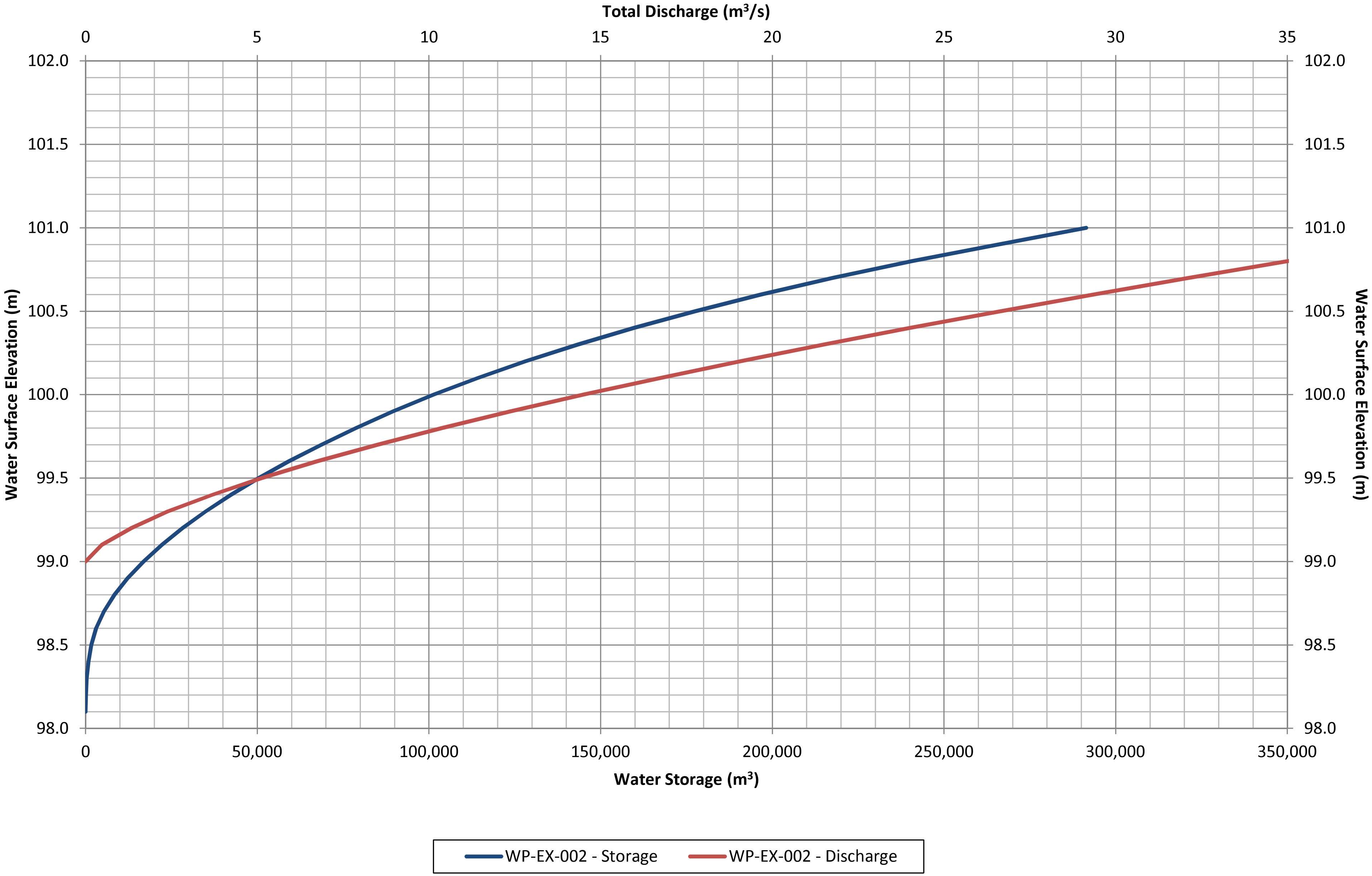
The following information was developed for use in hydrologic routing of the water pond spillway, which operates under broad-crested weir control ($Q = C * L * H^{1.5}$), with coefficient "C" taken from: *Brater, E.F. & King, H.W. (1996) "Handbook of Hydraulics, Seventh Edition",* New York, N.Y: McGraw-Hill.

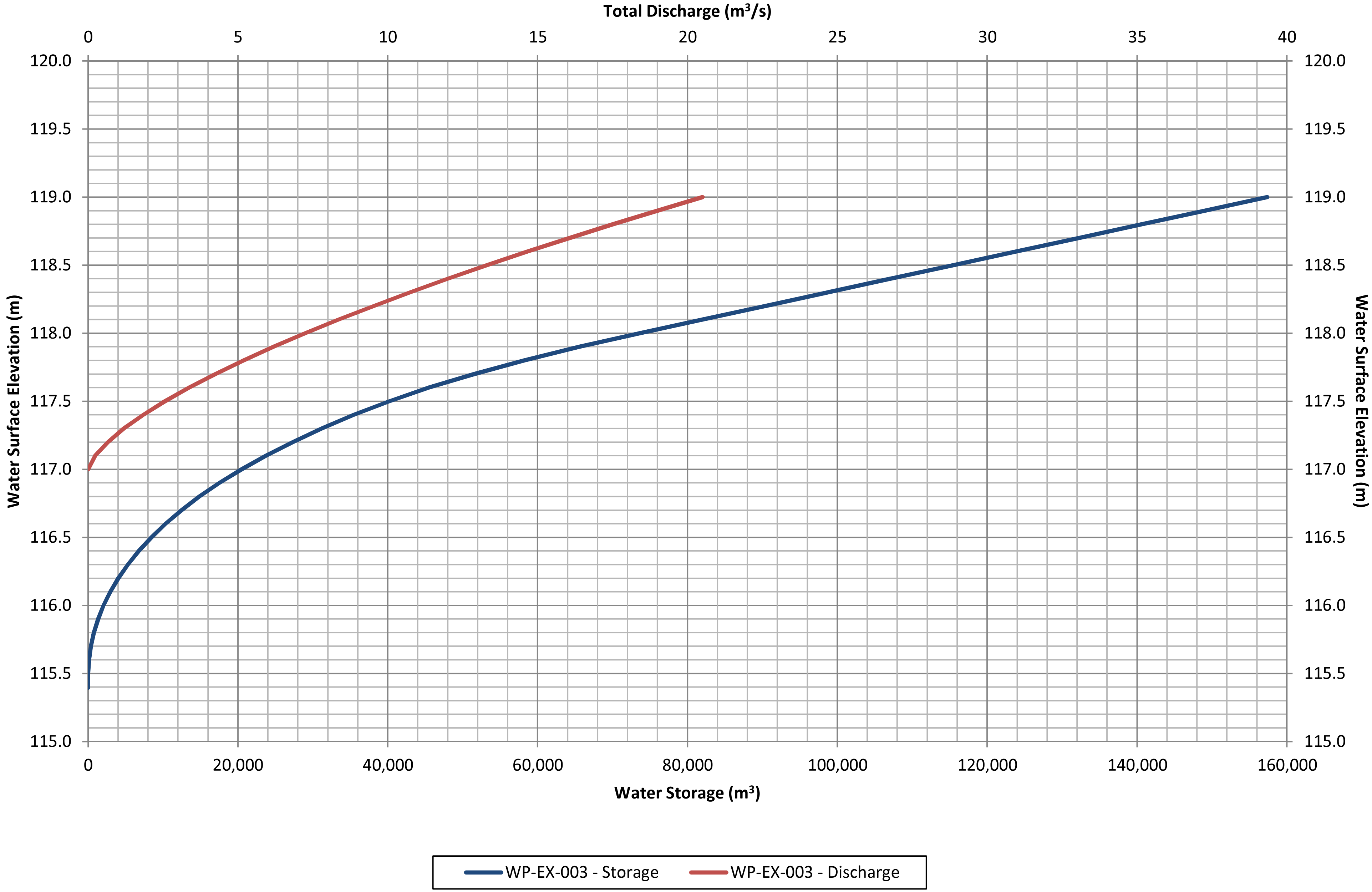
Table entries were derived either from a RIFT model using global SRTM topography or were approximated using pond area and assumed depth. Where nessesary, the stage storages were linearly extrapolated such that they extended 2.0 m above the spillway invert. Crest flow was not considered in these calculations.

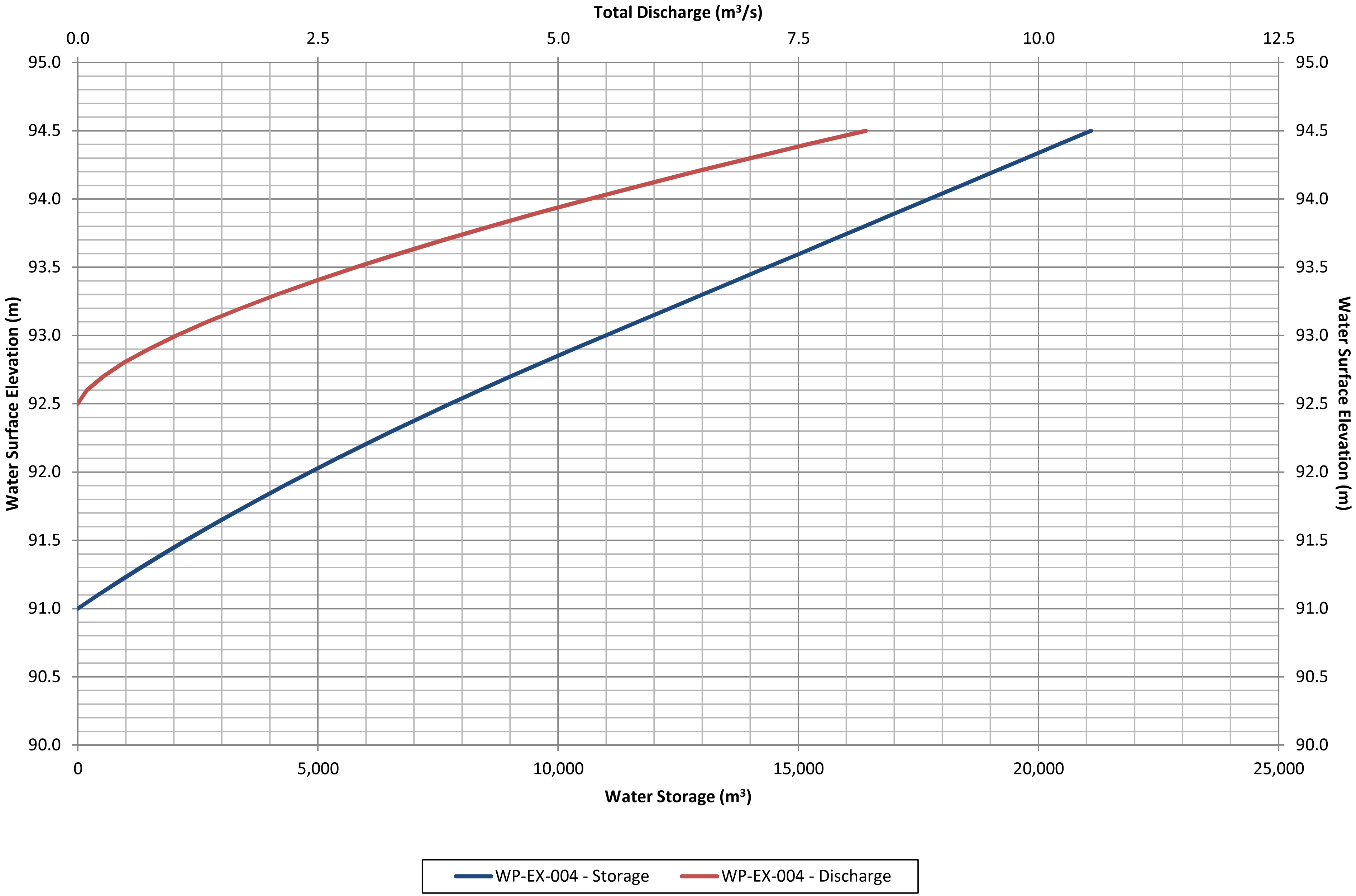
Assume spillway crest length is:	5.0 m	Dam crest length is:	960.9 m
Assume spillway crest breadth is:	>4.5 m	Dam crest breadth is:	5.0 m
Assume spillway invert elevation is:	109.0 m	Dam crest invert elevation is:	111.0 m

Elevation	Water Surface		Channel Spillway Outflow		Crest Overflow		Combined
(m)	Area (m^2)	Volume (m^3)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Weir Coefficient	{Weir Eqn.} (m^3/s)	Total (m^3/s)
106.7	0	0	#N/A	0.0	#N/A	#N/A	0.0
106.8	46	2	#N/A	0.0	#N/A	#N/A	0.0
106.9	215	13	#N/A	0.0	#N/A	#N/A	0.0
107.0	538	50	#N/A	0.0	#N/A	#N/A	0.0
107.1	999	125	#N/A	0.0	#N/A	#N/A	0.0
107.2	1,565	253	#N/A	0.0	#N/A	#N/A	0.0
107.3	2,270	443	#N/A	0.0	#N/A	#N/A	0.0
107.4	3,089	710	#N/A	0.0	#N/A	#N/A	0.0
107.5	3,950	1,062	#N/A	0.0	#N/A	#N/A	0.0
107.6	4,823	1,501	#N/A	0.0	#N/A	#N/A	0.0
107.7	5,755	2,029	#N/A	0.0	#N/A	#N/A	0.0
107.8	6,799	2,655	#N/A	0.0	#N/A	#N/A	0.0
107.9	7,972	3,392	#N/A	0.0	#N/A	#N/A	0.0
108.0	9,276	4,254	#N/A	0.0	#N/A	#N/A	0.0
108.1	10,719	5,252	#N/A	0.0	#N/A	#N/A	0.0
108.2	12,325	6,403	#N/A	0.0	#N/A	#N/A	0.0
108.3	14,114	7,723	#N/A	0.0	#N/A	#N/A	0.0
108.4	16,091	9,232	#N/A	0.0	#N/A	#N/A	0.0
108.5	18,274	10,948	#N/A	0.0	#N/A	#N/A	0.0
108.6	20,674	12,894	#N/A	0.0	#N/A	#N/A	0.0
108.7	23,474	15,096	#N/A	0.0	#N/A	#N/A	0.0
108.8	26,914	17,609	#N/A	0.0	#N/A	#N/A	0.0
108.9	31,061	20,502	#N/A	0.0	#N/A	#N/A	0.0
109.0	35,832	23,841	#N/A	0.0	#N/A	#N/A	0.0
109.1	41,175	27,687	1.490	0.0	#N/A	#N/A	0.0
109.2	46,989	32,092	1.490	0.2	#N/A	#N/A	0.2
109.3	53,375	37,102	1.450	0.2	#N/A	#N/A	0.2
109.4	60,661	42,798	1.460	0.7	#N/A	#N/A	0.7
109.5	68,339	49,247	1.450	1.2	#N/A	#N/A	1.2
109.6	76,043	56,465	2.450	3.1	#N/A	#N/A	3.1
109.7	84,086	64,466	3.450	6.1	#N/A	#N/A	6.1
109.8	92,808	73,304	4.450	10.3	#N/A	#N/A	10.3
109.9	102,652	83,063	5.450	16.0	#N/A	#N/A	16.0
110.0	114,020	93,877	6.450	23.1	#N/A	#N/A	23.1
110.1	127,166	105,921	7.450	31.8	#N/A	#N/A	31.8
110.2	142,916	119,394	8.450	42.3	#N/A	#N/A	42.3
110.3	161,883	134,605	9.450	54.5	#N/A	#N/A	54.5
110.4	183,670	151,851	10.450	68.7	#N/A	#N/A	68.7
110.5	210,151	171,475	11.450	84.9	#N/A	#N/A	84.9
110.6	238,209	193,888	12.450	103.1	#N/A	#N/A	103.1
110.7	264,615	219,056	13.450	123.5	#N/A	#N/A	123.5
110.8	288,006	246,713	14.450	146.2	#N/A	#N/A	146.2
110.9	309,183	276,614	15.450	171.2	#N/A	#N/A	171.2
111.0	327,266	308,261	16.450	198.6	#N/A	#N/A	198.6

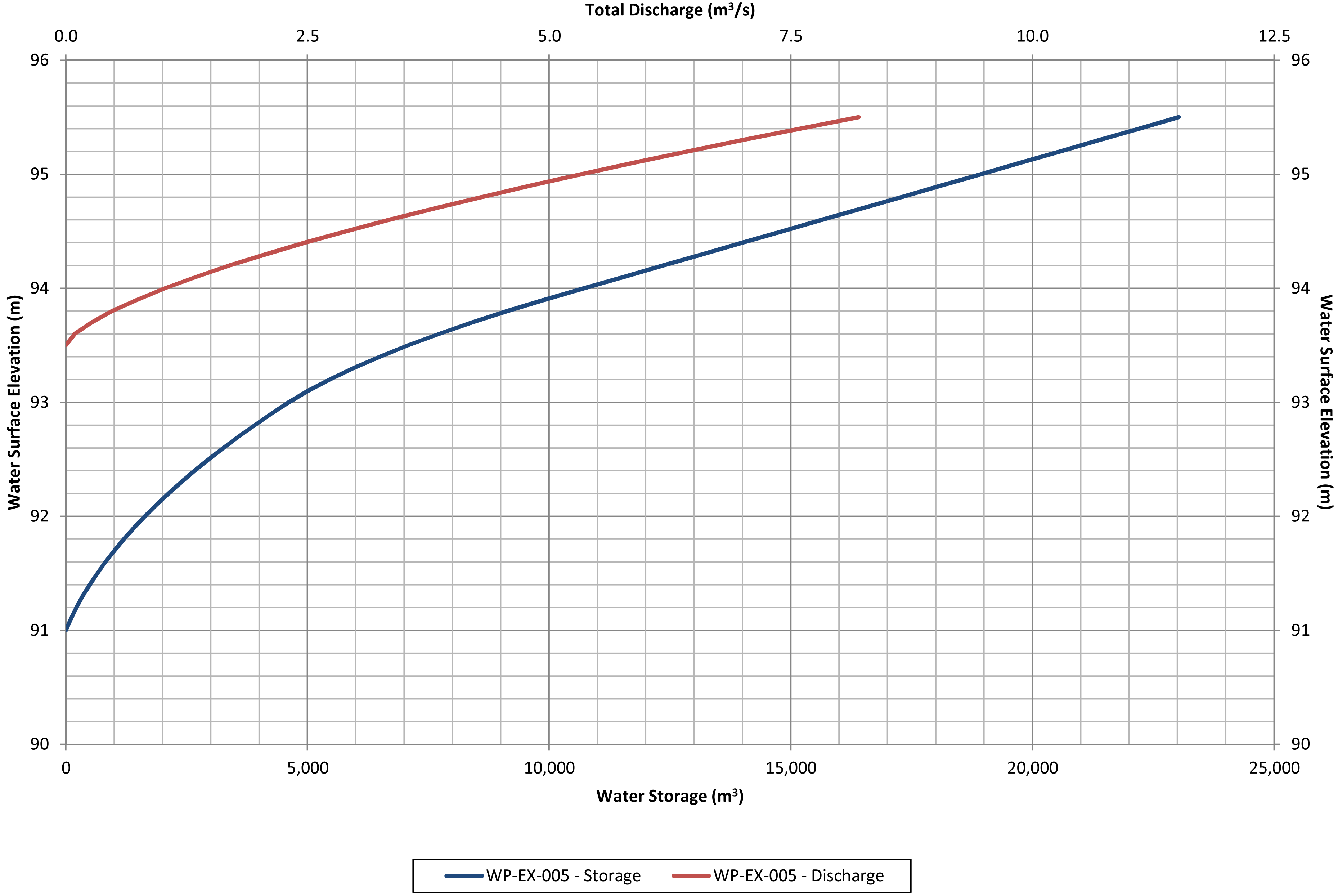

Total Discharge (m³/s)
0
5
10
15
20
25
30
35
120
115
110
105
100
Water Surface Elevation (m)
Water Surface Elevation (m)
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
14,000,000
Water Storage (m³)
WP-EX-001 - Storage
WP-EX-001 - Discharge


Total Discharge (m³/s)
0
5
10
15
20
25
30
35
102.0
101.5
101.0
100.5
100.0
99.5
99.0
98.5
98.0
Water Surface Elevation (m)
Water Surface Elevation (m)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Water Storage (m³)
WP-EX-002 - Storage
WP-EX-002 - Discharge

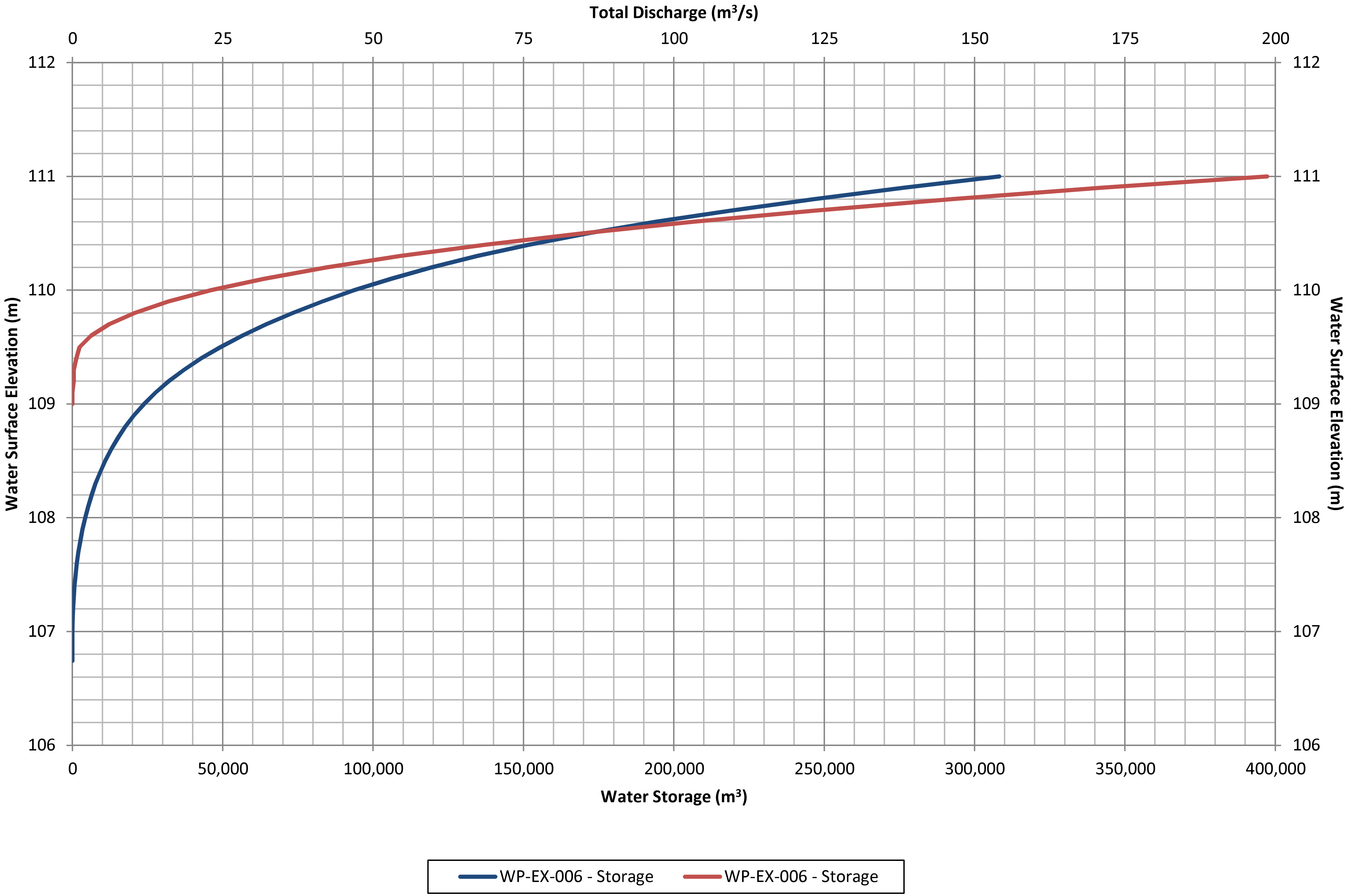

Total Discharge (m³/s)
0
5
10
15
20
25
30
35
40
120.0
119.5
119.0
118.5
118.0
117.5
117.0
116.5
116.0
115.5
115.0
Water Surface Elevation (m)
Water Surface Elevation (m)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
Water Storage (m³)
WP-EX-003 - Storage
WP-EX-003 - Discharge



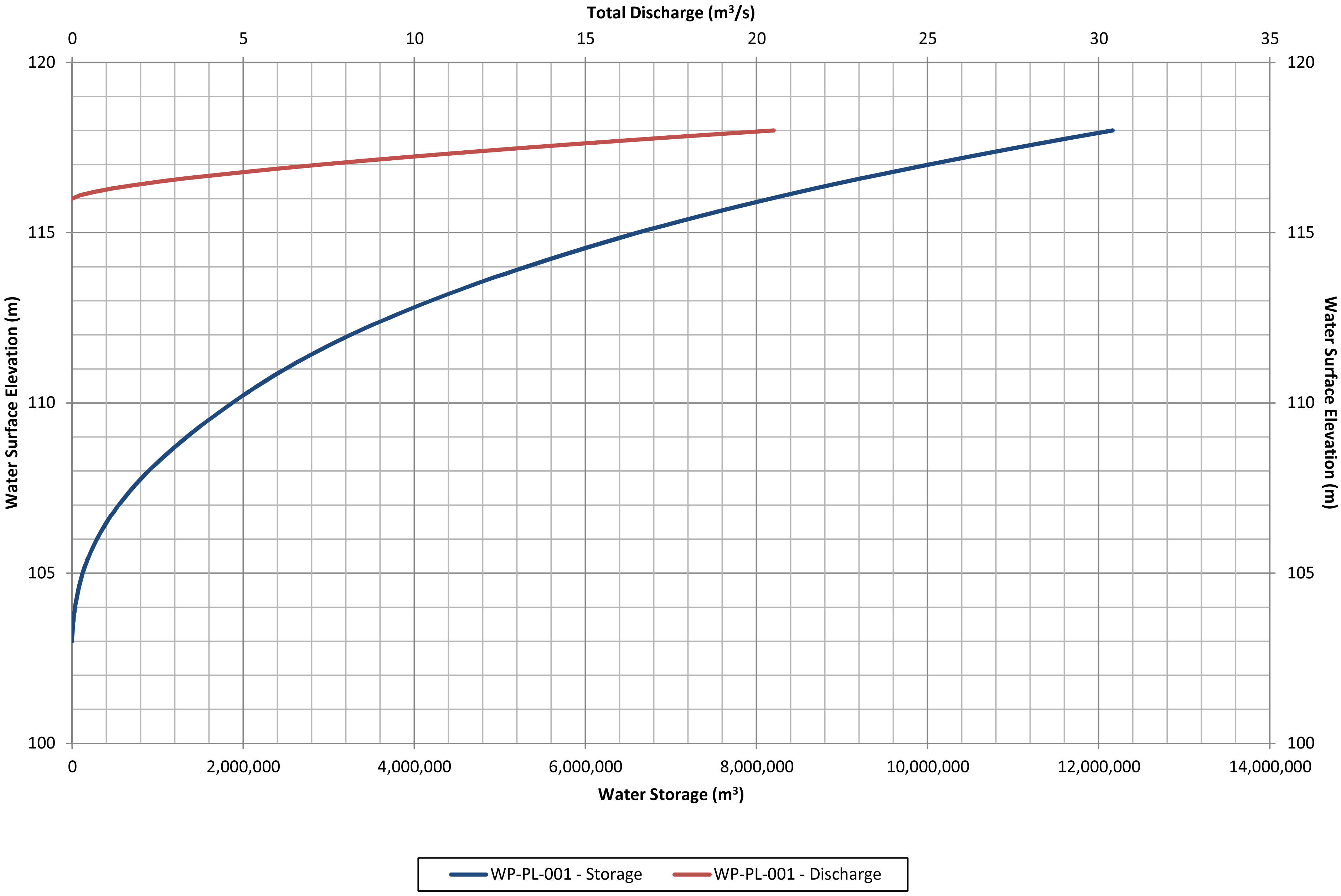
Total Discharge (m³/s)
0.0
2.5
5.0
7.5
10.0
12.5
Water Surface Elevation (m)
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
0
5,000
10,000
15,000
20,000
25,000
Water Storage (m³)
WP-EX-004 - Storage
WP-EX-004 - Discharge

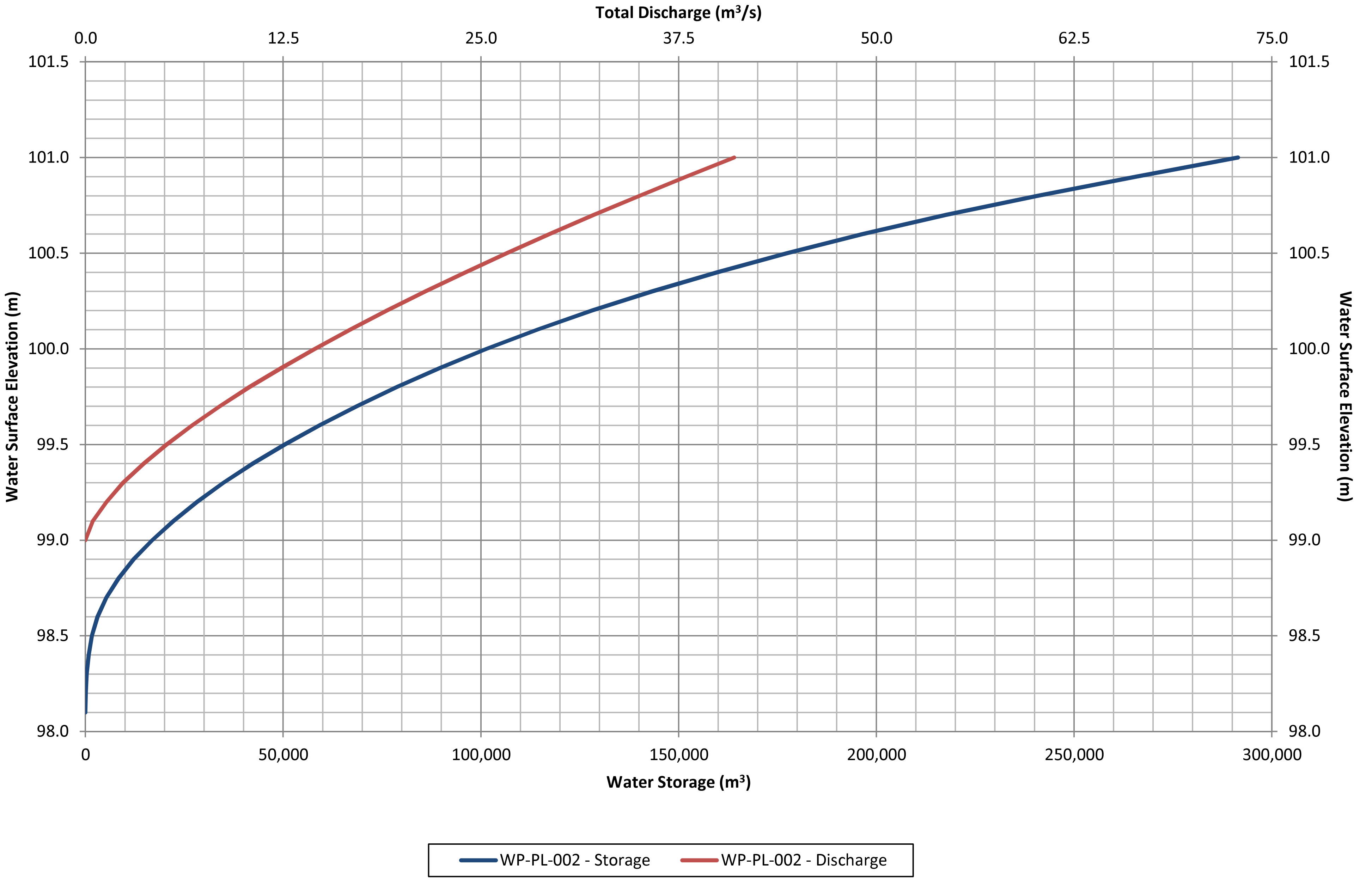


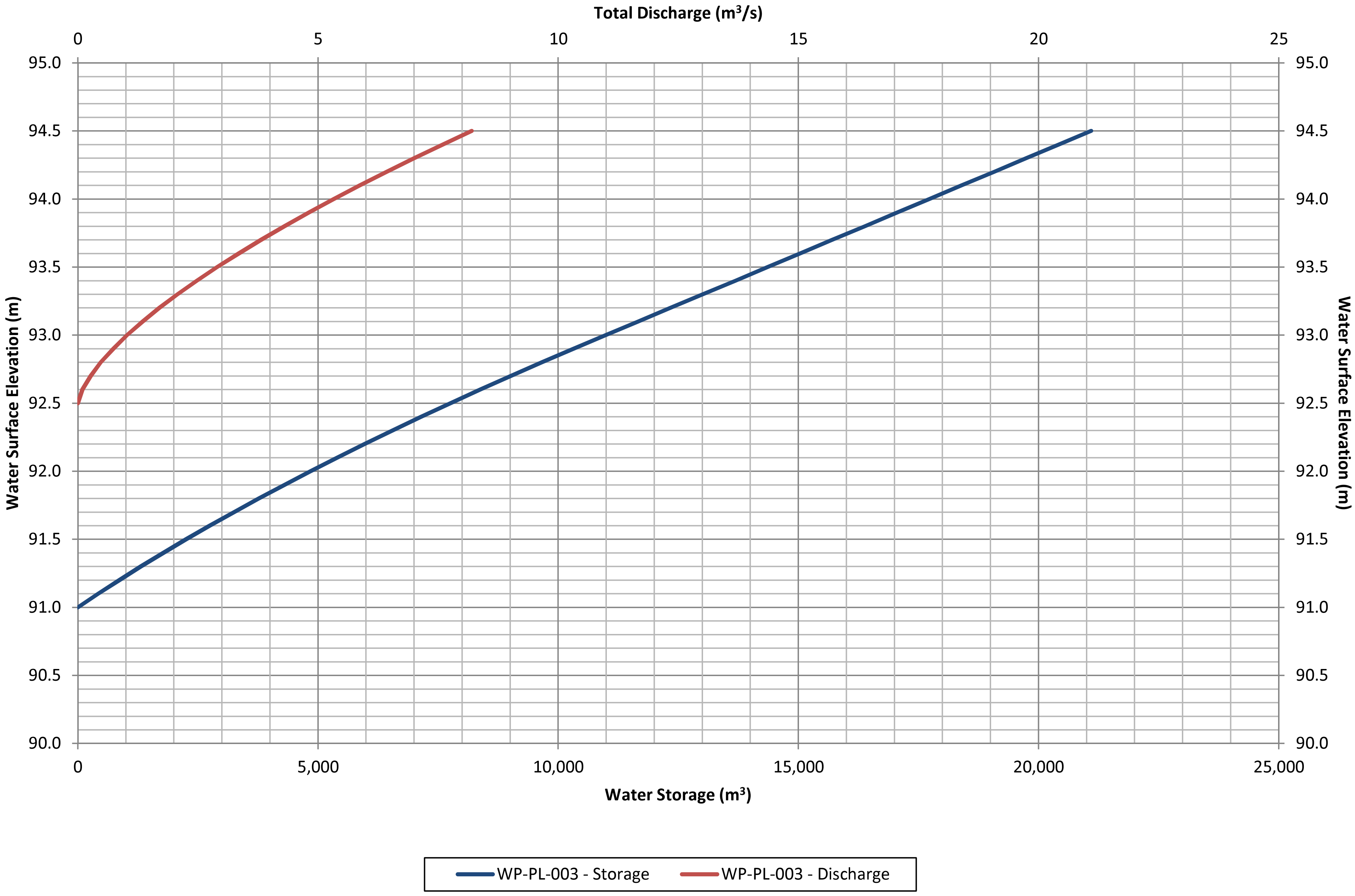
Total Discharge (m³/s)
0.0
2.5
5.0
7.5
10.0
12.5
96
95
94
93
92
91
90
Water Surface Elevation (m)
0
5,000
10,000
15,000
20,000
25,000
Water Storage (m³)
WP-EX-005 - Storage
WP-EX-005 - Discharge

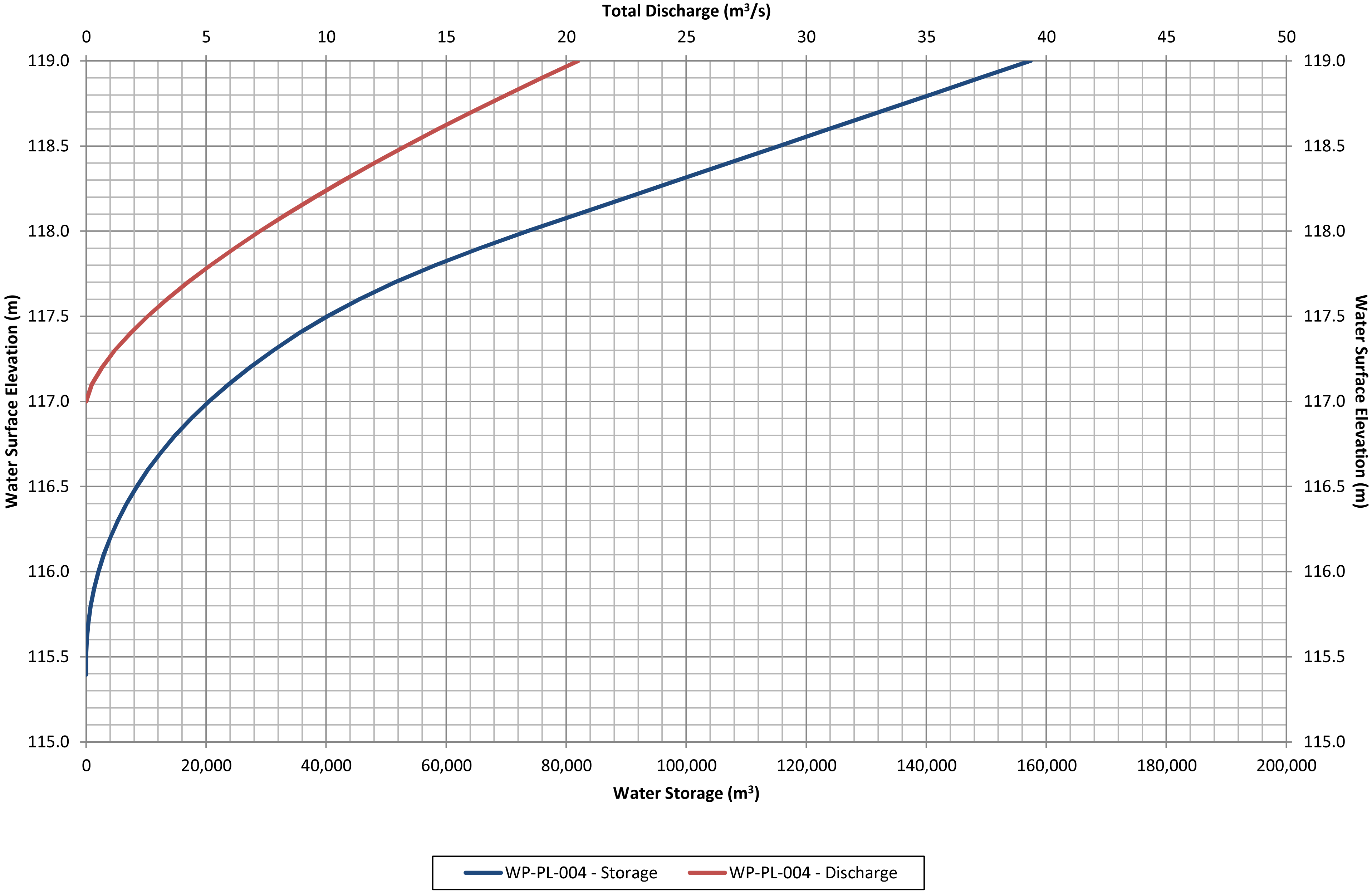


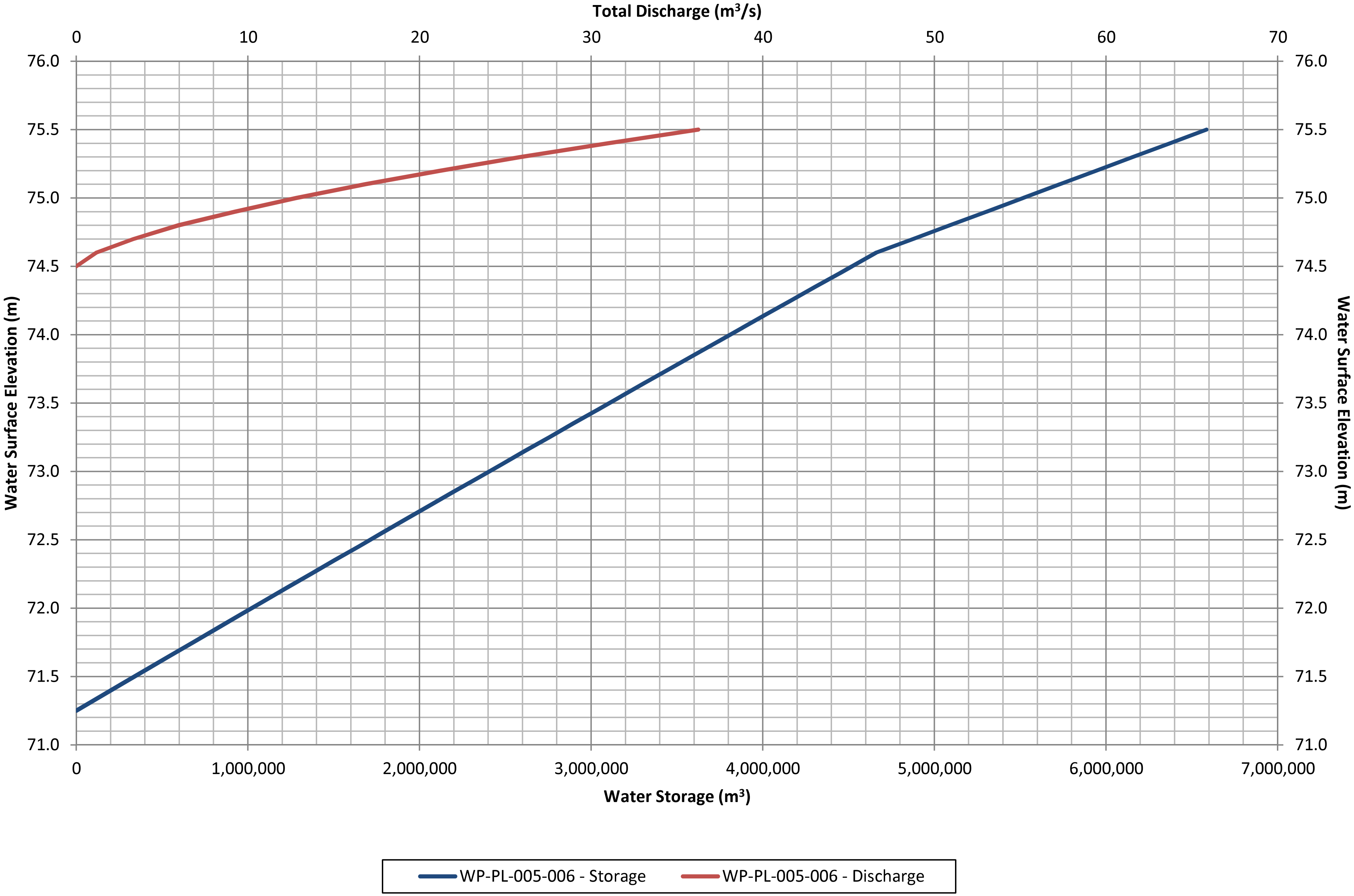
Total Discharge (m³/s)
0
25
50
75
100
125
150
175
200
112
111
110
109
108
107
106
Water Surface Elevation (m)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
Water Storage (m³)
WP-EX-006 - Storage
WP-EX-006 - Storage

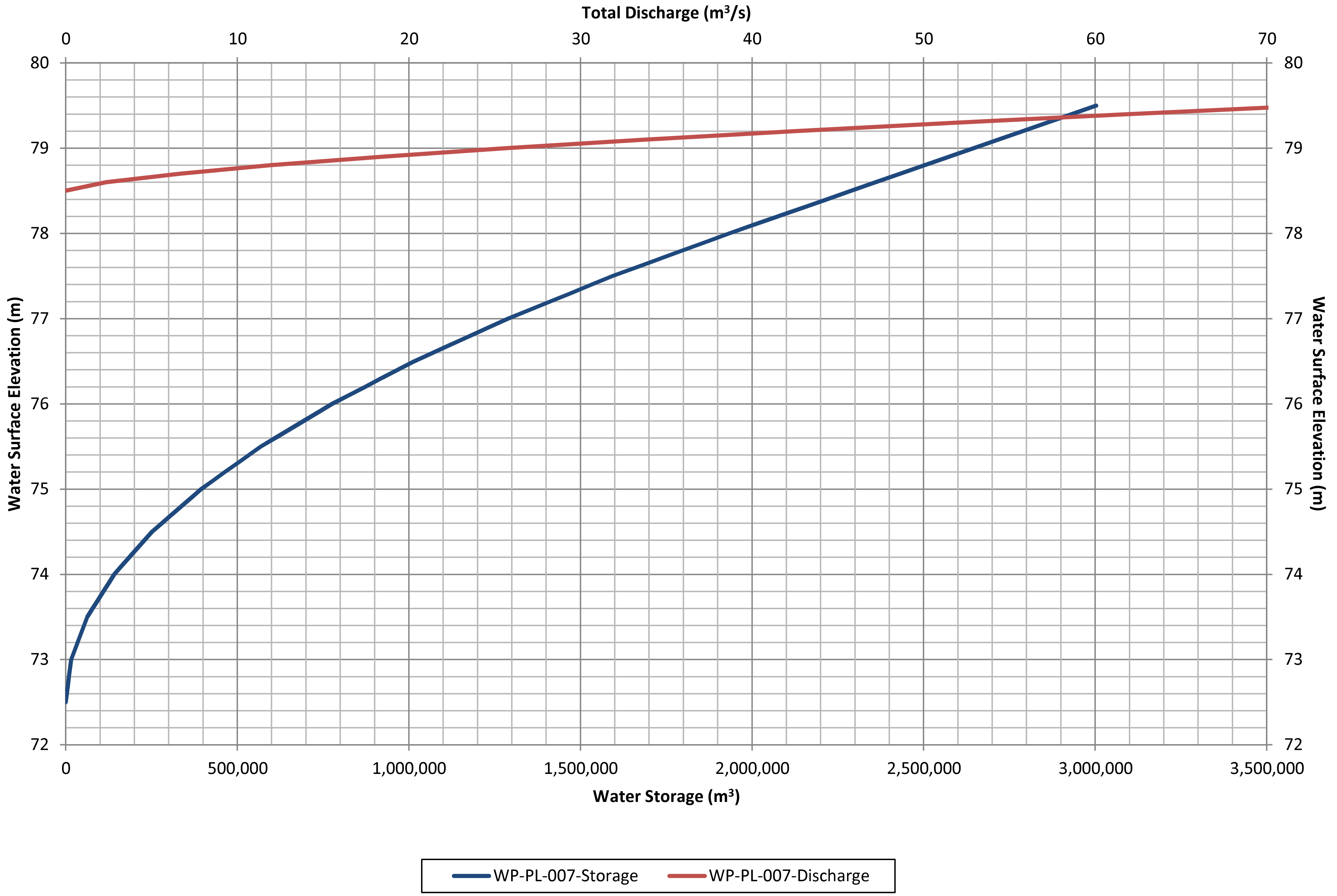

Total Discharge (m³/s)
0
5
10
15
20
25
30
35
Water Surface Elevation (m)
100
105
110
115
120
Water Storage (m³)
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
14,000,000
WP-PL-001 - Storage
WP-PL-001 - Discharge

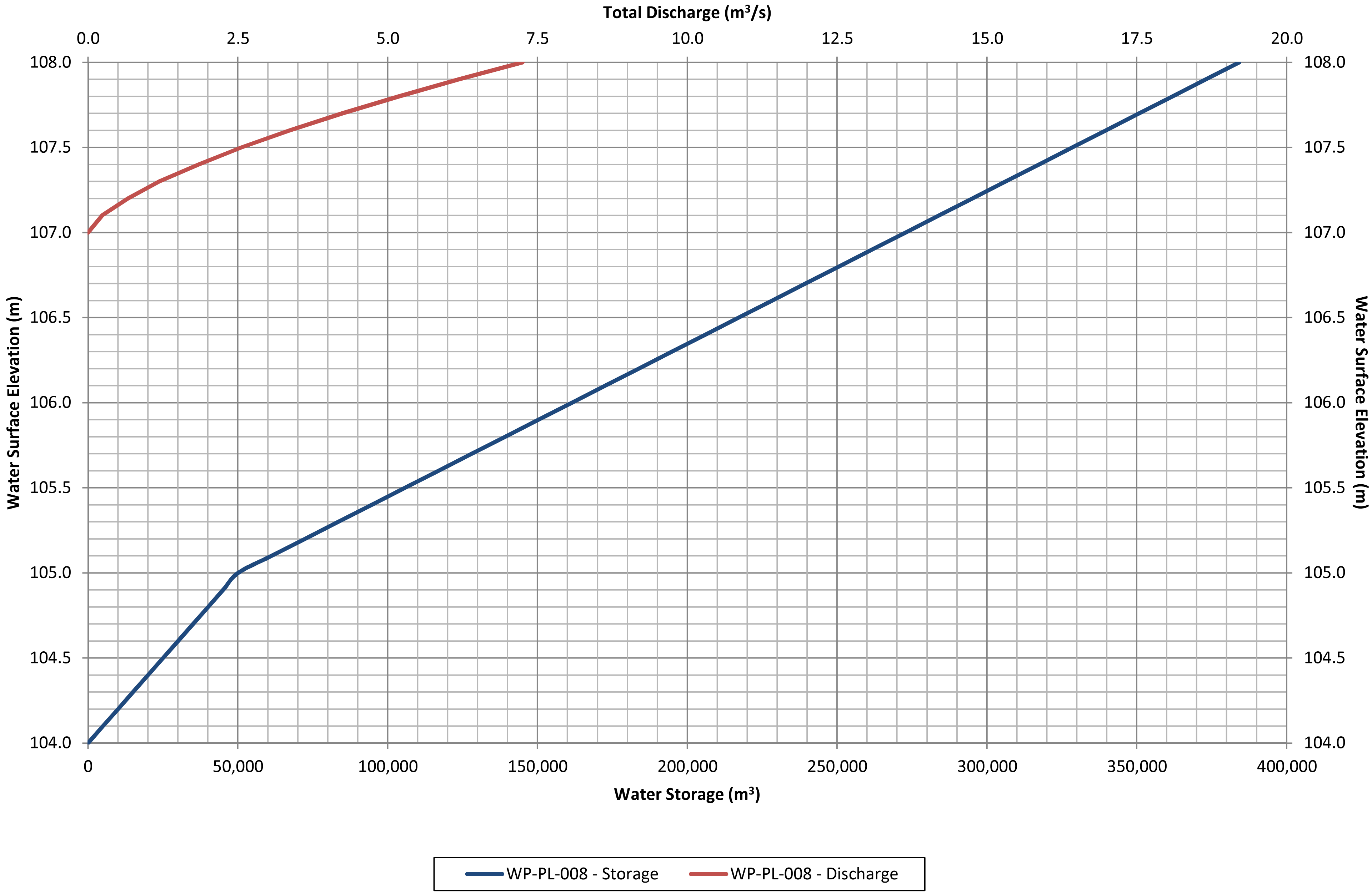

Total Discharge (m³/s)
0.0
12.5
25.0
37.5
50.0
62.5
75.0
101.5
101.0
100.5
100.0
99.5
99.0
98.5
98.0
Water Surface Elevation (m)
Water Surface Elevation (m)
0
50,000
100,000
150,000
200,000
250,000
300,000
Water Storage (m³)
WP-PL-002 - Storage
WP-PL-002 - Discharge


Total Discharge (m³/s)
0
5
10
15
20
25
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
Water Surface Elevation (m)
0
5,000
10,000
15,000
20,000
25,000
Water Storage (m³)
WP-PL-003 - Storage
WP-PL-003 - Discharge

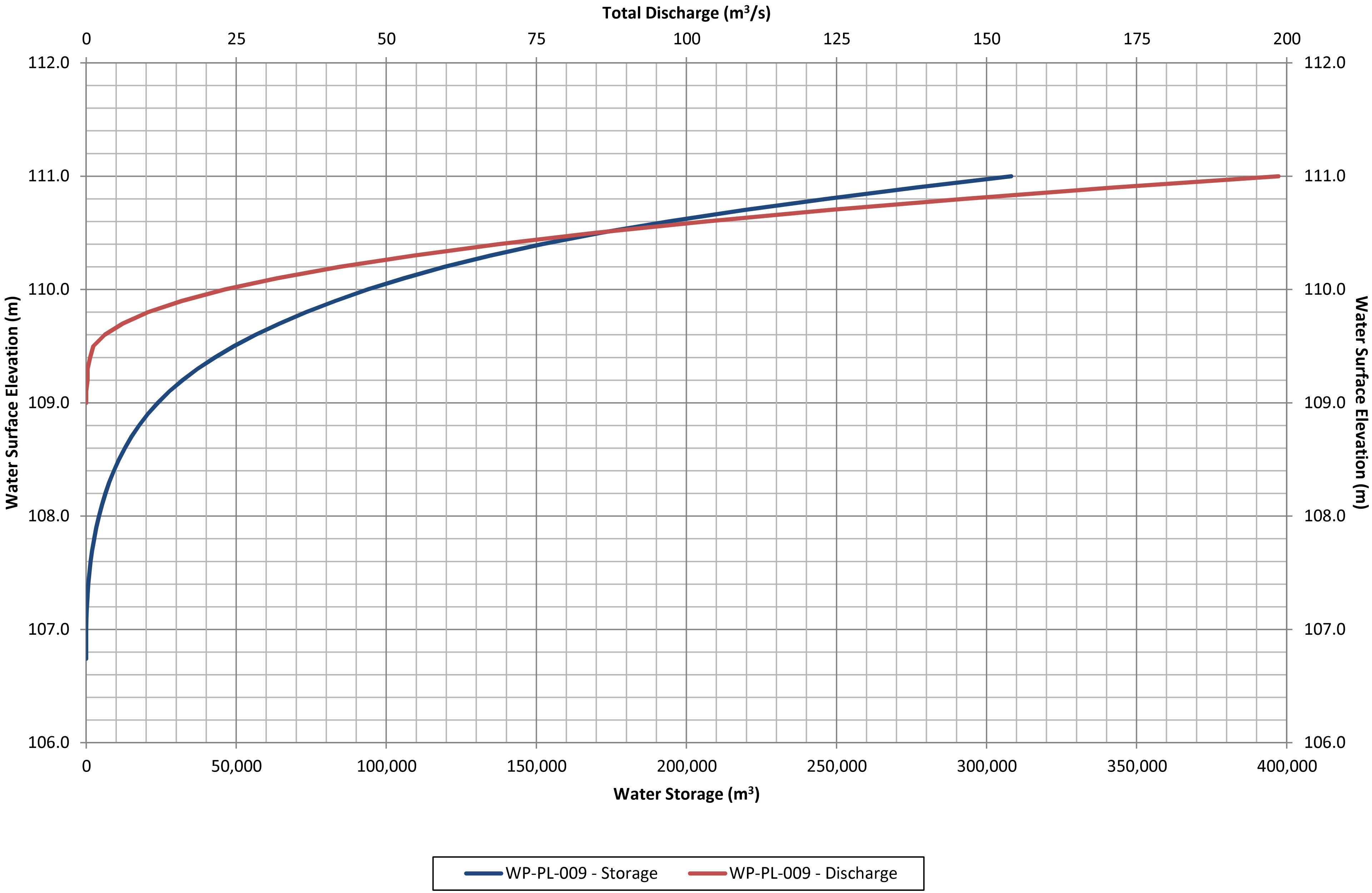

Total Discharge (m³/s)
0
5
10
15
20
25
30
35
40
45
50
119.0
118.5
118.0
117.5
117.0
116.5
116.0
115.5
115.0
Water Surface Elevation (m)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Water Storage (m³)
WP-PL-004 - Storage
WP-PL-004 - Discharge


Total Discharge (m³/s)
0
10
20
30
40
50
60
70
76.0
75.5
75.0
74.5
74.0
73.5
73.0
72.5
72.0
71.5
71.0
Water Surface Elevation (m)
Water Surface Elevation (m)
0
1,000,000
2,000,000
3,000,000
4,000,000
5,000,000
6,000,000
7,000,000
Water Storage (m³)
WP-PL-005-006 - Storage
WP-PL-005-006 - Discharge


Total Discharge (m³/s)
0
10
20
30
40
50
60
70
80
79
78
77
76
75
74
73
72
Water Surface Elevation (m)
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
3,500,000
Water Storage (m³)
WP-PL-007-Storage
WP-PL-007-Discharge



Total Discharge (m^3/s)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Water Surface Elevation (m)
108.0
107.5
107.0
106.5
106.0
105.5
105.0
104.5
104.0
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
Water Storage (m^3)
WP-PL-008 - Storage
WP-PL-008 - Discharge

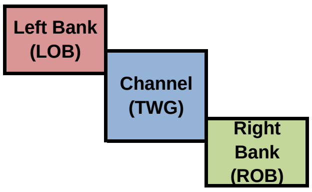

Total Discharge (m³/s)
0
25
50
75
100
125
150
175
200
112.0
111.0
110.0
109.0
108.0
107.0
106.0
Water Surface Elevation (m)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
Water Storage (m³)
WP-PL-009 - Storage
WP-PL-009 - Discharge

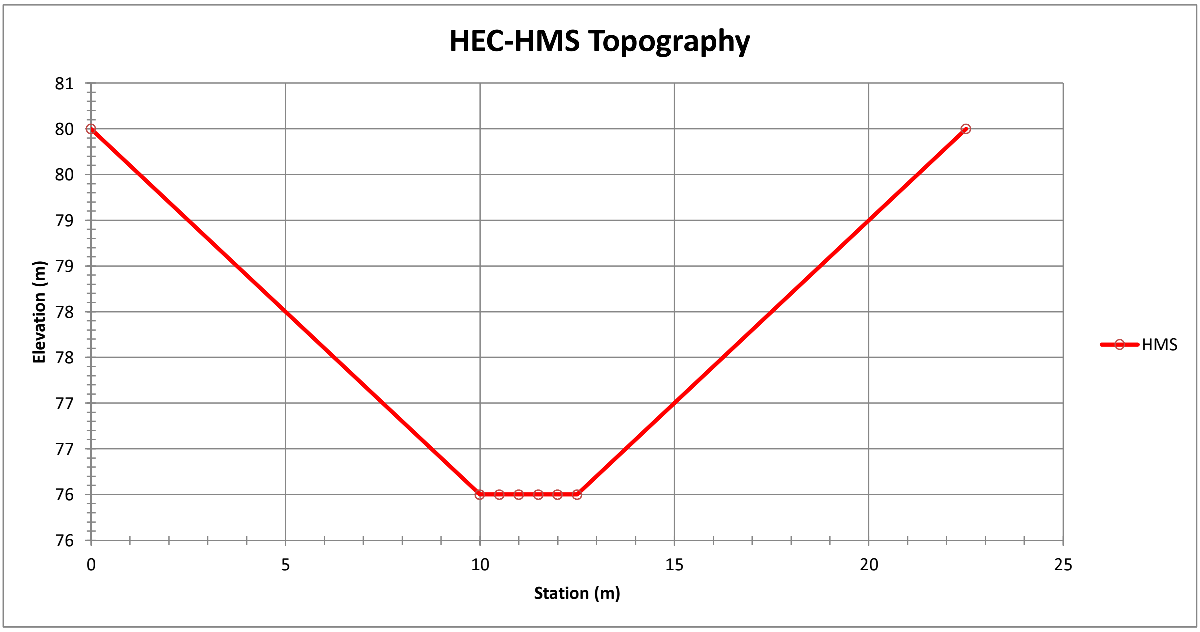
HEC-HMS Channel Topography (For DC-EX-001)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	3170.0	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	**3**
11.000	76.000	4
11.500	76.000	5
12.000	76.000	**6**
12.500	76.000	7
22.500	80.000	8





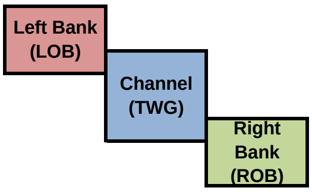
Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining	Made by: AB	Job No.: PE701-00022/01
	Letpadaung	Checked	Date: 19/07/2013
	Surface Water Management Impact Assess.	Approved	

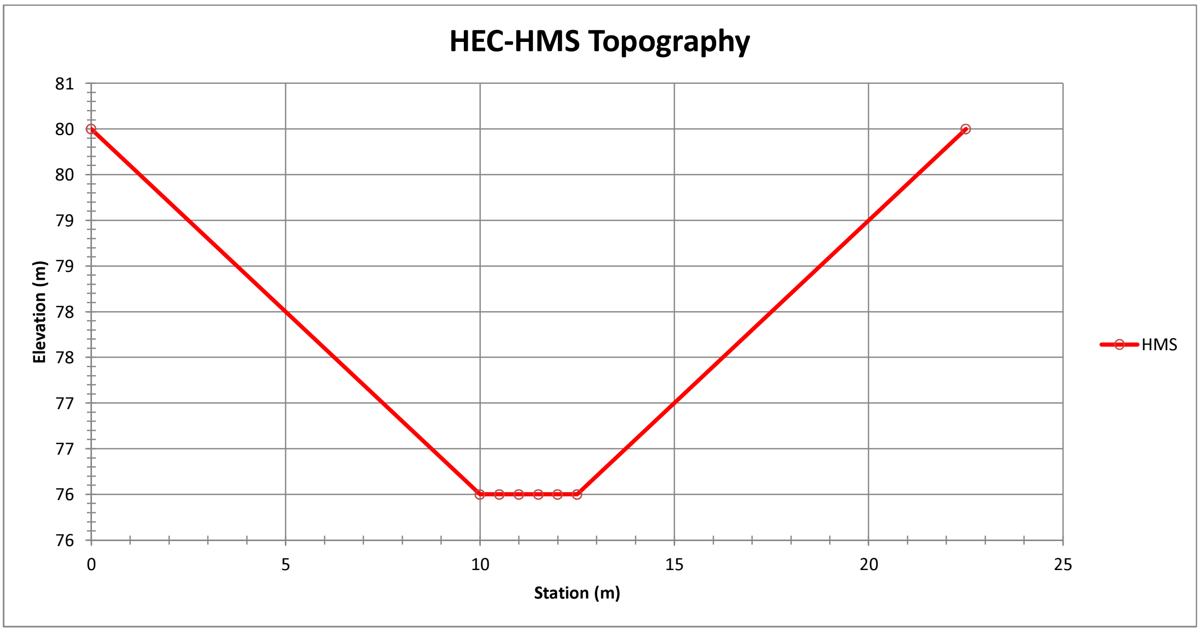
HEC-HMS Channel Topography (For DC-EX-002)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	836.7	(m)
Channel slope, S =	0.005	(m/m)
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	(m)
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	(m)

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	3
11.000	76.000	4
11.500	76.000	5
12.000	76.000	6
12.500	76.000	7
22.500	80.000	8



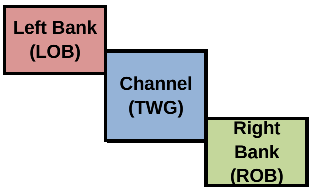


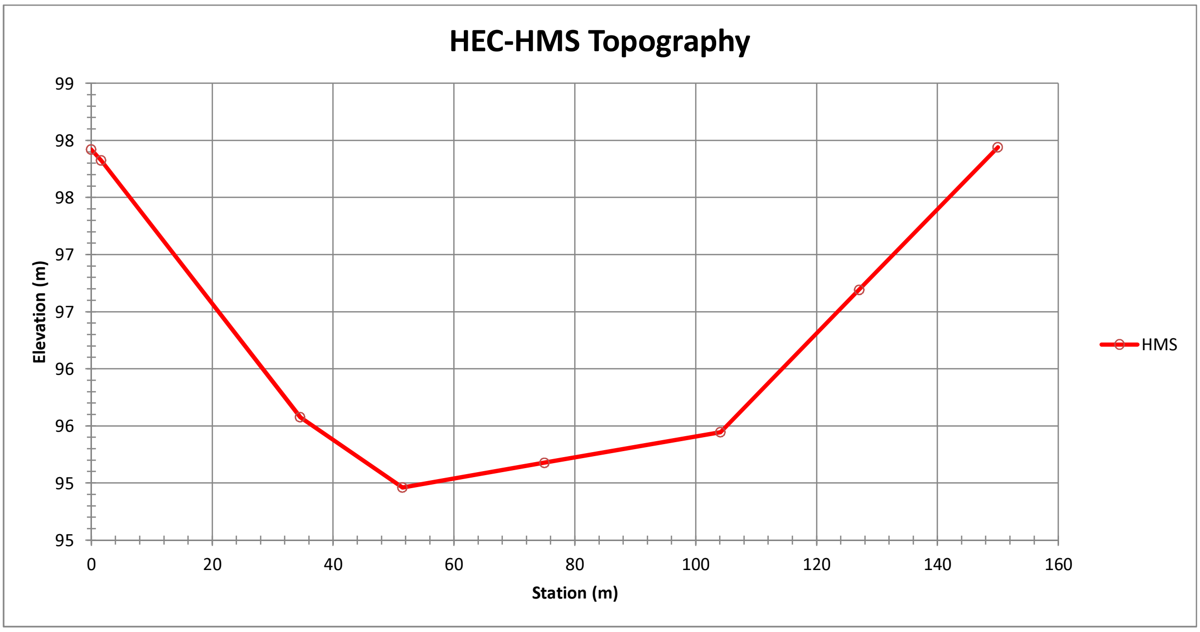
HEC-HMS Channel Topography (For NC-EX-003)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	4885.0	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	97.919	1
1.632	97.824	2
34.528	95.576	**3**
51.508	94.961	4
75.000	95.177	5
104.127	95.444	**6**
127.064	96.692	7
150.000	97.940	8





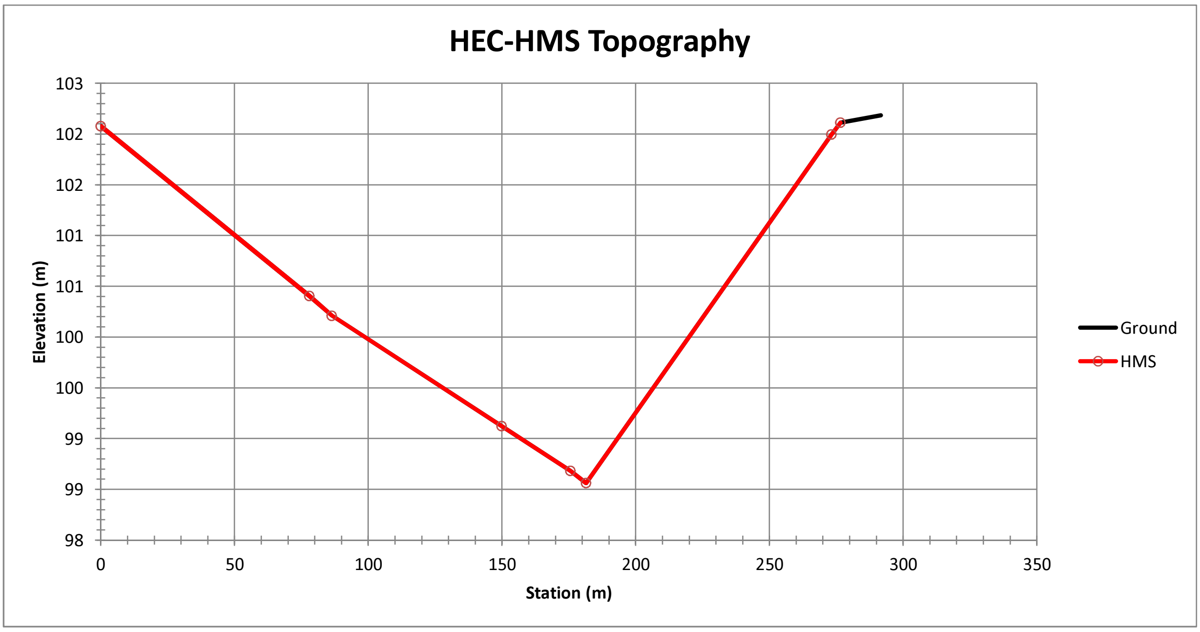
HEC-HMS Channel Topography (For NC-EX-004)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 1383.7 **(m)**
Channel slope, S = 0.011 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	102.078	1
78.005	100.404	2
86.383	100.211	**3**
149.917	99.122	4
175.632	98.681	5
181.500	98.563	**6**
273.261	101.997	7
276.618	102.111	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



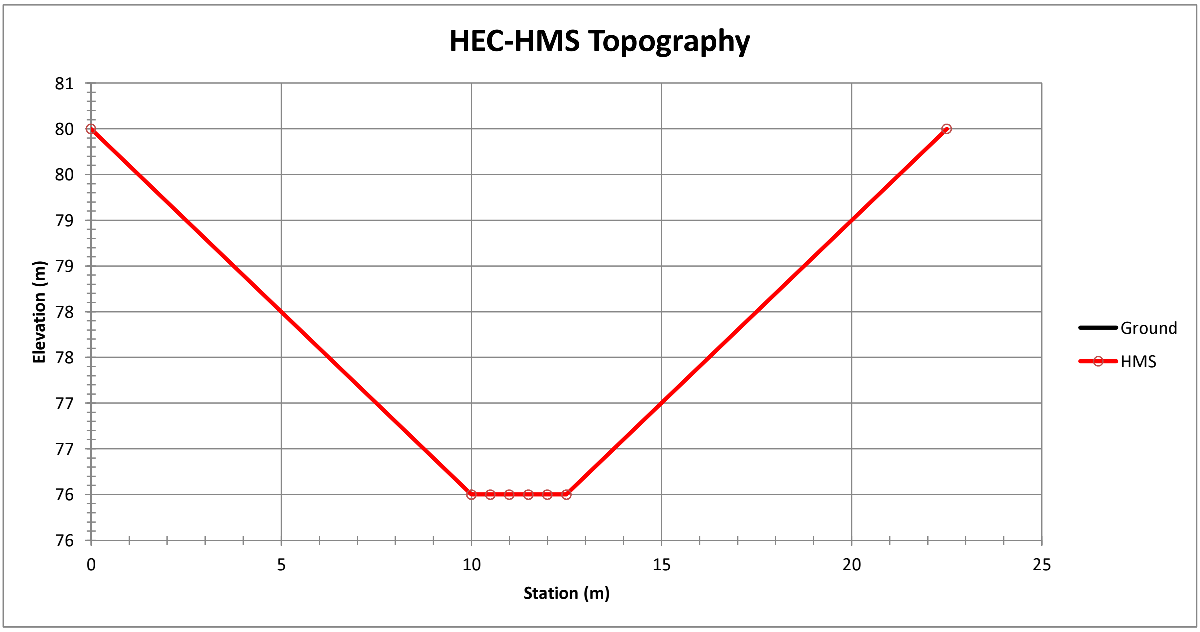
HEC-HMS Channel Topography (For DC-EX-005)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	3158.1	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	**3**
11.000	76.000	4
11.500	76.000	5
12.000	76.000	**6**
12.500	76.000	7
22.500	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



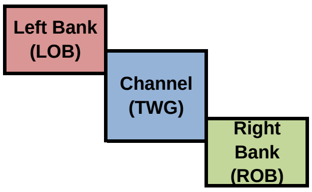
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 19/07/2013
	Surface Water Management Impact Assess.	Approved	

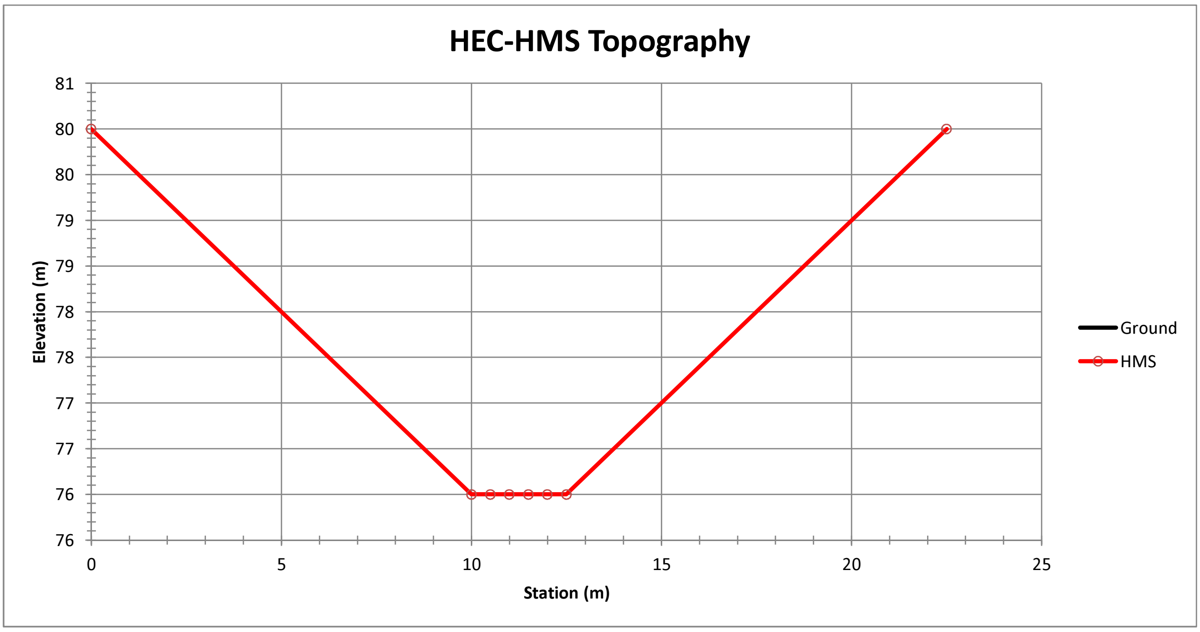
HEC-HMS Channel Topography (For DC-EX-006)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2079.0	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	**3**
11.000	76.000	4
11.500	76.000	5
12.000	76.000	**6**
12.500	76.000	7
22.500	80.000	8



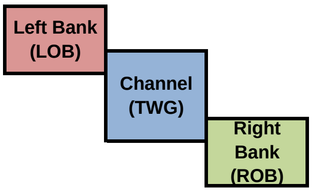


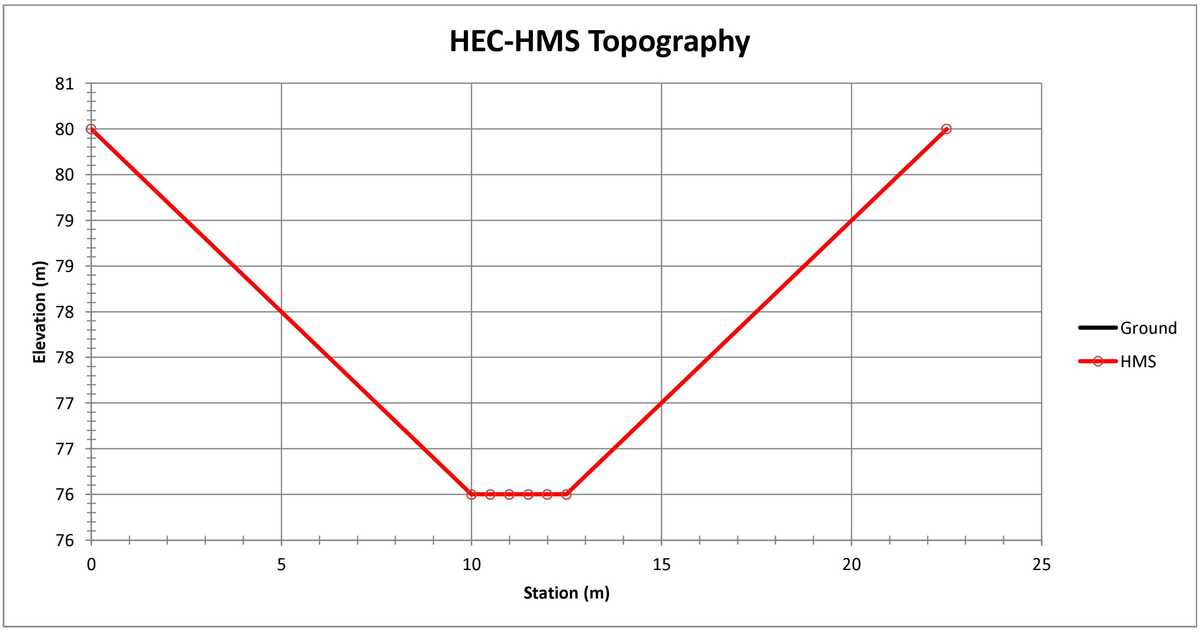
HEC-HMS Channel Topography (For DC-EX-007)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	433.4	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	3
11.000	76.000	4
11.500	76.000	5
12.000	76.000	6
12.500	76.000	7
22.500	80.000	8



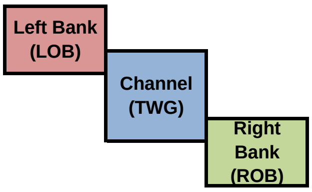


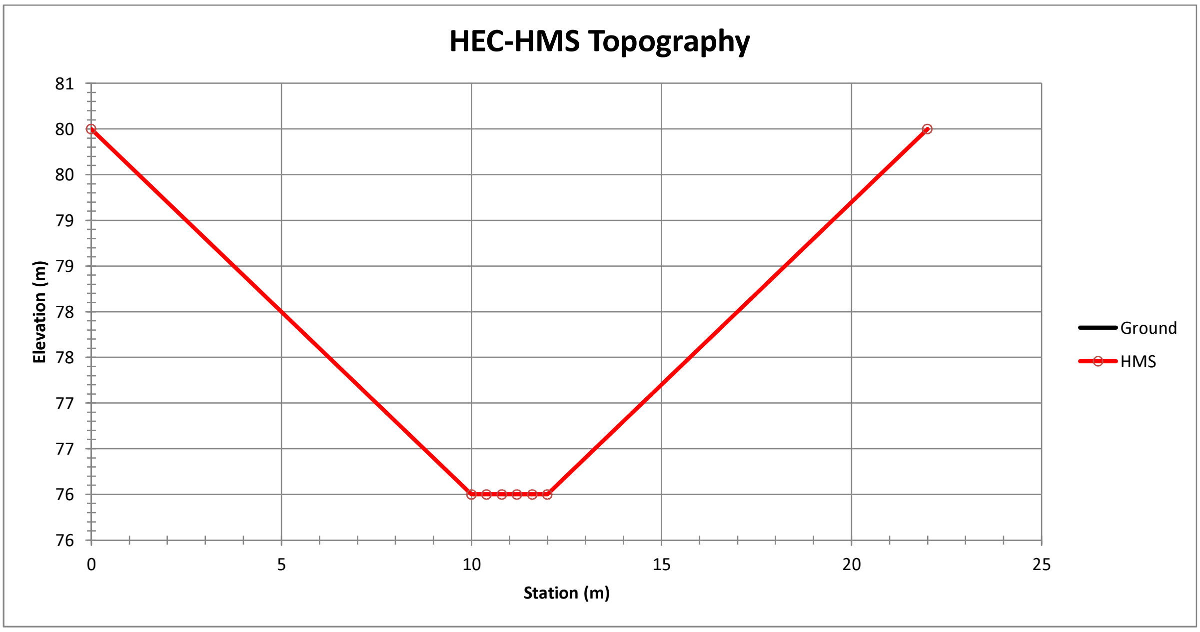
HEC-HMS Channel Topography (For DC-EX-008)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	473.7	**(m)**
Channel slope, S =	0.004	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8





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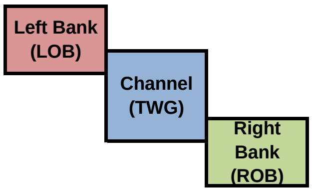
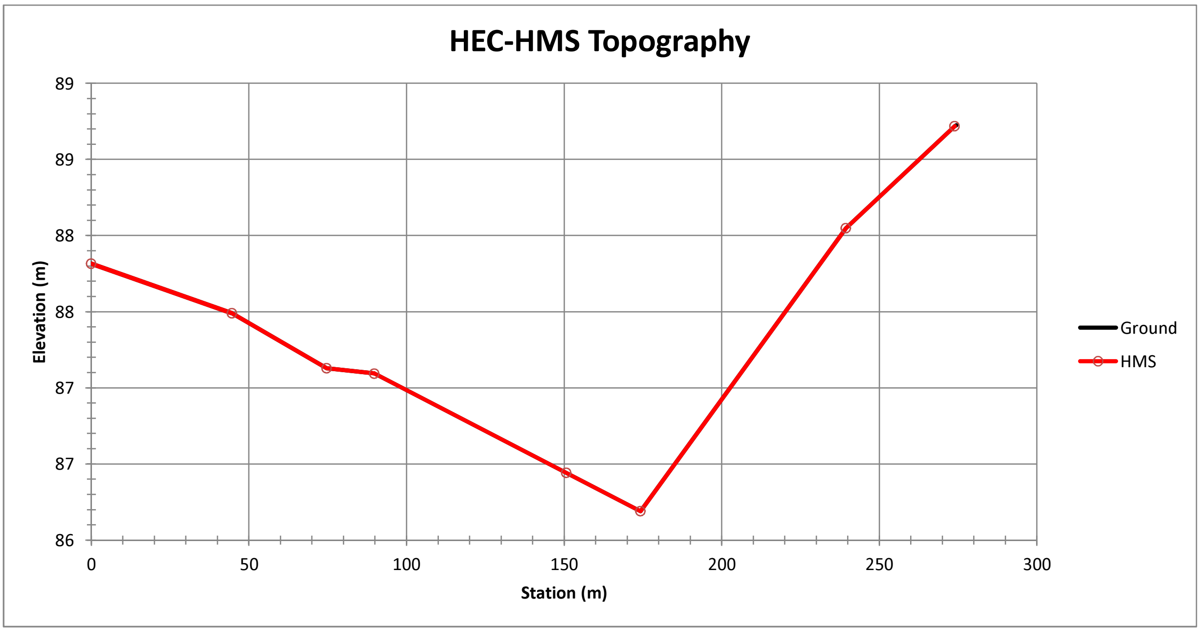
HEC-HMS Channel Topography (For NC-EX-009)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	3367.893	**(m)**
Channel slope, S =	0.004	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	87.816	1
44.672	87.489	2
74.686	87.129	**3**
89.765	87.094	4
150.729	86.442	5
174.289	86.190	**6**
239.410	88.048	7
273.891	88.718	8





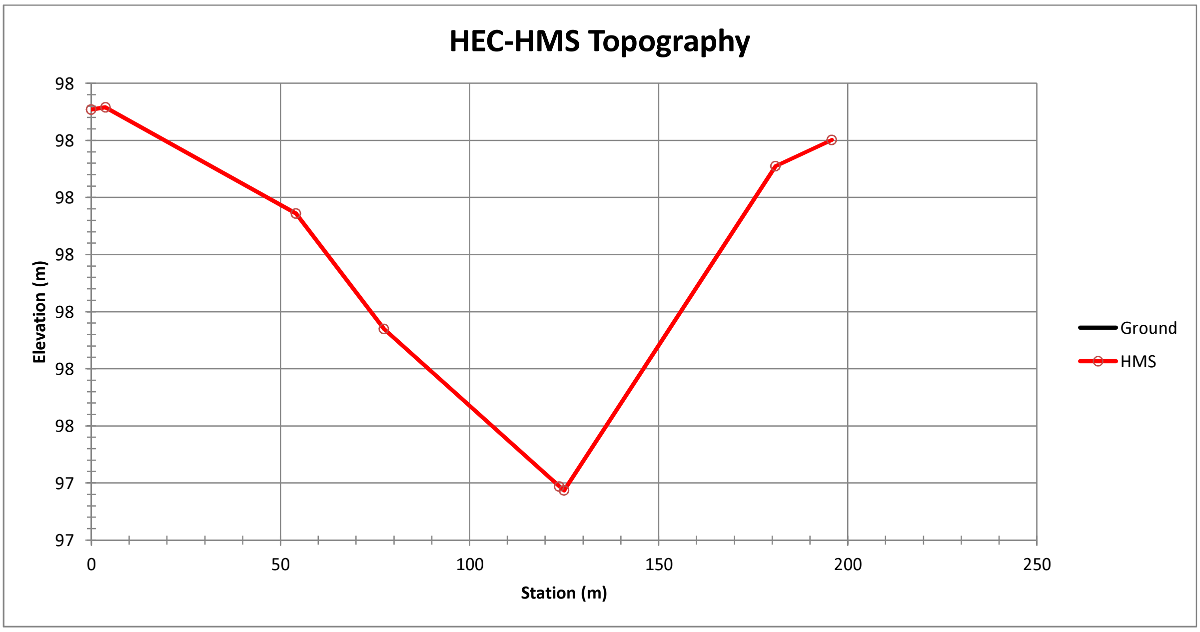
HEC-HMS Channel Topography (For NC-EX-010)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 751.5 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	98.054	1
3.732	98.058	2
54.141	97.872	**3**
77.378	97.670	4
123.701	97.394	5
124.982	97.387	**6**
180.874	97.955	7
195.823	98.001	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**

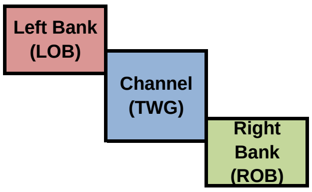


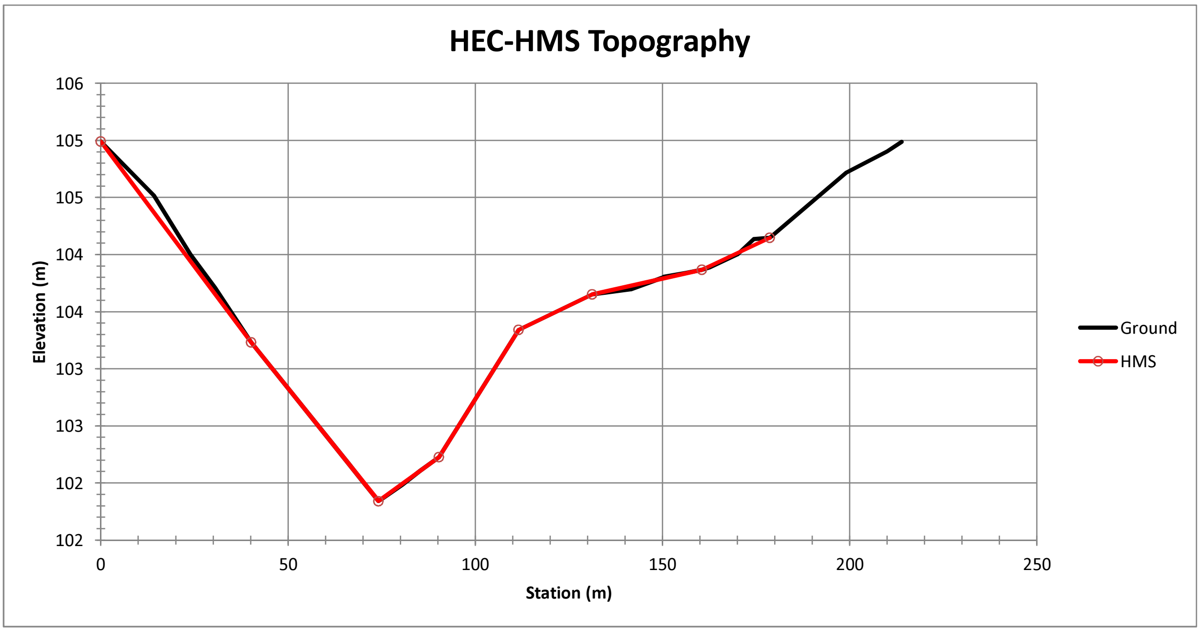
HEC-HMS Channel Topography (For NC-EX-011)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 2850.6 **(m)**
Channel slope, S = 0.004 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	104.989	1
40.175	103.232	2
74.184	101.841	**3**
90.298	102.227	4
111.616	103.340	5
131.256	103.652	**6**
160.528	103.867	7
178.653	104.147	8



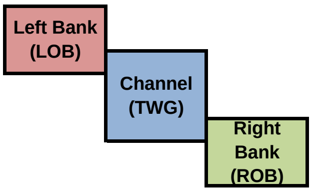


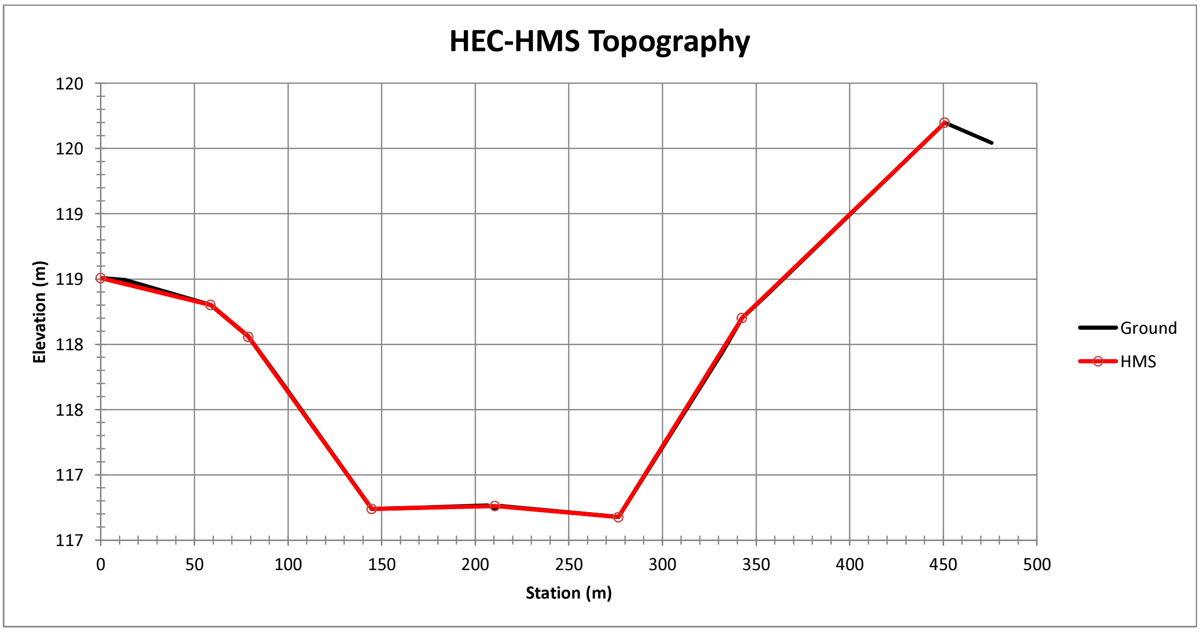
HEC-HMS Channel Topography (For NC-EX-012)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1140.5	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	118.507	1
58.568	118.302	2
78.809	118.058	**3**
144.710	116.738	4
210.610	116.760	5
276.511	116.676	**6**
342.411	118.202	7
450.803	119.698	8





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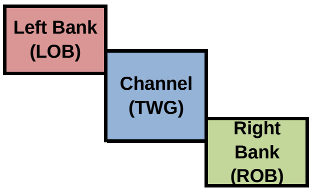
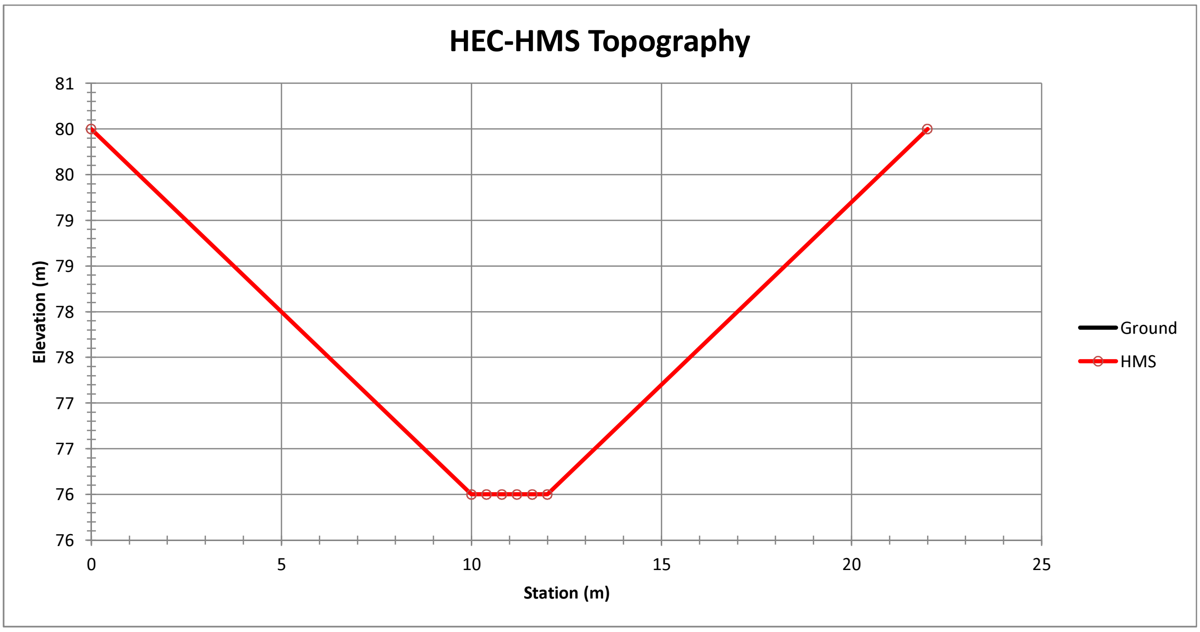
HEC-HMS Channel Topography (For DC-EX-013)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1466.5	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8





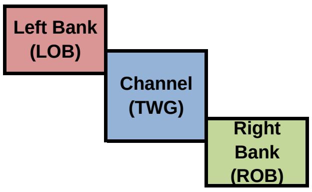
HEC-HMS Channel Topography (For NC-EX-014)

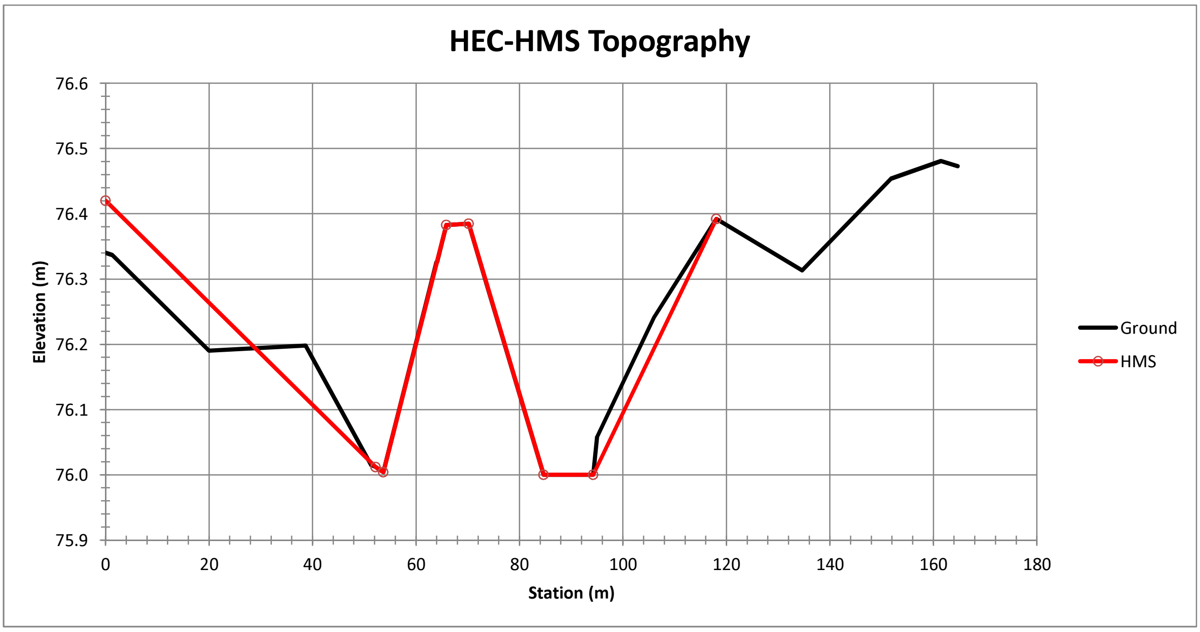
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	793.1	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	76.420	1
52.179	76.012	2
53.687	76.004	**3**
65.895	76.383	4
70.181	76.385	5
84.640	76.000	**6**
94.254	76.000	7
118.033	76.392	8





HEC-HMS Channel Topography (For NC-EX-015)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

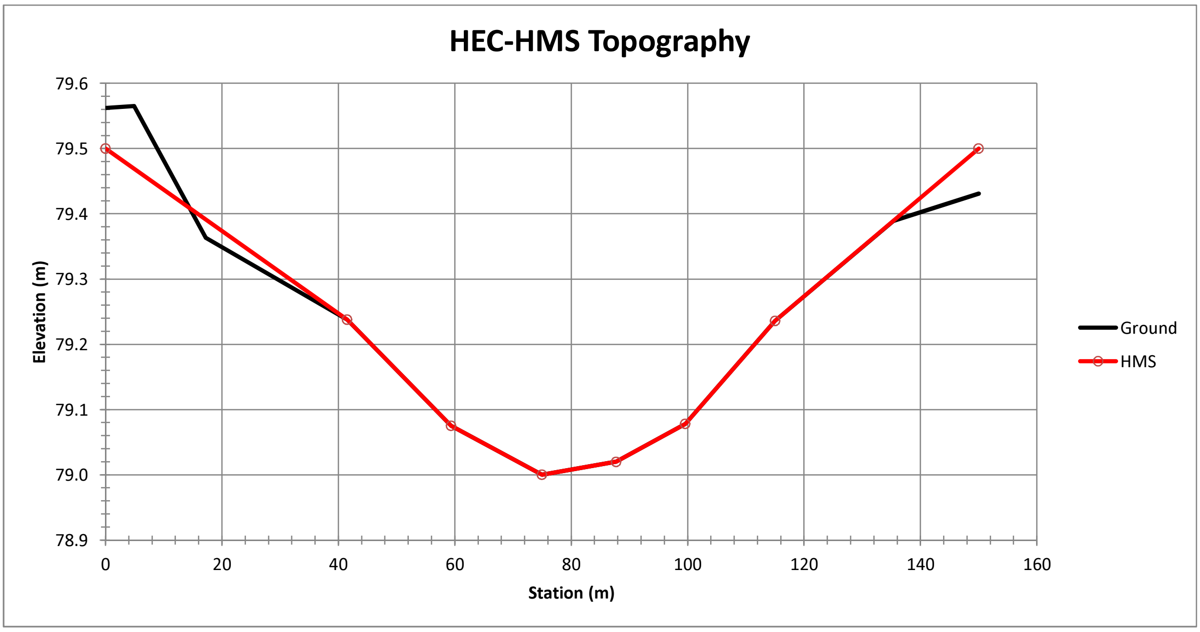
Channel length, L =	1914.2	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	79.500	1
41.492	79.238	2
59.397	79.075	**3**
75.000	79.000	4
87.724	79.020	5
99.599	79.078	**6**
115.026	79.236	7
150.000	79.500	8

Left Bank (LOB)

Channel (TWG)

Right Bank (ROB)

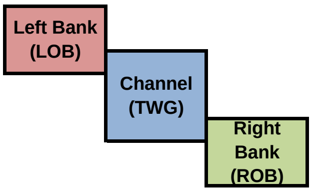


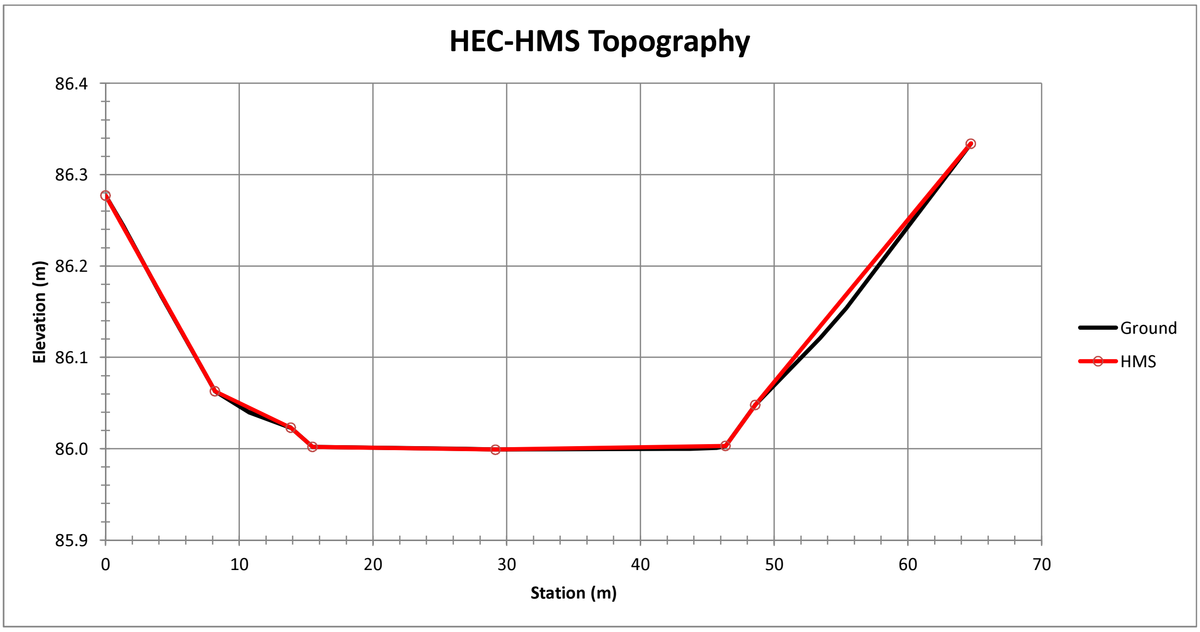
HEC-HMS Channel Topography (For NC-EX-016)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 167.9 **(m)**
Channel slope, S = 0.018 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	86.277	1
8.184	86.063	2
13.854	86.023	**3**
15.481	86.002	4
29.170	85.999	5
46.378	86.003	**6**
48.603	86.048	7
64.724	86.334	8





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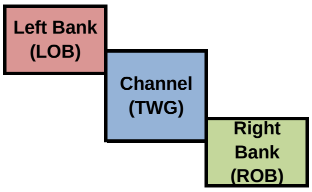
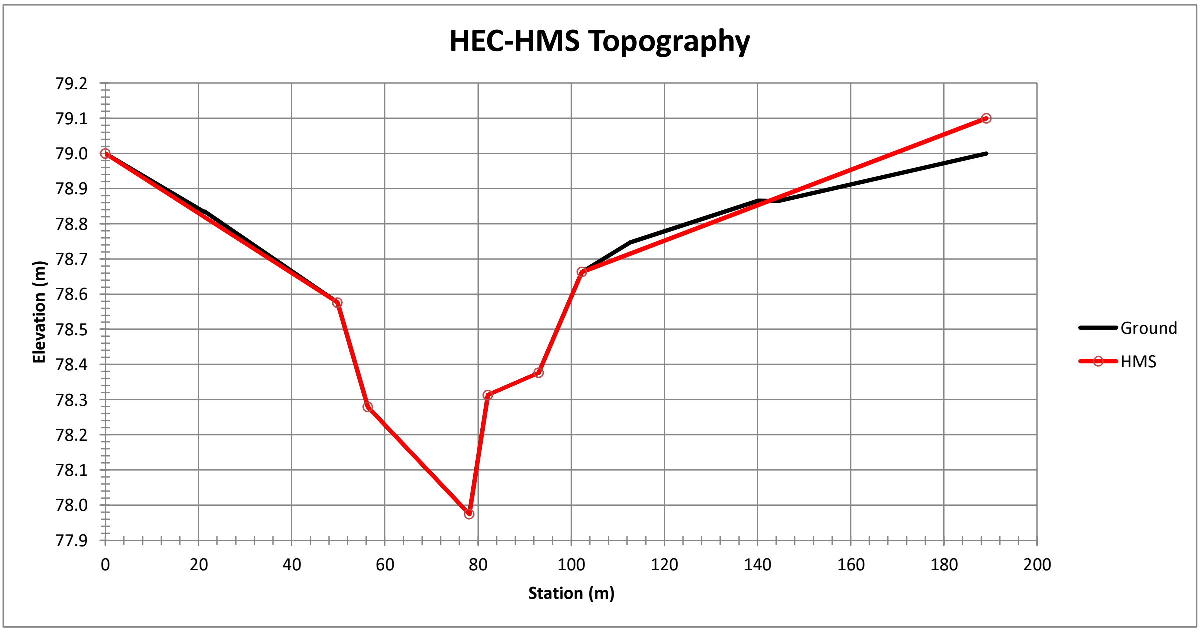
HEC-HMS Channel Topography (For NC-EX-017)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	821.0	**(m)**
Channel slope, S =	0.004	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	79.000	1
49.808	78.576	2
56.363	78.279	**3**
78.145	77.974	4
82.115	78.313	5
93.048	78.376	**6**
102.345	78.663	7
189.127	79.100	8



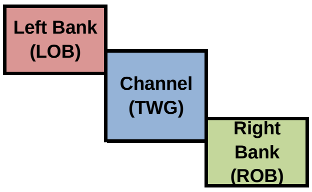


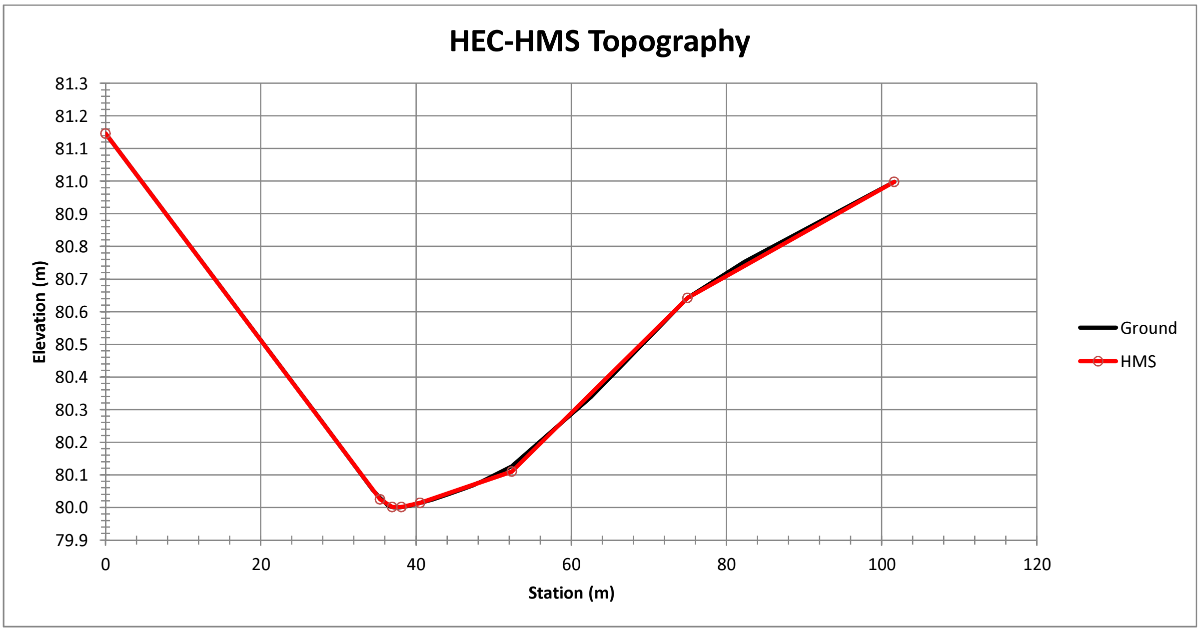
HEC-HMS Channel Topography (For NC-EX-018)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 602.4 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	81.146	1
35.384	80.025	2
36.940	80.001	**3**
38.152	80.001	4
40.542	80.014	5
52.355	80.110	**6**
75.000	80.642	7
101.637	80.998	8





HEC-HMS Channel Topography (For NC-EX-019)

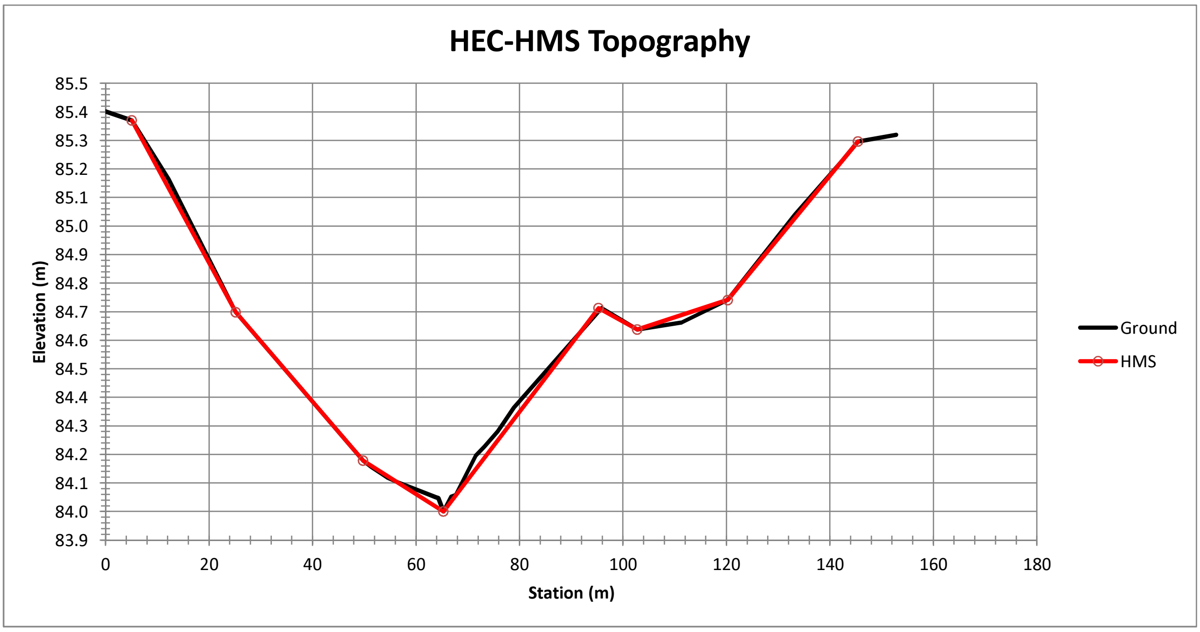
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 1278.2 **(m)**
Channel slope, S = 0.007 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

120.299 84.741

Eight-point channel shape		
Station (m)	**Elevation (m)**	
5.067	85.370	1
25.196	84.698	2
49.784	84.178	**3**
65.297	84.000	4
95.300	84.712	5
102.797	84.637	**6**
120.299	84.741	7
145.436	85.296	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



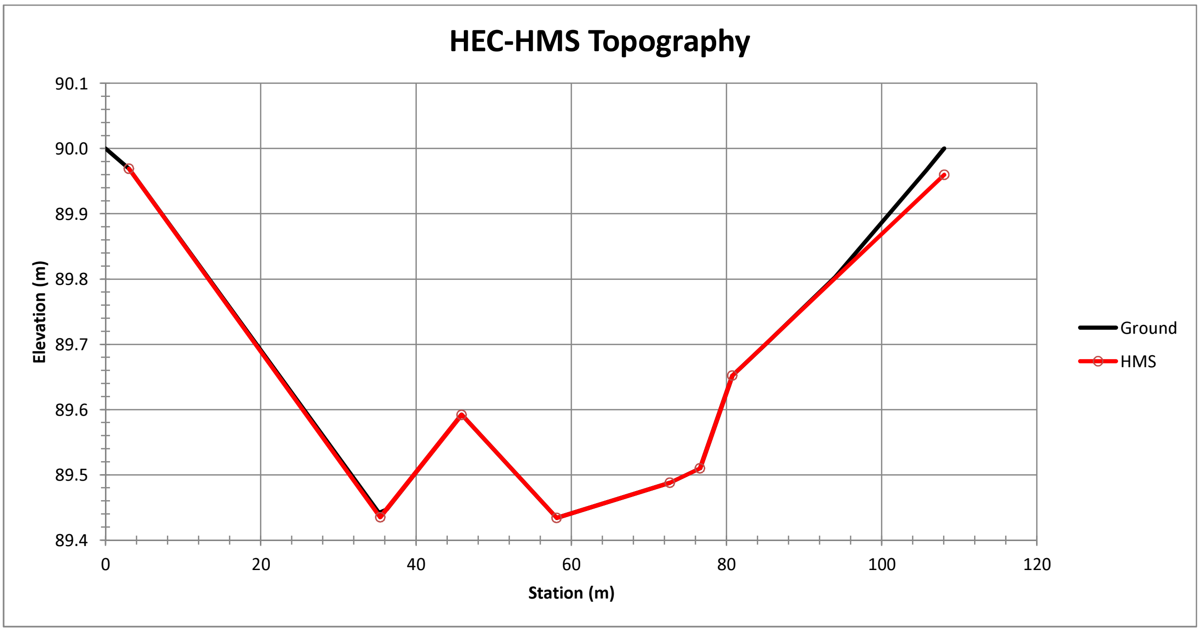
HEC-HMS Channel Topography (For NC-EX-020)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 138.6 **(m)**
Channel slope, S = 0.029 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
3.019	89.969	1
35.400	89.435	2
45.904	89.592	**3**
58.137	89.434	4
72.713	89.488	5
76.614	89.510	**6**
80.773	89.652	7
108.075	89.960	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**

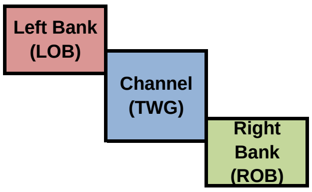


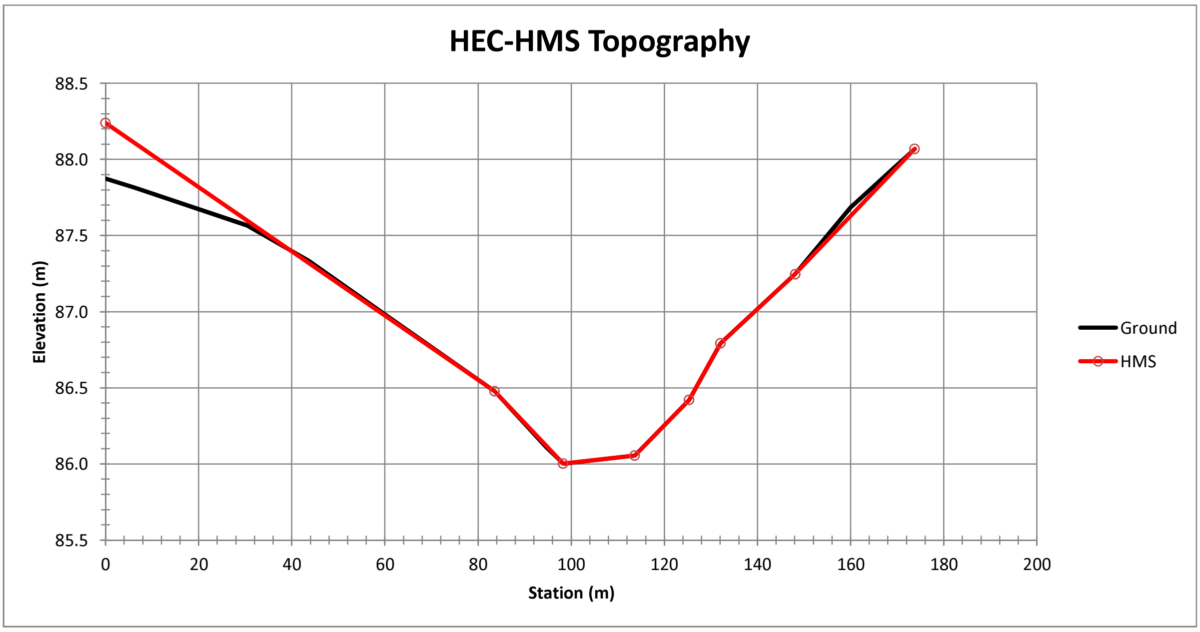
HEC-HMS Channel Topography (For NC-EX-021)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 2102.5 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	88.240	1
83.533	86.478	2
98.264	86.002	**3**
113.666	86.055	4
125.317	86.420	5
132.046	86.792	**6**
148.110	87.247	7
173.779	88.070	8



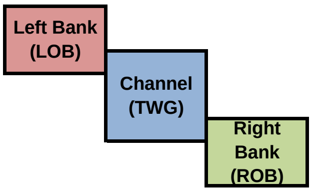


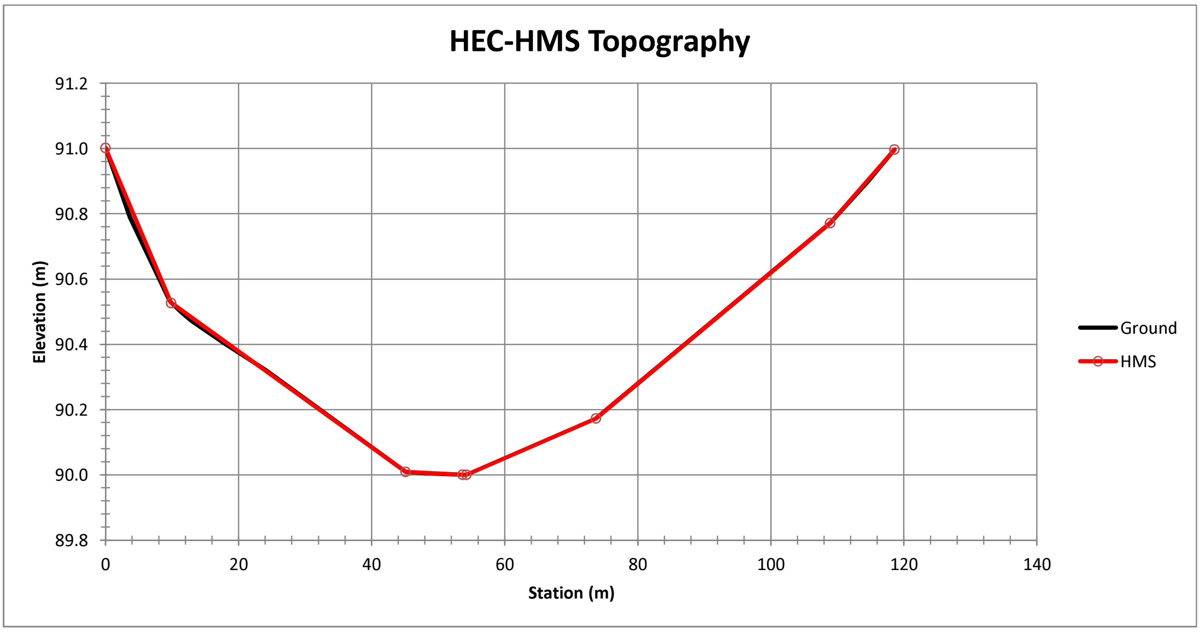
HEC-HMS Channel Topography (For NC-EX-022)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 277.1 **(m)**
Channel slope, S = 0.004 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	91.002	1
9.877	90.527	2
45.117	90.009	**3**
53.672	90.000	4
54.260	90.000	5
73.721	90.173	**6**
108.959	90.772	7
118.620	90.997	8





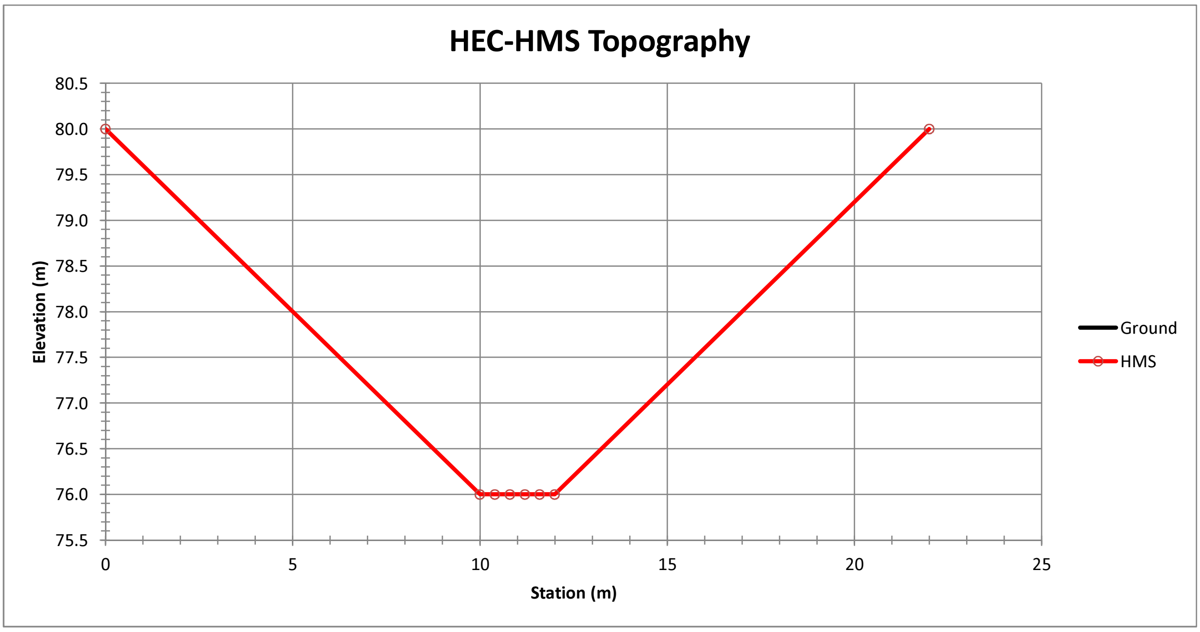
HEC-HMS Channel Topography (For DC-EX-023)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1321.5	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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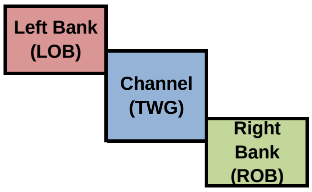
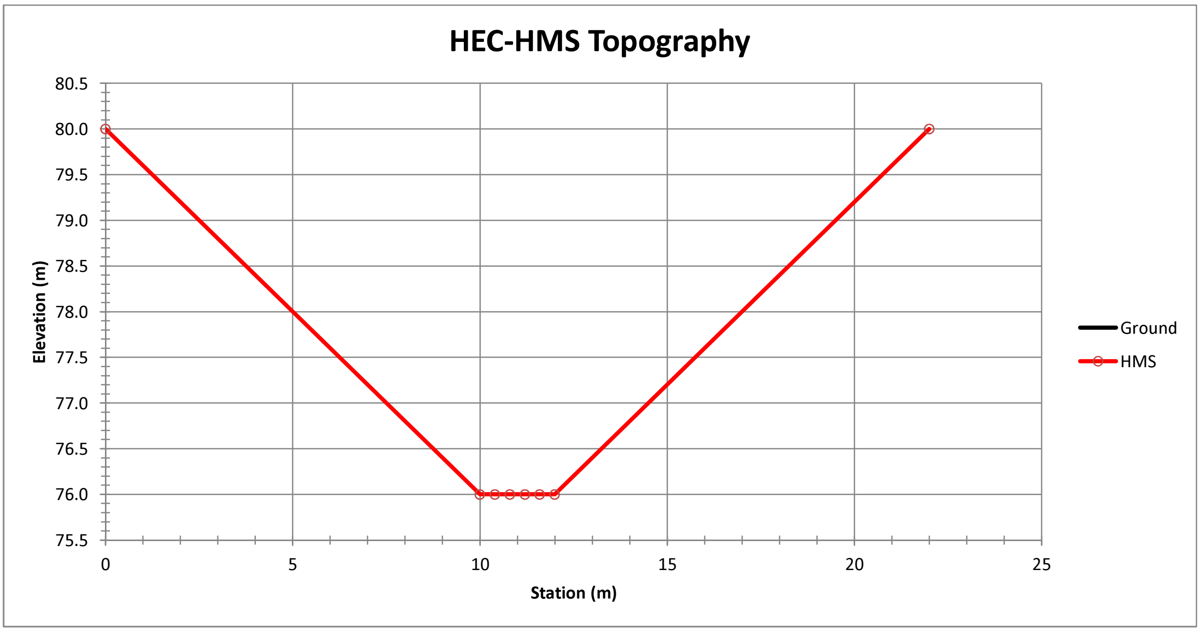
HEC-HMS Channel Topography (For DC-EX-024)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	805.4	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8



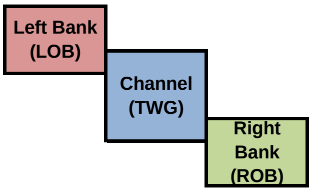


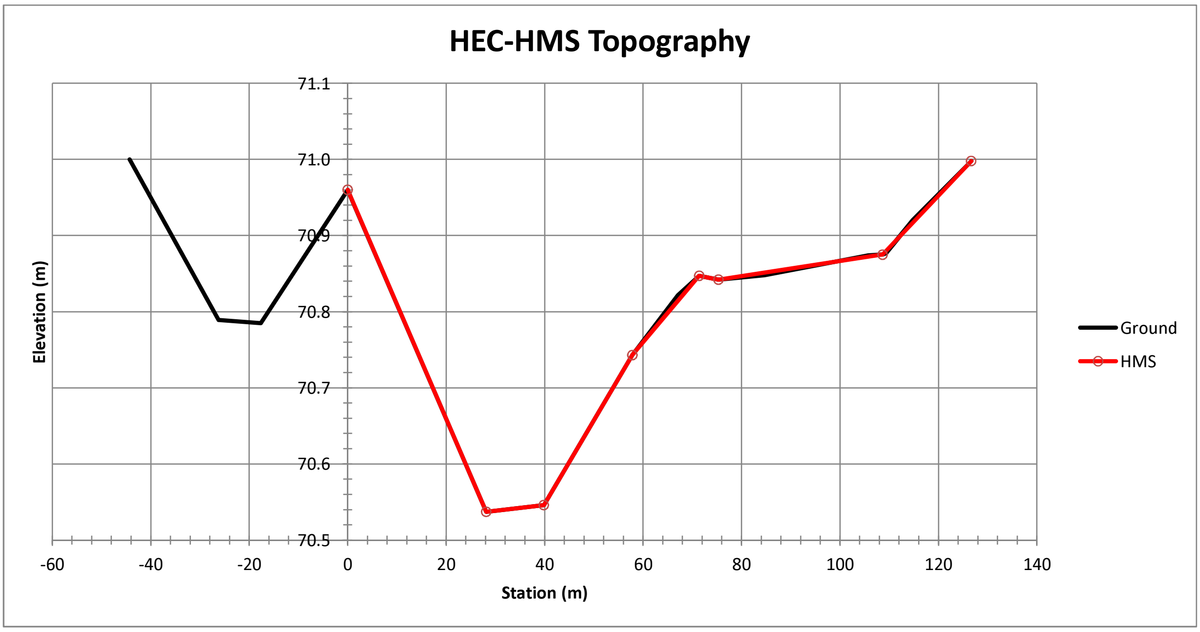
HEC-HMS Channel Topography (For NC-EX-025)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	634.7	**(m)**
Channel slope, S =	0.002	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	70.960	1
28.138	70.537	2
39.840	70.546	**3**
57.832	70.743	4
71.419	70.847	5
75.355	70.842	**6**
108.698	70.875	7
126.691	70.998	8



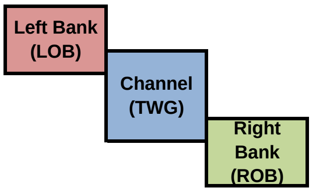


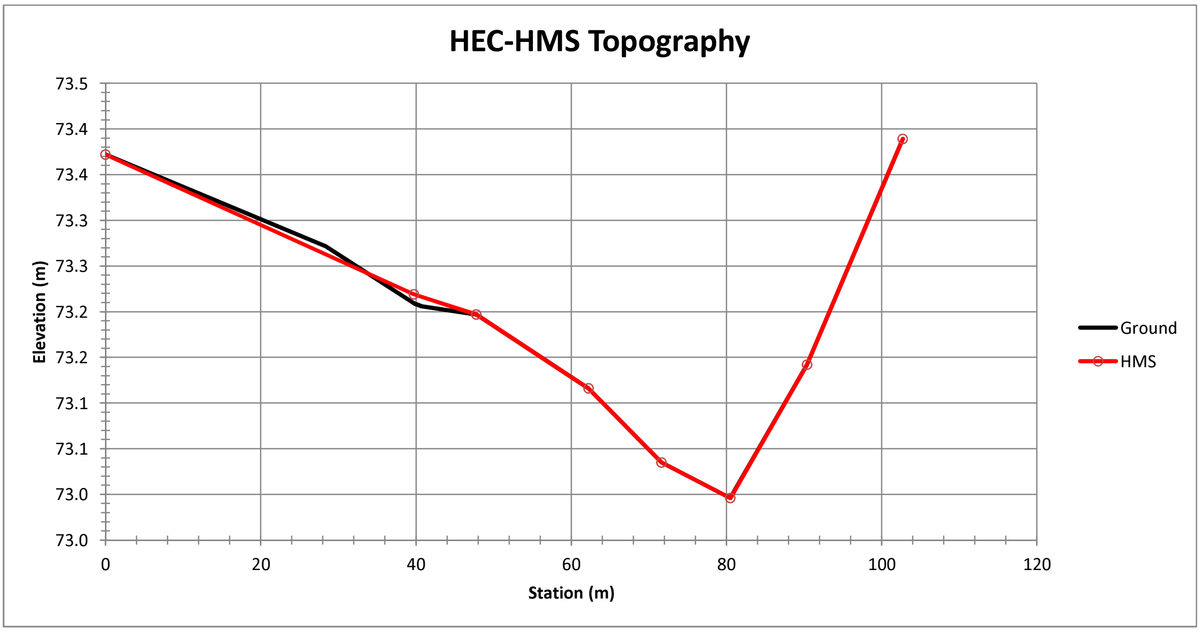
HEC-HMS Channel Topography (For NC-EX-026)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 138.6 **(m)**
Channel slope, S = 0.029 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	Elevation (m)	
0.000	73.372	1
39.733	73.219	2
47.775	73.197	**3**
62.233	73.116	4
71.636	73.035	5
80.514	72.996	**6**
90.386	73.142	7
102.719	73.389	8



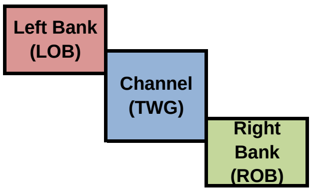


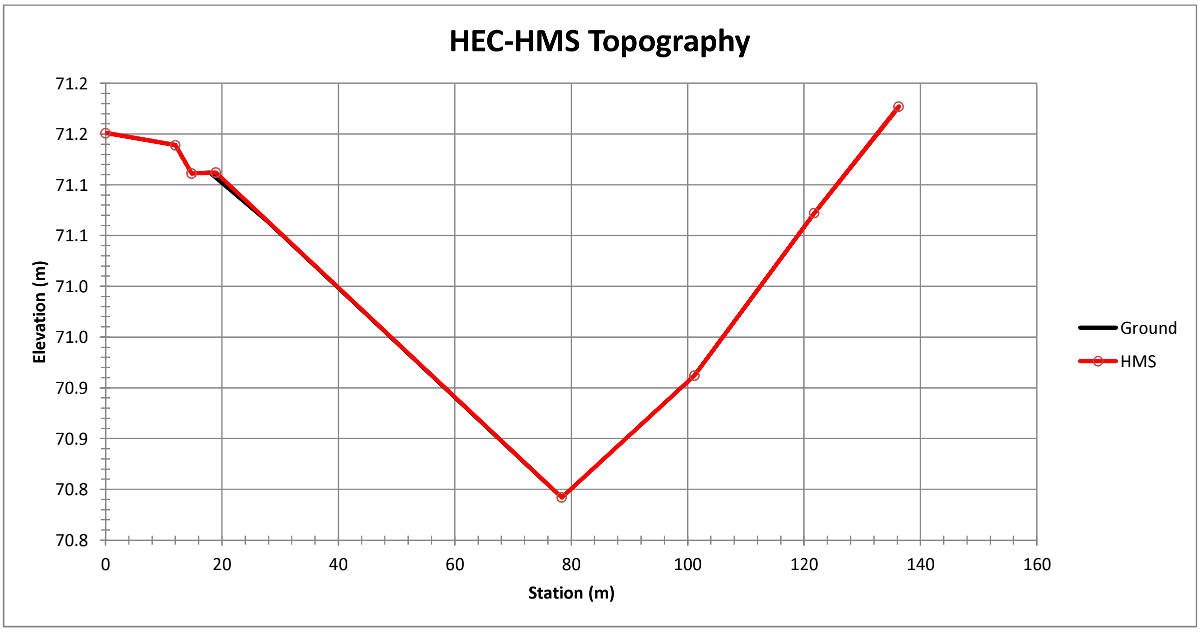
HEC-HMS Channel Topography (For NC-EX-026)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	457.1	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	71.151	1
11.996	71.139	2
14.826	71.111	**3**
19.000	71.112	4
78.386	70.792	5
101.173	70.912	**6**
121.775	71.072	7
136.271	71.177	8





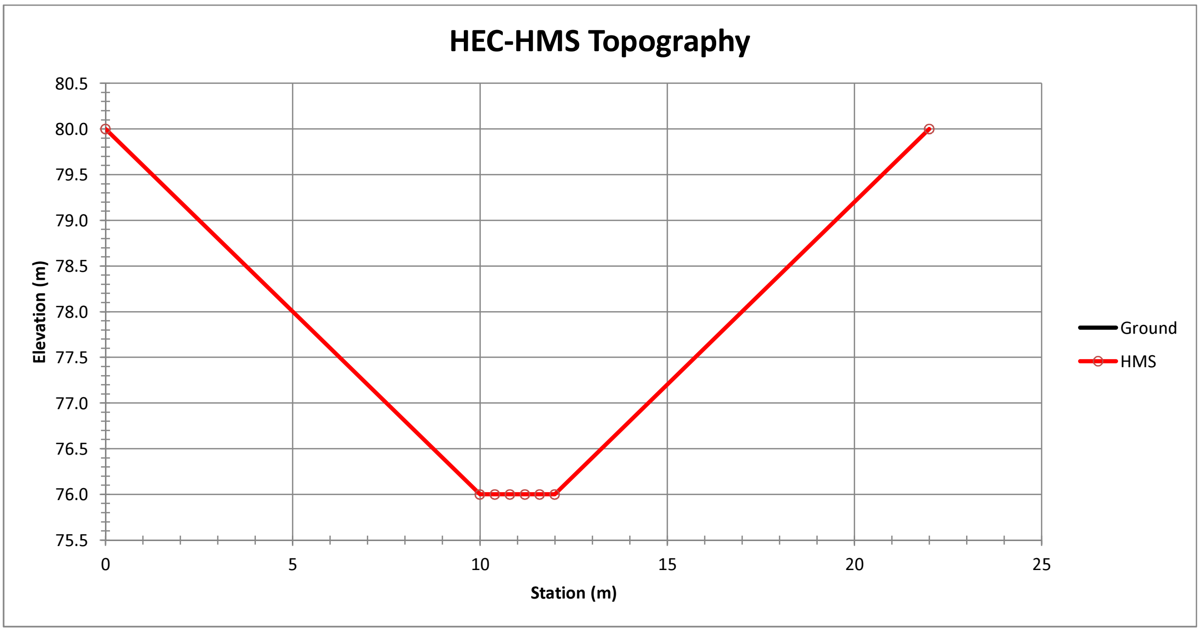
HEC-HMS Channel Topography (For DC-EX-028)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	934.2	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	3
10.800	76.000	4
11.200	76.000	5
11.600	76.000	6
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) **Channel (TWG)** **Right Bank (ROB)**

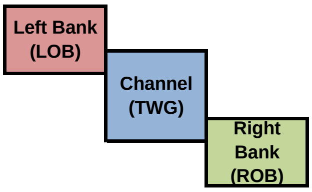


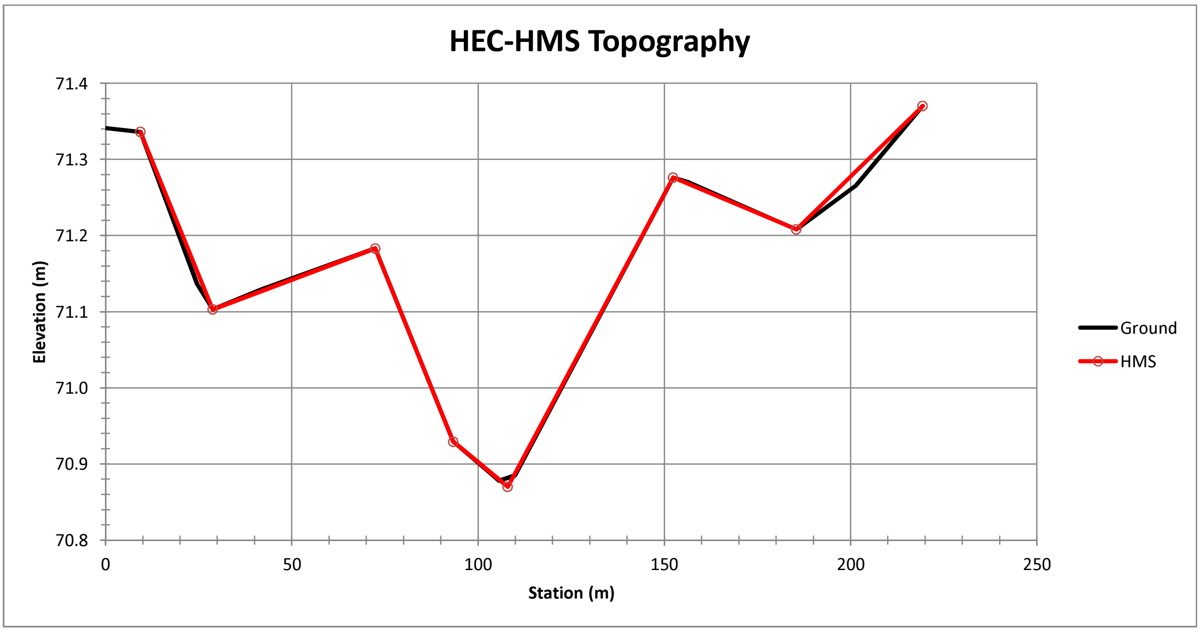
HEC-HMS Channel Topography (For NC-EX-029)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 261.4 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
9.348	71.336	1
28.831	71.103	2
72.415	71.183	**3**
93.352	70.929	4
108.000	70.870	5
152.386	71.276	**6**
185.404	71.208	7
219.350	71.370	8



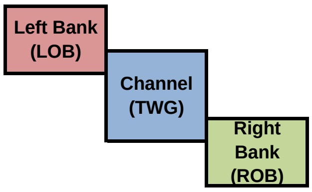


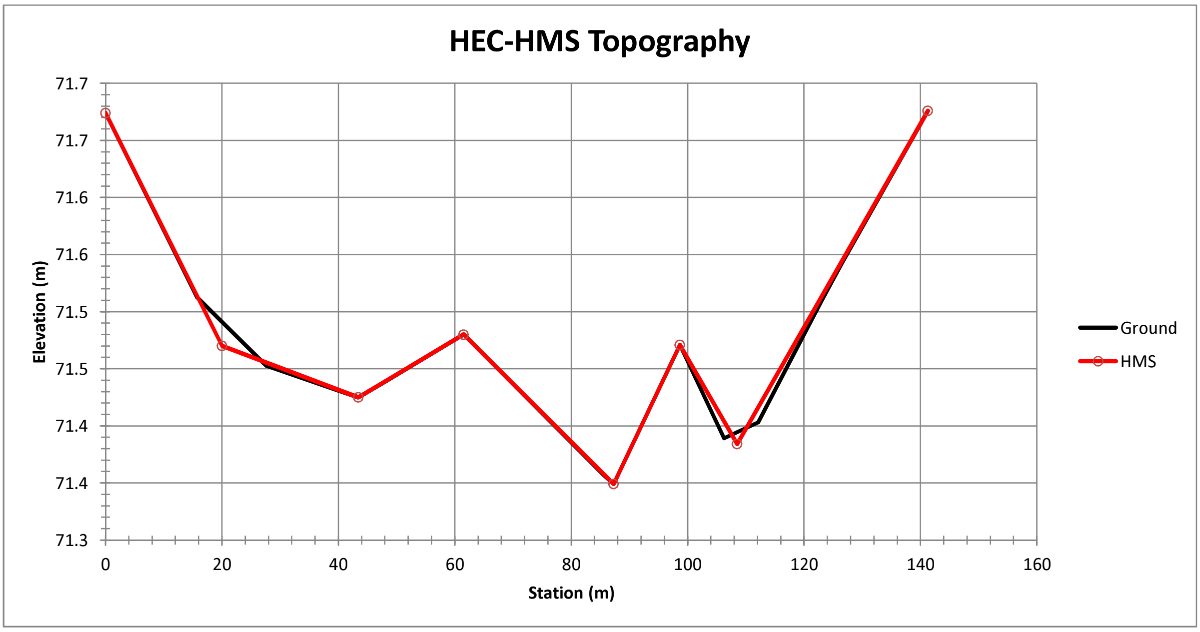
HEC-HMS Channel Topography (For NC-EX-030)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 596.5 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	71.674	1
20.000	71.470	2
43.438	71.425	**3**
61.513	71.480	4
87.278	71.349	5
98.692	71.471	**6**
108.500	71.384	7
141.283	71.676	8





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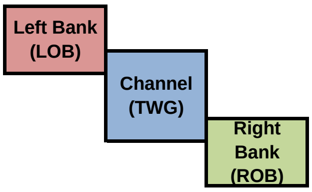
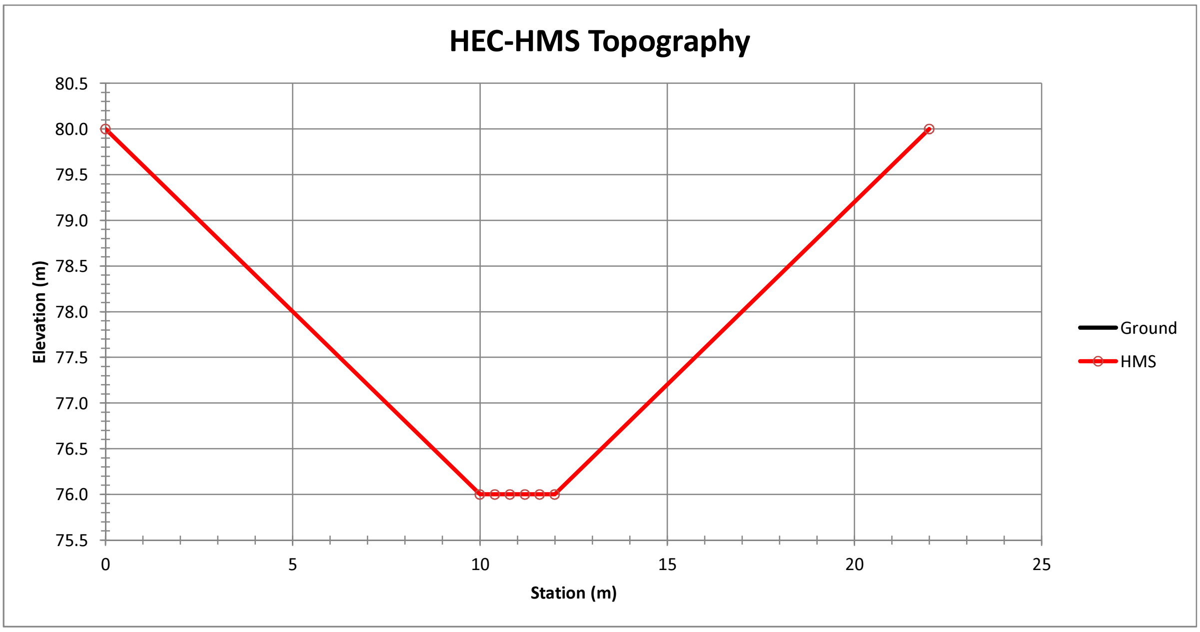
HEC-HMS Channel Topography (For DC-EX-031)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 942.3 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.017
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.017
Right bank Manning's roughness, n_{ROB} = 0.017
Approximate Channel Base Width = 2.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	3
10.800	76.000	4
11.200	76.000	5
11.600	76.000	6
12.000	76.000	7
22.000	80.000	8





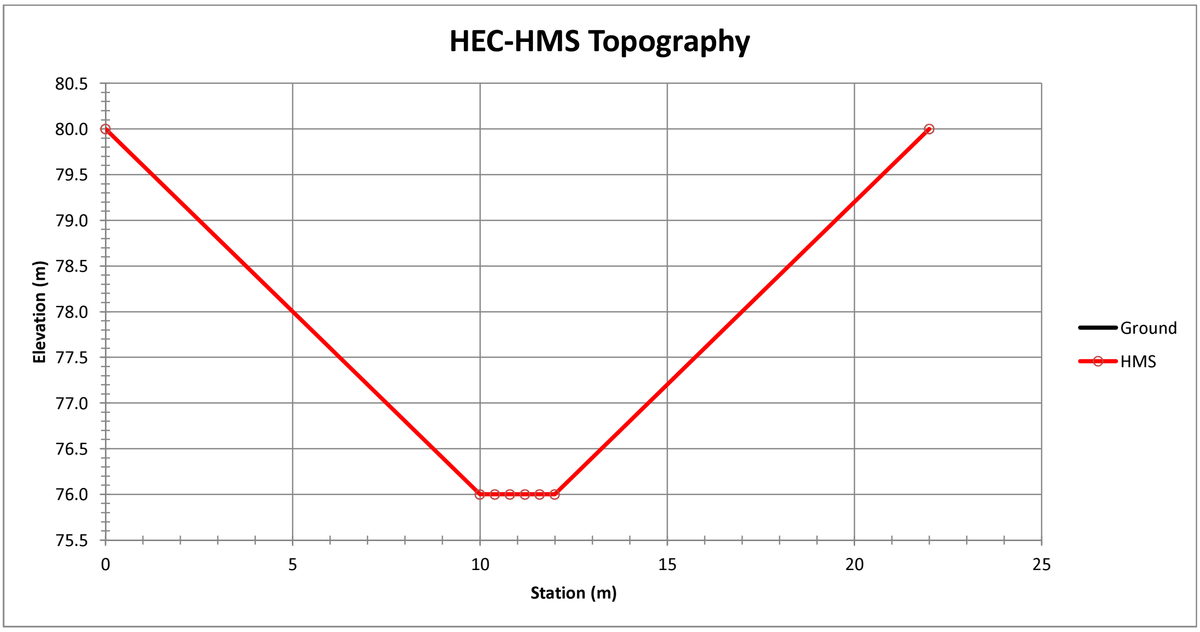
HEC-HMS Channel Topography (For DC-EX-032)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	251.9	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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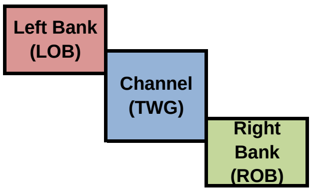
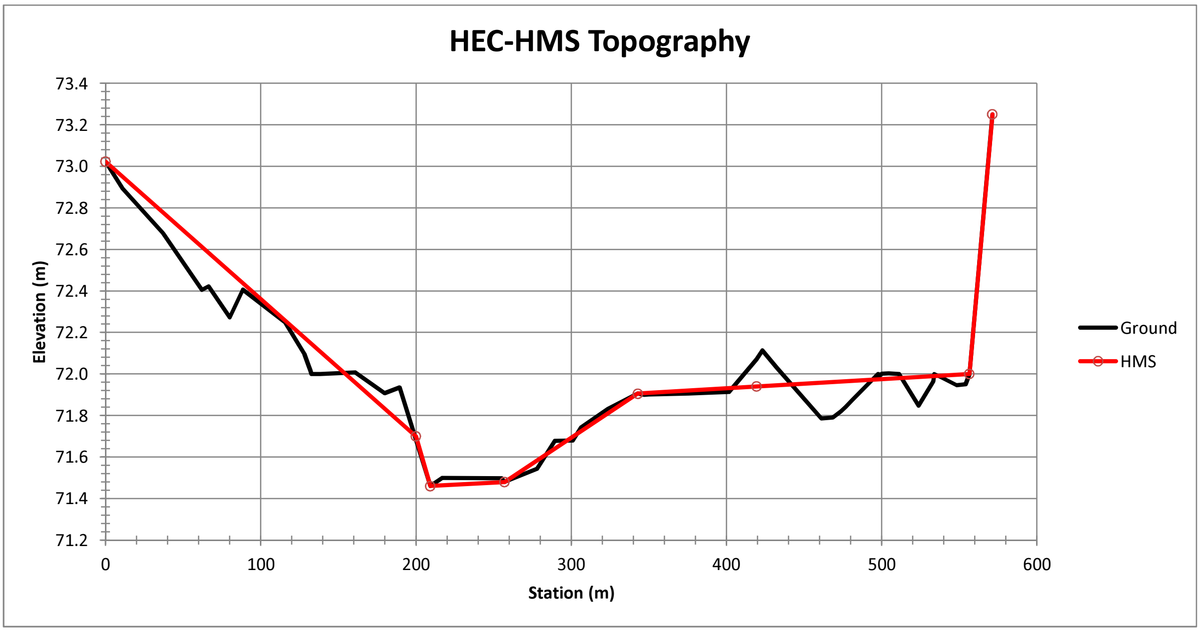
HEC-HMS Channel Topography (For NC-EX-033)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	807.2	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	73.022	1
200.000	71.700	2
209.199	71.460	**3**
257.006	71.479	4
342.916	71.905	5
419.447	71.940	**6**
556.540	72.000	7
571.412	73.251	8





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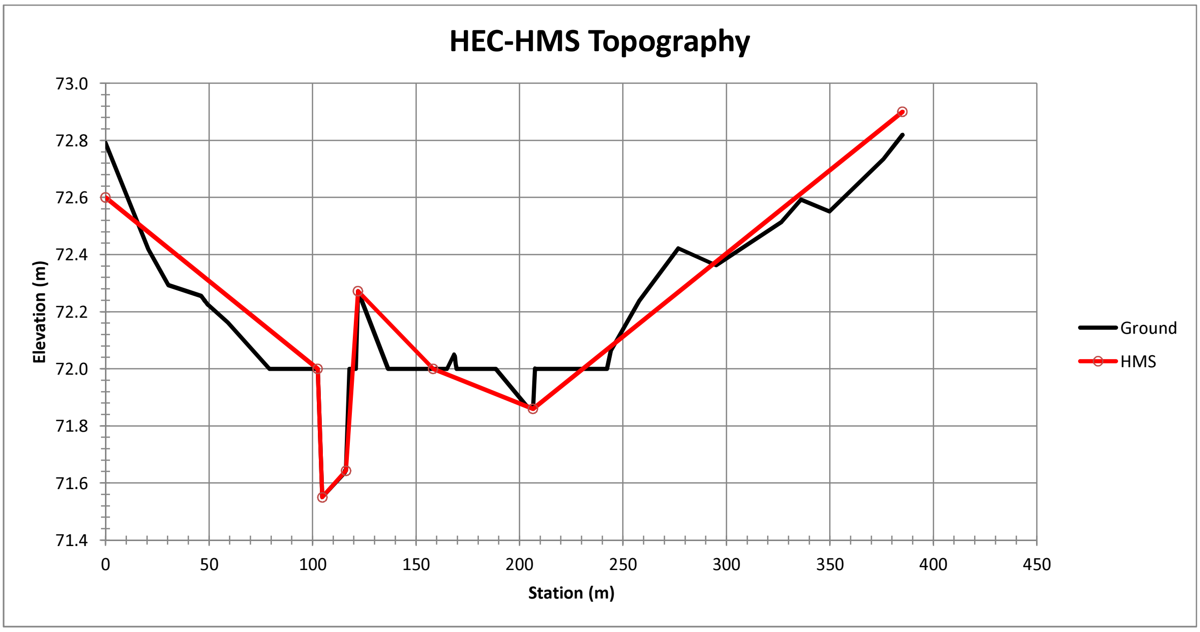
HEC-HMS Channel Topography (For NC-EX-034)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 355.8 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	72.600	1
102.471	72.000	2
104.771	71.550	**3**
116.209	71.643	4
122.003	72.272	5
158.267	72.000	**6**
206.558	71.860	7
385.104	72.900	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**

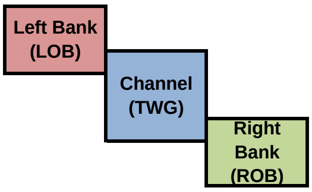


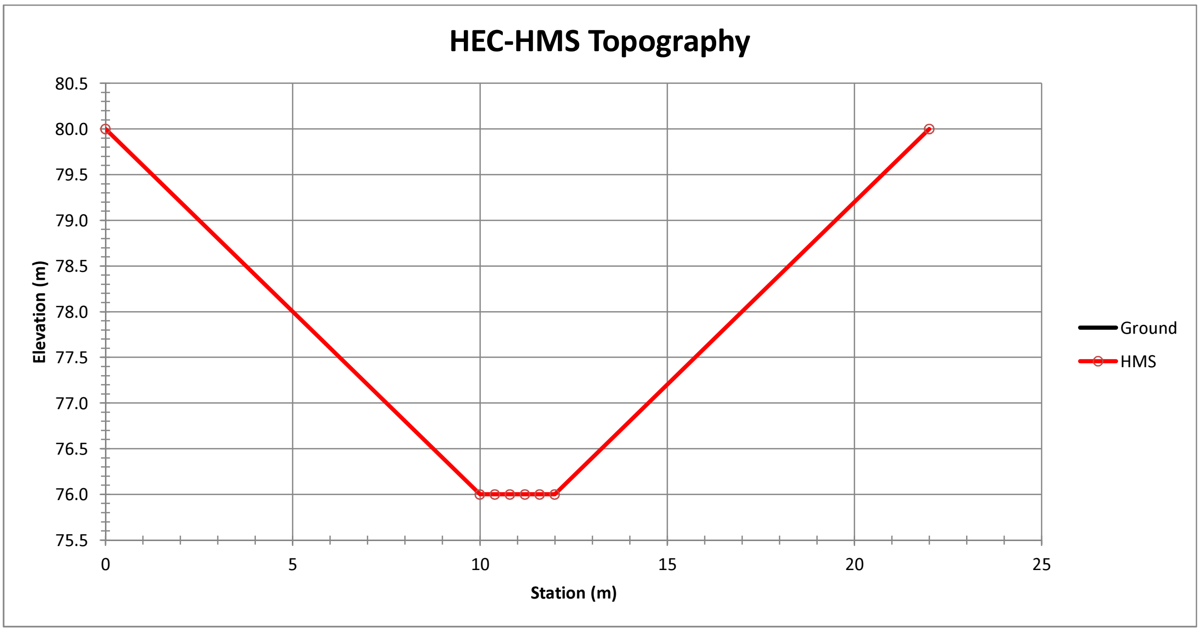
HEC-HMS Channel Topography (For DC-EX-035)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	882.8	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	3
10.800	76.000	4
11.200	76.000	5
11.600	76.000	6
12.000	76.000	7
22.000	80.000	8





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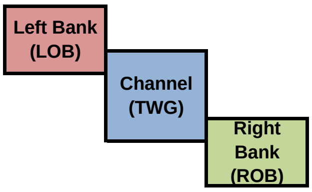
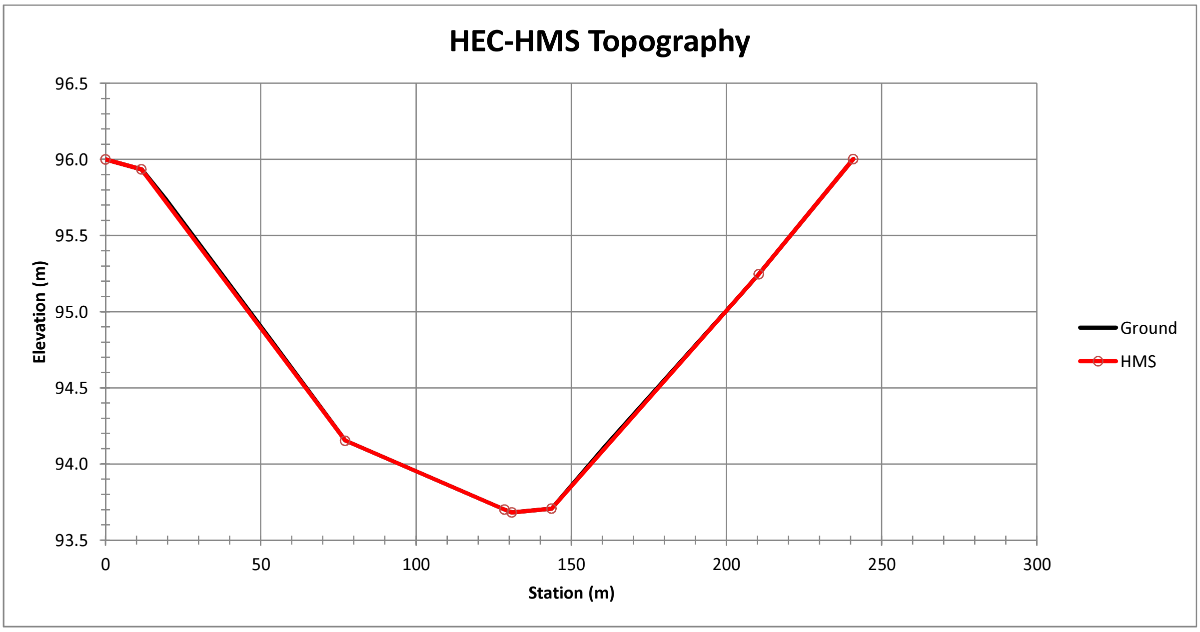
HEC-HMS Channel Topography (For NC-EX-036)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 1472.2 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	96.000	1
11.553	95.934	2
77.264	94.153	**3**
128.570	93.701	4
130.885	93.681	5
143.658	93.706	**6**
210.437	95.247	7
240.847	96.002	8





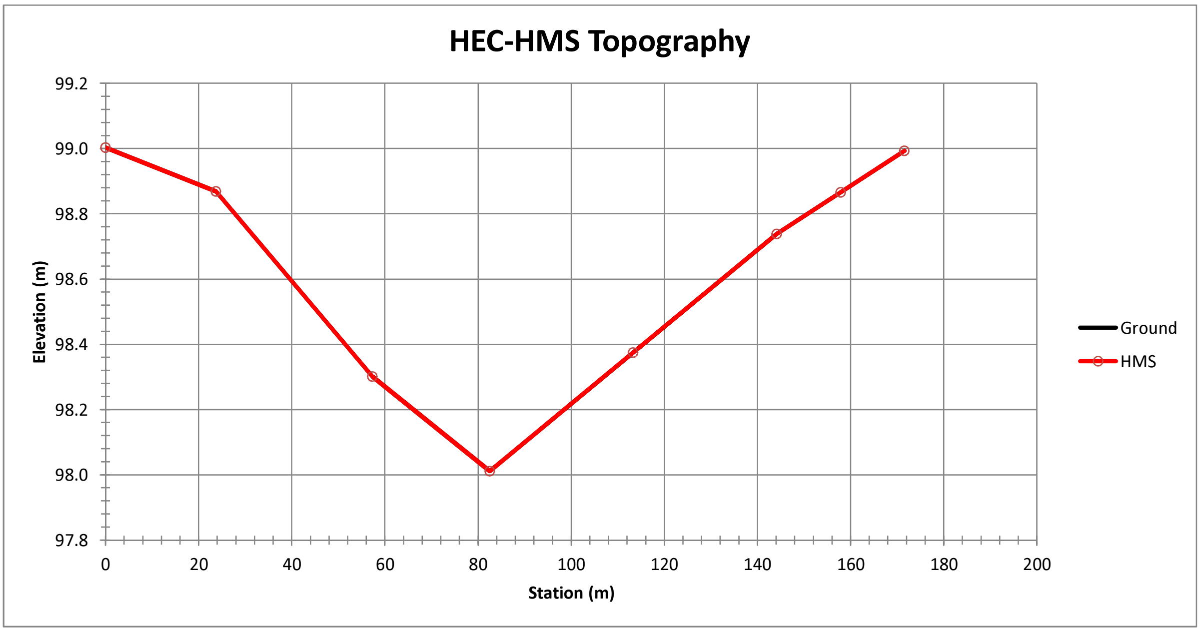
HEC-HMS Channel Topography (For NC-EX-037)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 758.8 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	99.003	1
23.737	98.869	2
57.306	98.301	**3**
82.515	98.011	4
113.323	98.375	5
144.130	98.738	**6**
157.861	98.866	7
171.592	98.993	8

Left Bank (LOB)
Channel (TWG)
Right Bank (ROB)



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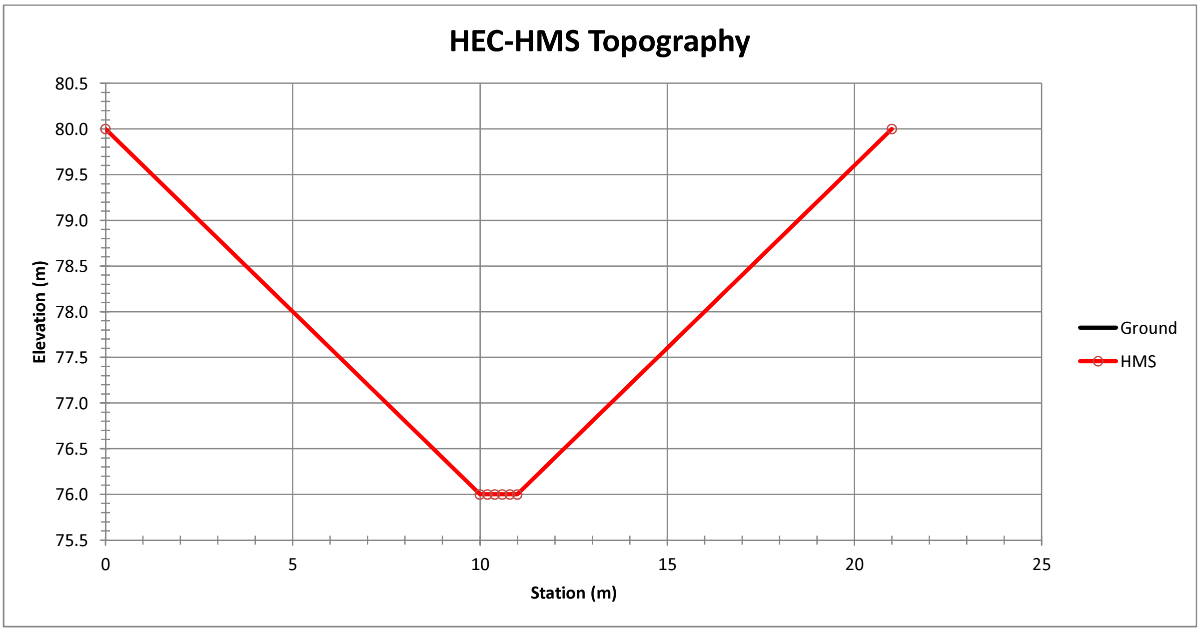
HEC-HMS Channel Topography (For DC-EX-038)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1467.2	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	1.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.200	76.000	3
10.400	76.000	4
10.600	76.000	5
10.800	76.000	6
11.000	76.000	7
21.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



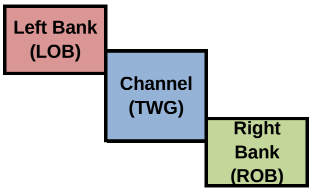
HEC-HMS Channel Topography (For DC-EX-039)

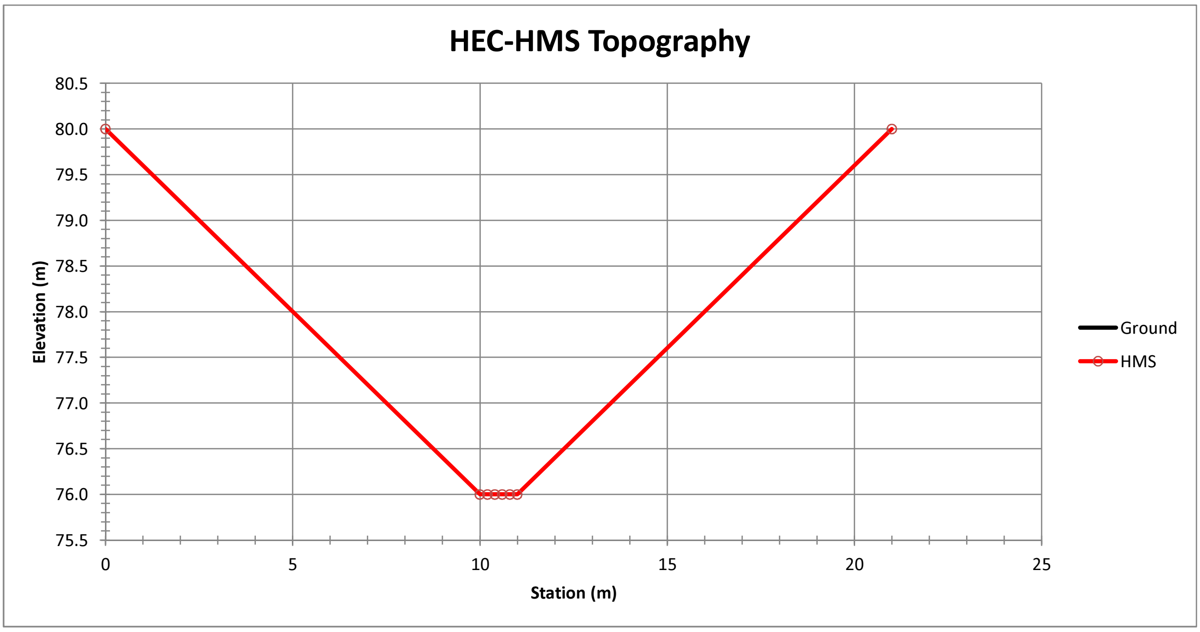
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	696.4	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	1.0	**(m)**

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
10.200	76.000	3
10.400	76.000	4
10.600	76.000	5
10.800	76.000	6
11.000	76.000	7
21.000	80.000	8





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	Letpadaung	Checked	Date: 24/07/2013
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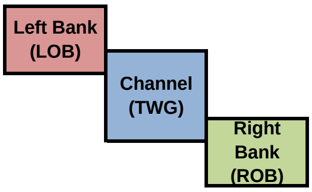
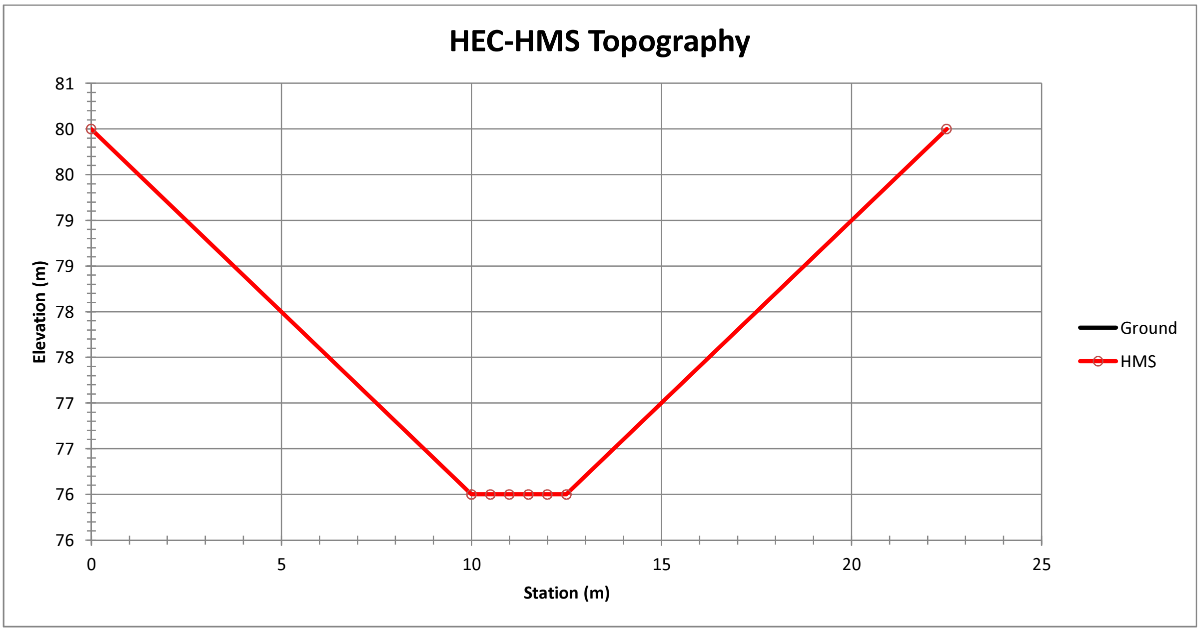
HEC-HMS Channel Topography (For DC-PL-001)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	3170.0	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	3
11.000	76.000	4
11.500	76.000	5
12.000	76.000	6
12.500	76.000	7
22.500	80.000	8



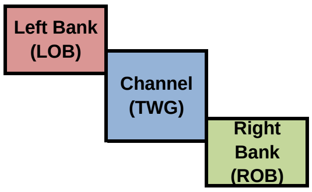


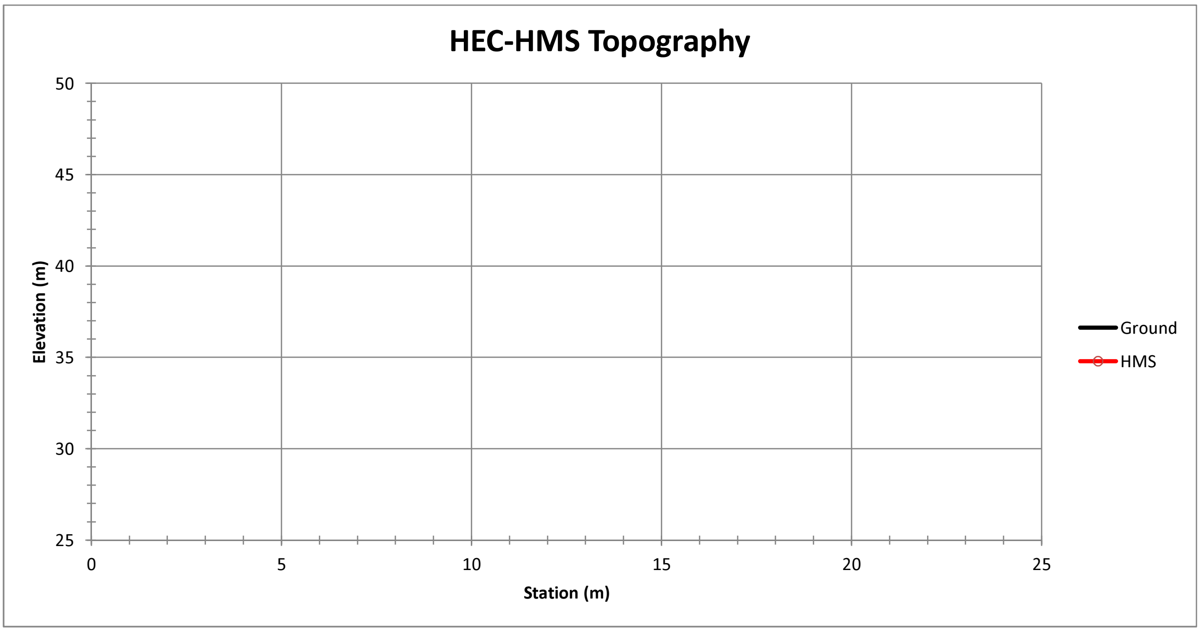
HEC-HMS Channel Topography (For DC-PL-002)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	836.7	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	**3**
11.000	76.000	4
11.500	76.000	5
12.000	76.000	**6**
12.500	76.000	7
22.500	80.000	8





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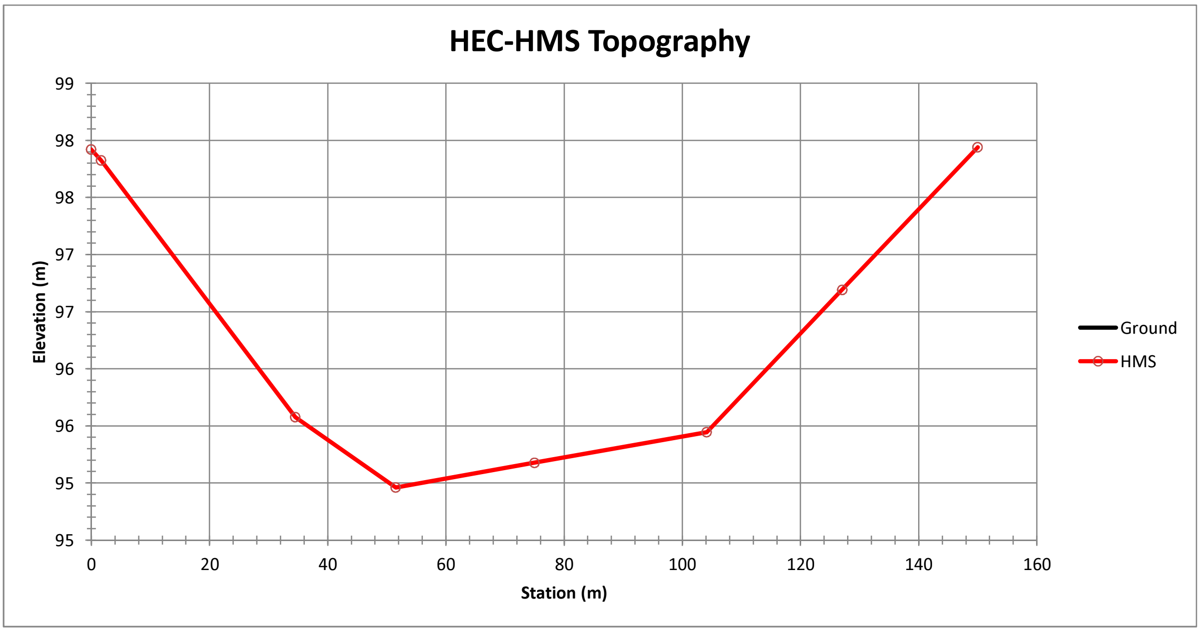
HEC-HMS Channel Topography (For NC-PL-003)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	4885.0	(m)
Channel slope, S =	0.003	(m/m)
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	(m)
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	97.919	1
1.632	97.824	2
34.528	95.576	**3**
51.508	94.961	4
75.000	95.177	5
104.127	95.444	**6**
127.064	96.692	7
150.000	97.940	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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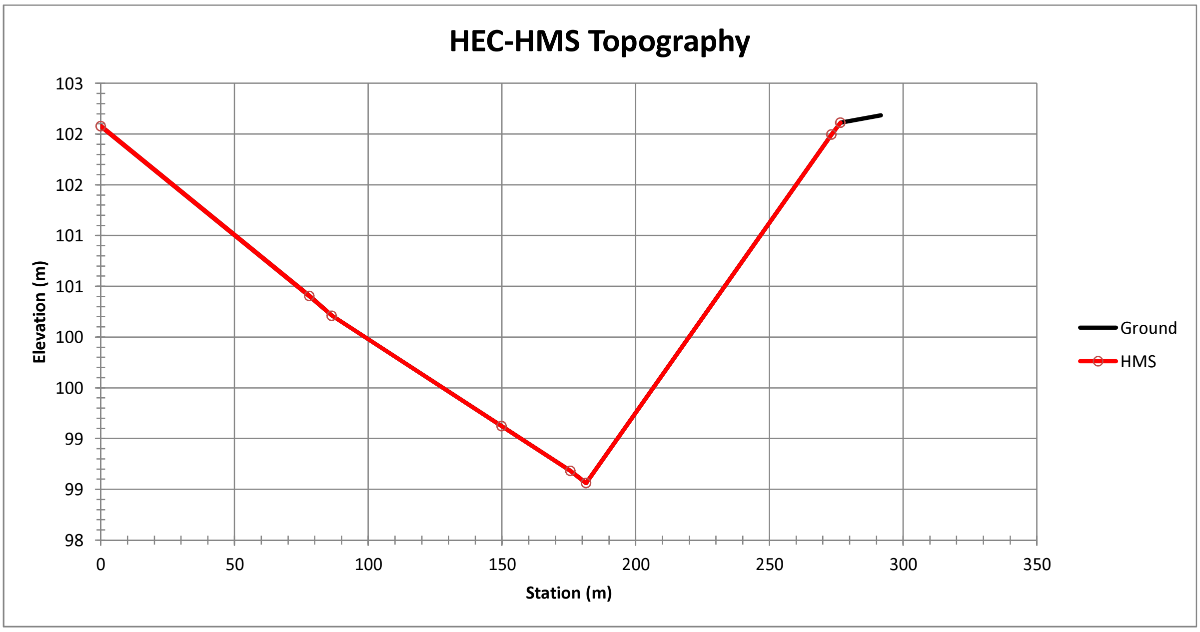
HEC-HMS Channel Topography (For NC-PL-004)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1383.7	**(m)**
Channel slope, S =	0.011	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	102.078	1
78.005	100.404	2
86.383	100.211	**3**
149.917	99.122	4
175.632	98.681	5
181.500	98.563	**6**
273.261	101.997	7
276.618	102.111	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**

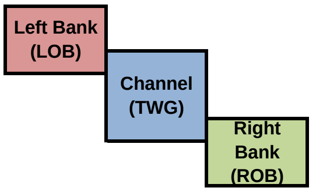


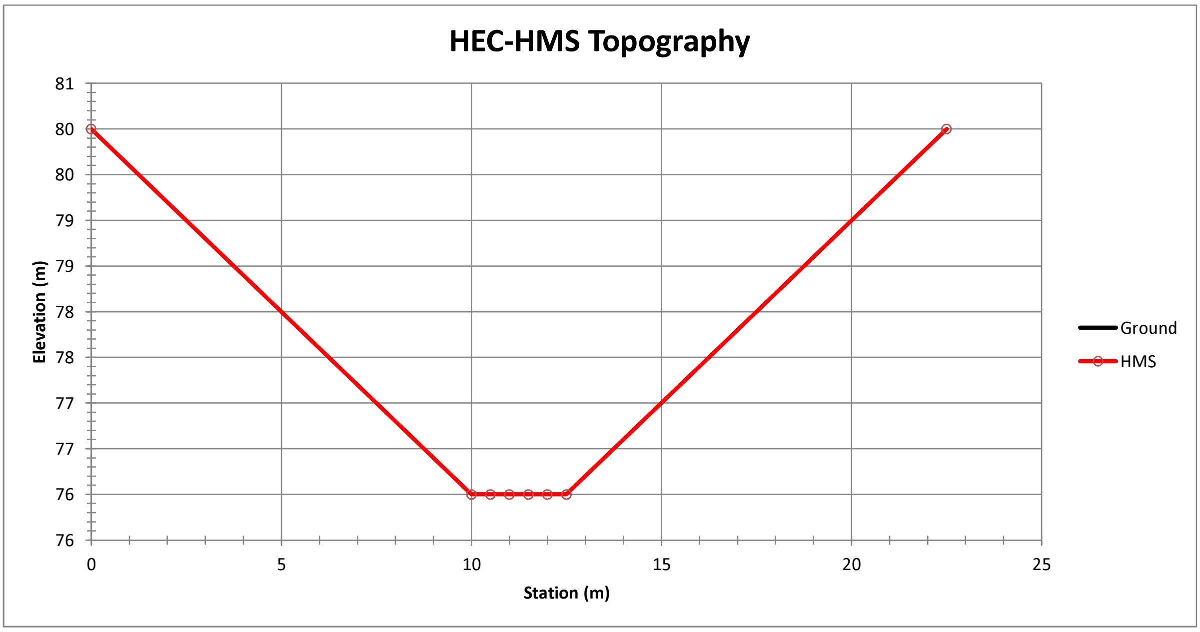
HEC-HMS Channel Topography (For DC-PL-005)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	3158.1	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	3
11.000	76.000	4
11.500	76.000	5
12.000	76.000	6
12.500	76.000	7
22.500	80.000	8





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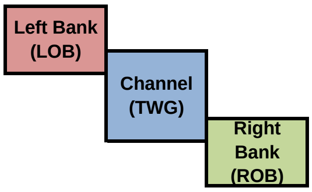
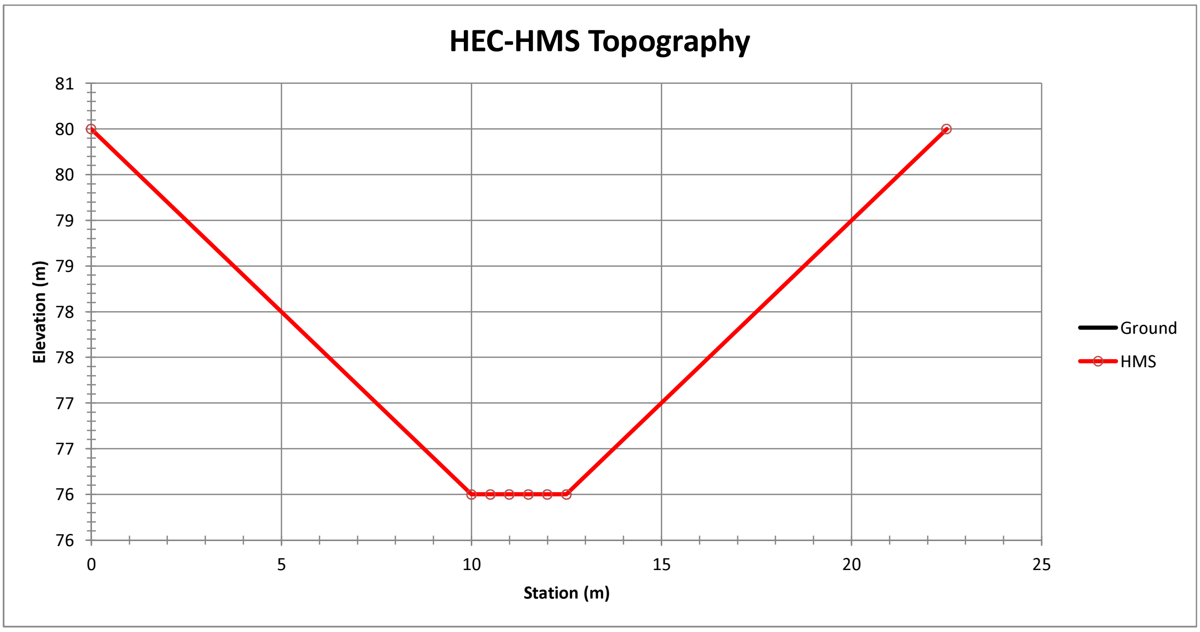
HEC-HMS Channel Topography (For DC-PL-006)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2079.0	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	3
11.000	76.000	4
11.500	76.000	5
12.000	76.000	6
12.500	76.000	7
22.500	80.000	8



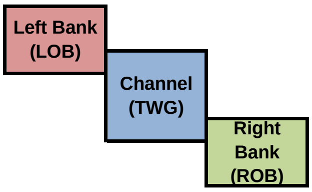


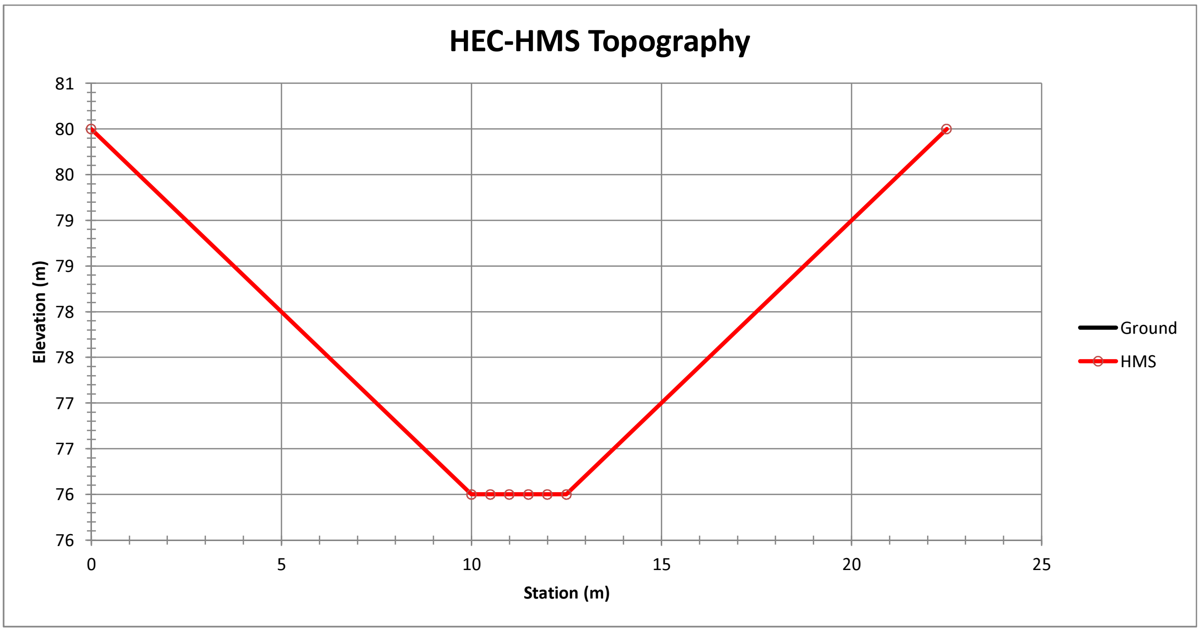
HEC-HMS Channel Topography (For DC-PL-007)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	433.4	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.5	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.500	76.000	**3**
11.000	76.000	4
11.500	76.000	5
12.000	76.000	**6**
12.500	76.000	7
22.500	80.000	8





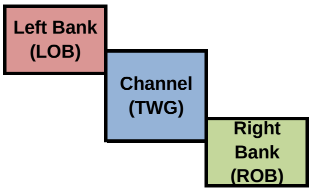
HEC-HMS Channel Topography (For DC-PL-008)

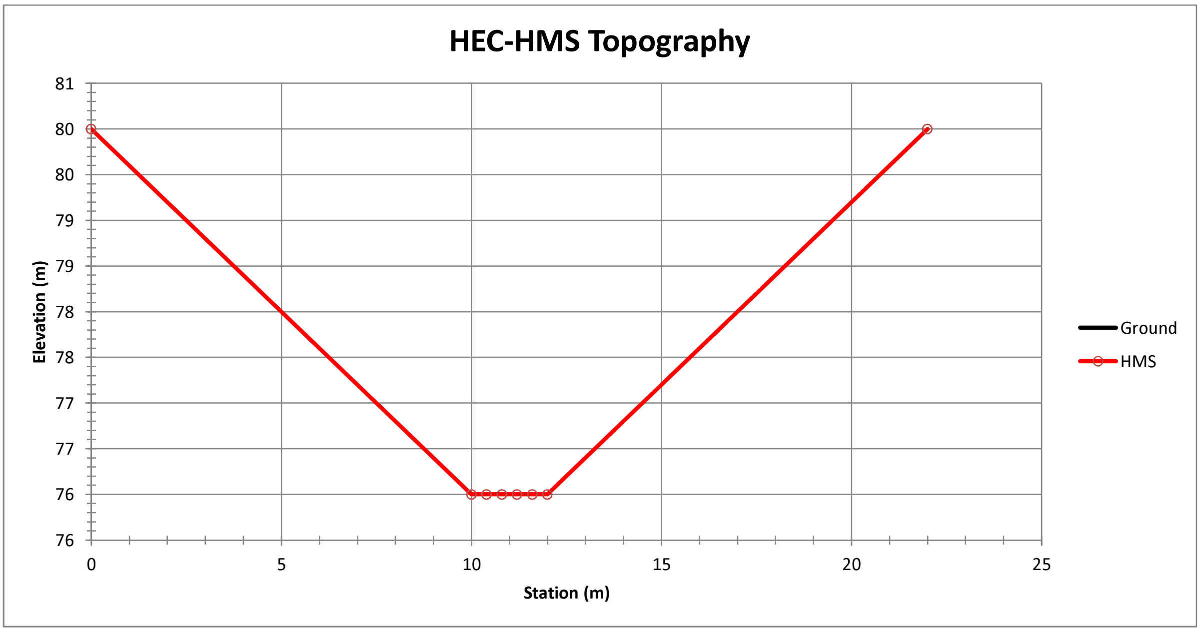
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	473.7	(m)
Channel slope, S =	0.004	(m/m)
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	(m)
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	(m)

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	3
10.800	76.000	4
11.200	76.000	5
11.600	76.000	6
12.000	76.000	7
22.000	80.000	8



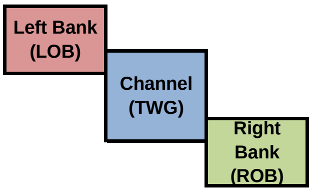


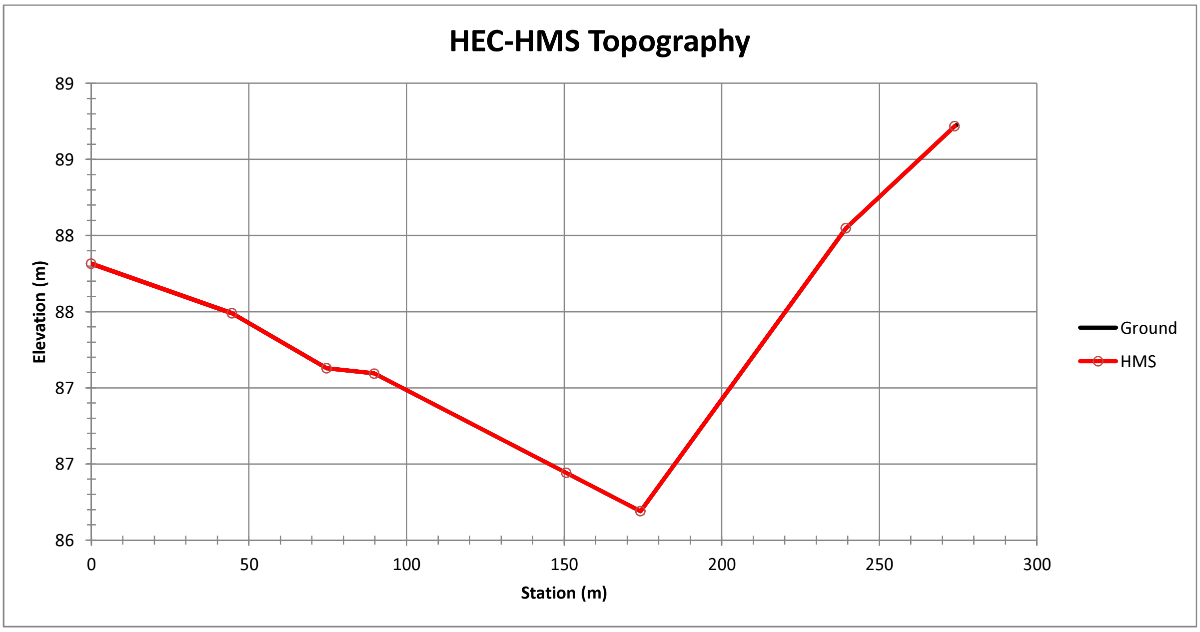
HEC-HMS Channel Topography (For NC-PL-009)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 3367.893 **(m)**
Channel slope, S = 0.004 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	87.816	1
44.672	87.489	2
74.686	87.129	**3**
89.765	87.094	4
150.729	86.442	5
174.289	86.190	**6**
239.410	88.048	7
273.891	88.718	8





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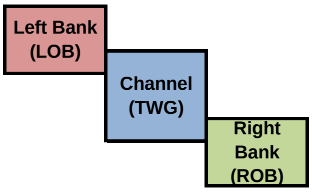
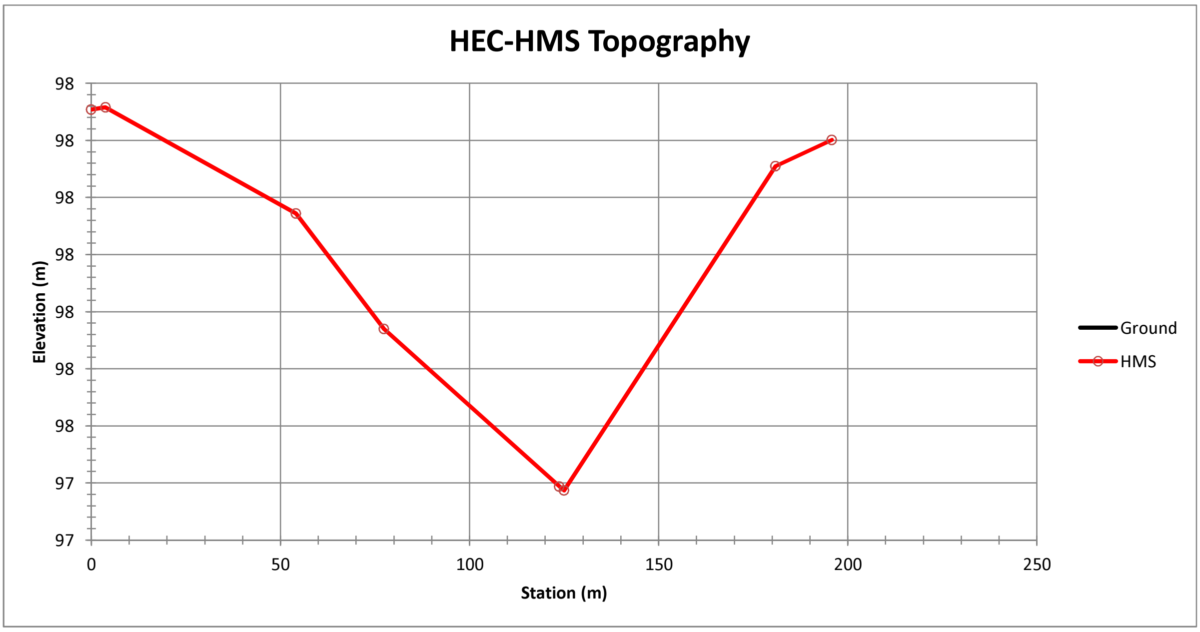
HEC-HMS Channel Topography (For NC-PL-010)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	751.499	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	98.054	1
3.732	98.058	2
54.141	97.872	**3**
77.378	97.670	4
123.701	97.394	5
124.982	97.387	**6**
180.874	97.955	7
195.823	98.001	8





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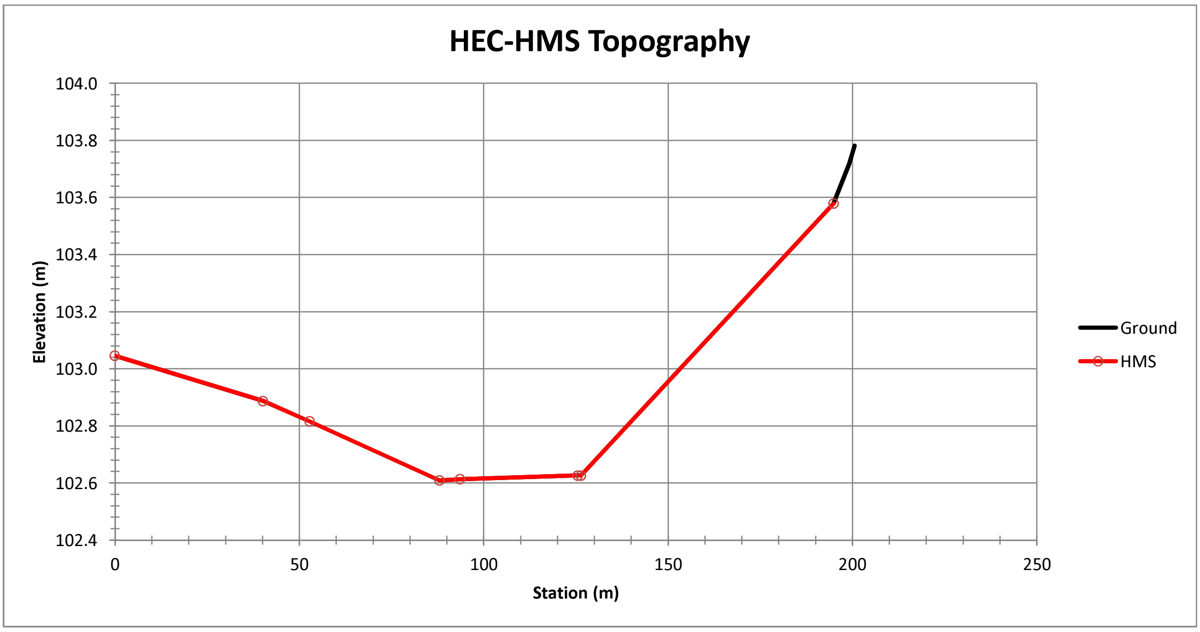
HEC-HMS Channel Topography (For NC-EX-011)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	651.444	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	103.046	1
40.117	102.887	2
52.768	102.816	**3**
88.051	102.609	4
93.572	102.613	5
125.551	102.626	**6**
126.409	102.626	7
194.878	103.579	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



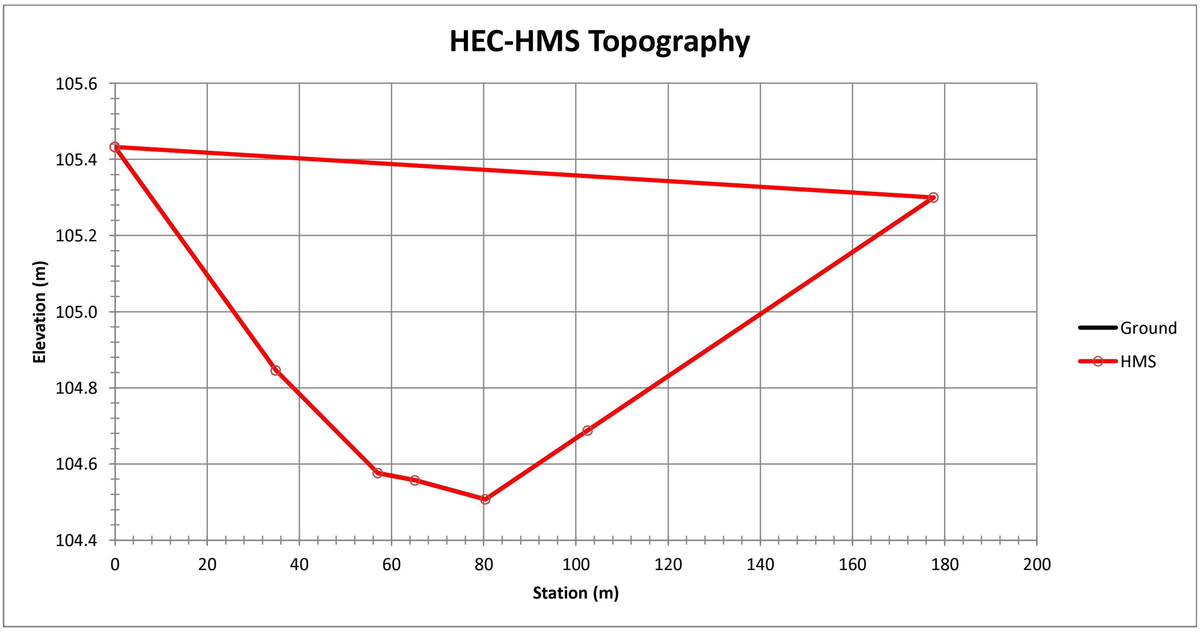
HEC-HMS Channel Topography (For NC-EX-012)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 413.639 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	105.433	1
34.895	104.846	2
57.010	104.576	**3**
65.082	104.557	4
80.367	104.507	5
102.582	104.688	**6**
177.582	105.300	7
#NAME?	105.433	8

Left Bank (LOB)	Channel (TWG)	Right Bank (ROB)



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HEC-HMS Channel Topography (For DC-PL-013)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

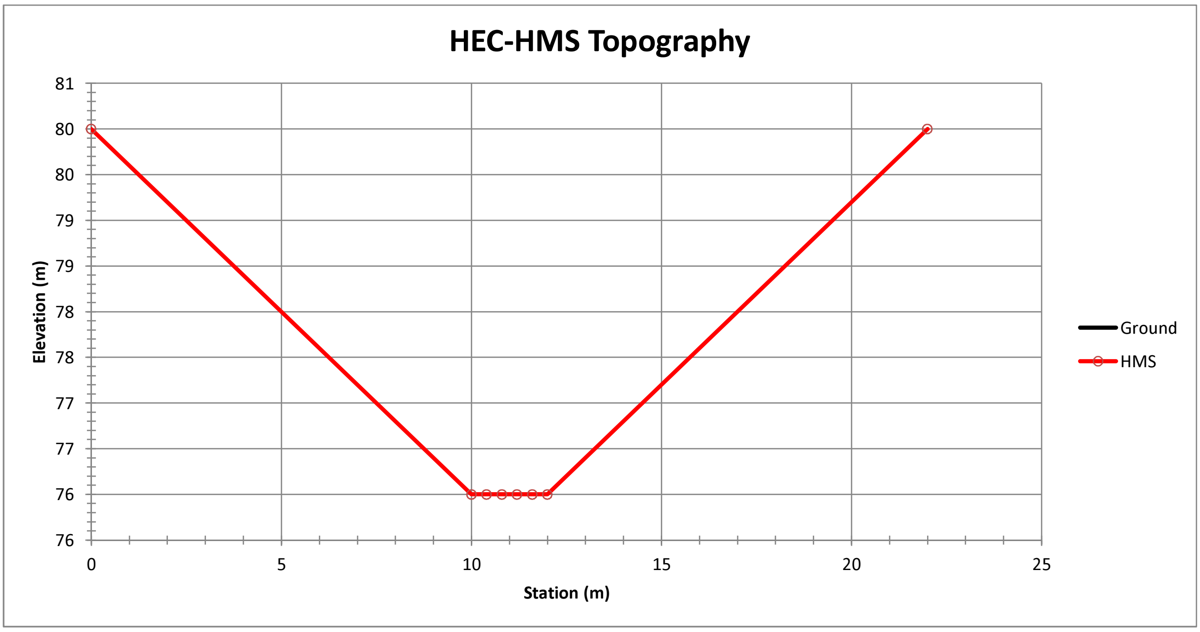
Parameter	Value	Unit
Channel length, L =	735.350	(m)
Channel slope, S =	0.005	(m/m)
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	(m)
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	(m)

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB)

Channel (TWG)

Right Bank (ROB)



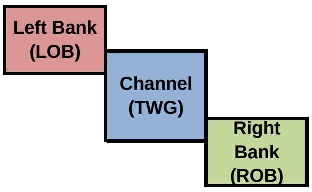
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

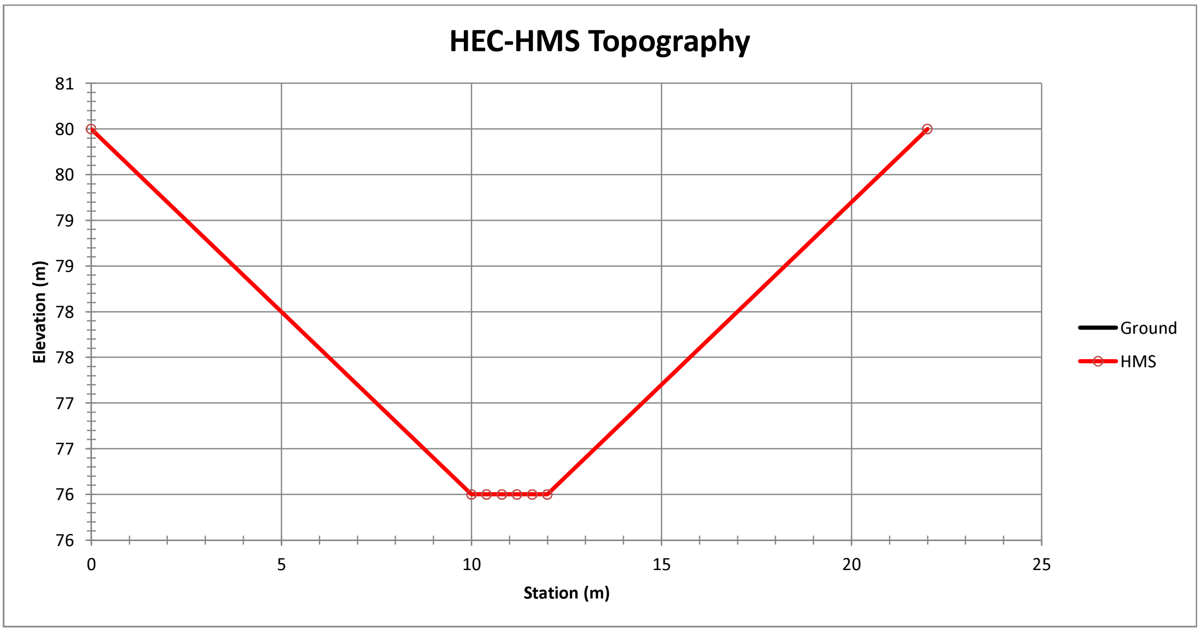
HEC-HMS Channel Topography (For DC-PL-014)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	436.753	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8





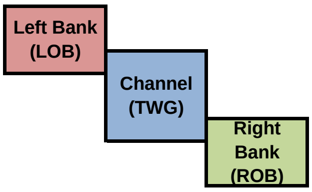
HEC-HMS Channel Topography (For NC-PL-015)

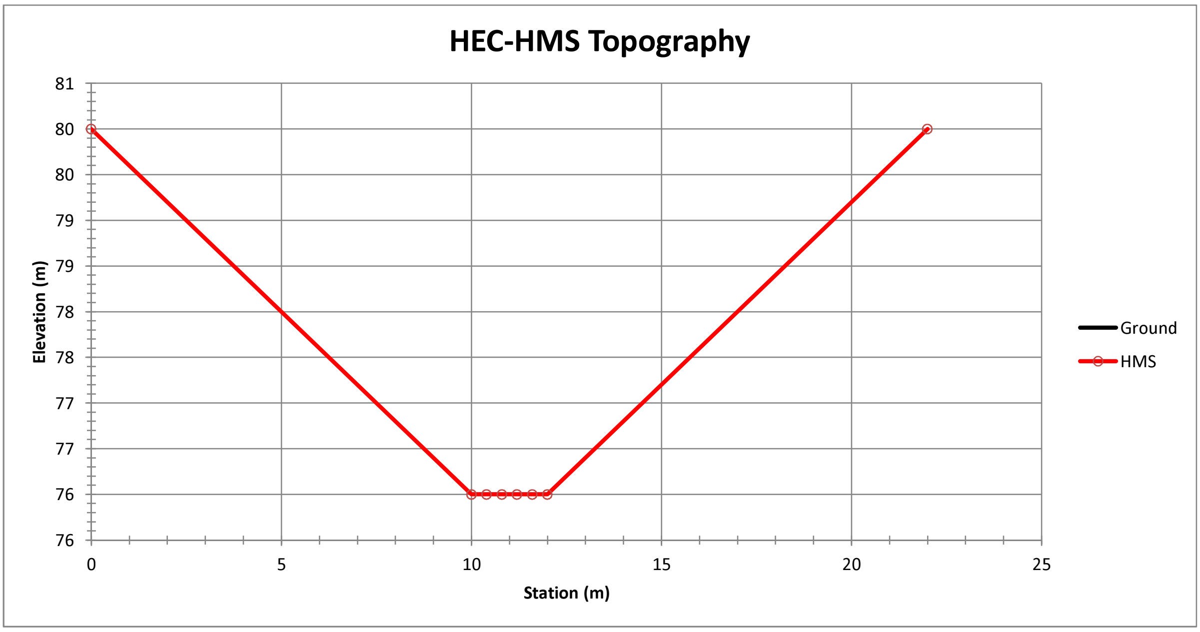
*The cross section for NC-PL-015 was assumed to be that of a design channel with a 2 m base.

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 2434.131 **(m)**
Channel slope, S = 0.006 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.030
Right bank Manning's roughness, n_{ROB} = 0.030
Approximate Channel Base Width = 2.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	3
10.800	76.000	4
11.200	76.000	5
11.600	76.000	6
12.000	76.000	7
22.000	80.000	8





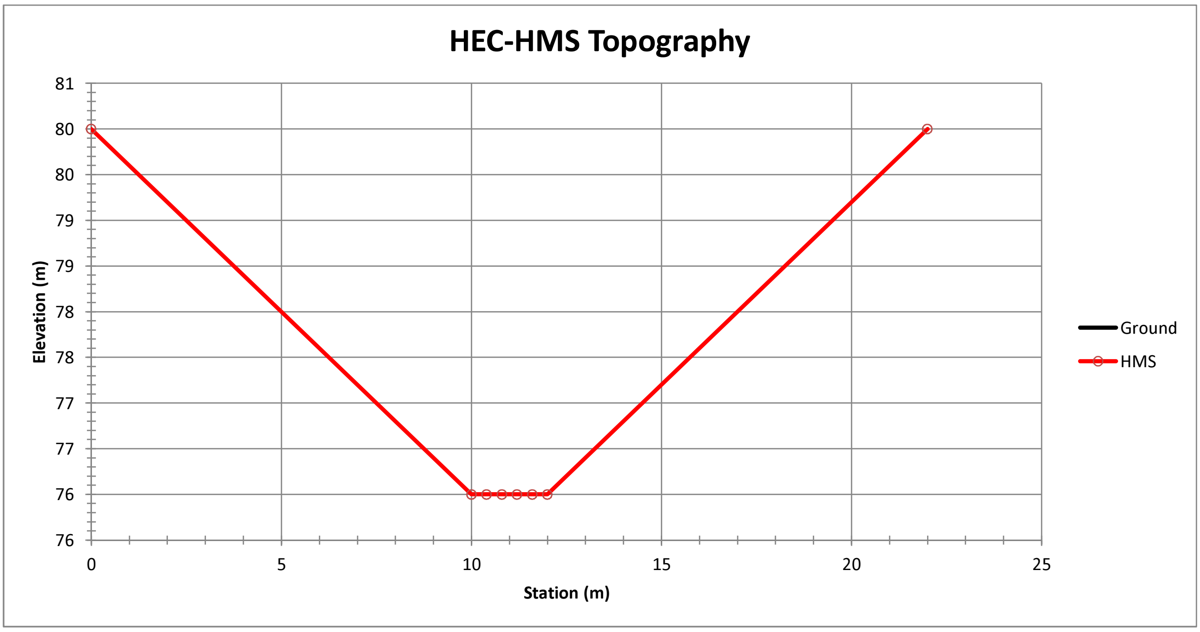
HEC-HMS Channel Topography (For DC-PL-016)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	294.351	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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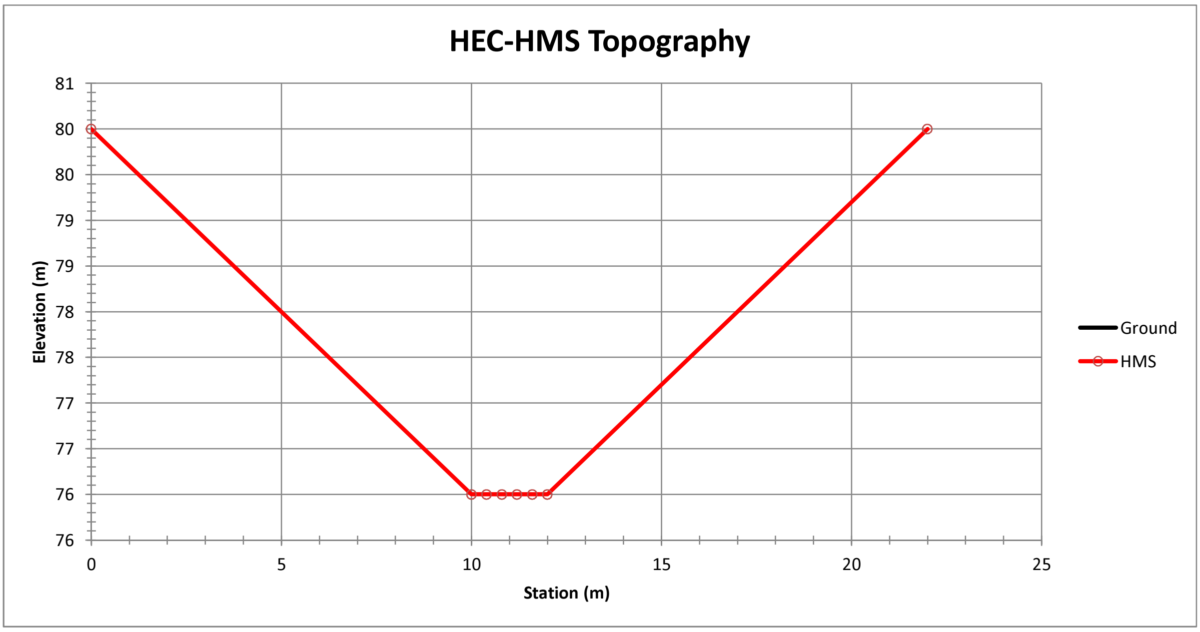
HEC-HMS Channel Topography (For DC-PL-017)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1321.547	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



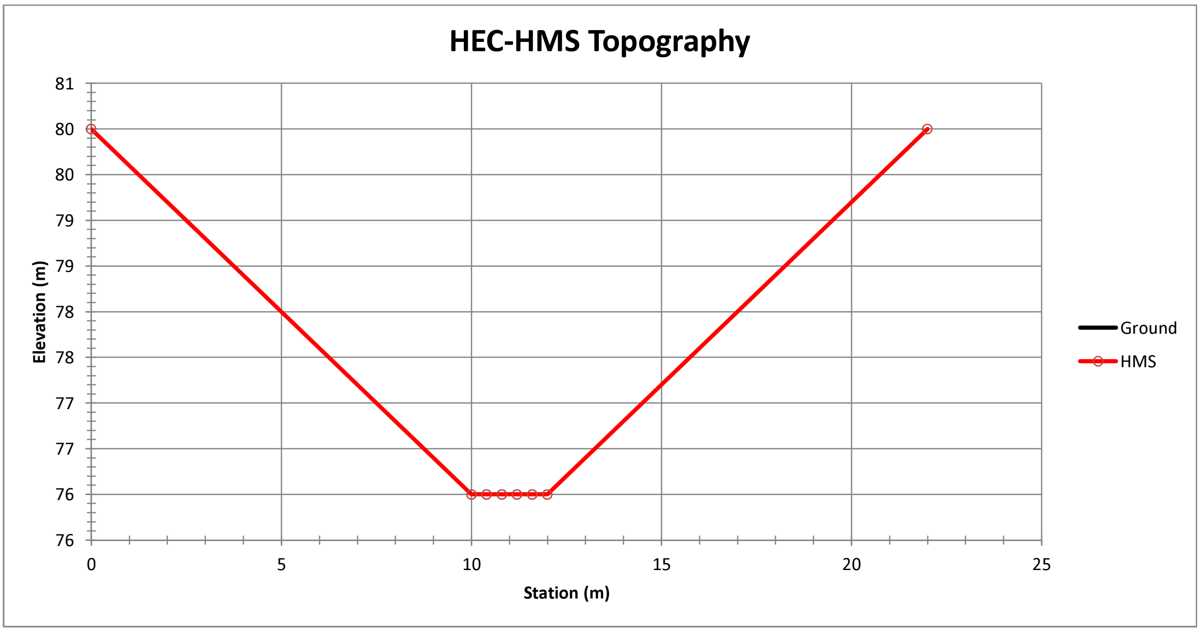
HEC-HMS Channel Topography (For DC-PL-018)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	805.376	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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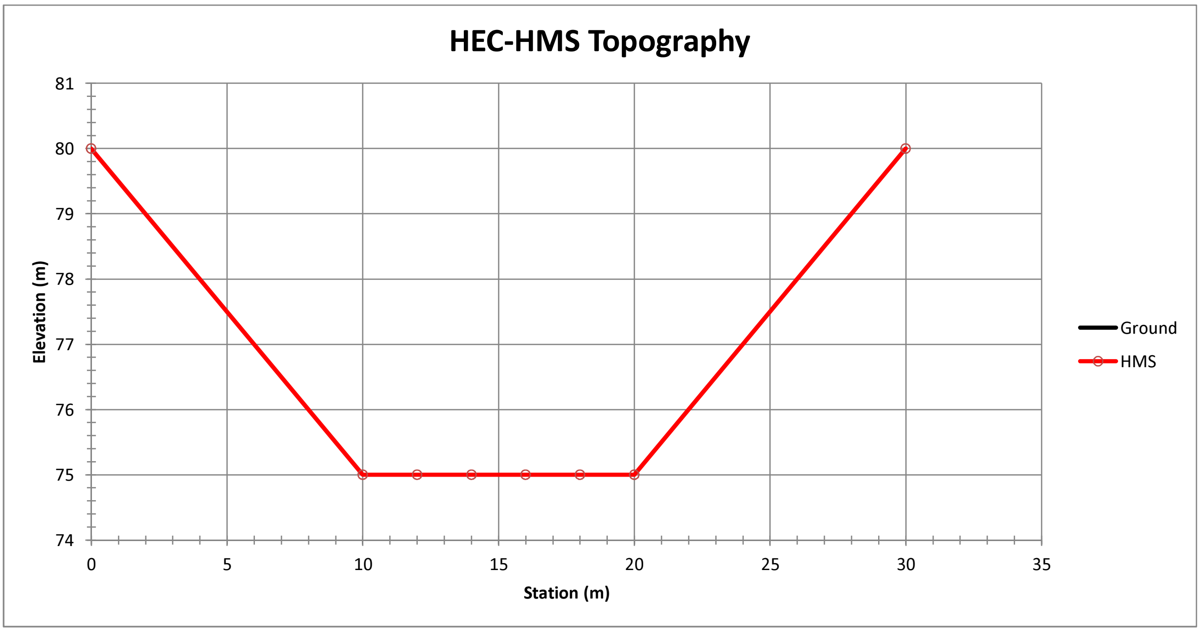
HEC-HMS Channel Topography (For DC-PL-019)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	843.796	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	3
14.000	75.000	4
16.000	75.000	5
18.000	75.000	6
20.000	75.000	7
30.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



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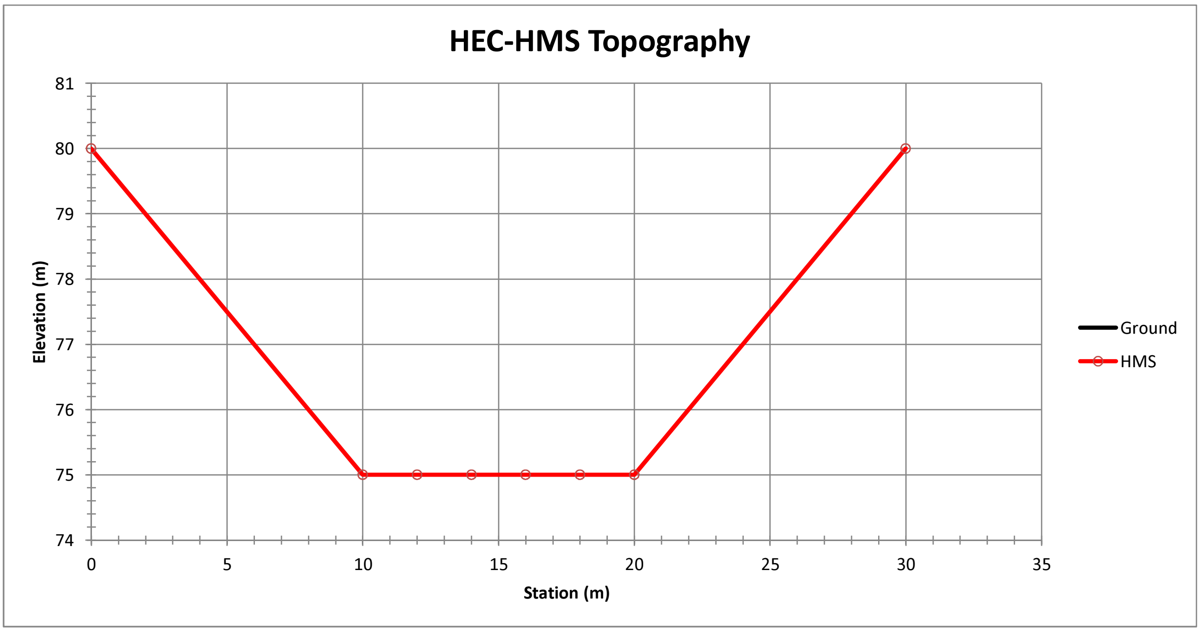
HEC-HMS Channel Topography (For DC-PL-020)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1137.573	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	**3**
14.000	75.000	4
16.000	75.000	5
18.000	75.000	**6**
20.000	75.000	7
30.000	80.000	8

Left Bank (LOB) **Channel (TWG)** **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
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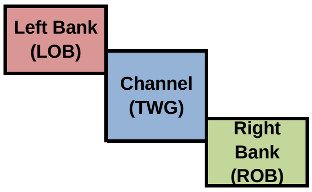
	HEC-HMS XS	Approved	

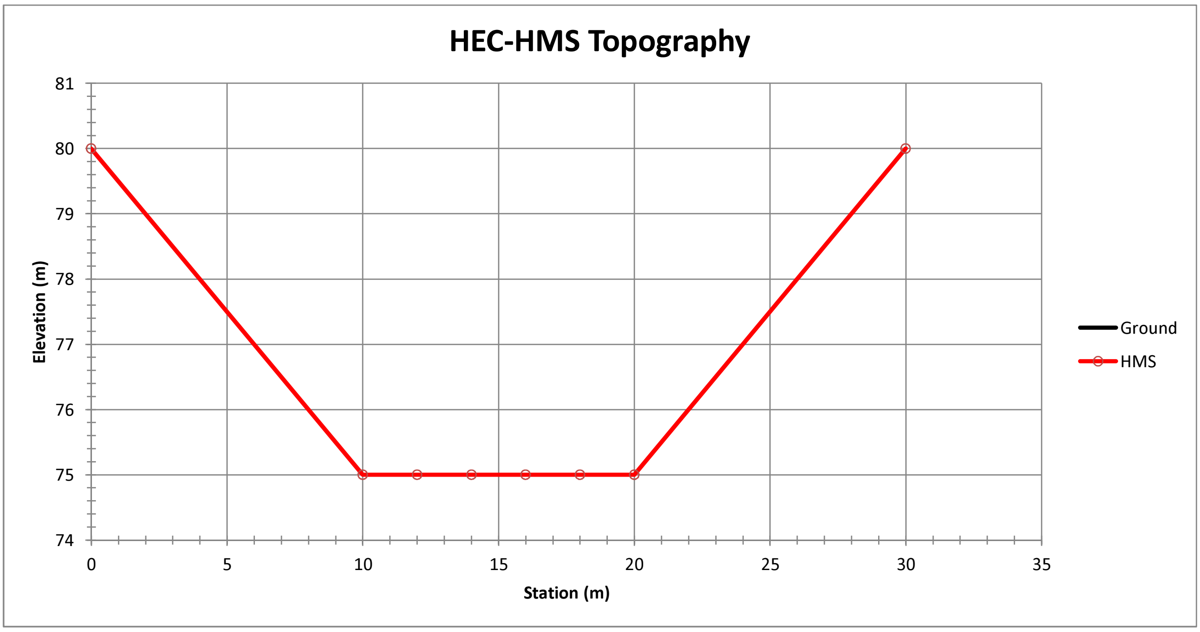
HEC-HMS Channel Topography (For DC-PL-021)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1514.570	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	3
14.000	75.000	4
16.000	75.000	5
18.000	75.000	6
20.000	75.000	7
30.000	80.000	8





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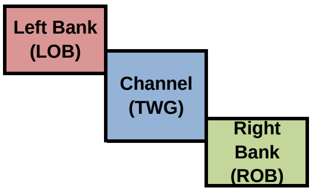
	HEC-HMS XS	Approved	

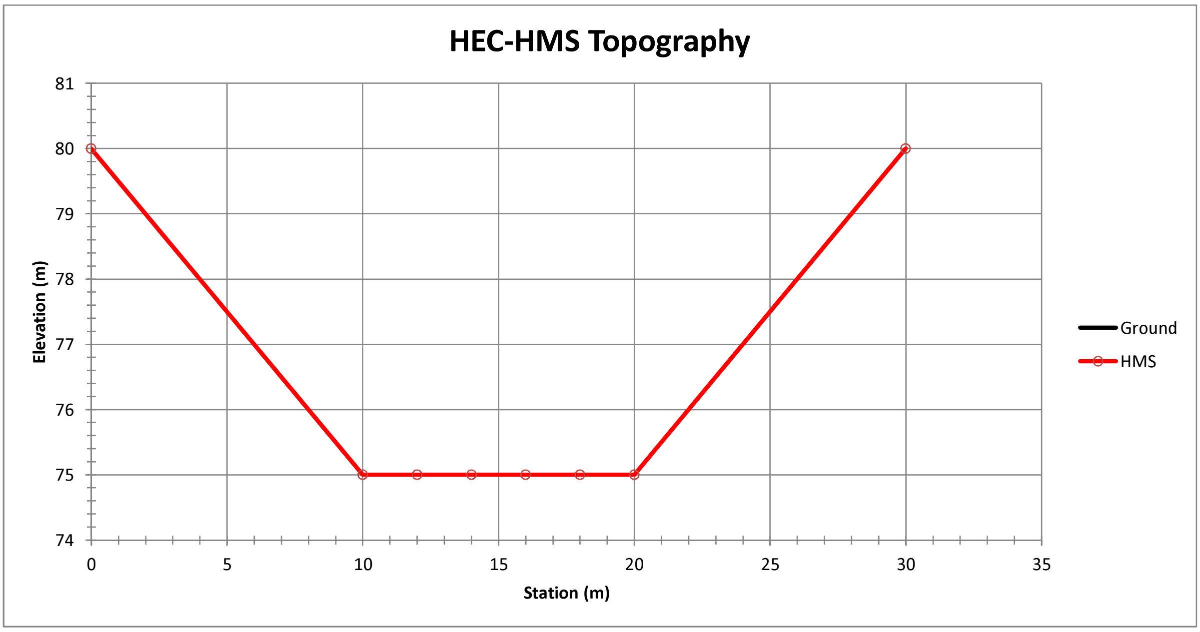
HEC-HMS Channel Topography (For DC-PL-022)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	497.205	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	3
14.000	75.000	4
16.000	75.000	5
18.000	75.000	6
20.000	75.000	7
30.000	80.000	8



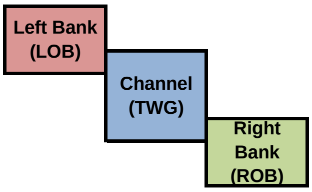


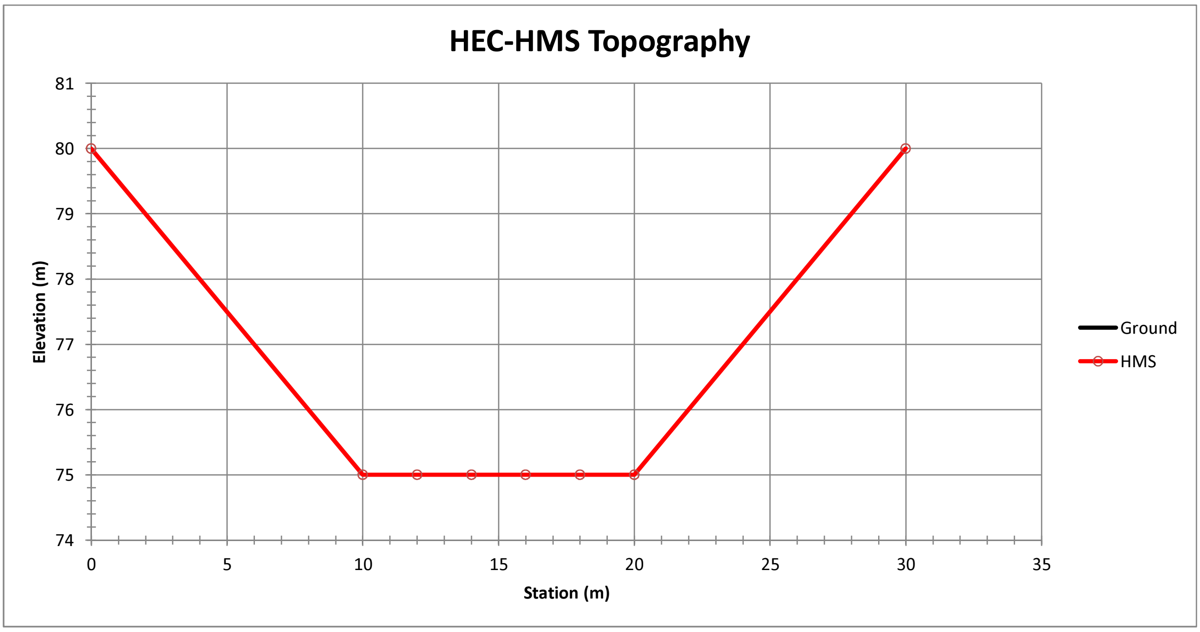
HEC-HMS Channel Topography (For DC-PL-023)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2479.689	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	**3**
14.000	75.000	4
16.000	75.000	5
18.000	75.000	**6**
20.000	75.000	7
30.000	80.000	8



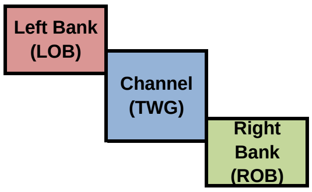


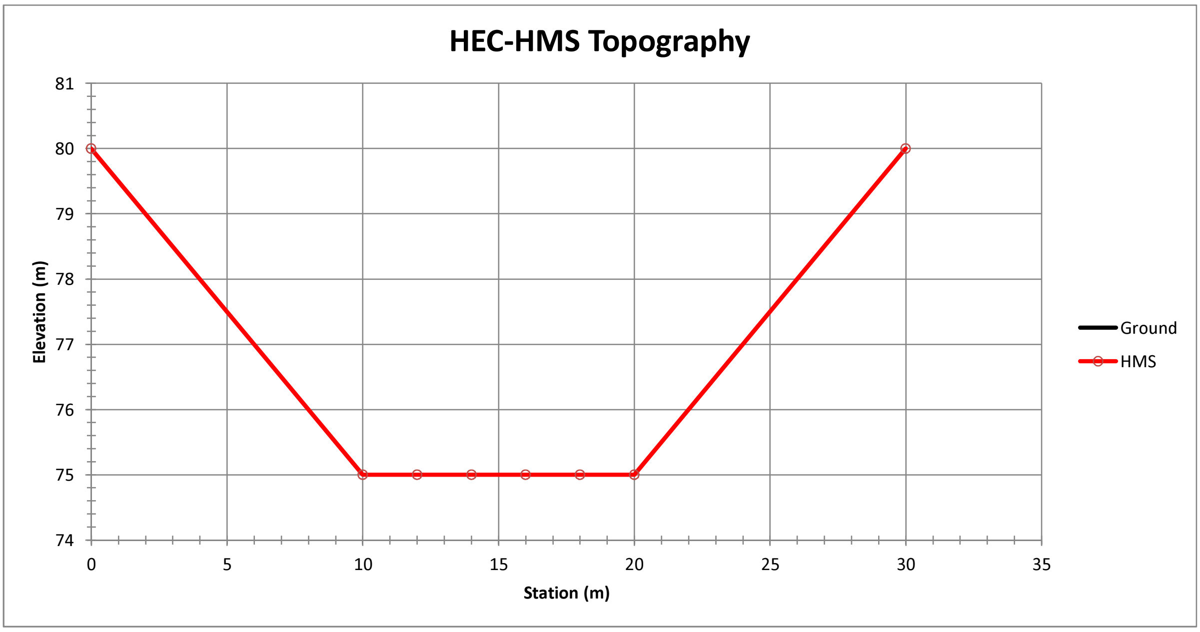
HEC-HMS Channel Topography (For DC-PL-024)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1351.837	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.035	
Channel invert elevation, Z_o =		**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.035	
Right bank Manning's roughness, n_{ROB} =	0.035	
Approximate Channel Base Width =	10.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	75.000	2
12.000	75.000	**3**
14.000	75.000	4
16.000	75.000	5
18.000	75.000	**6**
20.000	75.000	7
30.000	80.000	8





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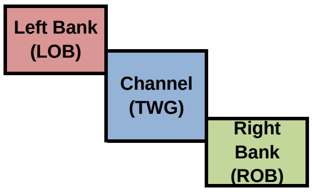
HEC-HMS Channel Topography (For NC-PL-025)

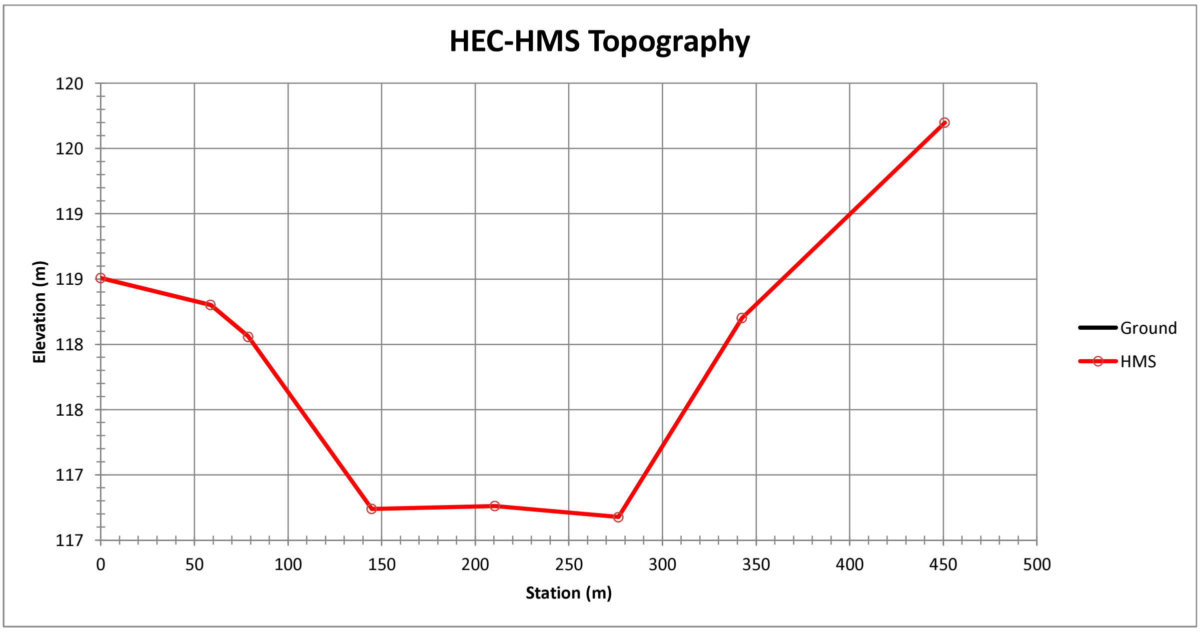
*NC-PL-025 was assumed to have the same channel shape as NC-PL-026

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	584.546	**(m)**
Channel slope, S =	0.009	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	118.507	1
58.568	118.302	2
78.809	118.058	**3**
144.710	116.738	4
210.610	116.760	5
276.511	116.676	**6**
342.411	118.202	7
450.803	119.698	8



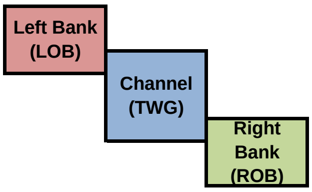


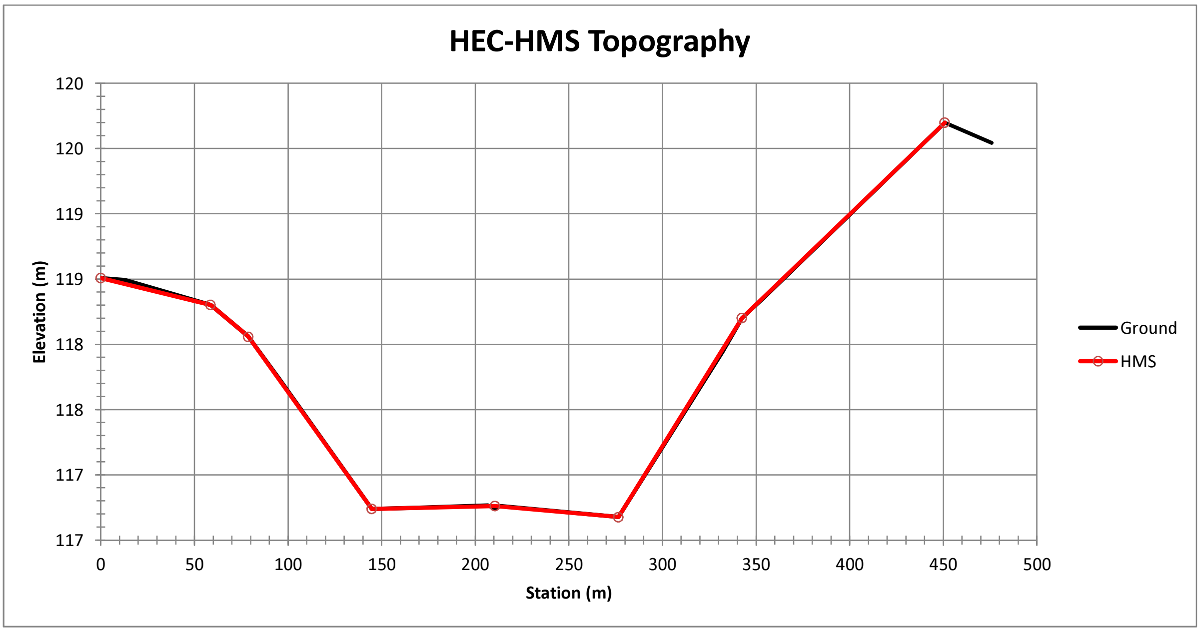
HEC-HMS Channel Topography (For NC-PL-026)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	556.000	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	118.507	1
58.568	118.302	2
78.809	118.058	**3**
144.710	116.738	4
210.610	116.760	5
276.511	116.676	**6**
342.411	118.202	7
450.803	119.698	8



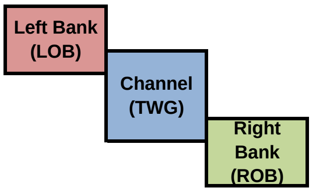


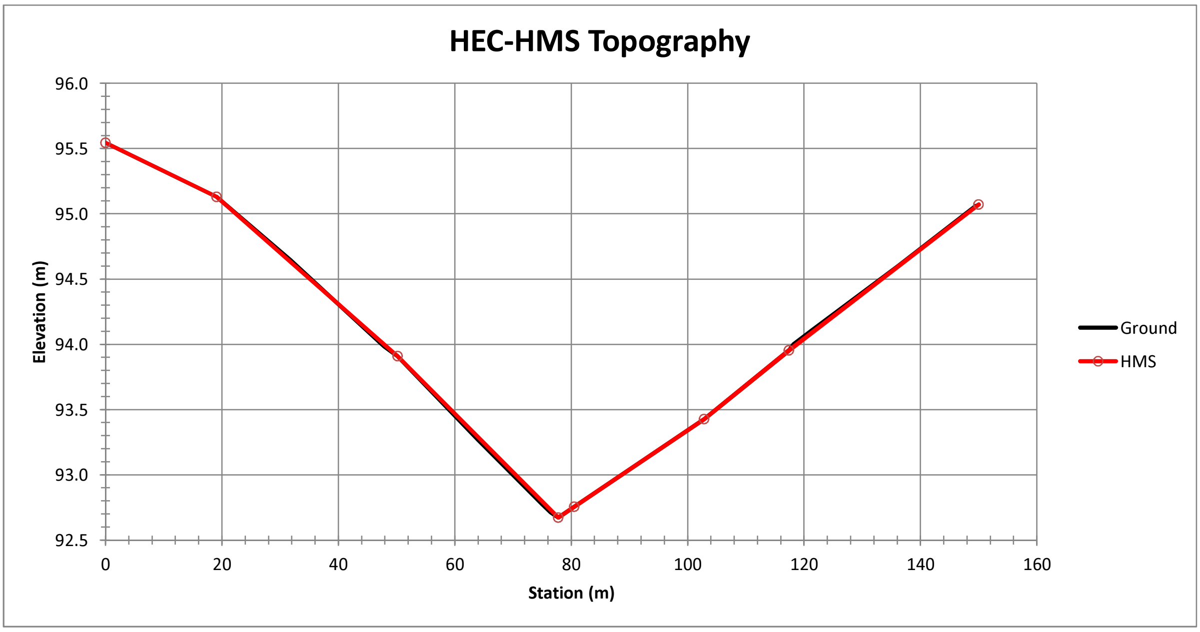
HEC-HMS Channel Topography (For NC-PL-027)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	682.683	**(m)**
Channel slope, S =	0.008	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	95.545	1
19.113	95.129	2
50.169	93.910	**3**
77.767	92.672	4
80.533	92.756	5
102.841	93.428	**6**
117.394	93.953	7
150.000	95.071	8



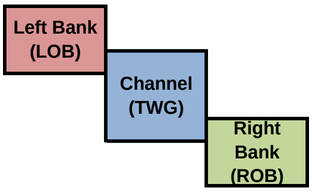


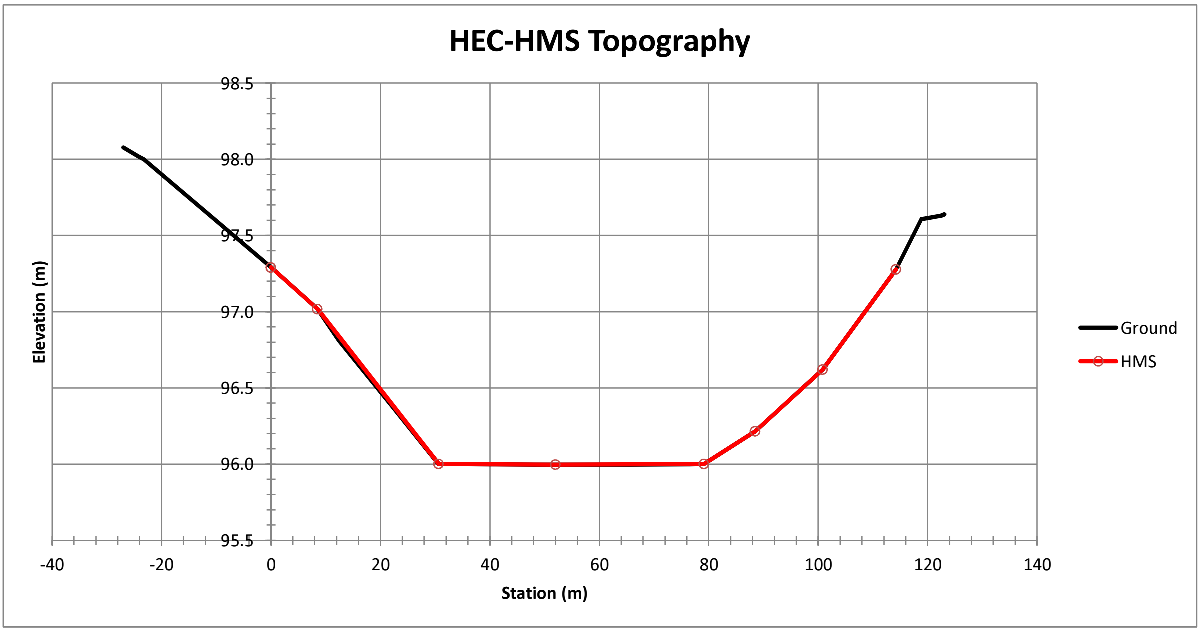
HEC-HMS Channel Topography (For NC-PL-028)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 281.377 **(m)**
Channel slope, S = 0.019 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.030
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.050
Right bank Manning's roughness, n_{ROB} = 0.050

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	97.291	1
8.491	97.018	2
30.610	96.000	**3**
51.983	95.996	4
79.104	96.000	5
88.467	96.214	**6**
100.833	96.620	7
114.200	97.278	8





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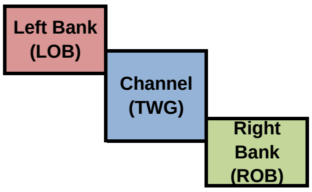
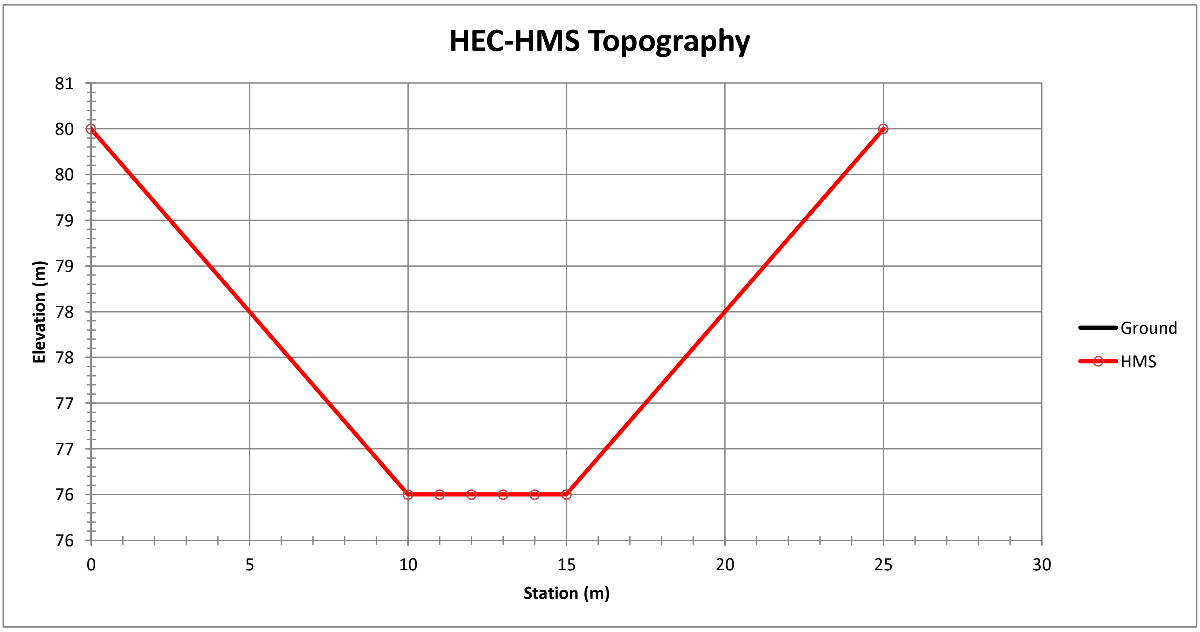
HEC-HMS Channel Topography (For DC-PL-029)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	730.528	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





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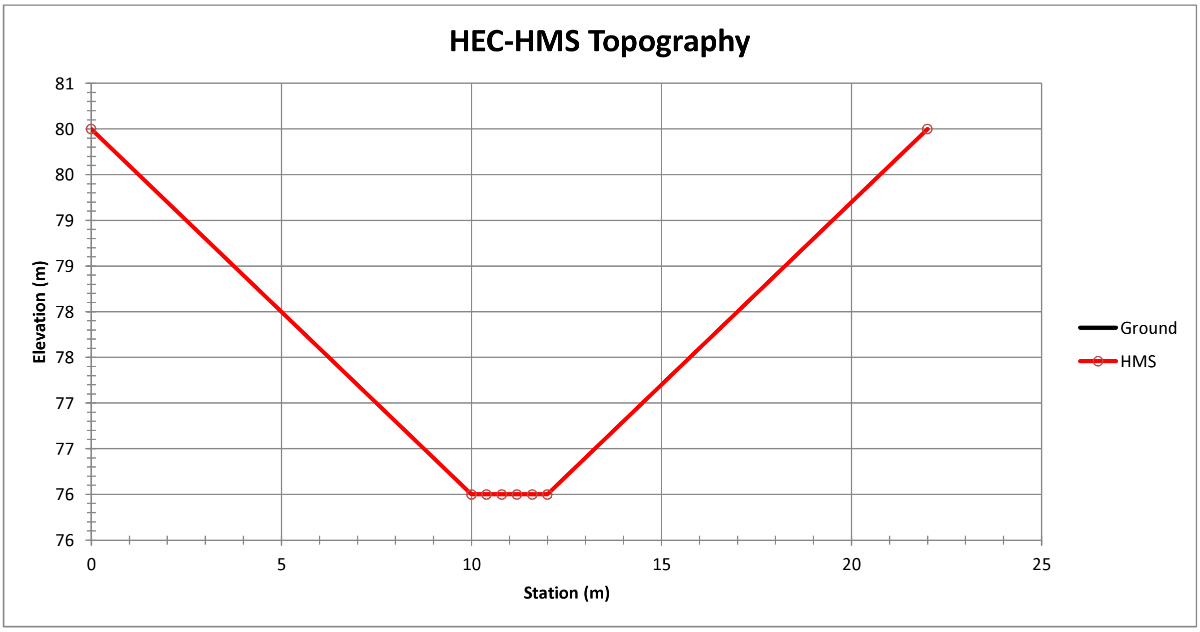
HEC-HMS Channel Topography (For DC-PL-030)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 785.160 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.017
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.017
Right bank Manning's roughness, n_{ROB} = 0.017
Approximate Channel Base Width = 2.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) **Channel (TWG)** **Right Bank (ROB)**

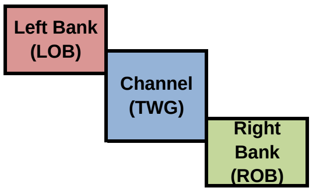


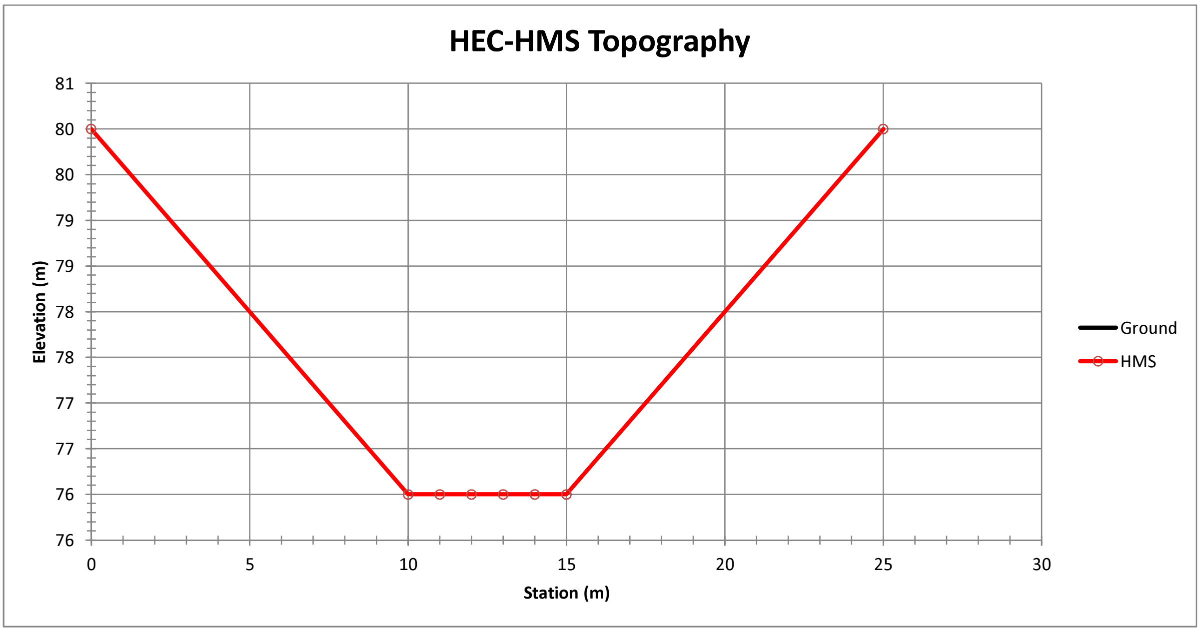
HEC-HMS Channel Topography (For DC-PL-031)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	5001.976	**(m)**
Channel slope, S =	0.006	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.013	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.013	
Right bank Manning's roughness, n_{ROB} =	0.013	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





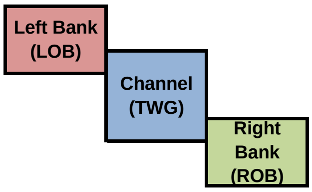
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

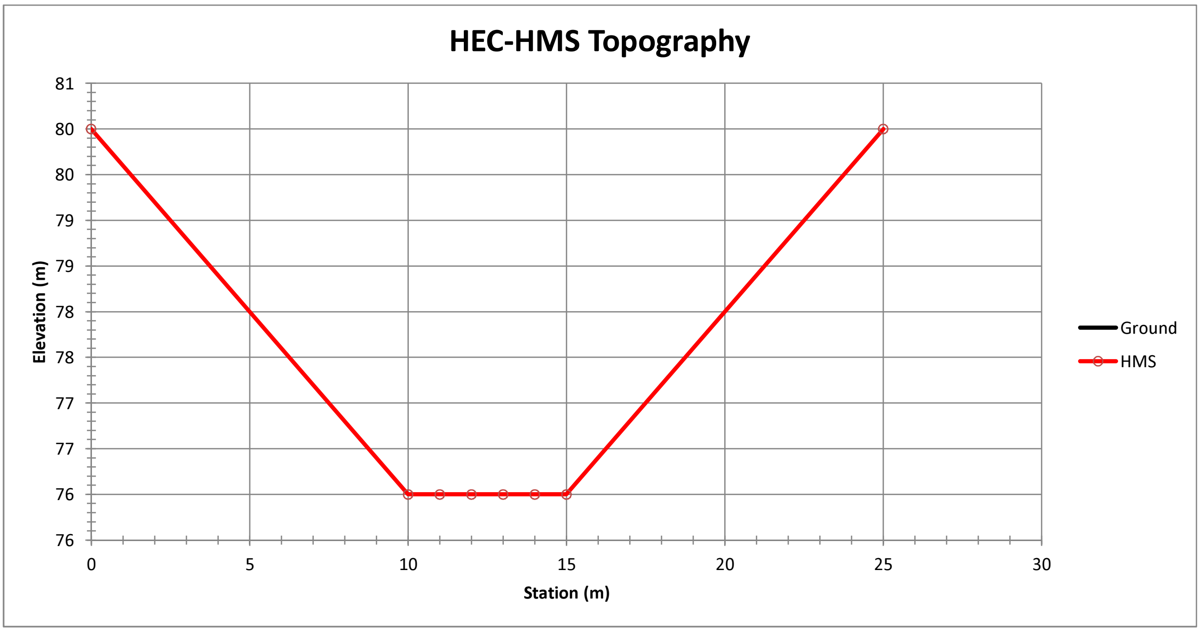
HEC-HMS Channel Topography (For DC-PL-032)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 4554.978 **(m)**
Channel slope, S = 0.007 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.013
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.013
Right bank Manning's roughness, n_{ROB} = 0.013
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8



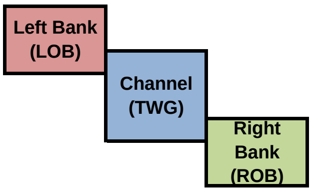


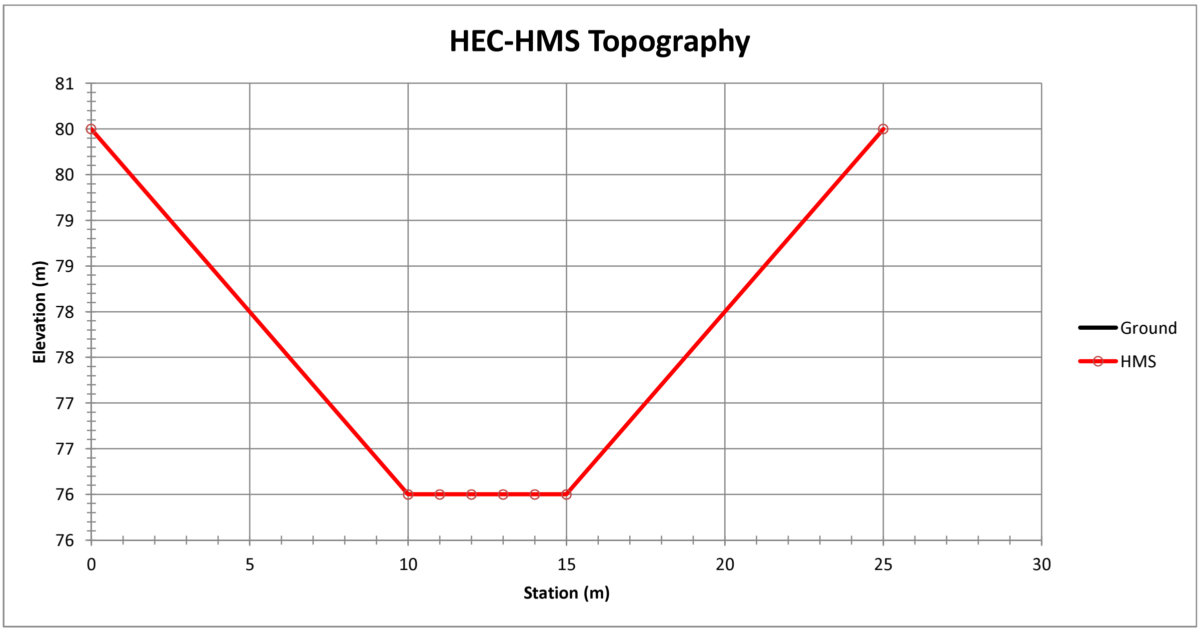
HEC-HMS Channel Topography (For DC-PL-033)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 715.441 **(m)**
Channel slope, S = 0.001 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8



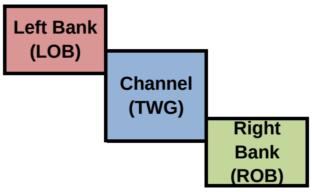


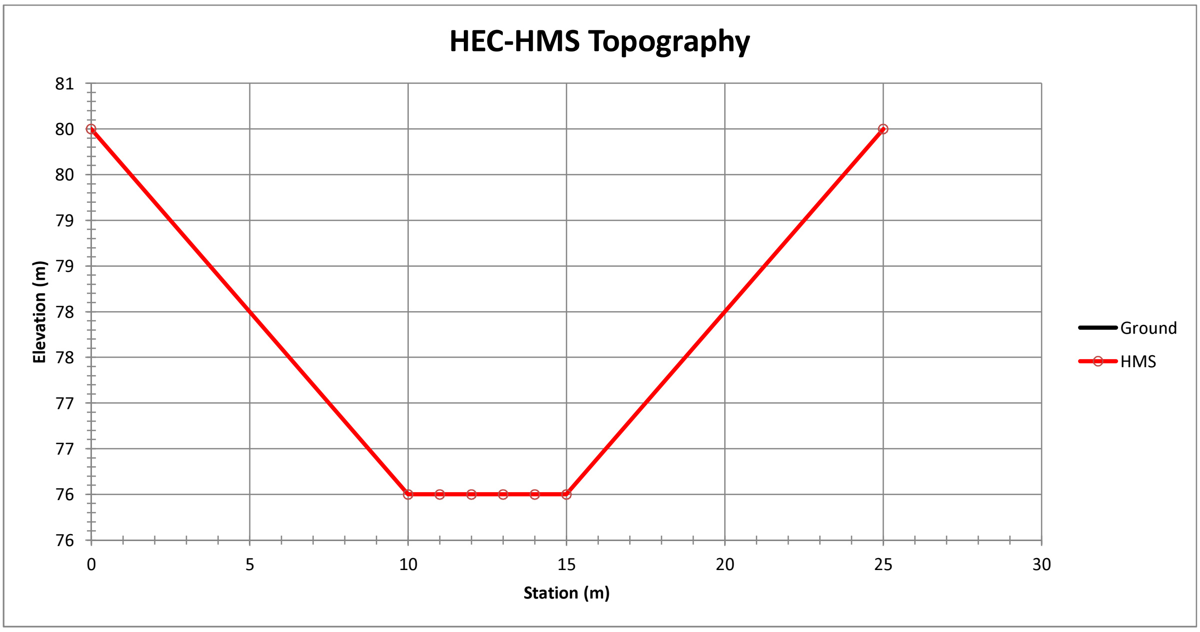
HEC-HMS Channel Topography (For DC-PL-034)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 550.308 **(m)**
Channel slope, S = 0.003 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8



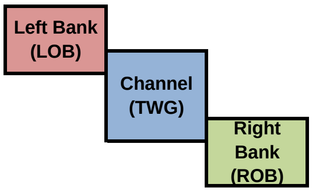


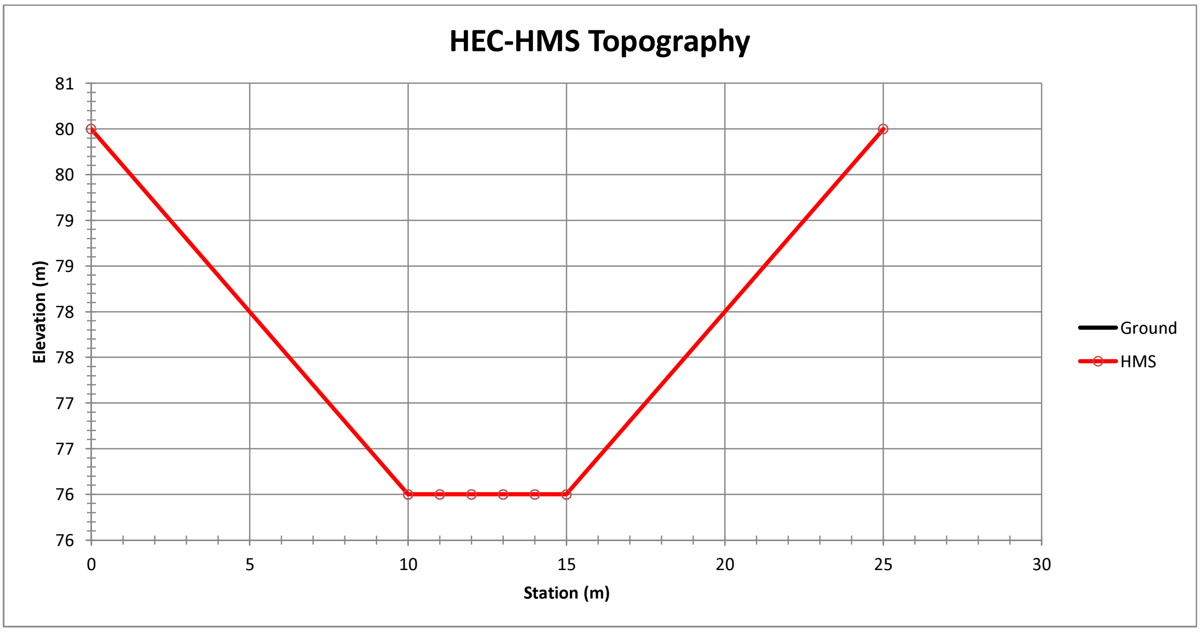
HEC-HMS Channel Topography (For DC-PL-035)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1180.350	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8



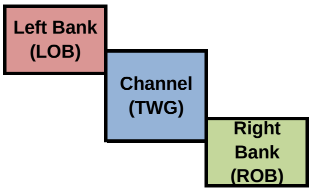


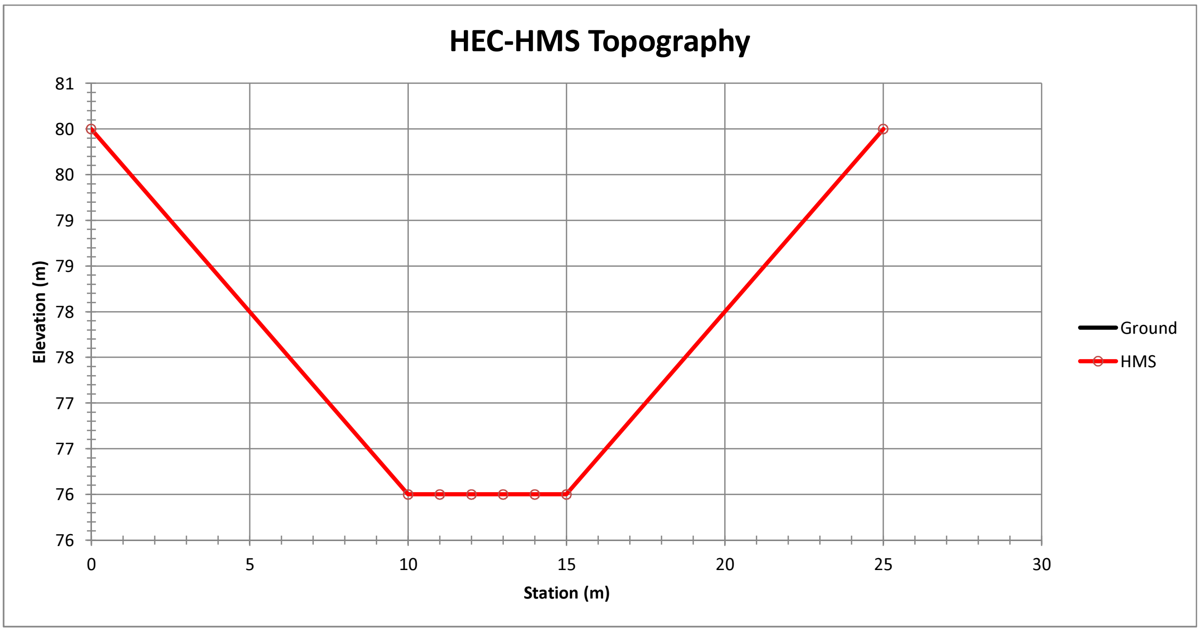
HEC-HMS Channel Topography (For DC-PL-036)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	261.544	**(m)**
Channel slope, S =	0.013	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8



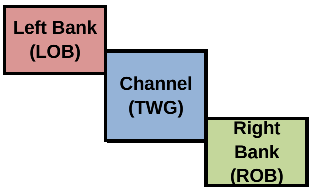


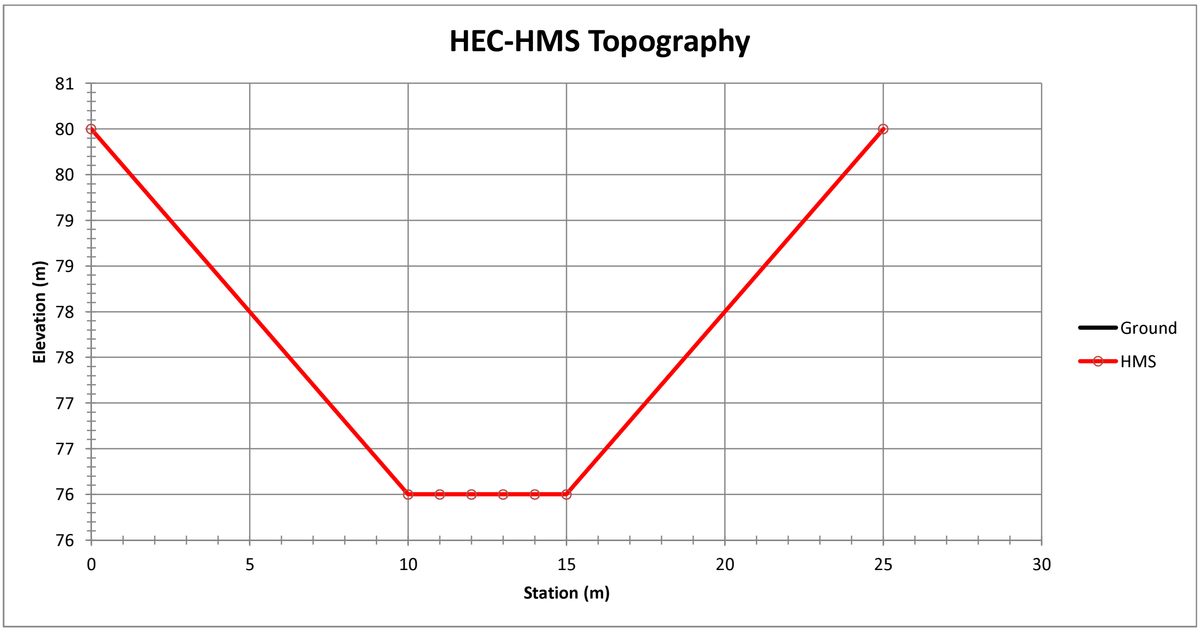
HEC-HMS Channel Topography (For DC-PL-037)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 208.348 **(m)**
Channel slope, S = 0.029 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
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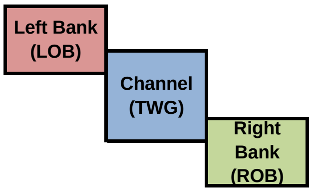
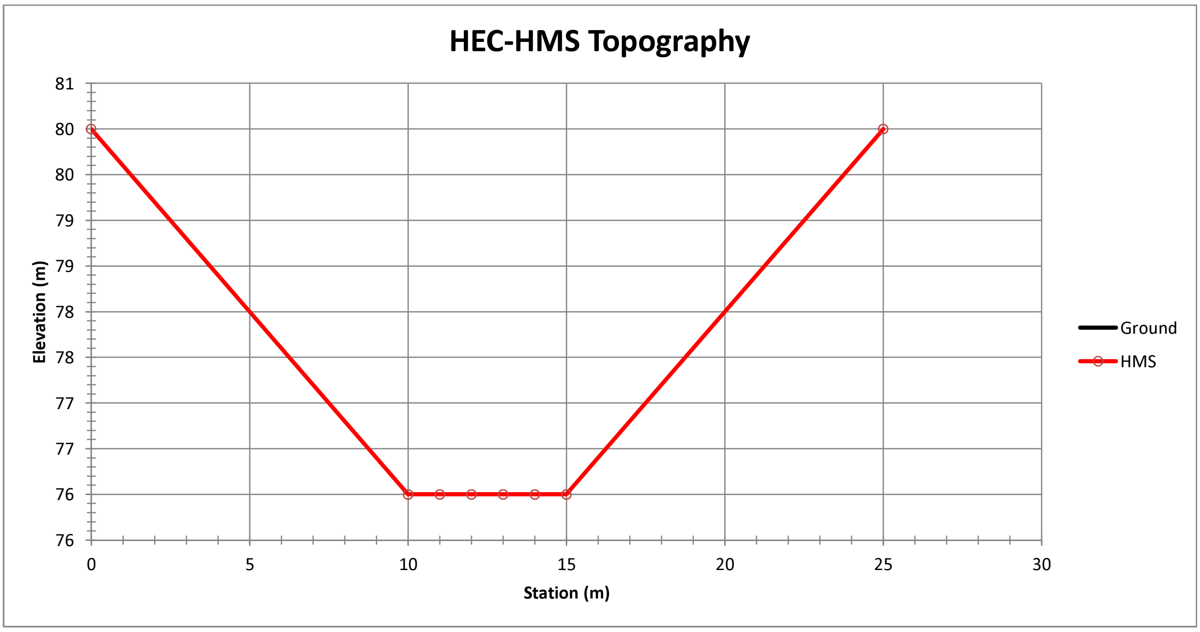
HEC-HMS Channel Topography (For DC-PL-038)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	793.079	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8



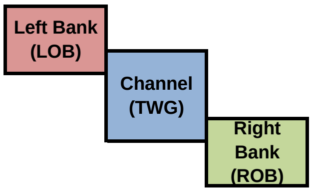


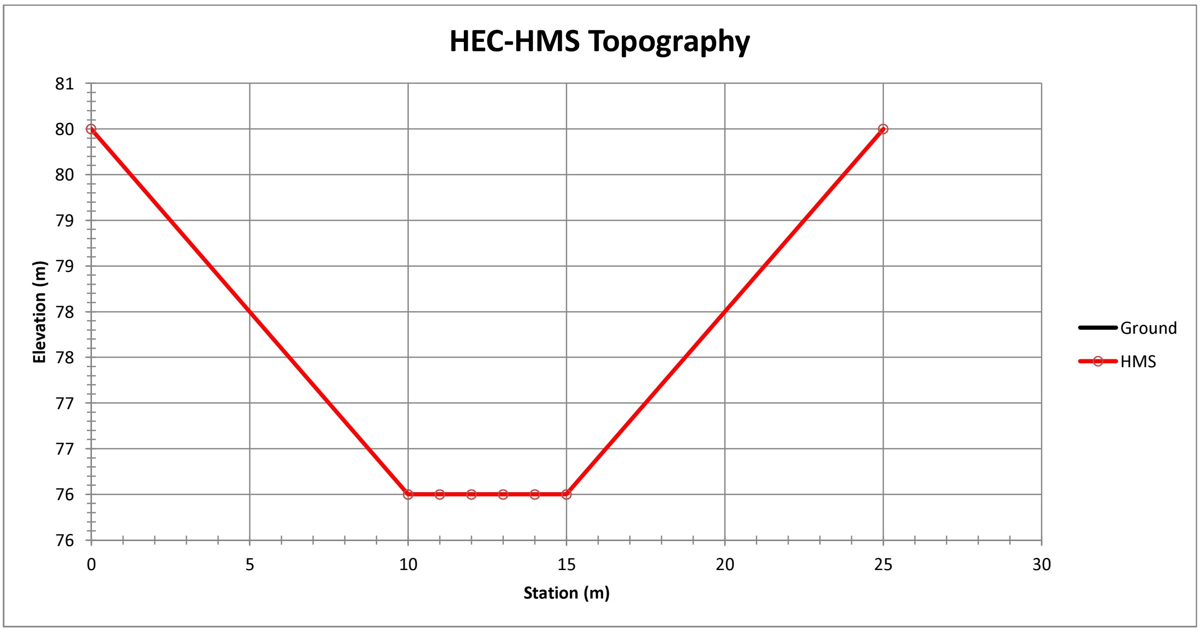
HEC-HMS Channel Topography (For DC-PL-039)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	725.708	**(m)**
Channel slope, S =	0.019	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





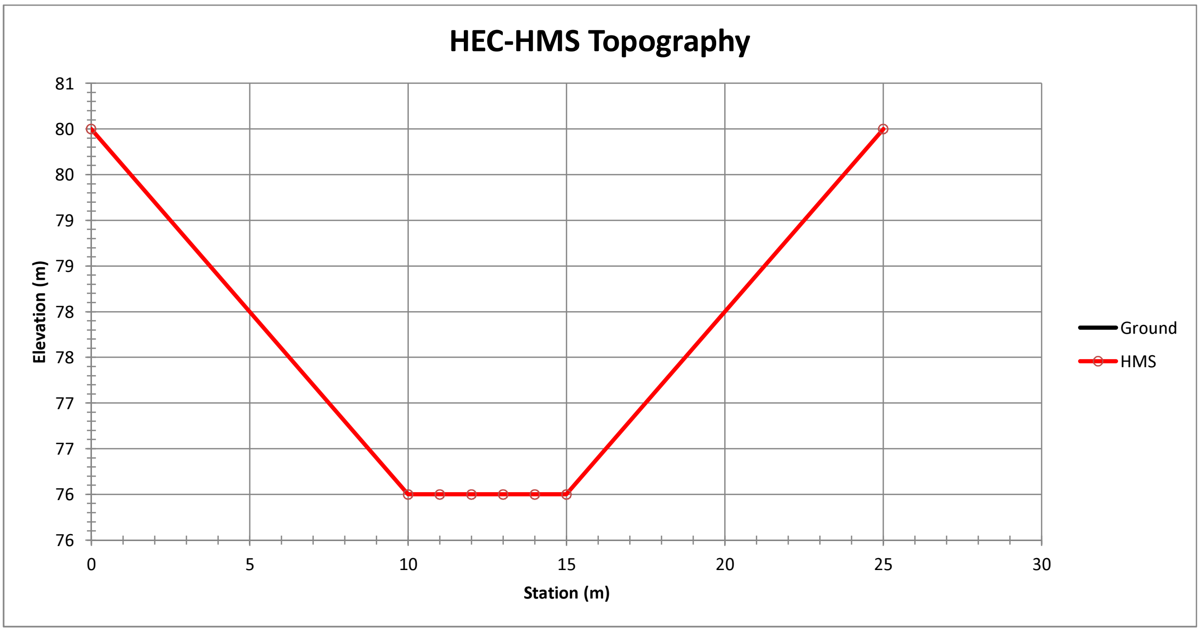
HEC-HMS Channel Topography (For DC-PL-040)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	218.236	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining	Made by: AB	Job No.: PE701-00022/01
	Letpadaung	Checked	Date: 24/07/2013
	HEC-HMS XS	Approved	

HEC-HMS Channel Topography (For DC-PL-041)

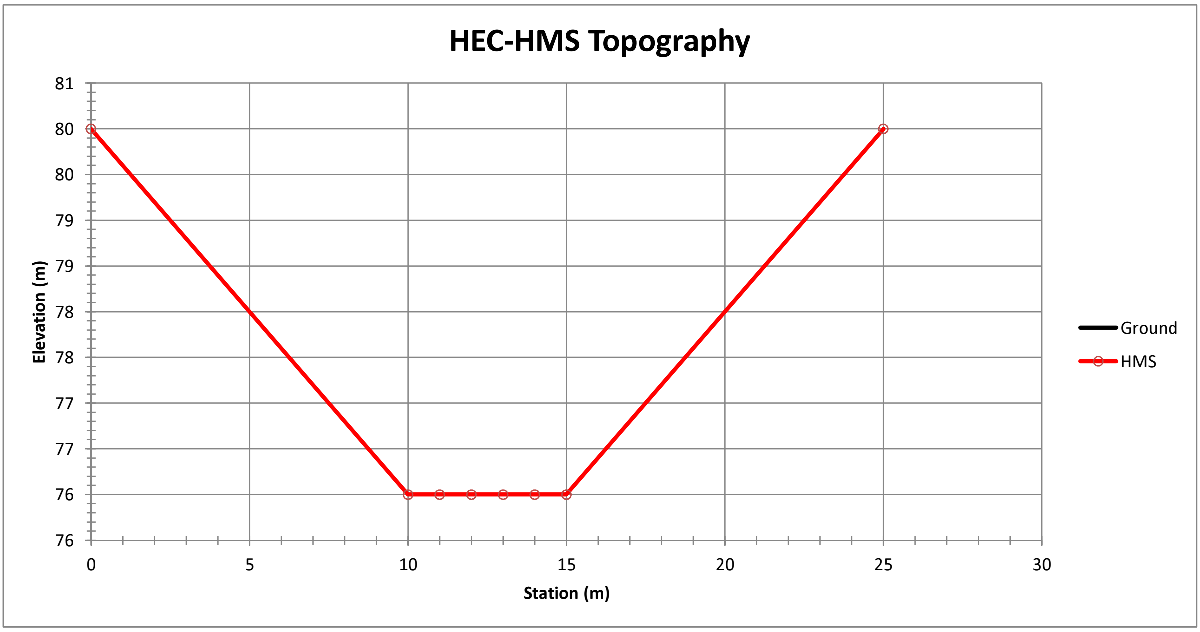
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1876.266	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | Channel (TWG) | Right Bank (ROB)



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

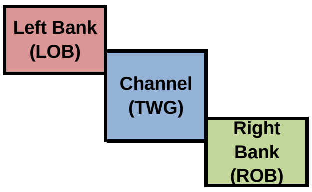
HEC-HMS Channel Topography (For DC-PL-042)

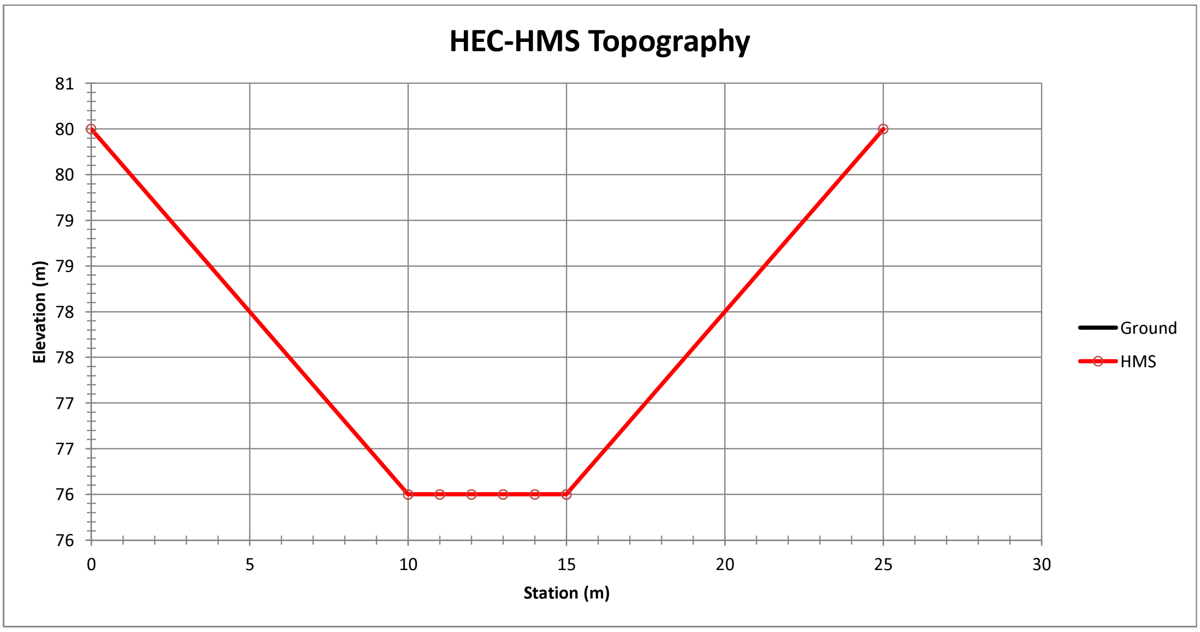
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	119.484	**(m)**
Channel slope, S =	0.008	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





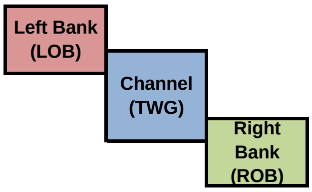
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

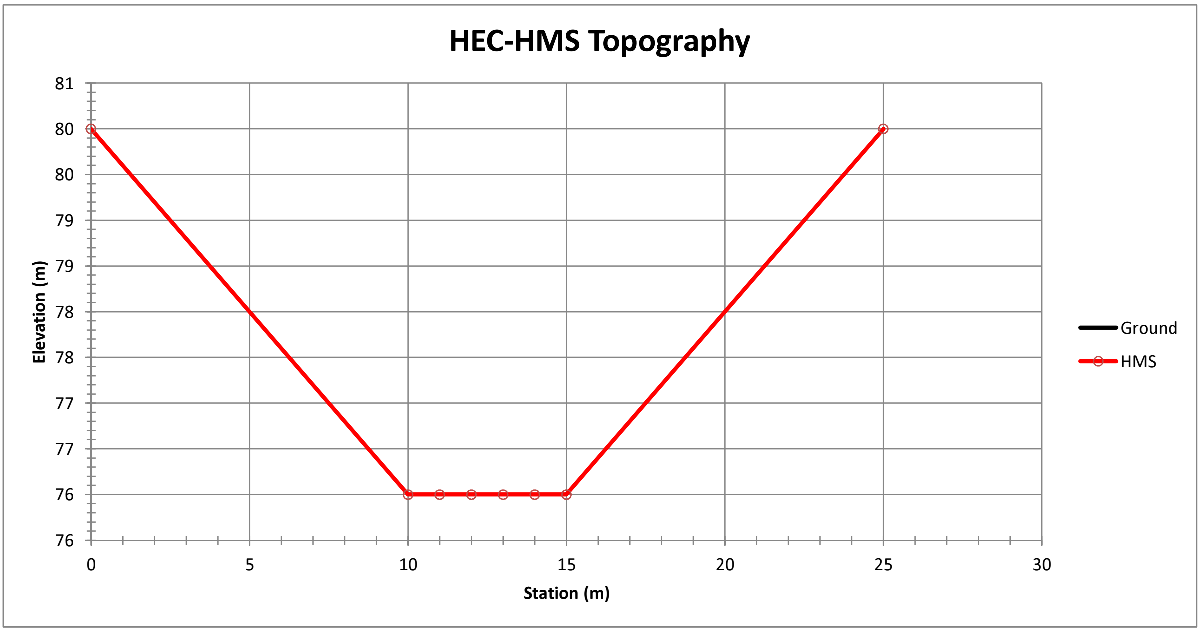
HEC-HMS Channel Topography (For DC-PL-043)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2194.740	**(m)**
Channel slope, S =	0.029	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining	Made by: AB	Job No.: PE701-00022/01
	Letpadaung	Checked	Date: 24/07/2013
	HEC-HMS XS	Approved	

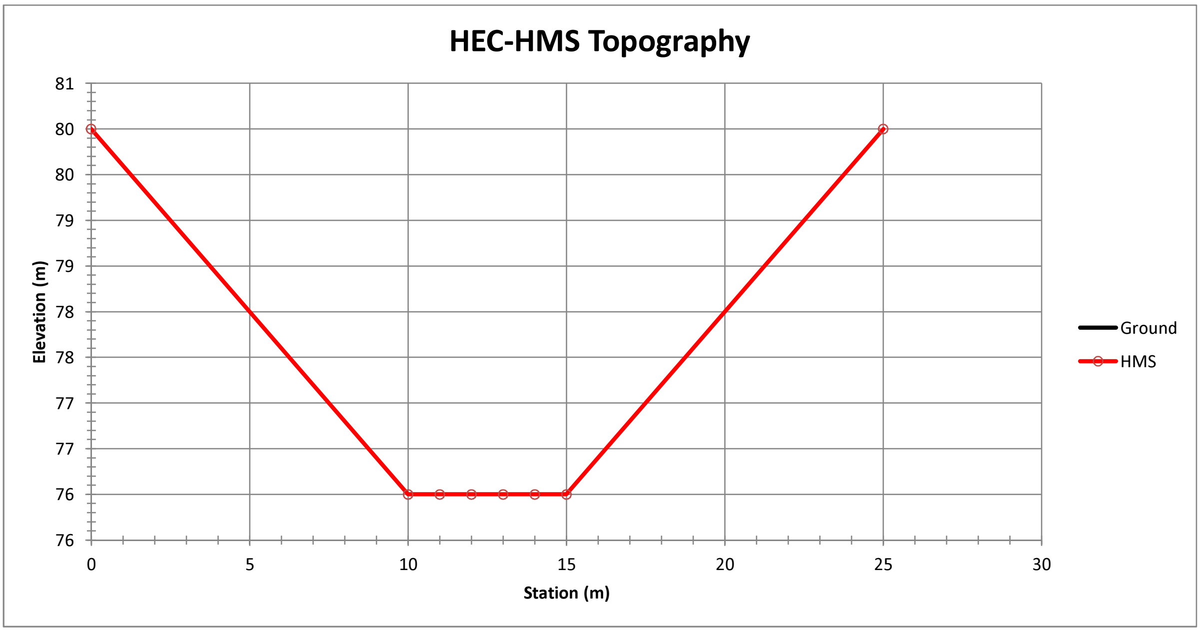
HEC-HMS Channel Topography (For DC-PL-044)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 352.362 **(m)**
Channel slope, S = 0.017 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

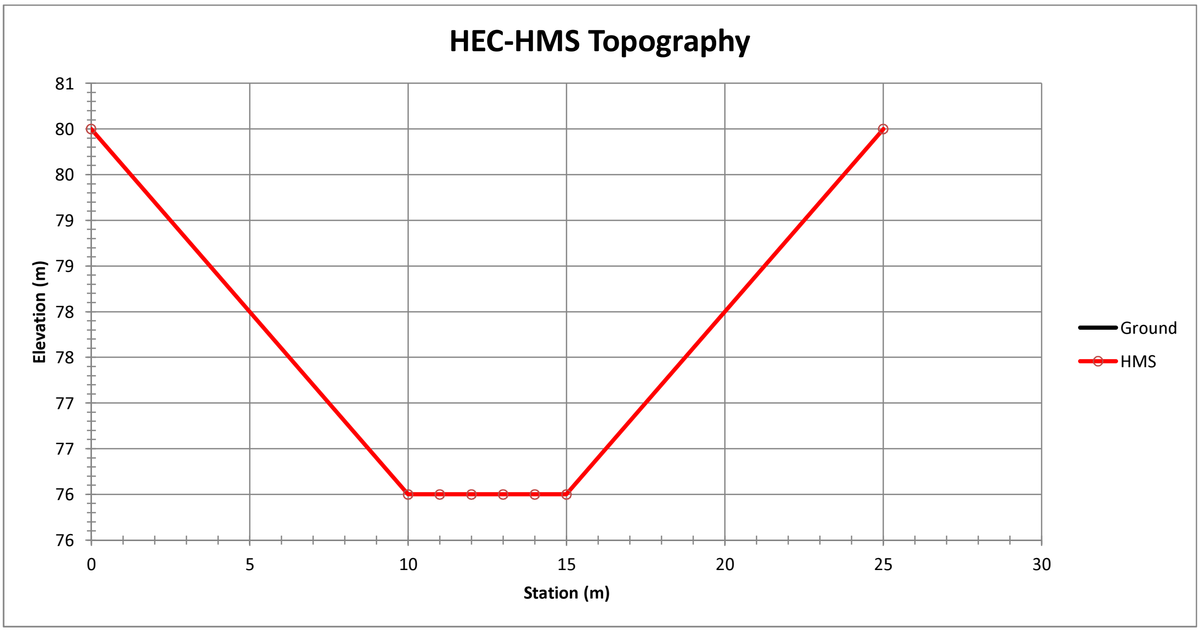
HEC-HMS Channel Topography (For DC-PL-045)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	558.204	**(m)**
Channel slope, S =	0.118	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**

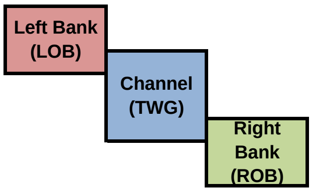


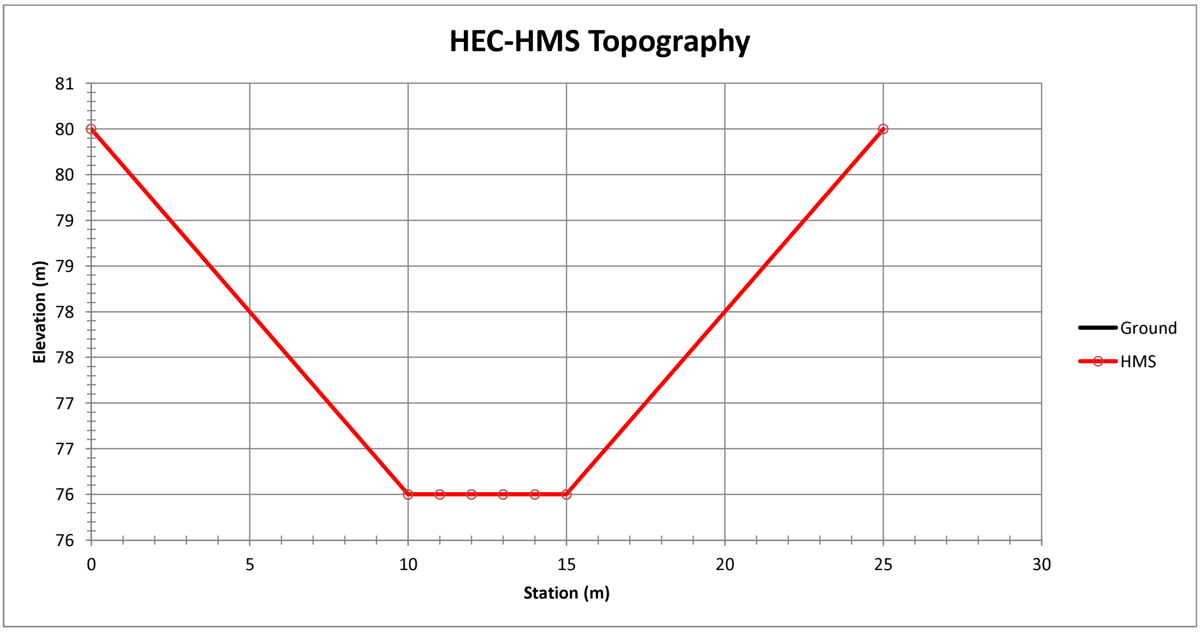
HEC-HMS Channel Topography (For DC-PL-046)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2273.05	**(m)**
Channel slope, S =	0.004	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8



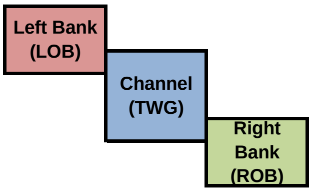


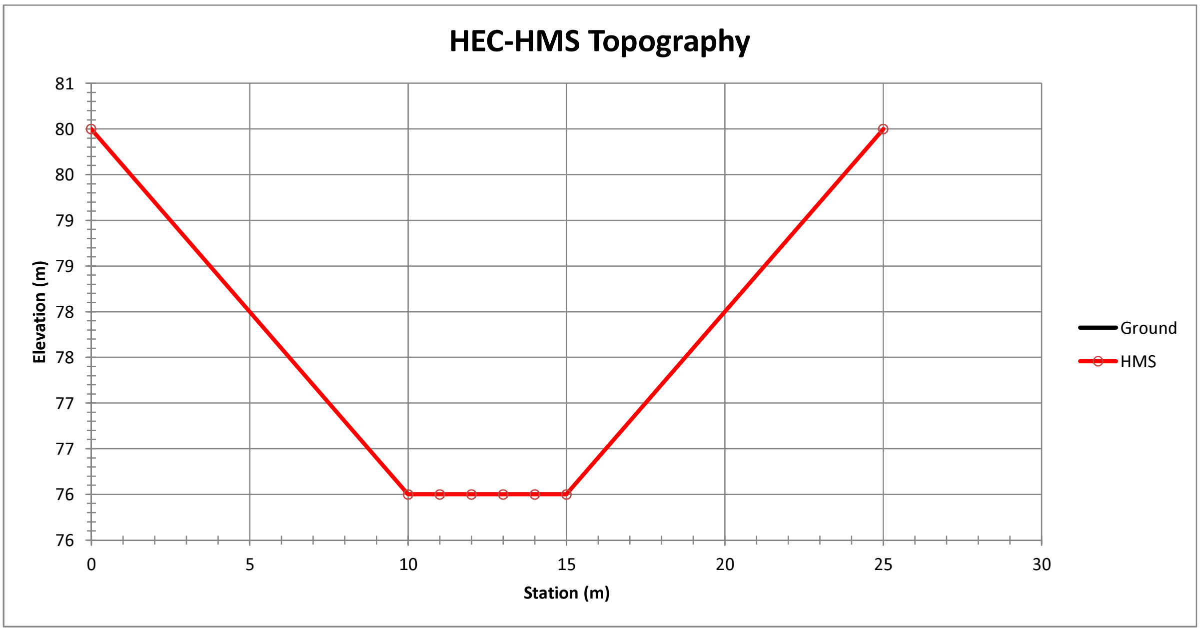
HEC-HMS Channel Topography (For DC-PL-047)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 785.016 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8





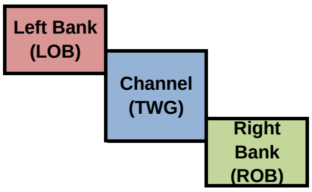
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

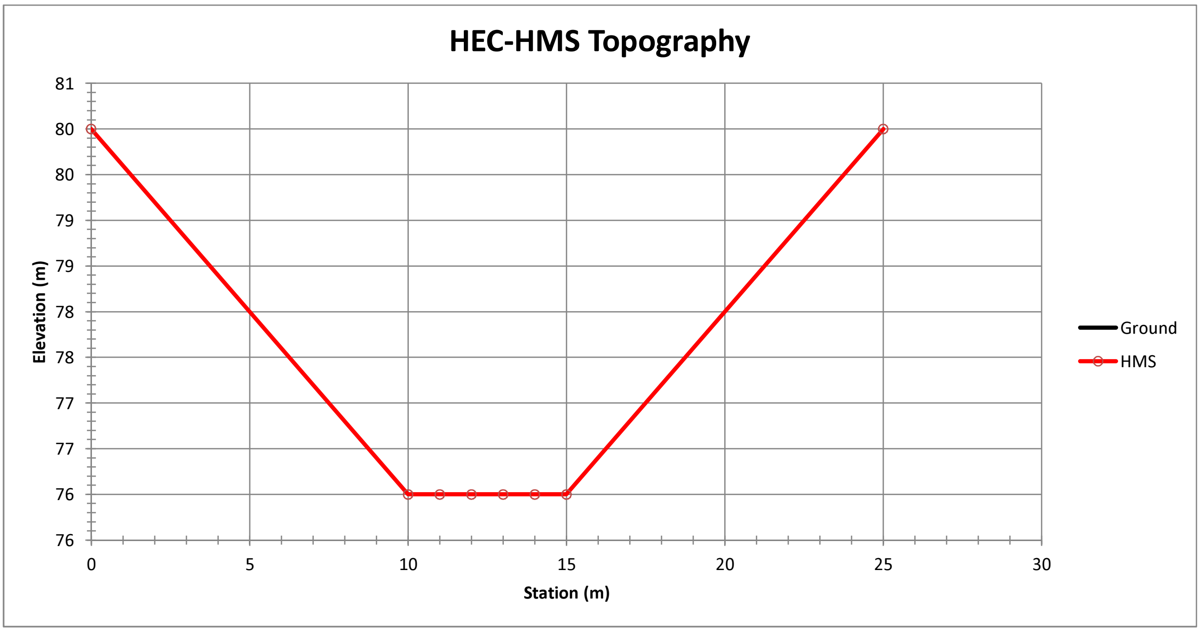
HEC-HMS Channel Topography (For DC-PL-048)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	2685.698	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
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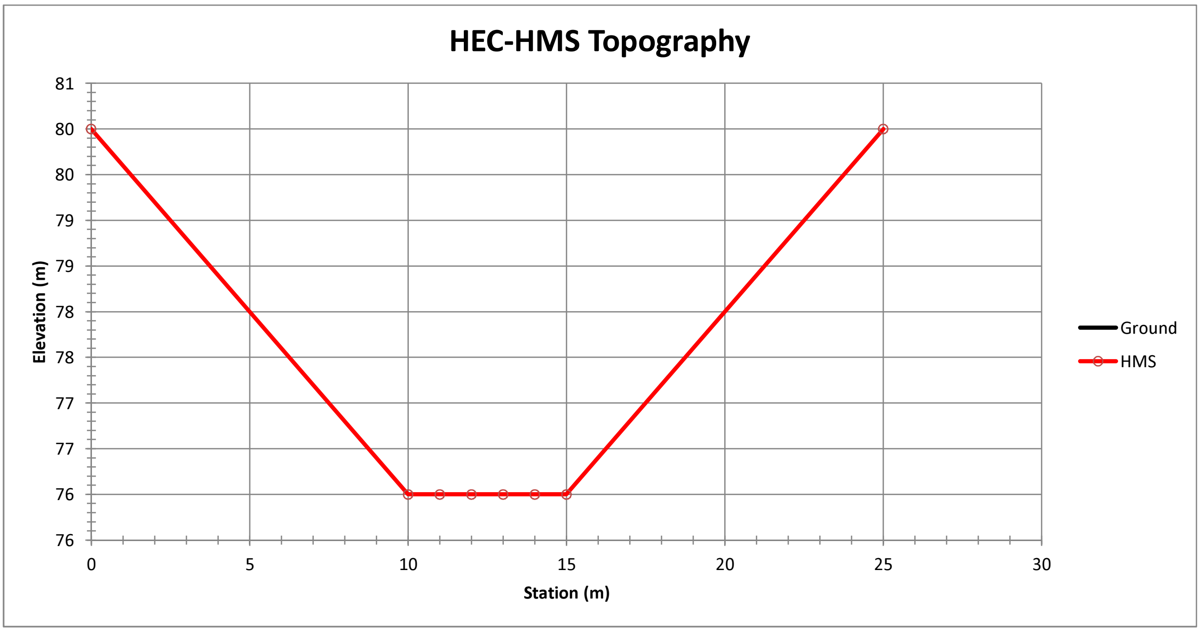
HEC-HMS Channel Topography (For DC-PL-049)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1488.798	**(m)**
Channel slope, S =	0.002	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

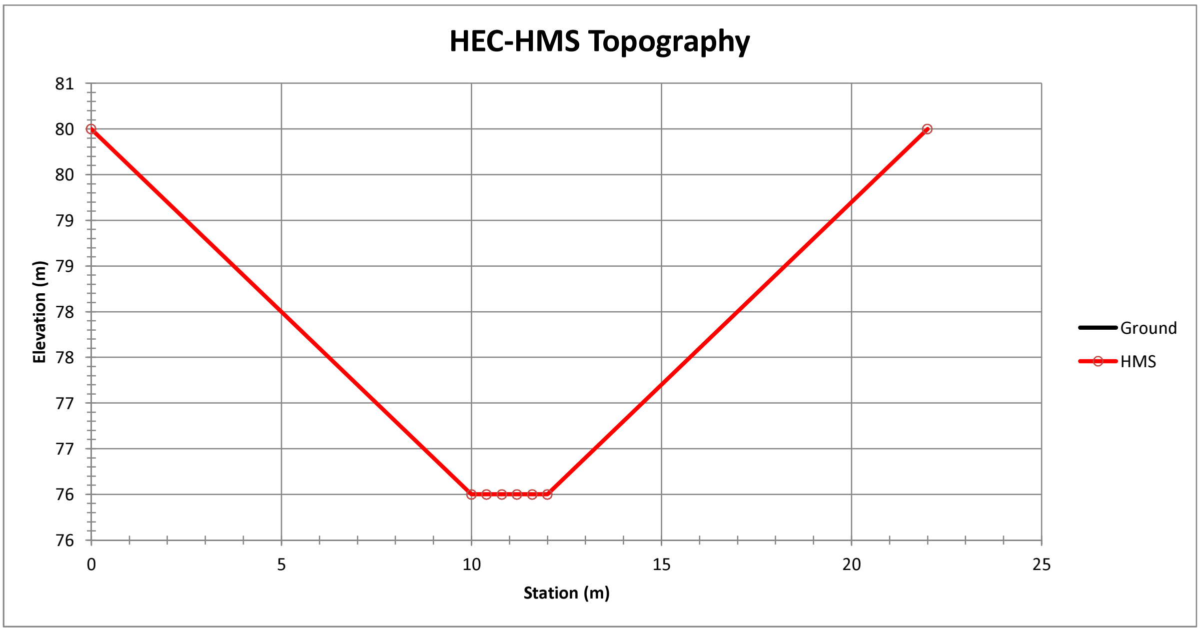
HEC-HMS Channel Topography (For DC-PL-050)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	2163.060	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.017	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.017	
Right bank Manning's roughness, n_{ROB} =	0.017	
Approximate Channel Base Width =	2.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.400	76.000	**3**
10.800	76.000	4
11.200	76.000	5
11.600	76.000	**6**
12.000	76.000	7
22.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

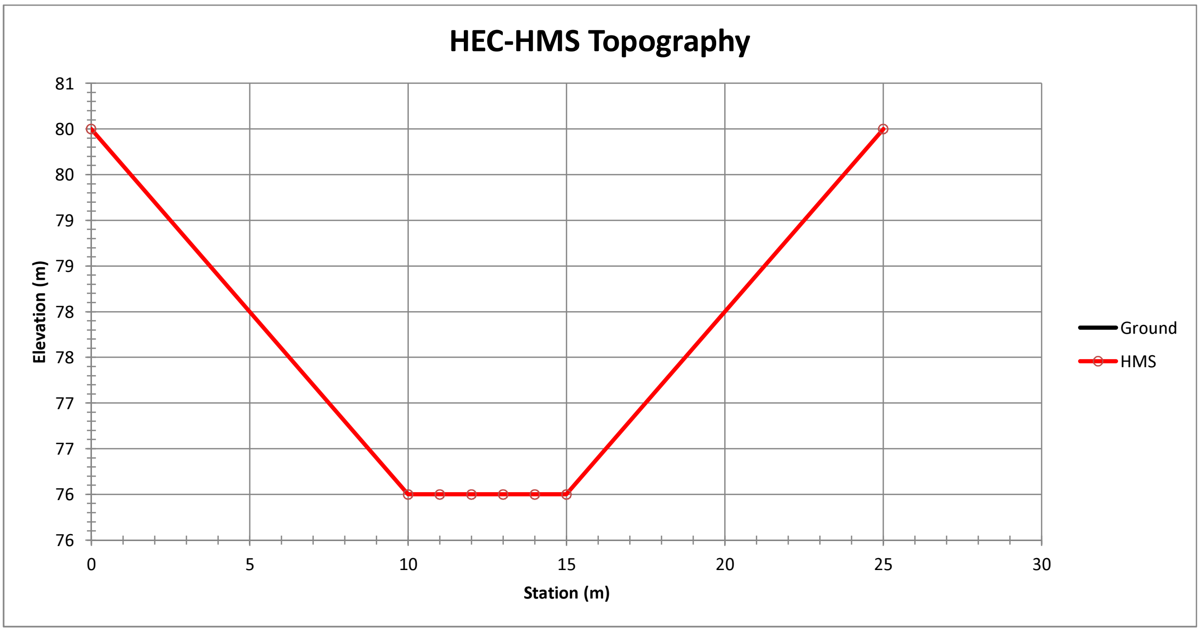
HEC-HMS Channel Topography (For DC-PL-051)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1760.959	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) **Channel (TWG)** **Right Bank (ROB)**



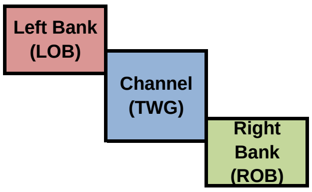
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

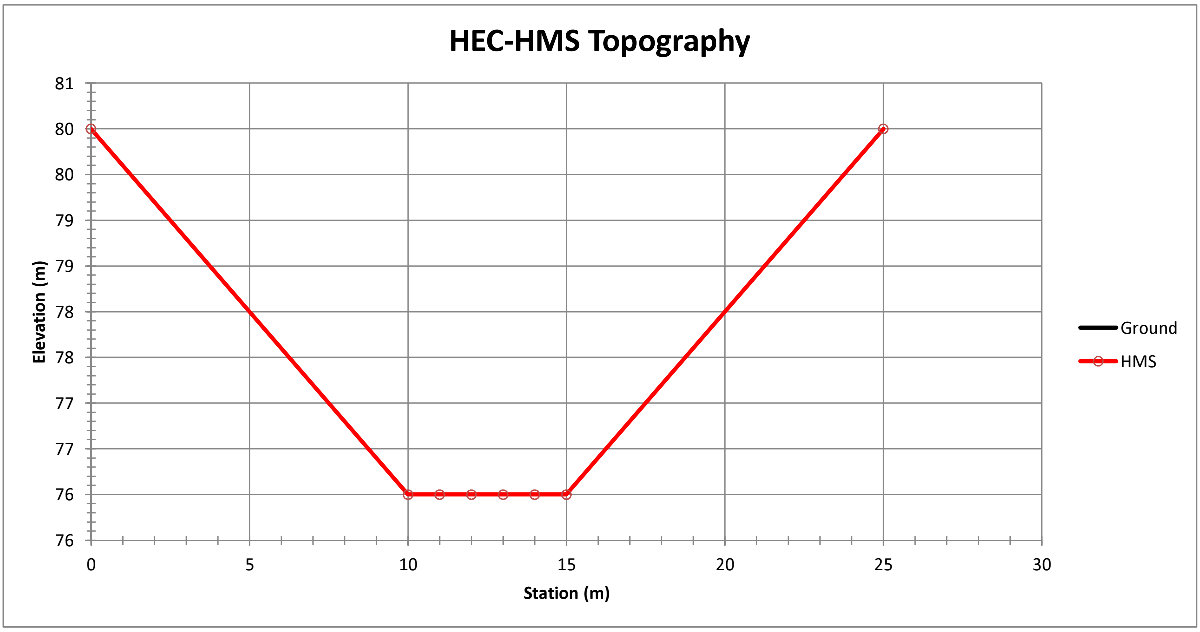
HEC-HMS Channel Topography (For DC-PL-052)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1031.713	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

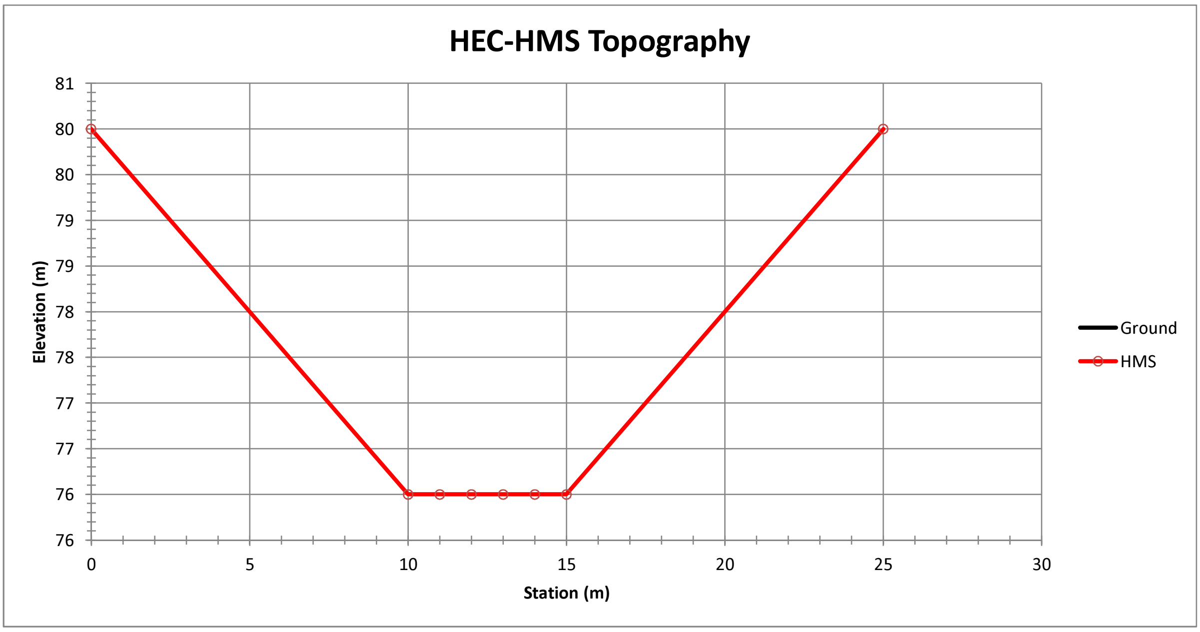
HEC-HMS Channel Topography (For DC-PL-053)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1644.206	**(m)**
Channel slope, S =	0.002	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) **Channel (TWG)** **Right Bank (ROB)**



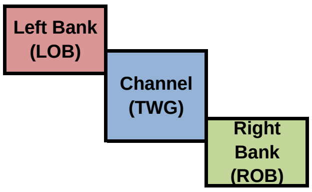
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

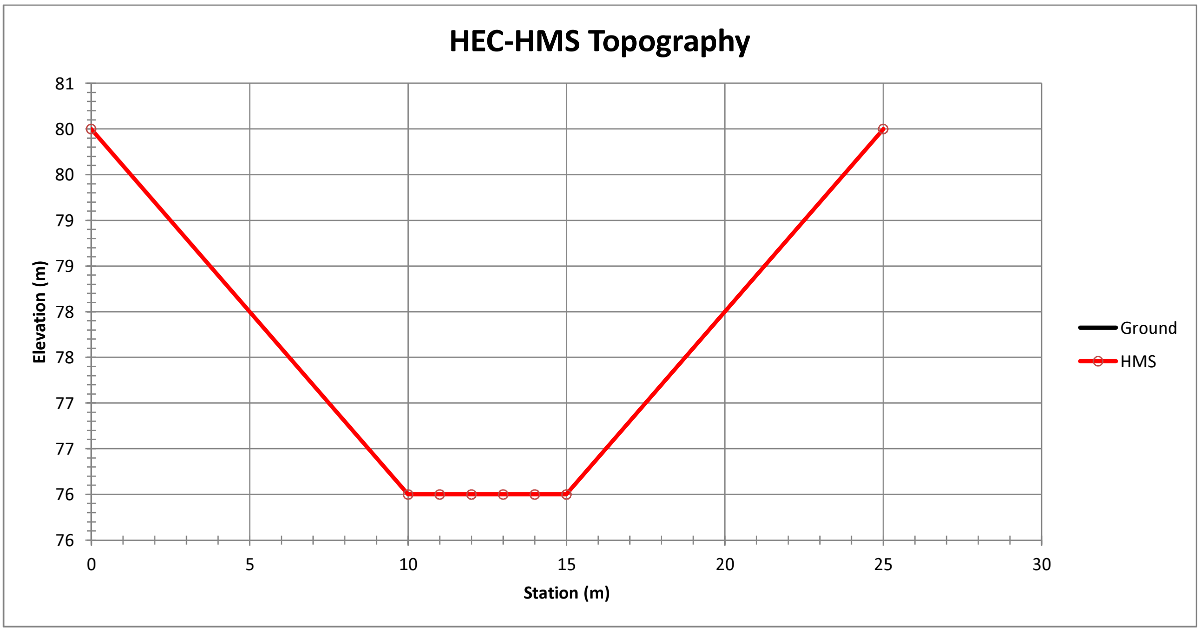
HEC-HMS Channel Topography (For DC-PL-054)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 372.875 **(m)**
Channel slope, S = 0.025 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	Elevation (m)	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	3
12.000	76.000	4
13.000	76.000	5
14.000	76.000	6
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

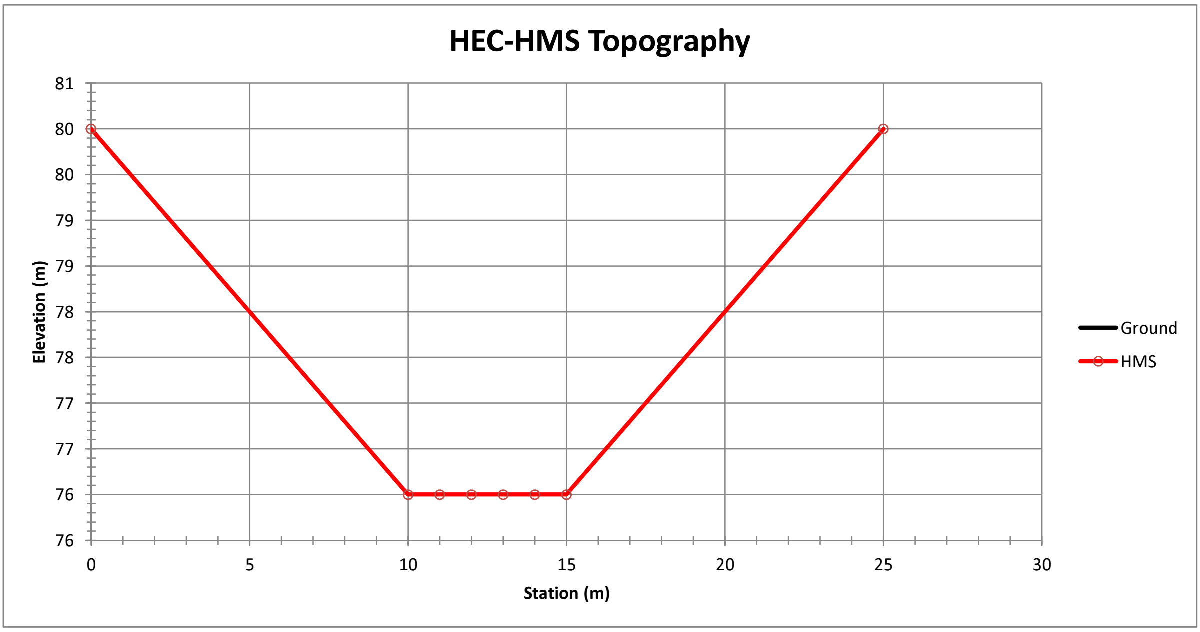
HEC-HMS Channel Topography (For DC-PL-055)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	336.284	**(m)**
Channel slope, S =	0.003	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB)
Channel (TWG)
Right Bank (ROB)



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

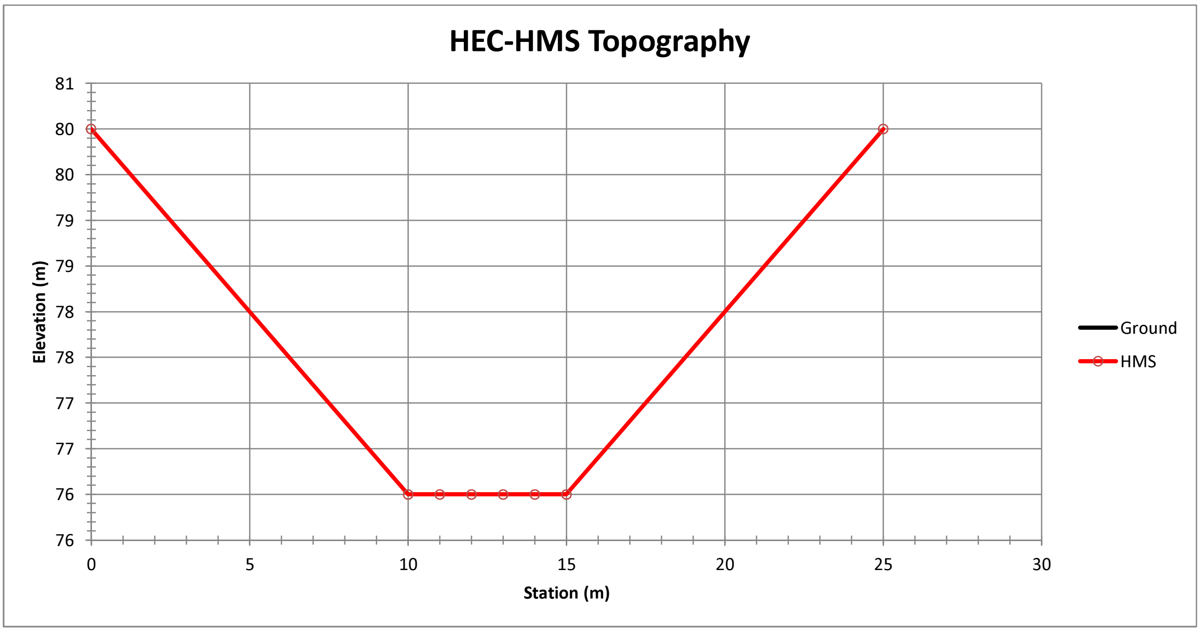
HEC-HMS Channel Topography (For DC-PL-056)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	741.107	**(m)**
Channel slope, S =	0.009	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



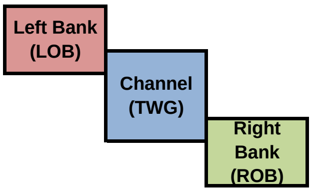
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

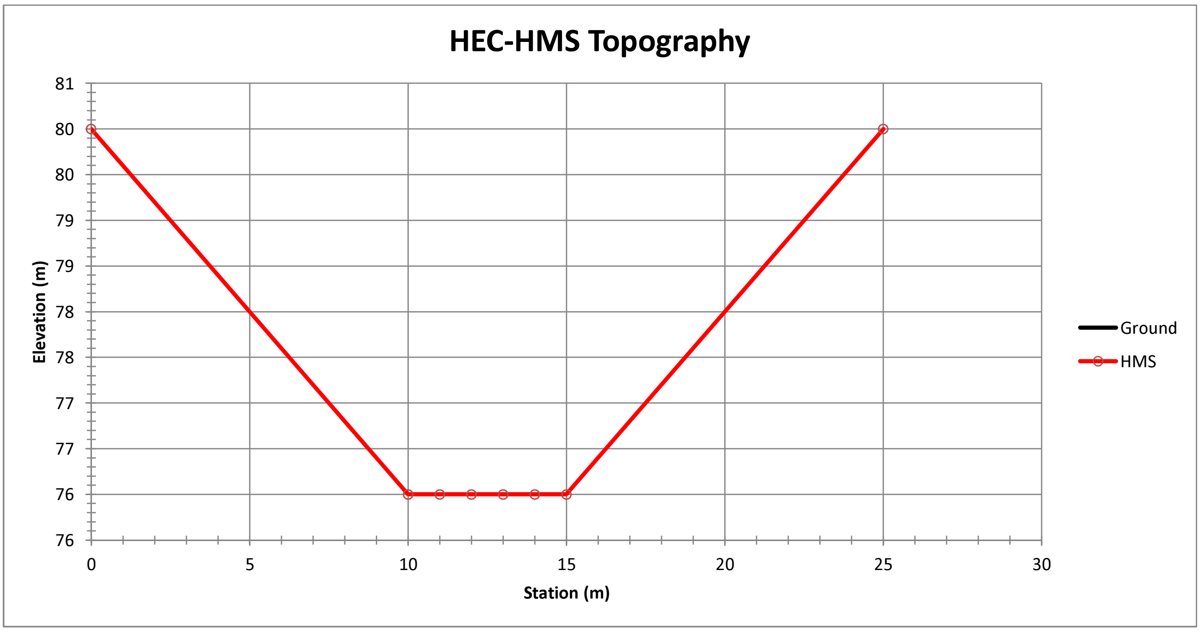
HEC-HMS Channel Topography (For DC-PL-057)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	350.183	**(m)**
Channel slope, S =	0.007	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8





Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining	Made by: AB	Job No.: PE701-00022/01
	Letpadaung	Checked	Date: 25/07/2013
	HEC-HMS XS	Approved	

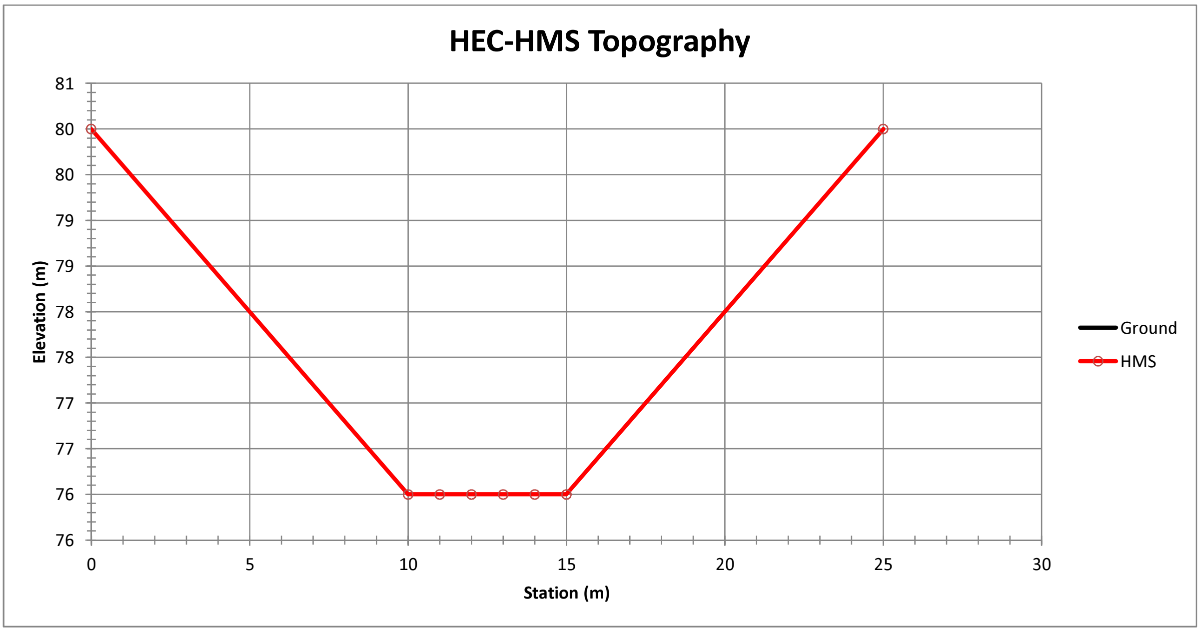
HEC-HMS Channel Topography (For DC-PL-058)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Parameter	Value	Unit
Channel length, L =	493.421	**(m)**
Channel slope, S =	0.002	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	5.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 25/07/2013
	HEC-HMS XS	Approved	

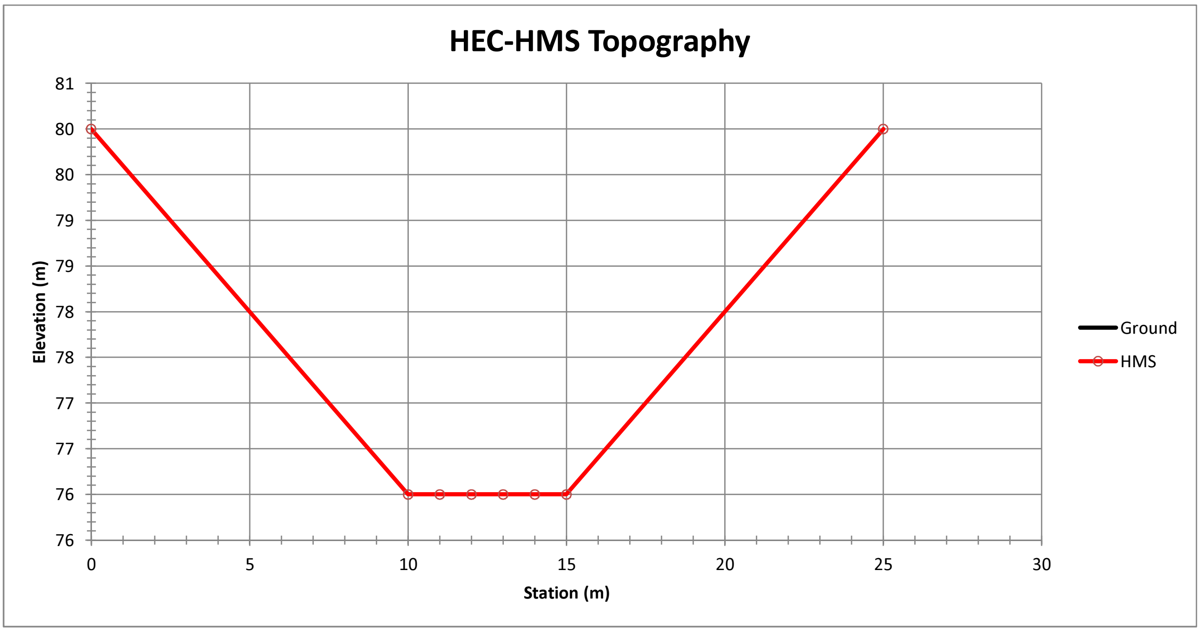
HEC-HMS Channel Topography (For DC-PL-059)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 1725.550 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 5.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
11.000	76.000	**3**
12.000	76.000	4
13.000	76.000	5
14.000	76.000	**6**
15.000	76.000	7
25.000	80.000	8

Left Bank (LOB) | **Channel (TWG)** | **Right Bank (ROB)**



Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining	Made by: AB	Job No.: PE701-00022/01
	Letpadaung	Checked	Date: 24/07/2013
	HEC-HMS XS	Approved	

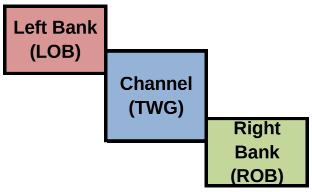
HEC-HMS Channel Topography (For NC-PL-060)

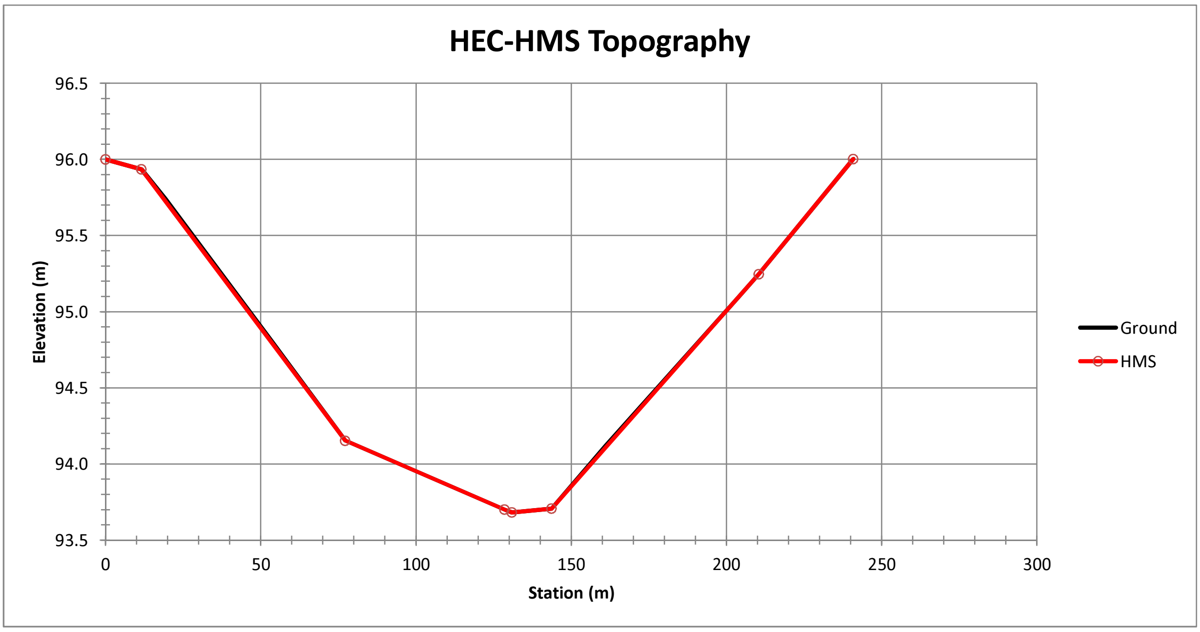
In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	1472.162	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape

Station (m)	Elevation (m)	
0.000	96.000	1
11.553	95.934	2
77.264	94.153	**3**
128.570	93.701	4
130.885	93.681	5
143.658	93.706	**6**
210.437	95.247	7
240.847	96.002	8





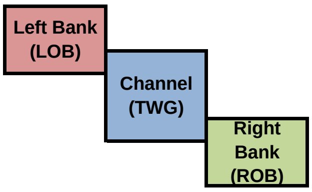
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

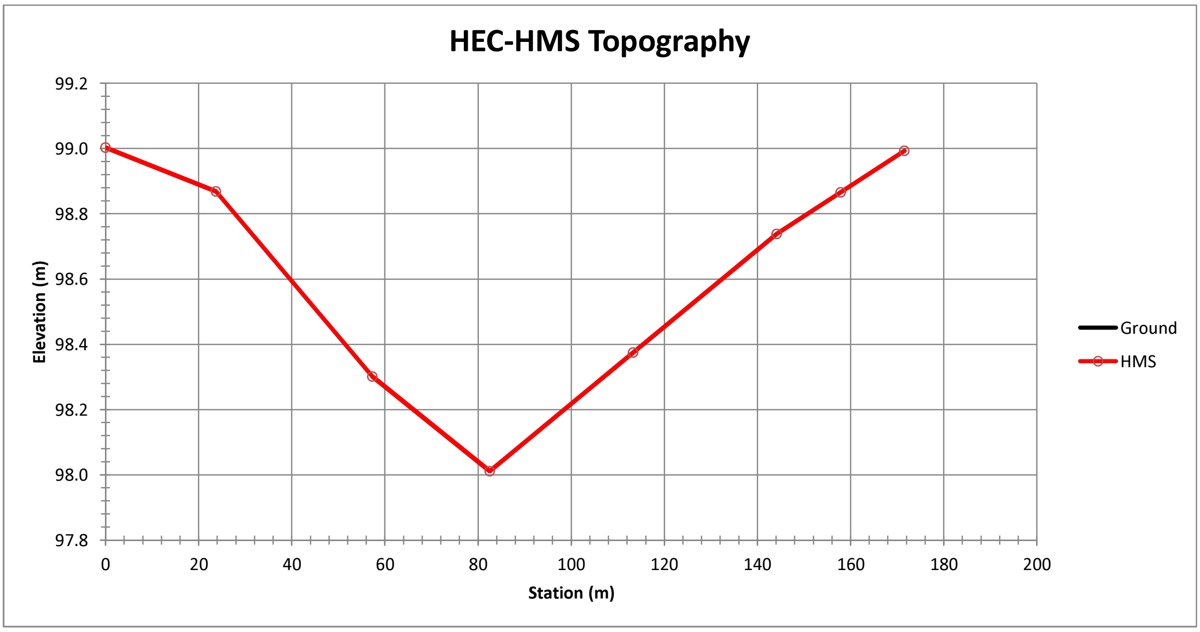
HEC-HMS Channel Topography (For NC-PL-061)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	758.839	**(m)**
Channel slope, S =	0.001	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.030	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.050	
Right bank Manning's roughness, n_{ROB} =	0.050	

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	99.003	1
23.737	98.869	2
57.306	98.301	**3**
82.515	98.011	4
113.323	98.375	5
144.130	98.738	**6**
157.861	98.866	7
171.592	98.993	8



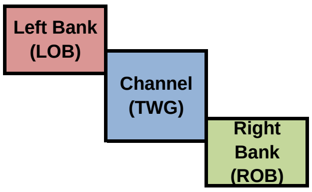


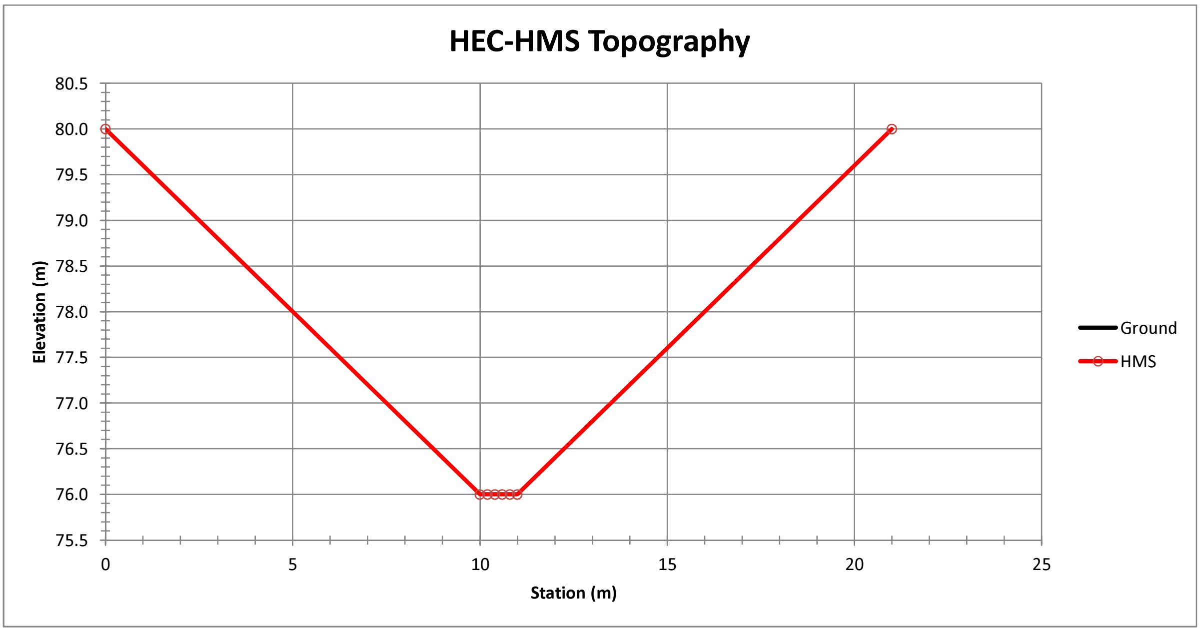
HEC-HMS Channel Topography (For DC-PL-067)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L = 1467.232 **(m)**
Channel slope, S = 0.005 **(m/m)**
Channel Manning's roughness, n_{TWG} = 0.022
Channel invert elevation, Z_o = N/A **(m)**
Channel shape = Eight-point
Left bank Manning's roughness, n_{LOB} = 0.022
Right bank Manning's roughness, n_{ROB} = 0.022
Approximate Channel Base Width = 1.0 **(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.200	76.000	3
10.400	76.000	4
10.600	76.000	5
10.800	76.000	6
11.000	76.000	7
21.000	80.000	8





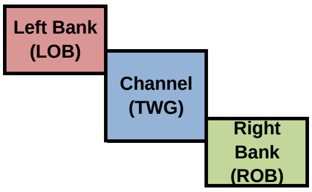
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/01
	Letpadaung	Checked	Date 24/07/2013
	HEC-HMS XS	Approved	

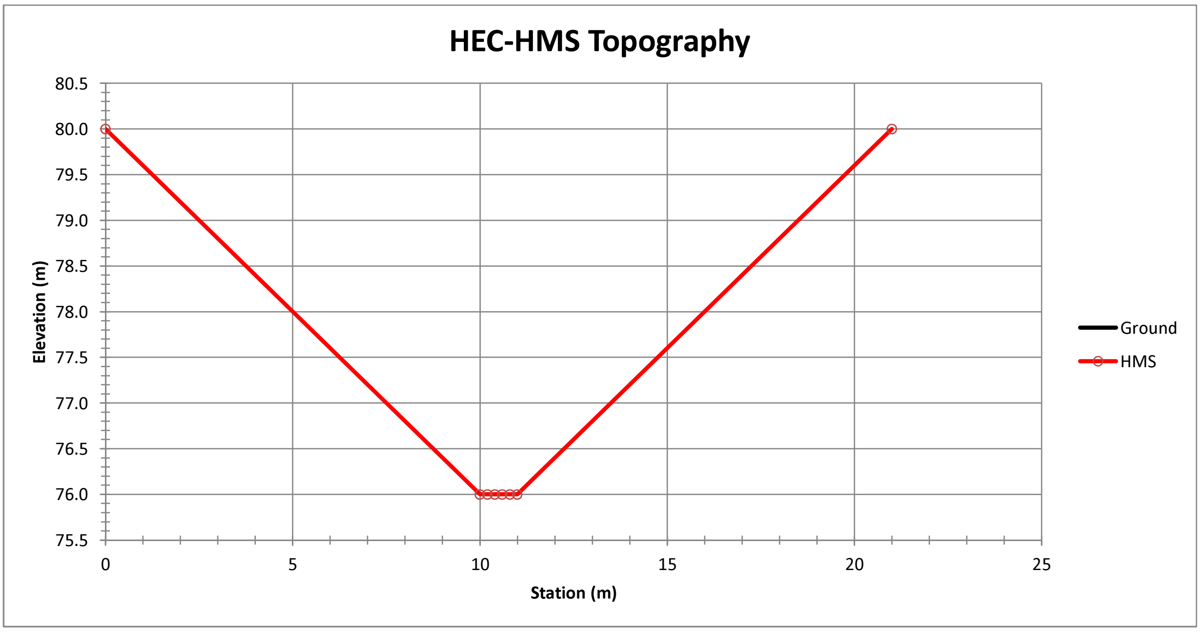
HEC-HMS Channel Topography (For DC-PL-068)

In order to create the HEC-HMS flood routing model, the Muskingum-Cunge 8-point channel routing method is used with the following geometric properties for representing the portion of the downstream channel between the indicated cross sections, assuming the upstream cross sectional shape remains constant through the channel.

Channel length, L =	696.378	**(m)**
Channel slope, S =	0.005	**(m/m)**
Channel Manning's roughness, n_{TWG} =	0.022	
Channel invert elevation, Z_o =	N/A	**(m)**
Channel shape =	Eight-point	
Left bank Manning's roughness, n_{LOB} =	0.022	
Right bank Manning's roughness, n_{ROB} =	0.022	
Approximate Channel Base Width =	1.0	**(m)**

Eight-point channel shape		
Station (m)	**Elevation (m)**	
0.000	80.000	1
10.000	76.000	2
10.200	76.000	3
10.400	76.000	4
10.600	76.000	5
10.800	76.000	6
11.000	76.000	7
21.000	80.000	8





Surface Water Existing (EX) and Planned (PL) Conditions: Estimation of precipitation hyetographs

100-year ARI storm depths of various duration were taken from the site IDF curve, which was derived using the Rainfall Ratio Method. The various storm depths were distributed using rainfall patterns established through analysis of sub-daily rainfall data.

100-yr Storm Depths

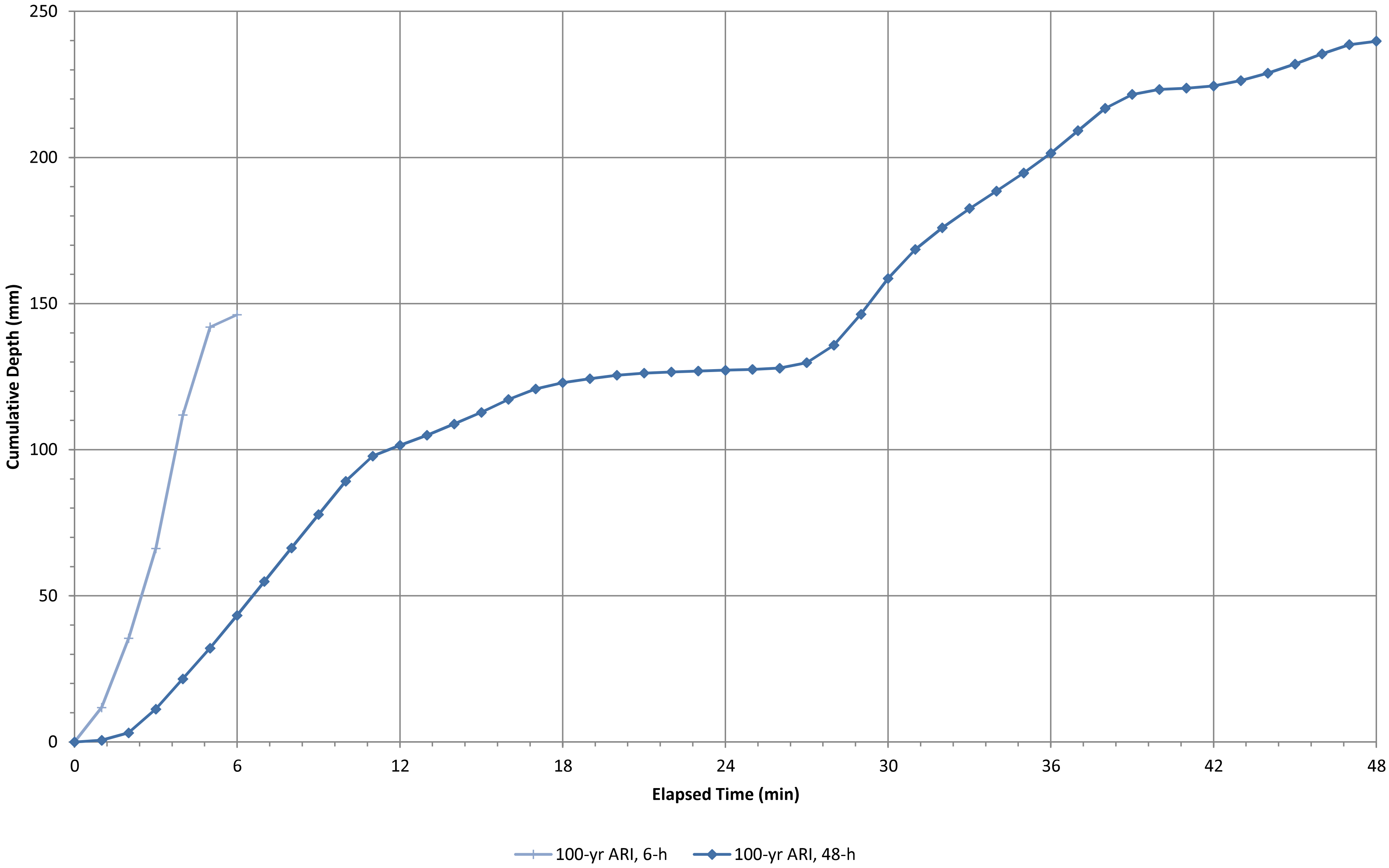
Depth (mm)	146.2	239.8
Duration (h)	6	48

6 Hour Pattern

Hour	% Cumulative Precip.	Cumulative Precip.
0	0.0%	0.0
1	8.1%	11.8
2	24.3%	35.5
3	45.3%	66.2
4	76.5%	111.8
5	97.1%	142.0
6	100.0%	146.2

48 Hour Pattern

Hour	% Cumulative Precip.	Cumulative Precip.
0	0.0%	0.0
1	0.2%	0.6
2	1.3%	3.1
3	4.7%	11.2
4	9.0%	21.6
5	13.4%	32.1
6	18.1%	43.3
7	22.9%	54.9
8	27.7%	66.4
9	32.5%	77.8
10	37.2%	89.2
11	40.8%	97.8
12	42.4%	101.6
13	43.8%	104.9
14	45.4%	108.8
15	47.0%	112.7
16	48.9%	117.2
17	50.4%	120.8
18	51.3%	123.0
19	51.8%	124.3
20	52.3%	125.5
21	52.6%	126.2
22	52.8%	126.6
23	52.9%	126.9
24	53.0%	127.2
25	53.2%	127.5
26	53.3%	127.9
27	54.1%	129.8
28	56.6%	135.8
29	61.0%	146.4
30	66.1%	158.6
31	70.3%	168.5
32	73.4%	175.9
33	76.1%	182.5
34	78.6%	188.5
35	81.2%	194.7
36	84.0%	201.4
37	87.2%	209.2
38	90.4%	216.8
39	92.4%	221.6
40	93.1%	223.3
41	93.3%	223.7
42	93.6%	224.5
43	94.4%	226.3
44	95.4%	228.8
45	96.7%	231.9
46	98.2%	235.5
47	99.5%	238.6
48	100.0%	239.8



250
200
150
100
50
0
Cumulative Depth (mm)
0
6
12
18
24
30
36
42
48
Elapsed Time (min)
100-yr ARI, 6-h
100-yr ARI, 48-h

Results comparison of design runoff under existing and planned conditions for 100 year ARI, 6 hour duration storms

The HEC-HMS models were executed with 100 year ARI, 6 hour duration storms to estimate the hydrologic response of the Letpadaung site. A summary of results at key runoff reporting points is given below.

In this scenario, all water dams were assumed to be full at the start of the simulation excluding WP-PL-005/006 and WP-PL-007. WP-PL-005/006 was assumed to be empty whilst WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6 m)

Runoff Reporting Point	Existing (EX) Conditions Results for 100 yr ARI, 6 hour storm				Runoff Reporting Point	Planned (PL) Conditions Results for 100 yr ARI, 6 hour storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
Selected Runon and Runoff Points from the Letpadaung property in the Chindwin River catchment									
WP-EX-002	13.29	52.1	1,431,800	8.53	WP-PL-002	10.53	42.4	1,127,200	7.10
CP-EX-017	4.54	24.0	480,800	7.60	CP-PL-032	6.20	26.1	666,900	7.05
WP-EX-004	0.05	0.5	6,000	4.48	WP-PL-003	0.03	0.3	3,200	4.42
CP-EX-020	23.34	161.8	2,463,800	5.45	CP-PL-023	26.00	24.4	254,300	4.23
CP-EX-033	10.43	98.4	1,088,800	4.57	CP-PL-025	25.75	22.1	227,000	4.17
{Area cut-off}	0.00	0.0	0	#N/A	CP-PL-040	23.87	0.0	0	0.00
CP-EX-044	0.69	5.1	75,100	6.00	CP-PL-065	1.71	20.2	207,300	4.02
Chindwin River	87.13	222.6	8,694,000	5.83	Chindwin River	87.72	117.3	6,264,600	6.98
Selected Runon and Runoff Points from the Letpadaung property in the Yama Stream catchment									
CP-EX-045	2.64	21.8	229,100	5.00	{Area cut-off}	0.00	0.0	0	#N/A
CP-EX-046	0.79	8.9	78,700	4.07	CP-PL-076	0.43	5.2	54,100	4.13
CP-EX-047	2.60	17.0	267,500	6.35	CP-PL-077	0.76	8.9	100,200	4.27
CP-EX-048	17.09	53.4	1,781,300	9.75	CP-PL-078	17.20	52.9	1,798,300	9.92
Yama Stream	23.12	59.1	2,356,600	5.90	Yama Stream	18.40	52.9	1,952,500	9.92

Results comparison of design runoff under existing and planned conditions for 100 year ARI, 48 hour duration storms

The HEC-HMS models were executed with 100 year ARI, 48 hour duration storms to estimate the hydrologic response of the Letpadaung site. A summary of results at key runoff reporting points is given below.

In this scenario, all water dams were assumed to be full at the start of the simulation excluding WP-PL-005/006 and WP-PL-007. WP-PL-005/006 was assumed to be empty whilst WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6 m)

Runoff Reporting Point	Existing (EX) Conditions Results for 100 yr ARI, 48 hour storm				Runoff Reporting Point	Planned (PL) Conditions Results for 100 yr ARI, 48 hour storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
Selected Runon and Runoff Points from the Letpadaung property in the Chindwin River catchment									
WP-EX-002	13.29	26.7	2,648,000	13.58	WP-PL-002	10.53	21.4	2,090,400	12.45
CP-EX-017	4.54	10.1	895,100	13.07	CP-PL-032	6.20	13.1	1,234,000	11.62
WP-EX-004	0.05	0.2	10,800	10.12	WP-PL-003	0.03	0.1	5,800	10.17
CP-EX-020	23.34	59.8	4,595,800	10.72	CP-PL-023	26.00	6.8	451,700	30.37
CP-EX-033	10.43	30.1	2,040,900	30.67	CP-PL-025	25.75	6.1	401,300	30.23
{Area cut-off}	0.00	0.0	0	#N/A	CP-PL-040	23.87	0.0	0	0.00
CP-EX-044	0.69	1.8	138,400	11.18	CP-PL-065	1.71	5.6	365,600	30.35
Chindwin River	87.13	115.9	16,277,800	38.73	Chindwin River	87.72	70.9	11,724,100	39.22
Selected Runon and Runoff Points from the Letpadaung property in the Yama Stream catchment									
CP-EX-045	2.64	7.5	462,200	30.78	{Area cut-off}	0.00	0.0	0	#N/A
CP-EX-046	0.79	2.5	149,800	30.02	CP-PL-076	0.43	1.4	94,400	30.12
CP-EX-047	2.60	6.4	503,900	11.53	CP-PL-077	0.76	2.5	171,500	30.25
CP-EX-048	17.09	31.7	3,338,800	38.63	CP-PL-078	17.20	32.0	3,366,100	38.75
Yama Stream	23.12	43.3	4,454,700	38.15	Yama Stream	18.40	34.3	3,632,000	38.25

Results comparison of design runoff under existing and planned conditions for 100 year ARI, 6 hour duration storms

The HEC-HMS models were executed with 100 year ARI, 6 hour duration storms to estimate the hydrologic response of the Letpadaung site. A summary of results at key runoff reporting points is given below.

In this scenario, all water dams were assumed full excluding WP-PL-007. WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6

Runoff Reporting Point	Existing (EX) Conditions Results for 100 yr ARI, 6 hour storm				Runoff Reporting Point	Planned (PL) Conditions Results for 100 yr ARI, 6 hour storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
Selected Runon and Runoff Points from the Letpadaung property in the Chindwin River catchment									
WP-EX-002	13.29	52.1	1,431,800	8.53	WP-PL-002	10.53	42.4	1,127,200	7.10
CP-EX-017	4.54	24.0	480,800	7.60	CP-PL-032	6.20	26.1	666,900	7.05
WP-EX-004	0.05	0.5	6,000	4.48	WP-PL-003	0.03	0.3	3,200	4.42
CP-EX-020	23.34	161.8	2,463,800	5.45	CP-PL-023	26.00	35.5	2,031,800	4.67
CP-EX-033	10.43	98.4	1,088,800	4.57	CP-PL-025	25.75	33.5	2,004,400	4.55
{Area cut-off}	0.00	0.0	0	#N/A	CP-PL-040	23.87	21.3	1,777,500	6.90
CP-EX-044	0.69	5.1	75,100	6.00	CP-PL-065	1.71	20.2	207,300	4.02
Chindwin River	87.13	222.6	8,694,000	5.83	Chindwin River	87.72	138.2	8,041,900	7.03
Selected Runon and Runoff Points from the Letpadaung property in the Yama Stream catchment									
CP-EX-045	2.64	21.8	229,100	5.00	{Area cut-off}	0.00	0.0	0	#N/A
CP-EX-046	0.79	8.9	78,700	4.07	CP-PL-076	0.43	5.2	54,100	4.13
CP-EX-047	2.60	17.0	267,500	6.35	CP-PL-077	0.76	8.9	100,200	4.27
CP-EX-048	17.09	53.4	1,781,300	9.75	CP-PL-078	17.20	52.9	1,798,300	9.92
Yama Stream	23.12	59.1	2,356,600	5.90	Yama Stream	18.40	52.9	1,952,500	9.92

Results comparison of design runoff under existing and planned conditions for 100 year ARI, 48 hour duration storms

The HEC-HMS models were executed with 100 year ARI, 48 hour duration storms to estimate the hydrologic response of the Letpadaung site. A summary of results at key runoff reporting points is given below.

In this scenario, all water dams were assumed full excluding WP-PL-007. WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6

Runoff Reporting Point	Existing (EX) Conditions Results for 100 yr ARI, 48 hour storm				Runoff Reporting Point	Planned (PL) Conditions Results for 100 yr ARI, 48 hour storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
Selected Runon and Runoff Points from the Letpadaung property in the Chindwin River catchment									
WP-EX-002	13.29	26.7	2,648,000	13.58	WP-PL-002	10.53	21.4	2,090,400	12.45
CP-EX-017	4.54	10.1	895,100	13.07	CP-PL-032	6.20	13.1	1,234,000	11.62
WP-EX-004	0.05	0.2	10,800	10.12	WP-PL-003	0.03	0.1	5,800	10.17
CP-EX-020	23.34	59.8	4,595,800	10.72	CP-PL-023	26.00	23.4	3,765,200	38.12
CP-EX-033	10.43	30.1	2,040,900	30.67	CP-PL-025	25.75	23.0	3,715,000	38.23
{Area cut-off}	0.00	0.0	0	#N/A	CP-PL-040	23.87	19.5	3,313,800	39.43
CP-EX-044	0.69	1.8	138,400	11.18	CP-PL-065	1.71	5.6	365,600	30.35
Chindwin River	87.13	115.9	16,277,800	38.73	Chindwin River	87.72	90.1	15,037,500	39.15
Selected Runon and Runoff Points from the Letpadaung property in the Yama Stream catchment									
CP-EX-045	2.64	7.5	462,200	30.78	{Area cut-off}	0.00	0.0	0	#N/A
CP-EX-046	0.79	2.5	149,800	30.02	CP-PL-076	0.43	1.4	94,400	30.12
CP-EX-047	2.60	6.4	503,900	11.53	CP-PL-077	0.76	2.5	171,500	30.25
CP-EX-048	17.09	31.7	3,338,800	38.63	CP-PL-078	17.20	32.0	3,366,100	38.75
Yama Stream	23.12	43.3	4,454,700	38.15	Yama Stream	18.40	34.3	3,632,000	38.25

Surface Water Existing (EX) Conditions: Results for estimation of design runoff

The HEC-HMS Existing Conditions model was executed with storms of various duration to estimate the hydrologic response of the Letpadaung site. A summary of results at all runoff reporting points is given below.

Runoff Reporting Point	Results for 100 yr ARI, 6 hour duration storm				Runoff Reporting Point	Results for 100 yr ARI, 48 hour duration storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
CP-EX-001	2.20	15.16	239,100	6.08	CP-EX-001	2.20	5.7	440,800	11.33
CP-EX-002	0.44	4.13	48,100	5.10	CP-EX-002	0.44	1.3	88,600	31.05
CP-EX-003	0.44	4.13	48,100	5.00	CP-EX-003	0.44	1.3	88,600	30.93
CP-EX-004	3.13	13.73	331,200	7.03	CP-EX-004	3.13	6.4	616,900	13.15
CP-EX-005	0.91	8.36	93,300	4.90	CP-EX-005	0.91	2.7	175,800	30.80
CP-EX-006	0.00	0.00	0	0.00	CP-EX-006	0.00	0.0	0	0.00
CP-EX-007	40.67	19.27	3,757,600	7.83	CP-EX-007	40.67	29.0	7,094,400	48.63
CP-EX-008	37.95	16.51	3,464,600	16.37	CP-EX-008	37.95	27.0	6,554,200	49.20
CP-EX-009	37.95	16.51	3,465,700	16.22	CP-EX-009	37.95	27.0	6,556,300	49.08
CP-EX-010A	3.67	25.61	398,300	6.22	CP-EX-010A	3.67	9.6	734,400	11.37
CP-EX-010B	21.29	80.32	2,251,700	9.13	CP-EX-010B	21.29	40.8	4,195,600	14.27
CP-EX-010C	10.54	56.76	1,070,700	7.12	CP-EX-010C	10.54	23.7	2,027,800	12.28
CP-EX-010D	1.35	15.41	146,000	4.13	CP-EX-010D	1.35	4.4	269,300	30.08
CP-EX-011	41.13	184.28	4,366,200	5.72	CP-EX-011	41.13	85.1	8,125,700	11.62
CP-EX-012	41.13	184.29	4,366,200	5.70	CP-EX-012	41.13	85.1	8,125,700	11.60
CP-EX-013	17.80	70.01	1,902,400	8.90	CP-EX-013	17.80	35.5	3,529,900	14.13
CP-EX-014	13.29	52.01	1,431,600	8.80	CP-EX-014	13.29	26.7	2,647,800	13.93
CP-EX-015	13.29	52.10	1,431,800	8.53	CP-EX-015	13.29	26.7	2,648,000	13.58
CP-EX-016A	0.33	3.66	35,600	4.23	CP-EX-016A	0.33	1.1	66,000	30.17
CP-EX-016B	4.09	30.30	444,600	5.98	CP-EX-016B	4.09	10.9	819,800	11.17
CP-EX-016C	8.69	45.59	932,100	7.77	CP-EX-016C	8.69	19.4	1,727,500	13.03
CP-EX-016D	0.11	1.19	11,800	4.28	CP-EX-016D	0.11	0.4	21,800	30.22
CP-EX-017	4.54	24.01	480,800	7.60	CP-EX-017	4.54	10.1	895,100	13.07
CP-EX-018	4.54	24.02	480,800	7.38	CP-EX-018	4.54	10.1	895,100	12.77
CP-EX-019	4.51	31.19	477,300	6.20	CP-EX-019	4.51	11.5	889,400	11.37
CP-EX-020	23.34	161.80	2,463,800	5.45	CP-EX-020	23.34	59.8	4,595,800	10.72
CP-EX-021	8.10	55.13	853,300	6.07	CP-EX-021	8.10	20.5	1,592,600	11.47
CP-EX-022	0.05	0.49	6,000	4.55	CP-EX-022	0.05	0.2	10,800	10.22
CP-EX-023	0.05	0.49	6,000	4.48	CP-EX-023	0.05	0.2	10,800	10.12
CP-EX-024	0.05	0.54	5,100	4.07	CP-EX-024	0.05	0.2	9,300	30.03
CP-EX-025	8.05	54.69	847,300	5.85	CP-EX-025	8.05	20.3	1,581,700	11.32
CP-EX-026	2.68	22.62	287,700	5.53	CP-EX-026	2.68	7.4	532,700	31.63
CP-EX-027	0.67	6.10	72,800	5.22	CP-EX-027	0.67	1.9	134,500	31.38
CP-EX-028	0.67	6.10	72,800	5.20	CP-EX-028	0.67	1.9	134,500	31.35
CP-EX-029	0.66	6.33	70,600	4.78	CP-EX-029	0.66	2.0	130,900	30.70
CP-EX-030	4.35	26.06	449,200	6.20	CP-EX-030	4.35	10.5	845,300	11.25
CP-EX-031	4.35	26.07	449,300	6.13	CP-EX-031	4.35	10.5	845,300	11.17
CP-EX-032	13.24	106.89	1,394,500	4.67	CP-EX-032	13.24	35.1	2,604,600	10.45
CP-EX-033	10.43	98.38	1,088,800	4.57	CP-EX-033	10.43	30.1	2,040,900	30.67
CP-EX-034	6.91	68.30	713,700	4.45	CP-EX-034	6.91	20.7	1,343,800	30.50
CP-EX-035	2.22	21.94	230,600	4.43	CP-EX-035	2.22	6.8	432,800	30.35
CP-EX-036	4.69	46.74	483,500	4.32	CP-EX-036	4.69	14.0	911,100	30.33
CP-EX-037	1.09	7.99	117,700	5.78	CP-EX-037	1.09	2.9	217,200	11.00
CP-EX-038	2.65	26.29	274,400	4.47	CP-EX-038	2.65	8.0	517,000	30.55
CP-EX-039	2.65	26.73	274,800	4.25	CP-EX-039	2.65	8.1	517,000	30.20
CP-EX-040	0.69	5.08	75,000	6.18	CP-EX-040	0.69	1.8	138,400	11.40
CP-EX-041	0.69	5.09	75,100	6.15	CP-EX-041	0.69	1.8	138,400	11.35
CP-EX-042	0.87	9.49	92,100	4.42	CP-EX-042	0.87	2.8	171,900	30.42
CP-EX-043	0.87	9.78	92,400	4.17	CP-EX-043	0.87	2.8	172,100	30.10
CP-EX-044	0.69	5.10	75,100	6.00	CP-EX-044	0.69	1.8	138,400	11.18
CP-EX-045	2.64	21.83	229,100	5.00	CP-EX-045	2.64	7.5	462,200	30.78
CP-EX-046	0.79	8.86	78,700	4.07	CP-EX-046	0.79	2.5	149,800	30.02
CP-EX-047	2.60	17.02	267,500	6.35	CP-EX-047	2.60	6.4	503,900	11.53
CP-EX-048	17.09	53.37	1,781,300	9.75	CP-EX-048	17.09	31.7	3,338,800	38.63
CP-EX-049	14.64	48.38	1,515,400	10.08	CP-EX-049	14.64	27.1	2,848,500	38.33
CP-EX-050	14.64	48.38	1,515,400	9.95	CP-EX-050	14.64	27.1	2,848,500	38.20

Surface Water Existing (EX) Conditions: Results for estimation of design runoff

CP-EX-051	14.64	48.38	1,515,400	9.87	CP-EX-051	14.64	27.1	2,848,500	38.10
CP-EX-052	14.19	48.38	1,466,000	9.82	CP-EX-052	14.19	26.2	2,757,500	38.05
CP-EX-053	13.95	48.70	1,436,800	9.47	CP-EX-053	13.95	25.7	2,706,100	37.93
WP-EX-001	37.95	16.51	3,465,700	16.22	WP-EX-001	37.95	27.0	6,556,300	49.08
WP-EX-002	13.29	52.10	1,431,800	8.53	WP-EX-002	13.29	26.7	2,648,000	13.58
WP-EX-003	4.54	24.02	480,800	7.38	WP-EX-003	4.54	10.1	895,100	12.77
WP-EX-004	0.05	0.49	6,000	4.48	WP-EX-004	0.05	0.2	10,800	10.12
WP-EX-005	0.67	6.10	72,800	5.20	WP-EX-005	0.67	1.9	134,500	31.35
WP-EX-006	14.19	48.38	1,466,000	9.82	WP-EX-006	14.19	26.2	2,757,500	38.05
Chindwin River	87.13	222.56	8,694,000	5.83	Chindwin River	87.13	115.9	16,277,800	38.73
Yama Stream	23.12	59.11	2,356,600	5.90	Yama Stream	23.12	43.3	4,454,700	38.15

Surface Water Planned (PL) Conditions: Results for estimation of design runoff

The HEC-HMS Planned Conditions model was executed with storms of various duration to estimate the hydrologic response of the Letpadaung site. A summary of results at all runoff reporting points is given below.

All water dams were assumed full excluding WP-PL-005/006 and WP-PL-007. WP-PL-005/006 was assumed to be empty whilst WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6 m)

Runoff Reporting Point	Results for 100 yr ARI, 6 hour duration storm				Runoff Reporting Point	Results for 100 yr ARI, 48 hour duration storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
CP-PL-001	2.20	15.16	239,100	6.08	CP-PL-001	2.20	5.7	440,800	11.33
CP-PL-002	0.44	4.13	48,100	5.10	CP-PL-002	0.44	1.3	88,600	31.05
CP-PL-003	0.44	4.13	48,100	5.00	CP-PL-003	0.44	1.3	88,600	30.93
CP-PL-004	3.13	13.73	331,200	7.03	CP-PL-004	3.13	6.4	616,900	13.15
CP-PL-005	0.91	8.36	93,300	4.90	CP-PL-005	0.91	2.7	175,800	30.80
CP-PL-006	0.00	0.00	0	0.00	CP-PL-006	0.00	0.0	0	0.00
CP-PL-007	40.67	19.27	3,757,500	7.83	CP-PL-007	40.67	29.0	7,094,300	48.63
CP-PL-008	37.95	16.51	3,464,600	16.37	CP-PL-008	37.95	27.0	6,554,200	49.20
CP-PL-009	37.95	16.51	3,465,700	16.22	CP-PL-009	37.95	27.0	6,556,200	49.08
CP-PL-010A	3.67	25.61	398,300	6.22	CP-PL-010A	3.67	9.6	734,400	11.37
CP-PL-010B	21.29	80.32	2,251,700	9.13	CP-PL-010B	21.29	40.8	4,195,500	14.27
CP-PL-010C	10.54	56.76	1,070,700	7.12	CP-PL-010C	10.54	23.7	2,027,700	12.28
CP-PL-010D	1.35	15.41	146,000	4.13	CP-PL-010D	1.35	4.4	269,300	30.08
CP-PL-011	41.72	72.08	1,936,800	7.12	CP-PL-011	41.72	35.8	3,572,100	12.18
CP-PL-012	41.72	72.08	1,936,800	7.10	CP-PL-012	41.72	35.8	3,572,100	12.17
CP-PL-013	15.01	66.12	1,604,900	7.25	CP-PL-013	15.01	30.9	2,977,500	12.93
CP-PL-014	10.53	42.28	1,126,900	7.38	CP-PL-014	10.53	21.4	2,090,100	12.80
CP-PL-015	10.53	42.37	1,127,200	7.10	CP-PL-015	10.53	21.4	2,090,400	12.45
CP-PL-016A	0.33	3.66	35,600	4.23	CP-PL-016A	0.33	1.1	66,000	30.17
CP-PL-016B	10.06	56.83	1,074,600	5.72	CP-PL-016B	10.06	22.9	1,994,600	11.35
CP-PL-016C	0.08	0.93	9,200	4.27	CP-PL-016C	0.08	0.3	16,900	30.20
CP-PL-017	10.06	56.84	1,074,600	5.58	CP-PL-017	10.06	22.9	1,994,600	11.18
CP-PL-018	8.61	44.74	922,800	5.65	CP-PL-018	8.61	19.1	1,710,100	11.25
CP-PL-019	26.71	26.58	331,900	4.32	CP-PL-019	26.71	8.0	594,600	10.12
CP-PL-020	26.71	26.59	331,900	4.30	CP-PL-020	26.71	8.0	594,600	10.08
CP-PL-021	0.03	0.26	3,200	4.42	CP-PL-021	0.03	0.1	5,800	10.17
CP-PL-022	0.02	0.25	2,300	4.05	CP-PL-022	0.02	0.1	4,300	30.02
CP-PL-023	26.00	24.40	254,300	4.23	CP-PL-023	26.00	6.8	451,700	30.37
CP-PL-024	25.85	23.04	237,400	4.20	CP-PL-024	25.85	6.3	420,400	30.28
CP-PL-025	25.75	22.13	227,000	4.17	CP-PL-025	25.75	6.1	401,300	30.23
CP-PL-026	2.80	25.00	305,400	4.95	CP-PL-026	2.80	7.9	562,400	31.18
CP-PL-027	2.77	24.75	301,300	4.87	CP-PL-027	2.77	7.9	555,400	31.07
CP-PL-028	2.70	24.17	292,000	4.75	CP-PL-028	2.70	7.7	539,500	31.00
CP-PL-029	2.61	23.41	279,900	4.60	CP-PL-029	2.61	7.4	518,700	30.80
CP-PL-030	2.39	21.38	256,300	4.60	CP-PL-030	2.39	6.8	475,200	30.77
CP-PL-031	0.80	9.03	85,700	4.15	CP-PL-031	0.80	2.6	158,800	30.10
CP-PL-032	6.20	26.07	666,900	7.05	CP-PL-032	6.20	13.1	1,234,000	11.62
CP-PL-033	6.20	26.07	666,900	6.92	CP-PL-033	6.20	13.1	1,234,000	11.47
CP-PL-034	4.54	23.95	480,800	7.40	CP-PL-034	4.54	10.1	895,100	12.78
CP-PL-035	4.51	31.08	477,300	6.22	CP-PL-035	4.51	11.5	889,400	11.38
CP-PL-036	1.06	9.30	113,300	5.42	CP-PL-036	1.06	3.0	210,200	31.45
CP-PL-037	1.06	9.30	113,300	5.38	CP-PL-037	1.06	3.0	210,200	31.40
CP-PL-038	1.06	9.33	113,400	5.27	CP-PL-038	1.06	3.0	210,200	31.23
CP-PL-039	25.58	20.20	207,300	4.15	CP-PL-039	25.58	5.6	365,600	30.52
CP-PL-040	23.87	0.00	0	0.00	CP-PL-040	23.87	0.0	0	0.00
CP-PL-041A	10.65	10.75	147,500	4.87	CP-PL-041A	10.65	6.4	475,000	47.55
CP-PL-041B	5.61	58.44	695,700	4.08	CP-PL-041B	5.61	16.2	1,216,900	30.13
CP-PL-041C	3.34	41.21	432,000	4.10	CP-PL-041C	3.34	11.2	744,200	30.17
CP-PL-042A	0.63	5.89	82,800	5.37	CP-PL-042A	0.63	1.9	141,700	10.32
CP-PL-042B	9.53	0.00	0	0.00	CP-PL-042B	9.53	5.5	222,600	47.62
CP-PL-042C	0.49	5.46	64,700	4.50	CP-PL-042C	0.49	1.6	110,700	30.48
CP-PL-043A	4.38	50.89	458,500	4.20	CP-PL-043A	4.38	14.3	857,900	30.25
CP-PL-043B	4.43	51.42	463,500	4.18	CP-PL-043B	4.43	14.4	867,300	30.22

Surface Water Planned (PL) Conditions: Results for estimation of design runoff

CP-PL-044	4.38	50.95	458,500	4.03	CP-PL-044	4.38	14.3	857,900	30.00
CP-PL-045	4.43	51.45	463,500	4.03	CP-PL-045	4.43	14.5	867,300	30.00
CP-PL-046	0.78	9.82	102,700	4.00	CP-PL-046	0.78	2.6	175,800	30.00
CP-PL-047	4.83	48.77	593,200	4.07	CP-PL-047	4.83	13.6	1,041,200	30.10
CP-PL-048	4.83	48.87	593,200	4.02	CP-PL-048	4.83	13.6	1,041,200	30.02
CP-PL-049	4.20	41.46	511,500	4.13	CP-PL-049	4.20	11.6	901,300	30.13
CP-PL-050	3.38	32.05	424,000	4.13	CP-PL-050	3.38	9.2	738,800	10.13
CP-PL-051	3.38	32.23	424,400	4.08	CP-PL-051	3.38	9.2	738,900	10.07
CP-PL-052	2.89	26.38	365,300	4.13	CP-PL-052	2.89	7.8	633,900	10.13
CP-PL-053	2.77	25.18	354,200	4.13	CP-PL-053	2.77	7.5	612,300	10.17
CP-PL-054	2.77	25.29	354,200	4.02	CP-PL-054	2.77	7.5	612,300	10.02
CP-PL-055	1.10	6.13	145,300	5.17	CP-PL-055	1.10	2.4	248,100	11.08
CP-PL-056A	0.46	5.76	60,100	4.10	CP-PL-056A	0.46	1.5	102,900	30.13
CP-PL-056B	0.54	6.80	71,100	4.00	CP-PL-056B	0.54	1.8	121,800	30.00
CP-PL-057	0.46	5.76	60,100	4.00	CP-PL-057	0.46	1.5	102,900	30.00
CP-PL-058	1.67	20.75	208,900	4.00	CP-PL-058	1.67	5.6	364,200	30.00
CP-PL-059	0.59	7.45	77,900	4.00	CP-PL-059	0.59	2.0	133,300	30.00
CP-PL-060	1.82	22.90	239,100	4.00	CP-PL-060	1.82	6.2	409,200	30.00
CP-PL-061	0.38	4.30	45,000	4.27	CP-PL-061	0.38	1.2	80,000	30.22
CP-PL-062	1.14	14.16	148,100	4.08	CP-PL-062	1.14	3.8	255,000	30.22
CP-PL-063	1.14	14.29	149,200	4.00	CP-PL-063	1.14	3.8	255,500	30.00
CP-PL-064	0.39	4.86	50,700	4.00	CP-PL-064	0.39	1.3	86,800	30.00
CP-PL-065	1.71	20.25	207,300	4.02	CP-PL-065	1.71	5.6	365,600	30.35
CP-PL-066	1.53	18.37	183,900	4.25	CP-PL-066	1.53	5.1	325,700	30.35
CP-PL-067	0.19	2.39	25,000	4.00	CP-PL-067	0.19	0.6	42,900	30.00
CP-PL-068	1.34	16.00	159,100	4.18	CP-PL-068	1.34	4.4	282,900	30.23
CP-PL-069	1.23	14.73	144,000	4.03	CP-PL-069	1.23	4.1	257,000	30.02
CP-PL-070	0.77	8.98	83,700	4.05	CP-PL-070	0.77	2.5	153,700	30.02
CP-PL-071	0.63	7.32	67,200	4.05	CP-PL-071	0.63	2.0	124,500	30.07
CP-PL-072	0.63	7.32	67,200	4.00	CP-PL-072	0.63	2.0	124,500	30.00
CP-PL-073	0.35	4.05	38,000	4.05	CP-PL-073	0.35	1.1	69,700	30.02
CP-PL-074	0.16	2.02	21,100	4.13	CP-PL-074	0.16	0.5	36,200	30.23
CP-PL-075	0.16	2.02	21,100	4.00	CP-PL-075	0.16	0.5	36,200	30.00
CP-PL-076	0.43	5.19	54,100	4.13	CP-PL-076	0.43	1.4	94,400	30.12
CP-PL-077	0.76	8.94	100,200	4.27	CP-PL-077	0.76	2.5	171,500	30.25
CP-PL-078	17.20	52.91	1,798,300	9.92	CP-PL-078	17.20	32.0	3,366,100	38.75
CP-PL-079	14.68	48.30	1,518,800	10.22	CP-PL-079	14.68	27.2	2,855,300	38.40
CP-PL-080	14.68	48.38	1,519,100	9.95	CP-PL-080	14.68	27.2	2,855,400	38.20
CP-PL-081	14.68	48.39	1,519,100	9.87	CP-PL-081	14.68	27.2	2,855,400	38.10
CP-PL-082	14.19	48.38	1,466,000	9.82	CP-PL-082	14.19	26.2	2,757,500	38.05
CP-PL-083	13.95	48.70	1,436,800	9.47	CP-PL-083	13.95	25.7	2,706,200	37.93
WP-PL-001	37.95	16.51	3,465,700	16.22	WP-PL-001	37.95	27.0	6,556,200	49.08
WP-PL-002	10.53	42.37	1,127,200	7.10	WP-PL-002	10.53	21.4	2,090,400	12.45
WP-PL-003	0.03	0.26	3,200	4.42	WP-PL-003	0.03	0.1	5,800	10.17
WP-PL-004	4.54	23.95	480,800	7.40	WP-PL-004	4.54	10.1	895,100	12.78
WP-PL-005/006	23.87	0.00	0	0.00	WP-PL-005/006	23.87	0.0	0	0.00
WP-PL-007	9.53	0.00	0	0.00	WP-PL-007	9.53	5.5	222,600	47.62
WP-PL-008	1.10	6.13	145,300	5.17	WP-PL-008	1.10	2.4	248,100	11.08
WP-PL-009	14.19	48.38	1,466,000	9.82	WP-PL-009	14.19	26.2	2,757,500	38.05
Chindwin River	87.72	117.28	6,264,600	6.98	Chindwin River	87.72	70.9	11,724,100	39.22
Yama Stream	18.40	52.91	1,952,500	9.92	Yama Stream	18.40	34.3	3,632,000	38.25

Surface Water Planned (PL) Conditions: Results for estimation of design runoff

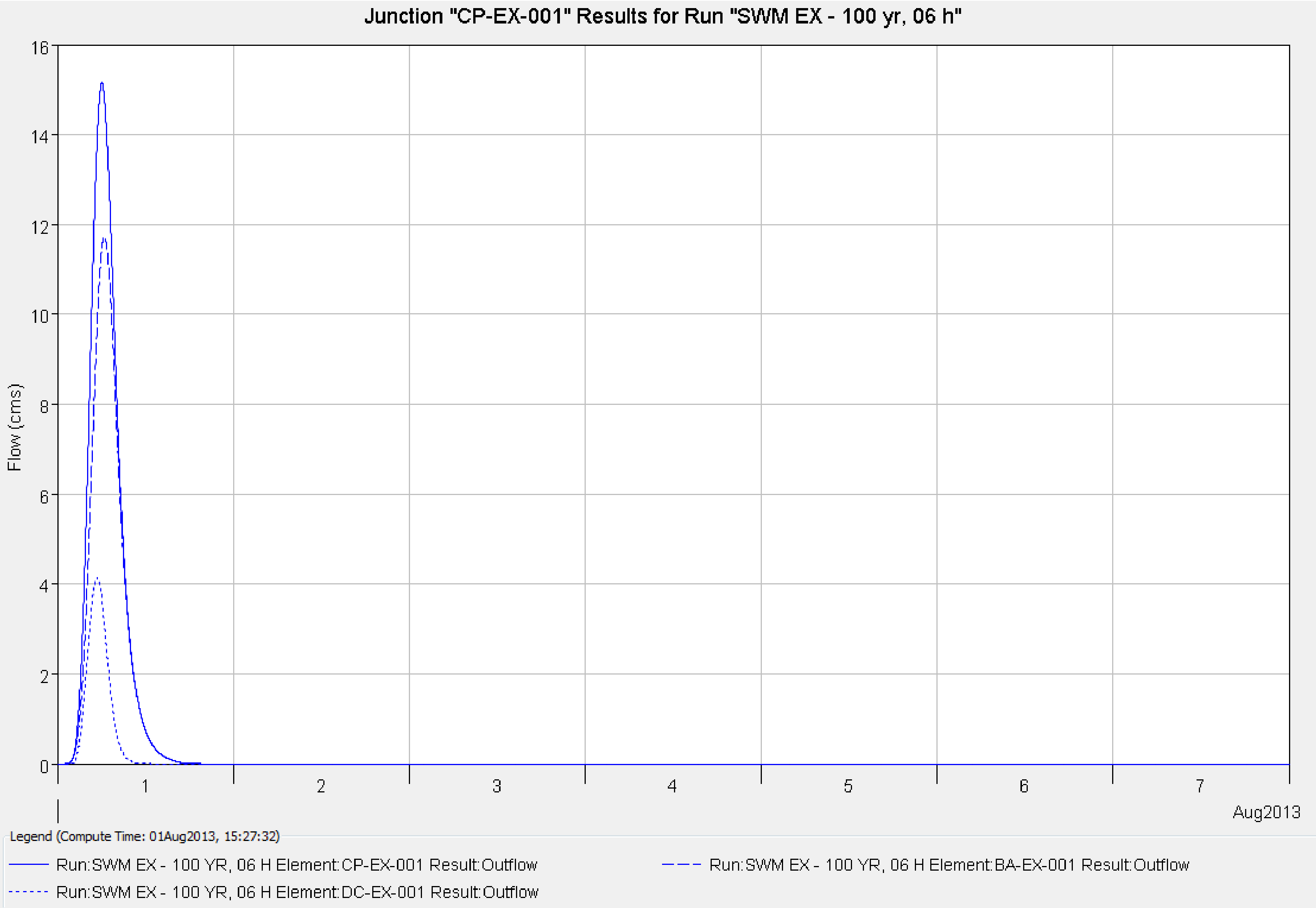
The HEC-HMS Planned Conditions model was executed with storms of various duration to estimate the hydrologic response of the Letpadaung site. A summary of results at all runoff reporting points is given below.

All water dams were assumed full excluding WP-PL-007. WP-PL-007 was assumed to have 620,000 m3 of water currently in it (or a water level of 75.6 m)

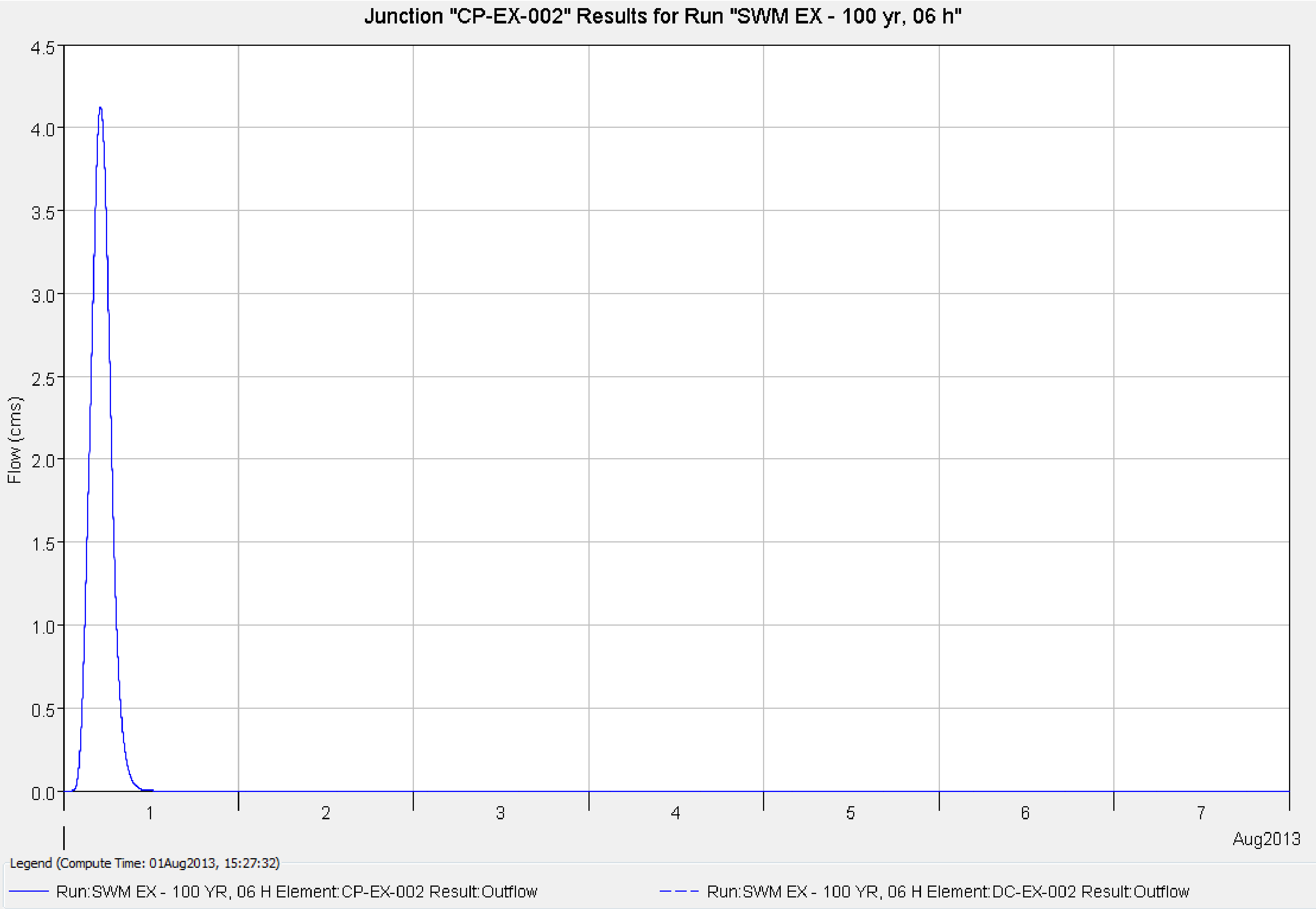
Runoff Reporting Point	Results for 100 yr ARI, 6 hour duration storm				Runoff Reporting Point	Results for 100 yr ARI, 48 hour duration storm			
	Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)		Drainage Area (km^2)	Peak Runoff Rate (m^3/s)	Total Runoff Volume (m^3)	Time to Peak Runoff Rate (h)
CP-PL-001	2.20	15.16	239,100	6.08	CP-PL-001	2.20	5.7	440,800	11.33
CP-PL-002	0.44	4.13	48,100	5.10	CP-PL-002	0.44	1.3	88,600	31.05
CP-PL-003	0.44	4.13	48,100	5.00	CP-PL-003	0.44	1.3	88,600	30.93
CP-PL-004	3.13	13.73	331,200	7.03	CP-PL-004	3.13	6.4	616,900	13.15
CP-PL-005	0.91	8.36	93,300	4.90	CP-PL-005	0.91	2.7	175,800	30.80
CP-PL-006	0.00	0.00	0	0.00	CP-PL-006	0.00	0.0	0	0.00
CP-PL-007	40.67	19.27	3,757,500	7.83	CP-PL-007	40.67	29.0	7,094,300	48.63
CP-PL-008	37.95	16.51	3,464,600	16.37	CP-PL-008	37.95	27.0	6,554,200	49.20
CP-PL-009	37.95	16.51	3,465,700	16.22	CP-PL-009	37.95	27.0	6,556,200	49.08
CP-PL-010A	3.67	25.61	398,300	6.22	CP-PL-010A	3.67	9.6	734,400	11.37
CP-PL-010B	21.29	80.32	2,251,700	9.13	CP-PL-010B	21.29	40.8	4,195,500	14.27
CP-PL-010C	10.54	56.76	1,070,700	7.12	CP-PL-010C	10.54	23.7	2,027,700	12.28
CP-PL-010D	1.35	15.41	146,000	4.13	CP-PL-010D	1.35	4.4	269,300	30.08
CP-PL-011	41.72	93.02	3,714,200	7.12	CP-PL-011	41.72	53.1	6,885,500	38.98
CP-PL-012	41.72	93.02	3,714,200	7.10	CP-PL-012	41.72	53.1	6,885,500	38.97
CP-PL-013	15.01	66.12	1,604,900	7.25	CP-PL-013	15.01	30.9	2,977,500	12.93
CP-PL-014	10.53	42.28	1,126,900	7.38	CP-PL-014	10.53	21.4	2,090,100	12.80
CP-PL-015	10.53	42.37	1,127,200	7.10	CP-PL-015	10.53	21.4	2,090,400	12.45
CP-PL-016A	0.33	3.66	35,600	4.23	CP-PL-016A	0.33	1.1	66,000	30.17
CP-PL-016B	10.06	56.83	1,074,600	5.72	CP-PL-016B	10.06	22.9	1,994,600	11.35
CP-PL-016C	0.08	0.93	9,200	4.27	CP-PL-016C	0.08	0.3	16,900	30.20
CP-PL-017	10.06	56.84	1,074,600	5.58	CP-PL-017	10.06	22.9	1,994,600	11.18
CP-PL-018	8.61	44.74	922,800	5.65	CP-PL-018	8.61	19.1	1,710,100	11.25
CP-PL-019	26.71	38.45	2,109,300	4.73	CP-PL-019	26.71	24.7	3,908,100	38.15
CP-PL-020	26.71	38.46	2,109,300	4.72	CP-PL-020	26.71	24.7	3,908,100	38.13
CP-PL-021	0.03	0.26	3,200	4.42	CP-PL-021	0.03	0.1	5,800	10.17
CP-PL-022	0.02	0.25	2,300	4.05	CP-PL-022	0.02	0.1	4,300	30.02
CP-PL-023	26.00	35.53	2,031,800	4.67	CP-PL-023	26.00	23.4	3,765,200	38.12
CP-PL-024	25.85	34.29	2,014,800	4.58	CP-PL-024	25.85	23.1	3,734,100	38.23
CP-PL-025	25.75	33.53	2,004,400	4.55	CP-PL-025	25.75	23.0	3,715,000	38.23
CP-PL-026	2.80	25.00	305,400	4.95	CP-PL-026	2.80	7.9	562,400	31.18
CP-PL-027	2.77	24.75	301,300	4.87	CP-PL-027	2.77	7.9	555,400	31.07
CP-PL-028	2.70	24.17	292,000	4.75	CP-PL-028	2.70	7.7	539,500	31.00
CP-PL-029	2.61	23.41	279,900	4.60	CP-PL-029	2.61	7.4	518,700	30.80
CP-PL-030	2.39	21.38	256,300	4.60	CP-PL-030	2.39	6.8	475,200	30.77
CP-PL-031	0.80	9.03	85,700	4.15	CP-PL-031	0.80	2.6	158,800	30.10
CP-PL-032	6.20	26.07	666,900	7.05	CP-PL-032	6.20	13.1	1,234,000	11.62
CP-PL-033	6.20	26.07	666,900	6.92	CP-PL-033	6.20	13.1	1,234,000	11.47
CP-PL-034	4.54	23.95	480,800	7.40	CP-PL-034	4.54	10.1	895,100	12.78
CP-PL-035	4.51	31.08	477,300	6.22	CP-PL-035	4.51	11.5	889,400	11.38
CP-PL-036	1.06	9.30	113,300	5.42	CP-PL-036	1.06	3.0	210,200	31.45
CP-PL-037	1.06	9.30	113,300	5.38	CP-PL-037	1.06	3.0	210,200	31.40
CP-PL-038	1.06	9.33	113,400	5.27	CP-PL-038	1.06	3.0	210,200	31.23
CP-PL-039	25.58	32.08	1,984,700	4.50	CP-PL-039	25.58	22.8	3,679,400	38.67
CP-PL-040	23.87	21.25	1,777,500	6.90	CP-PL-040	23.87	19.5	3,313,800	39.43
CP-PL-041A	10.65	10.75	147,500	4.87	CP-PL-041A	10.65	6.4	475,000	47.55
CP-PL-041B	5.61	58.44	695,700	4.08	CP-PL-041B	5.61	16.2	1,216,900	30.13
CP-PL-041C	3.34	41.21	432,000	4.10	CP-PL-041C	3.34	11.2	744,200	30.17
CP-PL-042A	0.63	5.89	82,800	5.37	CP-PL-042A	0.63	1.9	141,700	10.32
CP-PL-042B	9.53	0.00	0	0.00	CP-PL-042B	9.53	5.5	222,600	47.62
CP-PL-042C	0.49	5.46	64,700	4.50	CP-PL-042C	0.49	1.6	110,700	30.48
CP-PL-043A	4.38	50.89	458,500	4.20	CP-PL-043A	4.38	14.3	857,900	30.25
CP-PL-043B	4.43	51.42	463,500	4.18	CP-PL-043B	4.43	14.4	867,300	30.22

Surface Water Planned (PL) Conditions: Results for estimation of design runoff

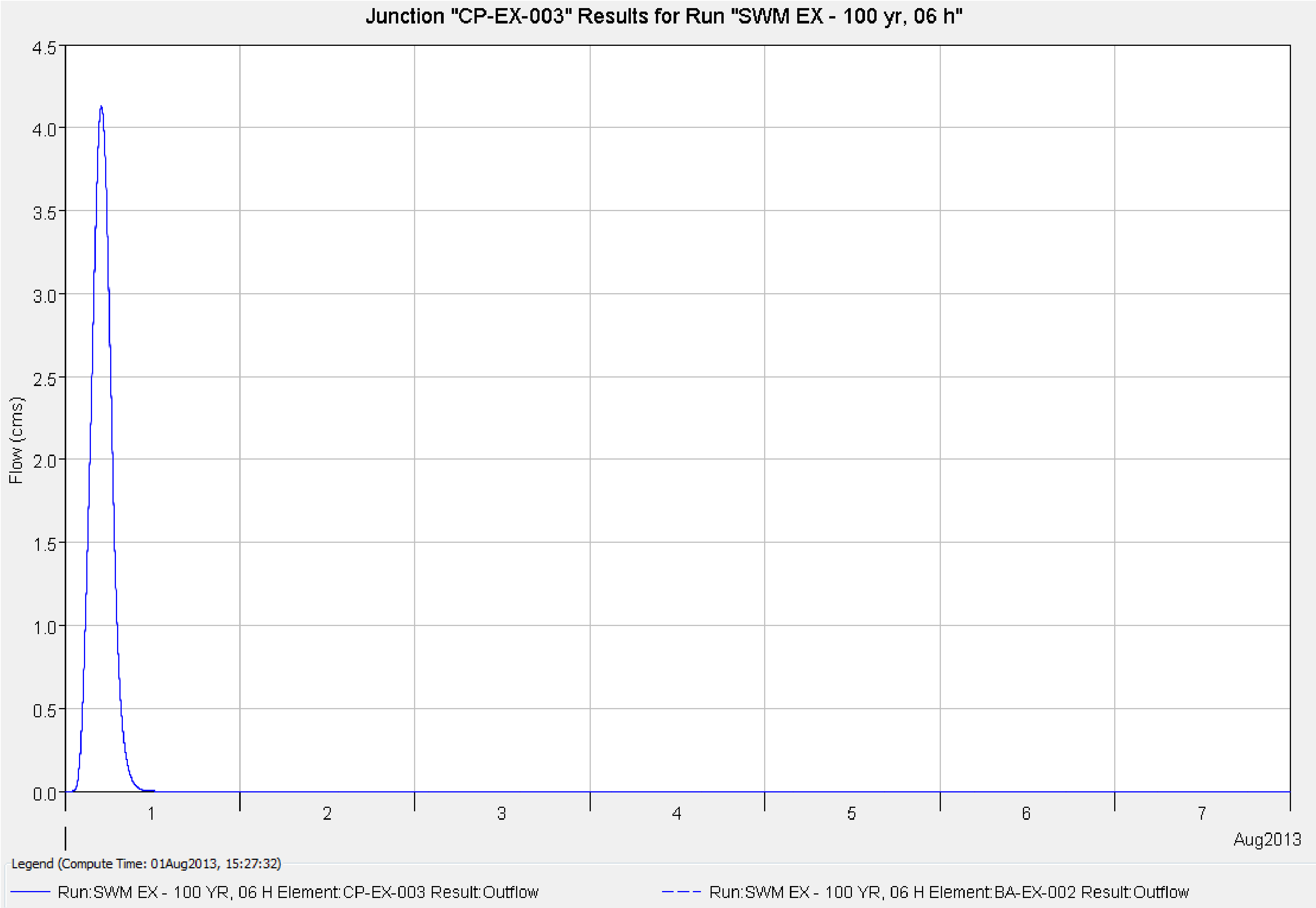
CP-PL-044	4.38	50.95	458,500	4.03	CP-PL-044	4.38	14.3	857,900	30.00
CP-PL-045	4.43	51.45	463,500	4.03	CP-PL-045	4.43	14.5	867,300	30.00
CP-PL-046	0.78	9.82	102,700	4.00	CP-PL-046	0.78	2.6	175,800	30.00
CP-PL-047	4.83	48.77	593,200	4.07	CP-PL-047	4.83	13.6	1,041,200	30.10
CP-PL-048	4.83	48.87	593,200	4.02	CP-PL-048	4.83	13.6	1,041,200	30.02
CP-PL-049	4.20	41.46	511,500	4.13	CP-PL-049	4.20	11.6	901,300	30.13
CP-PL-050	3.38	32.05	424,000	4.13	CP-PL-050	3.38	9.2	738,800	10.13
CP-PL-051	3.38	32.23	424,400	4.08	CP-PL-051	3.38	9.2	738,900	10.07
CP-PL-052	2.89	26.38	365,300	4.13	CP-PL-052	2.89	7.8	633,900	10.13
CP-PL-053	2.77	25.18	354,200	4.13	CP-PL-053	2.77	7.5	612,300	10.17
CP-PL-054	2.77	25.29	354,200	4.02	CP-PL-054	2.77	7.5	612,300	10.02
CP-PL-055	1.10	6.13	145,300	5.17	CP-PL-055	1.10	2.4	248,100	11.08
CP-PL-056A	0.46	5.76	60,100	4.10	CP-PL-056A	0.46	1.5	102,900	30.13
CP-PL-056B	0.54	6.80	71,100	4.00	CP-PL-056B	0.54	1.8	121,800	30.00
CP-PL-057	0.46	5.76	60,100	4.00	CP-PL-057	0.46	1.5	102,900	30.00
CP-PL-058	1.67	20.75	208,900	4.00	CP-PL-058	1.67	5.6	364,200	30.00
CP-PL-059	0.59	7.45	77,900	4.00	CP-PL-059	0.59	2.0	133,300	30.00
CP-PL-060	1.82	22.90	239,100	4.00	CP-PL-060	1.82	6.2	409,200	30.00
CP-PL-061	0.38	4.30	45,000	4.27	CP-PL-061	0.38	1.2	80,000	30.22
CP-PL-062	1.14	14.16	148,100	4.08	CP-PL-062	1.14	3.8	255,000	30.22
CP-PL-063	1.14	14.29	149,200	4.00	CP-PL-063	1.14	3.8	255,500	30.00
CP-PL-064	0.39	4.86	50,700	4.00	CP-PL-064	0.39	1.3	86,800	30.00
CP-PL-065	1.71	20.25	207,300	4.02	CP-PL-065	1.71	5.6	365,600	30.35
CP-PL-066	1.53	18.37	183,900	4.25	CP-PL-066	1.53	5.1	325,700	30.35
CP-PL-067	0.19	2.39	25,000	4.00	CP-PL-067	0.19	0.6	42,900	30.00
CP-PL-068	1.34	16.00	159,100	4.18	CP-PL-068	1.34	4.4	282,900	30.23
CP-PL-069	1.23	14.73	144,000	4.03	CP-PL-069	1.23	4.1	257,000	30.02
CP-PL-070	0.77	8.98	83,700	4.05	CP-PL-070	0.77	2.5	153,700	30.02
CP-PL-071	0.63	7.32	67,200	4.05	CP-PL-071	0.63	2.0	124,500	30.07
CP-PL-072	0.63	7.32	67,200	4.00	CP-PL-072	0.63	2.0	124,500	30.00
CP-PL-073	0.35	4.05	38,000	4.05	CP-PL-073	0.35	1.1	69,700	30.02
CP-PL-074	0.16	2.02	21,100	4.13	CP-PL-074	0.16	0.5	36,200	30.23
CP-PL-075	0.16	2.02	21,100	4.00	CP-PL-075	0.16	0.5	36,200	30.00
CP-PL-076	0.43	5.19	54,100	4.13	CP-PL-076	0.43	1.4	94,400	30.12
CP-PL-077	0.76	8.94	100,200	4.27	CP-PL-077	0.76	2.5	171,500	30.25
CP-PL-078	17.20	52.91	1,798,300	9.92	CP-PL-078	17.20	32.0	3,366,100	38.75
CP-PL-079	14.68	48.30	1,518,800	10.22	CP-PL-079	14.68	27.2	2,855,300	38.40
CP-PL-080	14.68	48.38	1,519,100	9.95	CP-PL-080	14.68	27.2	2,855,400	38.20
CP-PL-081	14.68	48.39	1,519,100	9.87	CP-PL-081	14.68	27.2	2,855,400	38.10
CP-PL-082	14.19	48.38	1,466,000	9.82	CP-PL-082	14.19	26.2	2,757,500	38.05
CP-PL-083	13.95	48.70	1,436,800	9.47	CP-PL-083	13.95	25.7	2,706,200	37.93
WP-PL-001	37.95	16.51	3,465,700	16.22	WP-PL-001	37.95	27.0	6,556,200	49.08
WP-PL-002	10.53	42.37	1,127,200	7.10	WP-PL-002	10.53	21.4	2,090,400	12.45
WP-PL-003	0.03	0.26	3,200	4.42	WP-PL-003	0.03	0.1	5,800	10.17
WP-PL-004	4.54	23.95	480,800	7.40	WP-PL-004	4.54	10.1	895,100	12.78
WP-PL-005/006	23.87	21.25	1,777,500	6.90	WP-PL-005/006	23.87	19.5	3,313,800	39.43
WP-PL-007	9.53	0.00	0	0.00	WP-PL-007	9.53	5.5	222,600	47.62
WP-PL-008	1.10	6.13	145,300	5.17	WP-PL-008	1.10	2.4	248,100	11.08
WP-PL-009	14.19	48.38	1,466,000	9.82	WP-PL-009	14.19	26.2	2,757,500	38.05
Chindwin River	87.72	138.18	8,041,900	7.03	Chindwin River	87.72	90.1	15,037,500	39.15
Yama Stream	18.40	52.91	1,952,500	9.92	Yama Stream	18.40	34.3	3,632,000	38.25



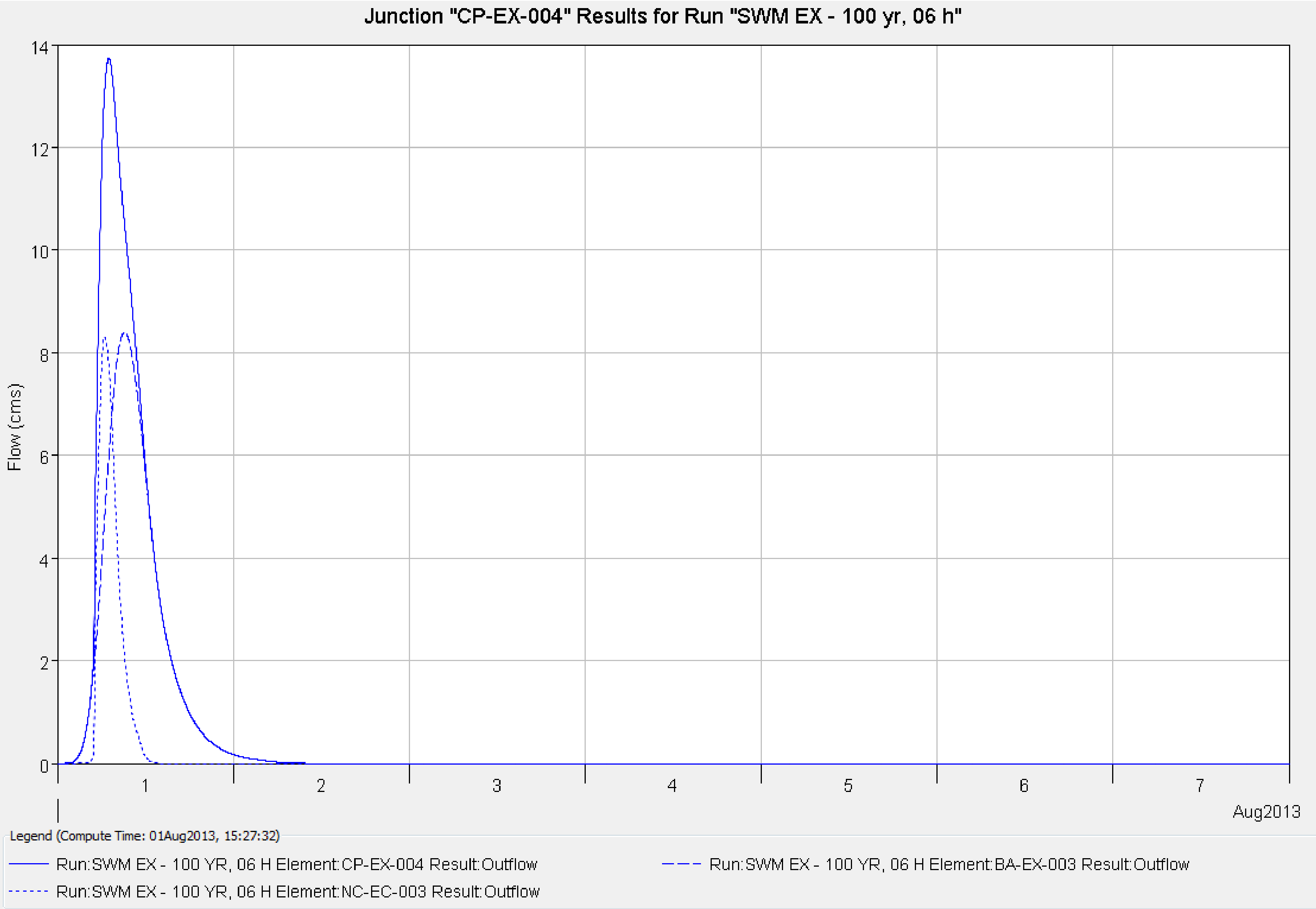
Junction "CP-EX-001" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-001 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-001 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-001 Result:Outflow



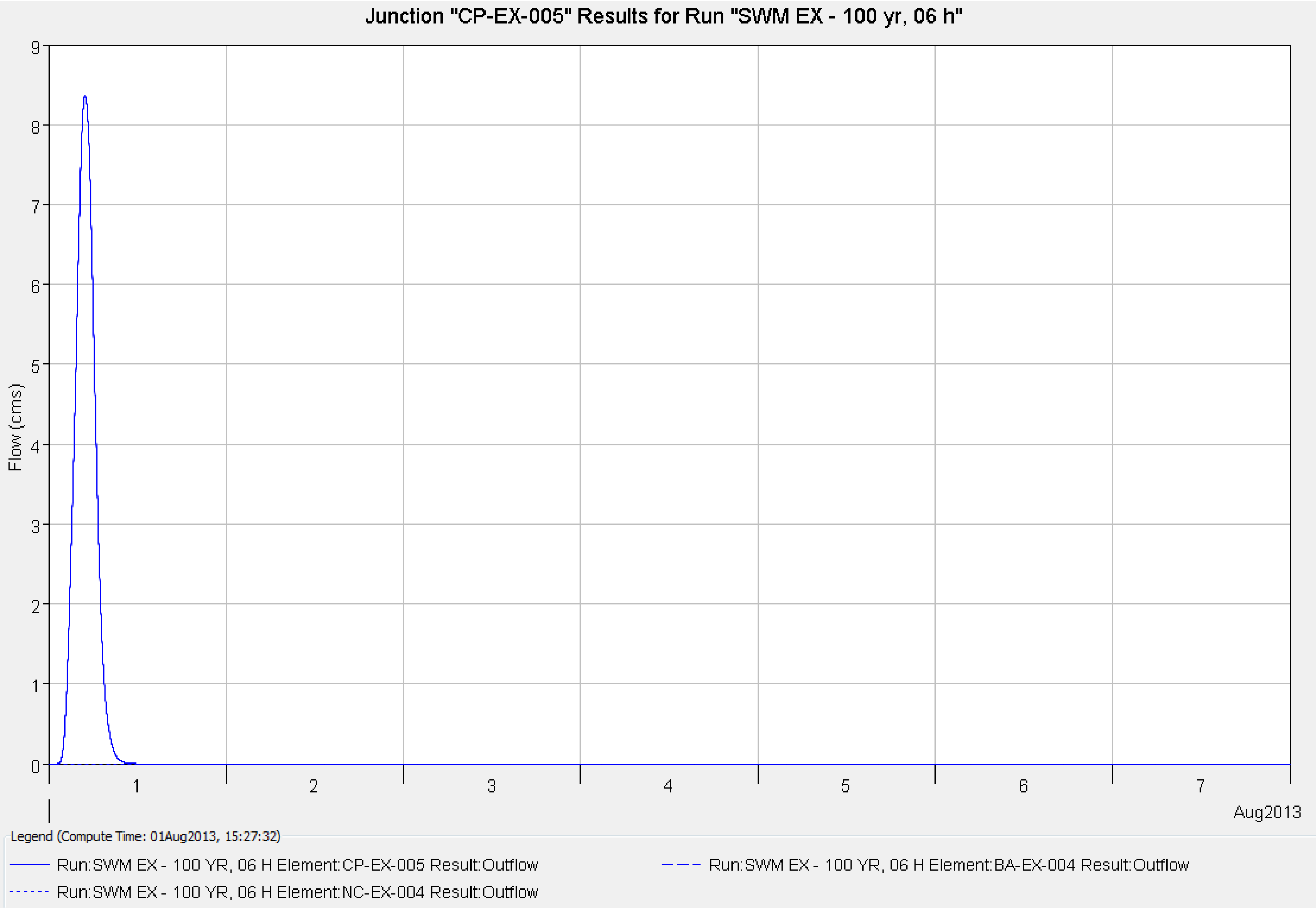
Junction "CP-EX-002" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-002 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-002 Result:Outflow



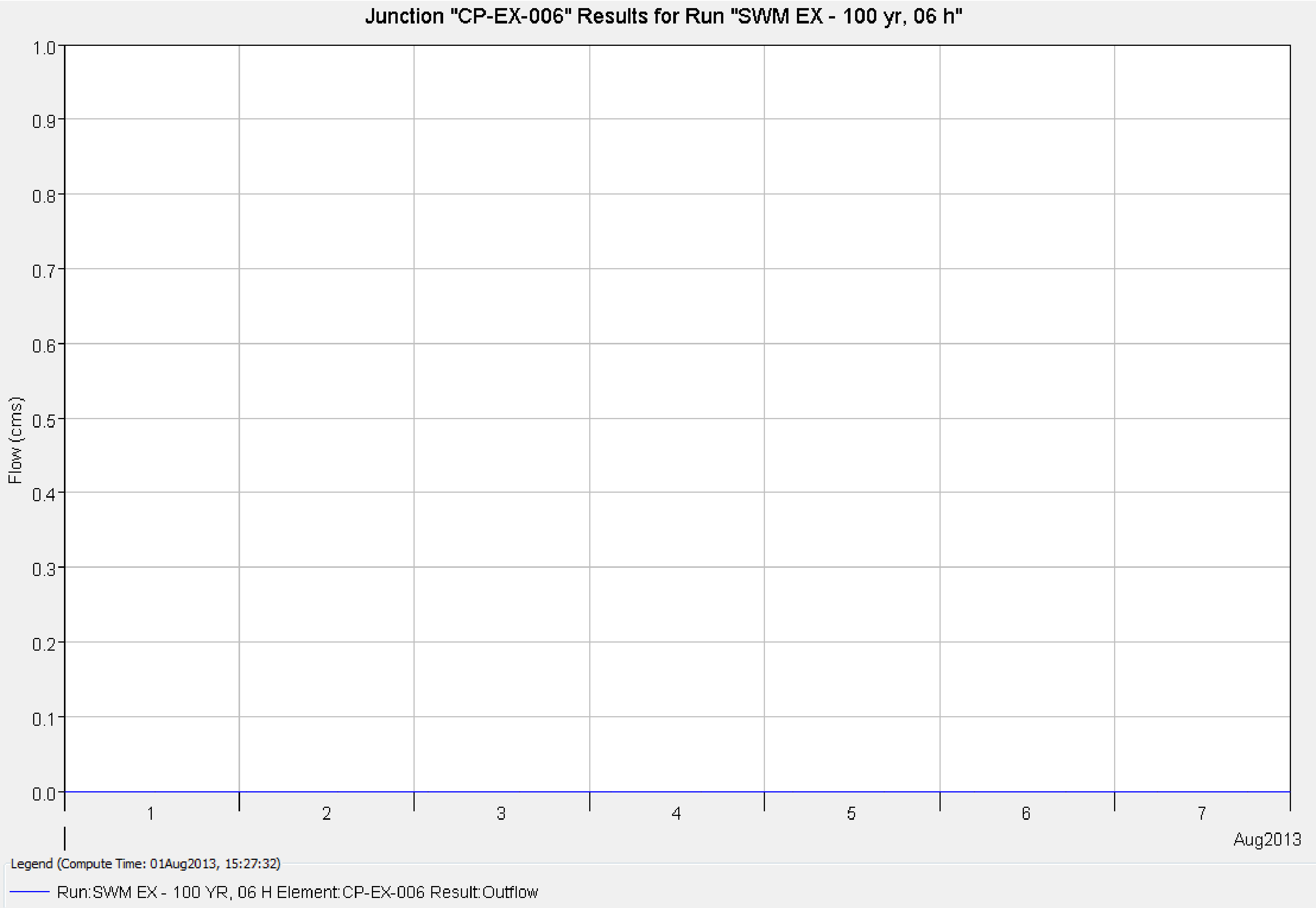
Junction "CP-EX-003" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-002 Result:Outflow

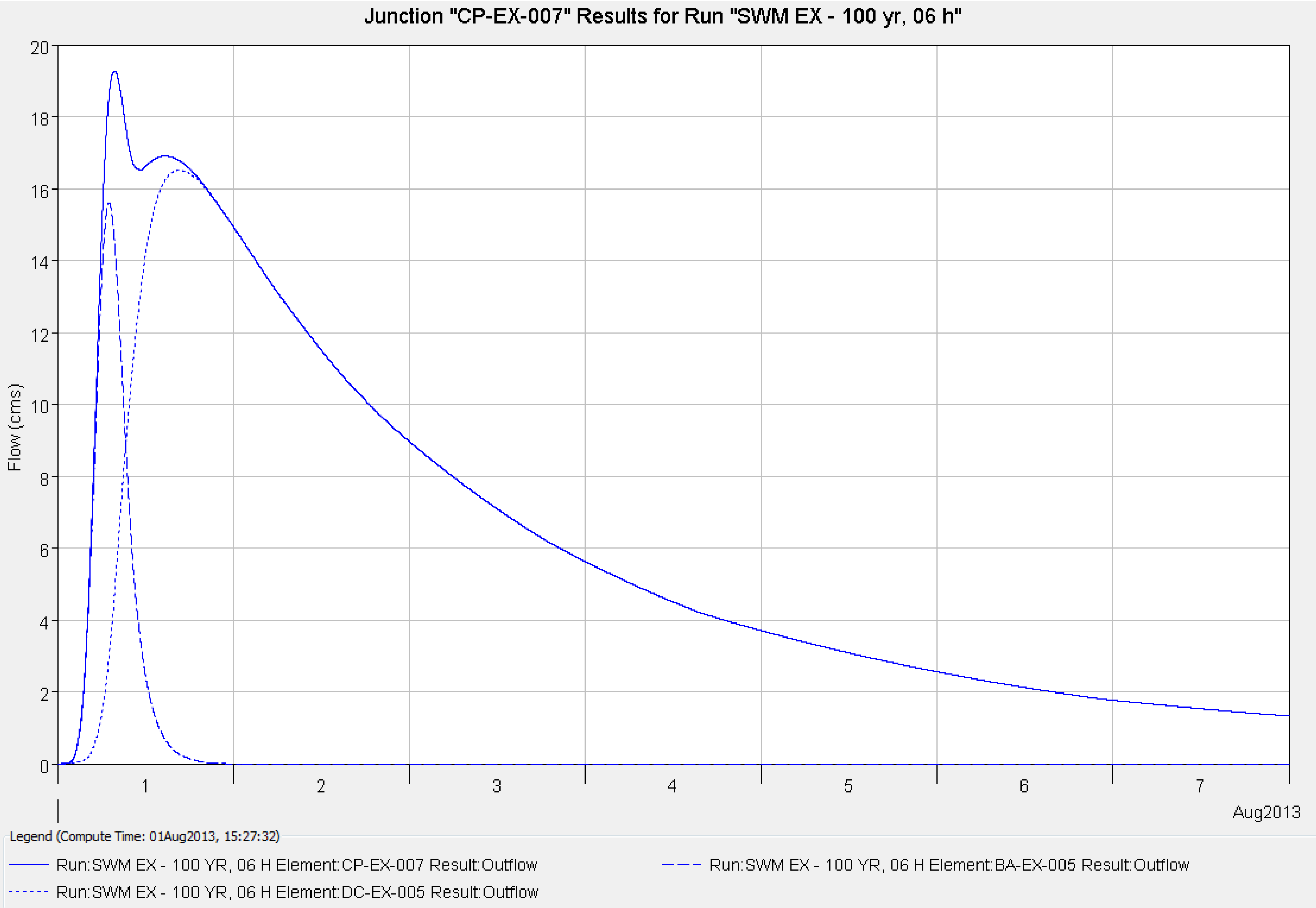


Junction "CP-EX-004" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
2
4
6
8
10
12
14
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EC-003 Result:Outflow

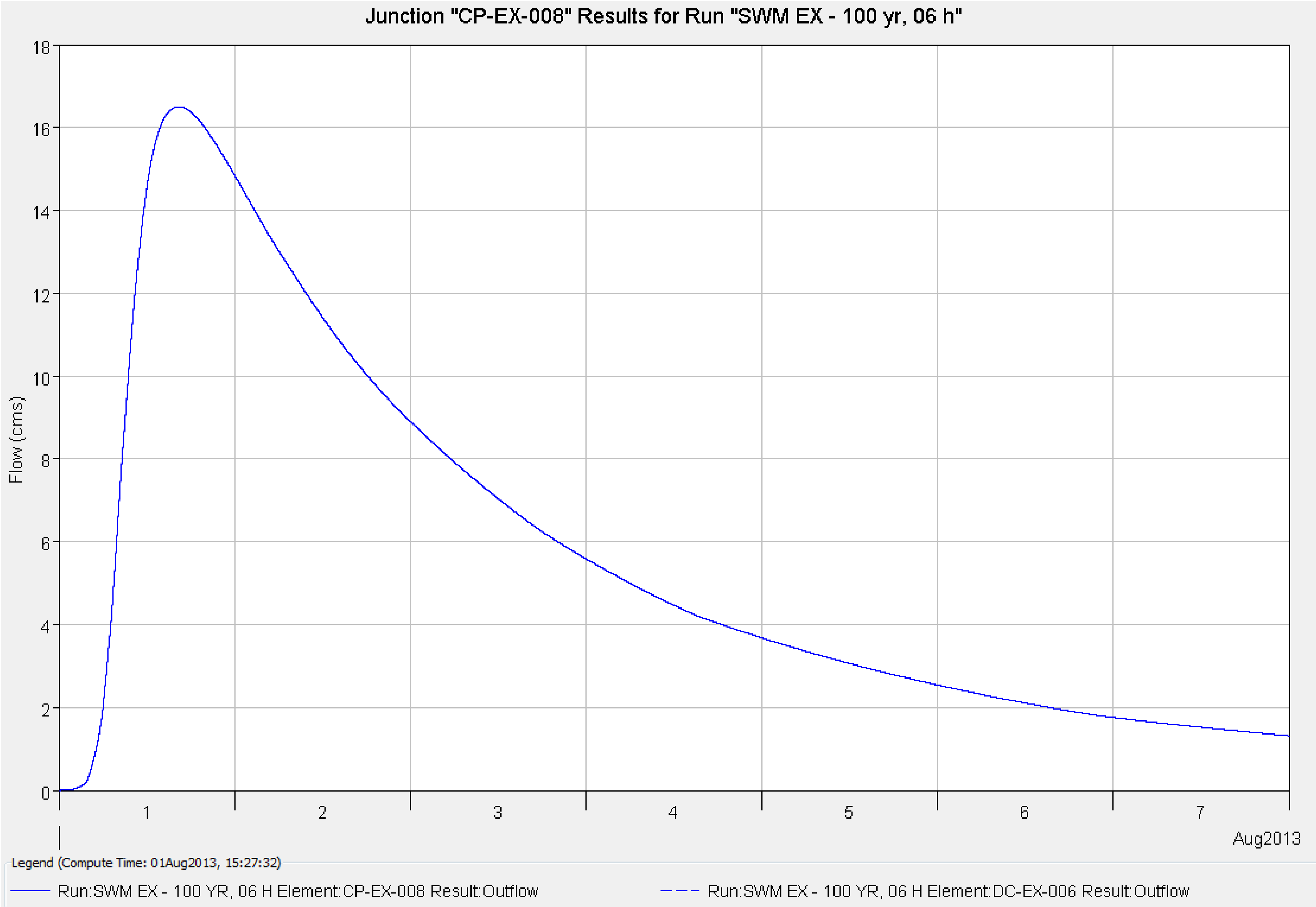


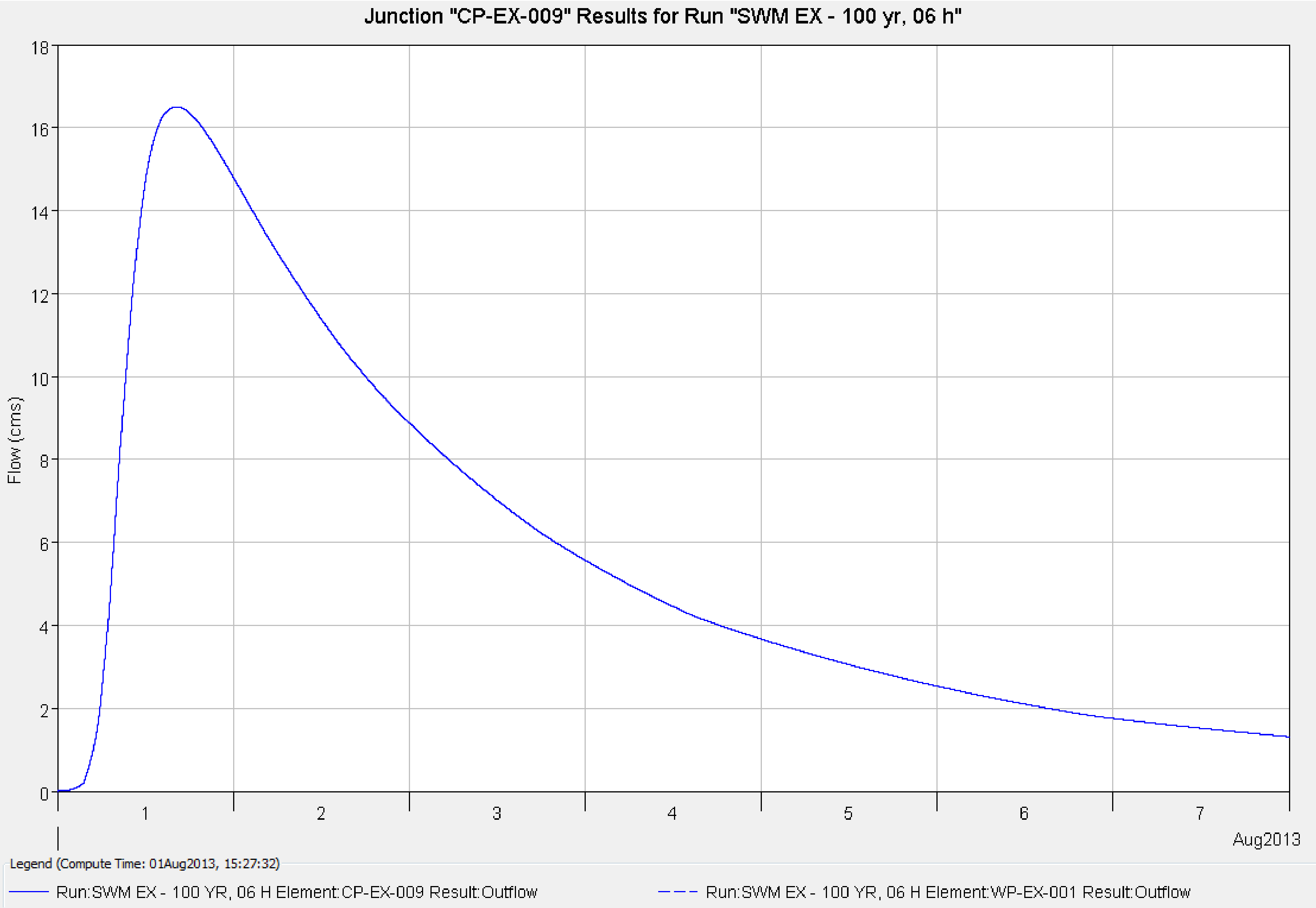
Junction "CP-EX-005" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-004 Result:Outflow


Junction "CP-EX-006" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-006 Result:Outflow

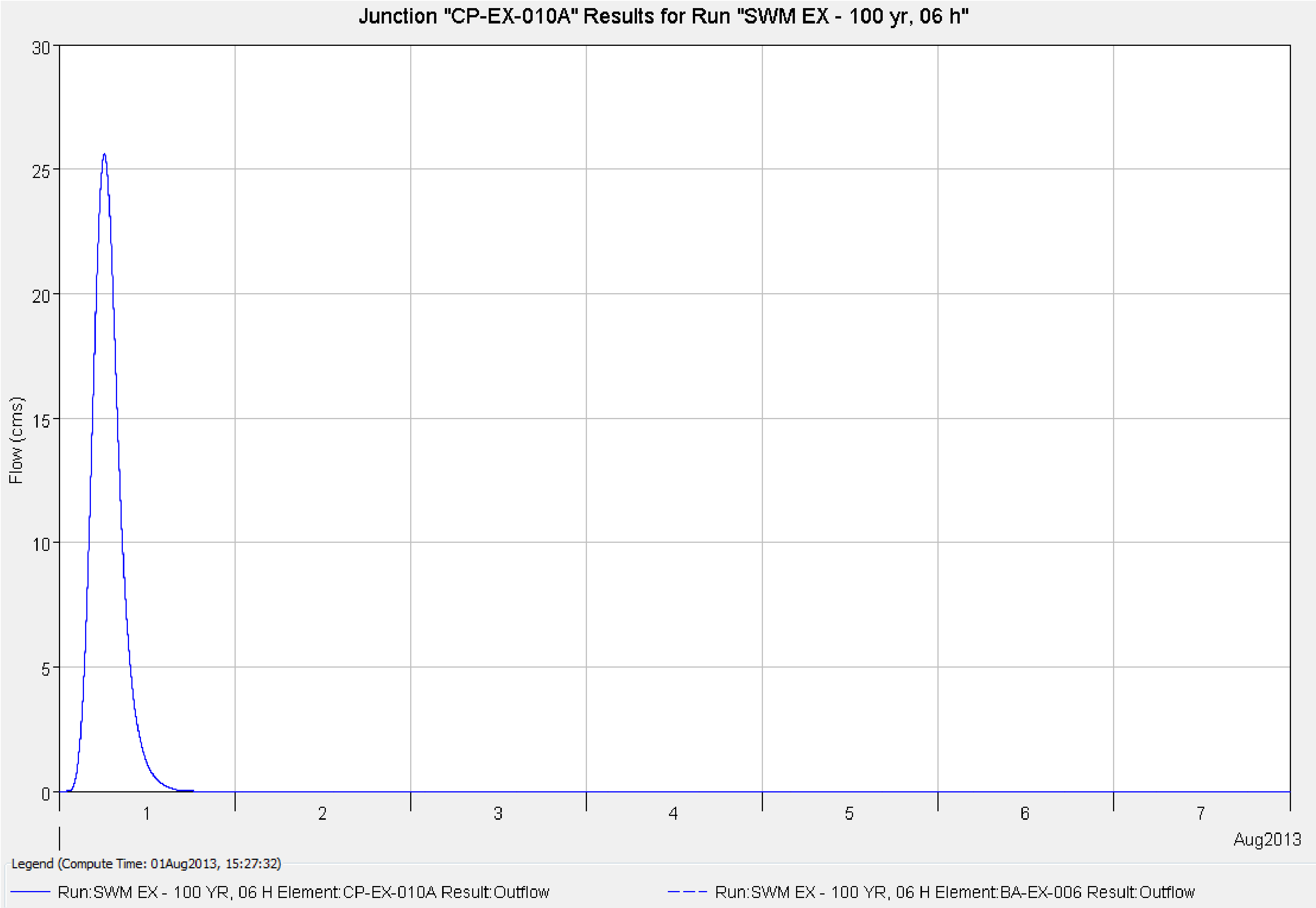


Junction "CP-EX-007" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-007 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-005 Result:Outflow

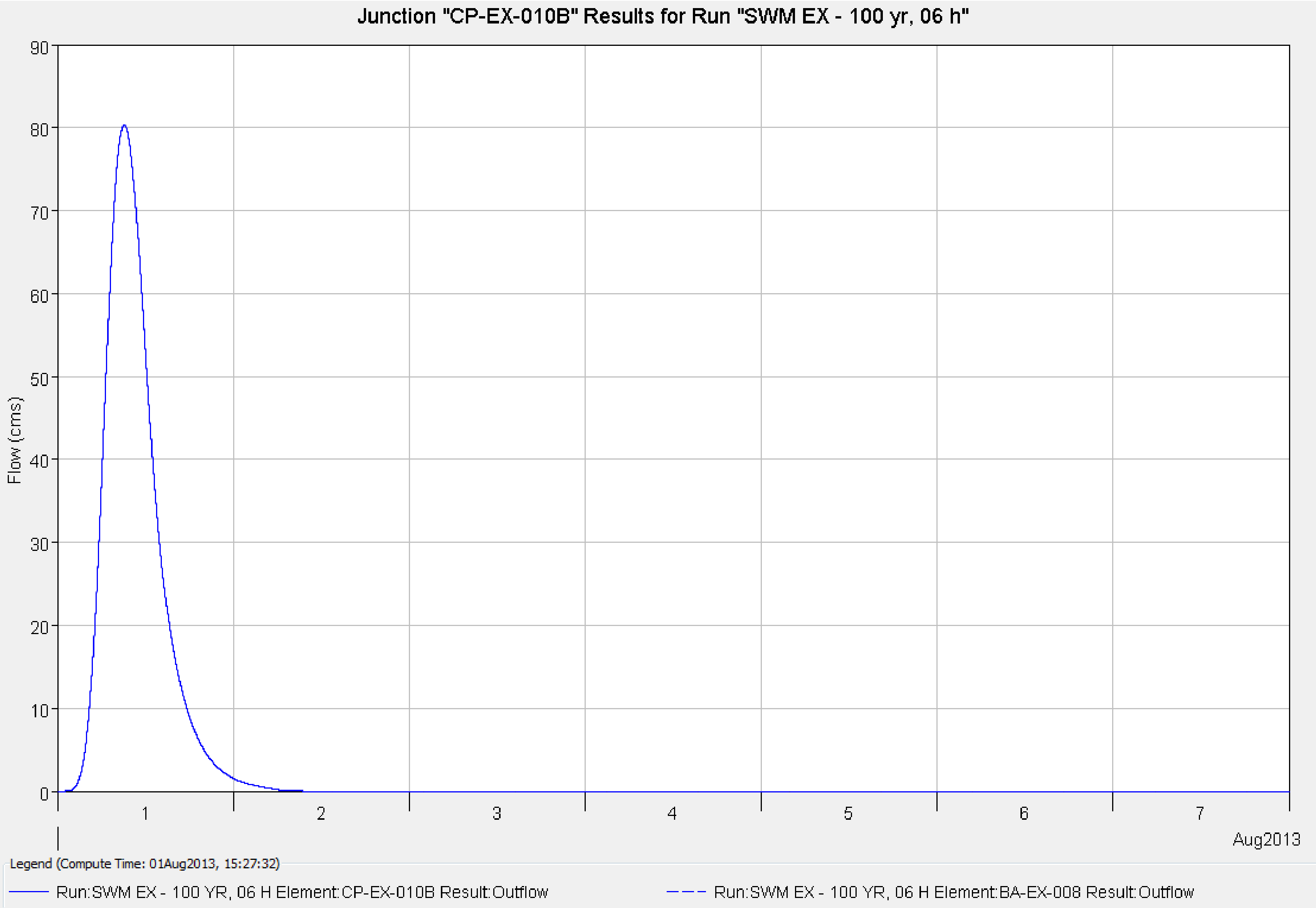

Junction "CP-EX-008" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-008 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-006 Result:Outflow



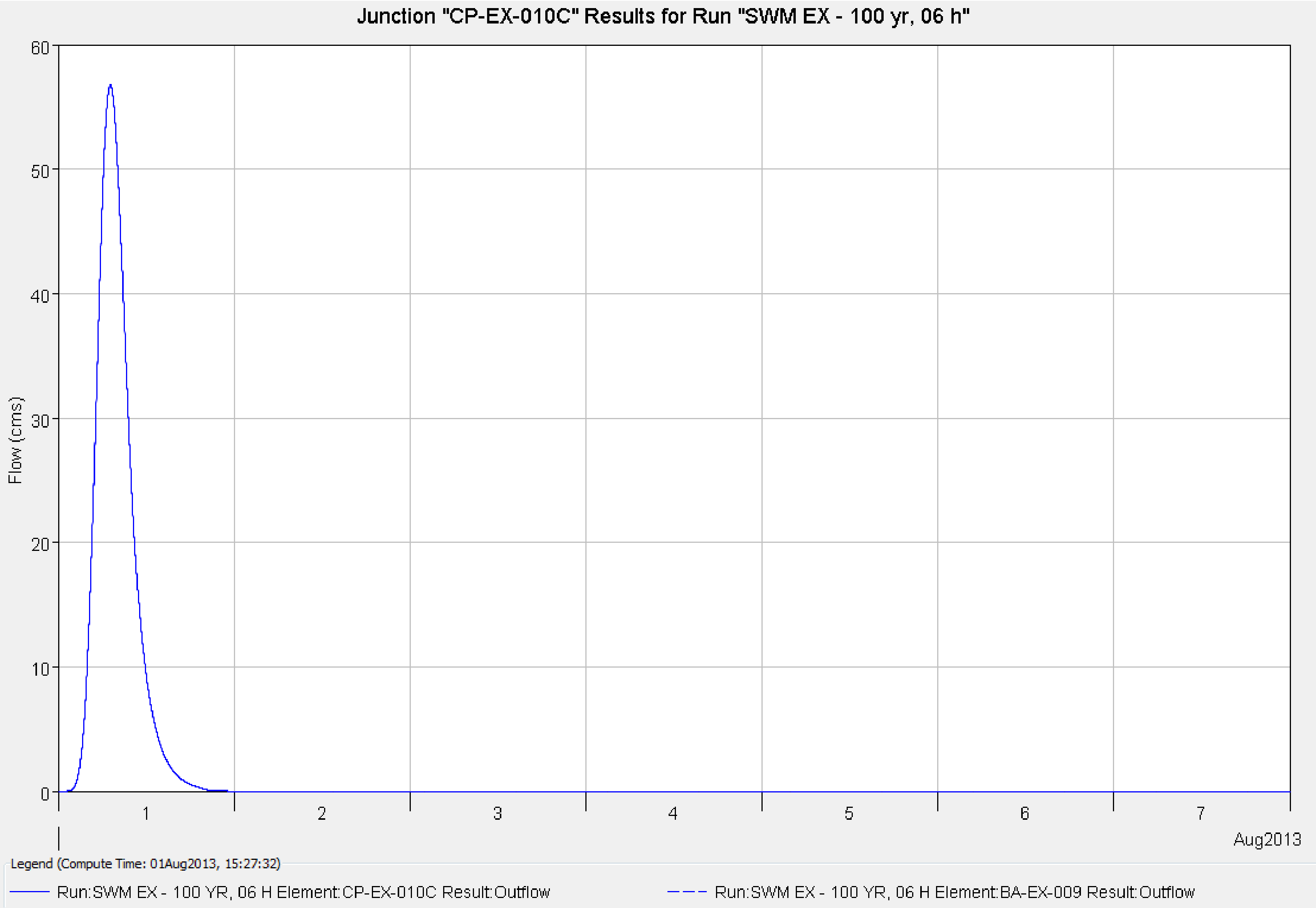
Junction "CP-EX-009" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-009 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-001 Result:Outflow

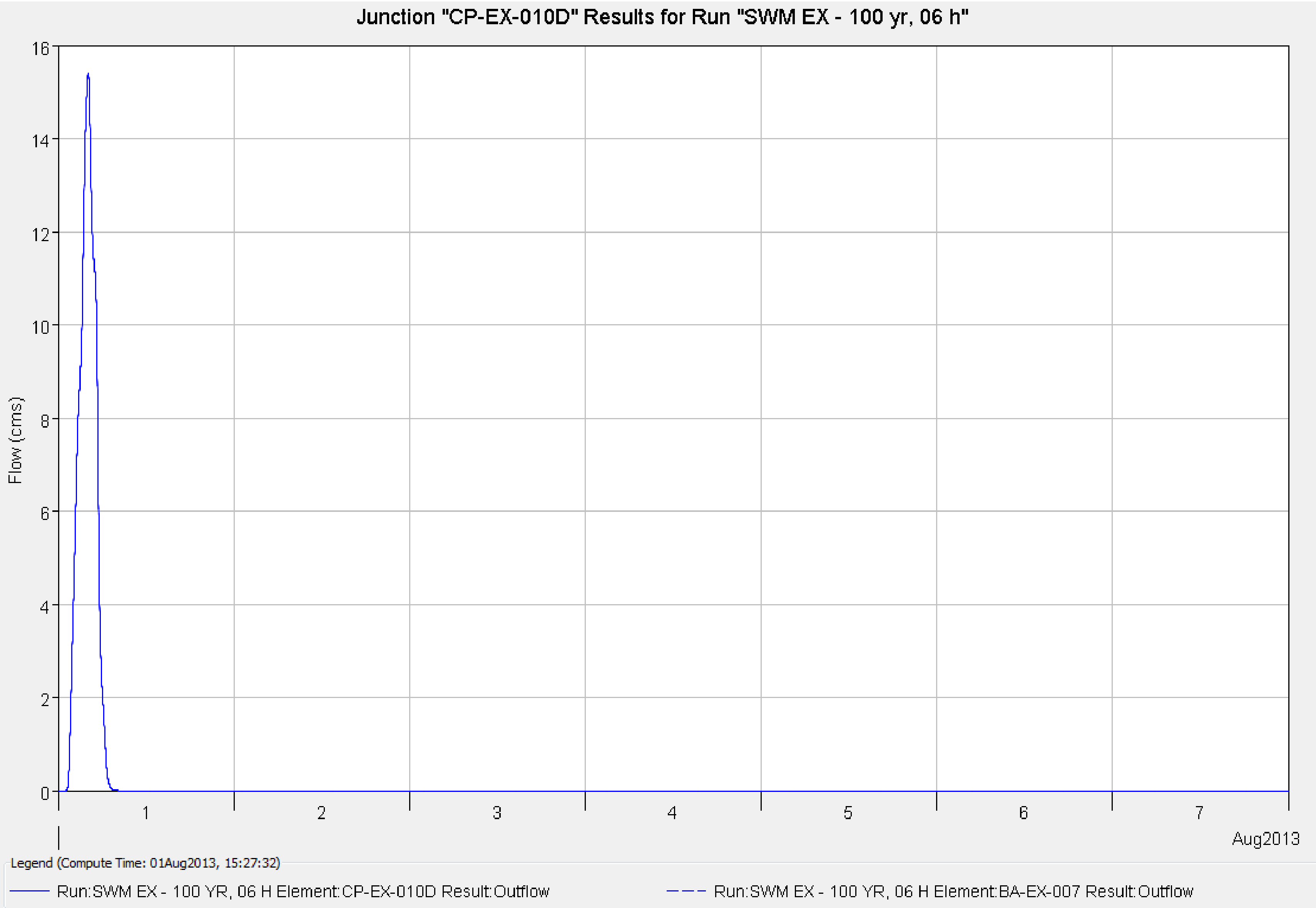


Junction "CP-EX-010A" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-010A Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-006 Result:Outflow

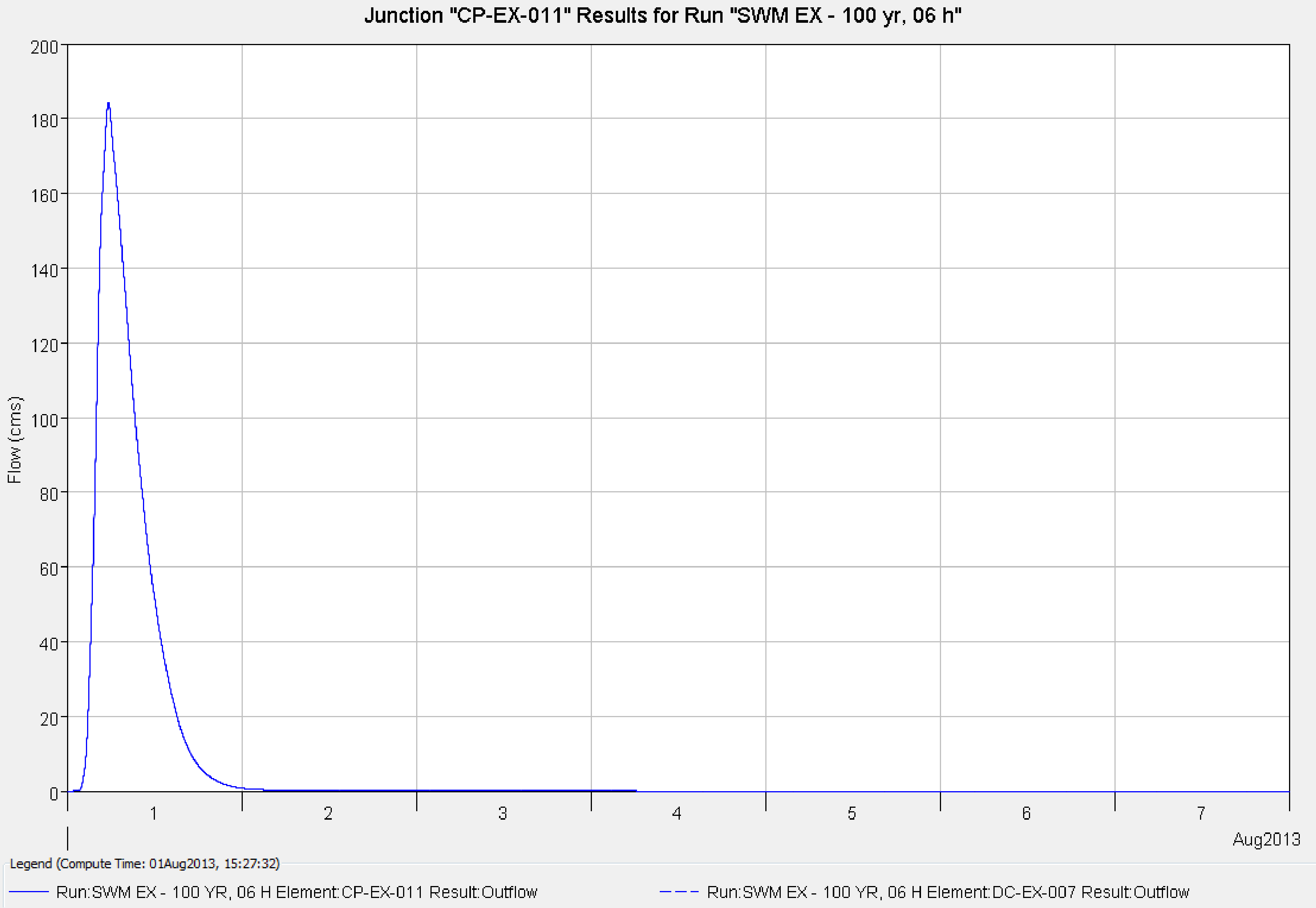


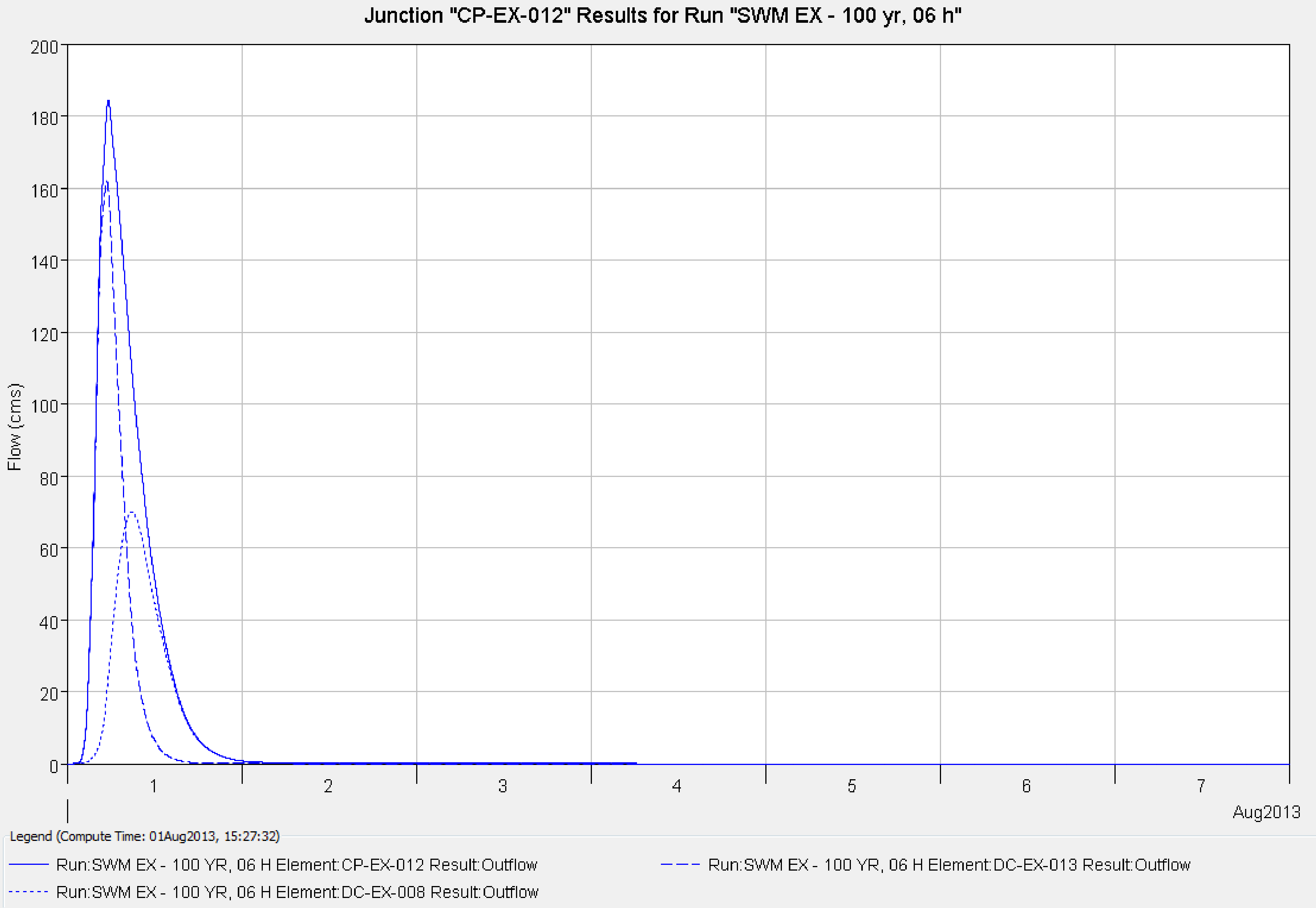
Junction "CP-EX-010B" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-010B Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-008 Result:Outflow


Junction "CP-EX-010C" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-010C Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-009 Result:Outflow

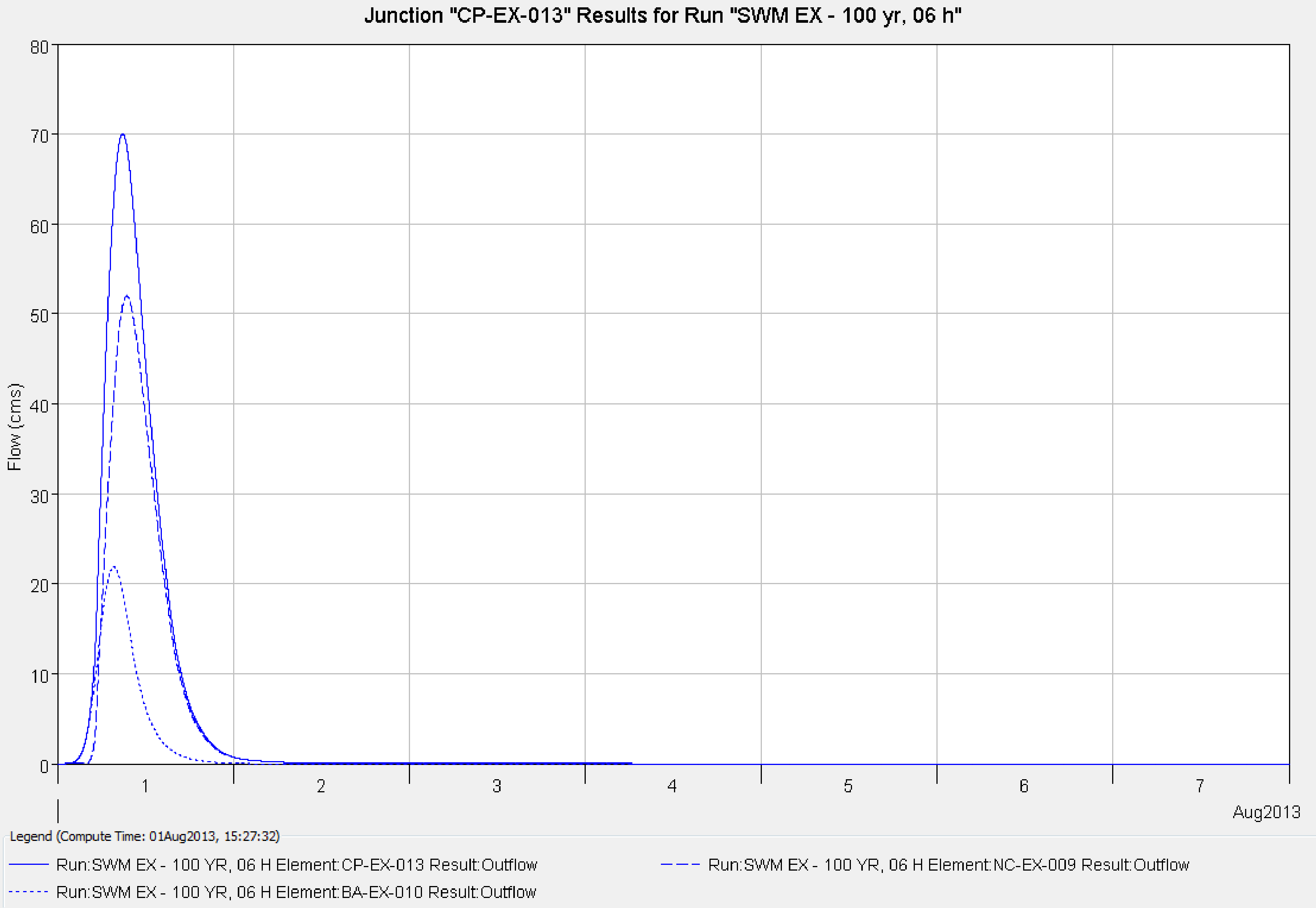


Junction "CP-EX-010D" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-010D Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-007 Result:Outflow

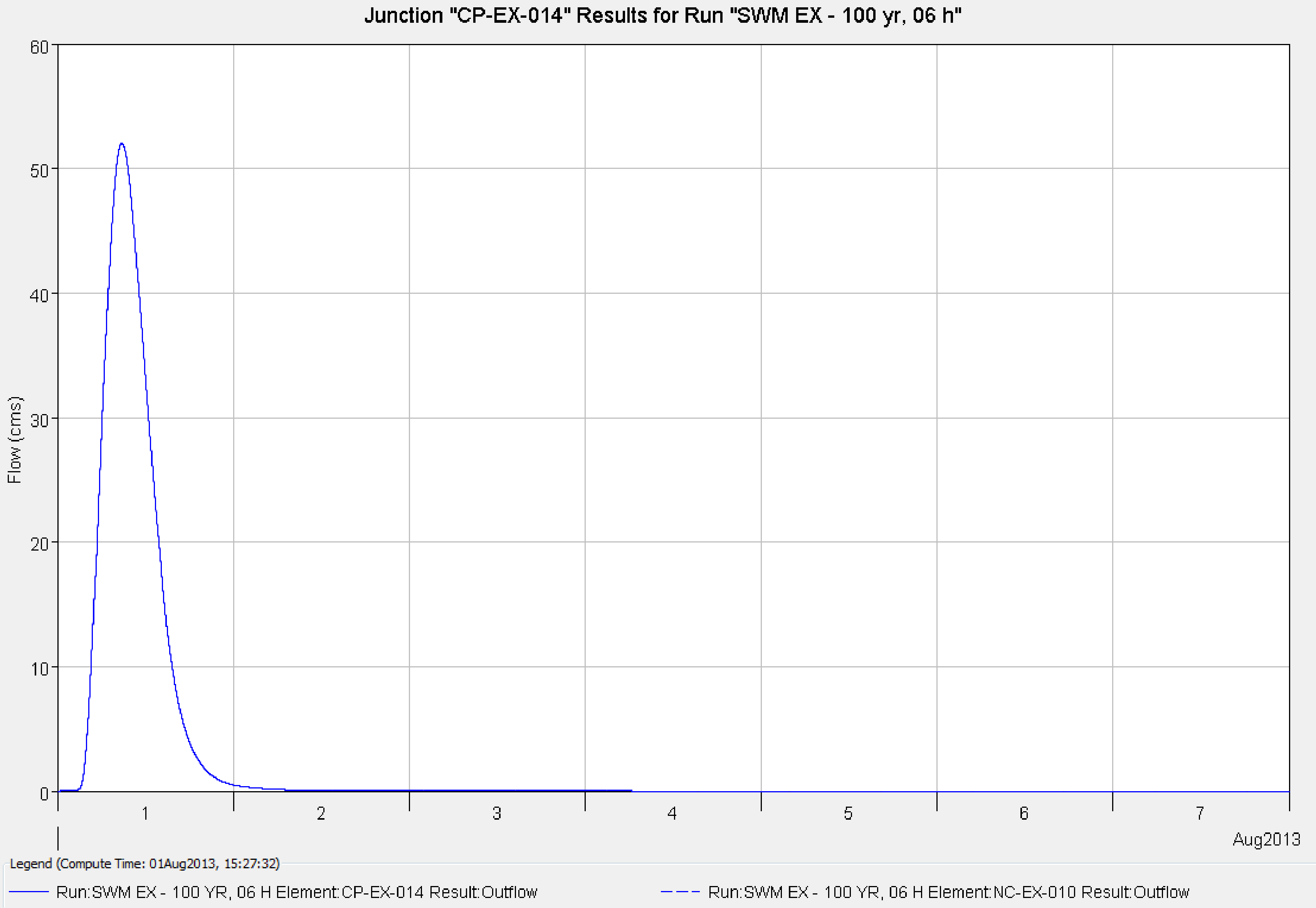

Junction "CP-EX-011" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-011 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-007 Result:Outflow



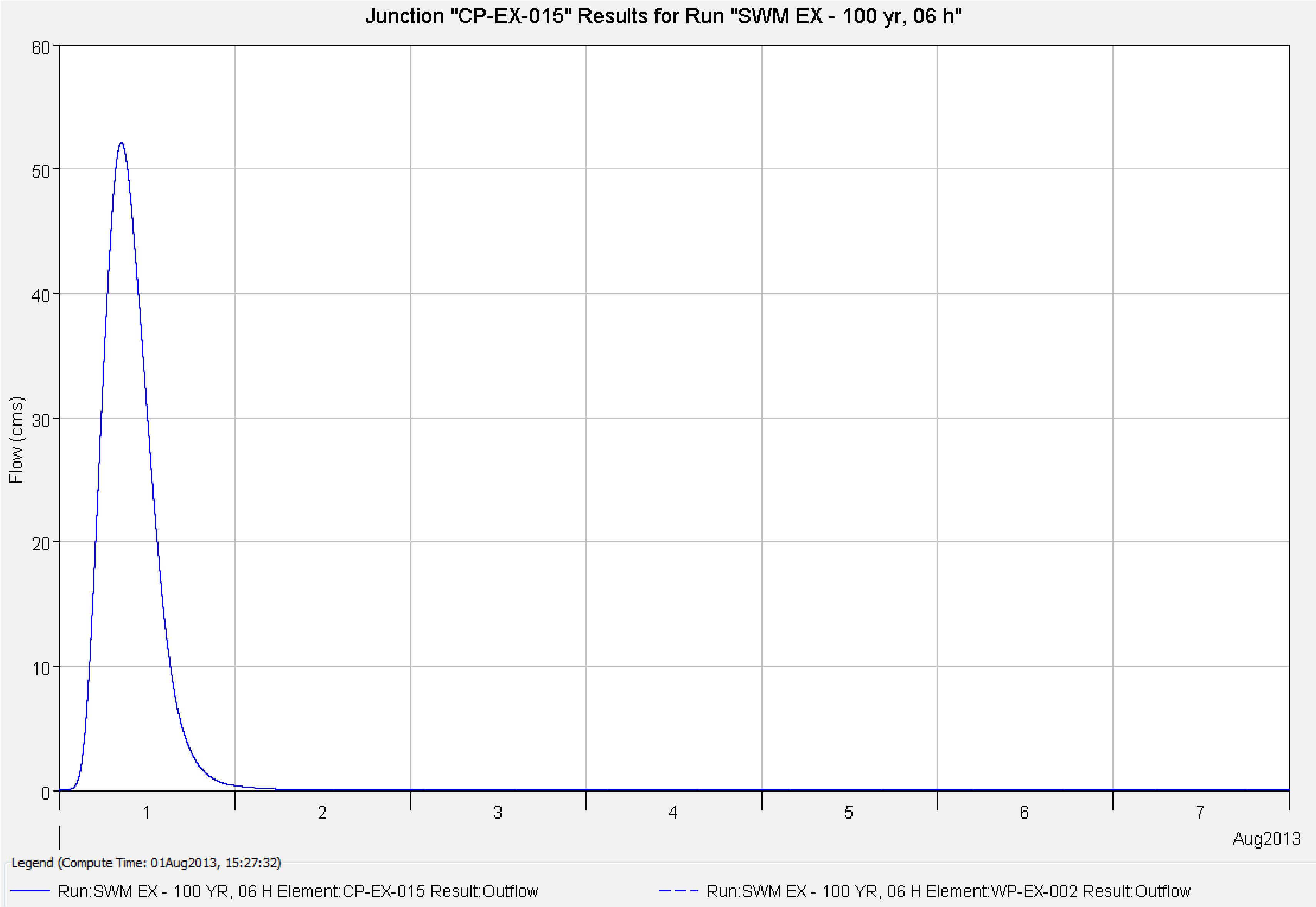
Junction "CP-EX-012" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-012 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-013 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-008 Result:Outflow

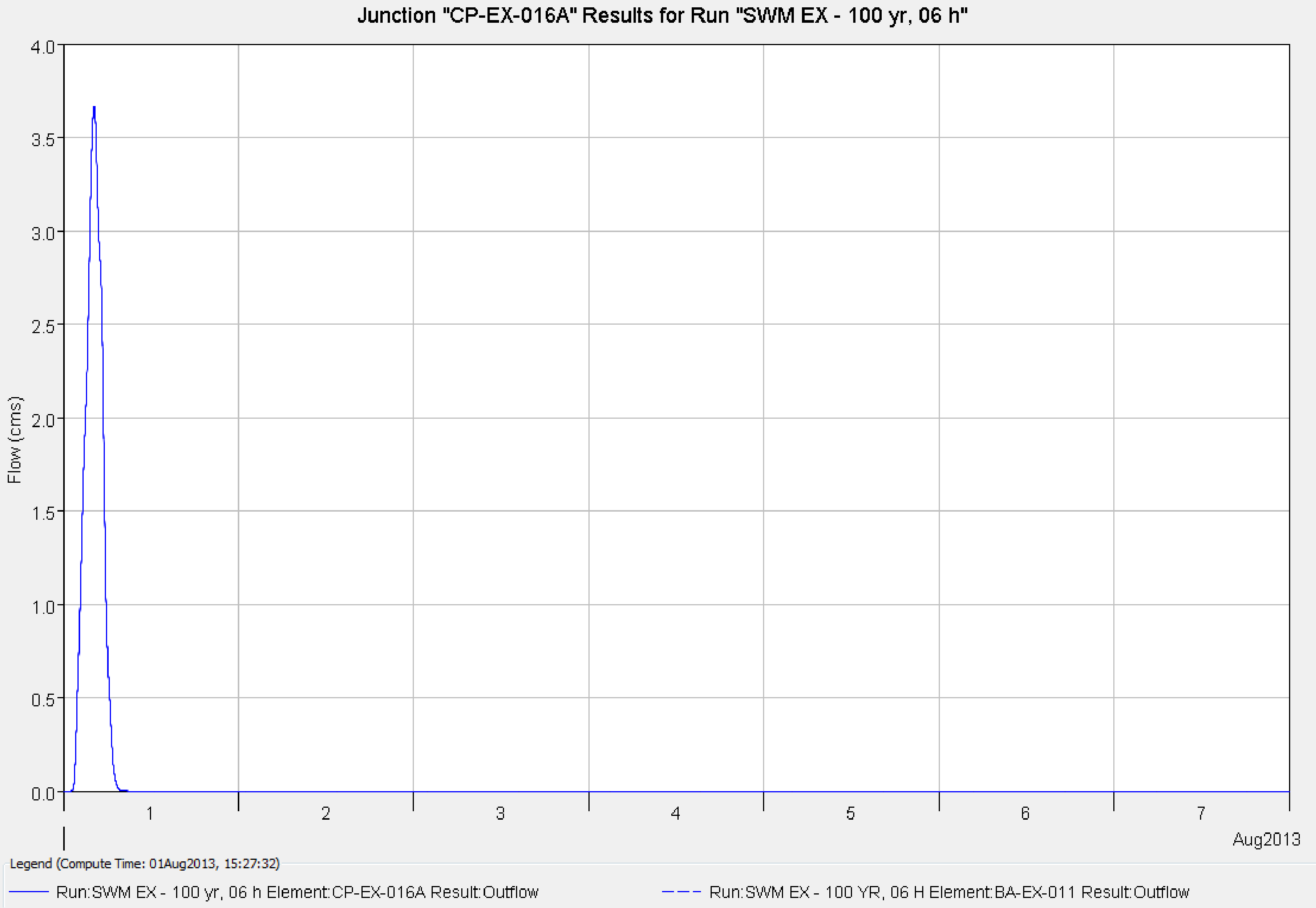


Junction "CP-EX-013" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-013 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-009 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-010 Result:Outflow

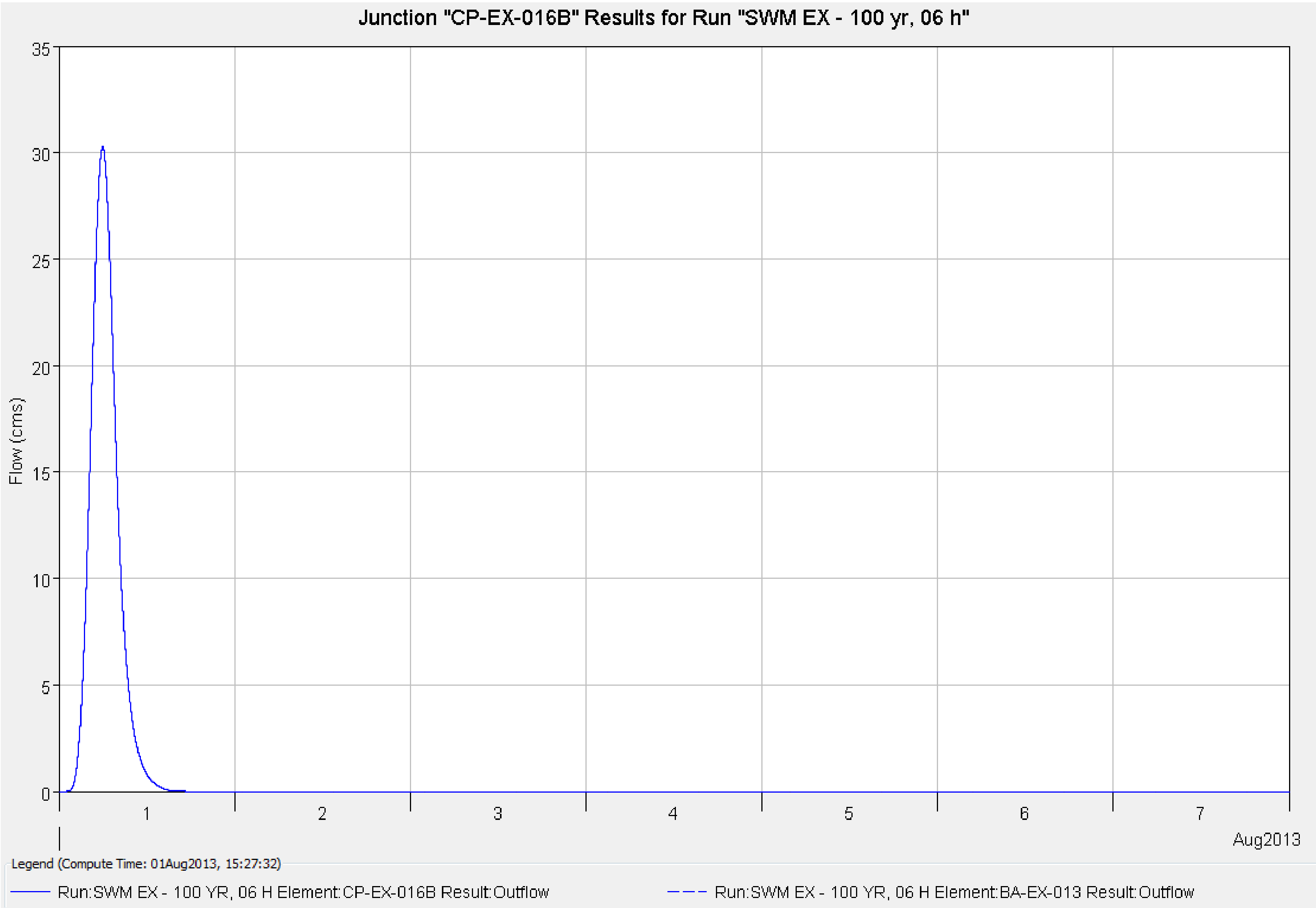


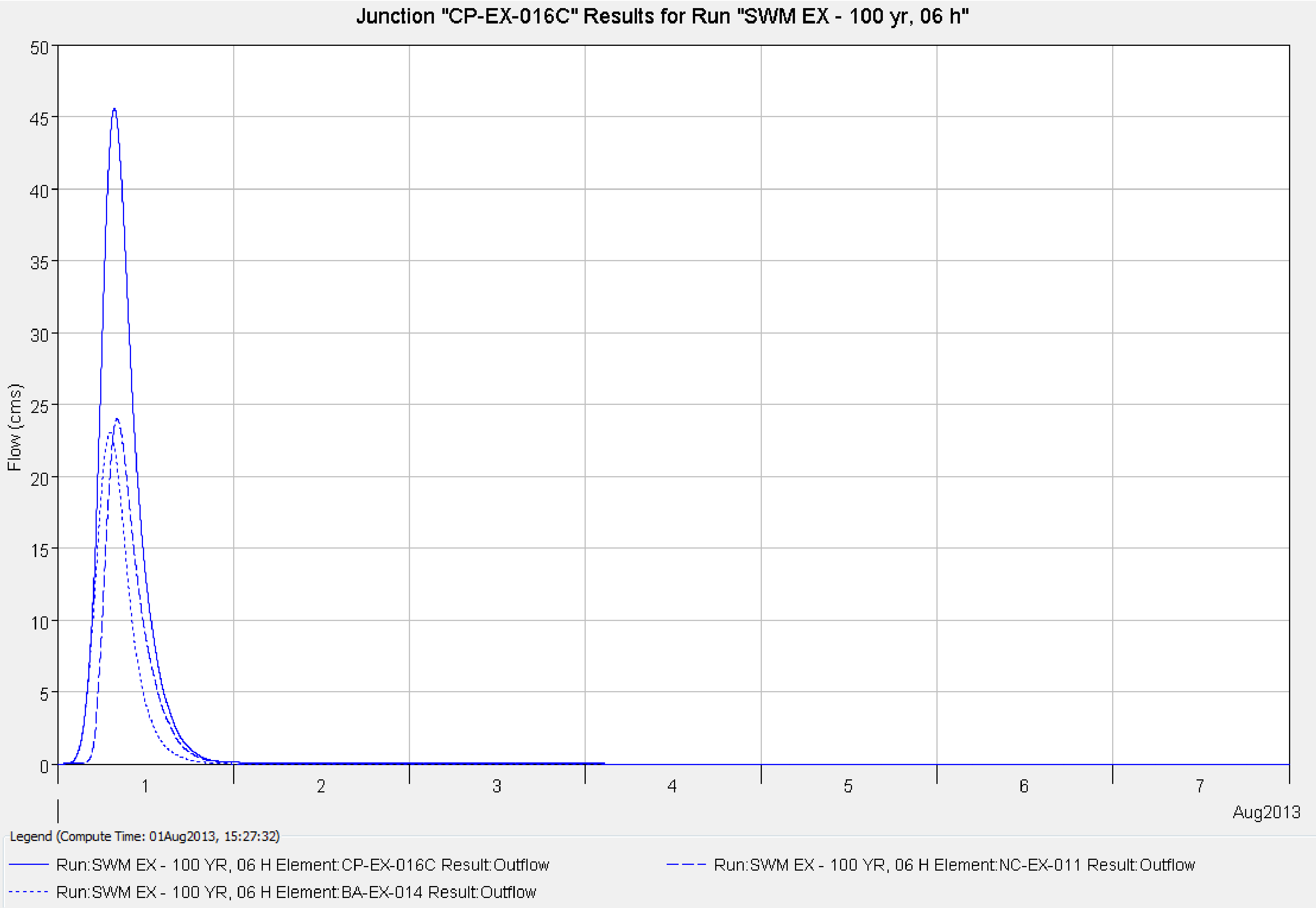
Junction "CP-EX-014" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-014 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-010 Result:Outflow

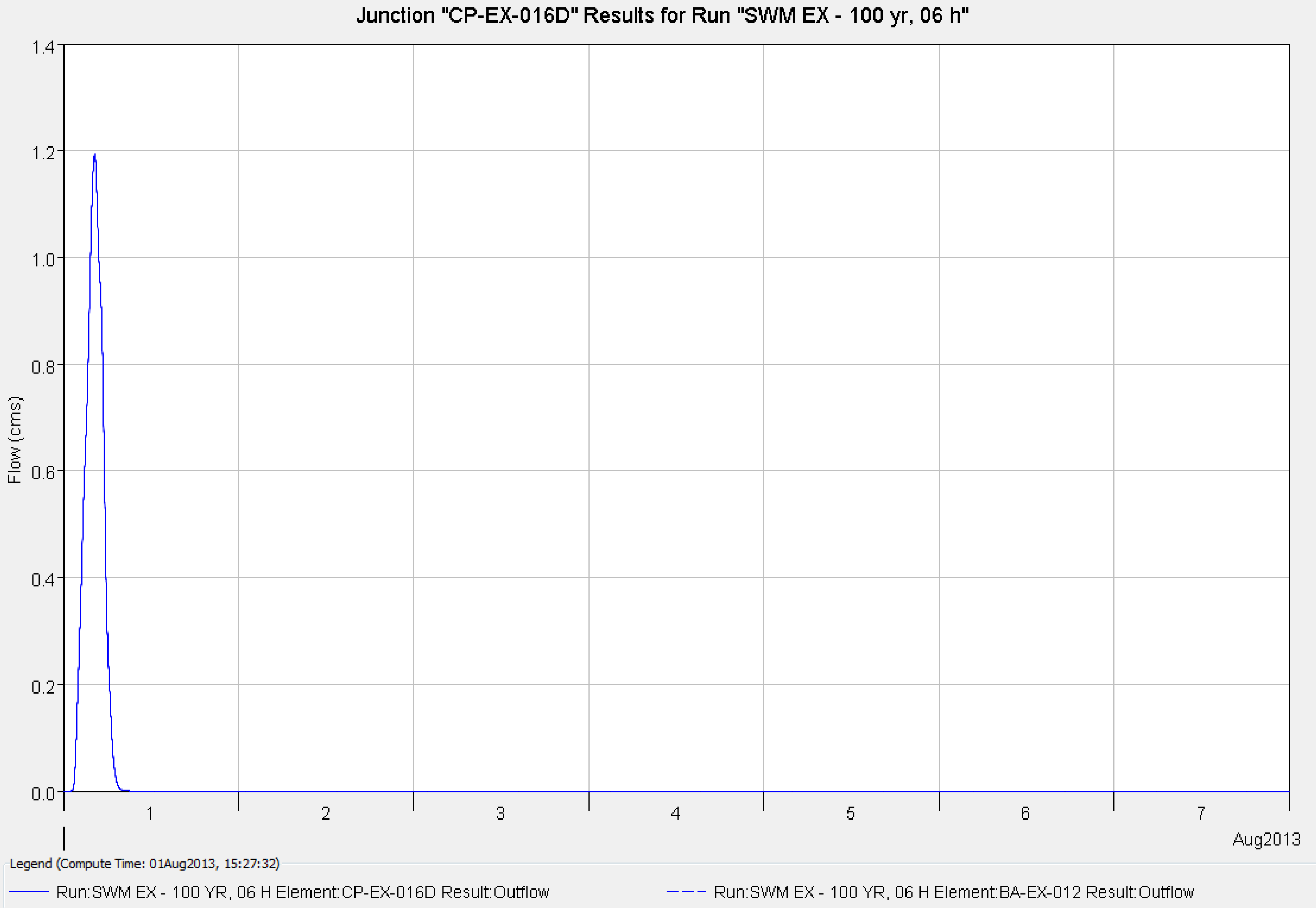

Junction "CP-EX-015" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-015 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-002 Result:Outflow



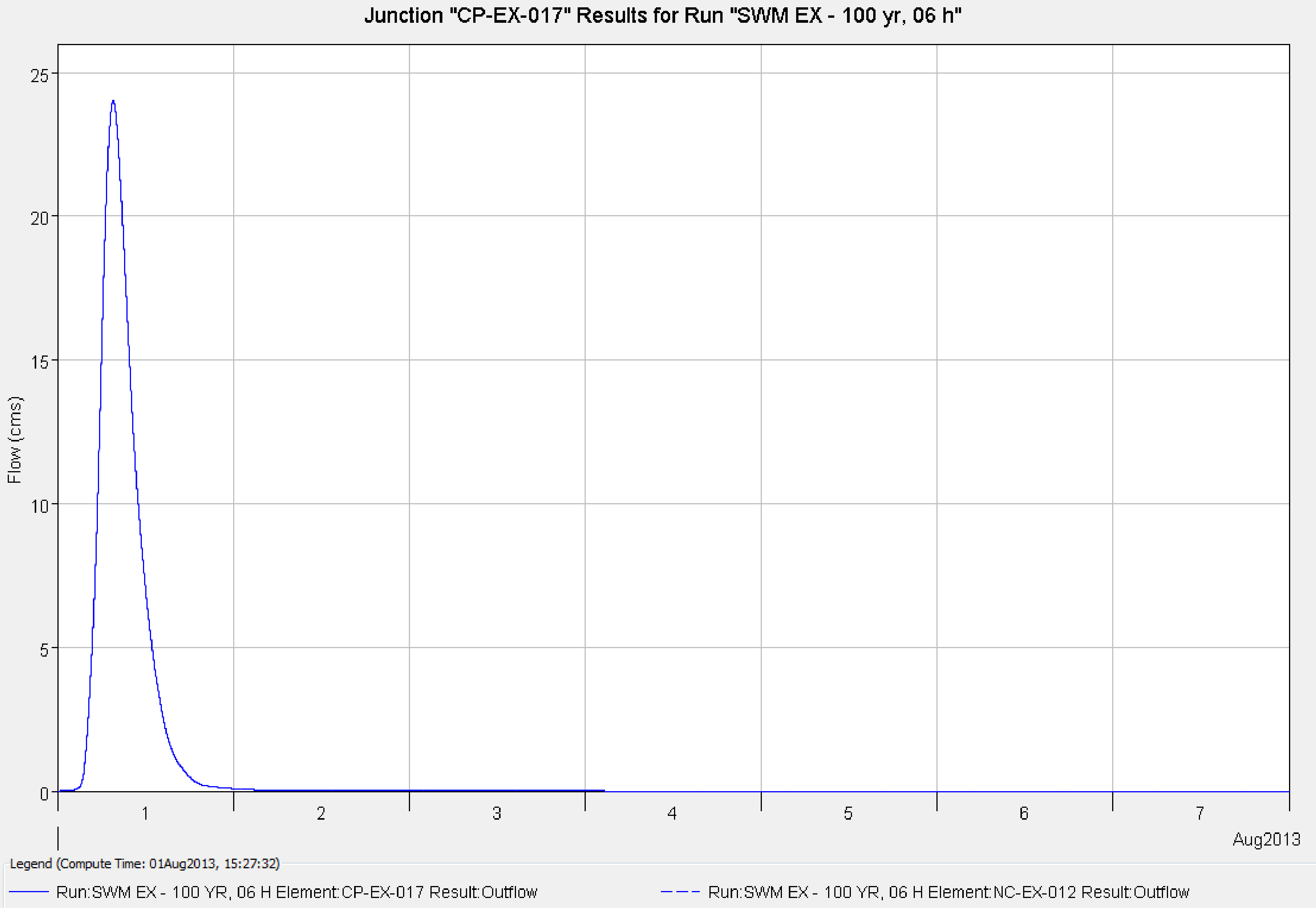
Junction "CP-EX-016A" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 yr, 06 h Element:CP-EX-016A Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-011 Result:Outflow

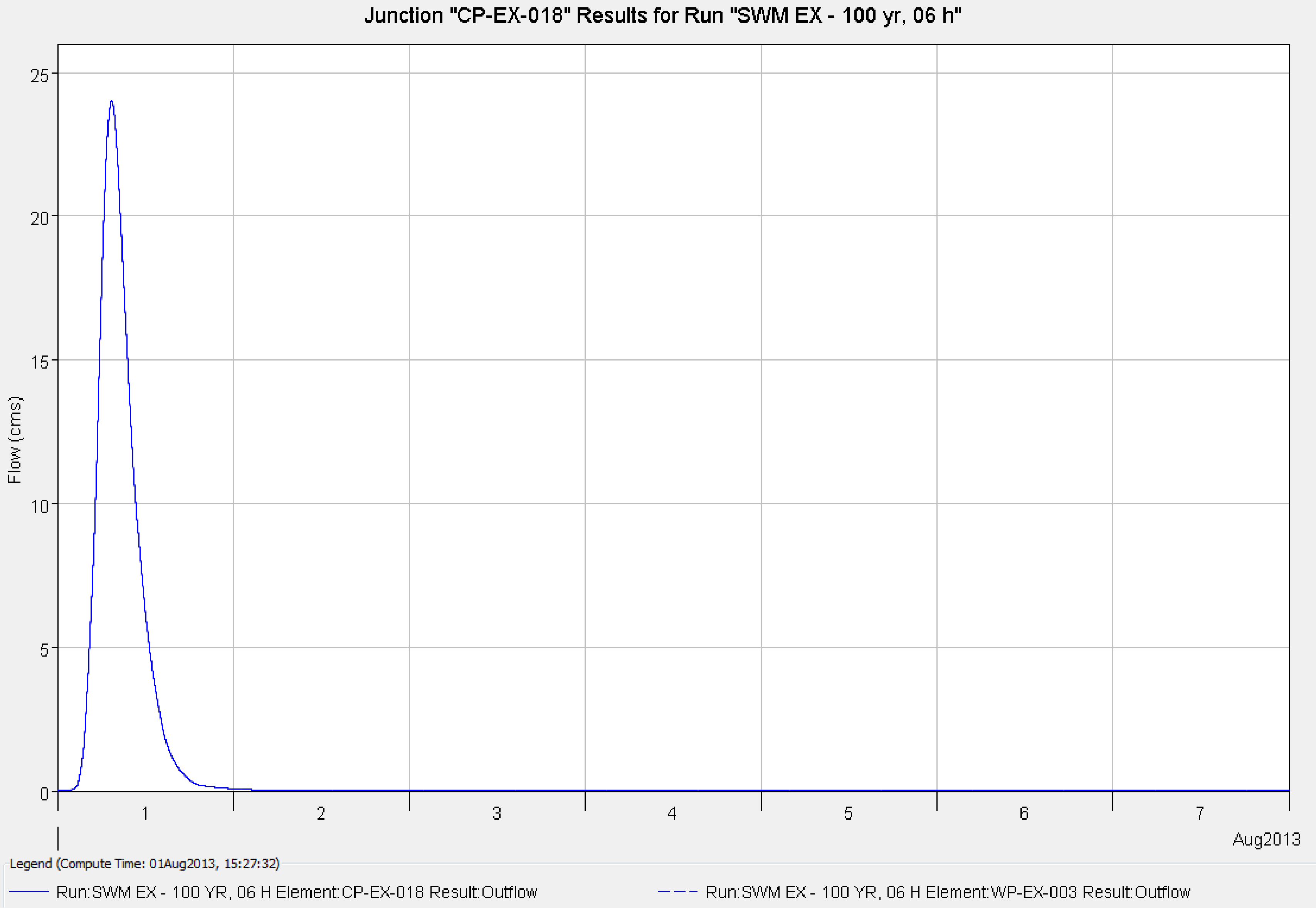

Junction "CP-EX-016B" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-016B Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-013 Result:Outflow


Junction "CP-EX-016C" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-016C Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-011 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-014 Result:Outflow

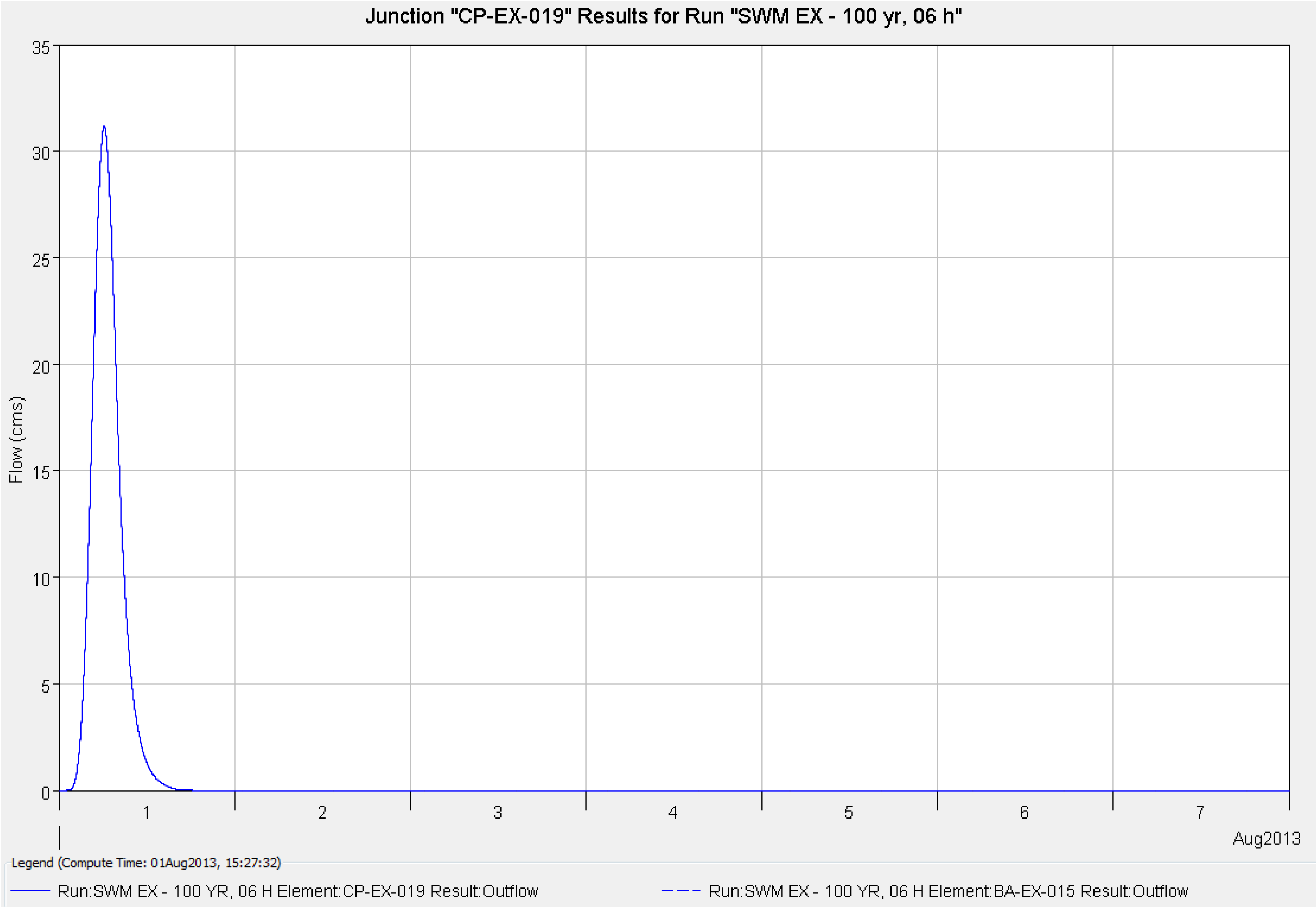


Junction "CP-EX-016D" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-016D Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-012 Result:Outflow

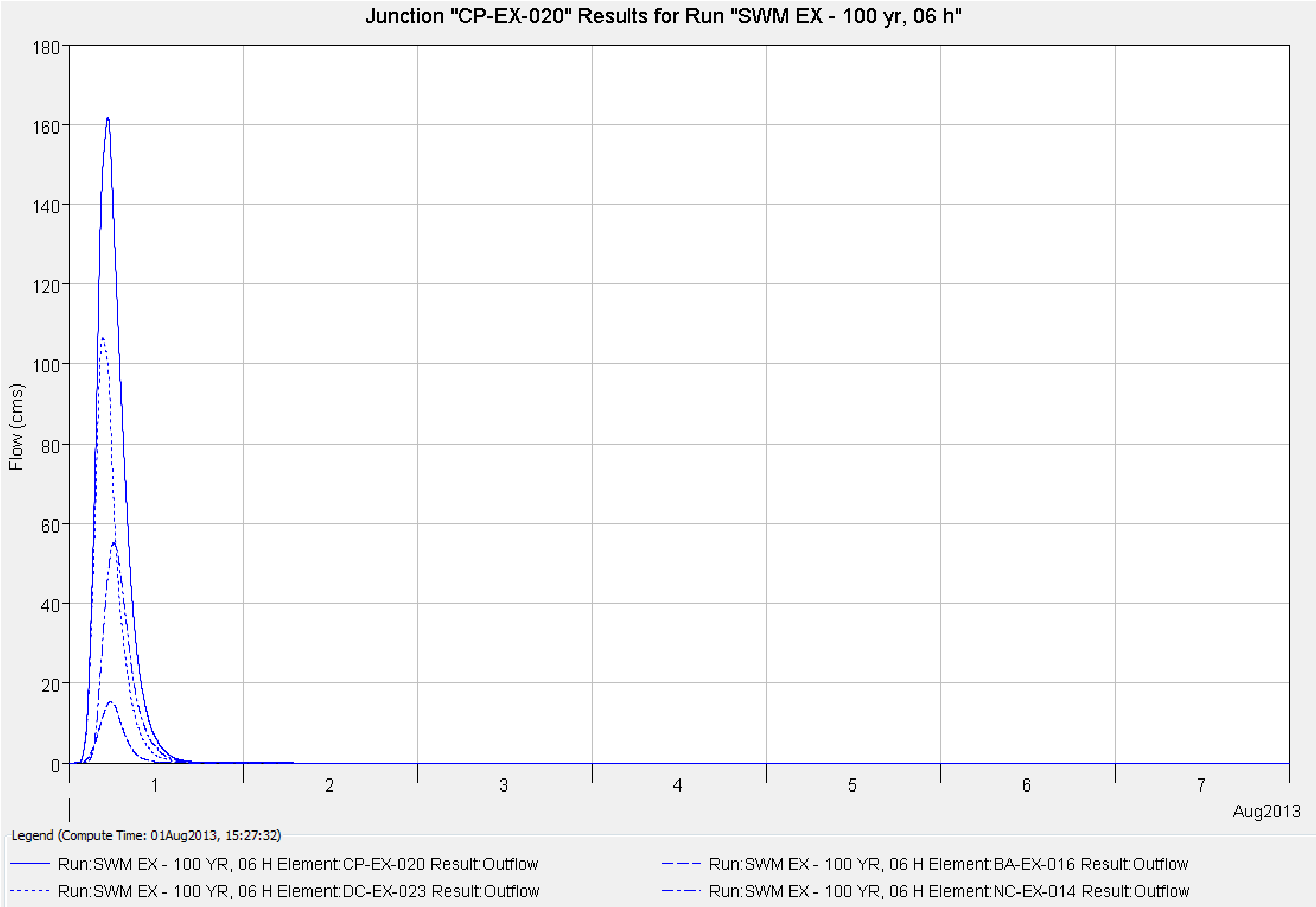

Junction "CP-EX-017" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-017 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-012 Result:Outflow



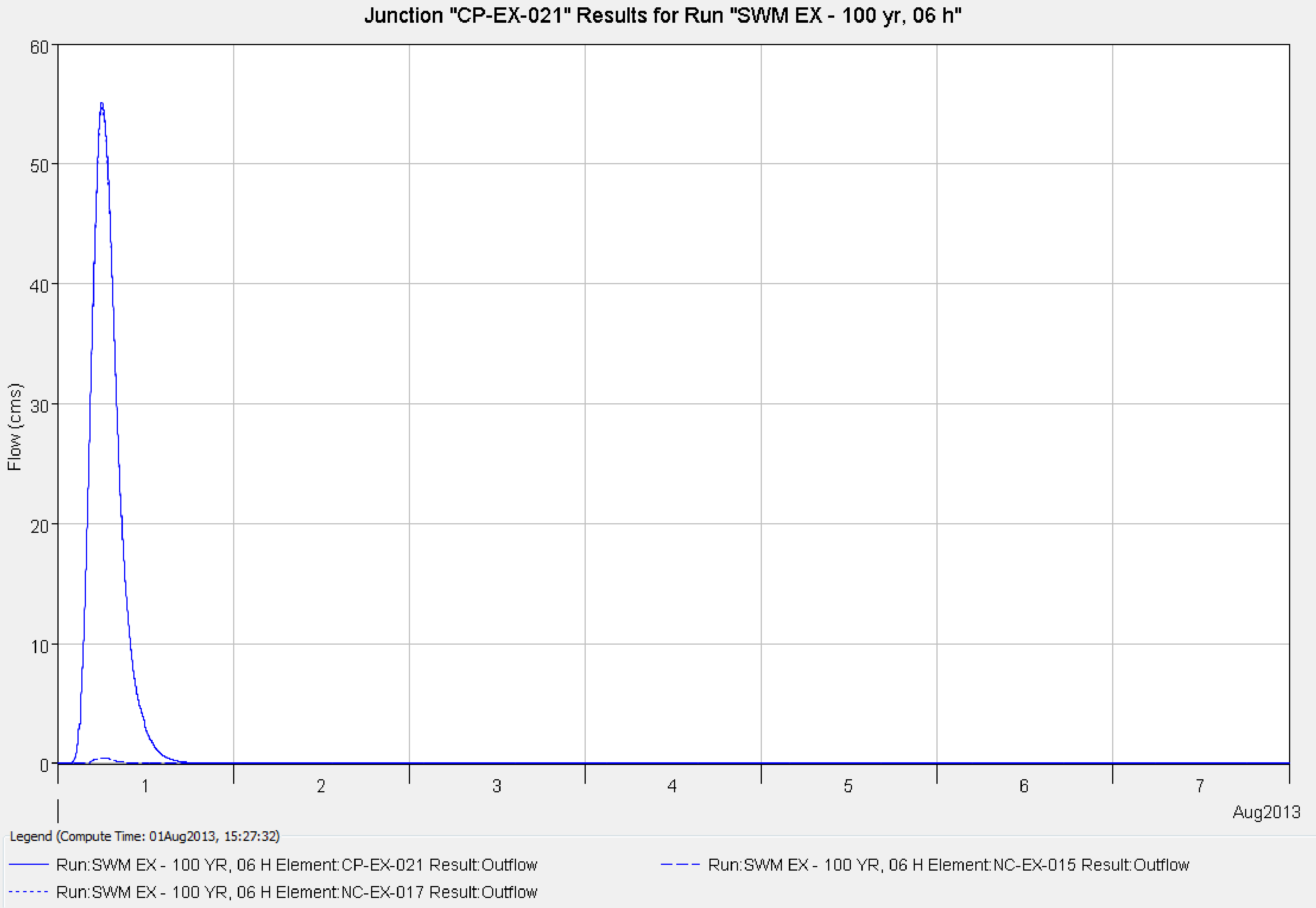
Junction "CP-EX-018" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-018 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-003 Result:Outflow



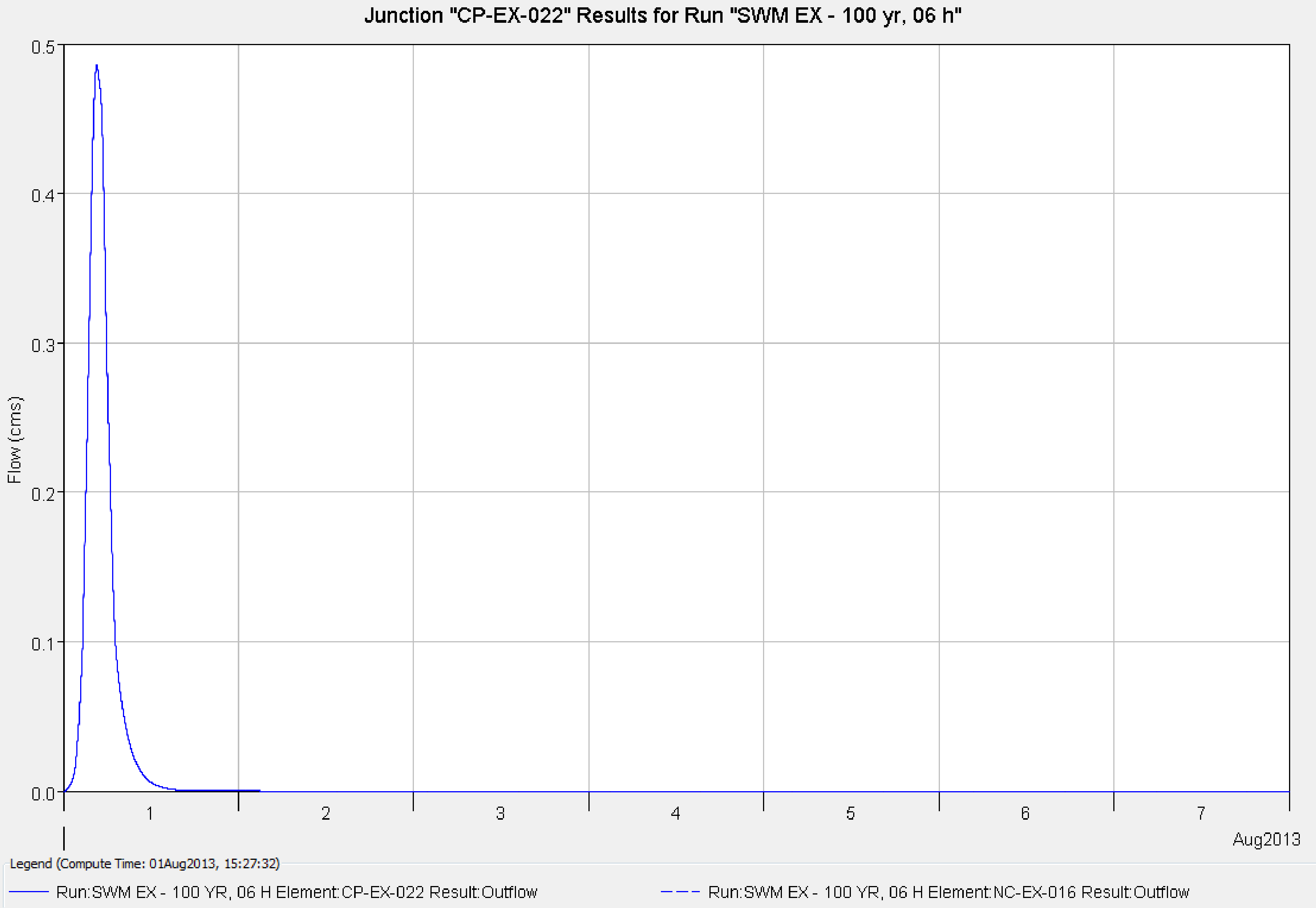
Junction "CP-EX-019" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-019 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-015 Result:Outflow



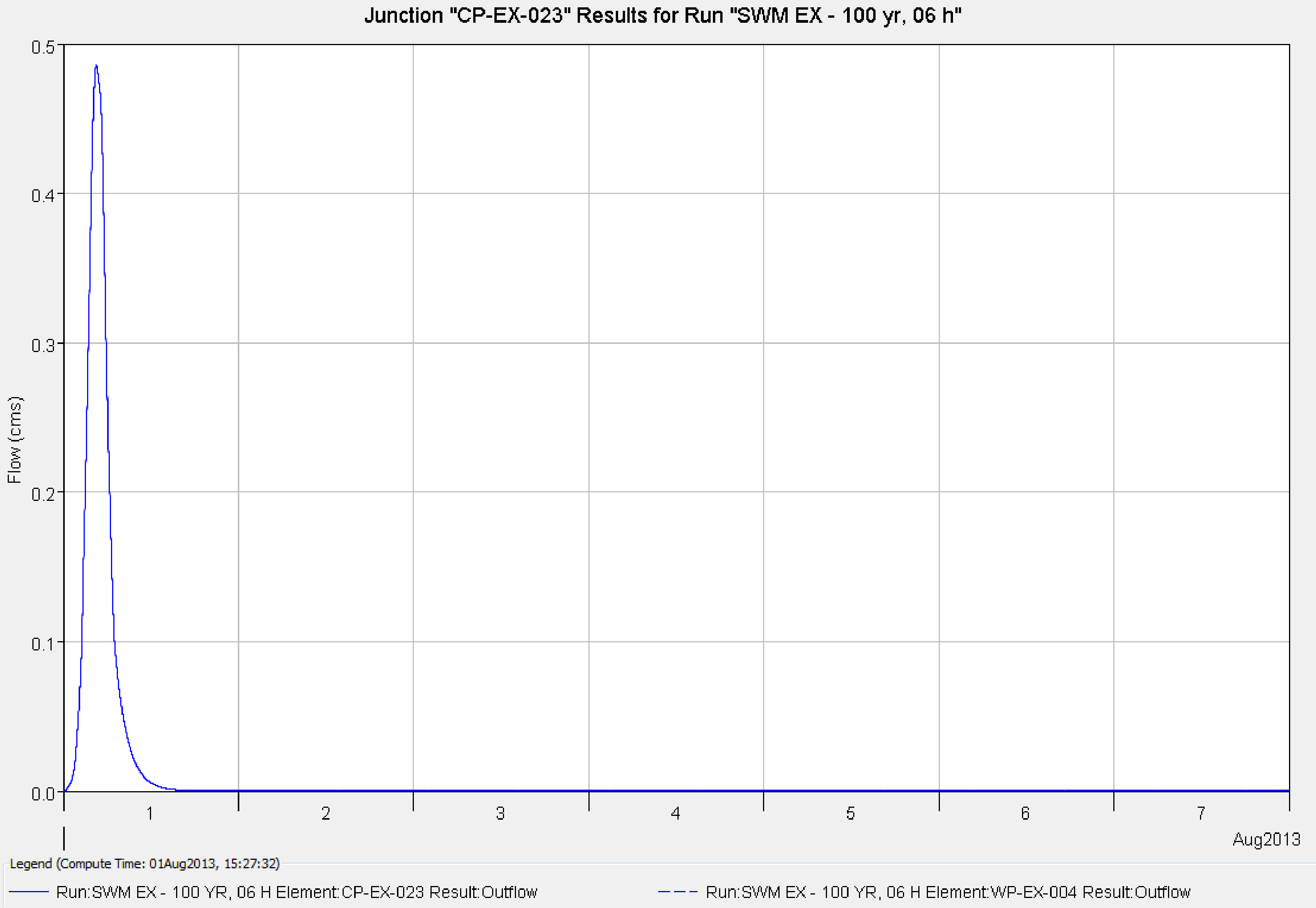
Junction "CP-EX-020" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-020 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-016 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-014 Result:Outflow



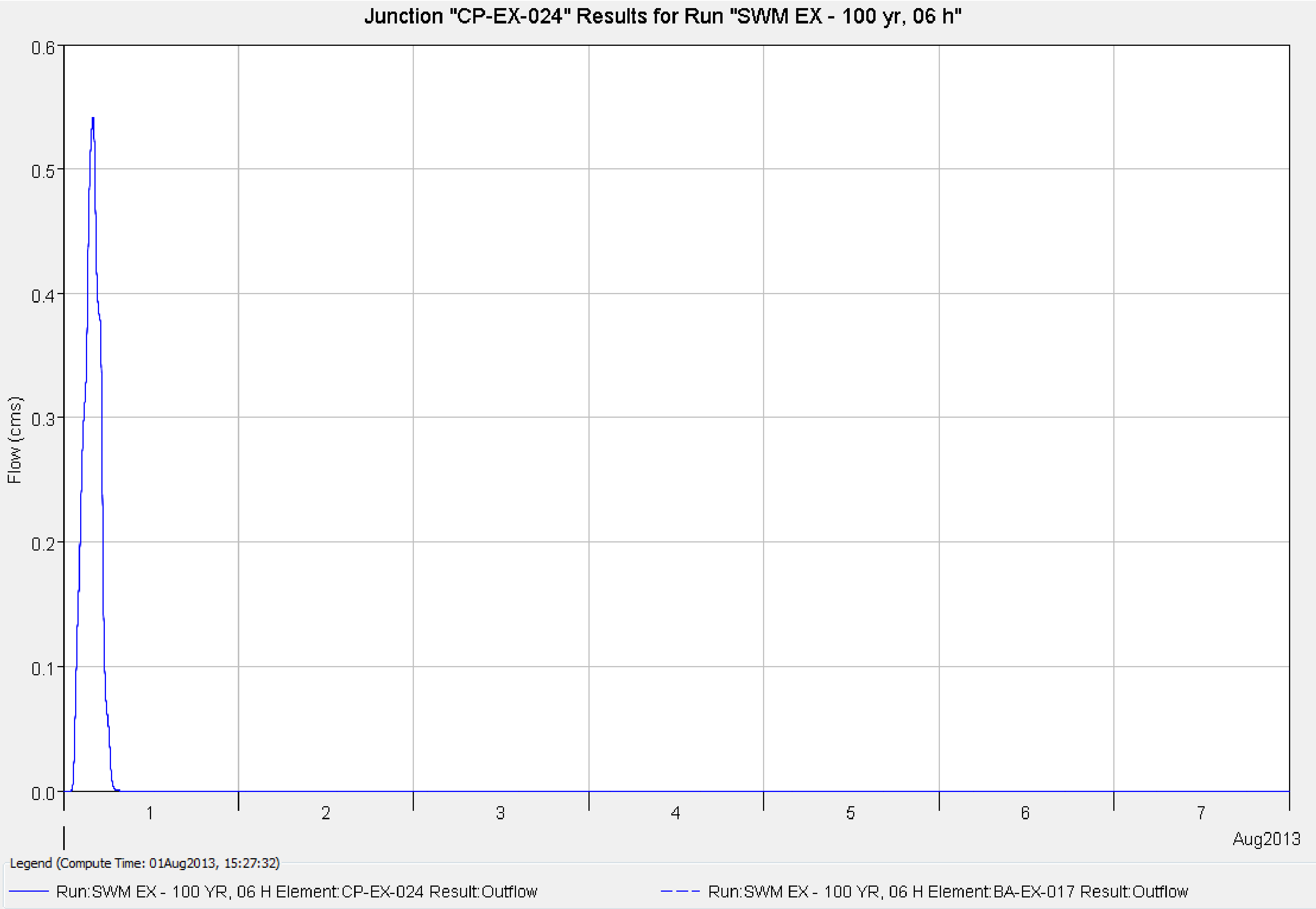
Junction "CP-EX-021" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
10
20
30
40
50
60
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-015 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-017 Result:Outflow



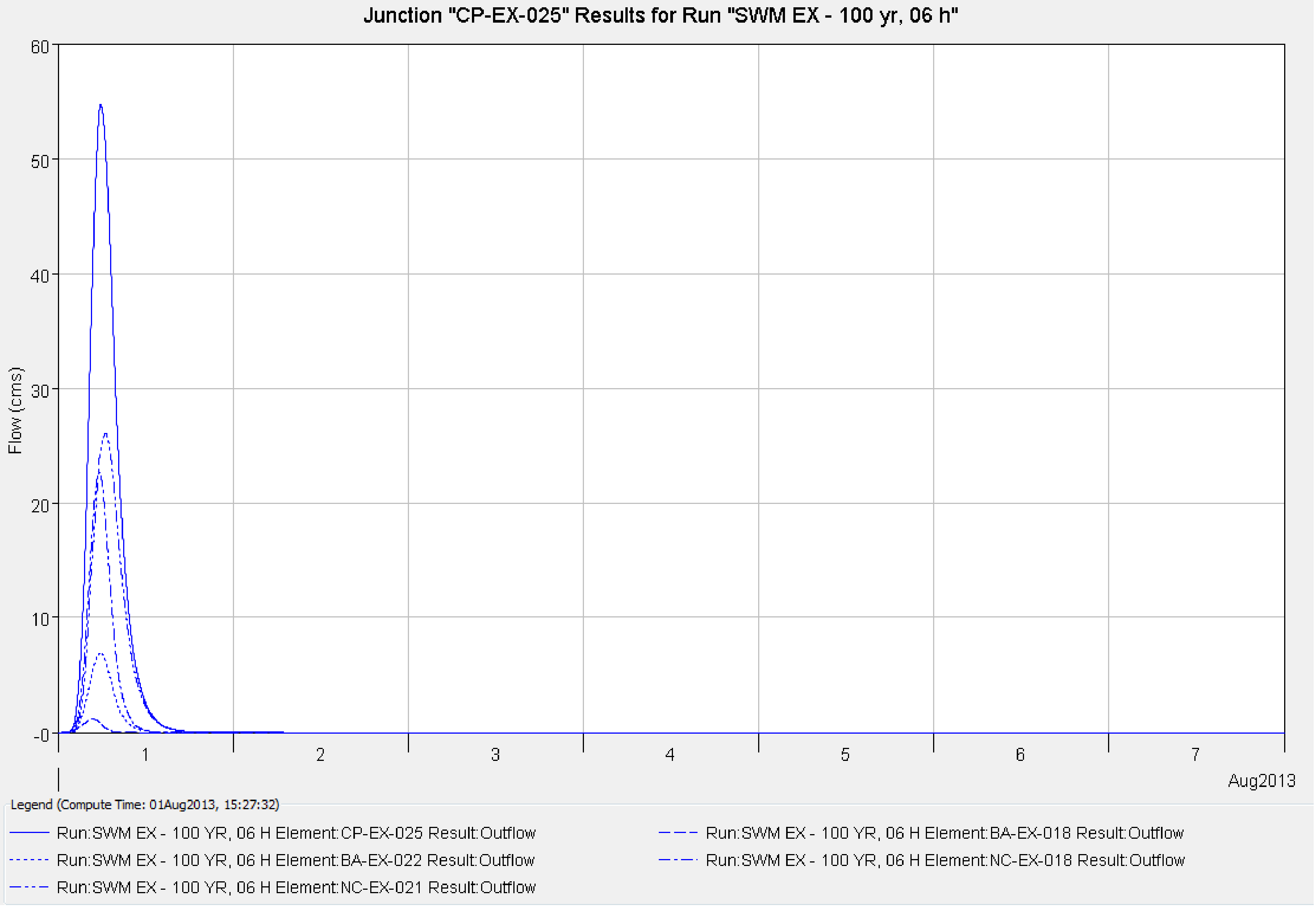
Junction "CP-EX-022" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-022 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-016 Result:Outflow



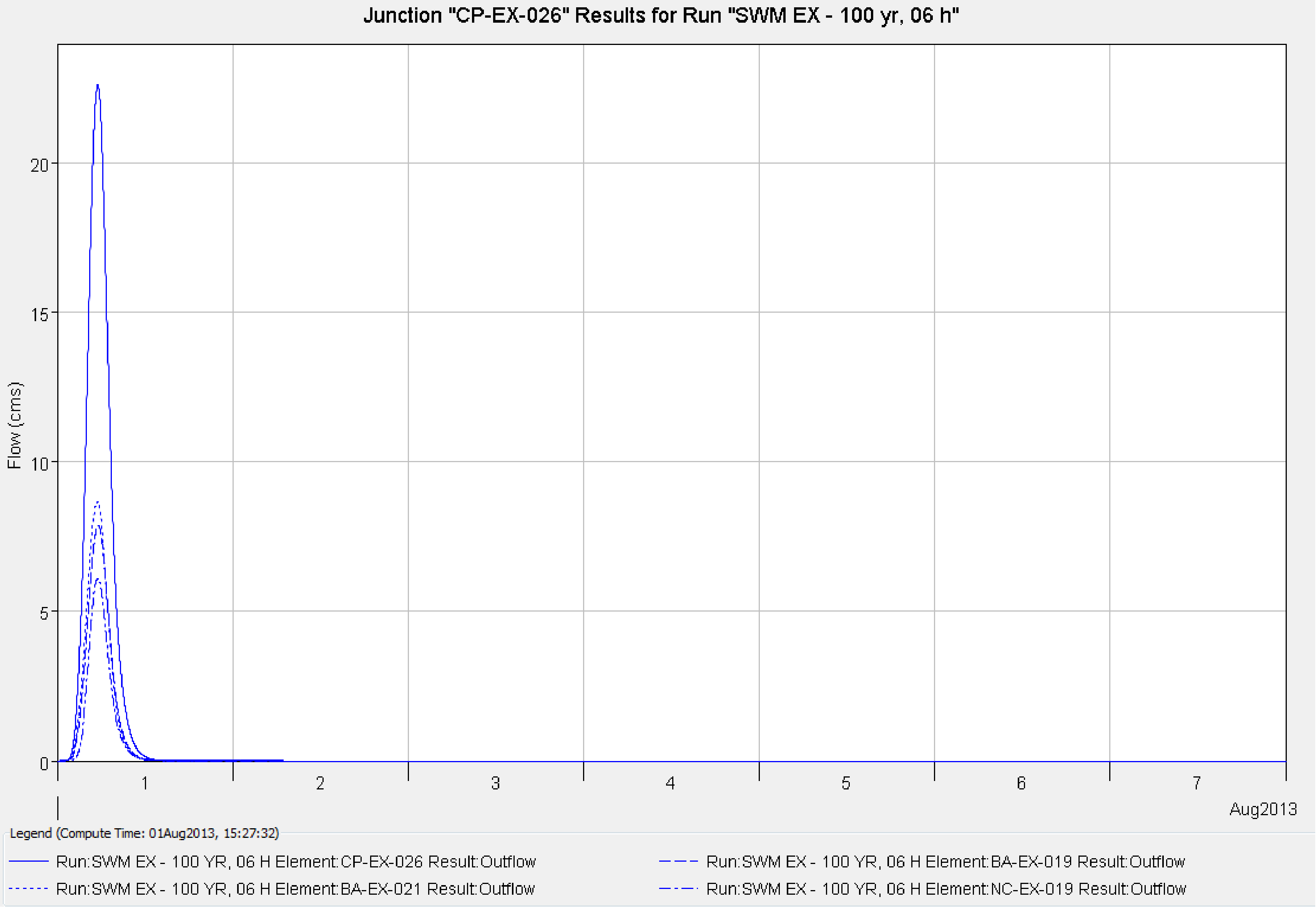
Junction "CP-EX-023" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-004 Result:Outflow

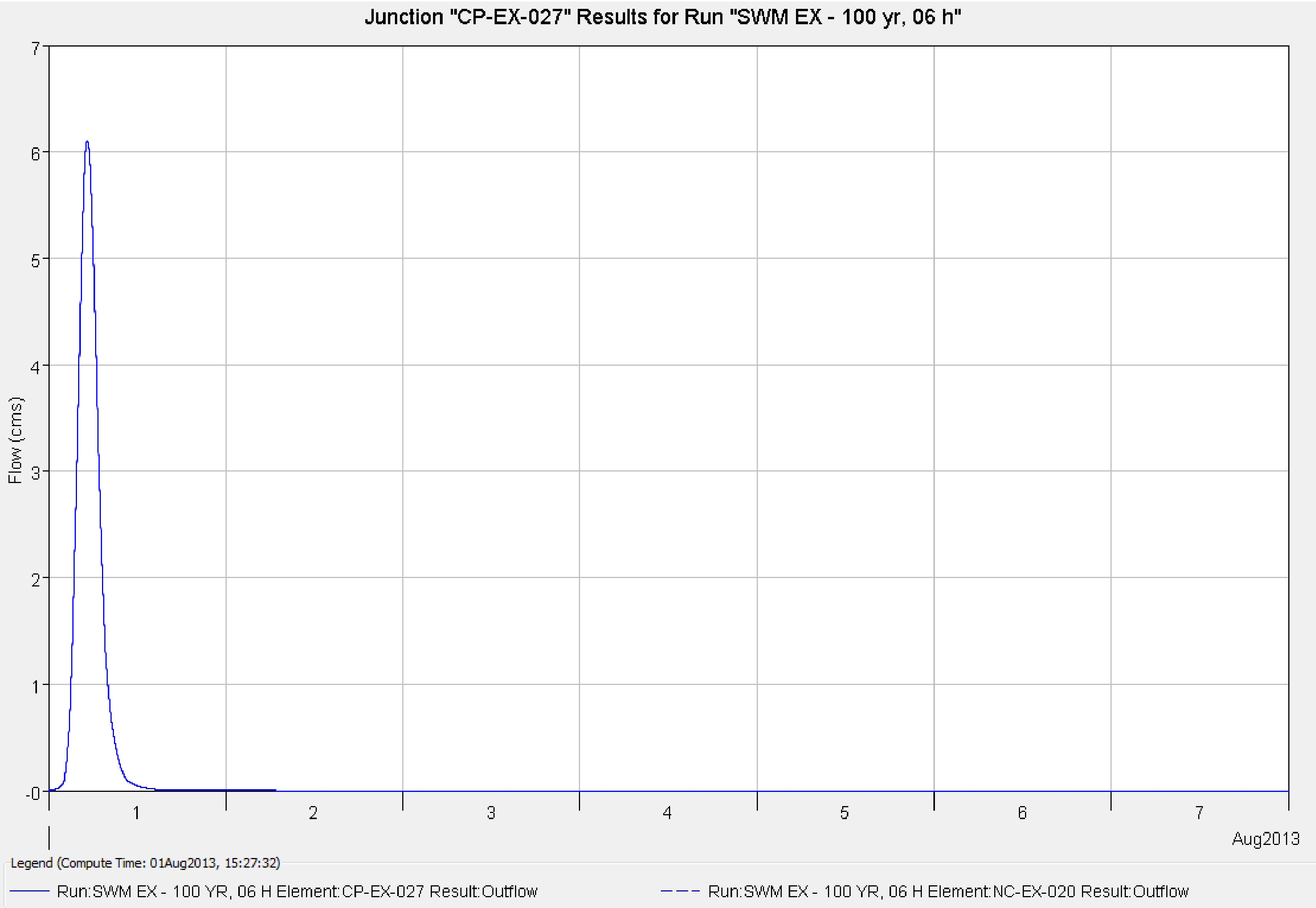


Junction "CP-EX-024" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-024 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-017 Result:Outflow

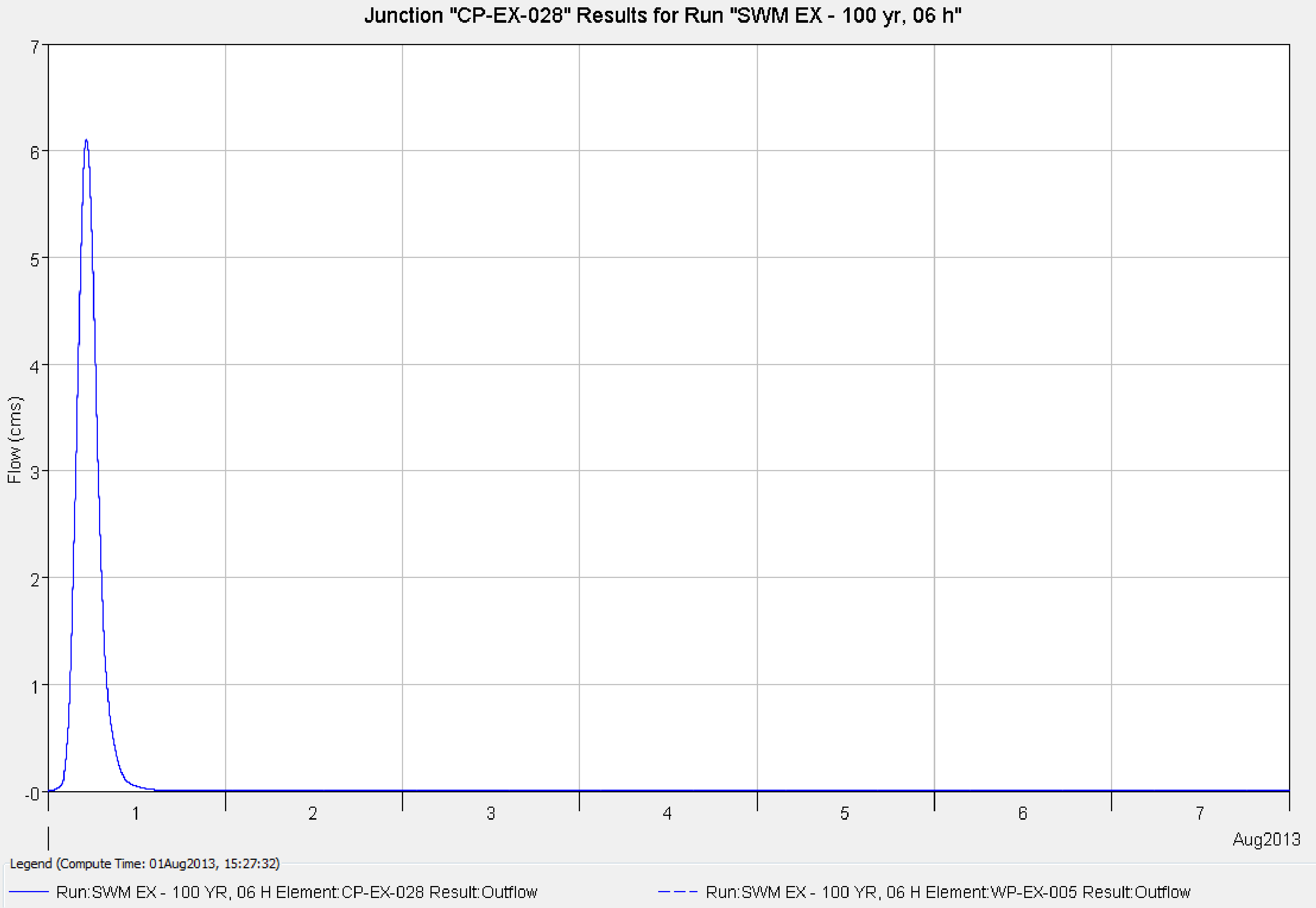


Junction "CP-EX-025" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
60
50
40
30
20
10
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-025 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-022 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-018 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-018 Result:Outflow

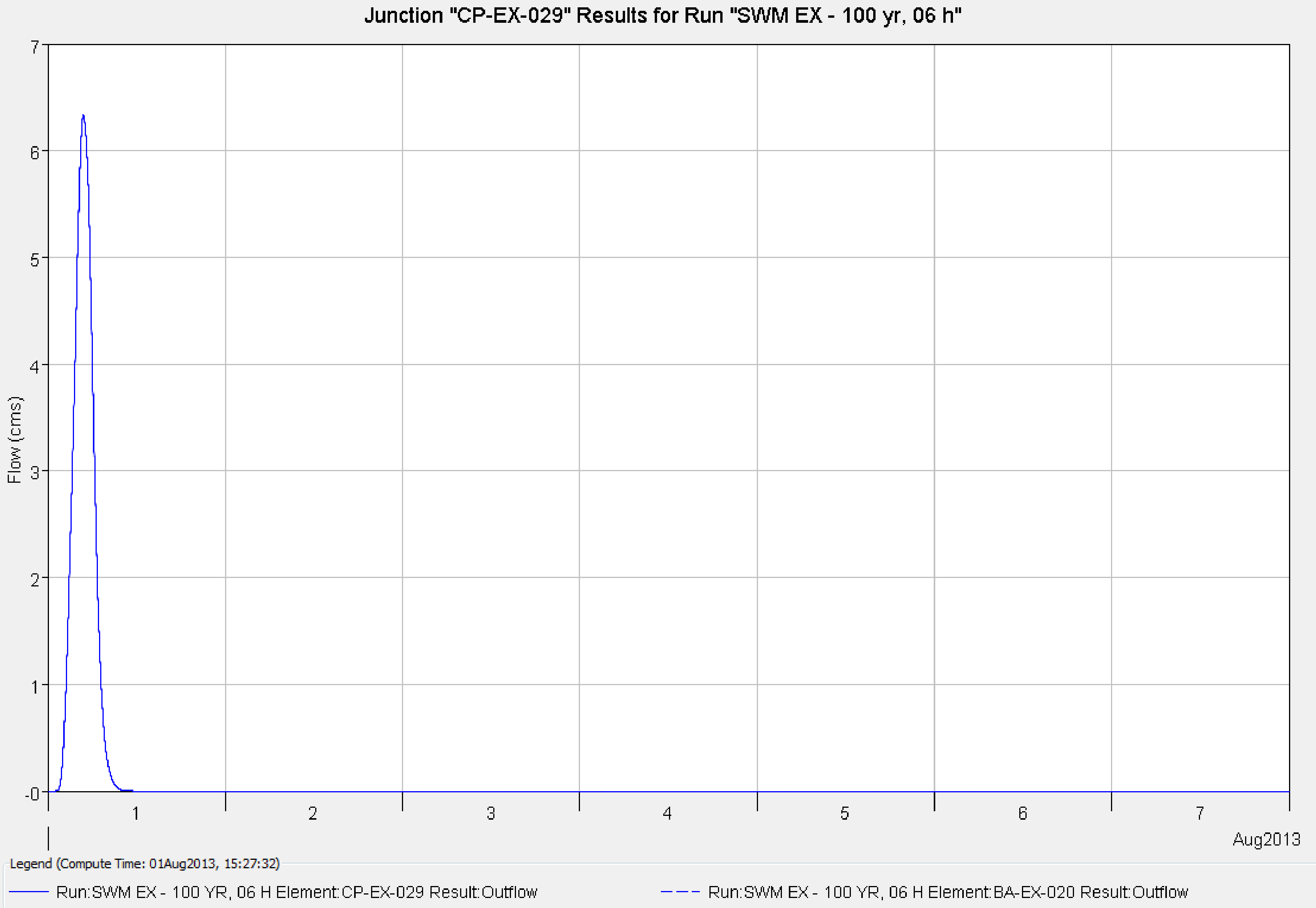

Junction "CP-EX-026" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-019 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-019 Result:Outflow

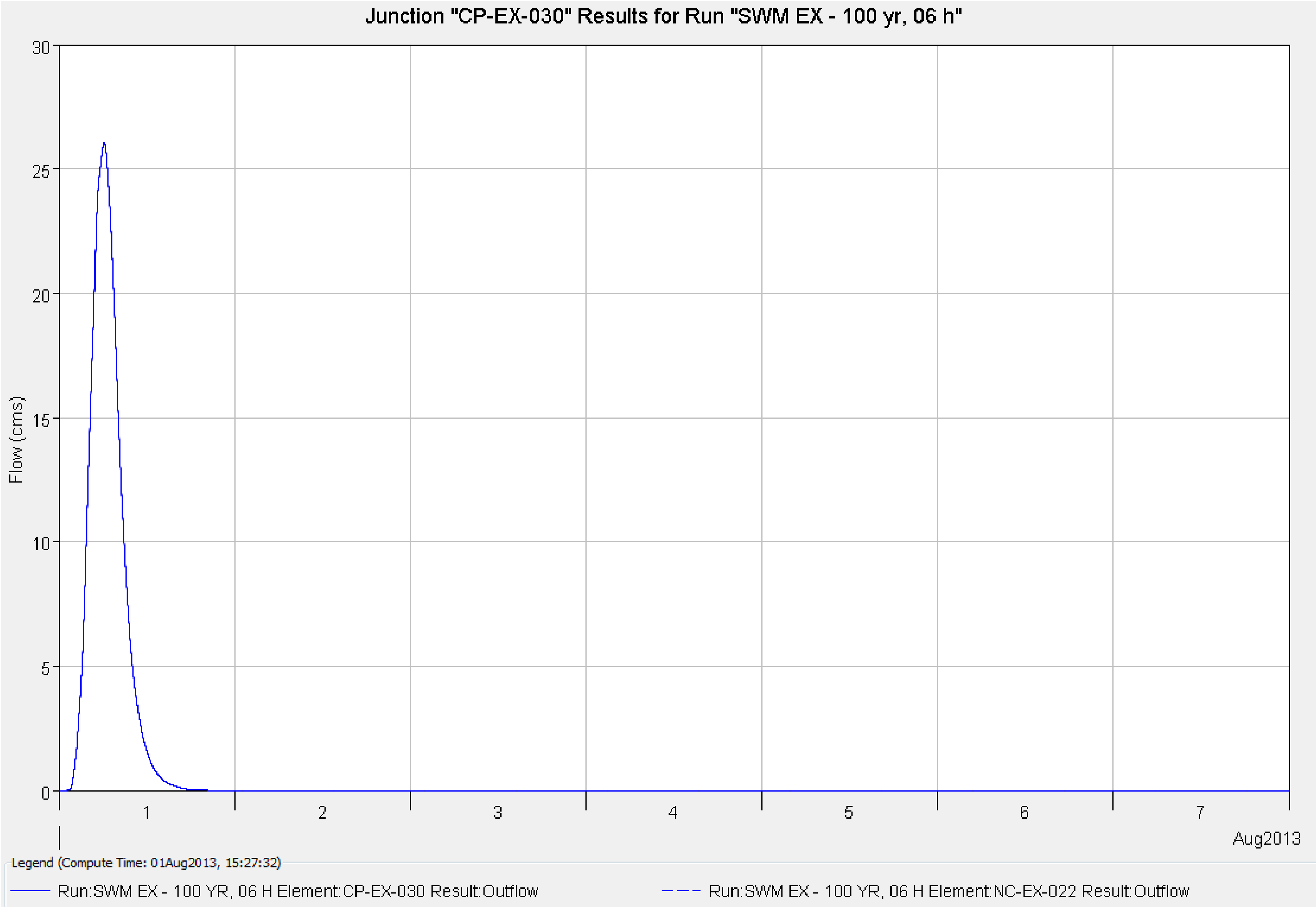


Junction "CP-EX-027" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-027 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-020 Result:Outflow

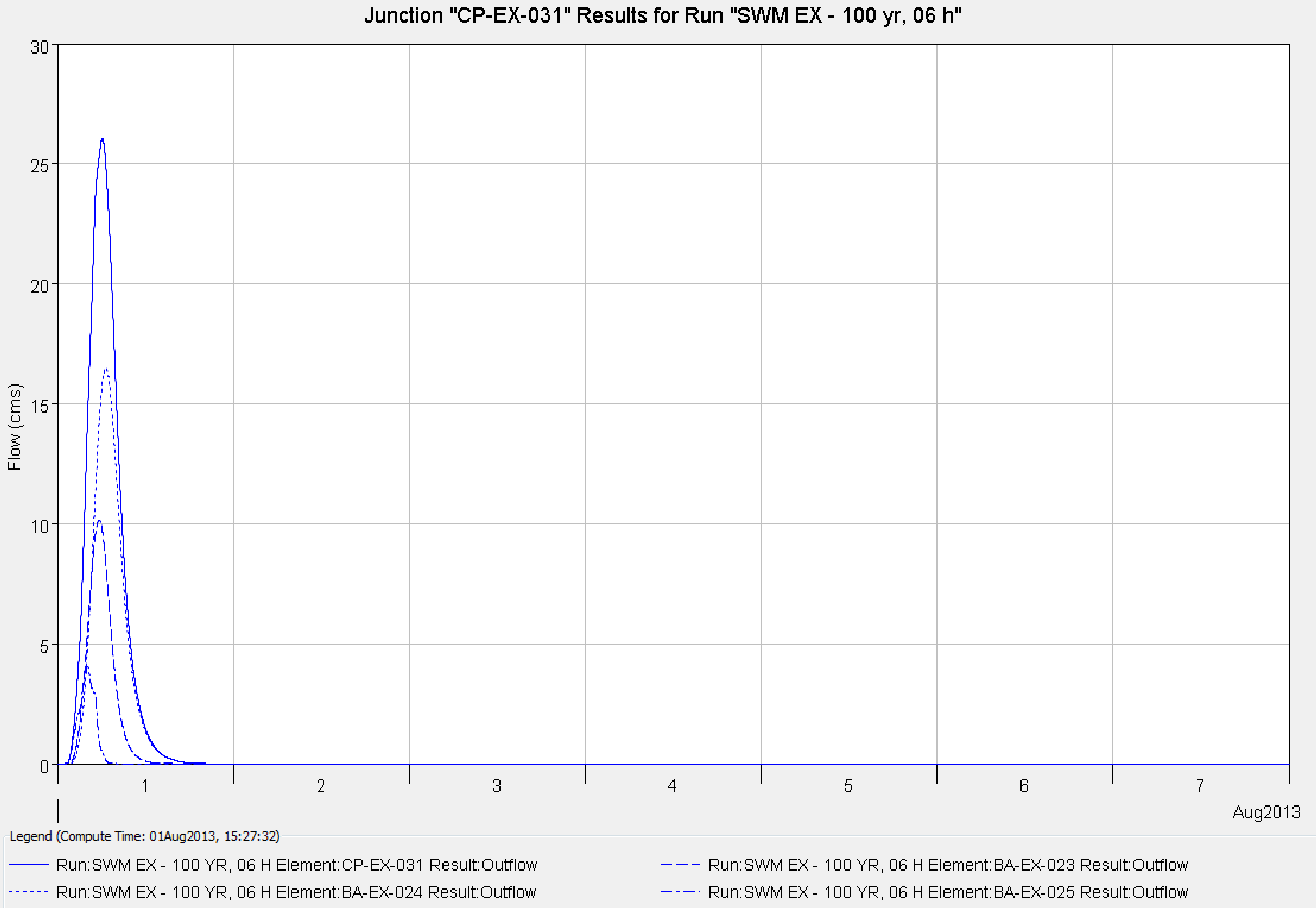


Junction "CP-EX-028" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-005 Result:Outflow

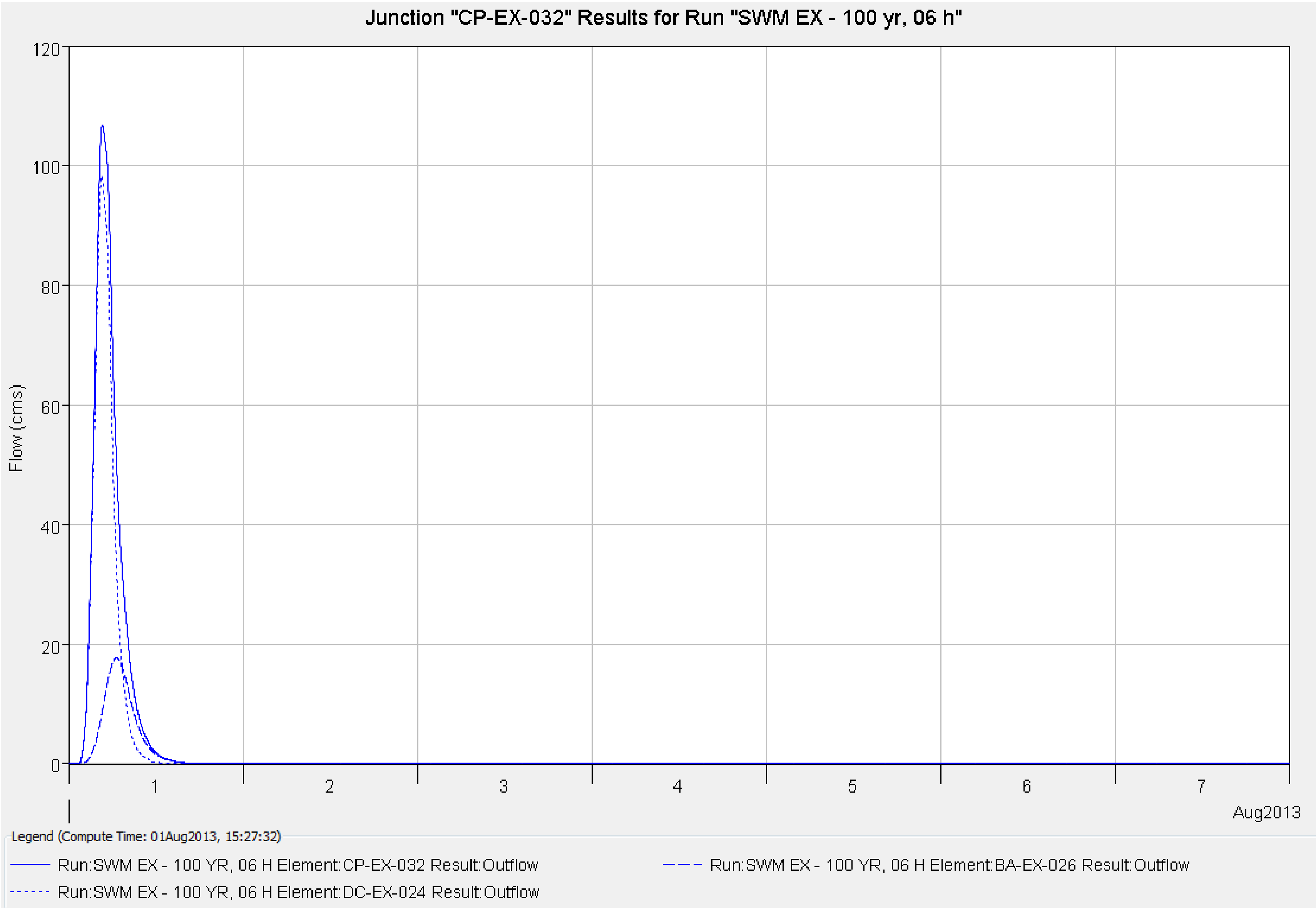

Junction "CP-EX-029" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-029 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-020 Result:Outflow



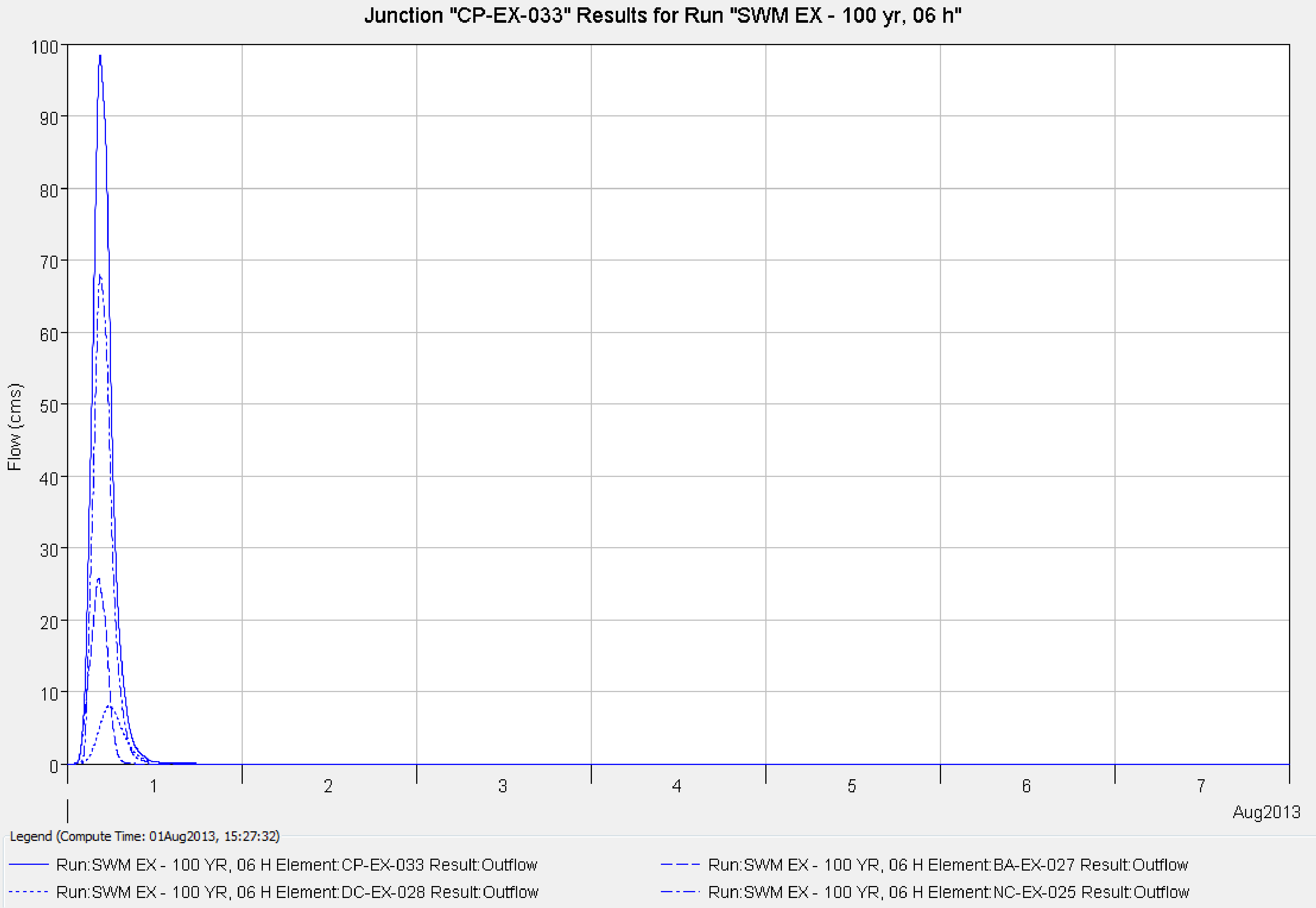
Junction "CP-EX-030" Results for Run "SWM EX - 100 yr, 06 h"
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-030 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-022 Result:Outflow

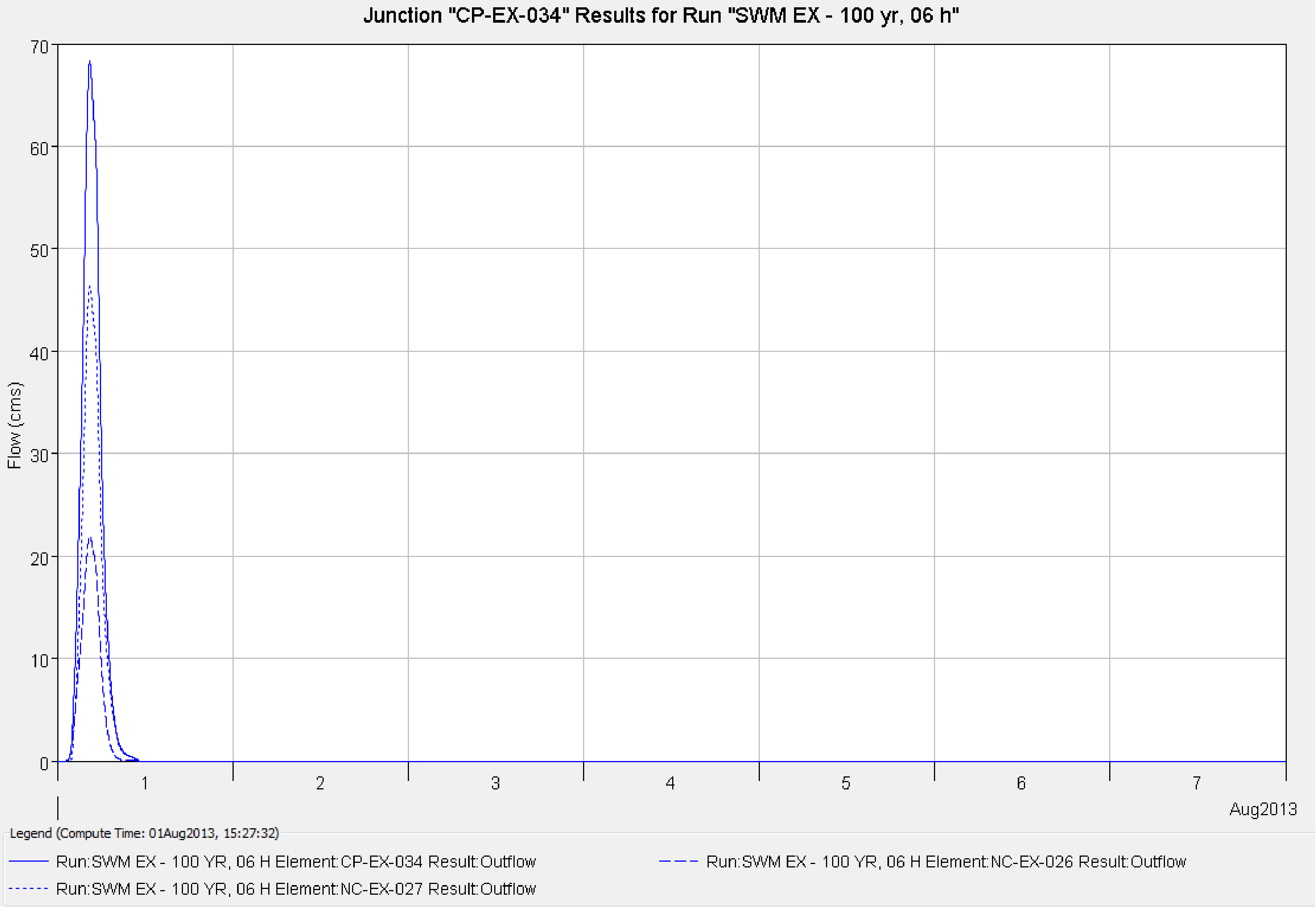


Junction "CP-EX-031" Results for Run "SWM EX - 100 yr, 06 h"
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-031 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-024 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-025 Result:Outflow

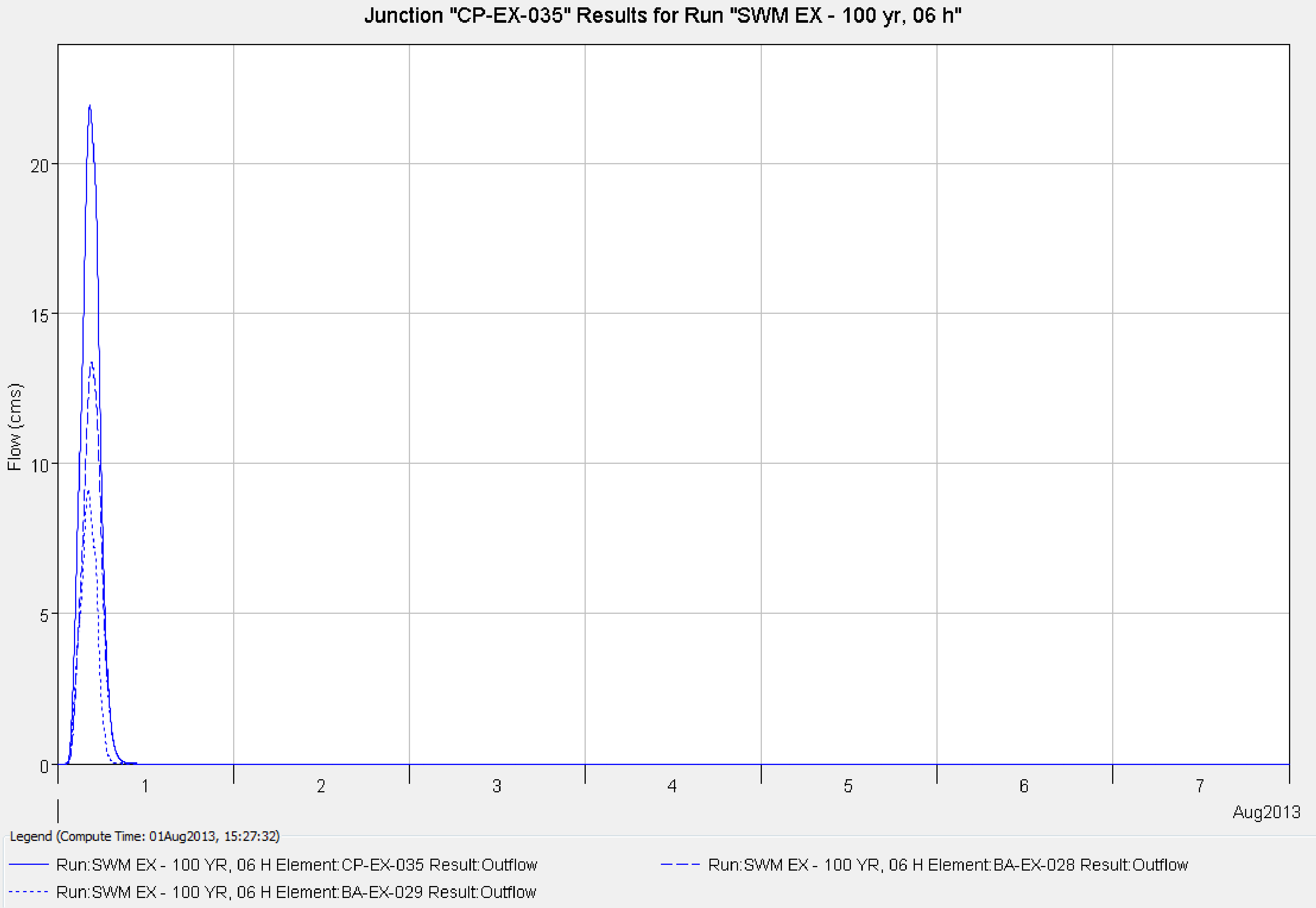


Junction "CP-EX-032" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-032 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-024 Result:Outflow

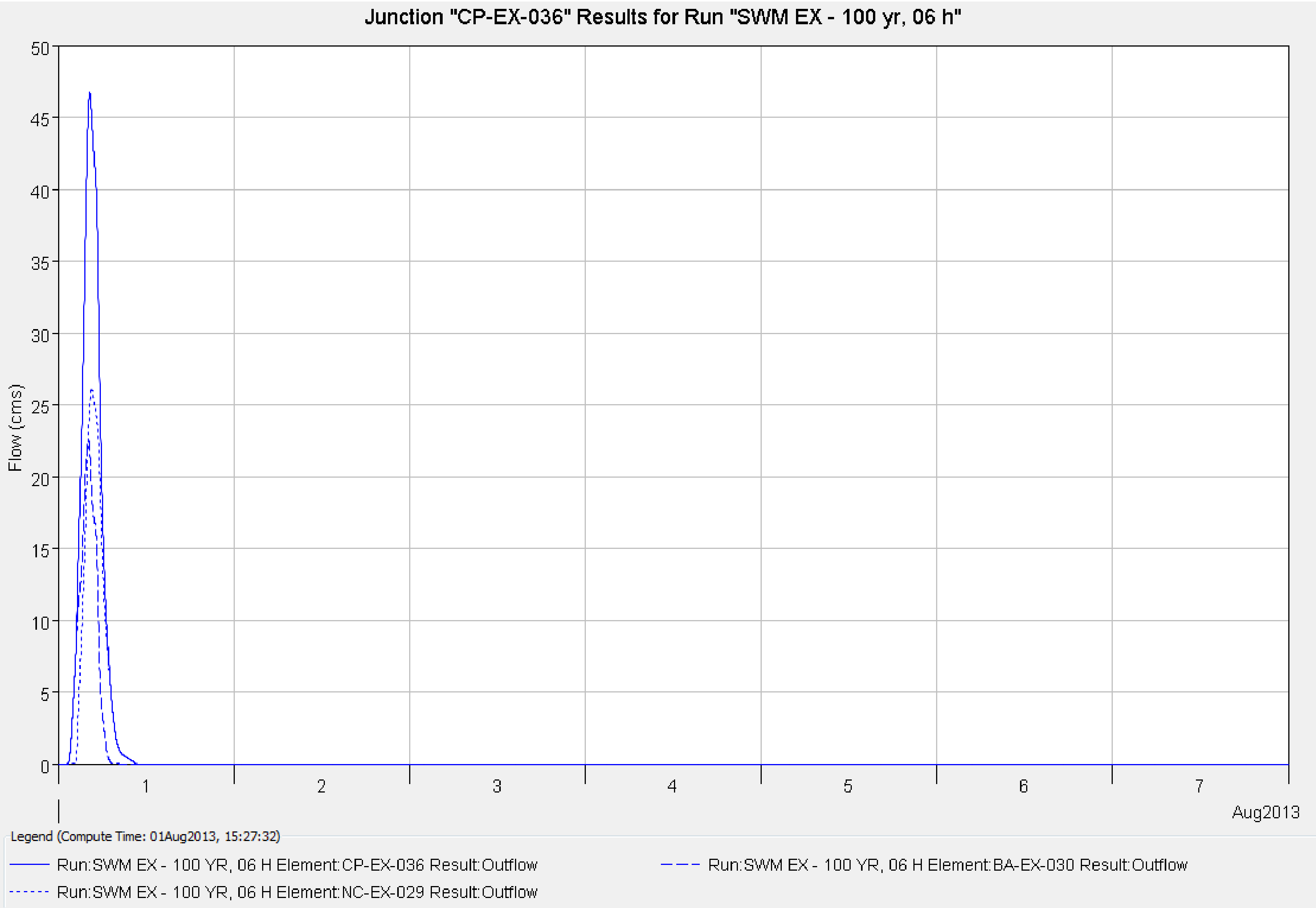

Junction "CP-EX-033" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-033 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-027 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-025 Result:Outflow



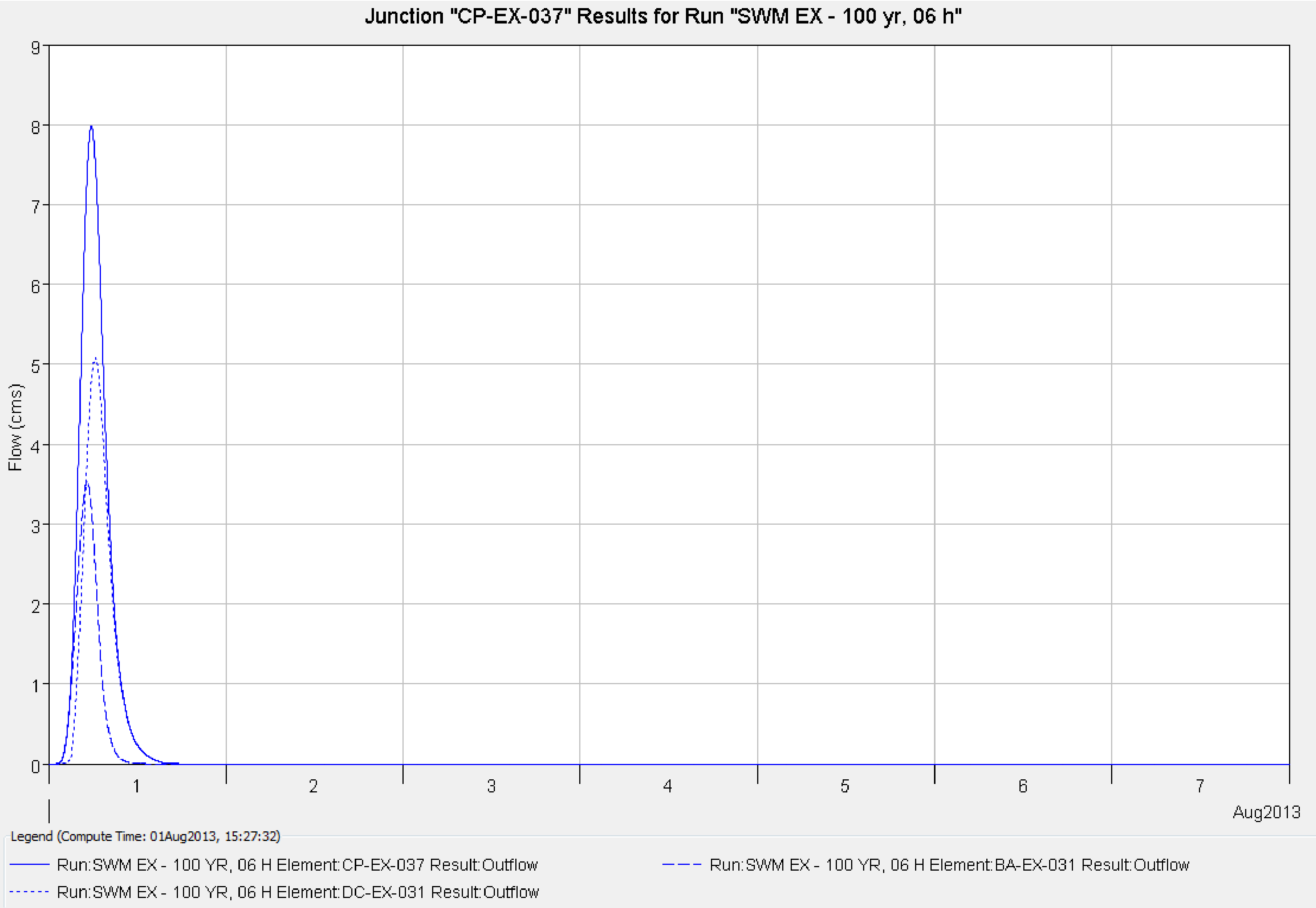
Junction "CP-EX-034" Results for Run "SWM EX - 100 yr, 06 h"
70
60
50
40
30
20
10
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-034 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-027 Result:Outflow



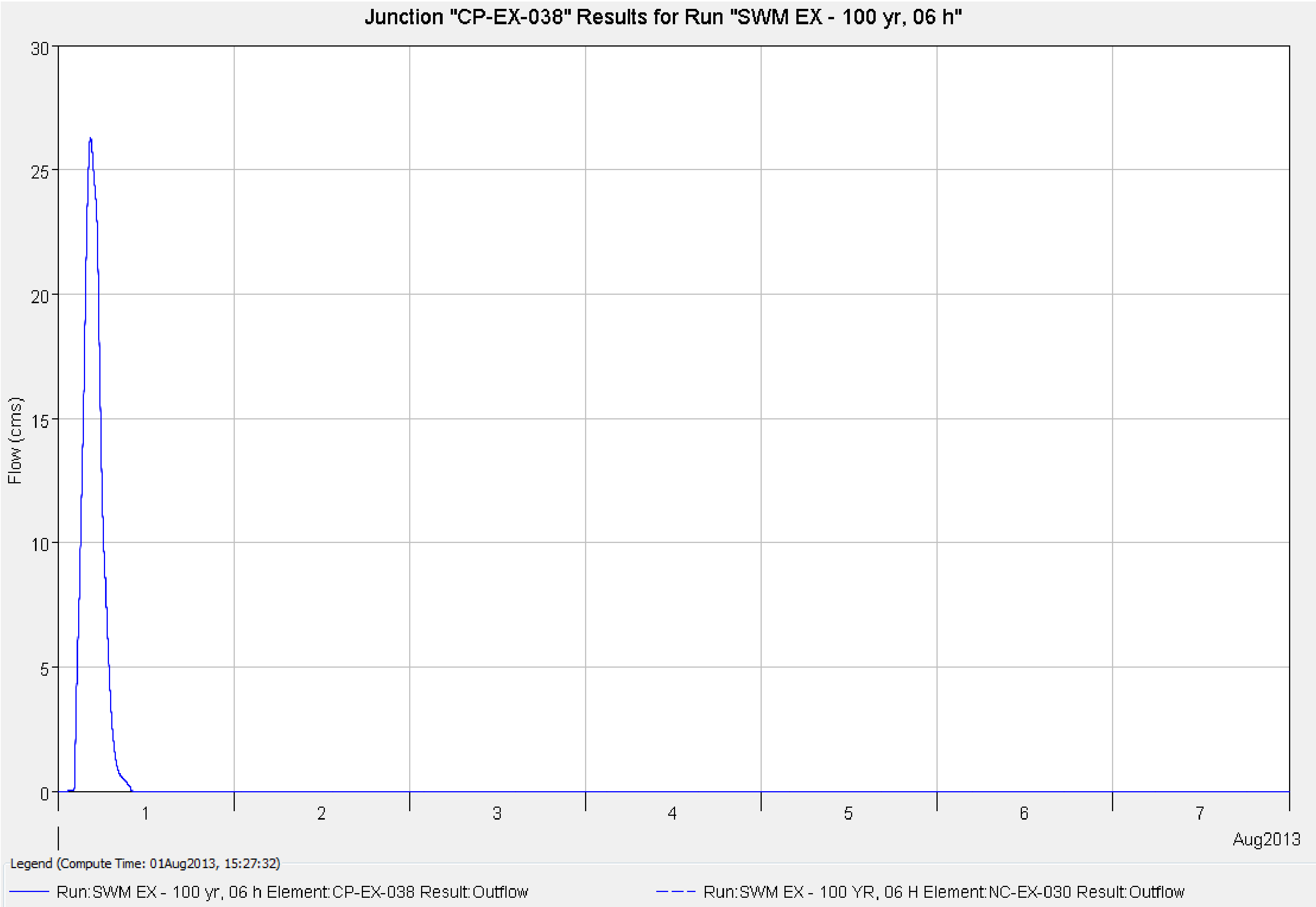
Junction "CP-EX-035" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-035 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-029 Result:Outflow



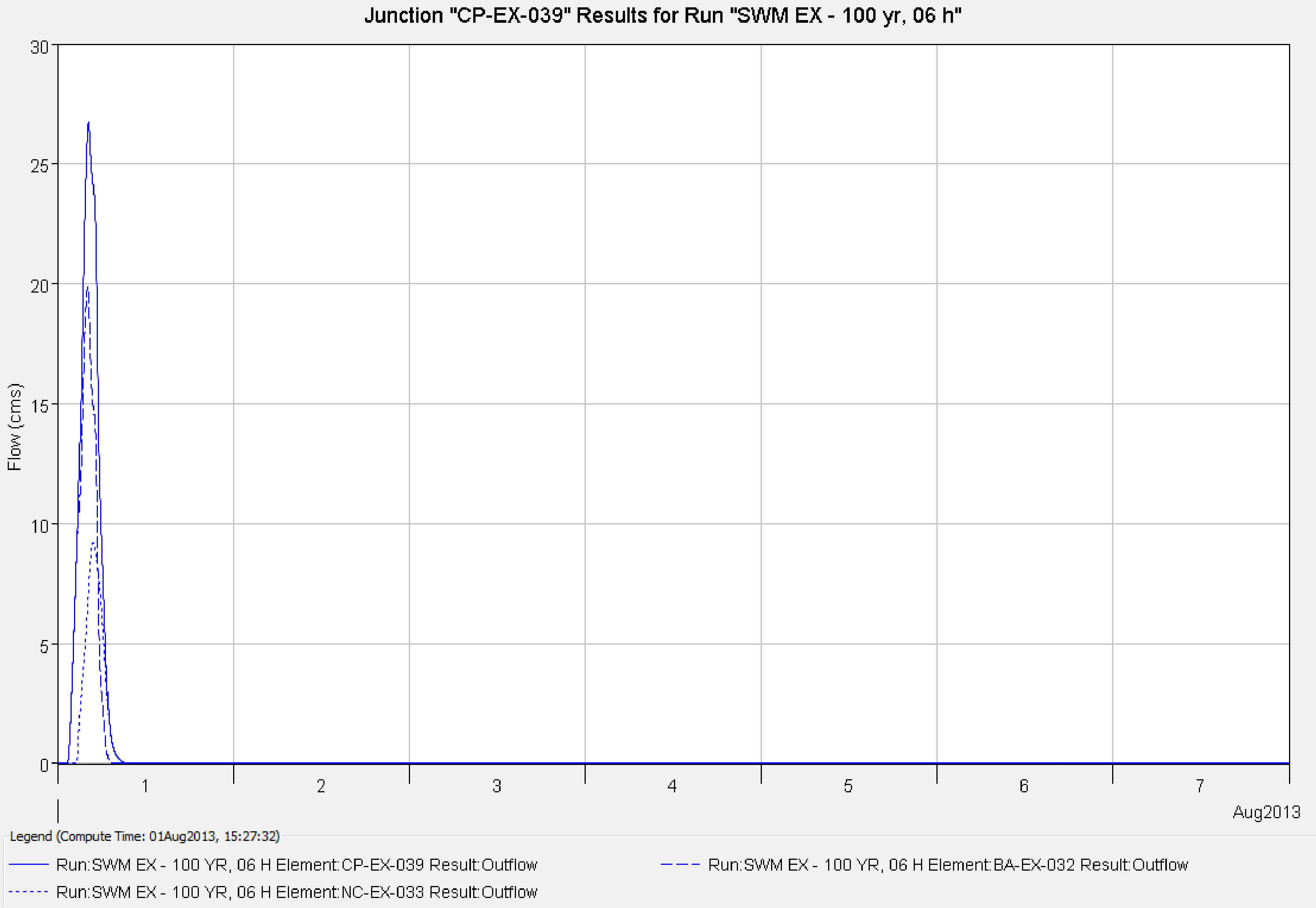
Junction "CP-EX-036" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-036 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-030 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-029 Result:Outflow



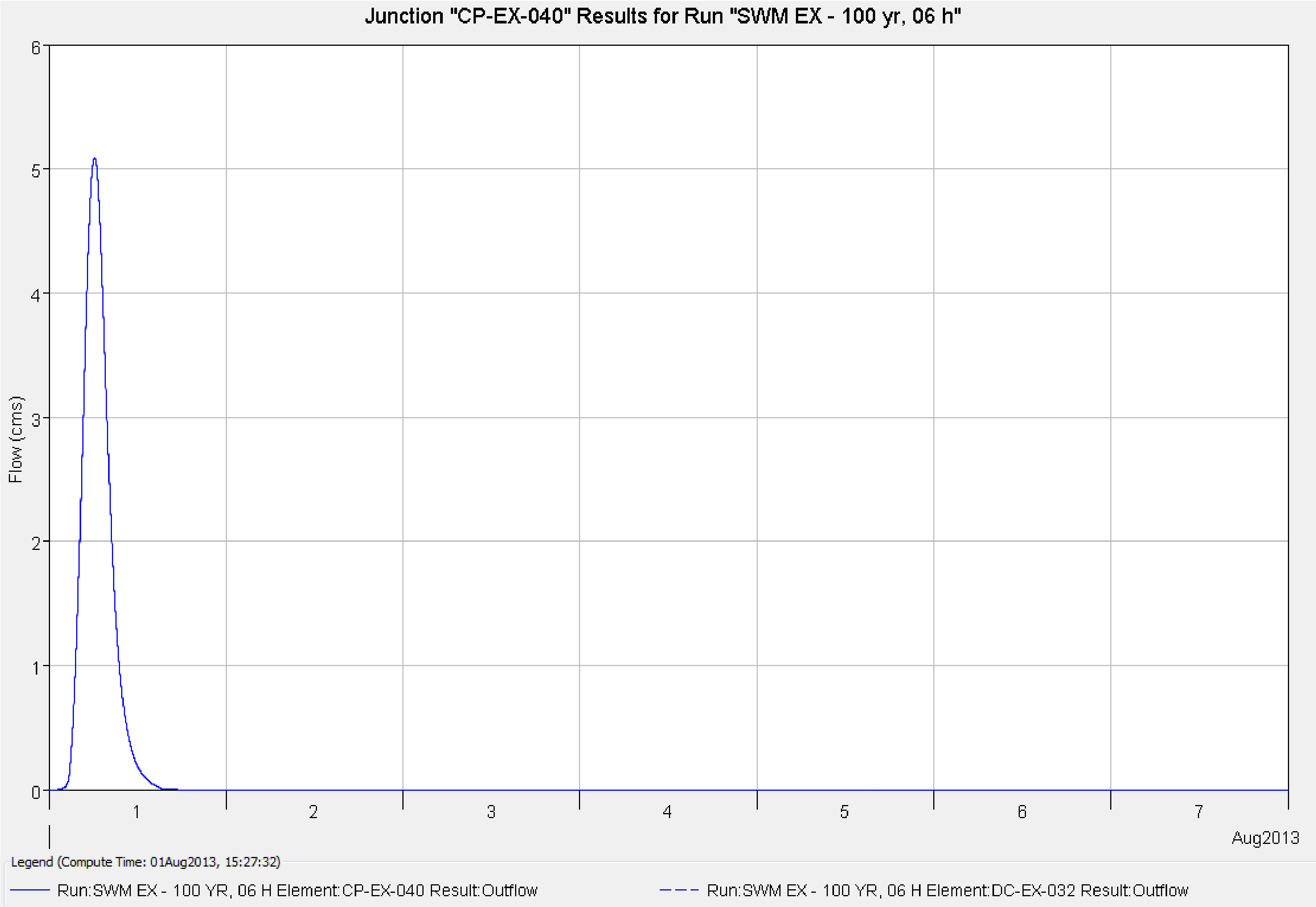
Junction "CP-EX-037" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-037 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-031 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-031 Result:Outflow

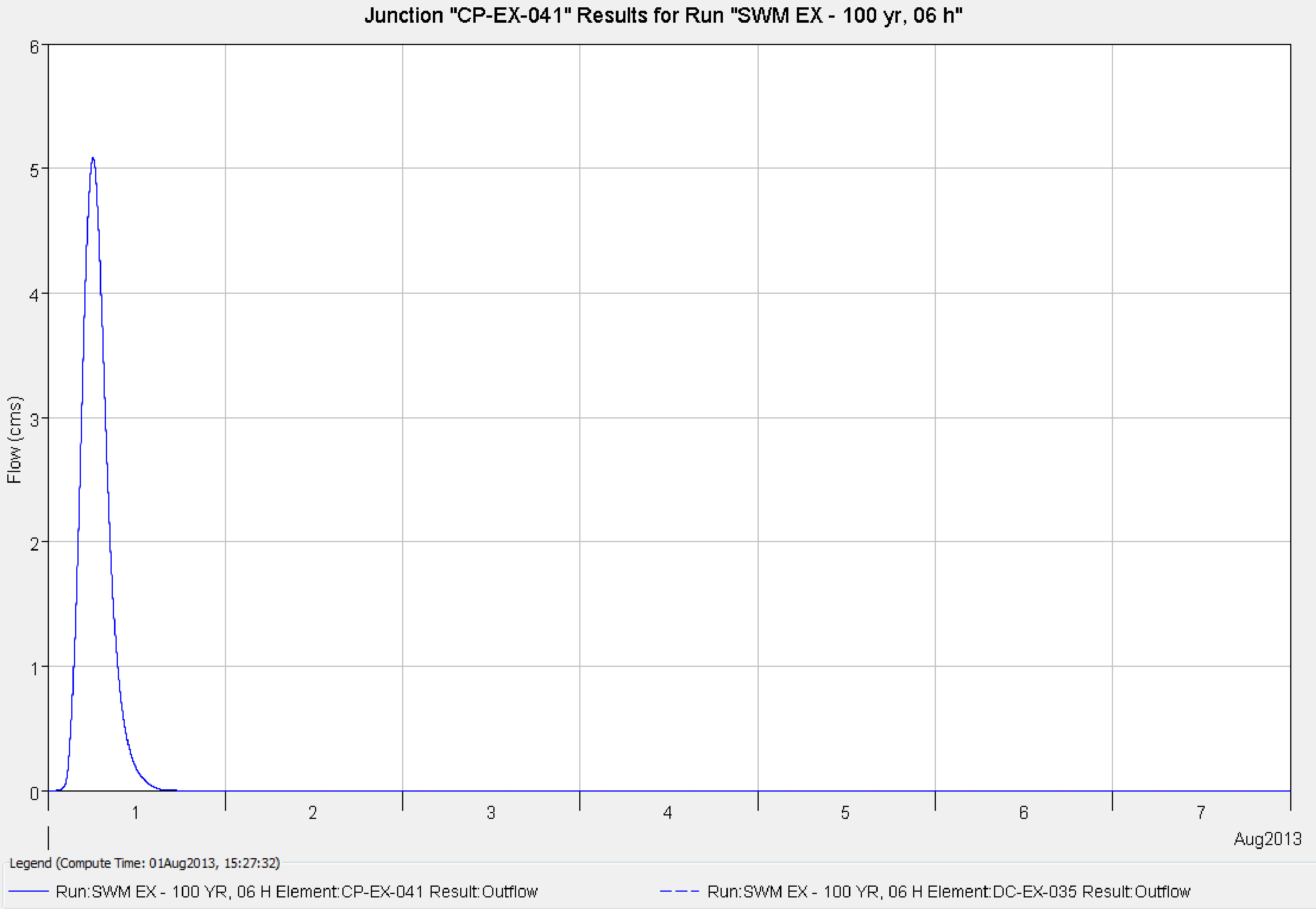


Junction "CP-EX-038" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 yr, 06 h Element:CP-EX-038 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-030 Result:Outflow

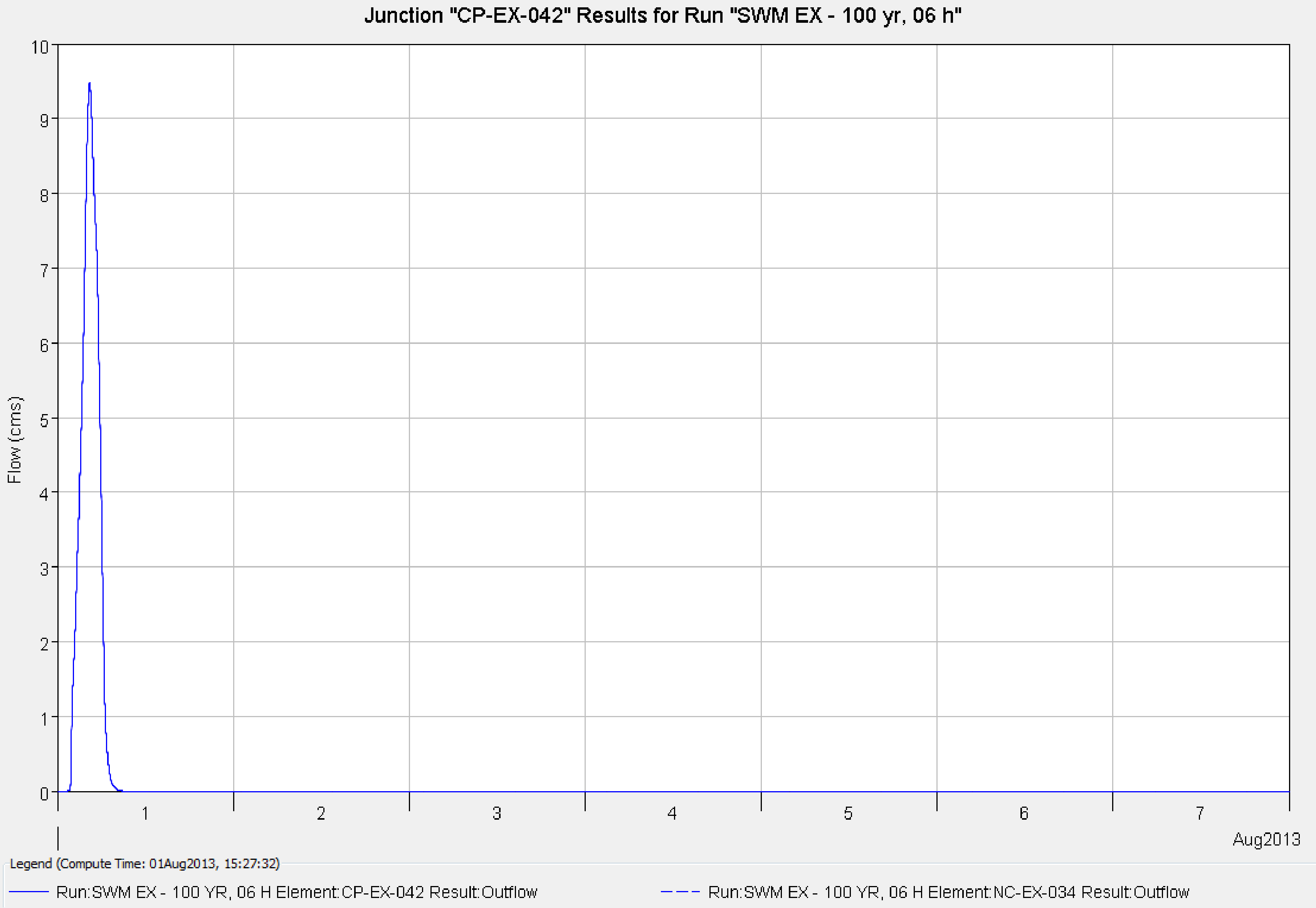


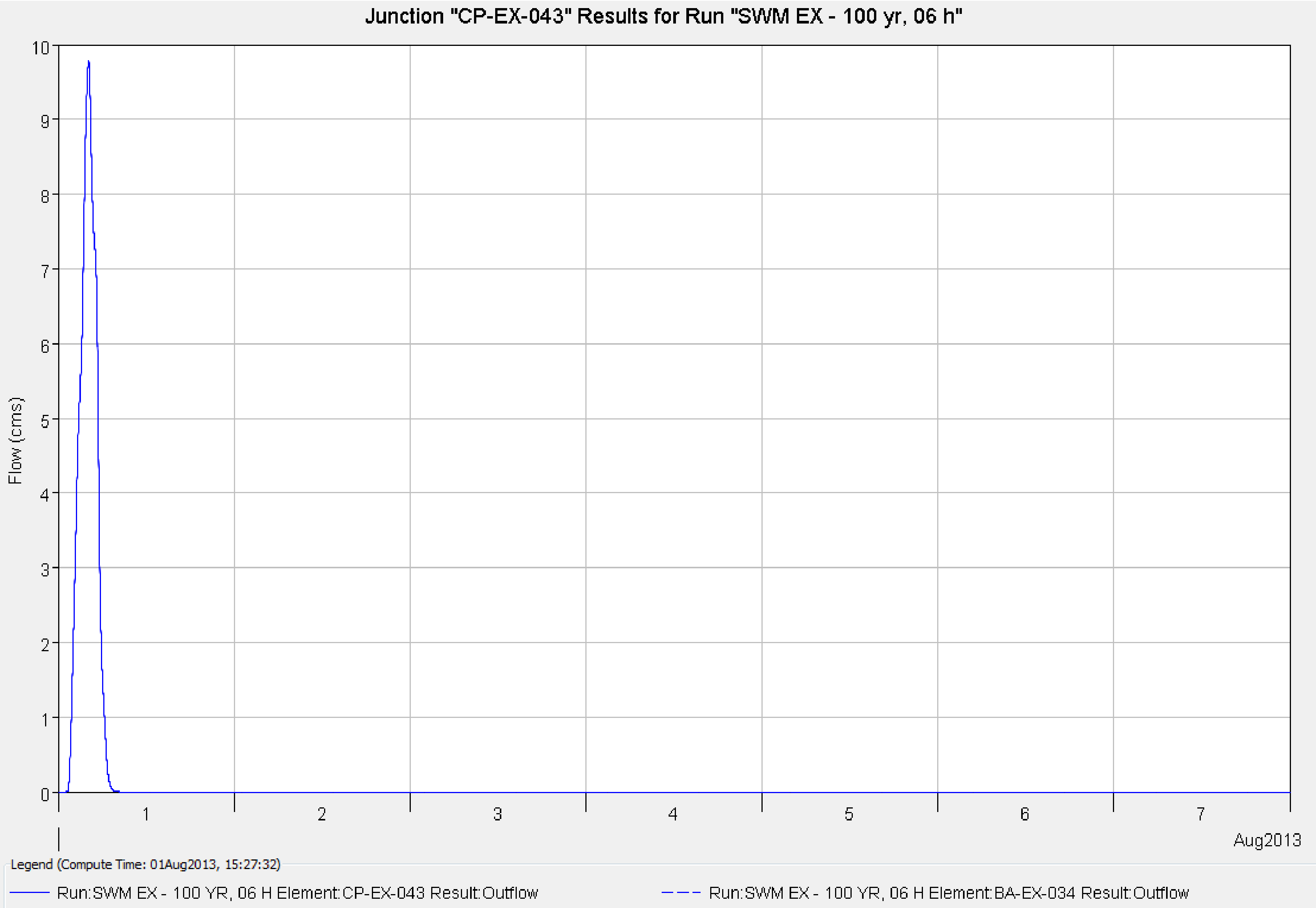
Junction "CP-EX-039" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-039 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-032 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-033 Result:Outflow


Junction "CP-EX-040" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-040 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-032 Result:Outflow

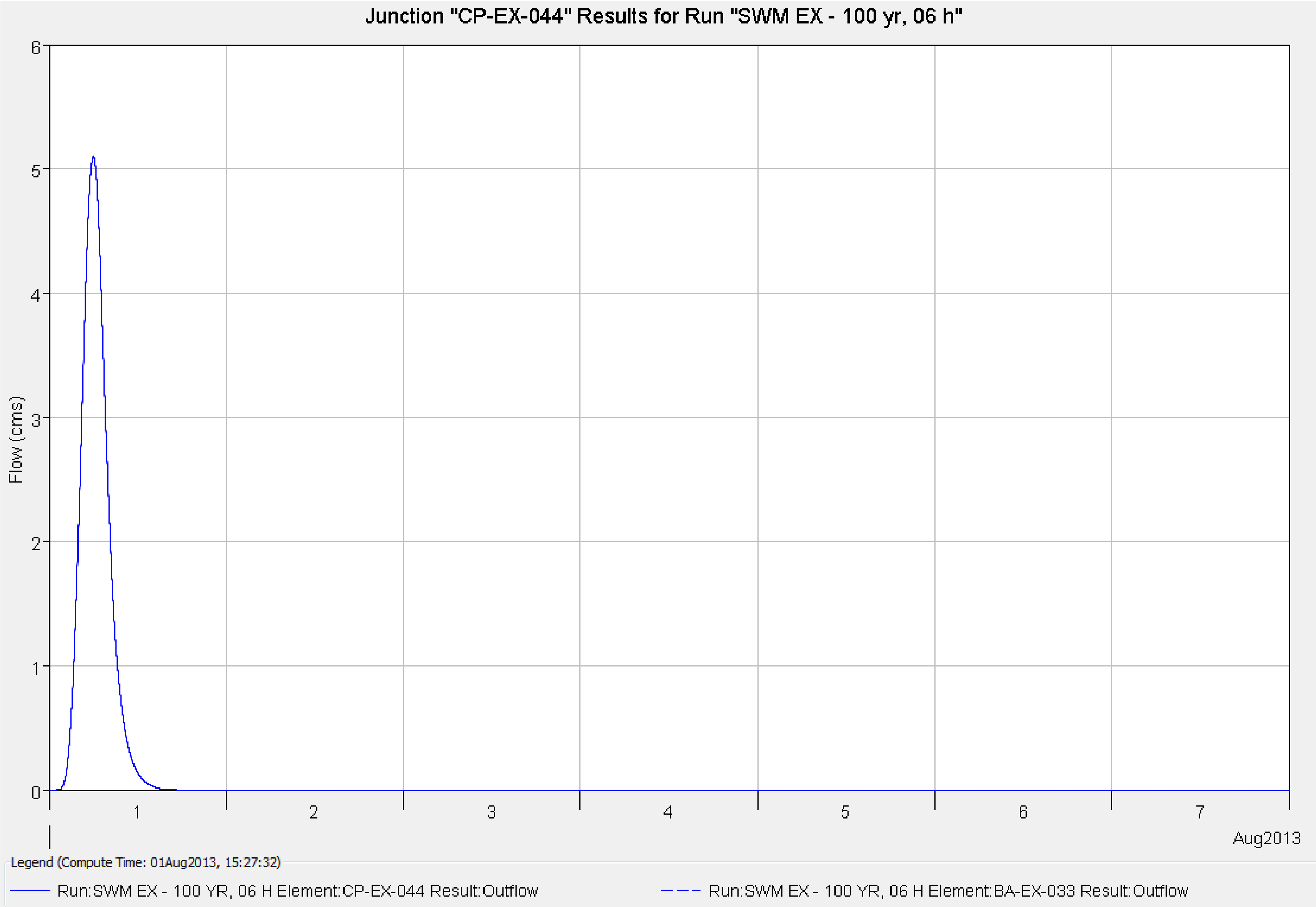


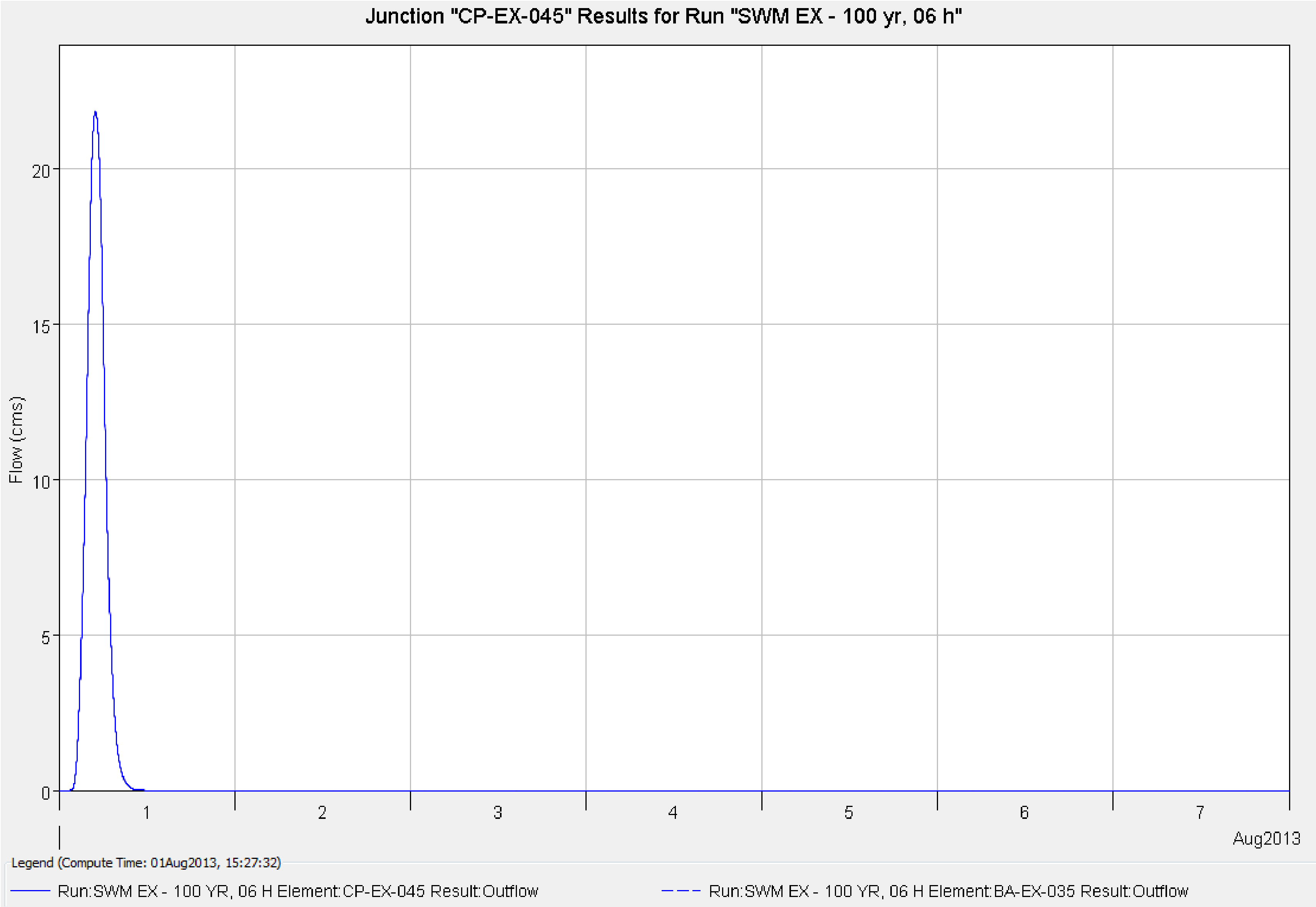
Junction "CP-EX-041" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-041 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-035 Result:Outflow


Junction "CP-EX-042" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-042 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-034 Result:Outflow

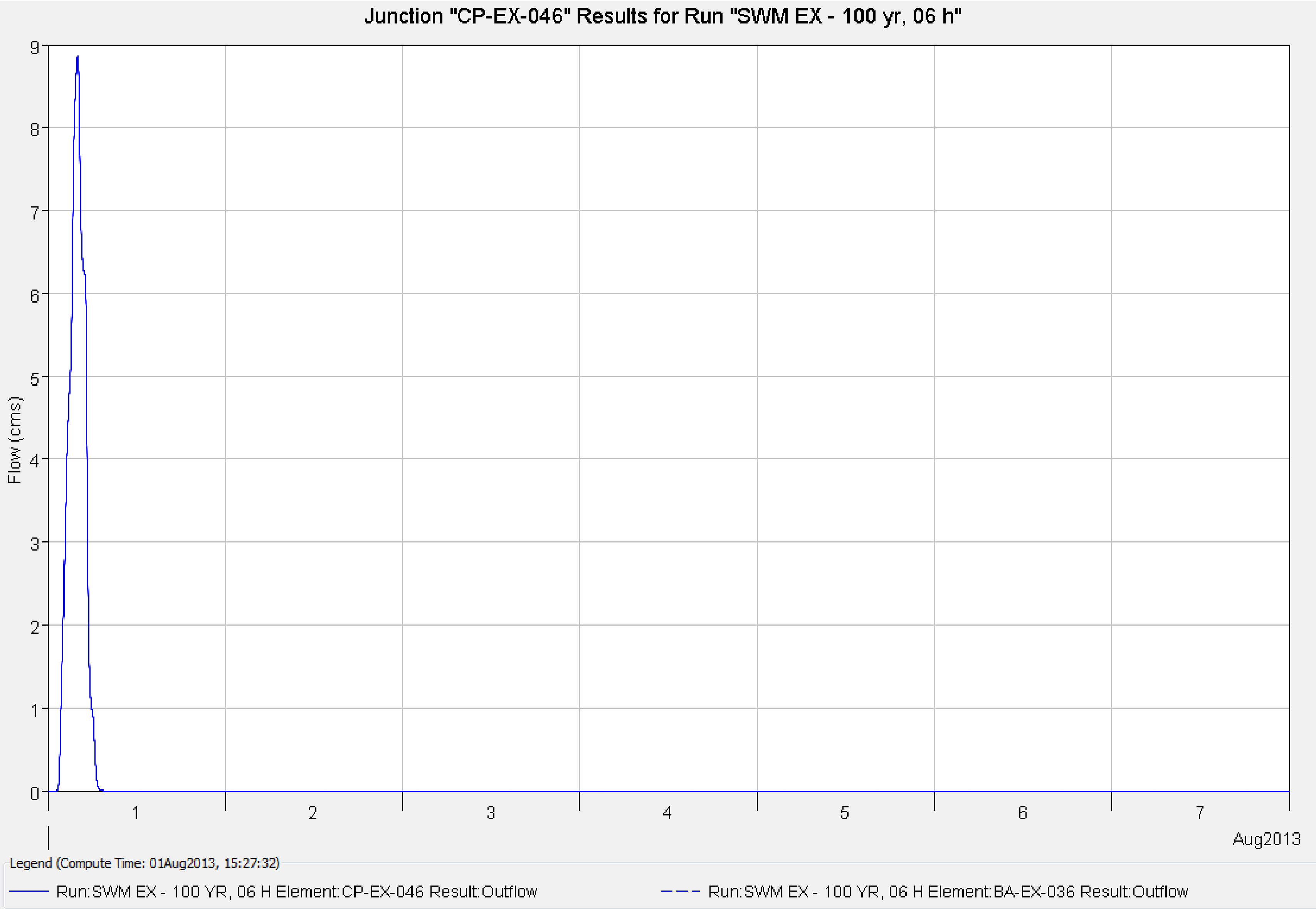


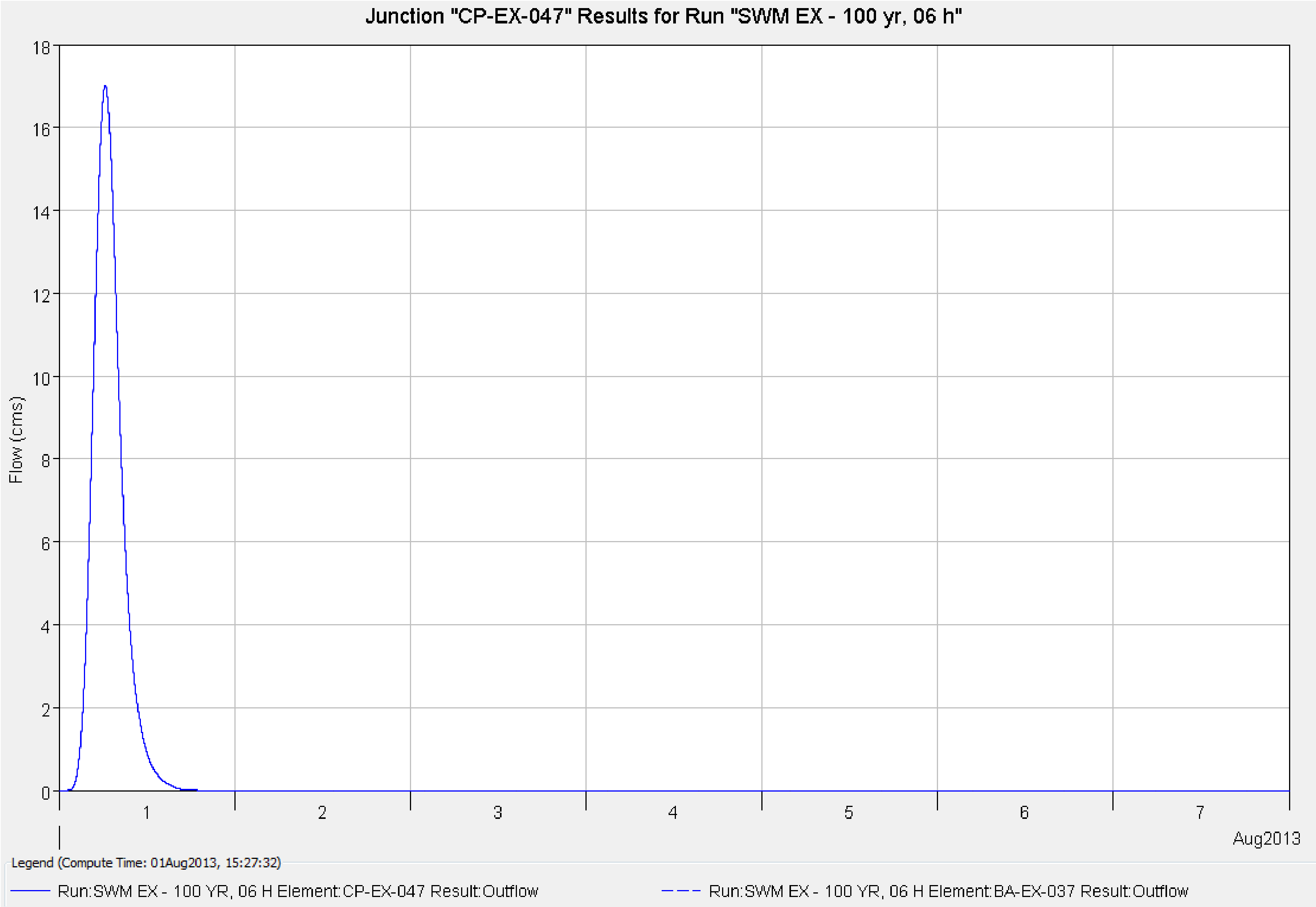
Junction "CP-EX-043" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-043 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-034 Result:Outflow


Junction "CP-EX-044" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-044 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-033 Result:Outflow

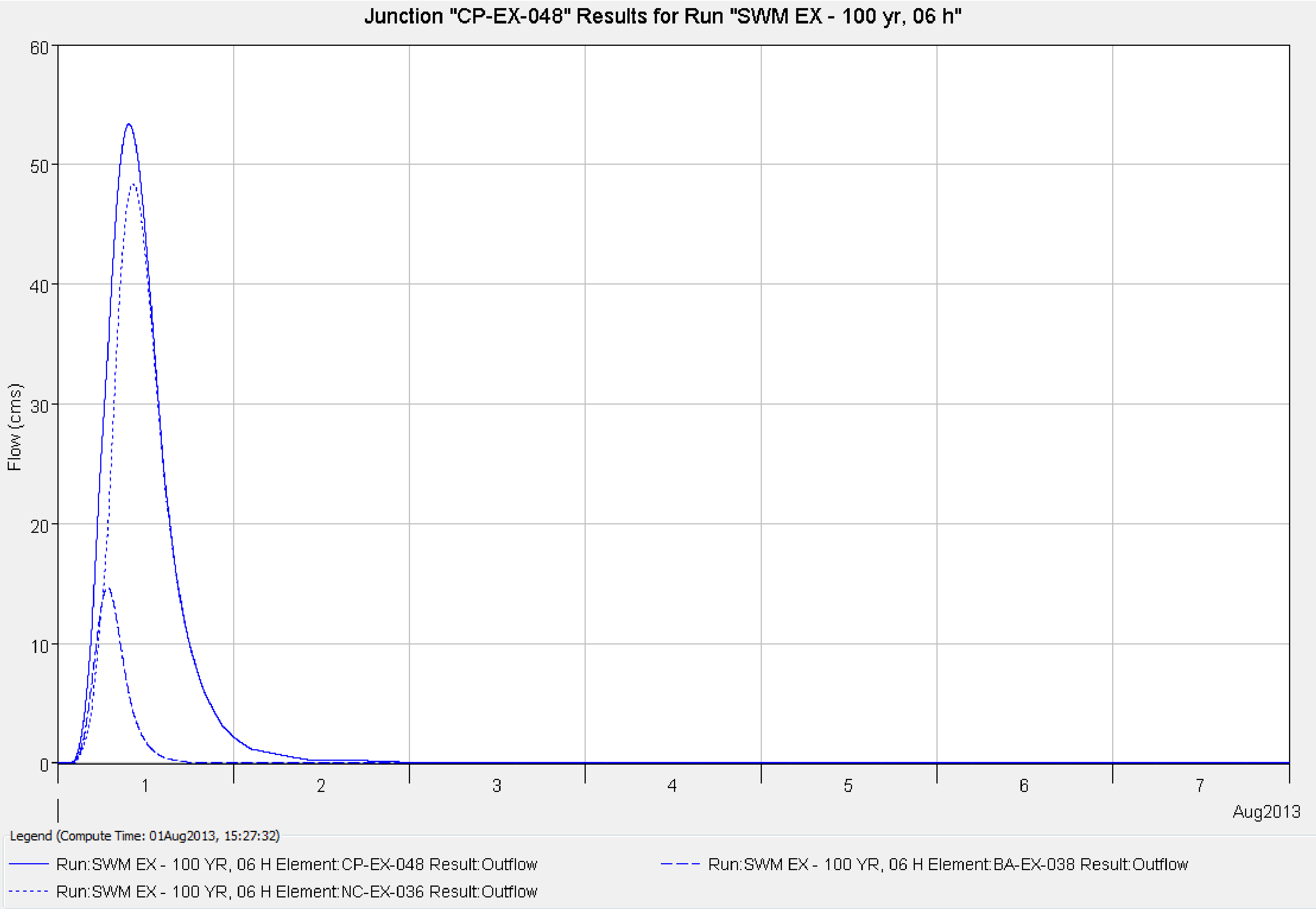


Junction "CP-EX-045" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-045 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-035 Result:Outflow

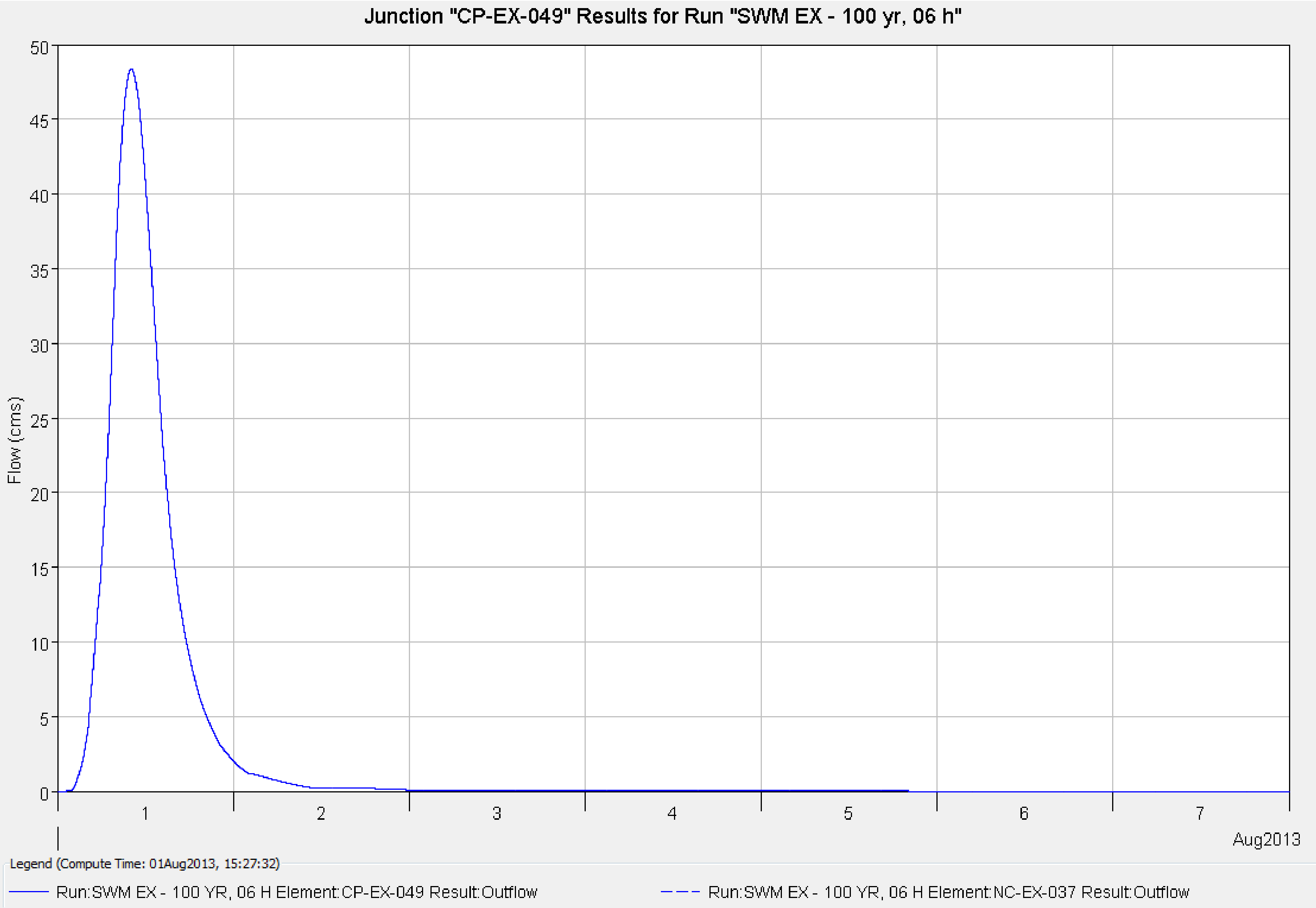

Junction "CP-EX-046" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-046 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-036 Result:Outflow



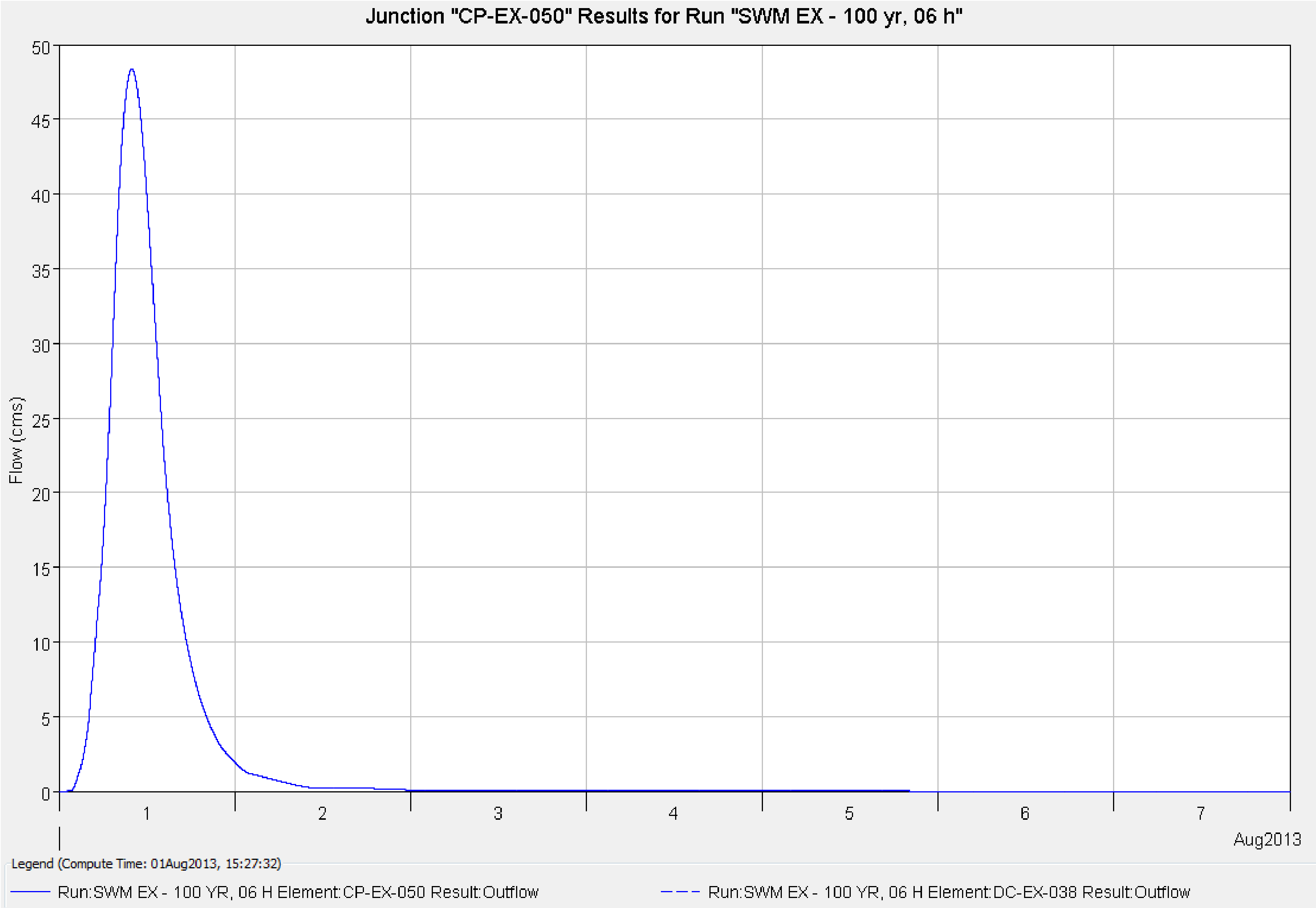
Junction "CP-EX-047" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-047 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-037 Result:Outflow



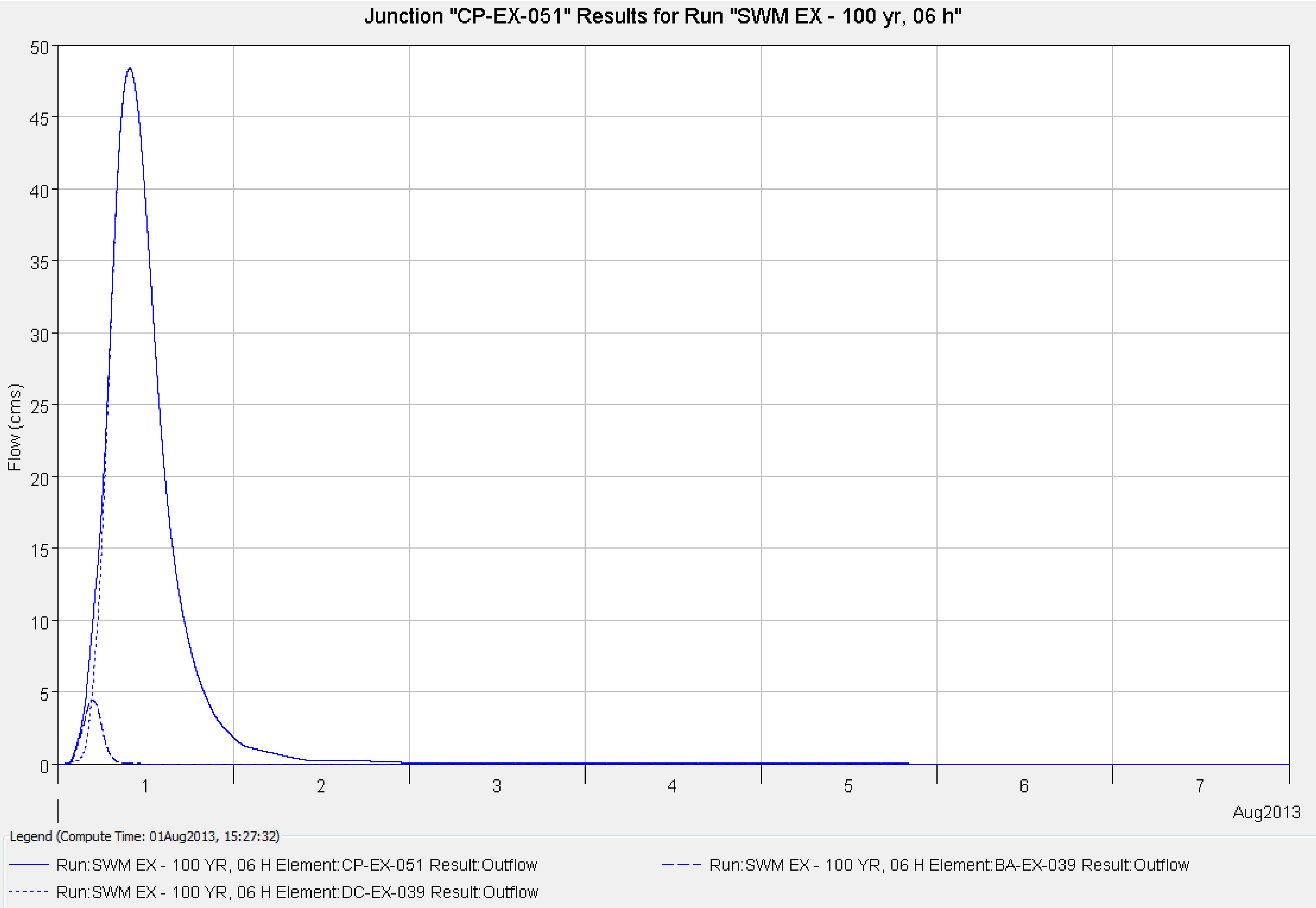
Junction "CP-EX-048" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-048 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-038 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-036 Result:Outflow

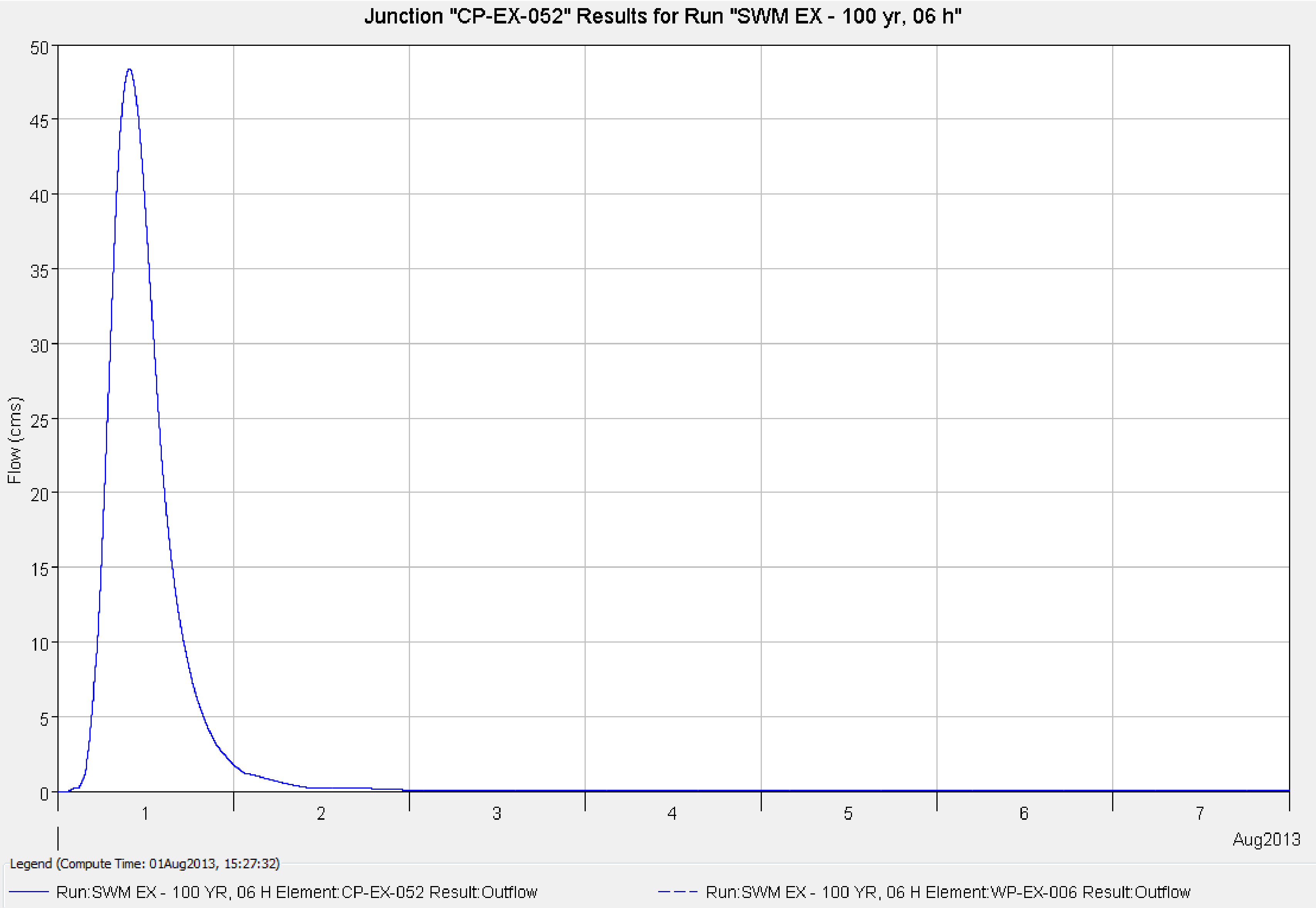


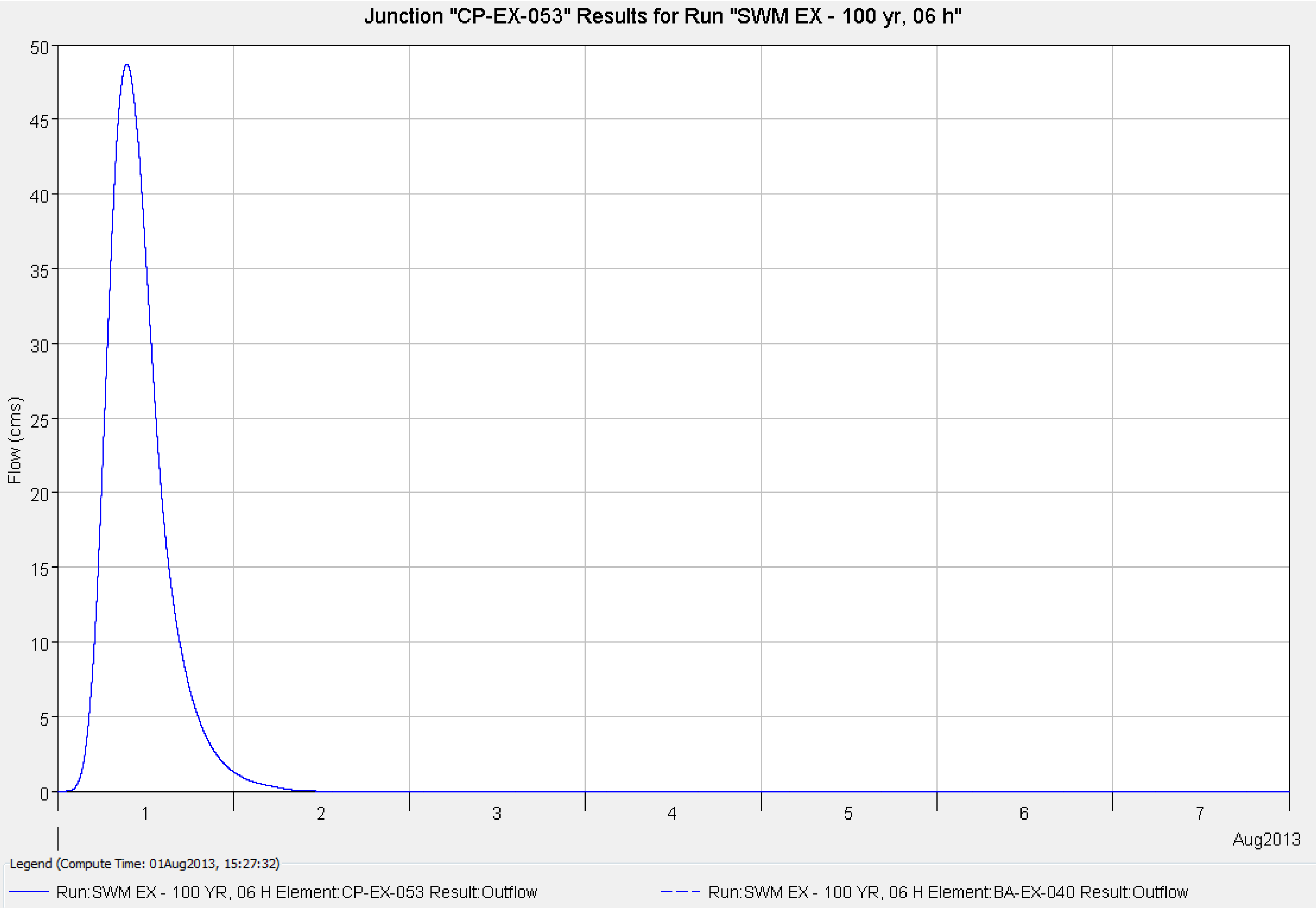
Junction "CP-EX-049" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-049 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:NC-EX-037 Result:Outflow

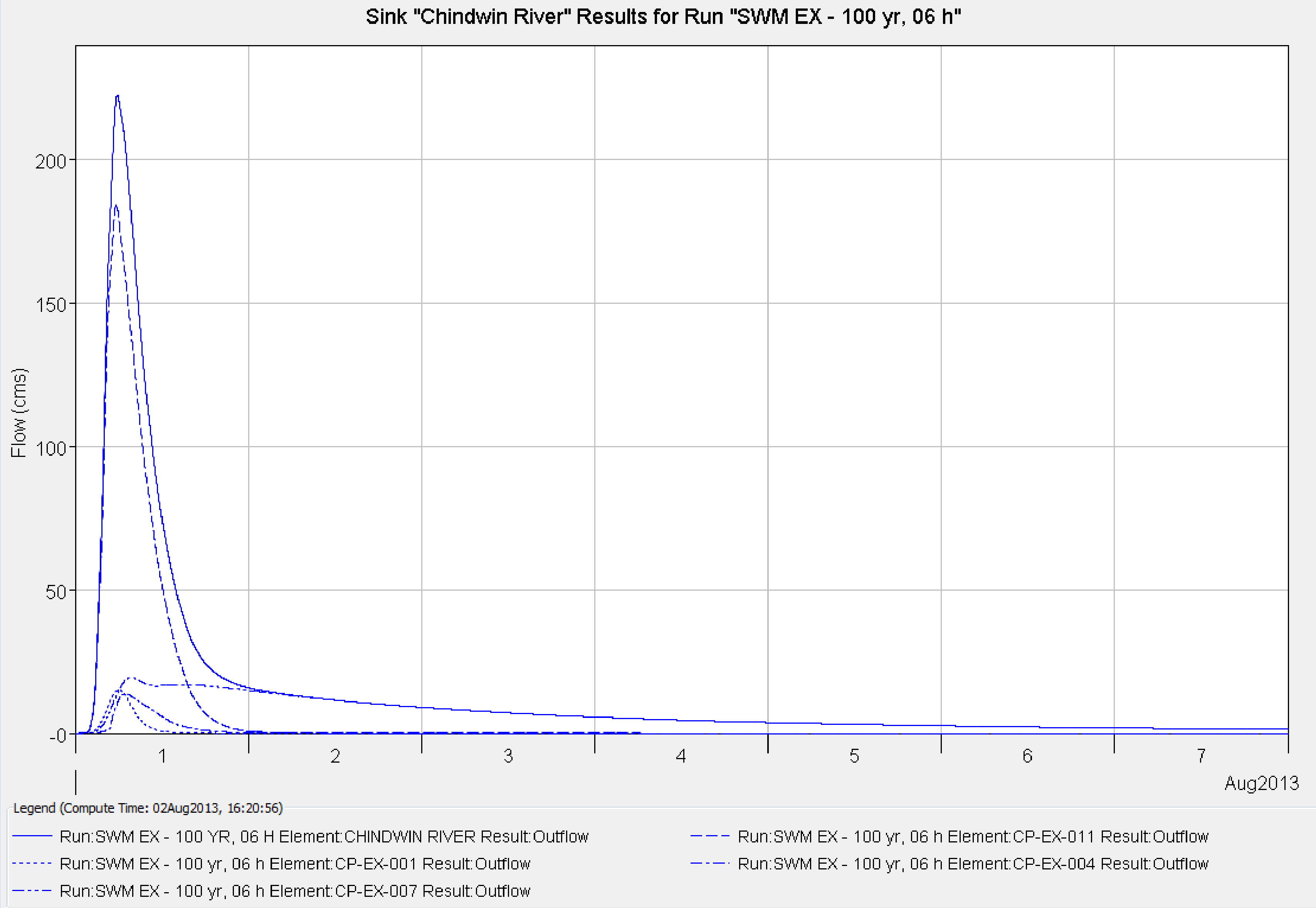


Junction "CP-EX-050" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-050 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-038 Result:Outflow

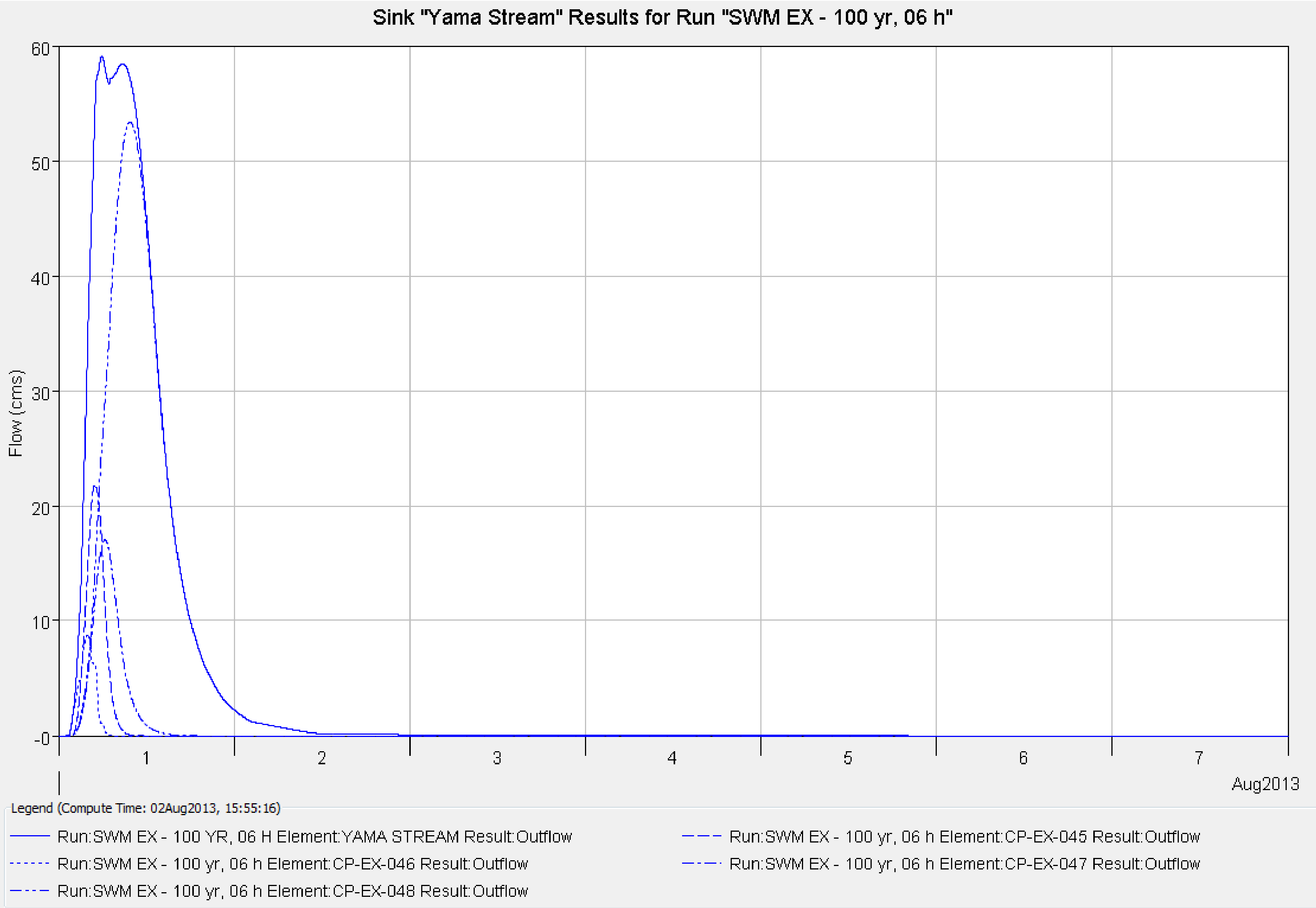

Junction "CP-EX-051" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-051 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-039 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:DC-EX-039 Result:Outflow


Junction "CP-EX-052" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-052 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-006 Result:Outflow

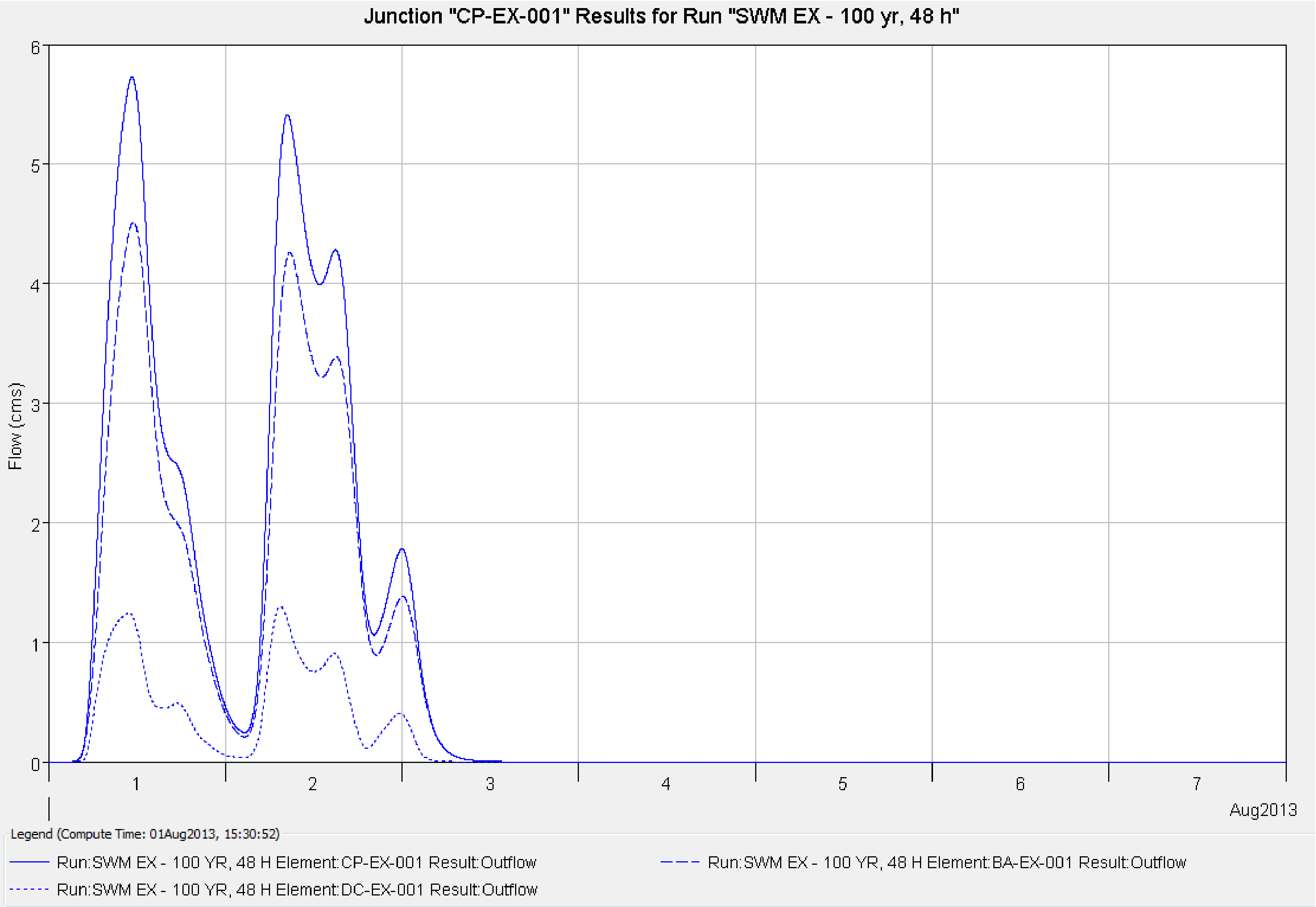

Junction "CP-EX-053" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:CP-EX-053 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:BA-EX-040 Result:Outflow



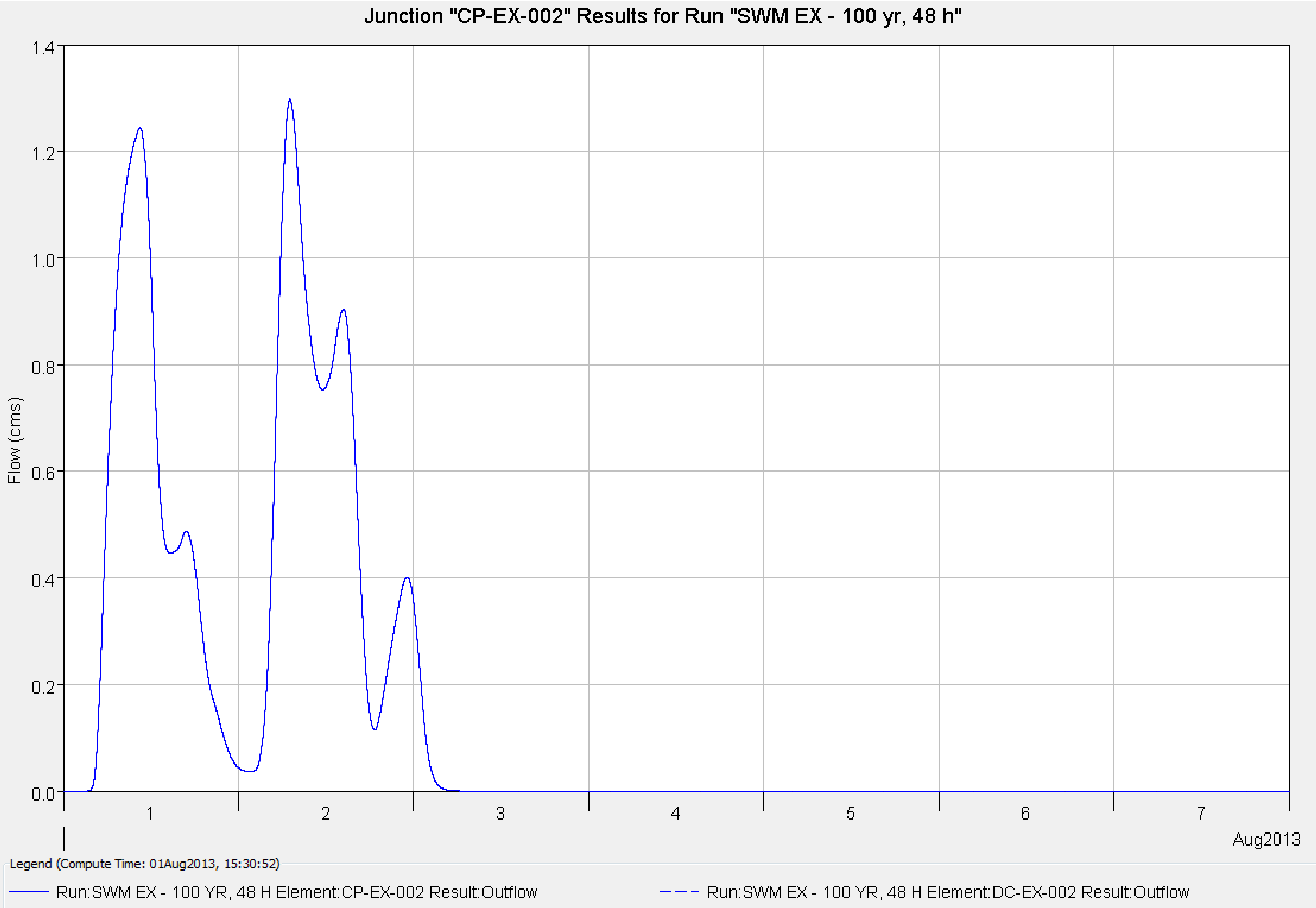
Sink "Chindwin River" Results for Run "SWM EX - 100 yr, 06 h"
Flow (cms)
200
150
100
50
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 02Aug2013, 16:20:56)
Run:SWM EX - 100 YR, 06 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-001 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-007 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-011 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-004 Result:Outflow



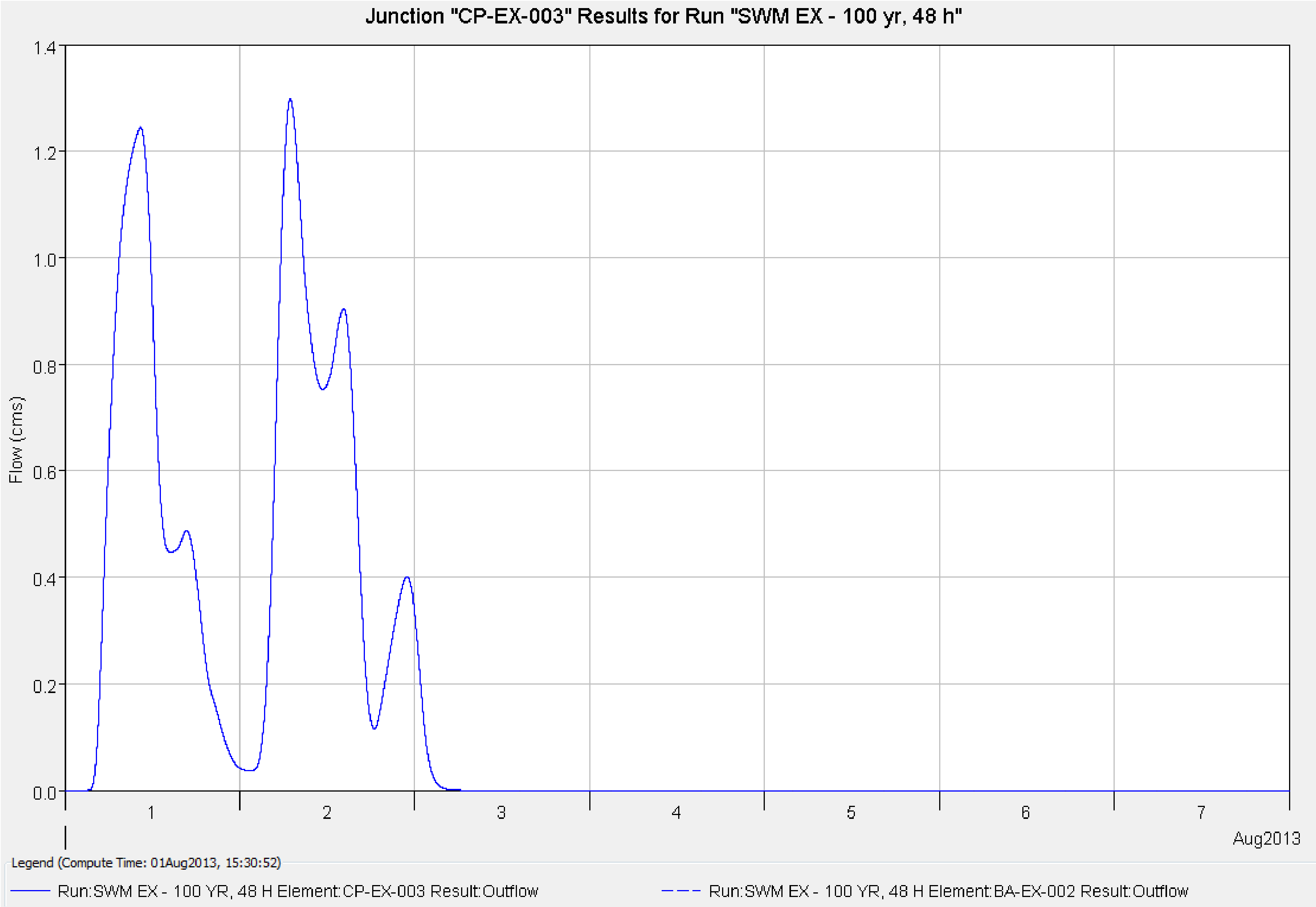
Sink "Yama Stream" Results for Run "SWM EX - 100 yr, 06 h"
60
50
40
30
20
10
-0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 02Aug2013, 15:55:16)
Run:SWM EX - 100 YR, 06 H Element:YAMA STREAM Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-045 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-046 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-047 Result:Outflow
Run:SWM EX - 100 yr, 06 h Element:CP-EX-048 Result:Outflow



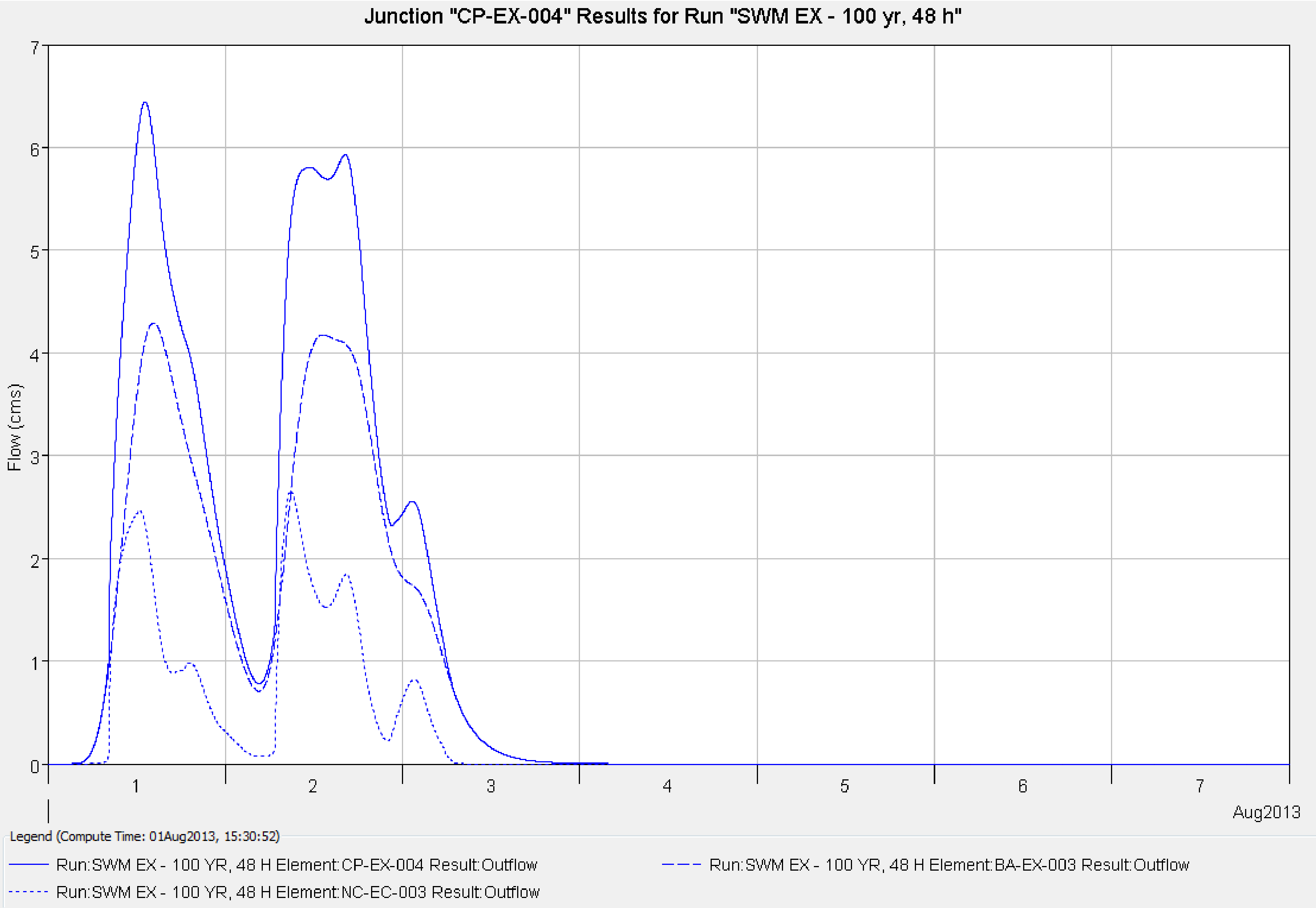
Junction "CP-EX-001" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-001 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-001 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-001 Result:Outflow



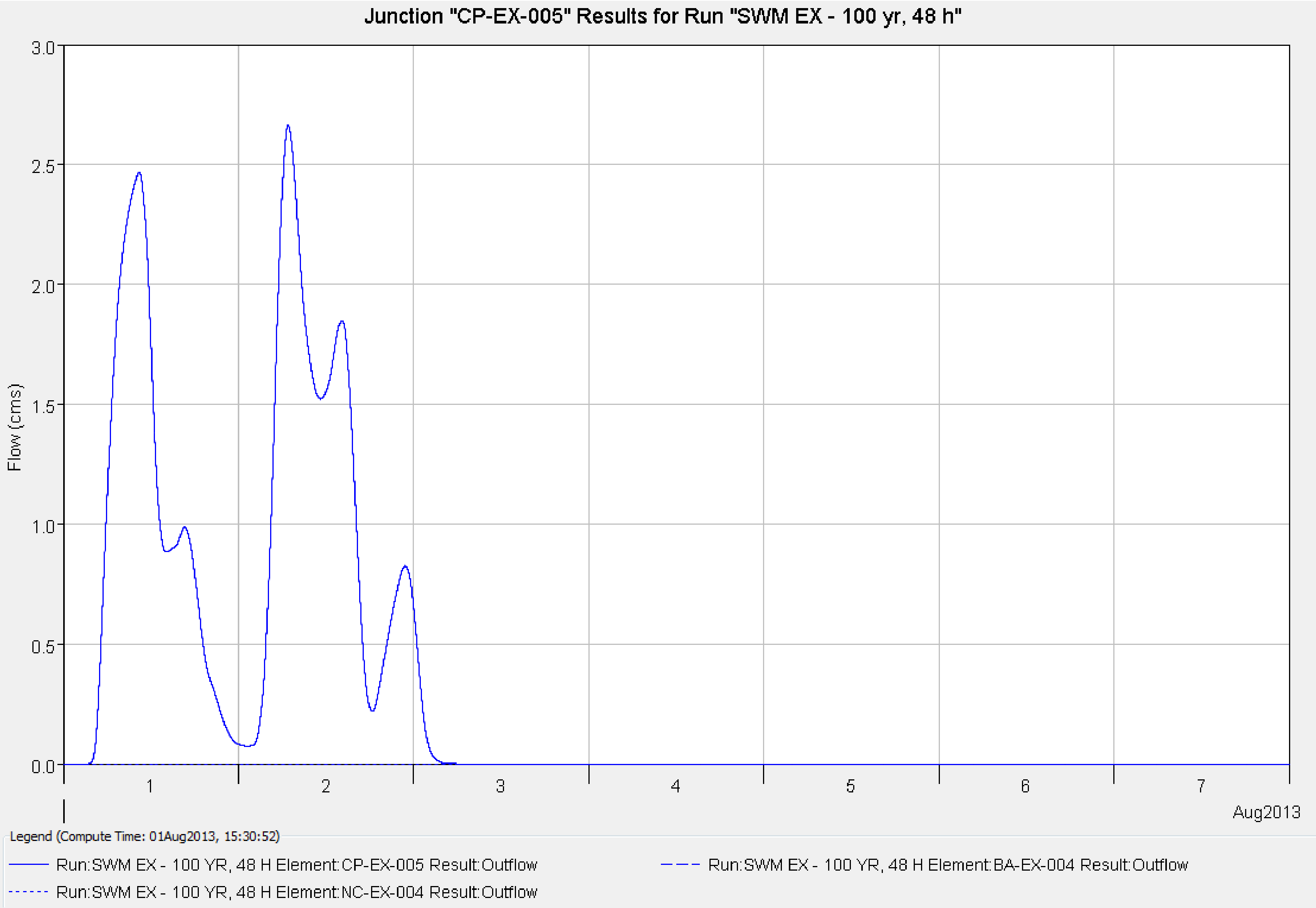
Junction "CP-EX-002" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-002 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-002 Result:Outflow



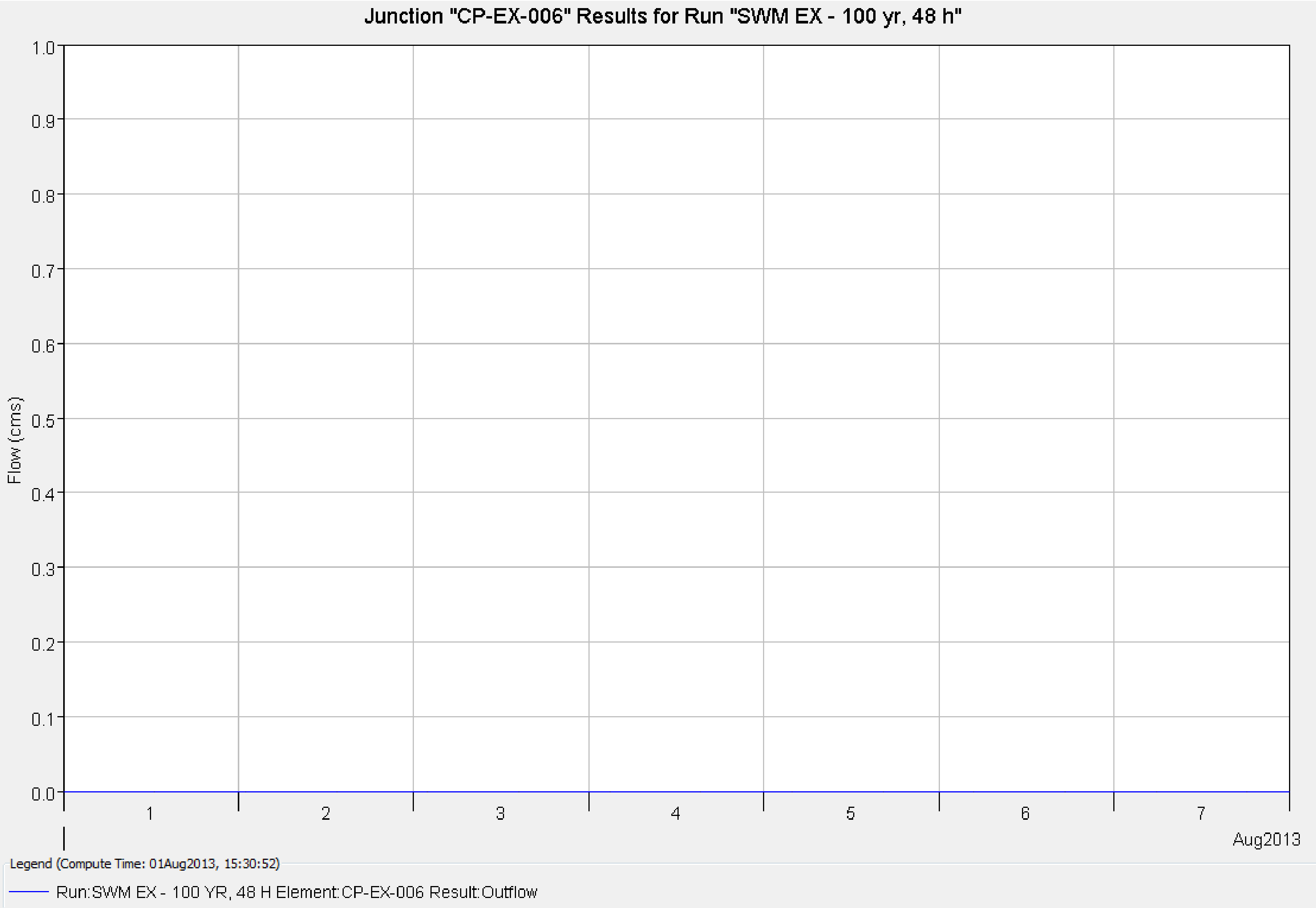
Junction "CP-EX-003" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-002 Result:Outflow



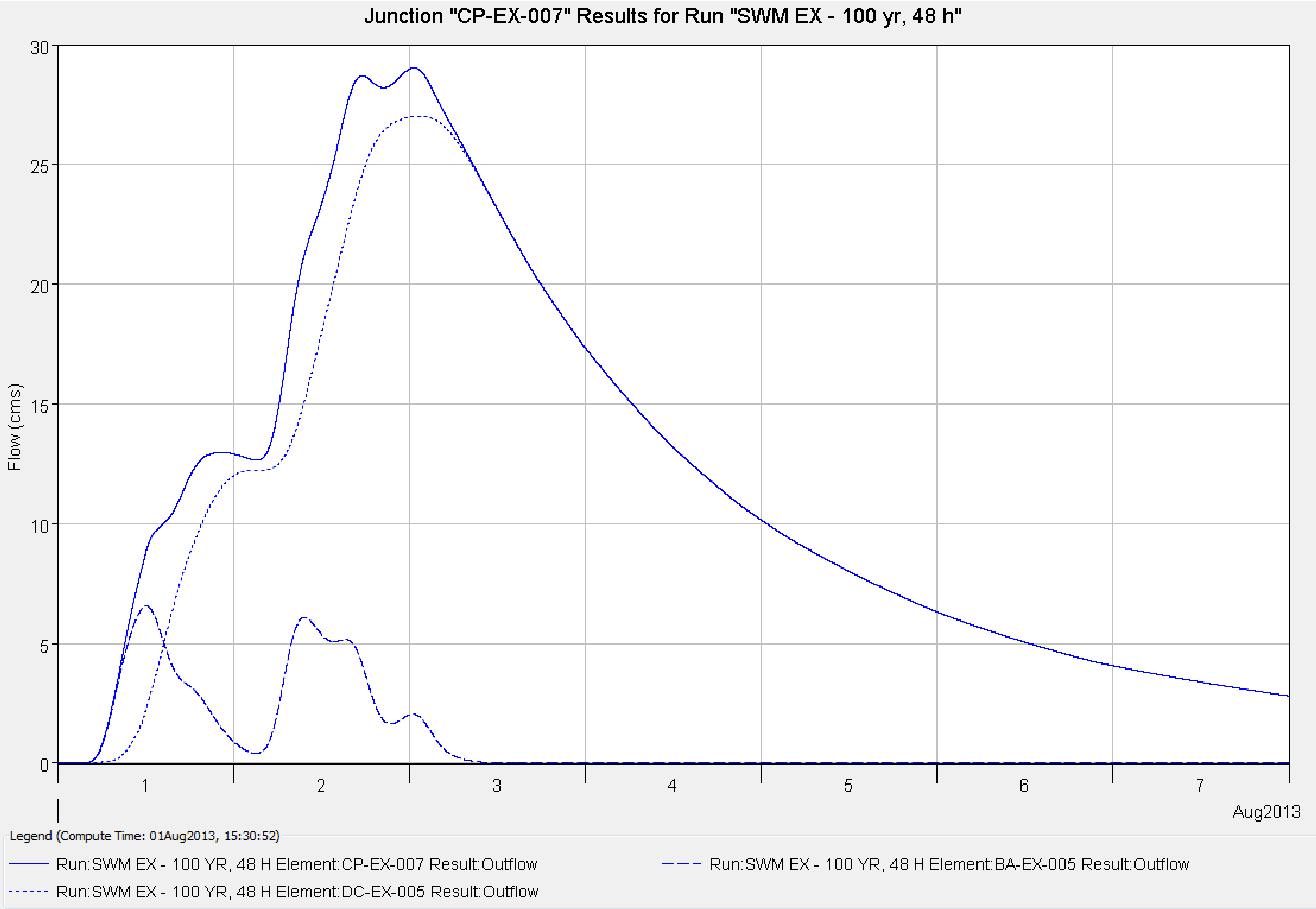
Junction "CP-EX-004" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EC-003 Result:Outflow

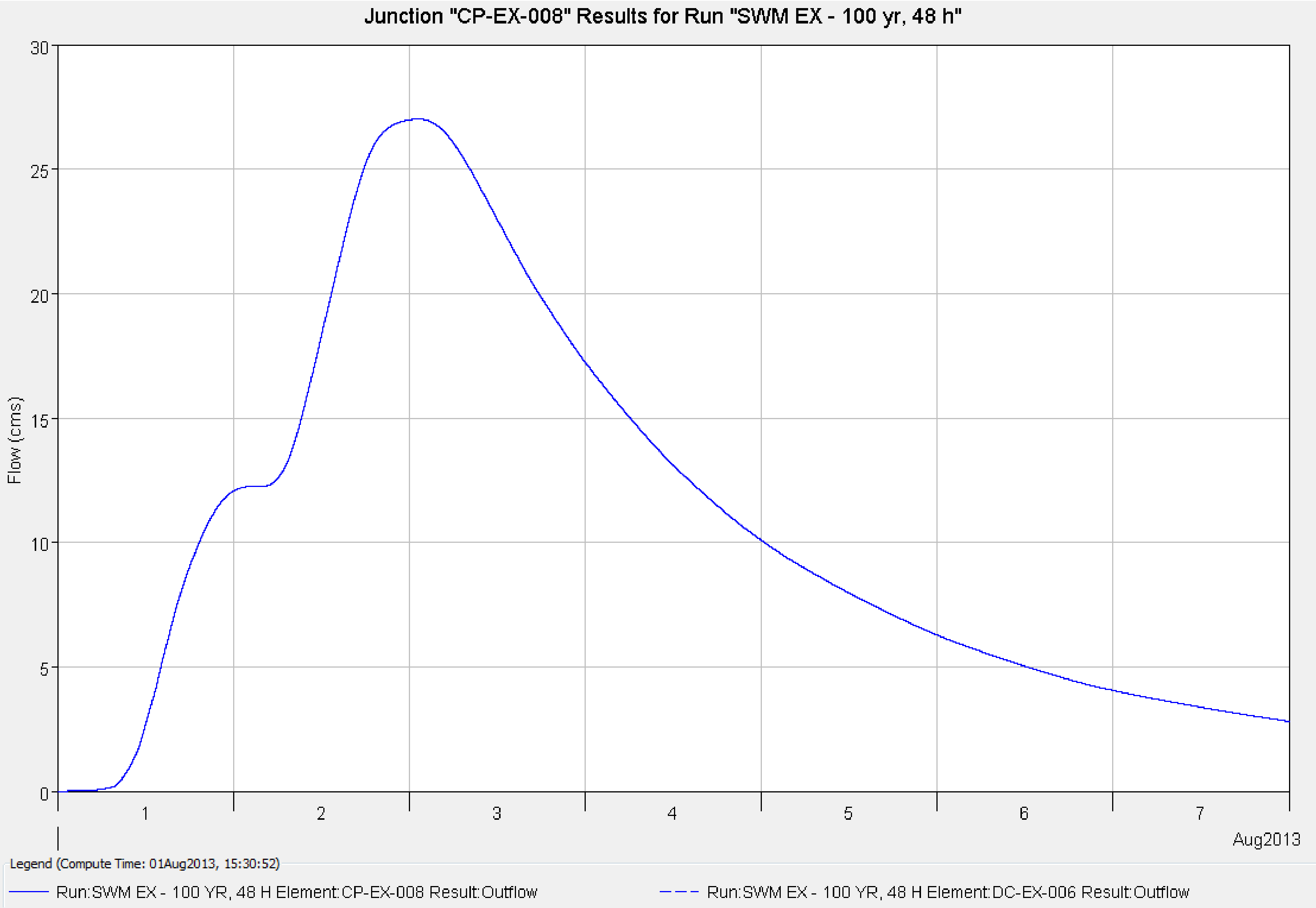


Junction "CP-EX-005" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-004 Result:Outflow

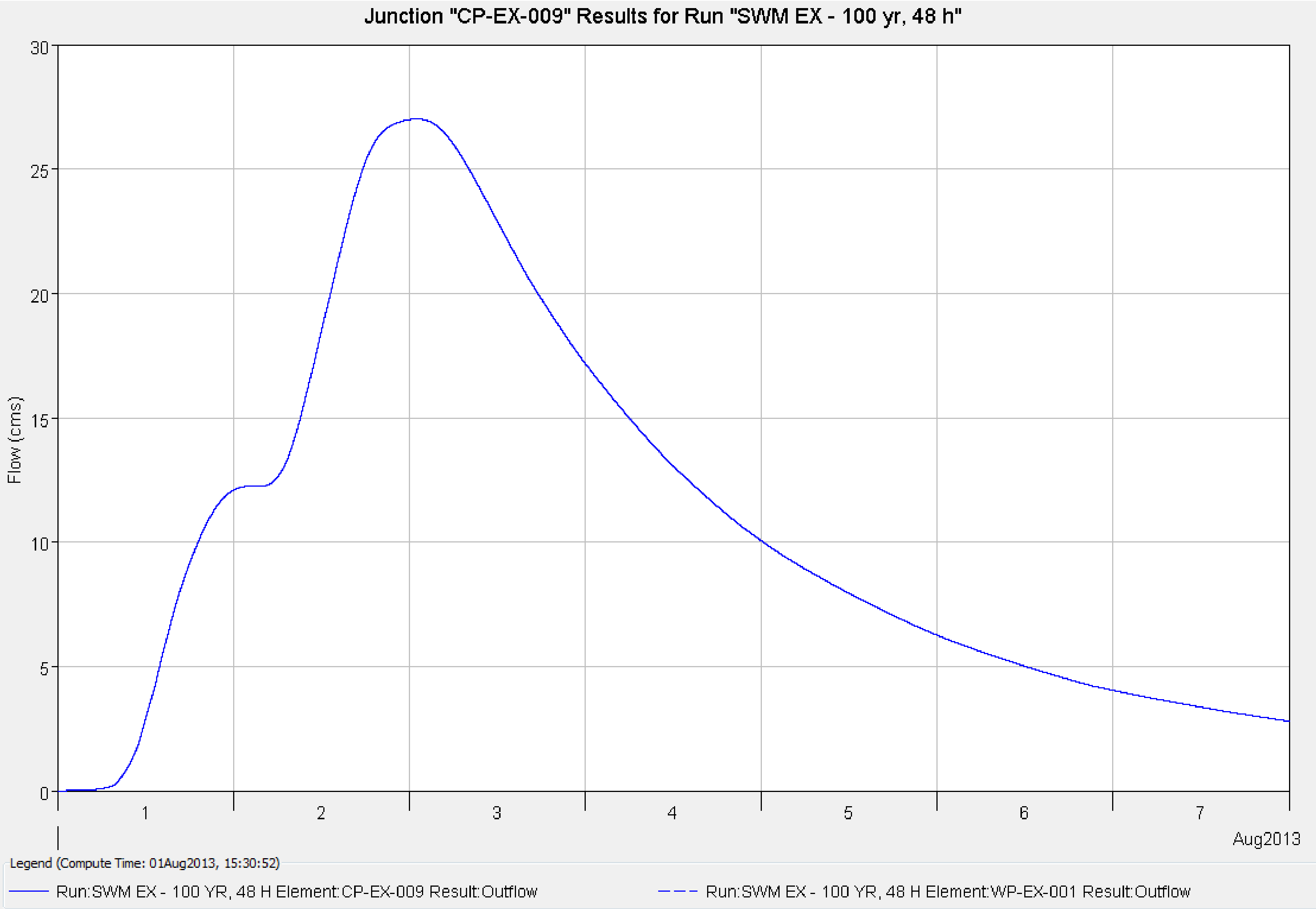


Junction "CP-EX-006" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-006 Result:Outflow

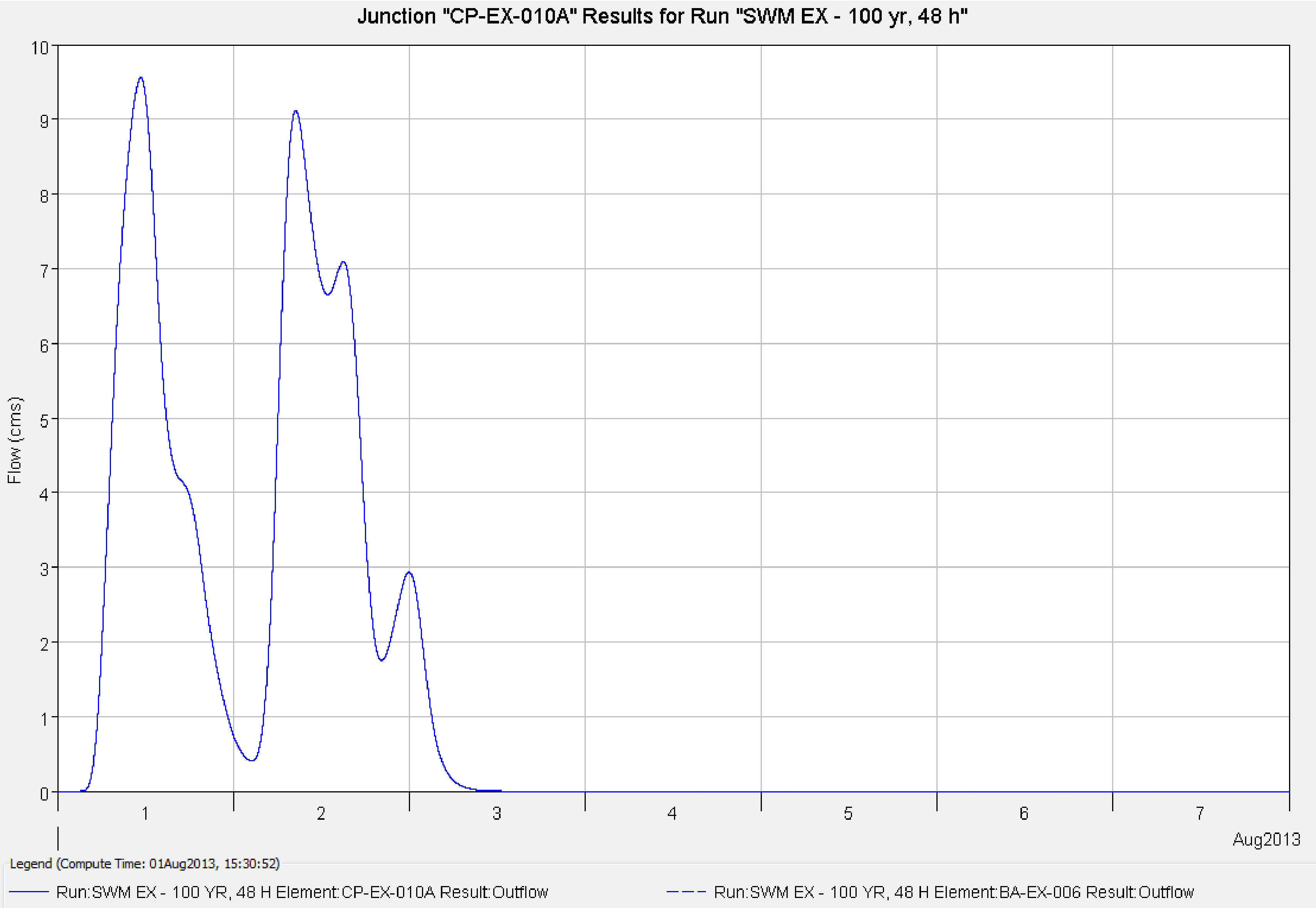

Junction "CP-EX-007" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-007 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-005 Result:Outflow



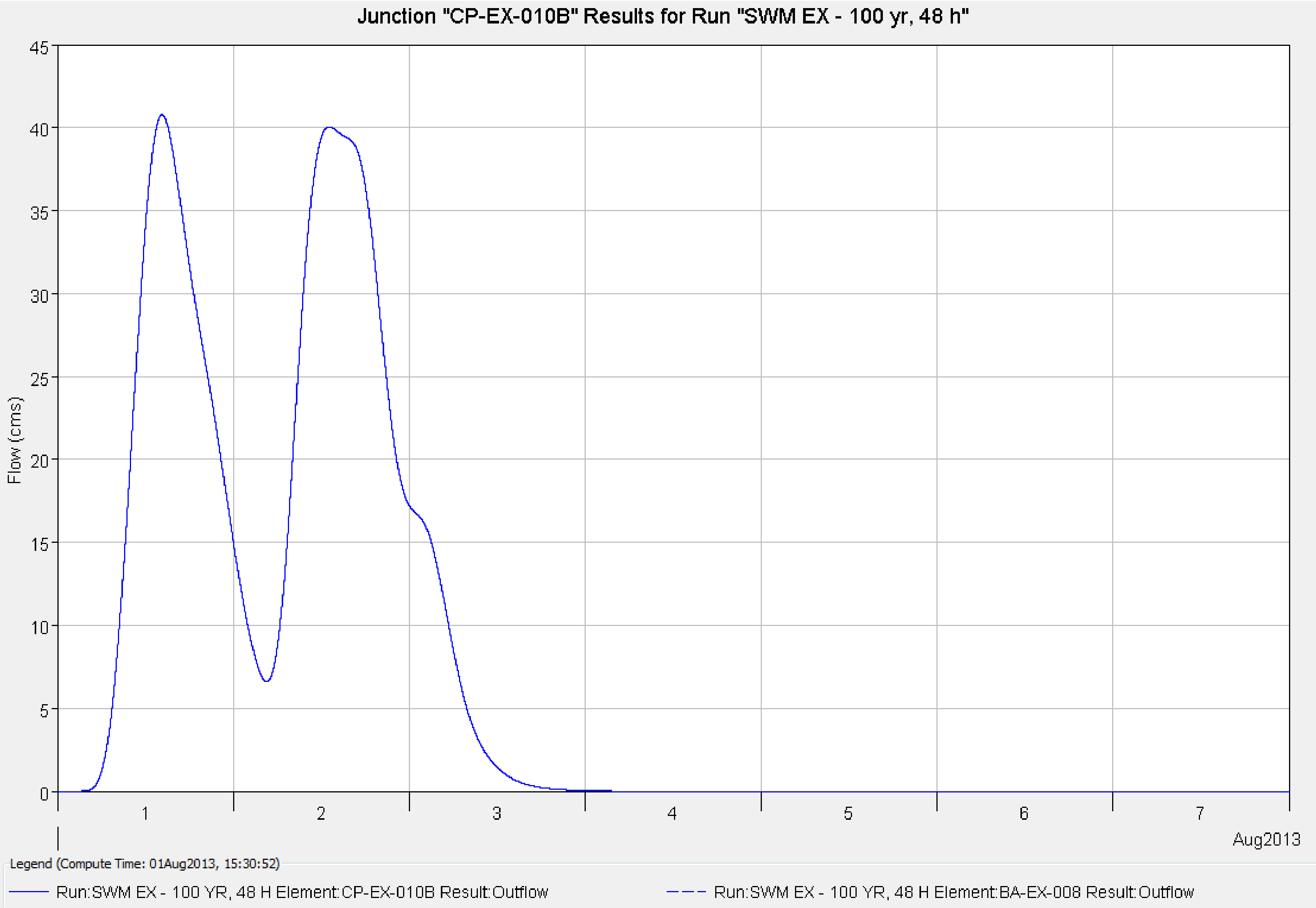
Junction "CP-EX-008" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-008 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-006 Result:Outflow

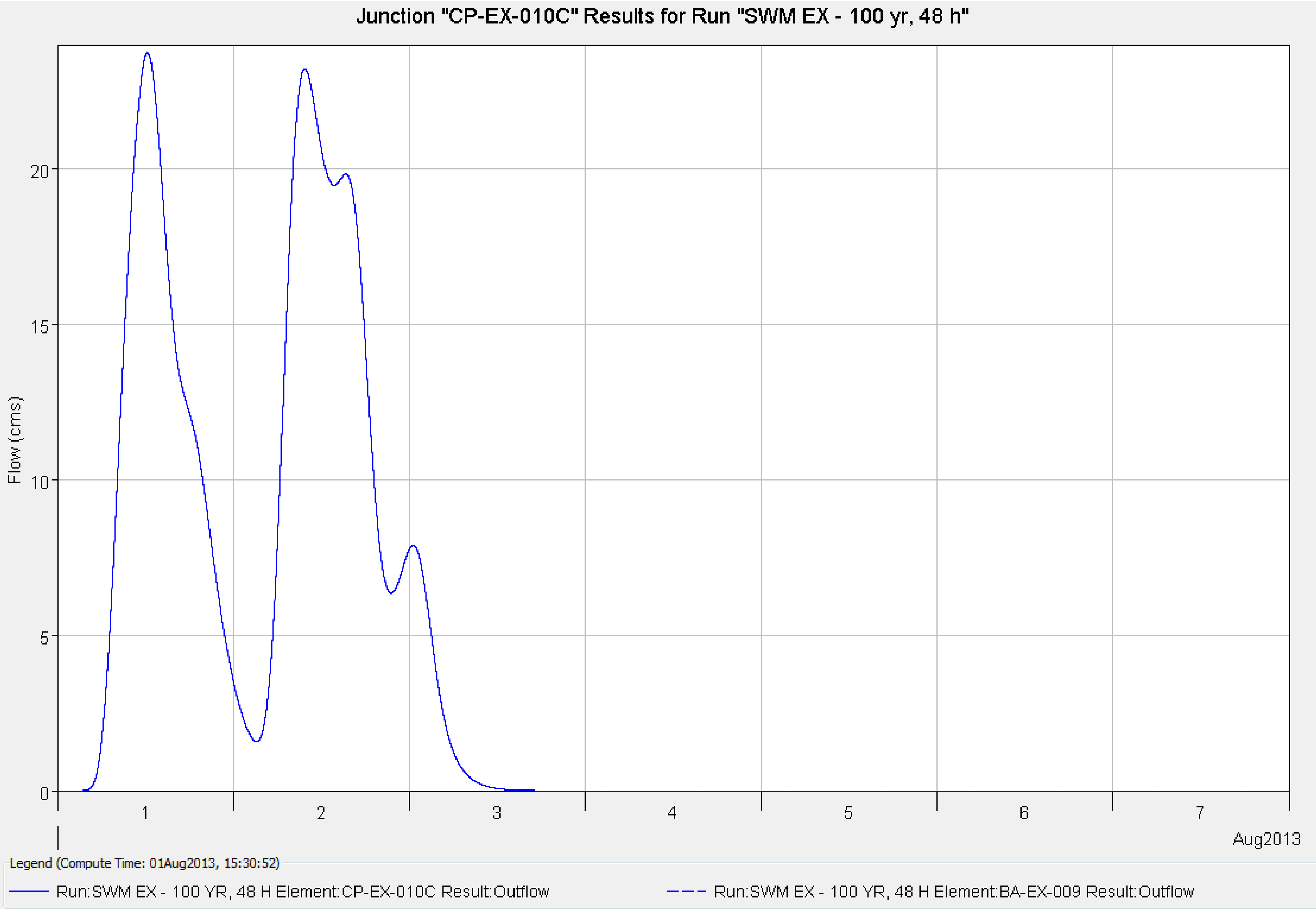


Junction "CP-EX-009" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-009 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-001 Result:Outflow

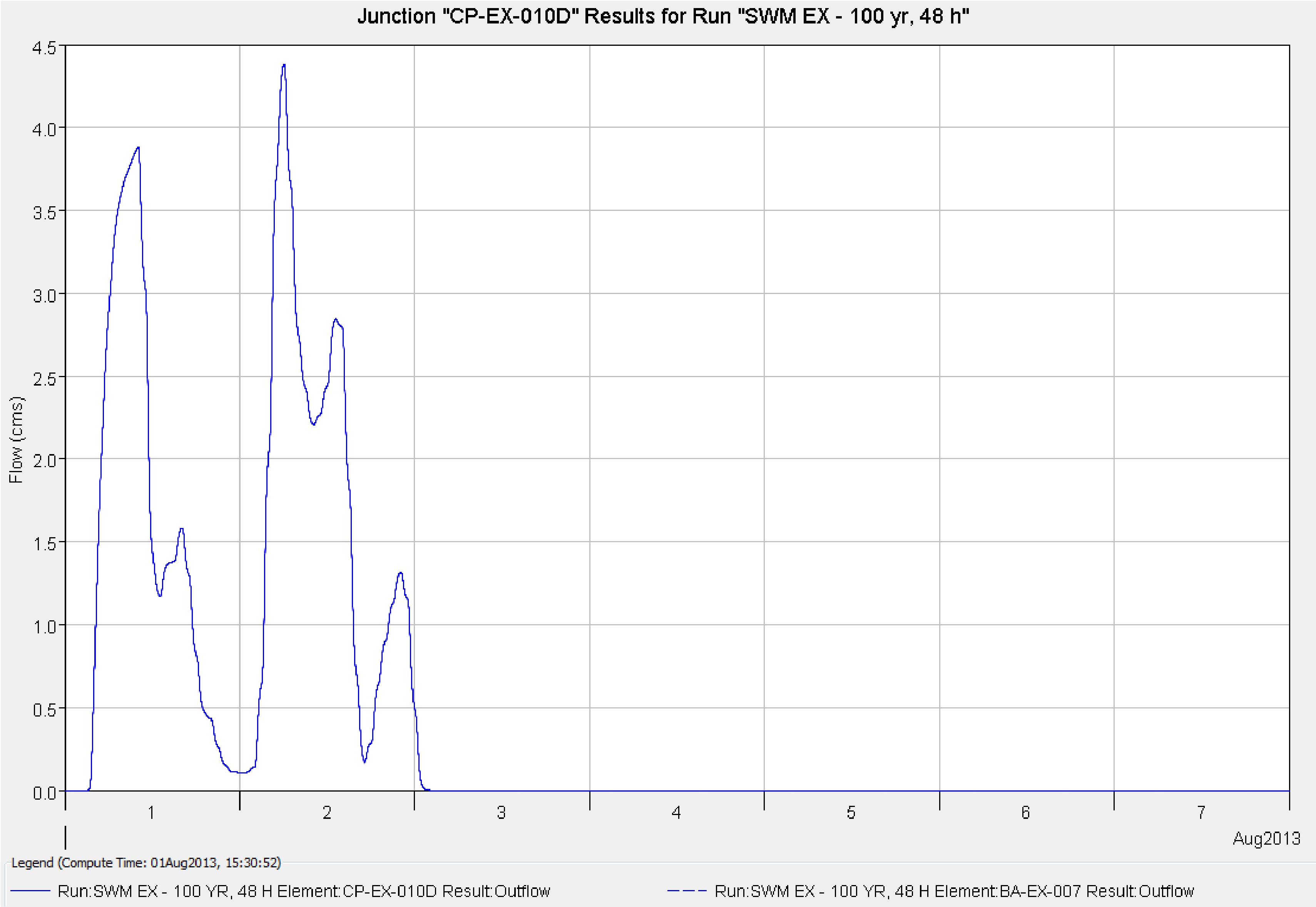


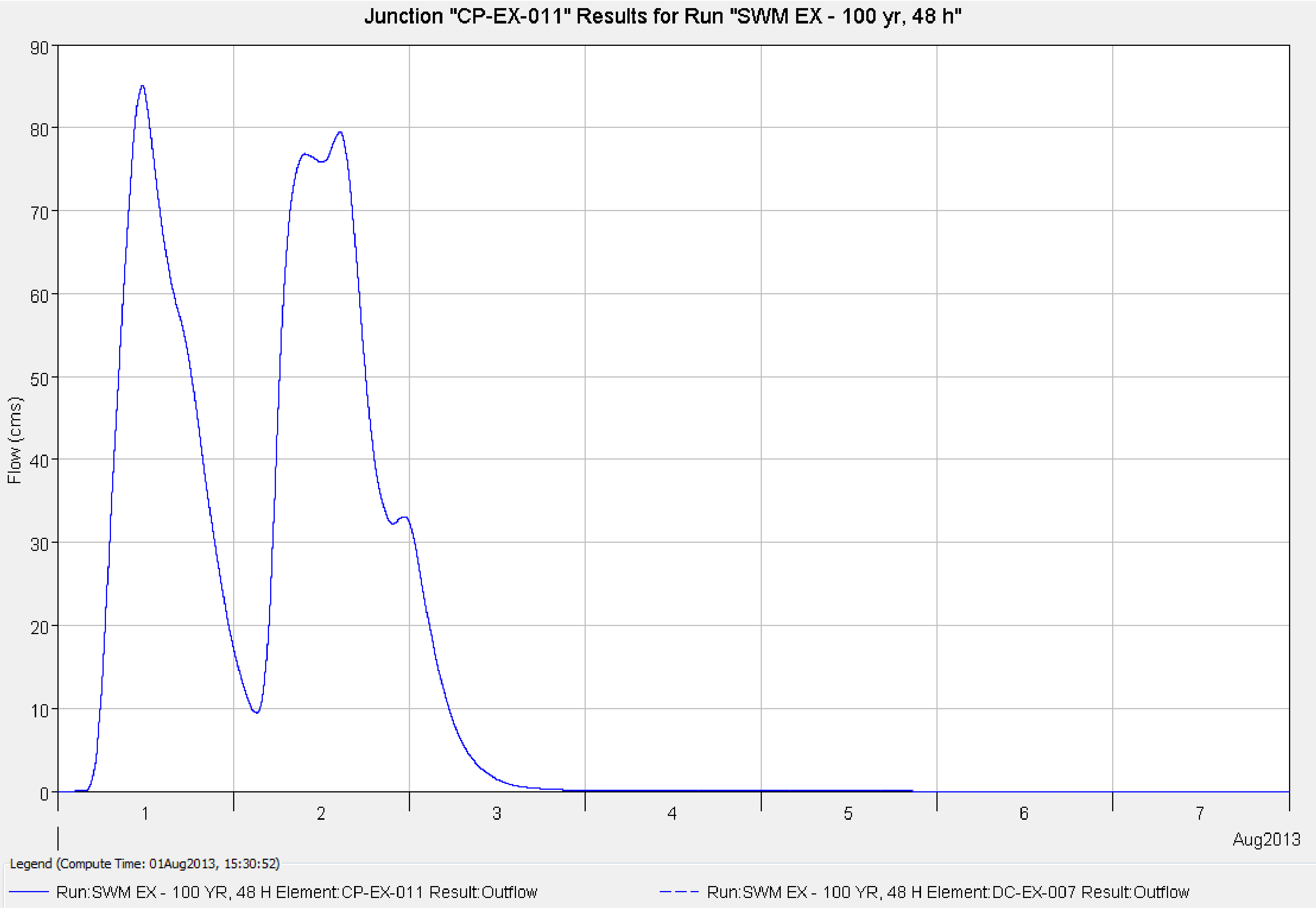
Junction "CP-EX-010A" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-010A Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-006 Result:Outflow


Junction "CP-EX-010B" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-010B Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-008 Result:Outflow

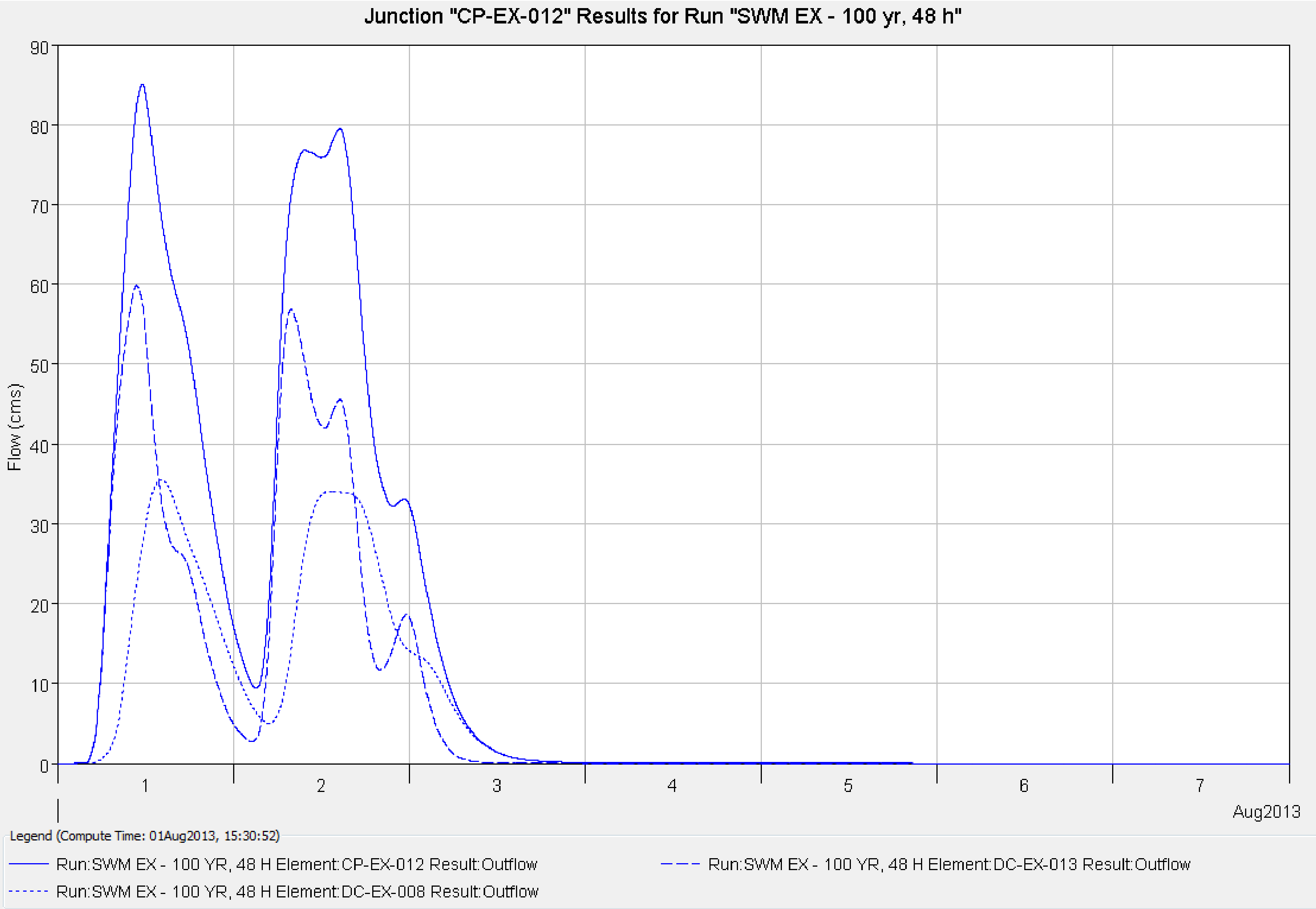


Junction "CP-EX-010C" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-010C Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-009 Result:Outflow

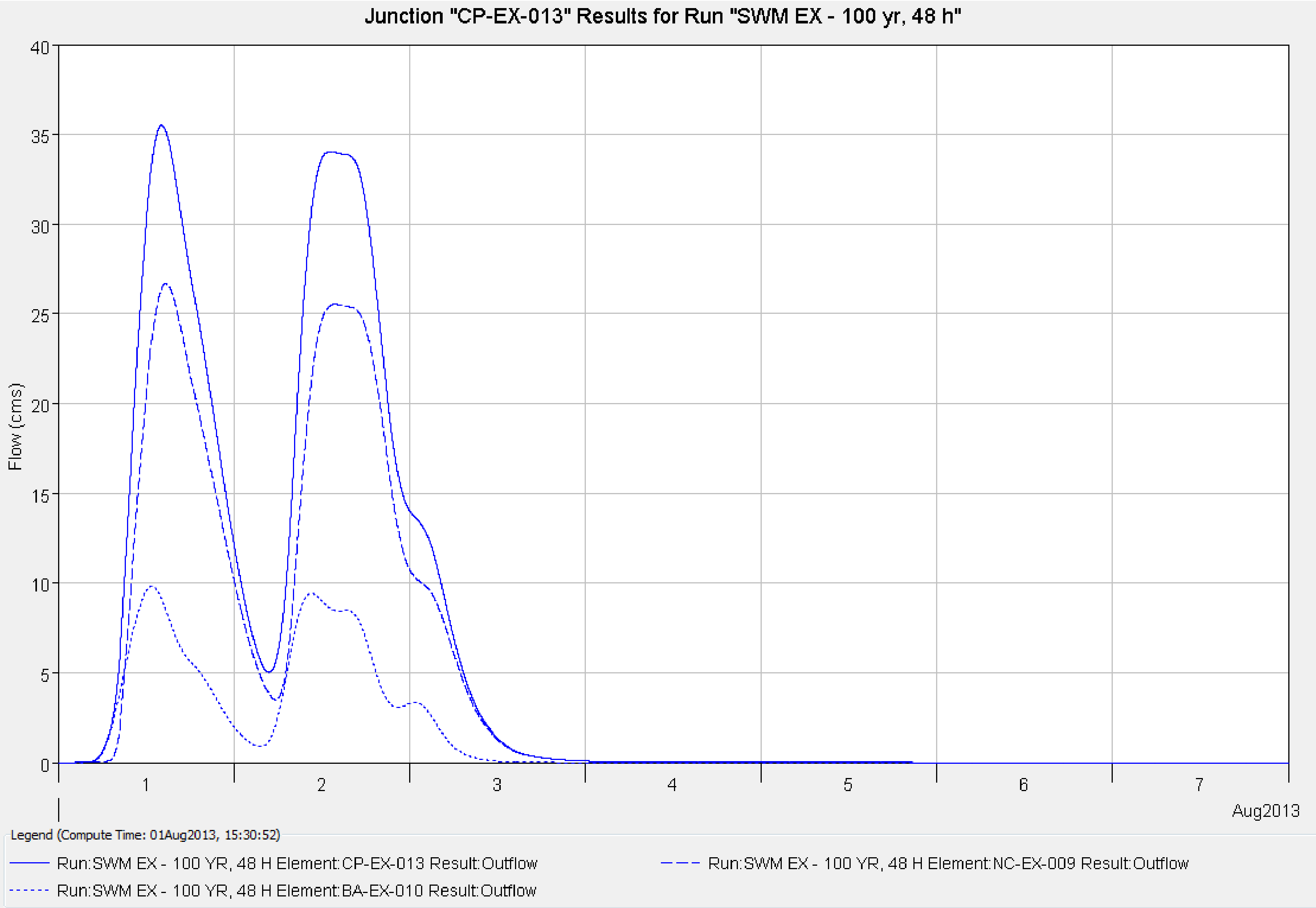

Junction "CP-EX-010D" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-010D Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-007 Result:Outflow



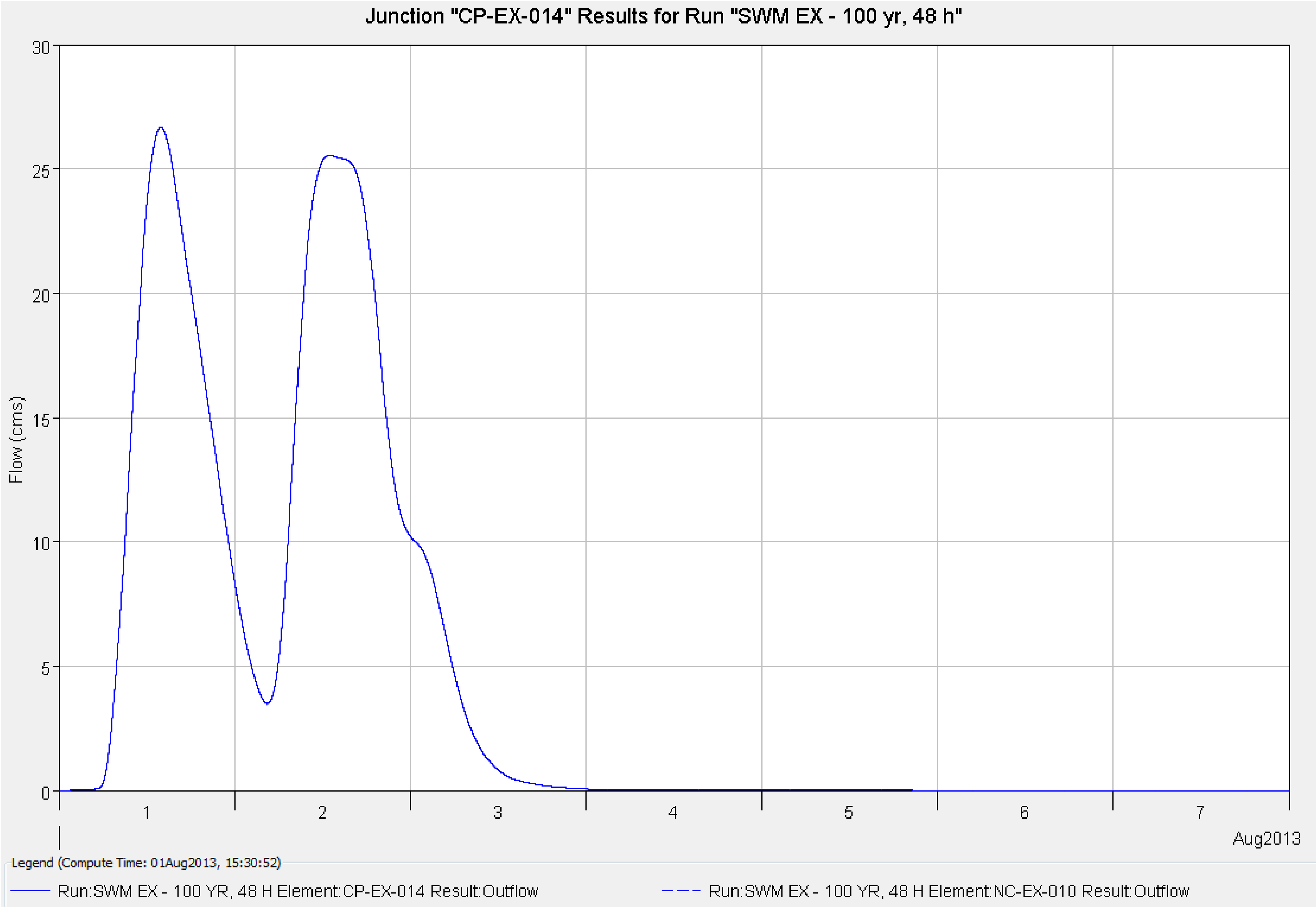
Junction "CP-EX-011" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
10
20
30
40
50
60
70
80
90
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-011 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-007 Result:Outflow

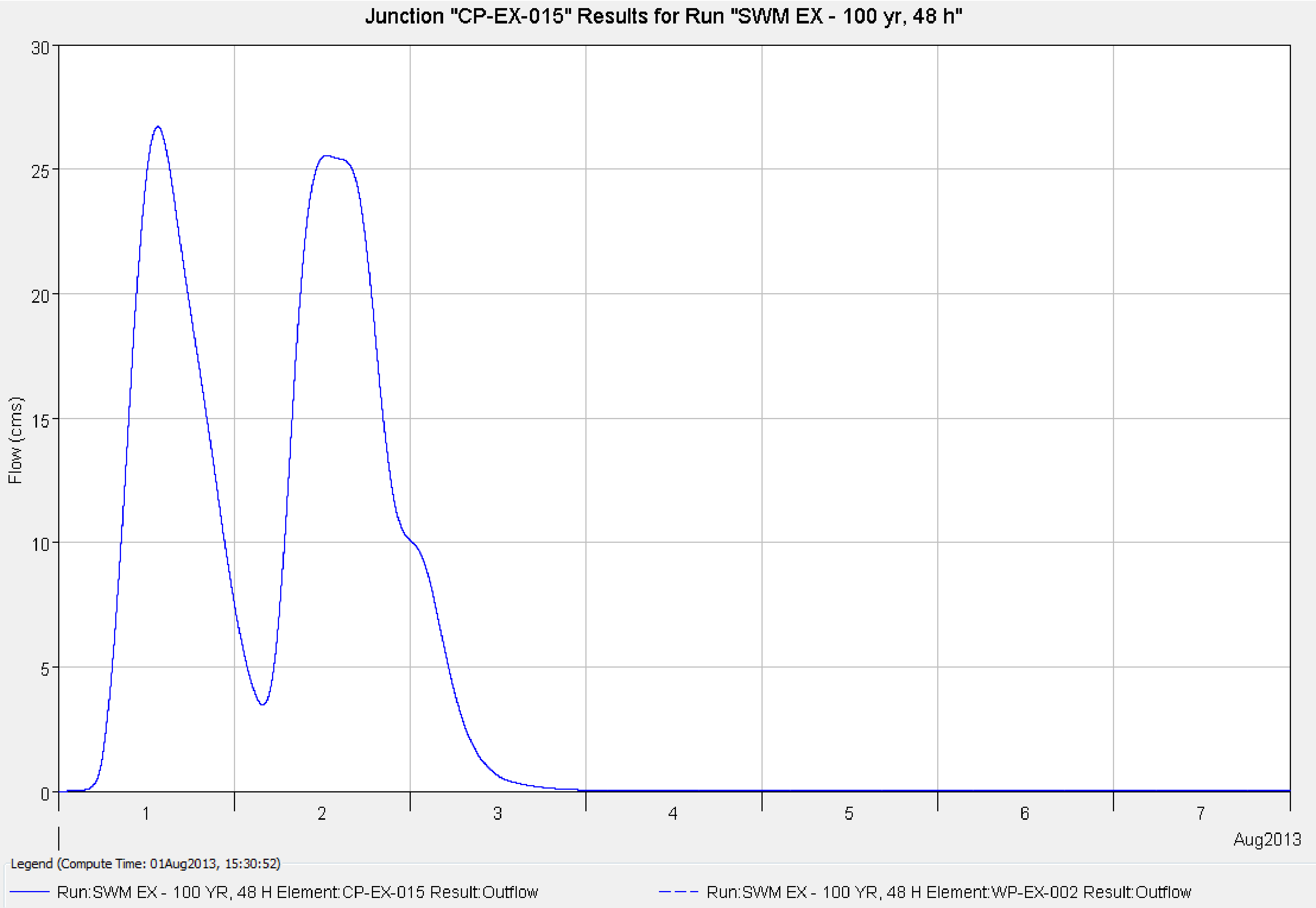


Junction "CP-EX-012" Results for Run "SWM EX - 100 yr, 48 h"
90
80
70
60
50
40
30
20
10
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-012 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-013 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-008 Result:Outflow

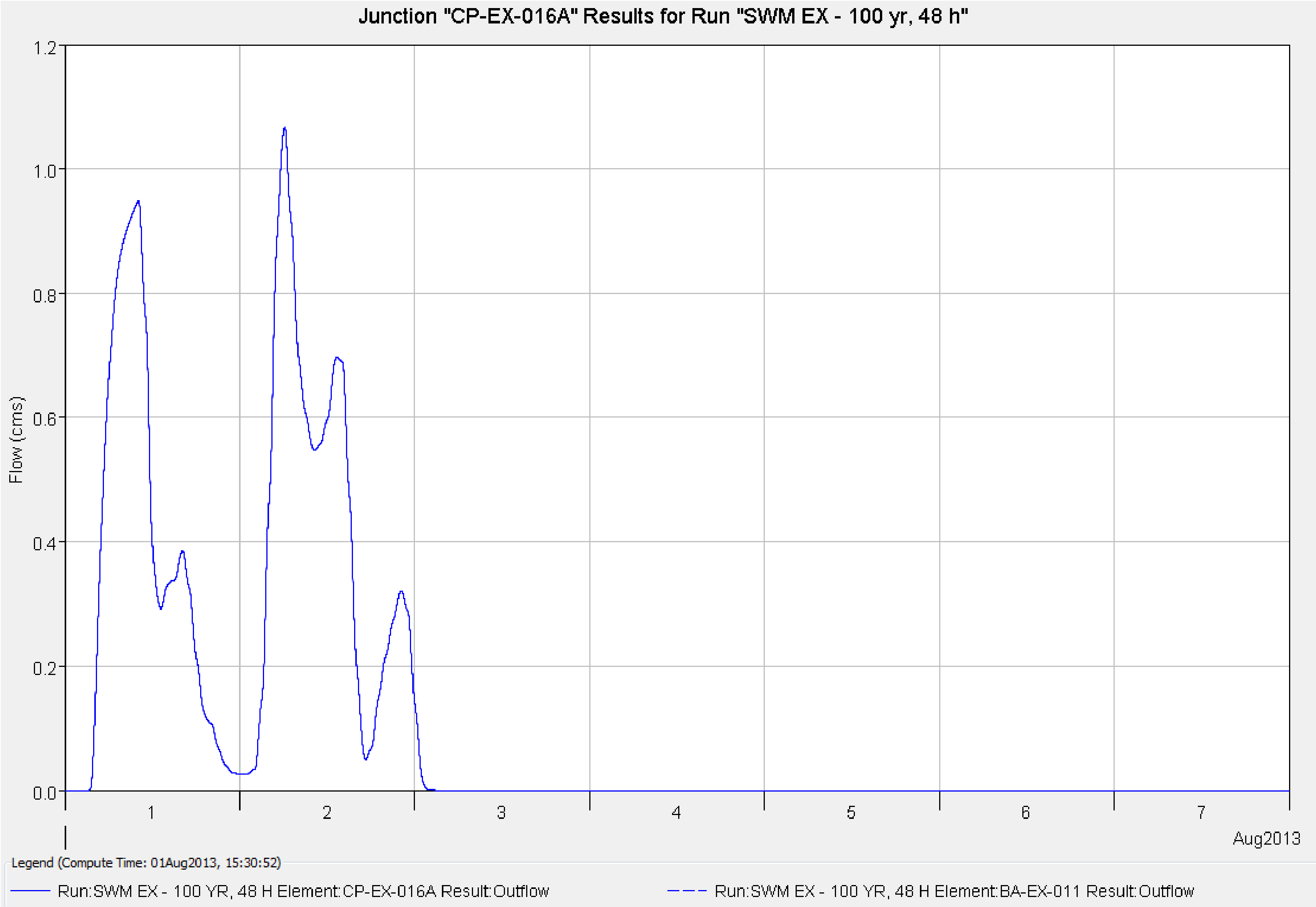


Junction "CP-EX-013" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-013 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-009 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-010 Result:Outflow

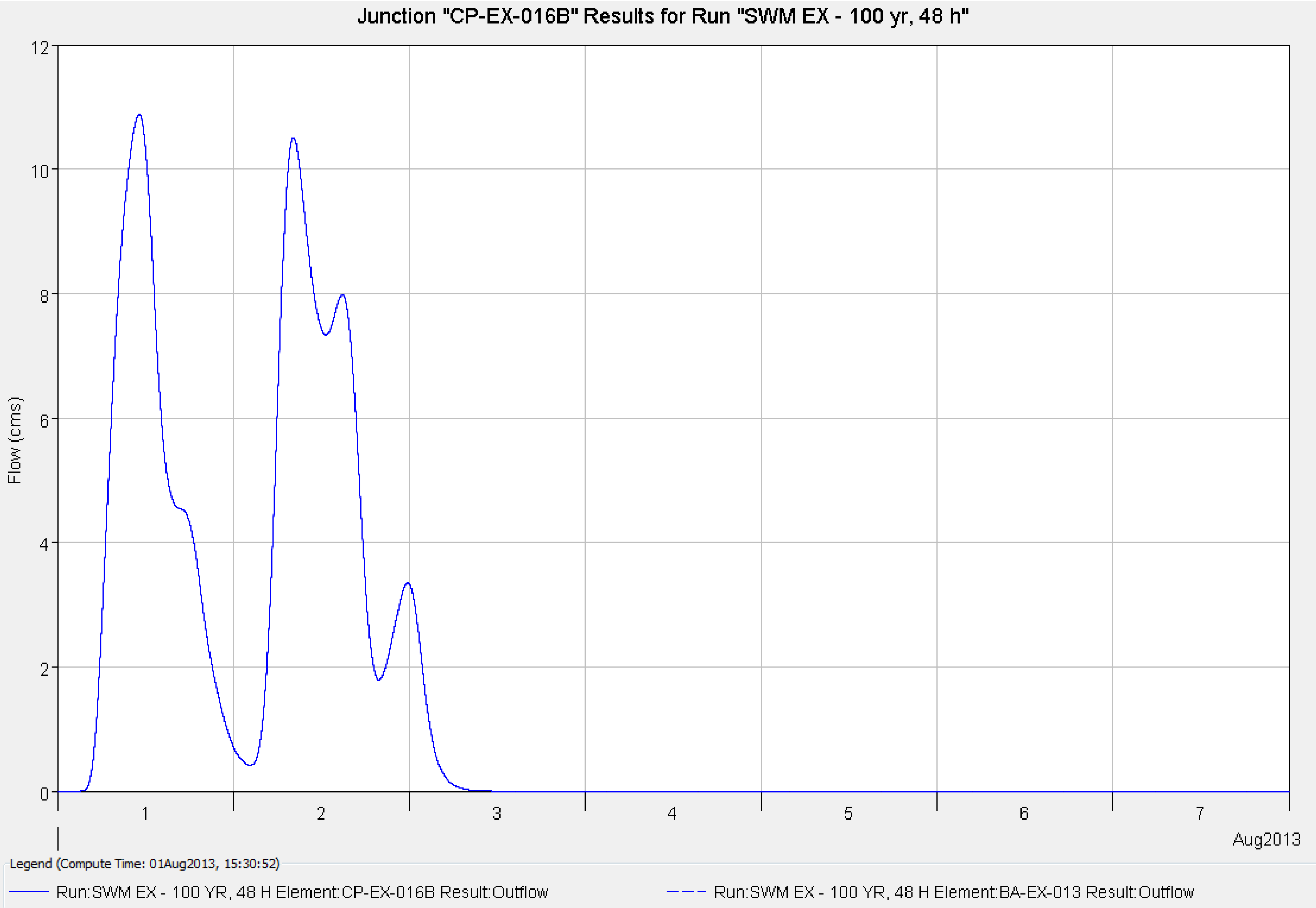

Junction "CP-EX-014" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-014 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-010 Result:Outflow



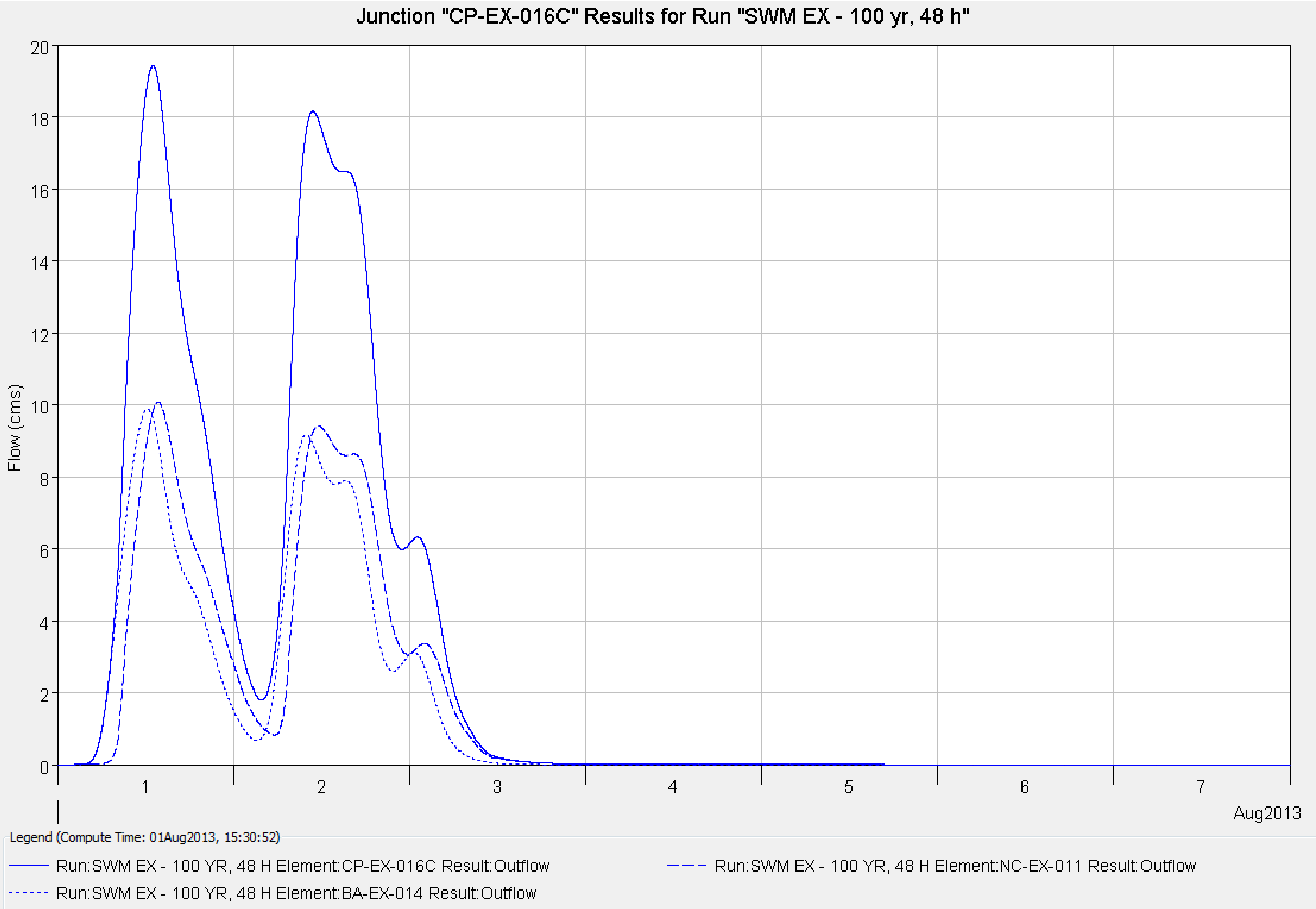
Junction "CP-EX-015" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-015 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-002 Result:Outflow

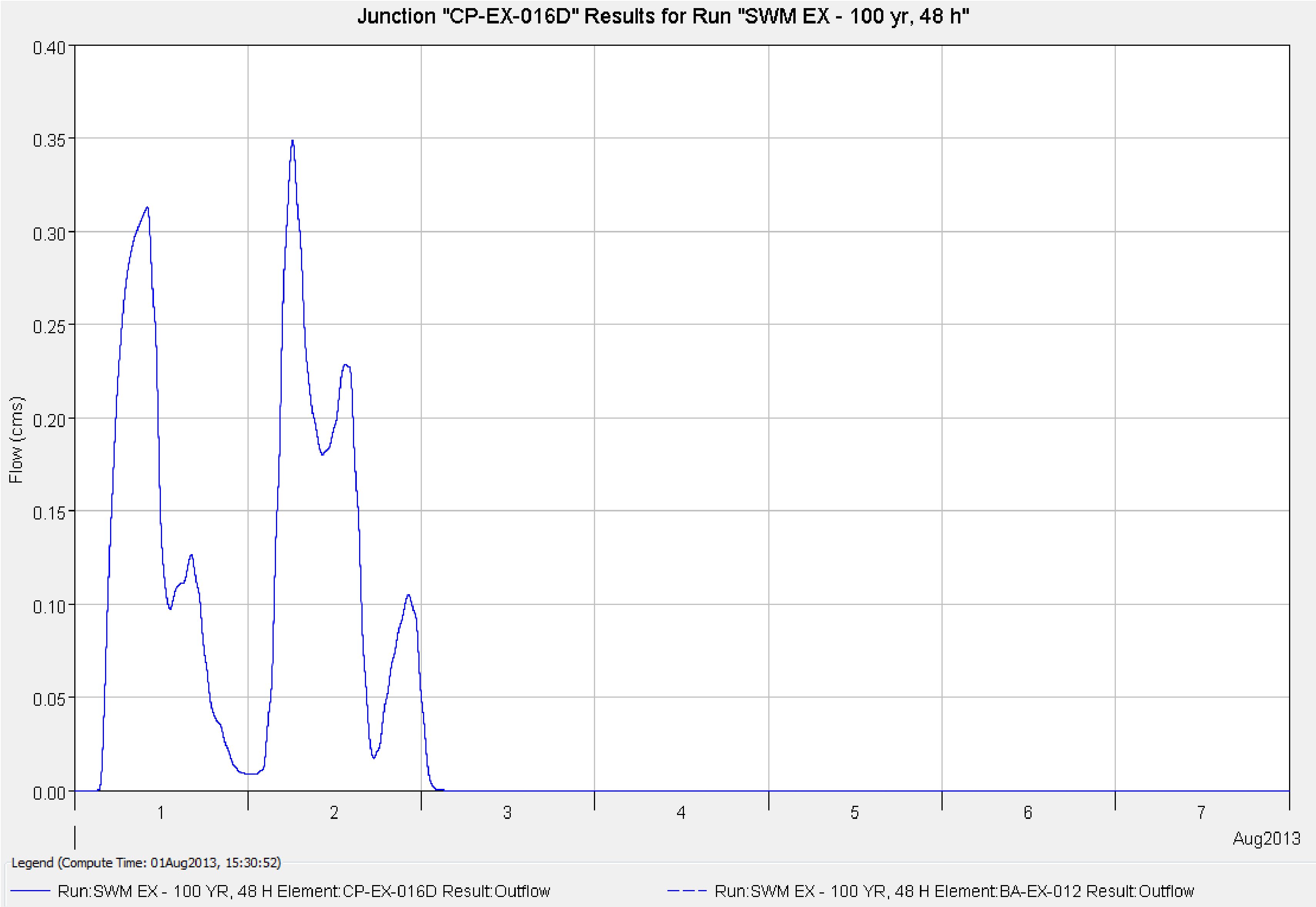


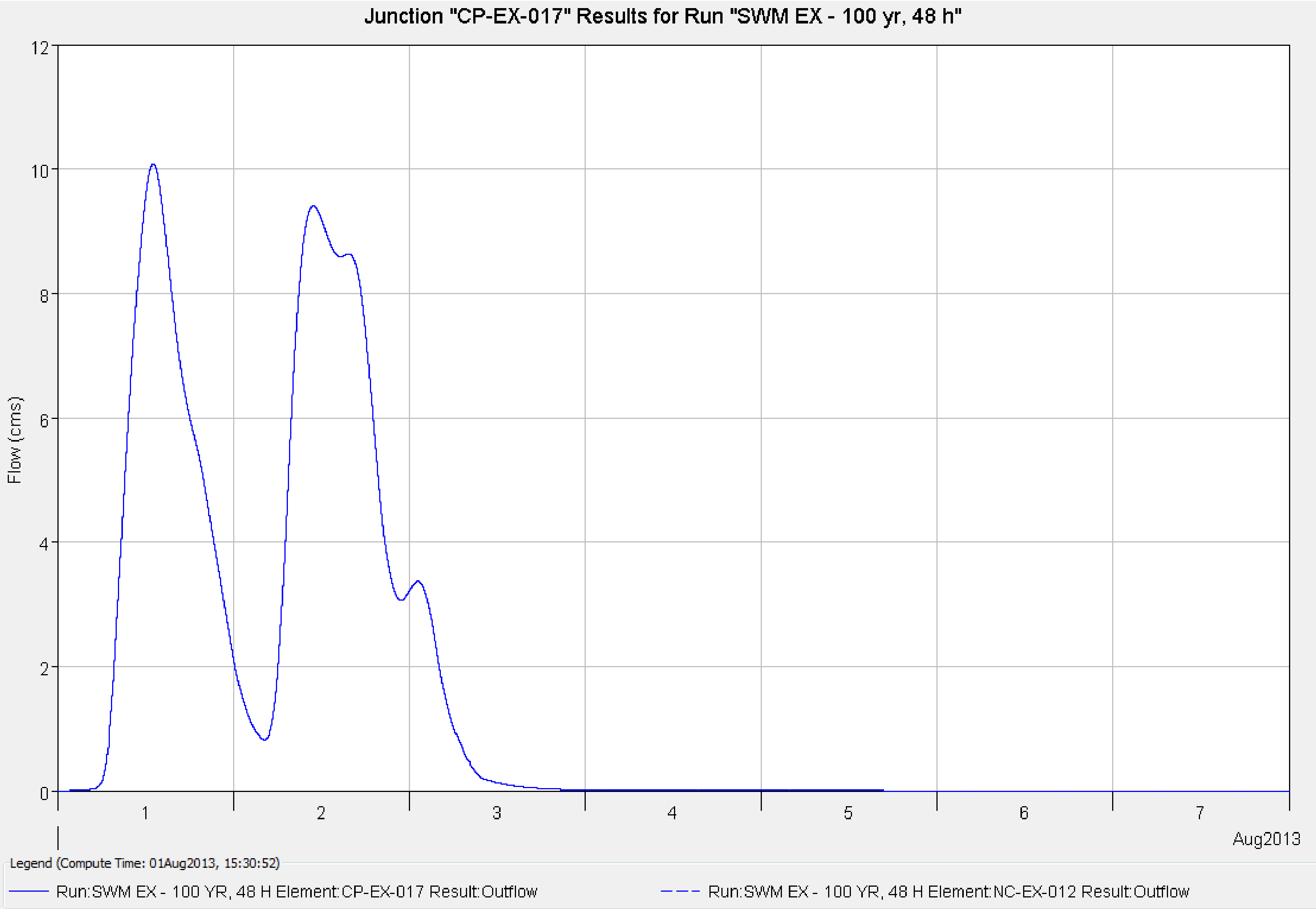
Junction "CP-EX-016A" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-016A Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-011 Result:Outflow

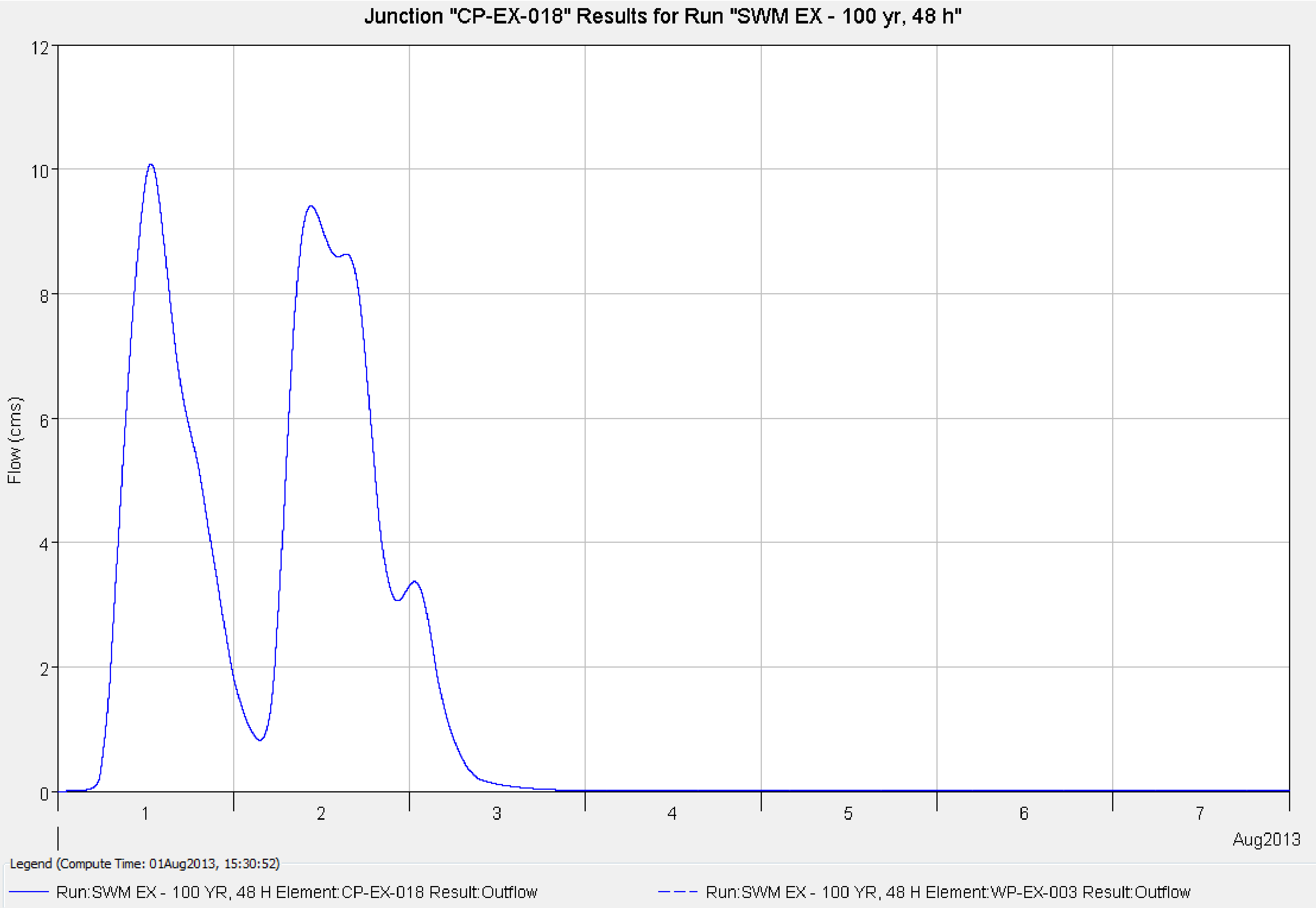


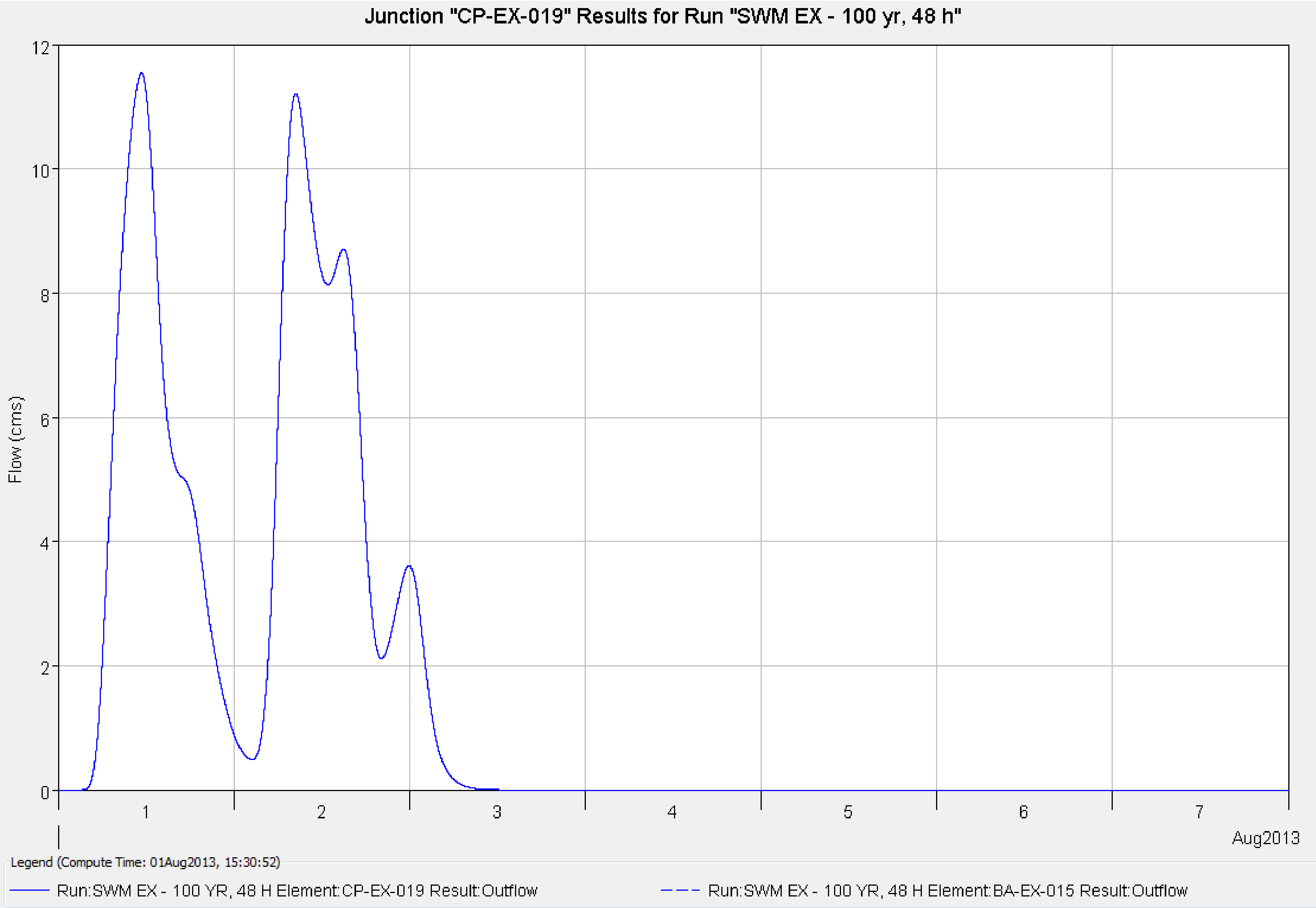
Junction "CP-EX-016B" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-016B Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-013 Result:Outflow


Junction "CP-EX-016C" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-016C Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-011 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-014 Result:Outflow

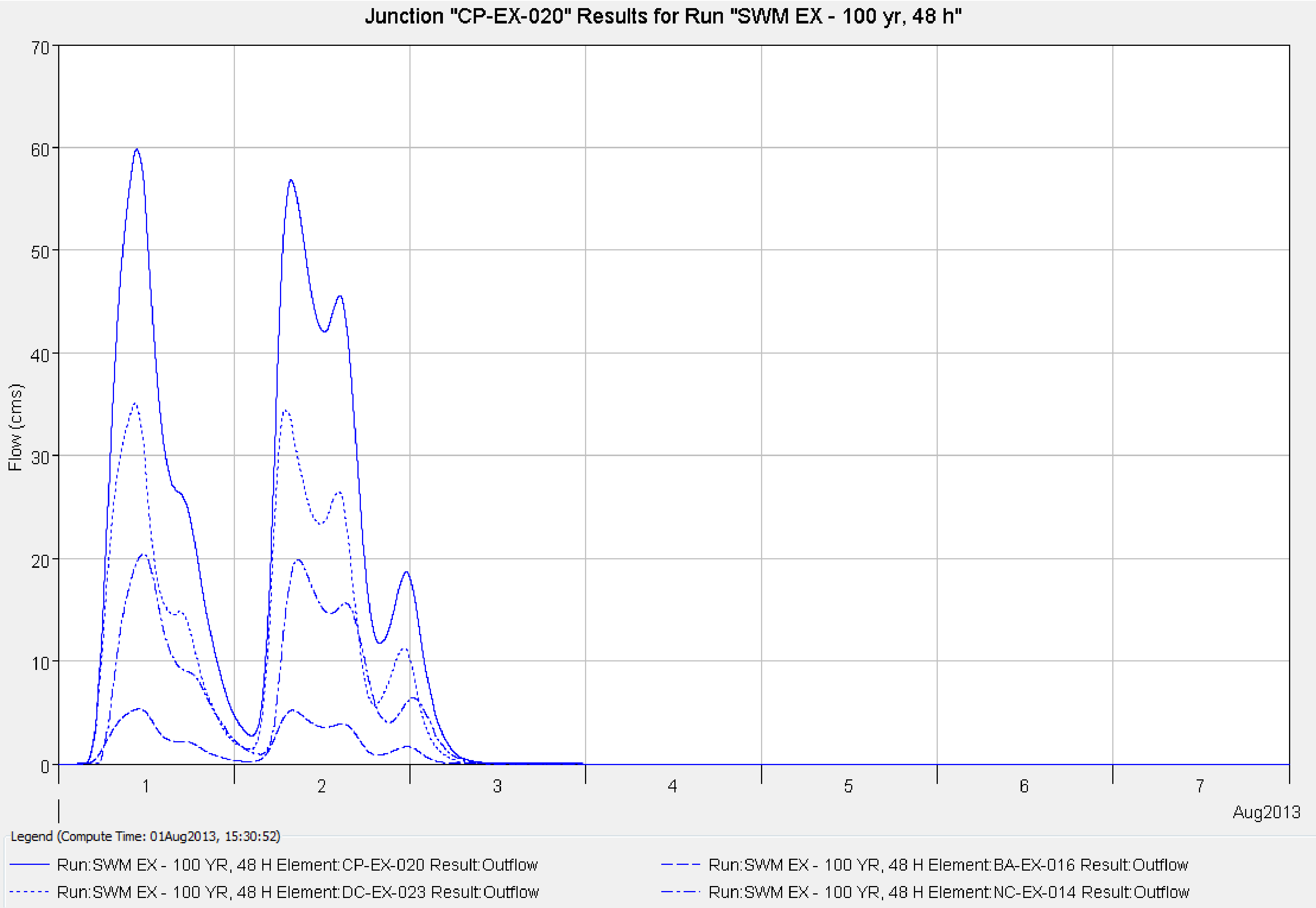

Junction "CP-EX-016D" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-016D Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-012 Result:Outflow

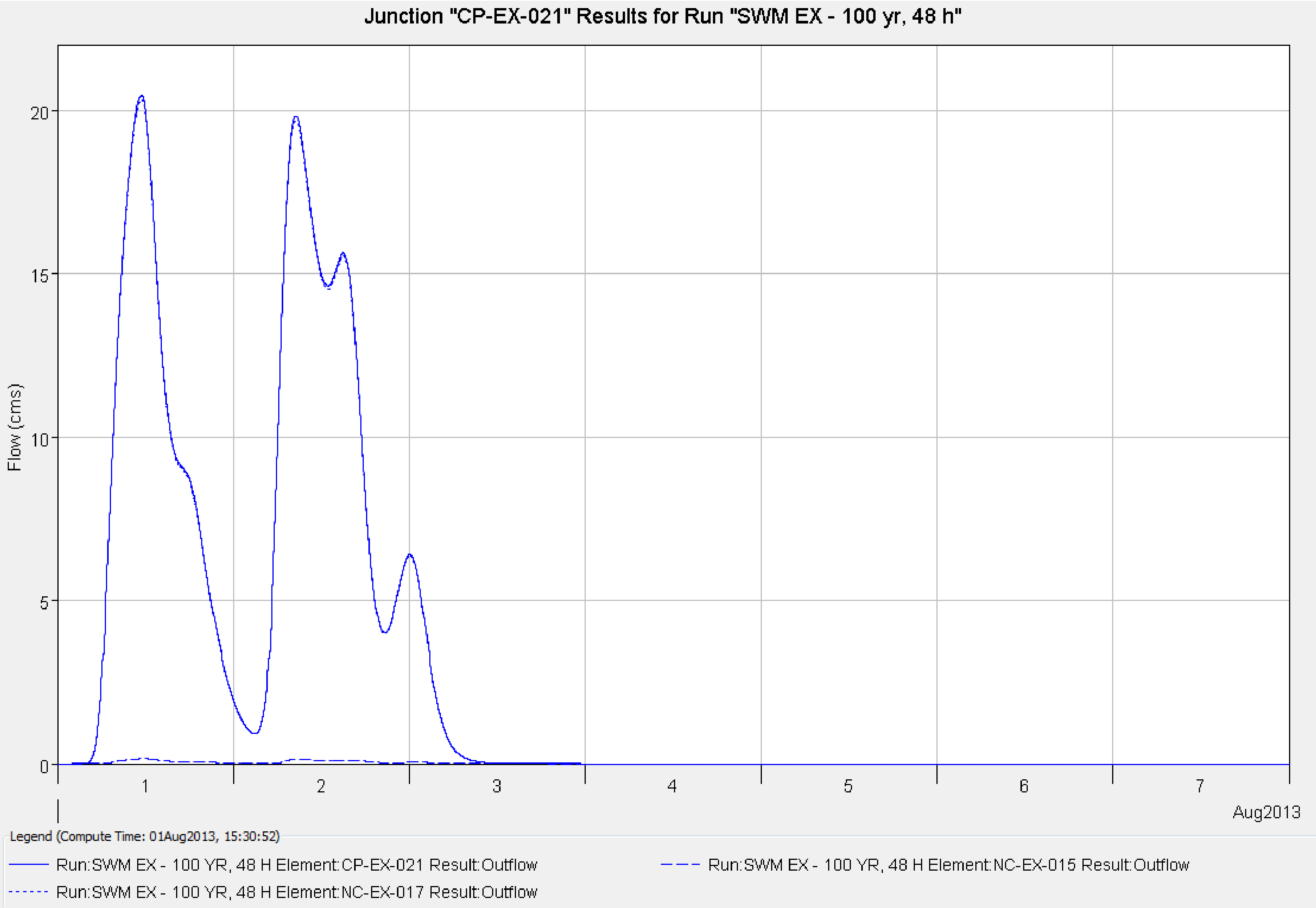

Junction "CP-EX-017" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-017 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-012 Result:Outflow


Junction "CP-EX-018" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-018 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-003 Result:Outflow

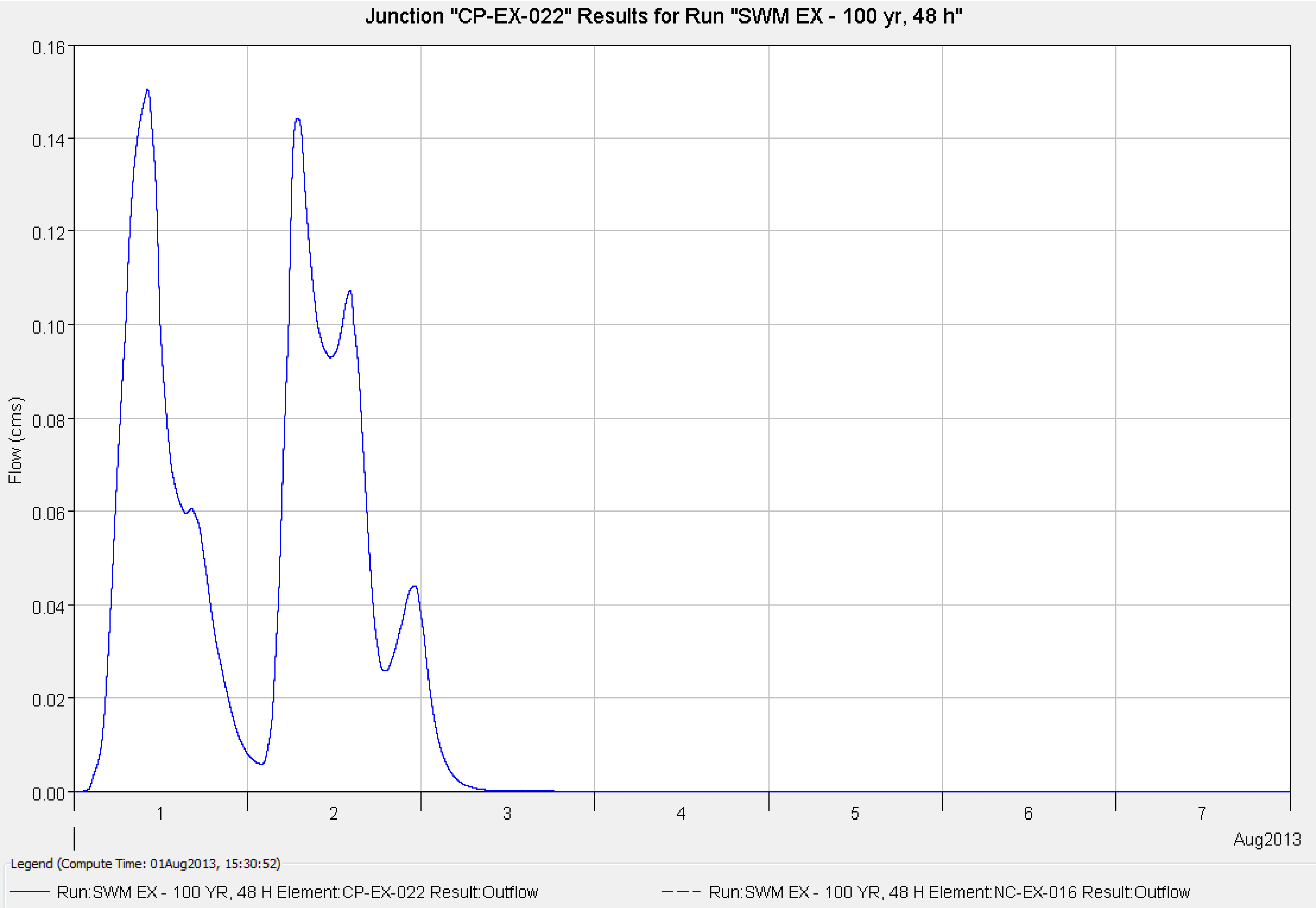


Junction "CP-EX-019" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-019 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-015 Result:Outflow

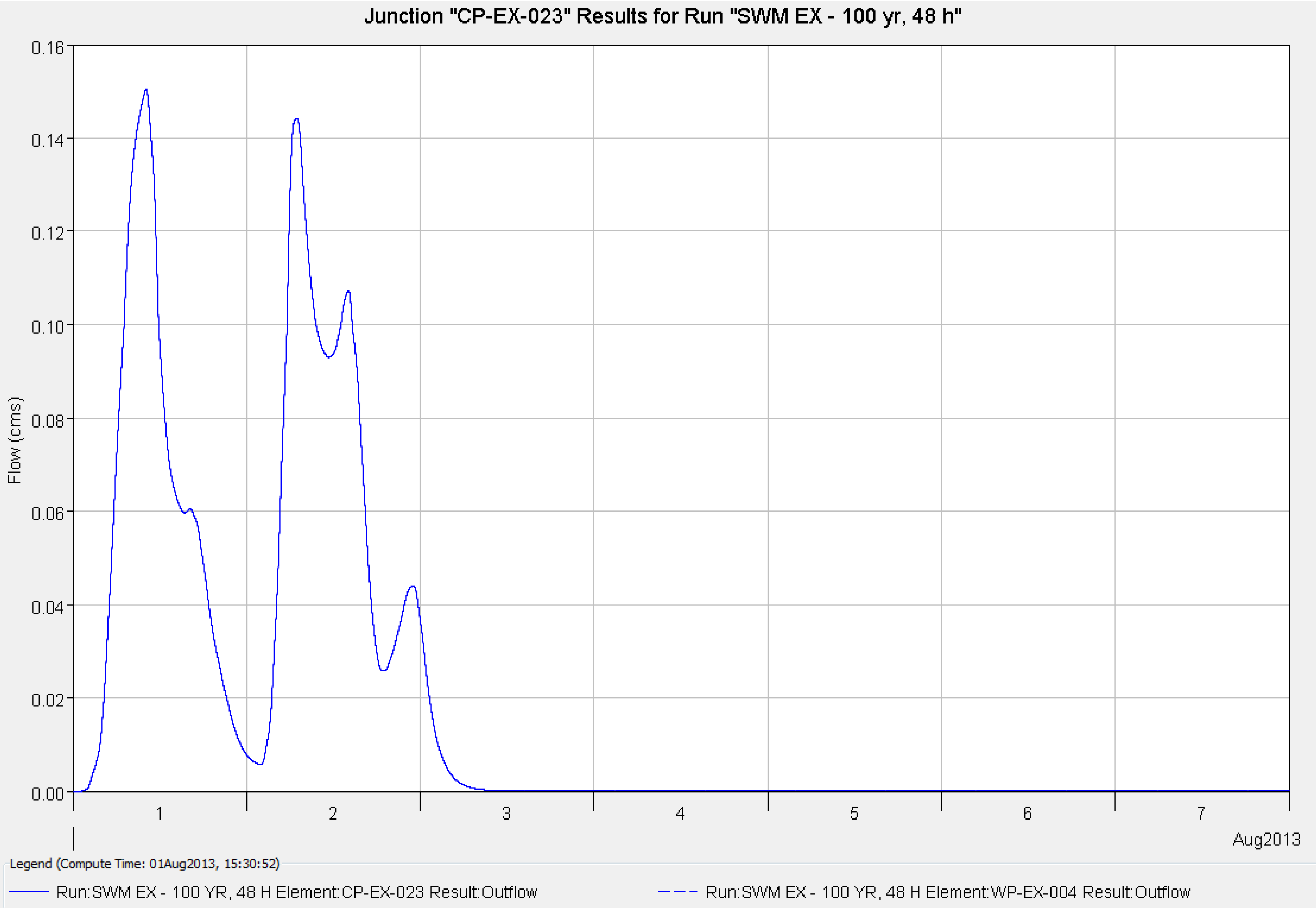

Junction "CP-EX-020" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-020 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-016 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-014 Result:Outflow



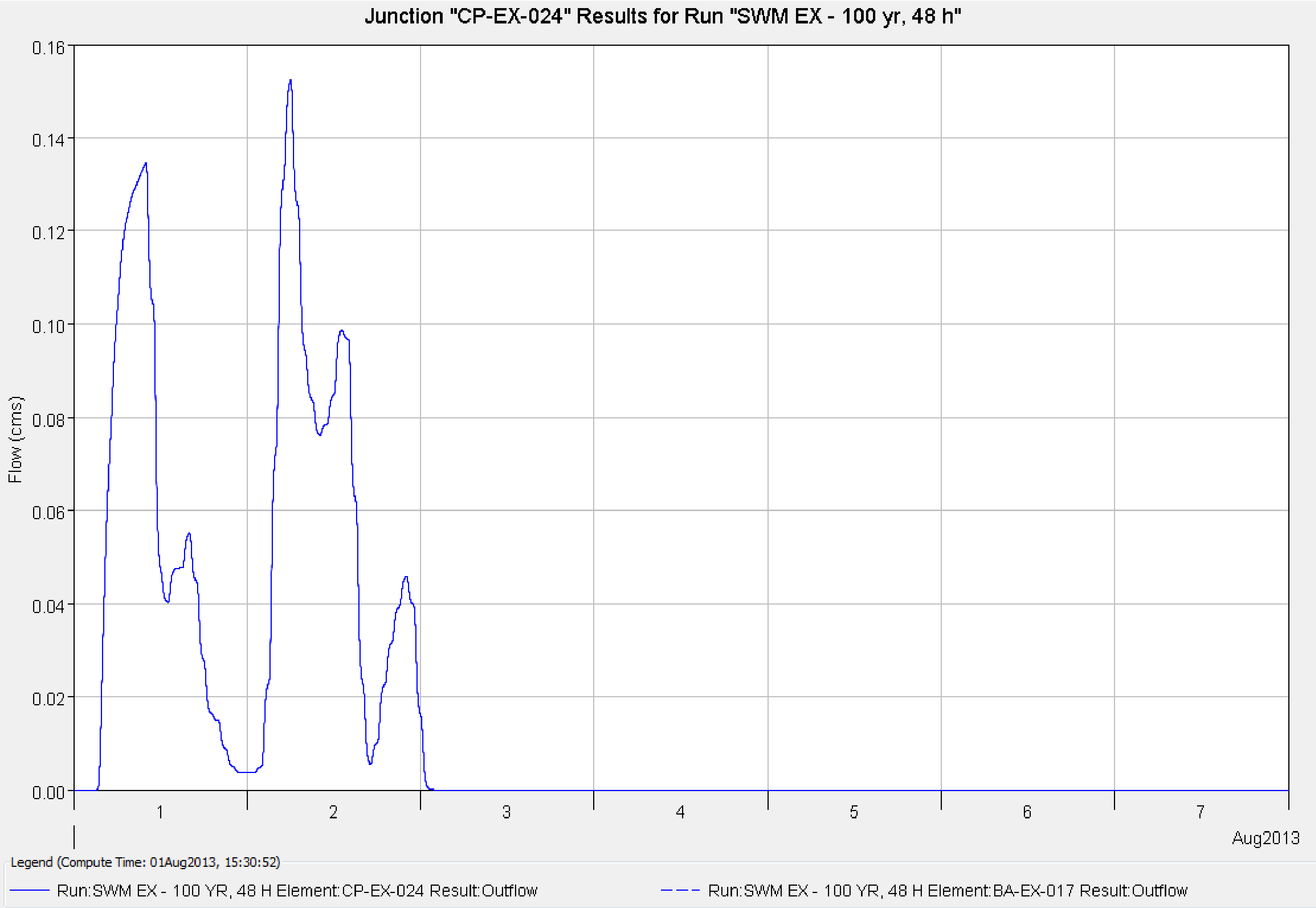
Junction "CP-EX-021" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-015 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-017 Result:Outflow



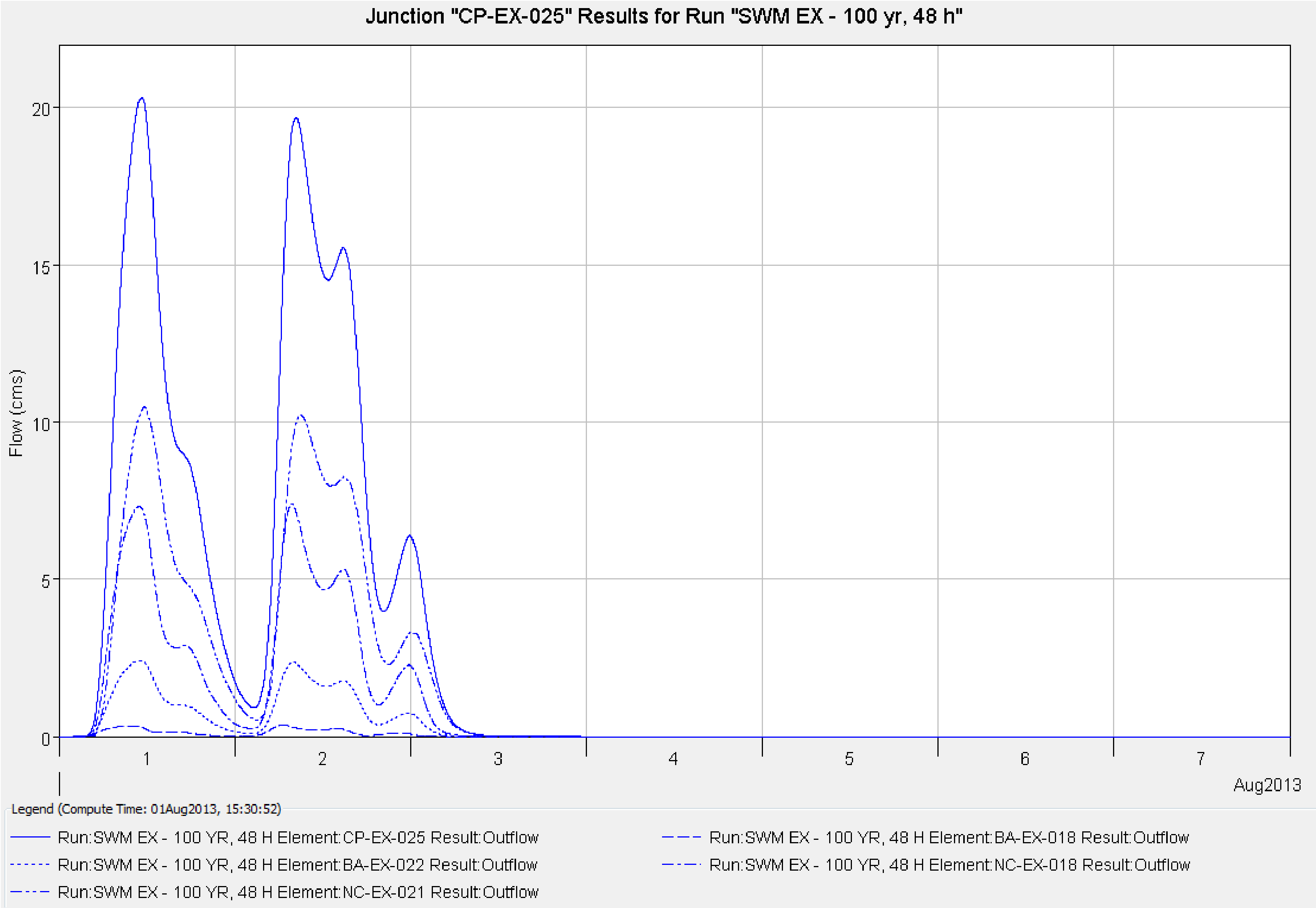
Junction "CP-EX-022" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-022 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-016 Result:Outflow



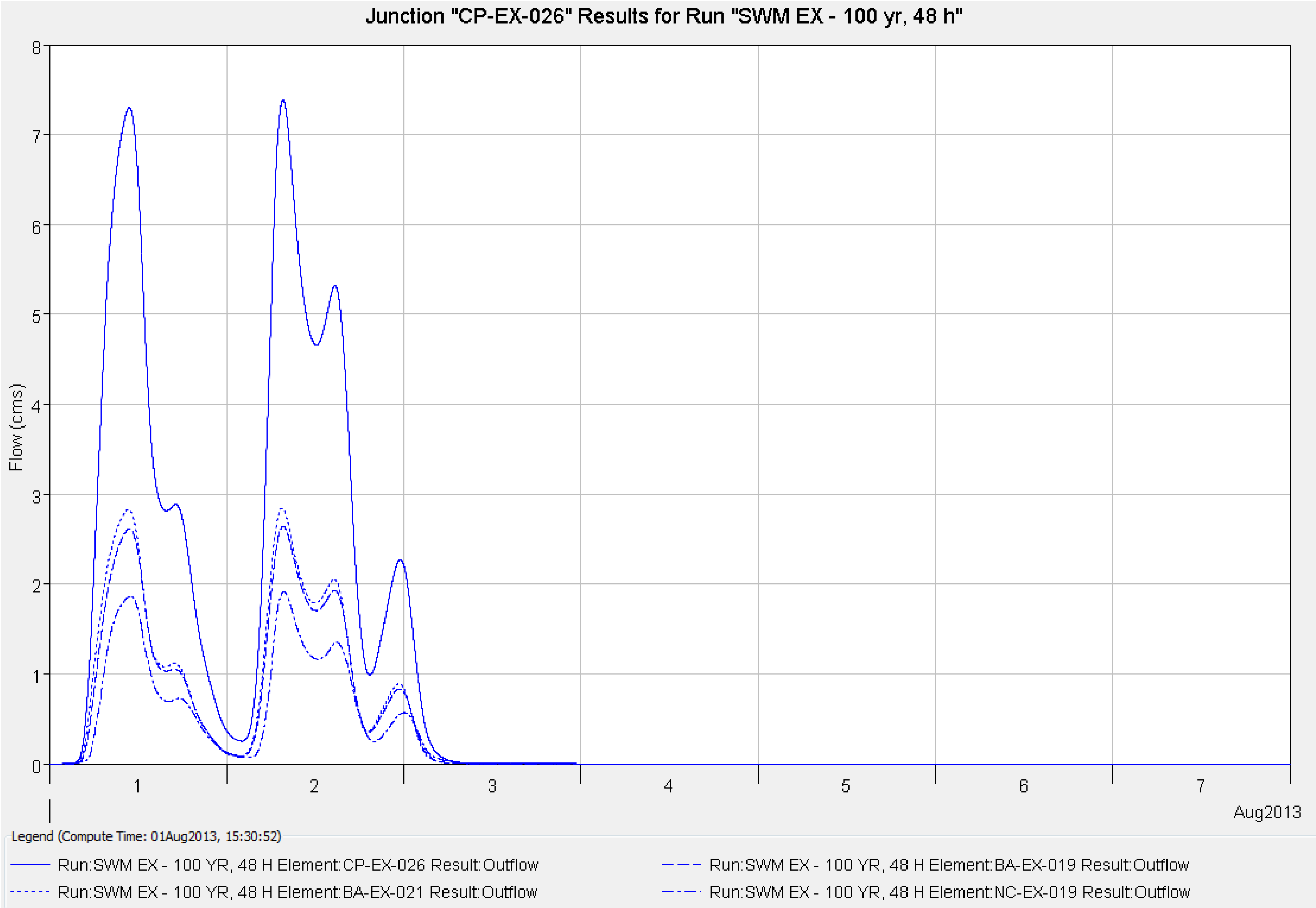
Junction "CP-EX-023" Results for Run "SWM EX - 100 yr, 48 h"
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-004 Result:Outflow



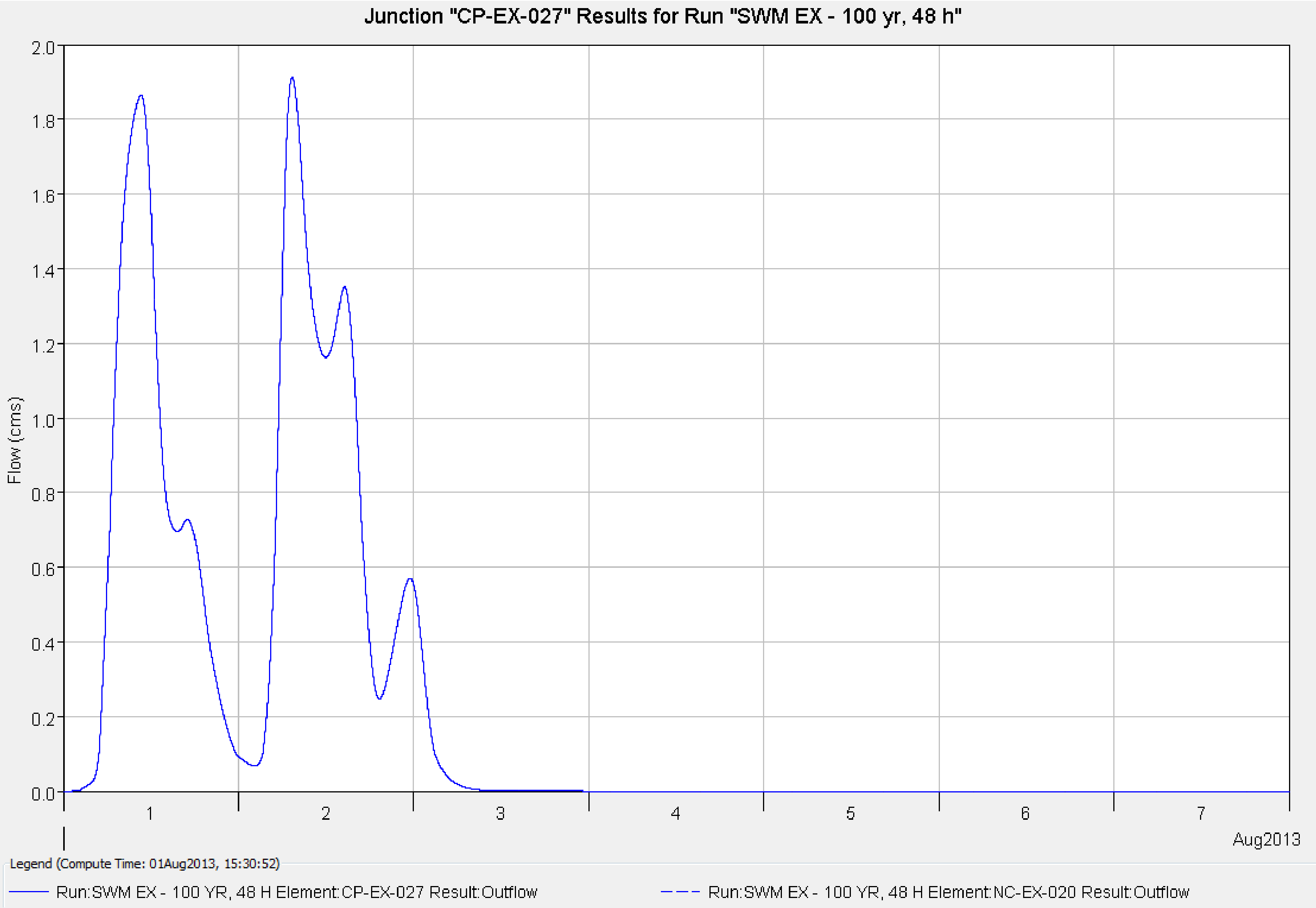
Junction "CP-EX-024" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-024 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-017 Result:Outflow



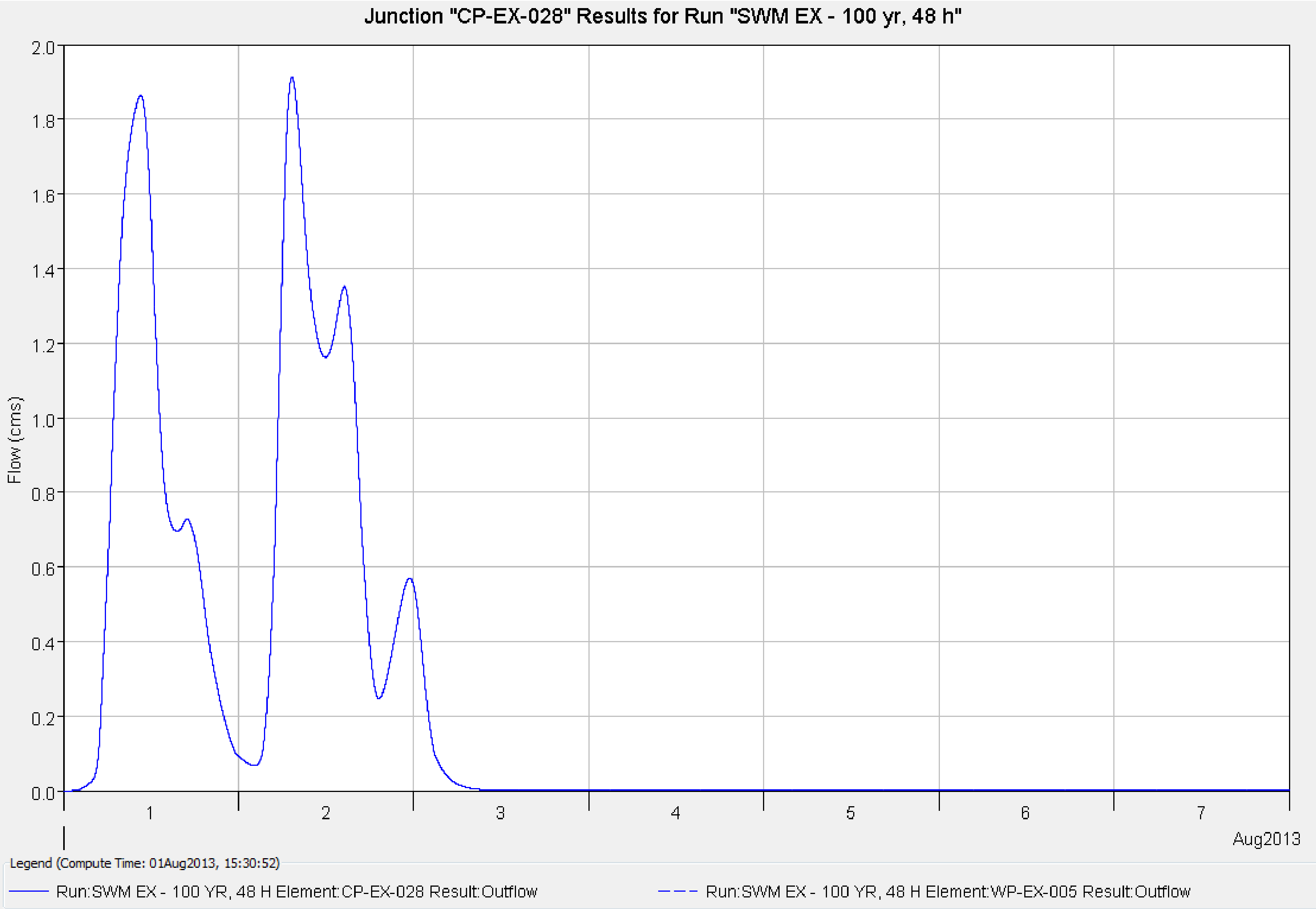
Junction "CP-EX-025" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-025 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-022 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-018 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-018 Result:Outflow

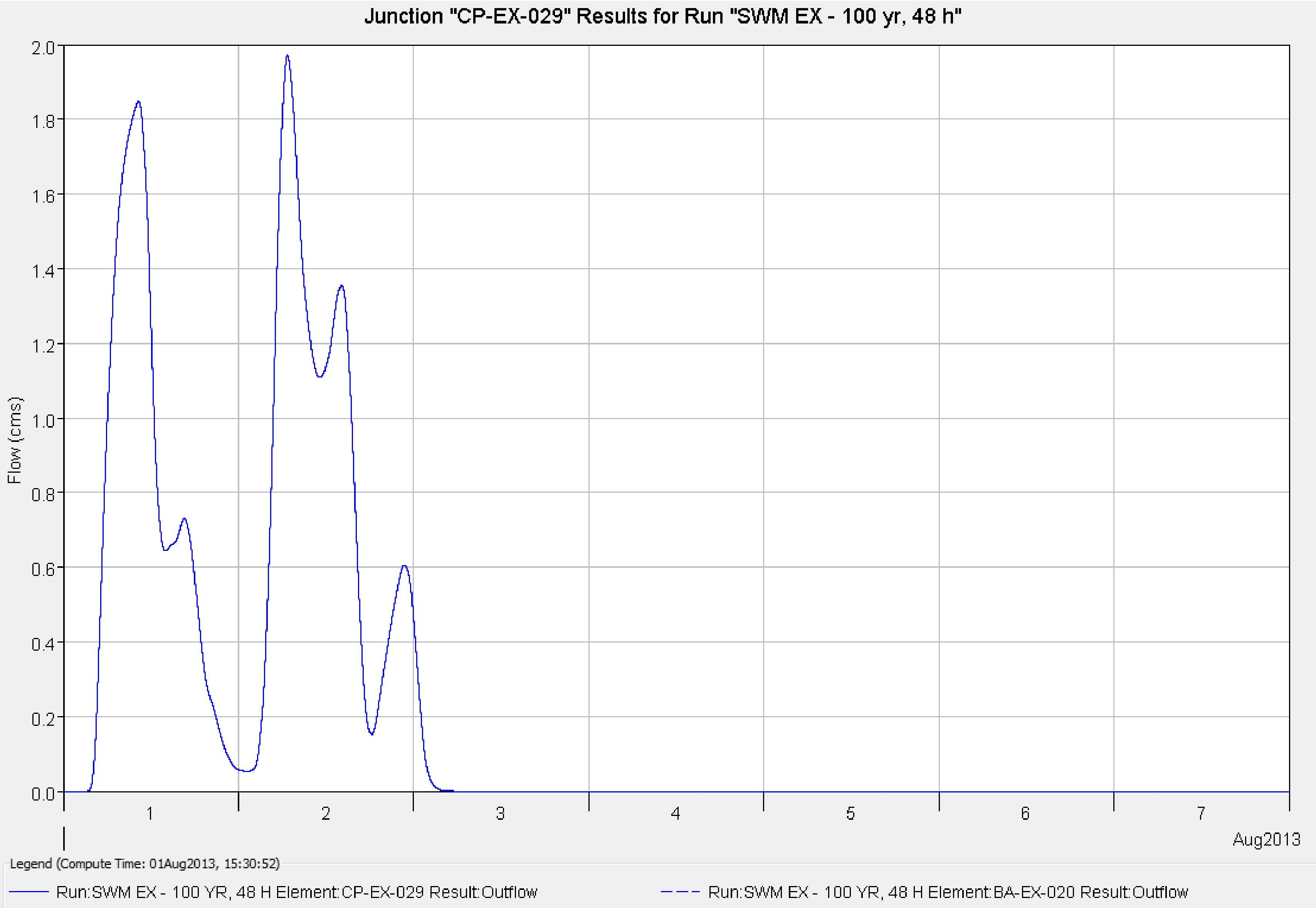


Junction "CP-EX-026" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-019 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-021 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-019 Result:Outflow

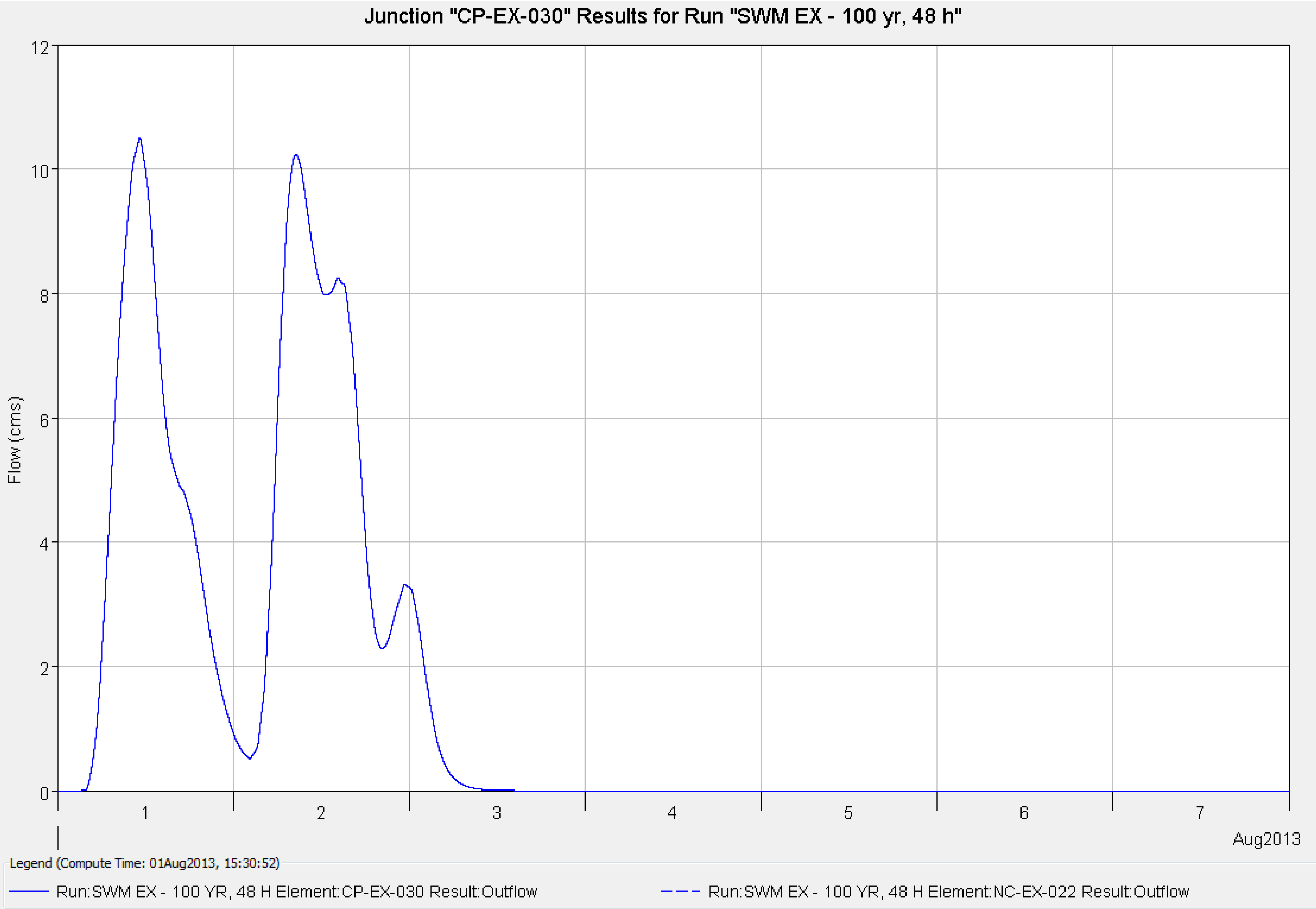


Junction "CP-EX-027" Results for Run "SWM EX - 100 yr, 48 h"
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-027 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-020 Result:Outflow

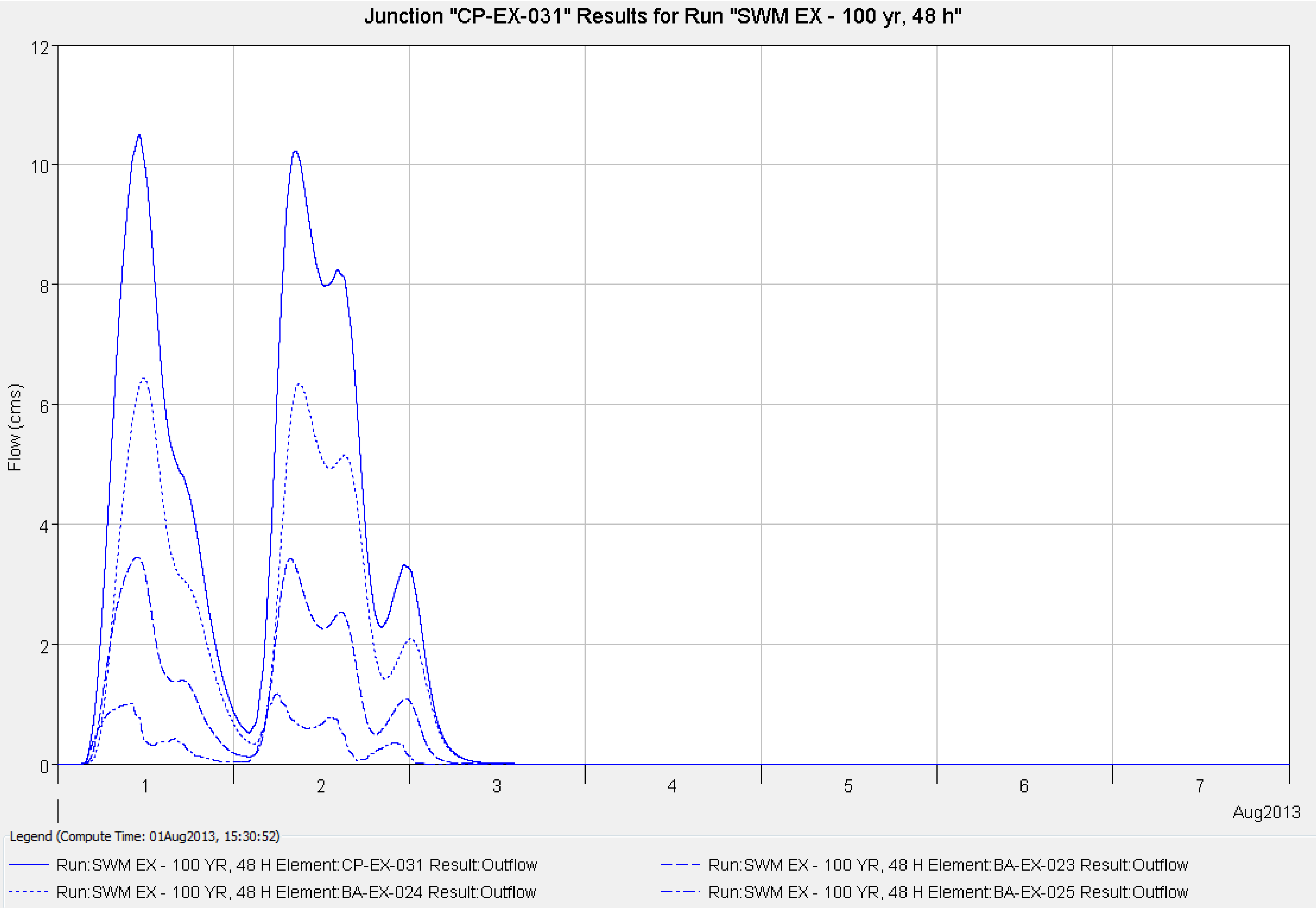

Junction "CP-EX-028" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-005 Result:Outflow



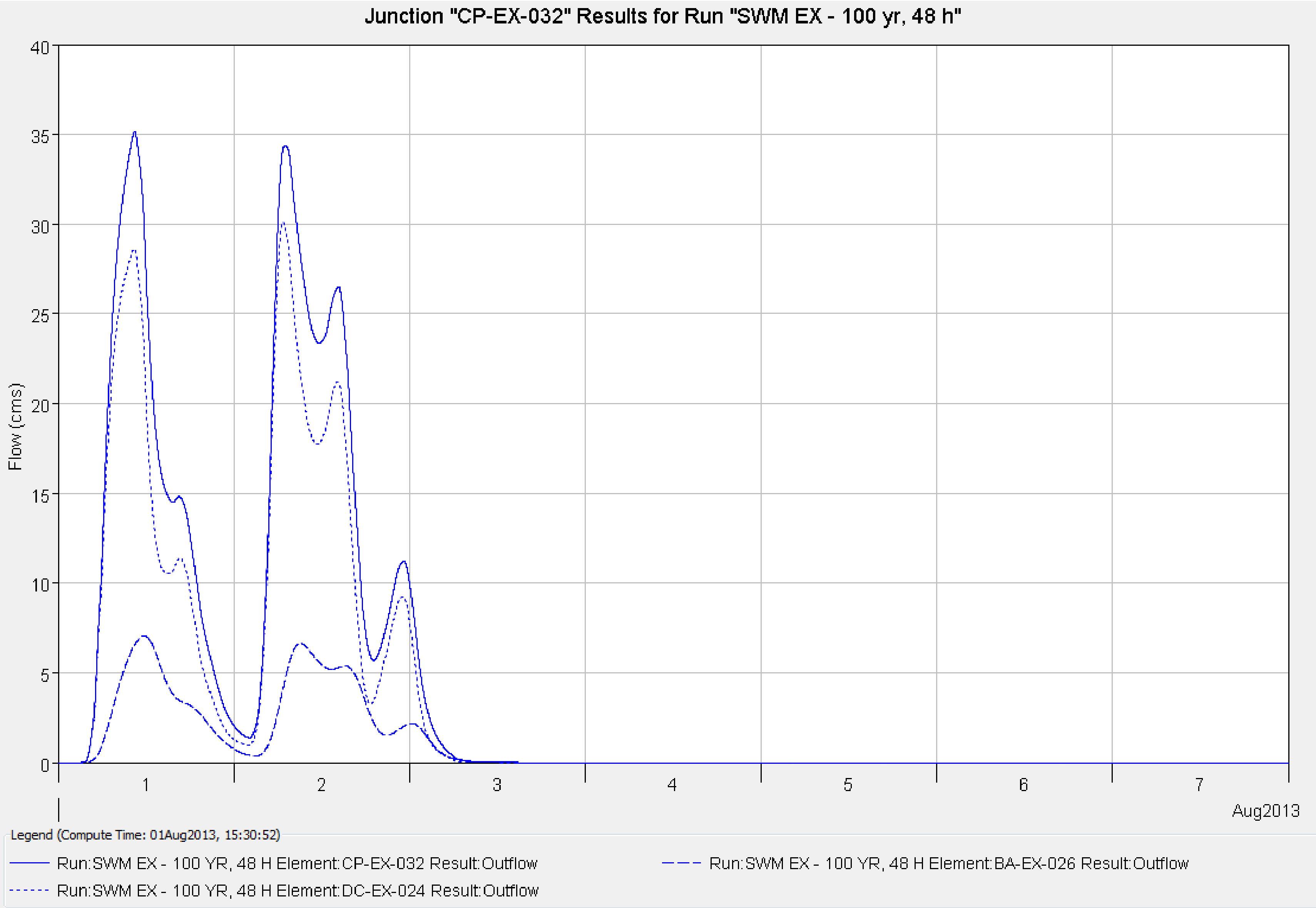
Junction "CP-EX-029" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-029 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-020 Result:Outflow

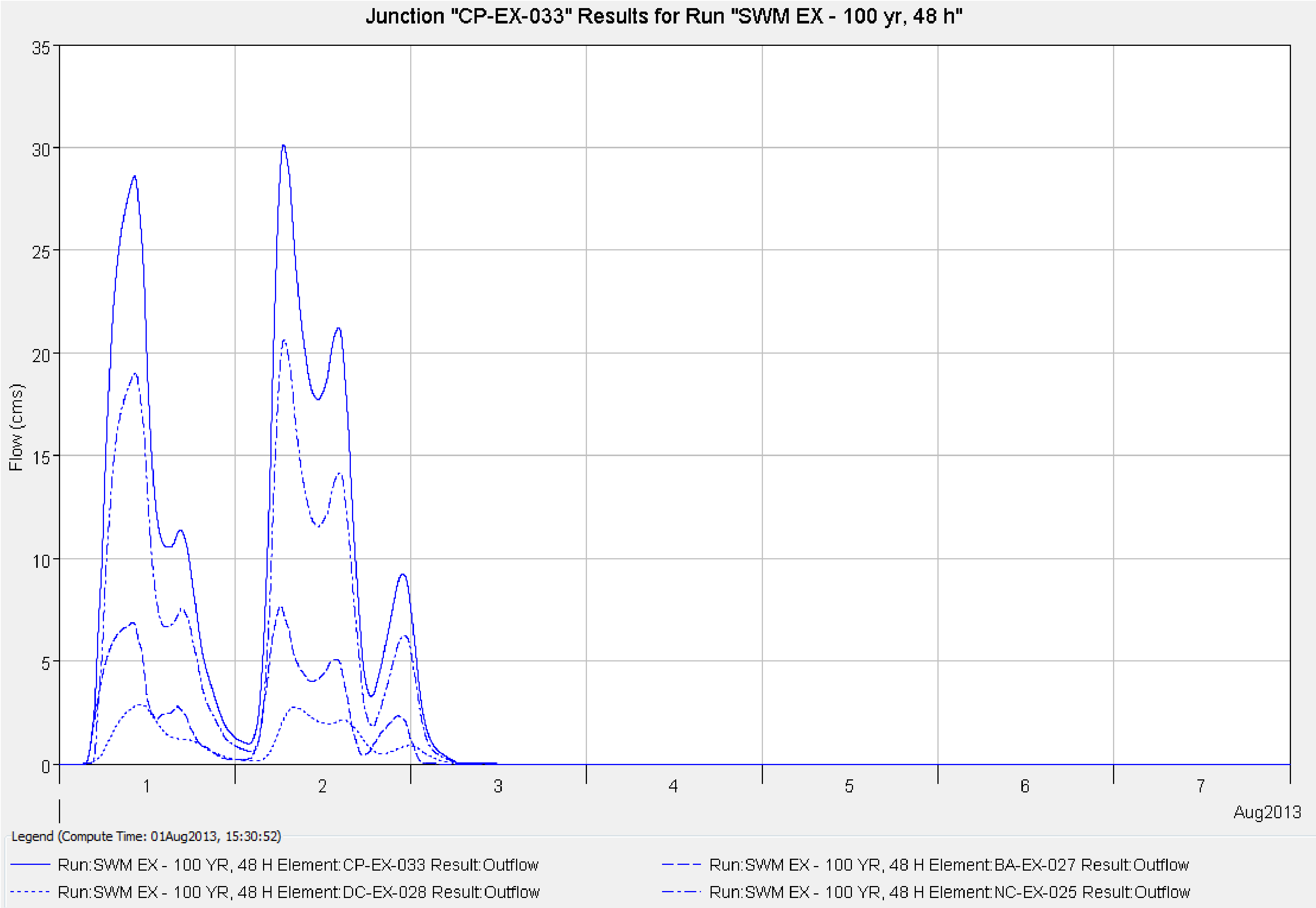


Junction "CP-EX-030" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-030 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-022 Result:Outflow

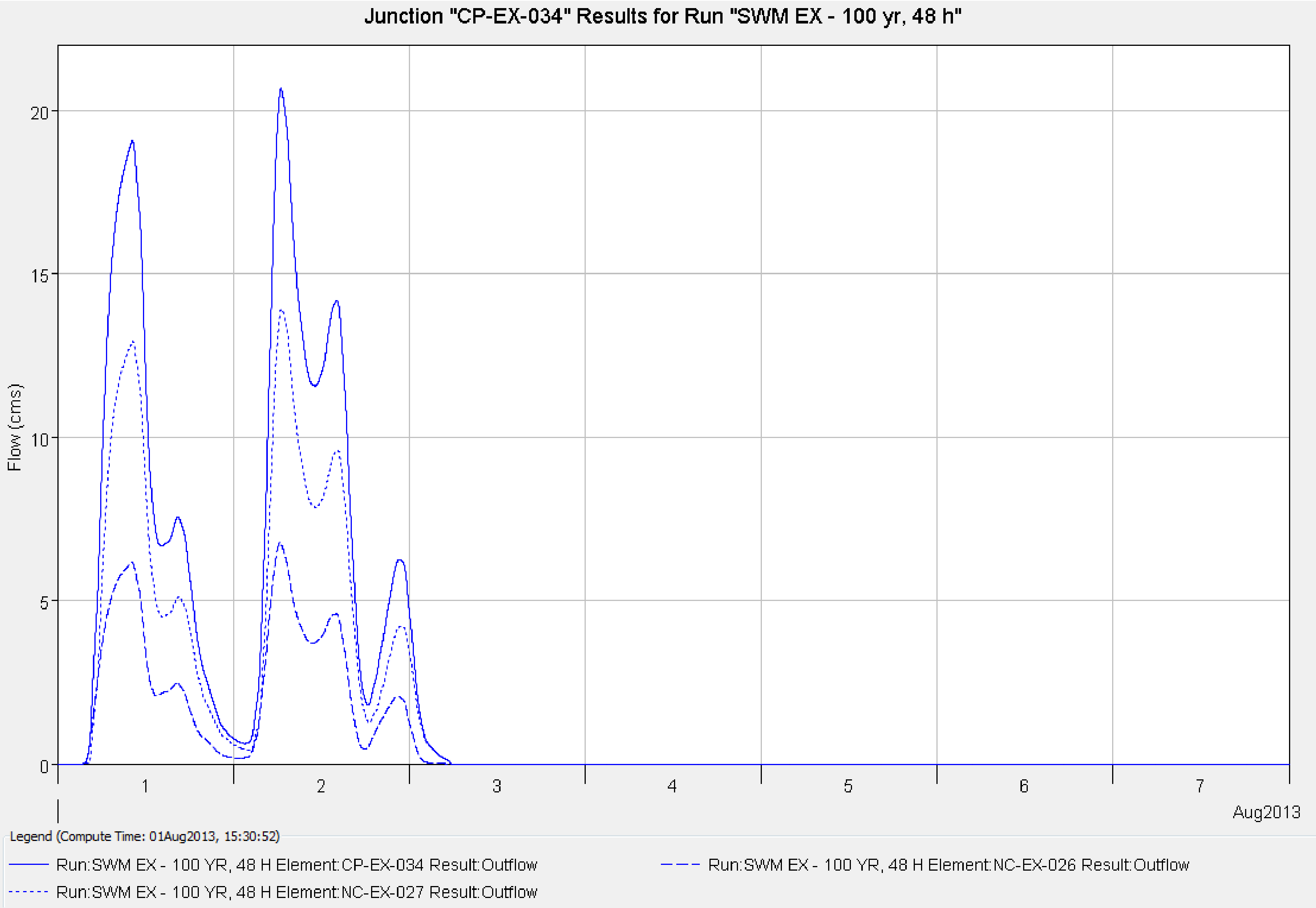


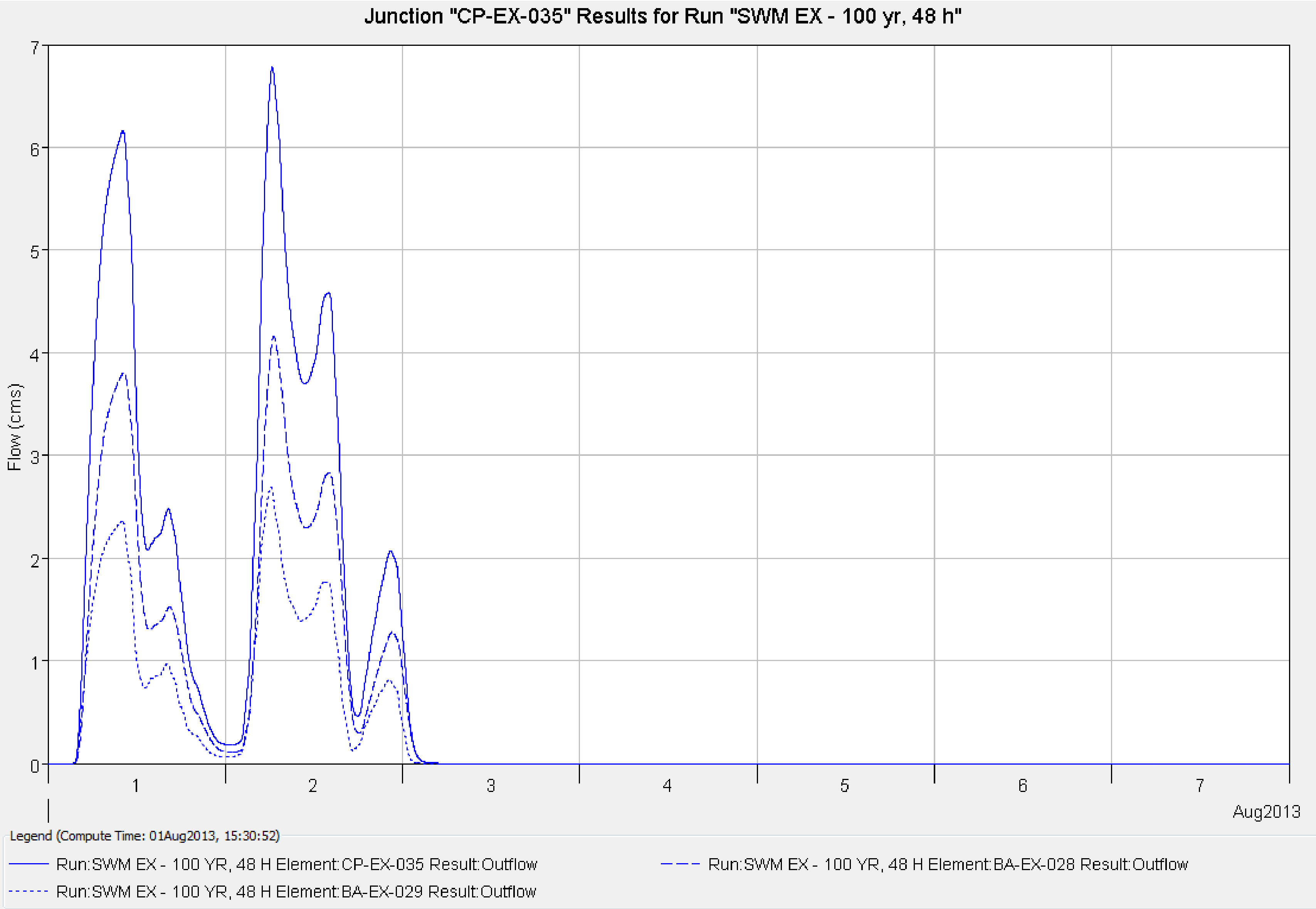
Junction "CP-EX-031" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-031 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-023 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-024 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-025 Result:Outflow


Junction "CP-EX-032" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-032 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-024 Result:Outflow

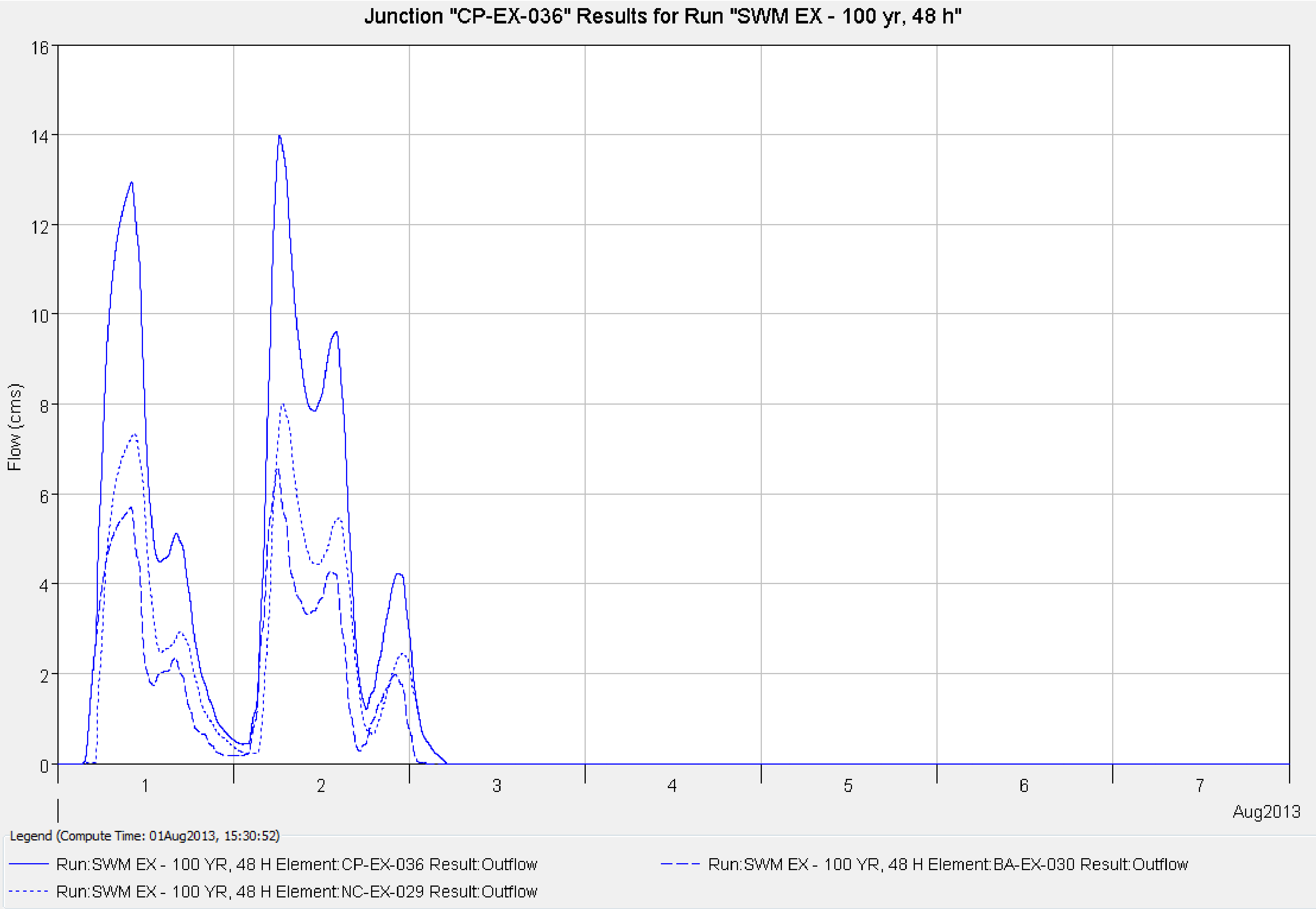


Junction "CP-EX-033" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-033 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-027 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-025 Result:Outflow

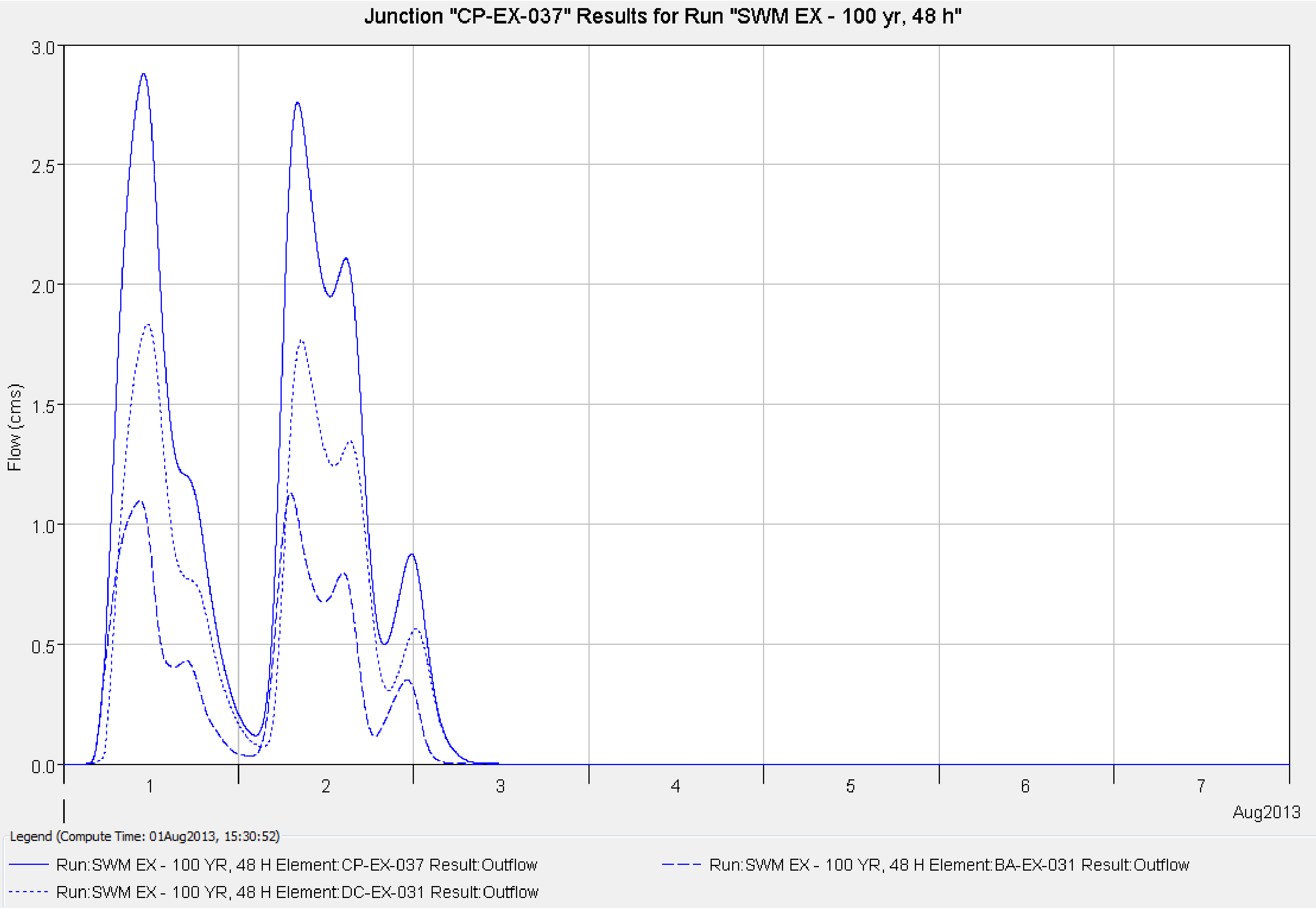

Junction "CP-EX-034" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-034 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-026 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-027 Result:Outflow



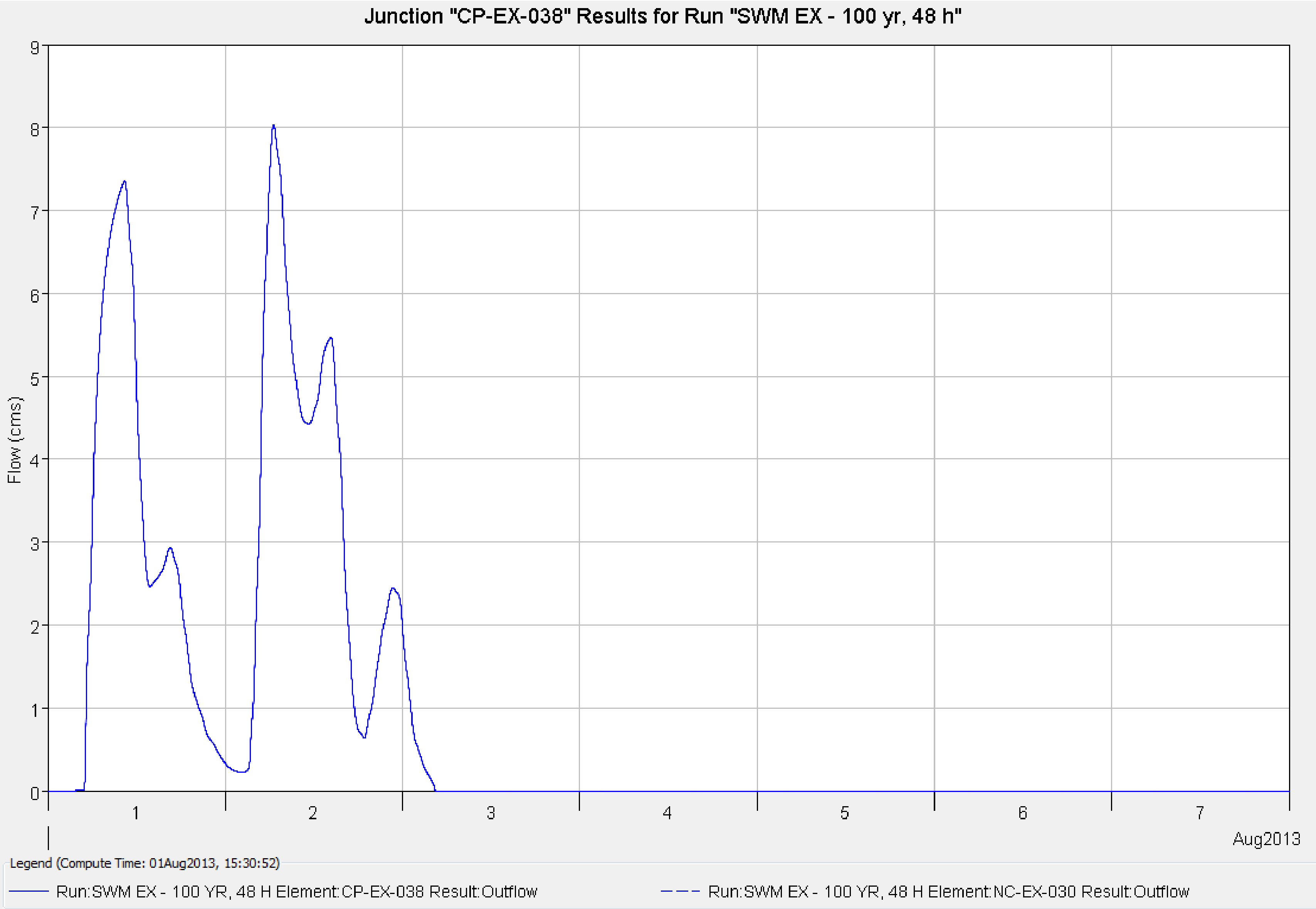
Junction "CP-EX-035" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-035 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-028 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-029 Result:Outflow

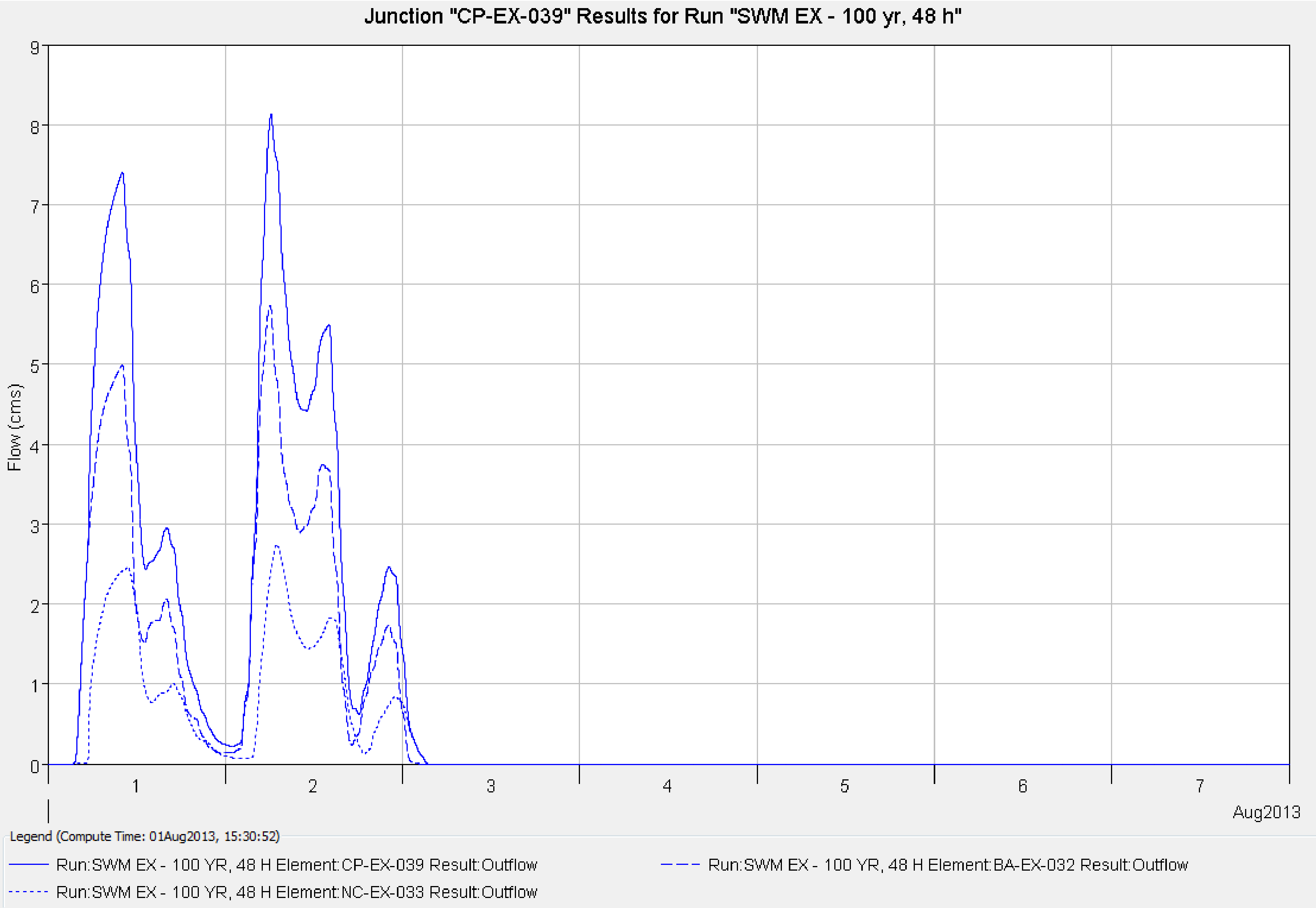


Junction "CP-EX-036" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-036 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-030 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-029 Result:Outflow

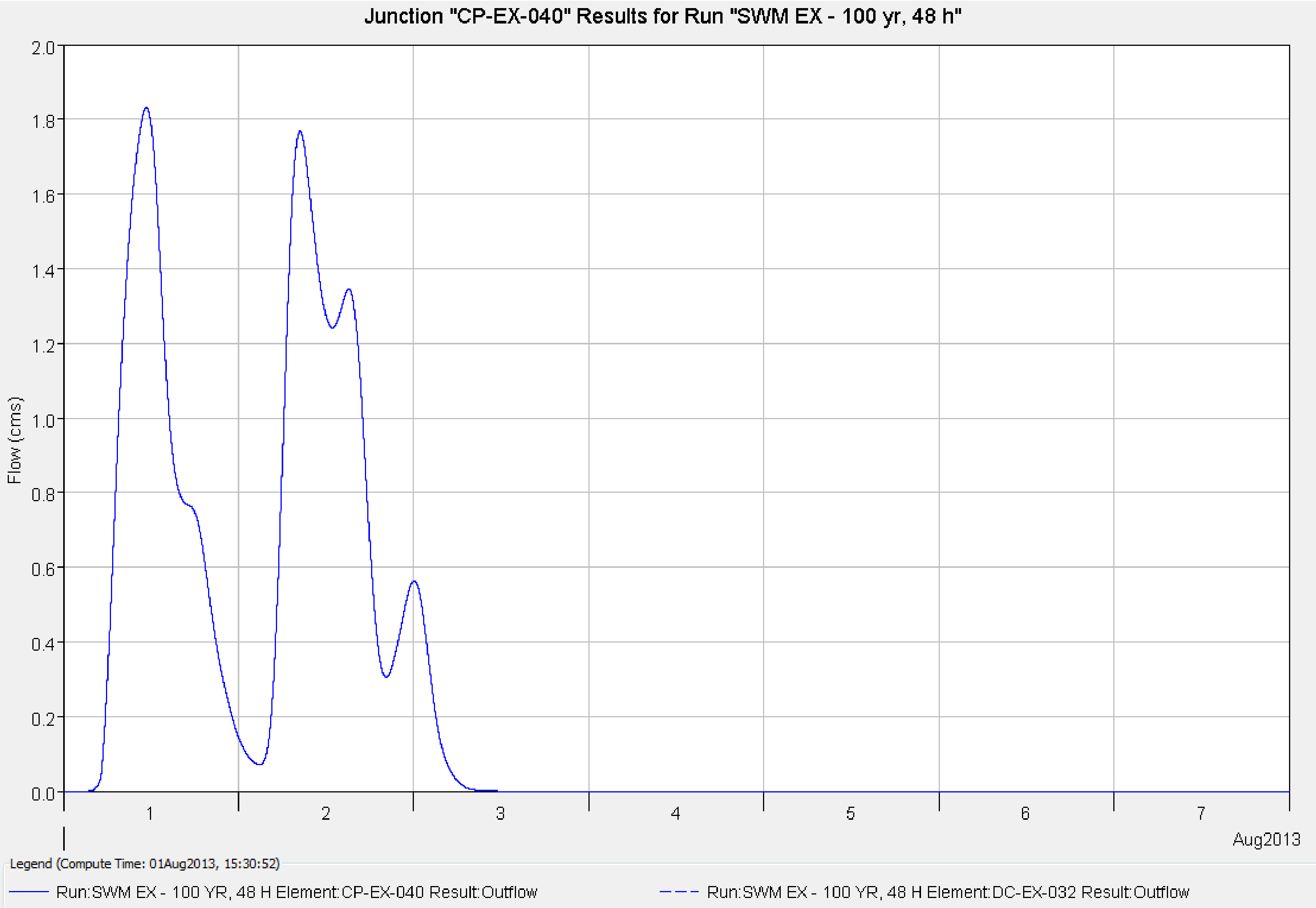


Junction "CP-EX-037" Results for Run "SWM EX - 100 yr, 48 h"
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-037 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-031 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-031 Result:Outflow

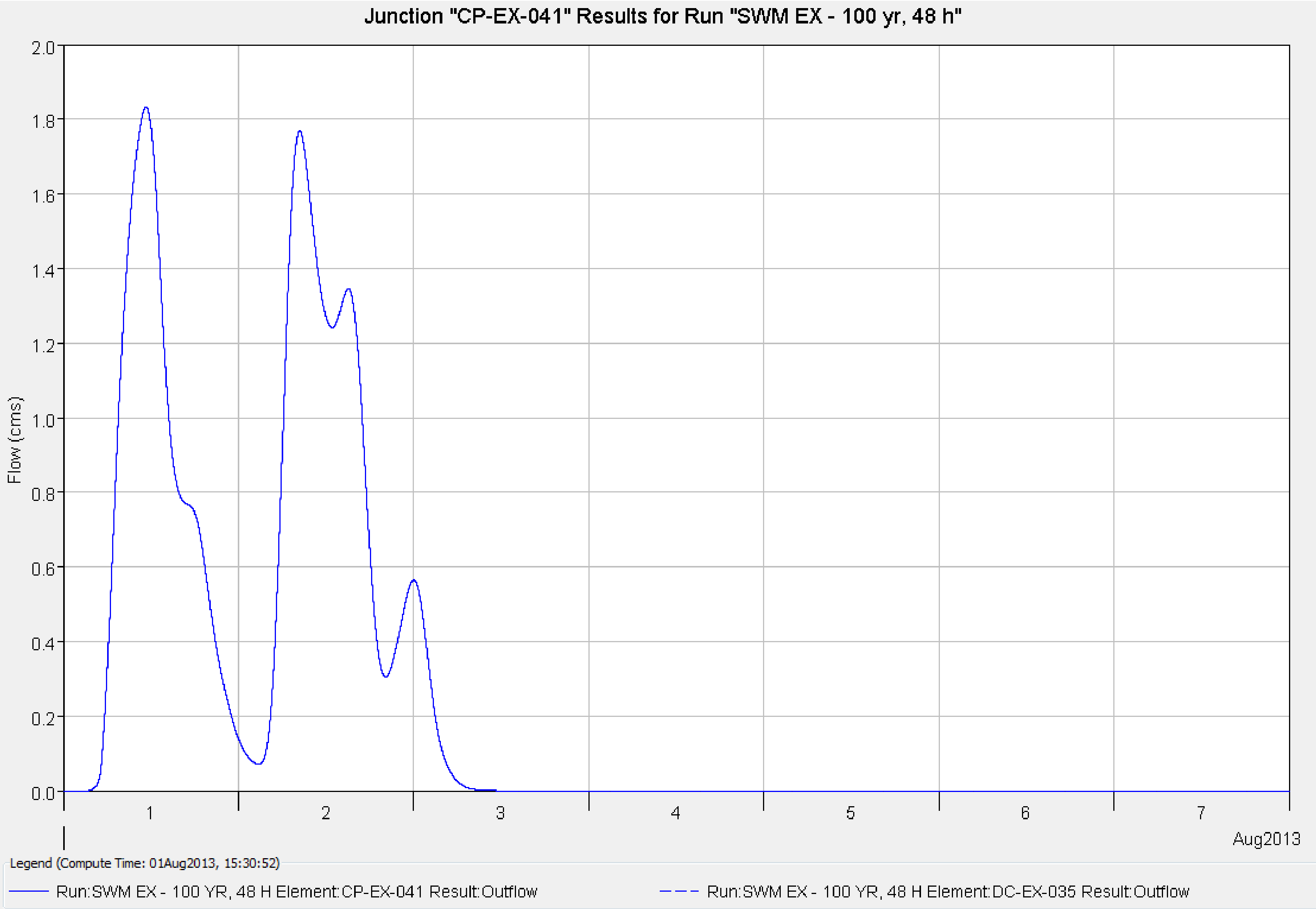

Junction "CP-EX-038" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-038 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-030 Result:Outflow



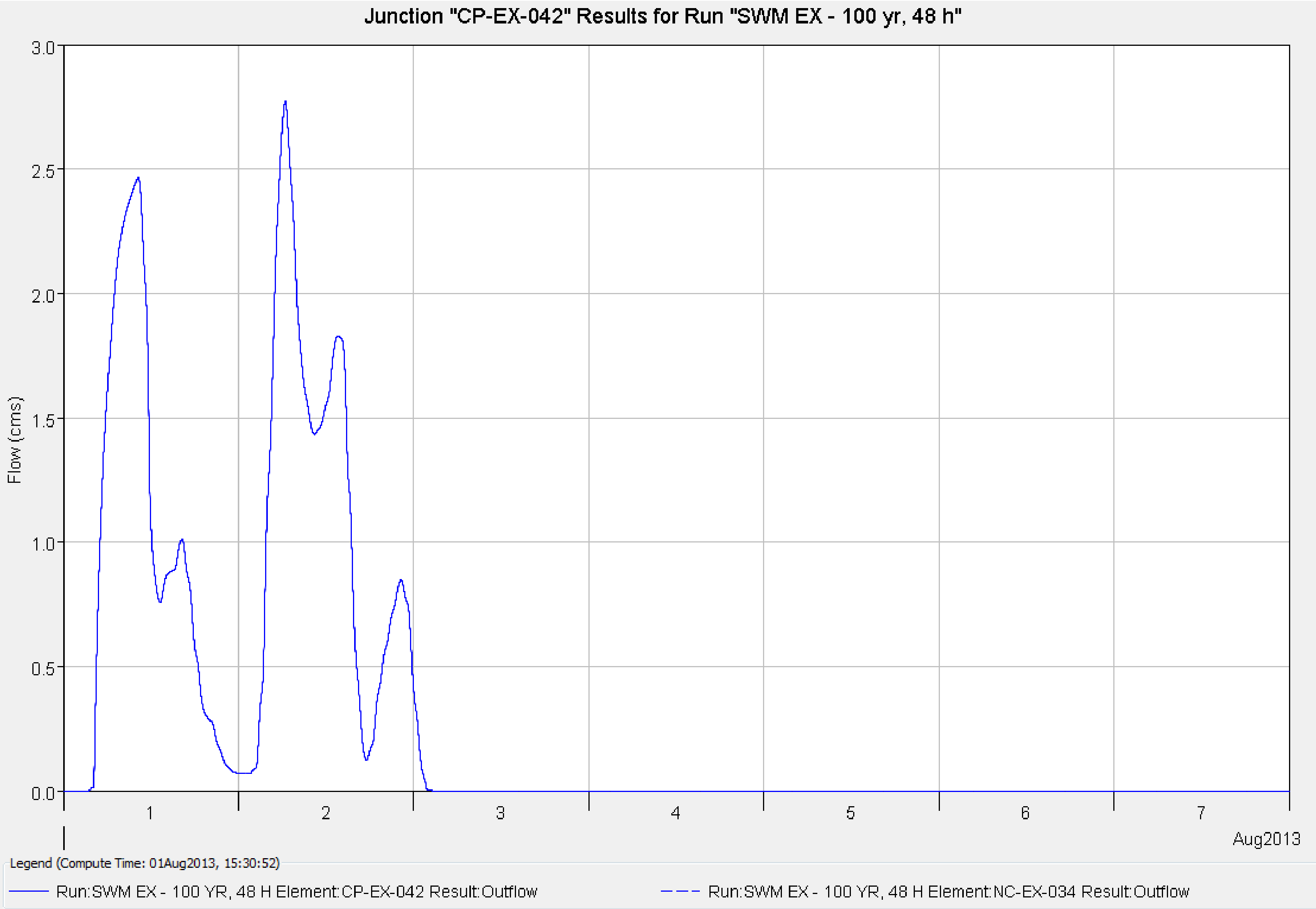
Junction "CP-EX-039" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-039 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-032 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-033 Result:Outflow



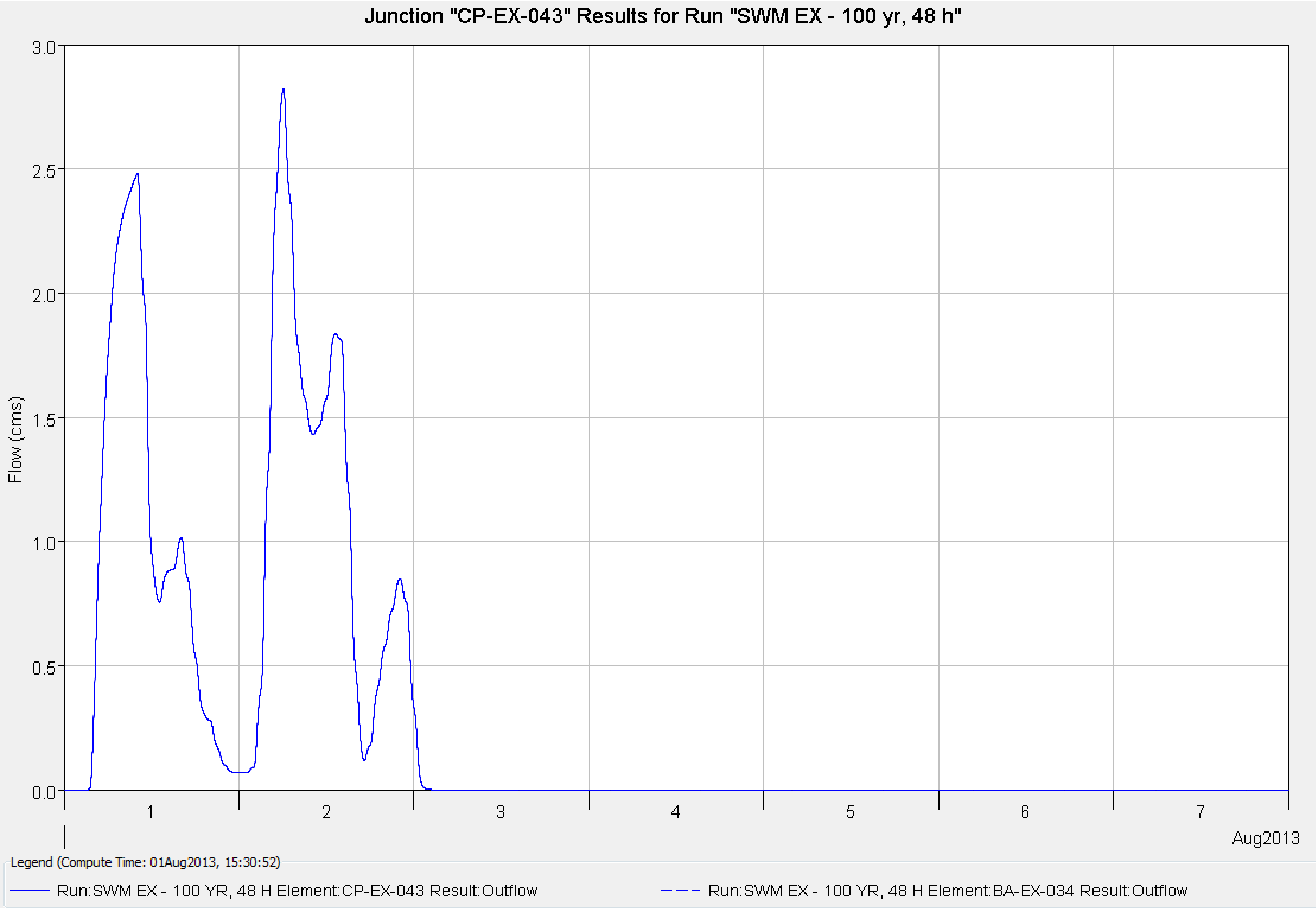
Junction "CP-EX-040" Results for Run "SWM EX - 100 yr, 48 h"
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-040 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-032 Result:Outflow



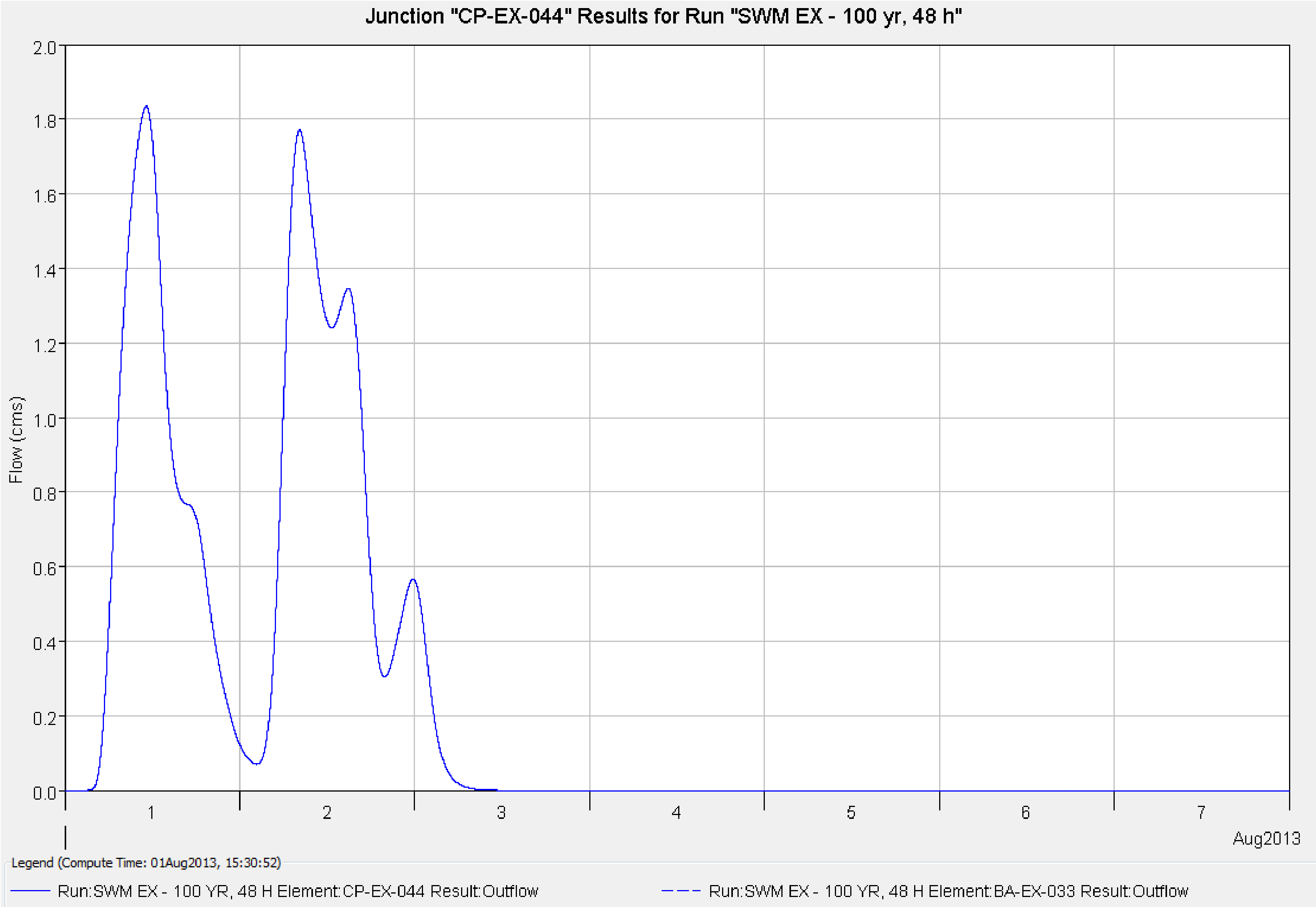
Junction "CP-EX-041" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-041 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-035 Result:Outflow



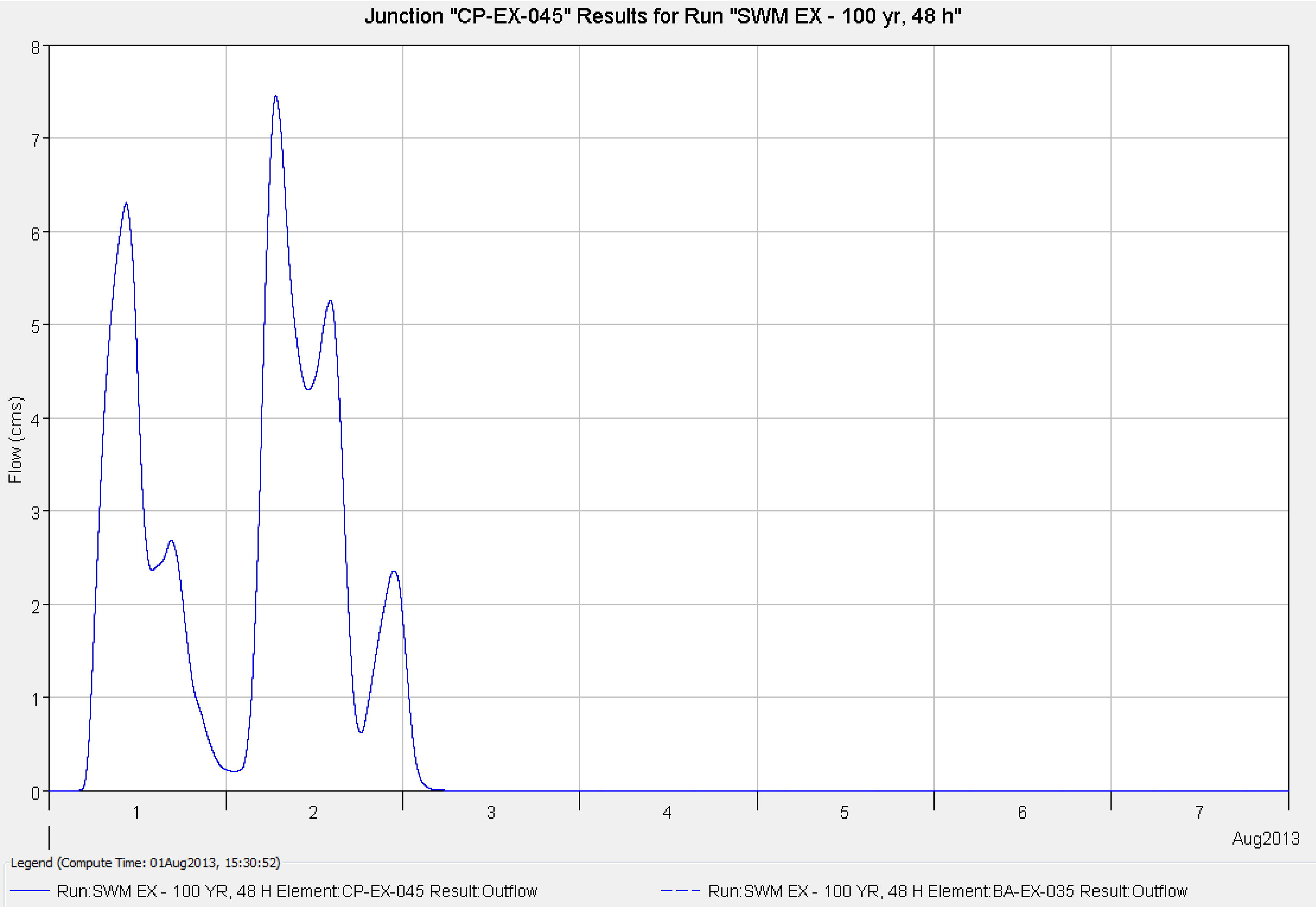
Junction "CP-EX-042" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-042 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-034 Result:Outflow



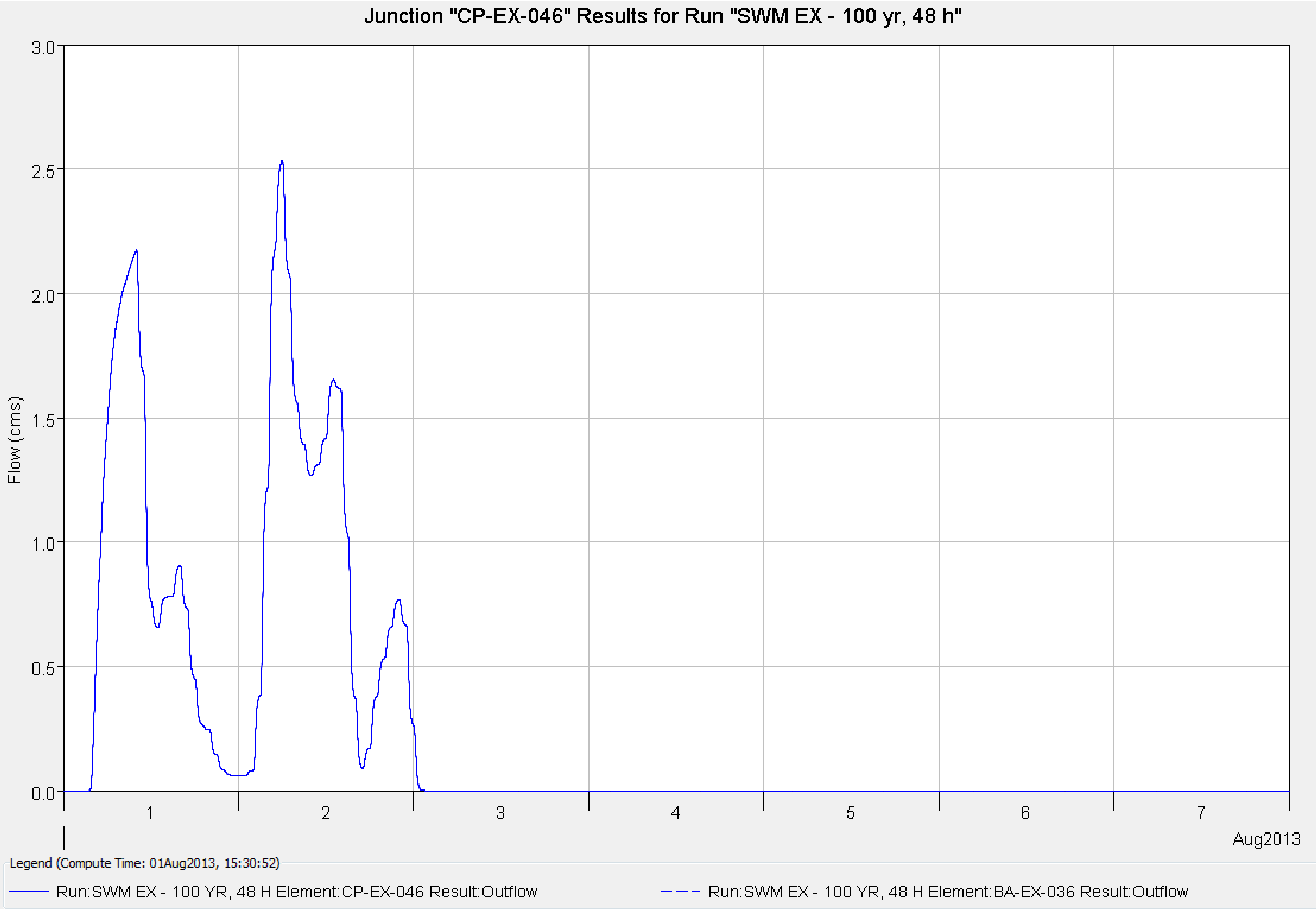
Junction "CP-EX-043" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-043 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-034 Result:Outflow



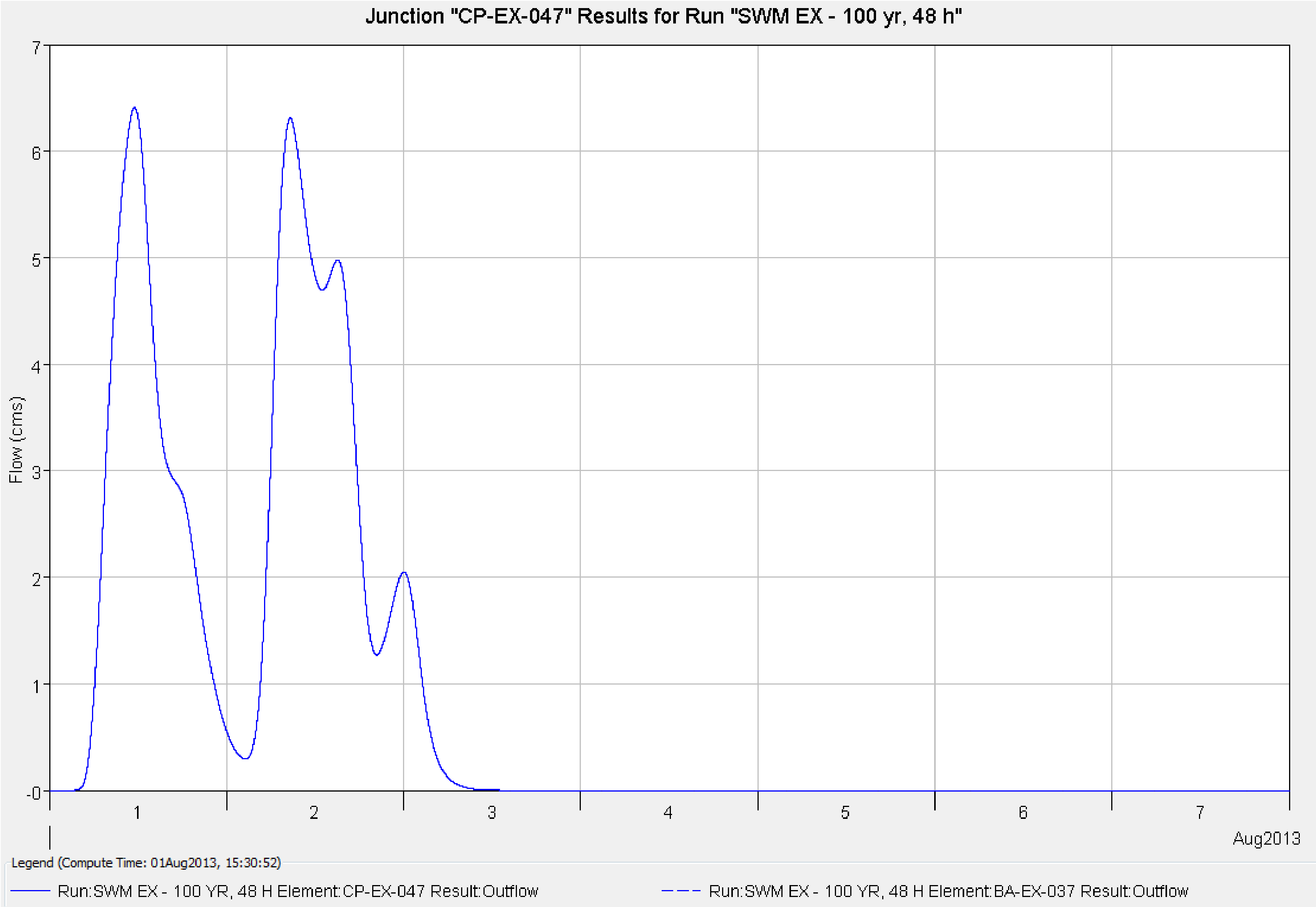
Junction "CP-EX-044" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-044 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-033 Result:Outflow



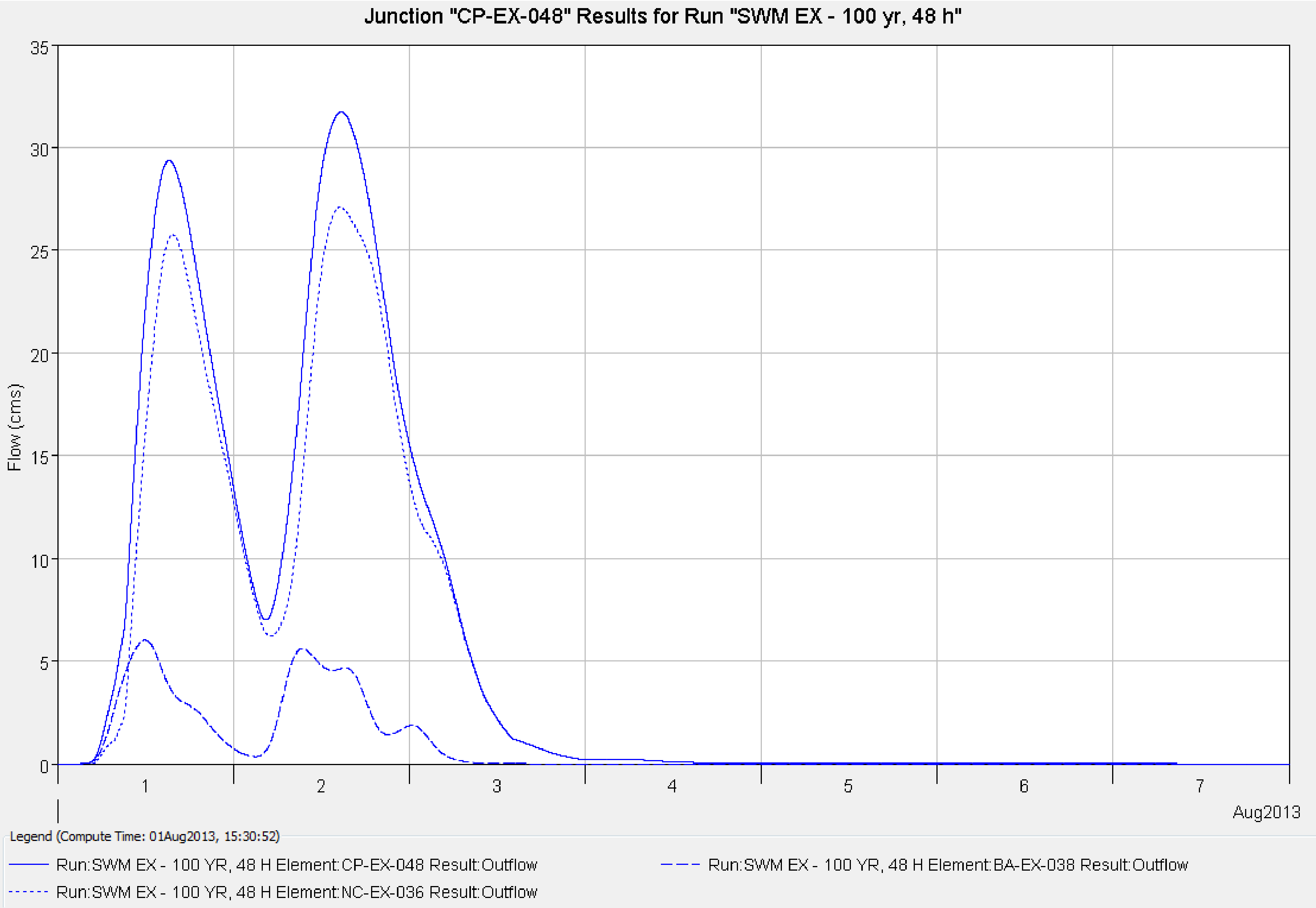
Junction "CP-EX-045" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-045 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-035 Result:Outflow



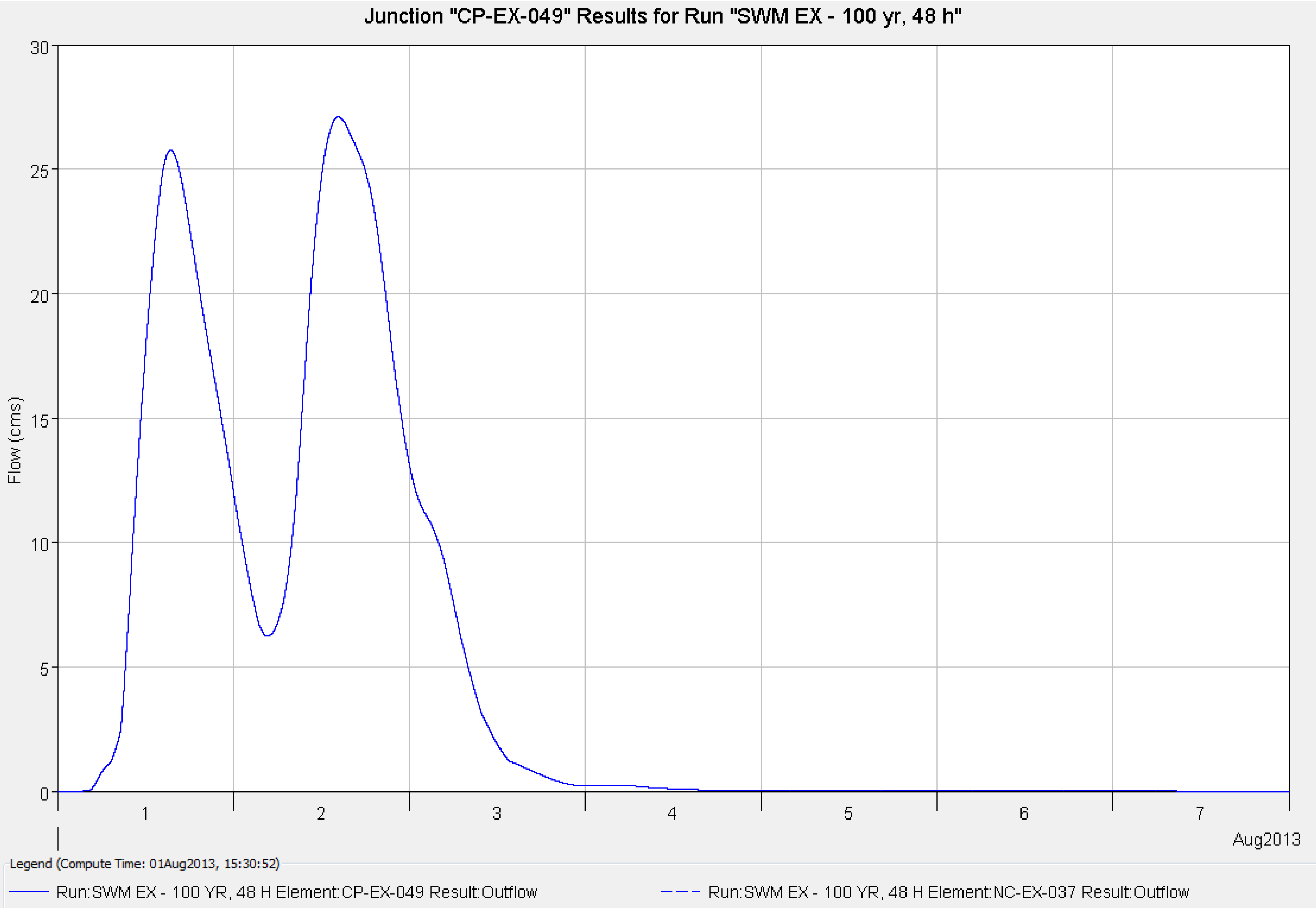
Junction "CP-EX-046" Results for Run "SWM EX - 100 yr, 48 h"
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-046 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-036 Result:Outflow



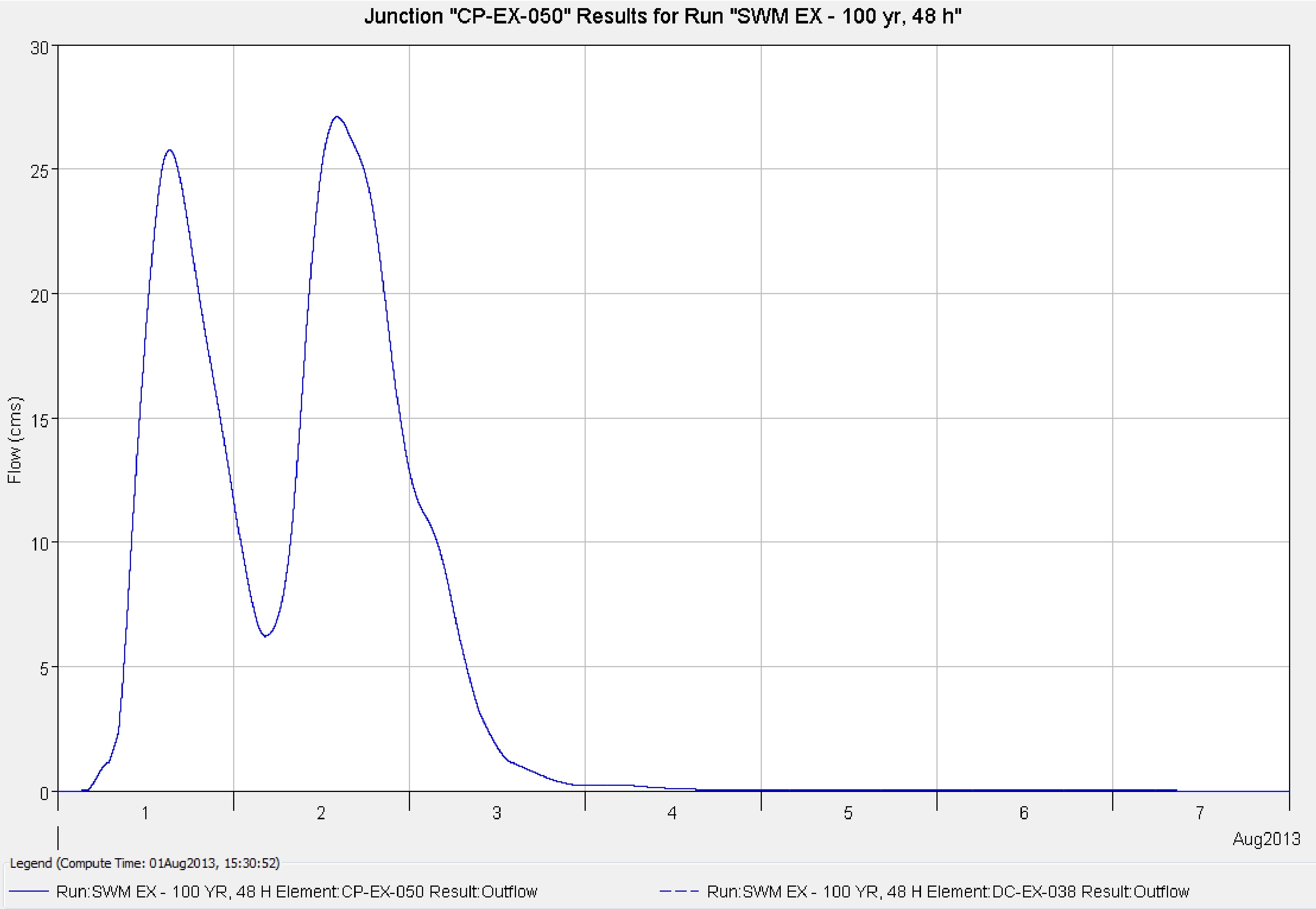
Junction "CP-EX-047" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-047 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-037 Result:Outflow



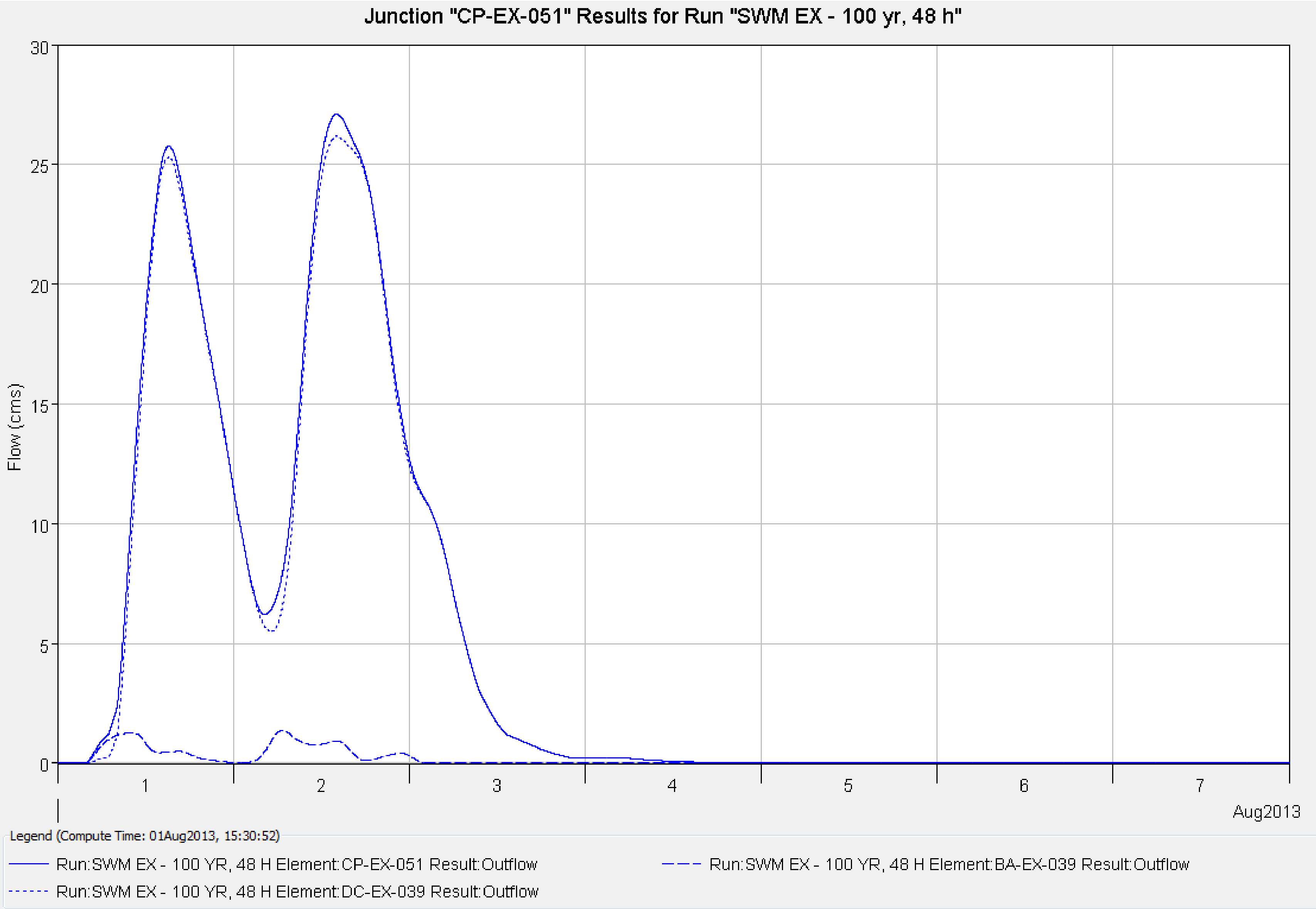
Junction "CP-EX-048" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-048 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-038 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-036 Result:Outflow

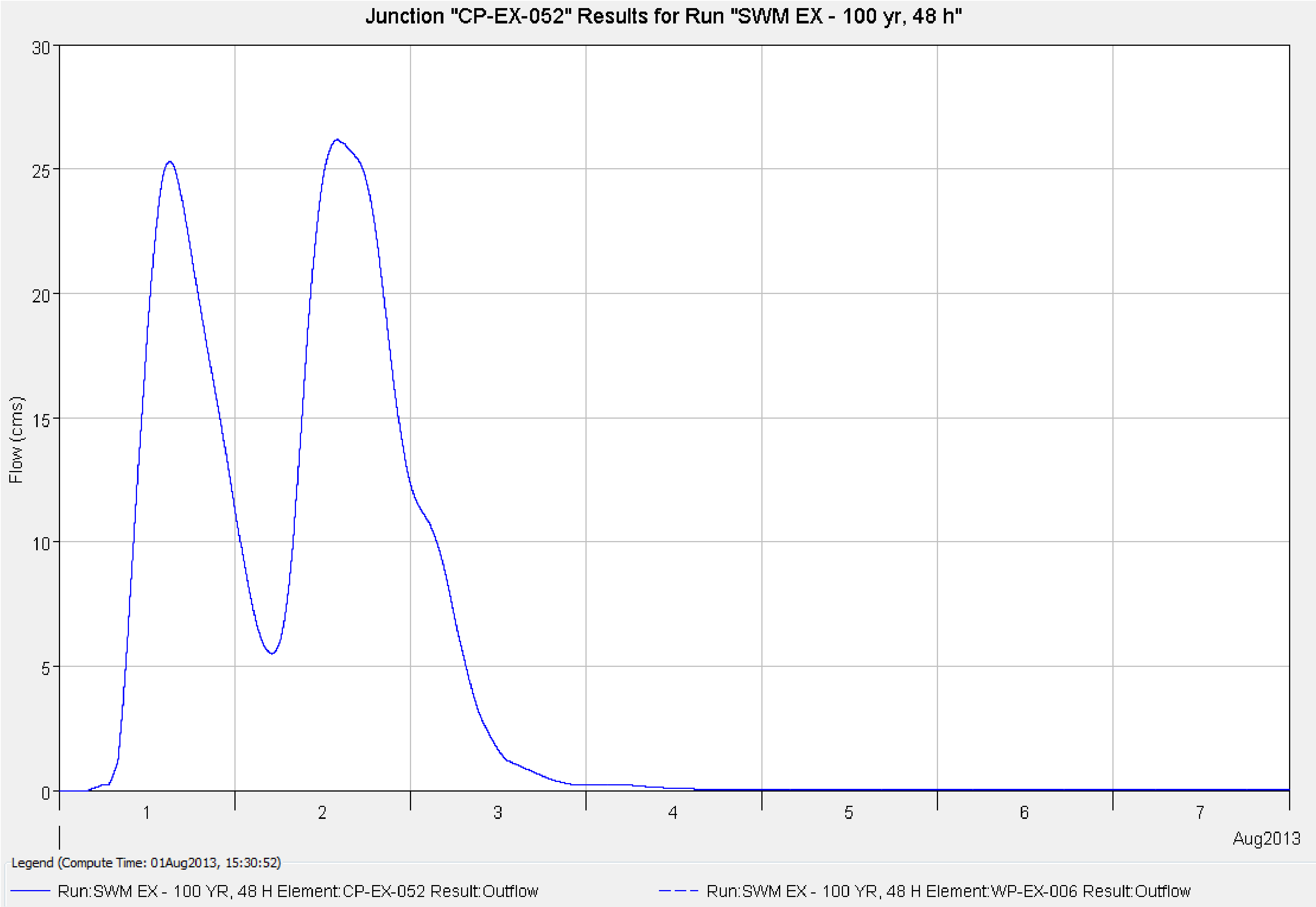


Junction "CP-EX-049" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
5
10
15
20
25
30
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-049 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:NC-EX-037 Result:Outflow

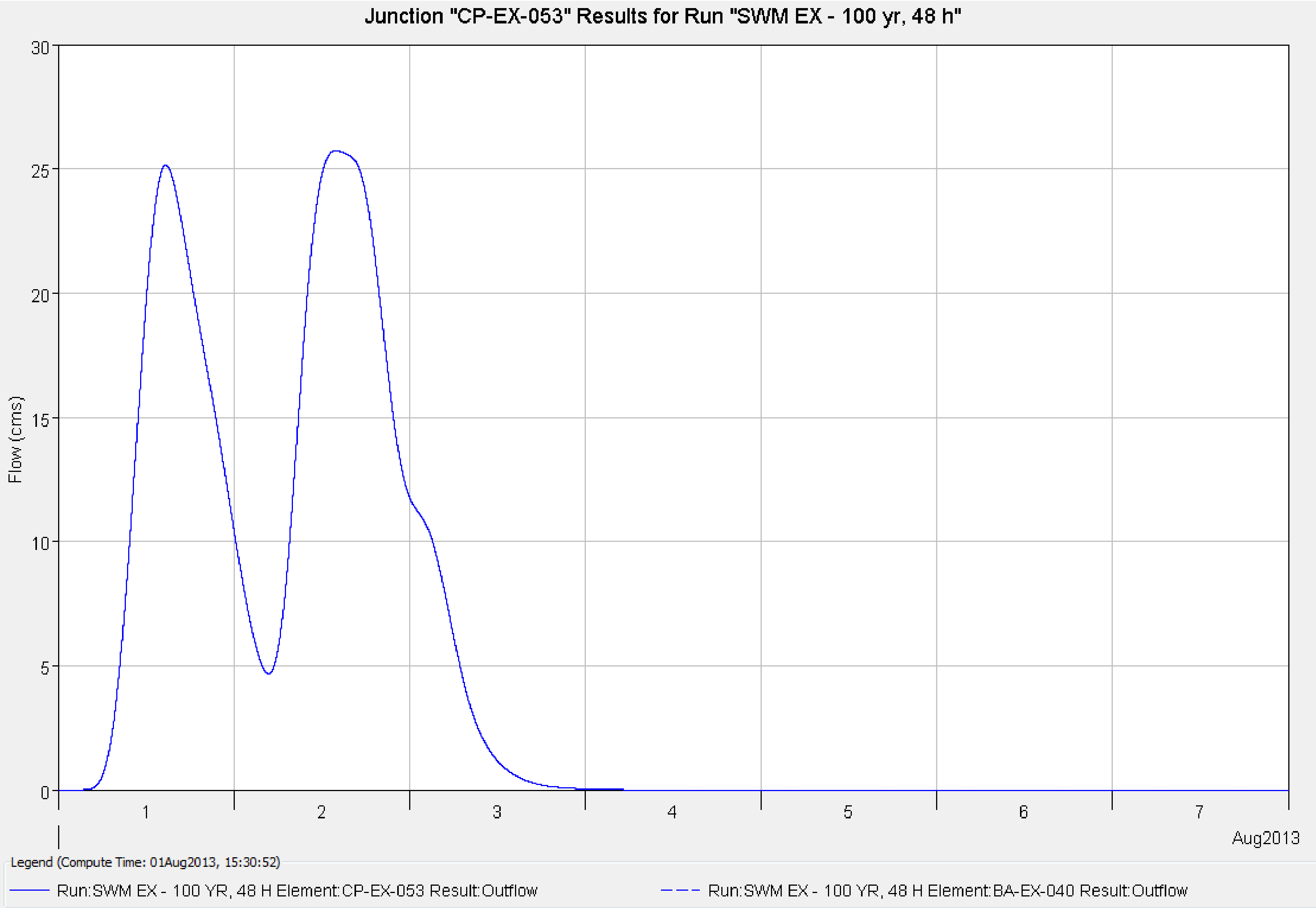


Junction "CP-EX-050" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-050 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-038 Result:Outflow

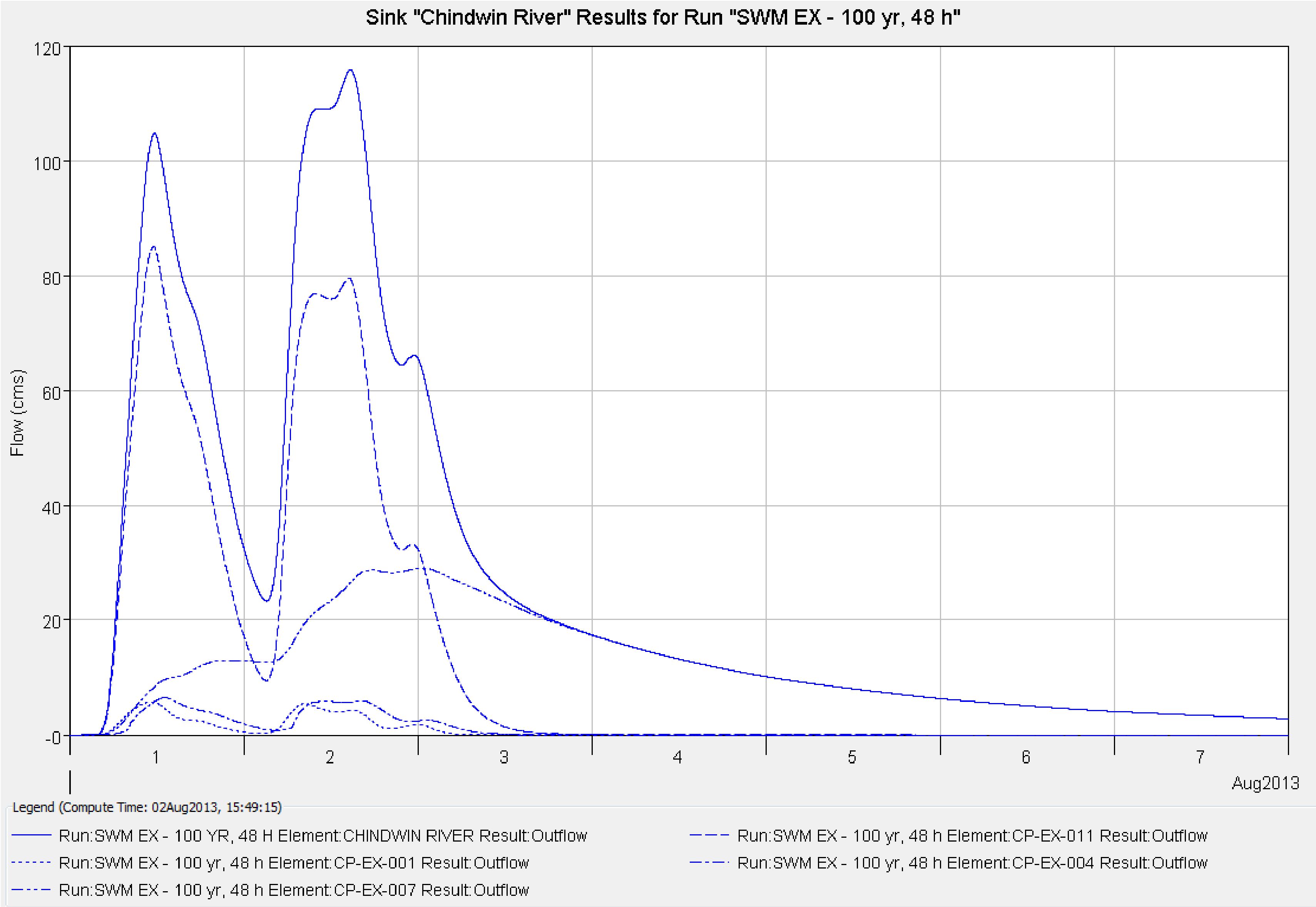

Junction "CP-EX-051" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-051 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-039 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:DC-EX-039 Result:Outflow



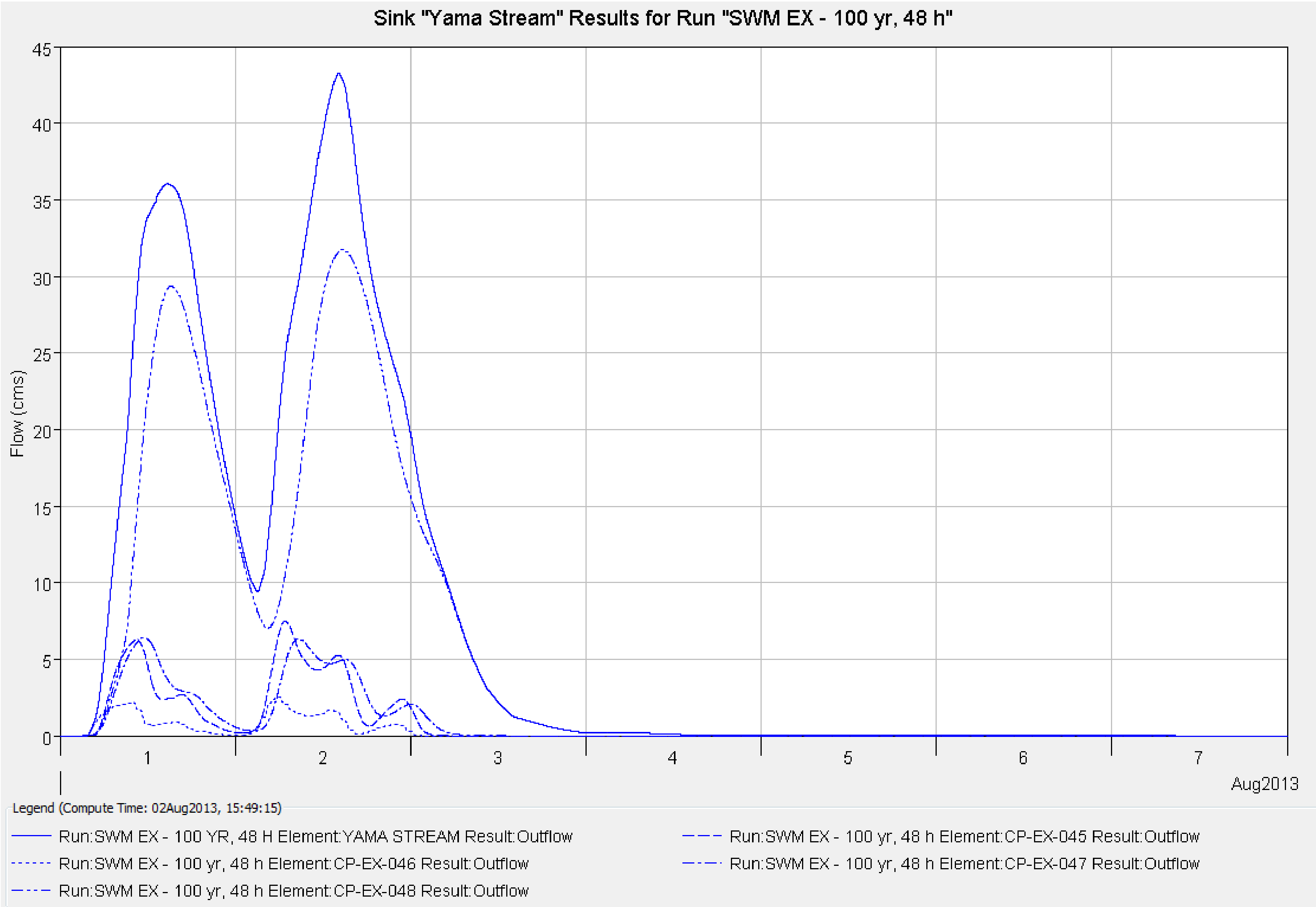
Junction "CP-EX-052" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
0
5
10
15
20
25
30
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-052 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-006 Result:Outflow



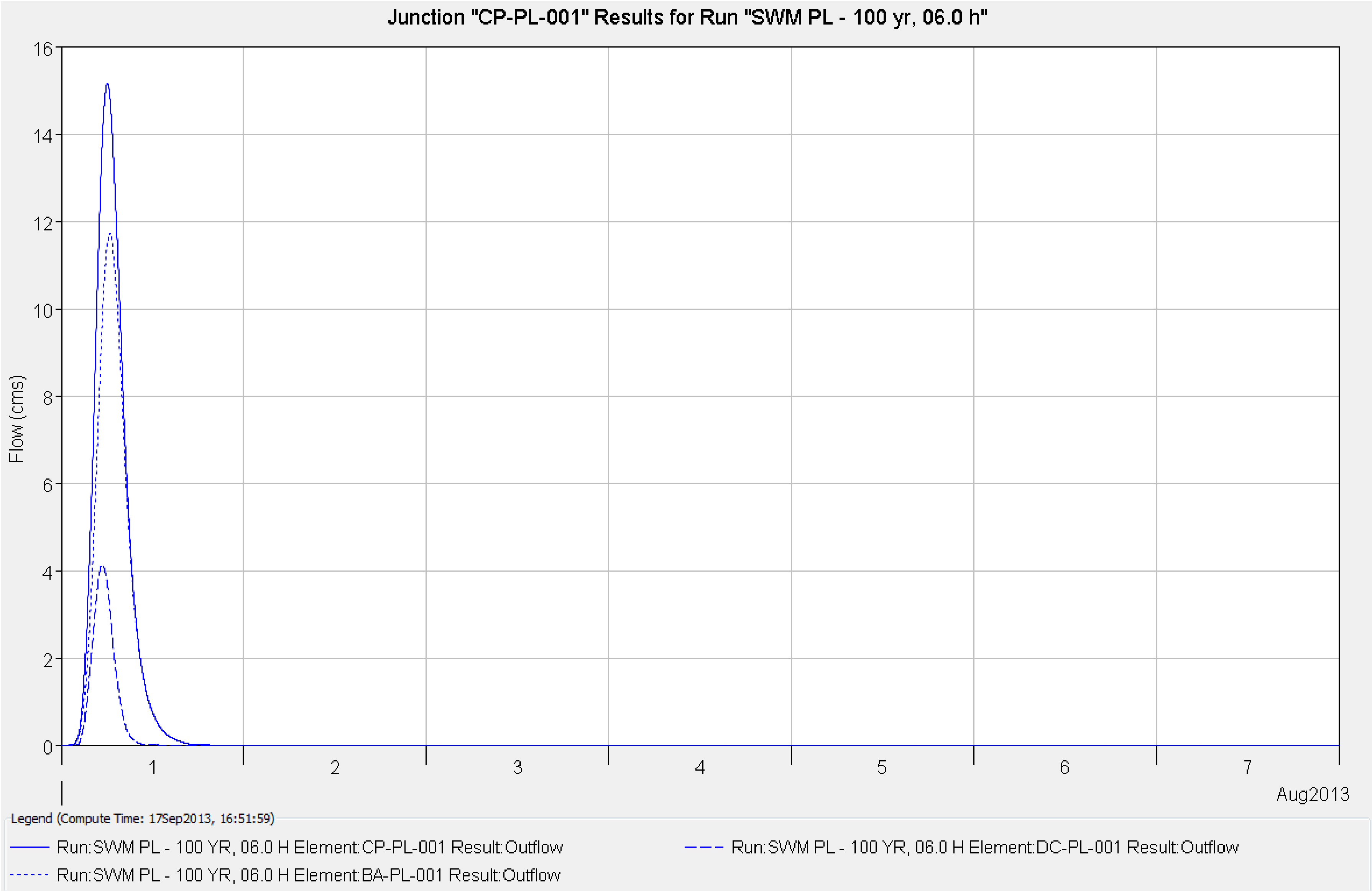
Junction "CP-EX-053" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:CP-EX-053 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:BA-EX-040 Result:Outflow



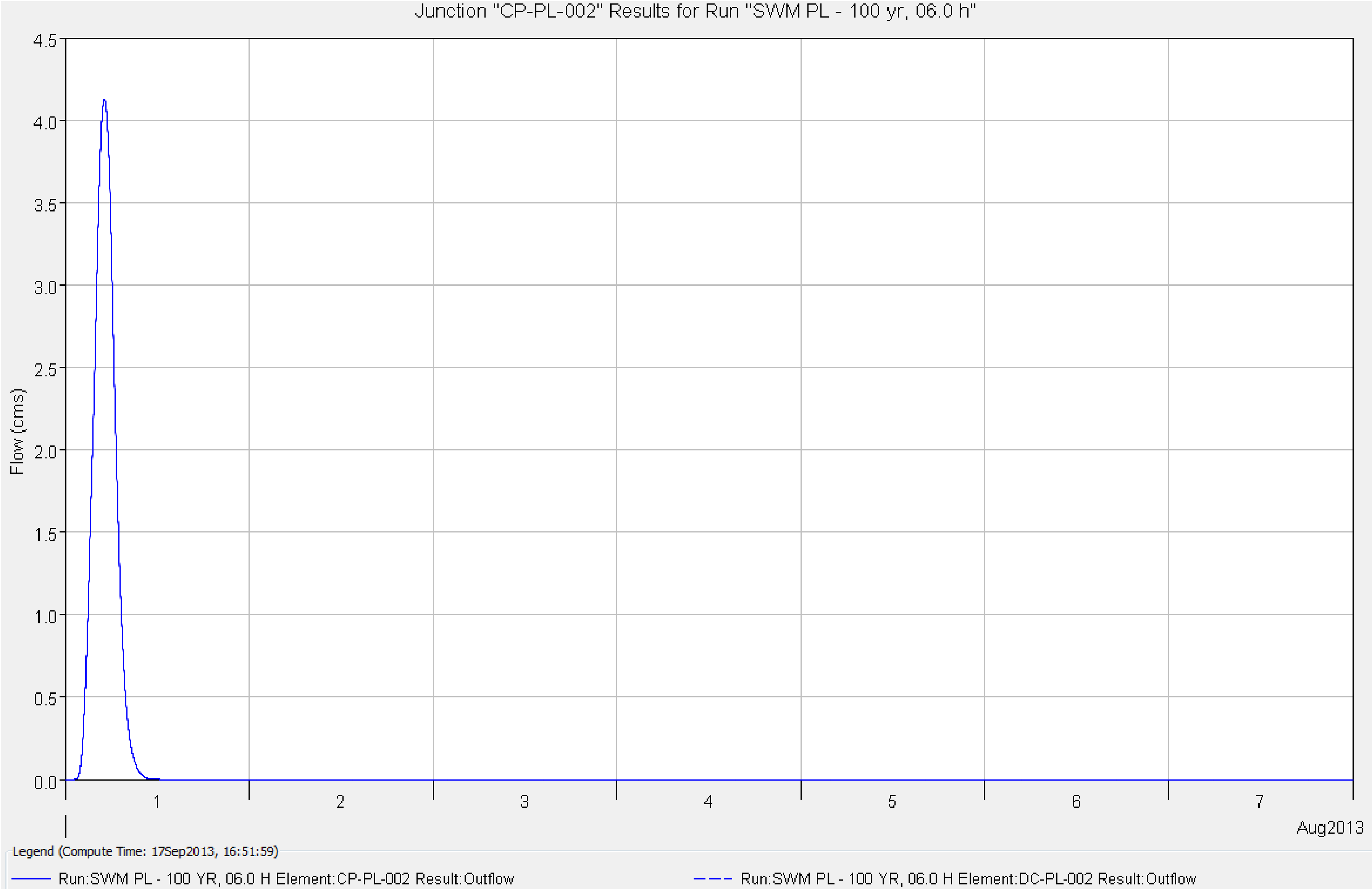
Sink "Chindwin River" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
120
100
80
60
40
20
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 02Aug2013, 15:49:15)
Run:SWM EX - 100 YR, 48 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-011 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-001 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-004 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-007 Result:Outflow



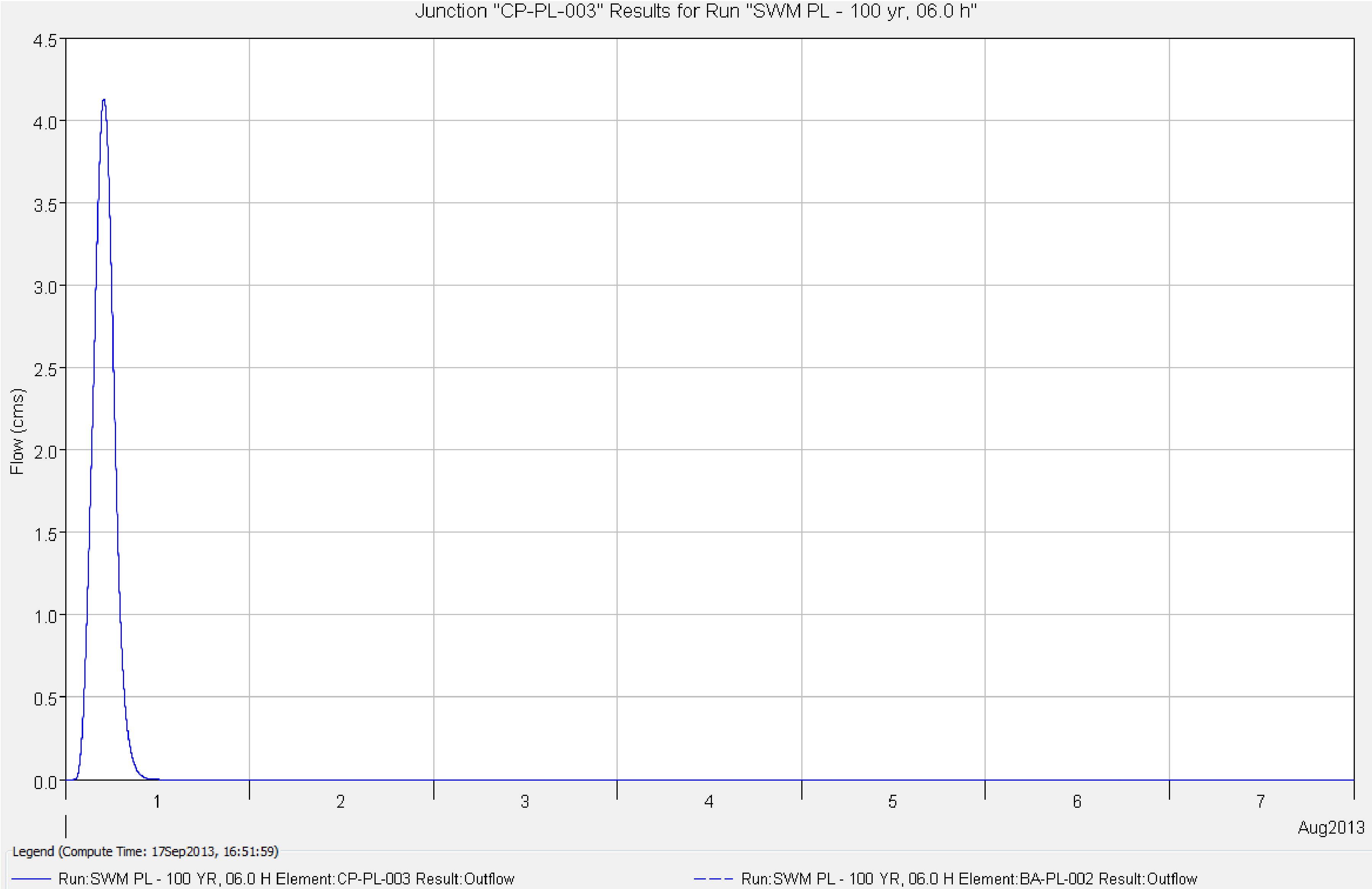
Sink "Yama Stream" Results for Run "SWM EX - 100 yr, 48 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 02Aug2013, 15:49:15)
Run:SWM EX - 100 YR, 48 H Element:YAMA STREAM Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-045 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-046 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-047 Result:Outflow
Run:SWM EX - 100 yr, 48 h Element:CP-EX-048 Result:Outflow



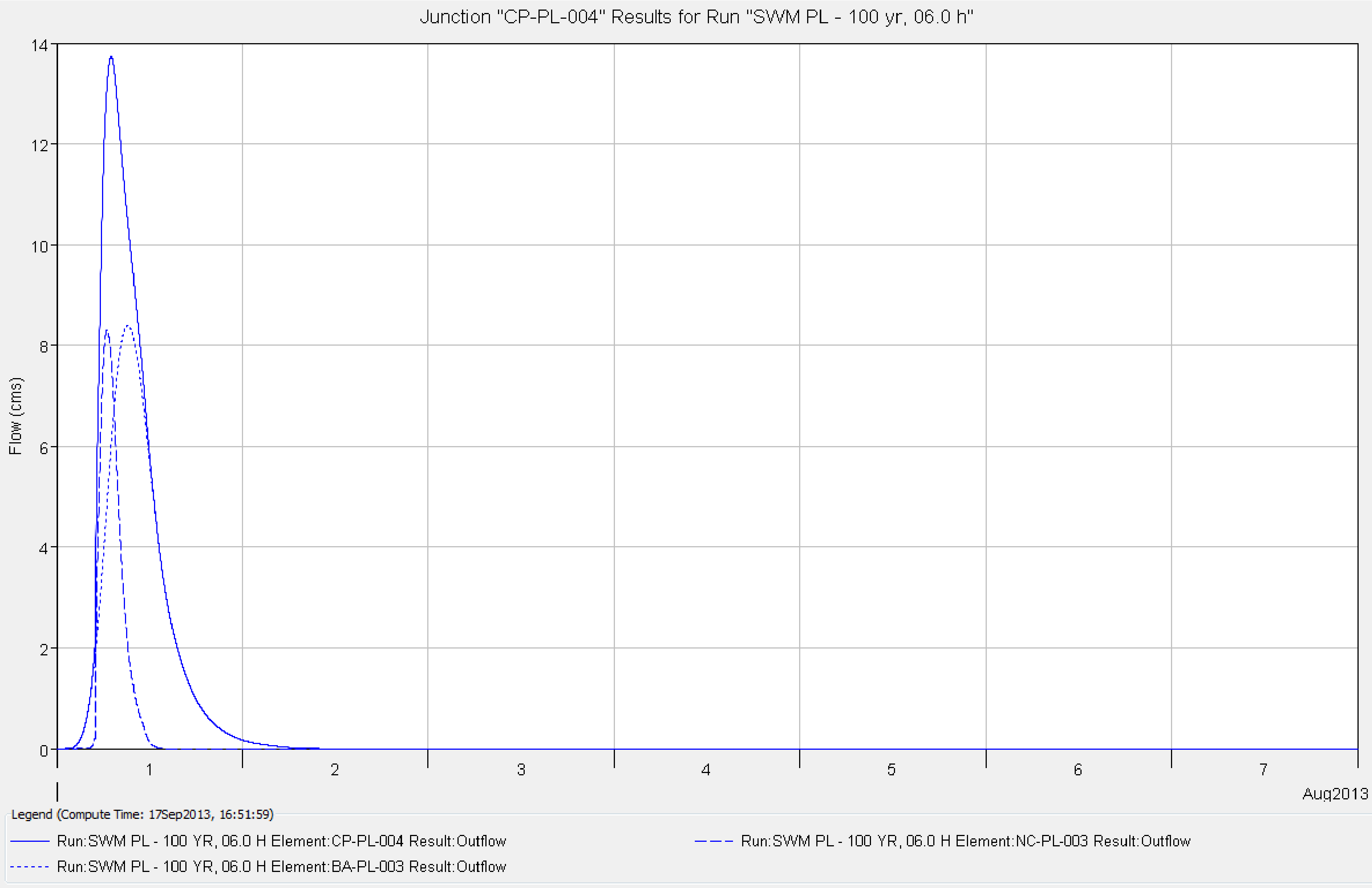
Junction "CP-PL-001" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-001 Result:Outflow



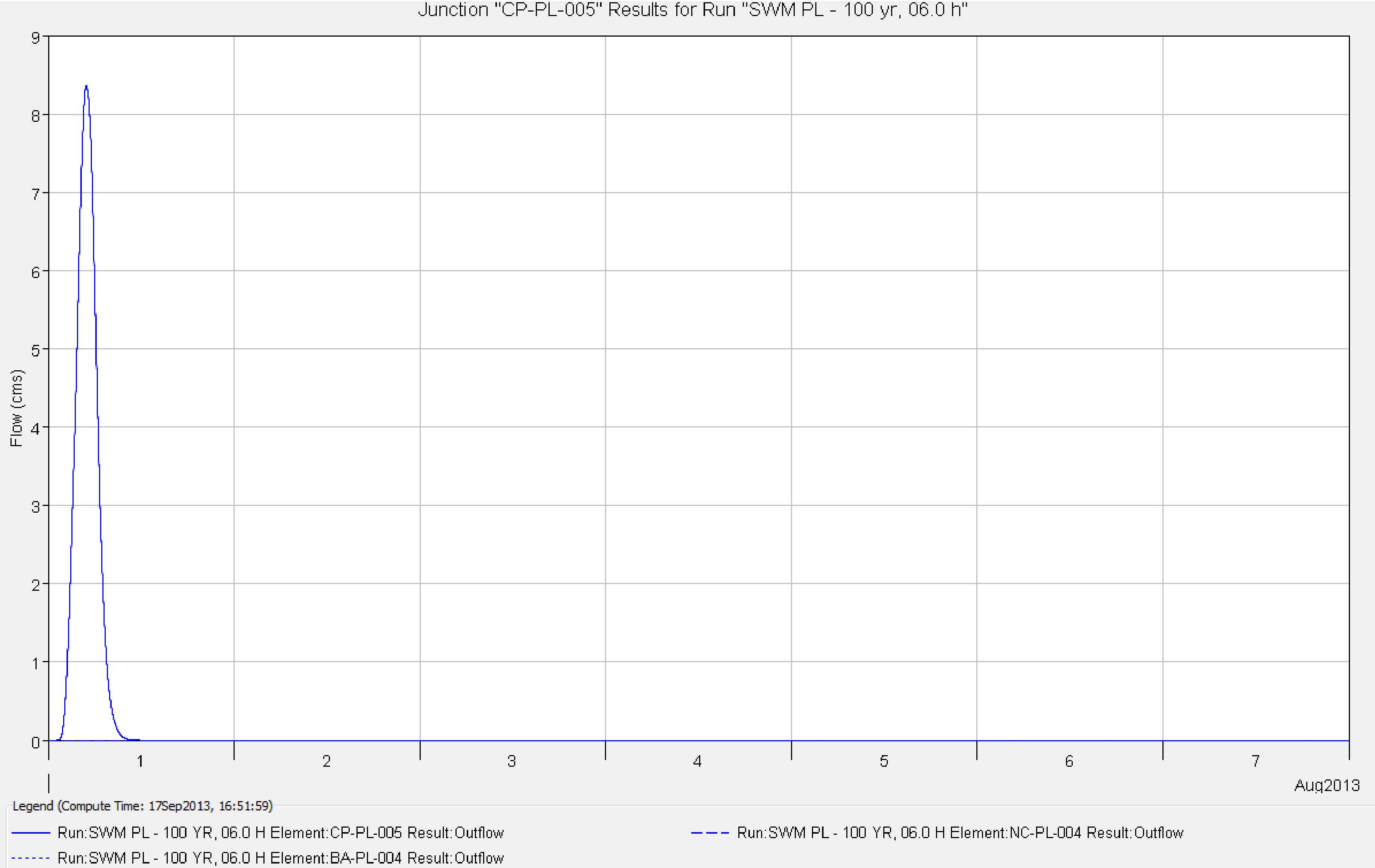
Junction "CP-PL-002" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-002 Result:Outflow



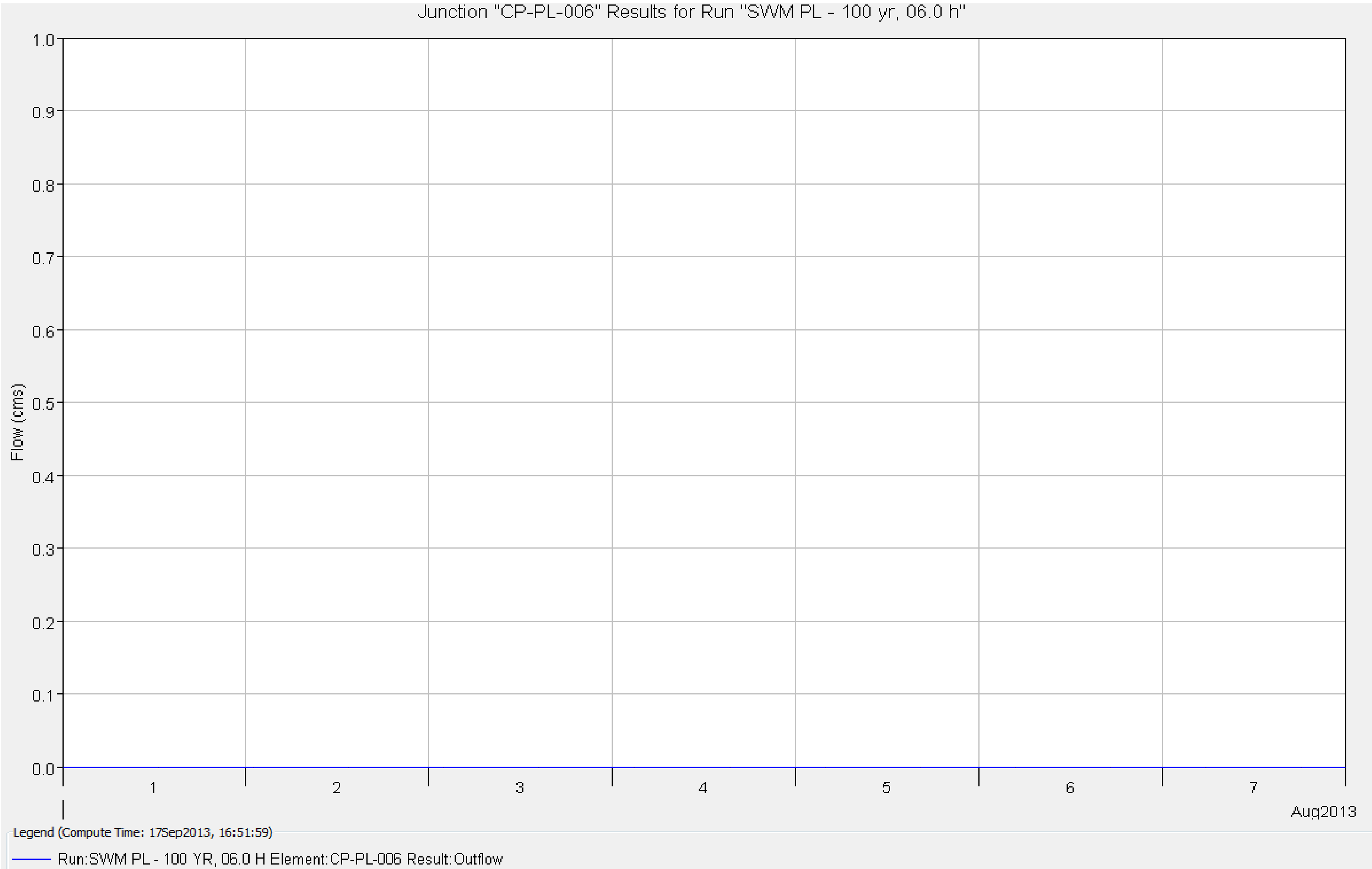
Junction "CP-PL-003" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-002 Result:Outflow

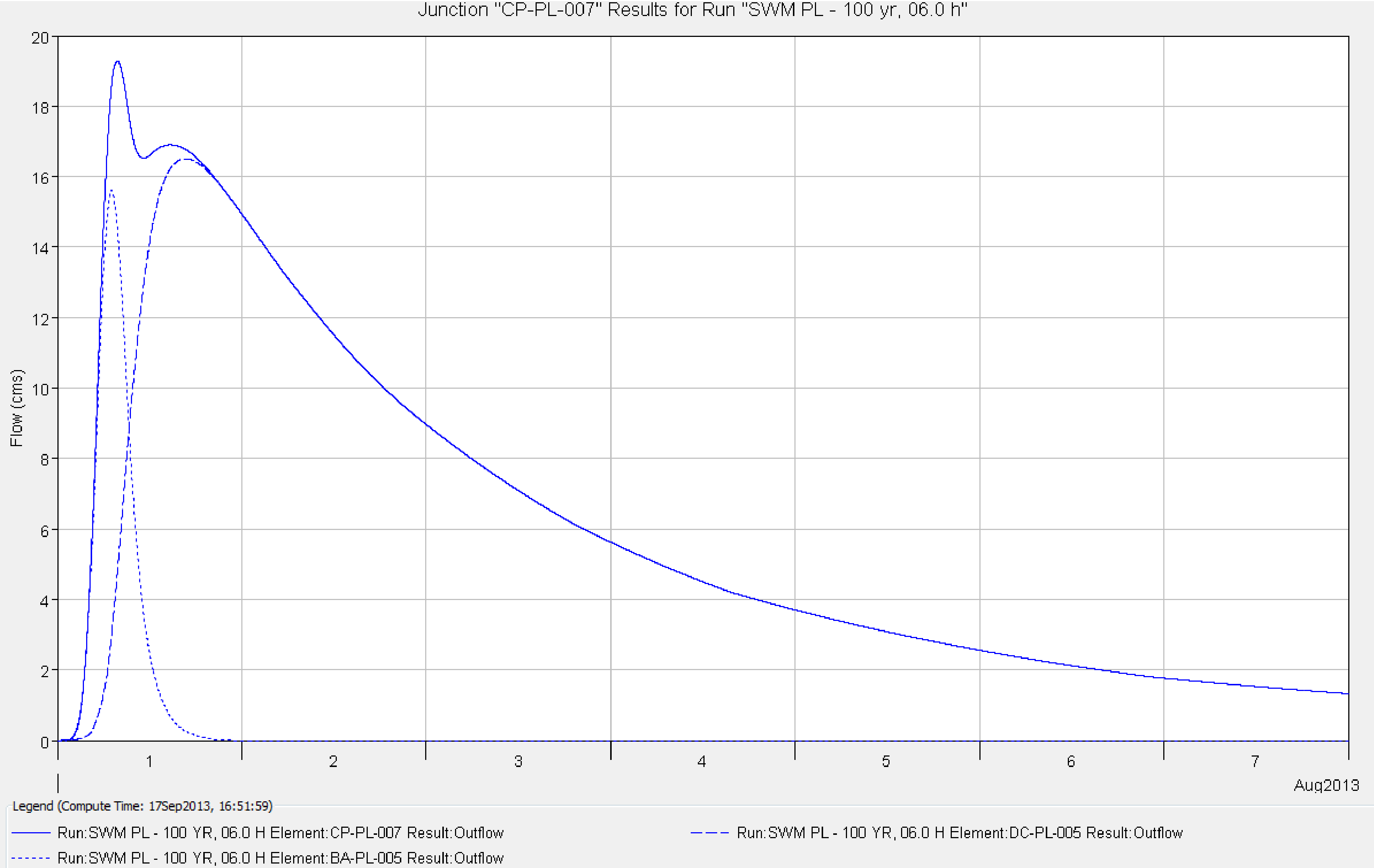


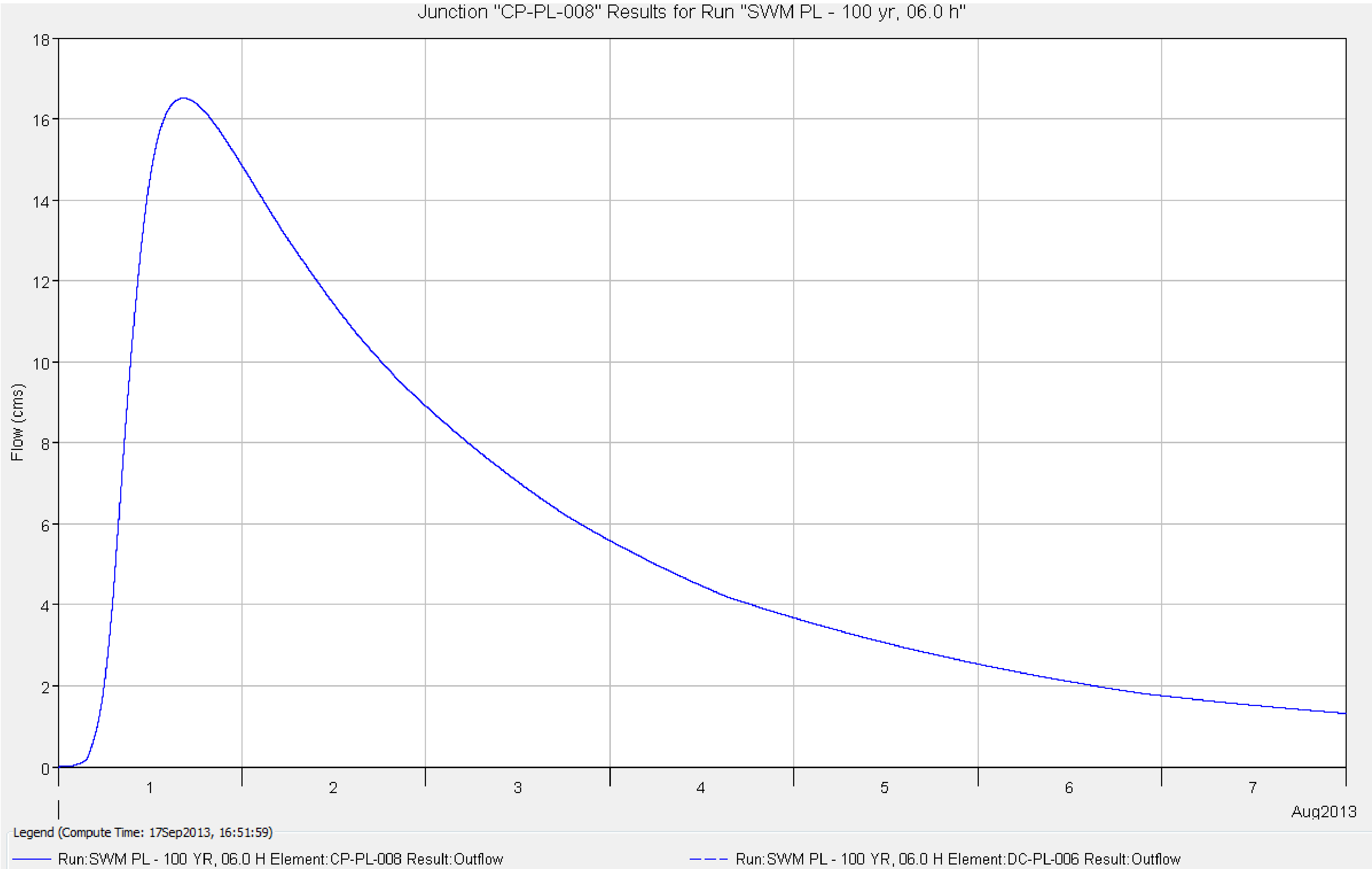
Junction "CP-PL-004" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-003 Result:Outflow



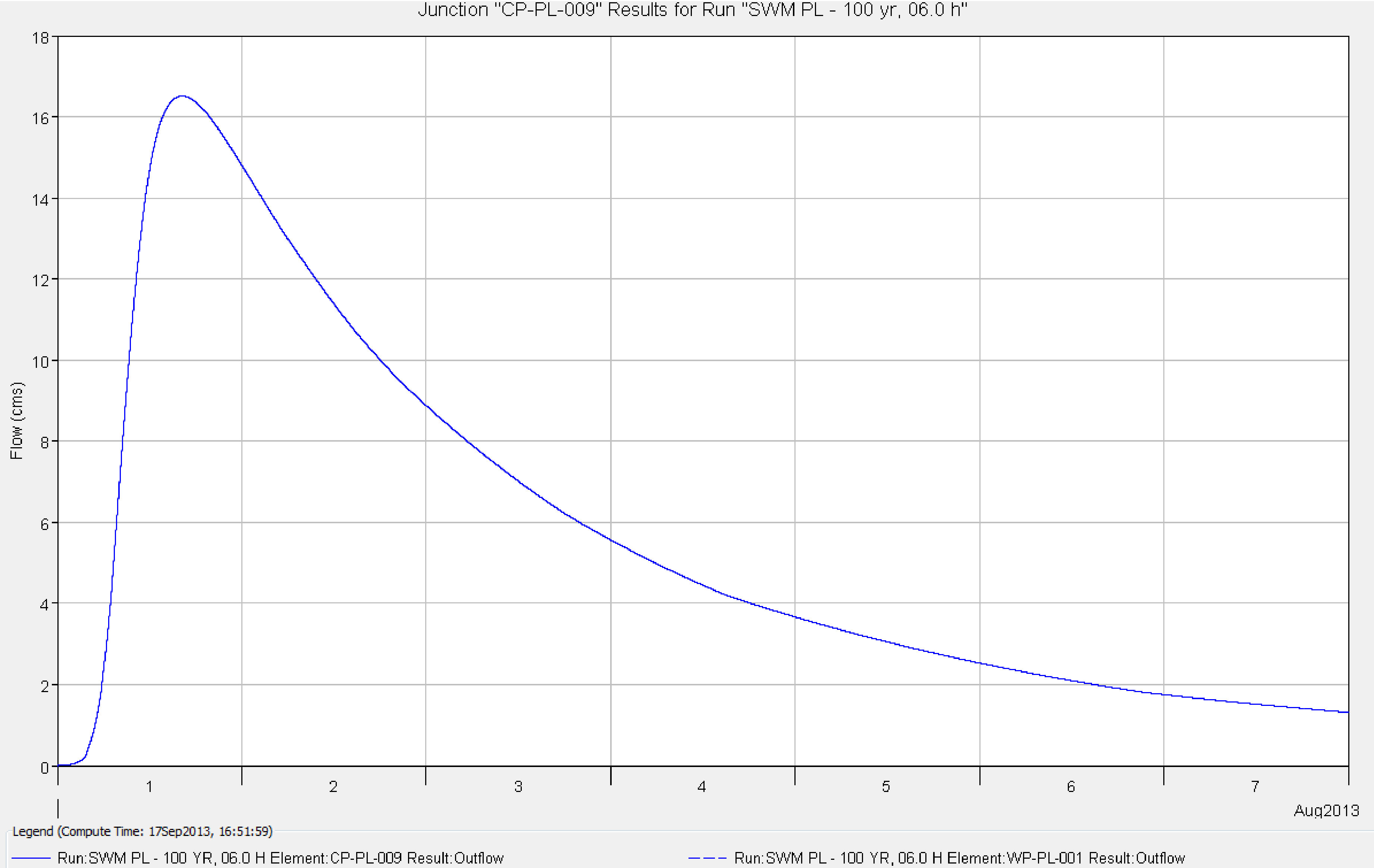
Junction "CP-PL-005" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-004 Result:Outflow

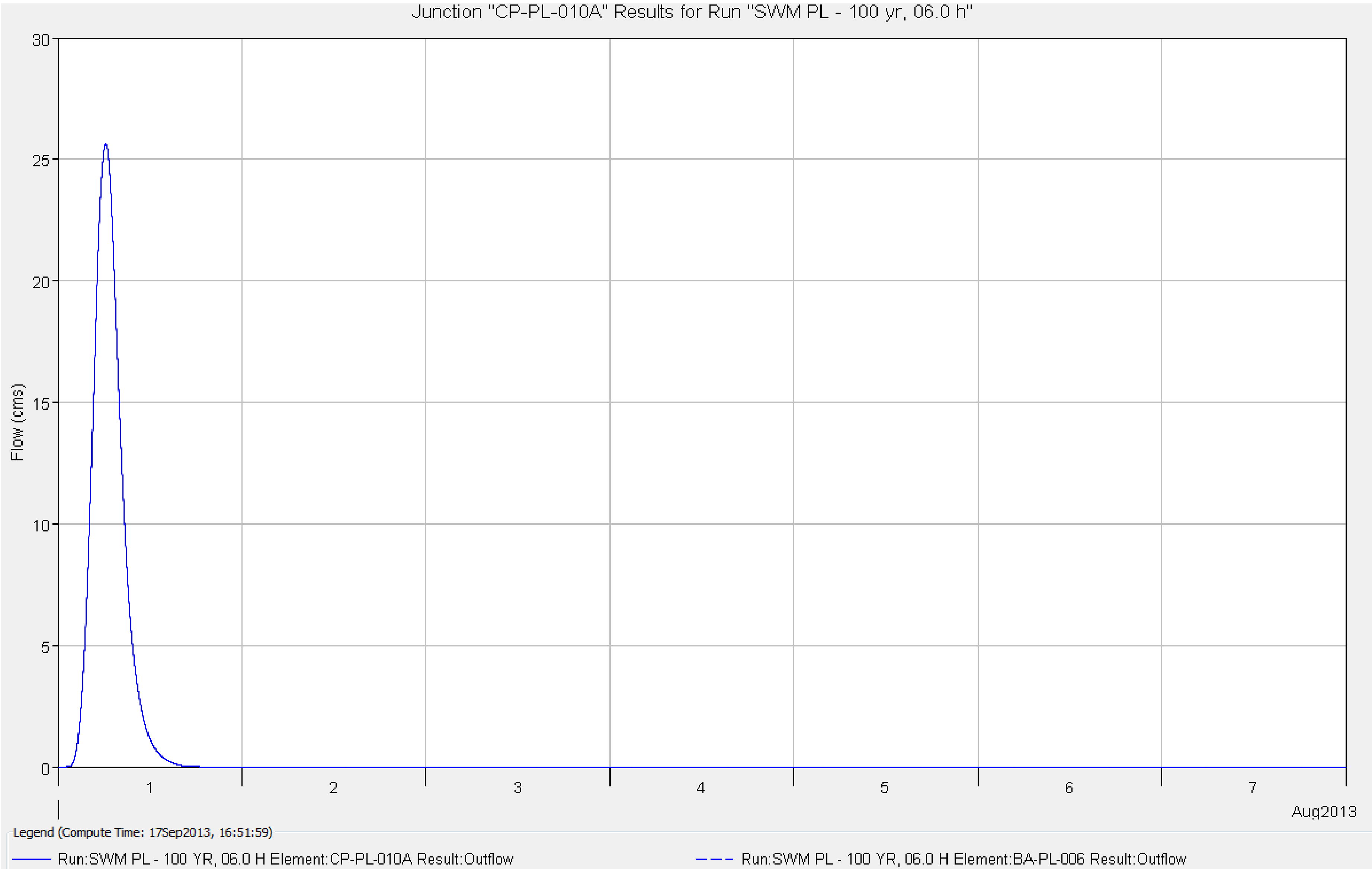

Junction "CP-PL-006" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-006 Result:Outflow


Junction "CP-PL-007" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-005 Result:Outflow

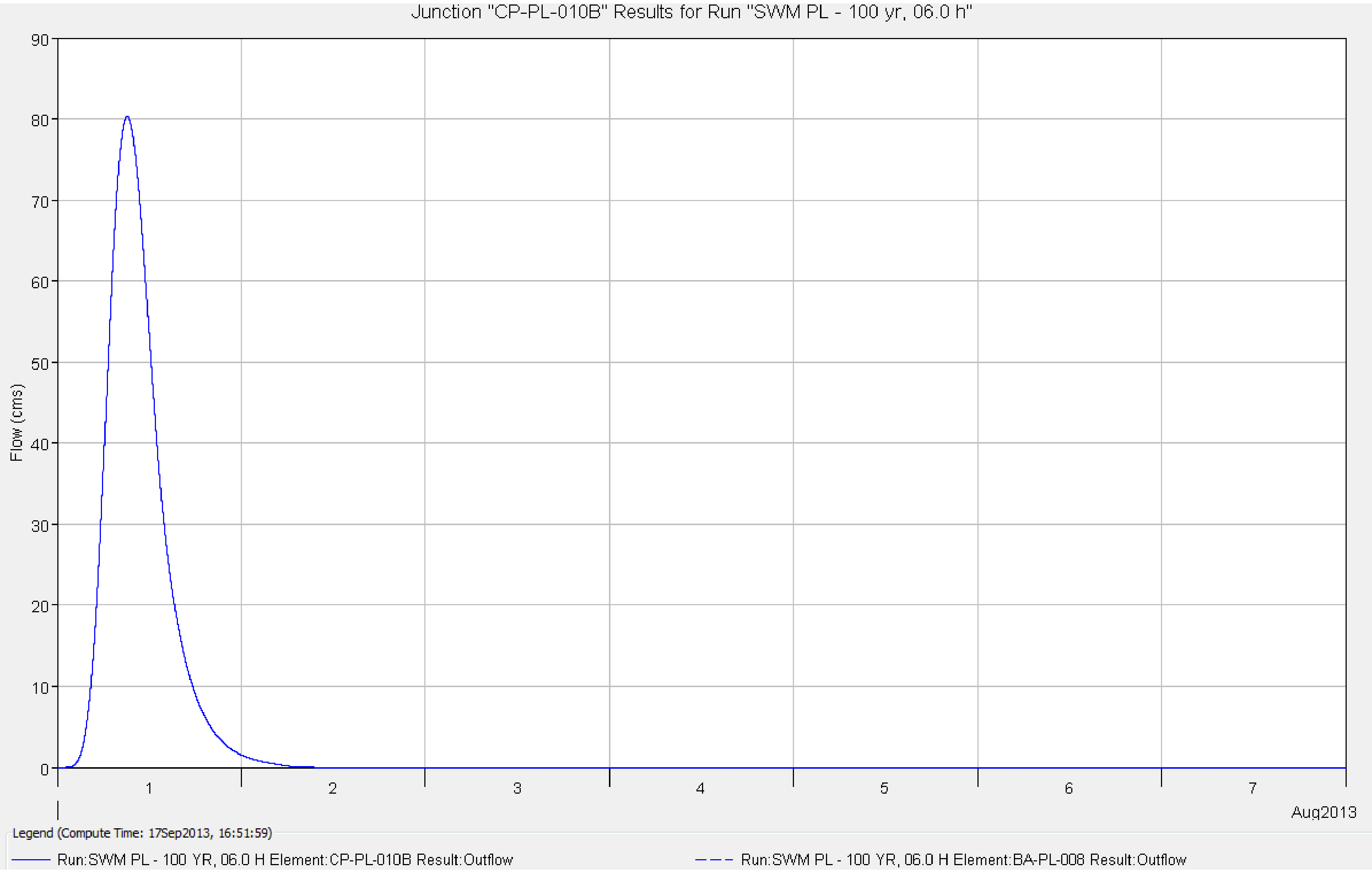


Junction "CP-PL-008" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-006 Result:Outflow

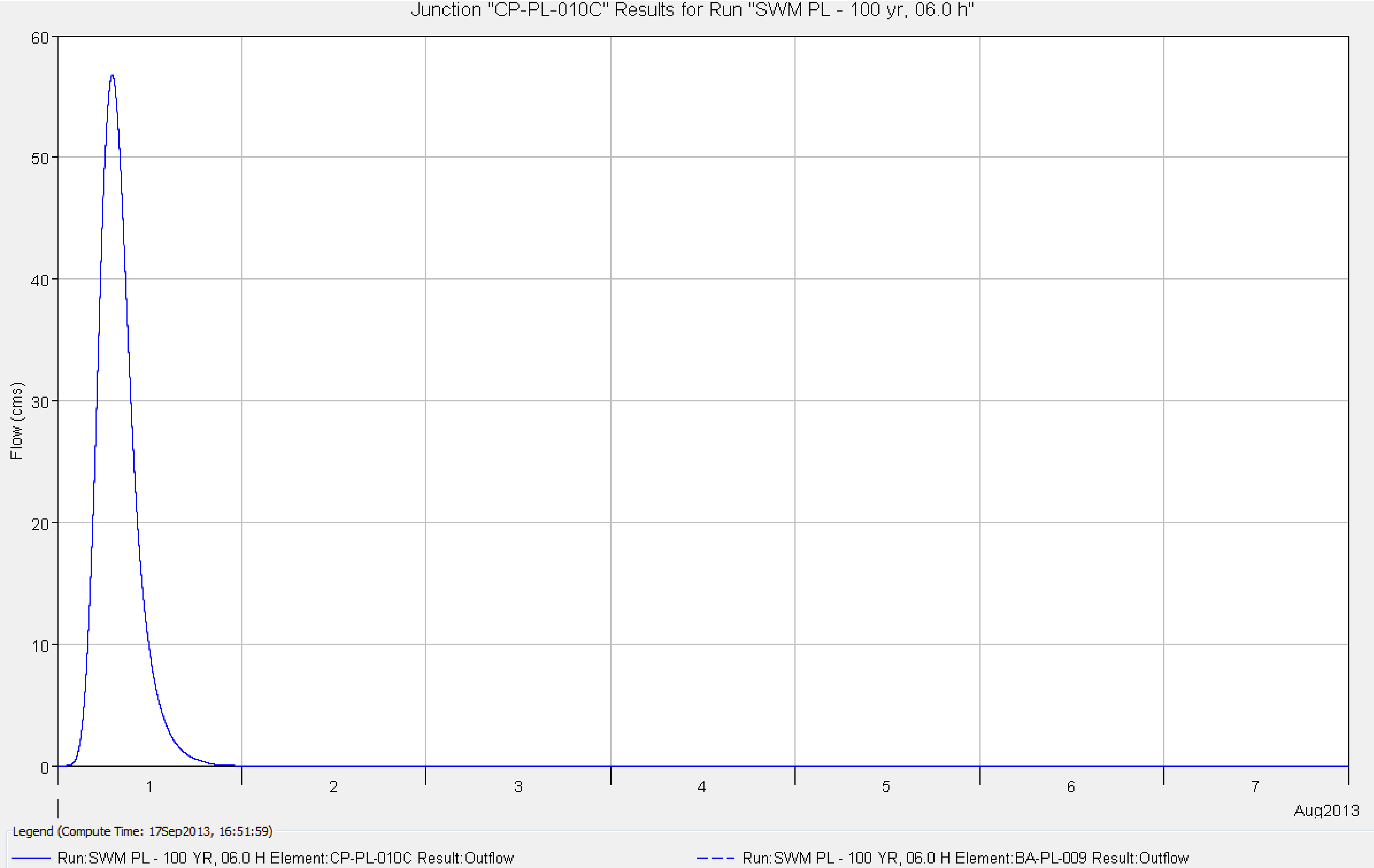

Junction "CP-PL-009" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Outflow



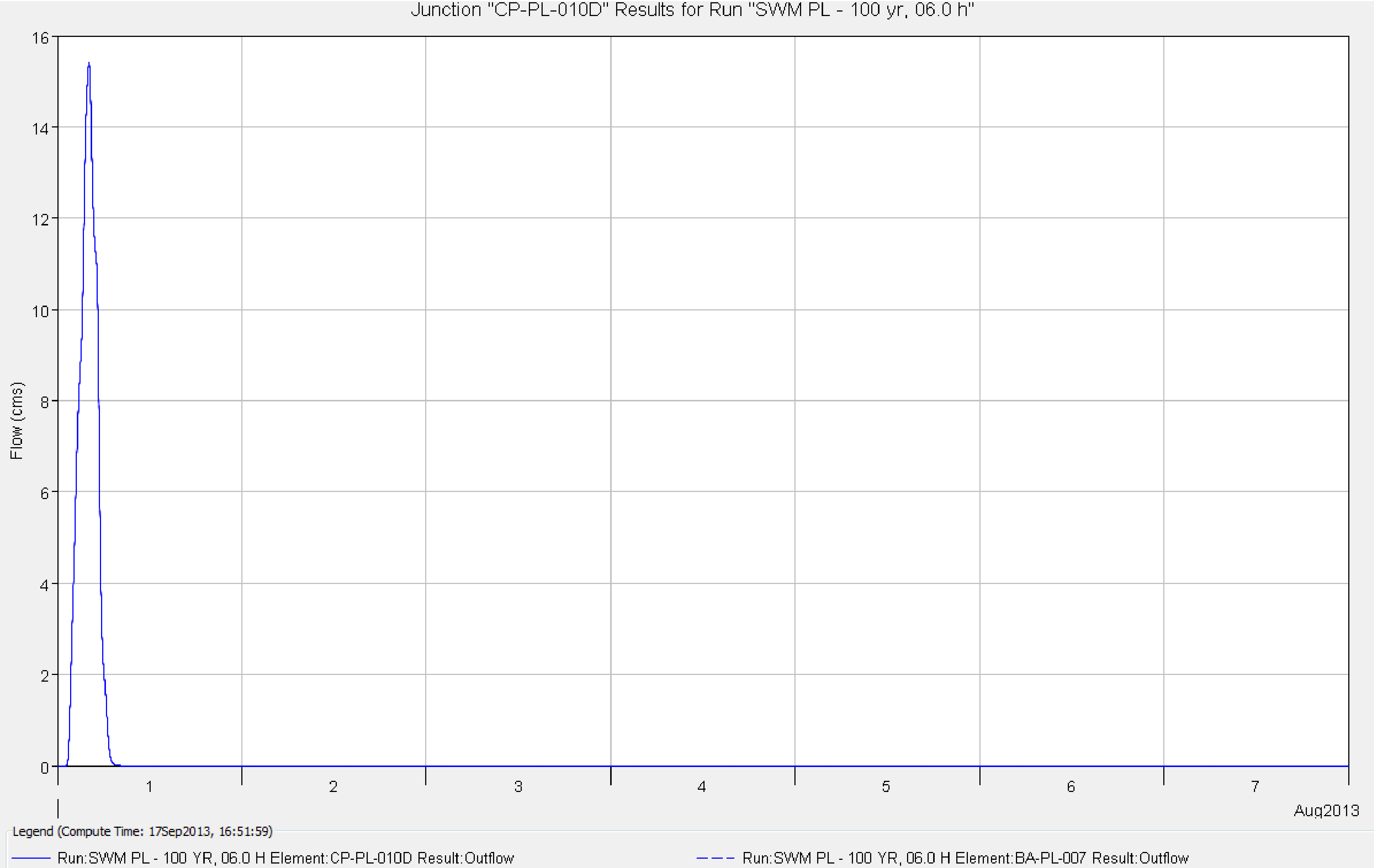
Junction "CP-PL-010A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-006 Result:Outflow



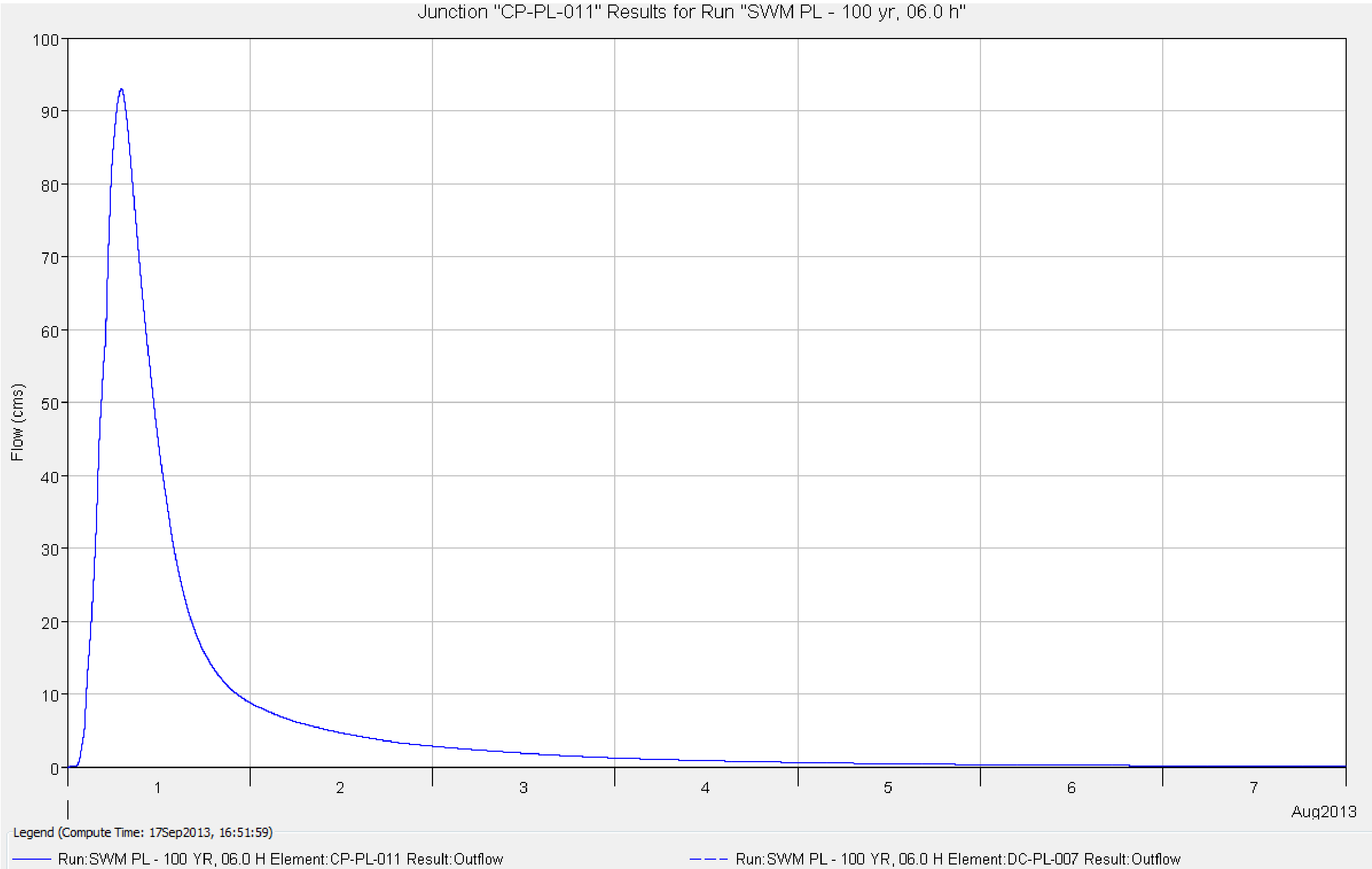
Junction "CP-PL-010B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-008 Result:Outflow



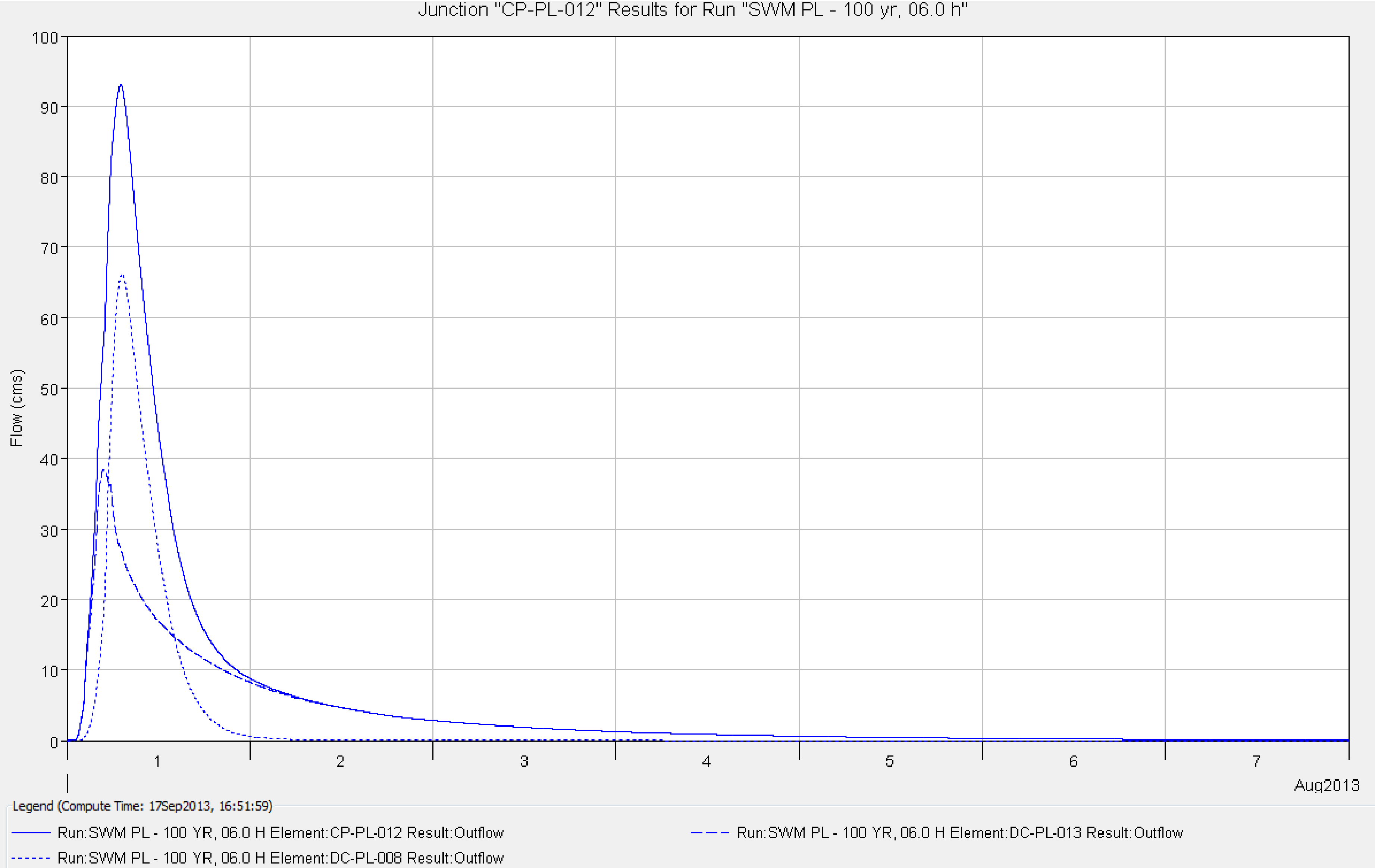
Junction "CP-PL-010C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-009 Result:Outflow



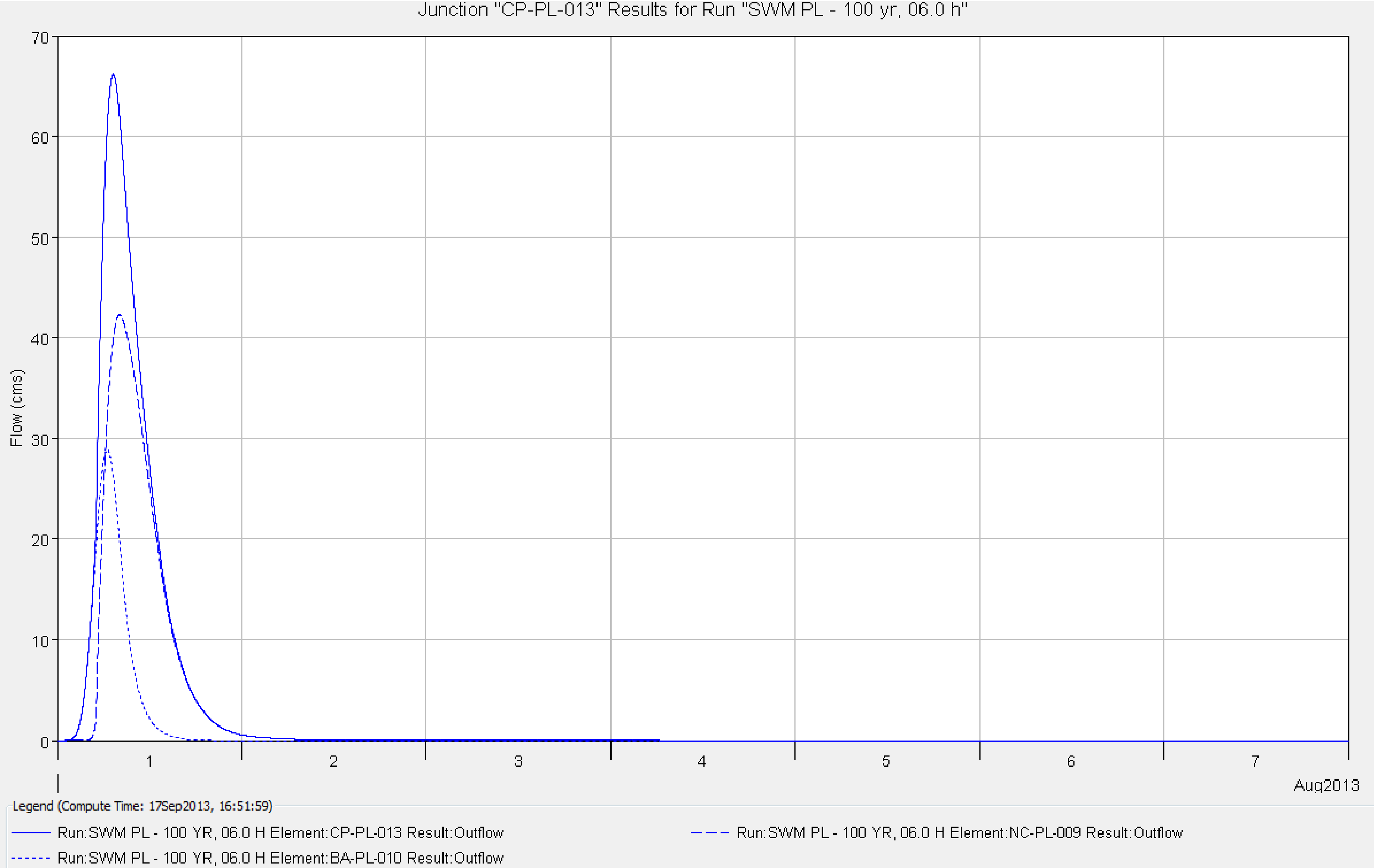
Junction "CP-PL-010D" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010D Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-007 Result:Outflow



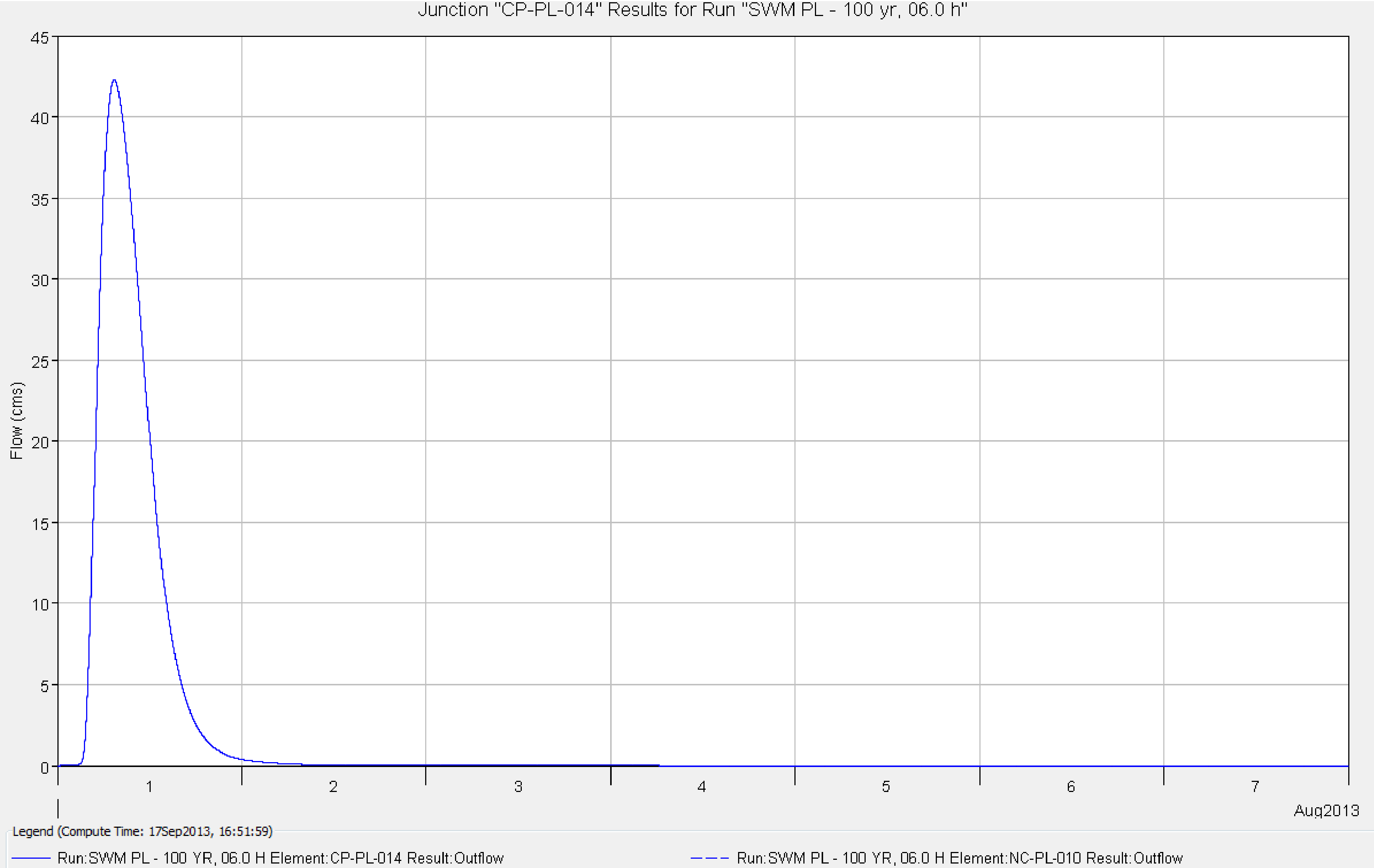
Junction "CP-PL-011" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-007 Result:Outflow



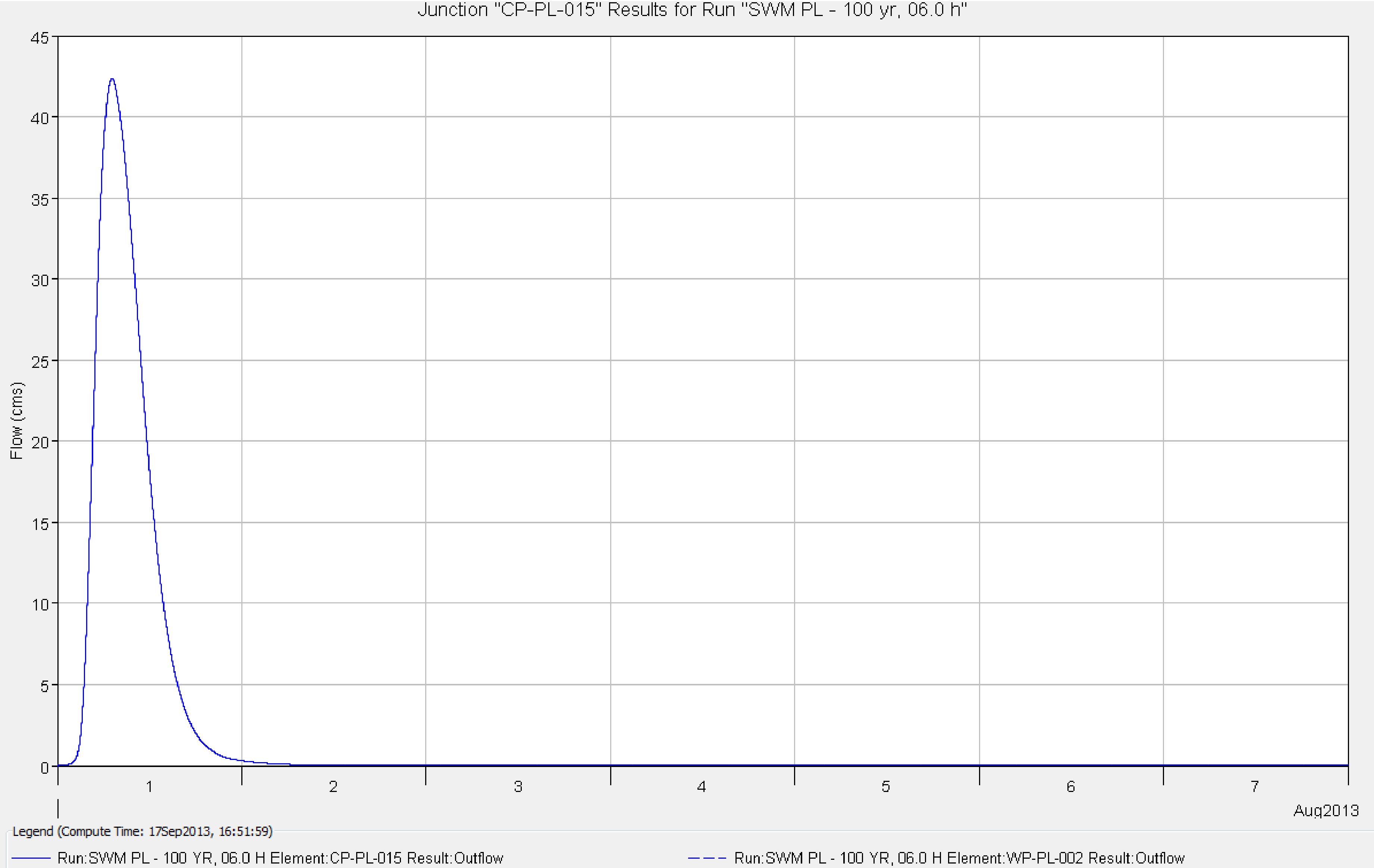
Junction "CP-PL-012" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-008 Result:Outflow



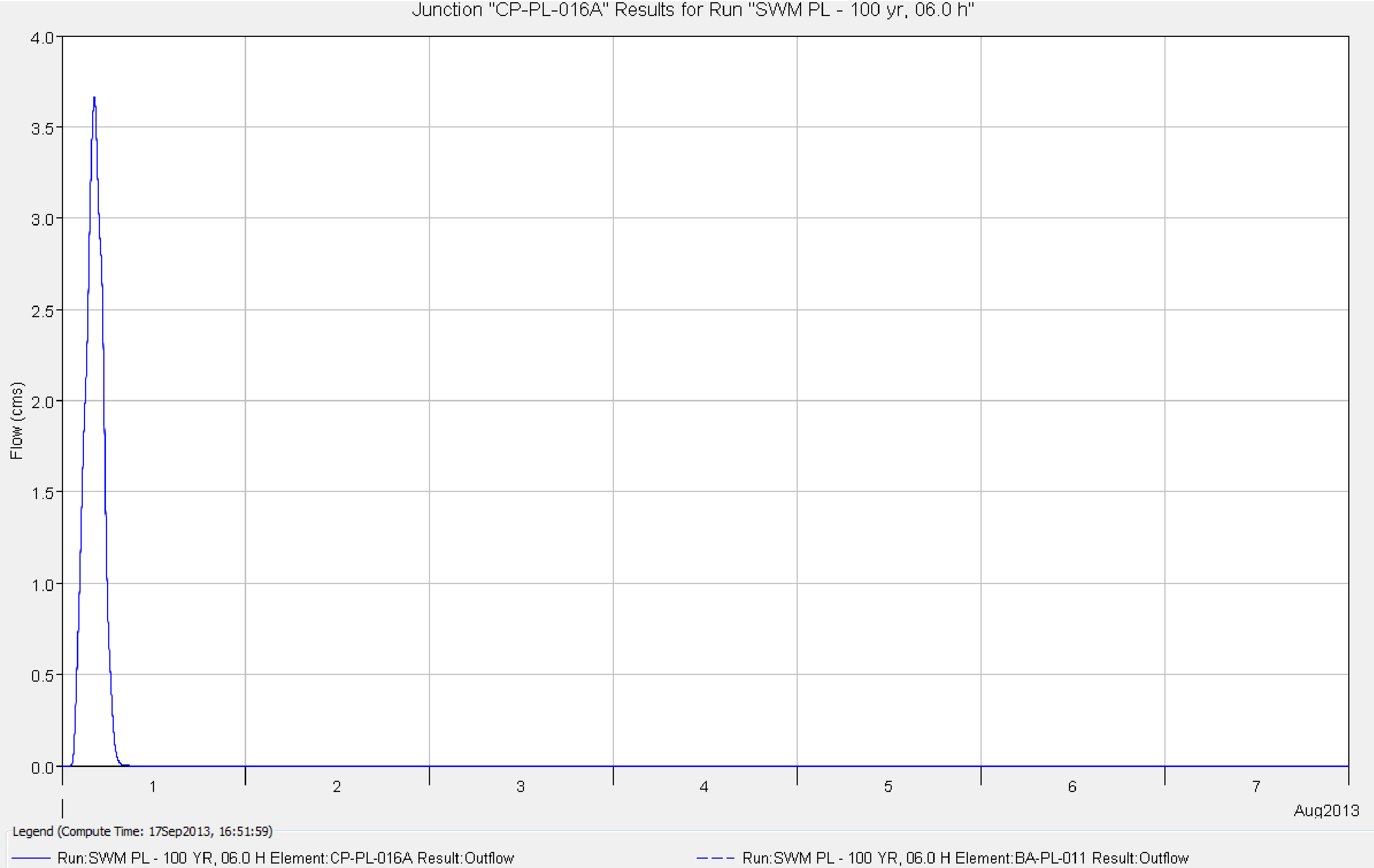
Junction "CP-PL-013" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-010 Result:Outflow

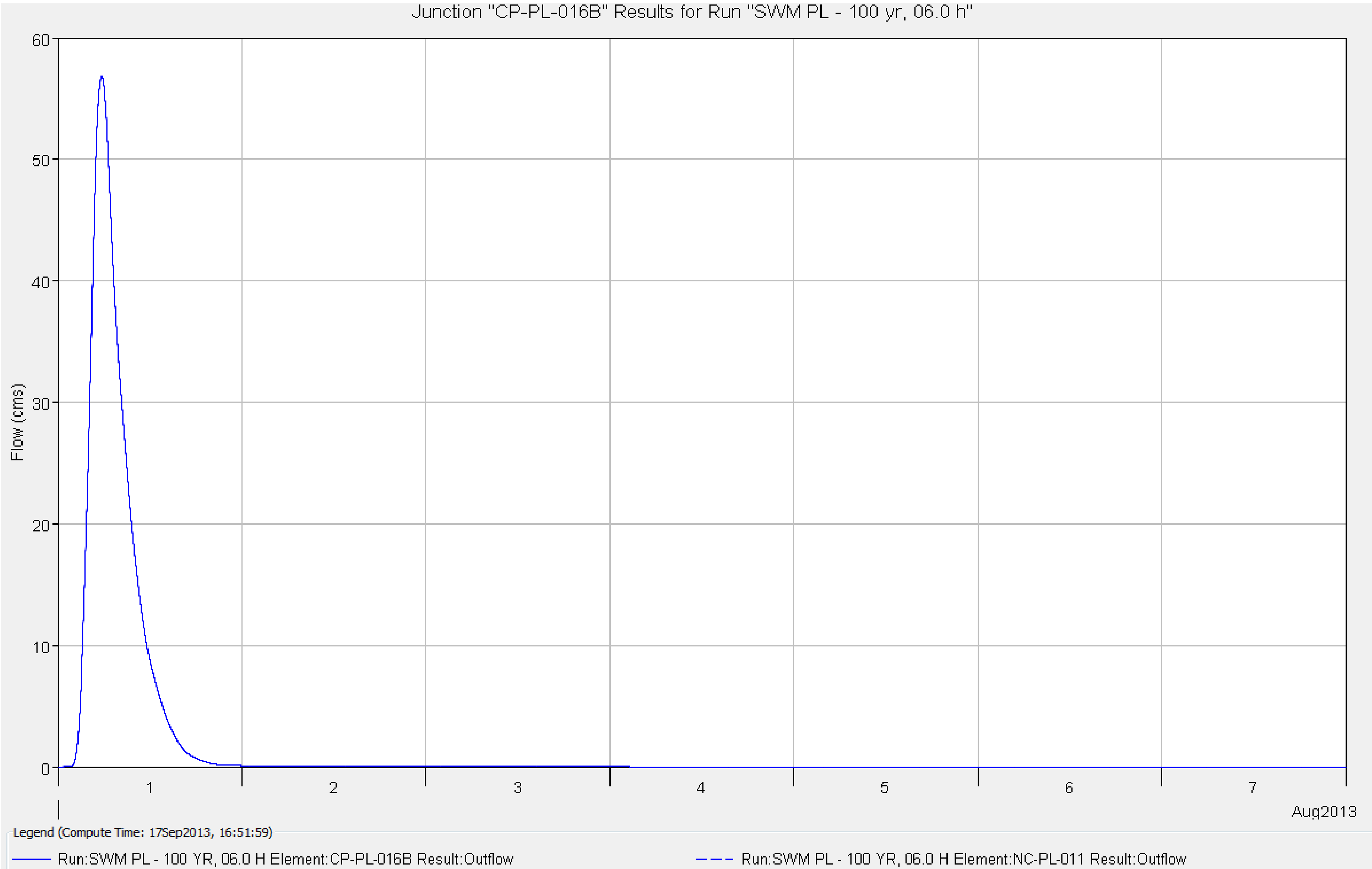


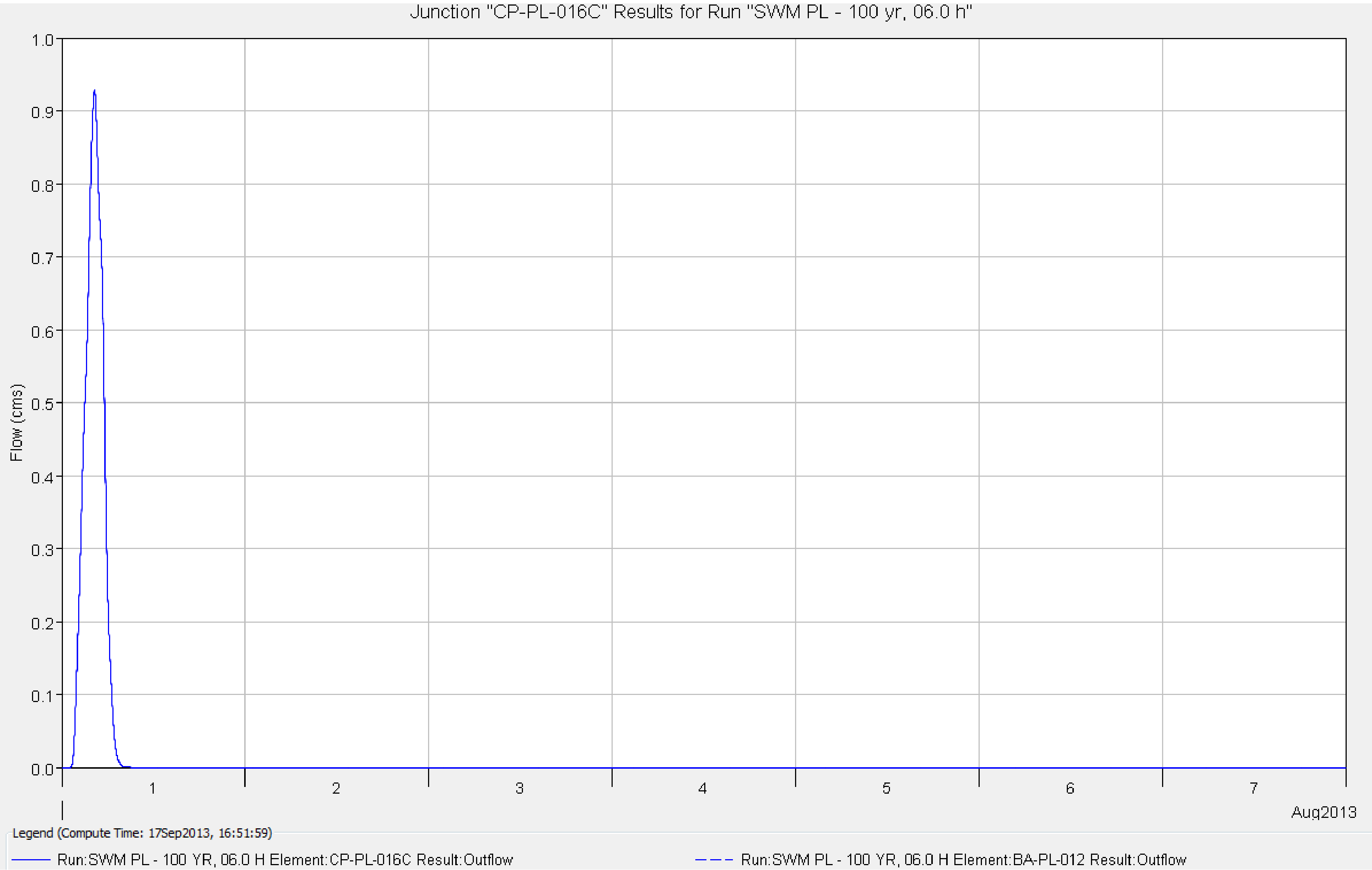
Junction "CP-PL-014" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-010 Result:Outflow

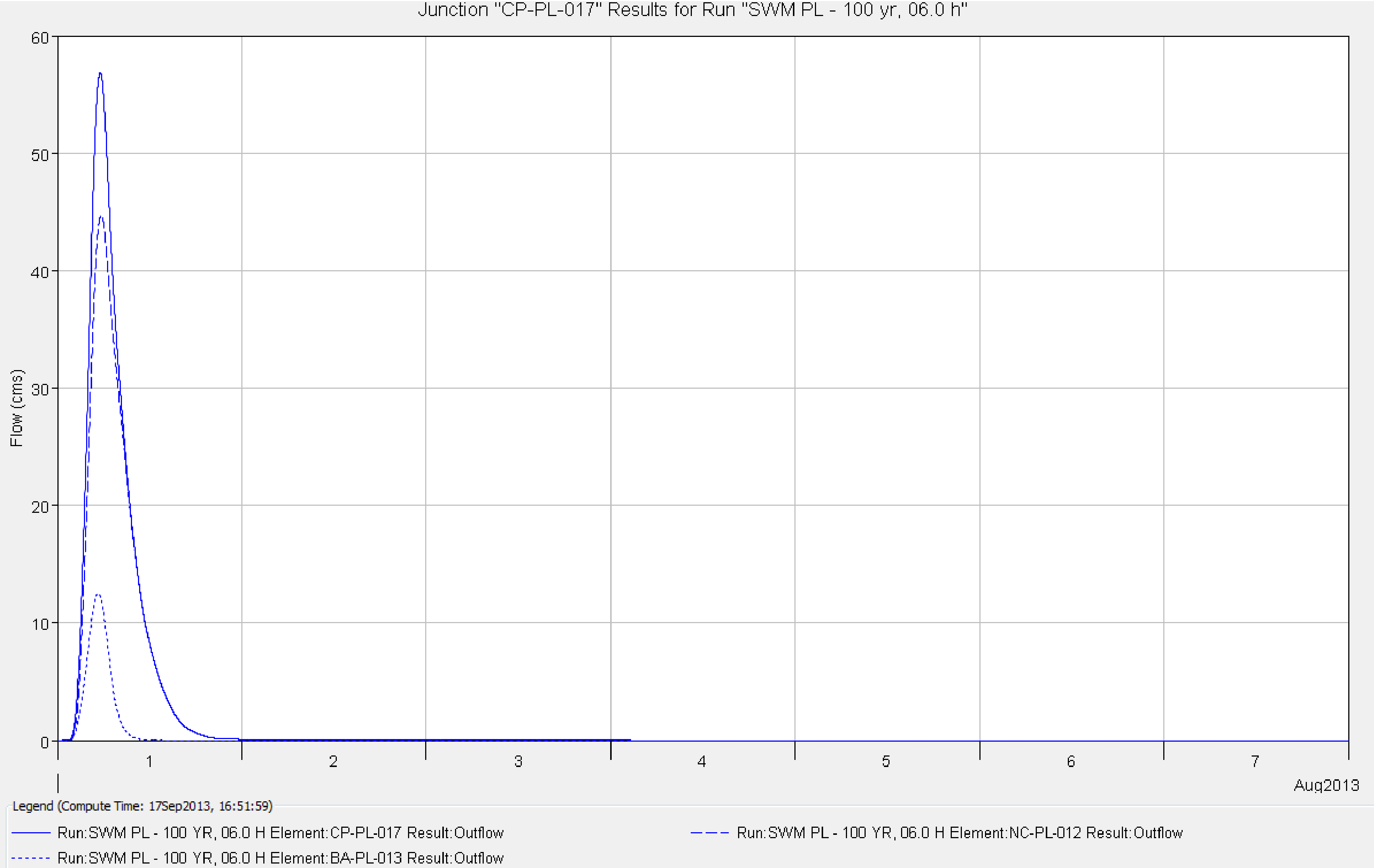


Junction "CP-PL-015" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-015 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Outflow

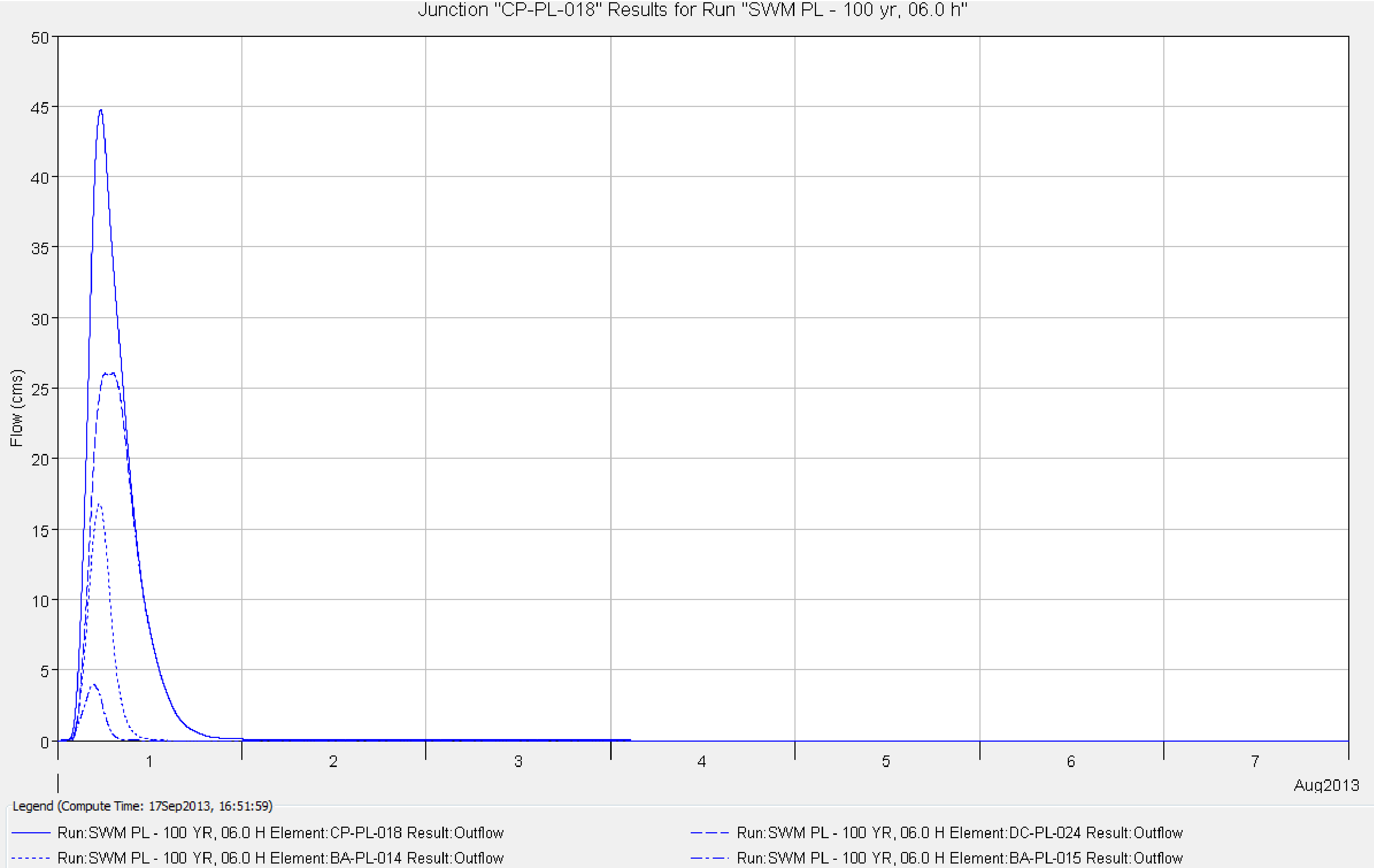

Junction "CP-PL-016A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-011 Result:Outflow


Junction "CP-PL-016B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
10
20
30
40
50
60
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-011 Result:Outflow

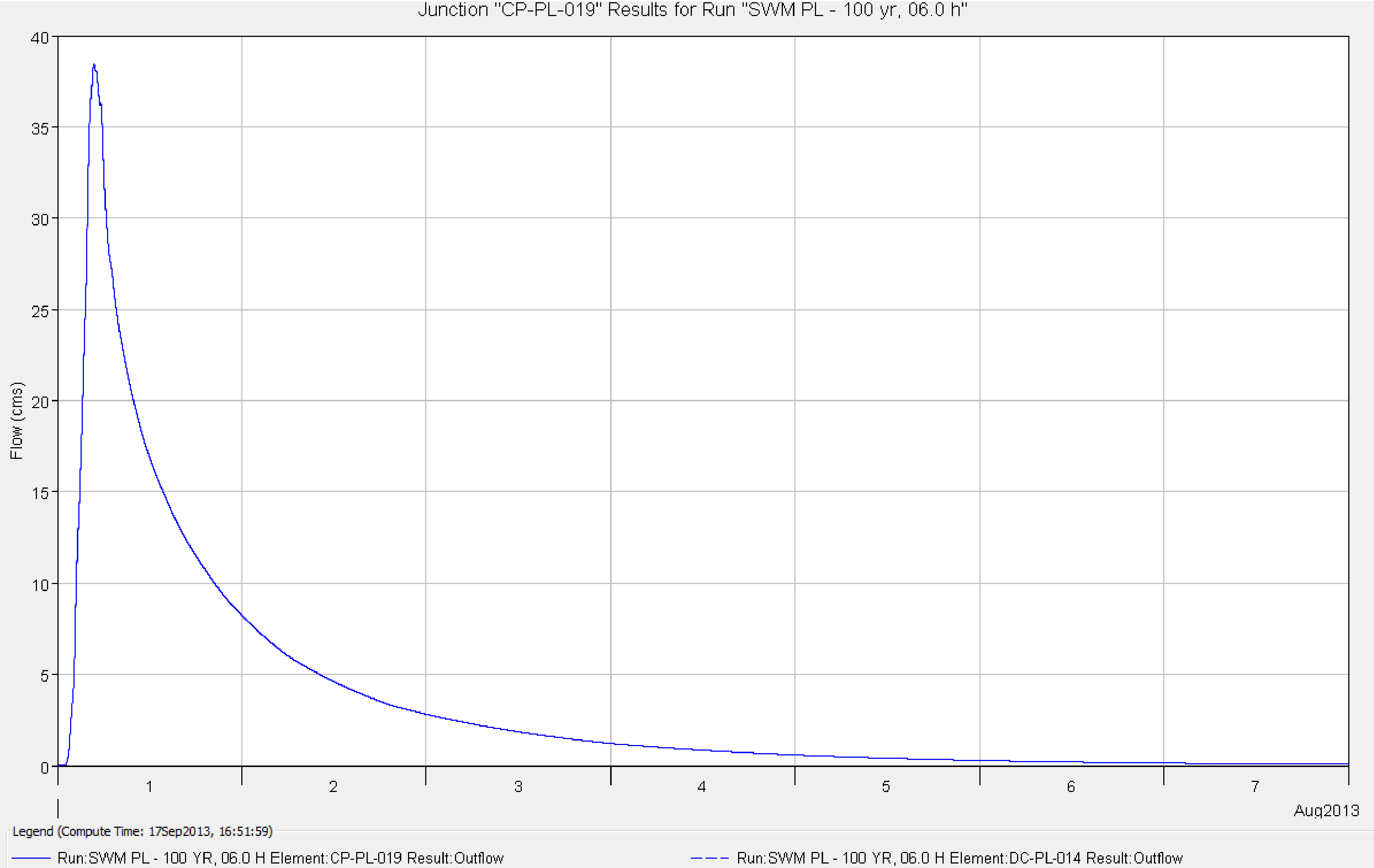

Junction "CP-PL-016C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-012 Result:Outflow



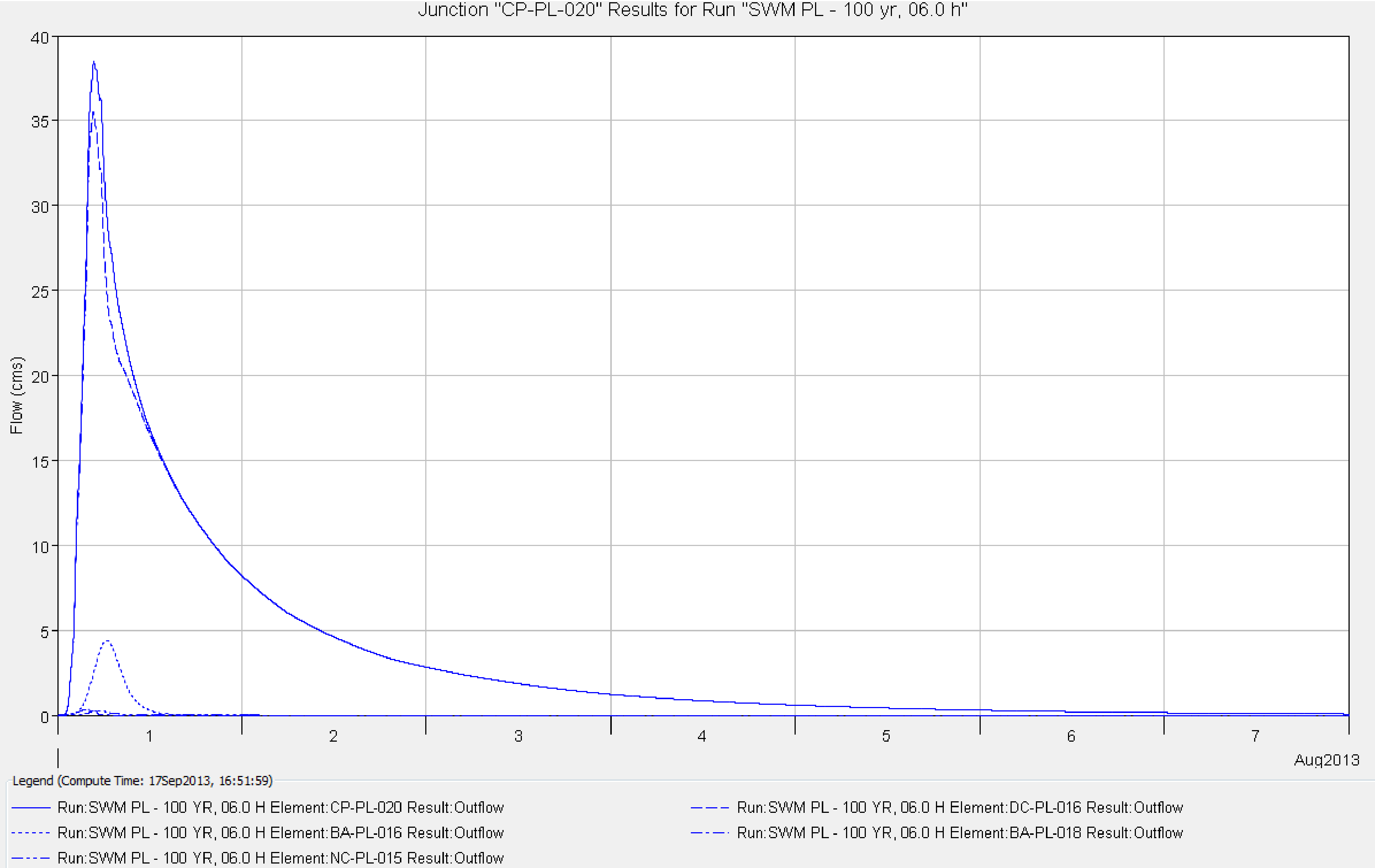
Junction "CP-PL-017" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
10
20
30
40
50
60
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-013 Result:Outflow

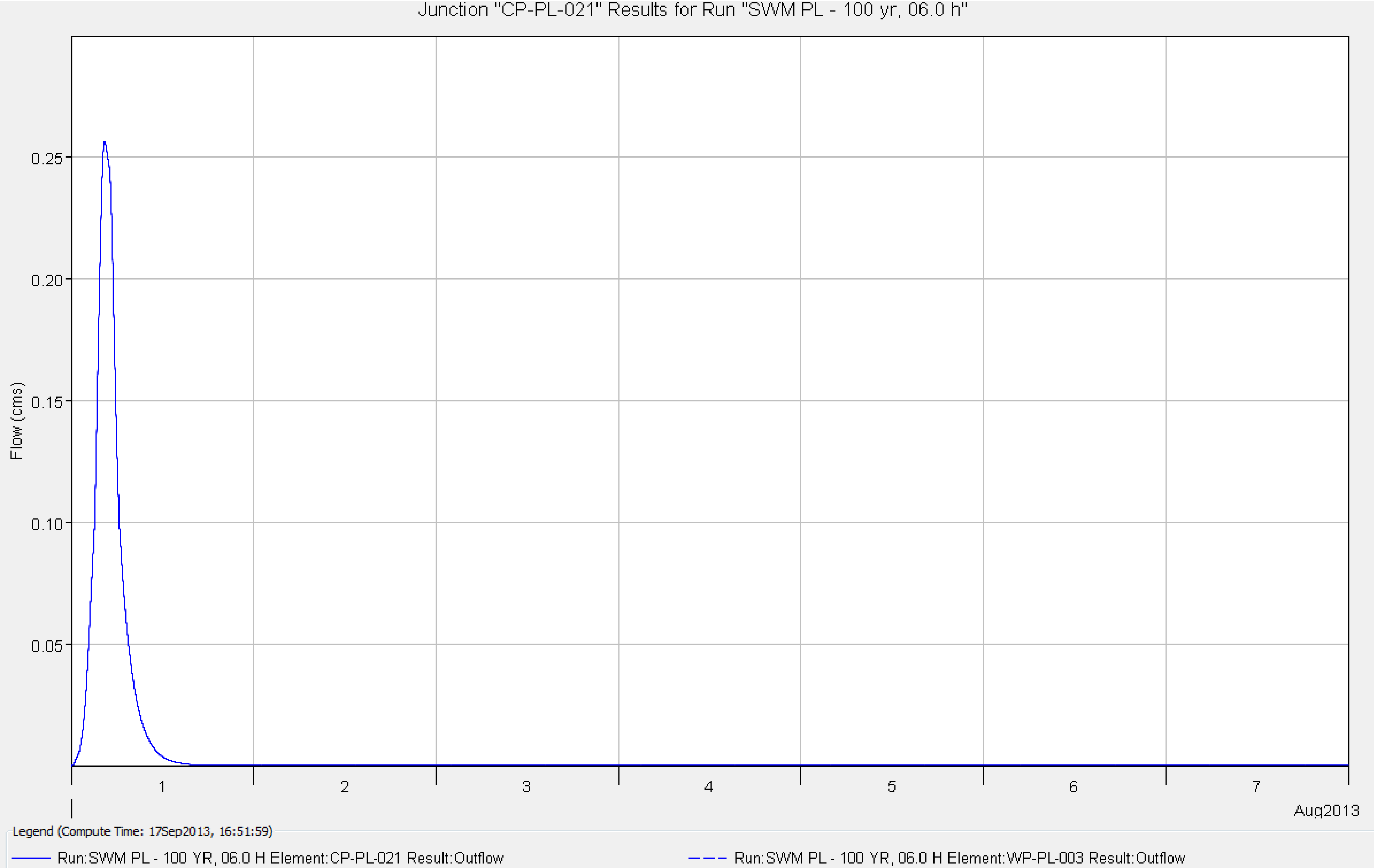


Junction "CP-PL-018" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-015 Result:Outflow

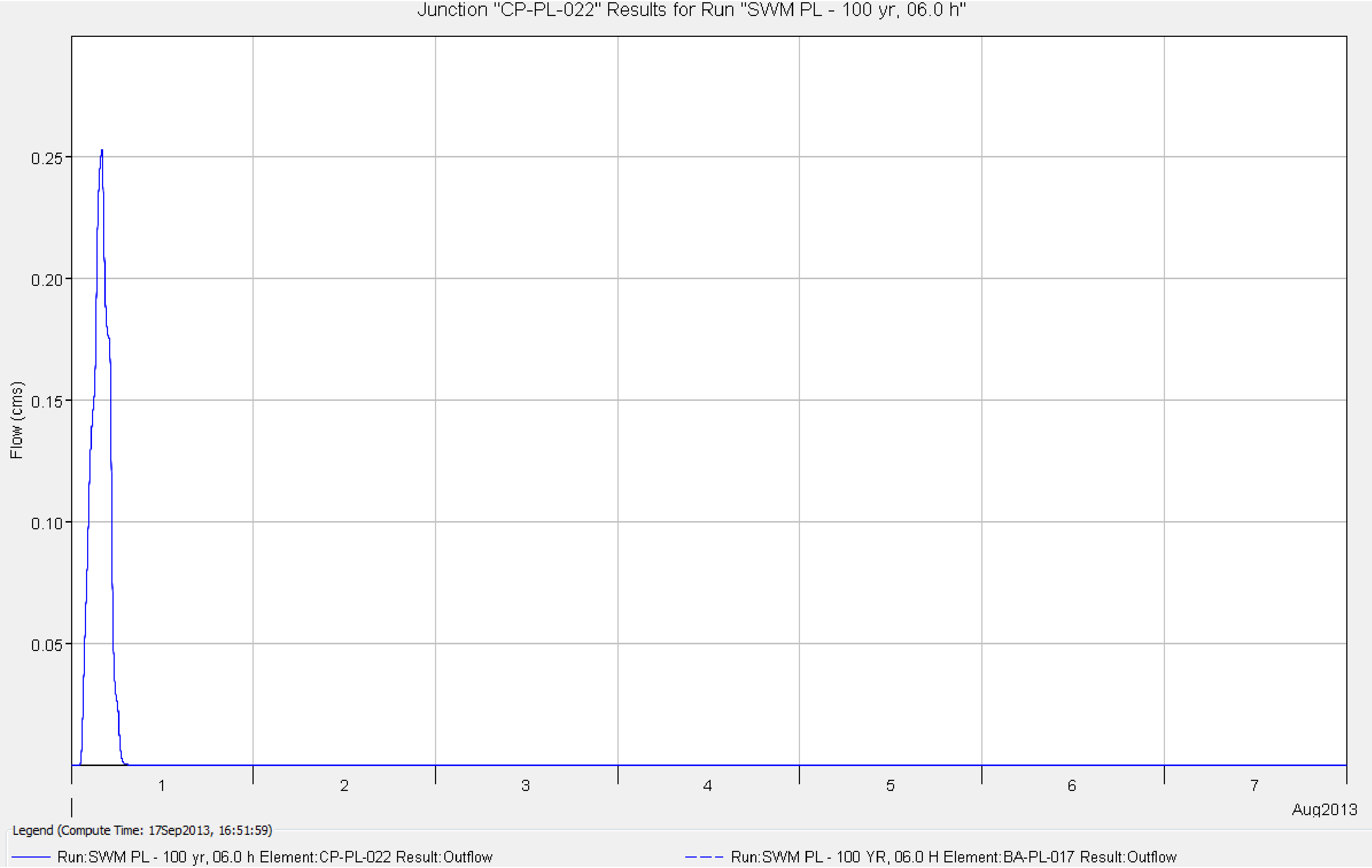


Junction "CP-PL-019" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-014 Result:Outflow

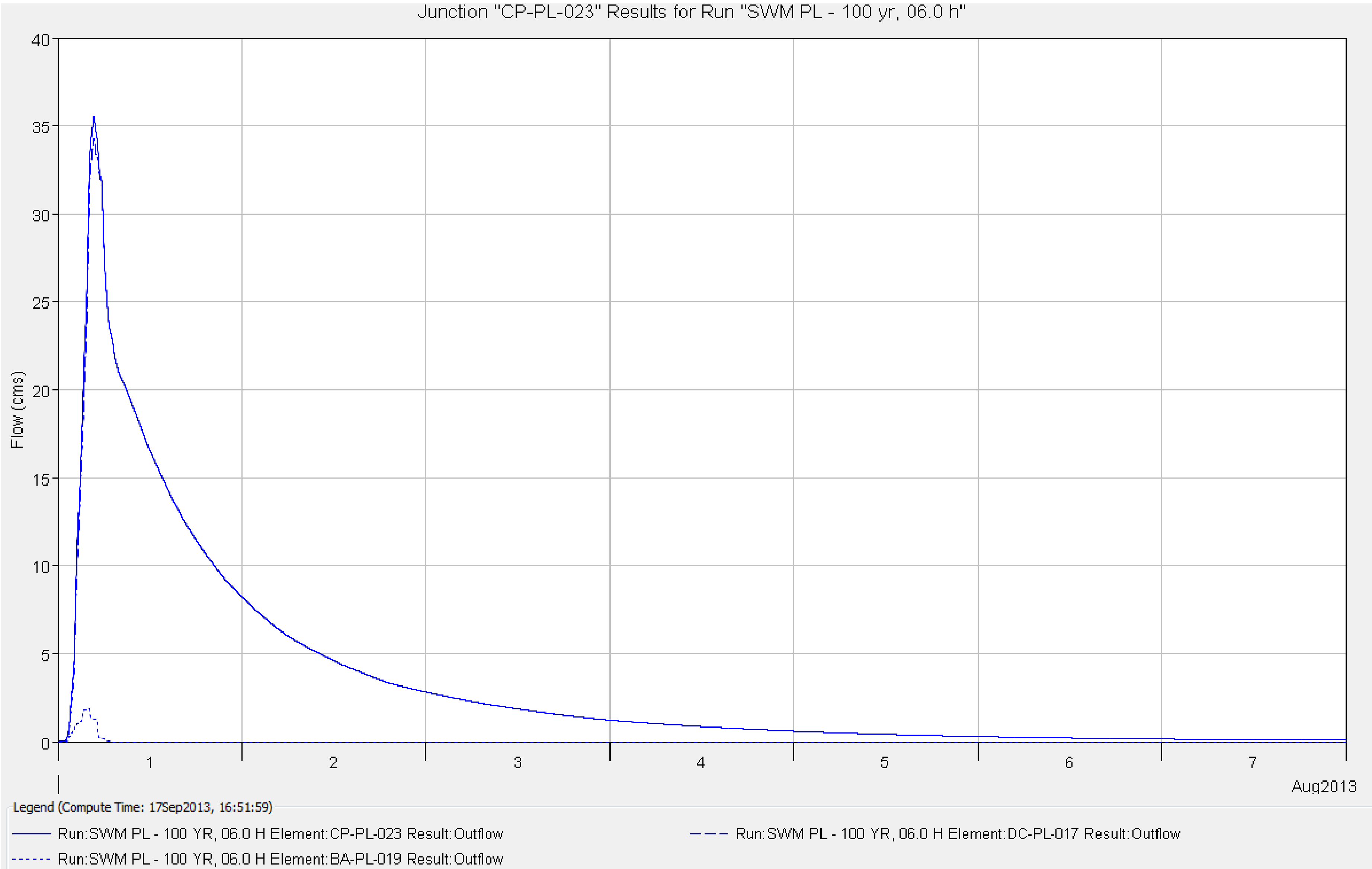

Junction "CP-PL-020" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-015 Result:Outflow



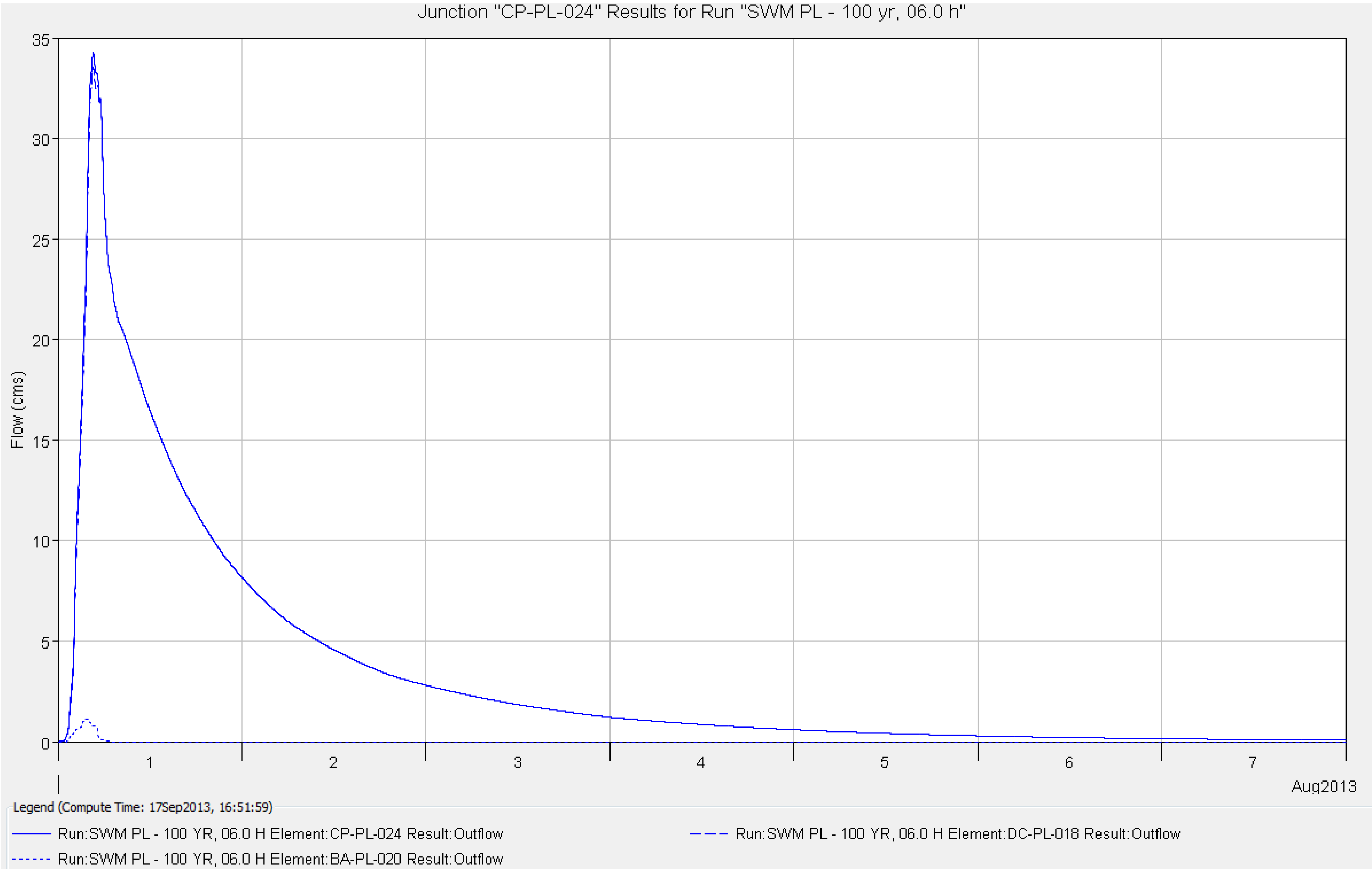
Junction "CP-PL-021" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0.25
0.20
0.15
0.10
0.05
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Outflow

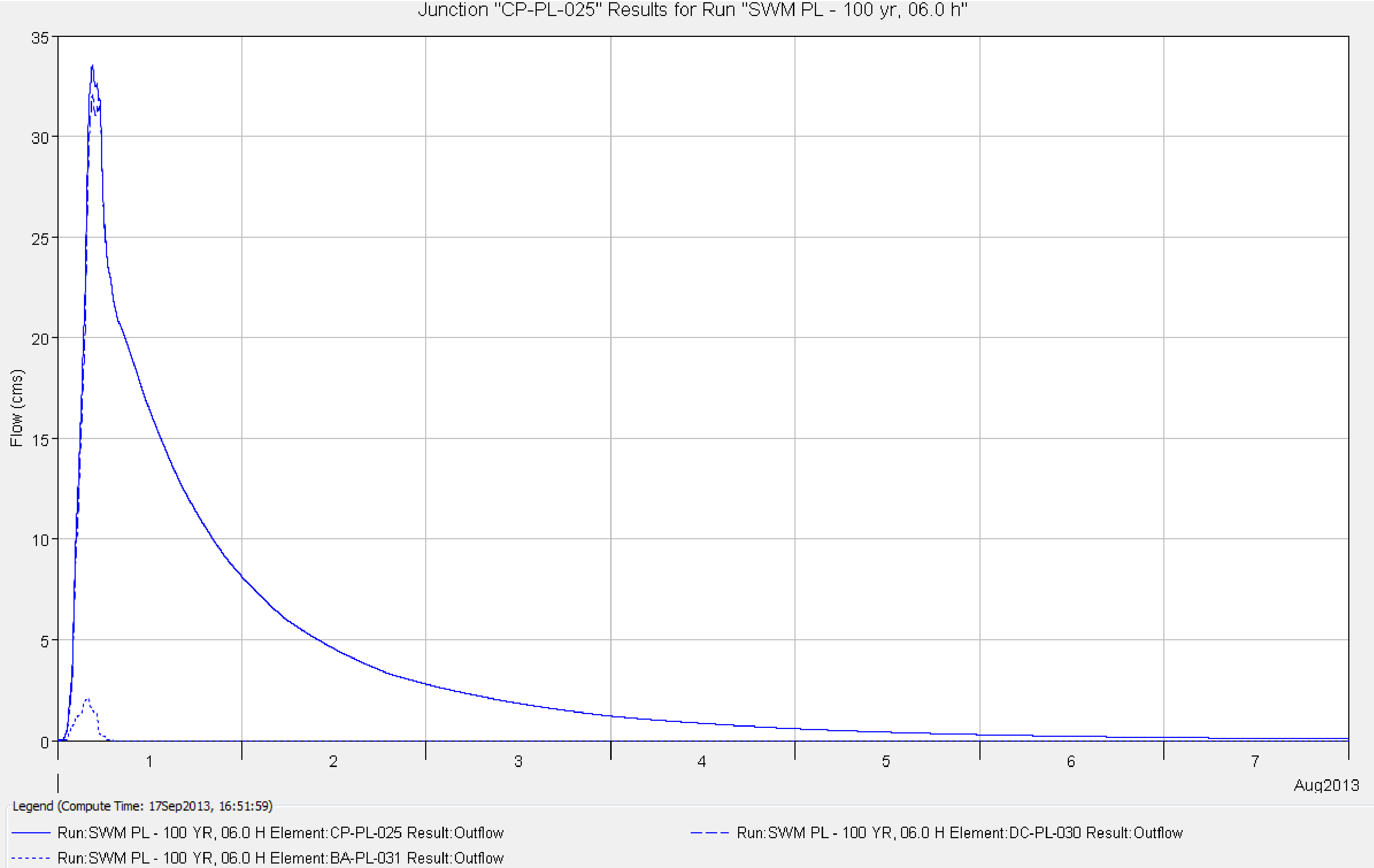


Junction "CP-PL-022" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0.25
0.20
0.15
0.10
0.05
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-017 Result:Outflow

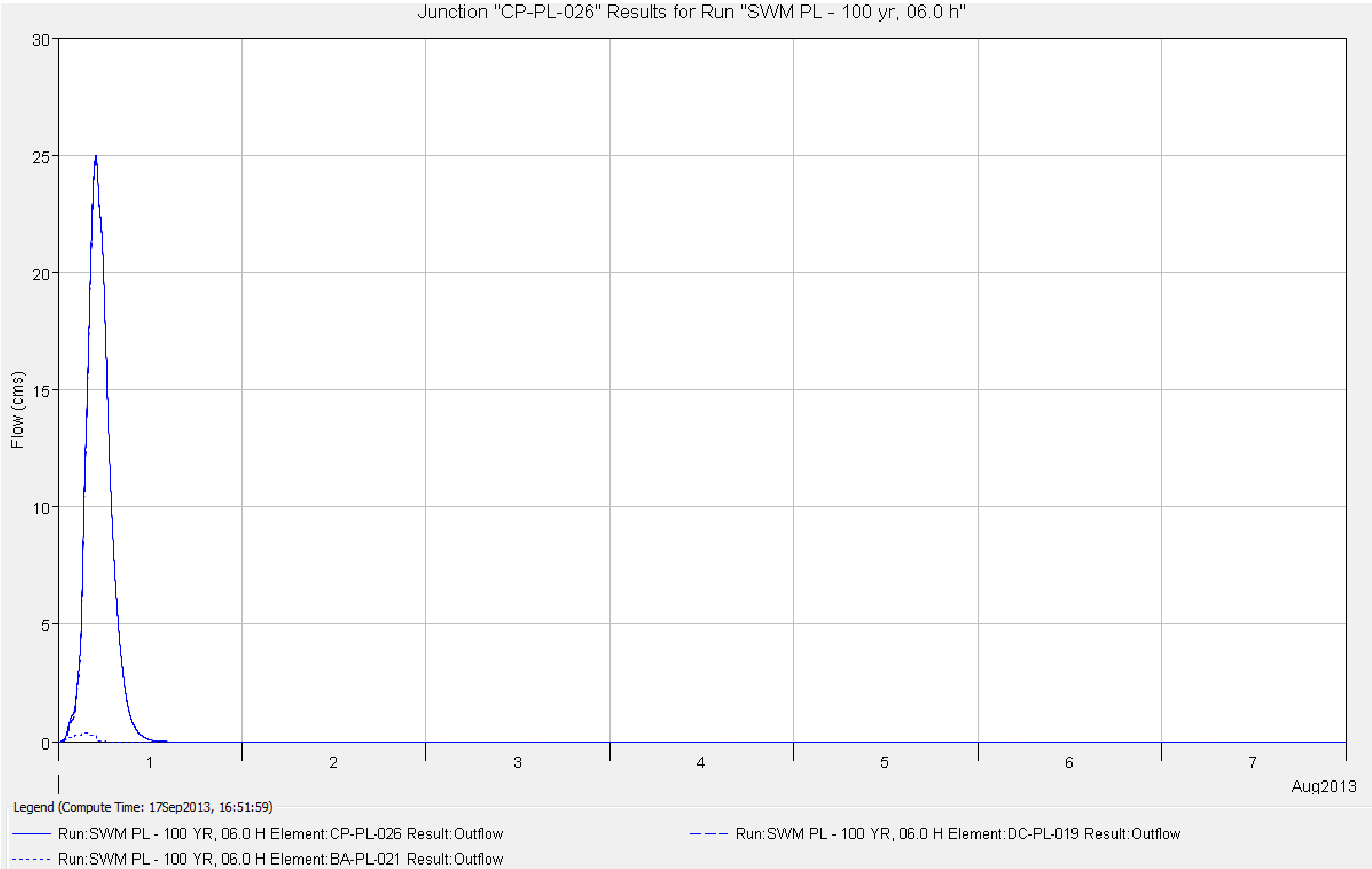


Junction "CP-PL-023" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-019 Result:Outflow

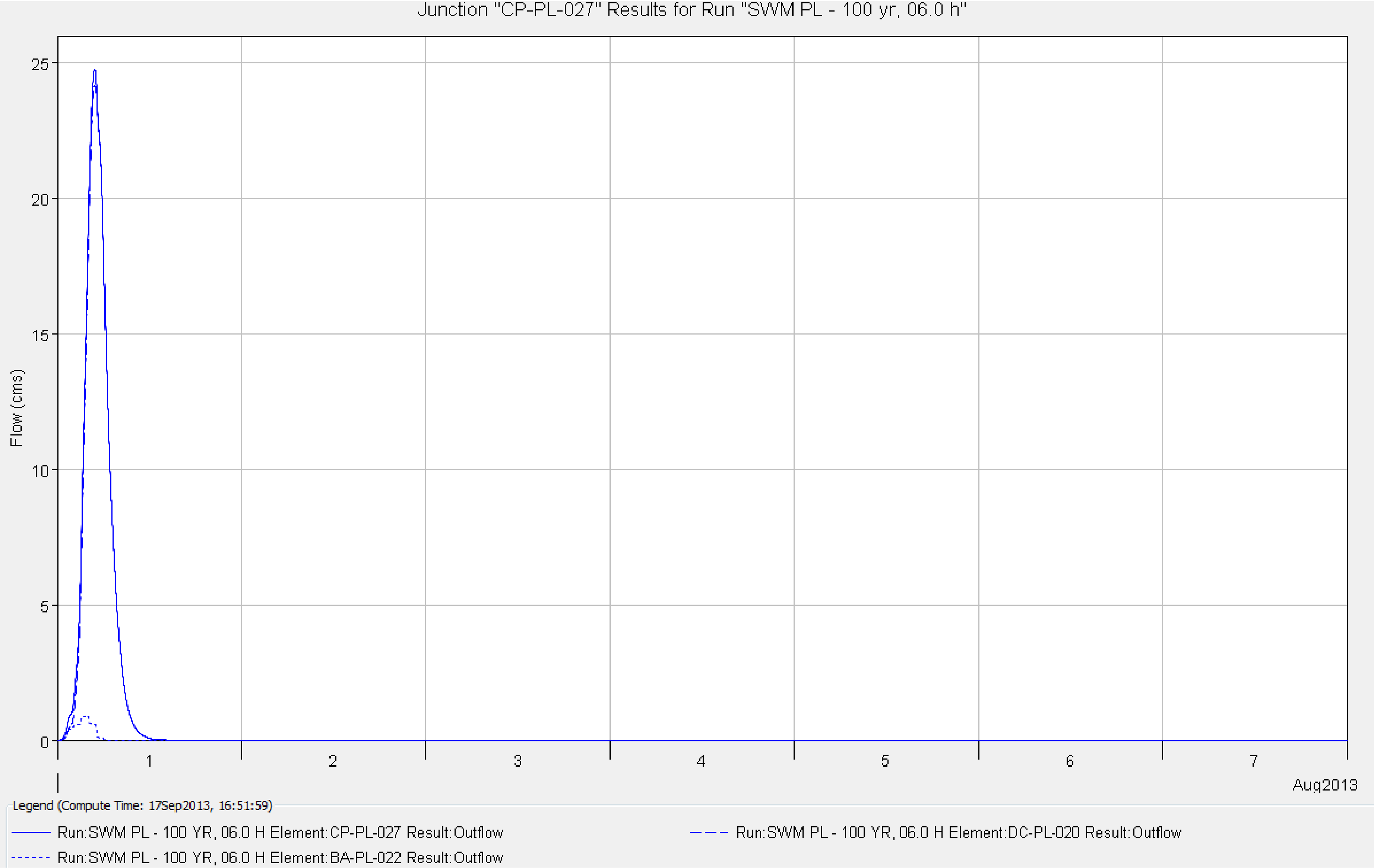

Junction "CP-PL-024" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-020 Result:Outflow

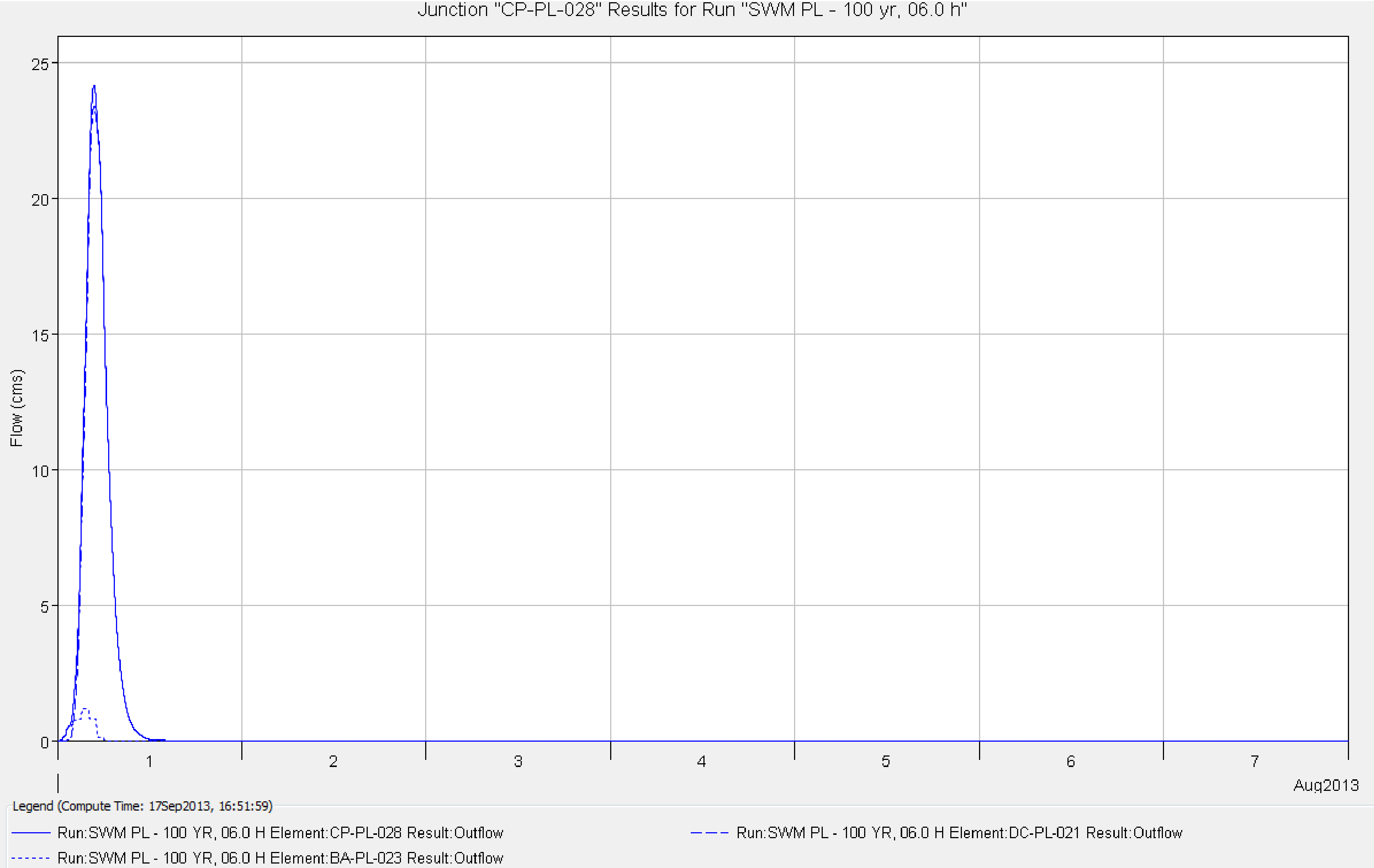


Junction "CP-PL-025" Results for Run "SWM PL - 100 yr, 06.0 h"
35
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-025 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-031 Result:Outflow

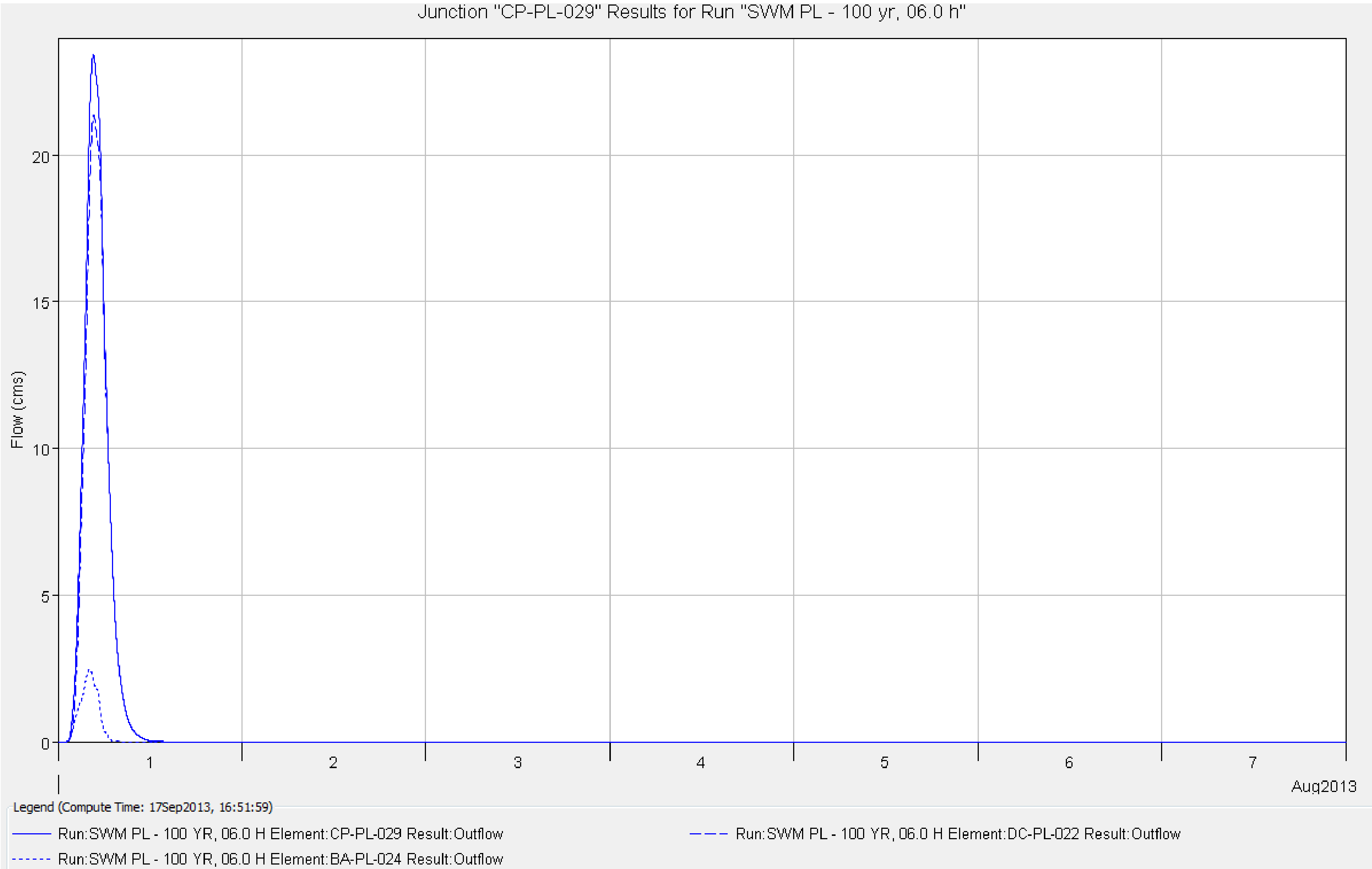


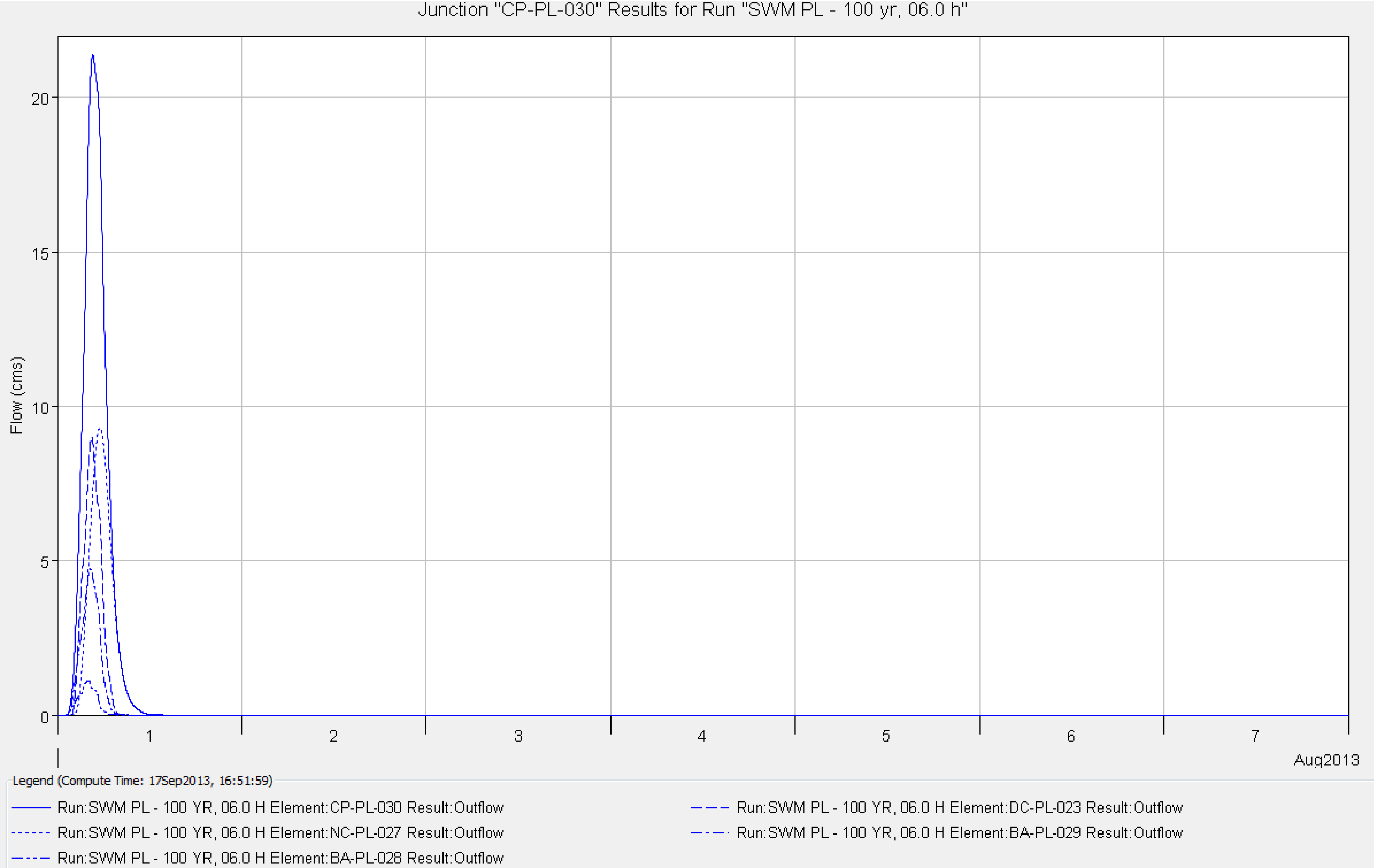
Junction "CP-PL-026" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-021 Result:Outflow


Junction "CP-PL-027" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-022 Result:Outflow

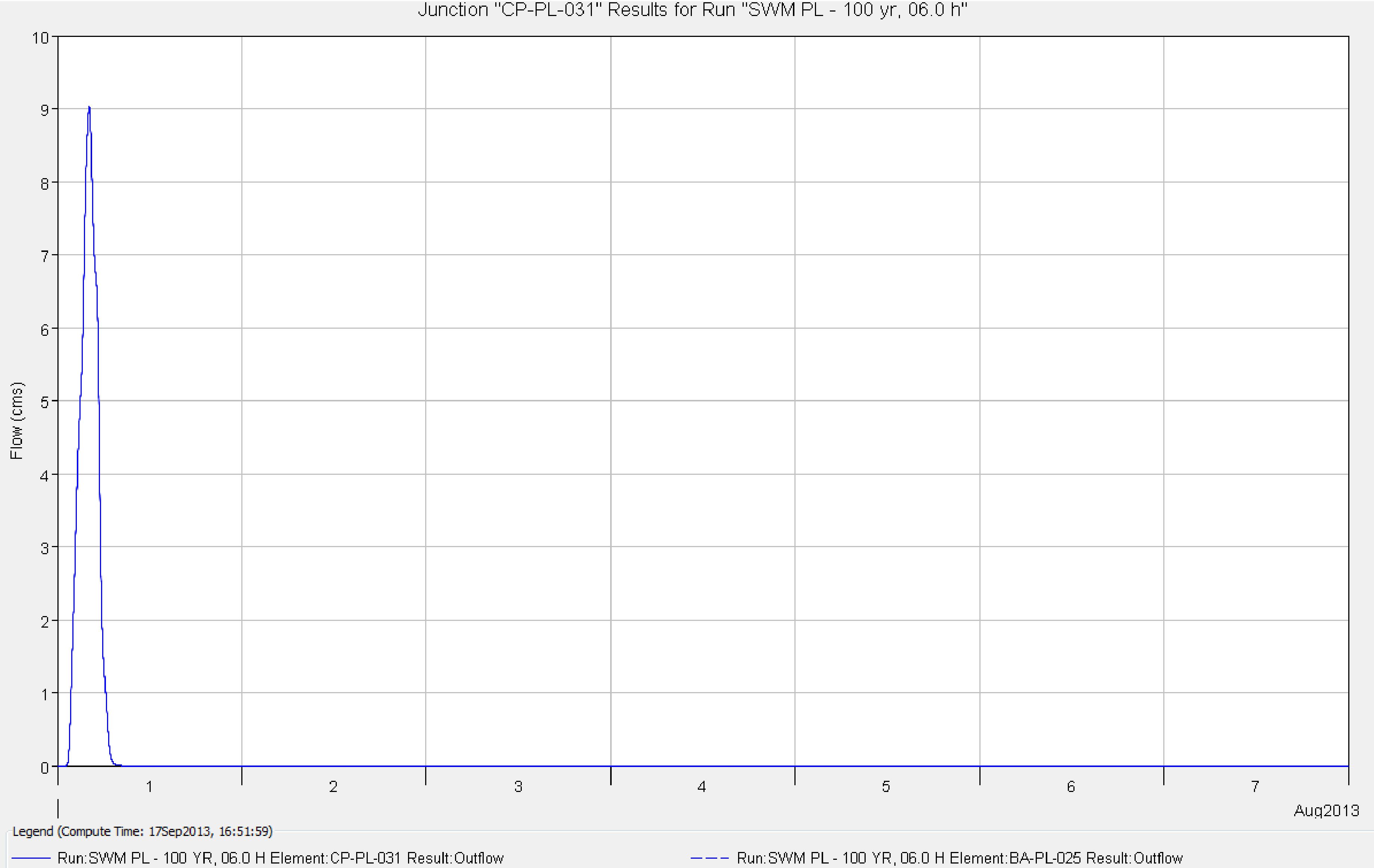


Junction "CP-PL-028" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-028 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-023 Result:Outflow

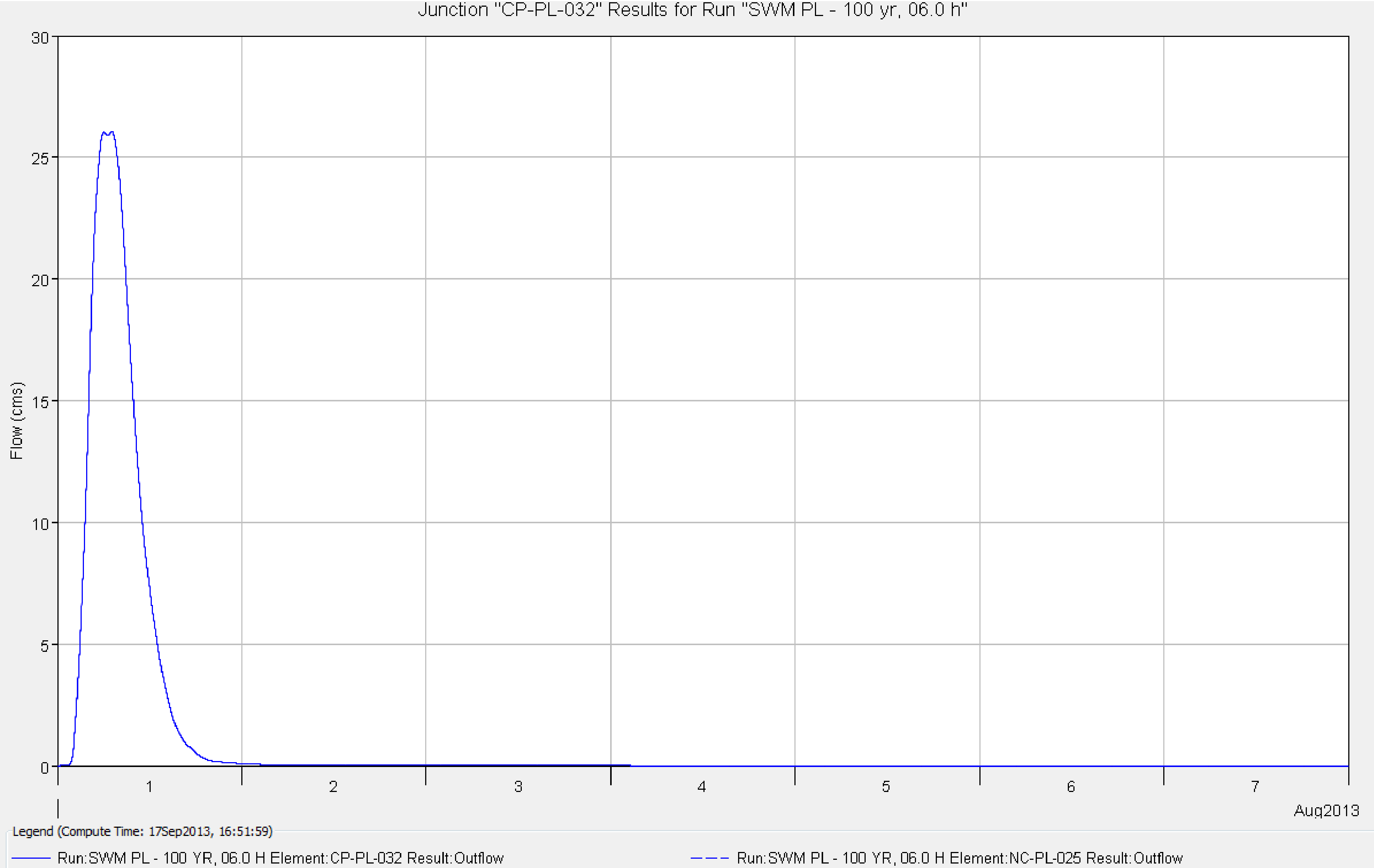

Junction "CP-PL-029" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-024 Result:Outflow



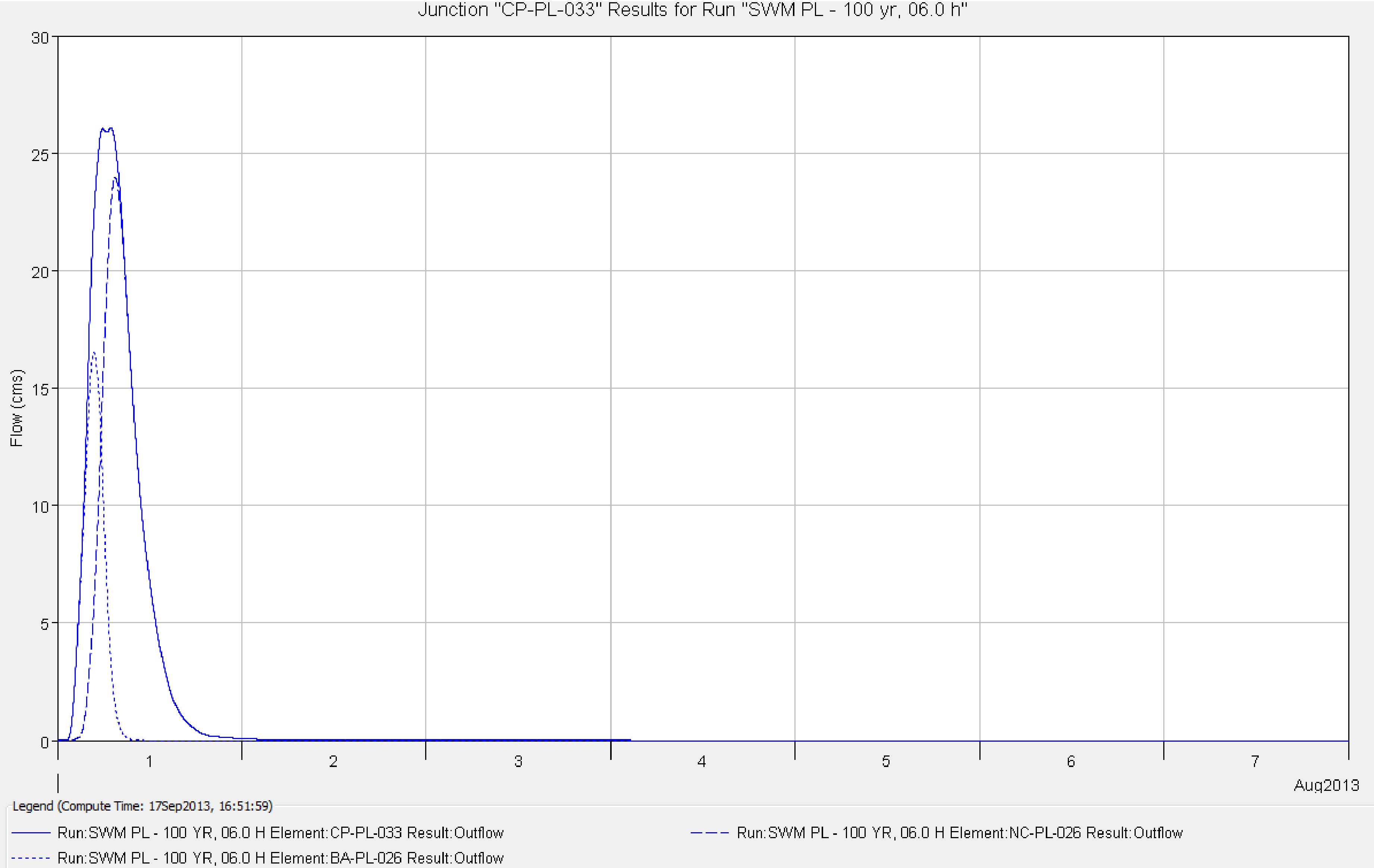
Junction "CP-PL-030" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-028 Result:Outflow



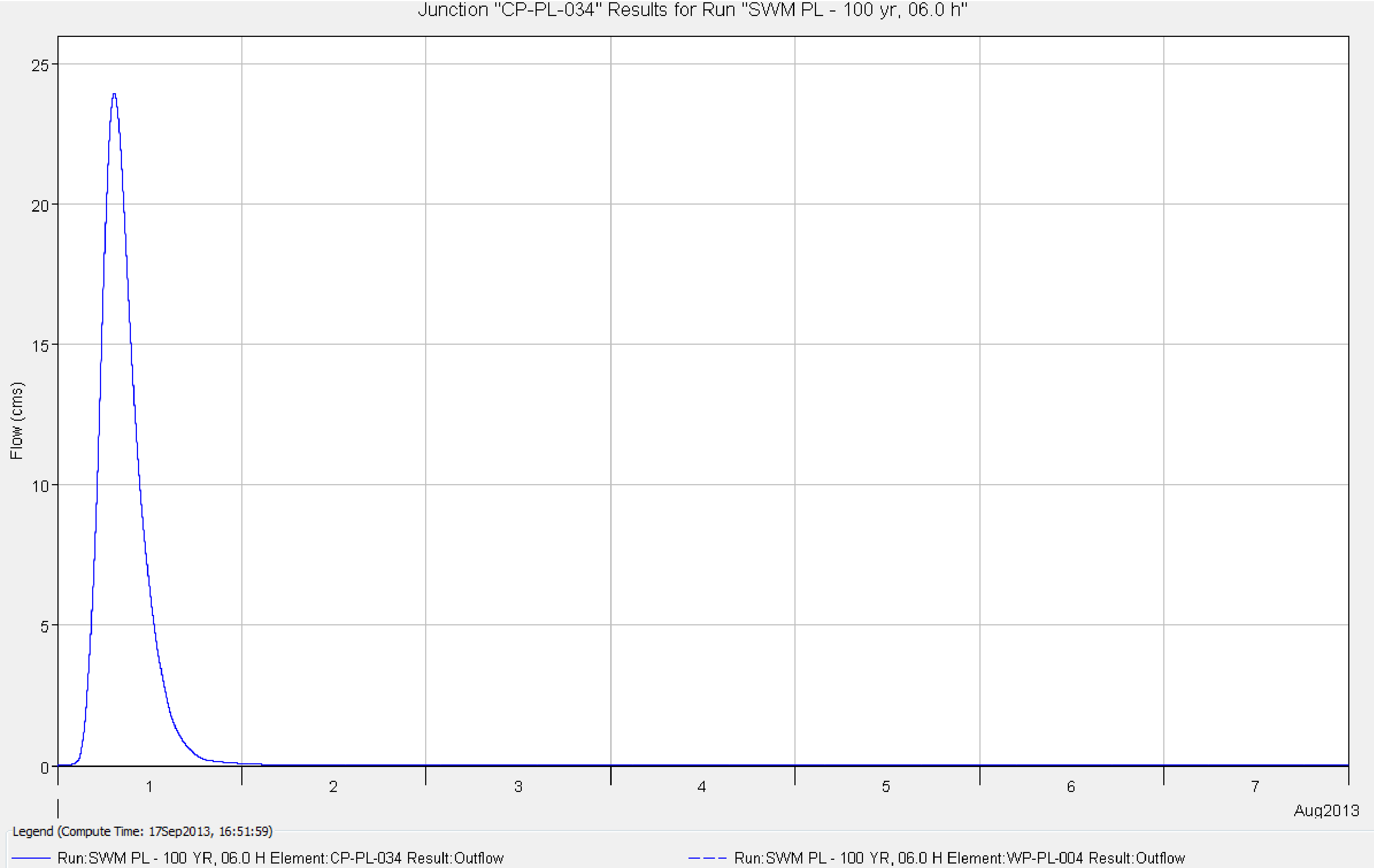
Junction "CP-PL-031" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-031 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-025 Result:Outflow



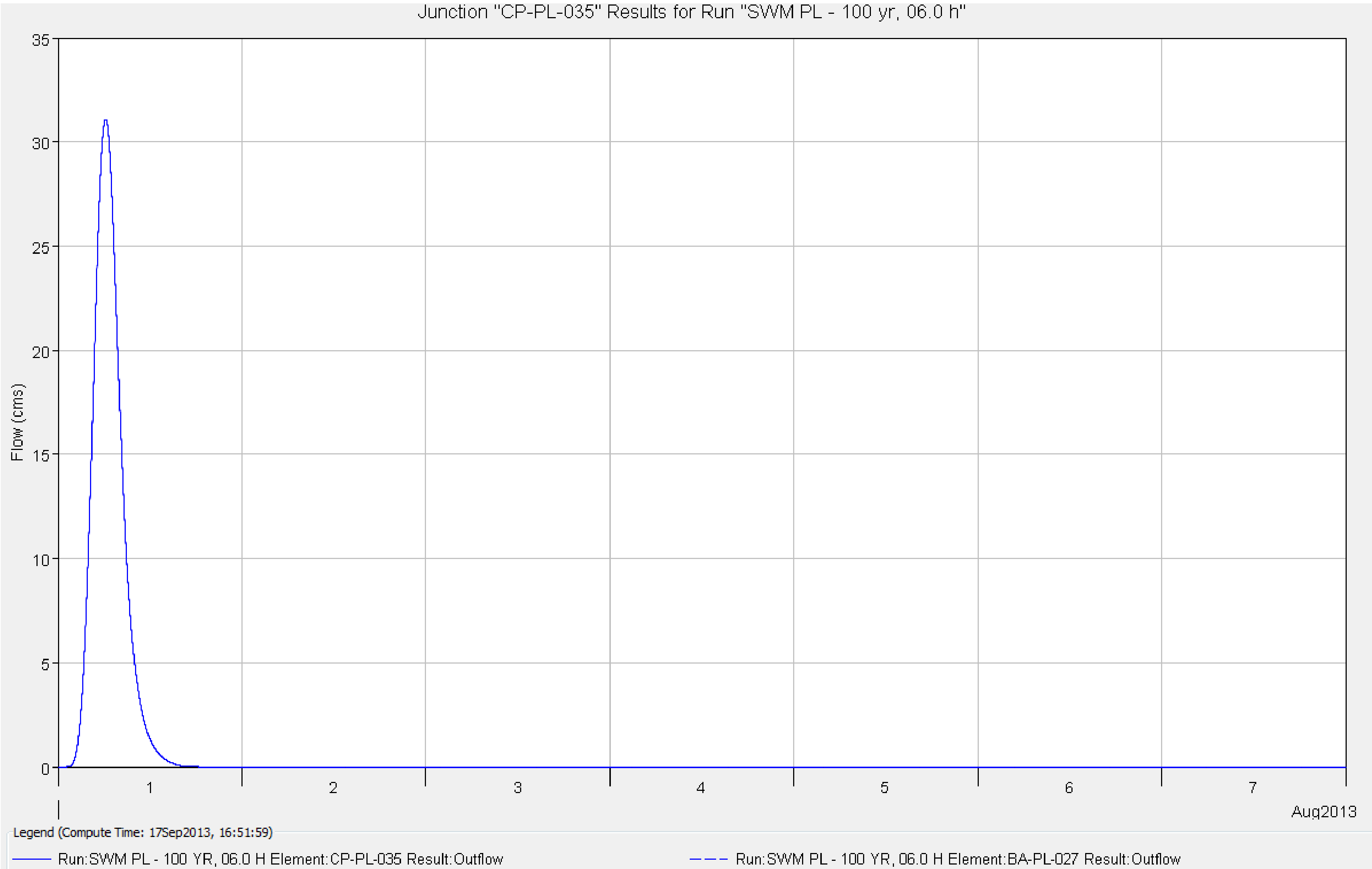
Junction "CP-PL-032" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-032 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-025 Result:Outflow



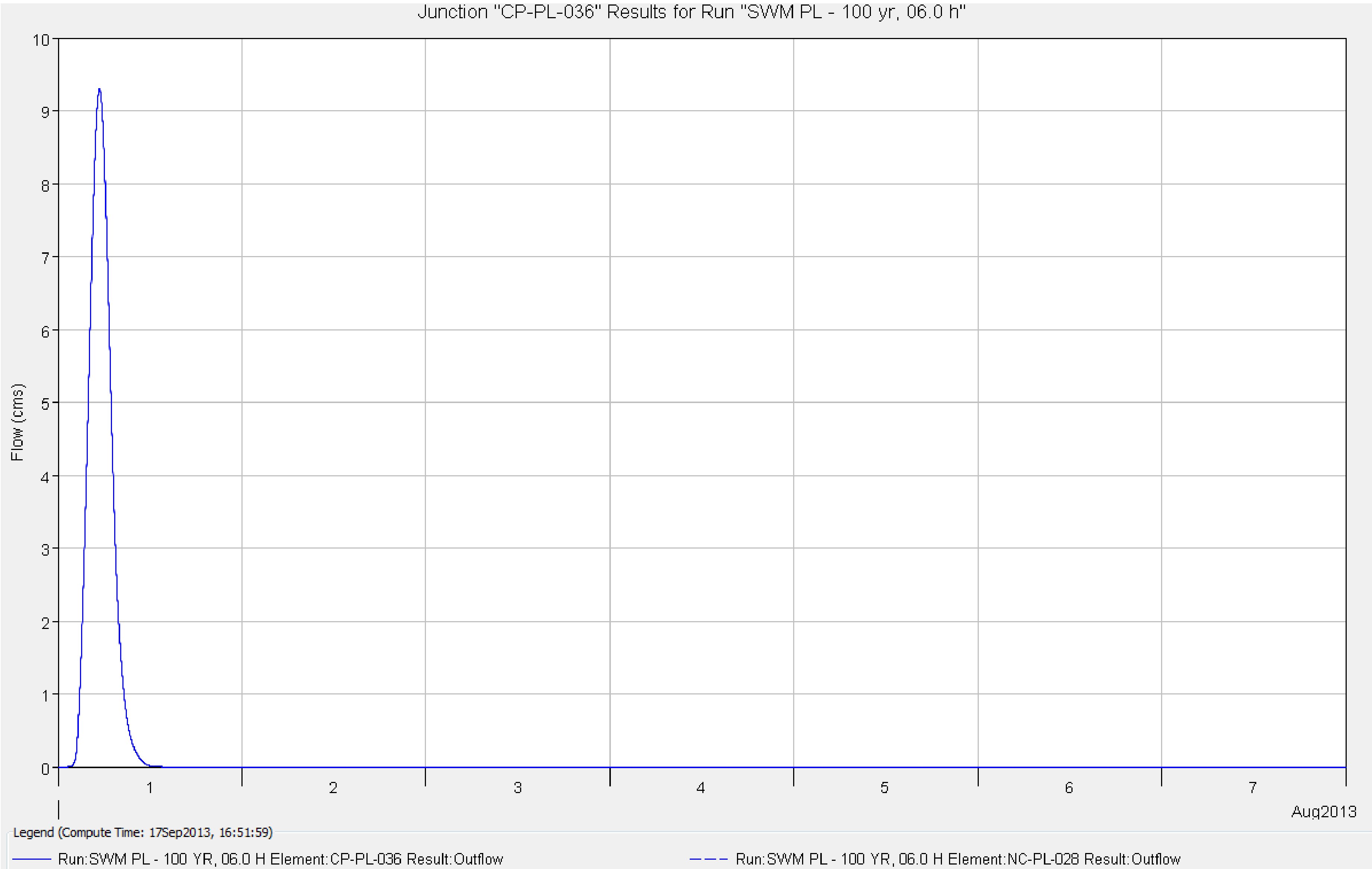
Junction "CP-PL-033" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-033 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-026 Result:Outflow



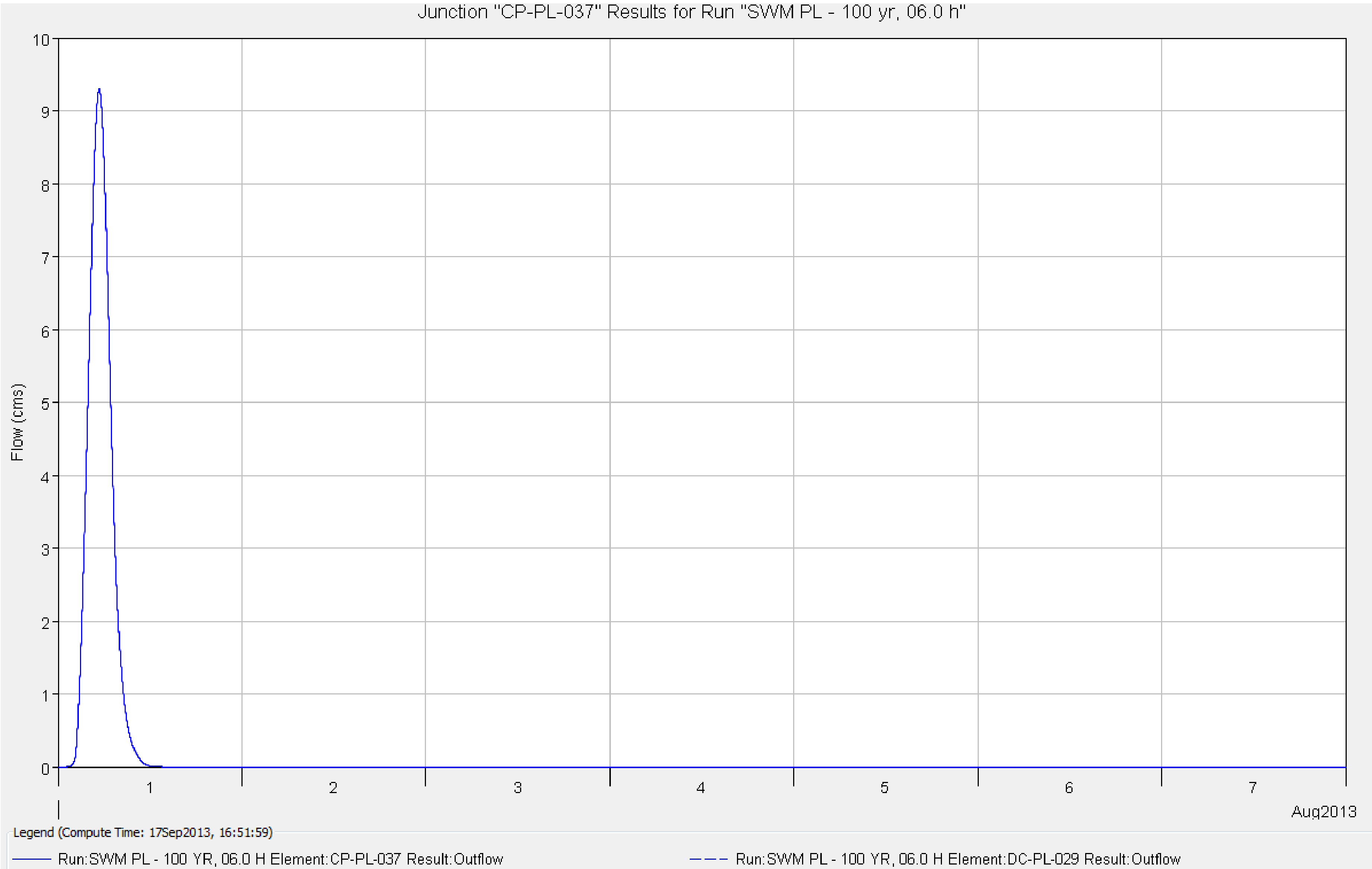
Junction "CP-PL-034" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Outflow



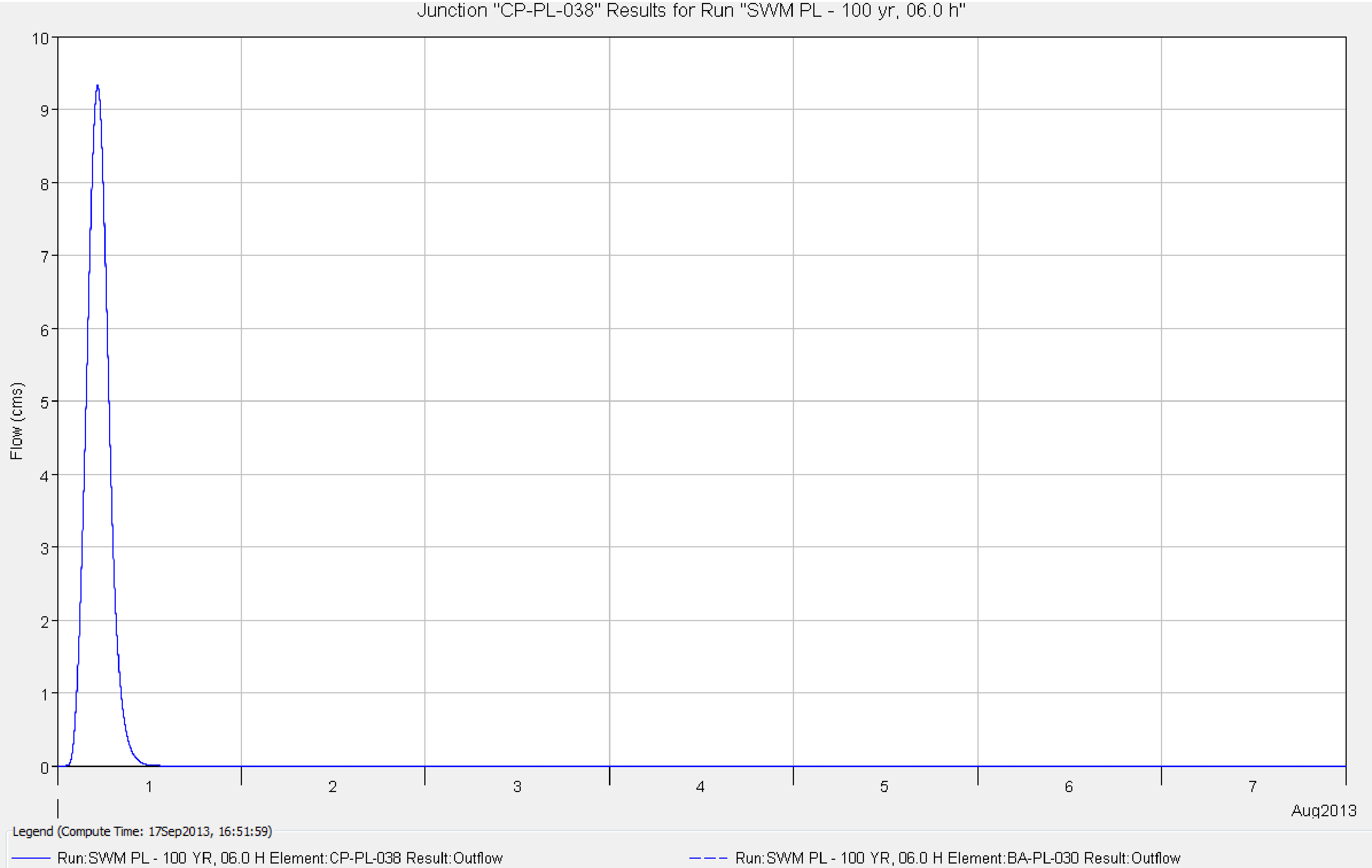
Junction "CP-PL-035" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-035 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-027 Result:Outflow



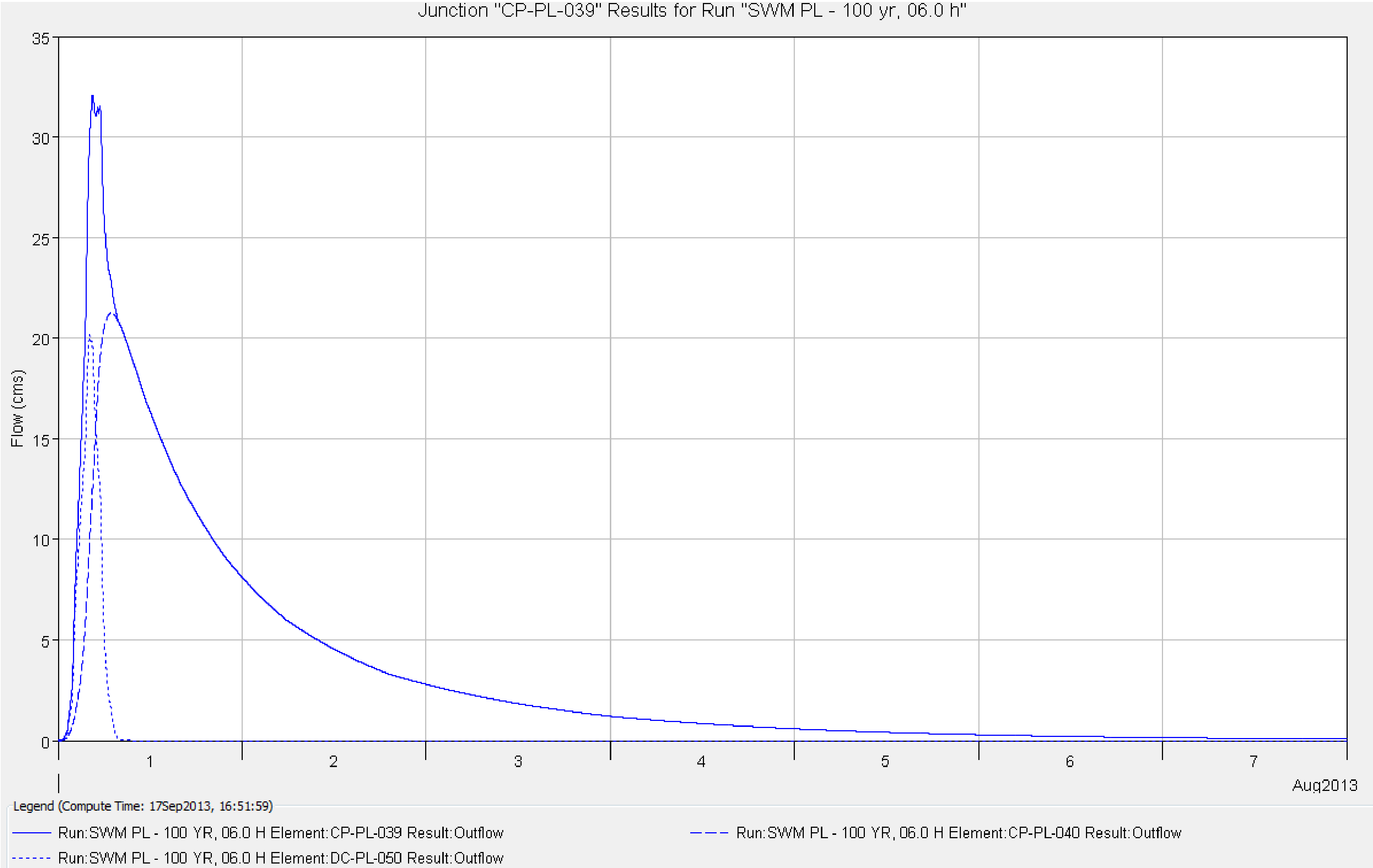
Junction "CP-PL-036" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-028 Result:Outflow



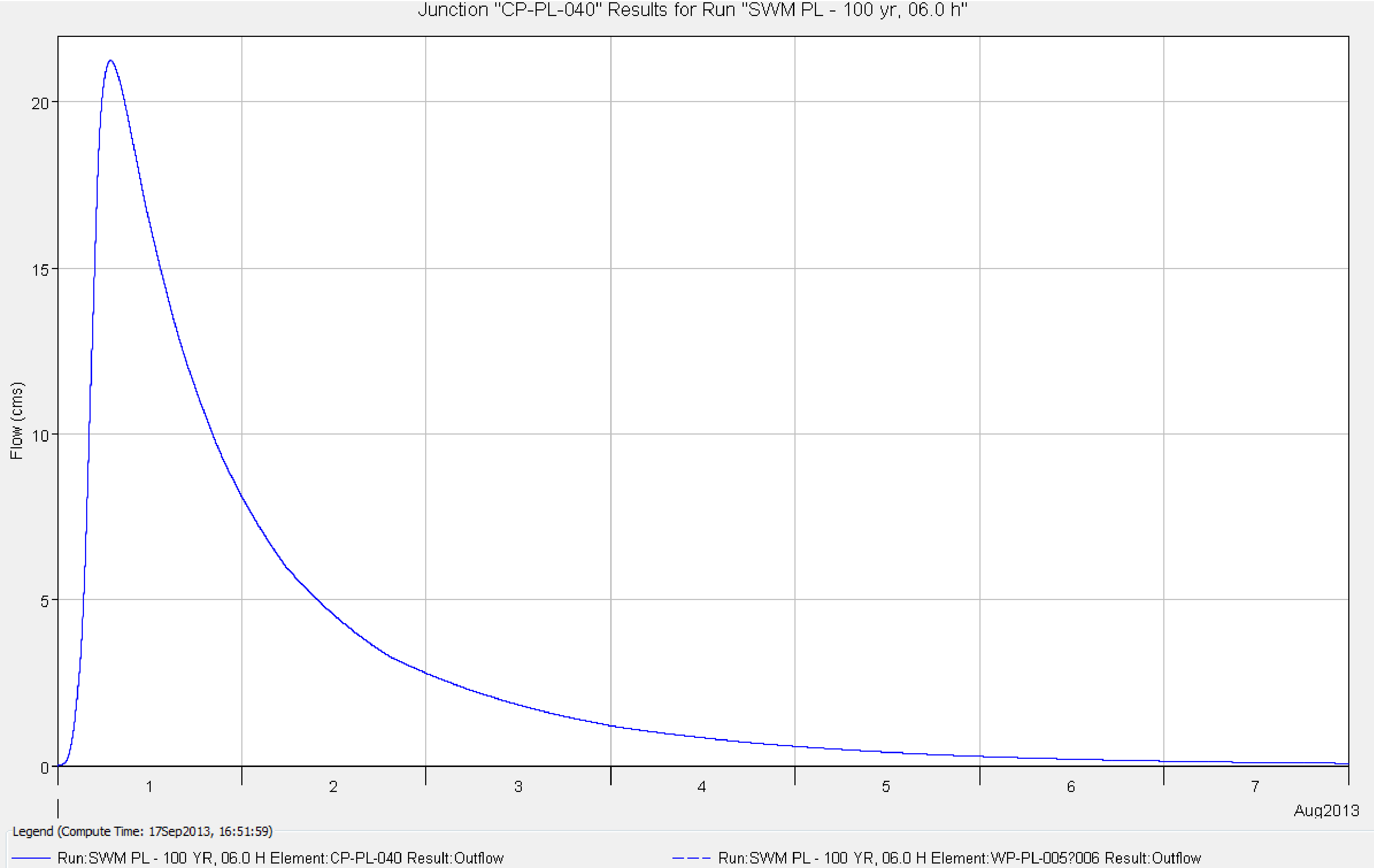
Junction "CP-PL-037" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-029 Result:Outflow



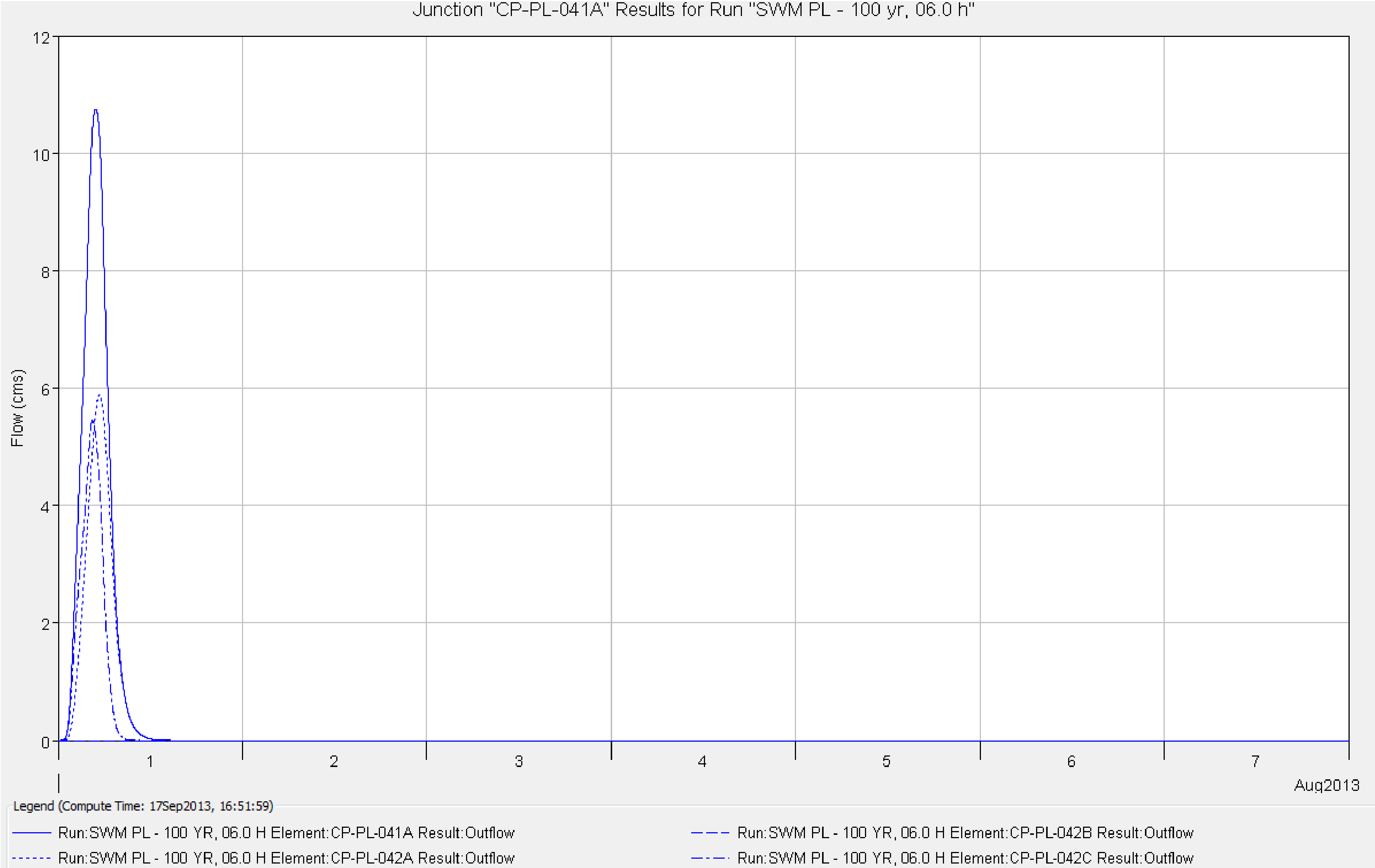
Junction "CP-PL-038" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-038 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-030 Result:Outflow

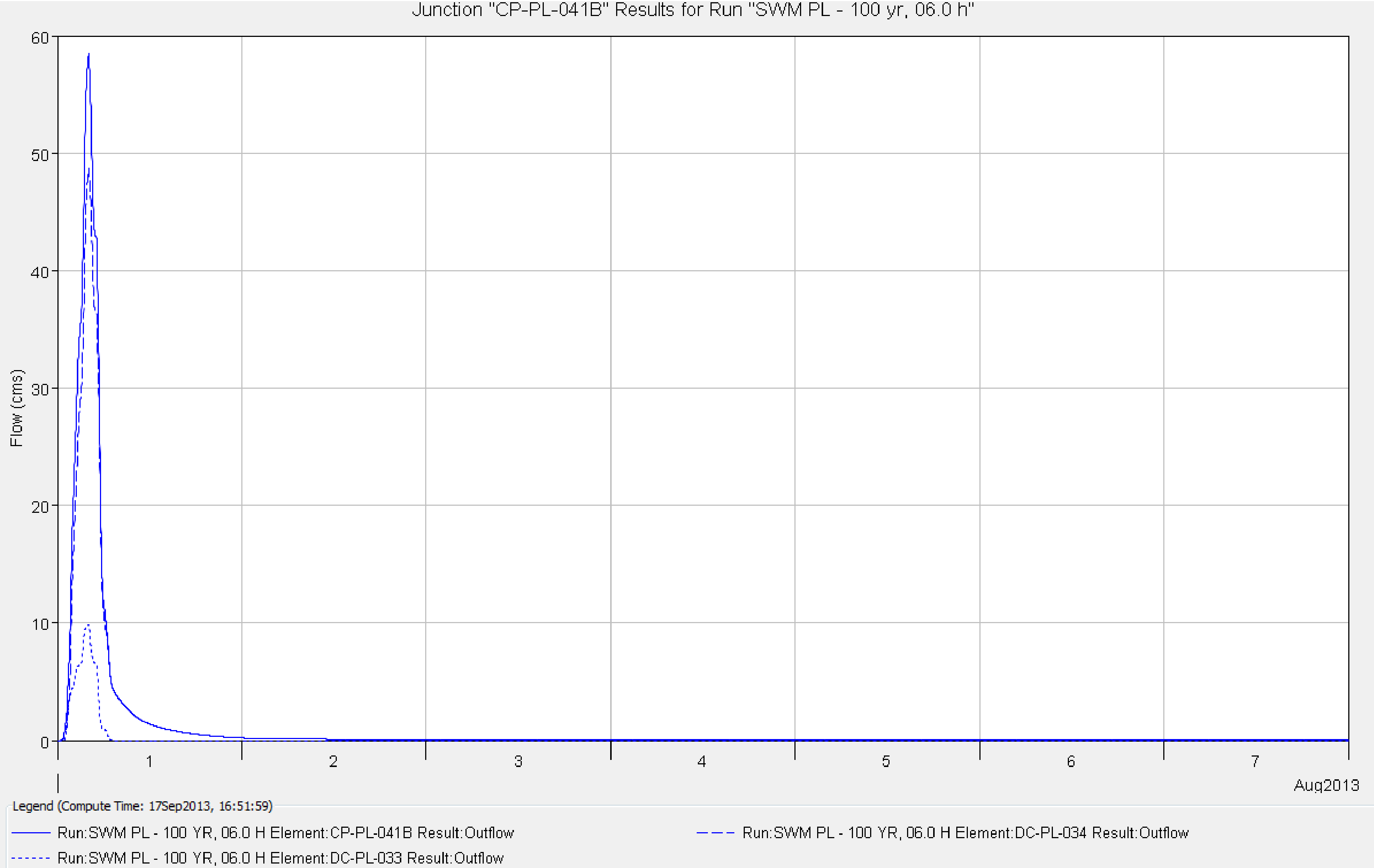


Junction "CP-PL-039" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-050 Result:Outflow

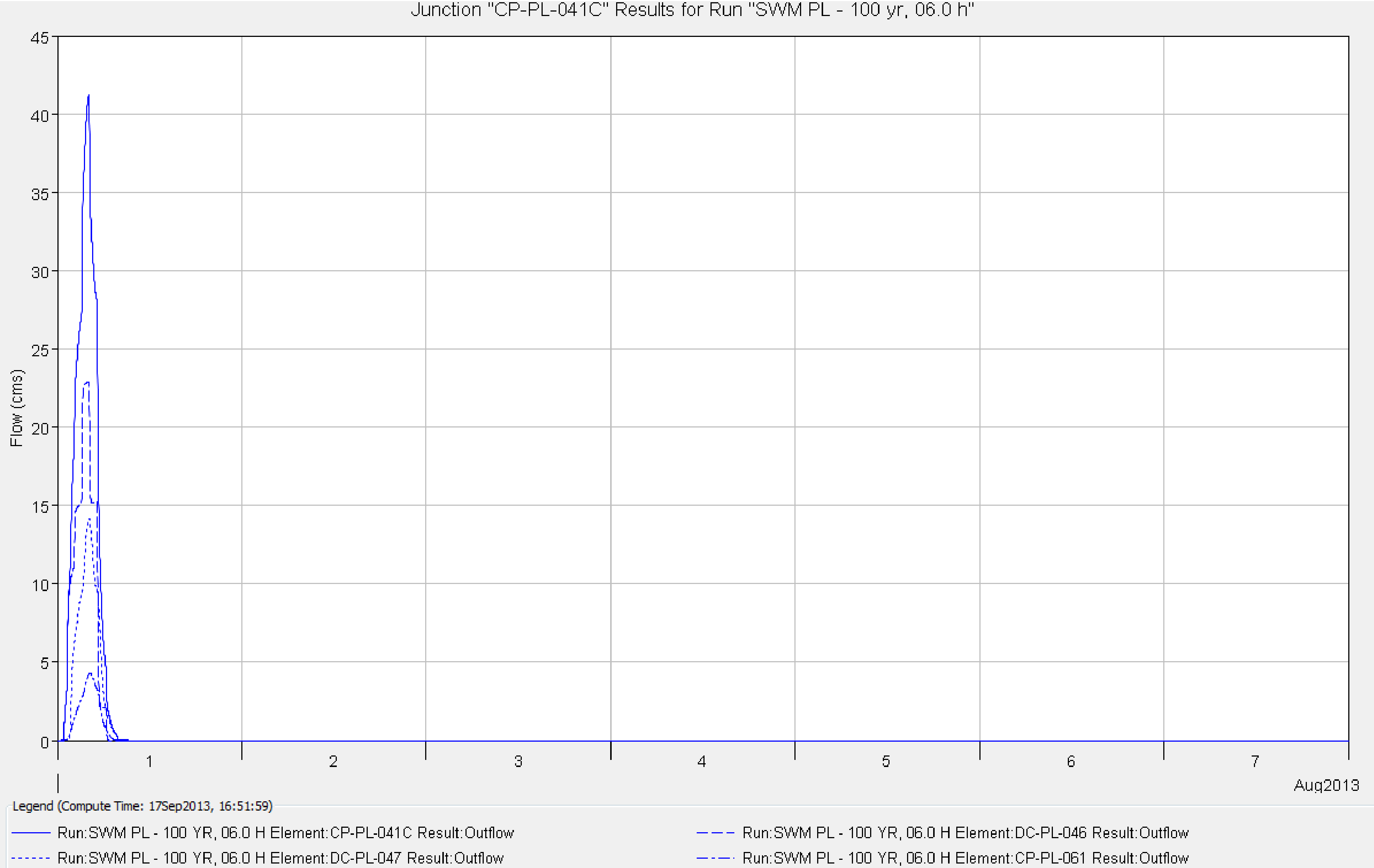


Junction "CP-PL-040" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Outflow

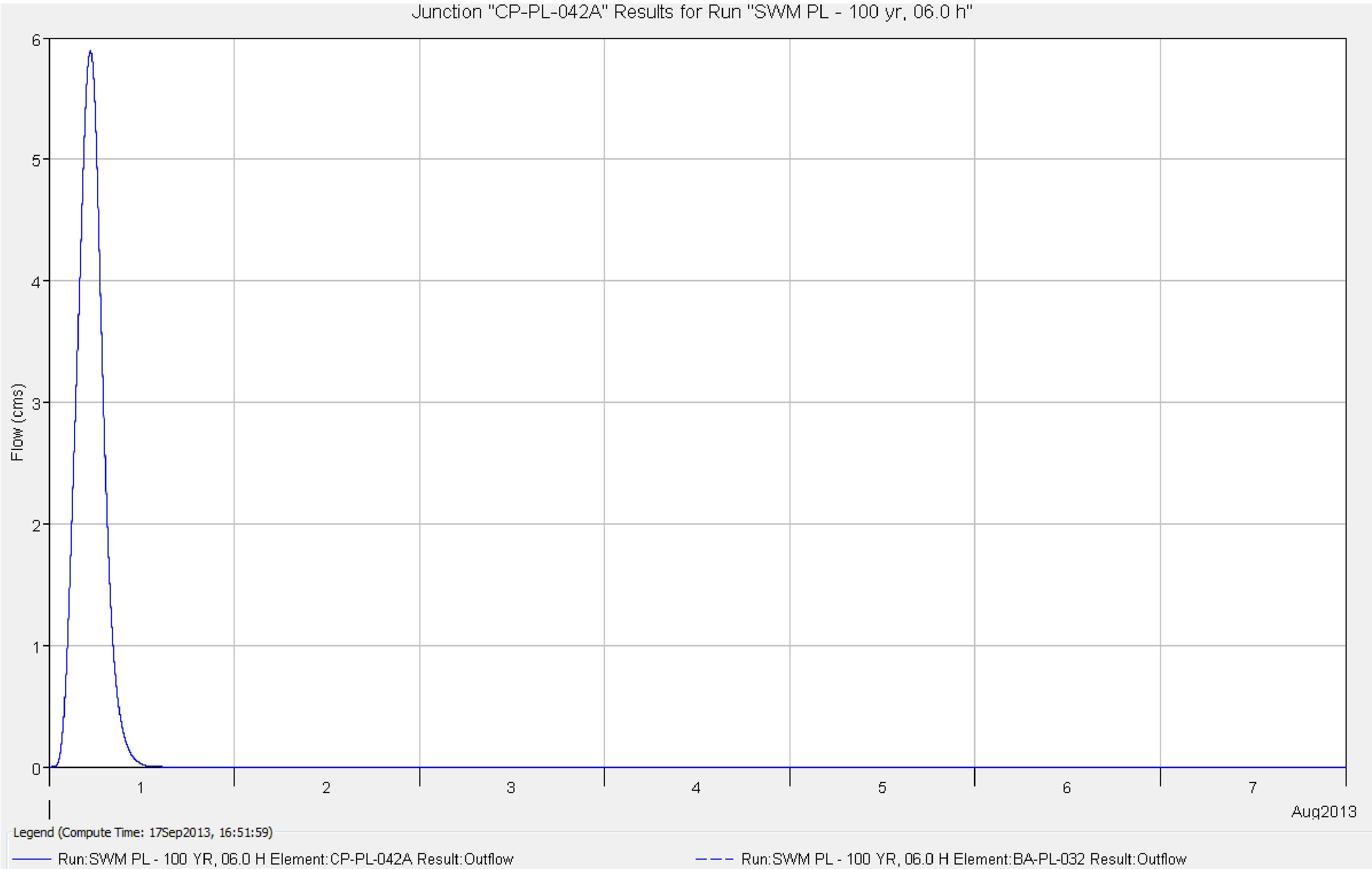

Junction "CP-PL-041A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042C Result:Outflow

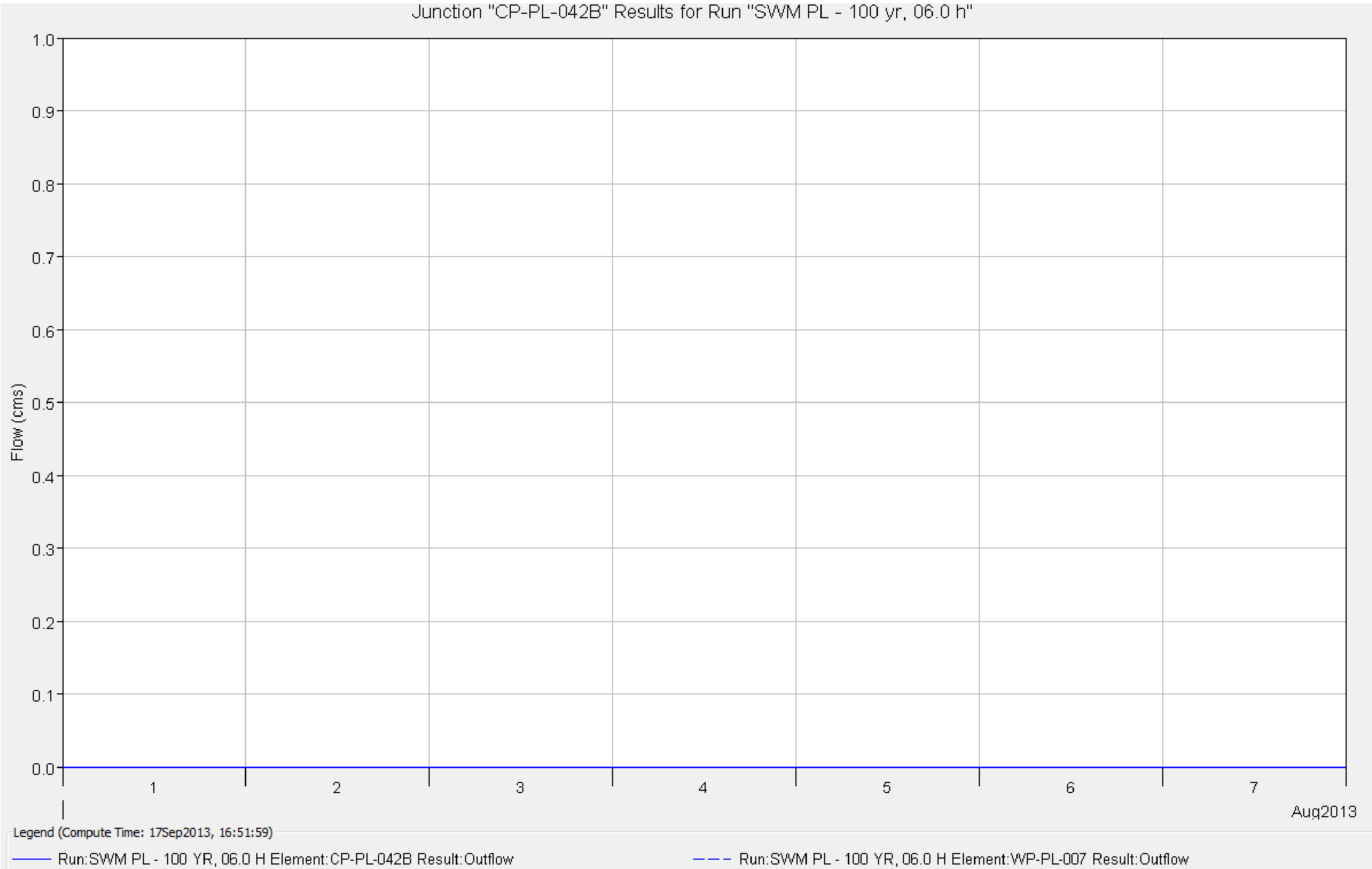


Junction "CP-PL-041B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-033 Result:Outflow

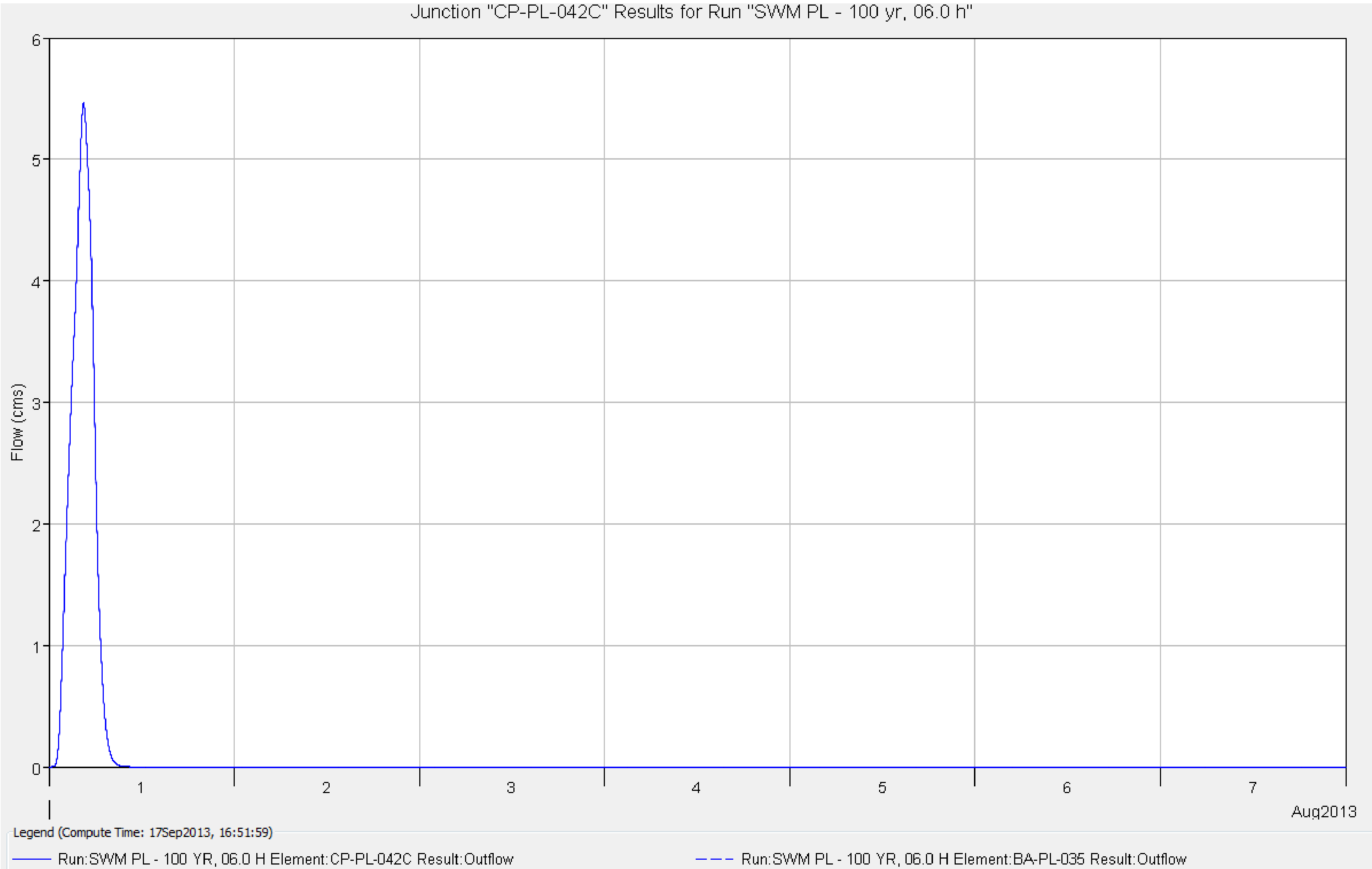


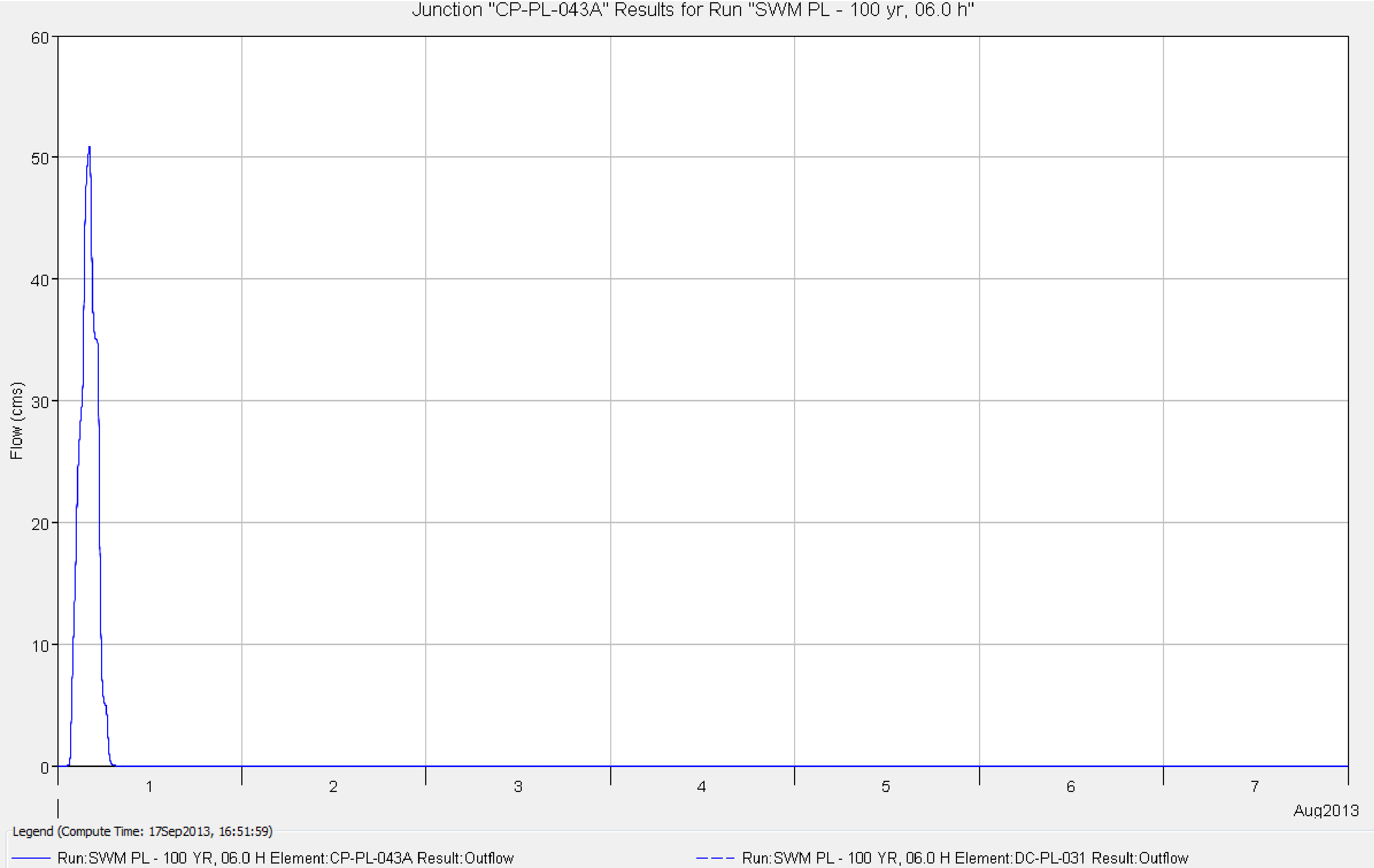
Junction "CP-PL-041C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-061 Result:Outflow

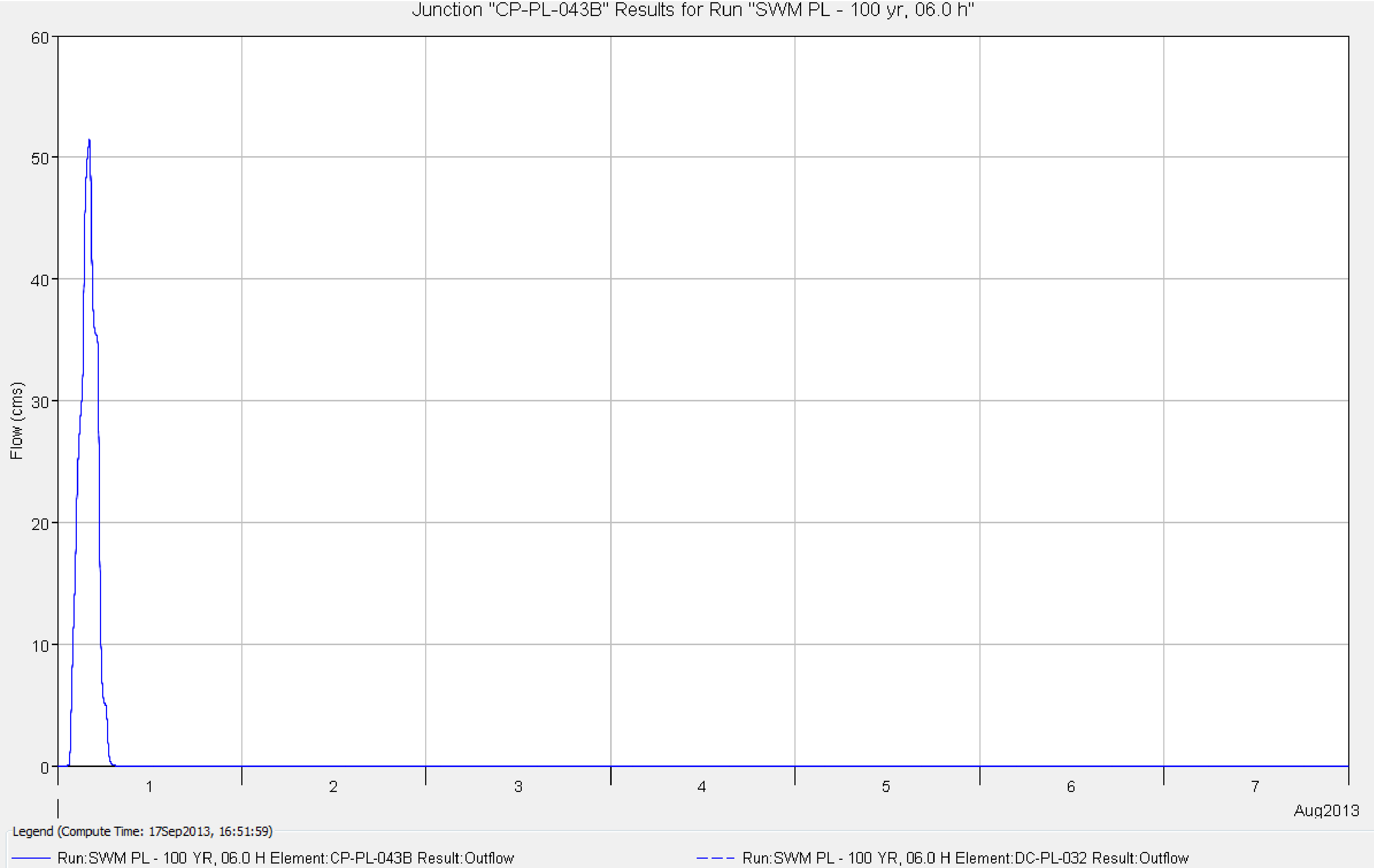

Junction "CP-PL-042A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-032 Result:Outflow



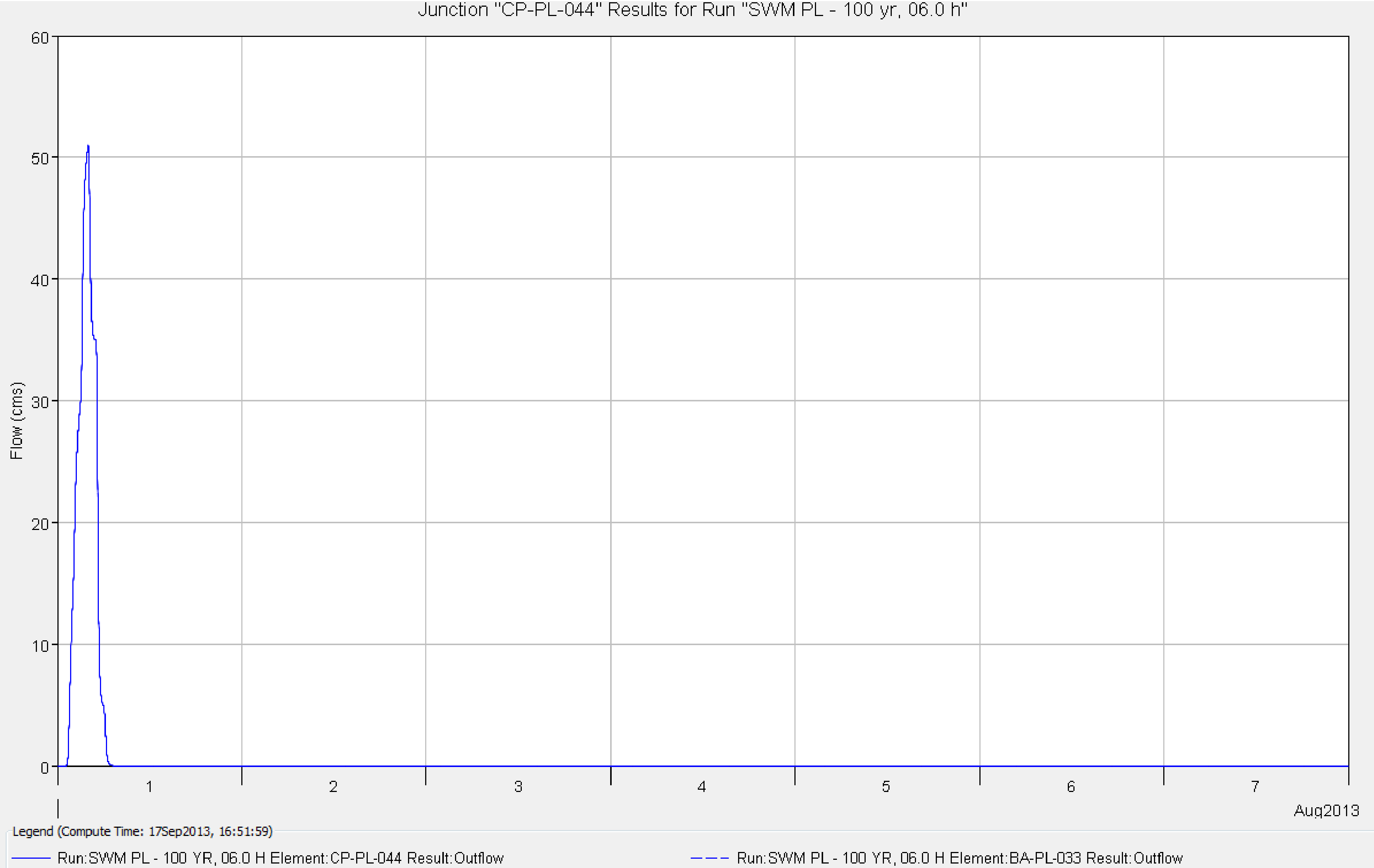
Junction "CP-PL-042B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Outflow


Junction "CP-PL-042C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-035 Result:Outflow

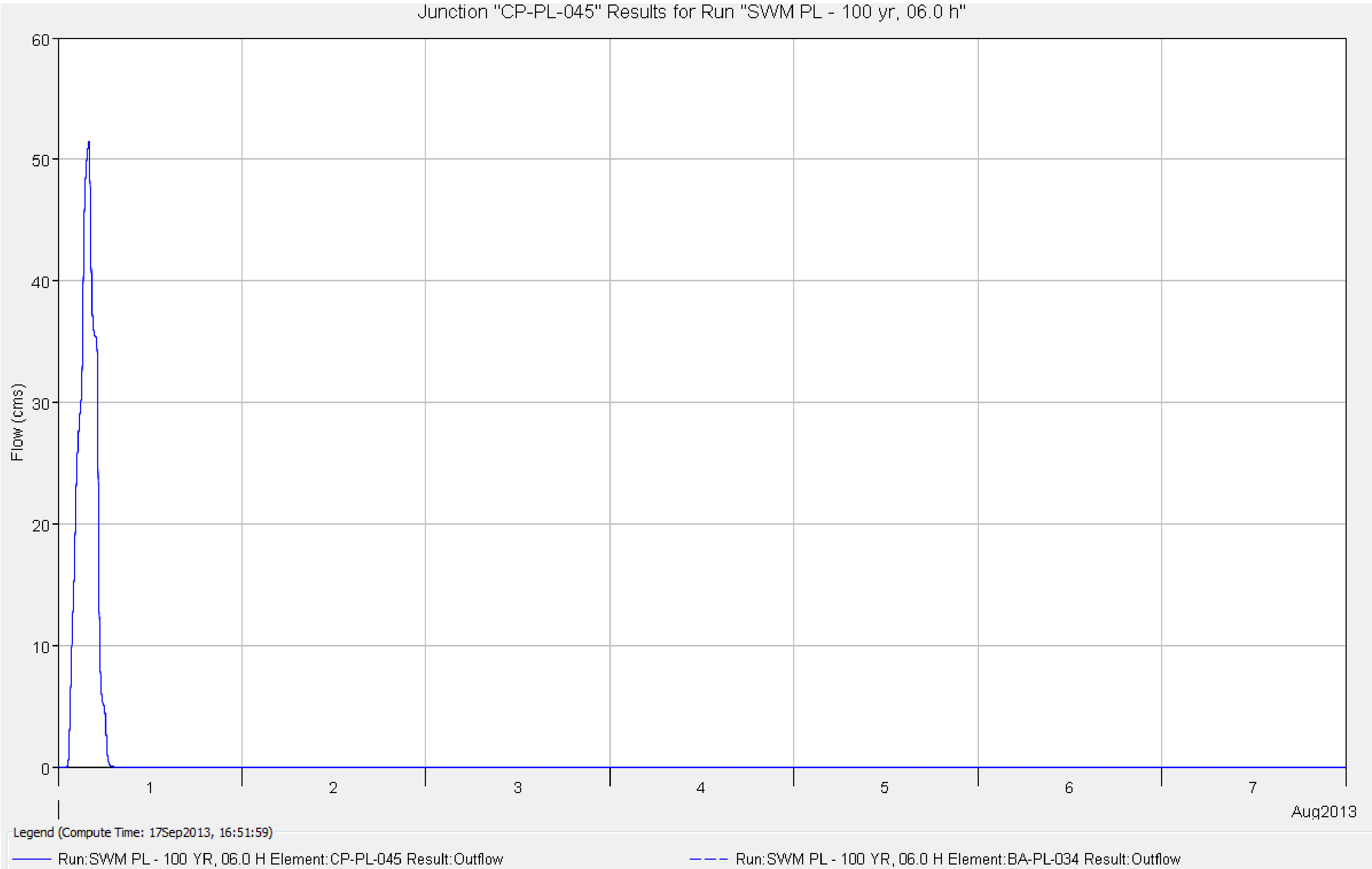

Junction "CP-PL-043A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-043A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-031 Result:Outflow

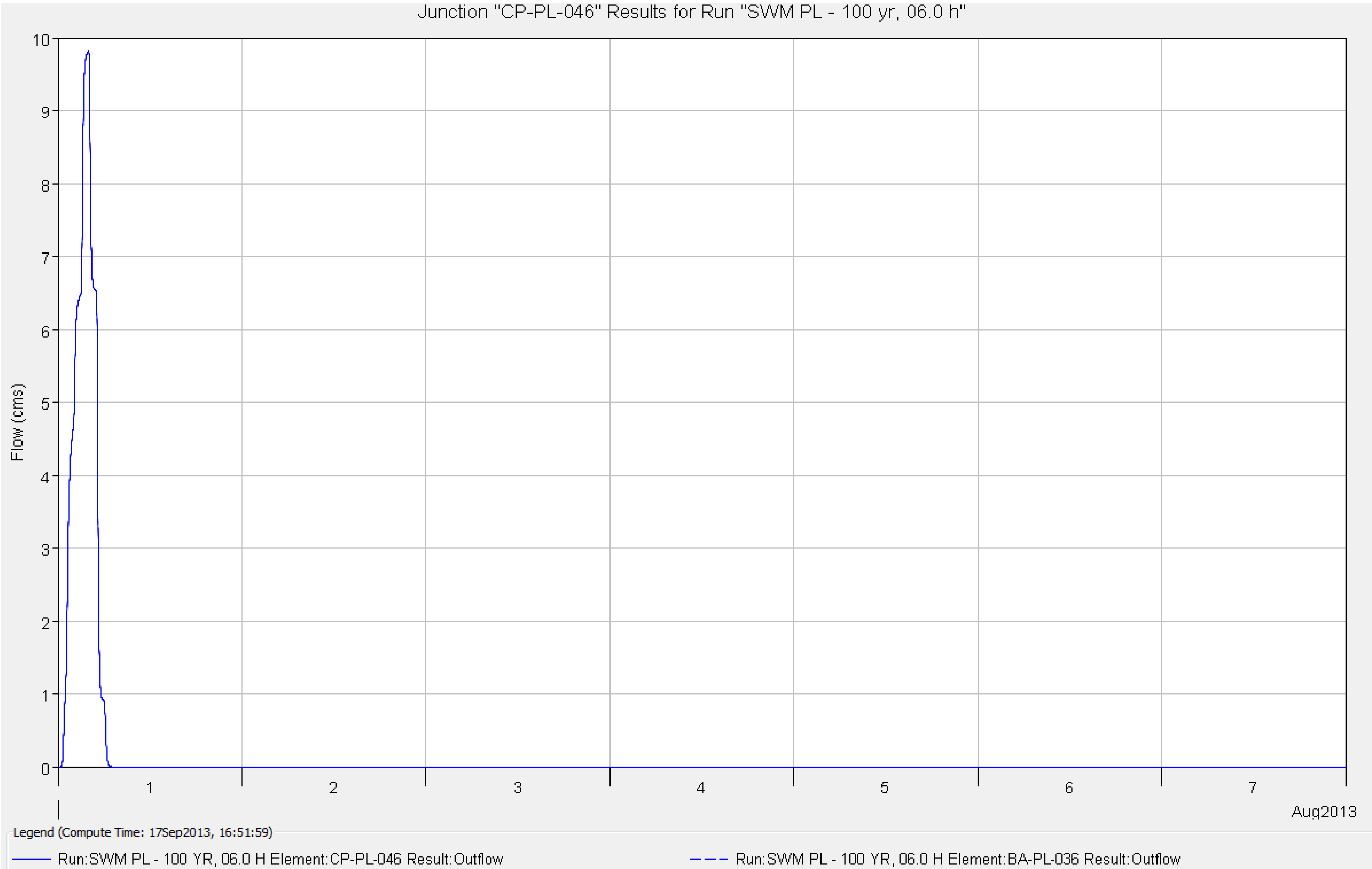


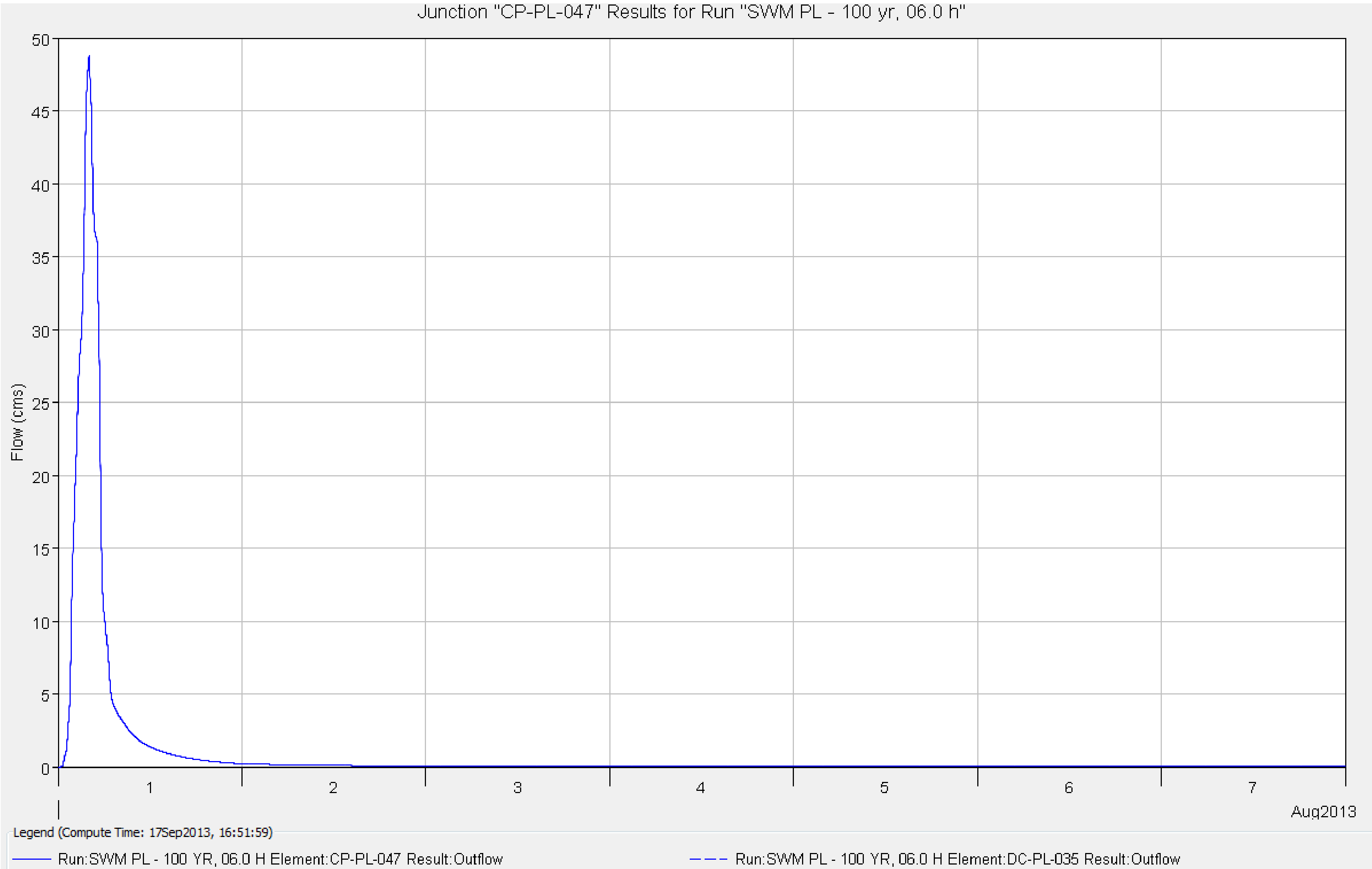
Junction "CP-PL-043B" Results for Run "SWM PL - 100 yr, 06.0 h"
60
50
40
30
20
10
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-043B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-032 Result:Outflow



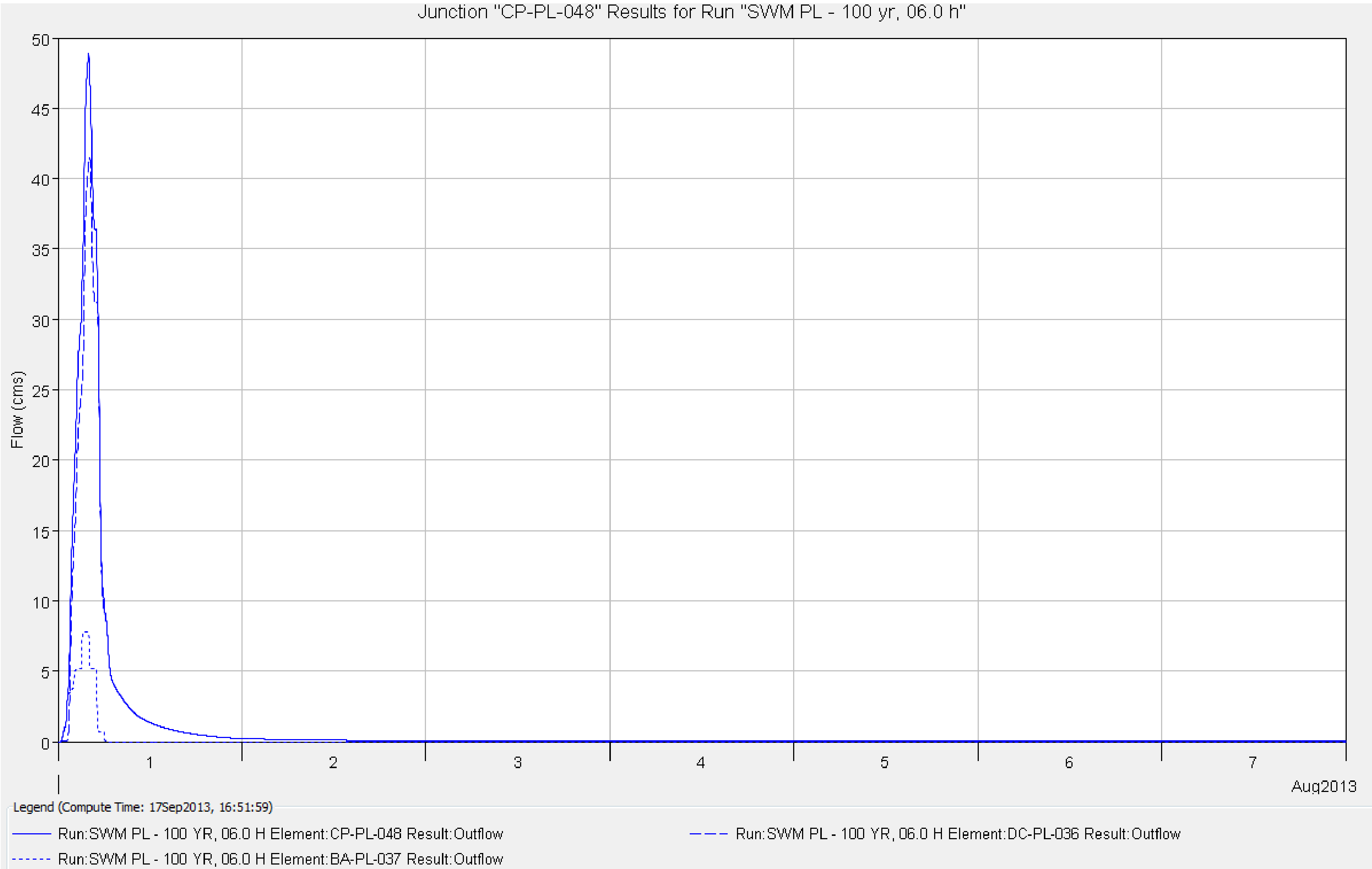
Junction "CP-PL-044" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-033 Result:Outflow


Junction "CP-PL-045" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-034 Result:Outflow

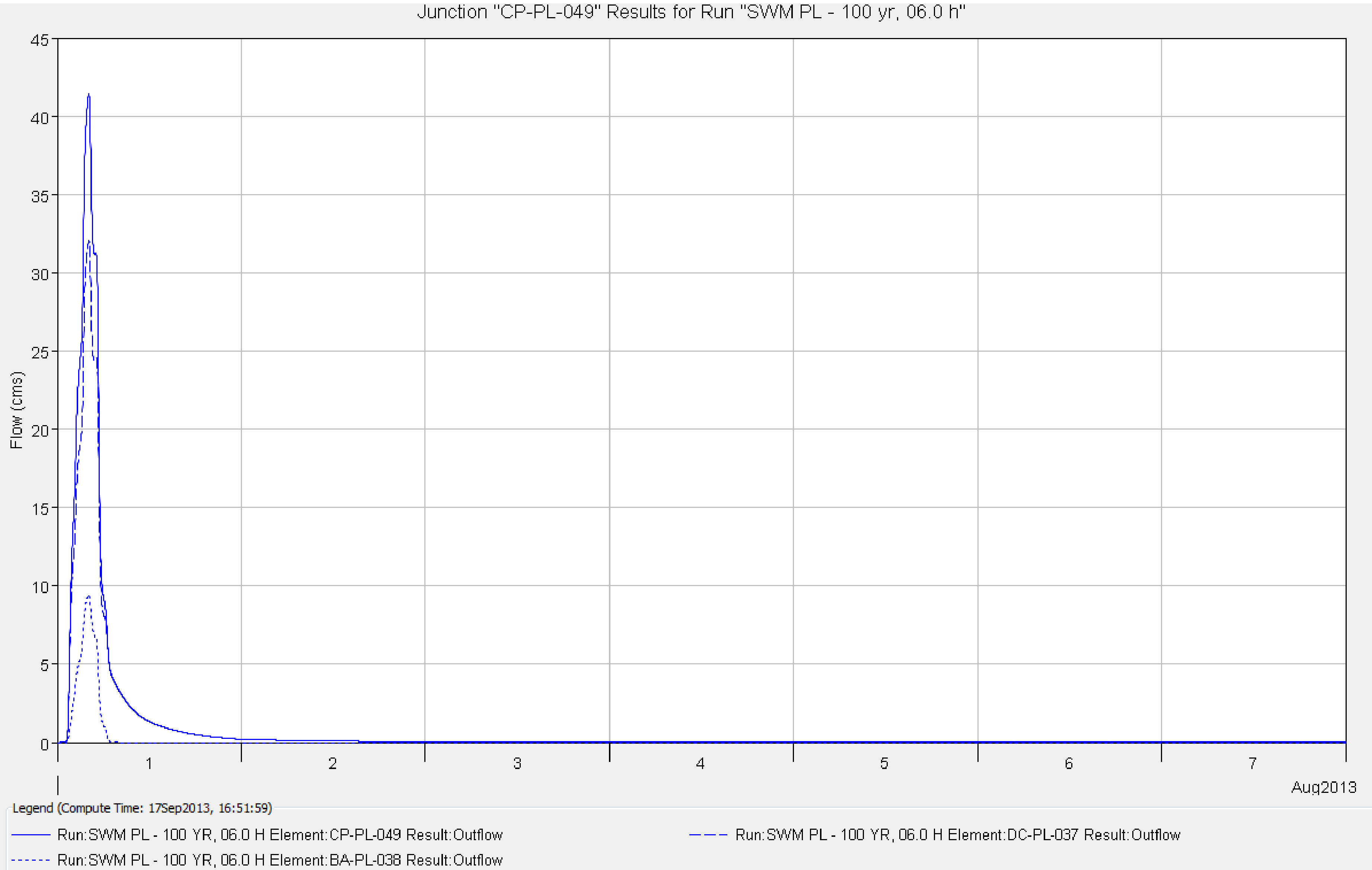

Junction "CP-PL-046" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-036 Result:Outflow



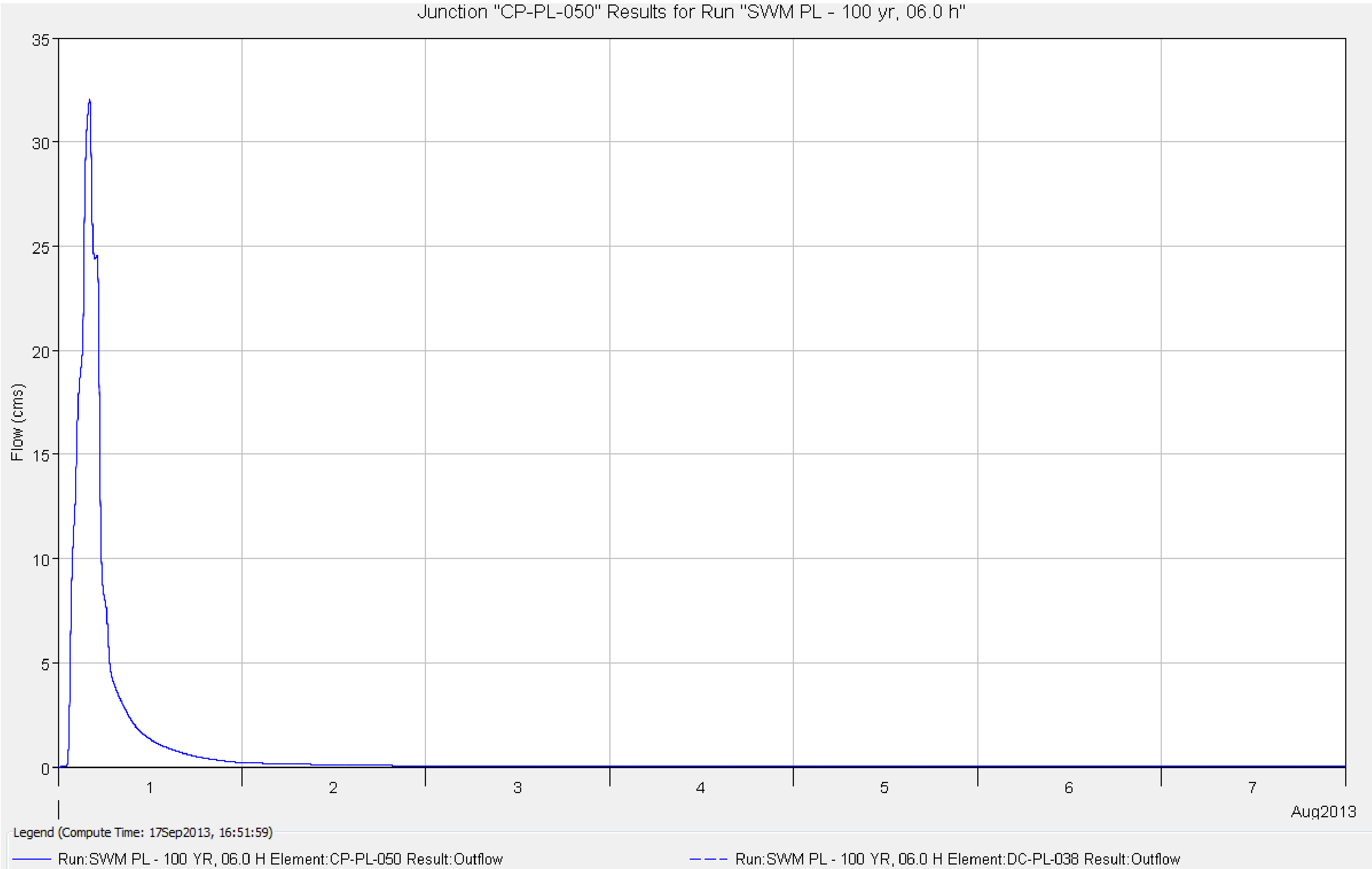
Junction "CP-PL-047" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-035 Result:Outflow



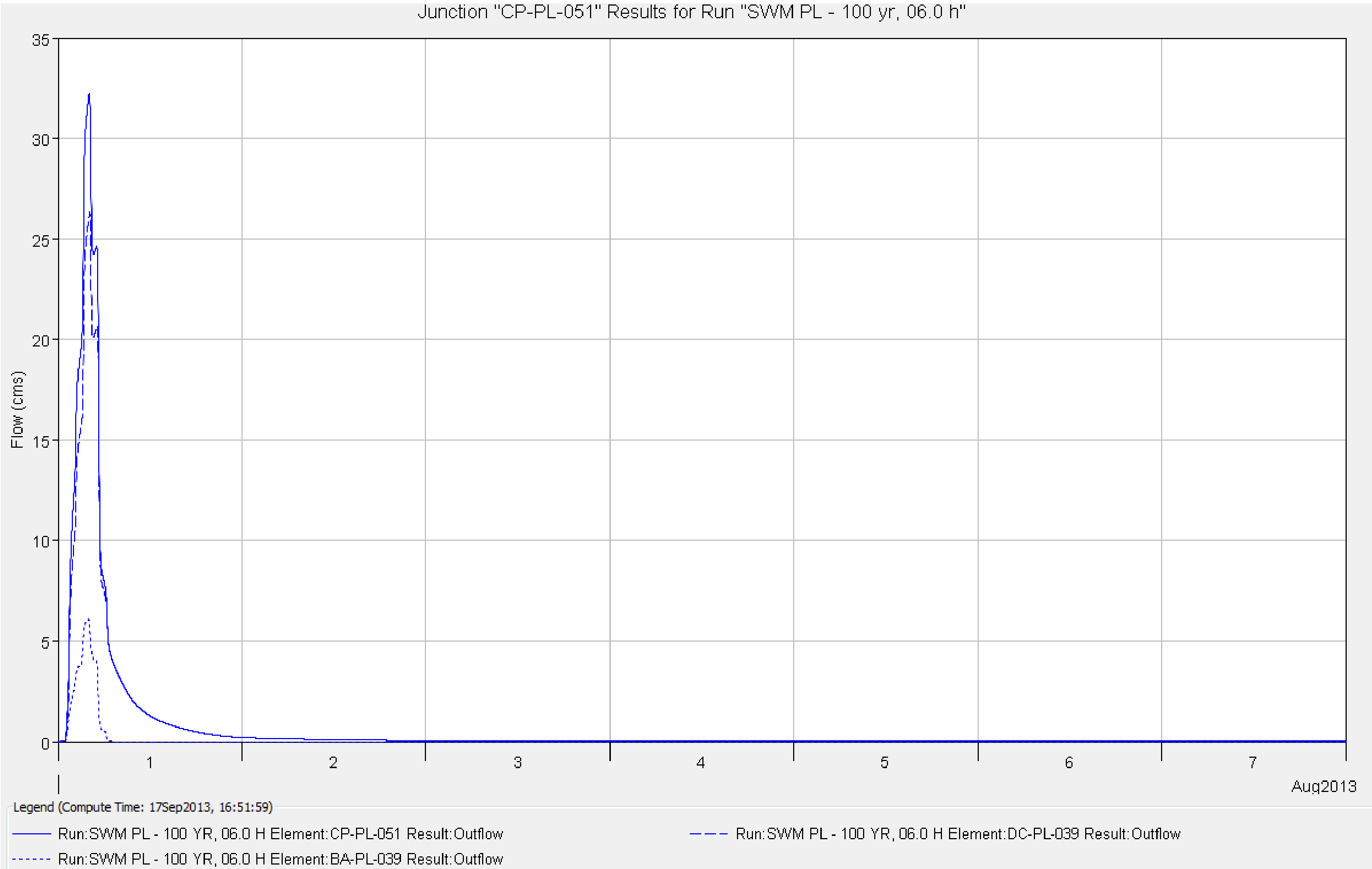
Junction "CP-PL-048" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-048 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-037 Result:Outflow



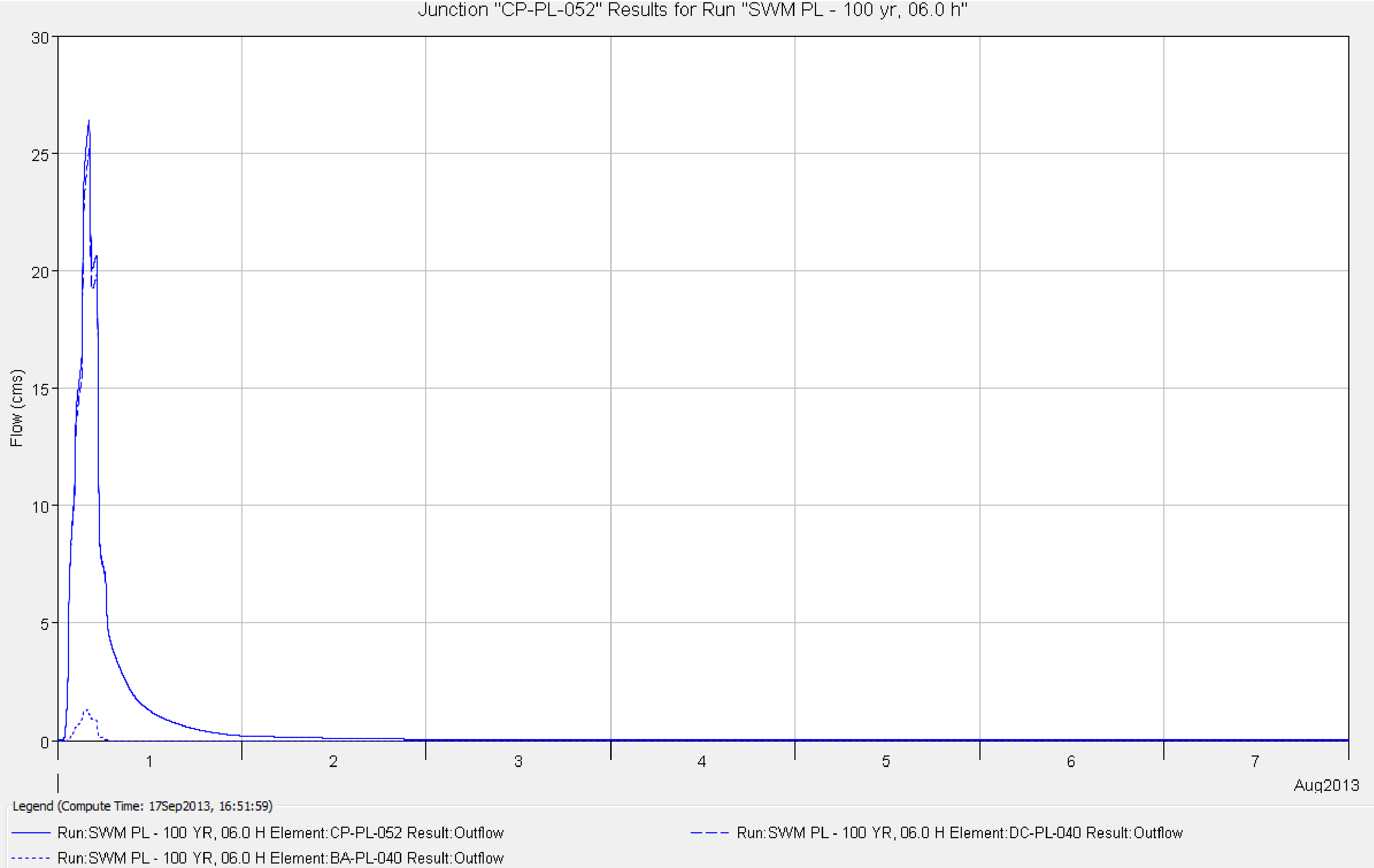
Junction "CP-PL-049" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-038 Result:Outflow



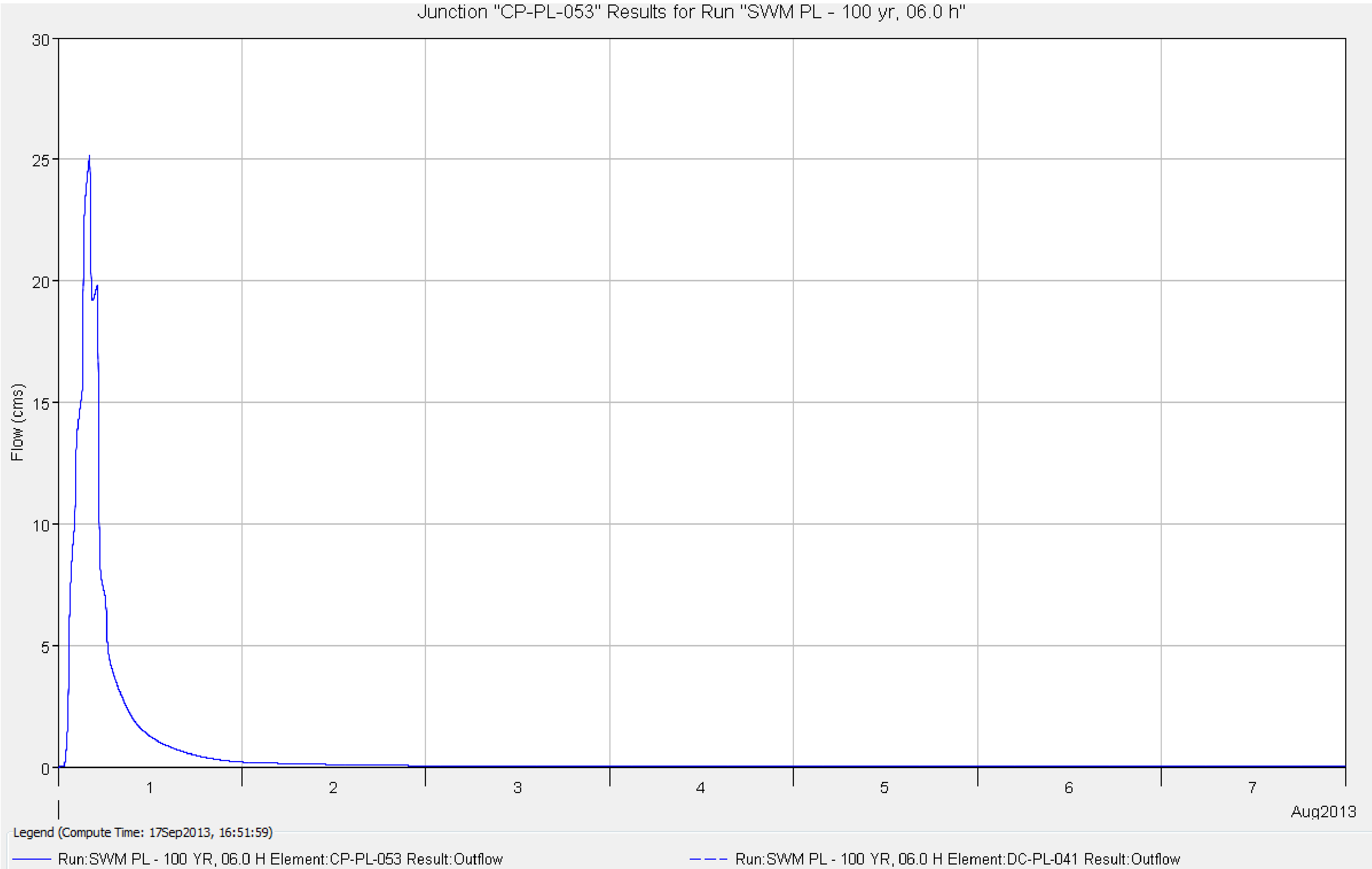
Junction "CP-PL-050" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-050 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-038 Result:Outflow



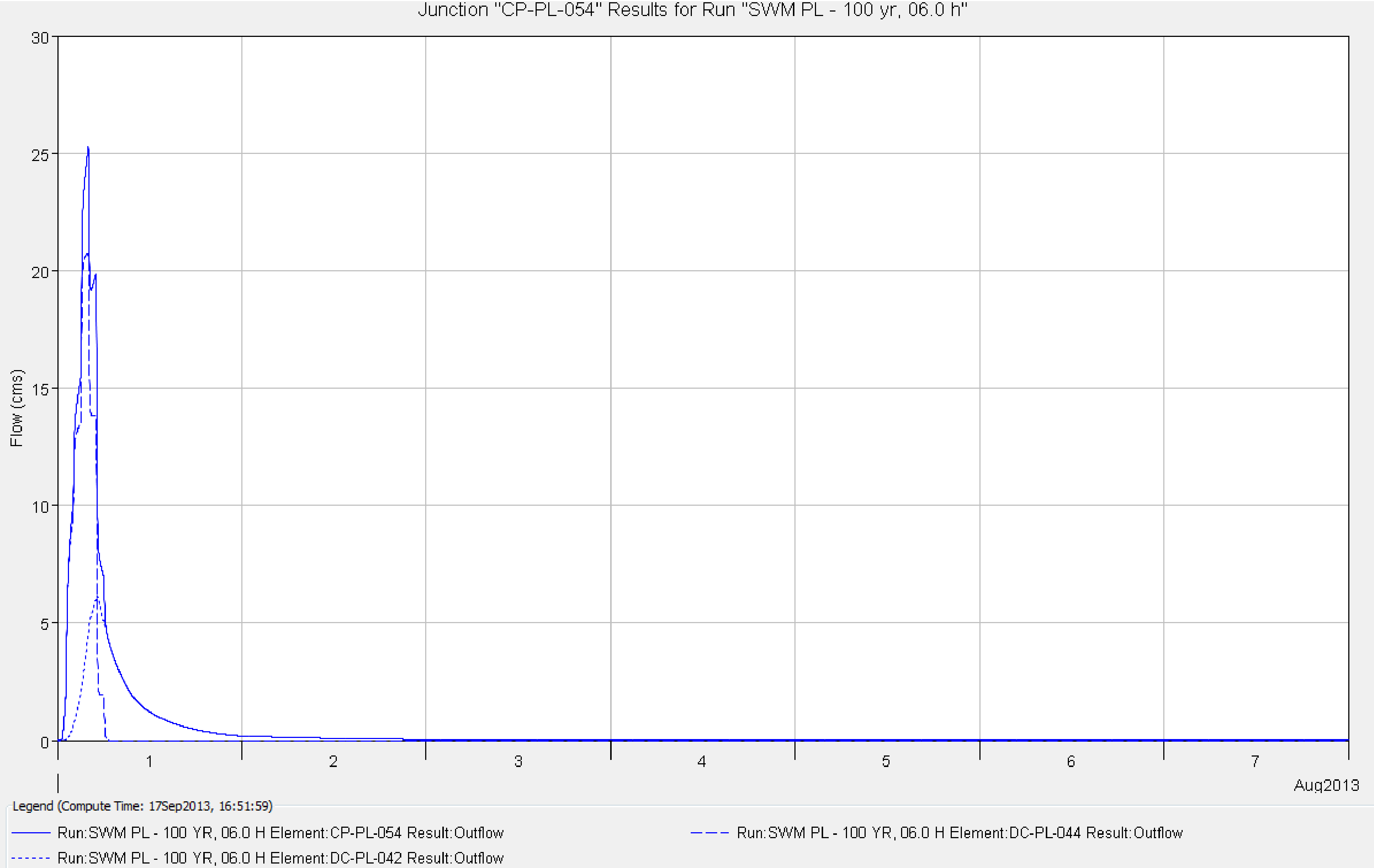
Junction "CP-PL-051" Results for Run "SWM PL - 100 yr, 06.0 h"
35
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-051 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-039 Result:Outflow

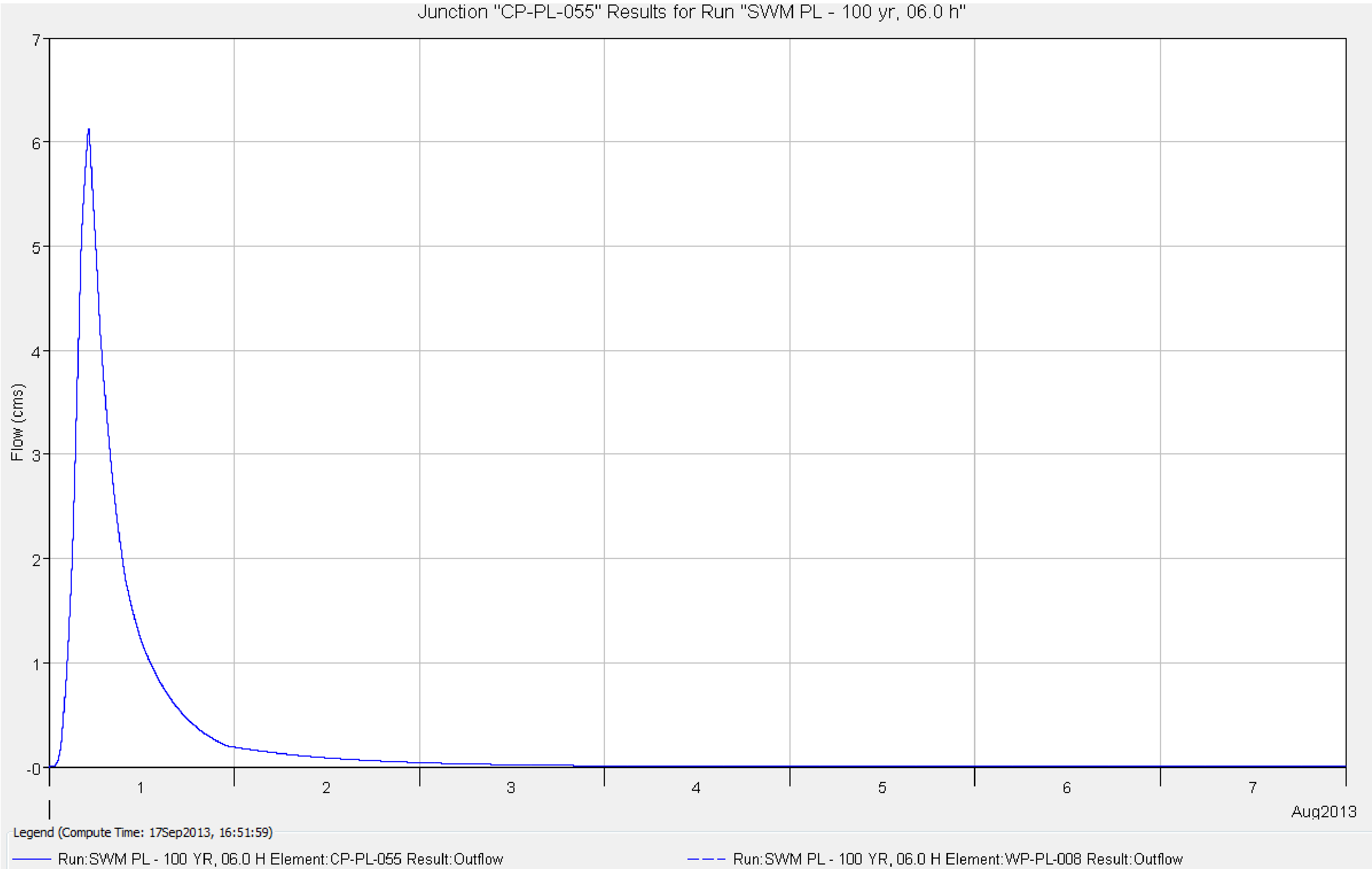


Junction "CP-PL-052" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-040 Result:Outflow

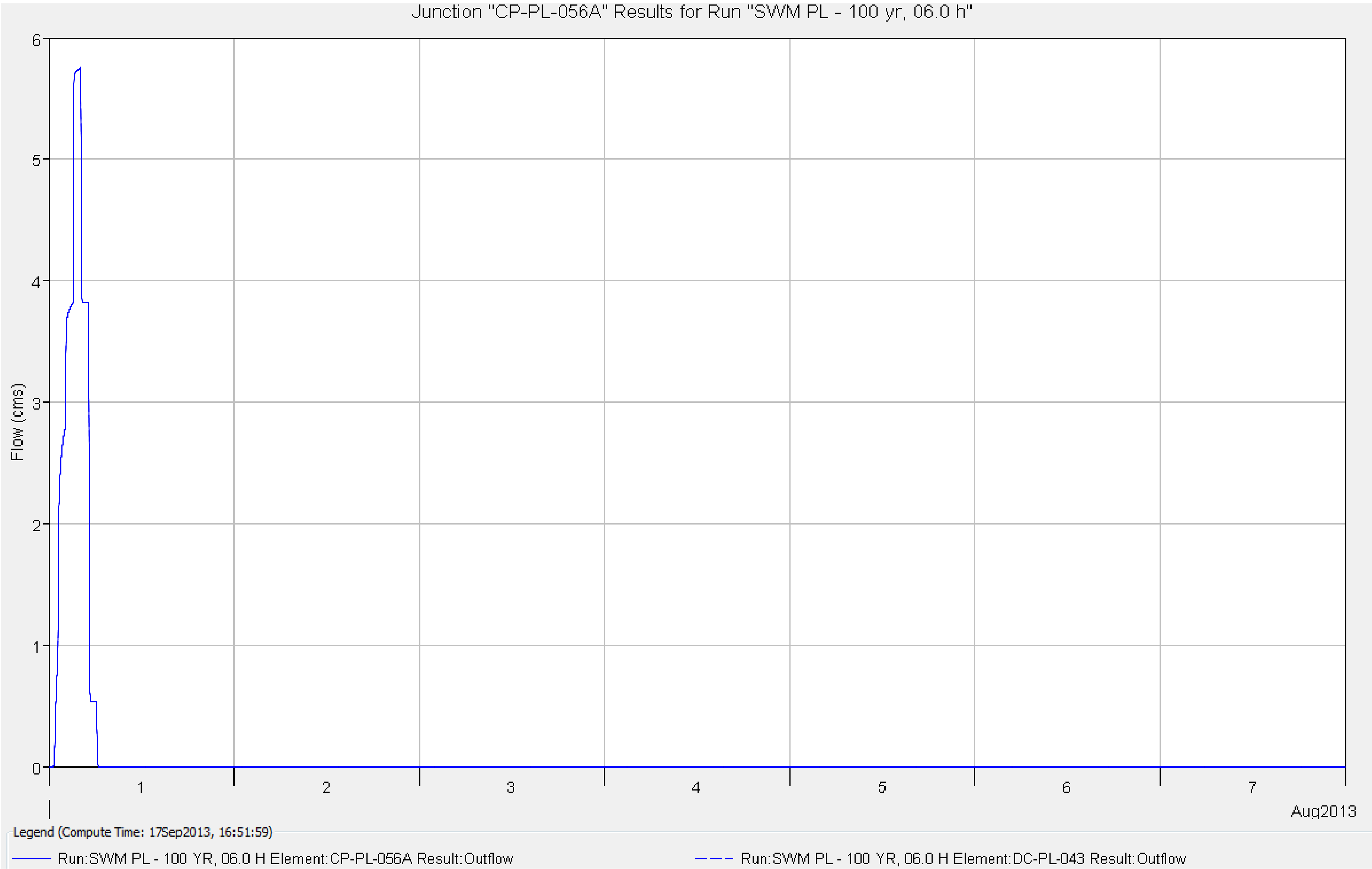


Junction "CP-PL-053" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-041 Result:Outflow

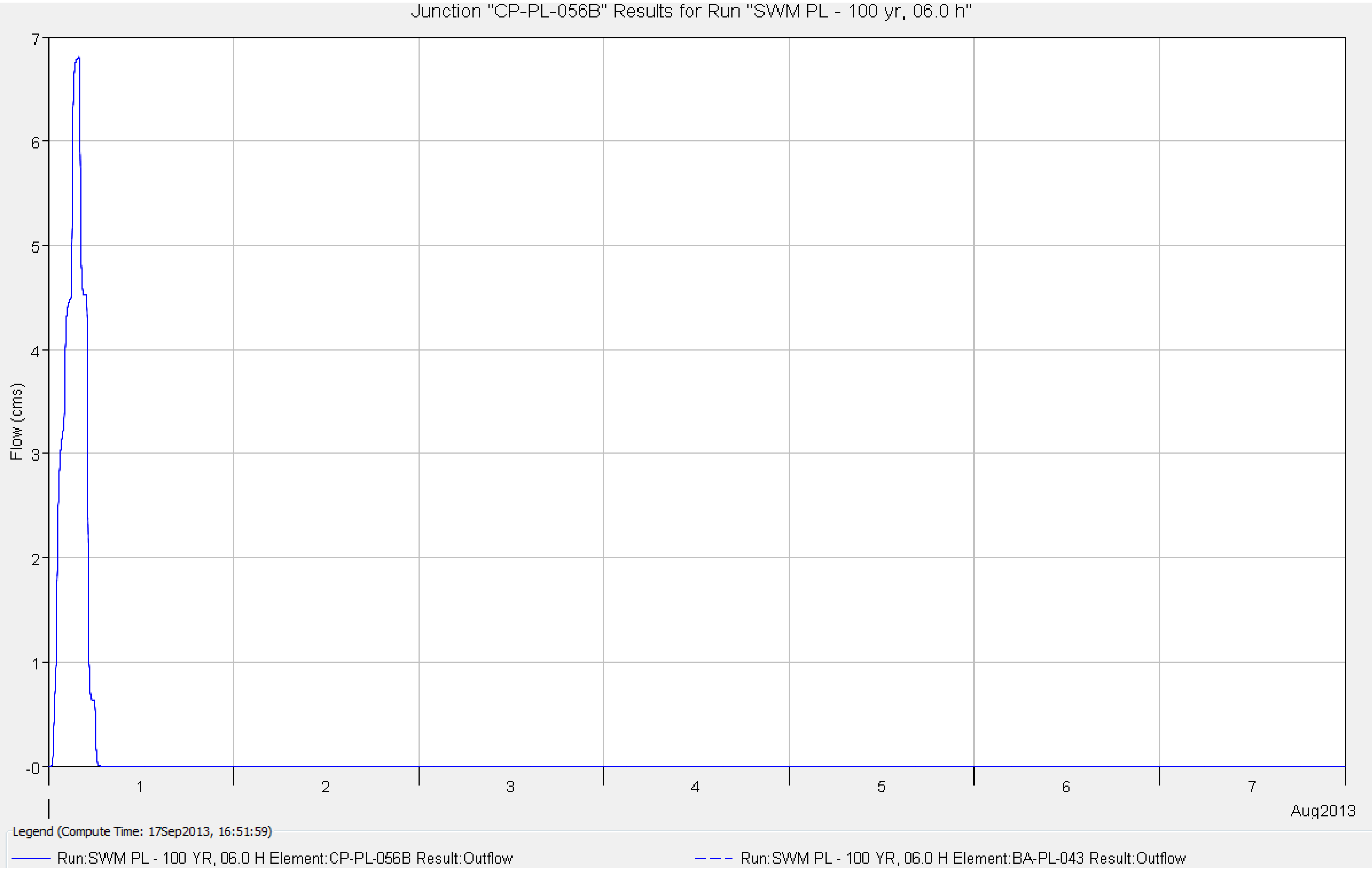

Junction "CP-PL-054" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-042 Result:Outflow



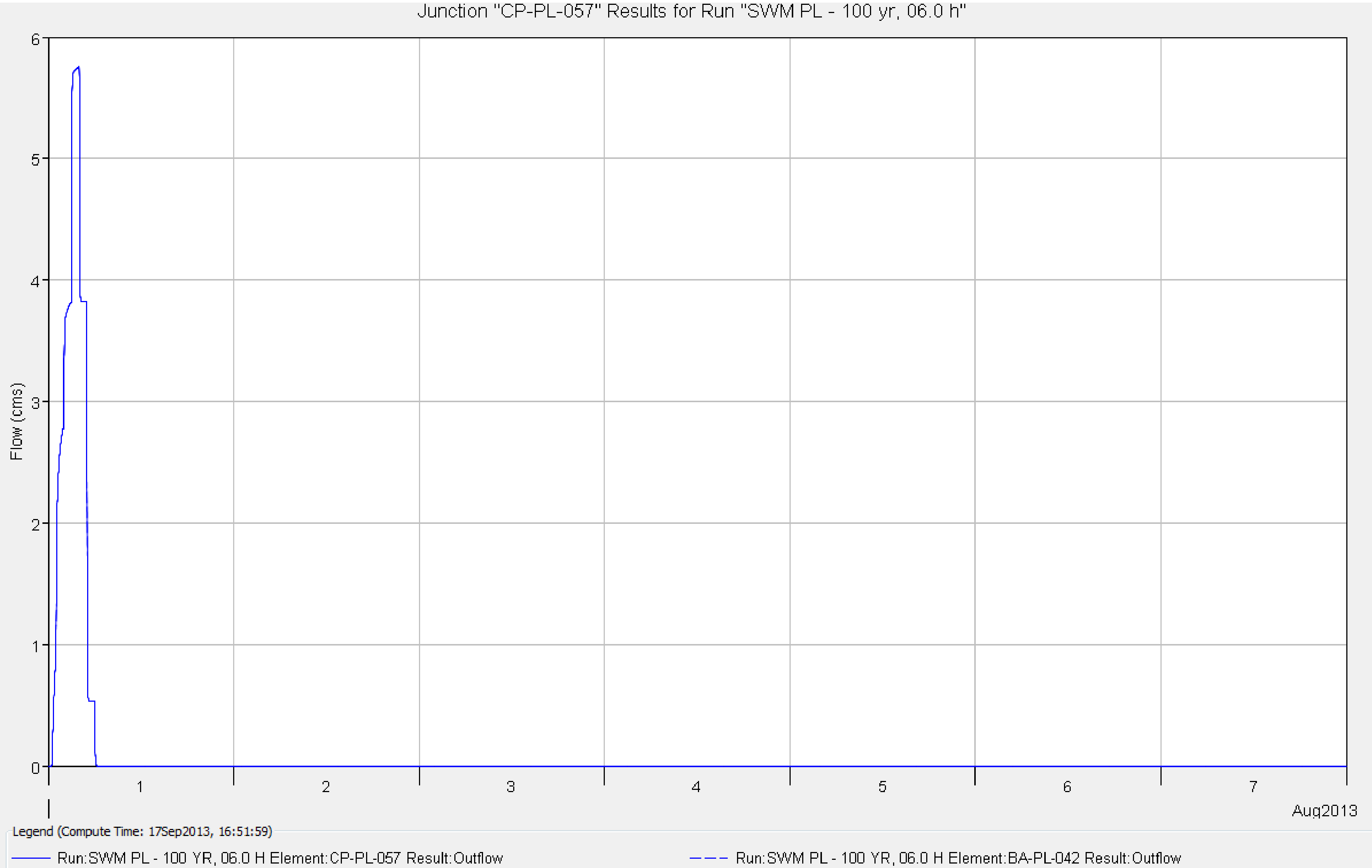
Junction "CP-PL-055" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Outflow



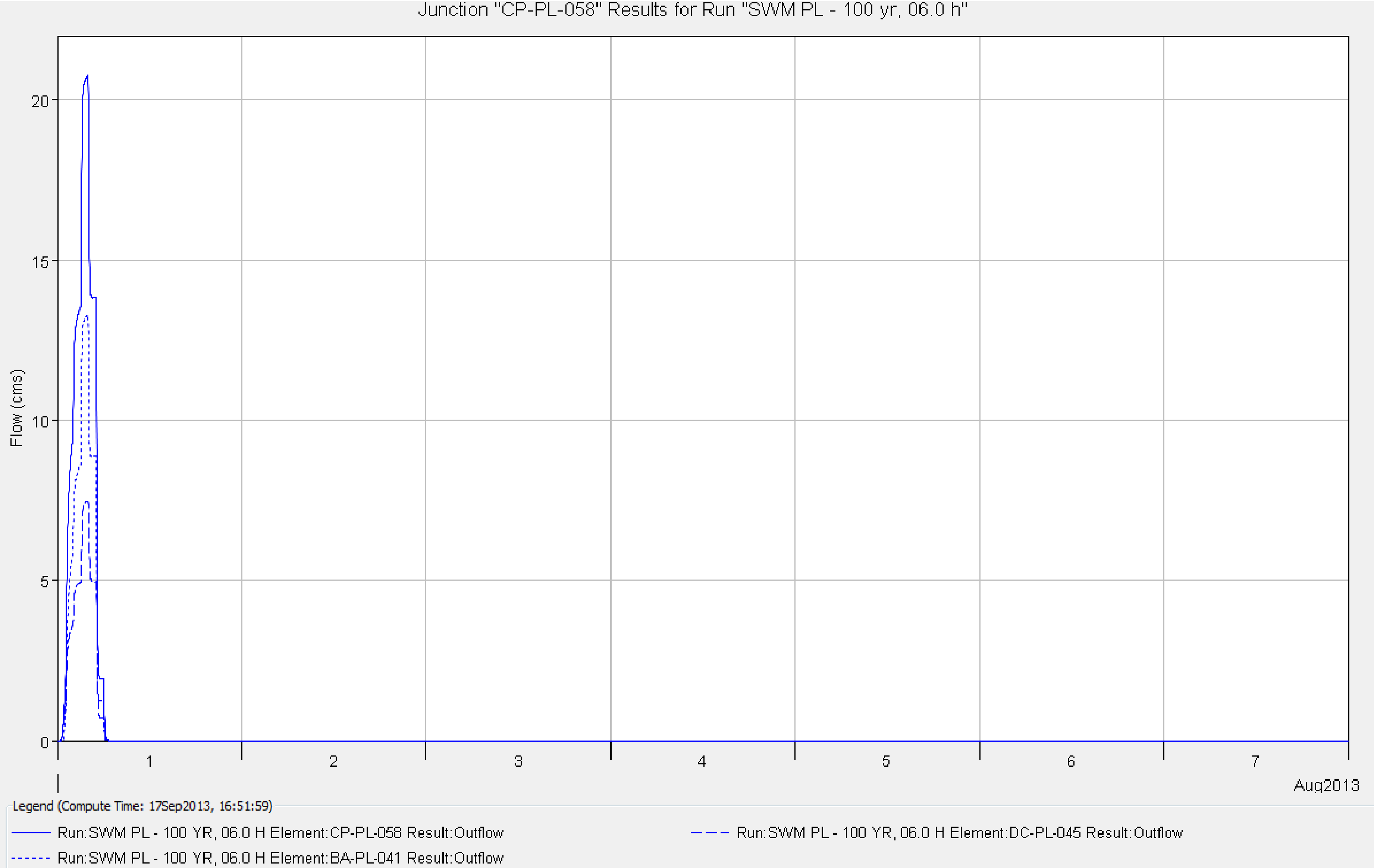
Junction "CP-PL-056A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-056A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-043 Result:Outflow

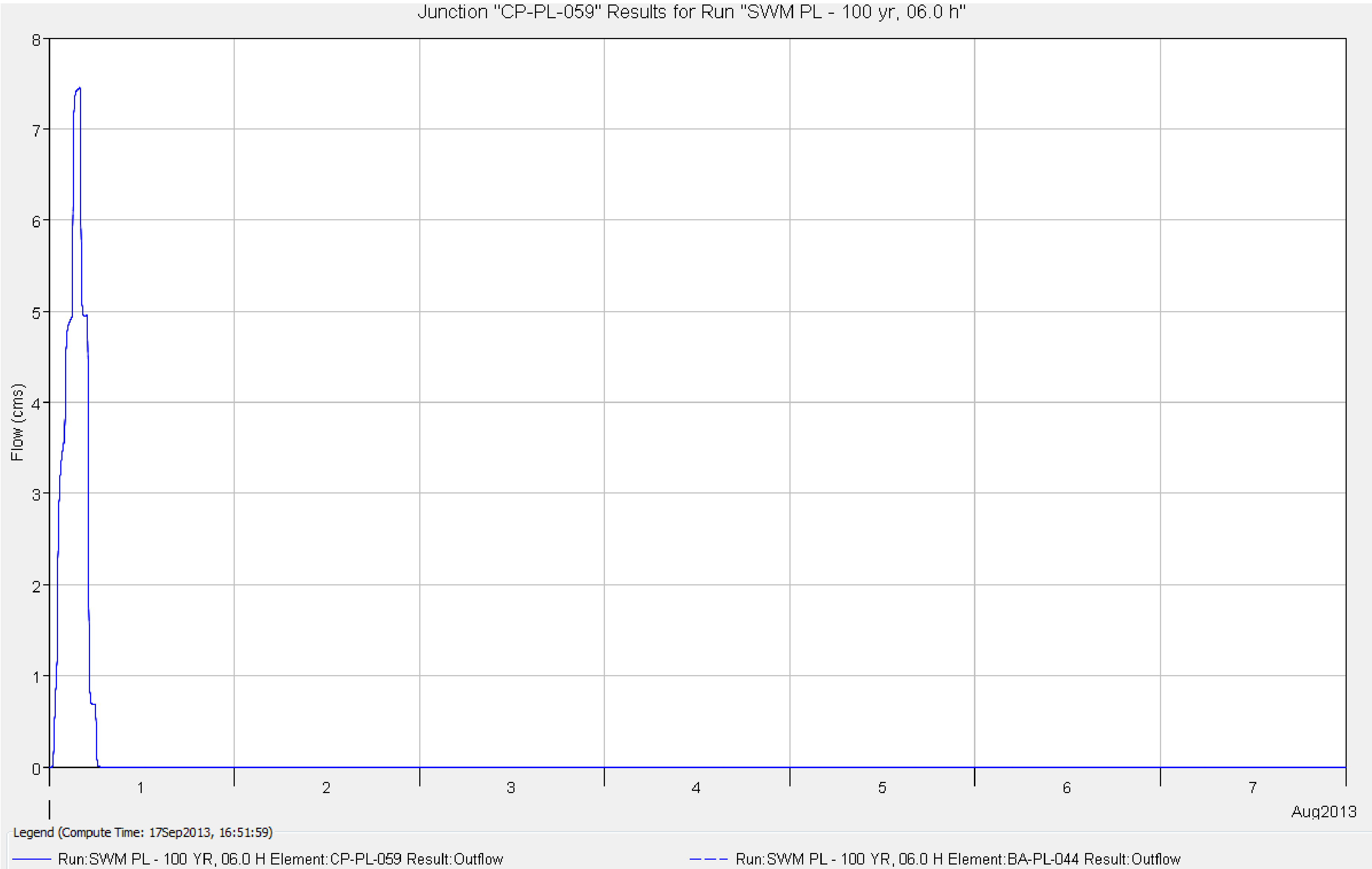


Junction "CP-PL-056B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
7
6
5
4
3
2
1
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-056B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-043 Result:Outflow

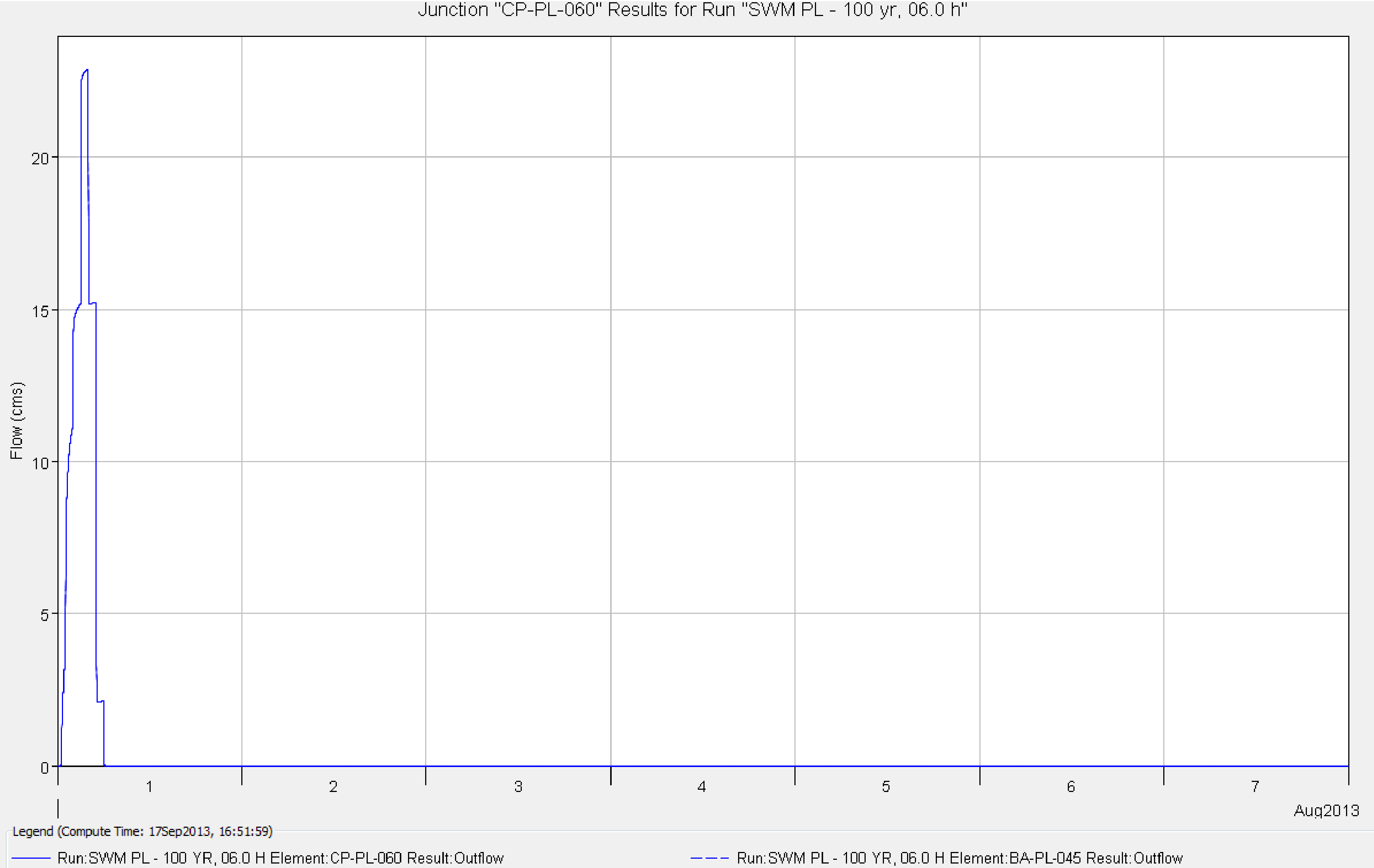


Junction "CP-PL-057" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-042 Result:Outflow

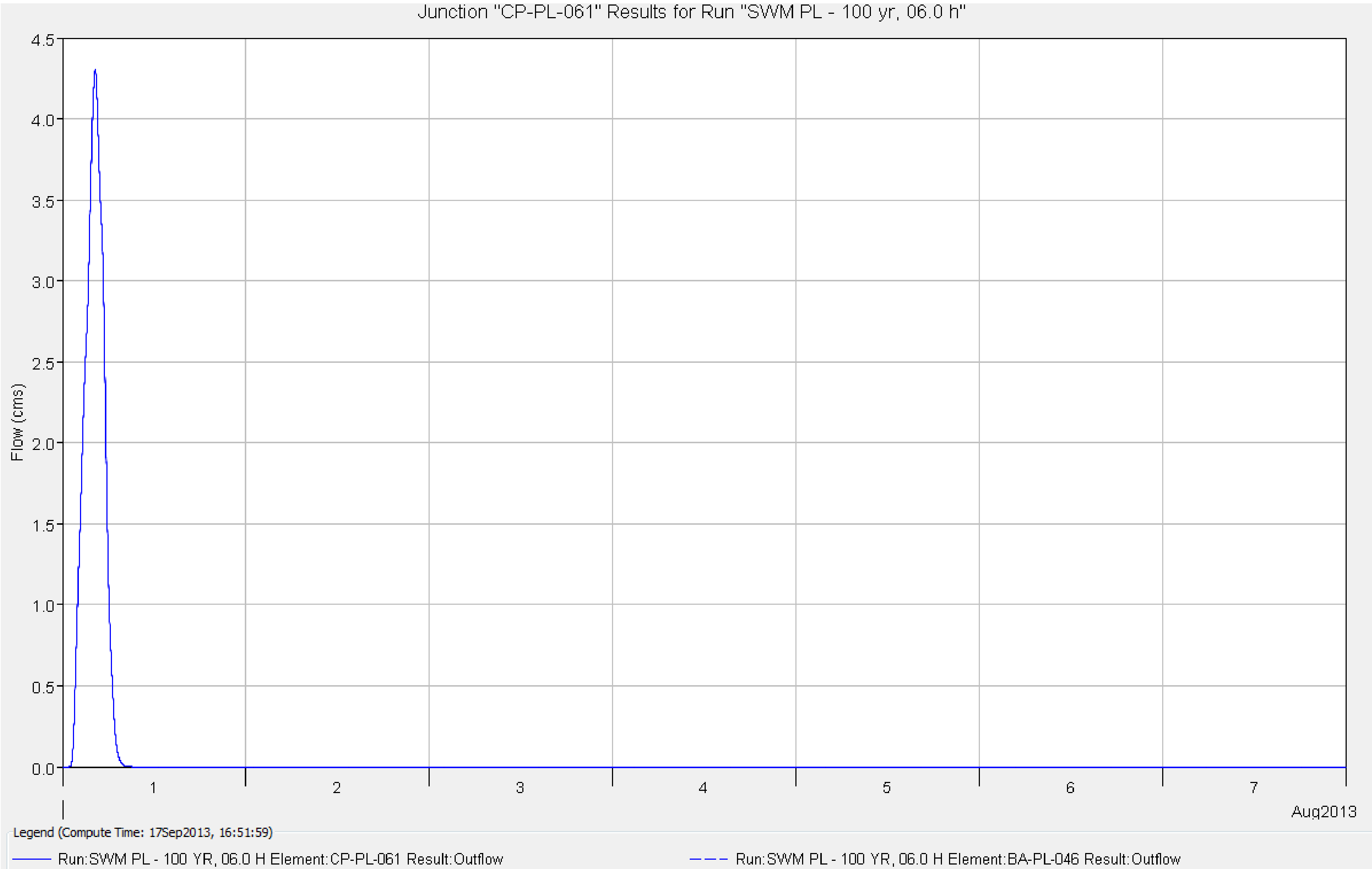

Junction "CP-PL-058" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-041 Result:Outflow



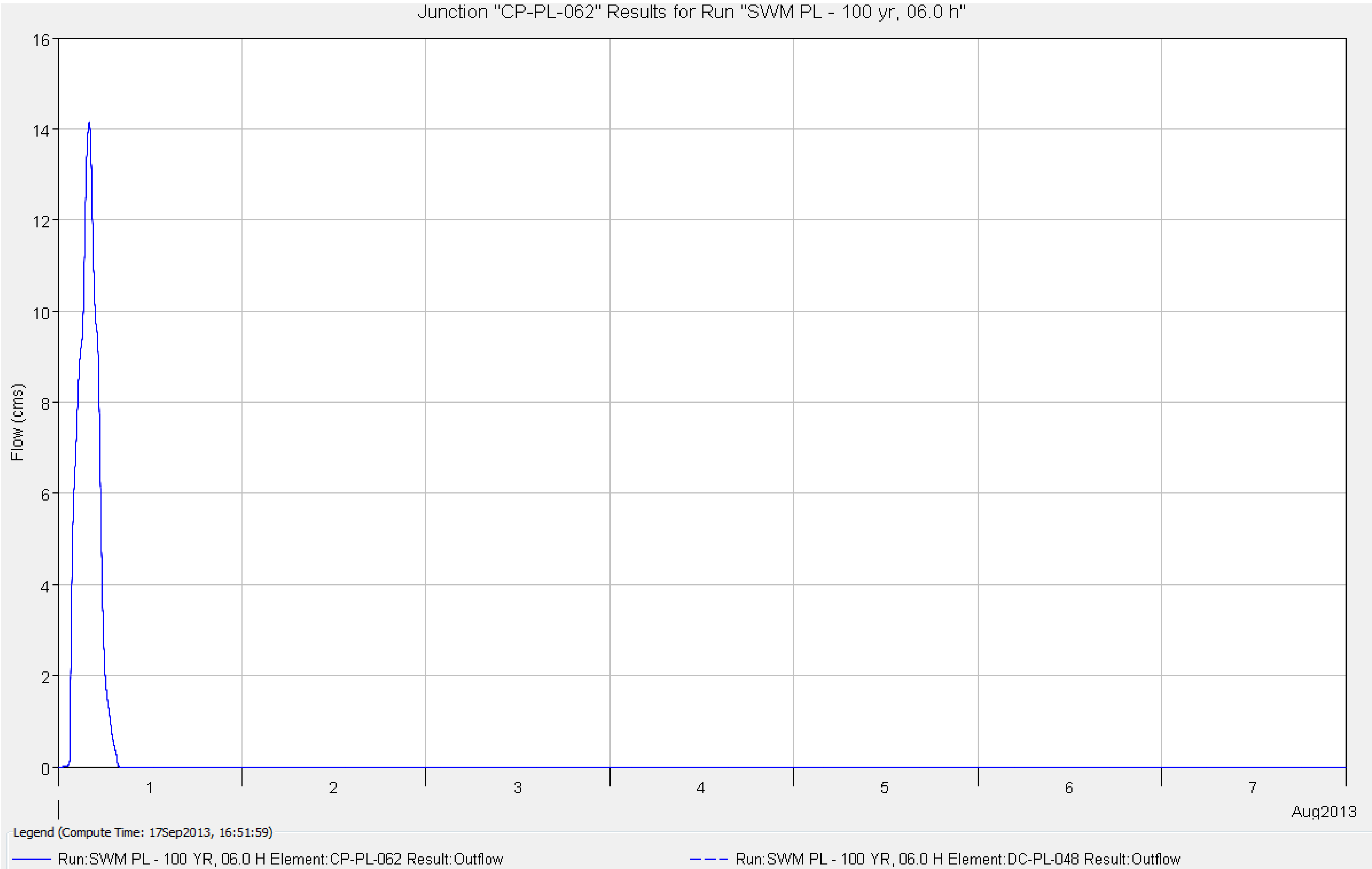
Junction "CP-PL-059" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-059 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-044 Result:Outflow



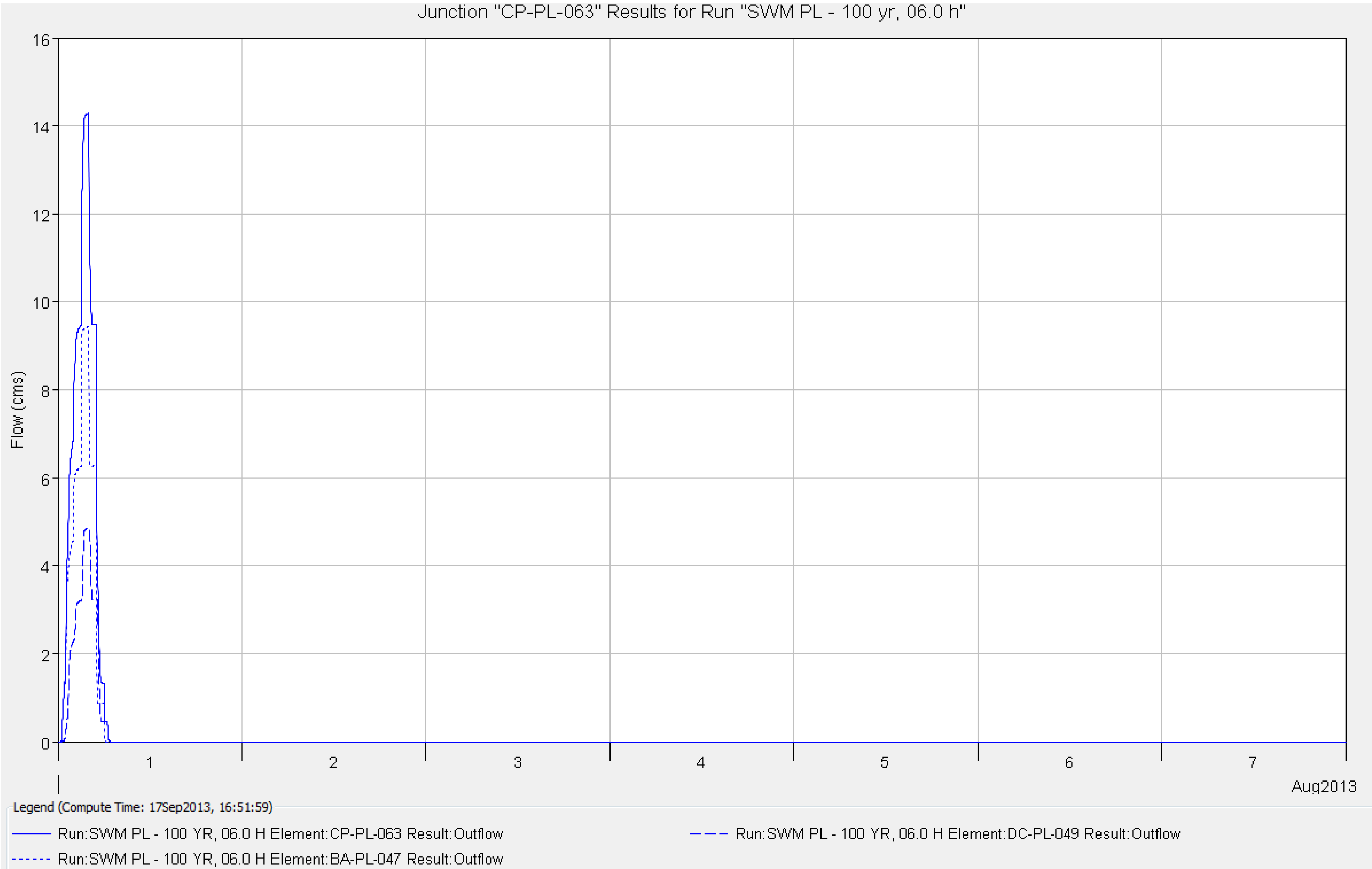
Junction "CP-PL-060" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-045 Result:Outflow

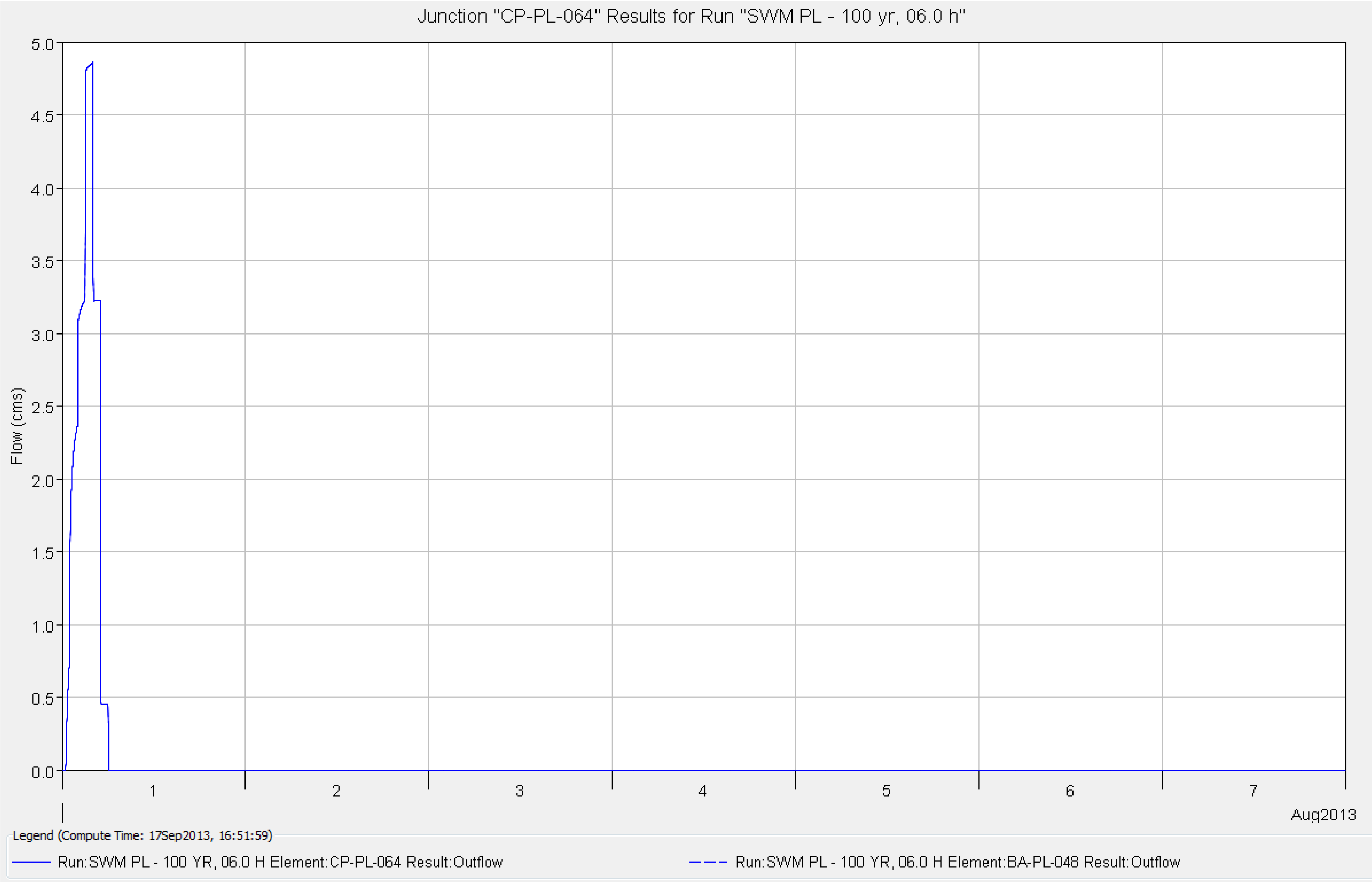


Junction "CP-PL-061" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-061 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-046 Result:Outflow

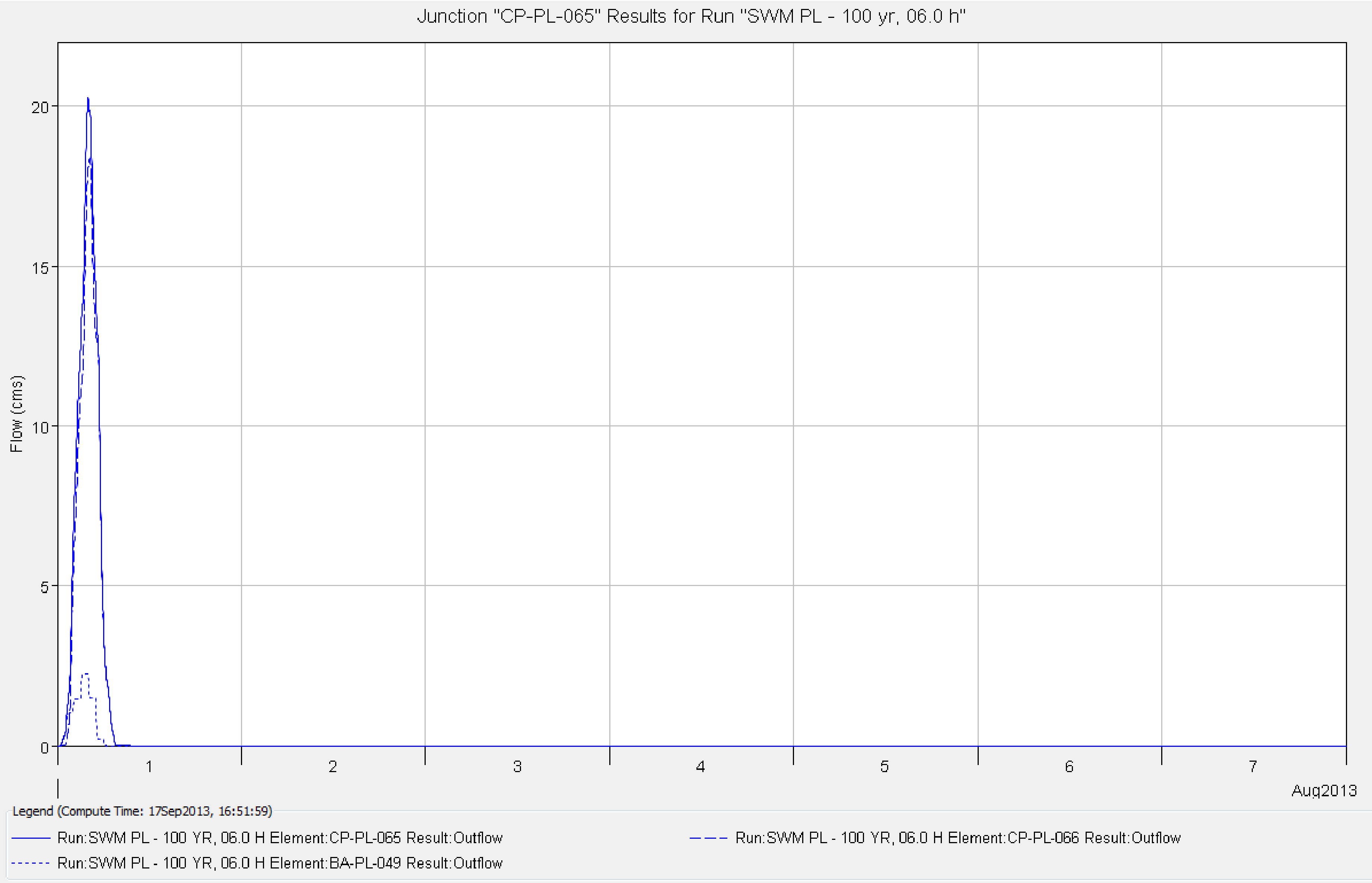


Junction "CP-PL-062" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-062 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-048 Result:Outflow

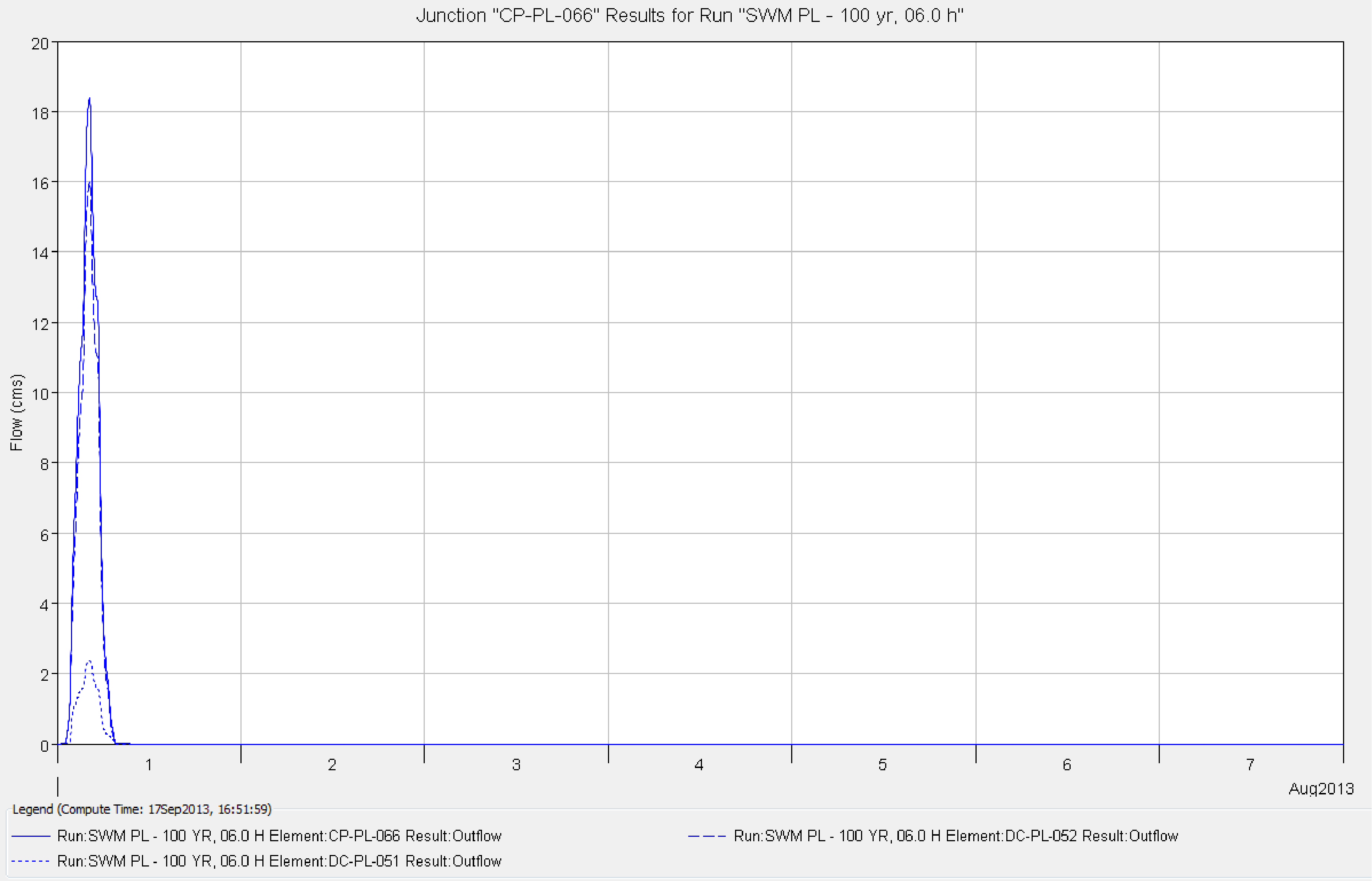

Junction "CP-PL-063" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-047 Result:Outflow

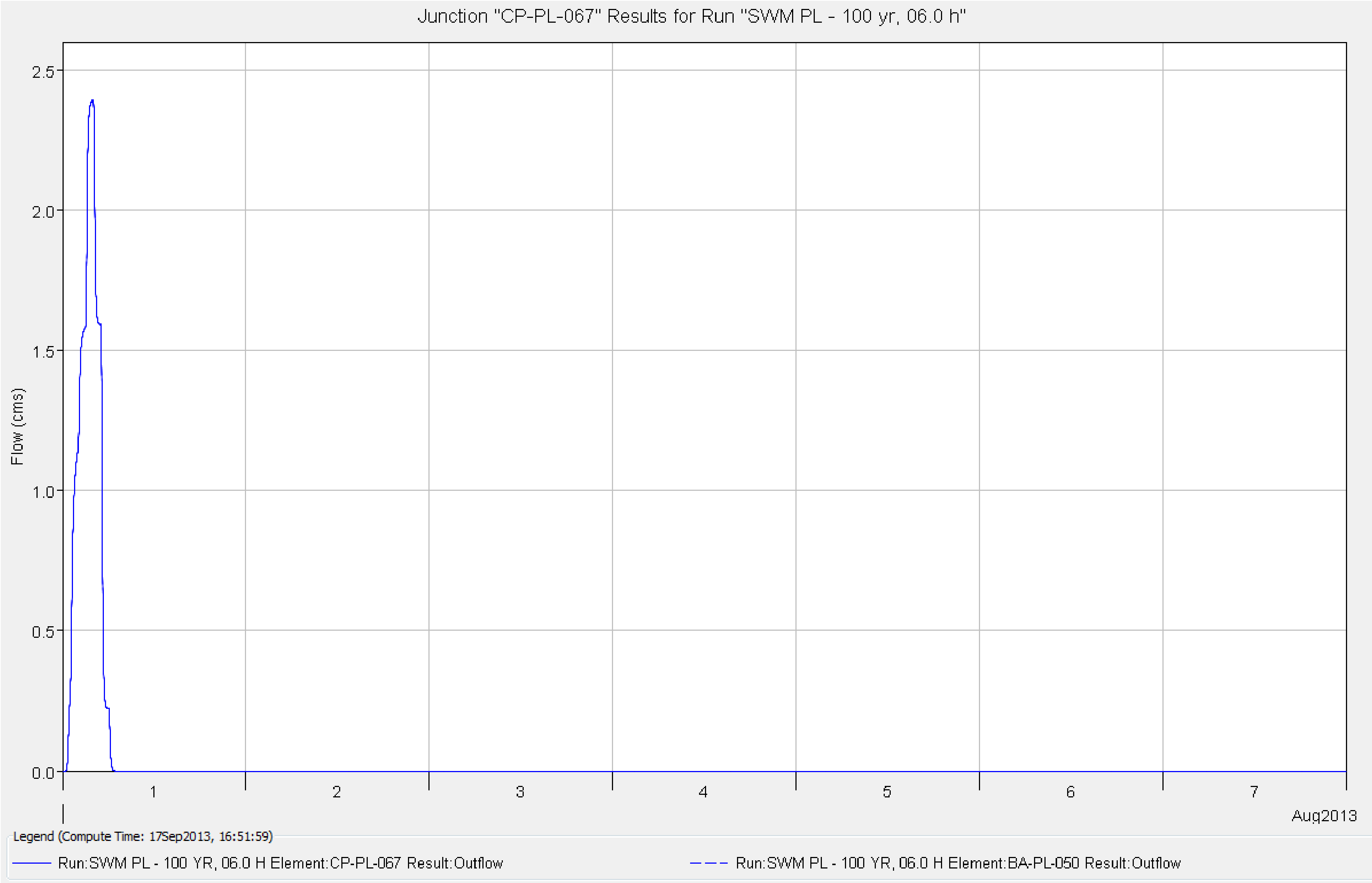


Junction "CP-PL-064" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-064 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-048 Result:Outflow

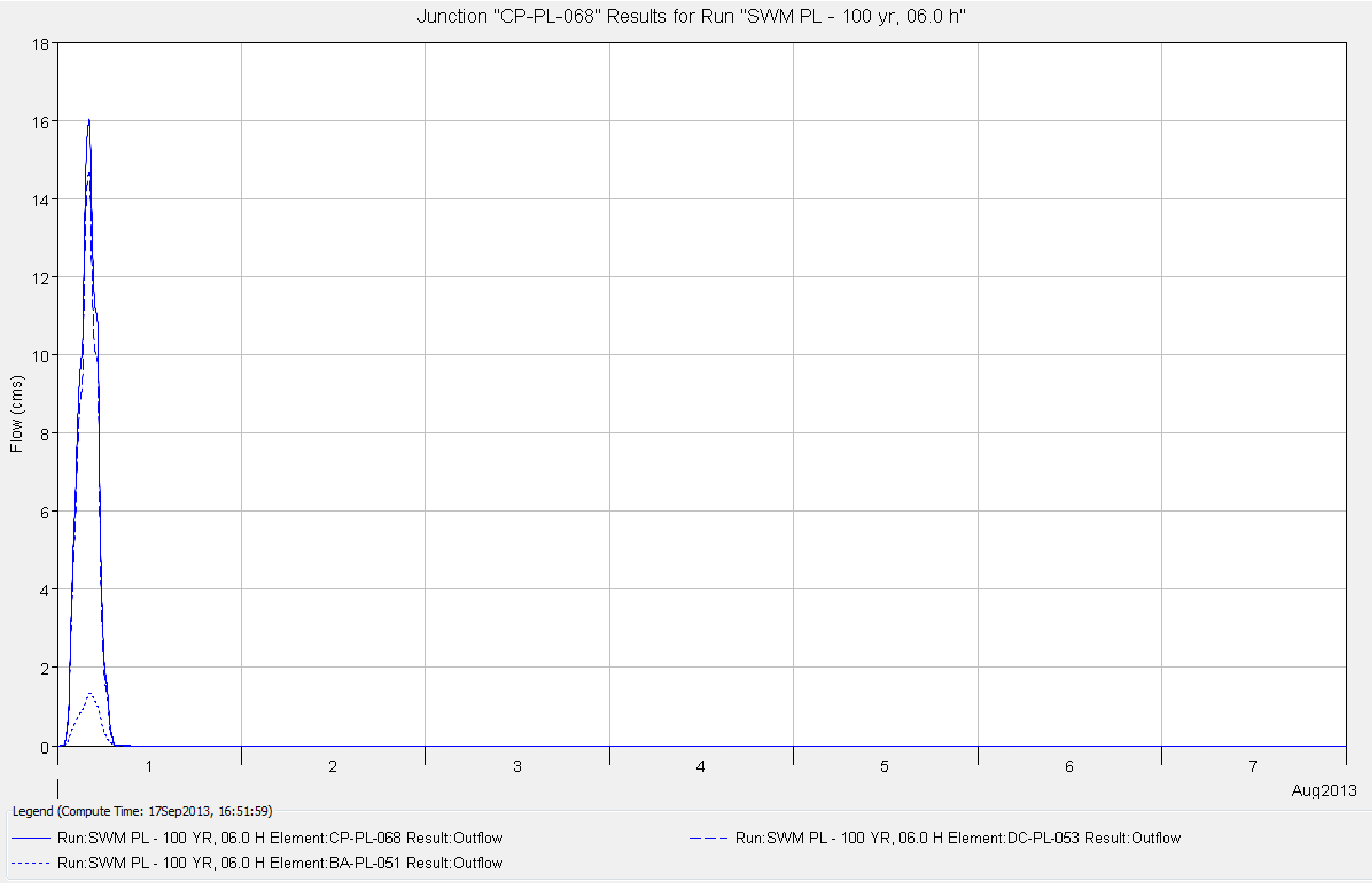


Junction "CP-PL-065" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-065 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-049 Result:Outflow

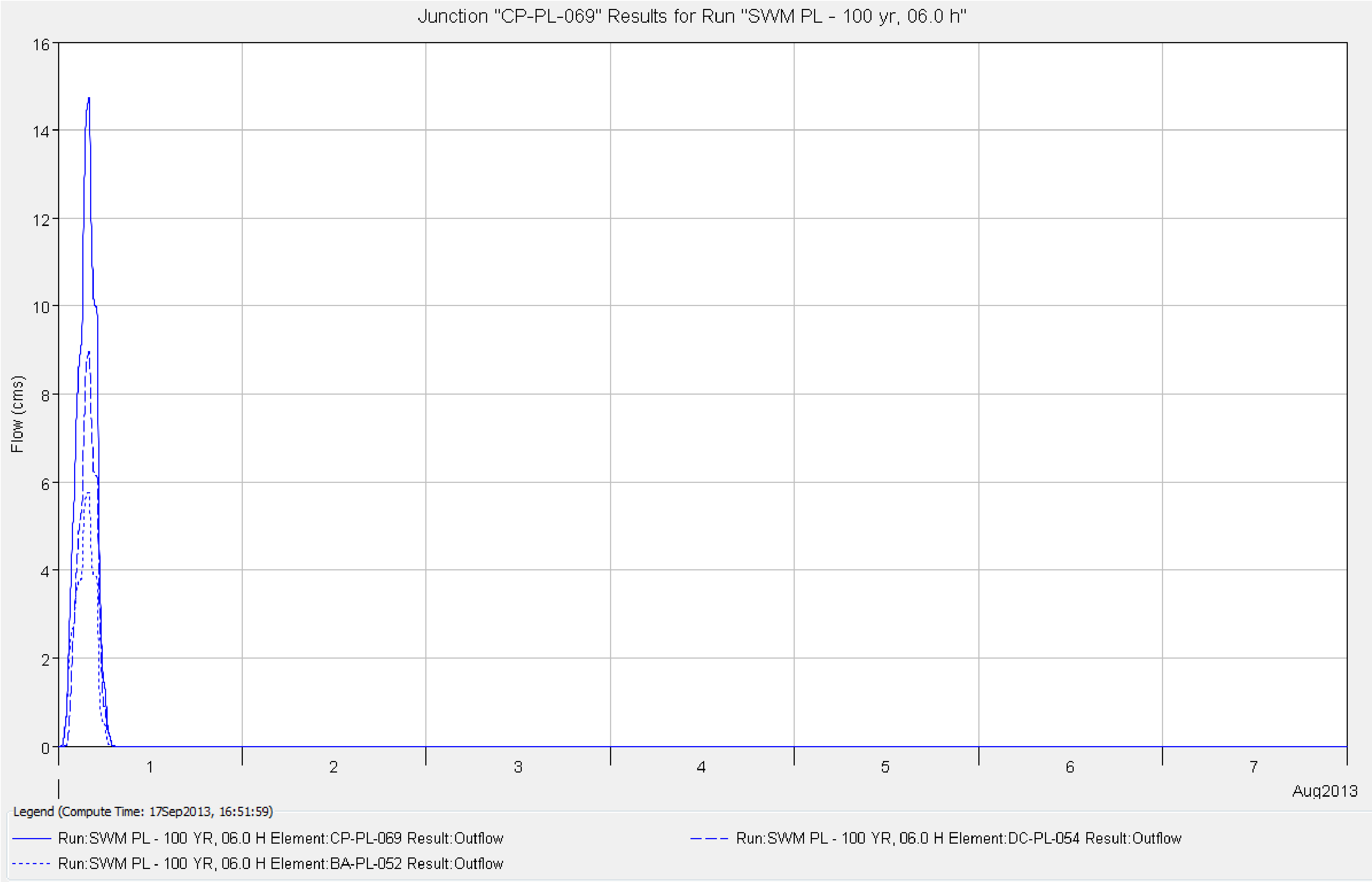

Junction "CP-PL-066" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-051 Result:Outflow

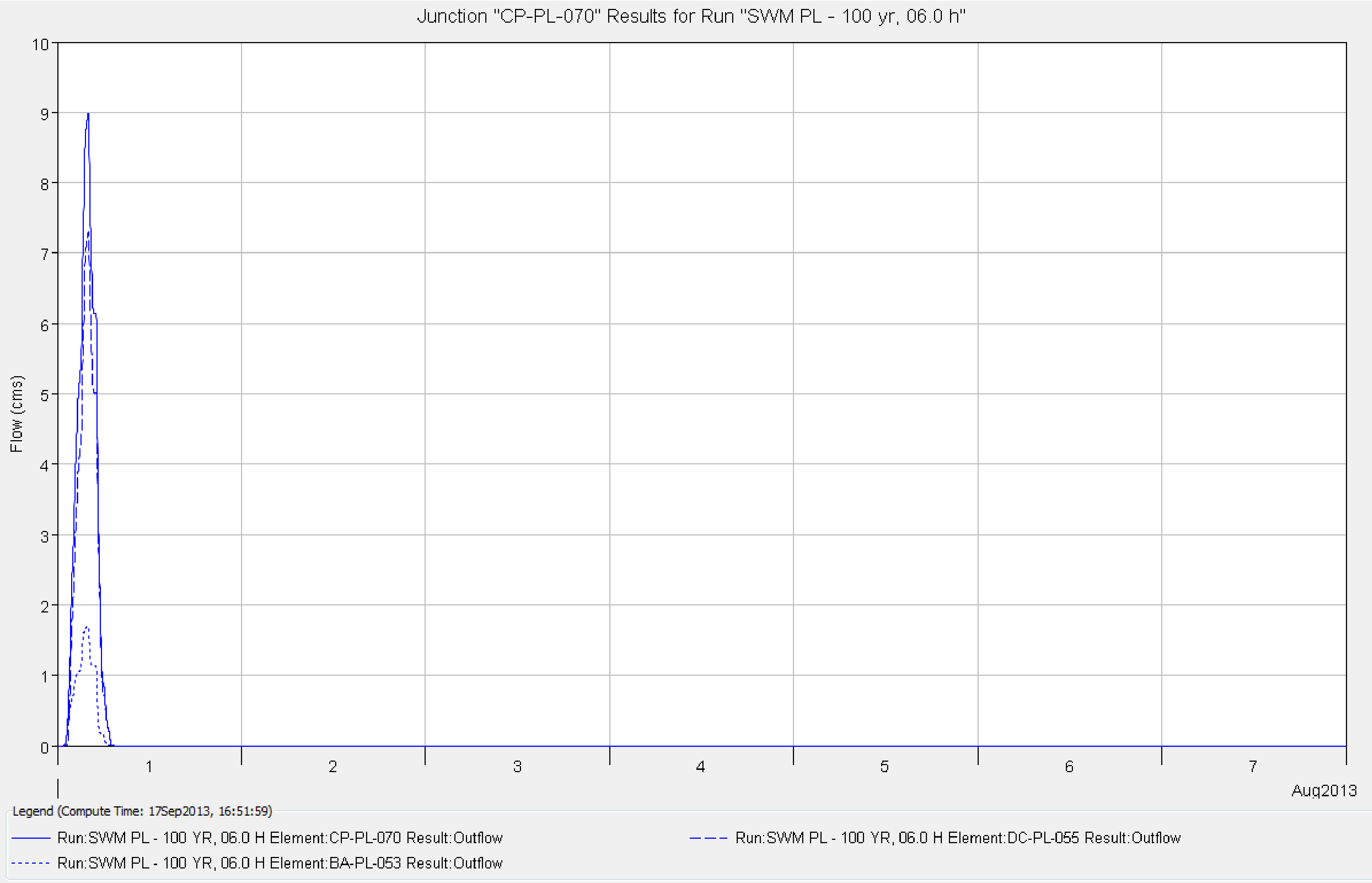


Junction "CP-PL-067" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-067 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-050 Result:Outflow

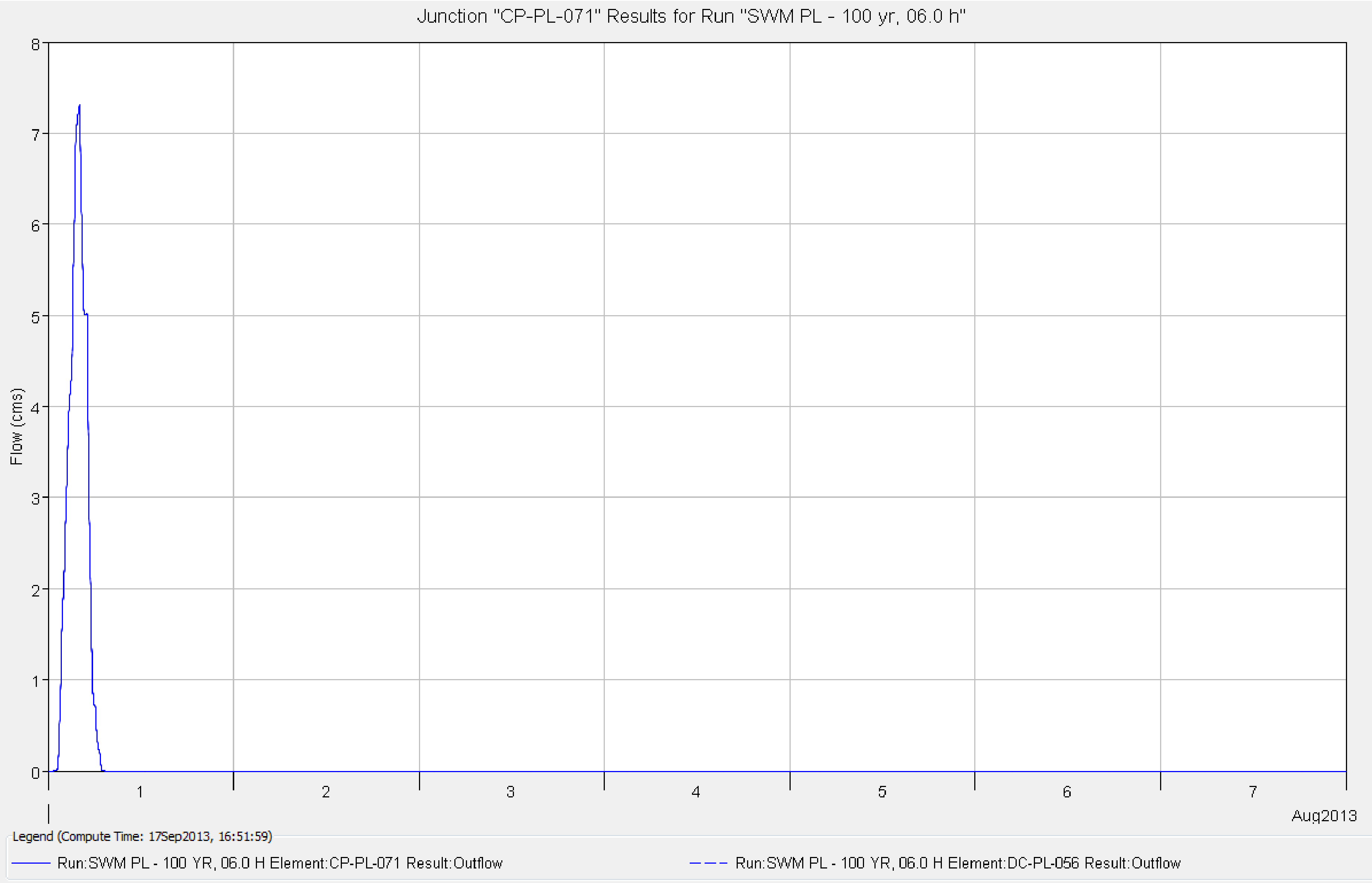


Junction "CP-PL-068" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-068 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-051 Result:Outflow

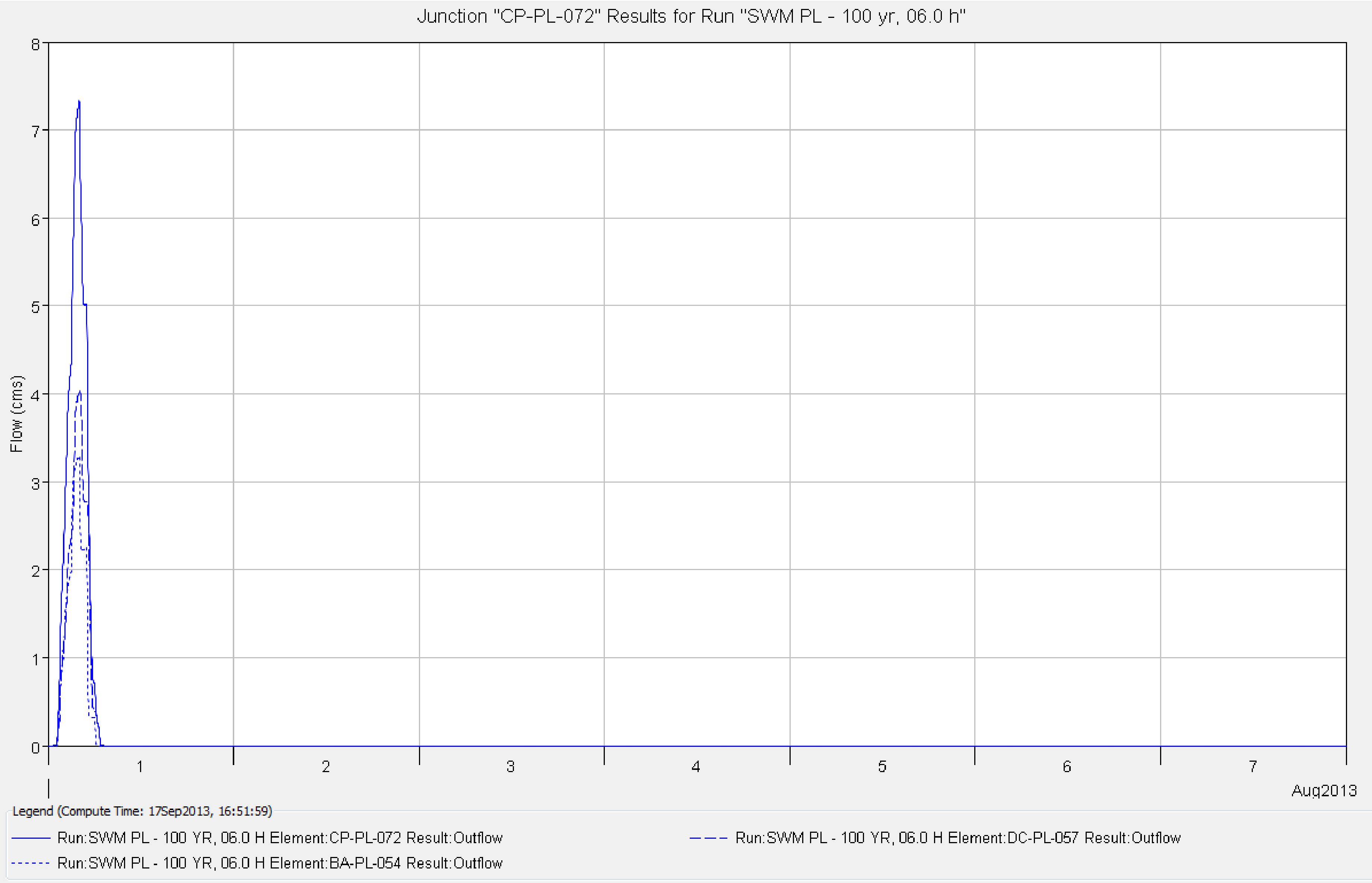

Junction "CP-PL-069" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-069 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-052 Result:Outflow



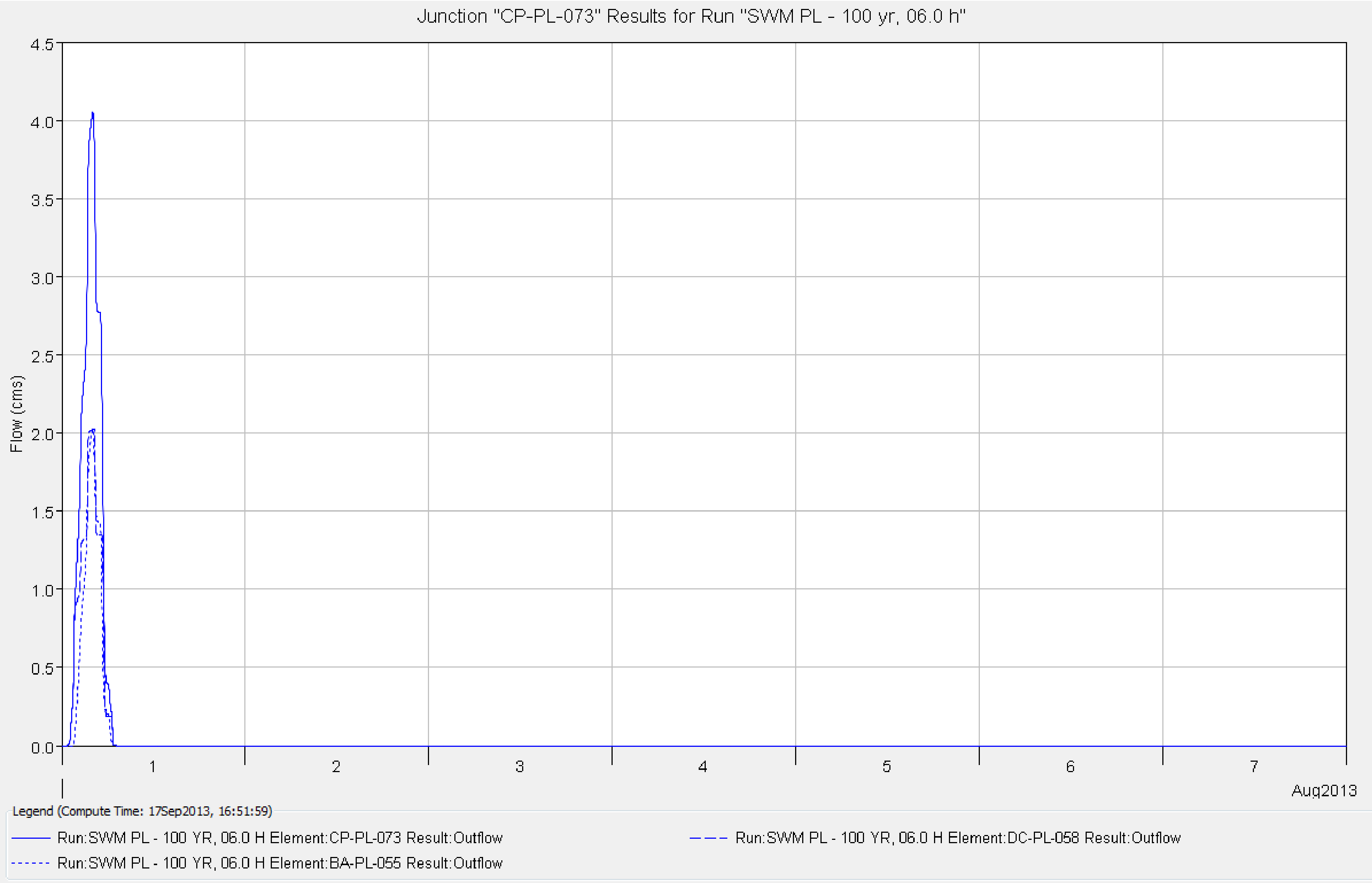
Junction "CP-PL-070" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-070 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-053 Result:Outflow



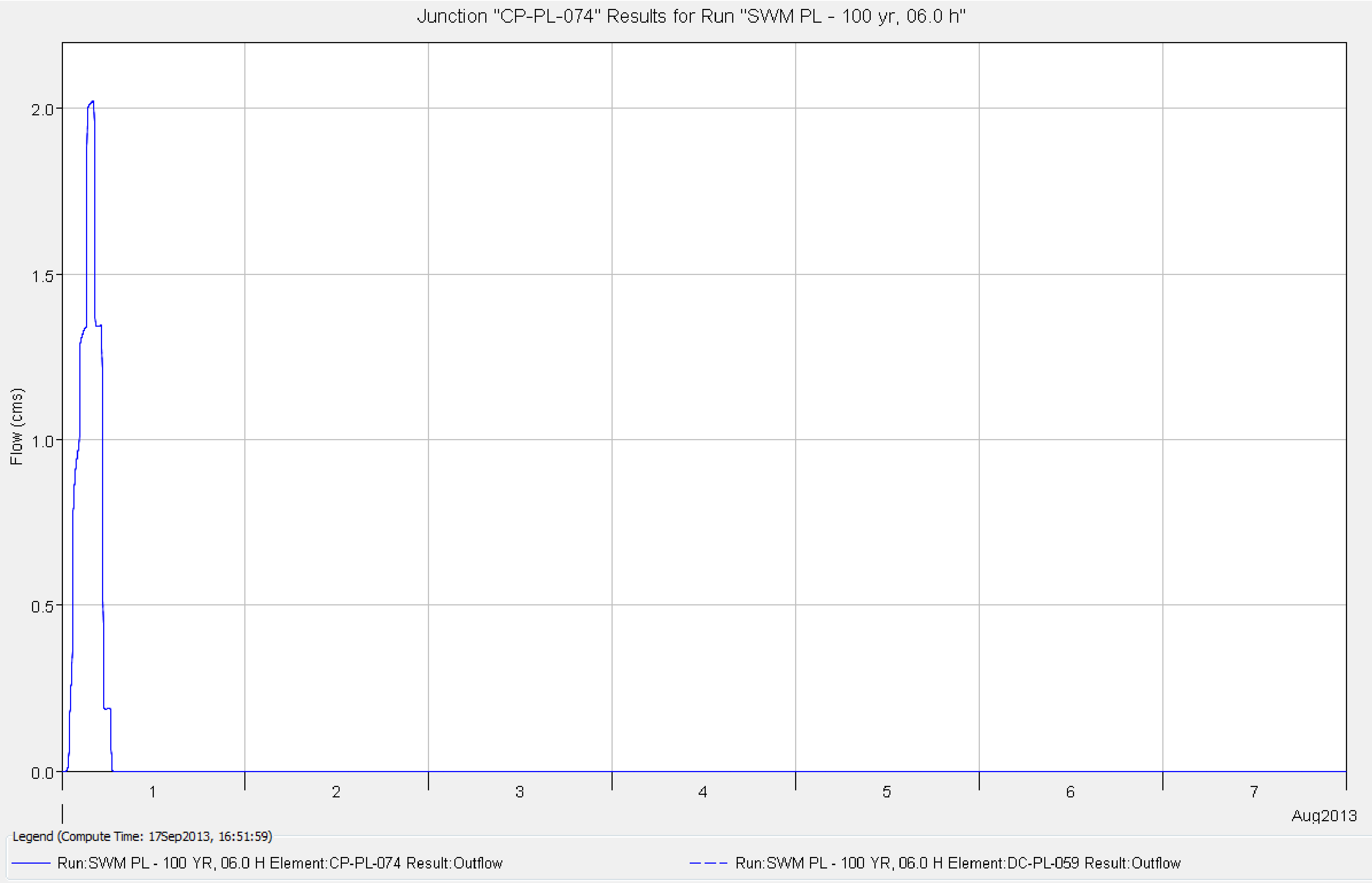
Junction "CP-PL-071" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-071 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-056 Result:Outflow



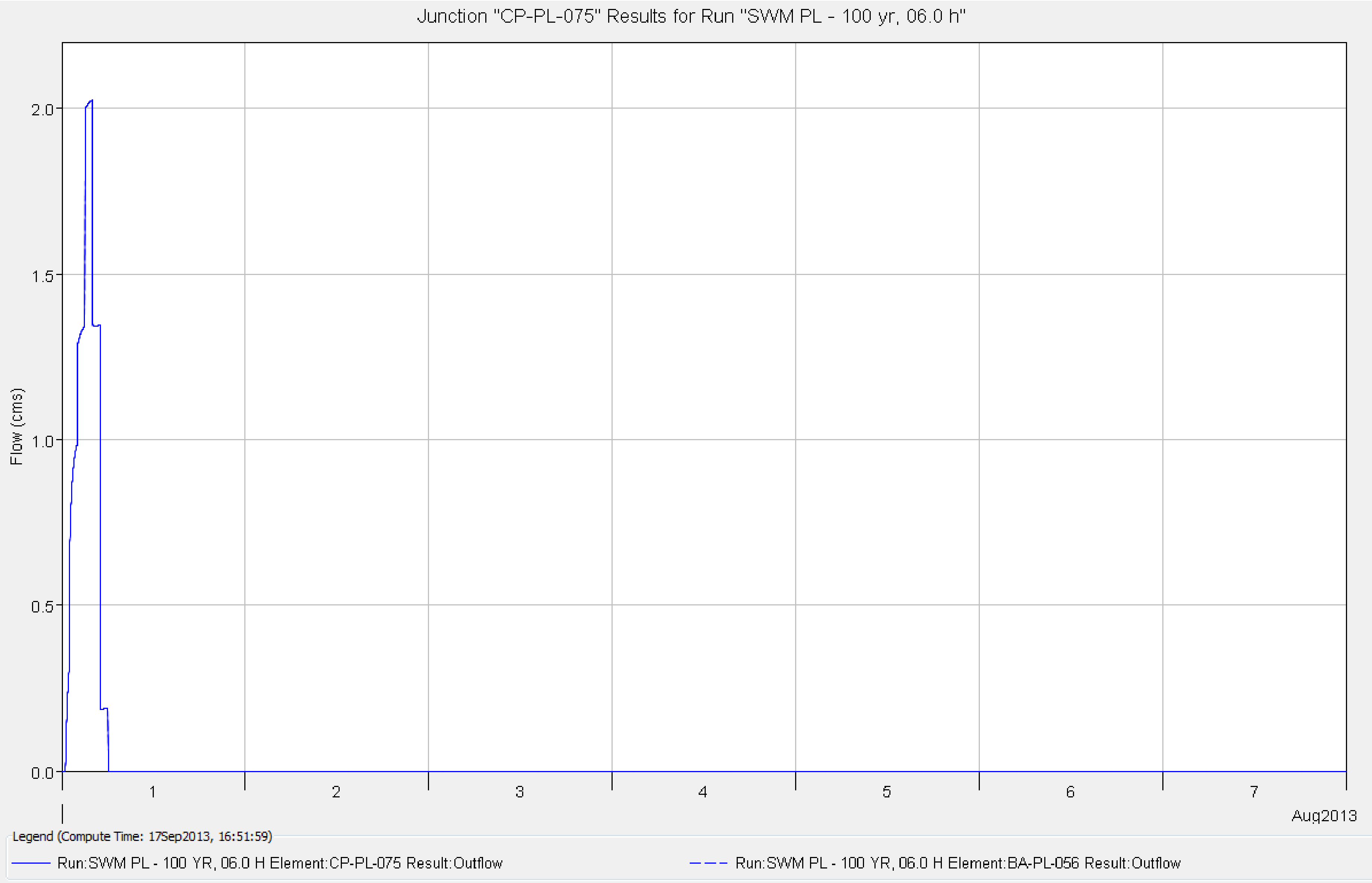
Junction "CP-PL-072" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-072 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-054 Result:Outflow



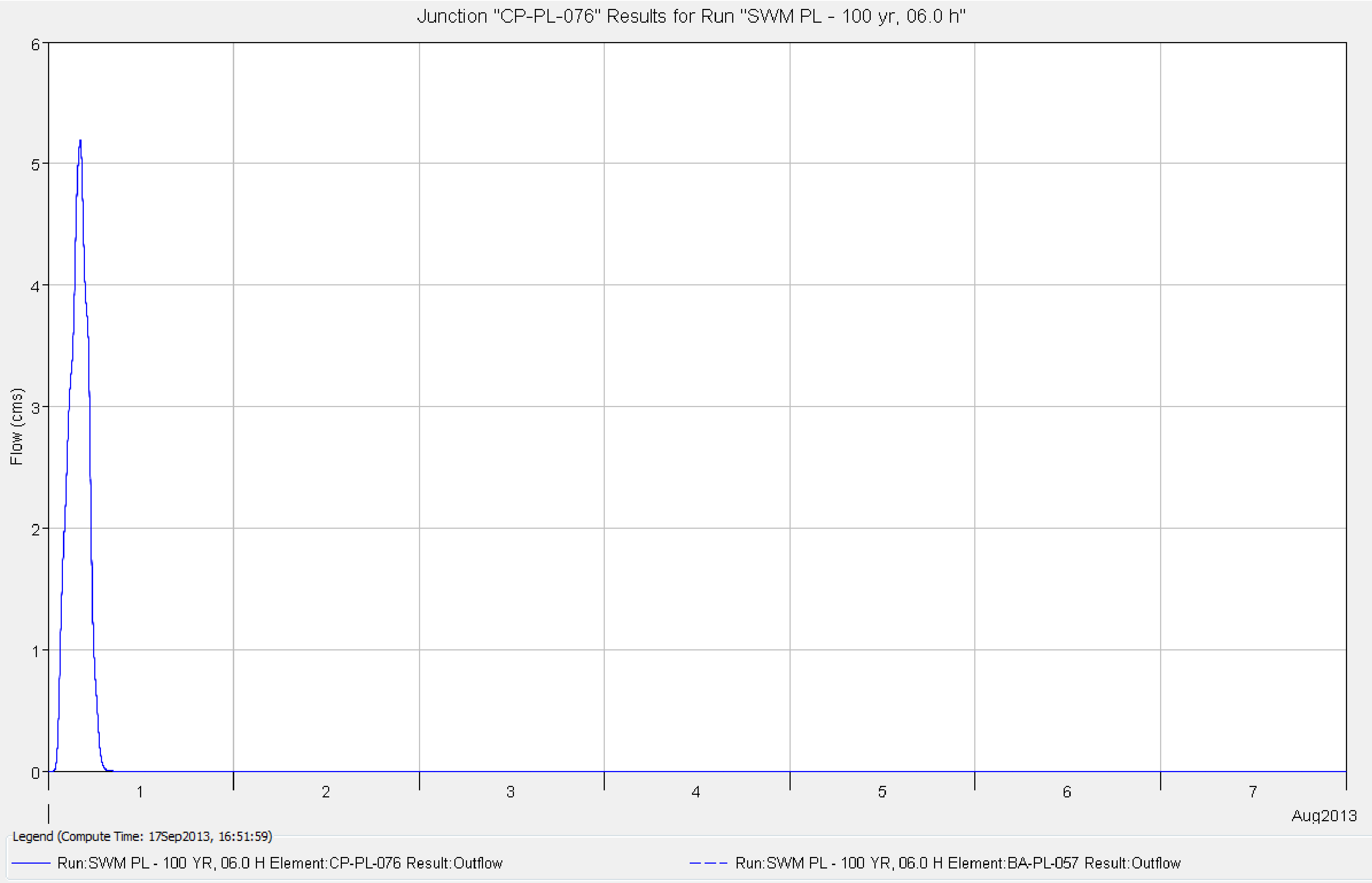
Junction "CP-PL-073" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-073 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-055 Result:Outflow



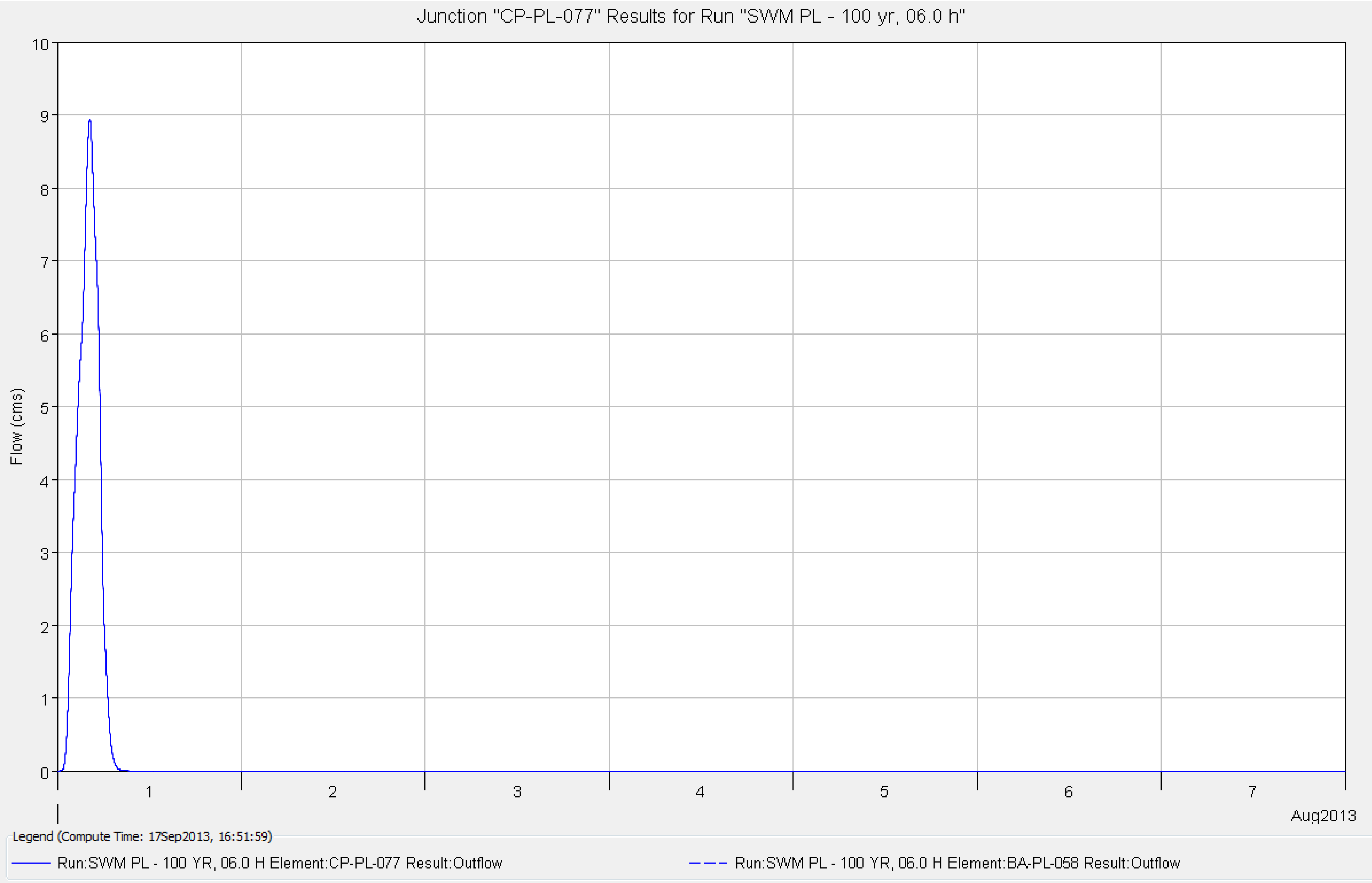
Junction "CP-PL-074" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-074 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-059 Result:Outflow

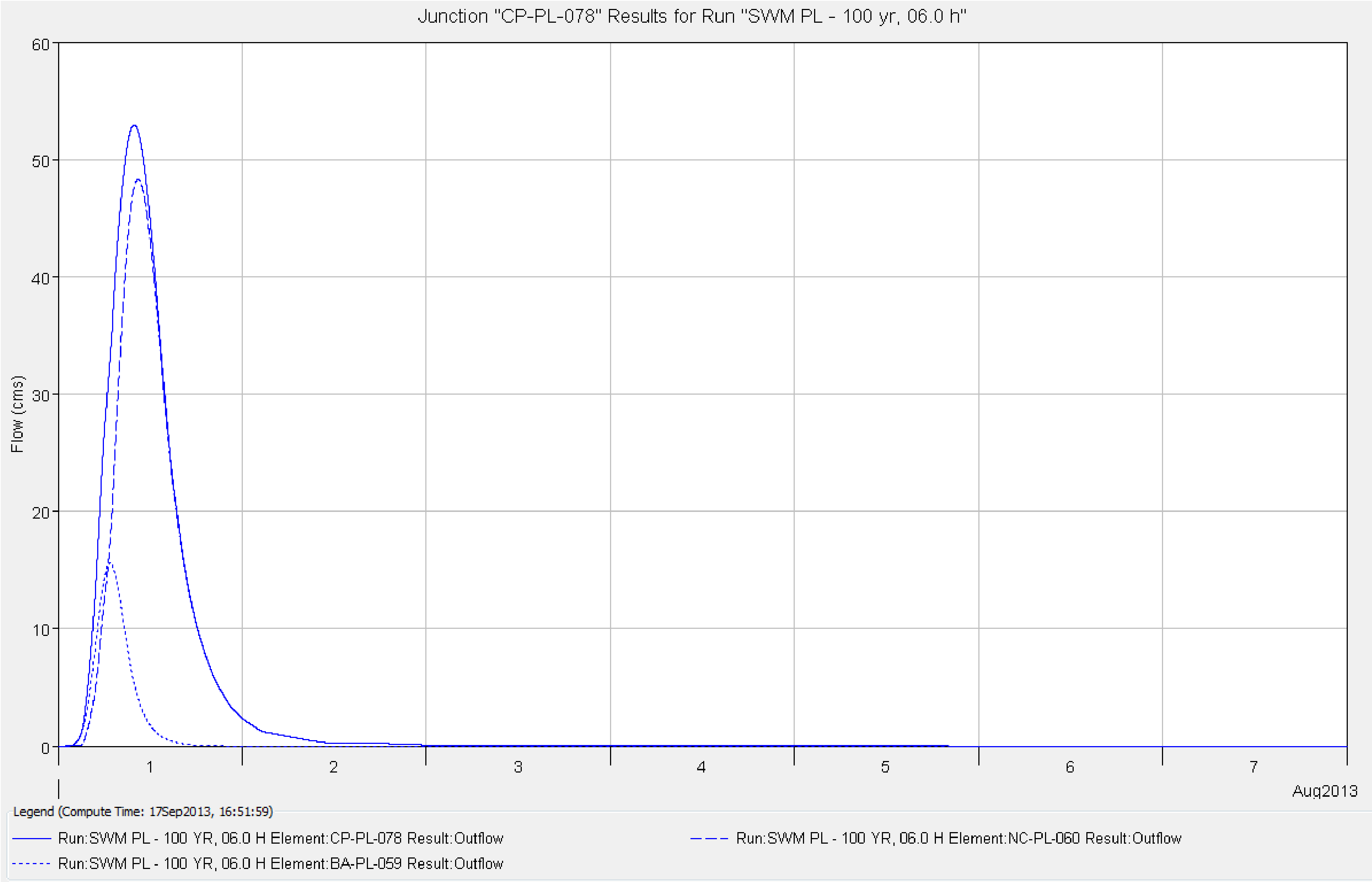


Junction "CP-PL-075" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-075 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-056 Result:Outflow

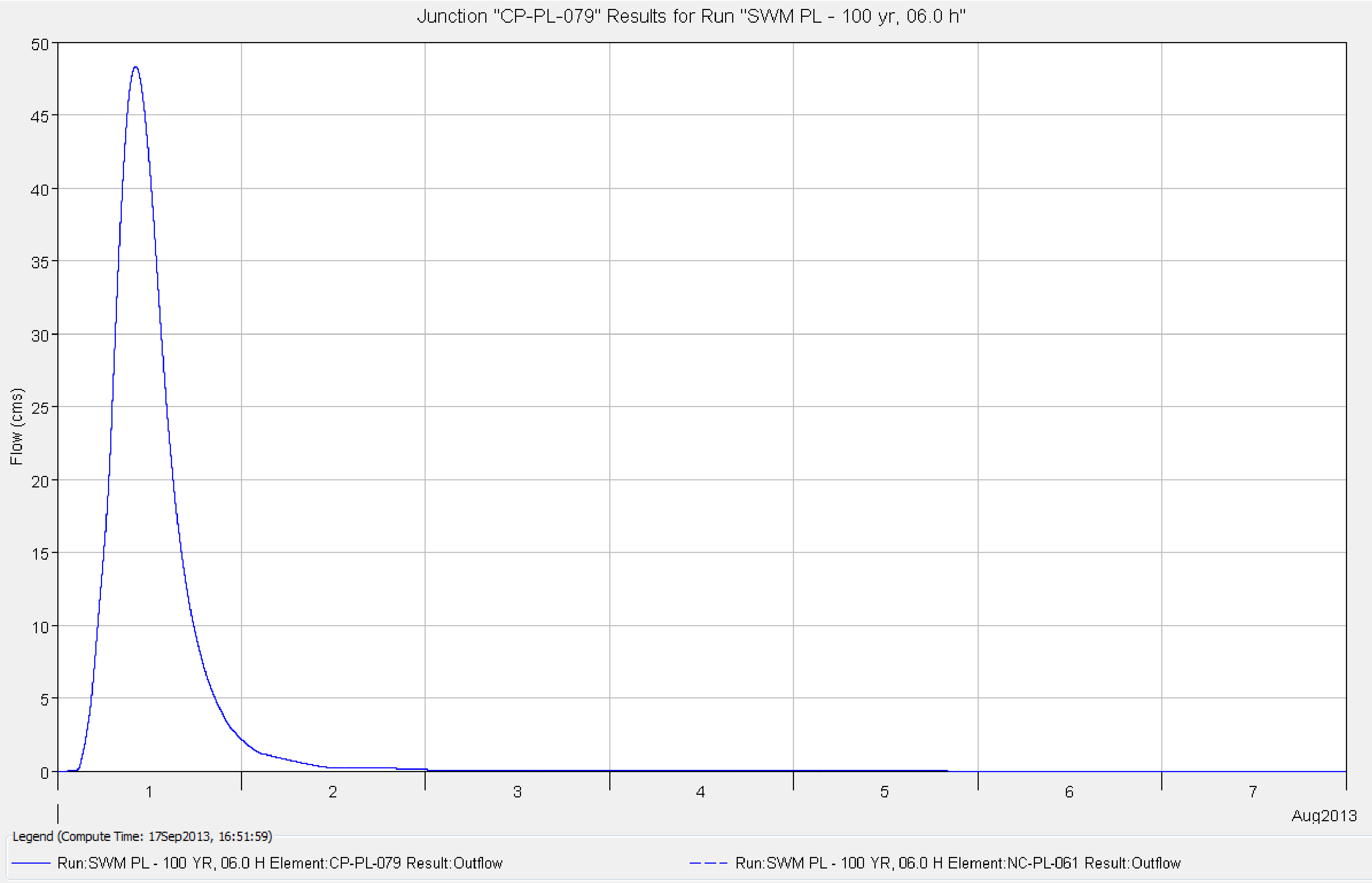


Junction "CP-PL-076" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-076 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-057 Result:Outflow

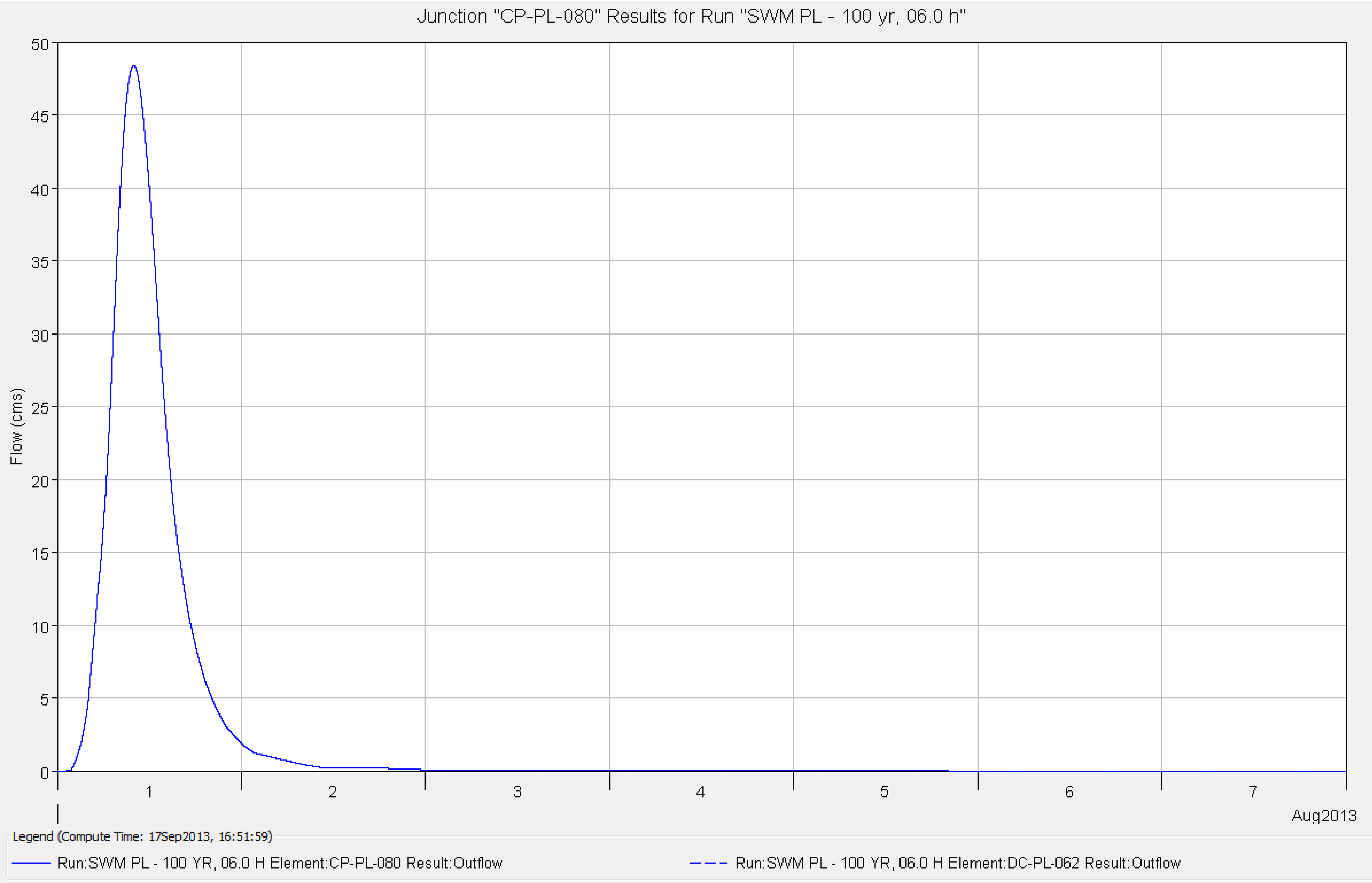

Junction "CP-PL-077" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-058 Result:Outflow

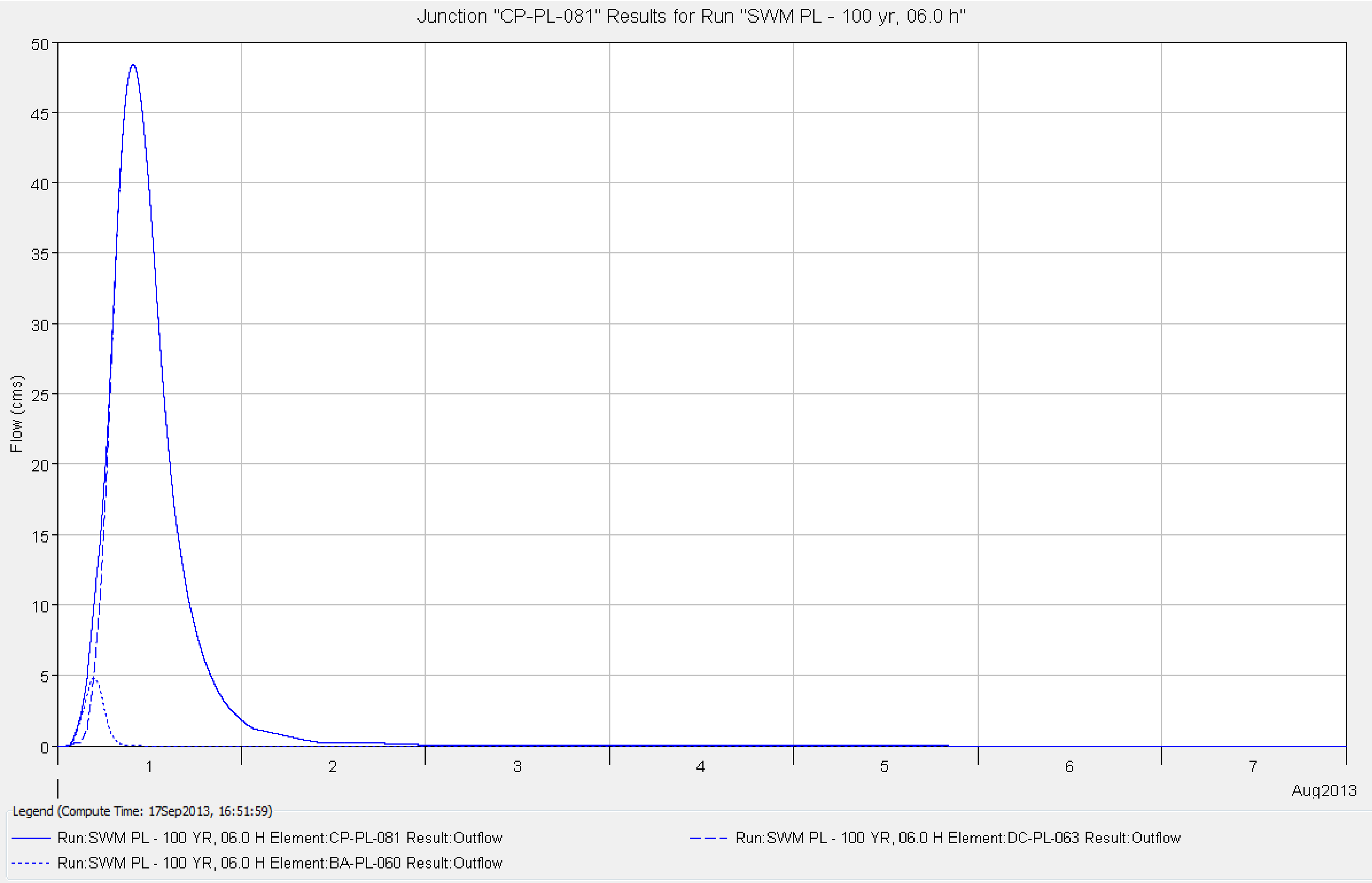


Junction "CP-PL-078" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-059 Result:Outflow

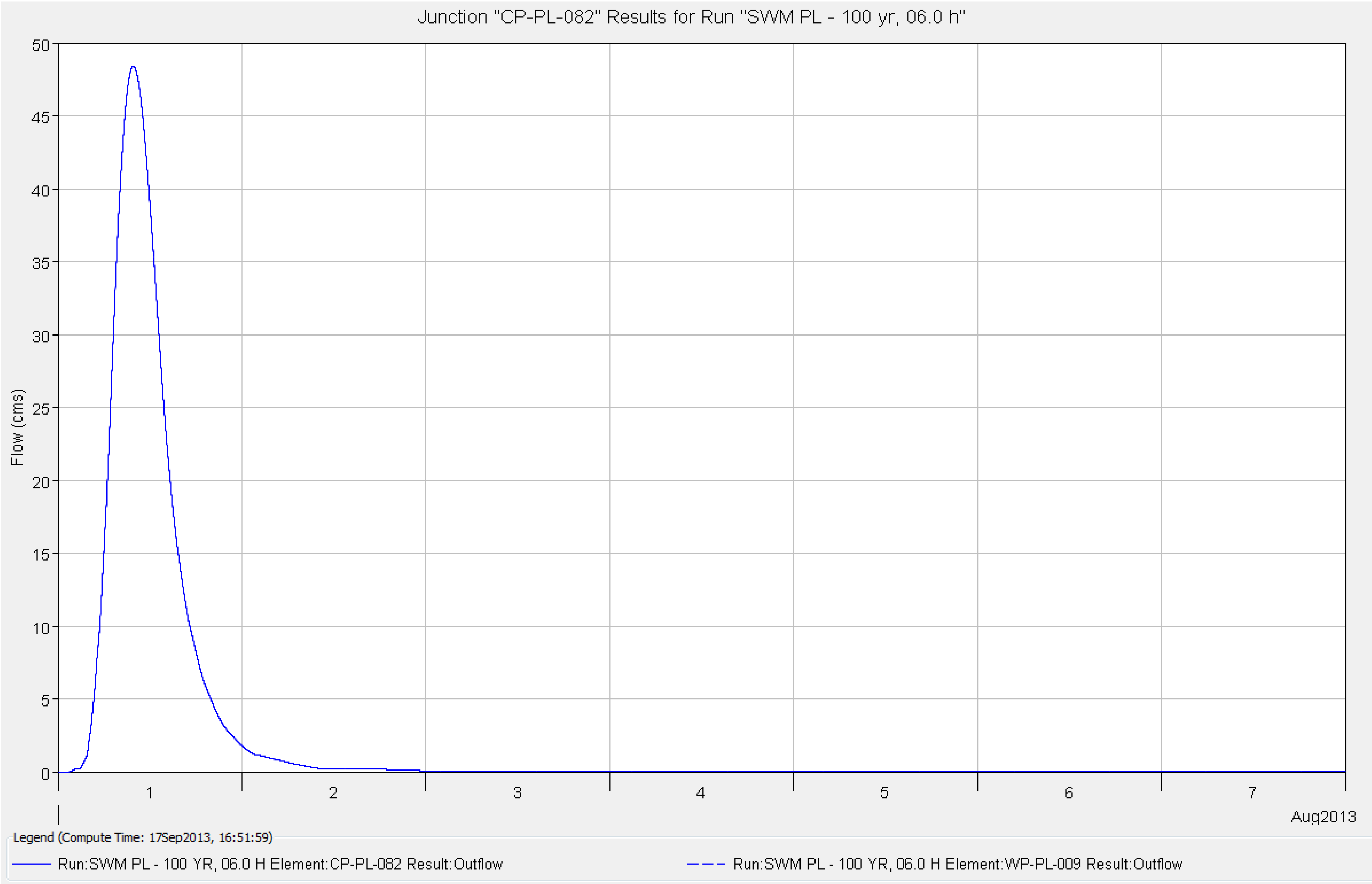


Junction "CP-PL-079" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-079 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-061 Result:Outflow

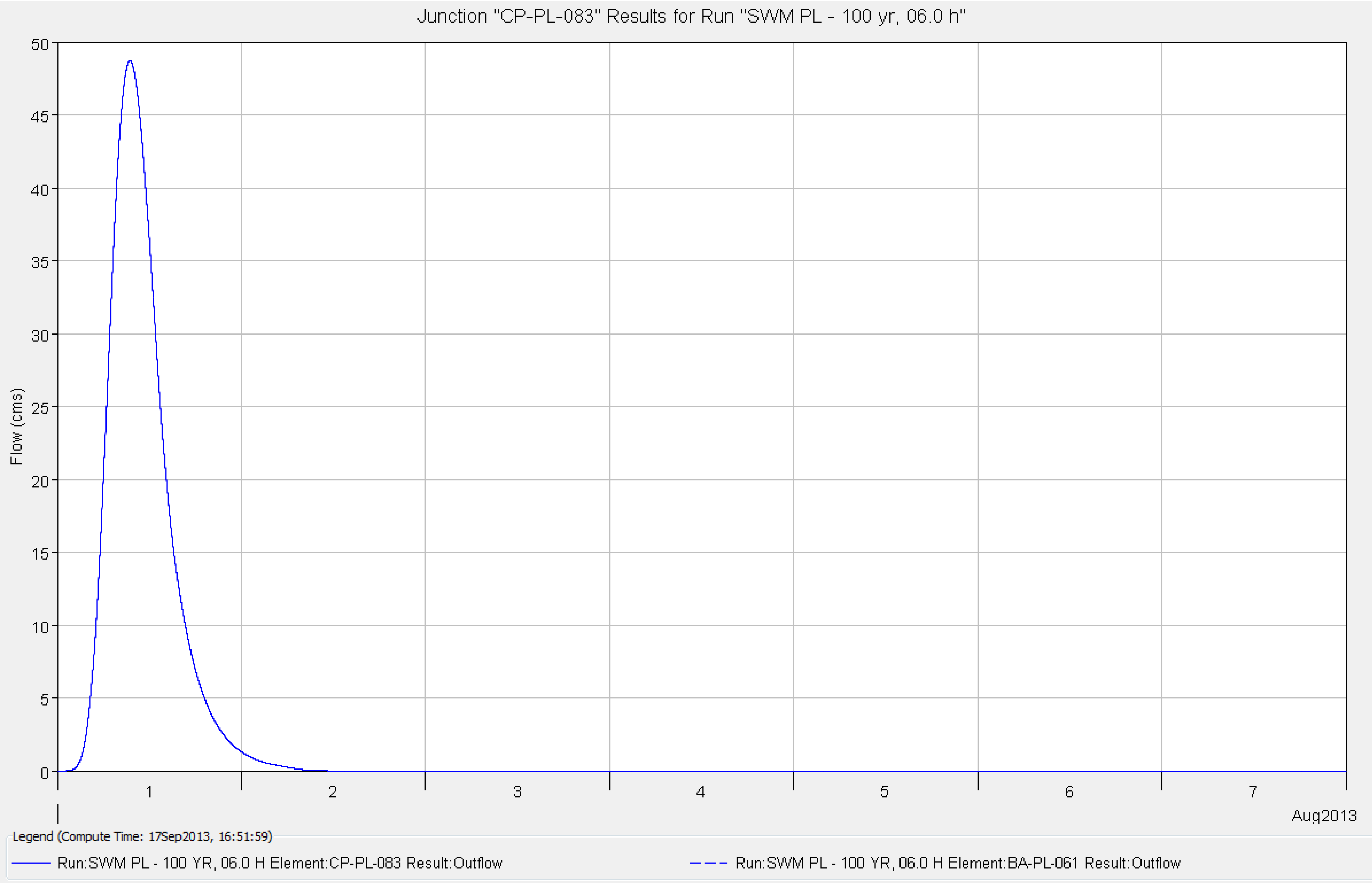

Junction "CP-PL-080" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-080 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-062 Result:Outflow

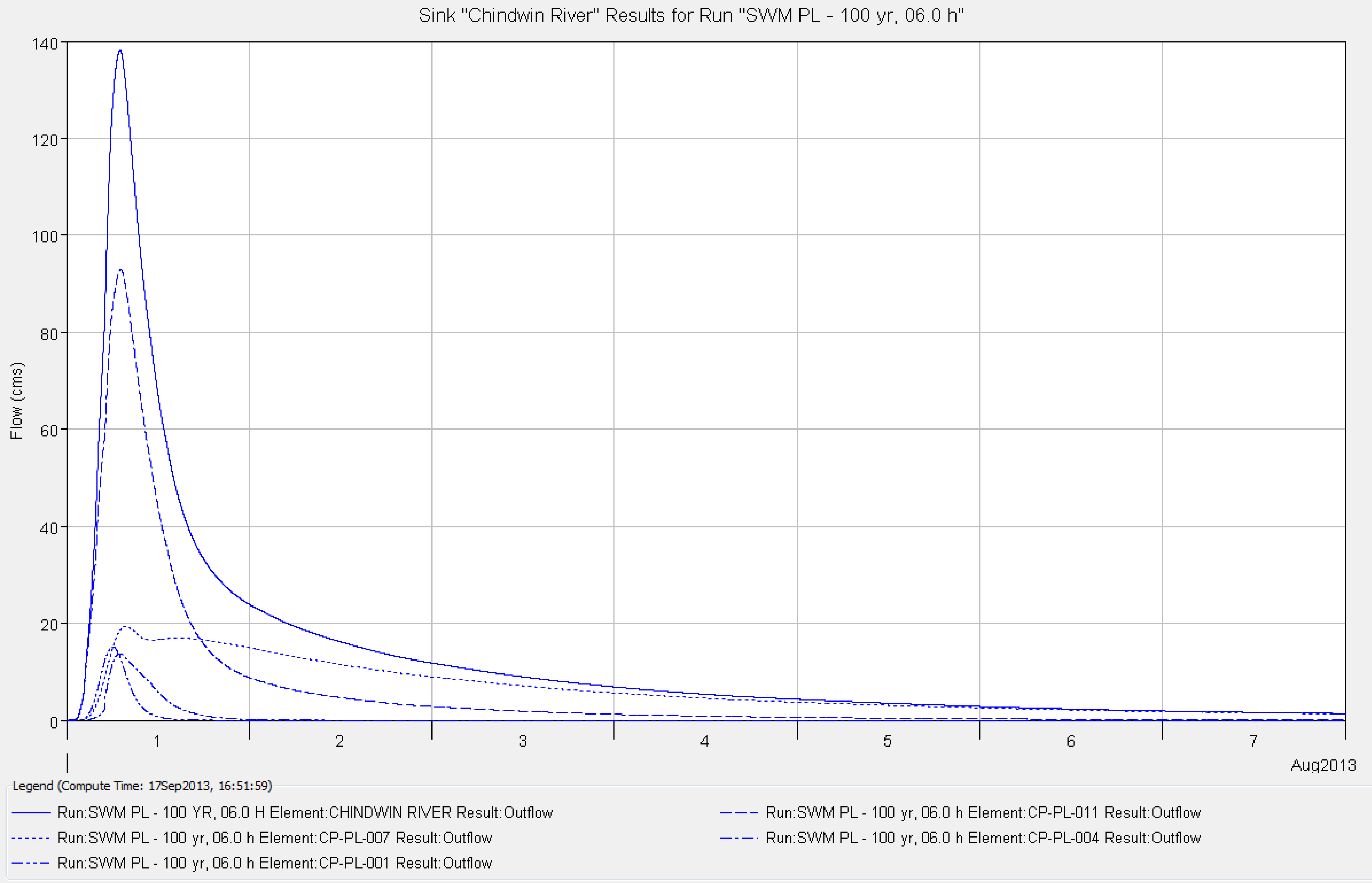


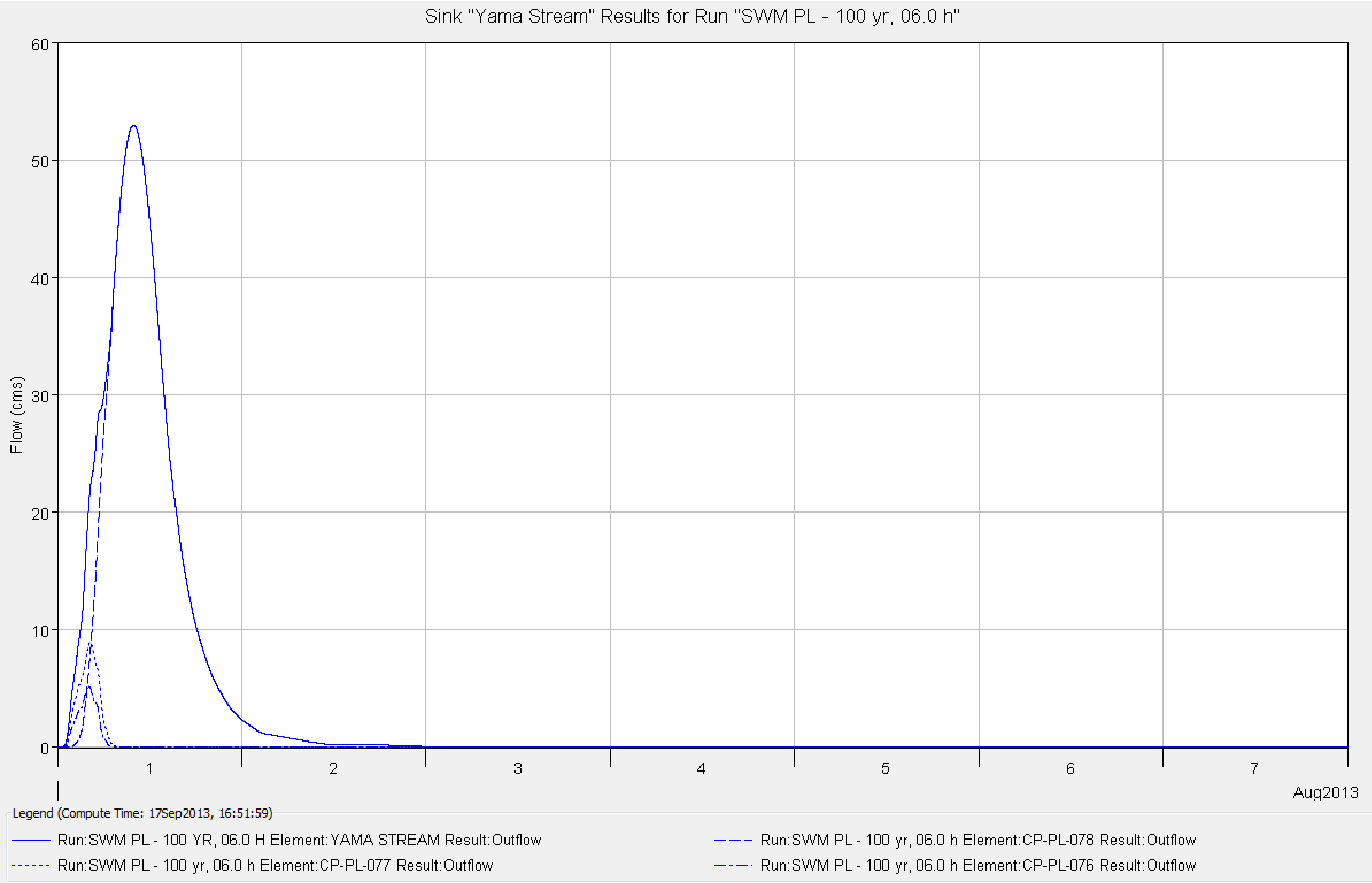
Junction "CP-PL-081" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-081 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-060 Result:Outflow

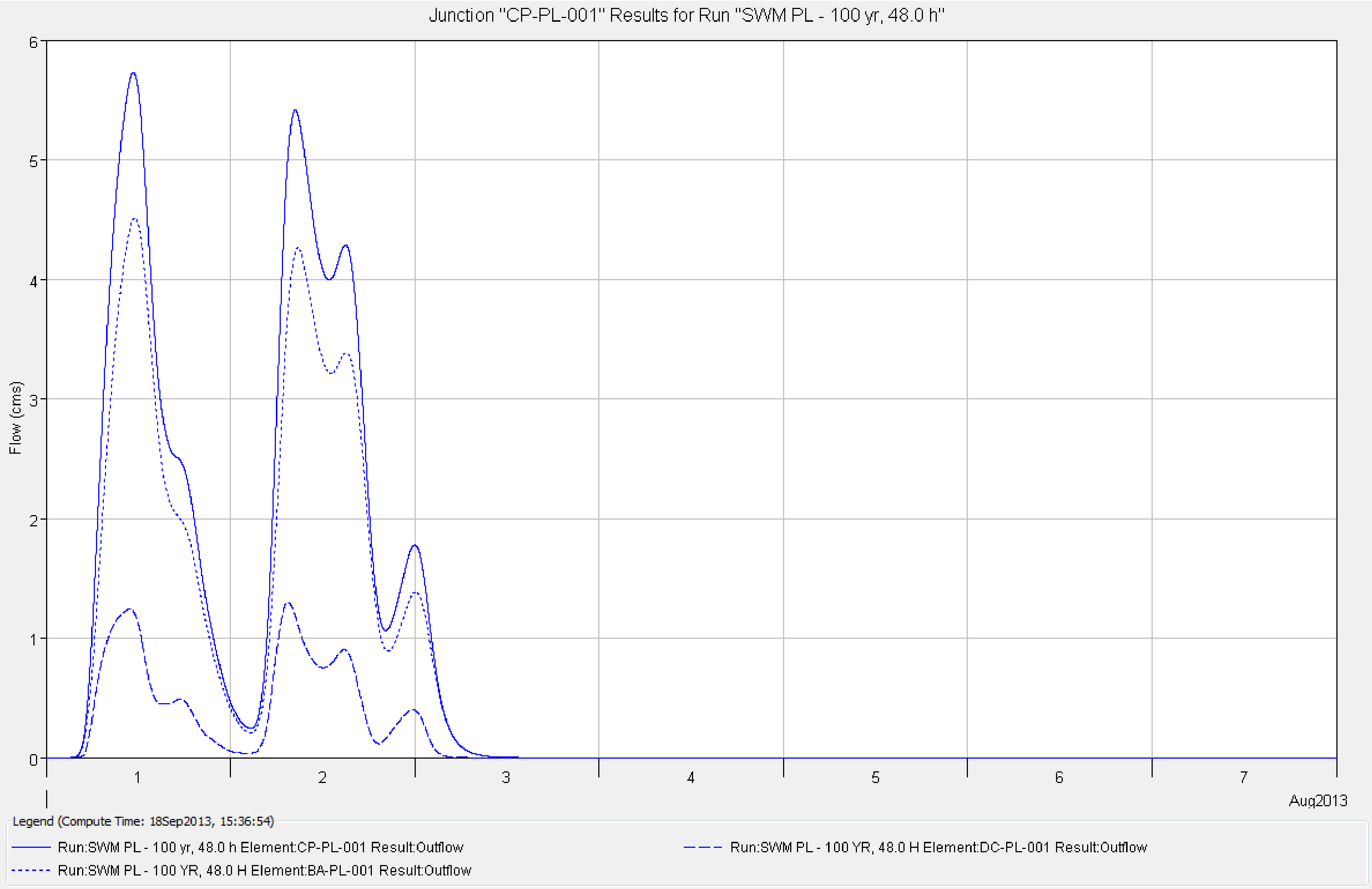


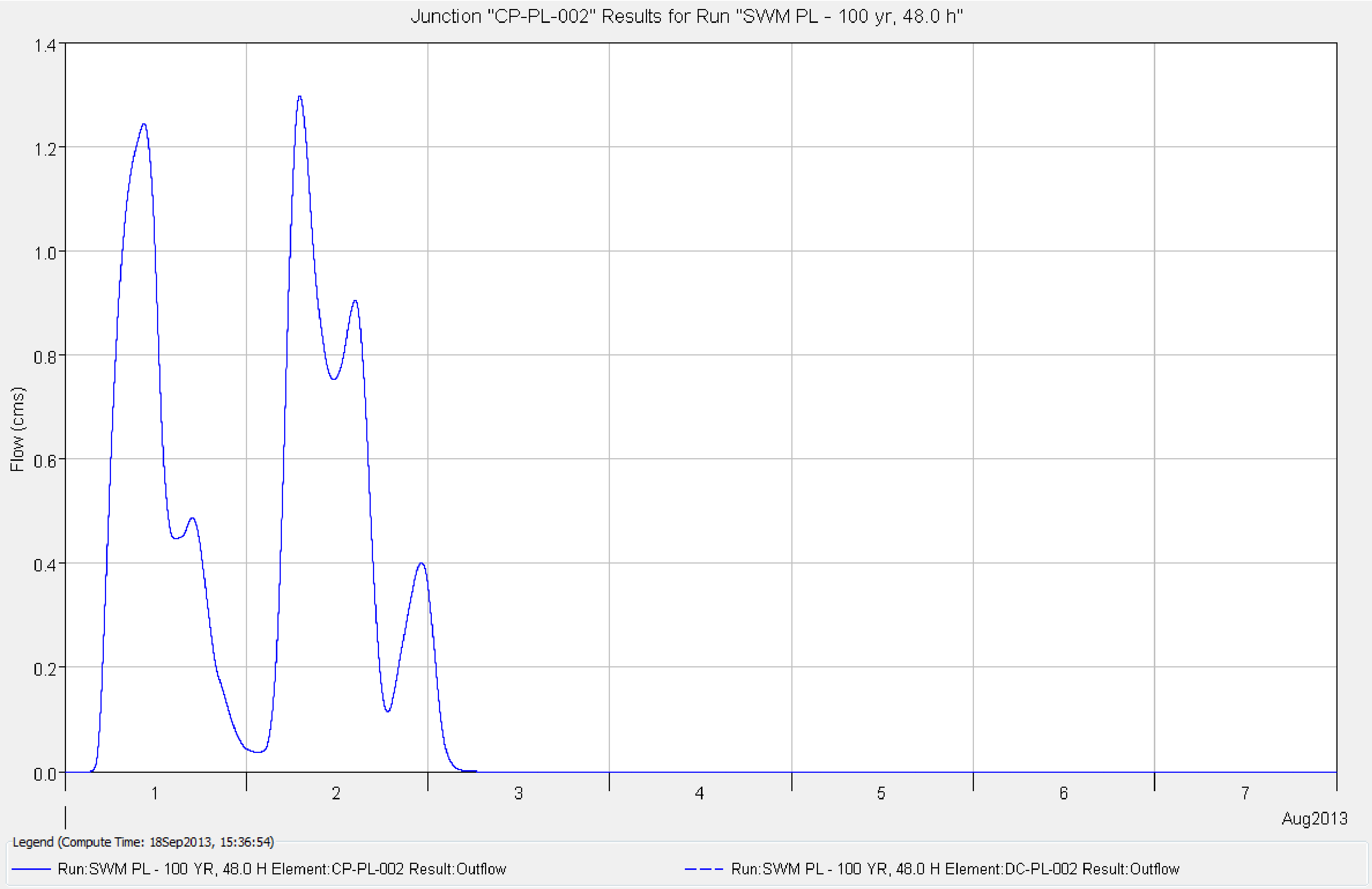
Junction "CP-PL-082" Results for Run "SWM PL - 100 yr, 06.0 h"
50
45
40
35
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-082 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Outflow


Junction "CP-PL-083" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-083 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-061 Result:Outflow

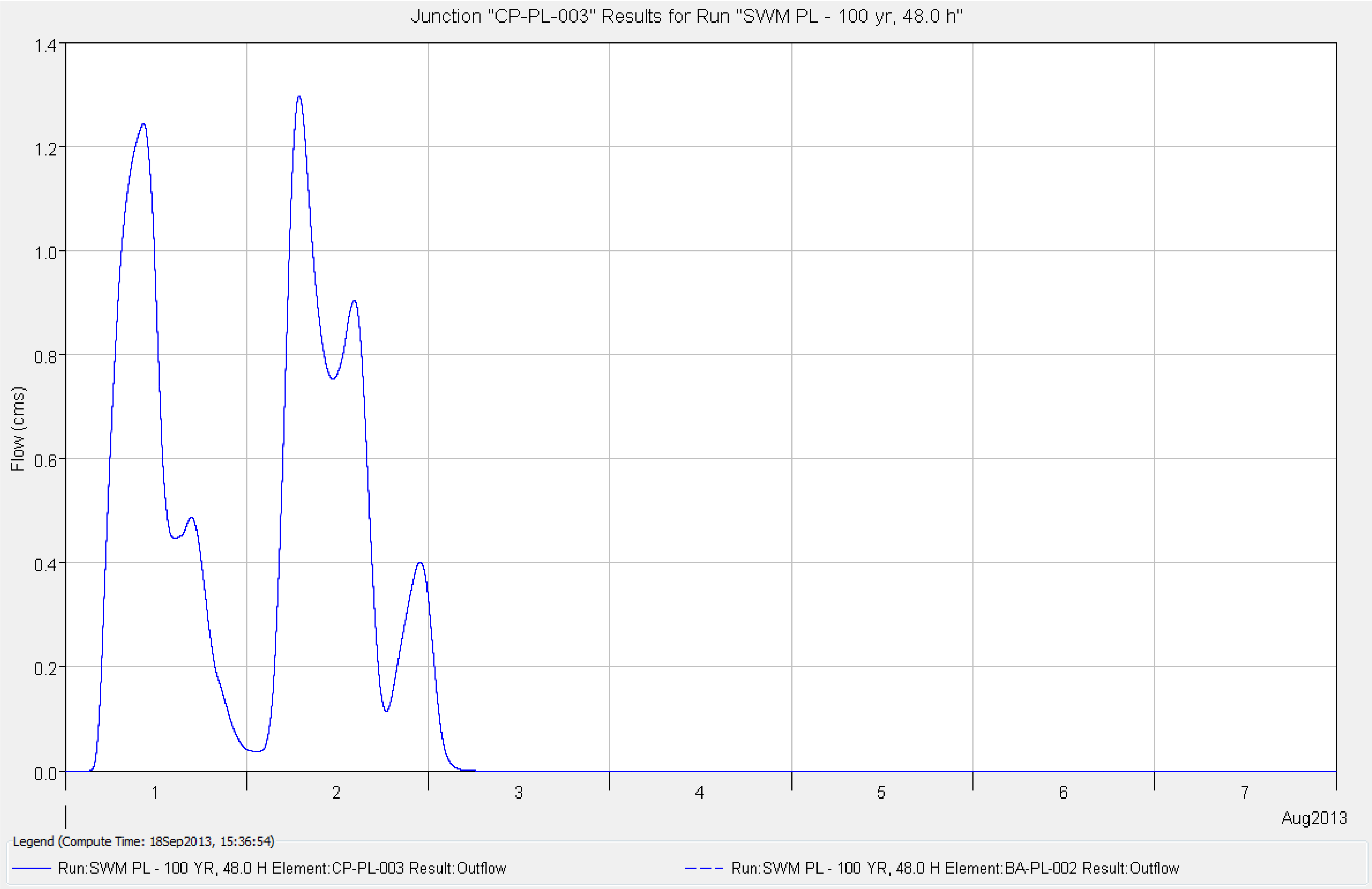

Sink "Chindwin River" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-001 Result:Outflow


Sink "Yama Stream" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 17Sep2013, 16:51:59)
Run:SWM PL - 100 YR, 06.0 H Element:YAMA STREAM Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-076 Result:Outflow

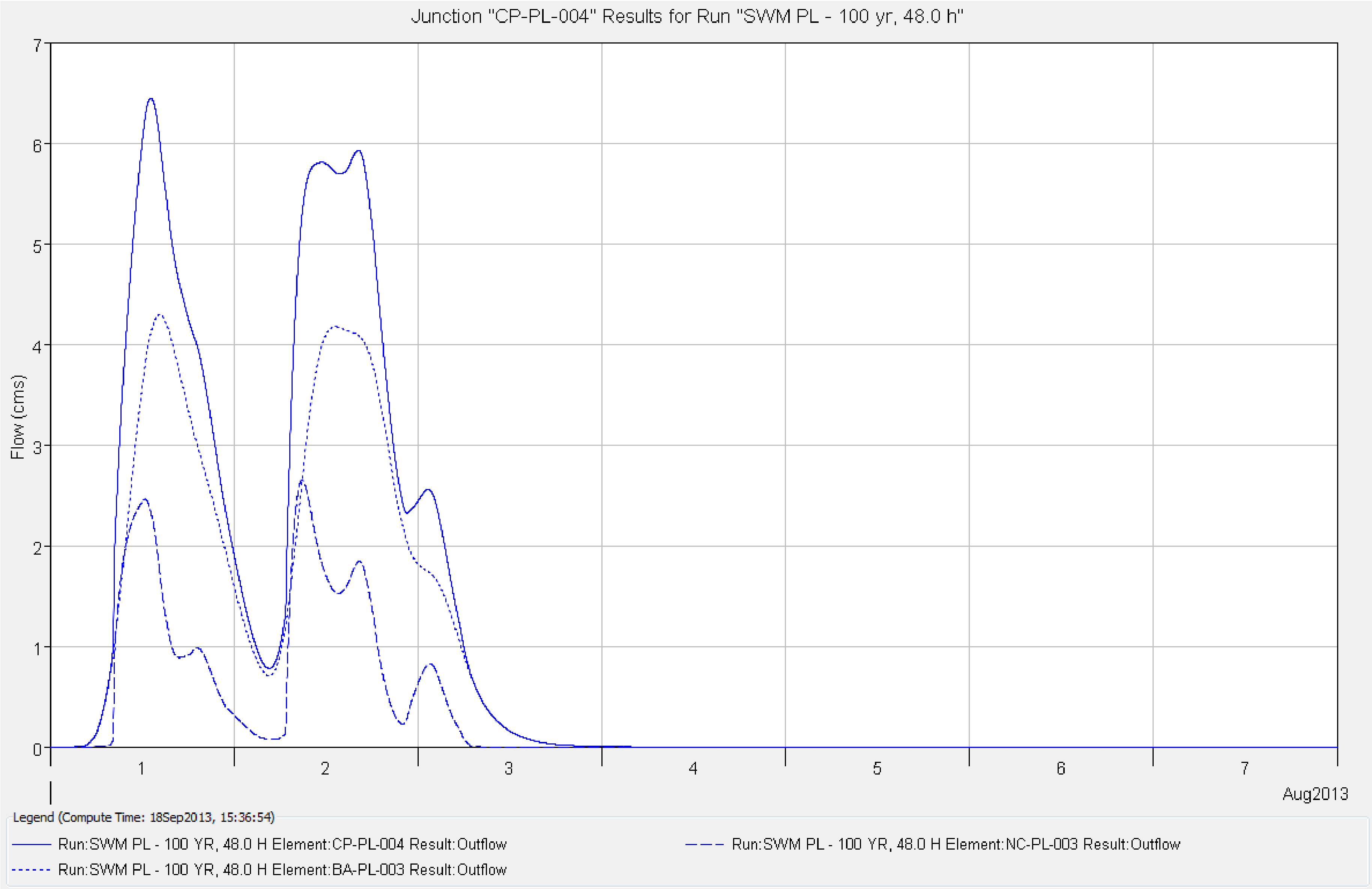

Junction "CP-PL-001" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-001 Result:Outflow



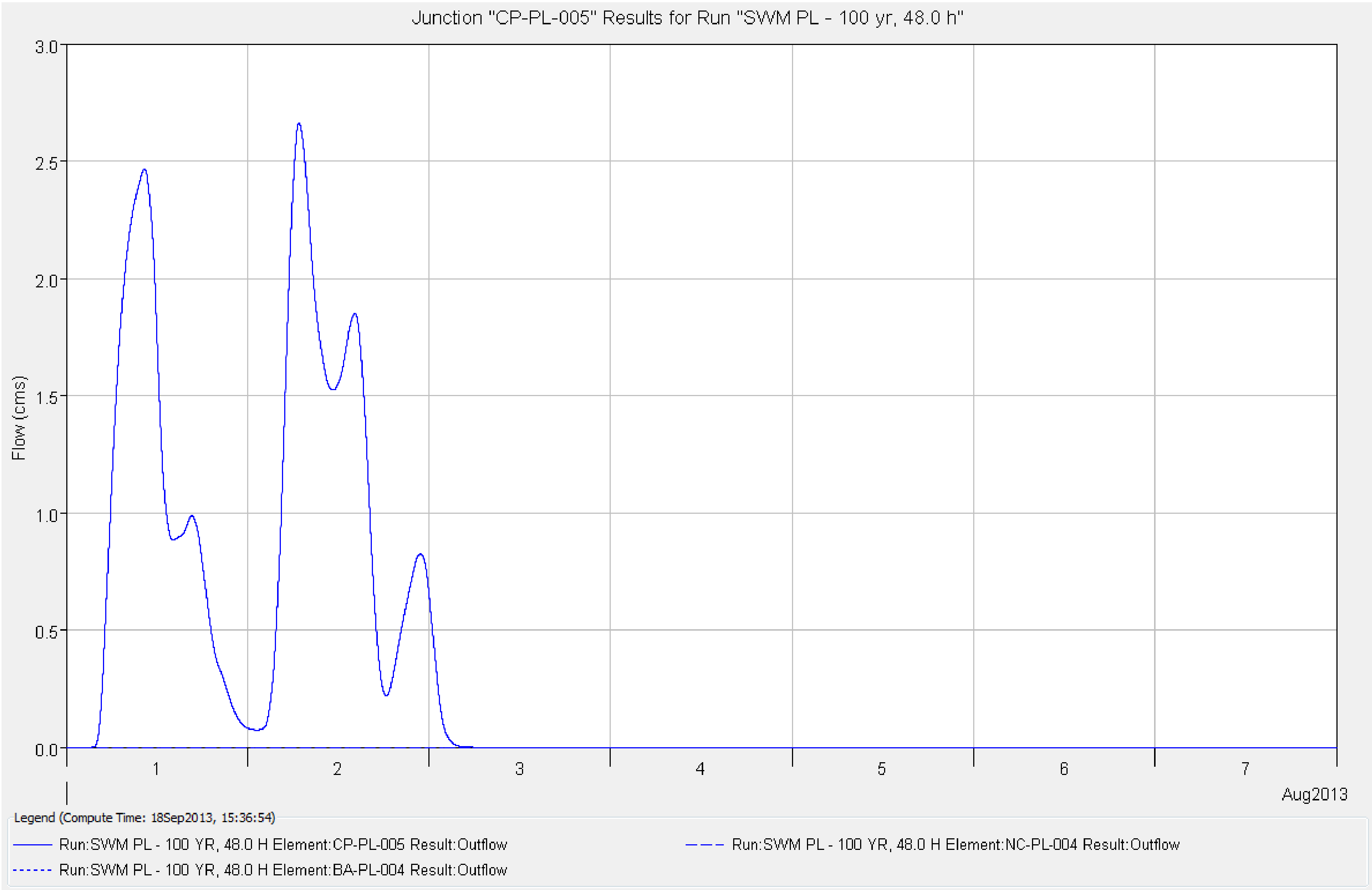
Junction "CP-PL-002" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-002 Result:Outflow



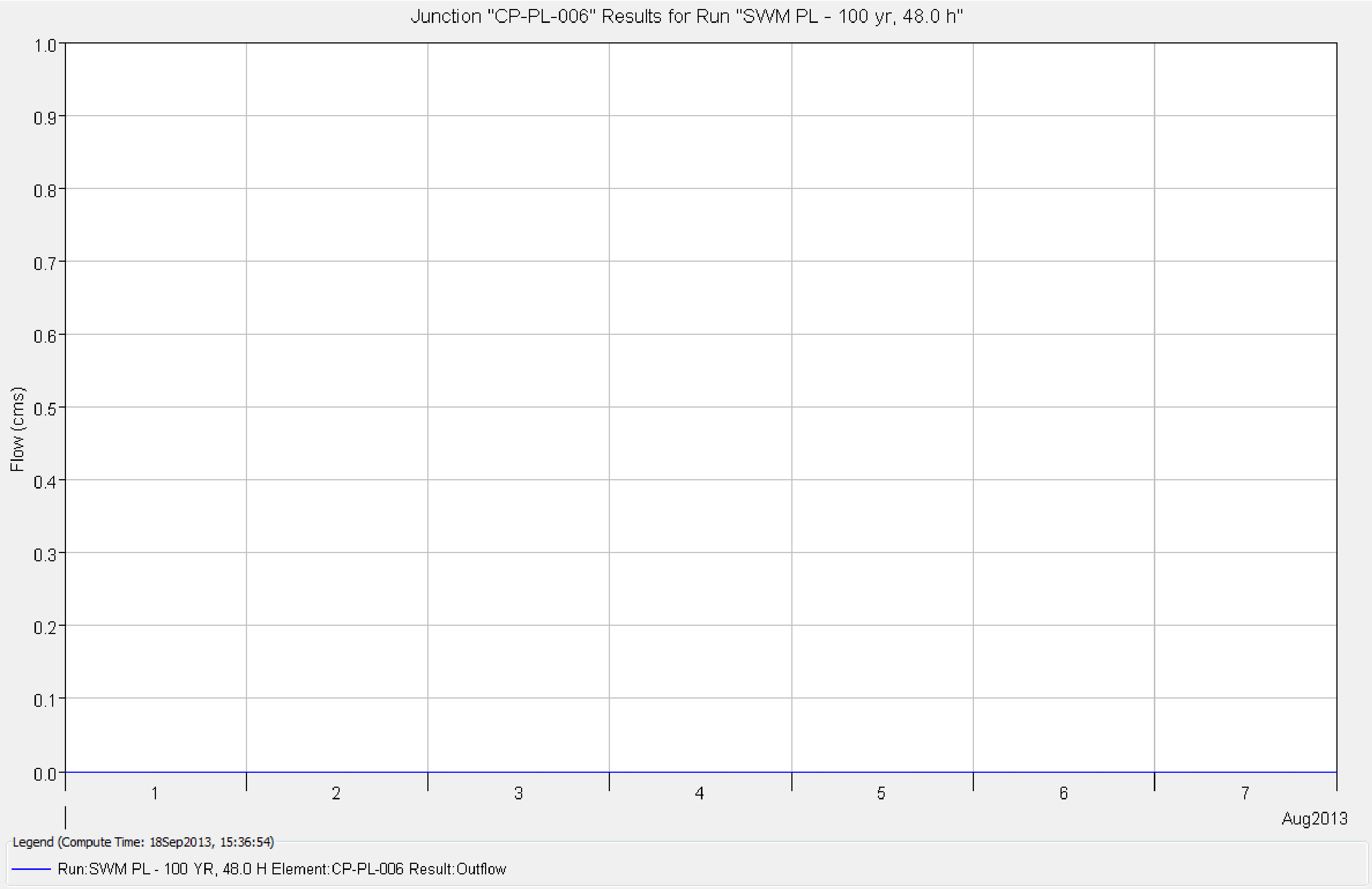
Junction "CP-PL-003" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-002 Result:Outflow



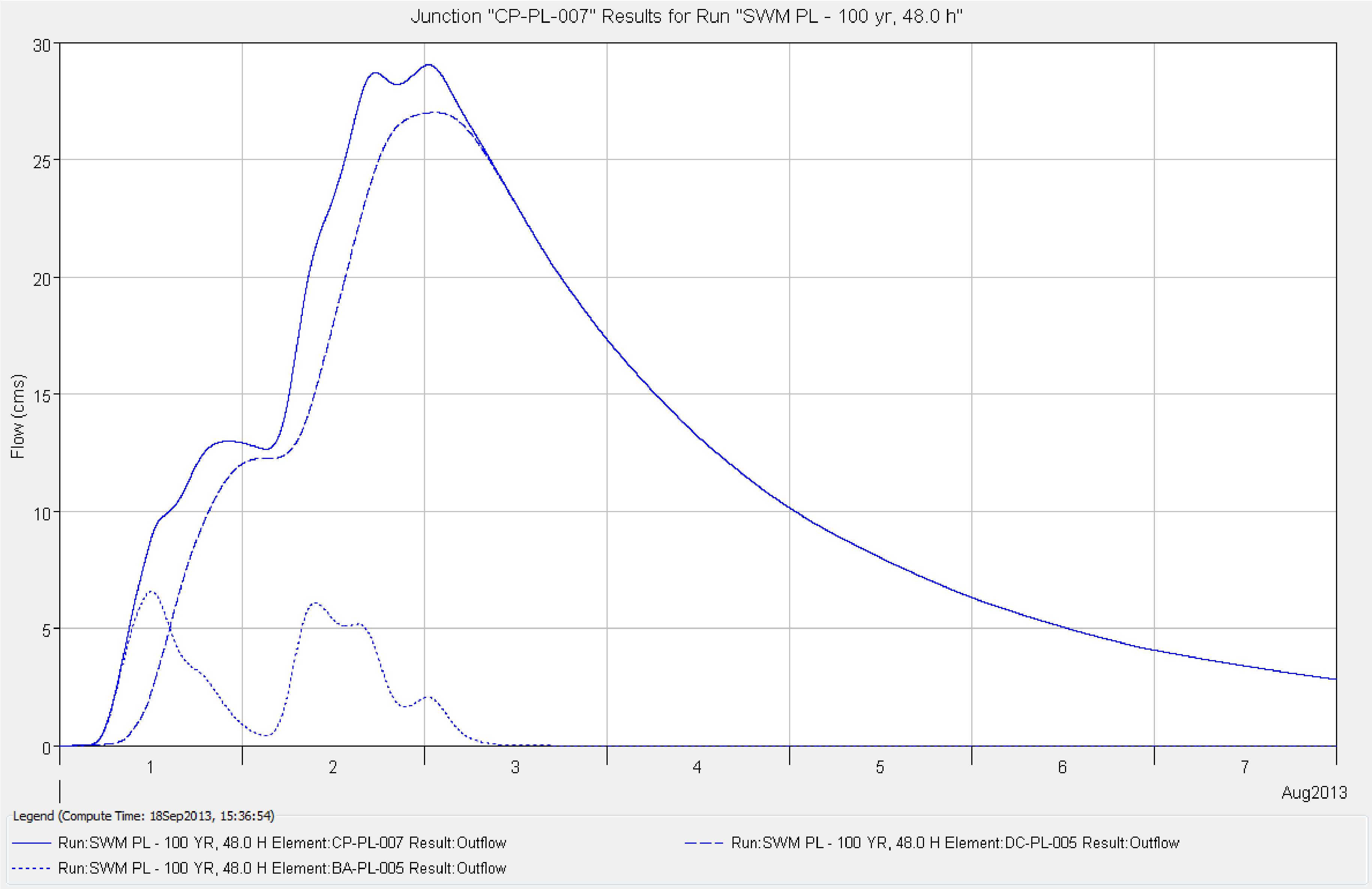
Junction "CP-PL-004" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-003 Result:Outflow



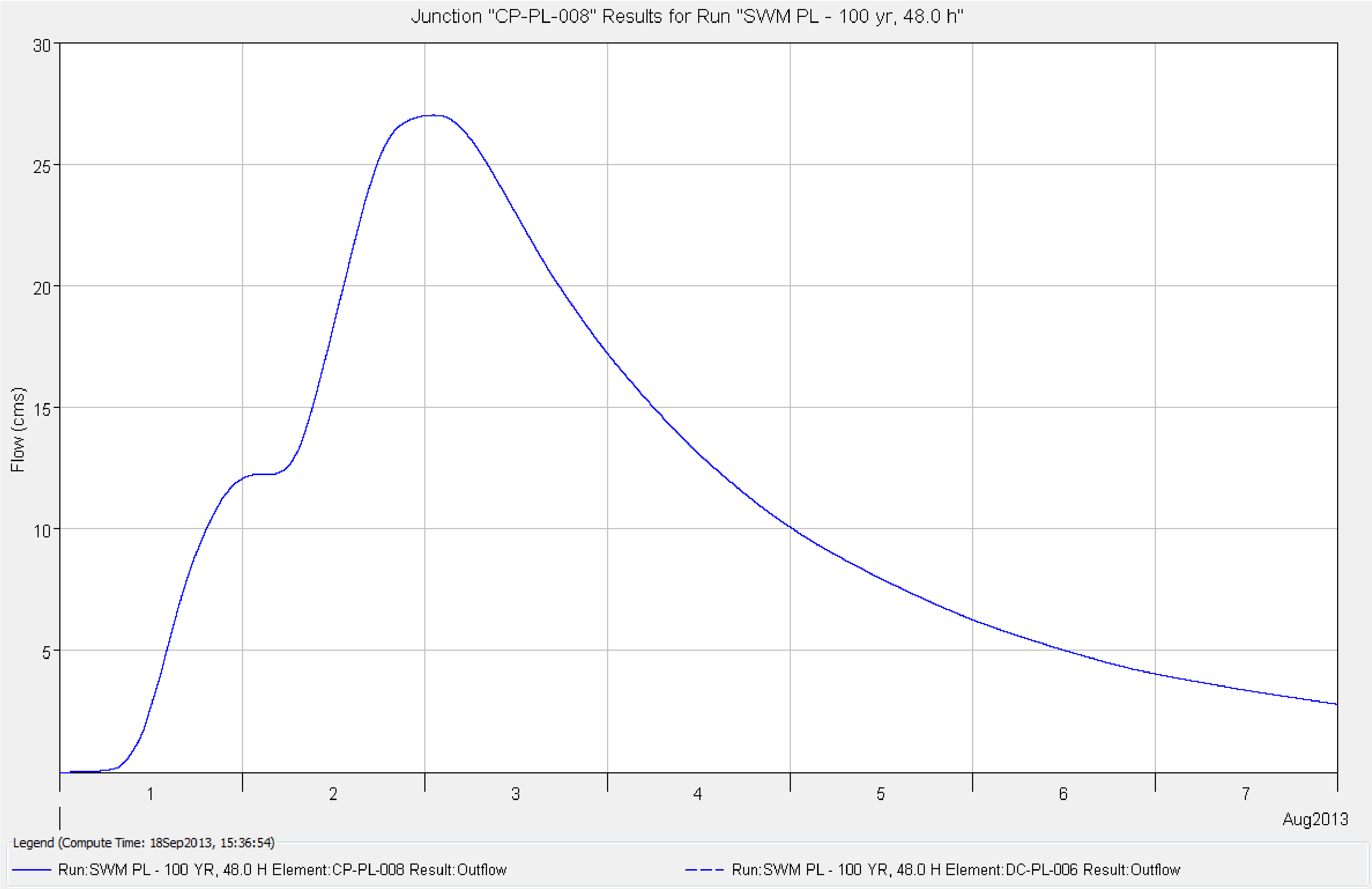
Junction "CP-PL-005" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-004 Result:Outflow



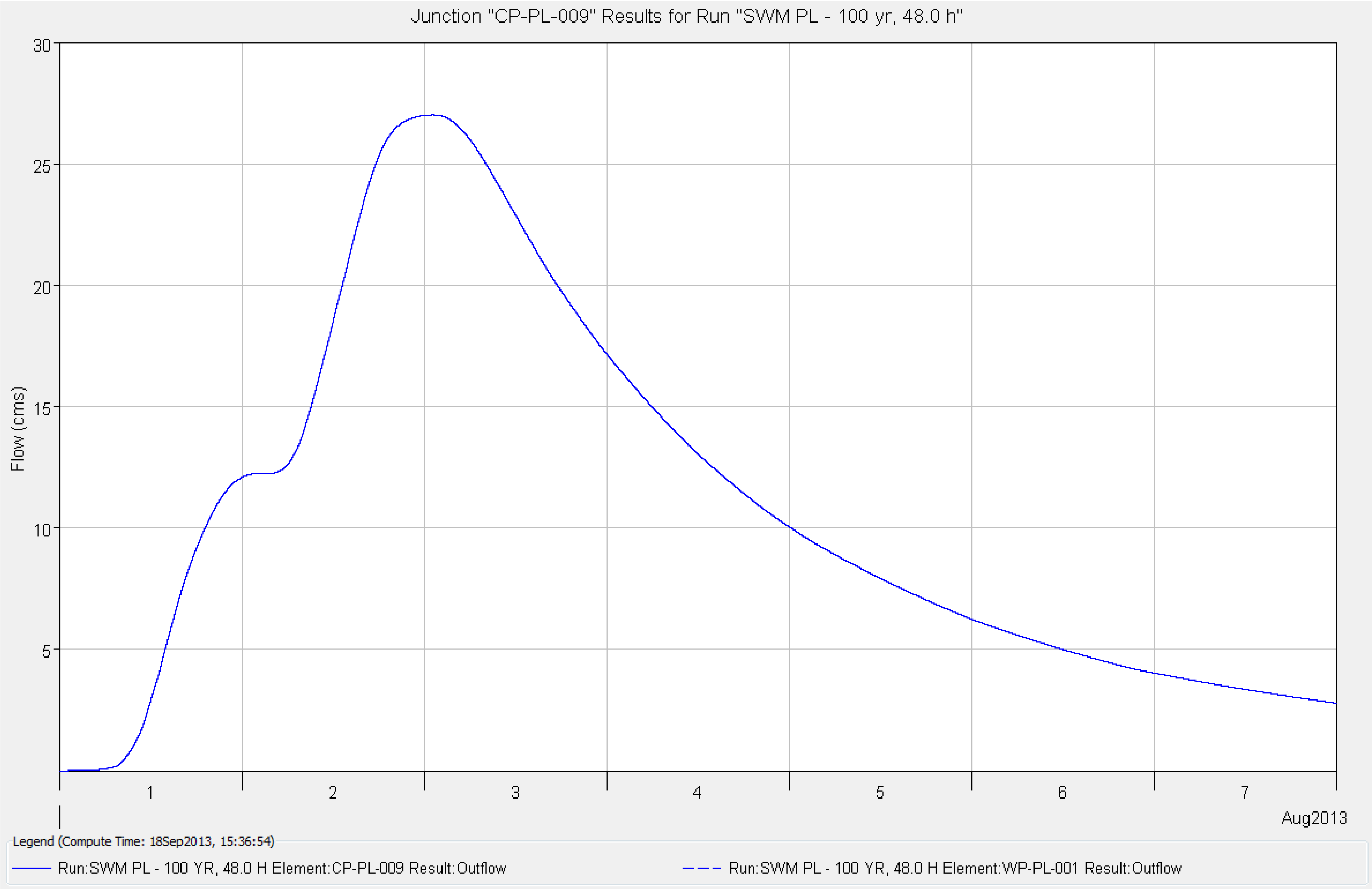
Junction "CP-PL-006" Results for Run "SWM PL - 100 yr, 48.0 h"
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-006 Result:Outflow



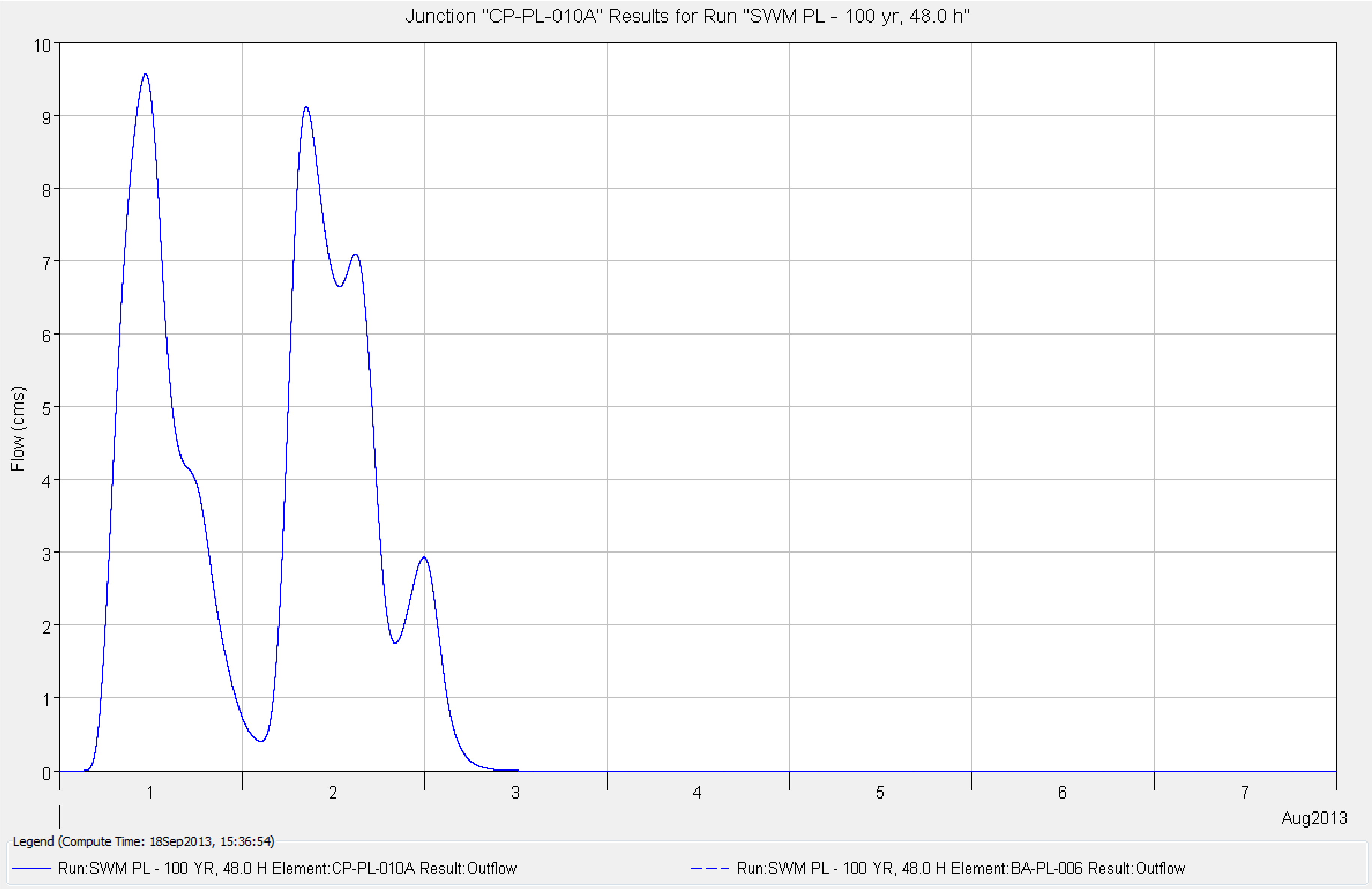
Junction "CP-PL-007" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-005 Result:Outflow



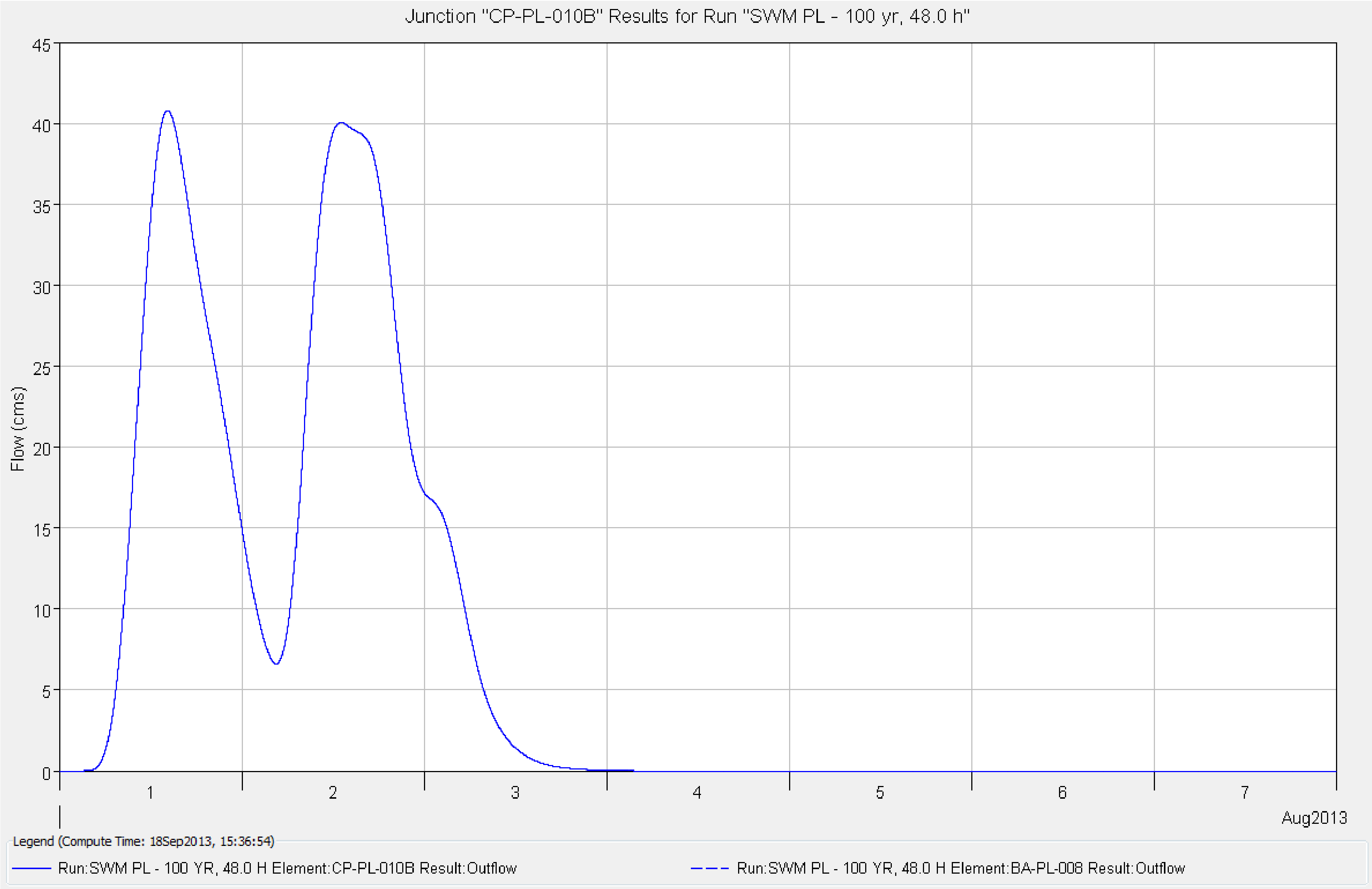
Junction "CP-PL-008" Results for Run "SWM PL - 100 yr, 48.0 h"
30
25
20
15
10
5
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-006 Result:Outflow



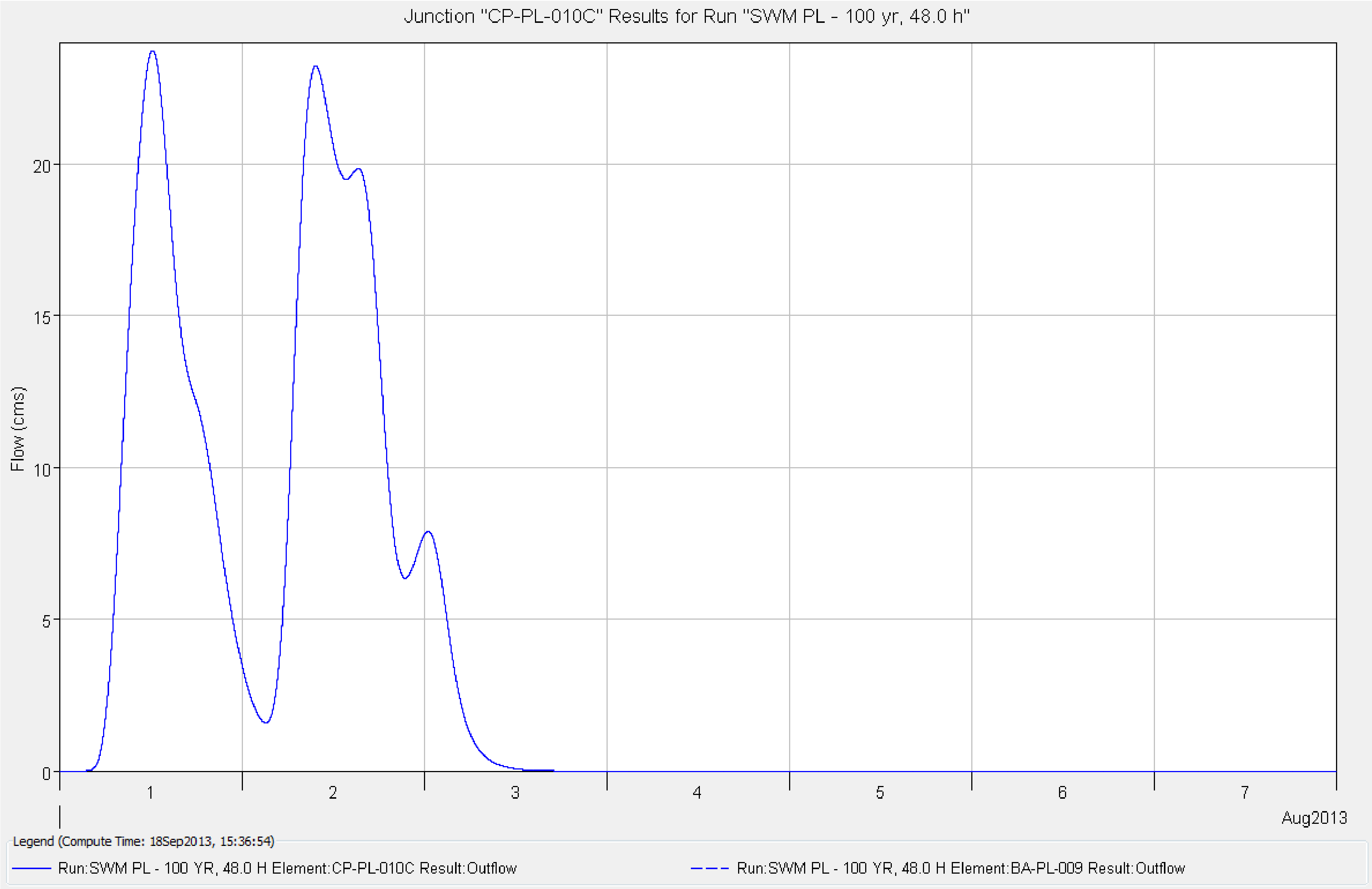
Junction "CP-PL-009" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Outflow



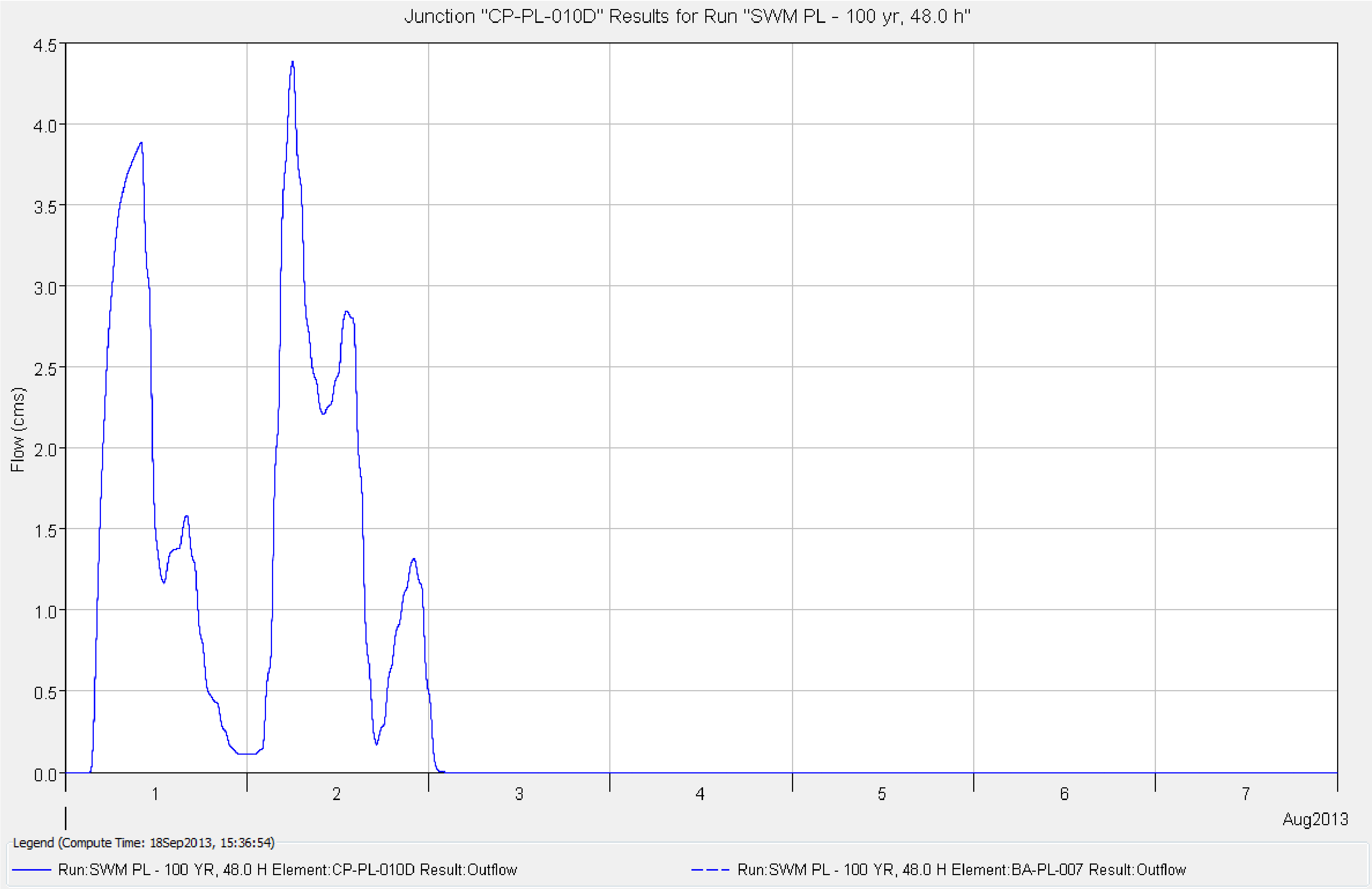
Junction "CP-PL-010A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-006 Result:Outflow

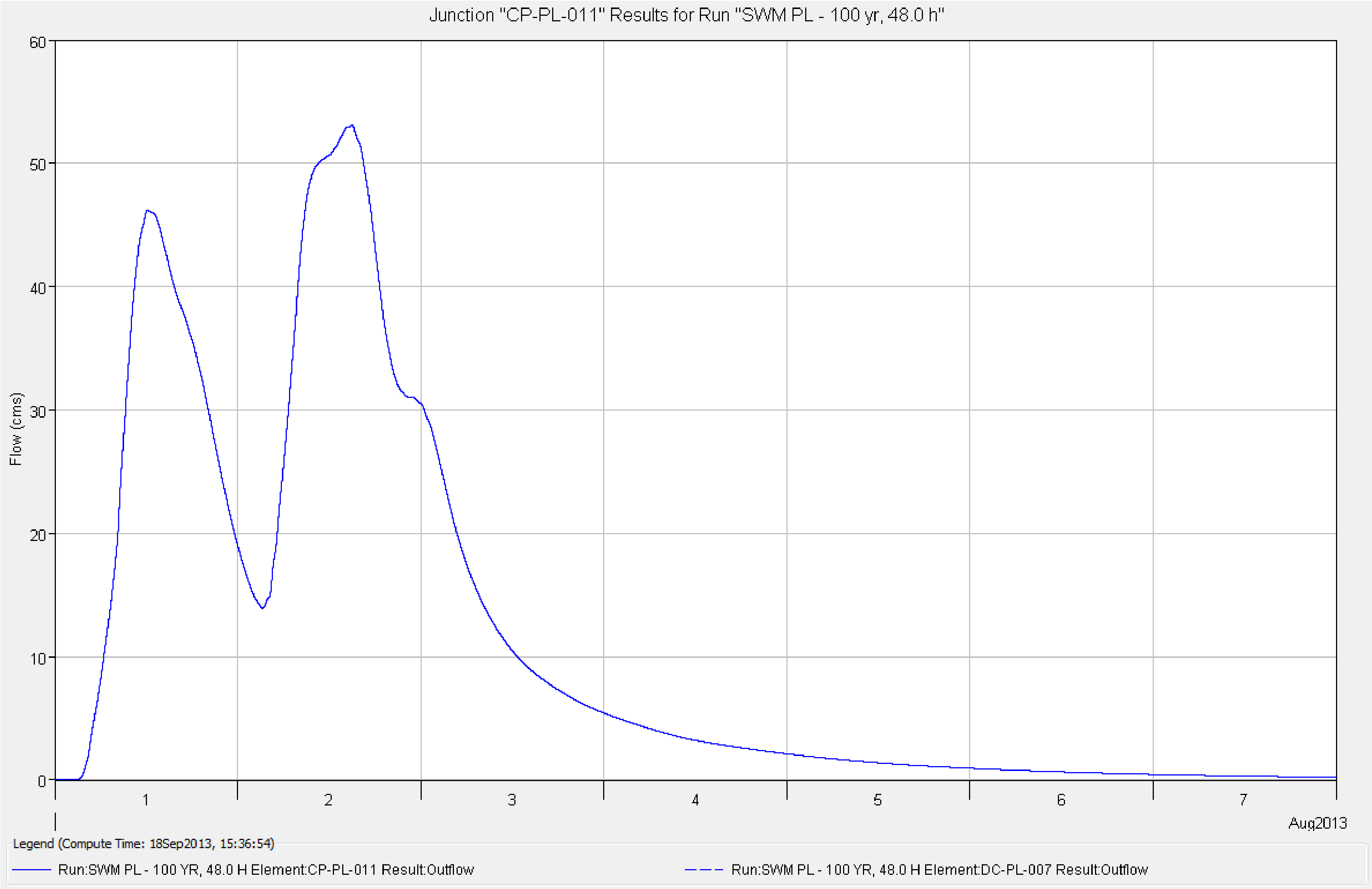


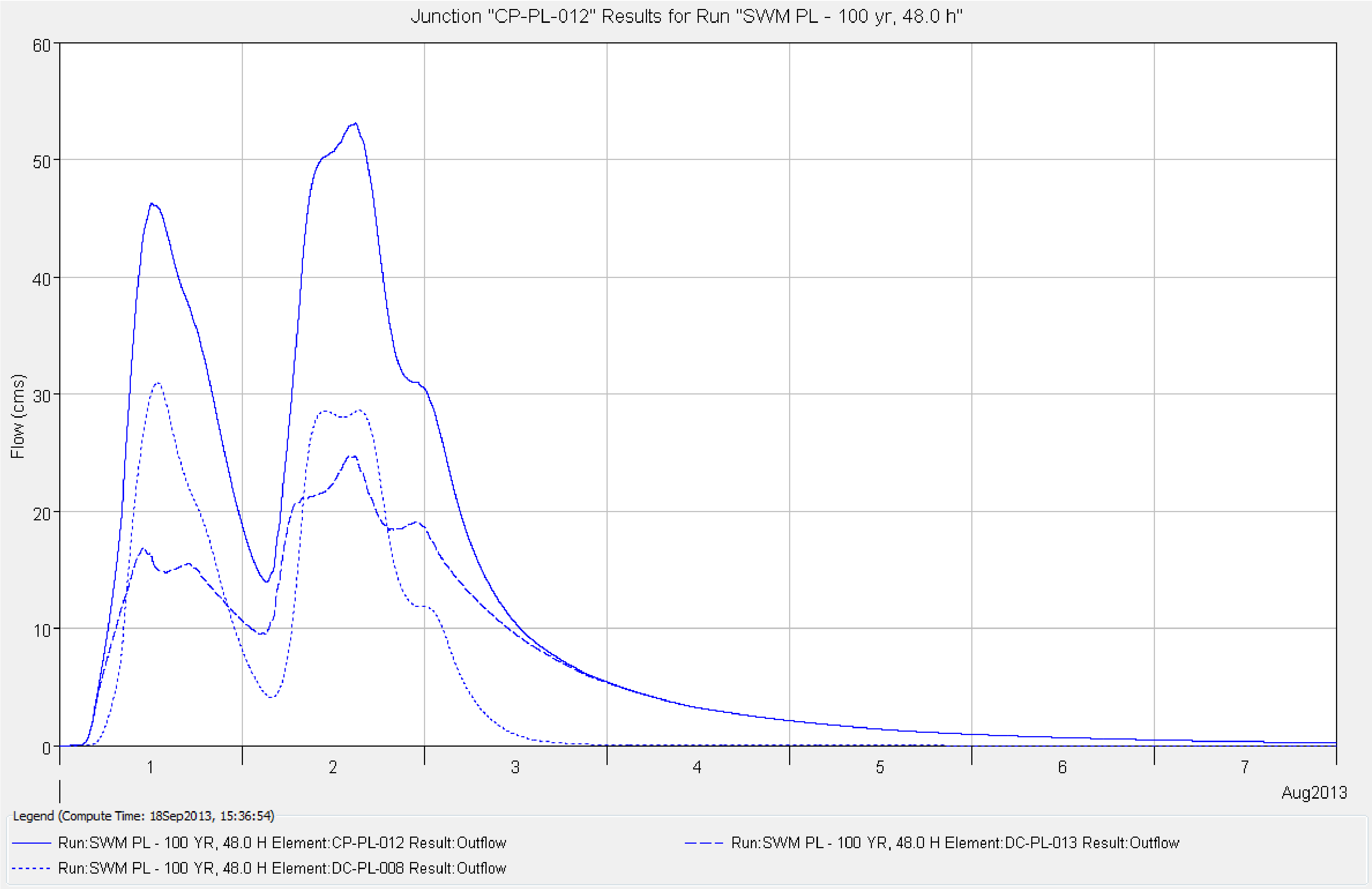
Junction "CP-PL-010B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-008 Result:Outflow



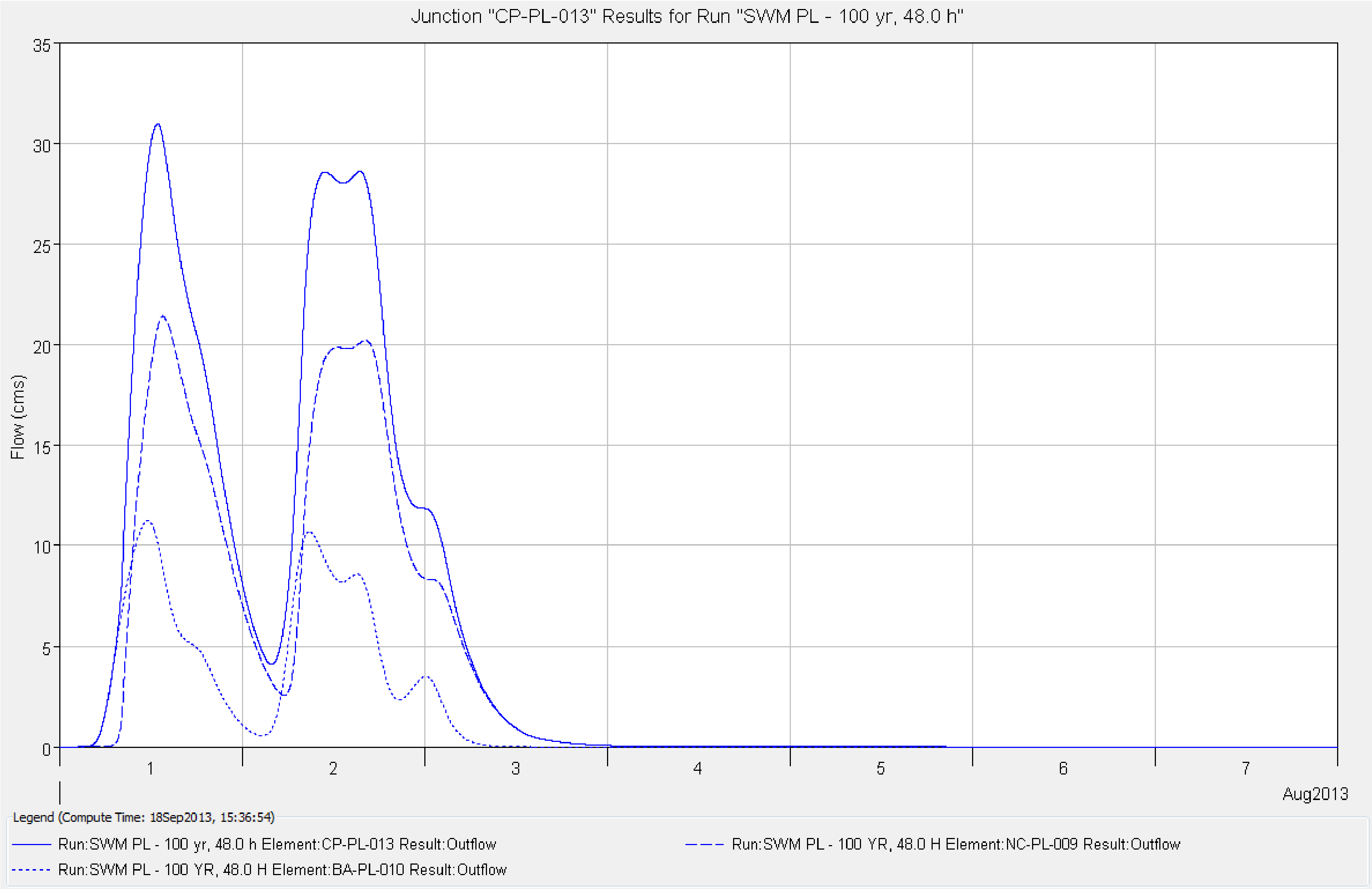
Junction "CP-PL-010C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-009 Result:Outflow


Junction "CP-PL-010D" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010D Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-007 Result:Outflow

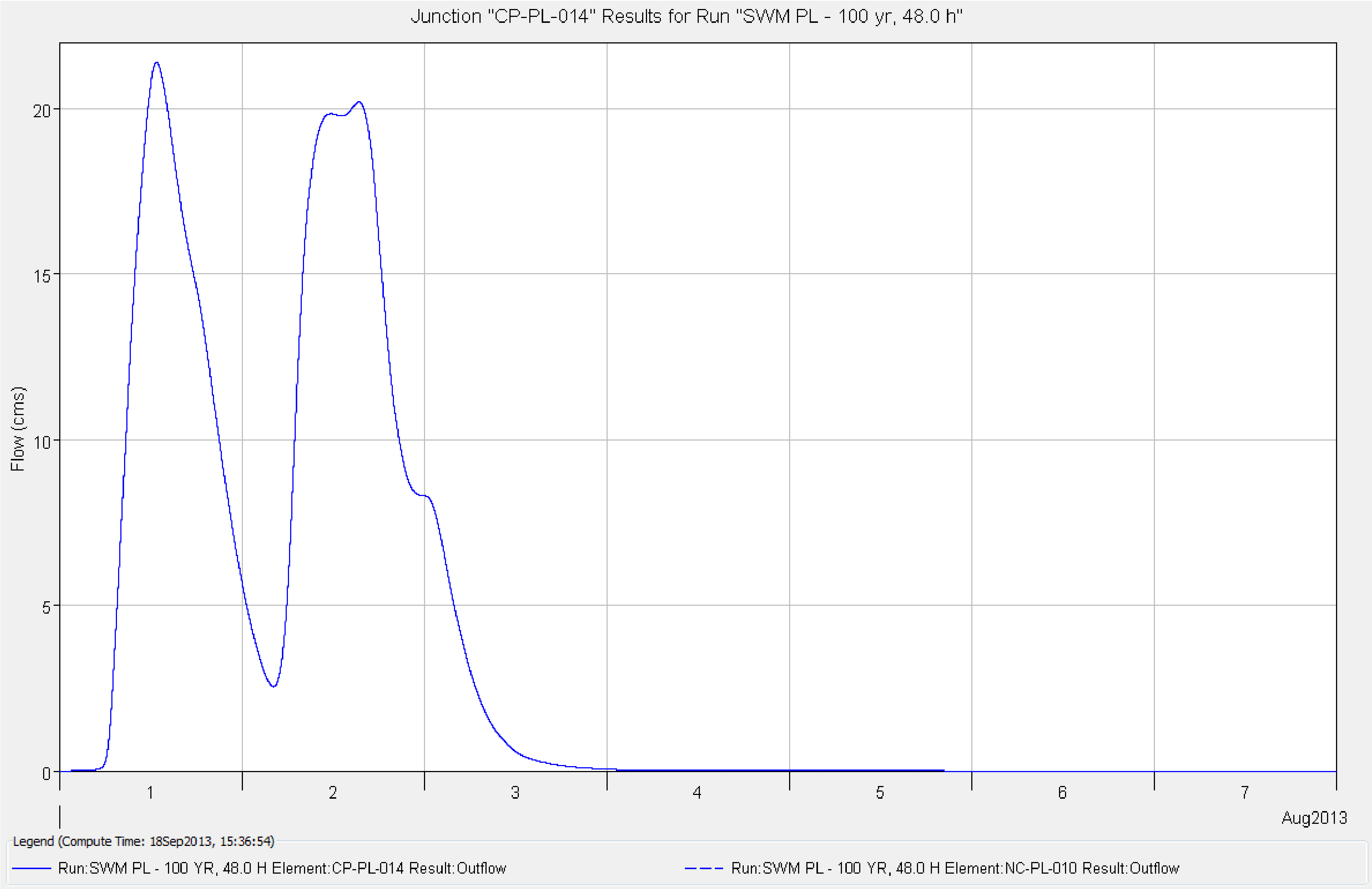

Junction "CP-PL-011" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-007 Result:Outflow

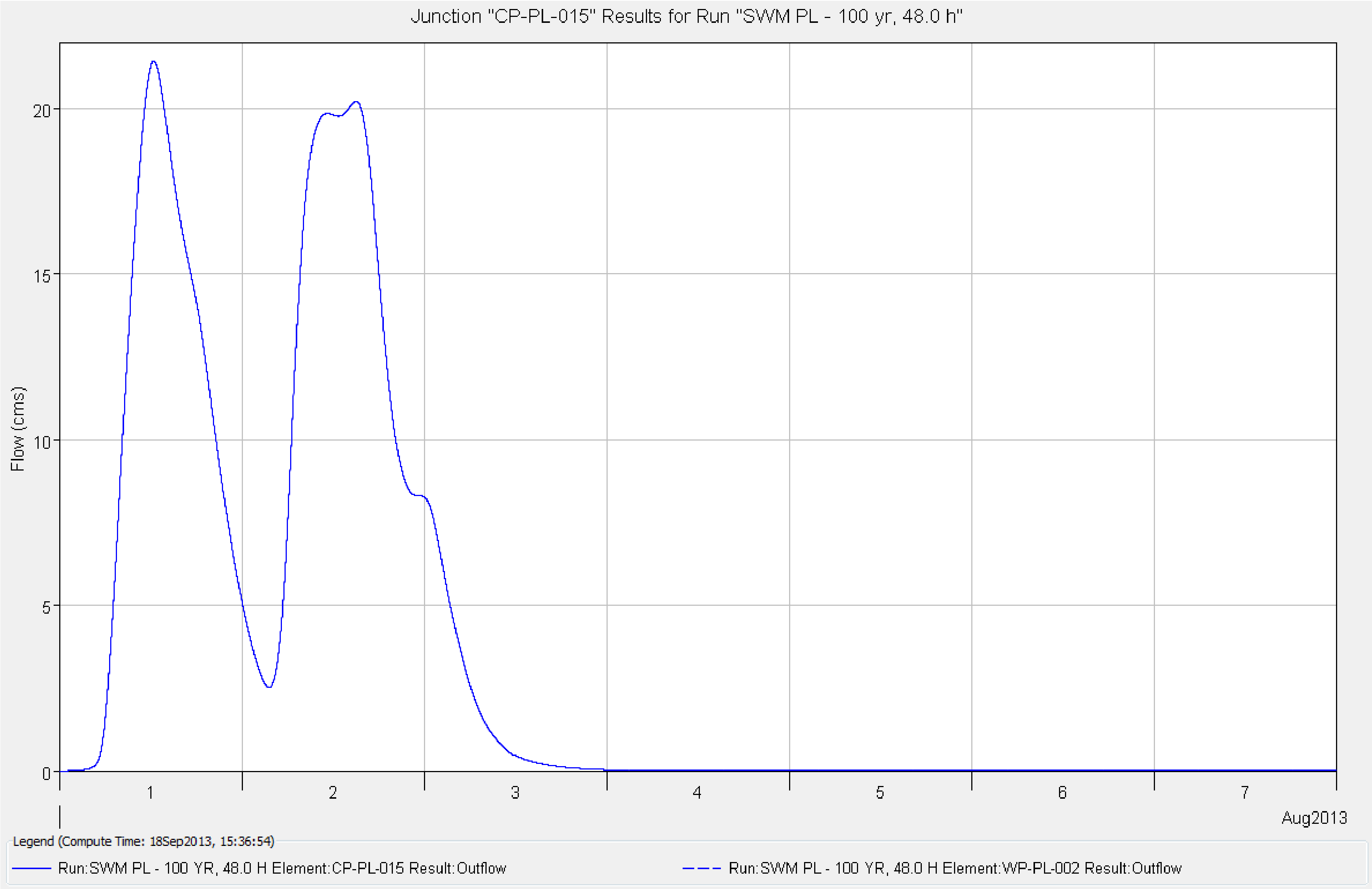


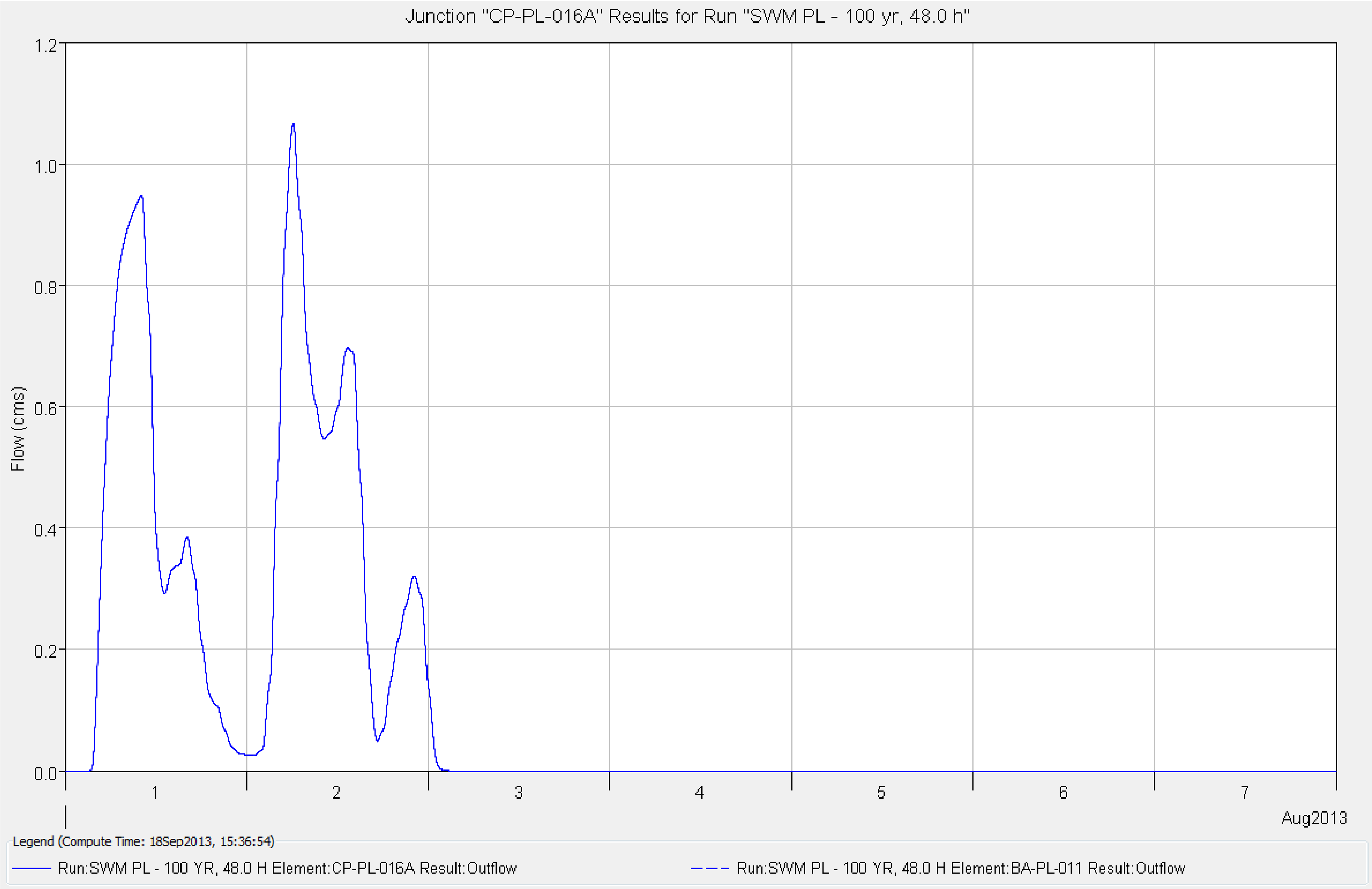
Junction "CP-PL-012" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-008 Result:Outflow



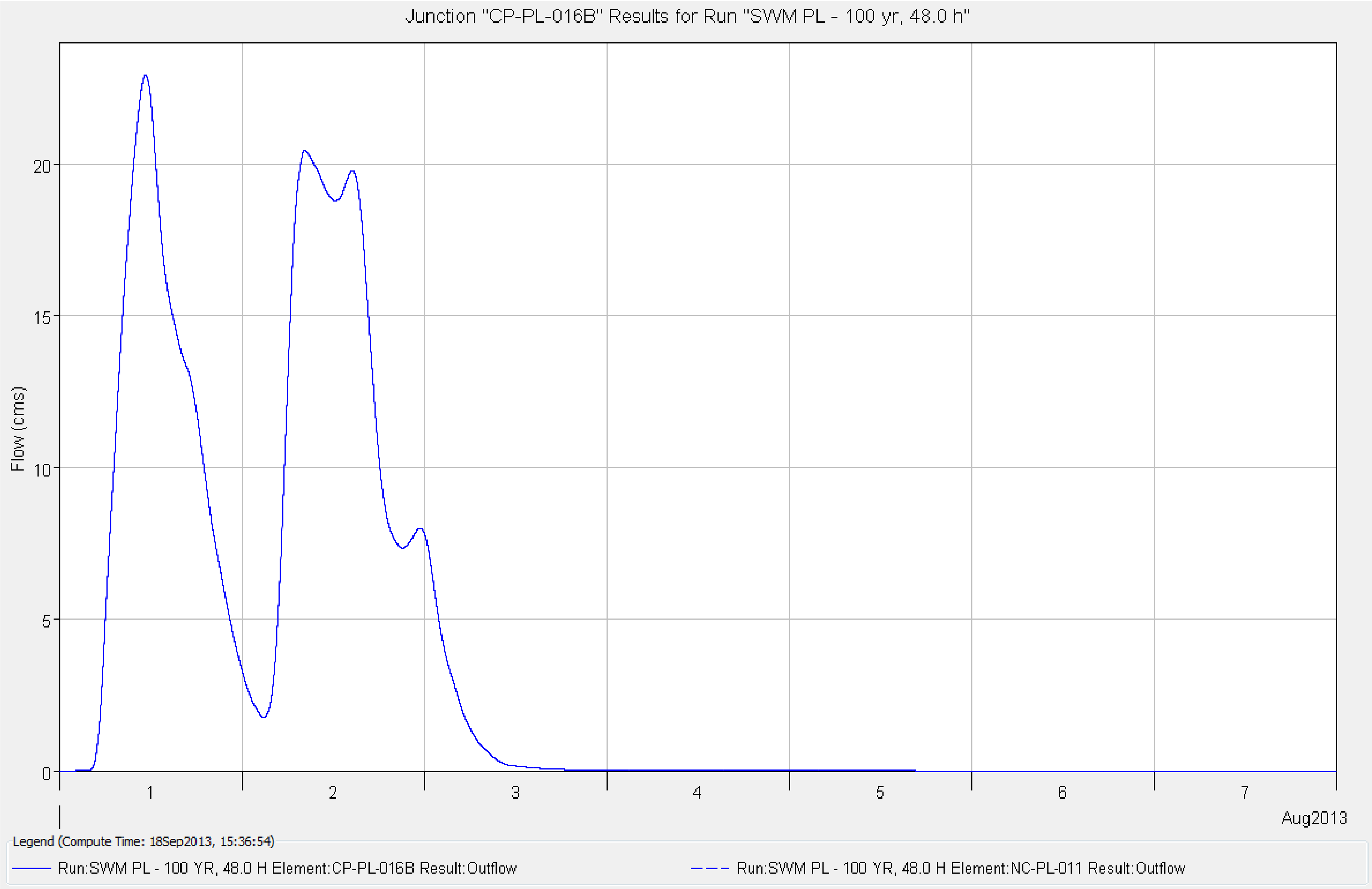
Junction "CP-PL-013" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
25
30
35
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-010 Result:Outflow

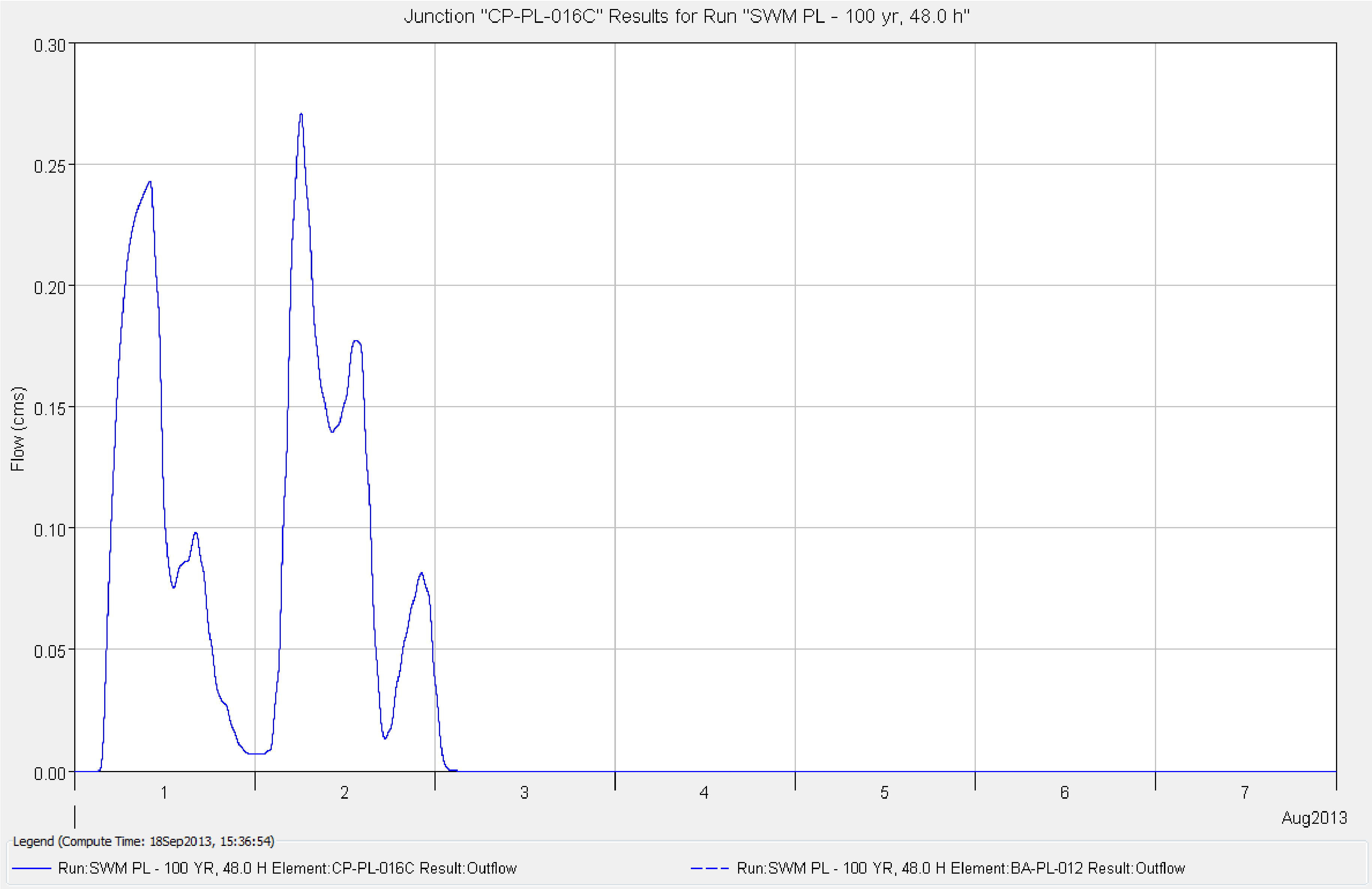

Junction "CP-PL-014" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-010 Result:Outflow


Junction "CP-PL-015" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-015 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Outflow

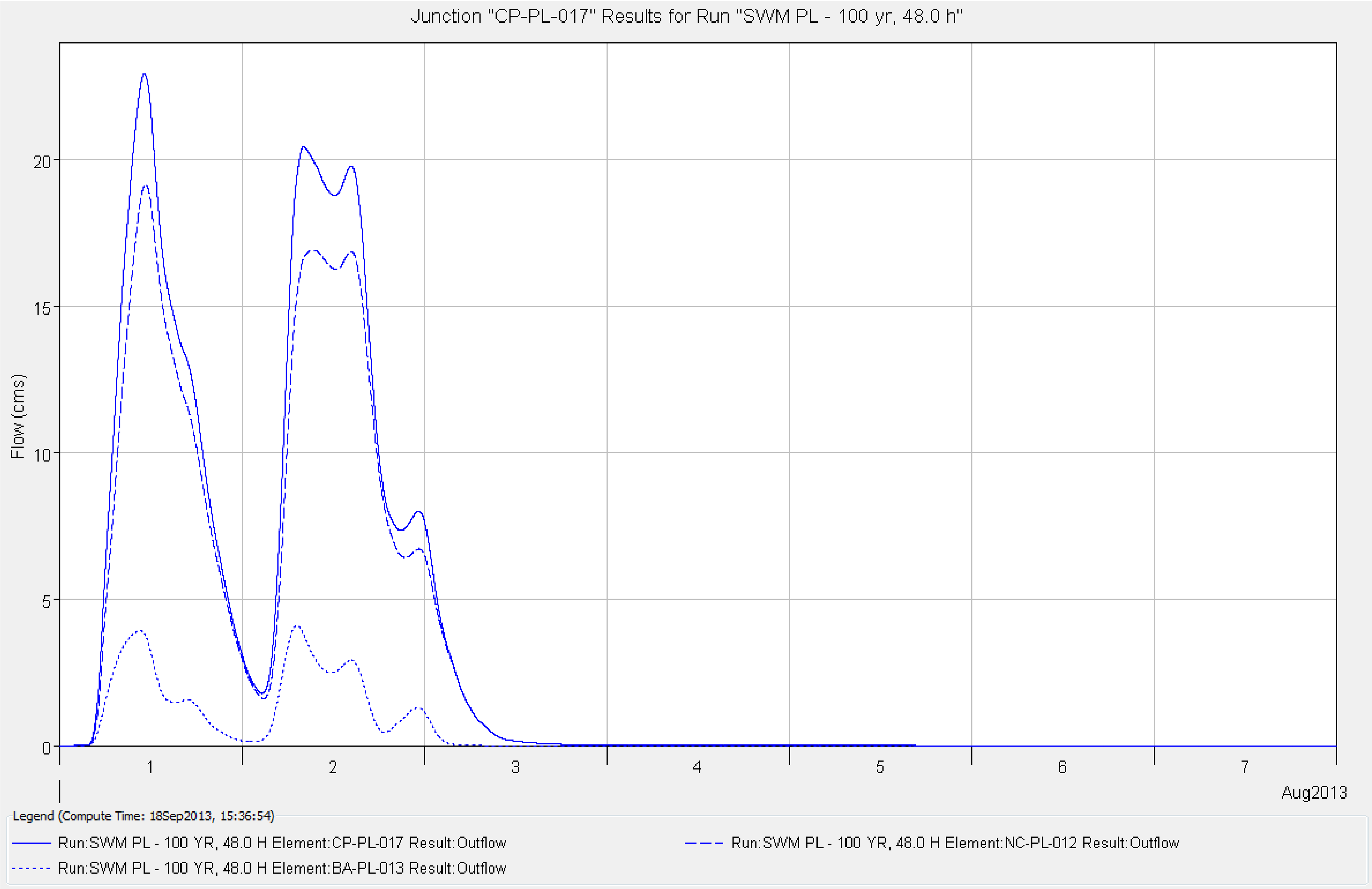


Junction "CP-PL-016A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-011 Result:Outflow

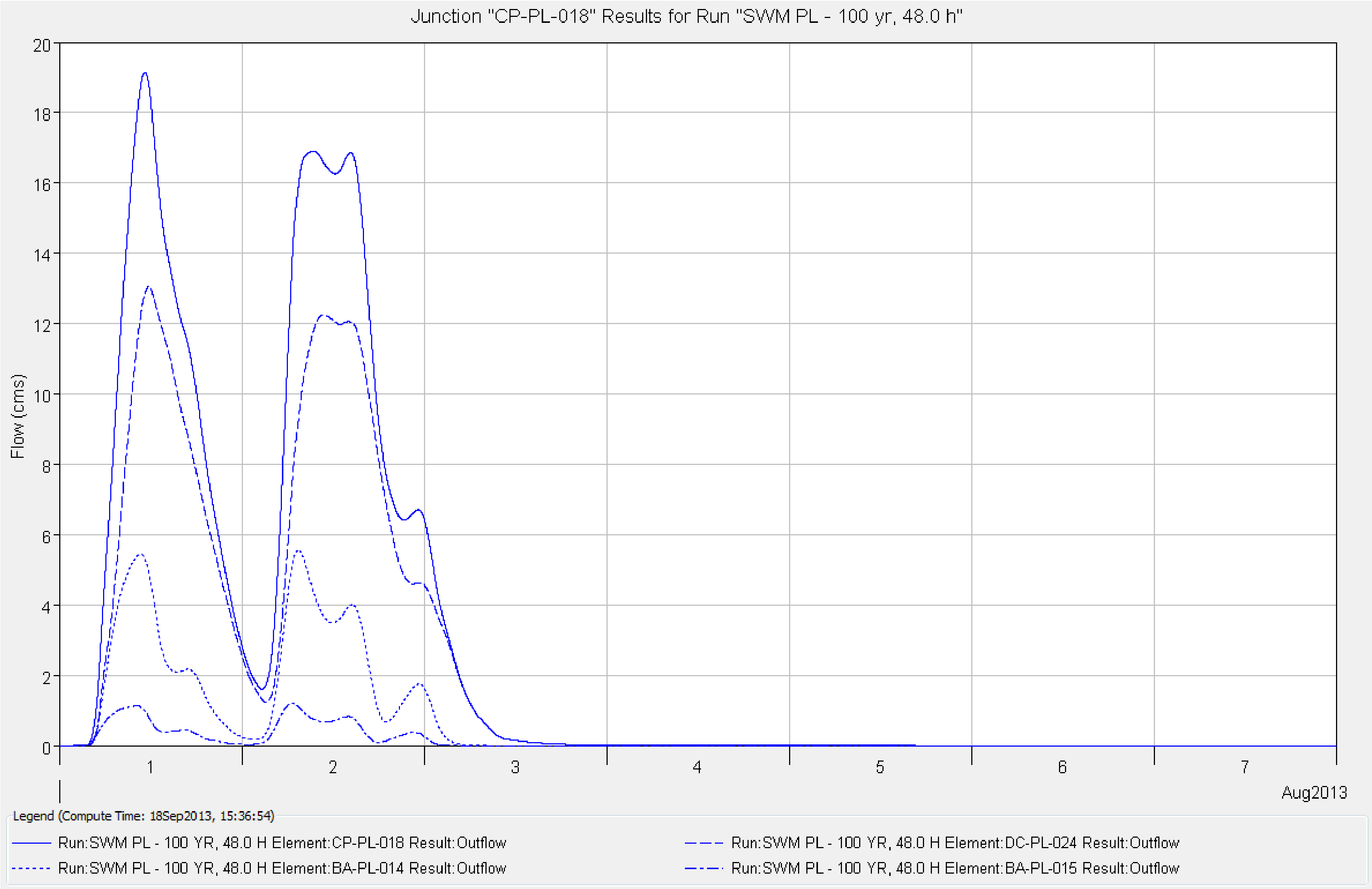

Junction "CP-PL-016B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-011 Result:Outflow



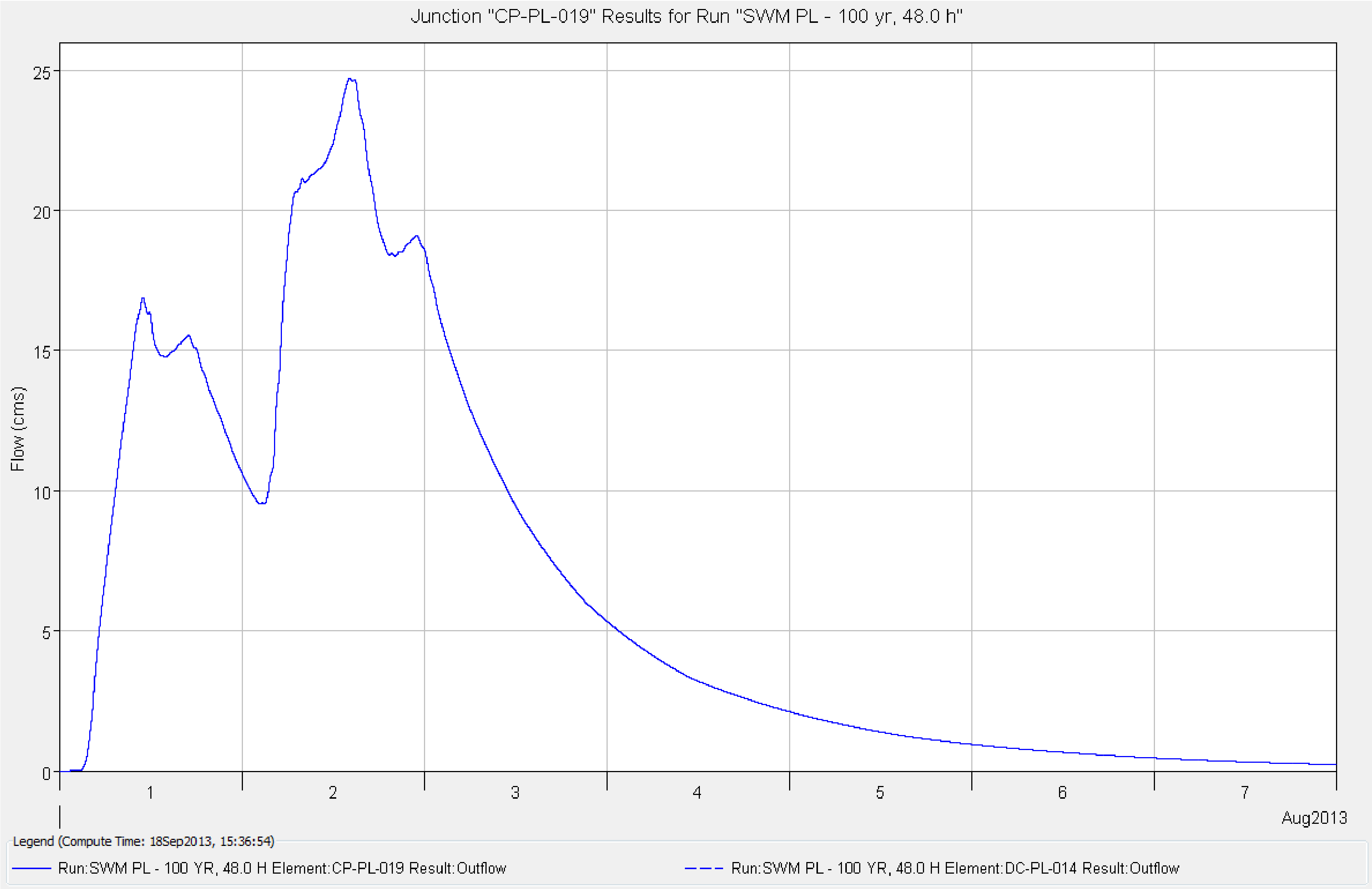
Junction "CP-PL-016C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-012 Result:Outflow



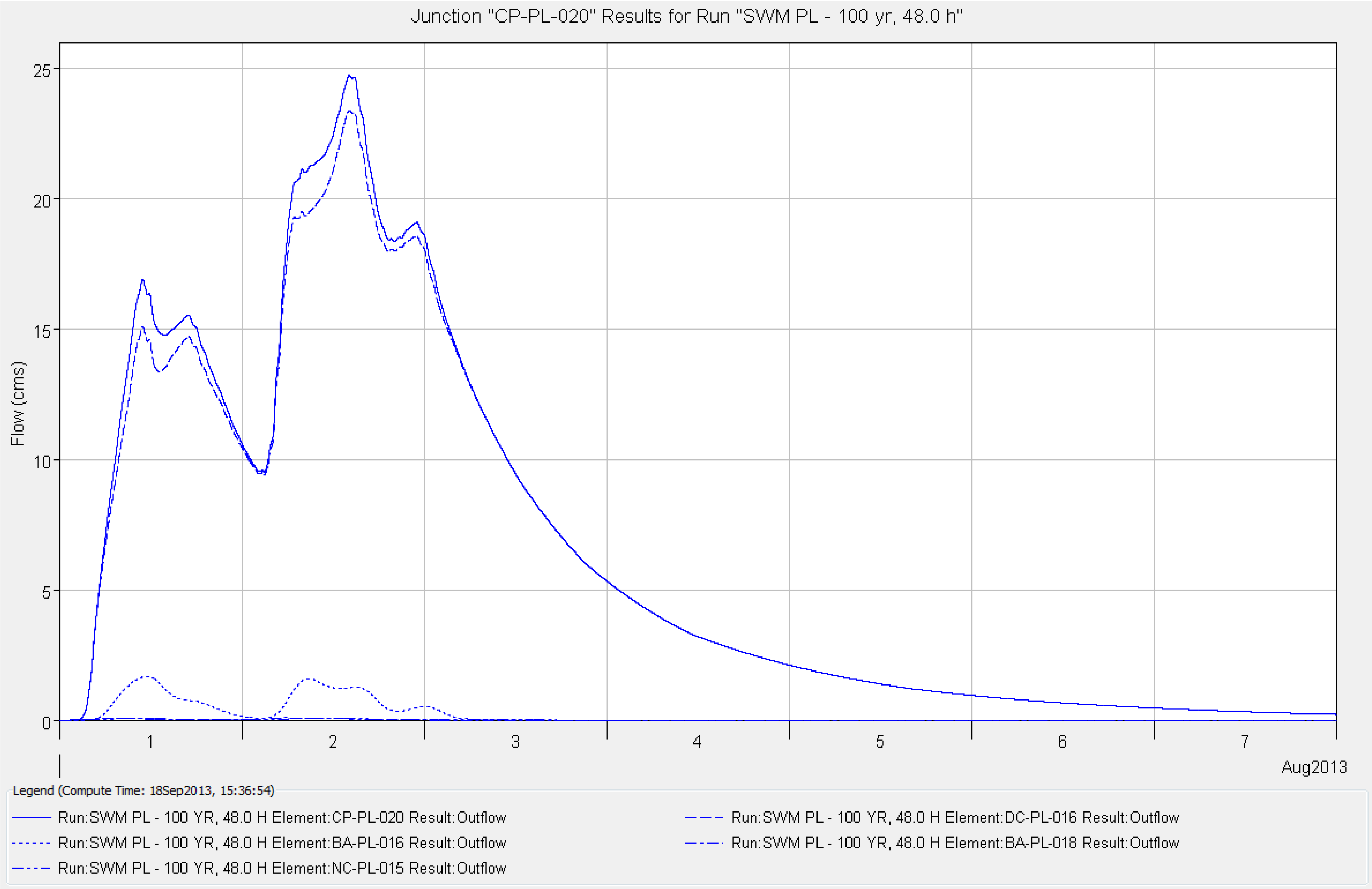
Junction "CP-PL-017" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-013 Result:Outflow



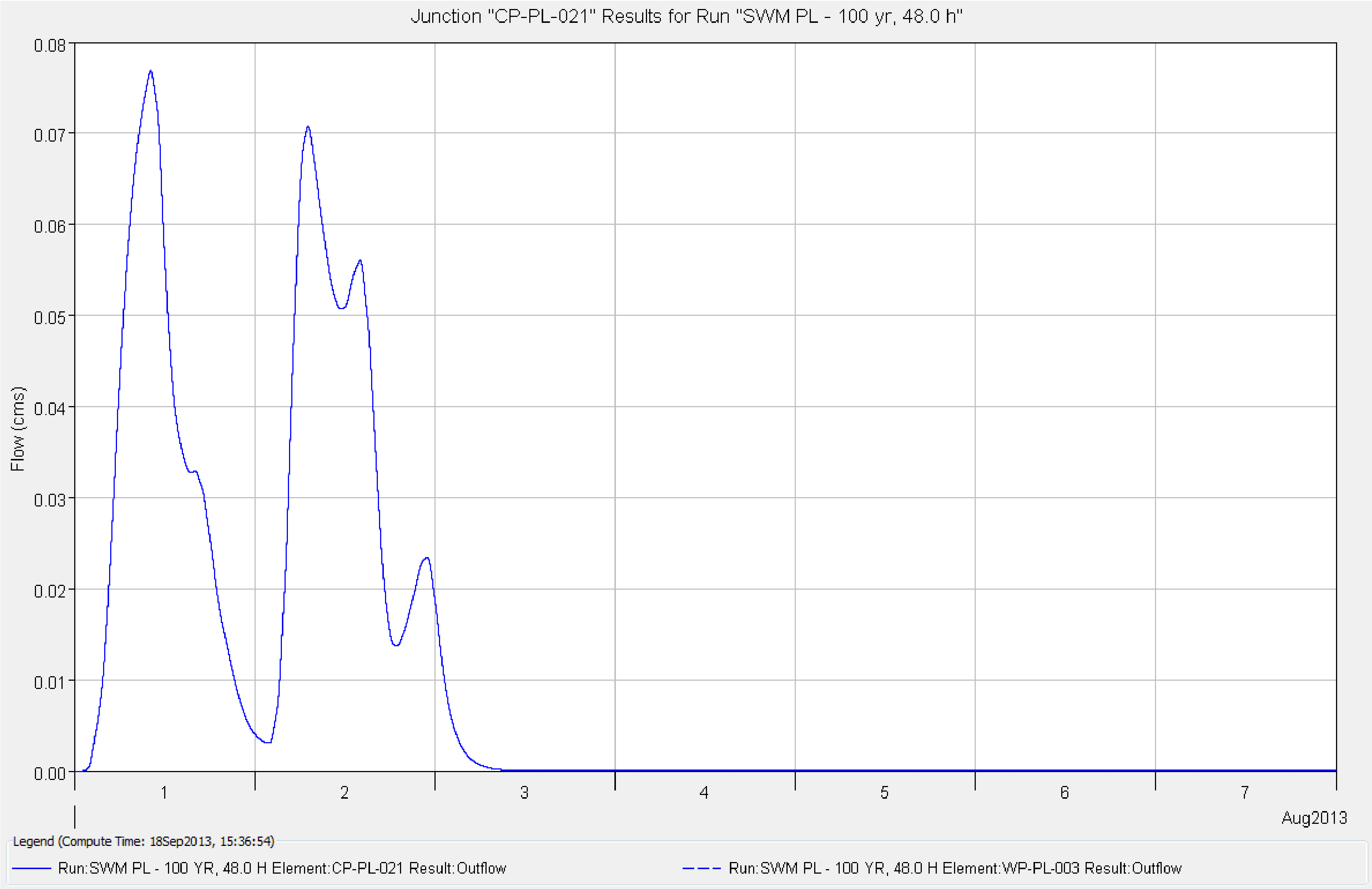
Junction "CP-PL-018" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-015 Result:Outflow

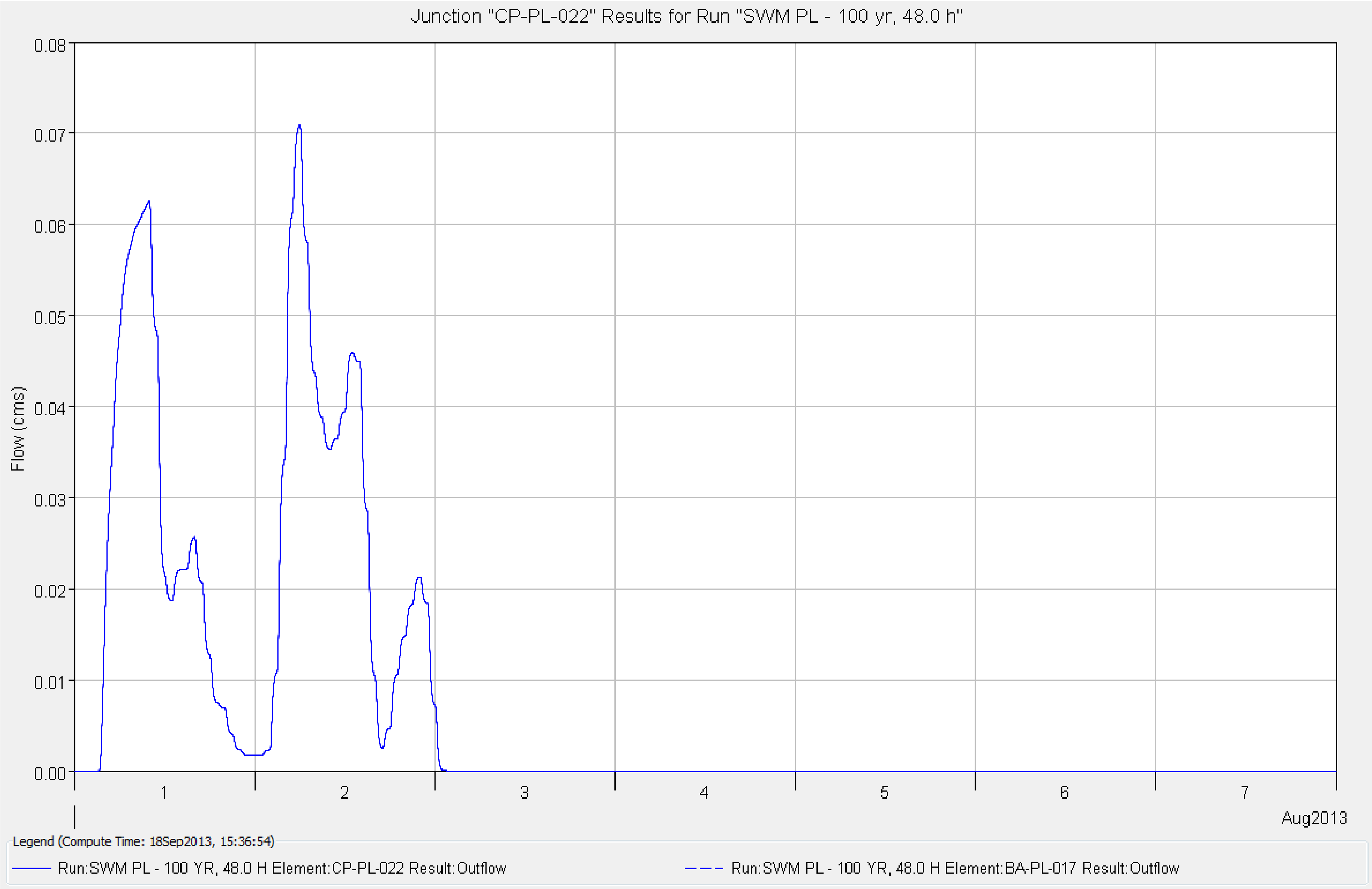


Junction "CP-PL-019" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-014 Result:Outflow

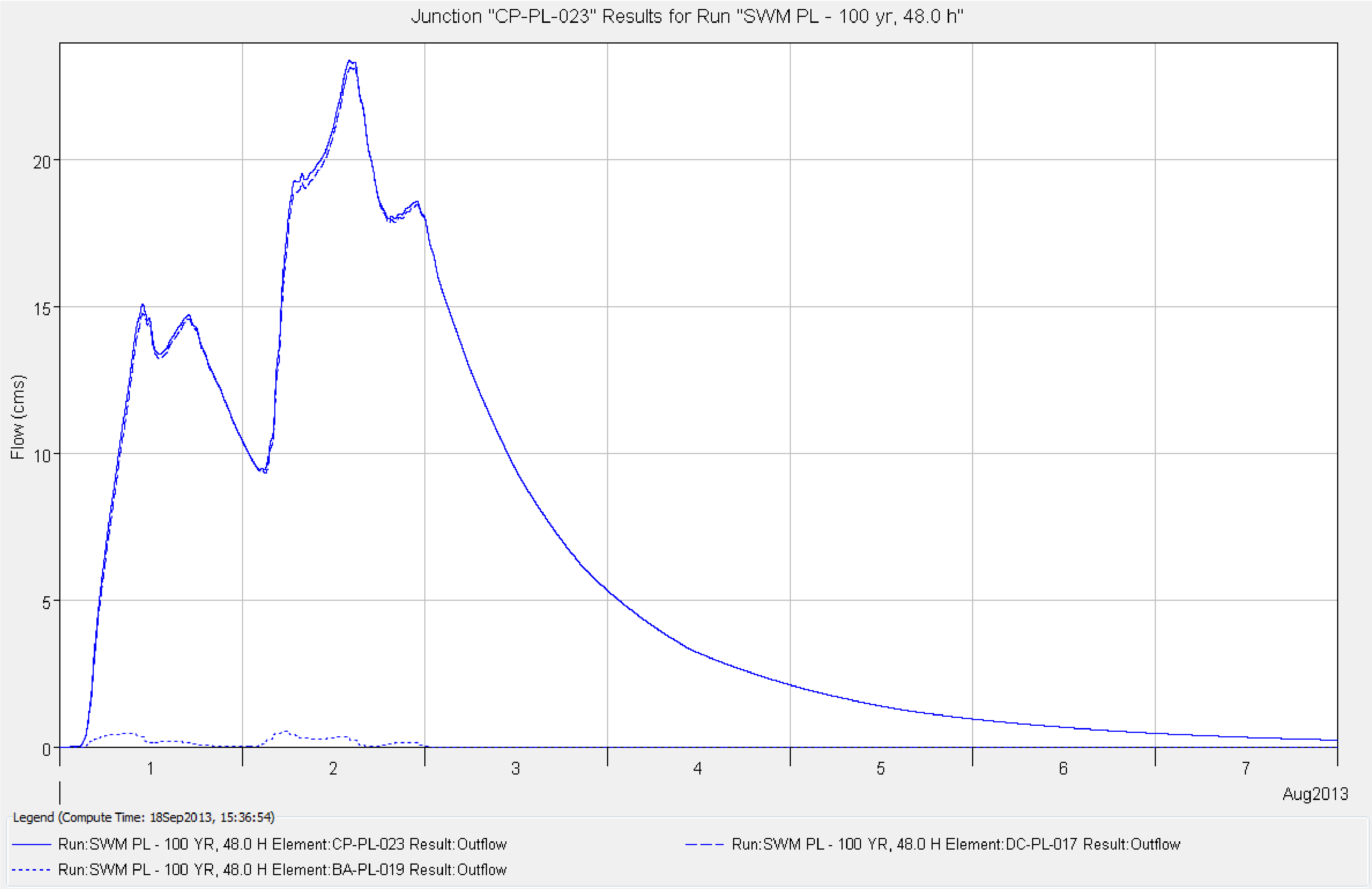


Junction "CP-PL-020" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-015 Result:Outflow

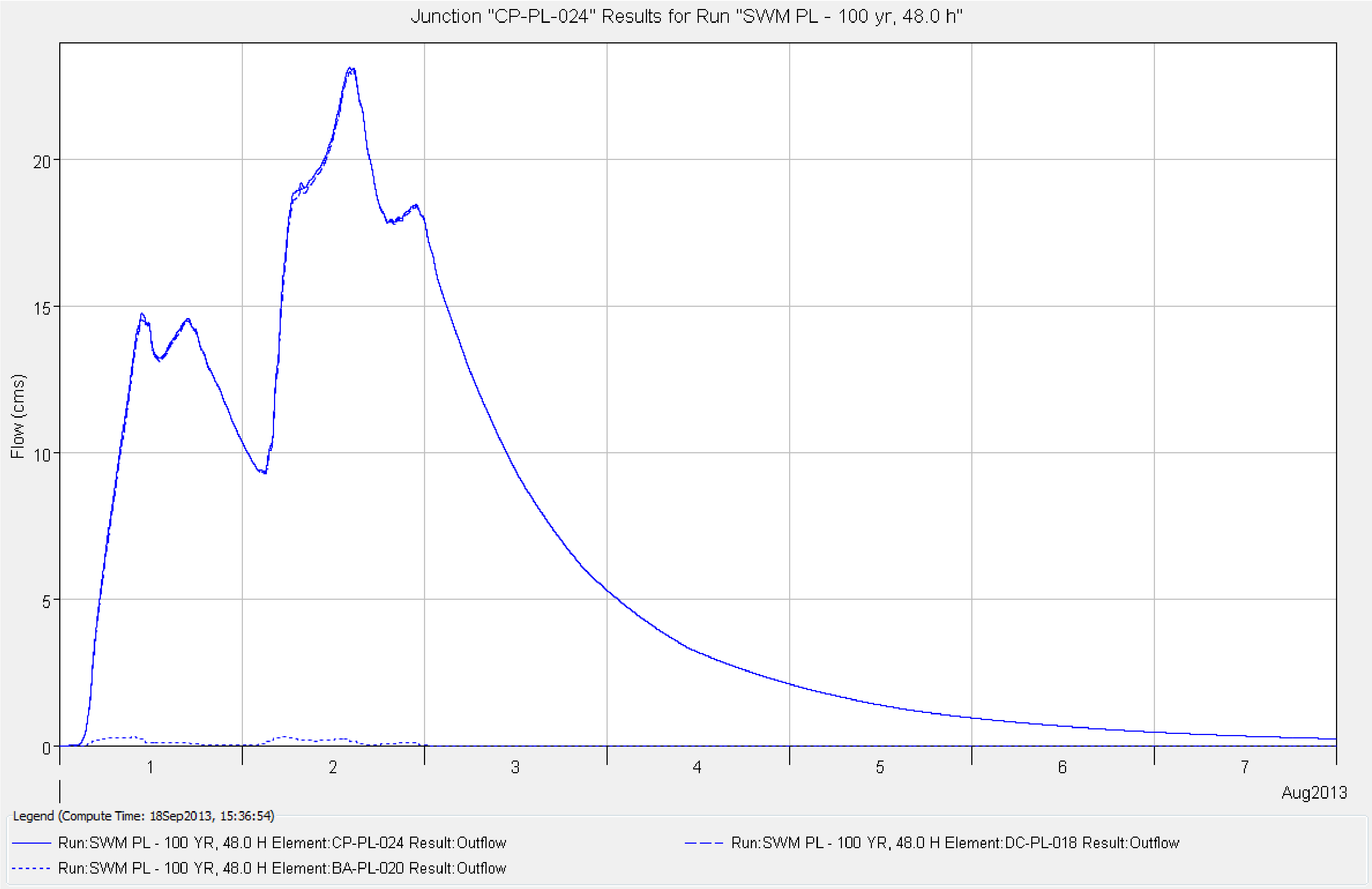

Junction "CP-PL-021" Results for Run "SWM PL - 100 yr, 48.0 h"
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Outflow



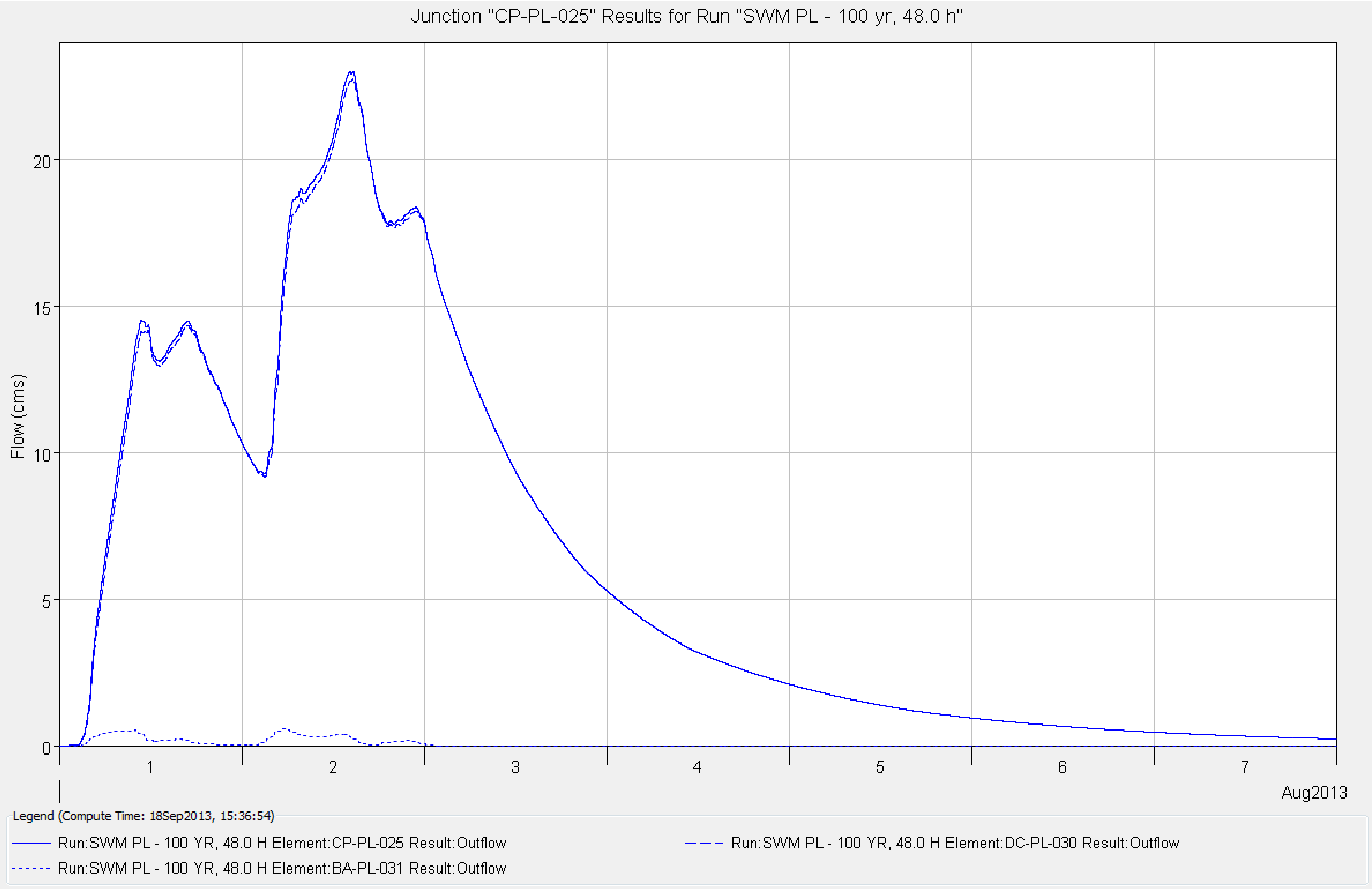
Junction "CP-PL-022" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-017 Result:Outflow



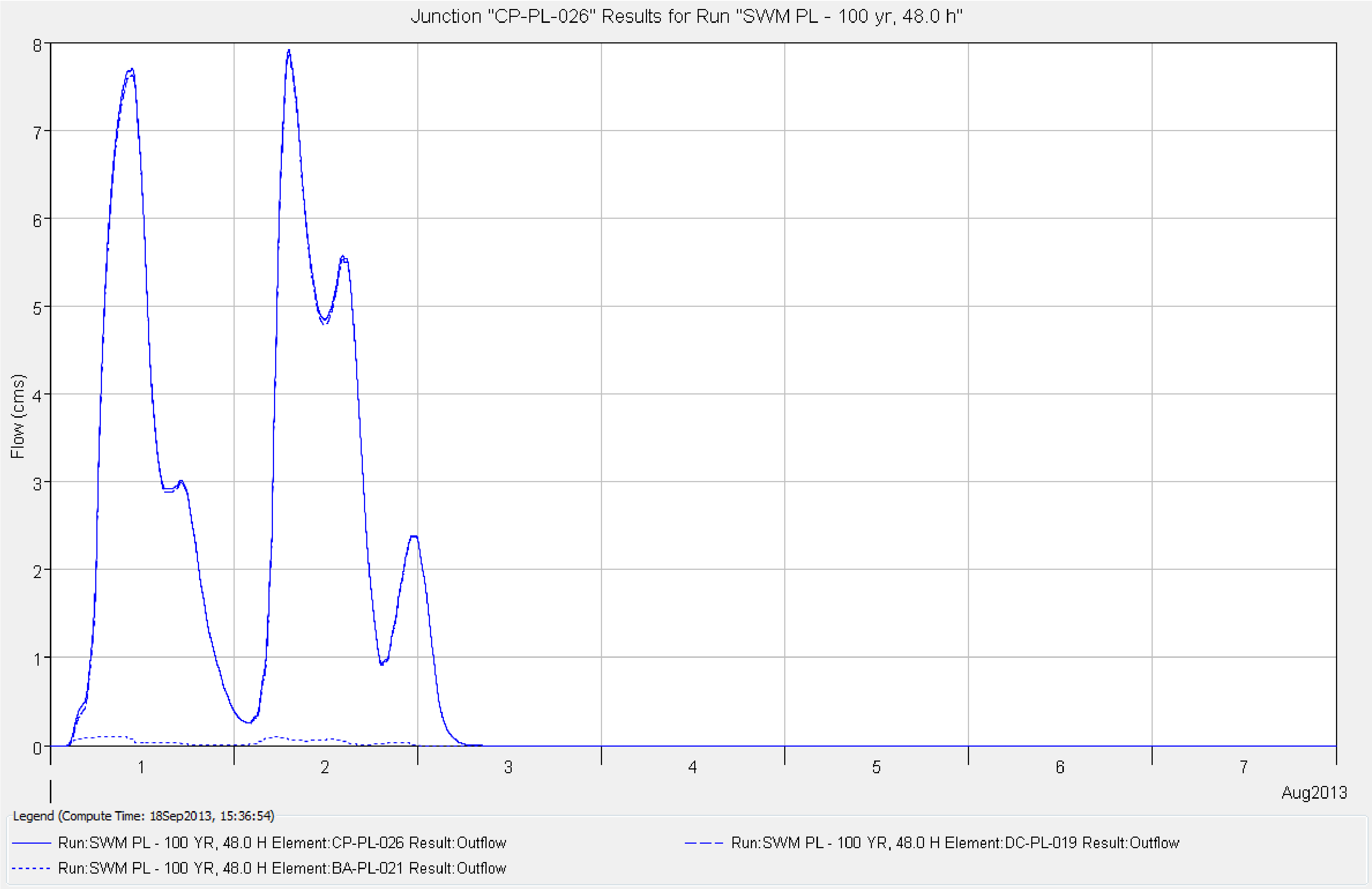
Junction "CP-PL-023" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-019 Result:Outflow



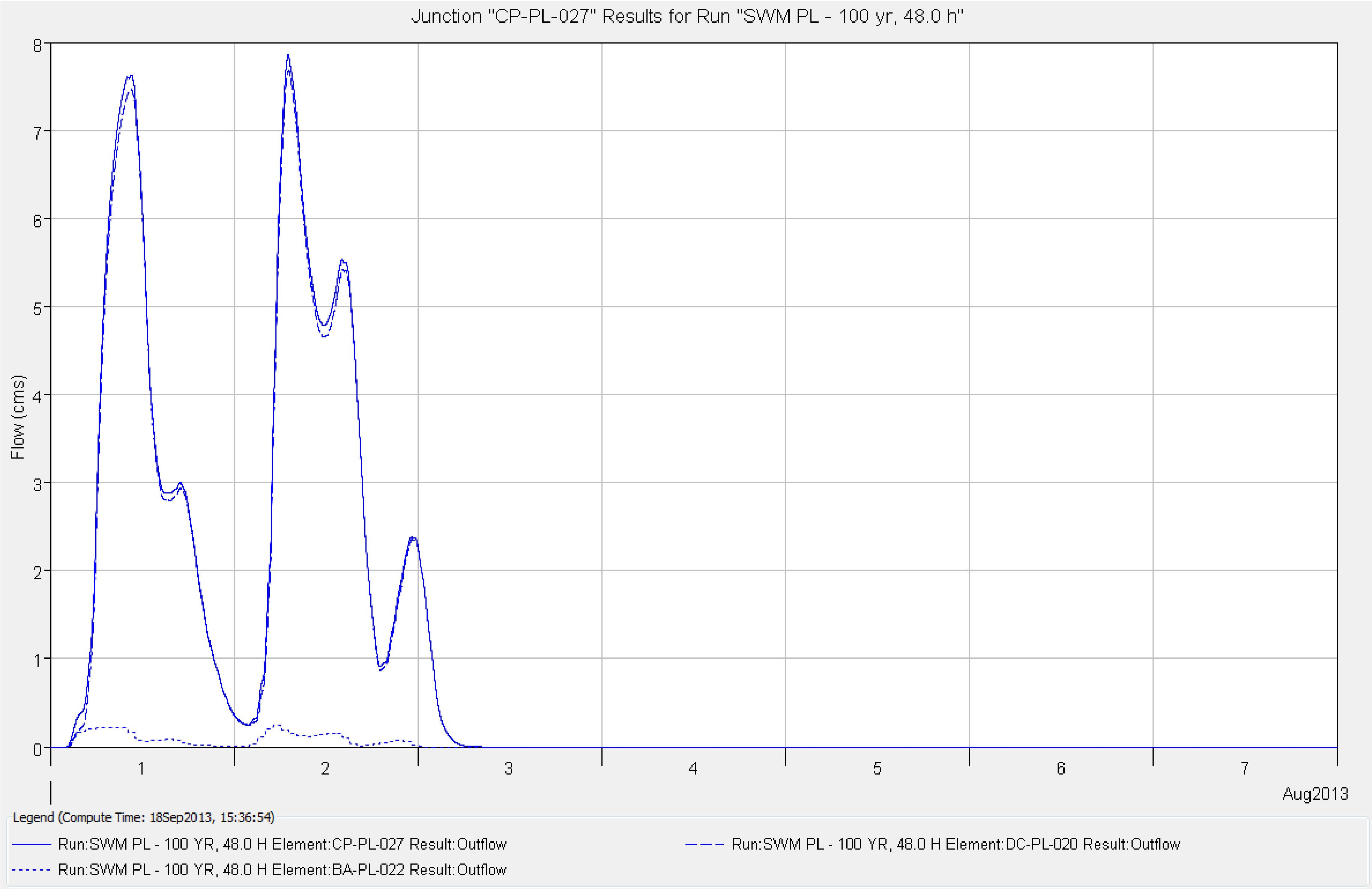
Junction "CP-PL-024" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-020 Result:Outflow



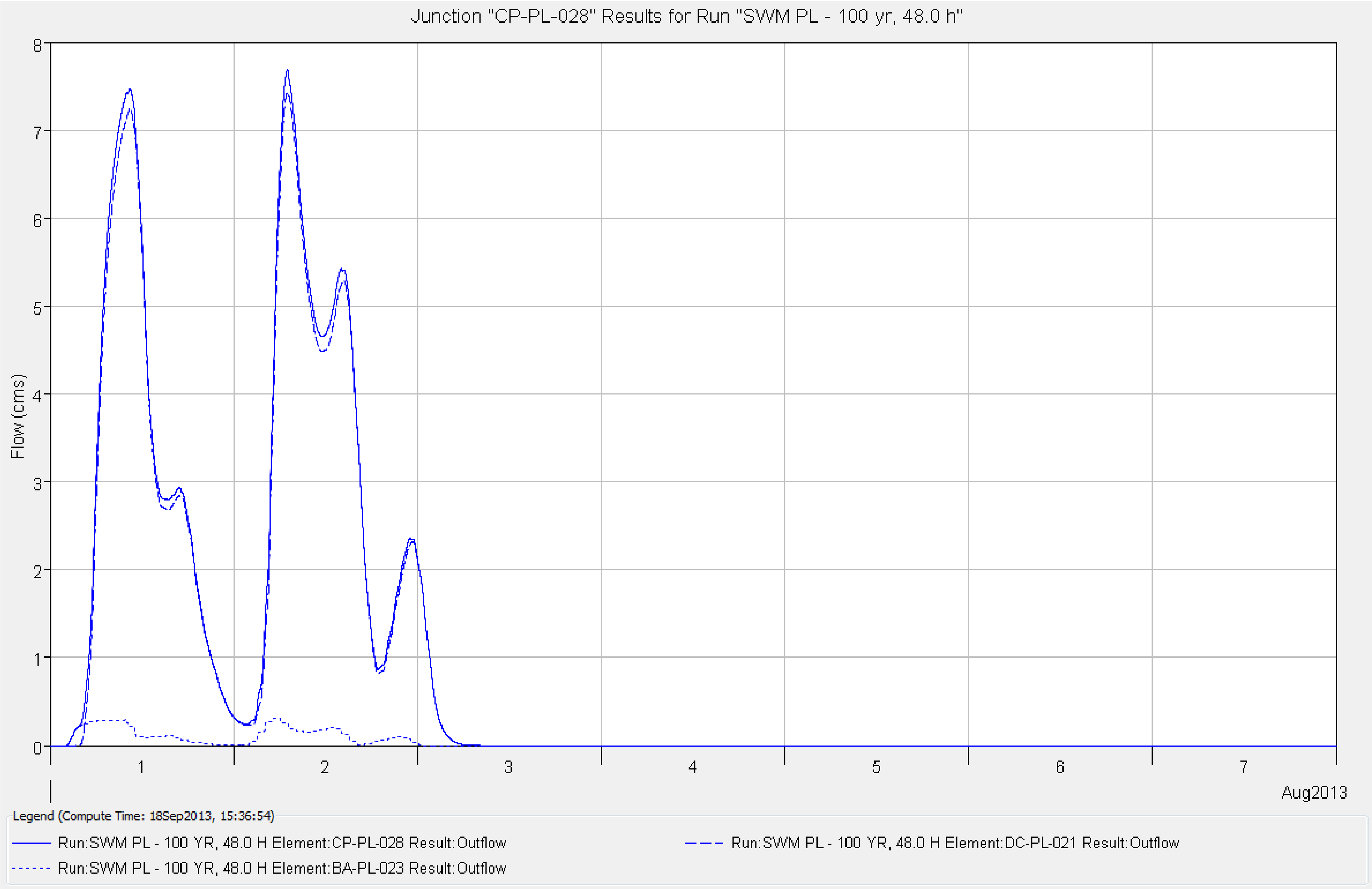
Junction "CP-PL-025" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-025 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-031 Result:Outflow



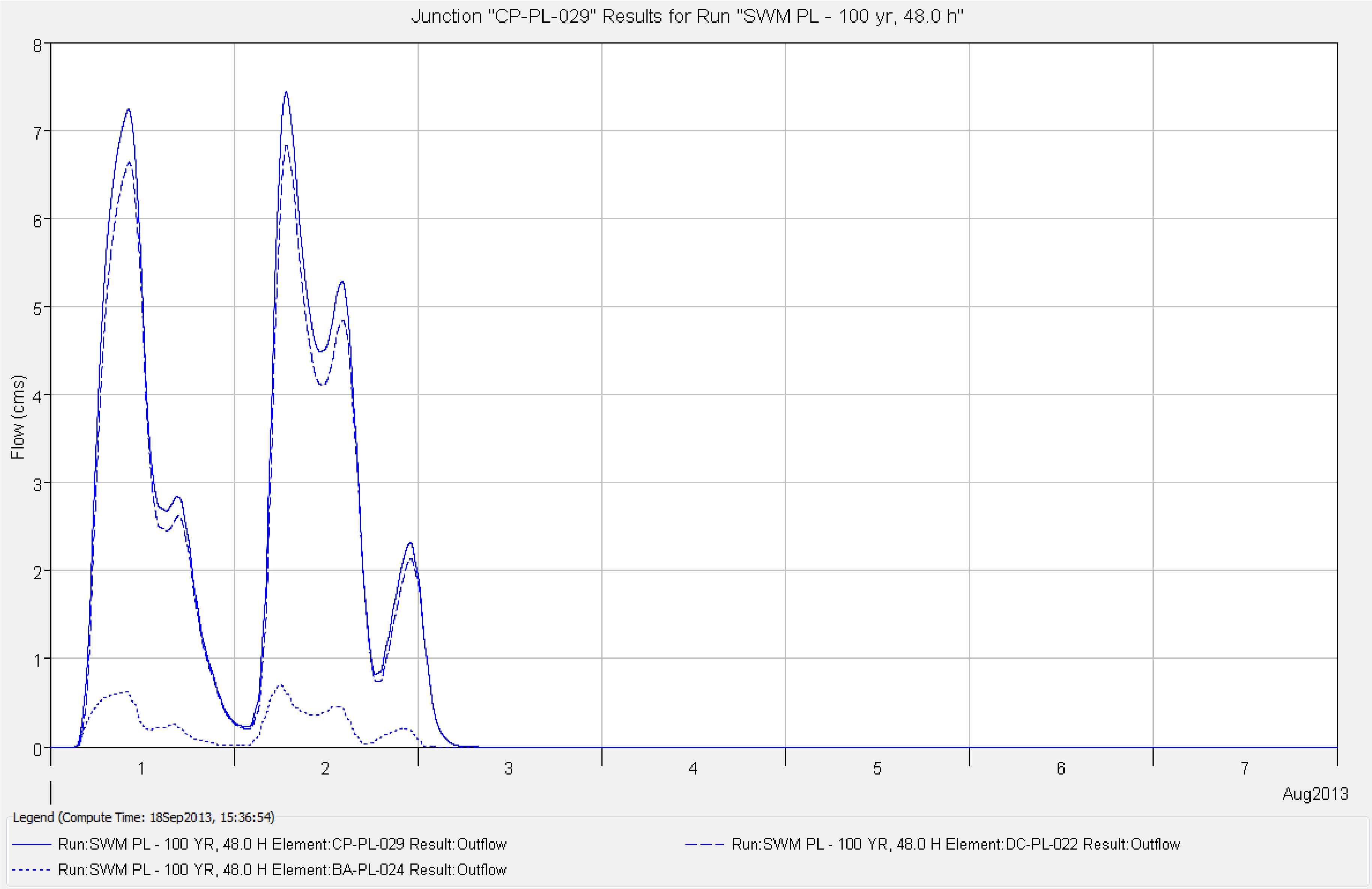
Junction "CP-PL-026" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-021 Result:Outflow



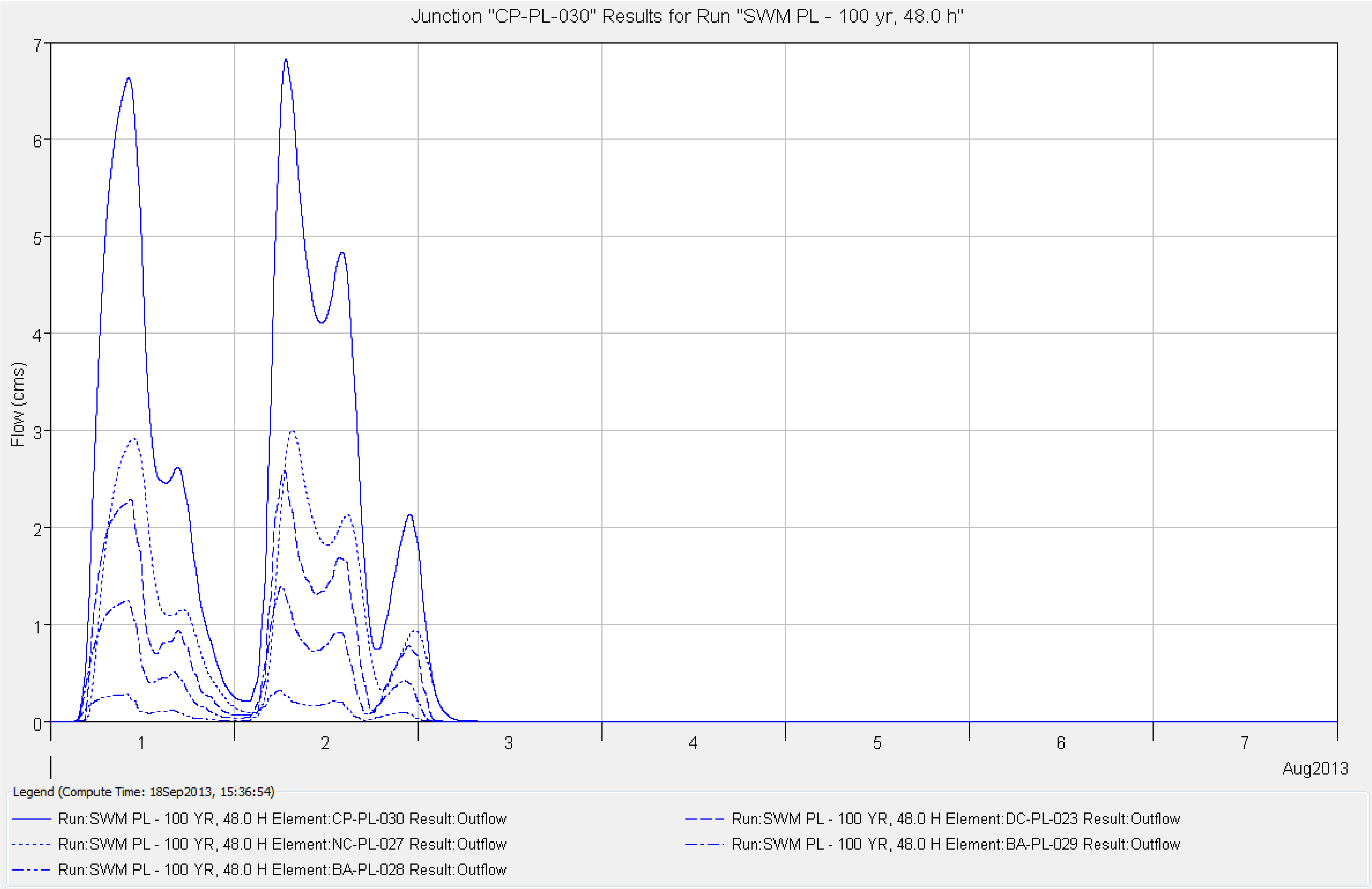
Junction "CP-PL-027" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-022 Result:Outflow

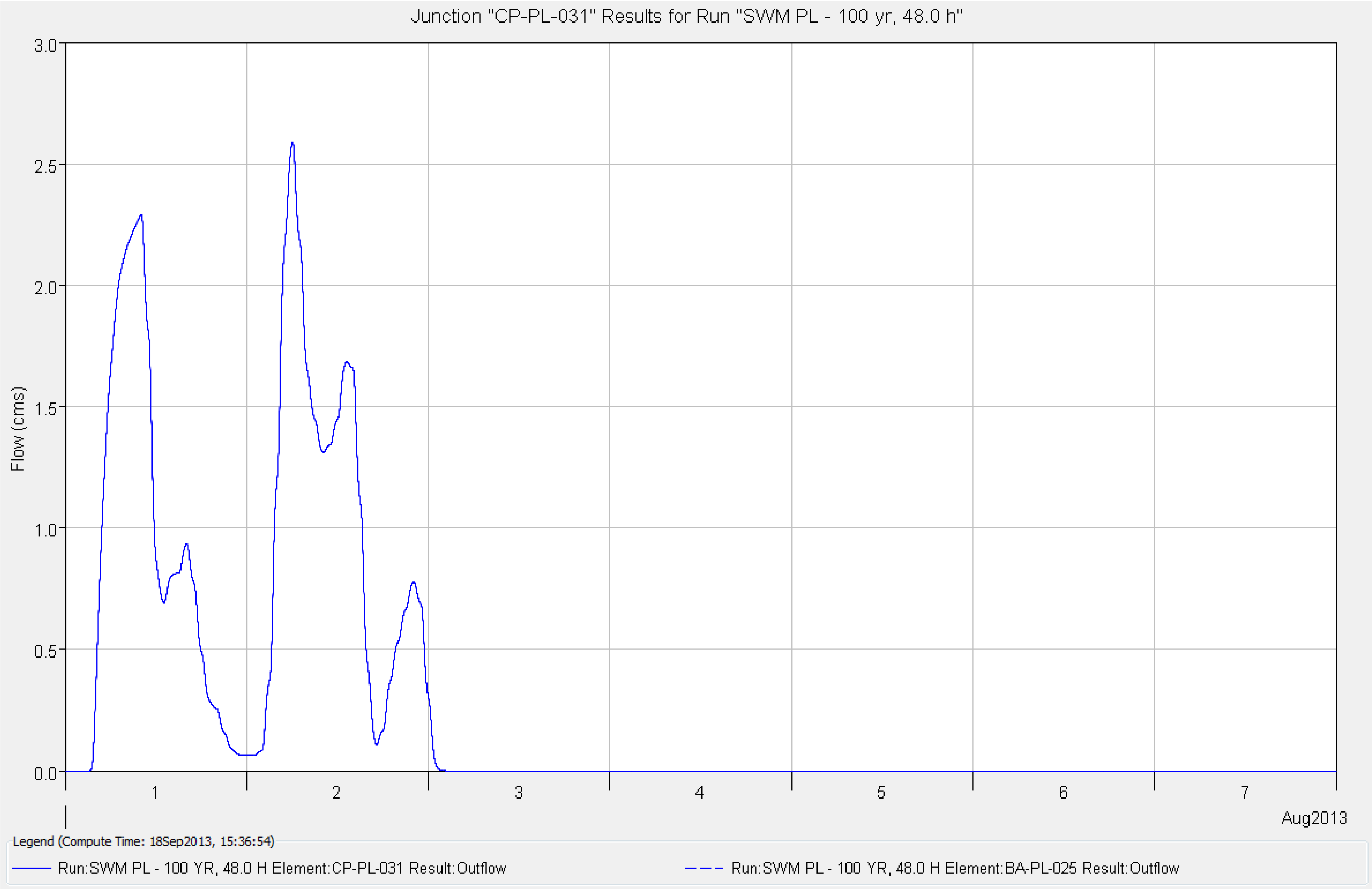


Junction "CP-PL-028" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-028 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-023 Result:Outflow

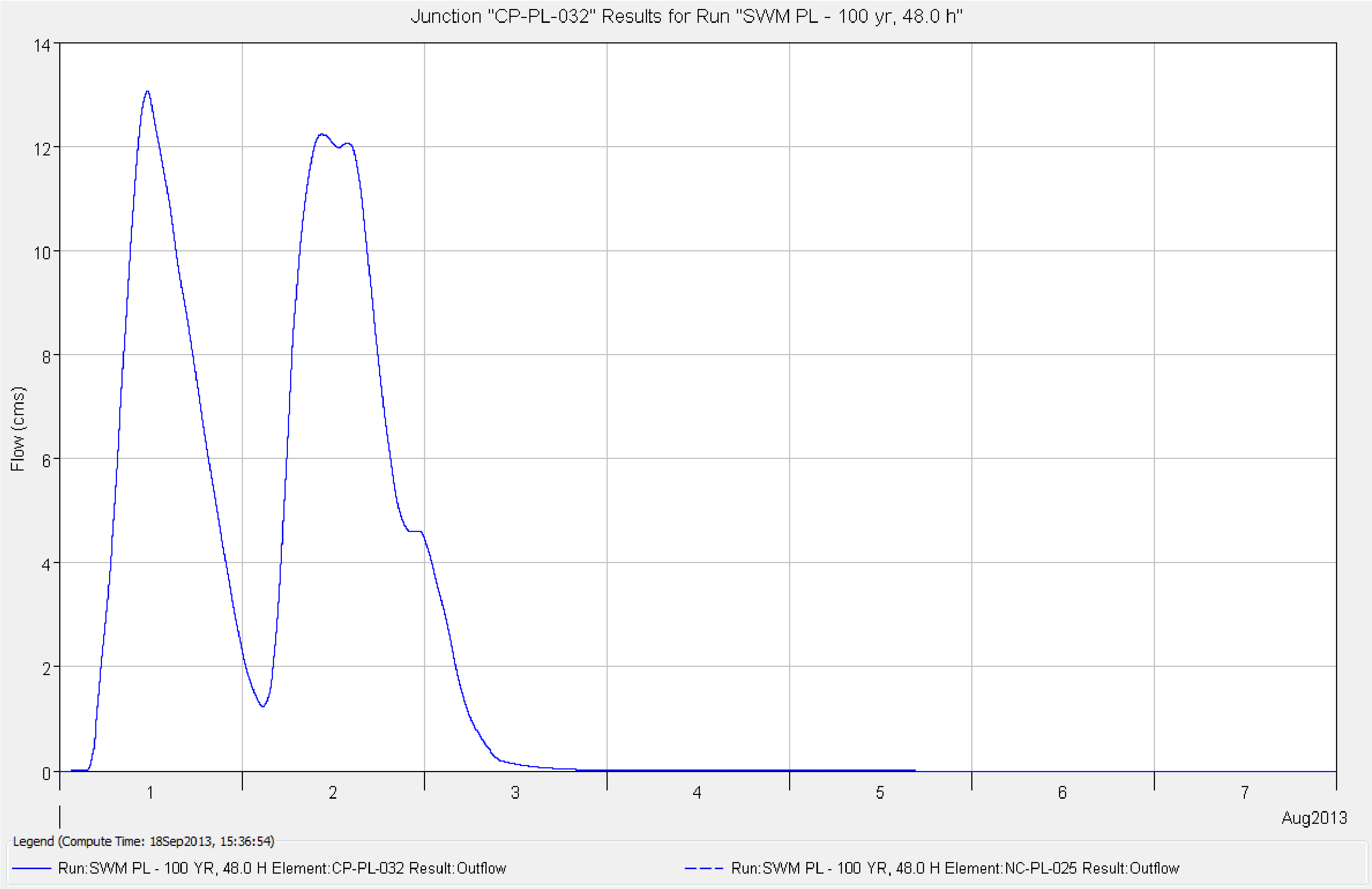


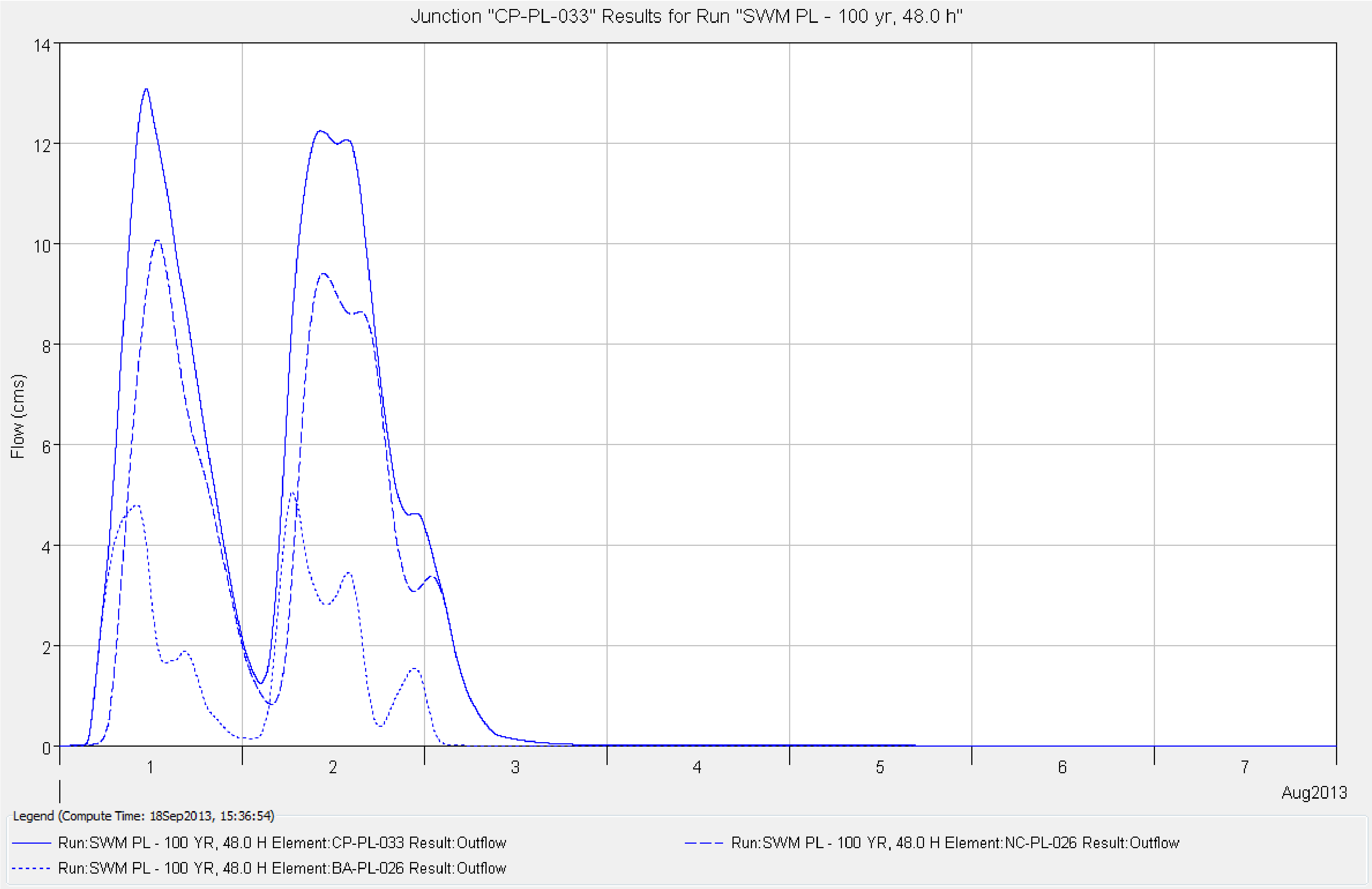
Junction "CP-PL-029" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-024 Result:Outflow

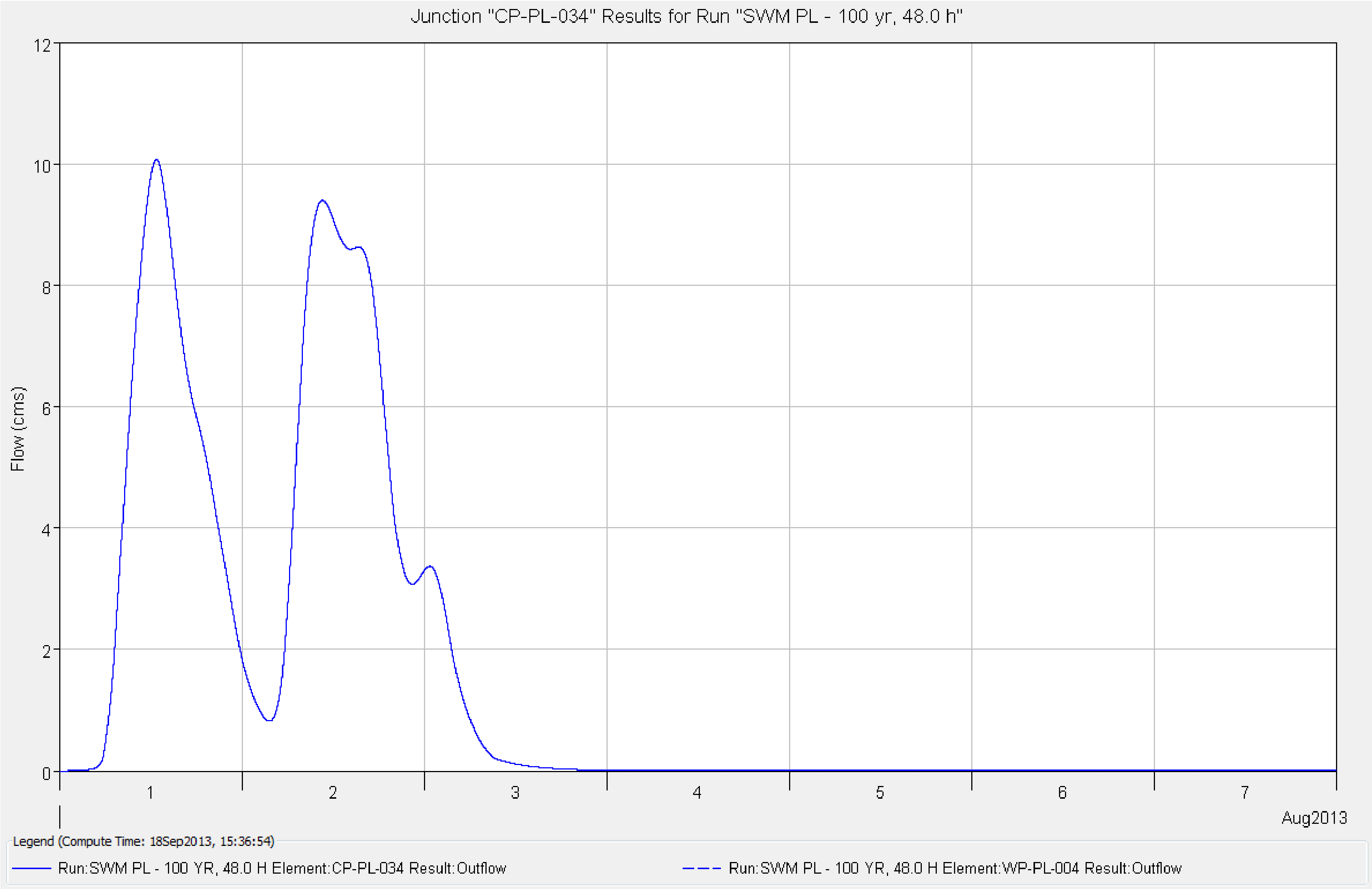

Junction "CP-PL-030" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-028 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-029 Result:Outflow

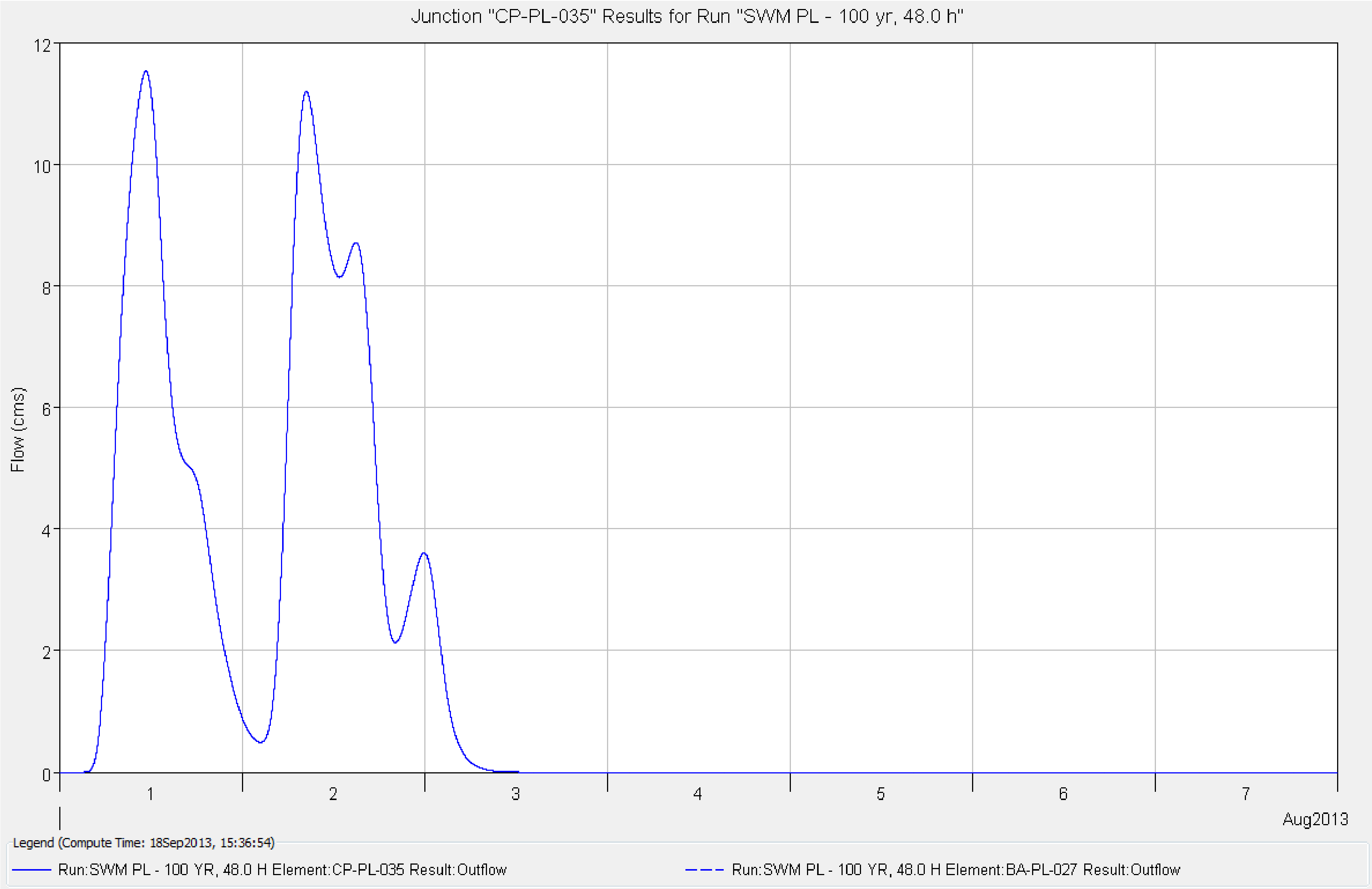


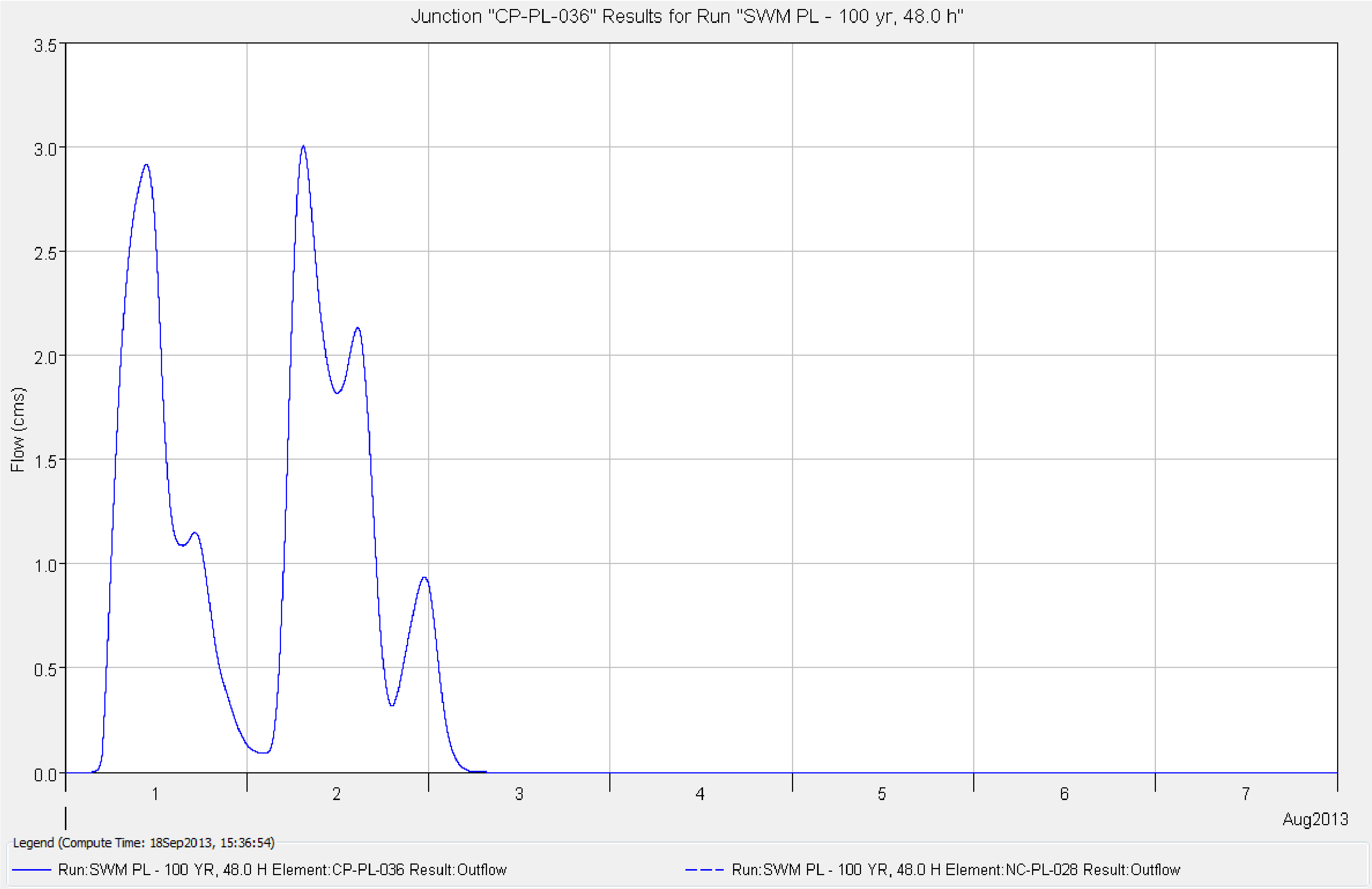
Junction "CP-PL-031" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-031 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-025 Result:Outflow

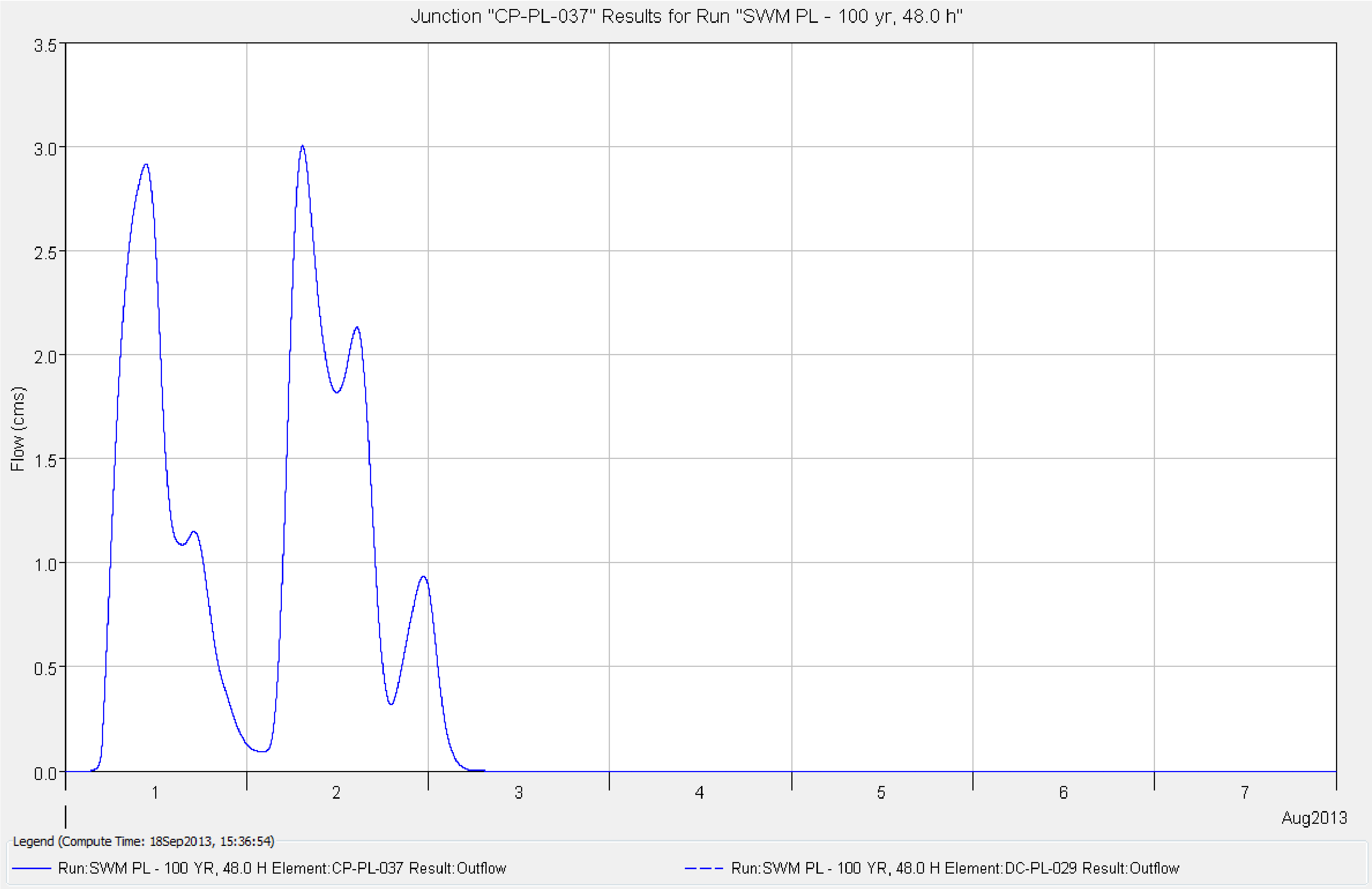

Junction "CP-PL-032" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-032 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-025 Result:Outflow


Junction "CP-PL-033" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-033 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-026 Result:Outflow

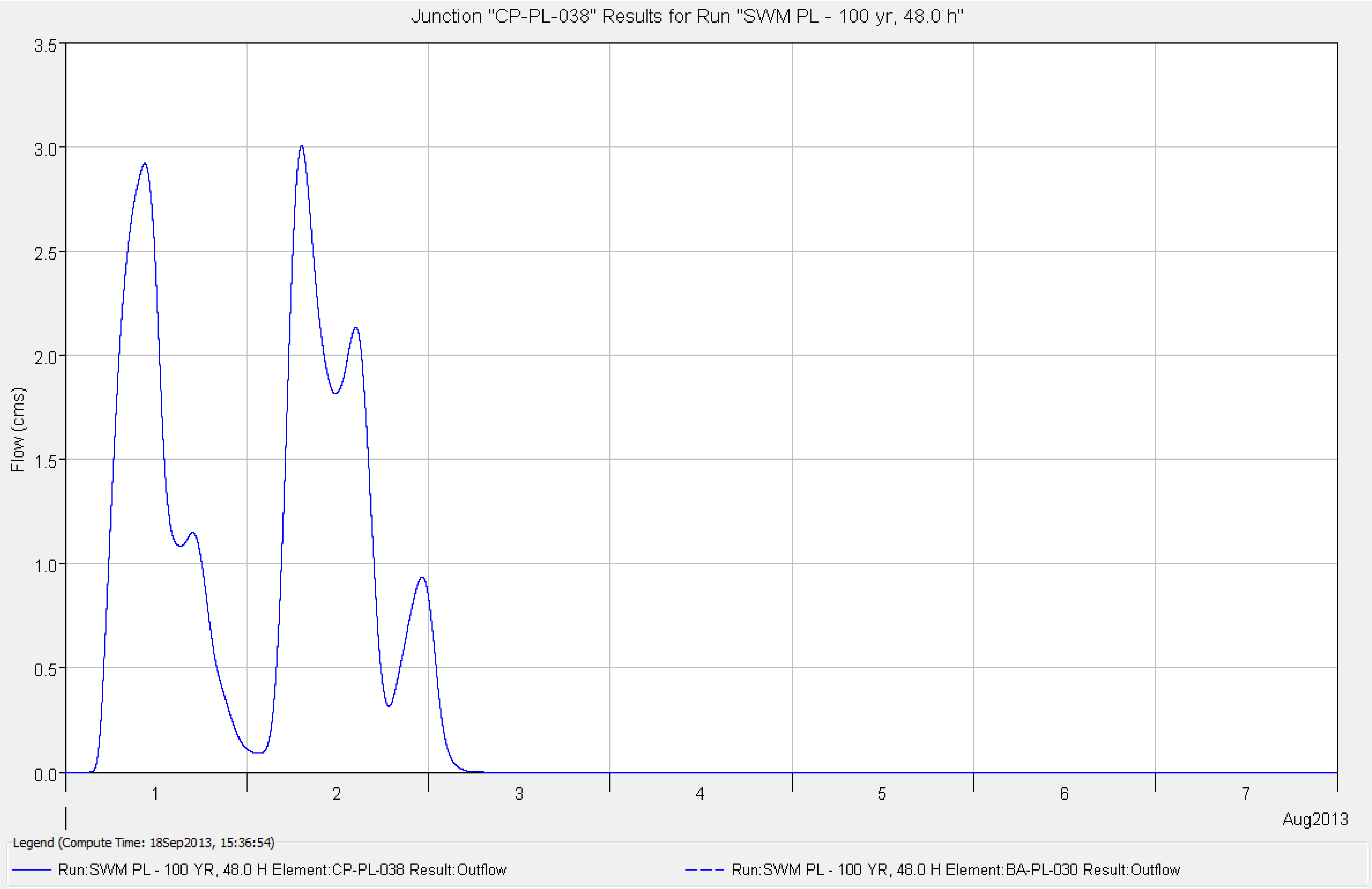

Junction "CP-PL-034" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Outflow


Junction "CP-PL-035" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-035 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-027 Result:Outflow

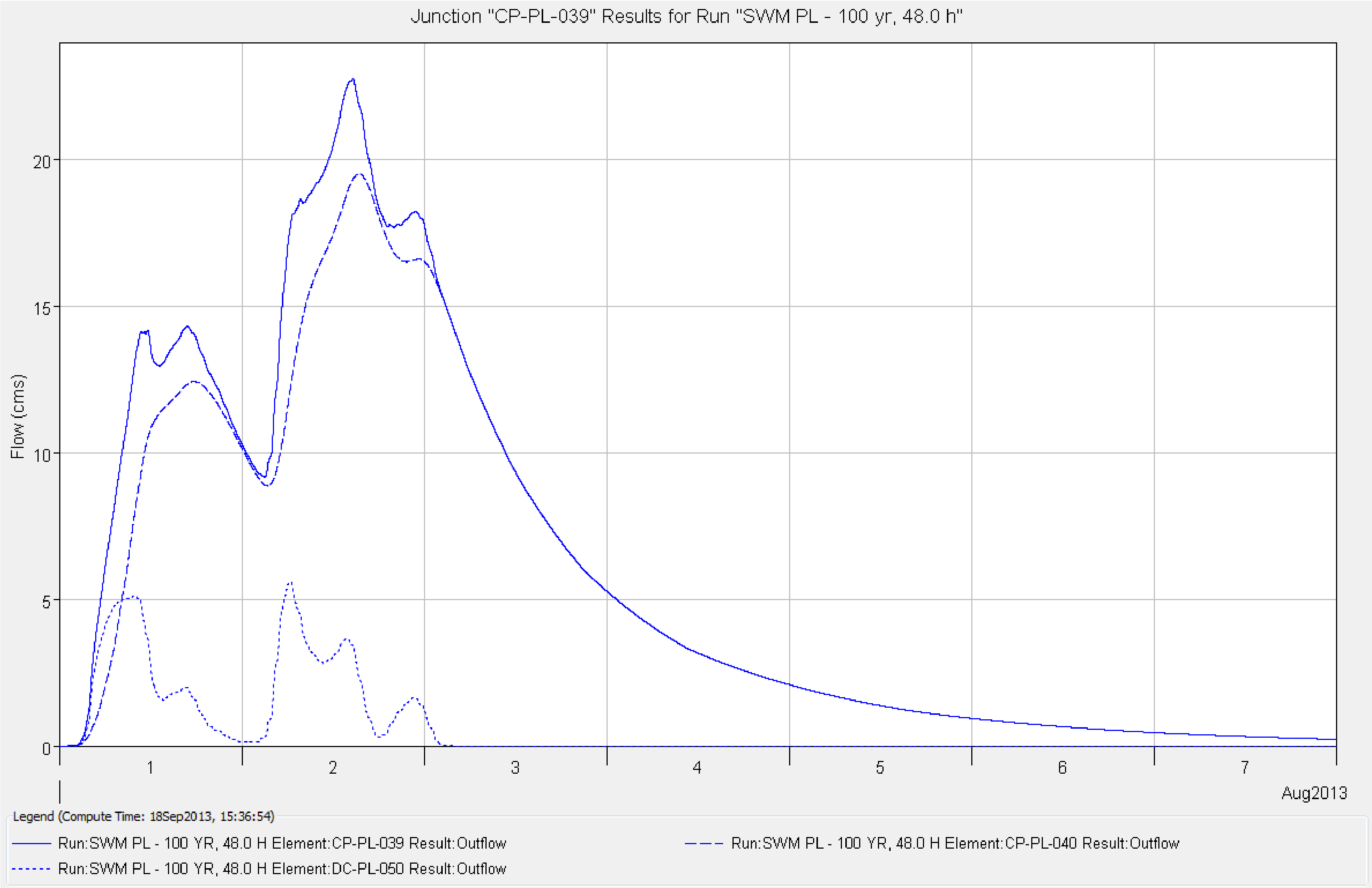

Junction "CP-PL-036" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-028 Result:Outflow

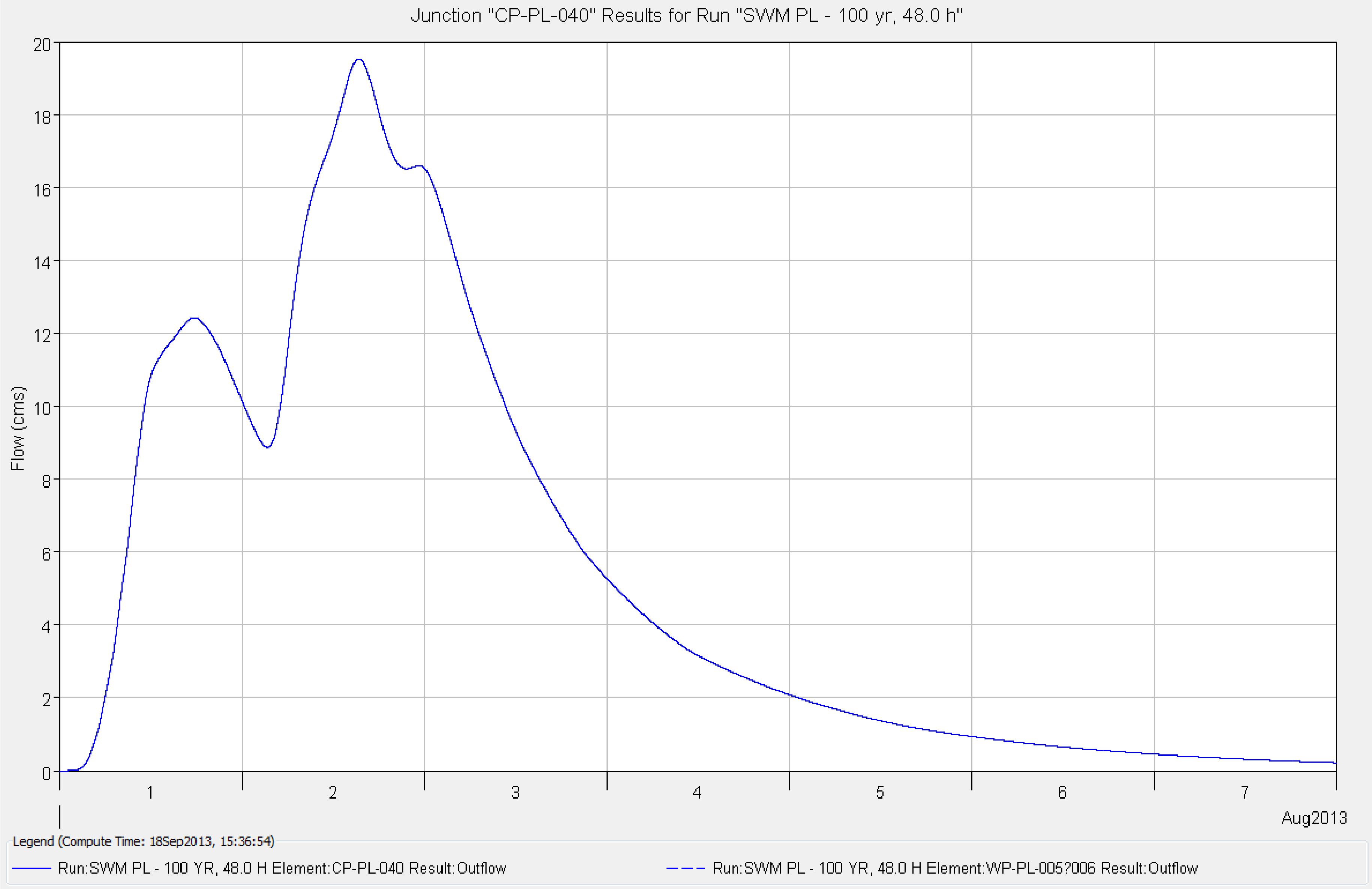


Junction "CP-PL-037" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-029 Result:Outflow

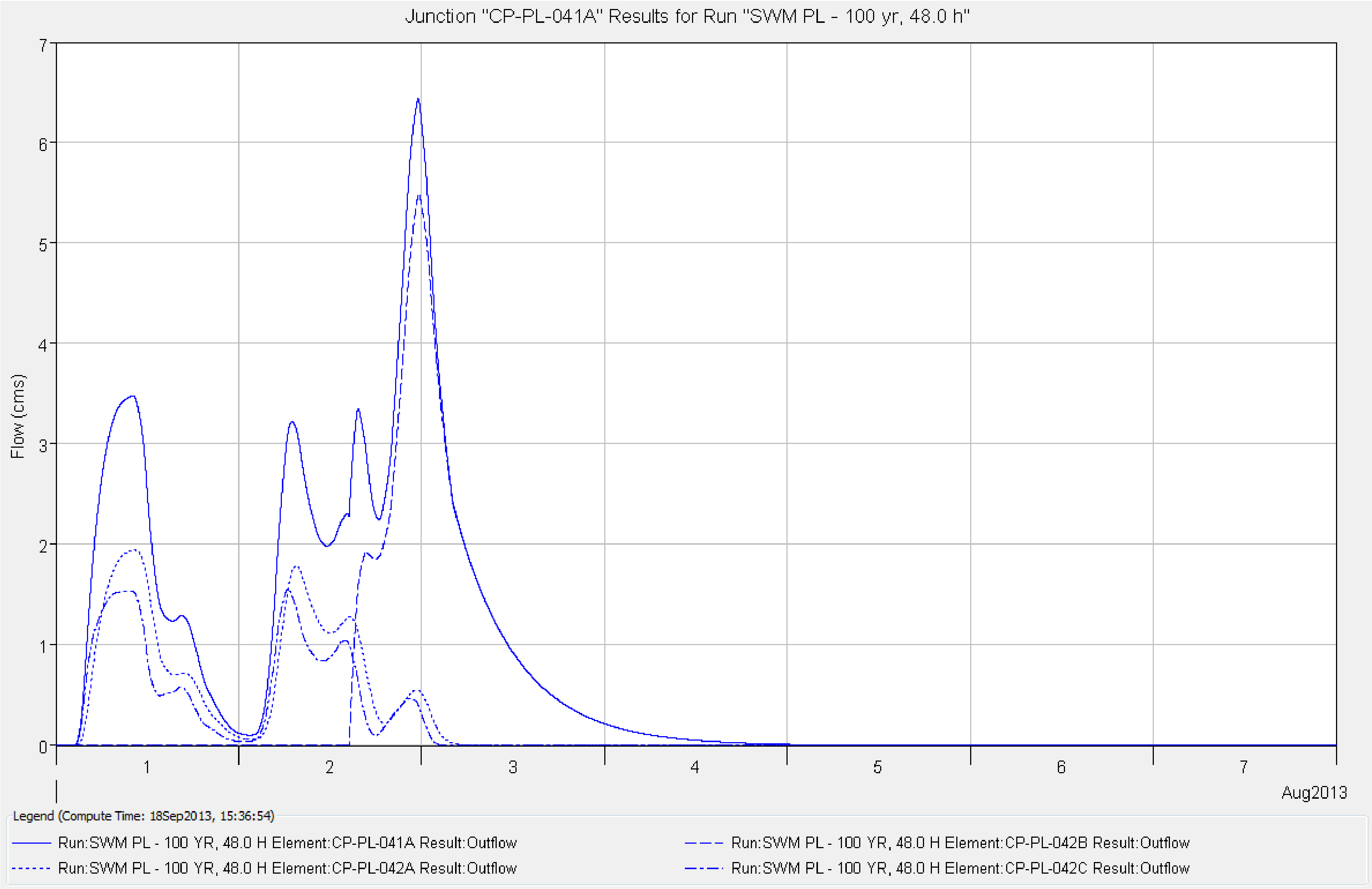


Junction "CP-PL-038" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-038 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-030 Result:Outflow

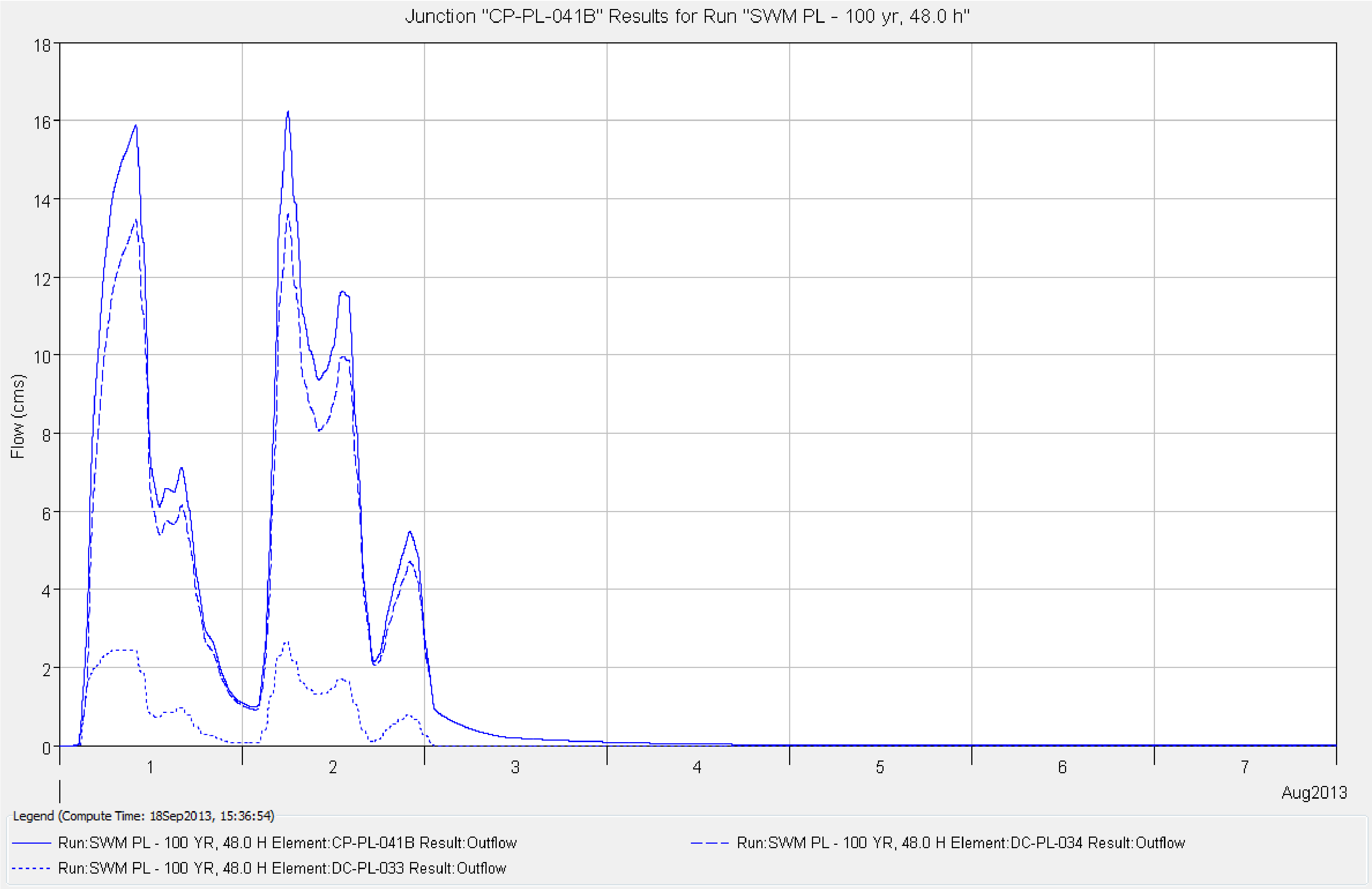

Junction "CP-PL-039" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-050 Result:Outflow



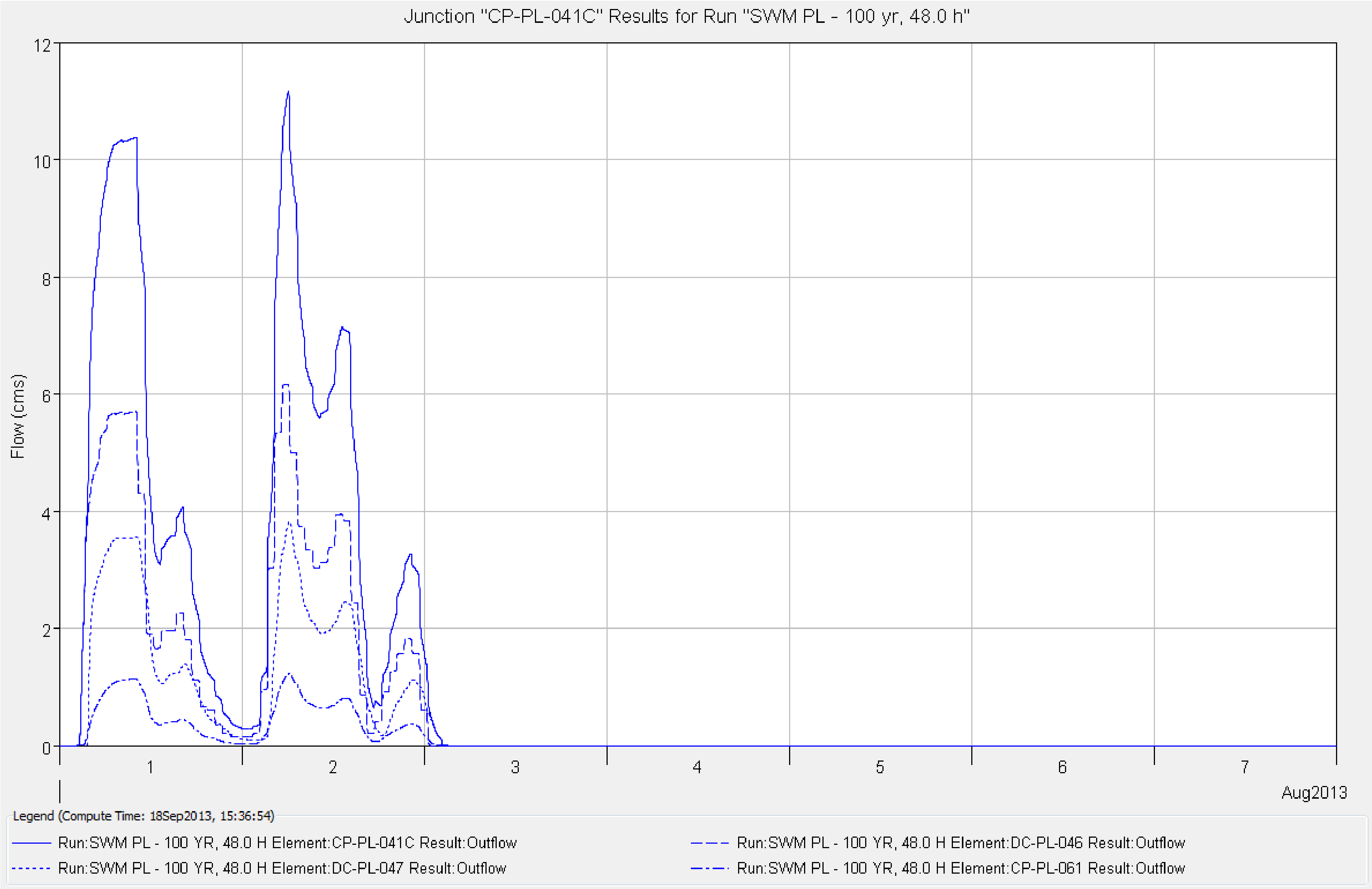
Junction "CP-PL-040" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Outflow



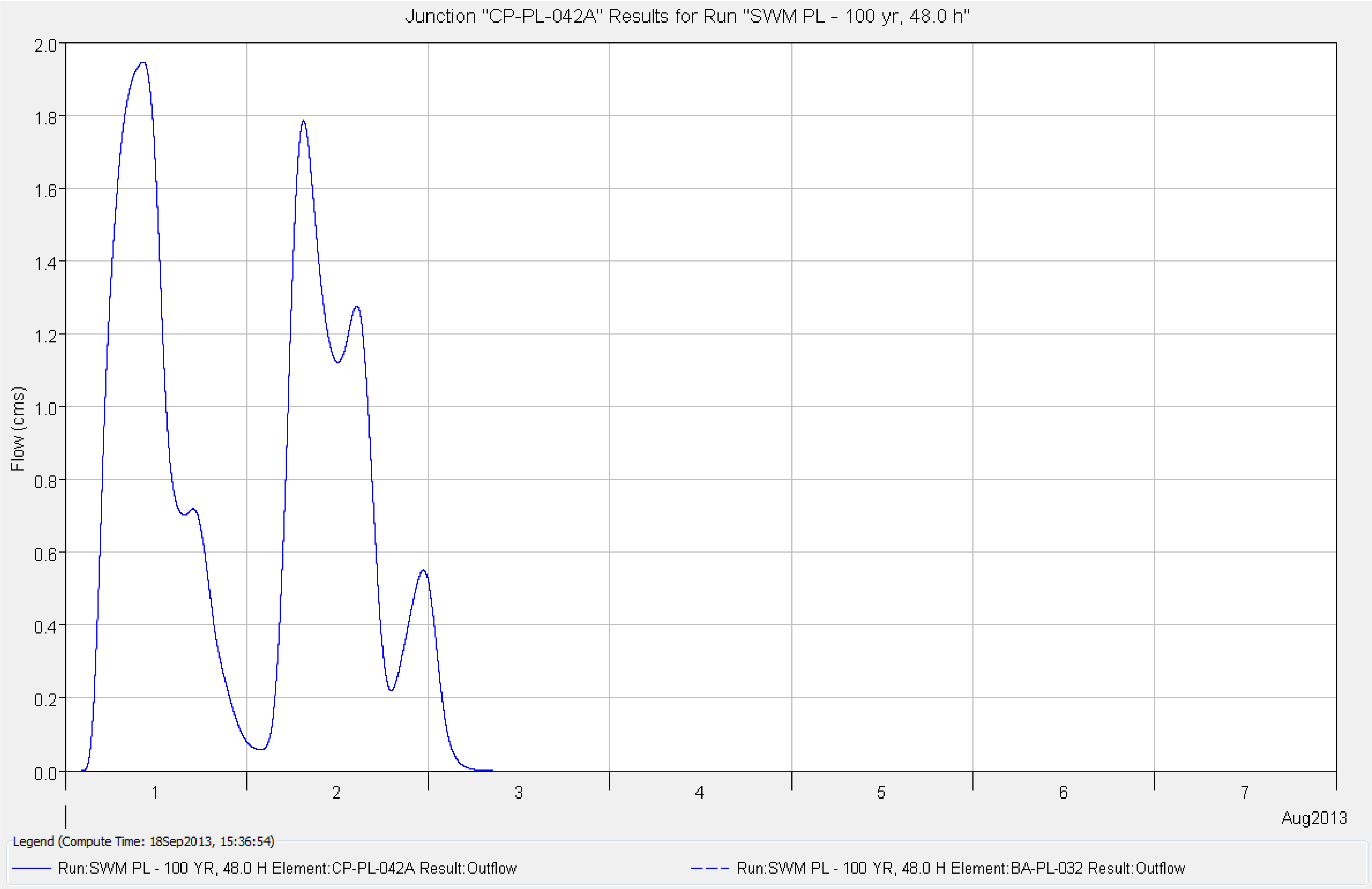
Junction "CP-PL-041A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042C Result:Outflow



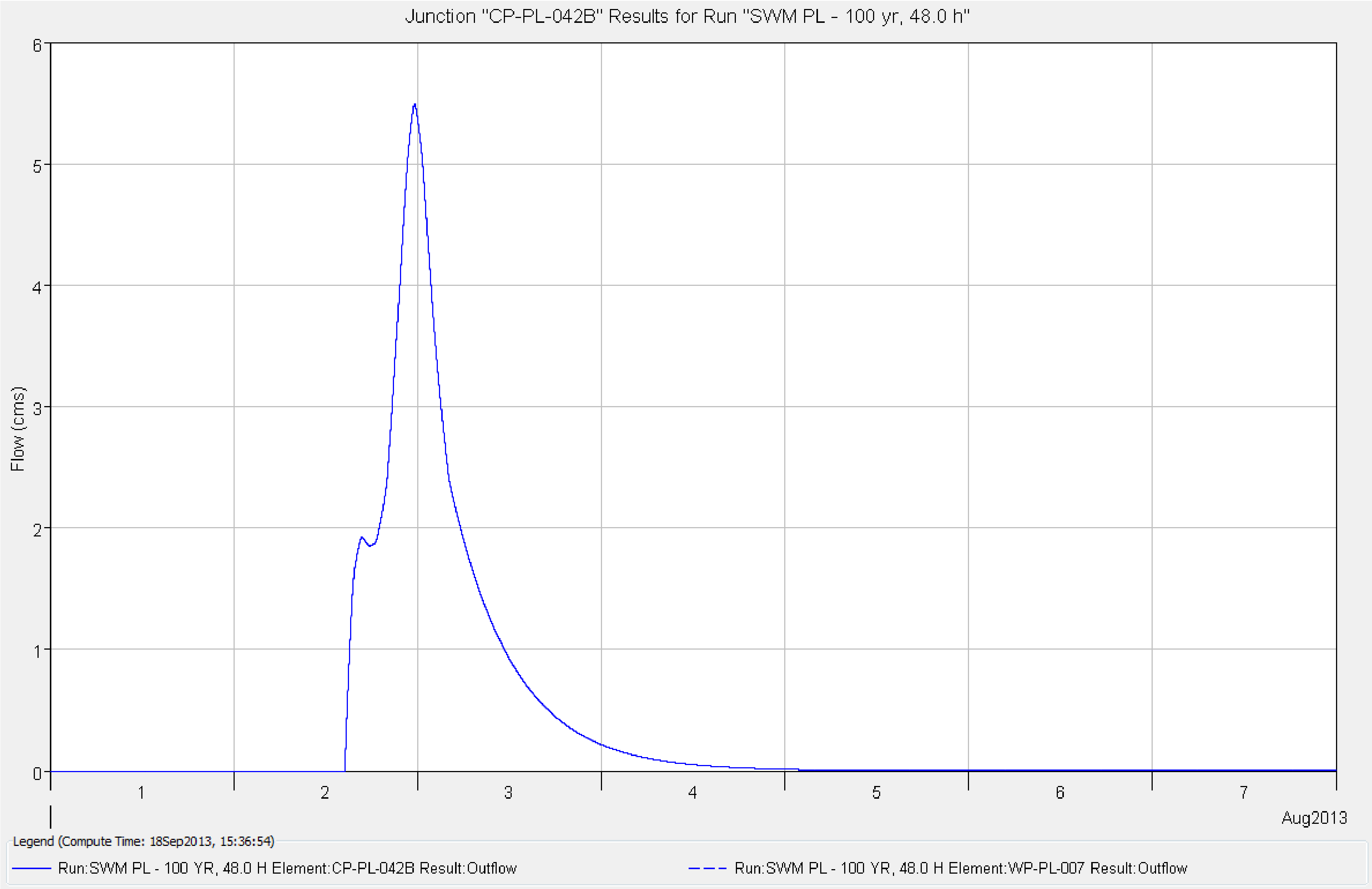
Junction "CP-PL-041B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-033 Result:Outflow



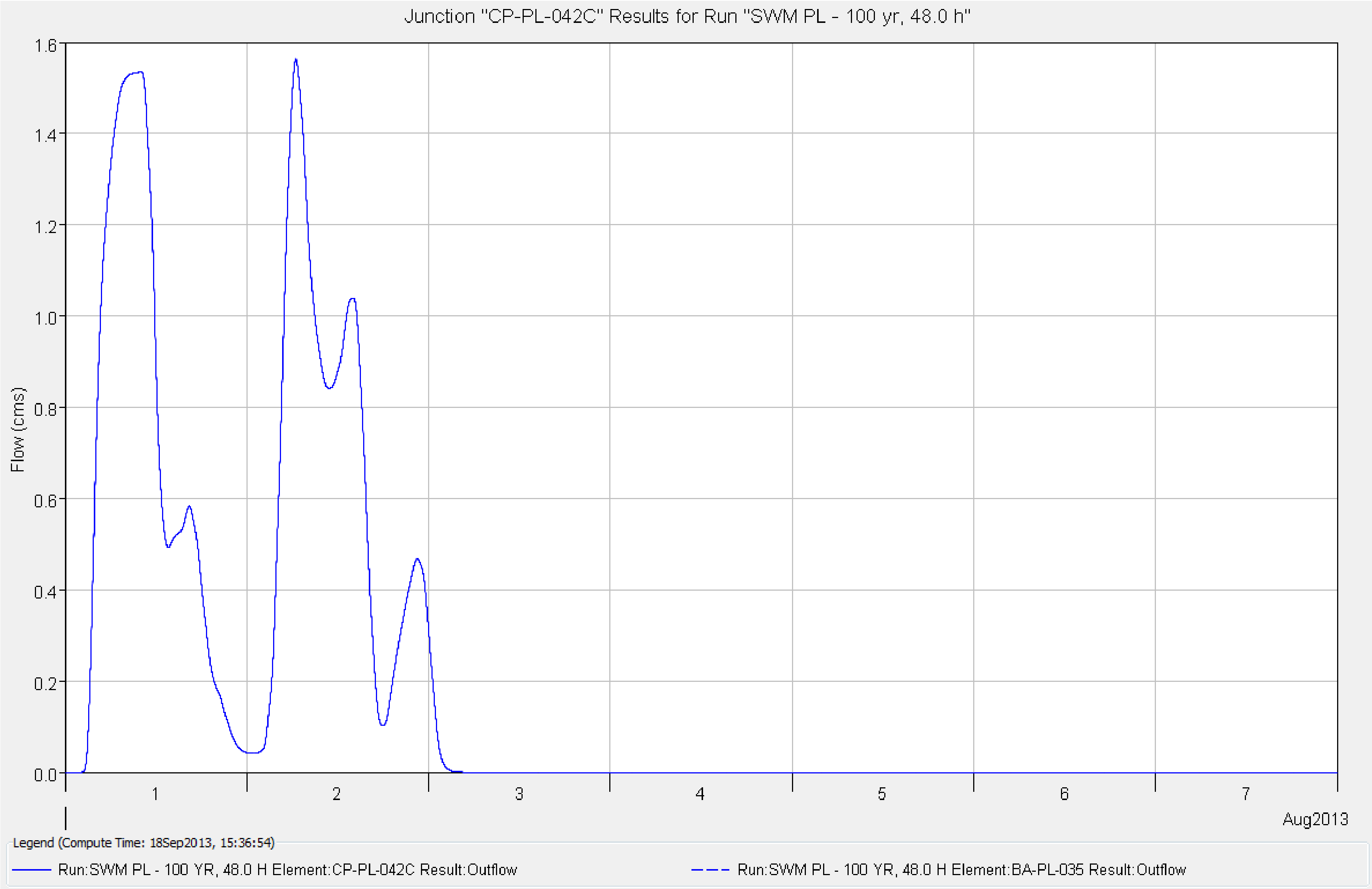
Junction "CP-PL-041C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-061 Result:Outflow

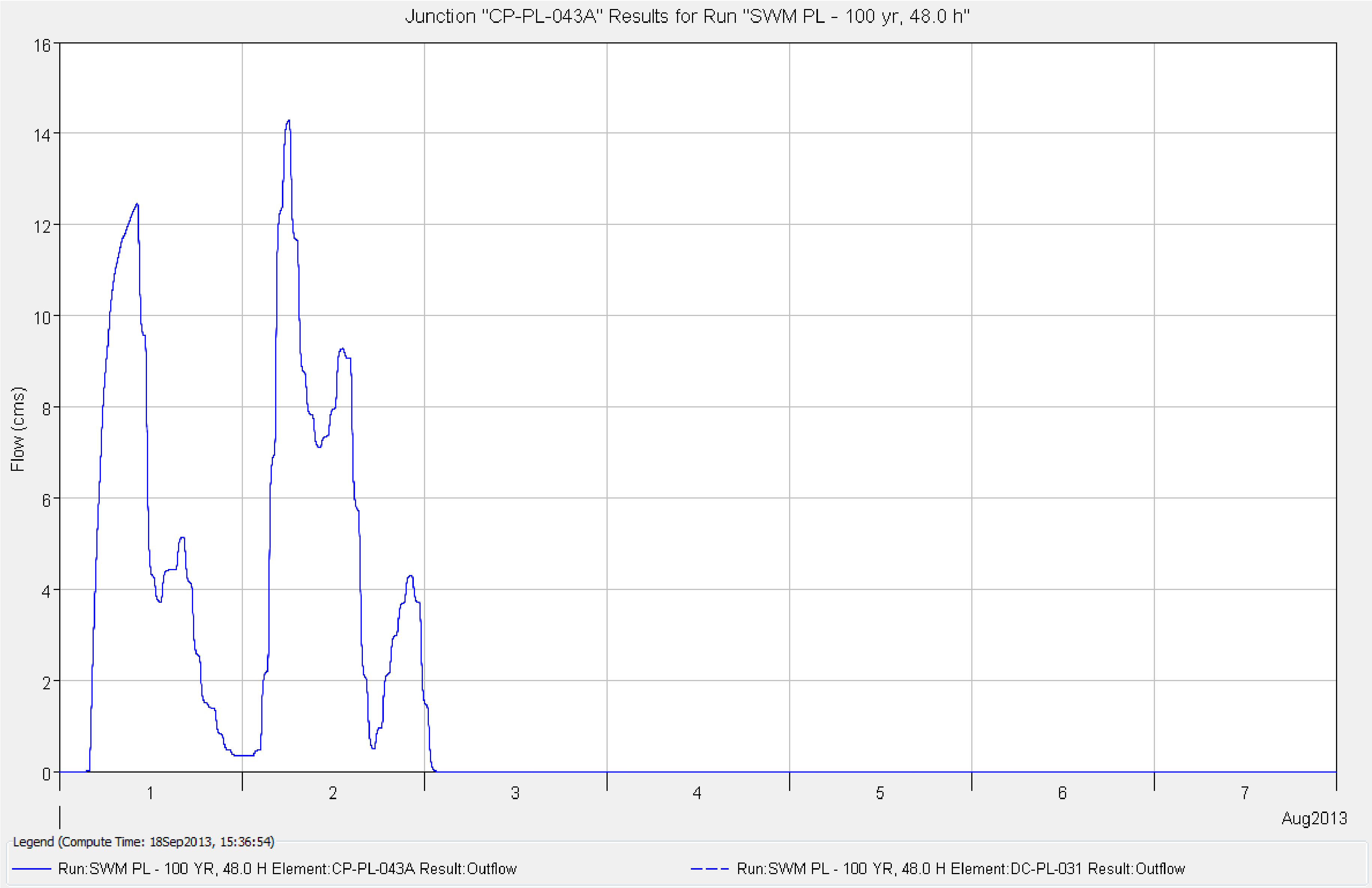


Junction "CP-PL-042A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-032 Result:Outflow

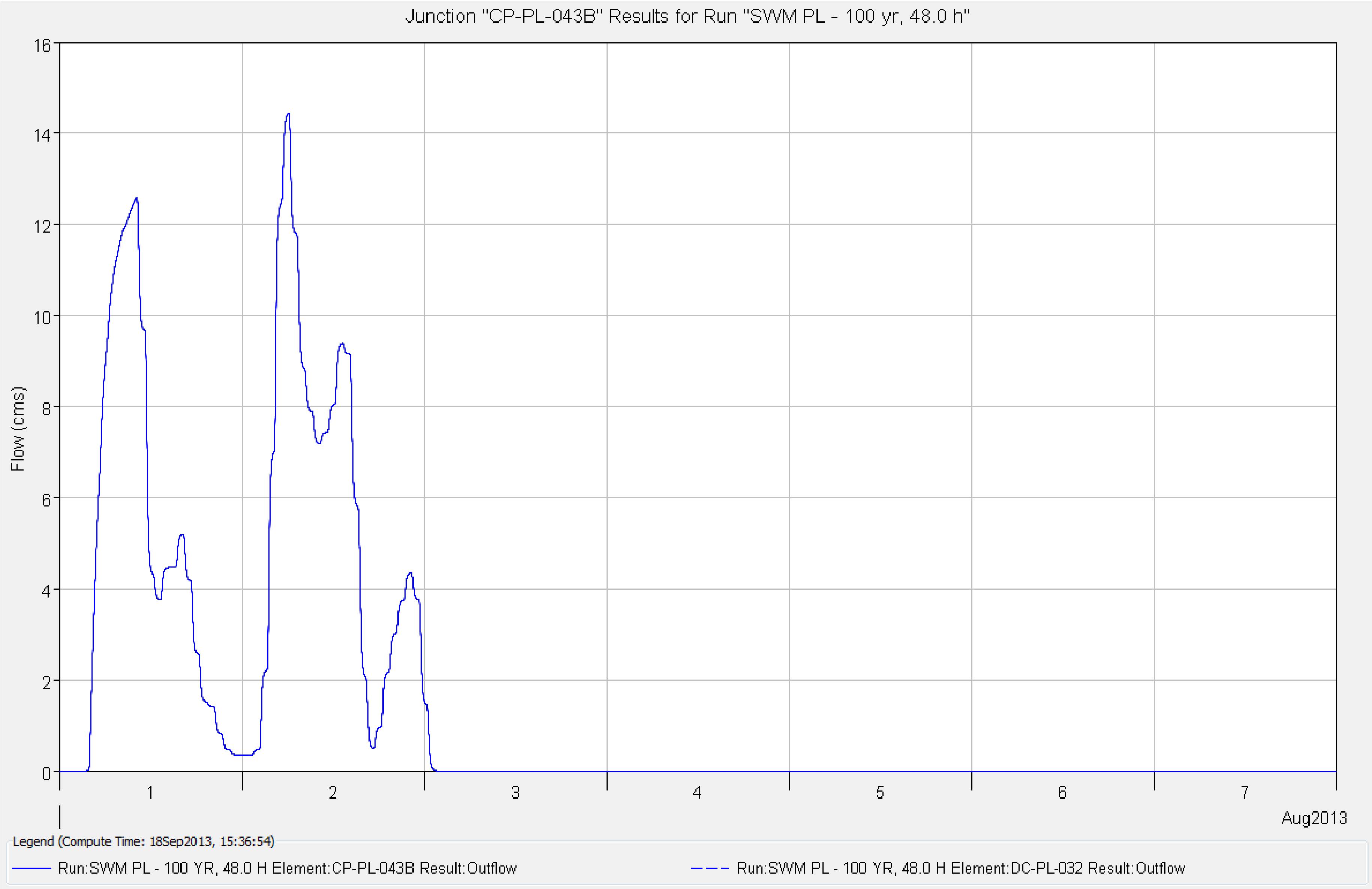


Junction "CP-PL-042B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Outflow

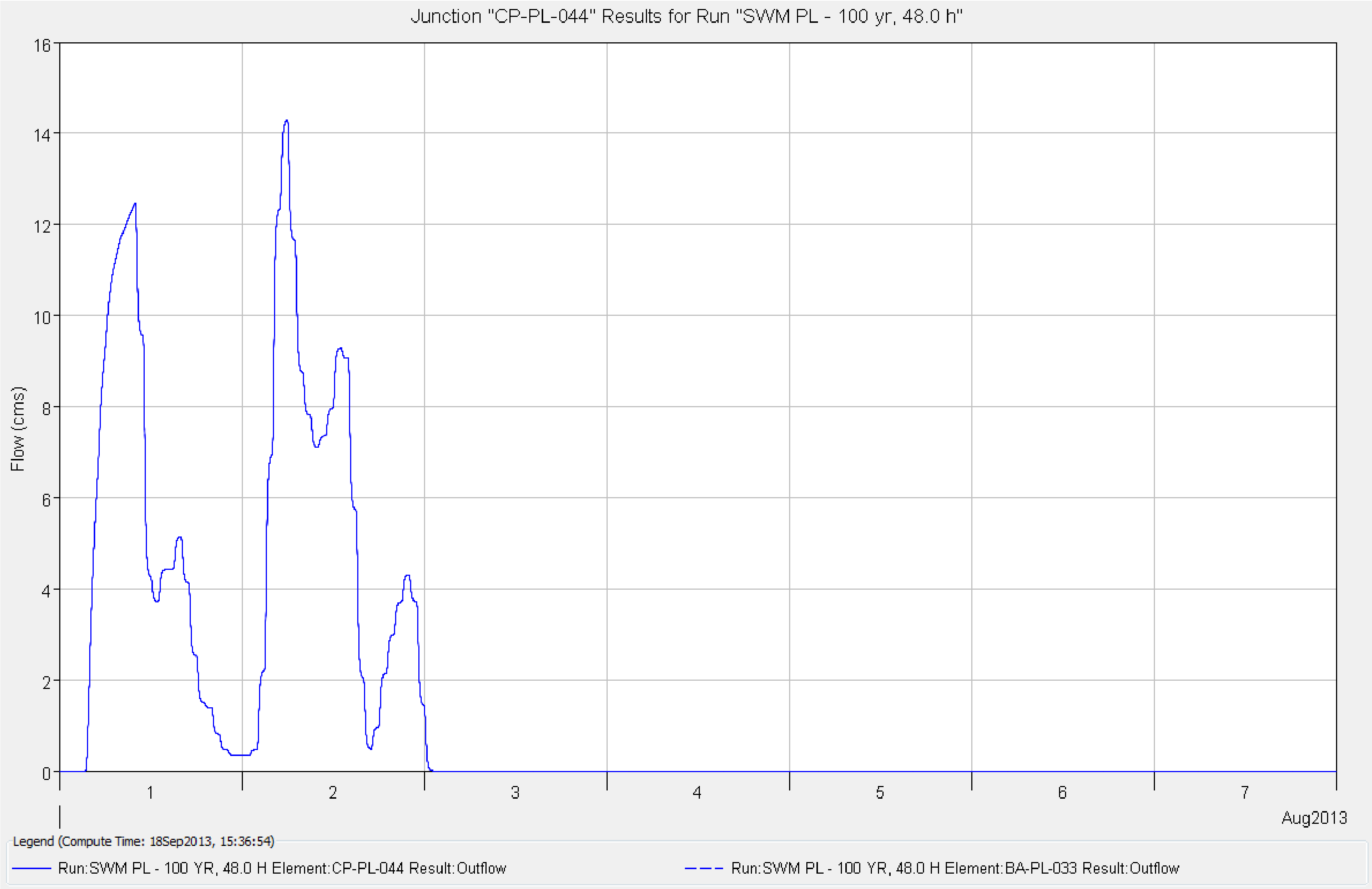

Junction "CP-PL-042C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-035 Result:Outflow



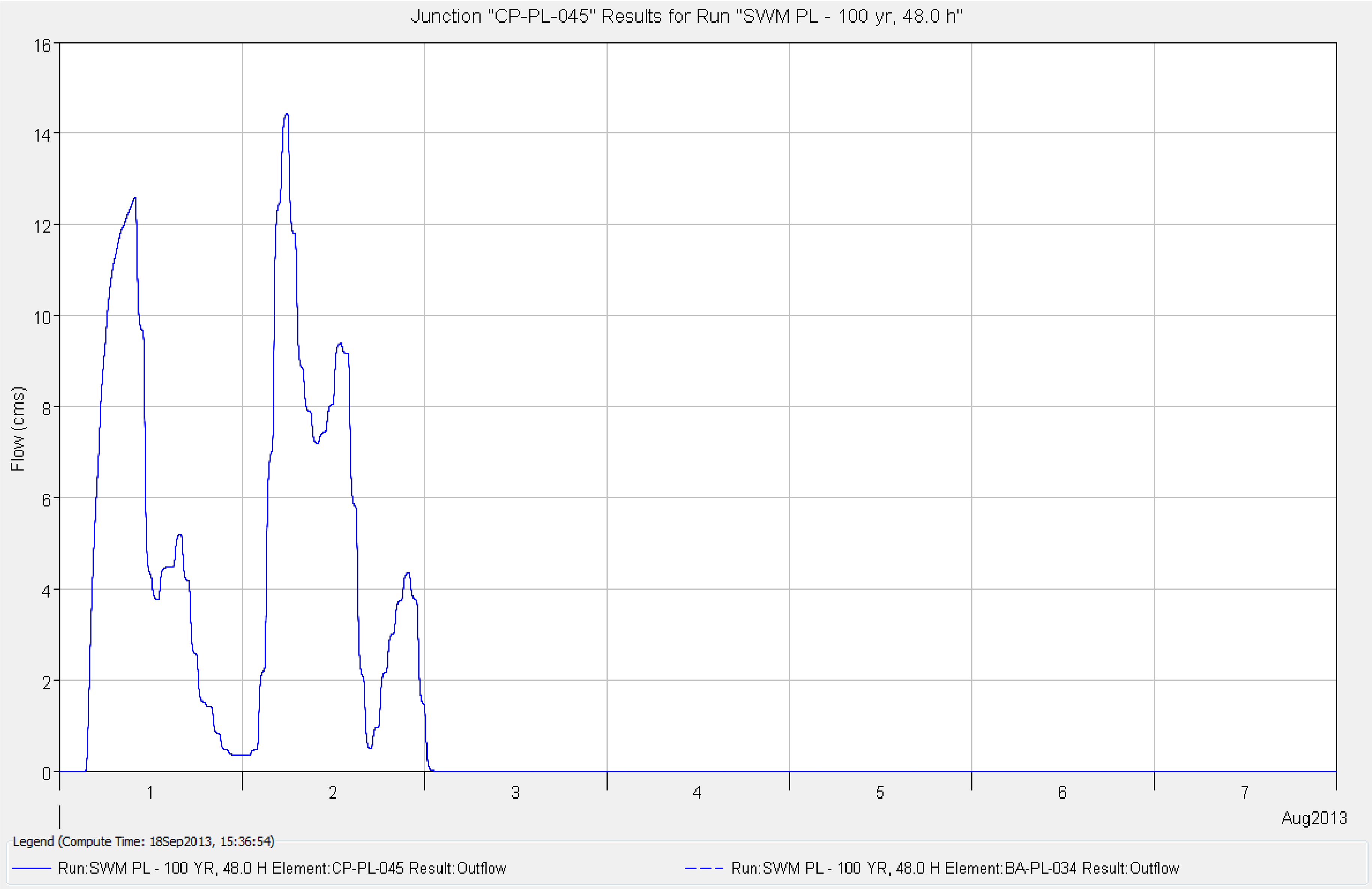
Junction "CP-PL-043A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-043A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-031 Result:Outflow



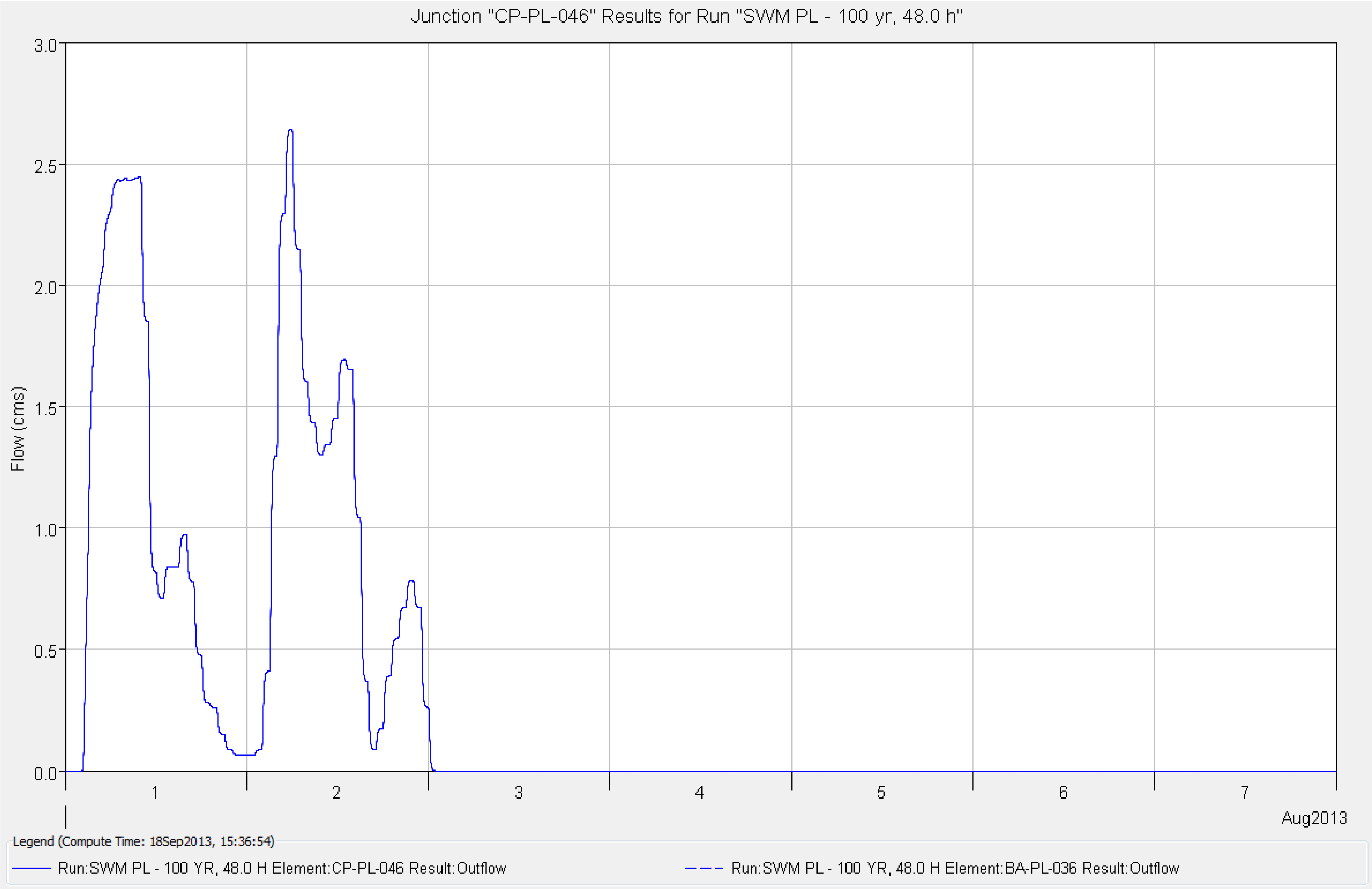
Junction "CP-PL-043B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-043B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-032 Result:Outflow



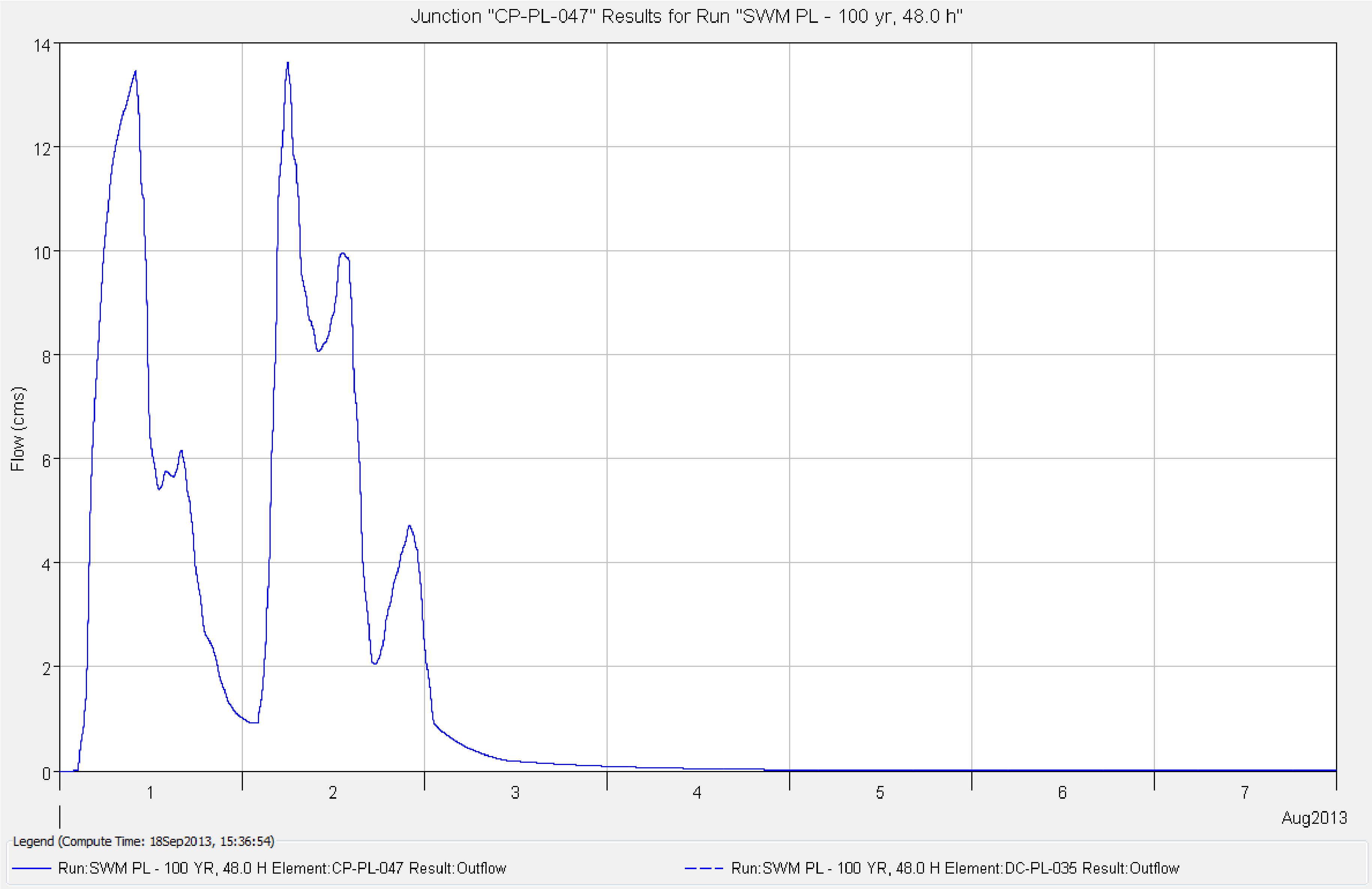
Junction "CP-PL-044" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-033 Result:Outflow

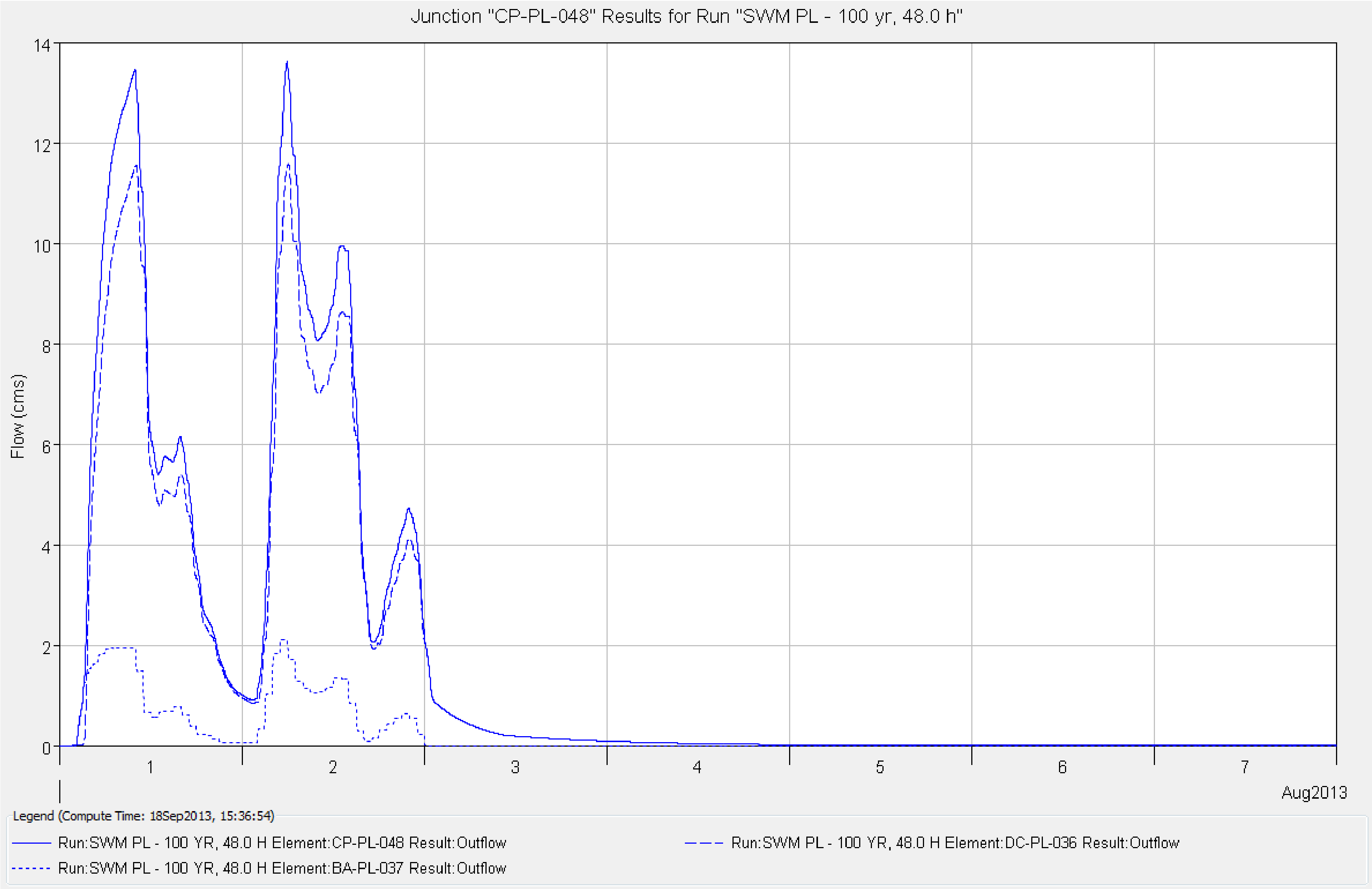


Junction "CP-PL-045" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-034 Result:Outflow

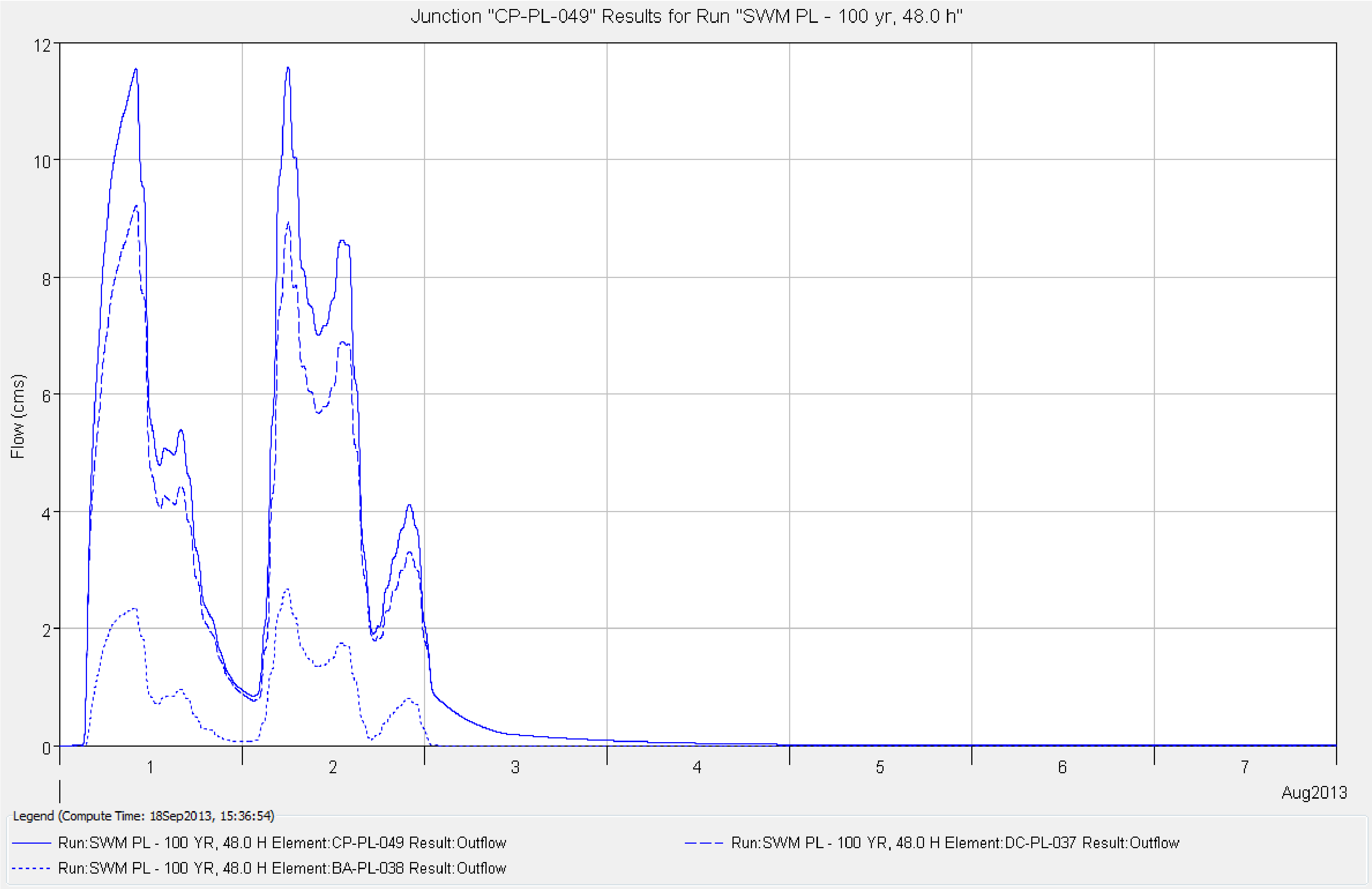


Junction "CP-PL-046" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-036 Result:Outflow

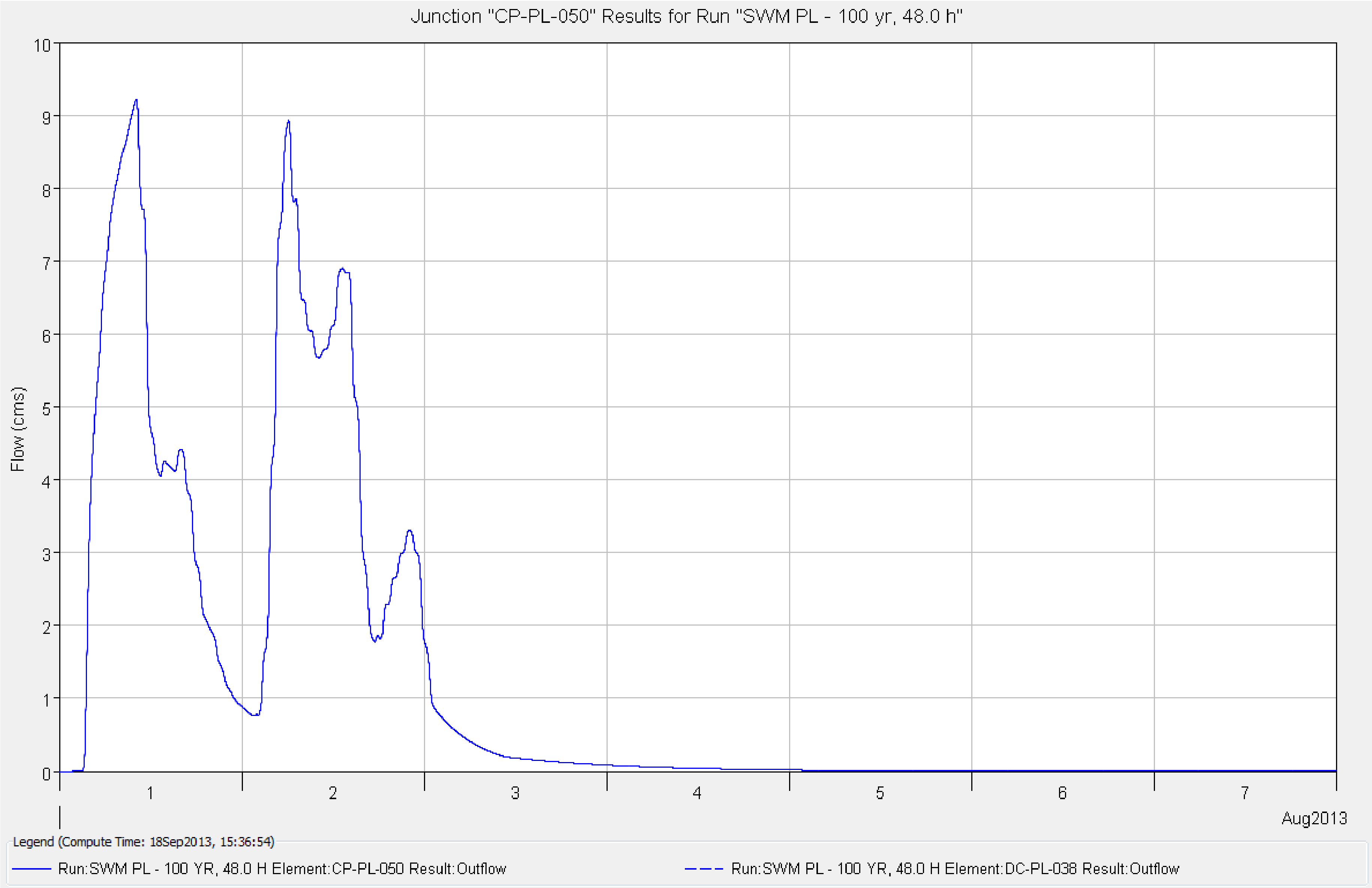

Junction "CP-PL-047" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-035 Result:Outflow

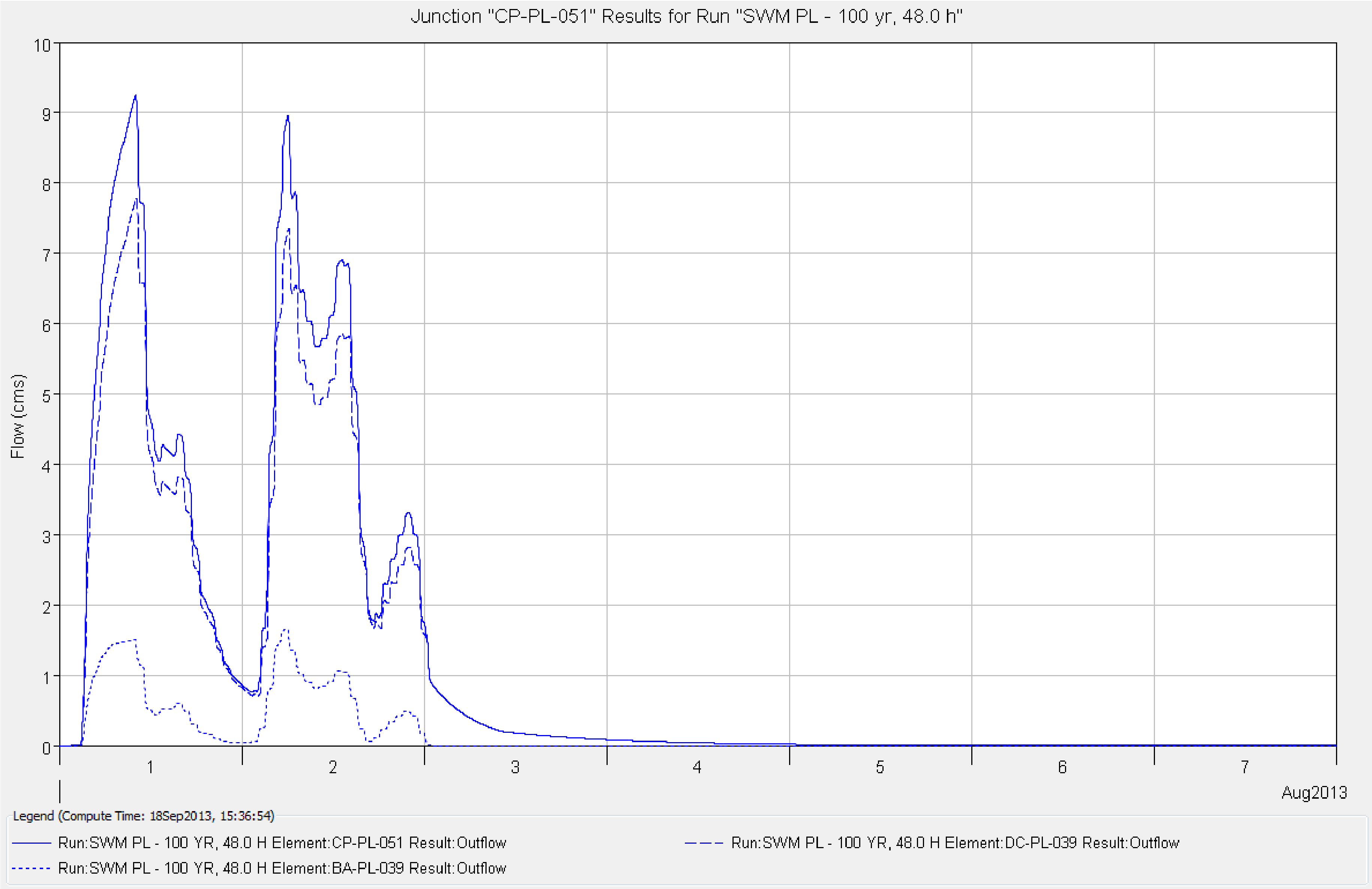


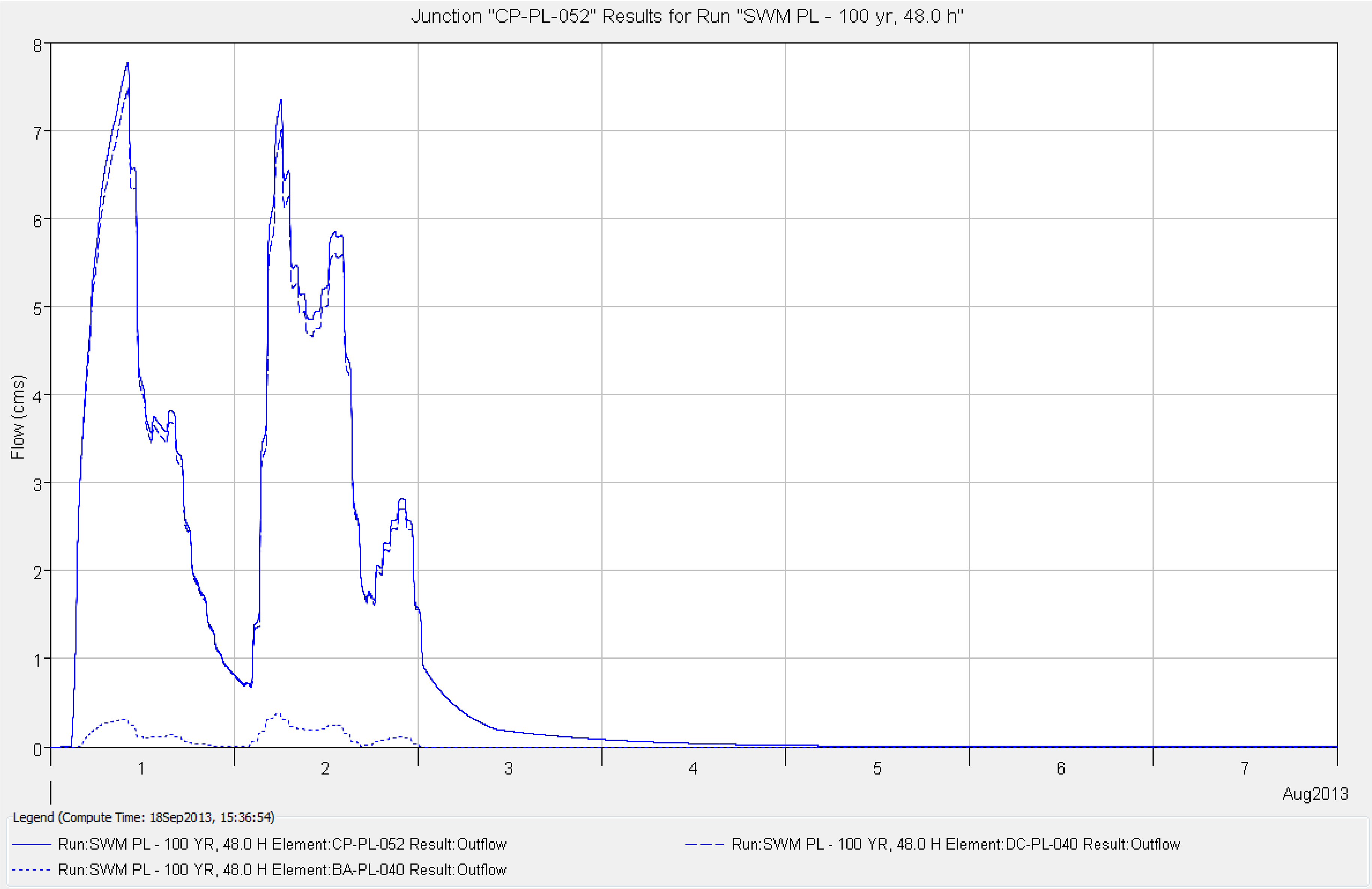
Junction "CP-PL-048" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-048 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-037 Result:Outflow



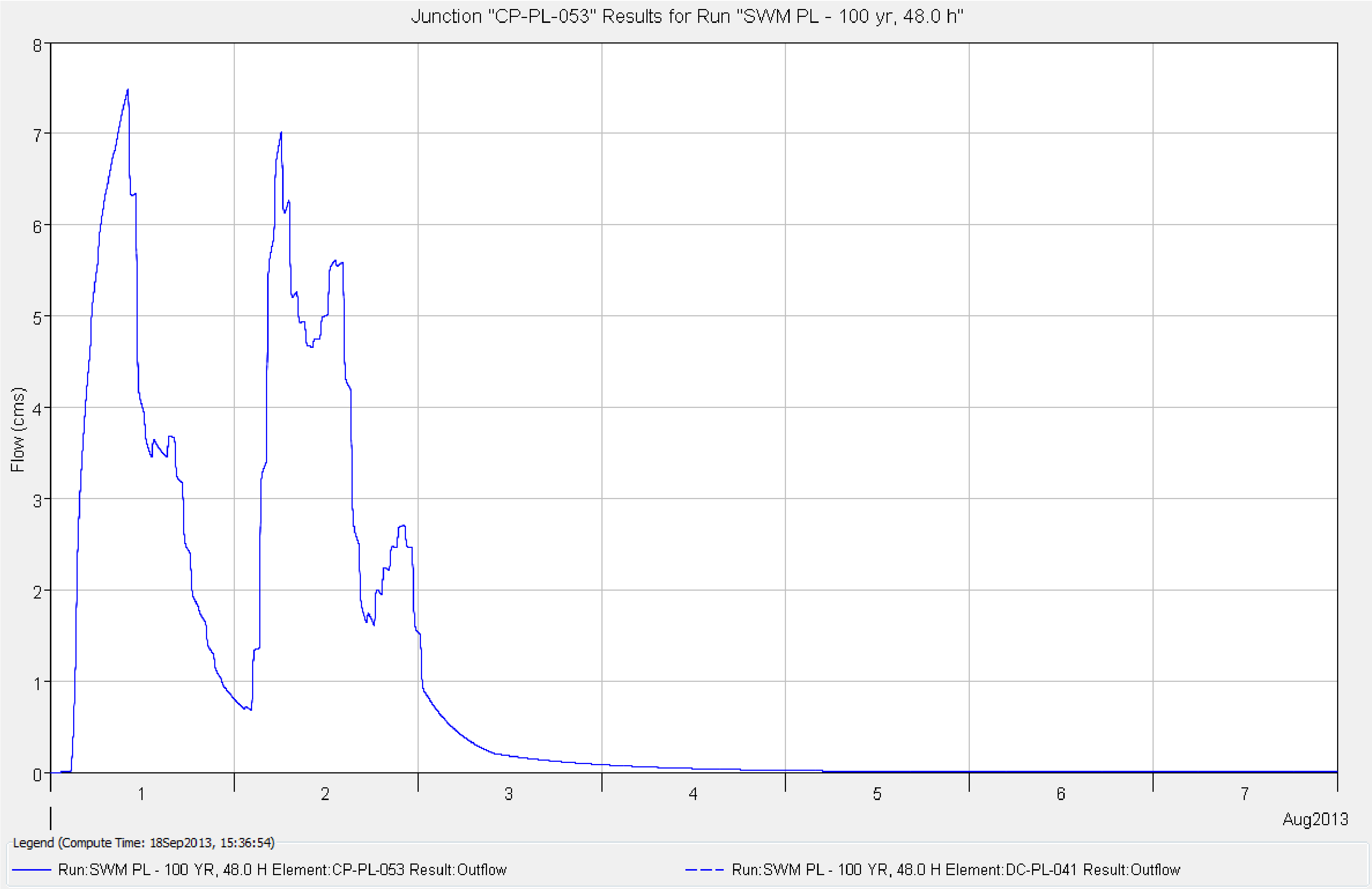
Junction "CP-PL-049" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-038 Result:Outflow

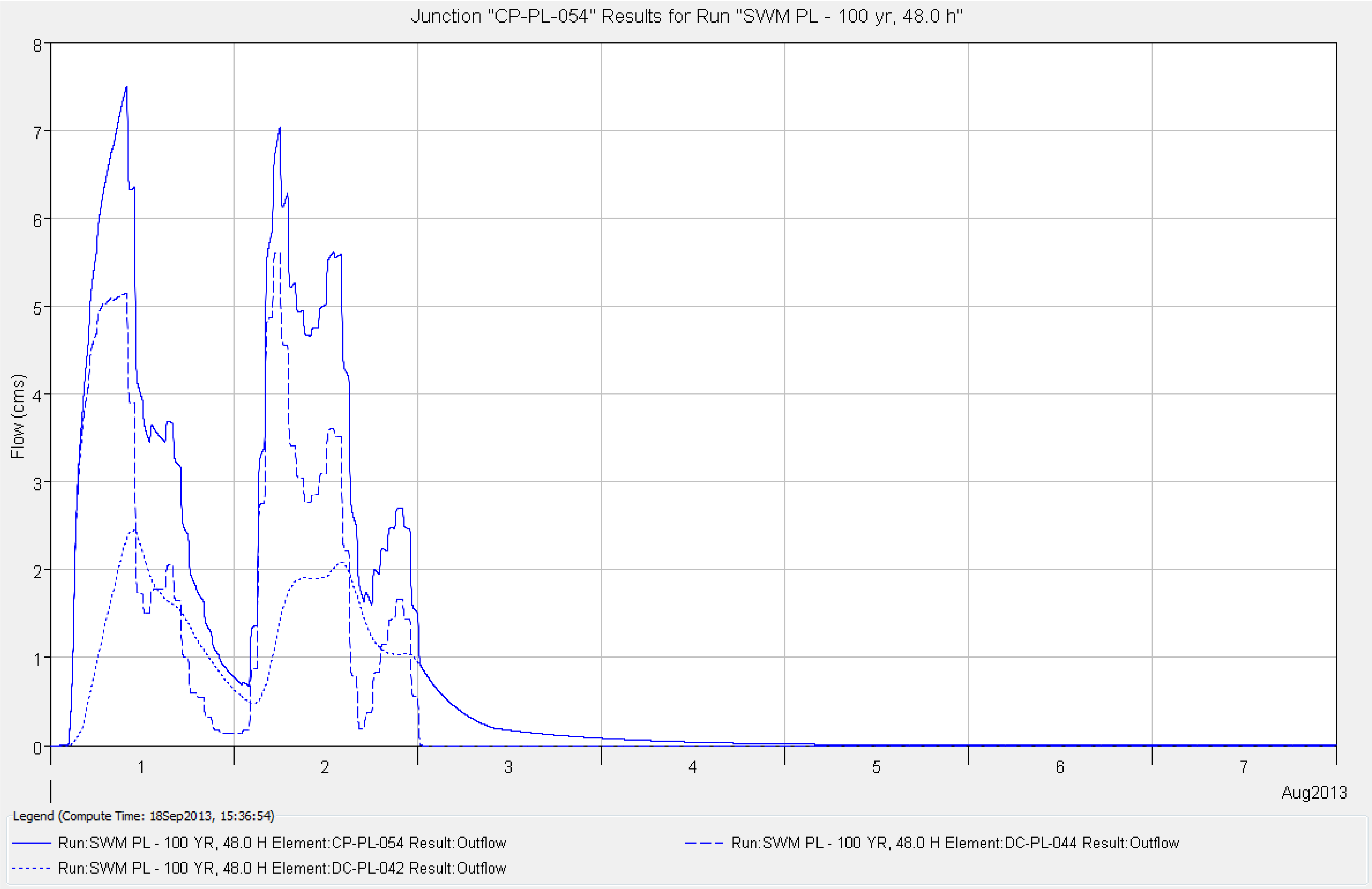

Junction "CP-PL-050" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-050 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-038 Result:Outflow


Junction "CP-PL-051" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-051 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-039 Result:Outflow

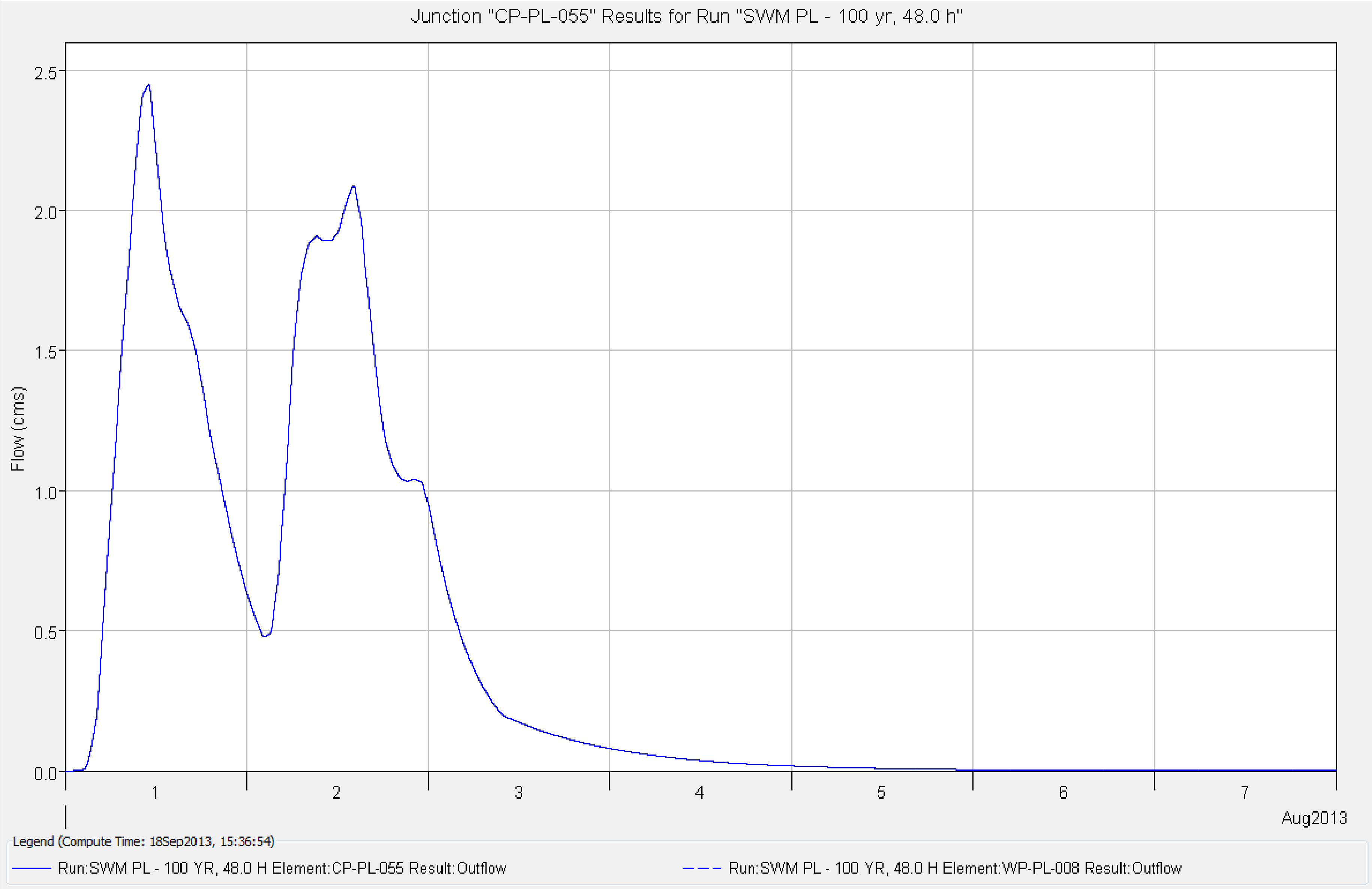


Junction "CP-PL-052" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-040 Result:Outflow

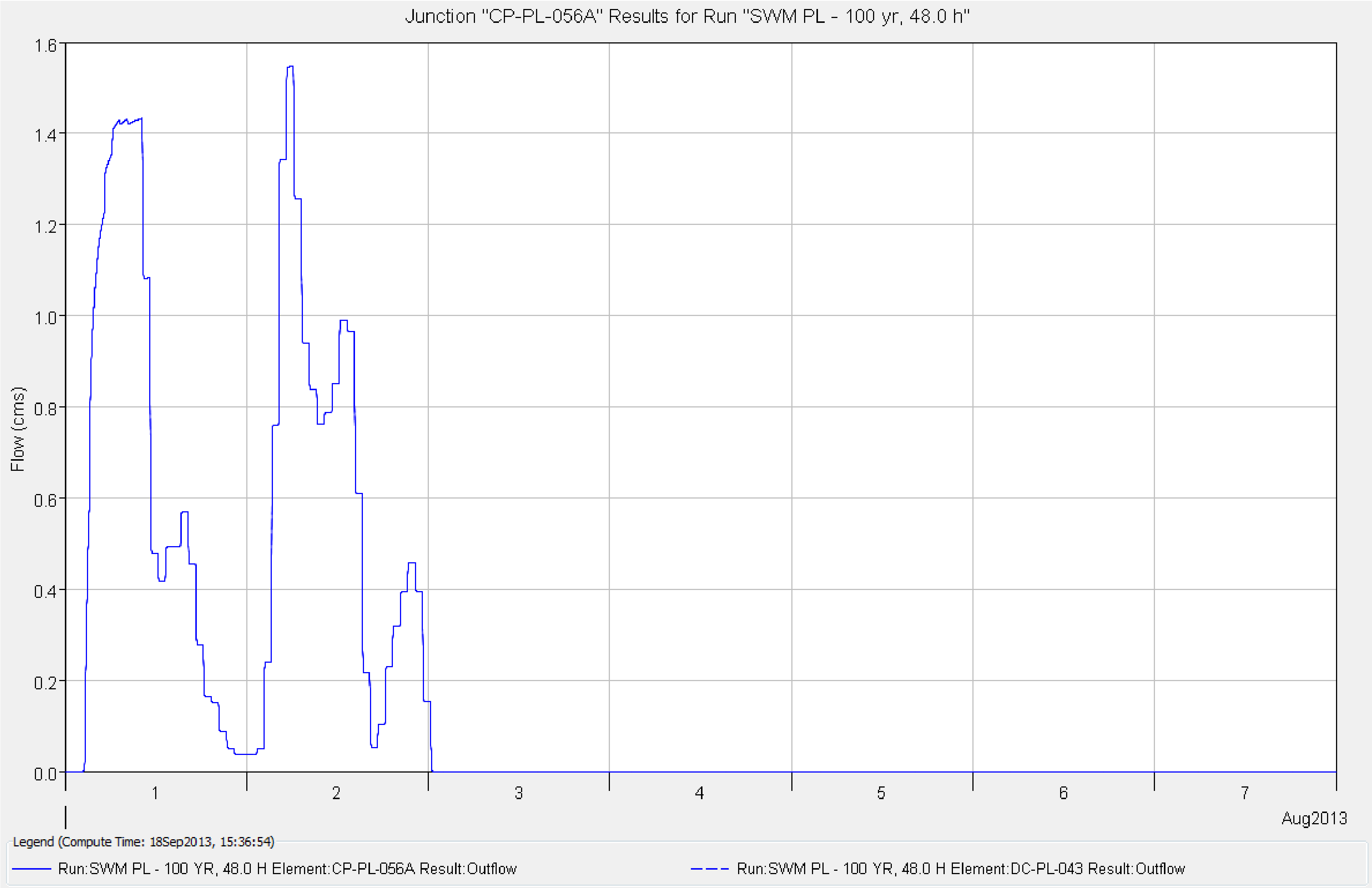

Junction "CP-PL-053" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-041 Result:Outflow



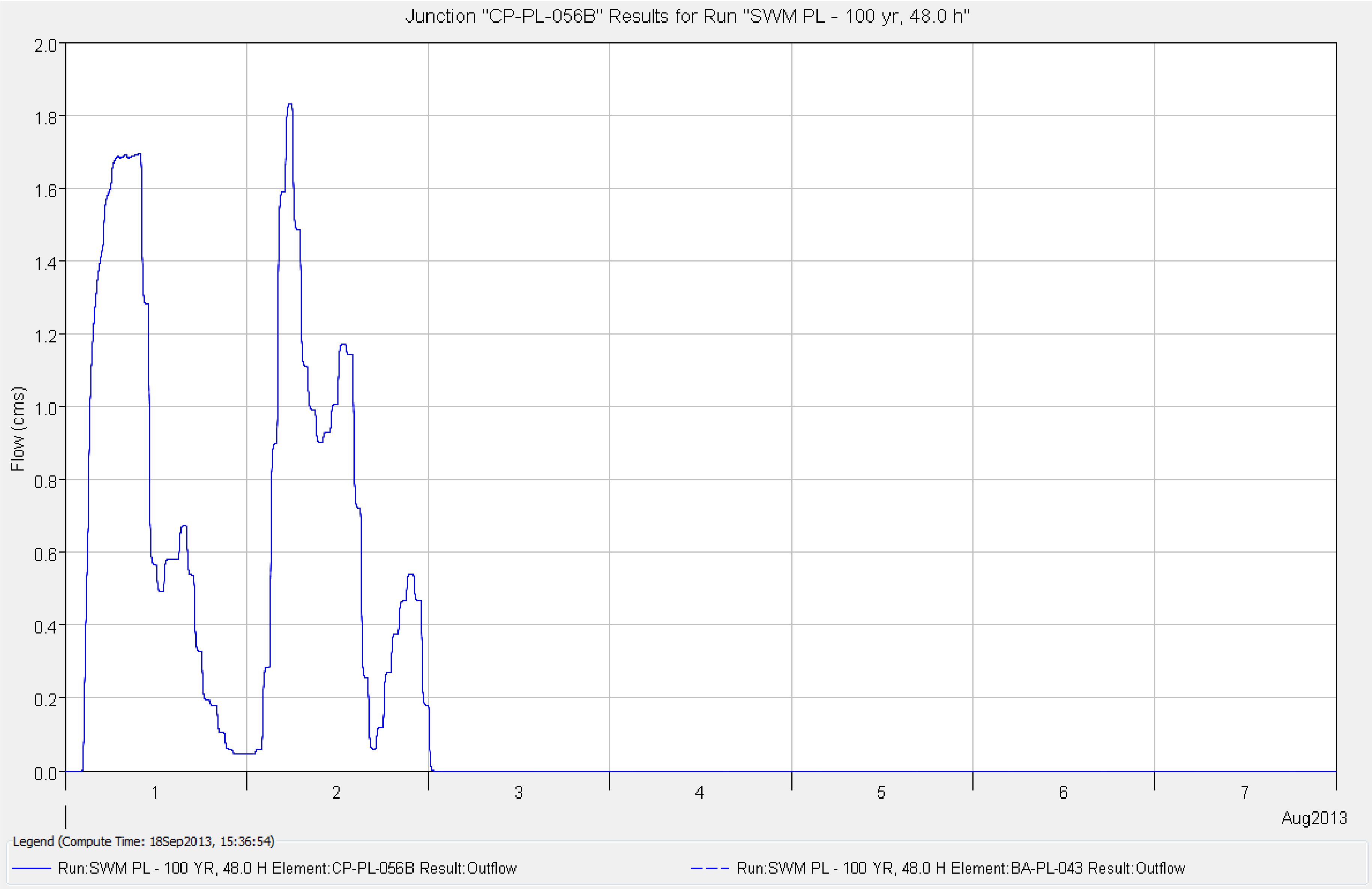
Junction "CP-PL-054" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-042 Result:Outflow

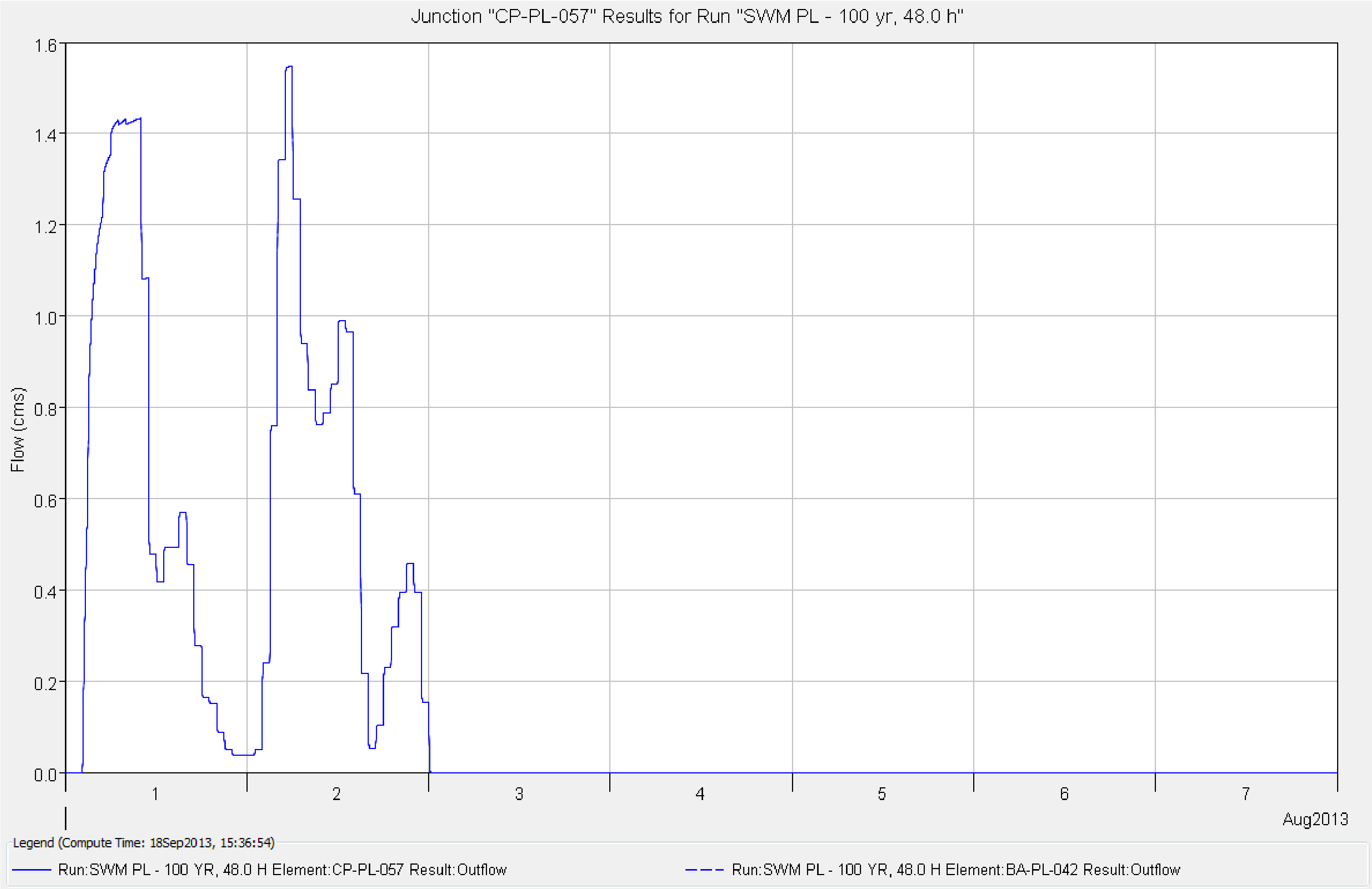


Junction "CP-PL-055" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Outflow

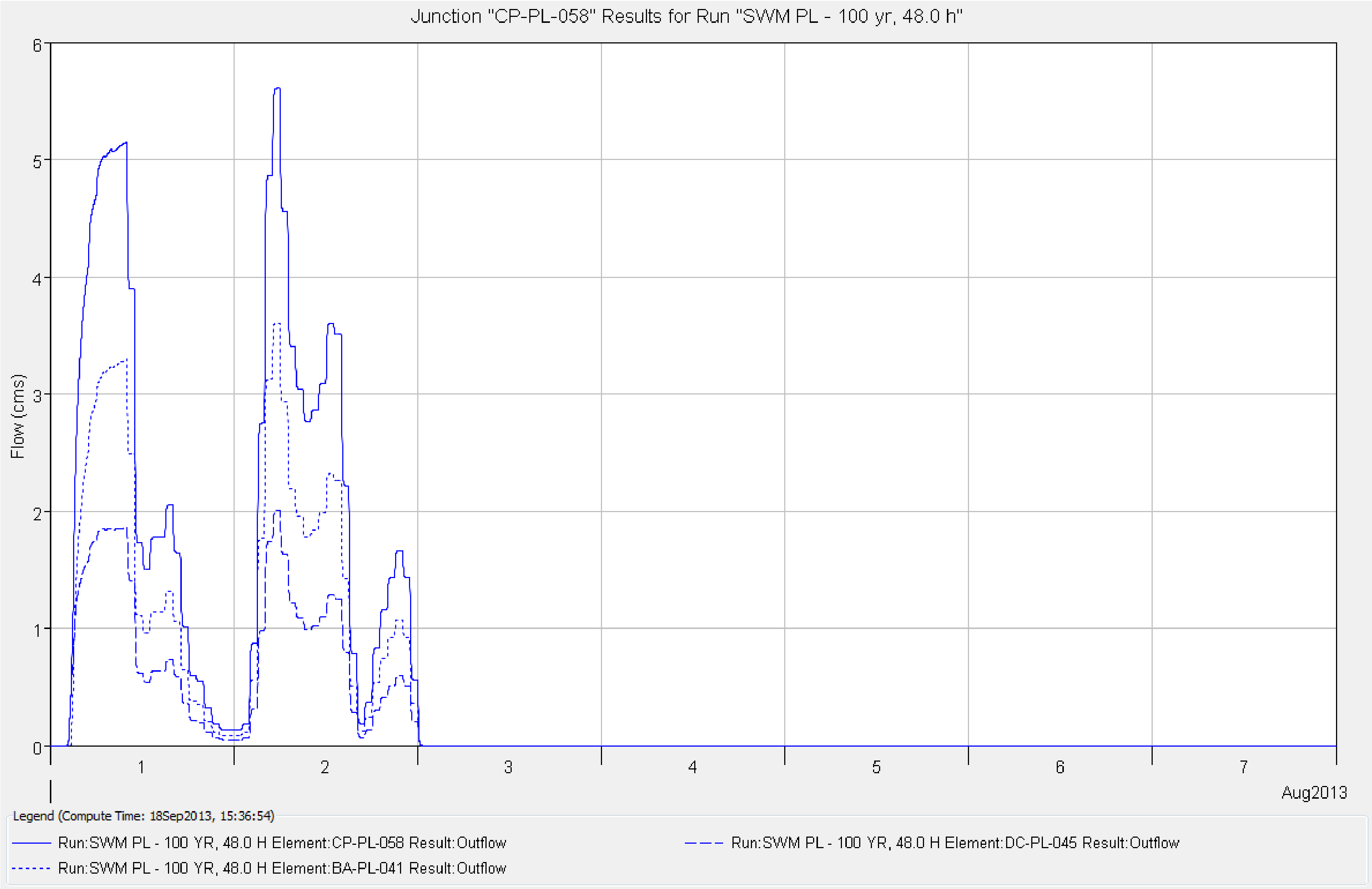


Junction "CP-PL-056A" Results for Run "SWM PL - 100 yr, 48.0 h"
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-056A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-043 Result:Outflow

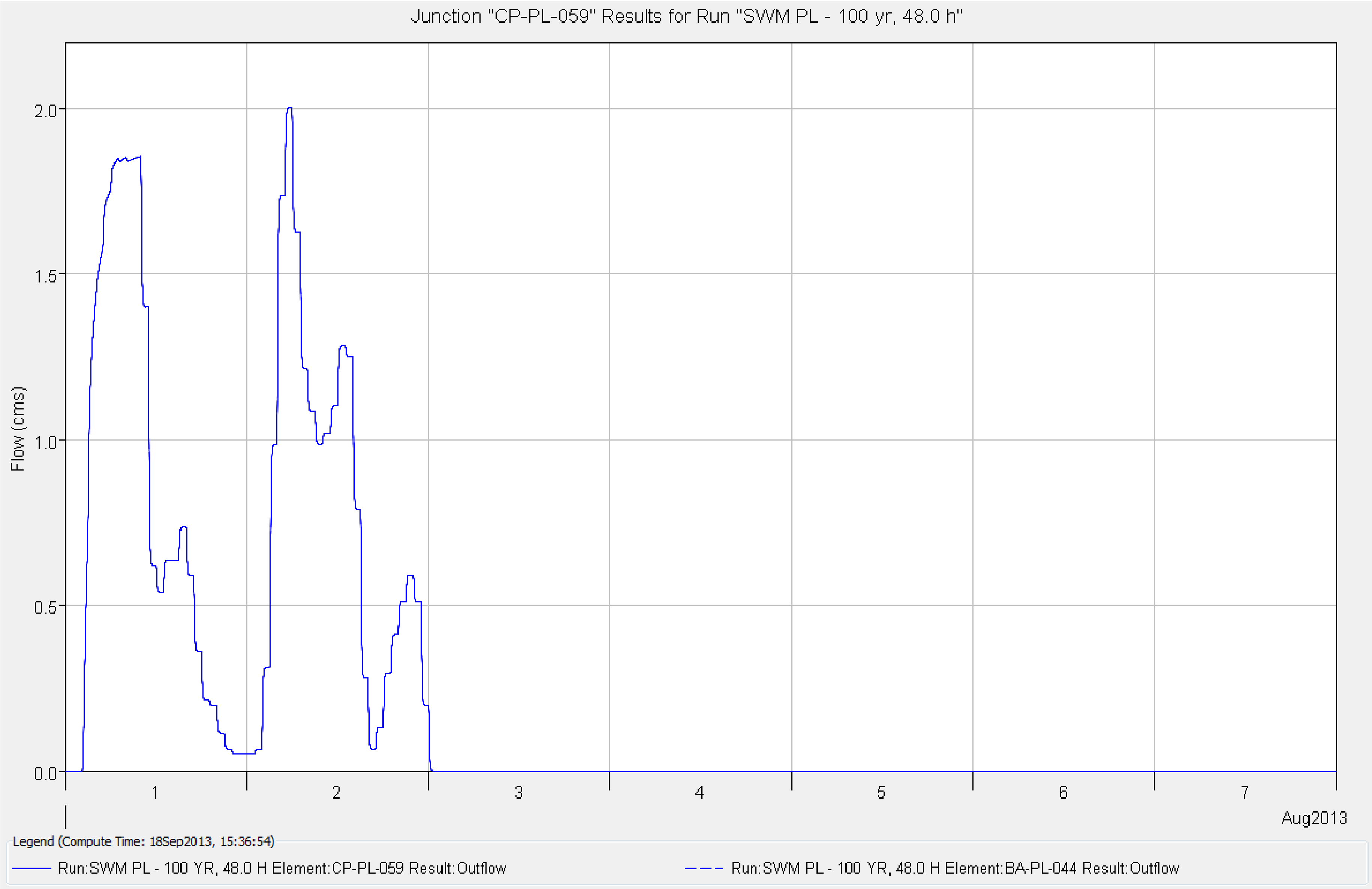

Junction "CP-PL-056B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-056B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-043 Result:Outflow

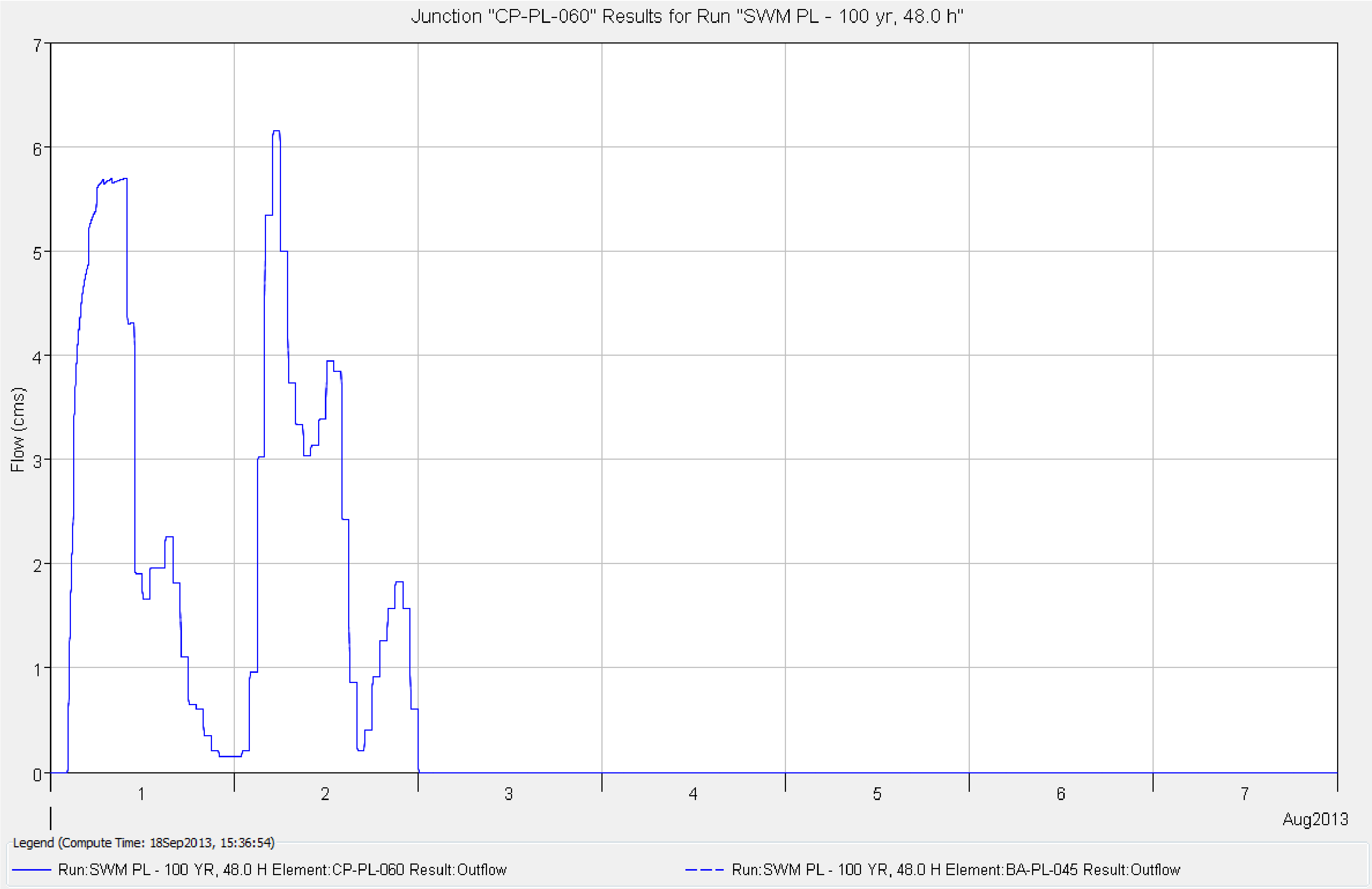


Junction "CP-PL-057" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-042 Result:Outflow

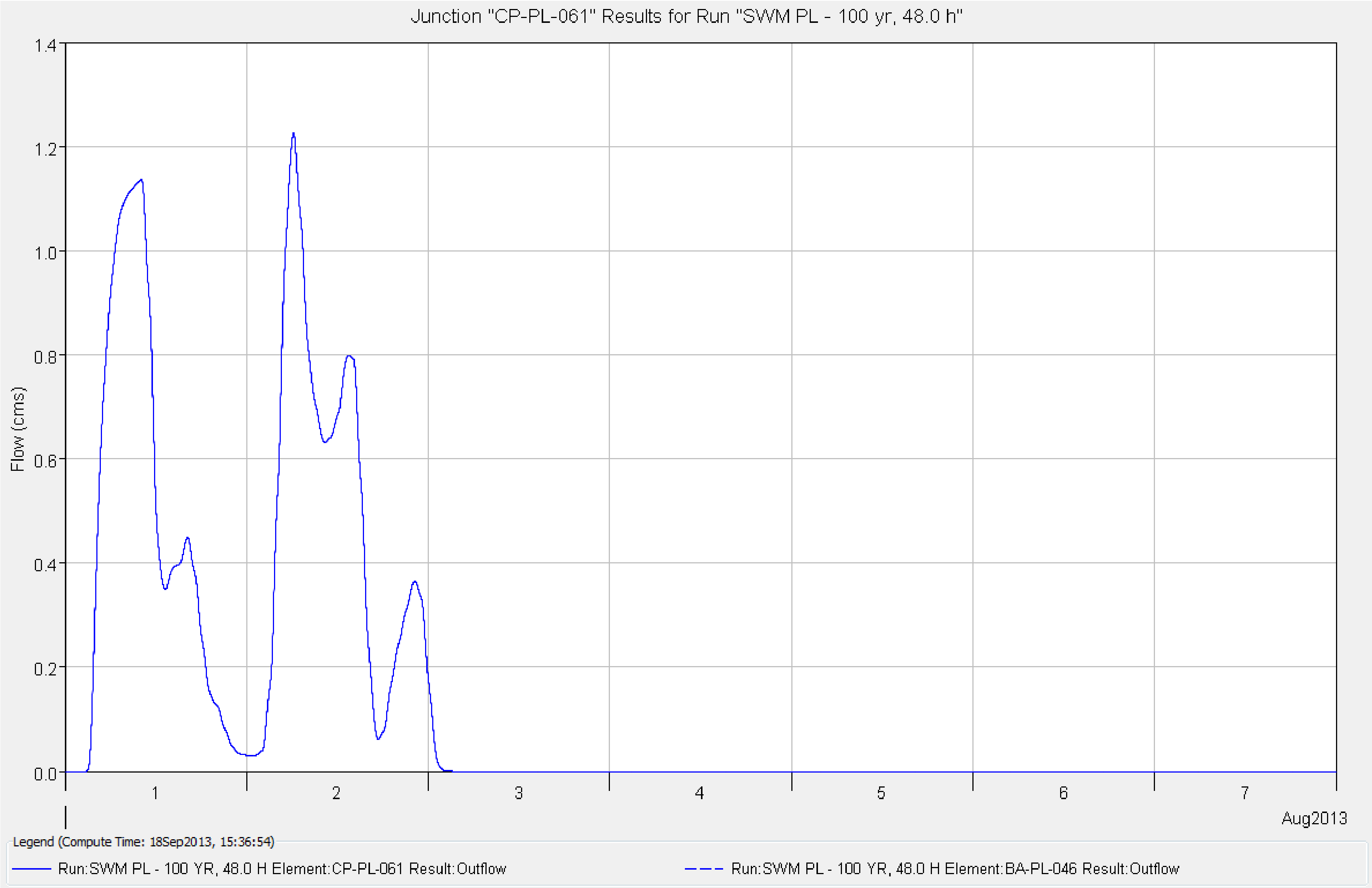


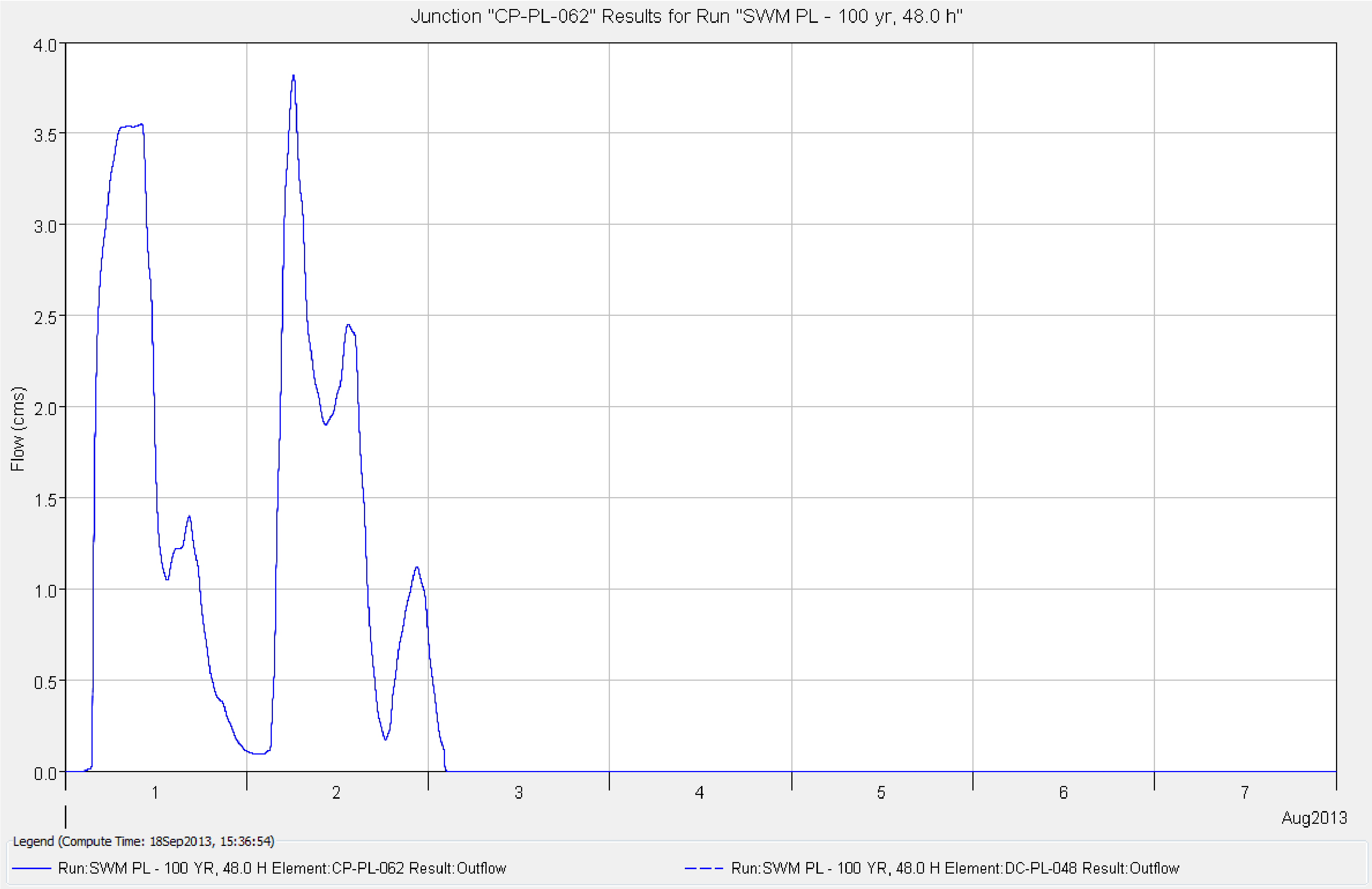
Junction "CP-PL-058" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-041 Result:Outflow

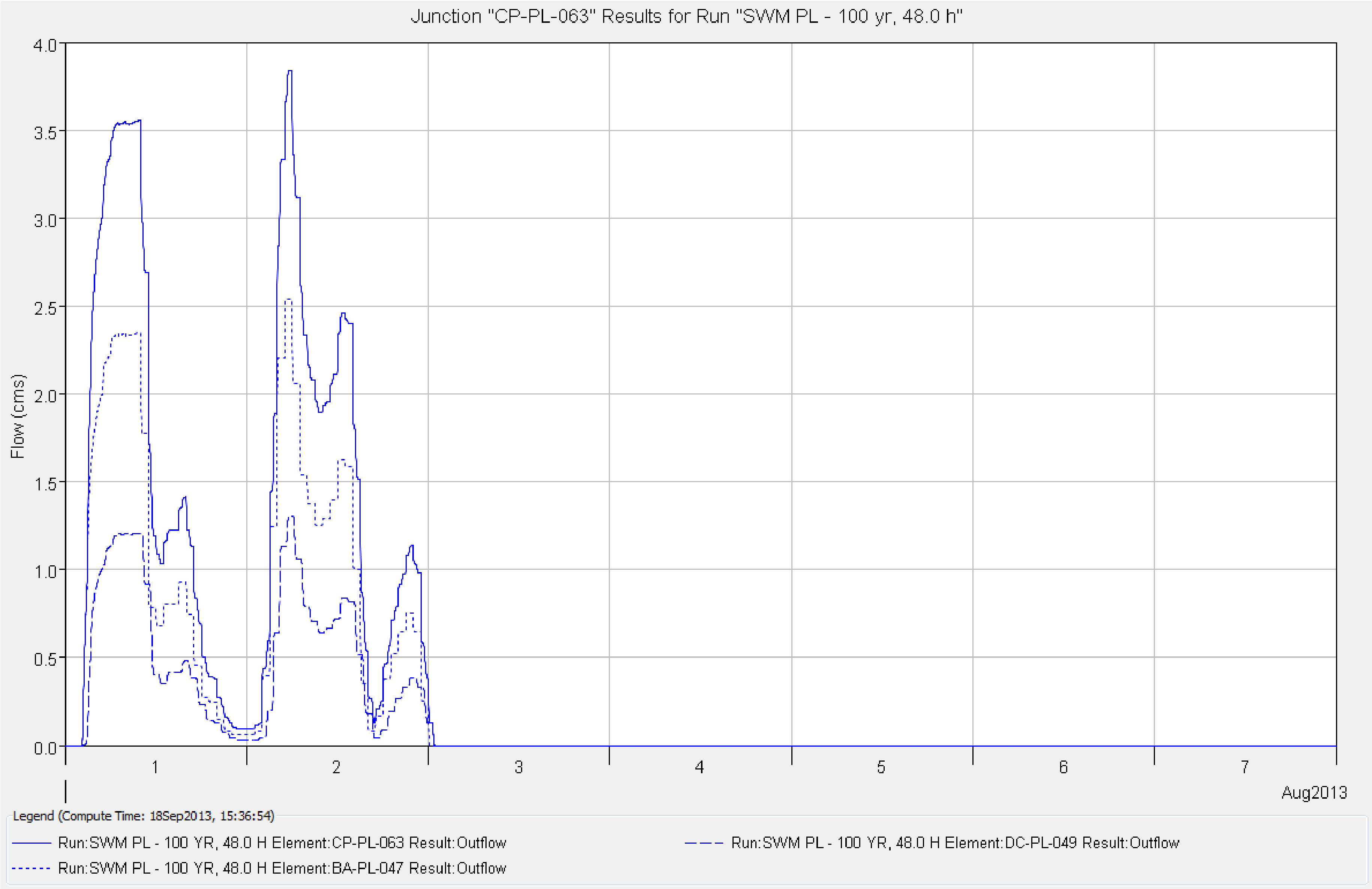

Junction "CP-PL-059" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-059 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-044 Result:Outflow



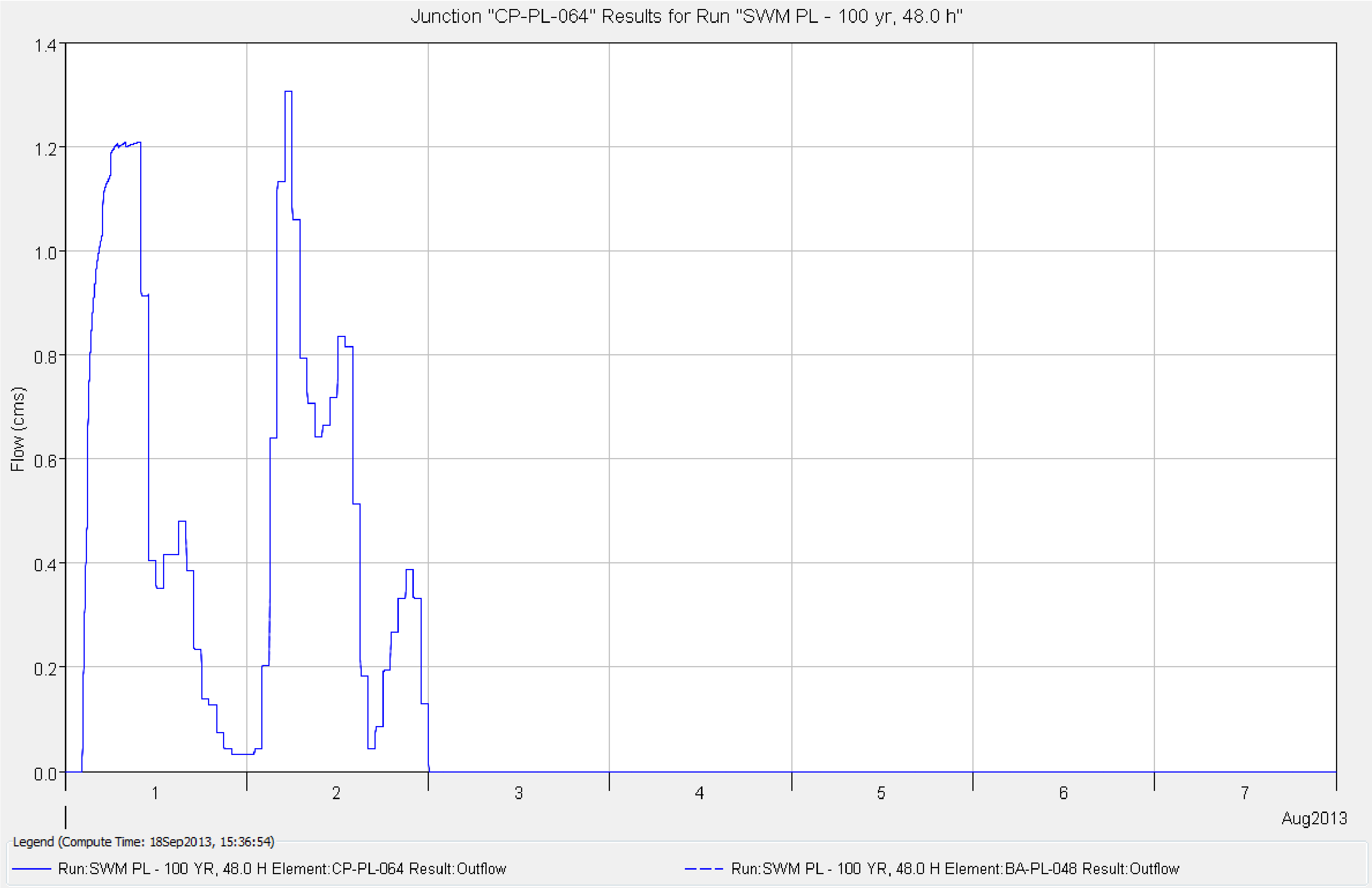
Junction "CP-PL-060" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-045 Result:Outflow


Junction "CP-PL-061" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-061 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-046 Result:Outflow

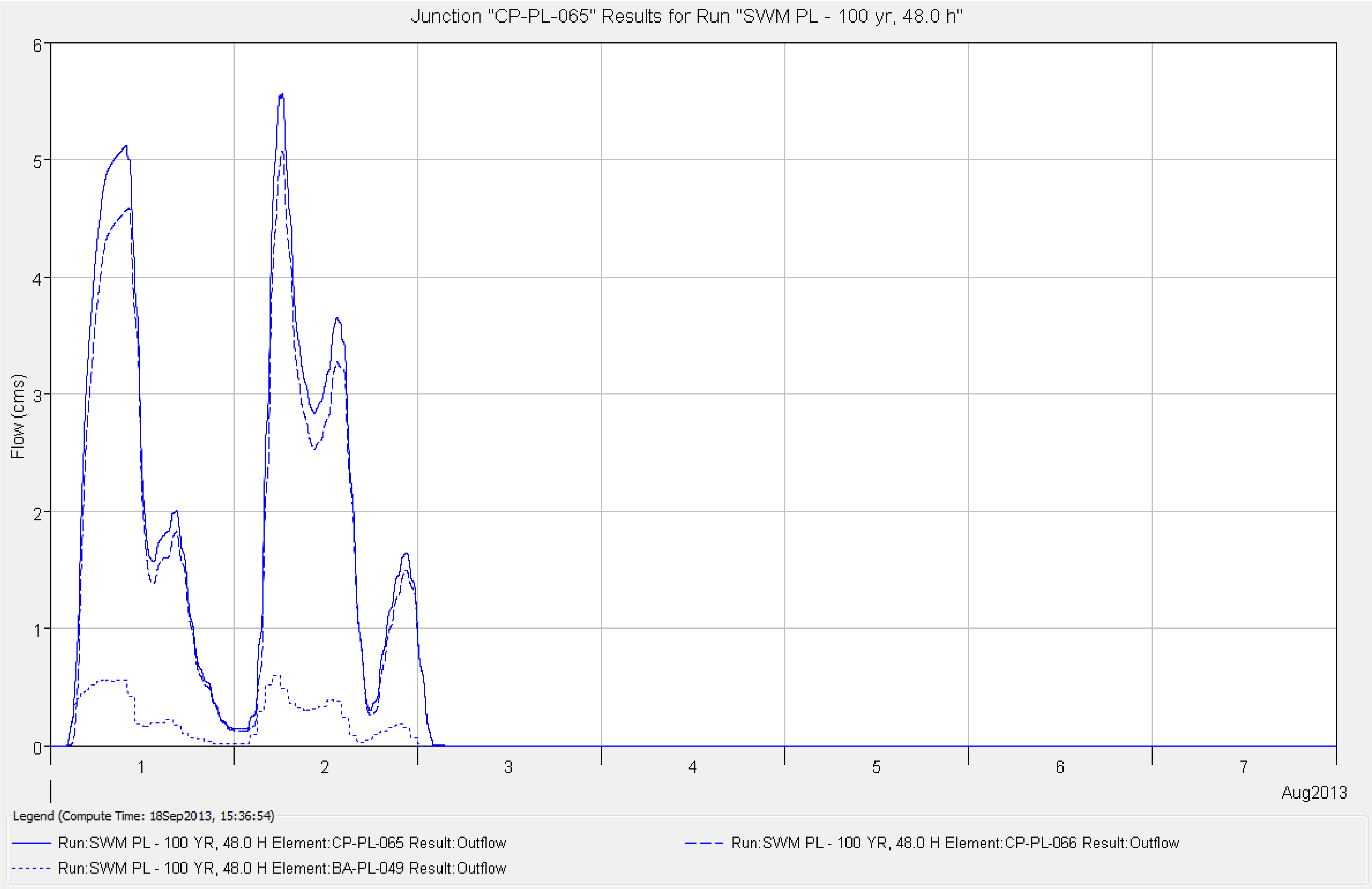

Junction "CP-PL-062" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-062 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-048 Result:Outflow



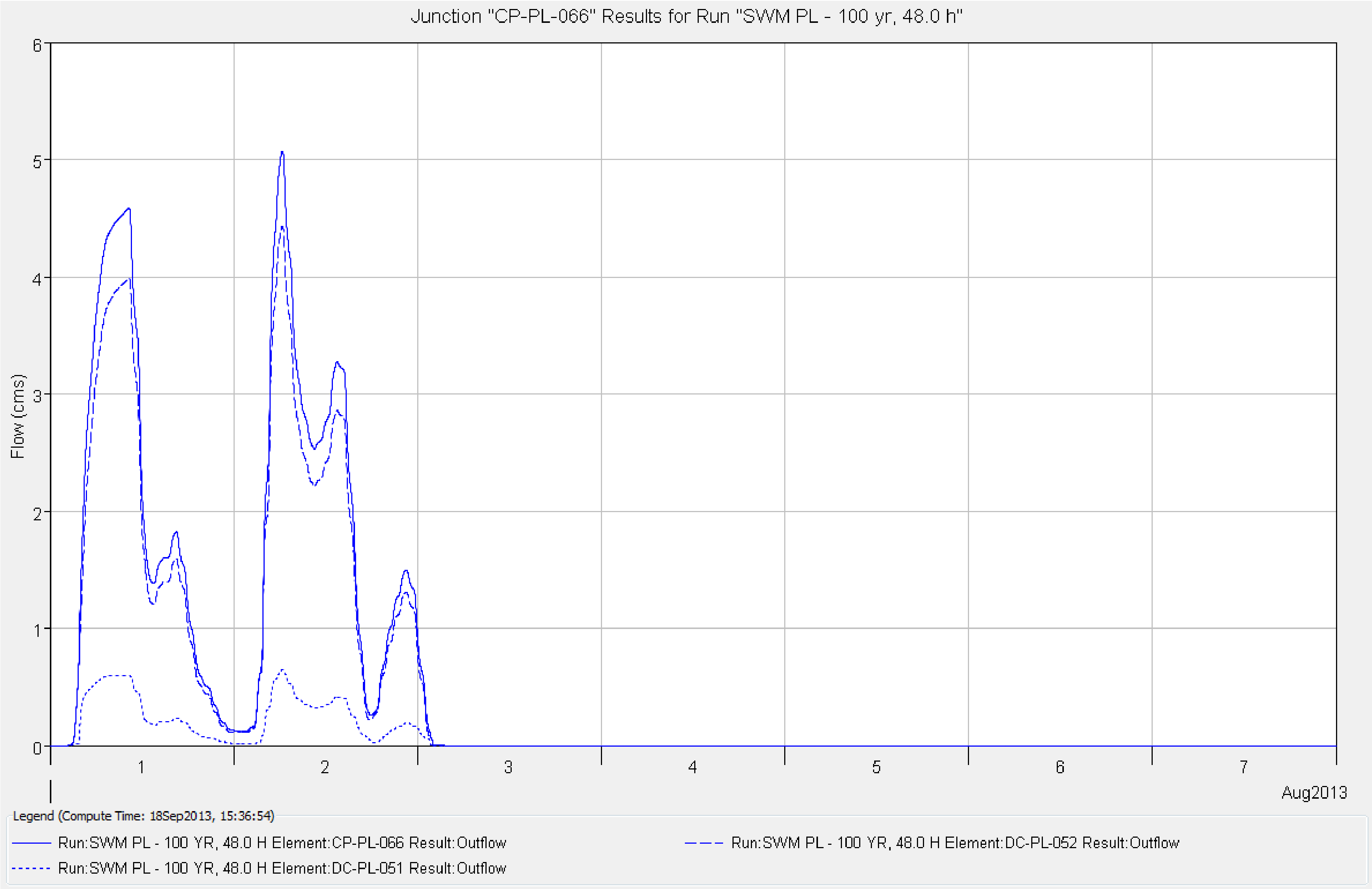
Junction "CP-PL-063" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-047 Result:Outflow

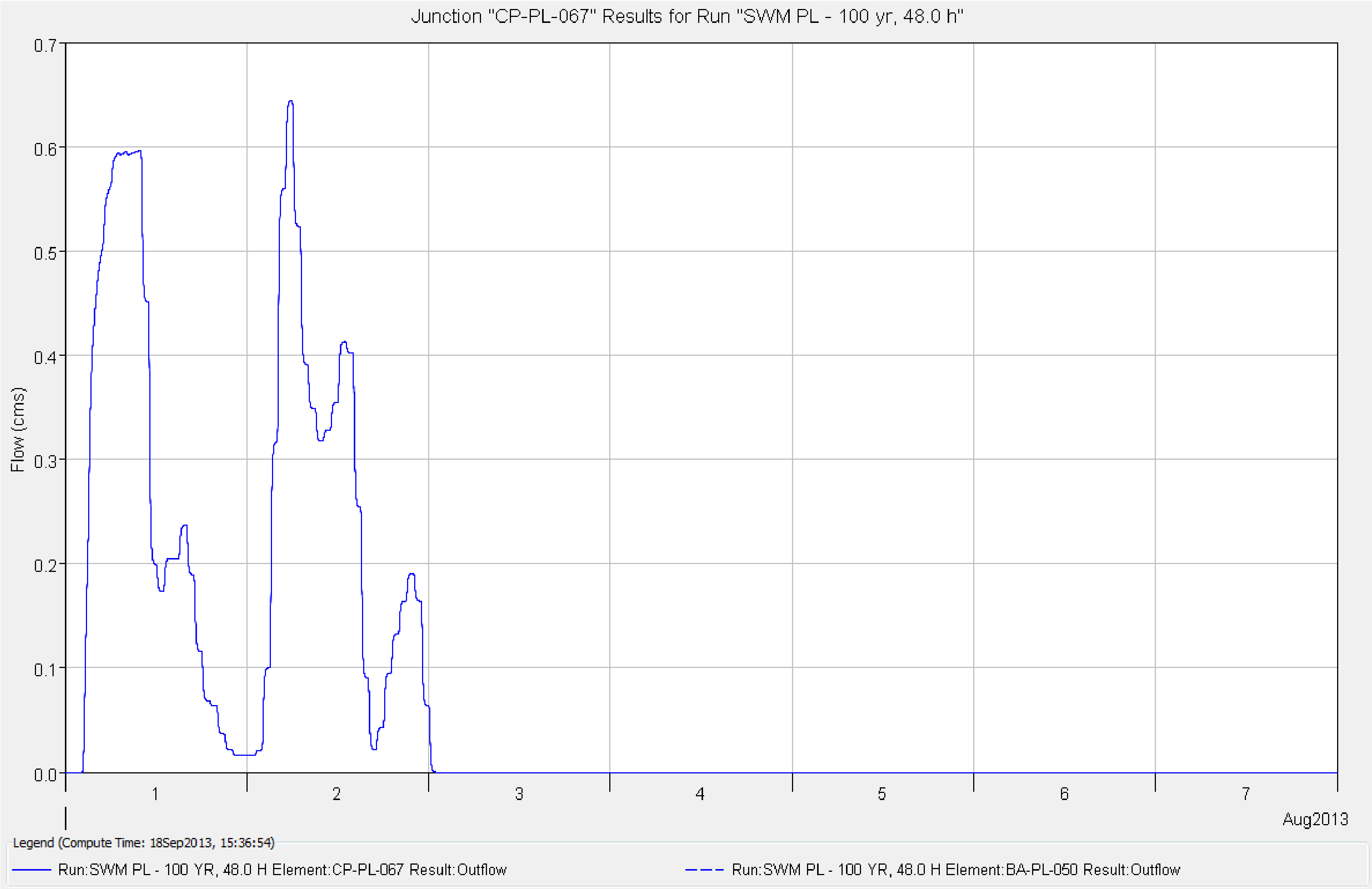


Junction "CP-PL-064" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-064 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-048 Result:Outflow

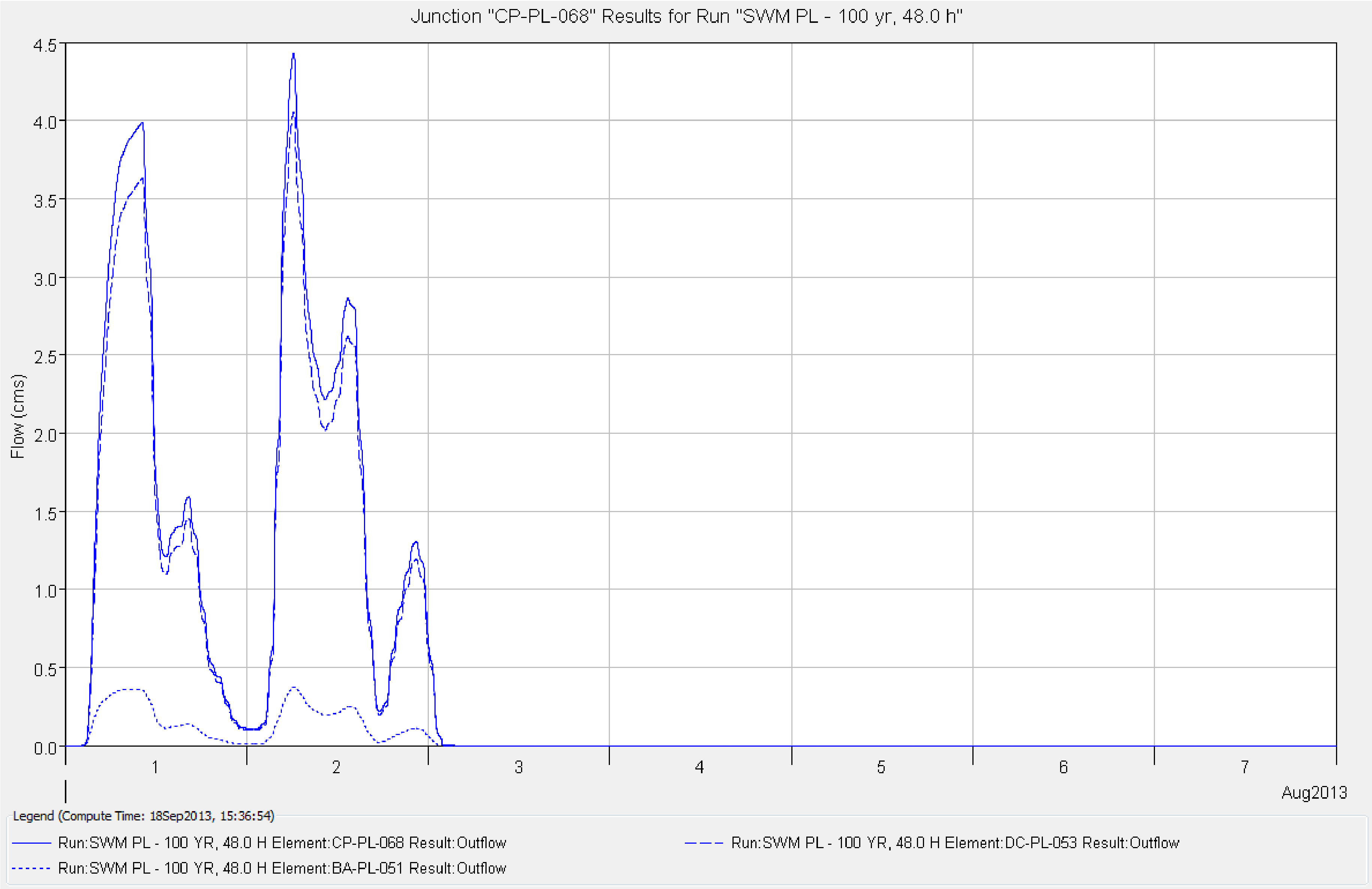


Junction "CP-PL-065" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-065 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-049 Result:Outflow

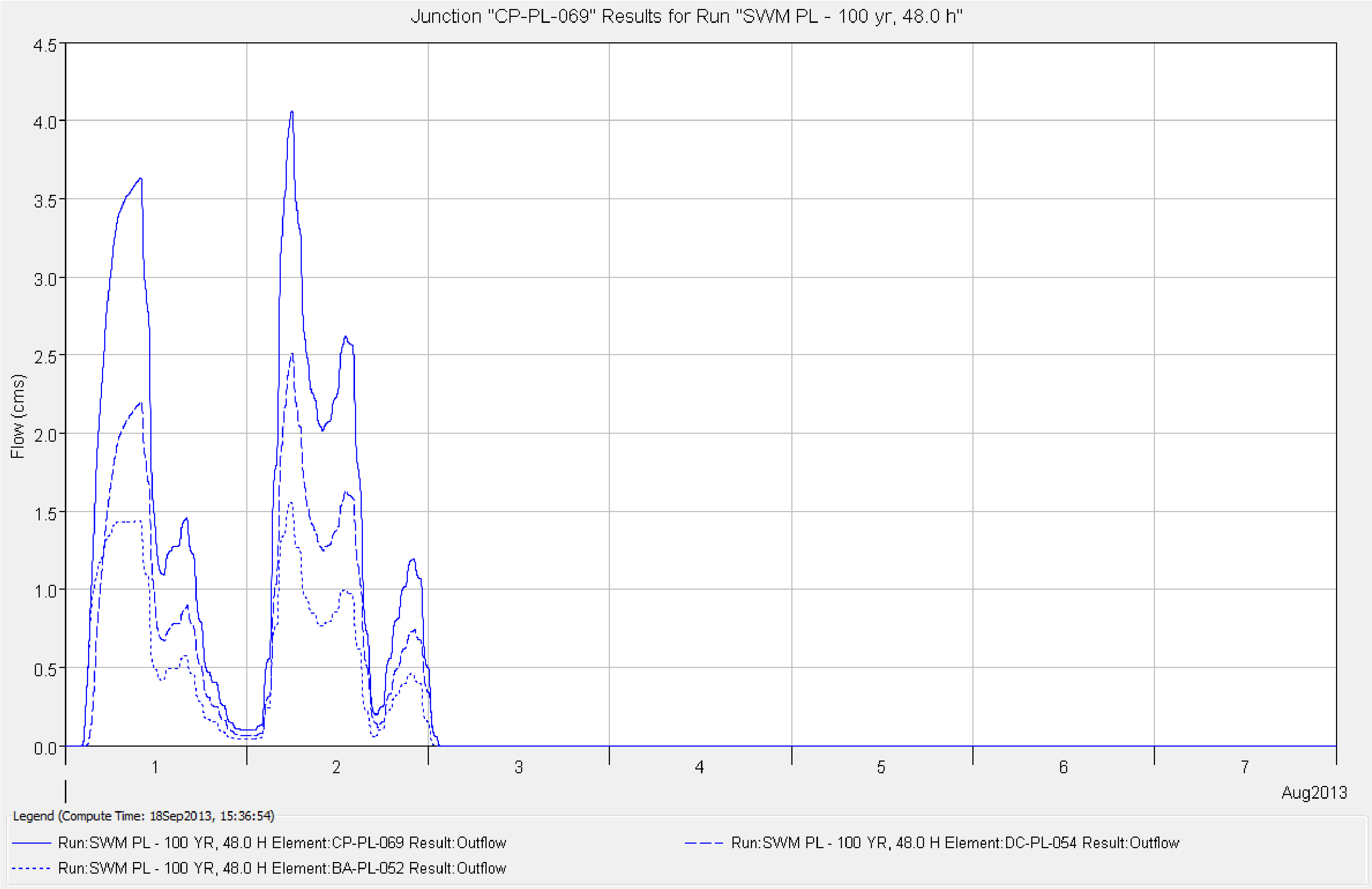

Junction "CP-PL-066" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-051 Result:Outflow



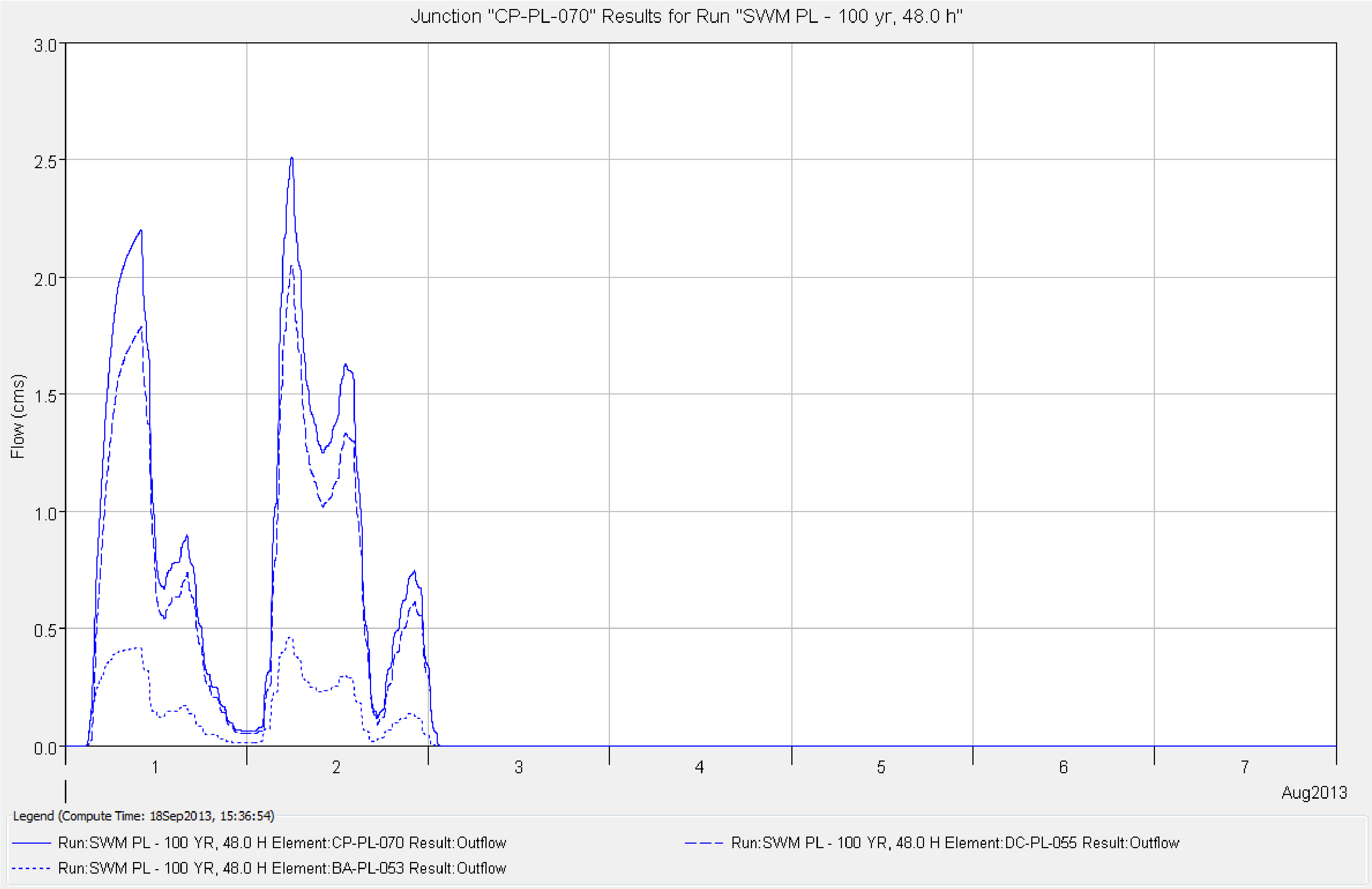
Junction "CP-PL-067" Results for Run "SWM PL - 100 yr, 48.0 h"
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-067 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-050 Result:Outflow



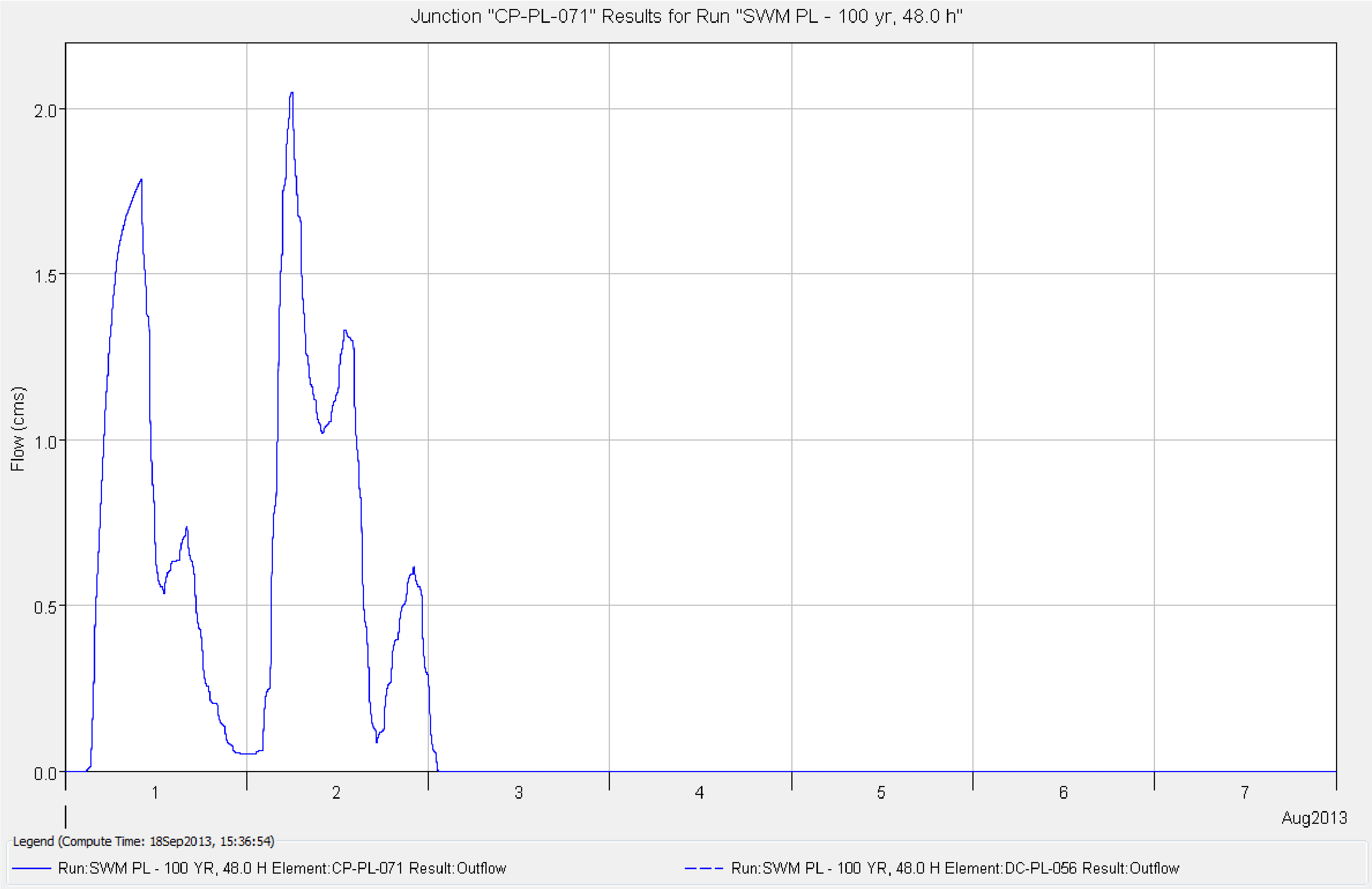
Junction "CP-PL-068" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-068 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-051 Result:Outflow



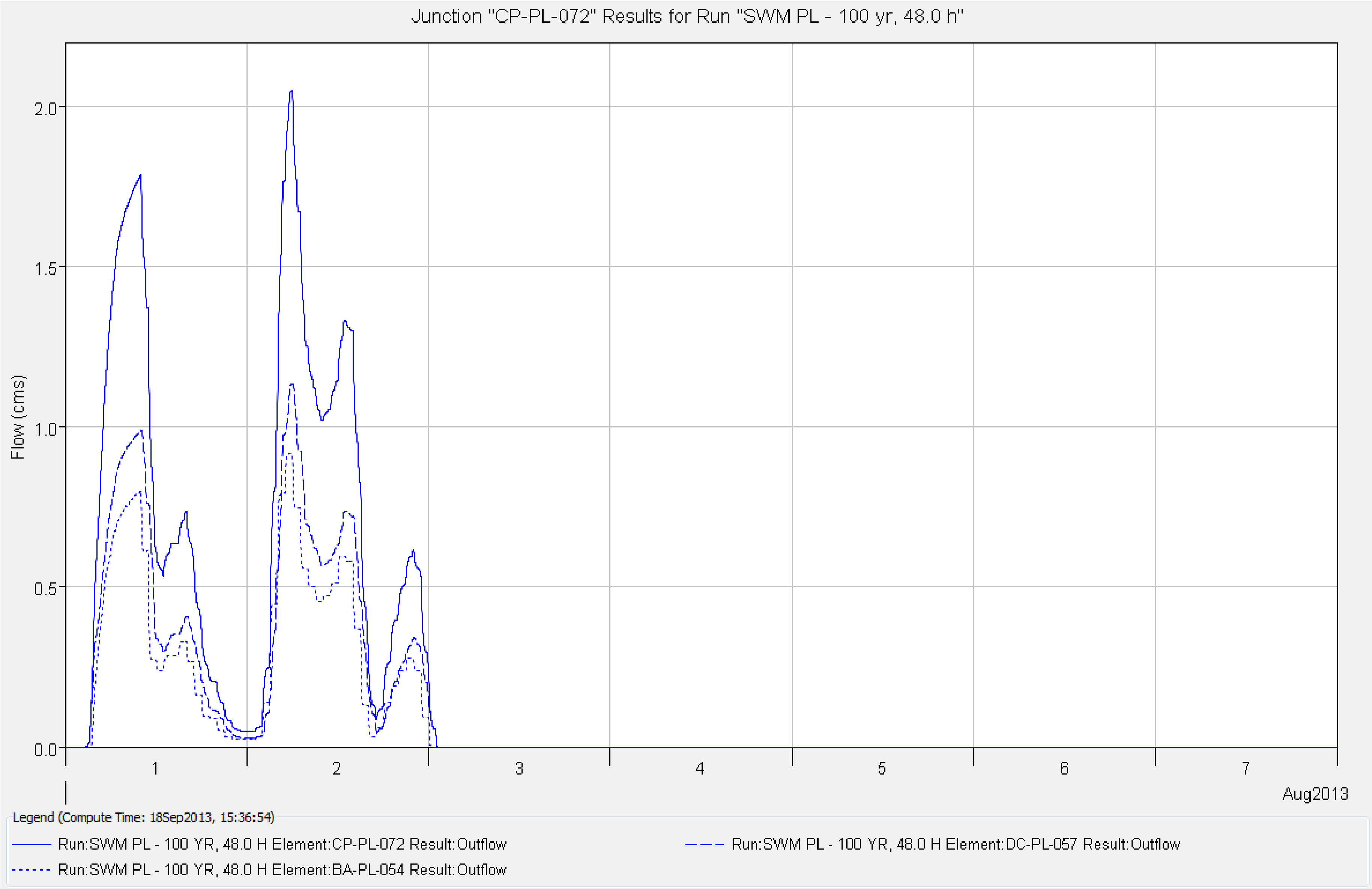
Junction "CP-PL-069" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-069 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-052 Result:Outflow



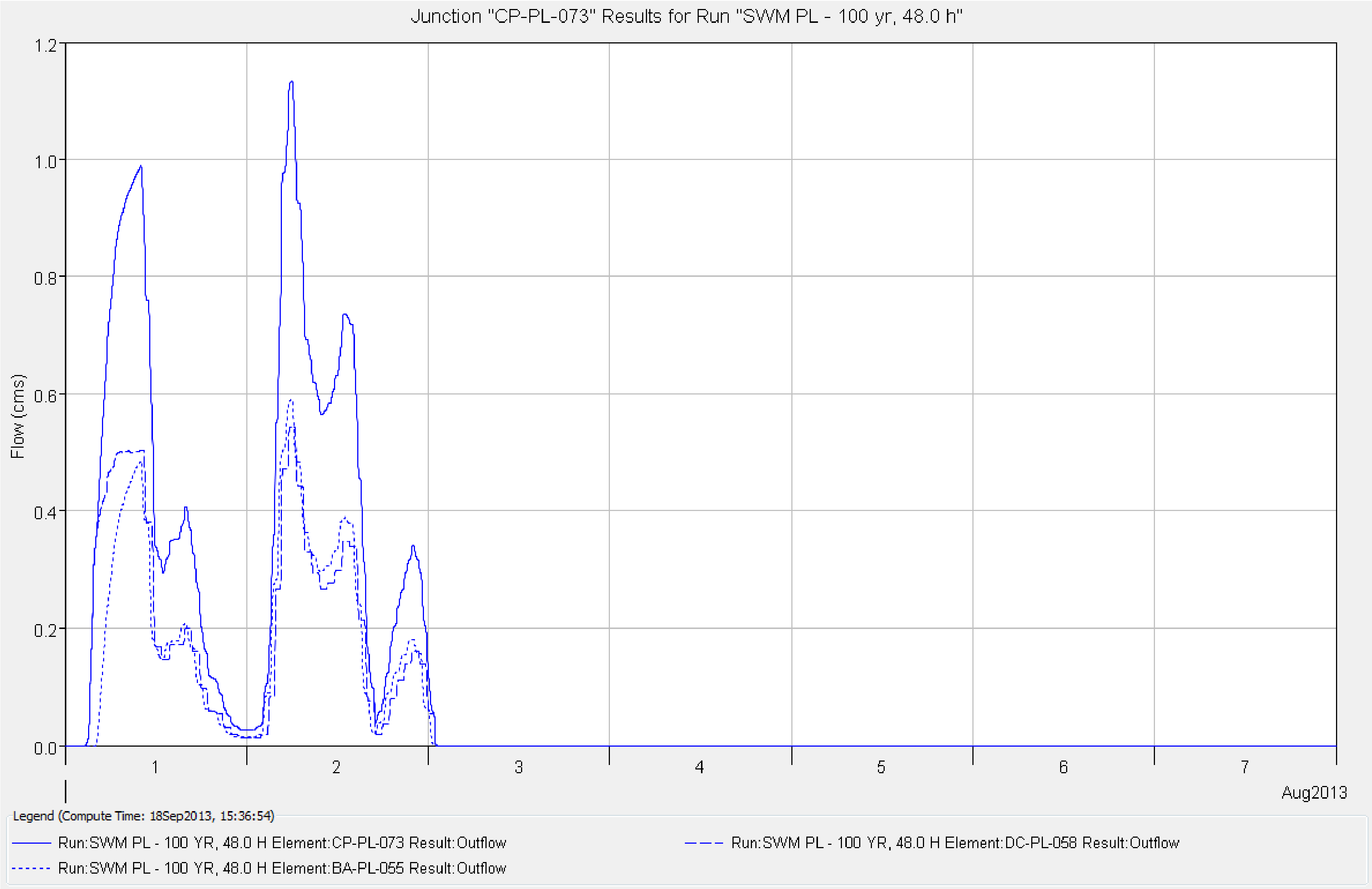
Junction "CP-PL-070" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-070 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-053 Result:Outflow

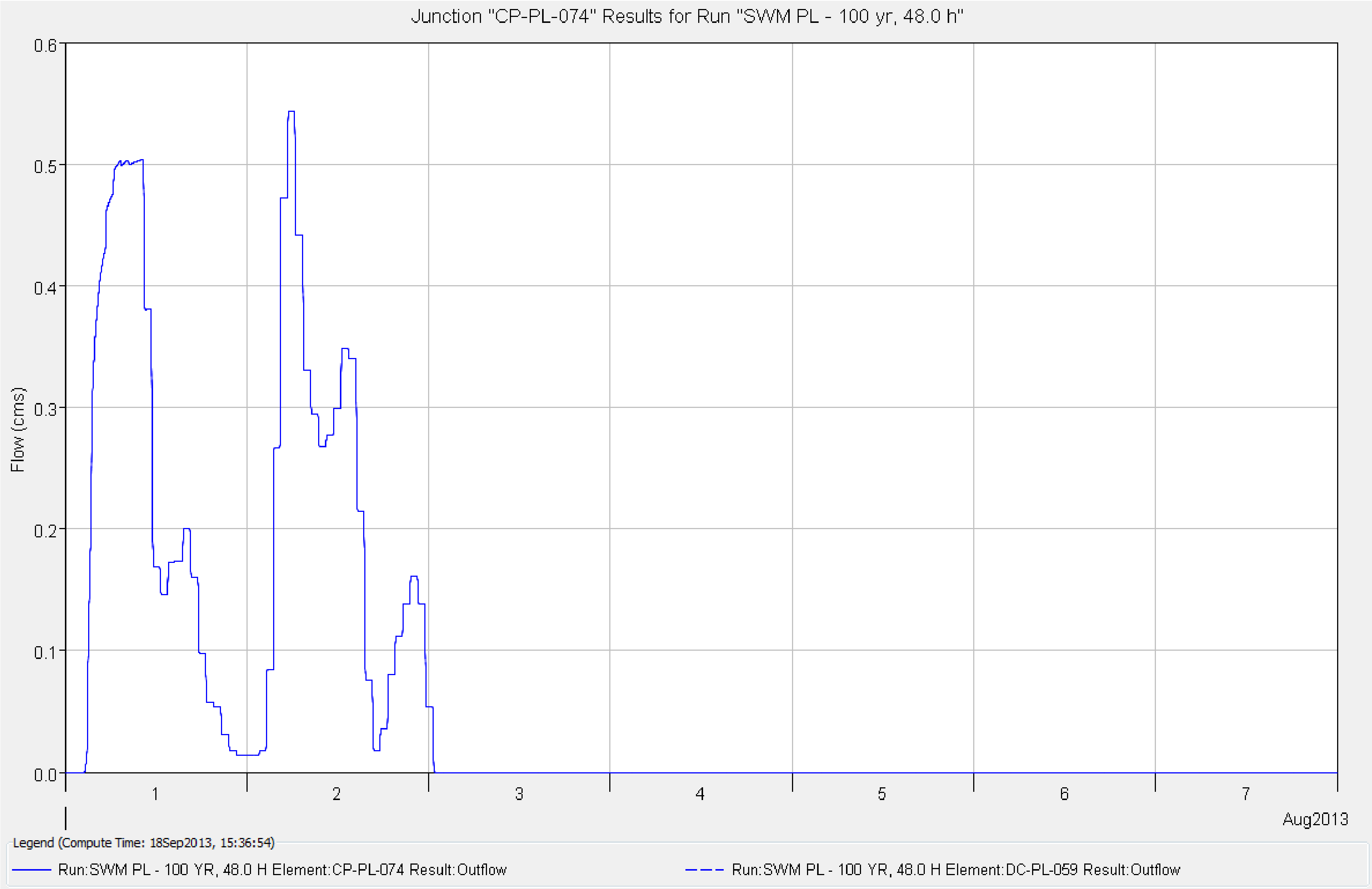


Junction "CP-PL-071" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-071 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-056 Result:Outflow

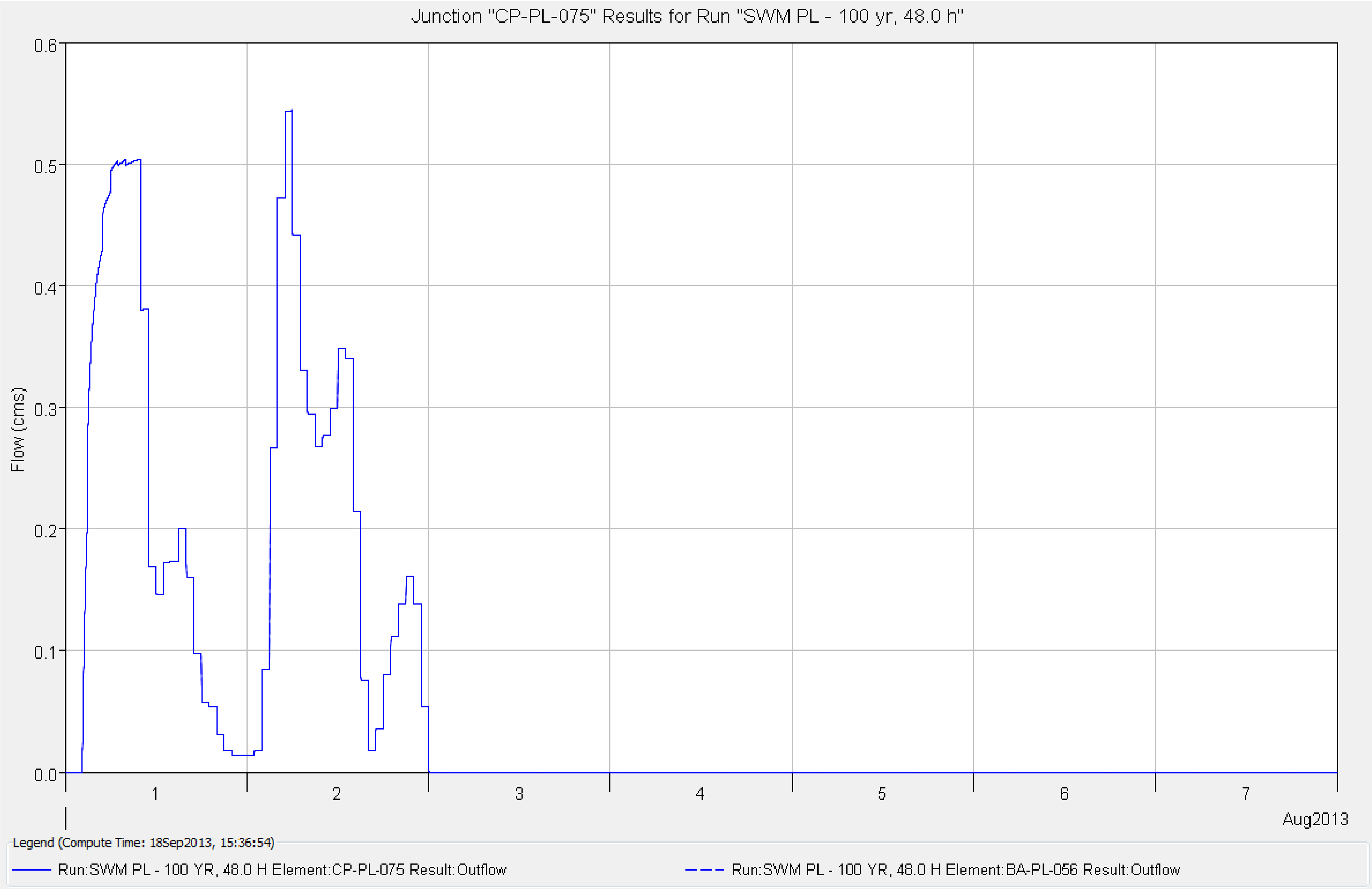


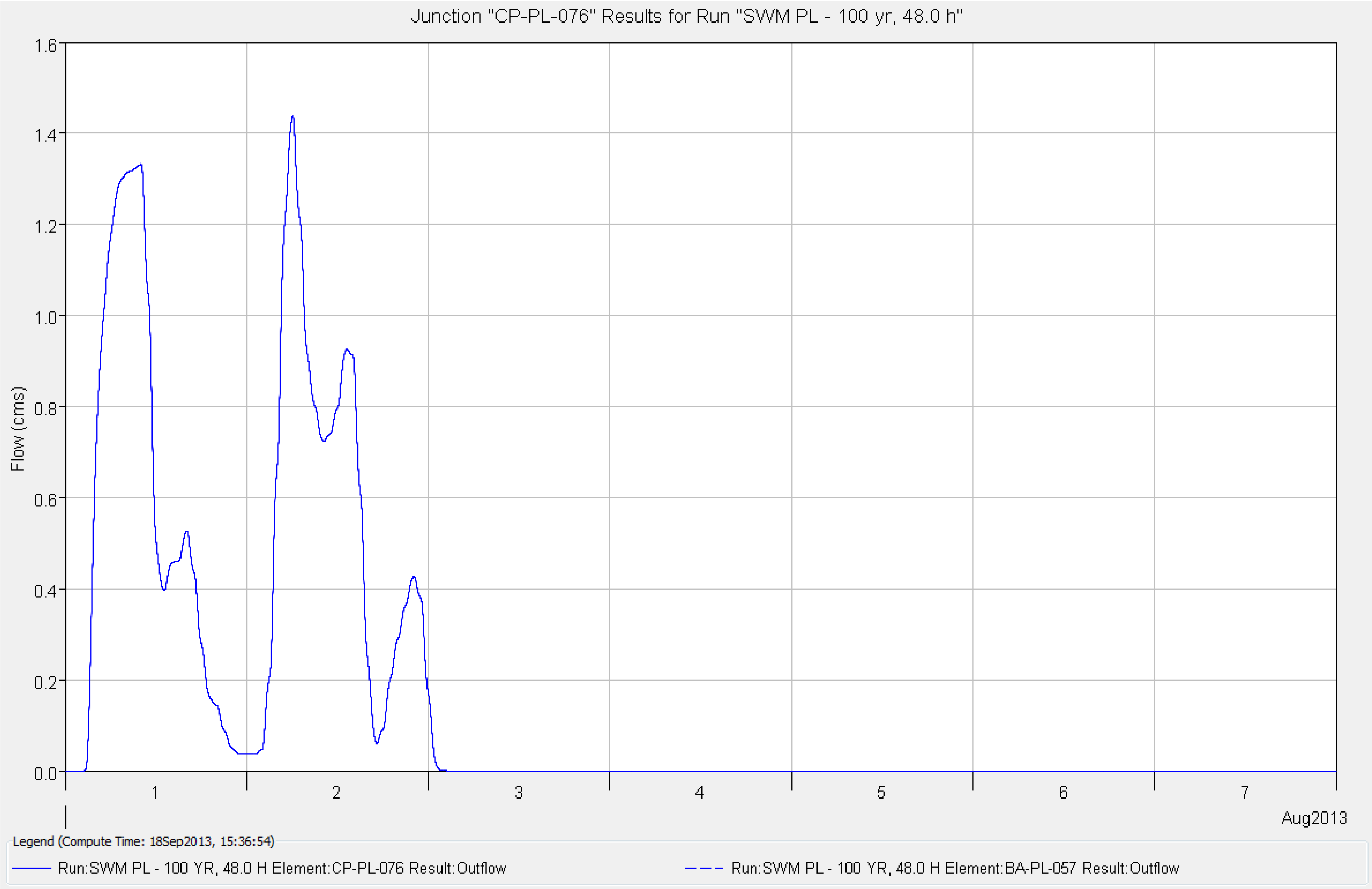
Junction "CP-PL-072" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-072 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-054 Result:Outflow


Junction "CP-PL-073" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-073 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-055 Result:Outflow

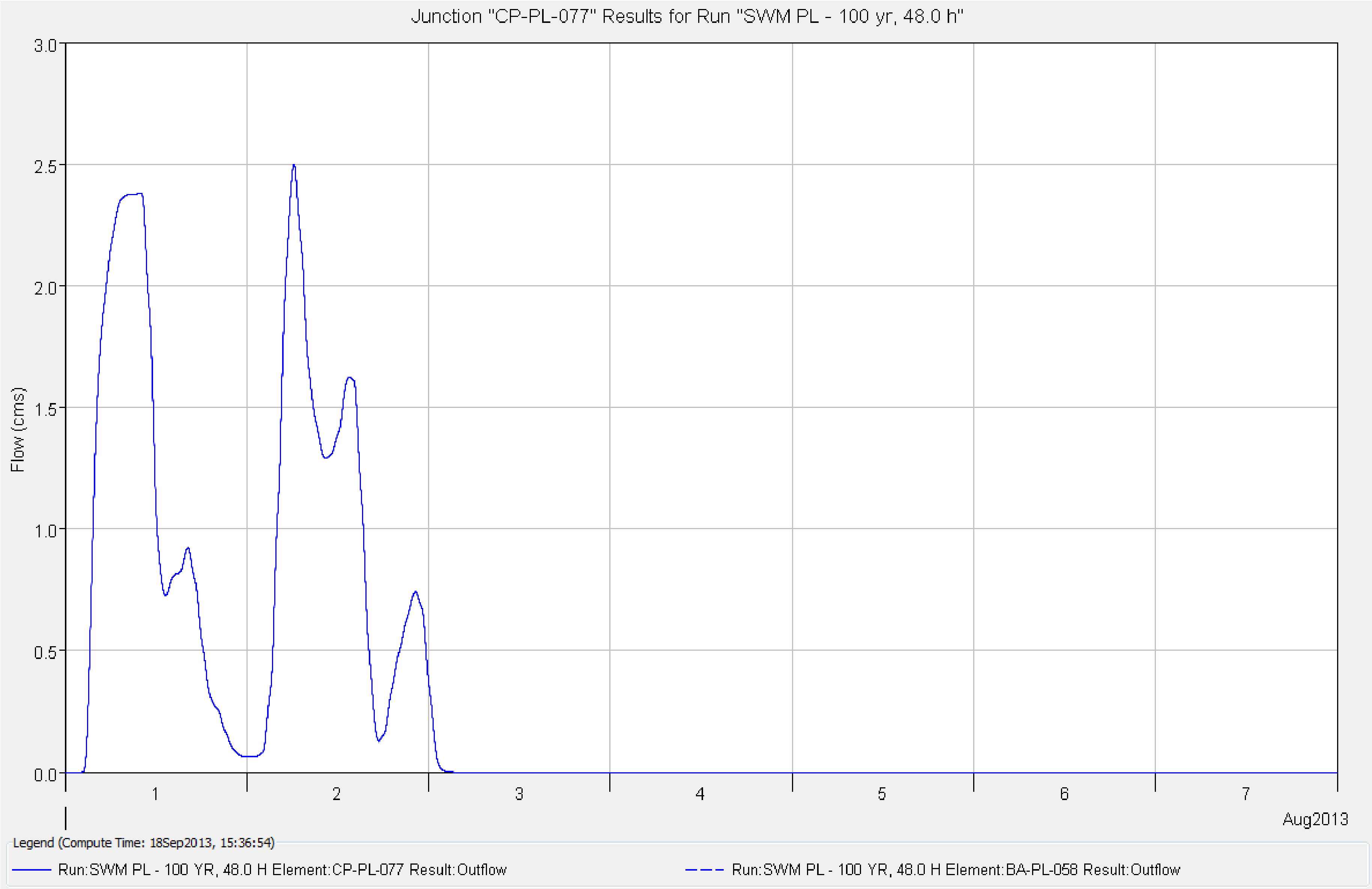


Junction "CP-PL-074" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-074 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-059 Result:Outflow

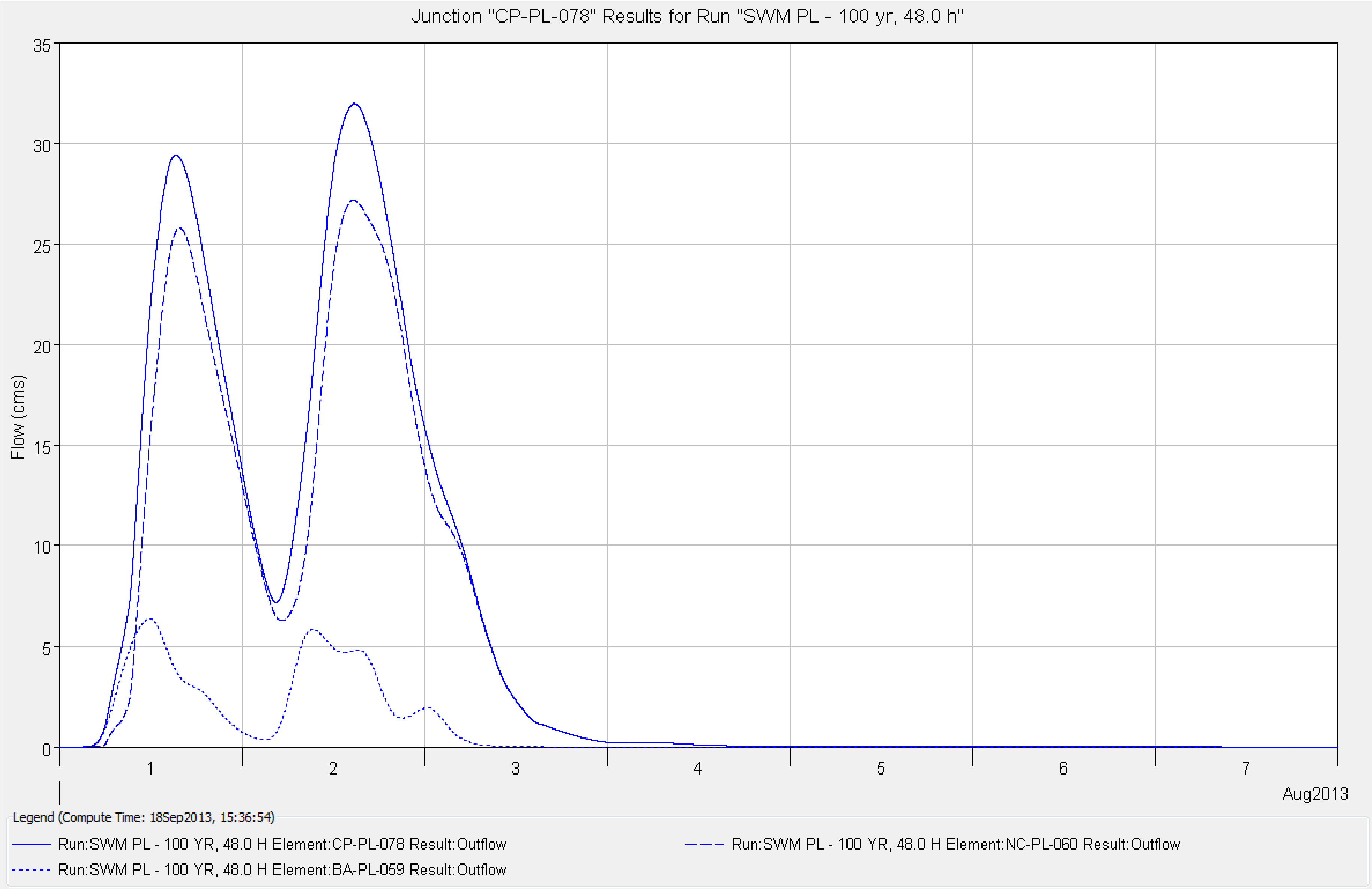

Junction "CP-PL-075" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-075 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-056 Result:Outflow



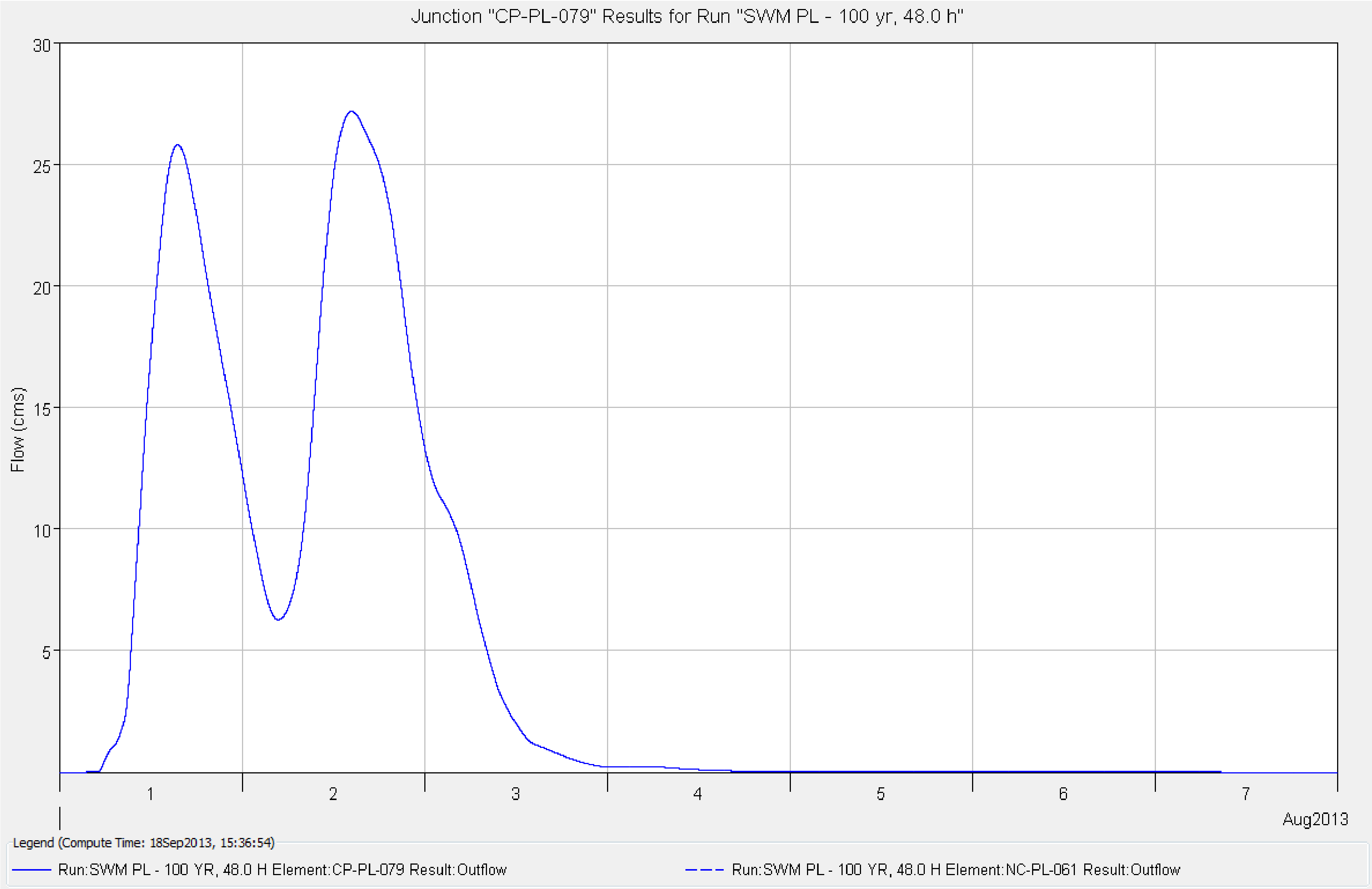
Junction "CP-PL-076" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-076 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-057 Result:Outflow



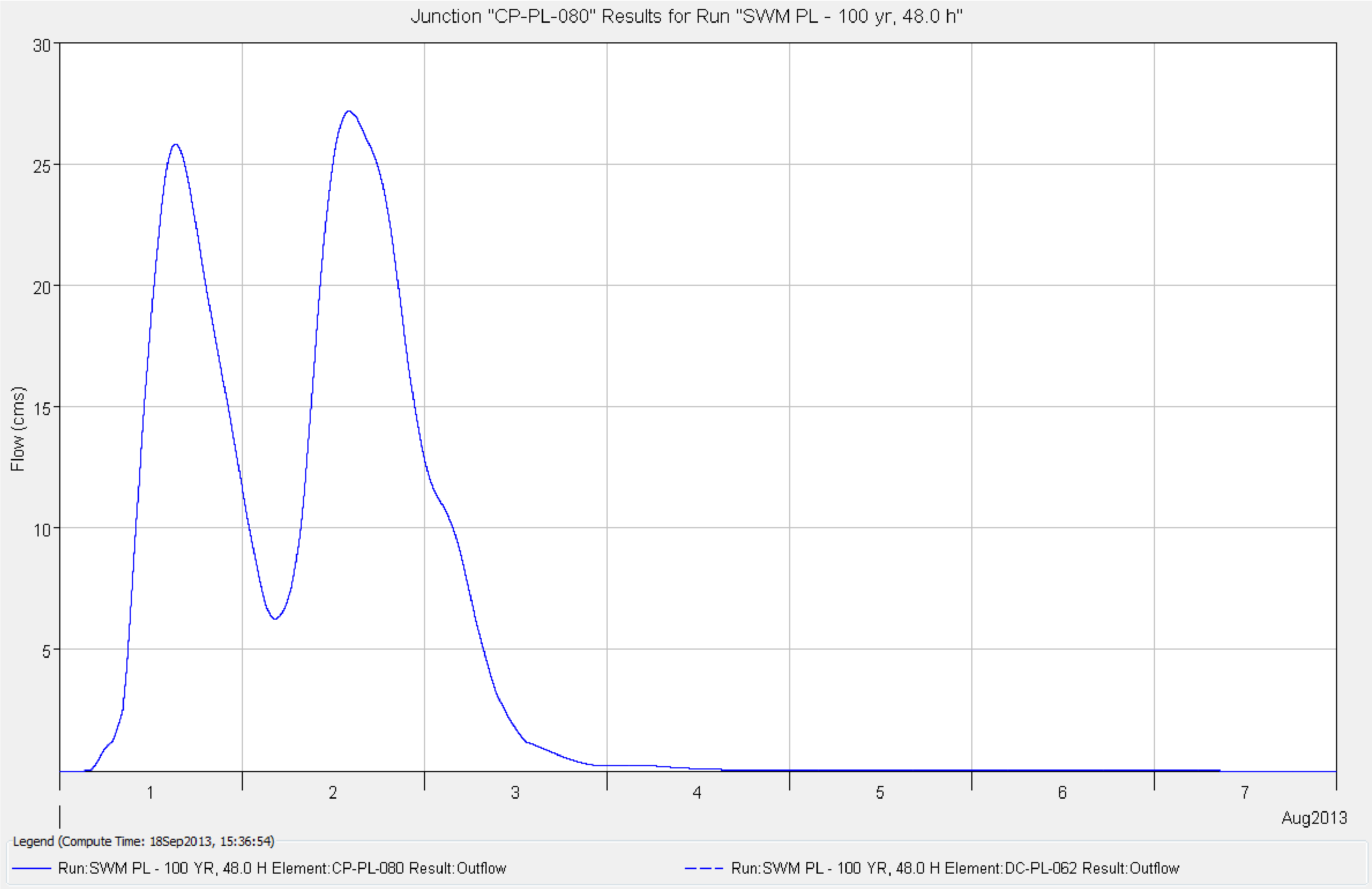
Junction "CP-PL-077" Results for Run "SWM PL - 100 yr, 48.0 h"
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-058 Result:Outflow

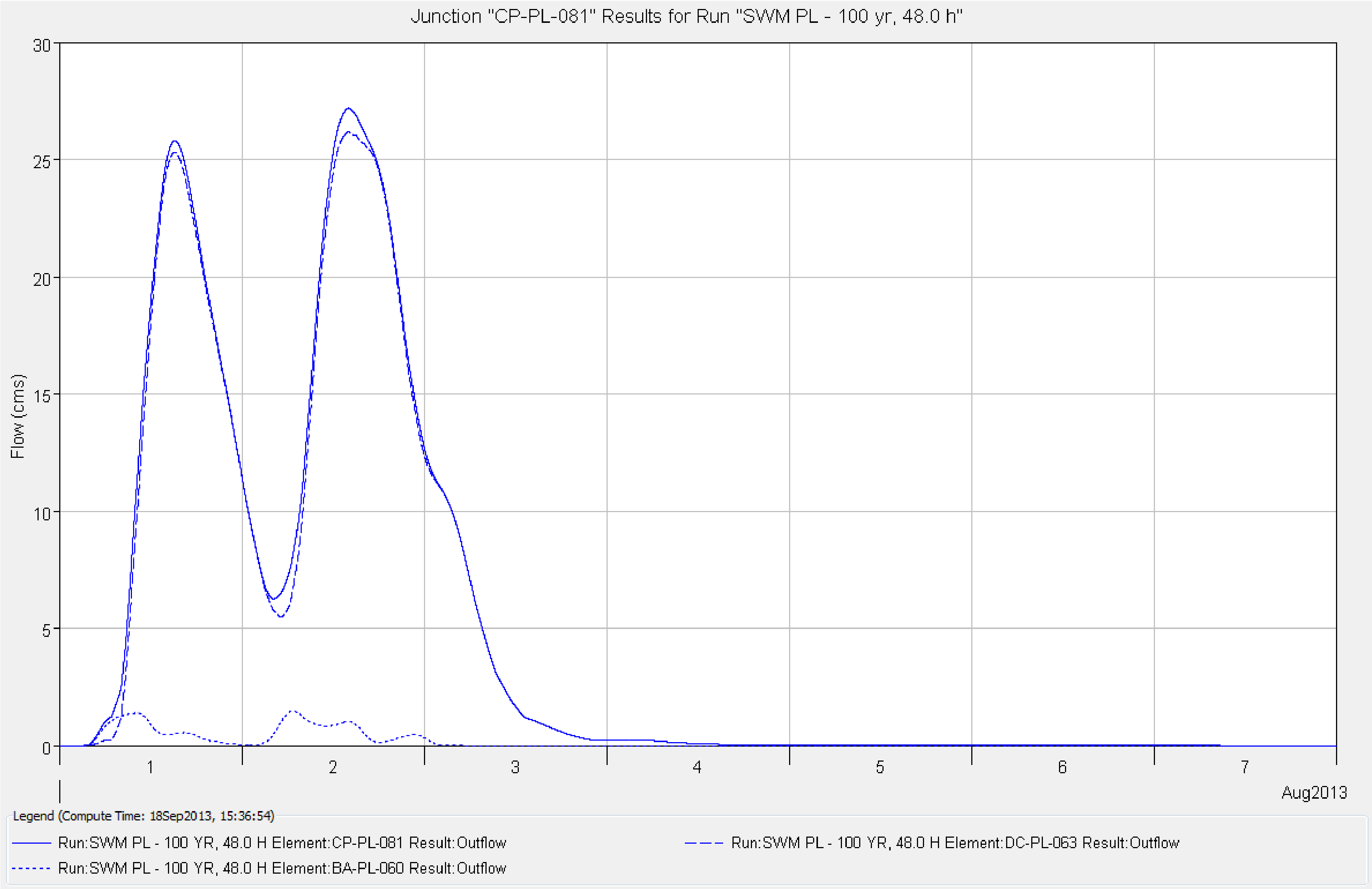


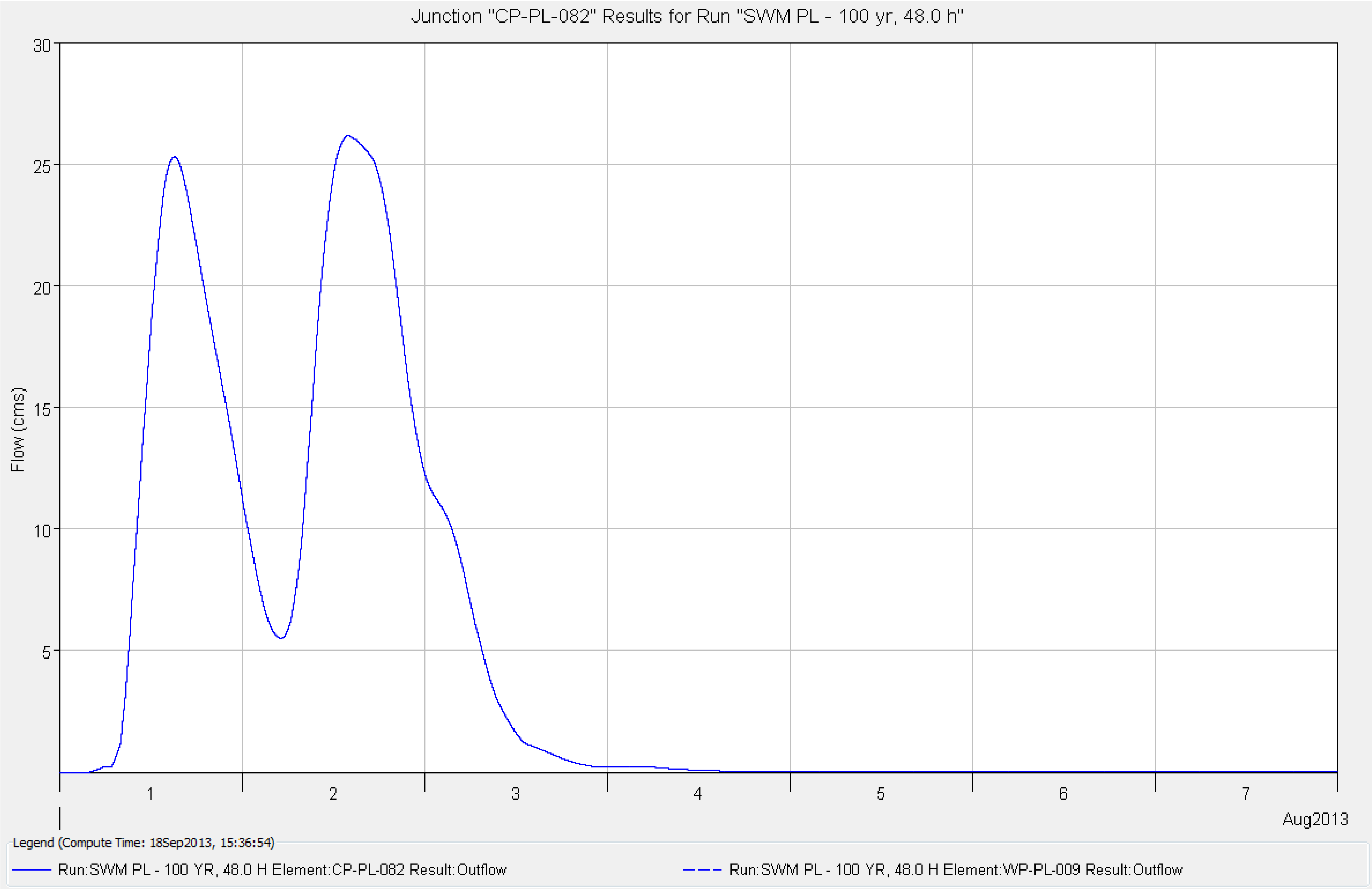
Junction "CP-PL-078" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-059 Result:Outflow



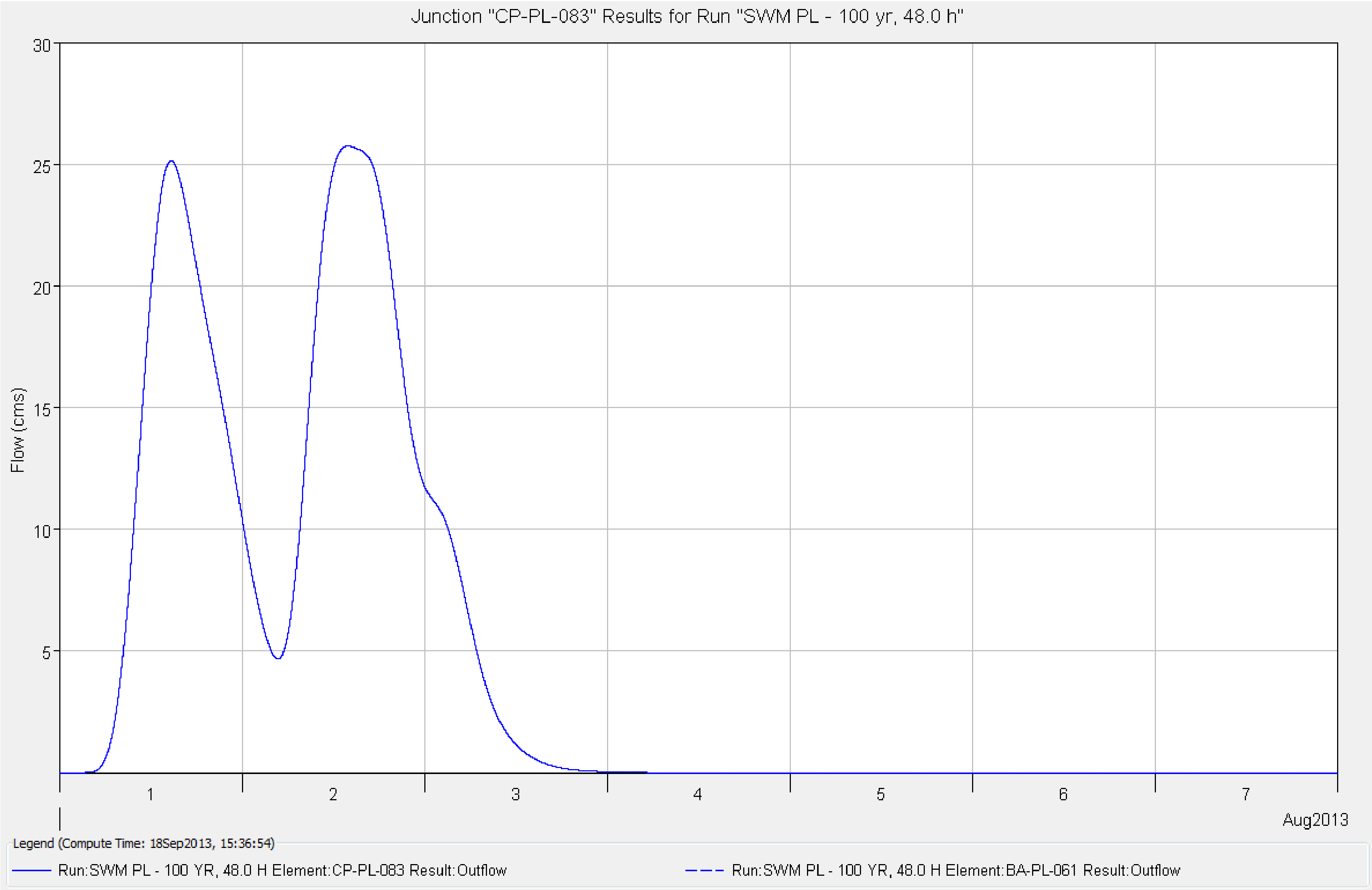
Junction "CP-PL-079" Results for Run "SWM PL - 100 yr, 48.0 h"
30
25
20
15
10
5
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-079 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-061 Result:Outflow


Junction "CP-PL-080" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-080 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-062 Result:Outflow

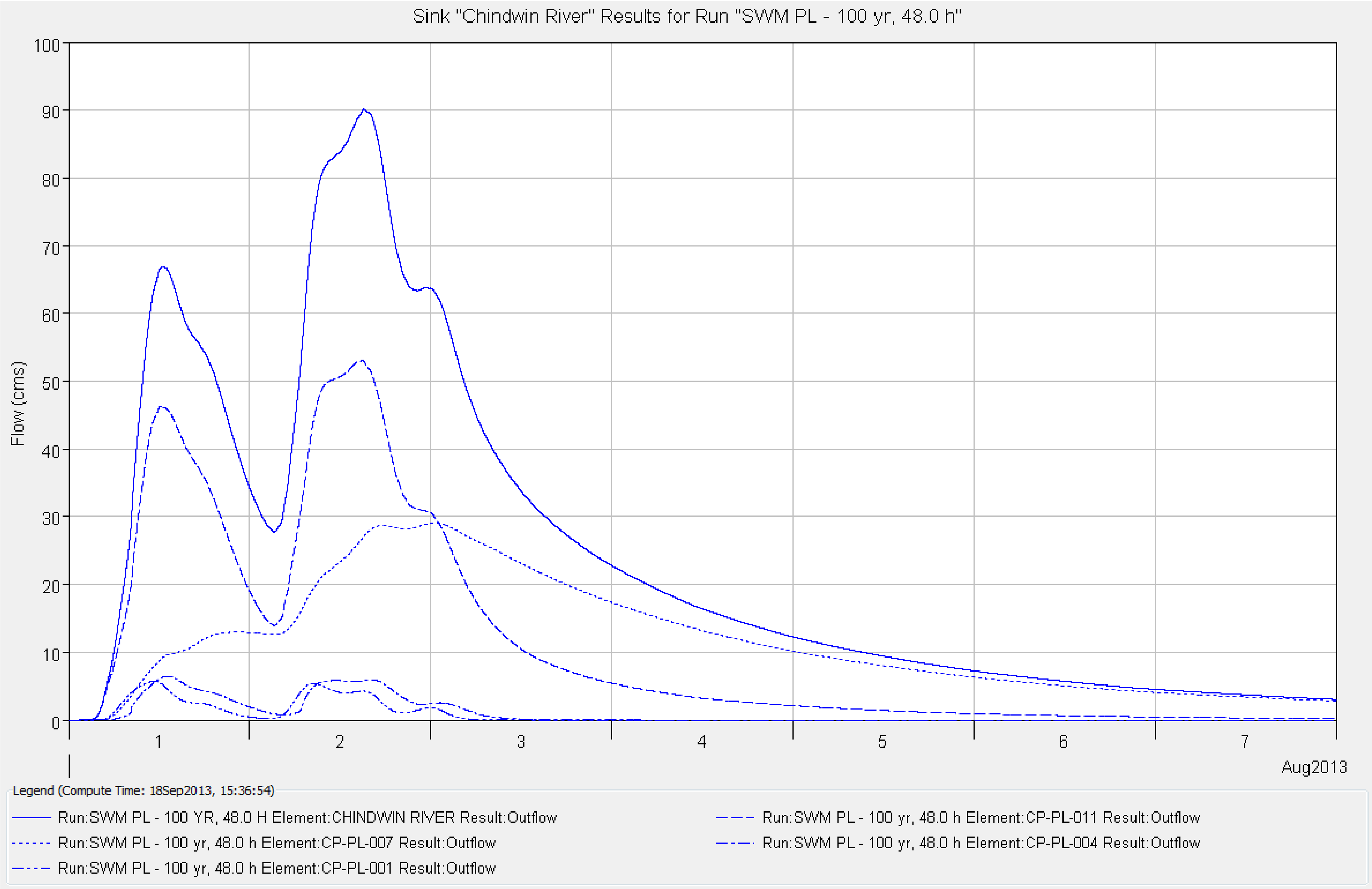

Junction "CP-PL-081" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-081 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-060 Result:Outflow

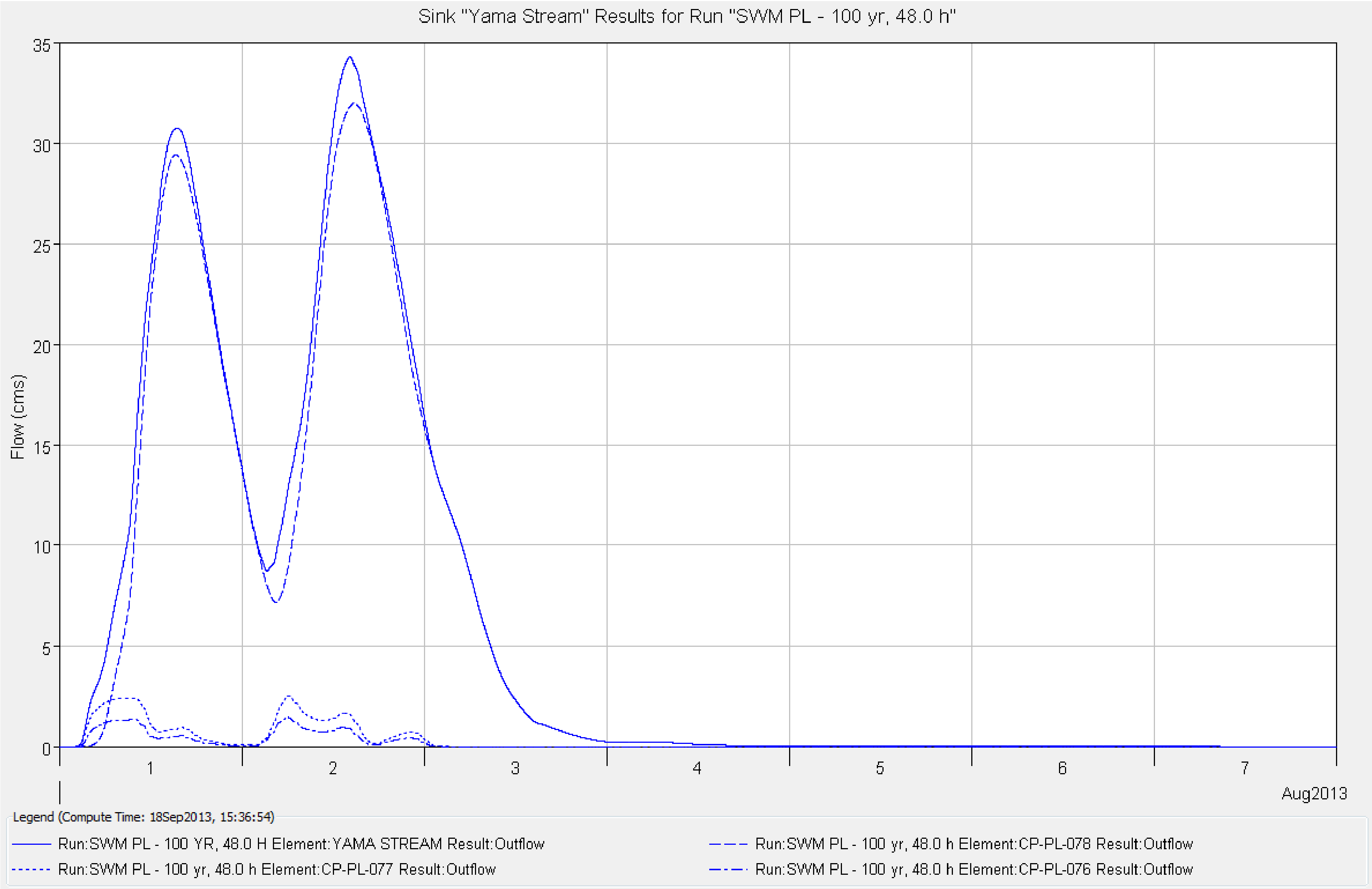


Junction "CP-PL-082" Results for Run "SWM PL - 100 yr, 48.0 h"
30
25
20
15
10
5
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-082 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Outflow

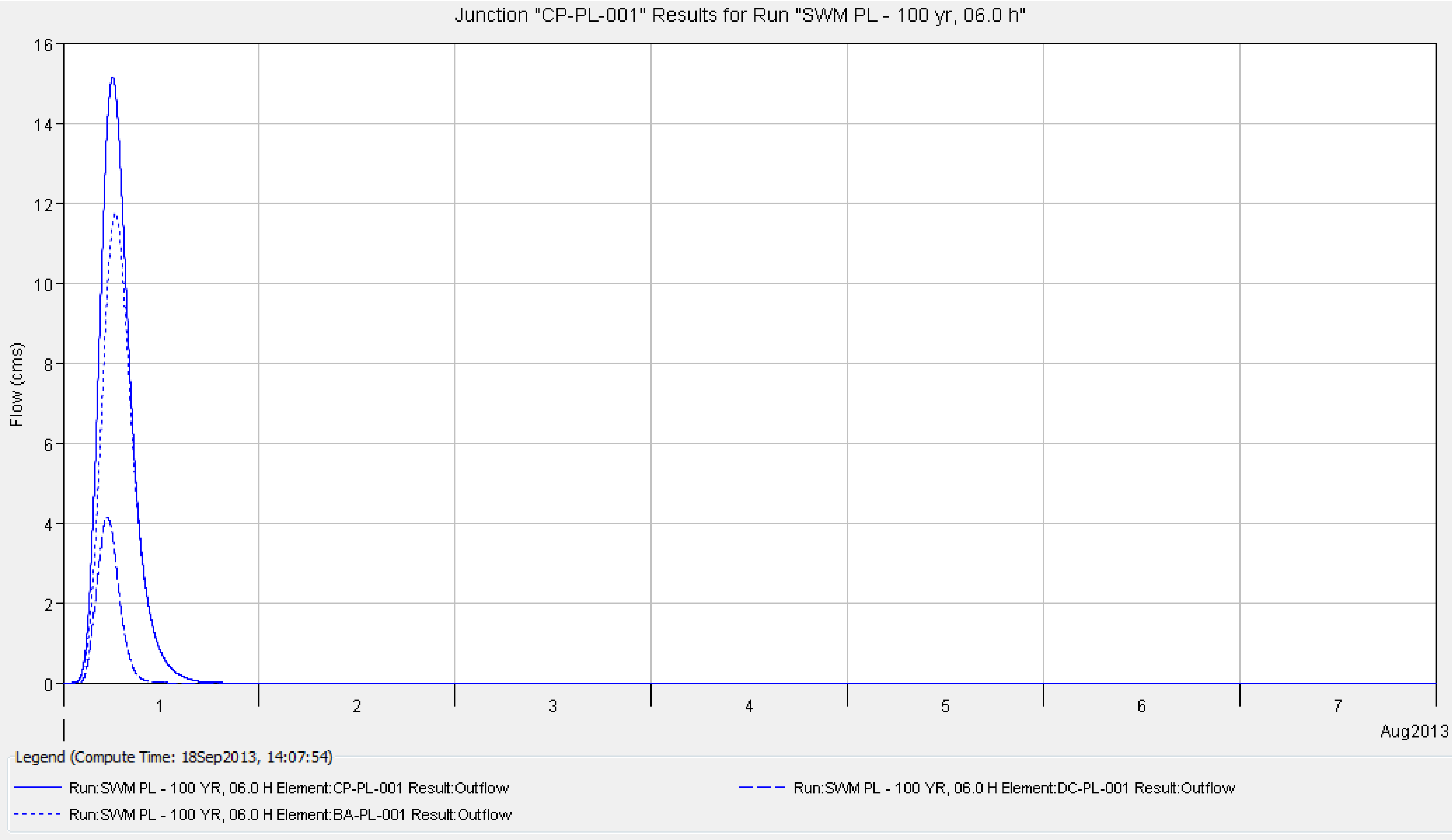


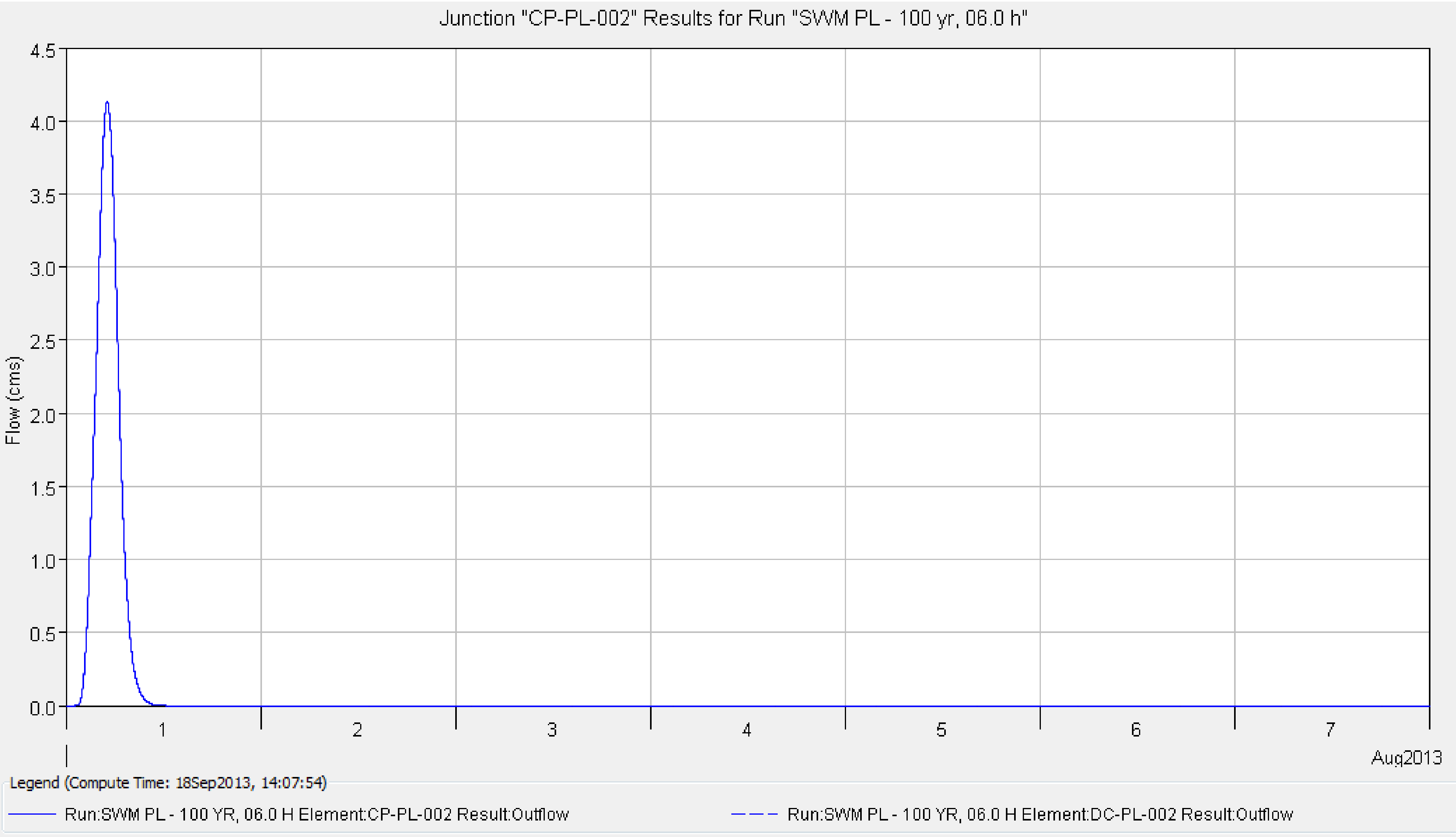
Junction "CP-PL-083" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-083 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-061 Result:Outflow

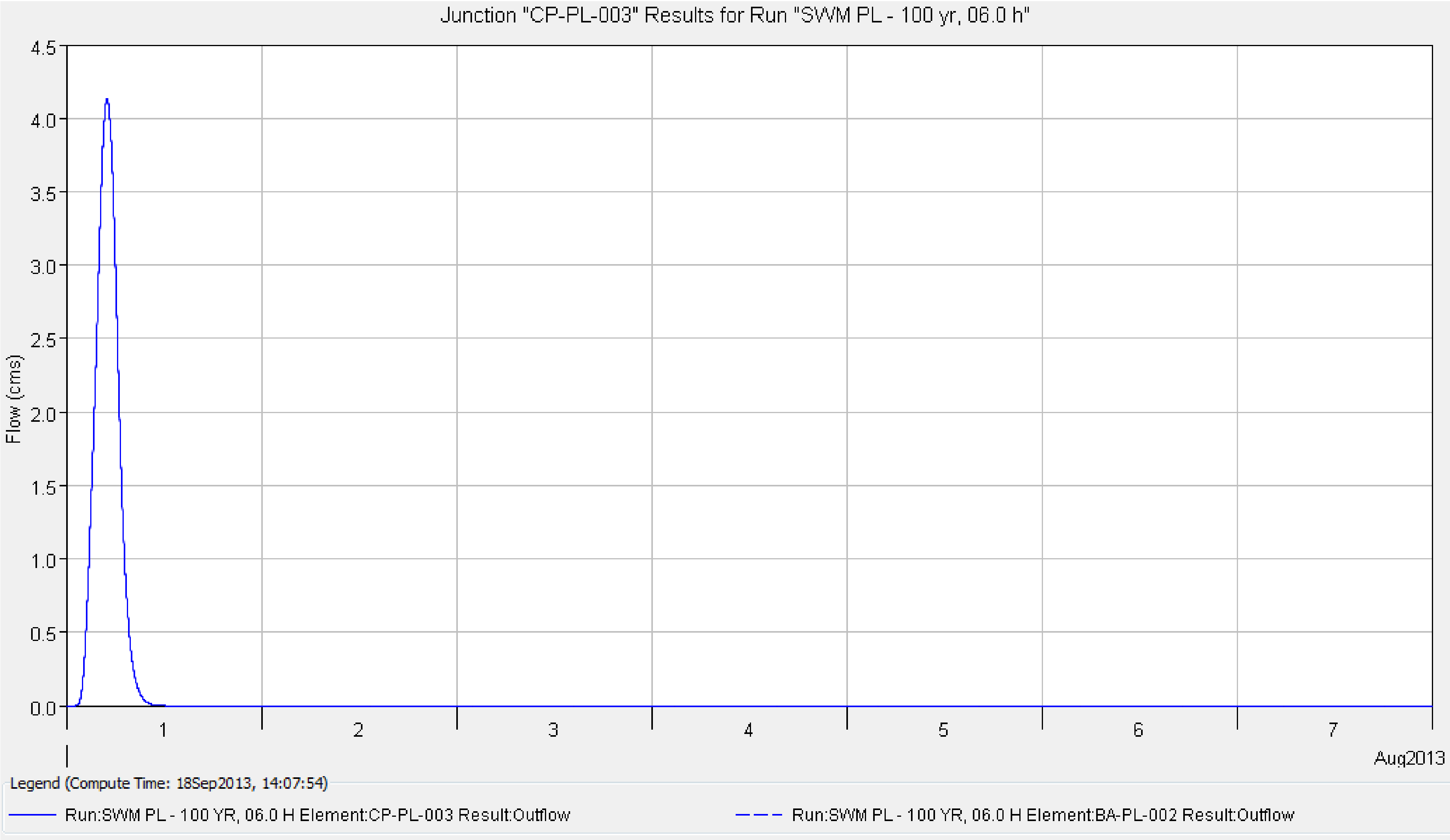

Sink "Chindwin River" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-001 Result:Outflow

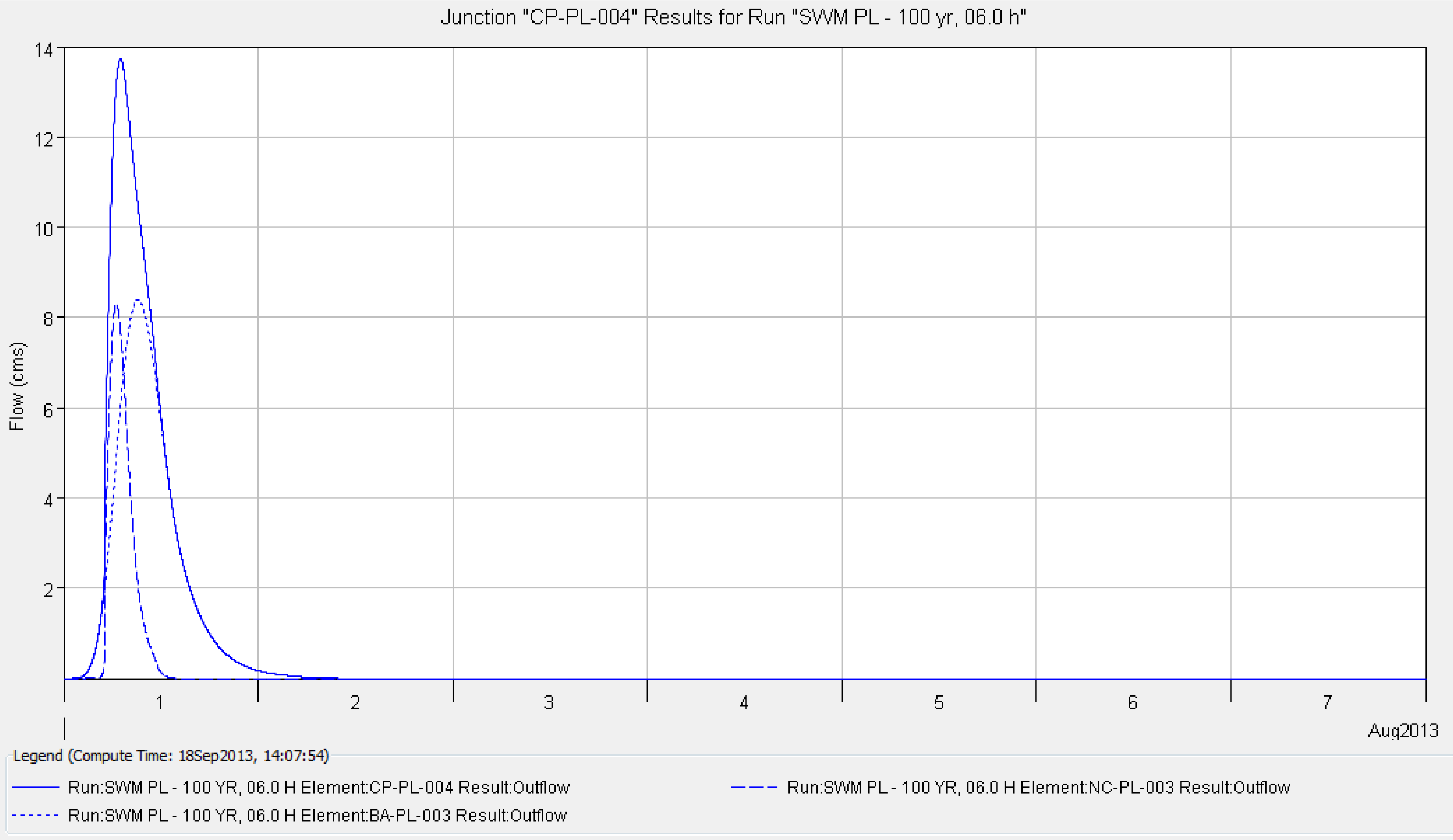


Sink "Yama Stream" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:YAMA STREAM Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-076 Result:Outflow

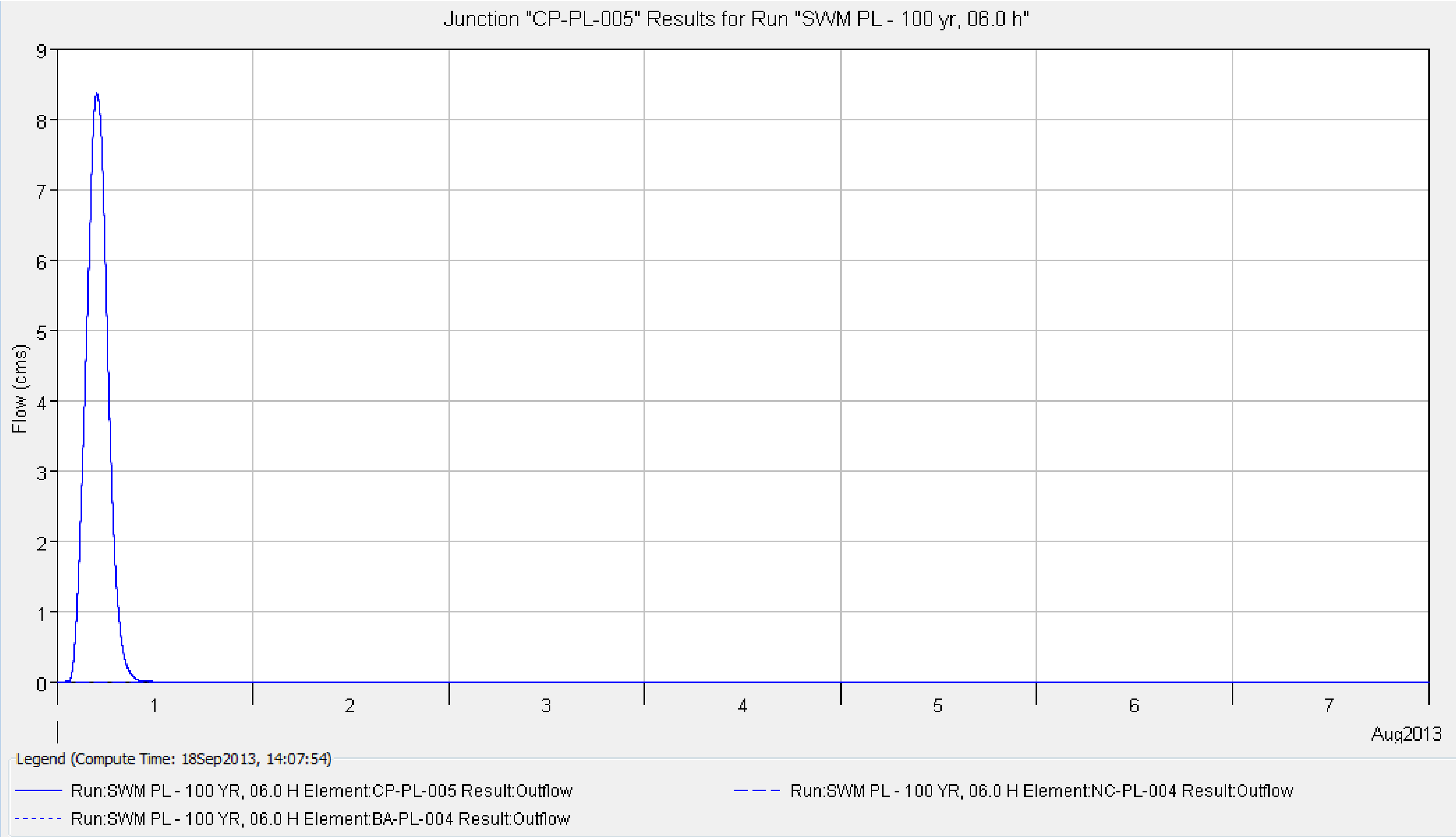

Junction "CP-PL-001" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-001 Result:Outflow

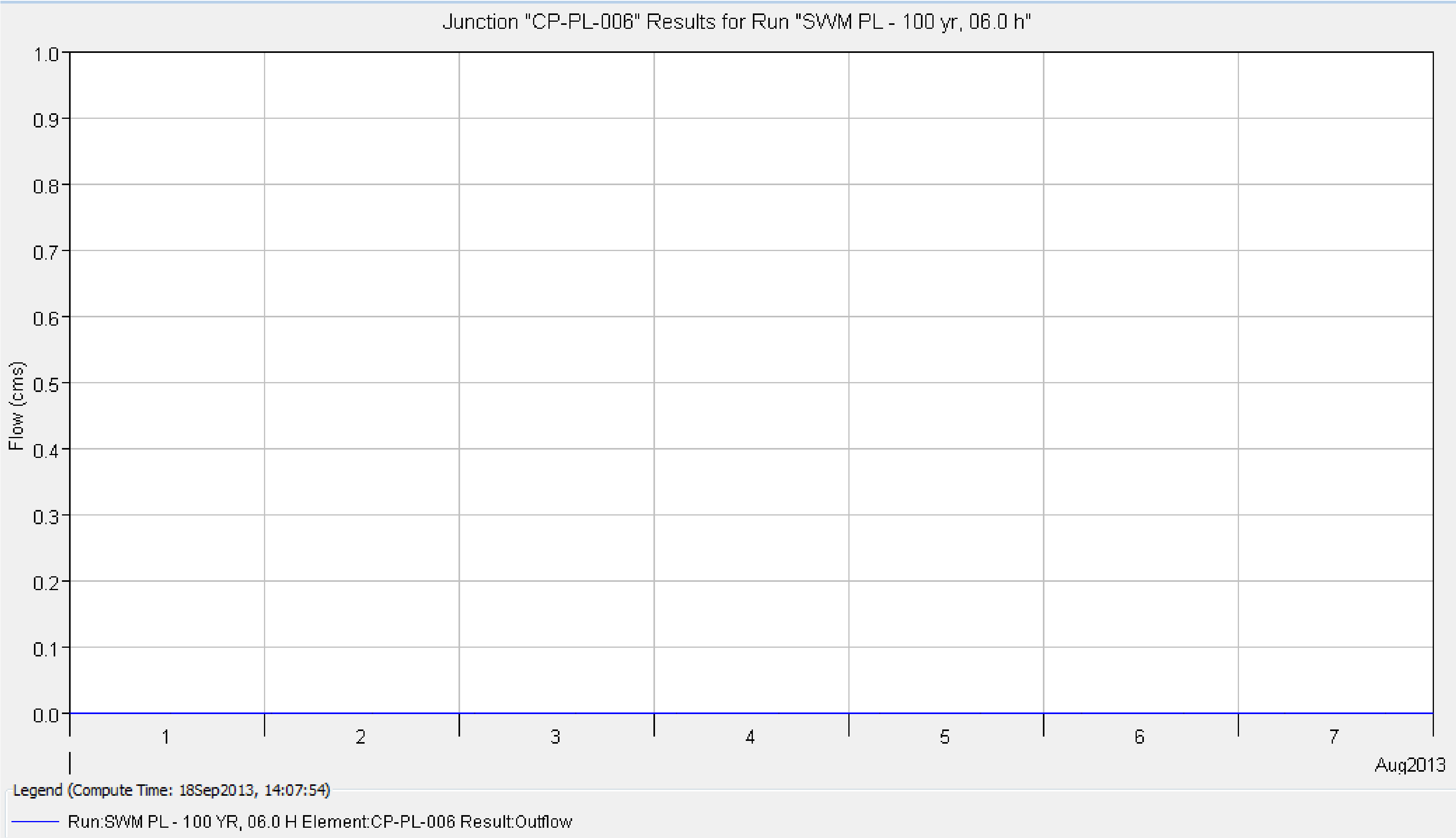

Junction "CP-PL-002" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-002 Result:Outflow


Junction "CP-PL-003" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-002 Result:Outflow

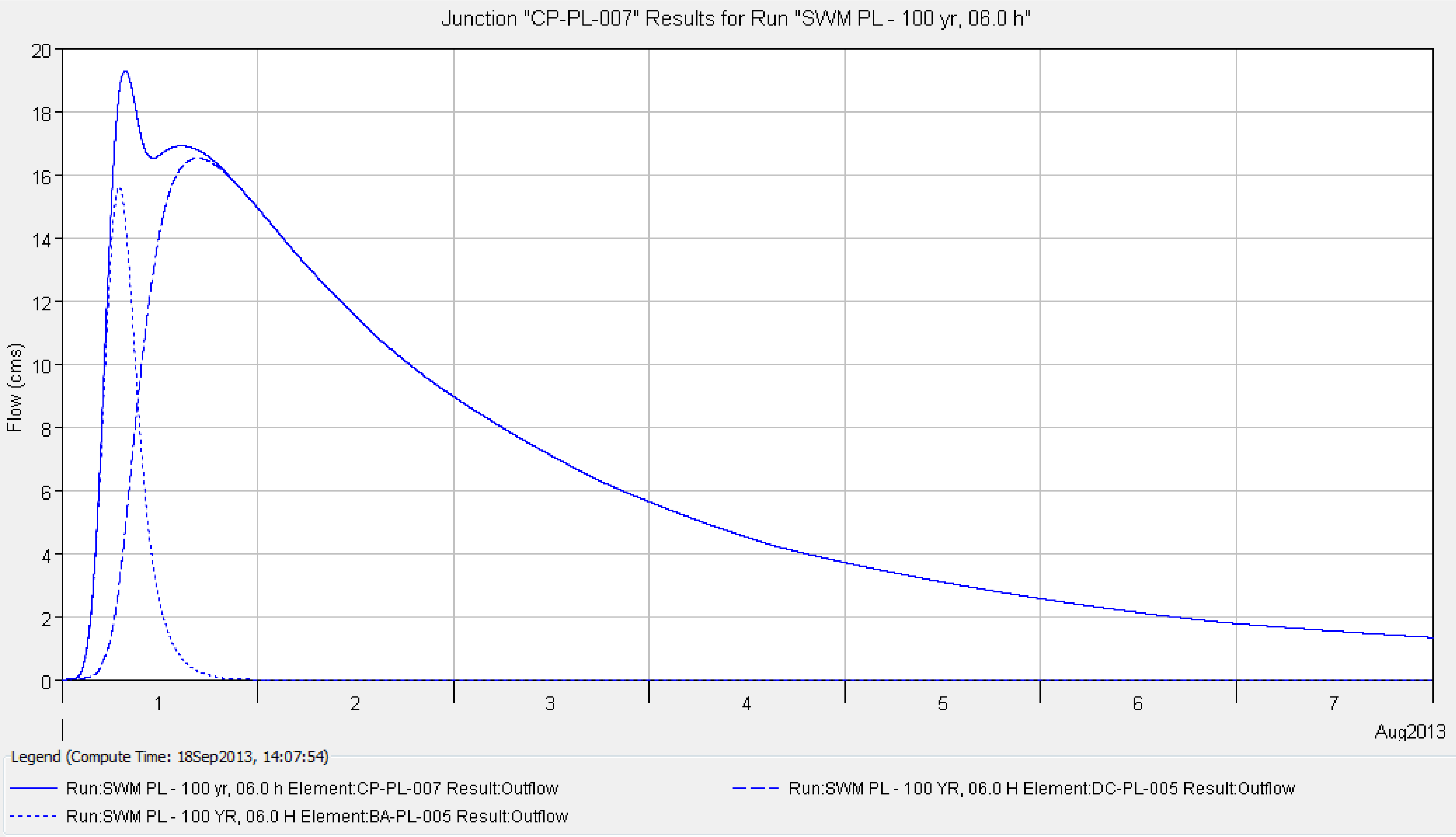


Junction "CP-PL-004" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
14
12
10
8
6
4
2
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-003 Result:Outflow

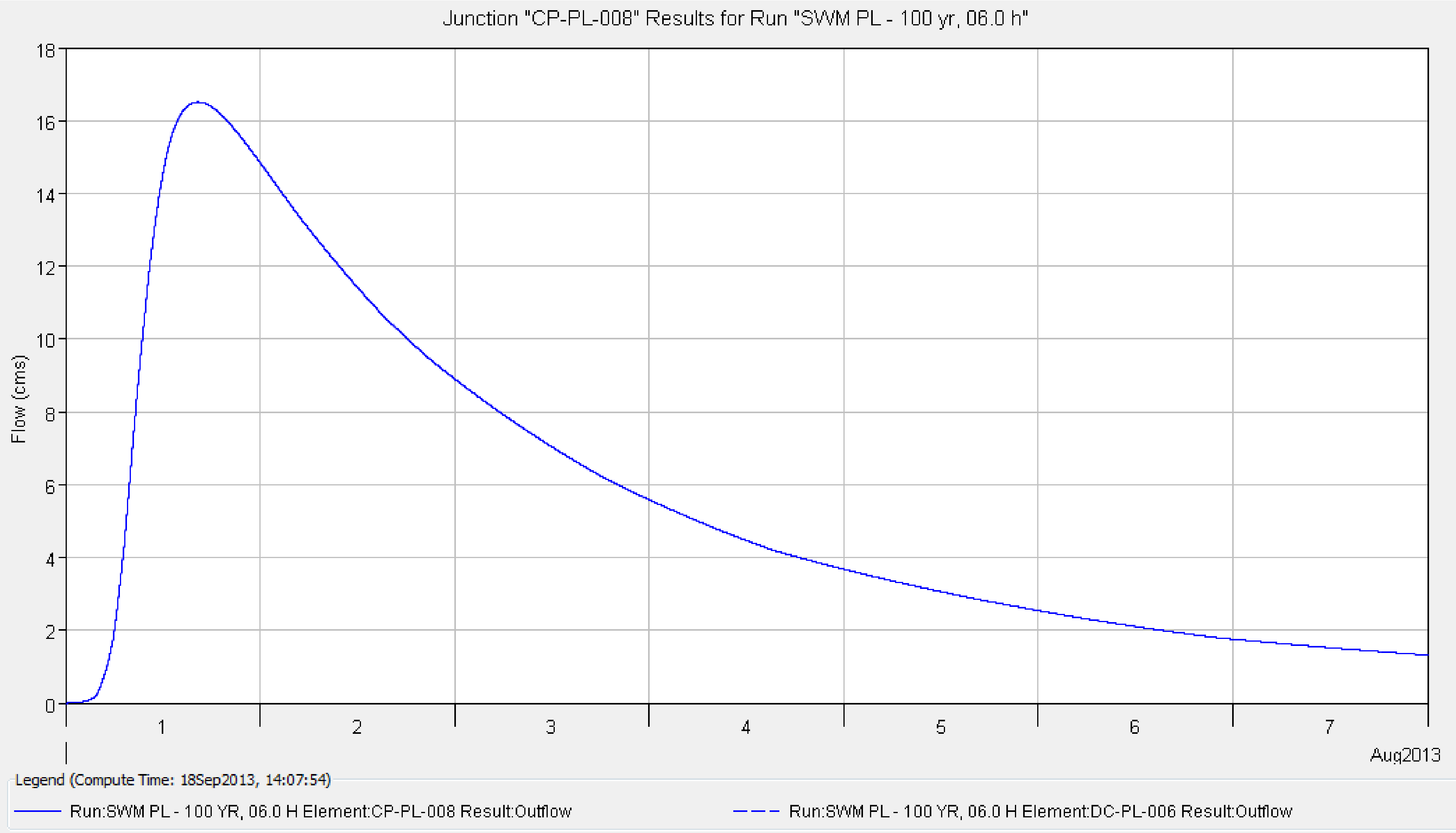

Junction "CP-PL-005" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-004 Result:Outflow

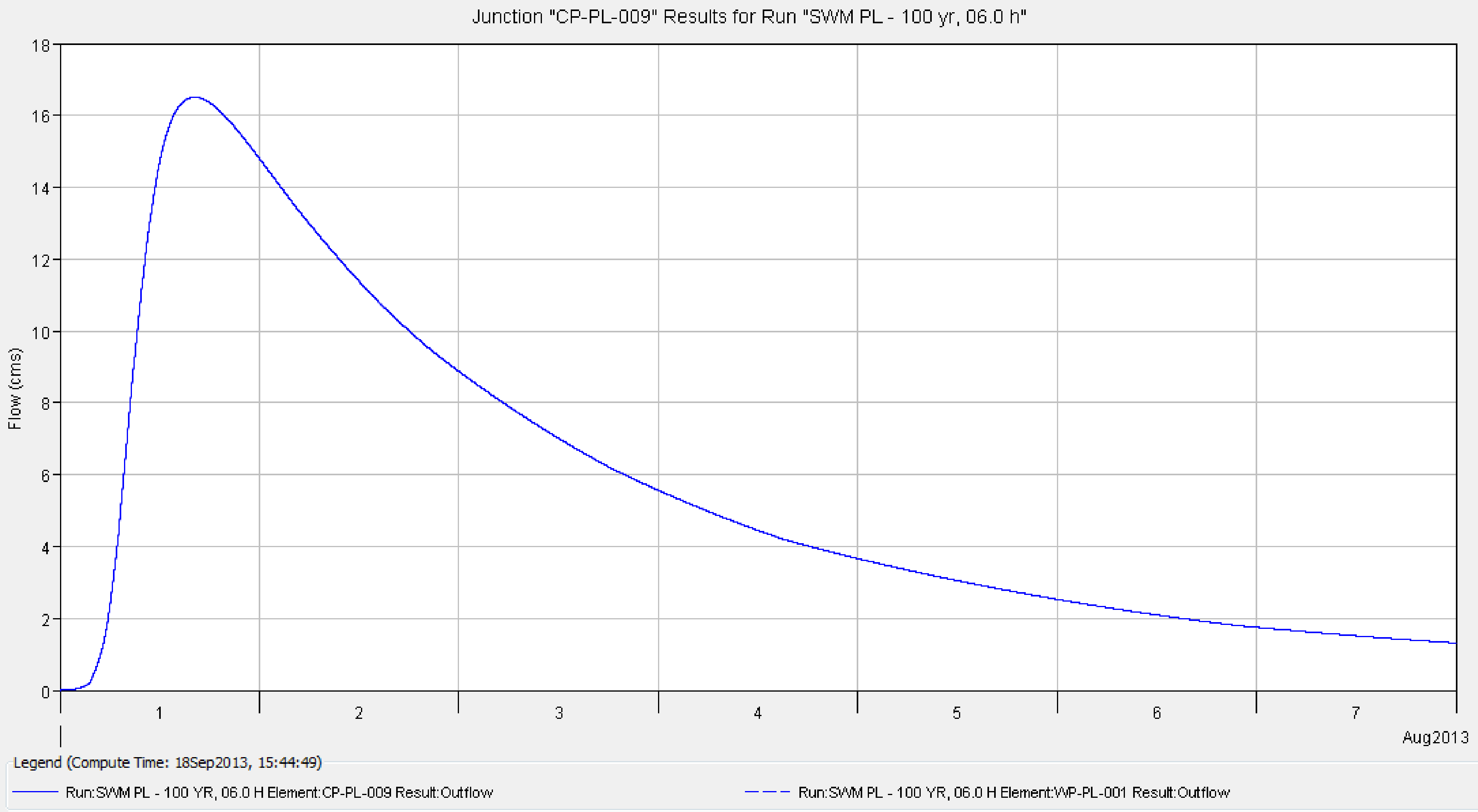


Junction "CP-PL-006" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-006 Result:Outflow

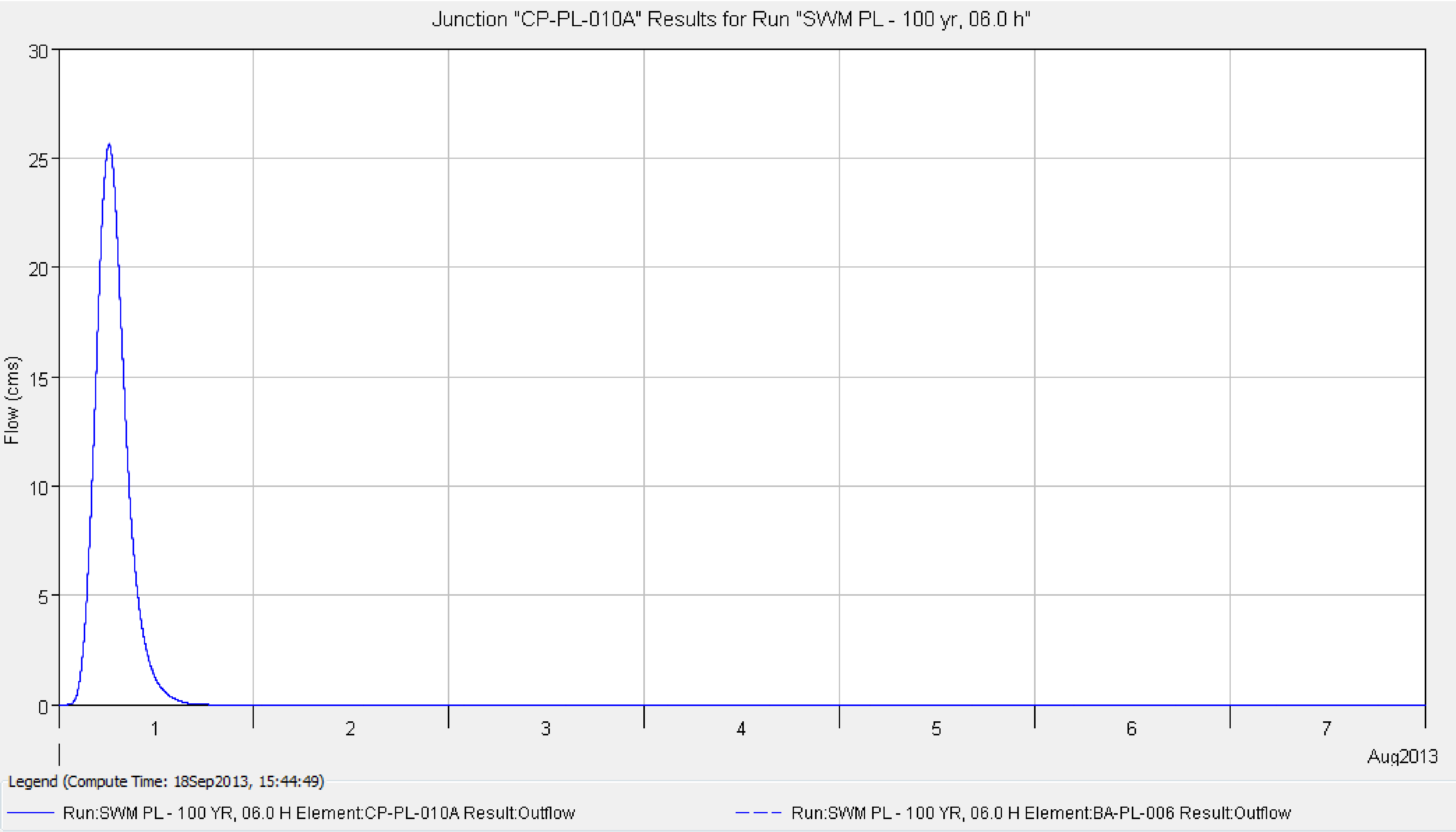


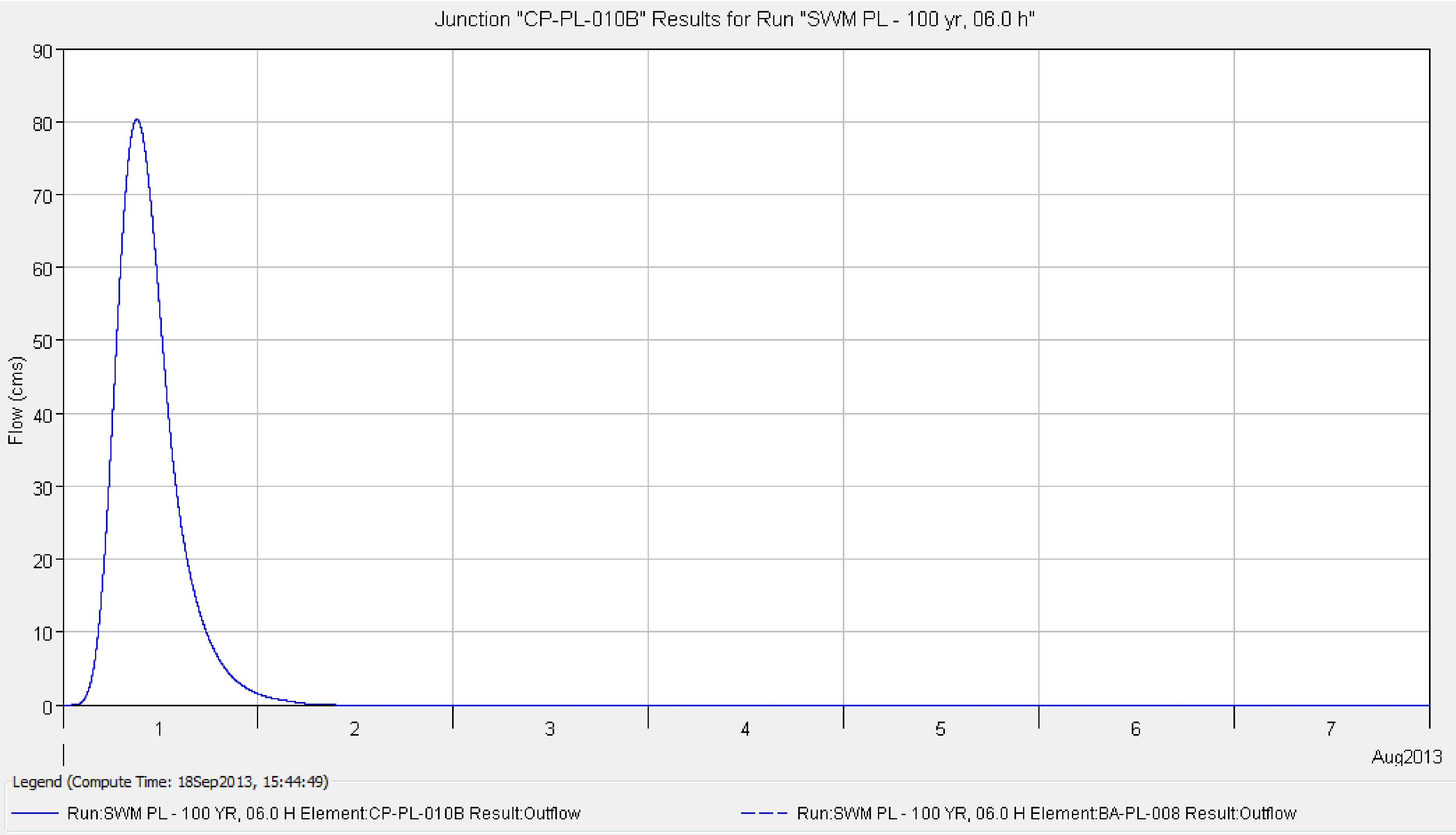
Junction "CP-PL-007" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-005 Result:Outflow

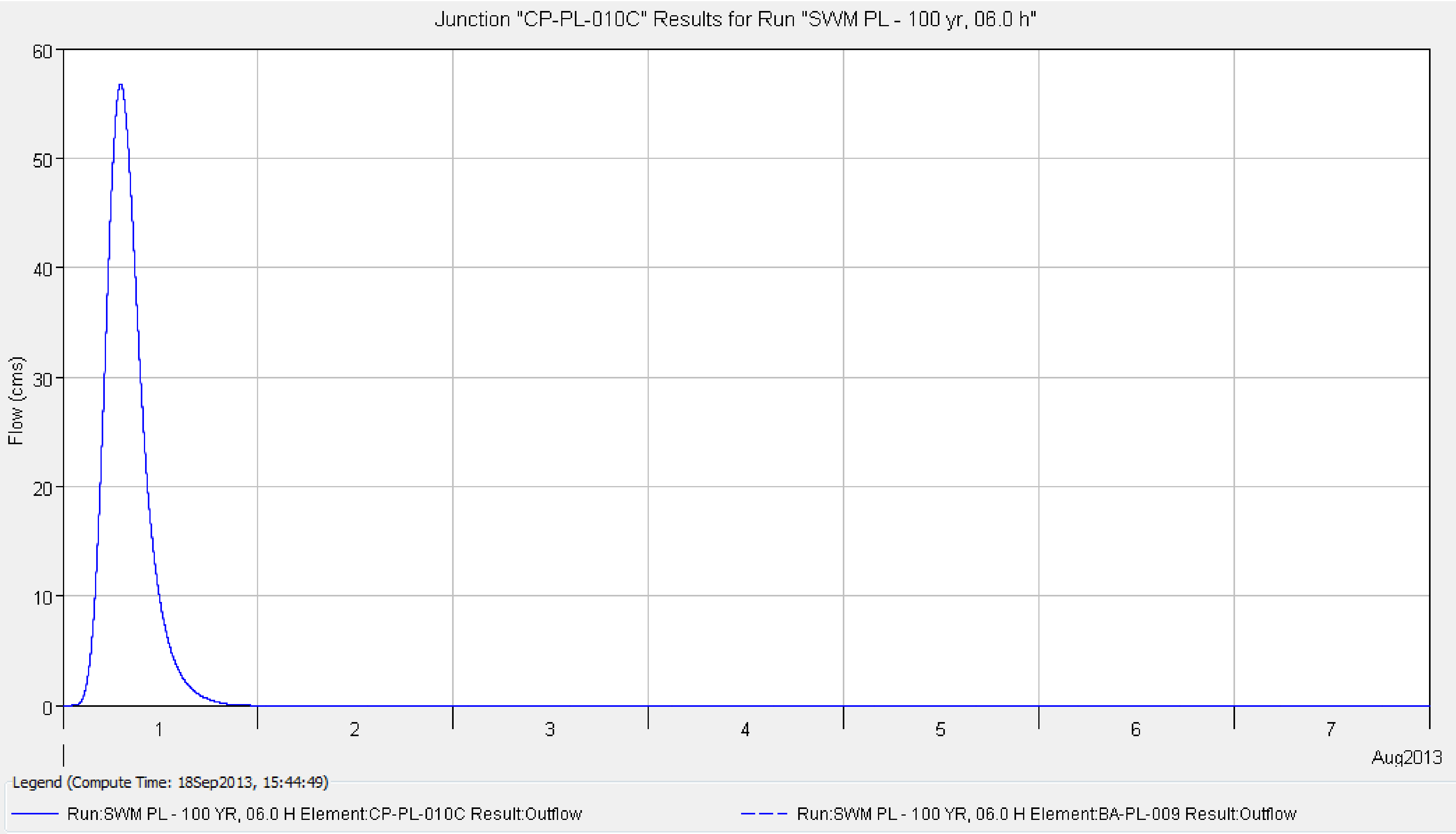

Junction "CP-PL-008" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 14:07:54)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-006 Result:Outflow

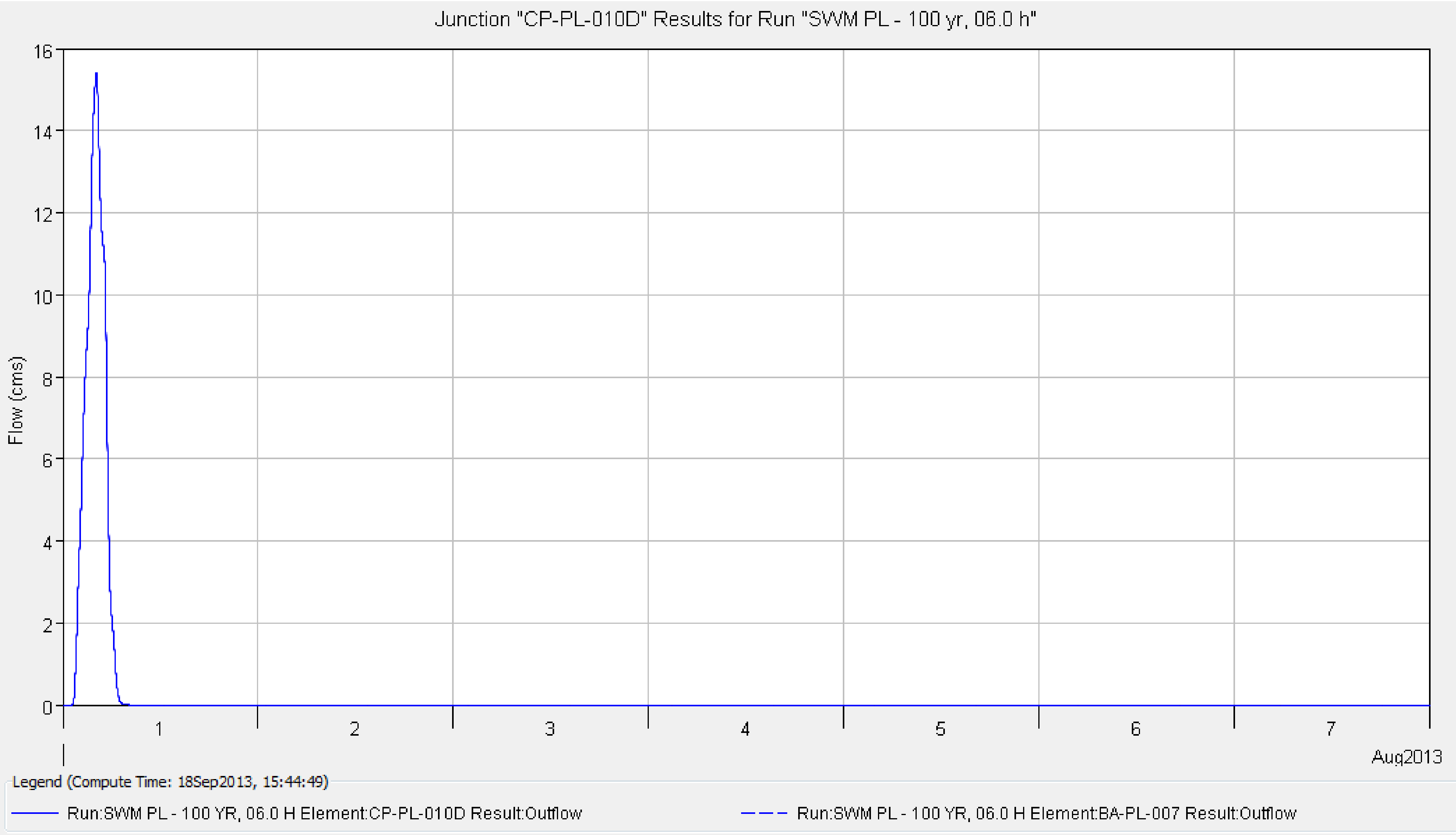


Junction "CP-PL-009" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Outflow

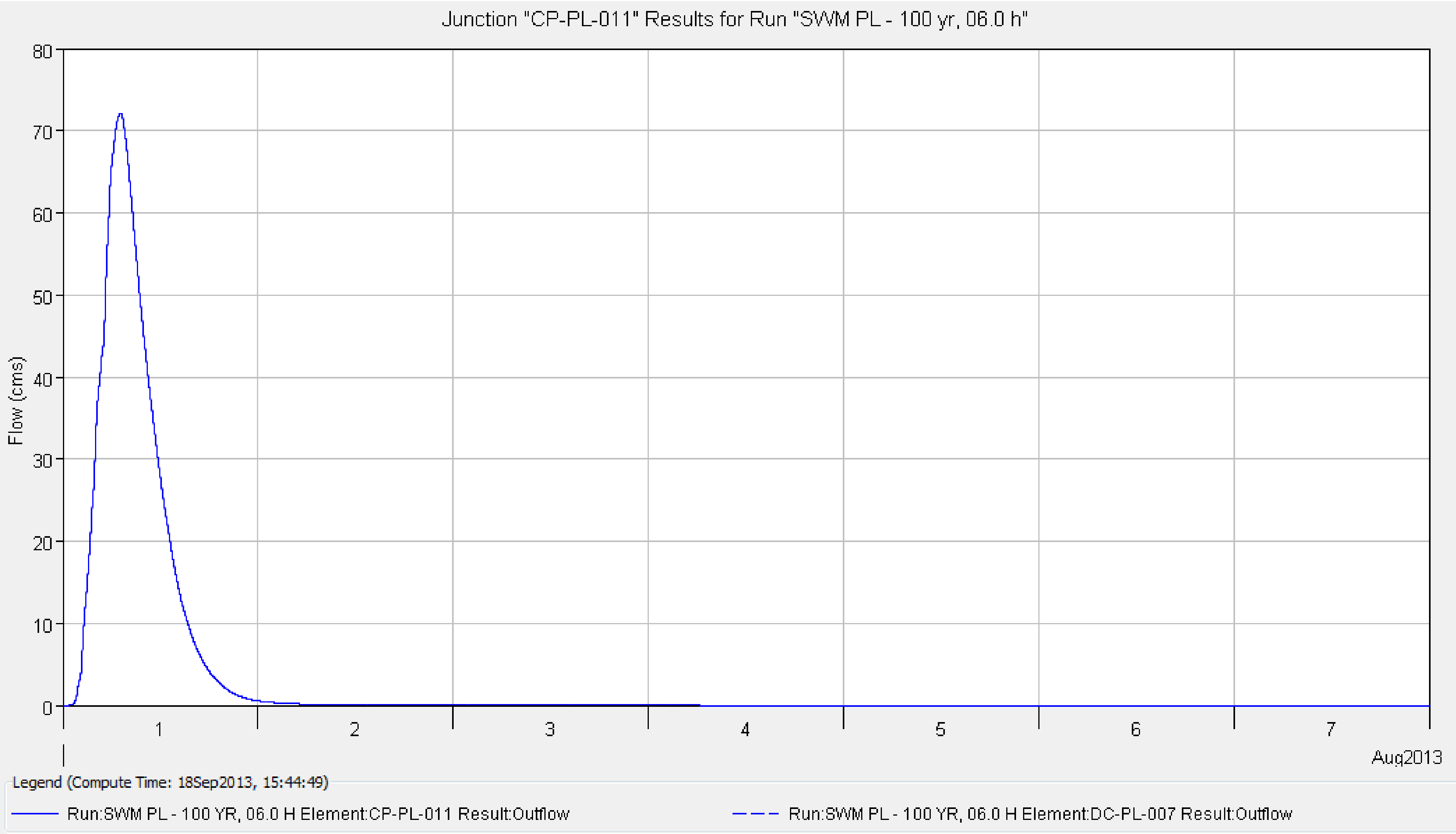

Junction "CP-PL-010A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-006 Result:Outflow


Junction "CP-PL-010B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-008 Result:Outflow

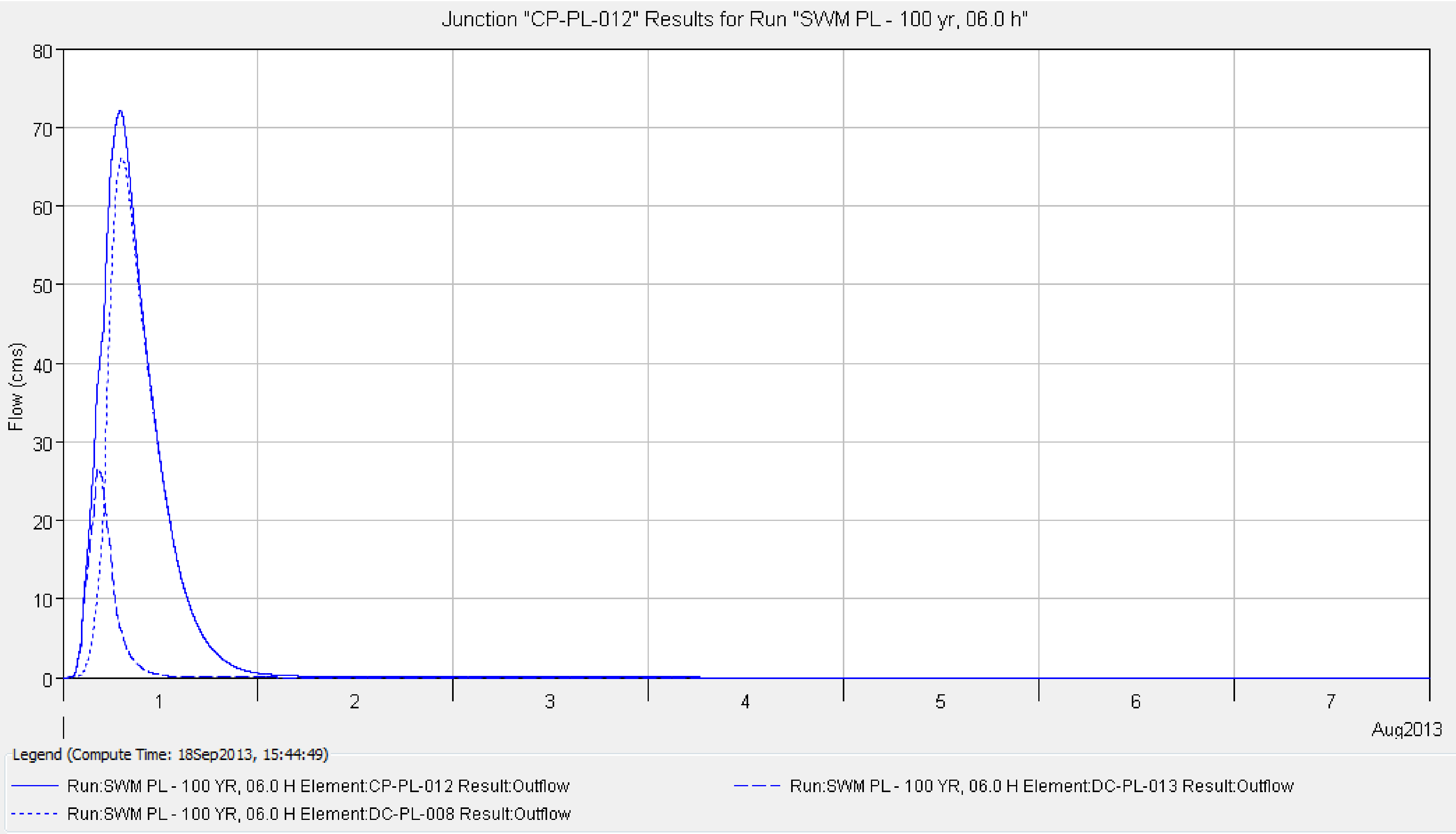

Junction "CP-PL-010C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
10
20
30
40
50
60
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-009 Result:Outflow



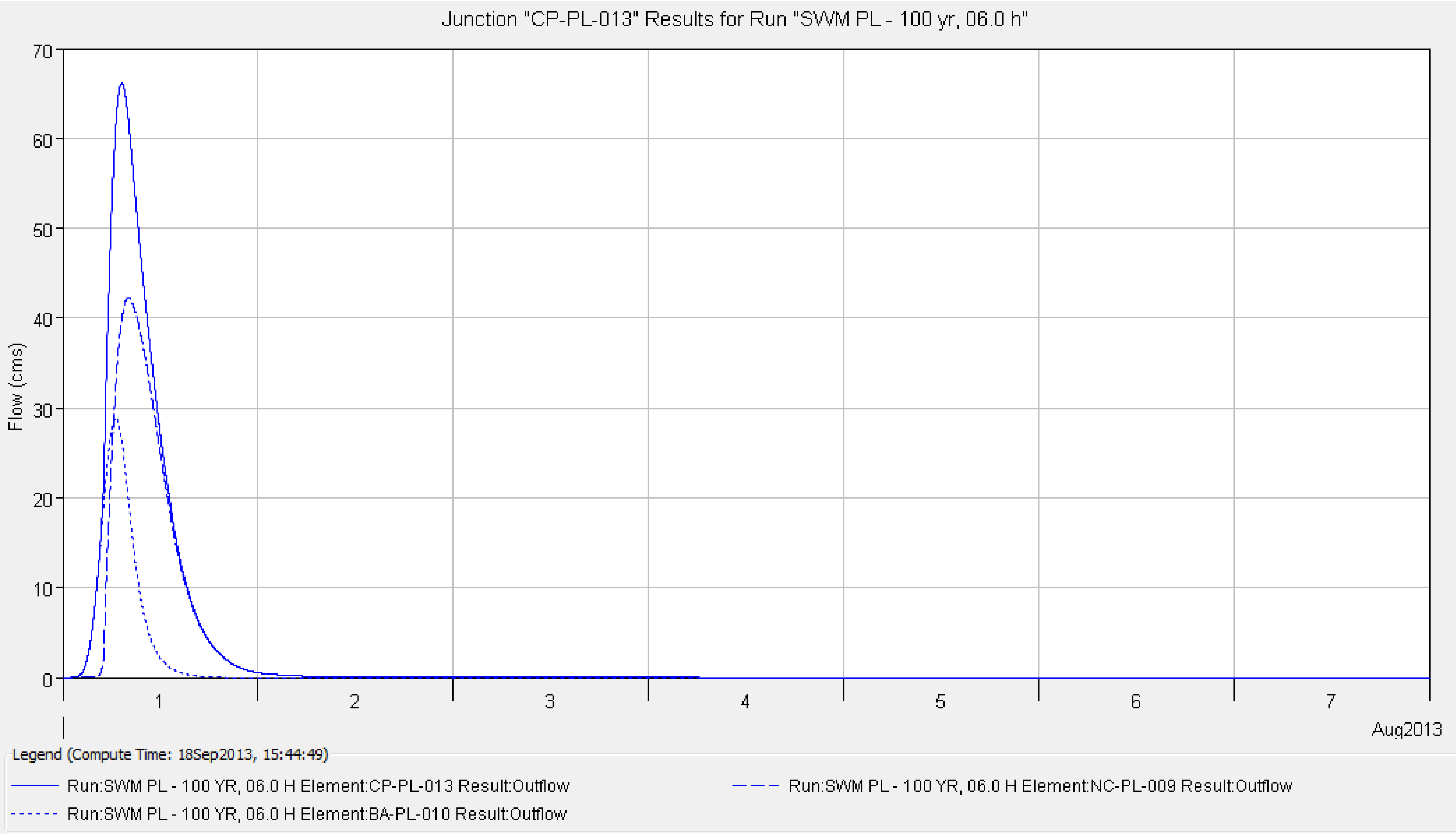
Junction "CP-PL-010D" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-010D Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-007 Result:Outflow

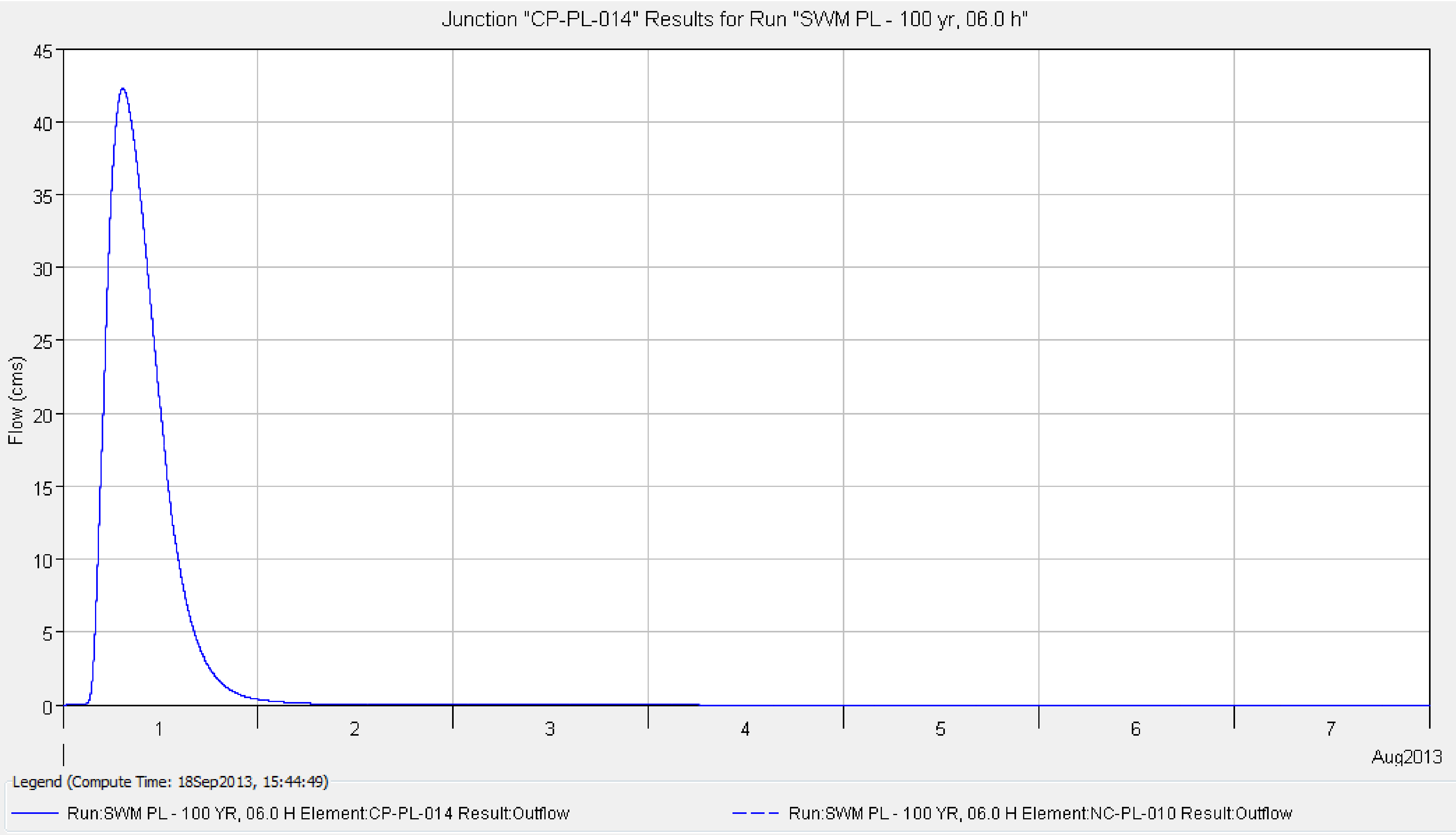


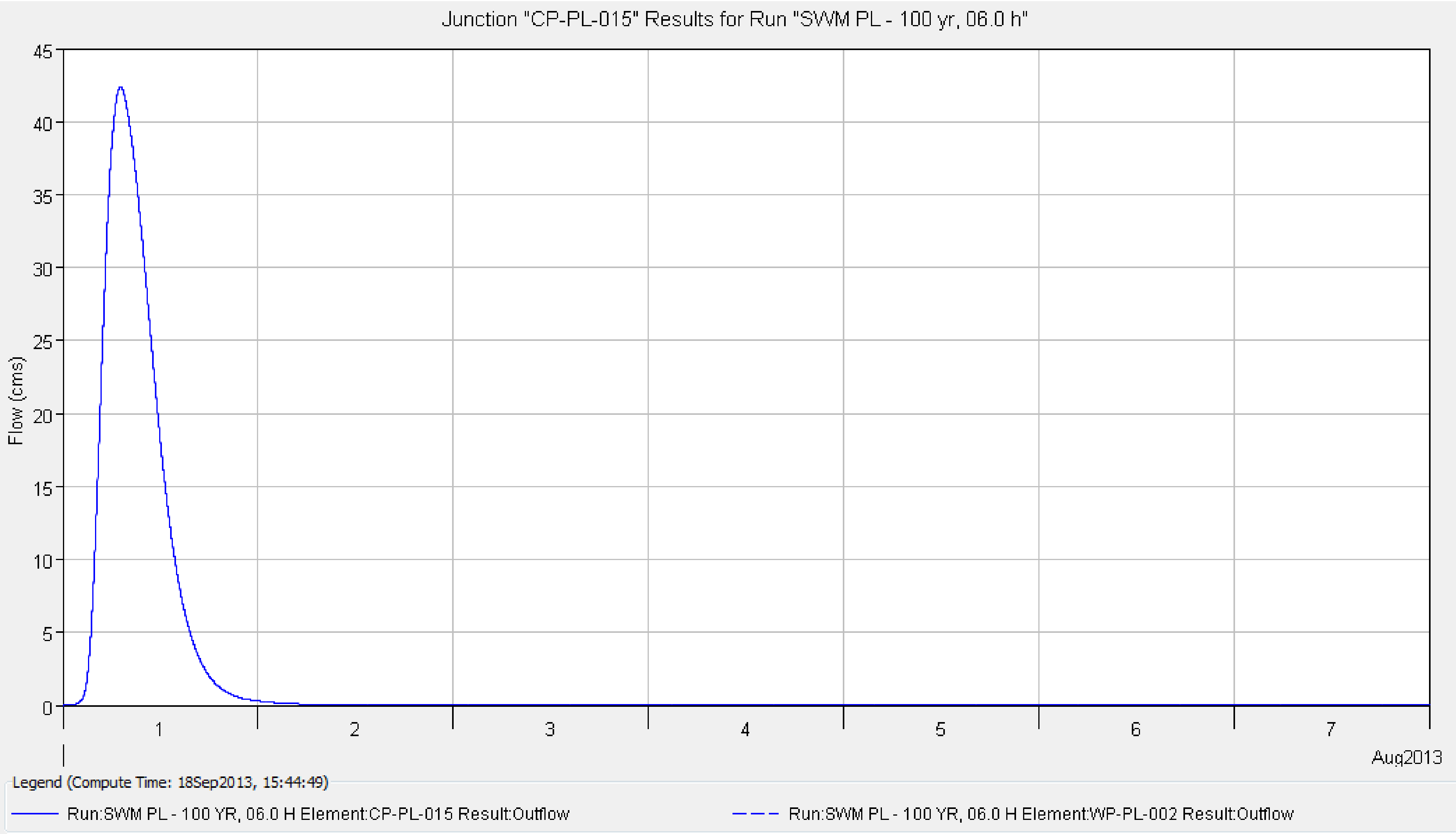
Junction "CP-PL-011" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-007 Result:Outflow

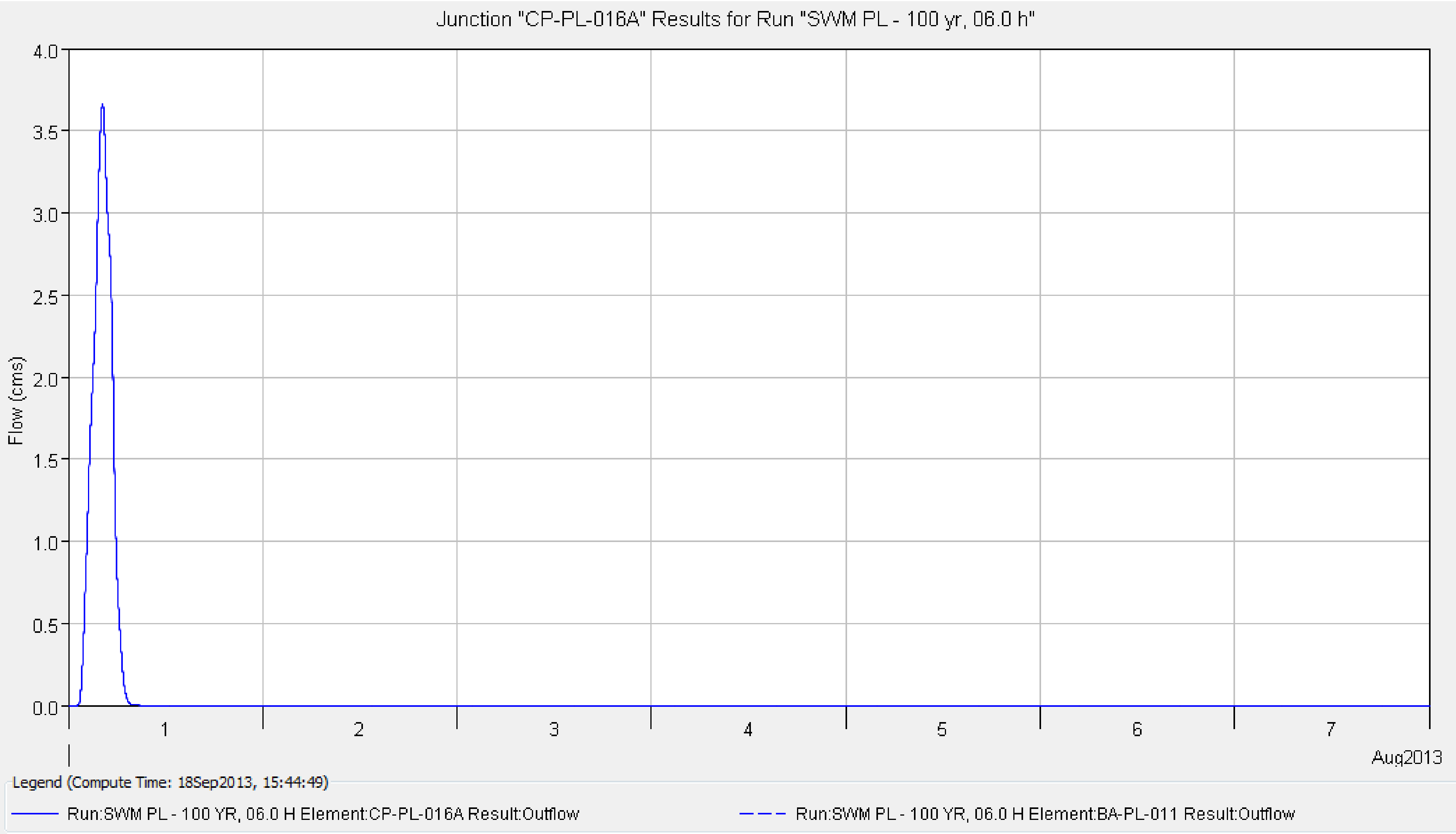


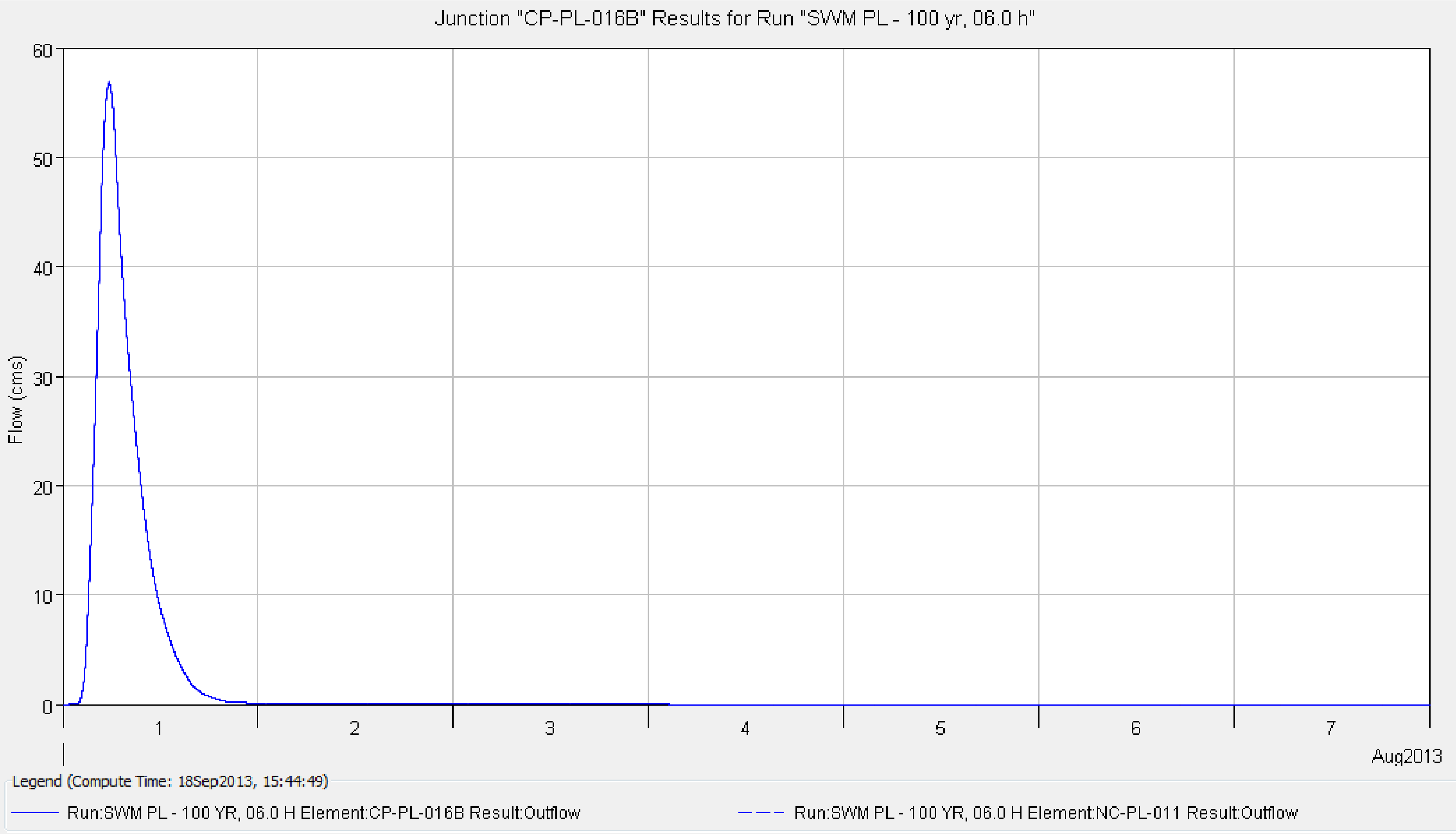
Junction "CP-PL-012" Results for Run "SWM PL - 100 yr, 06.0 h"
80
70
60
50
40
30
20
10
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-008 Result:Outflow


Junction "CP-PL-013" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-010 Result:Outflow

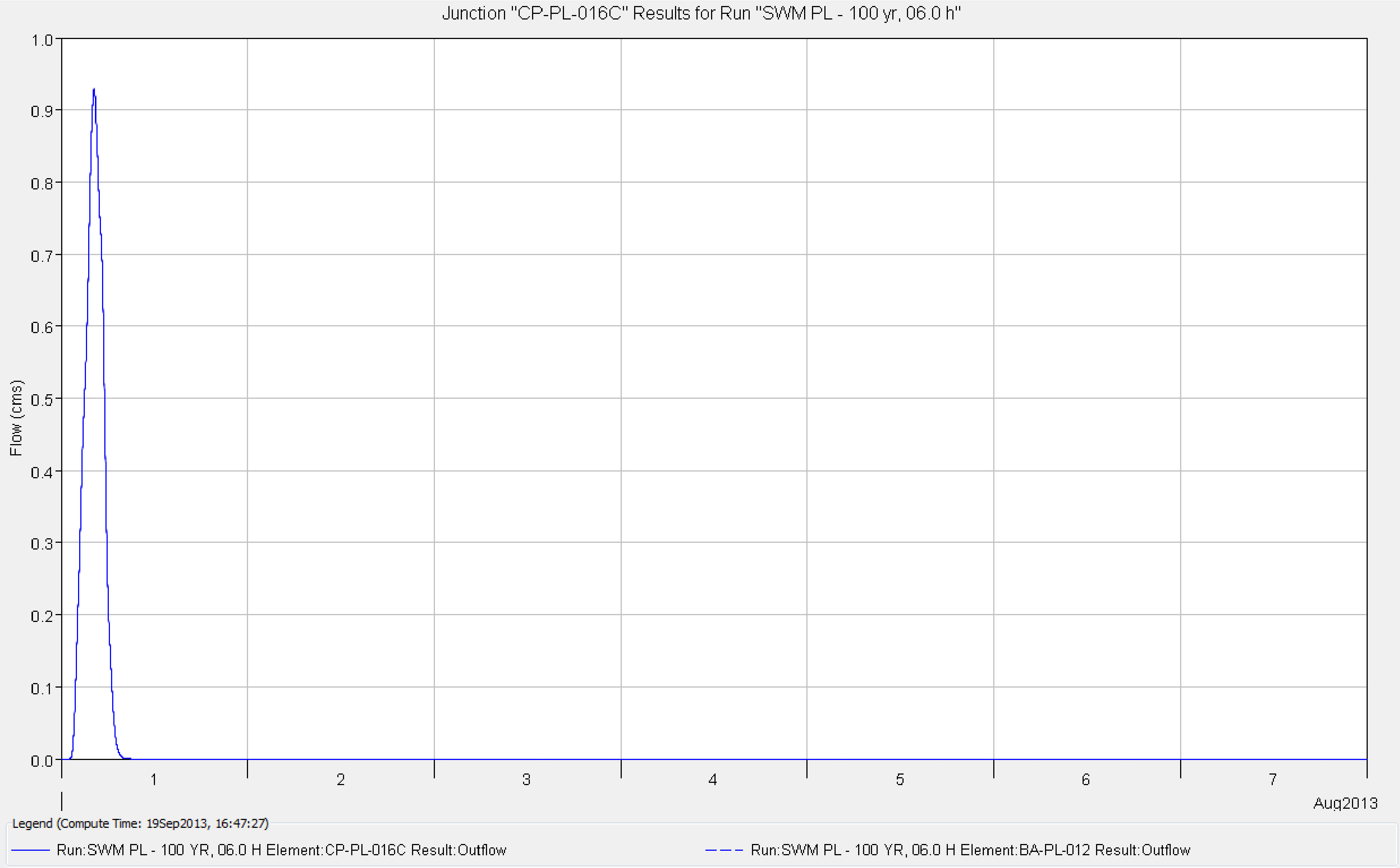

Junction "CP-PL-014" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
25
30
35
40
45
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-010 Result:Outflow


Junction "CP-PL-015" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-015 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Outflow

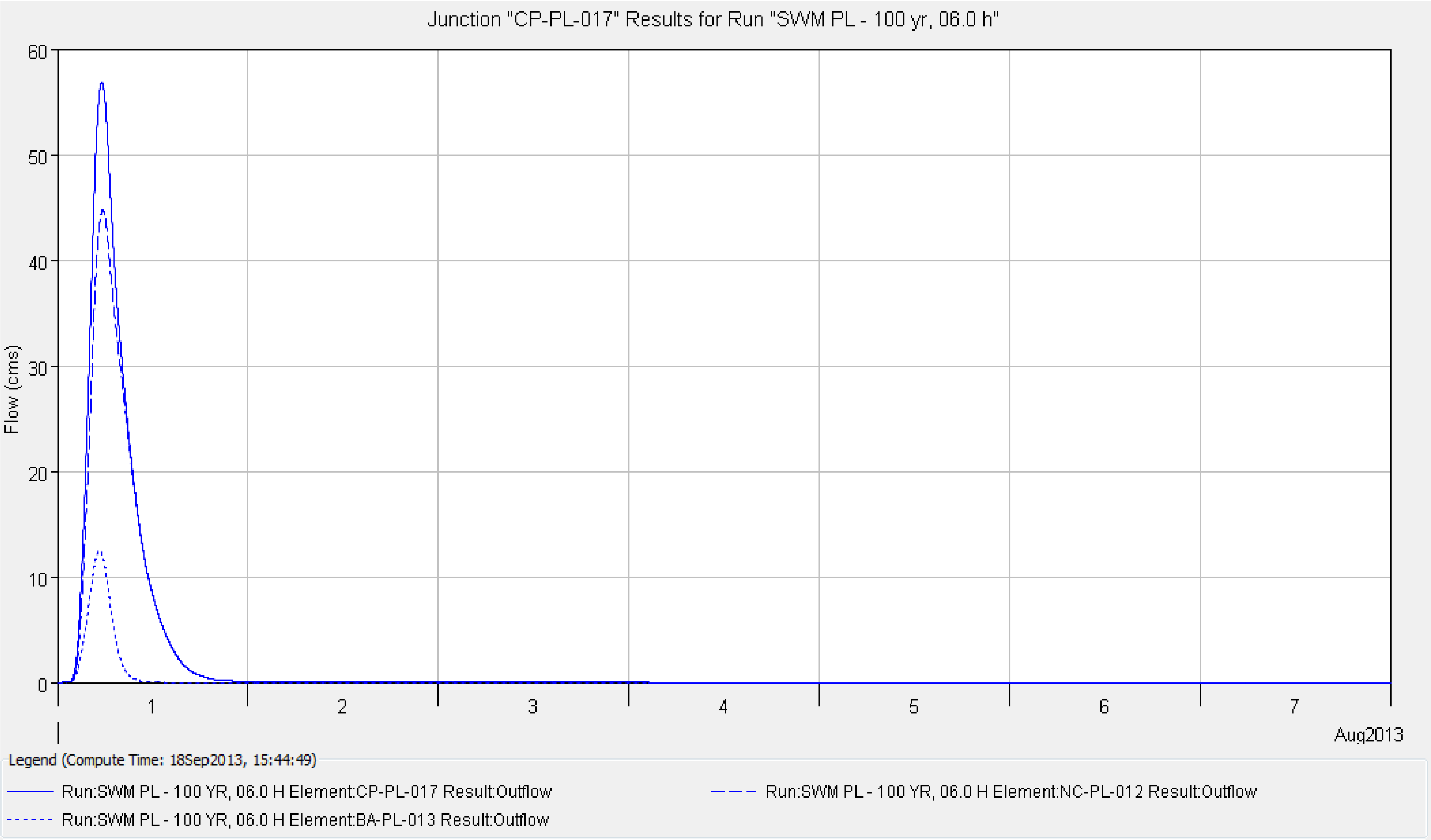

Junction "CP-PL-016A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-011 Result:Outflow



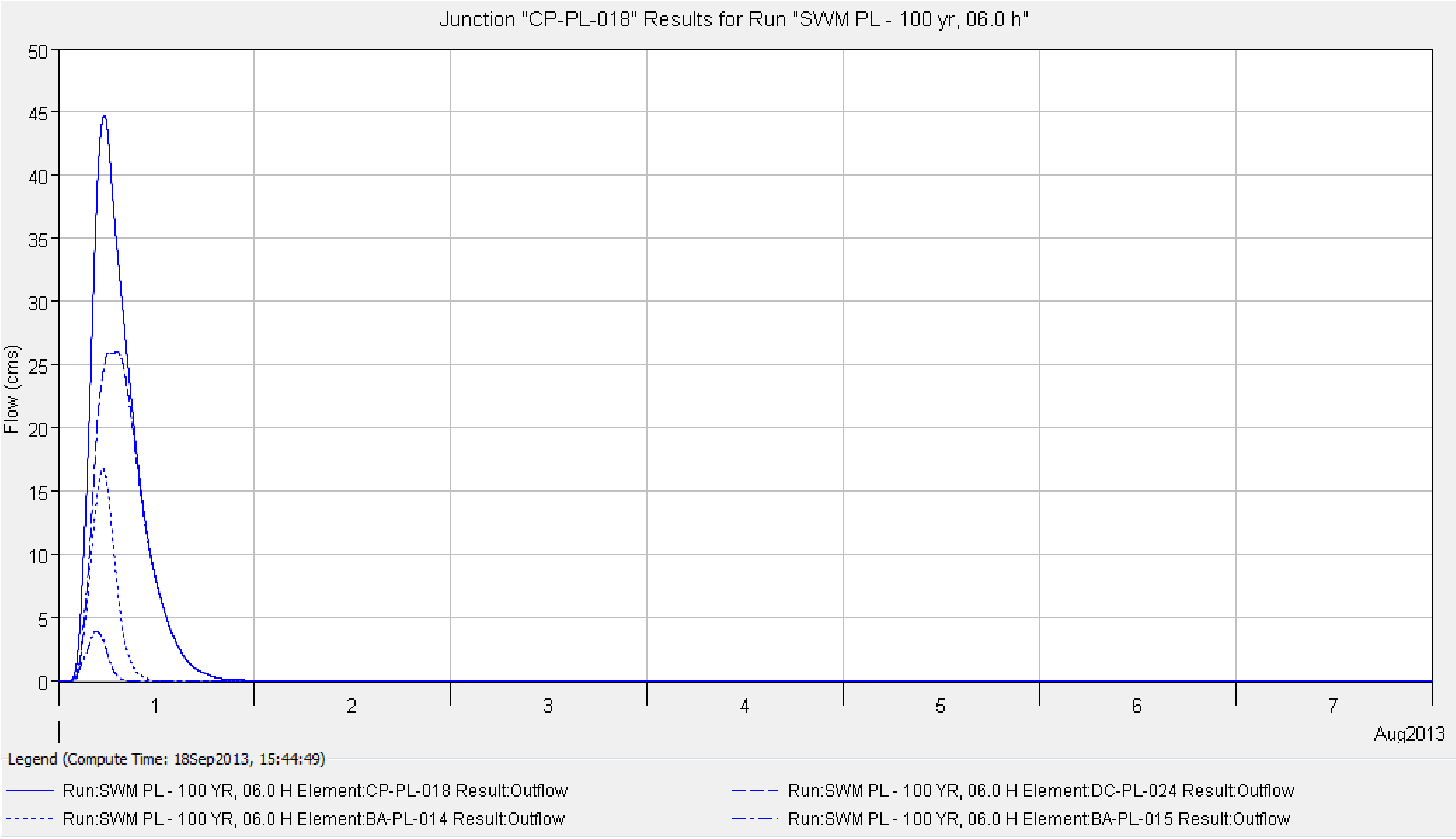
Junction "CP-PL-016B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-011 Result:Outflow



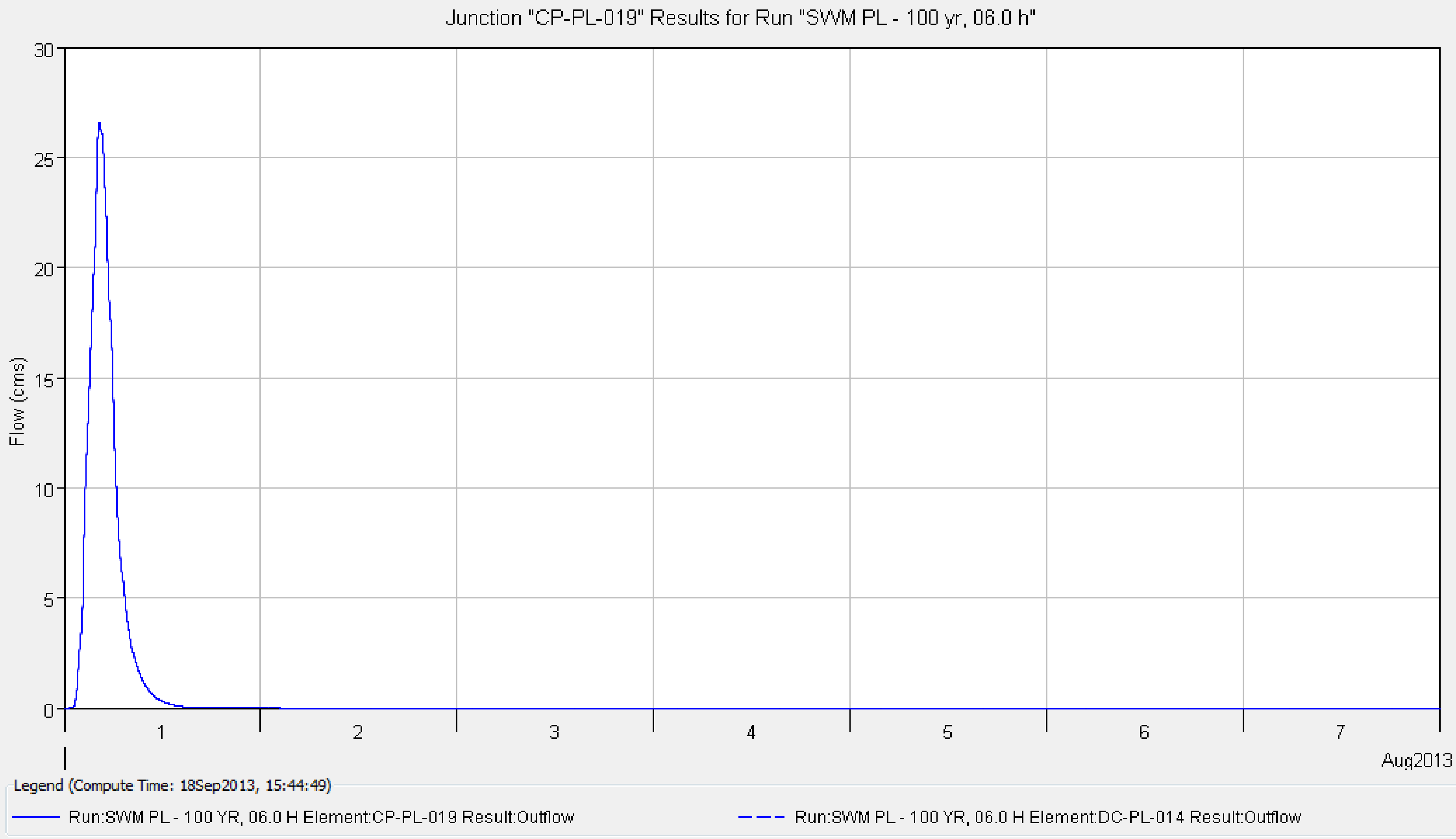
Junction "CP-PL-016C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-016C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-012 Result:Outflow



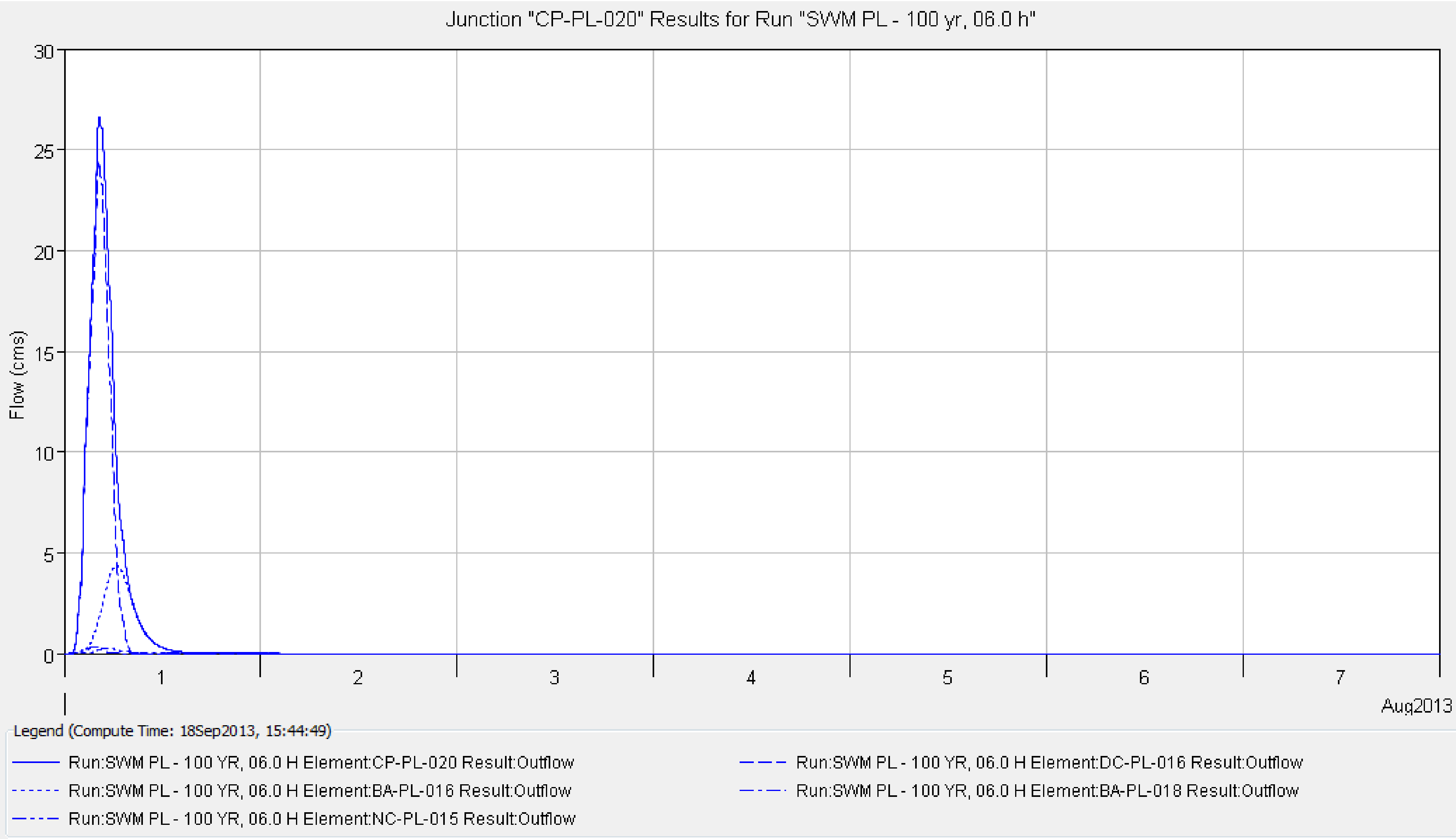
Junction "CP-PL-017" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-013 Result:Outflow



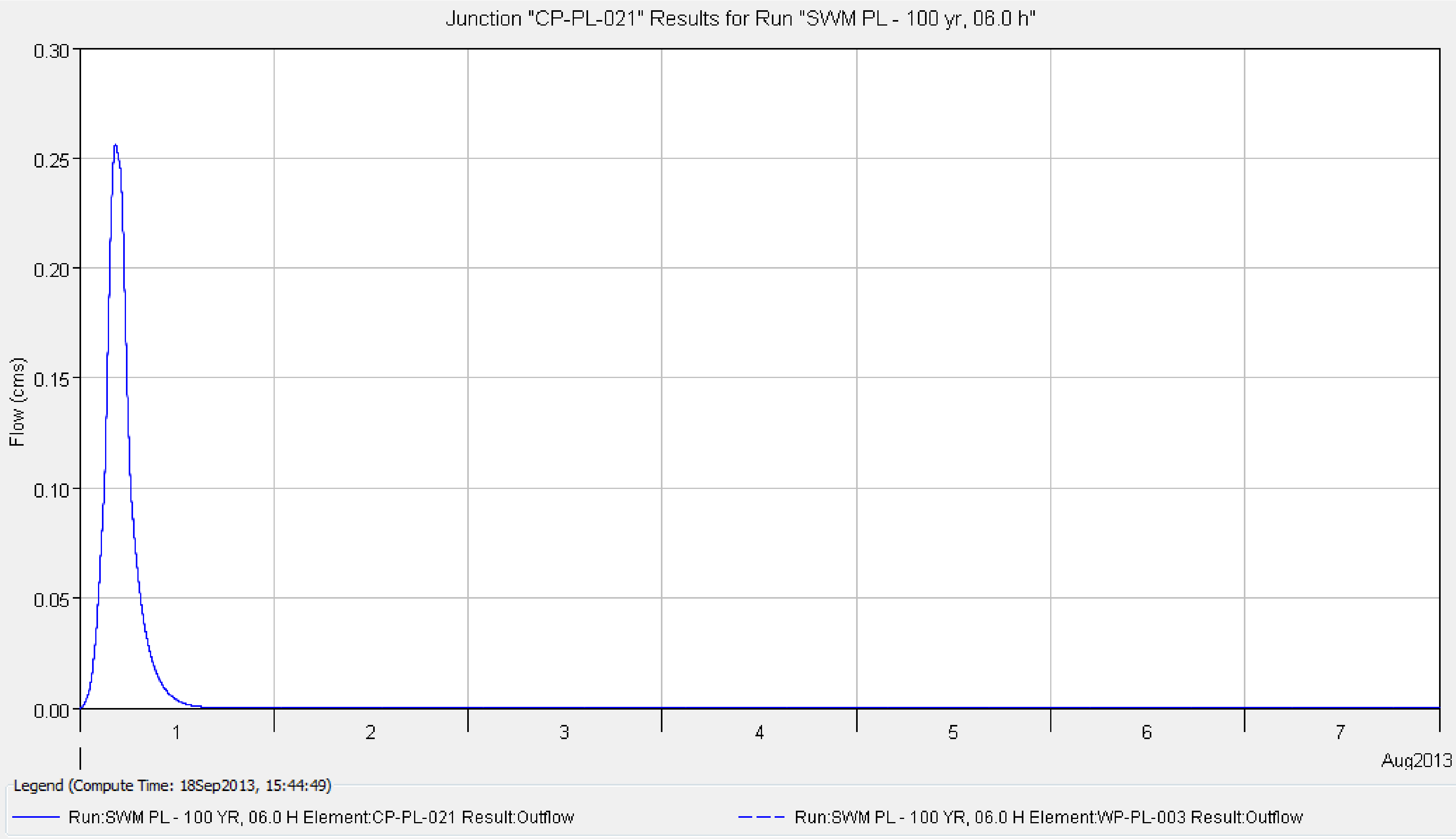
Junction "CP-PL-018" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-015 Result:Outflow



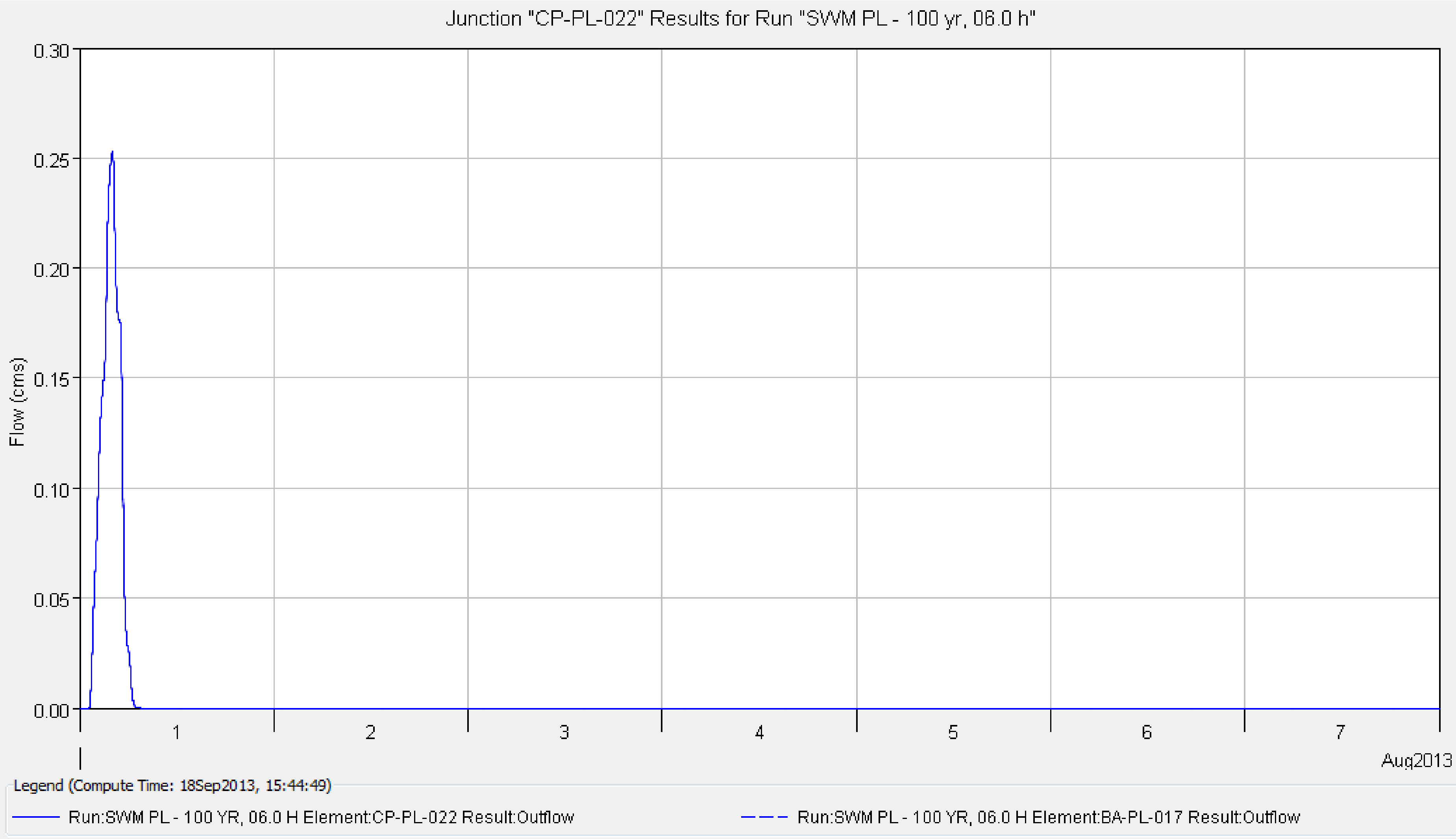
Junction "CP-PL-019" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-014 Result:Outflow

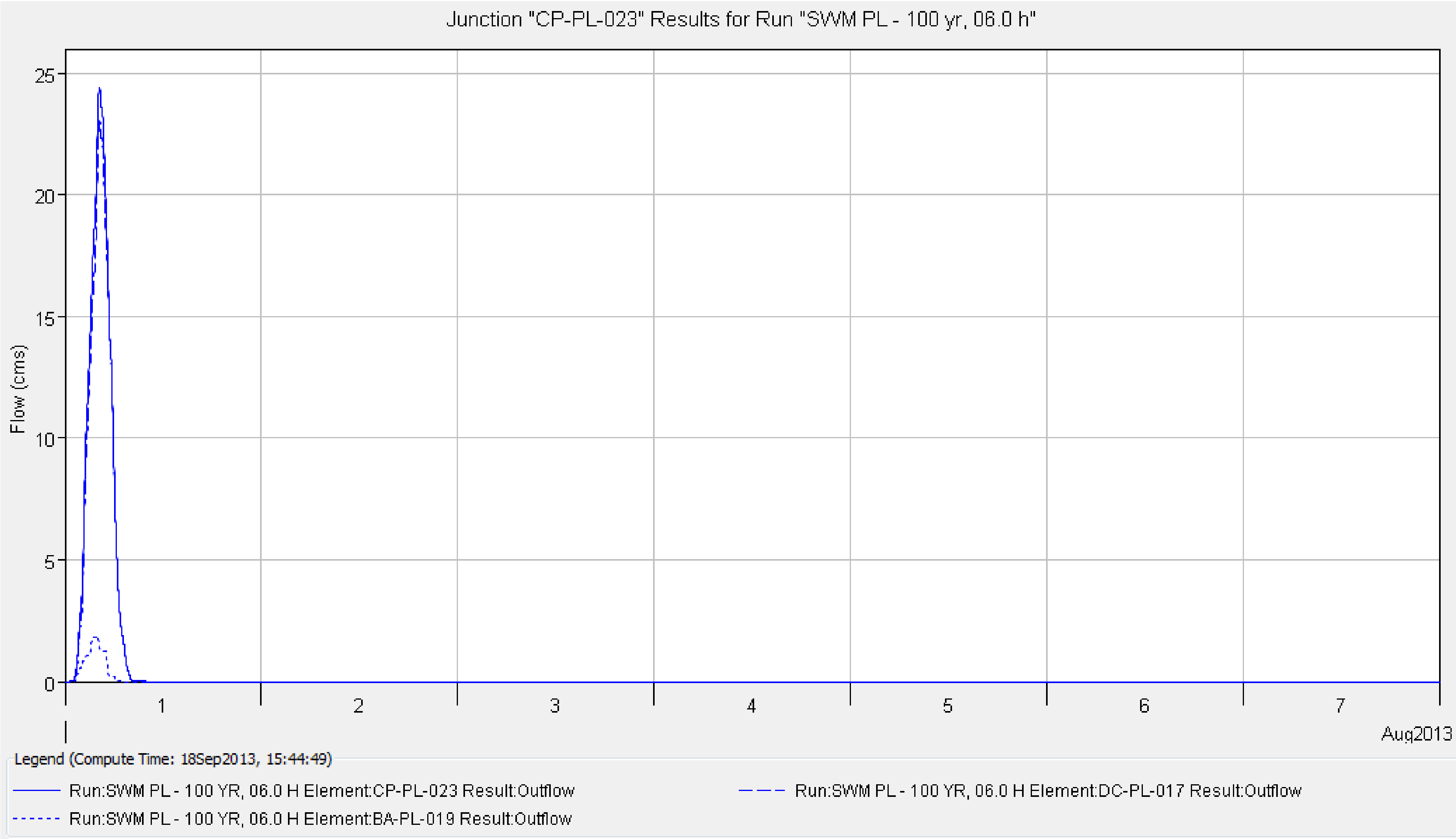


Junction "CP-PL-020" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-015 Result:Outflow

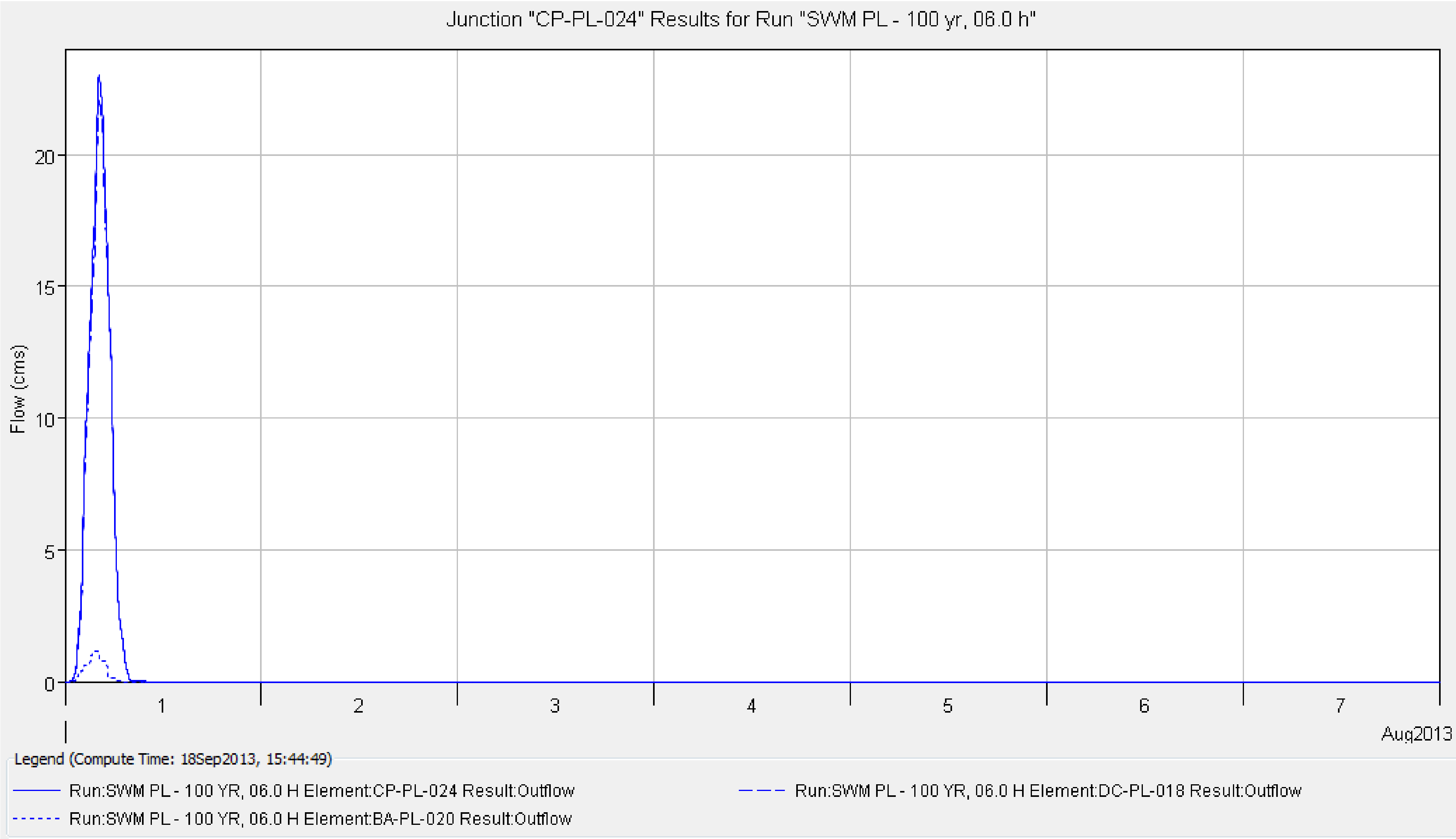


Junction "CP-PL-021" Results for Run "SWM PL - 100 yr, 06.0 h"
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Outflow

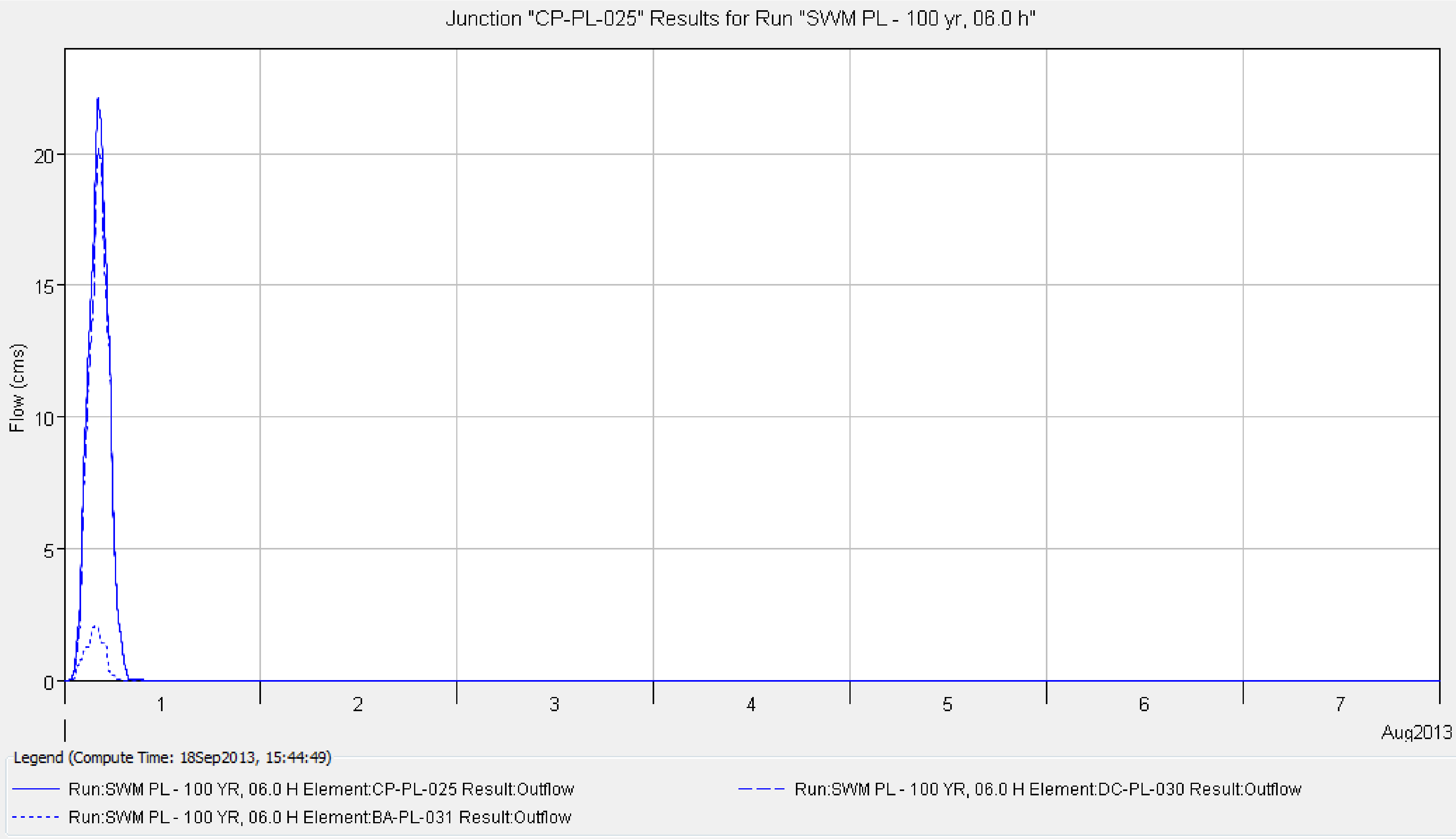

Junction "CP-PL-022" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-017 Result:Outflow

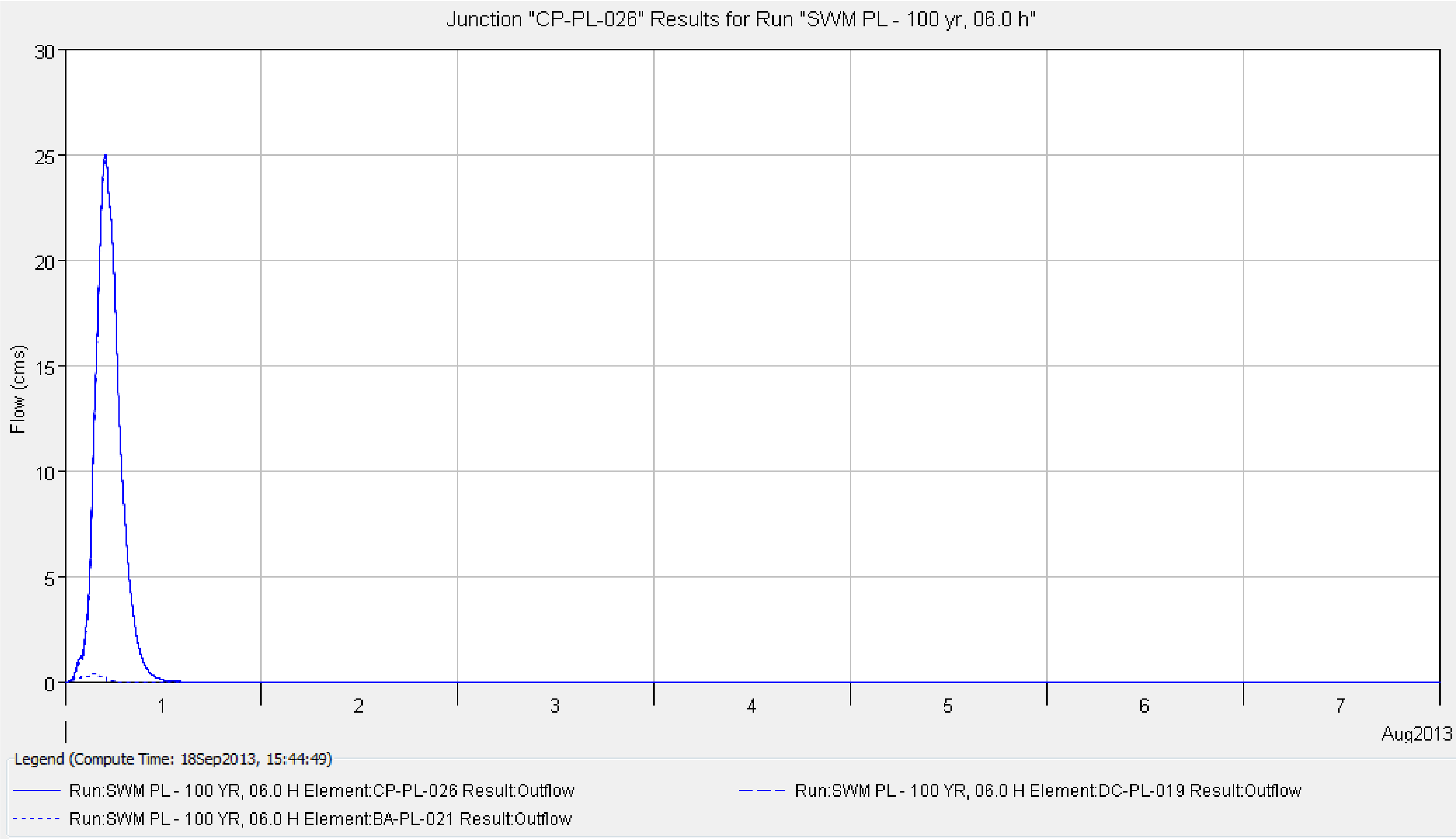


Junction "CP-PL-023" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-019 Result:Outflow

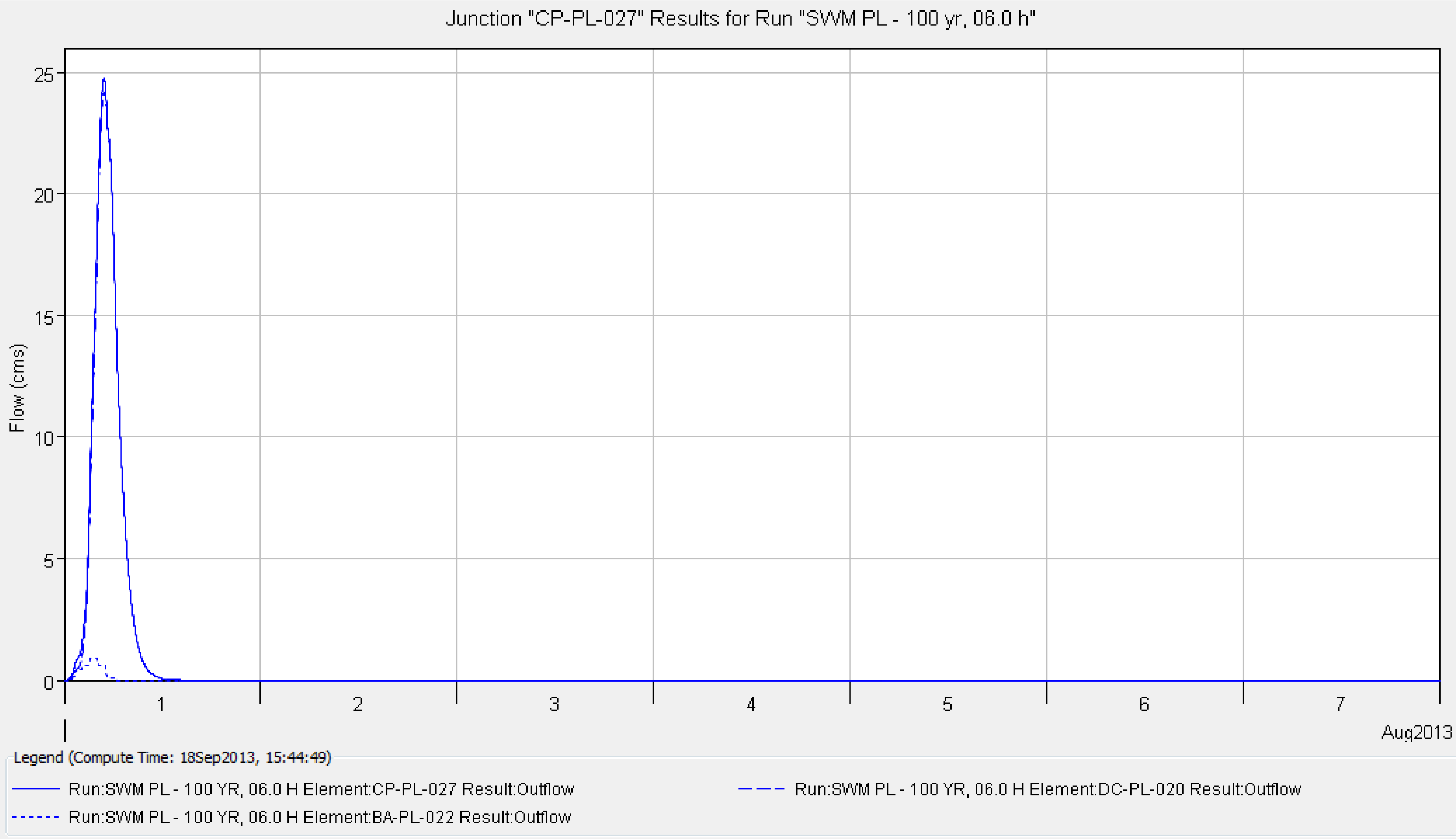


Junction "CP-PL-024" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-020 Result:Outflow

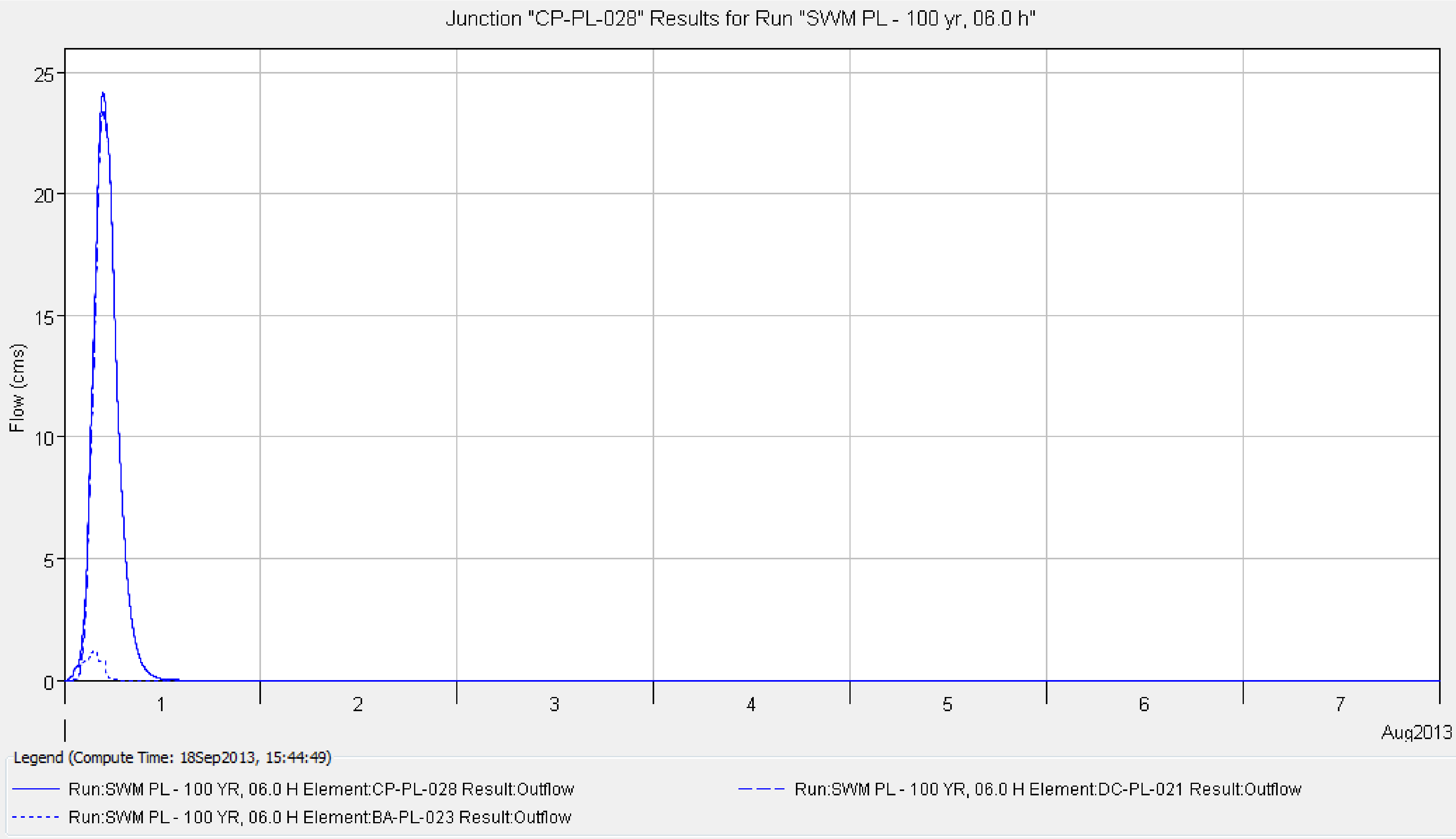

Junction "CP-PL-025" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-025 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-031 Result:Outflow



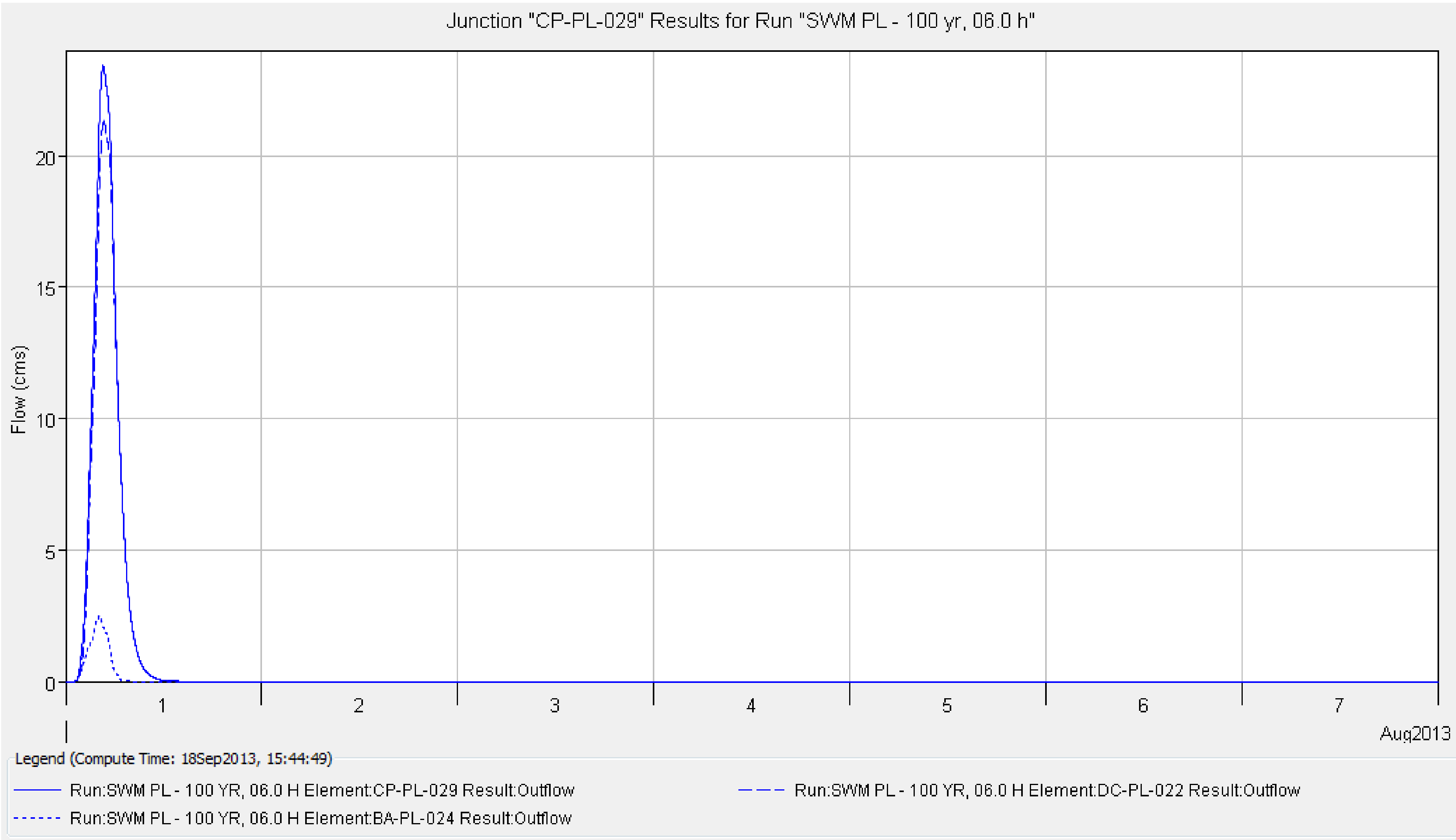
Junction "CP-PL-026" Results for Run "SWM PL - 100 yr, 06.0 h"
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-021 Result:Outflow

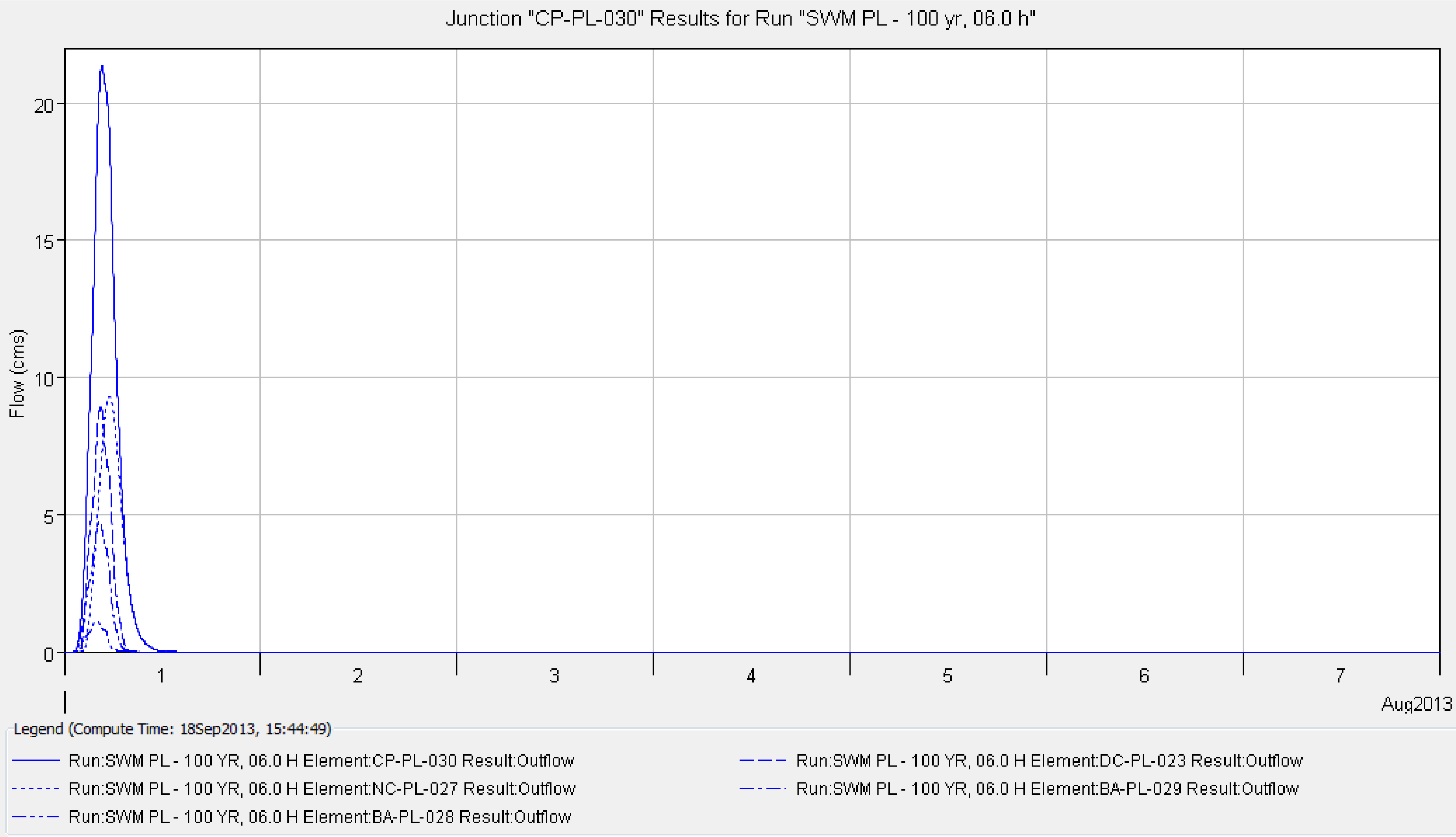


Junction "CP-PL-027" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-022 Result:Outflow

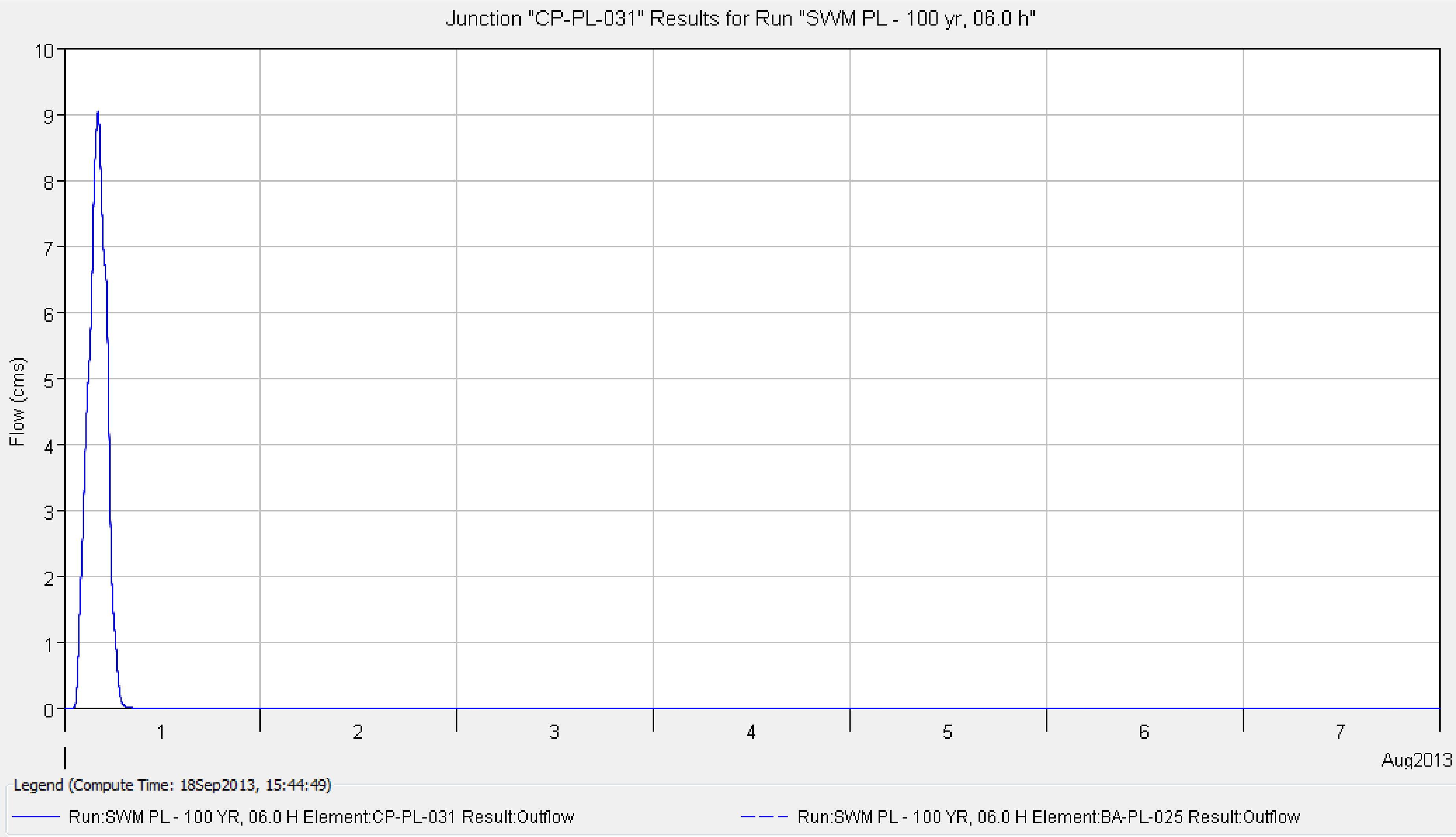


Junction "CP-PL-028" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-028 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-023 Result:Outflow

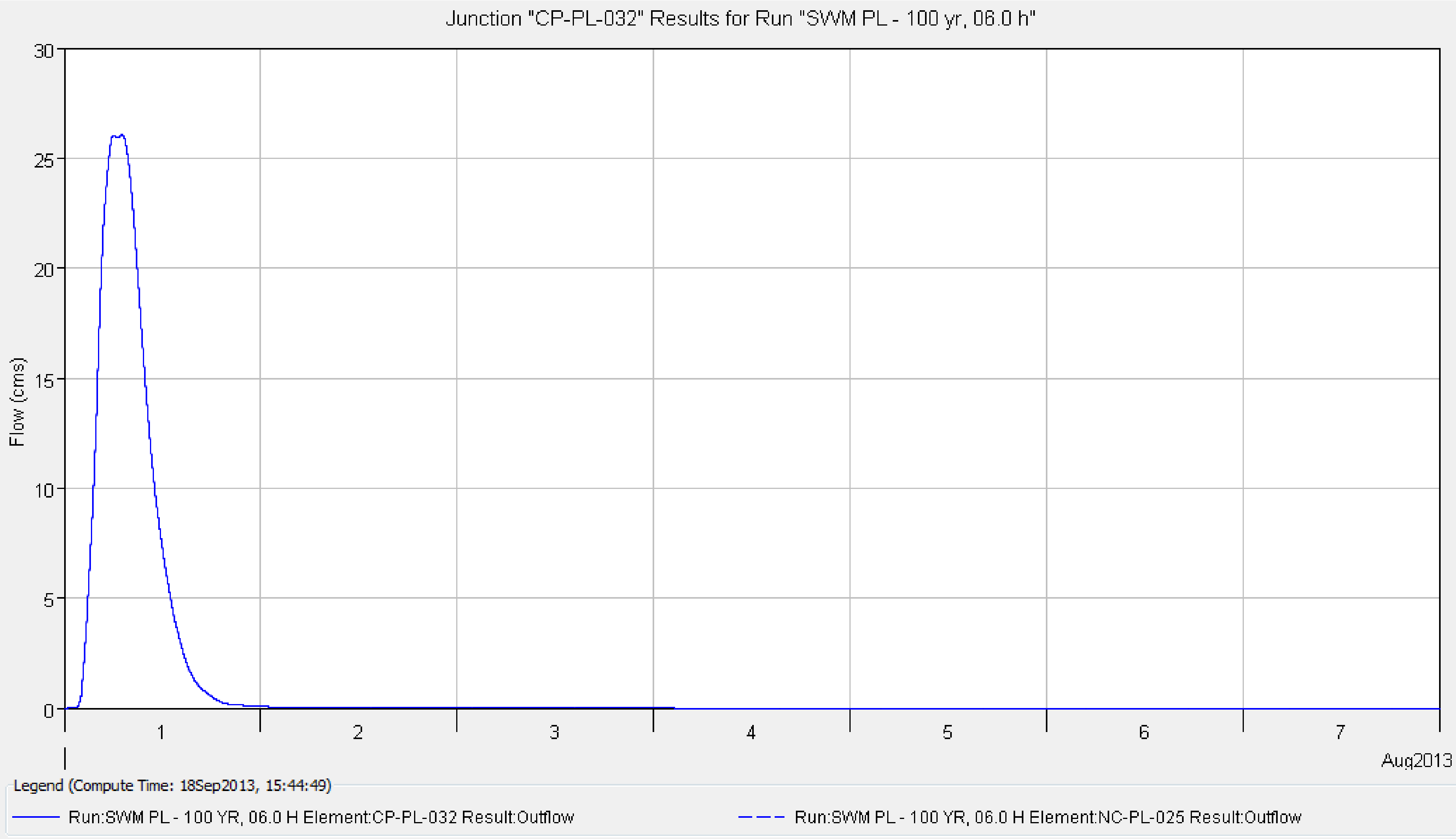

Junction "CP-PL-029" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-024 Result:Outflow

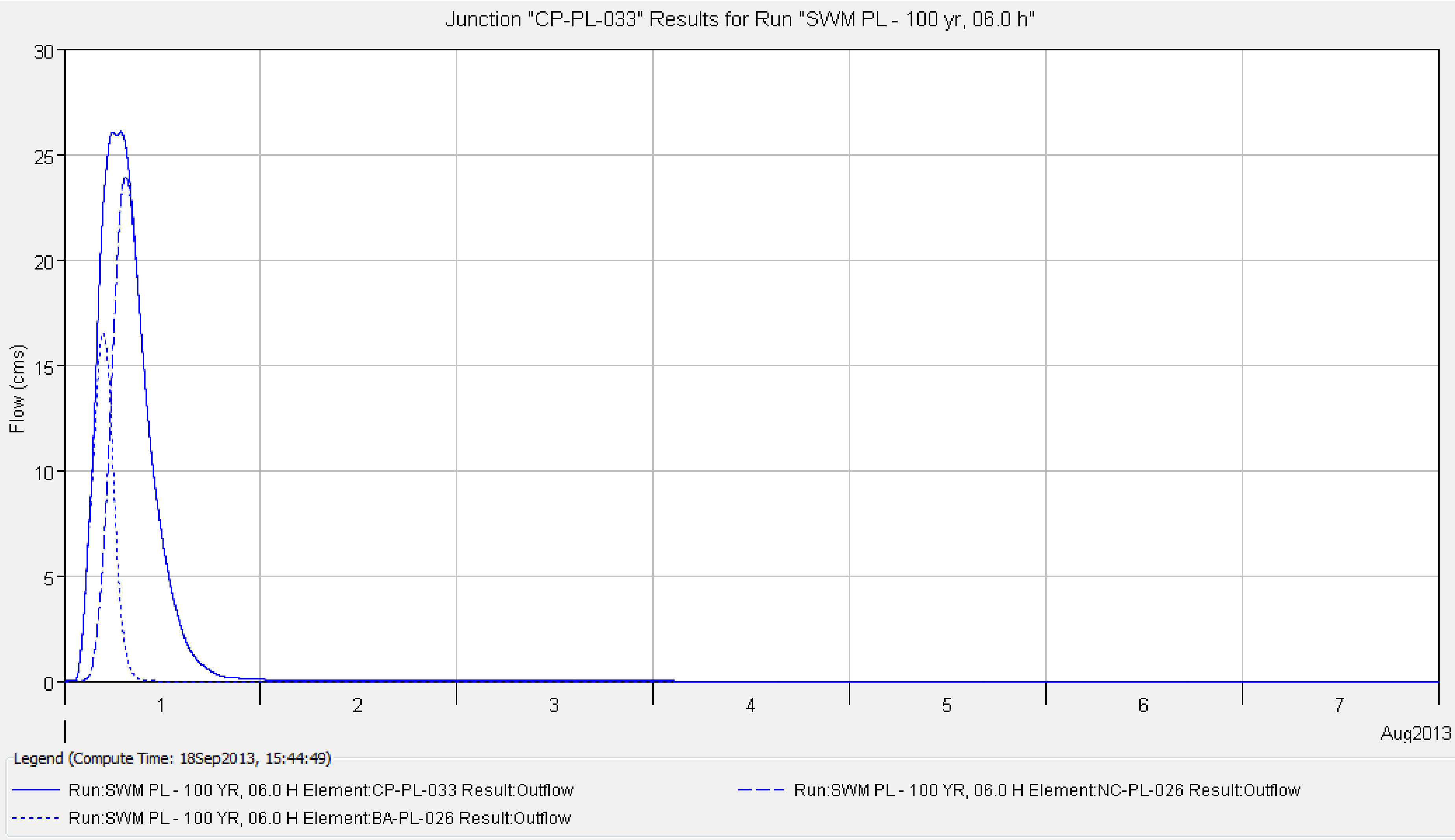


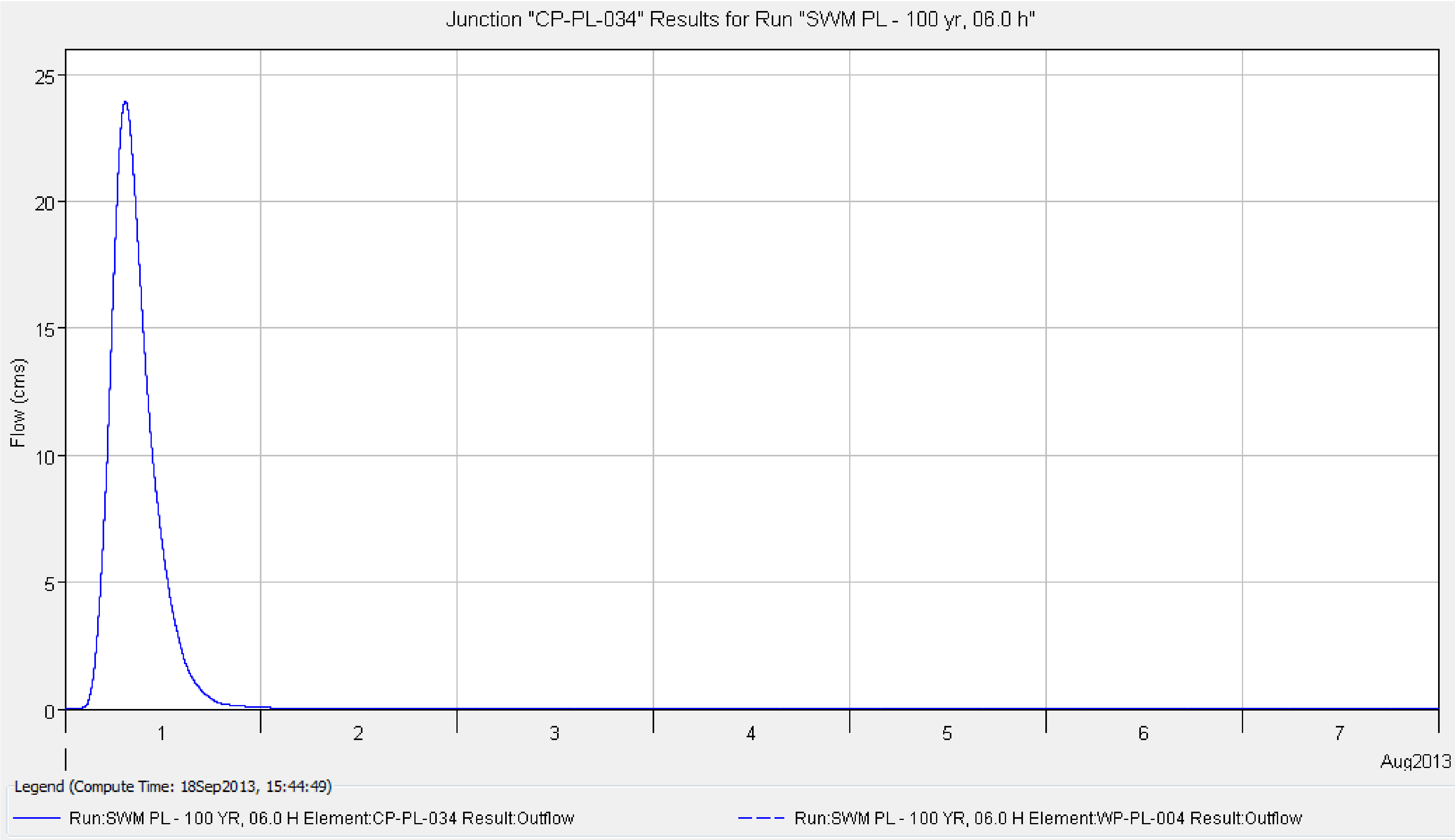
Junction "CP-PL-030" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-028 Result:Outflow



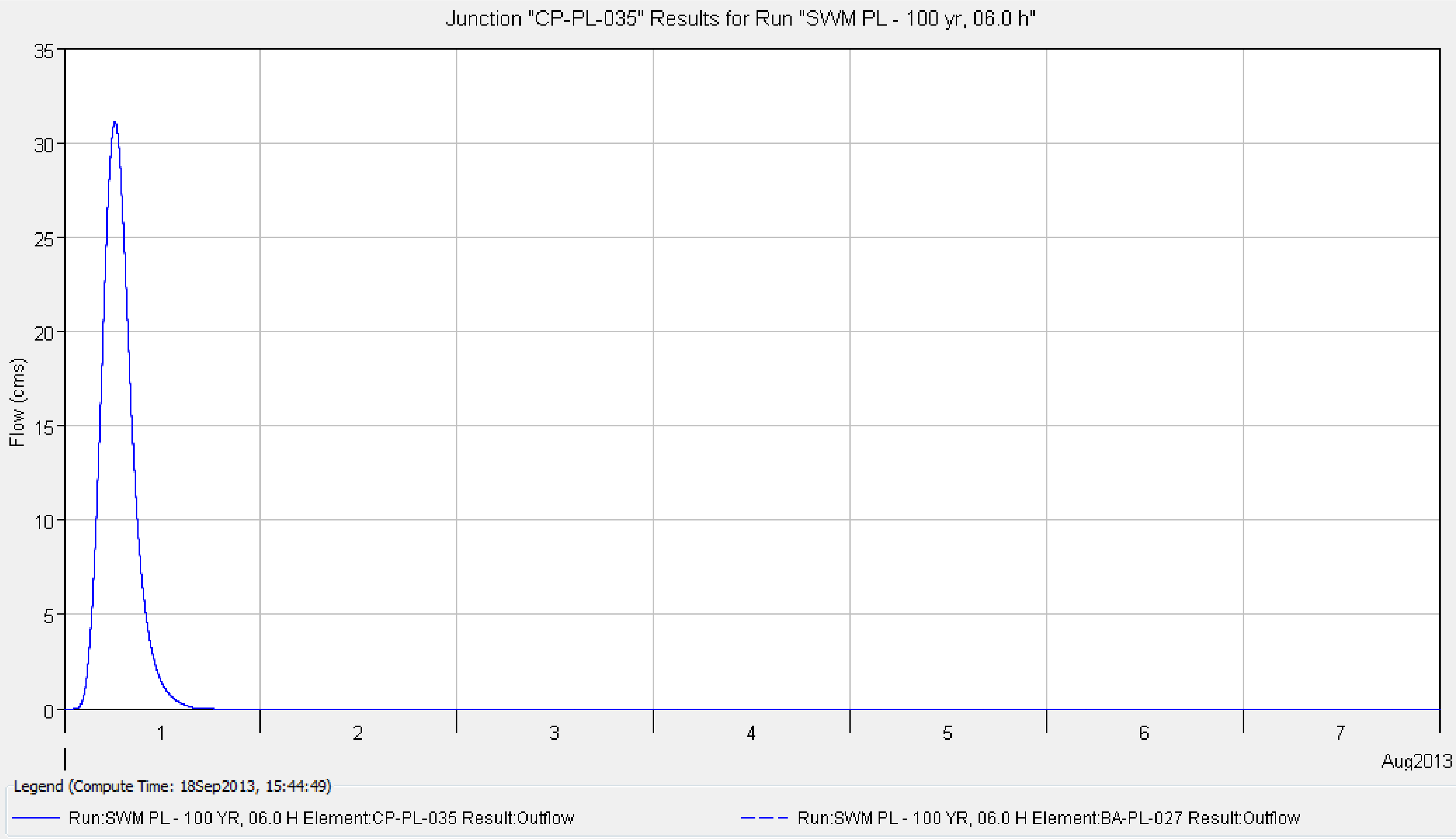
Junction "CP-PL-031" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-031 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-025 Result:Outflow


Junction "CP-PL-032" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-032 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-025 Result:Outflow

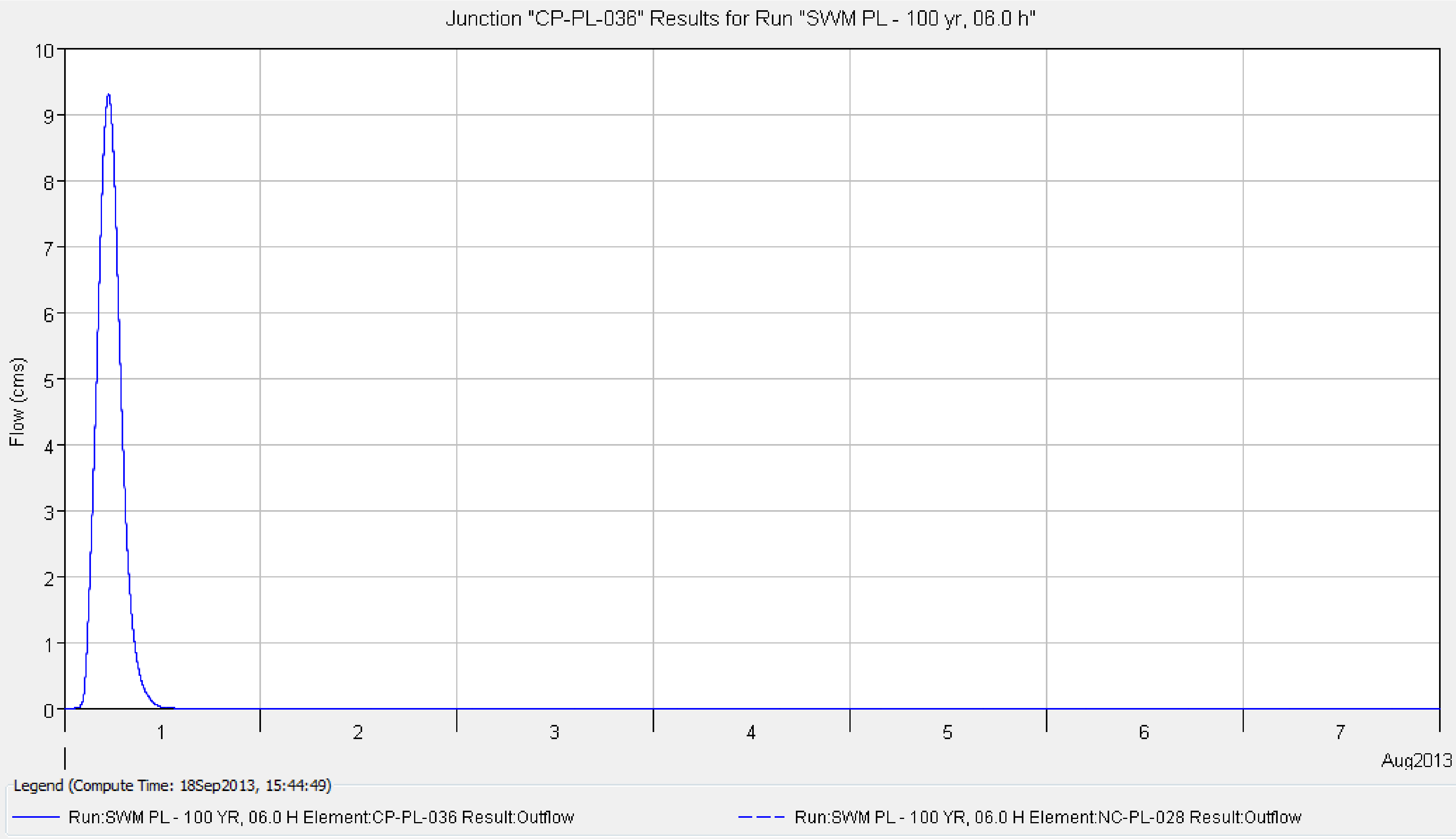

Junction "CP-PL-033" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-033 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-026 Result:Outflow

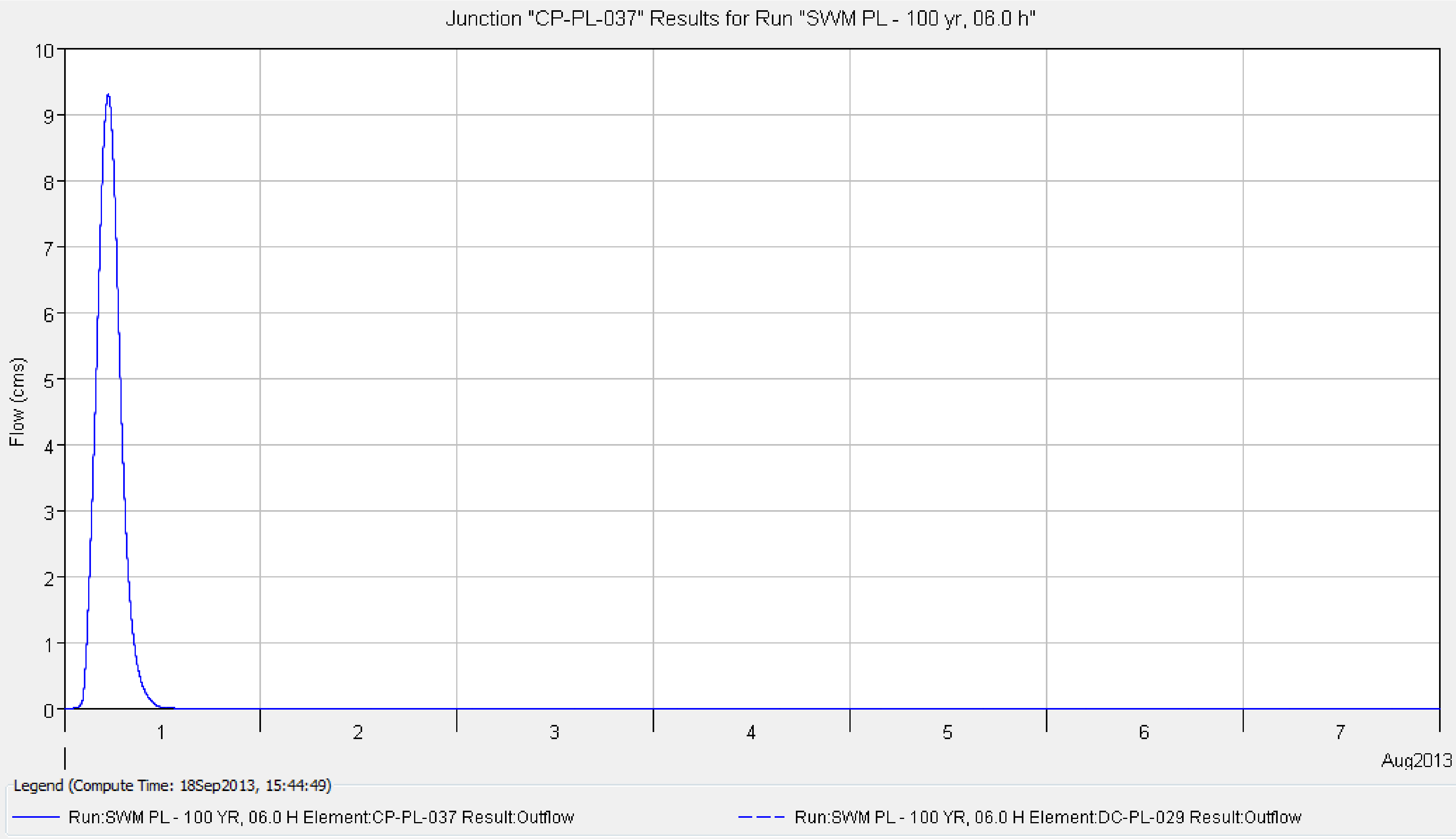


Junction "CP-PL-034" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Outflow

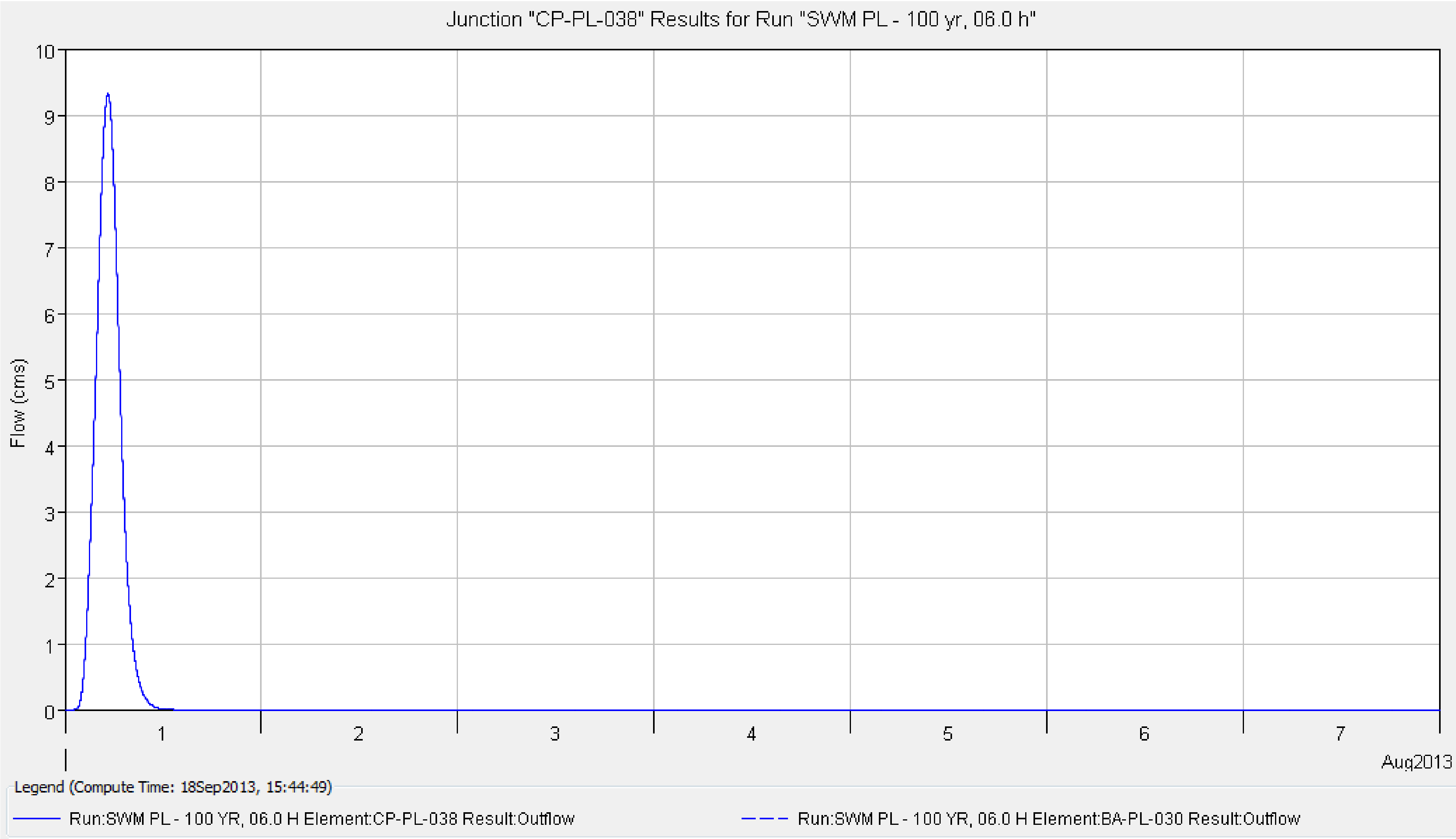


Junction "CP-PL-035" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-035 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-027 Result:Outflow

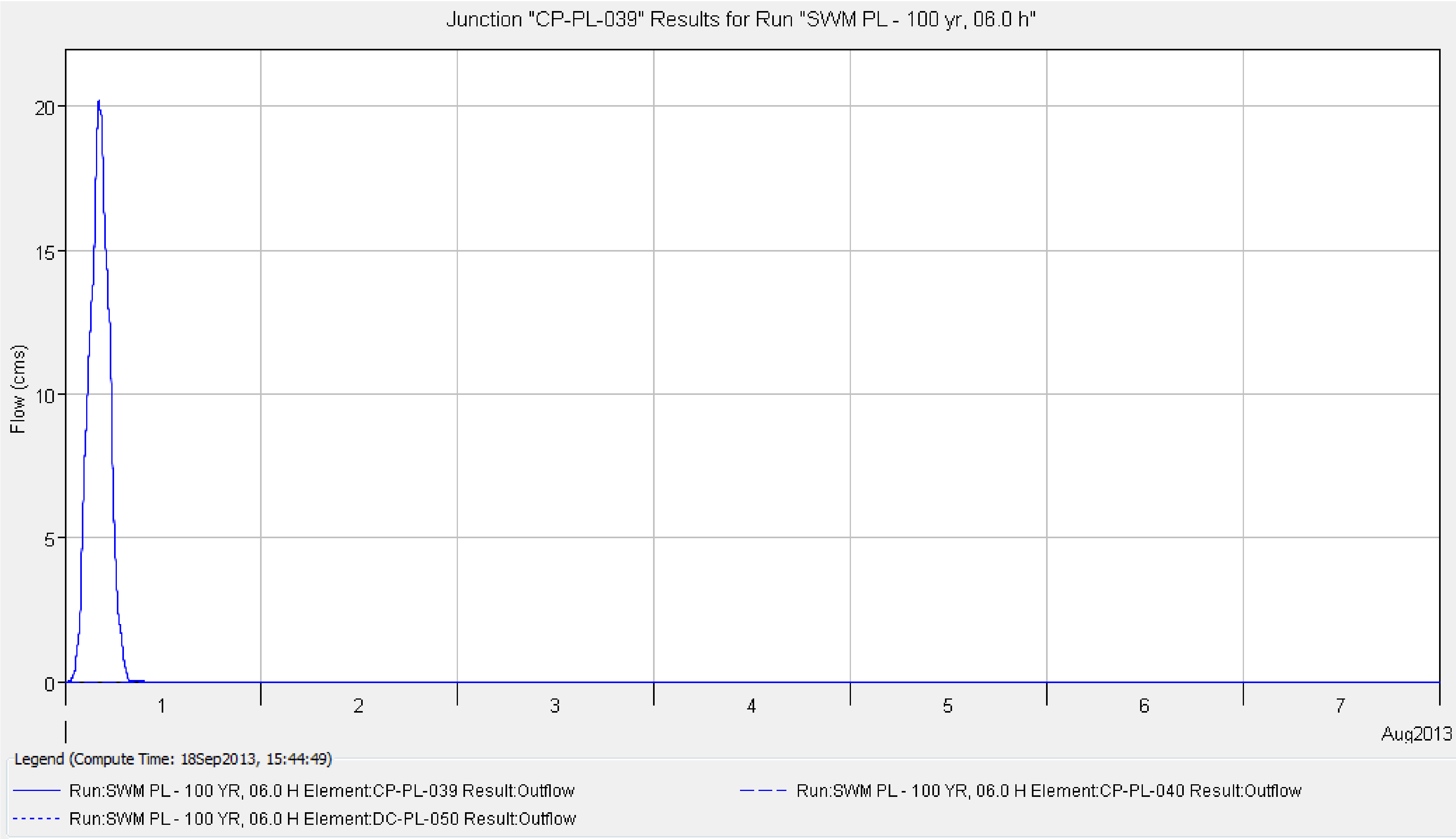

Junction "CP-PL-036" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-028 Result:Outflow



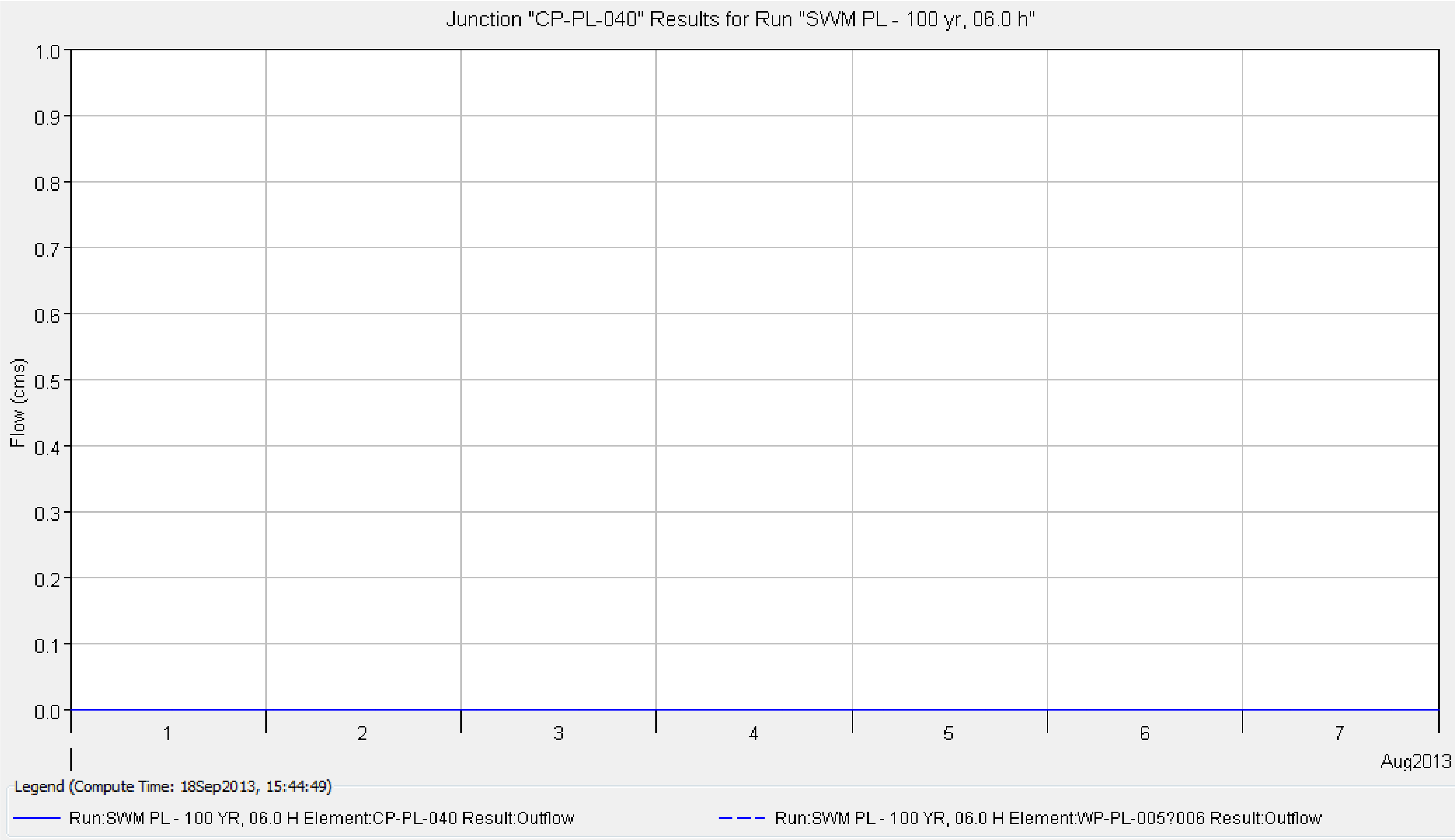
Junction "CP-PL-037" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-029 Result:Outflow

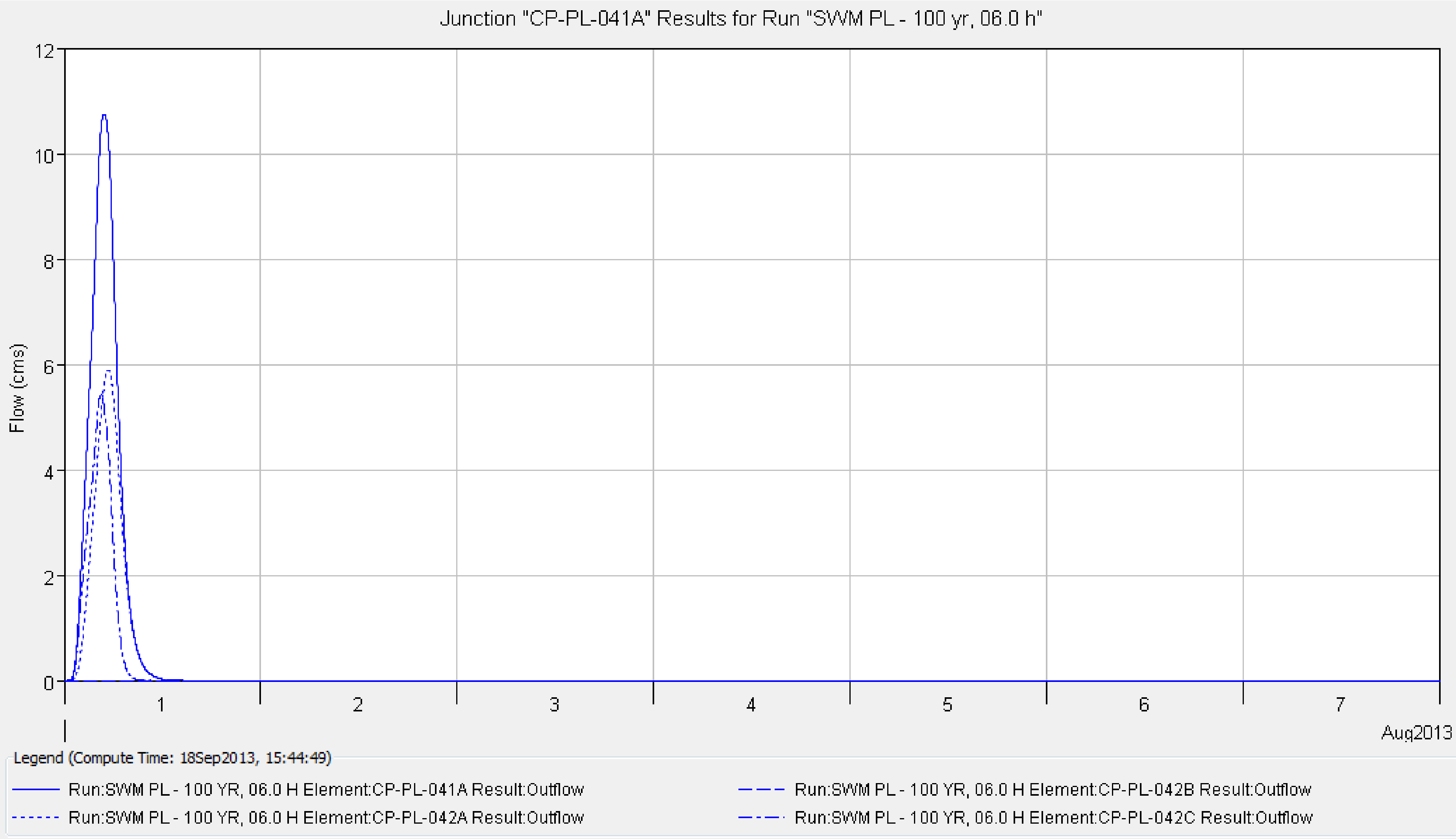


Junction "CP-PL-038" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-038 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-030 Result:Outflow

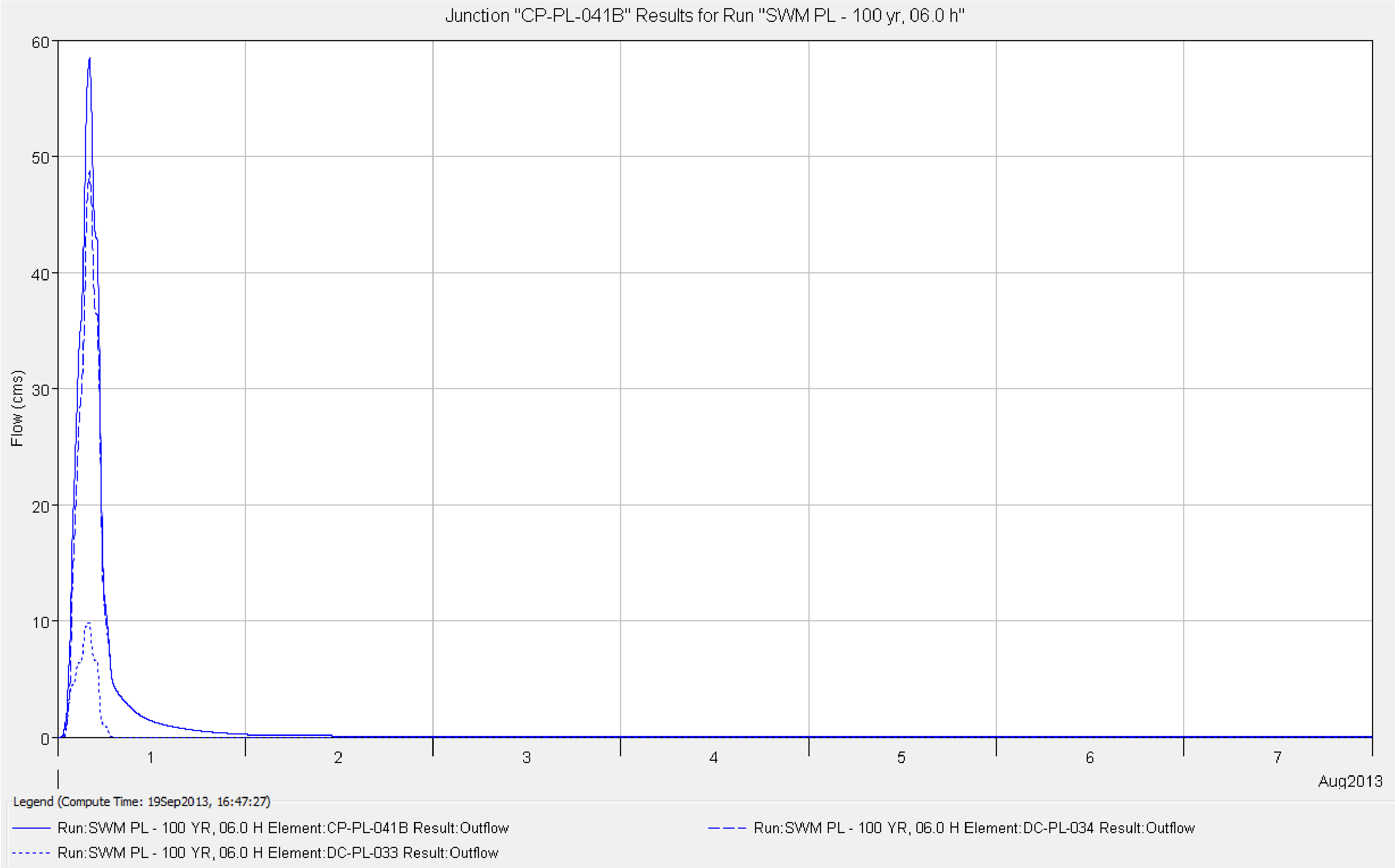


Junction "CP-PL-039" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-050 Result:Outflow


Junction "CP-PL-040" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Outflow

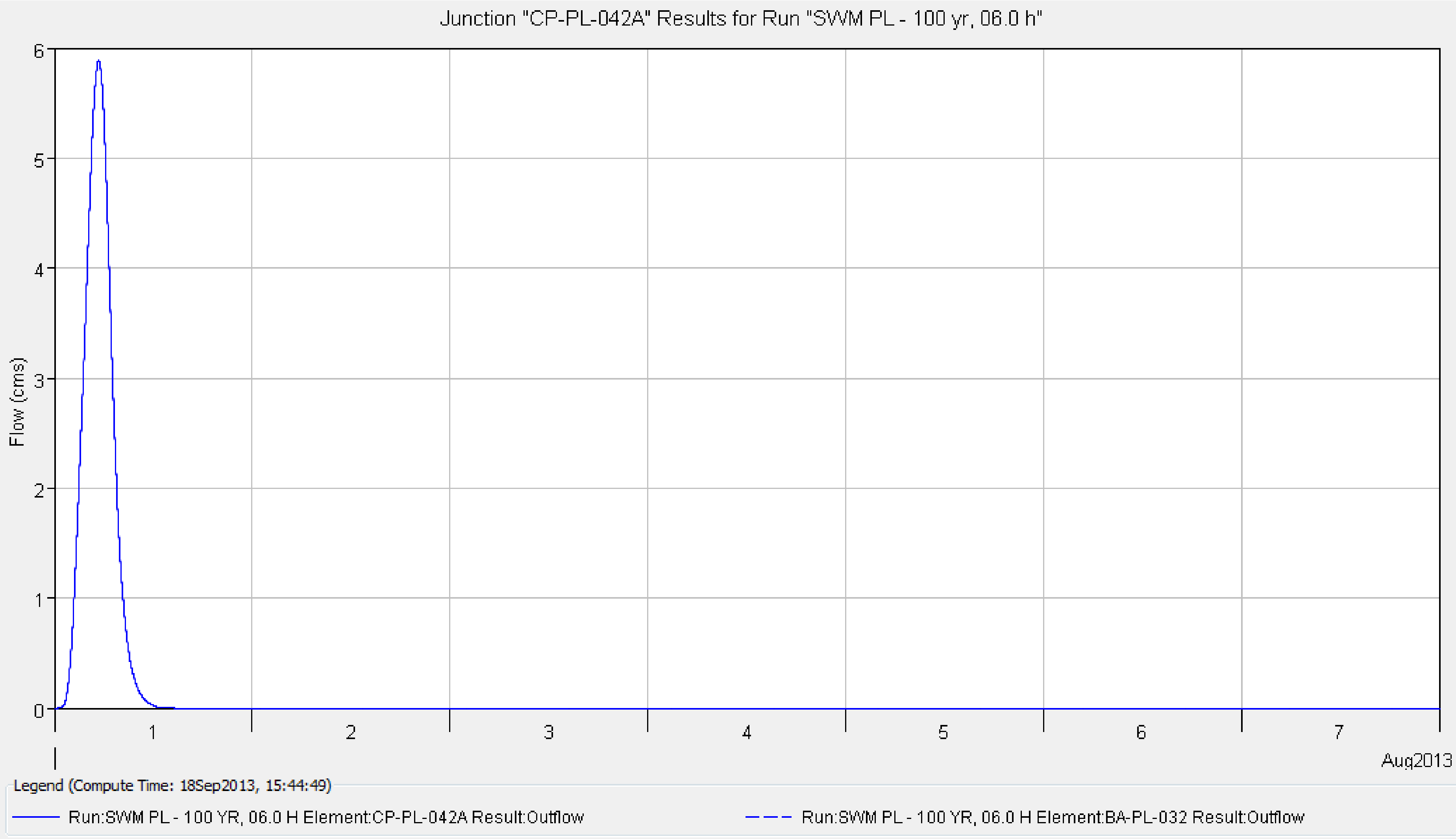


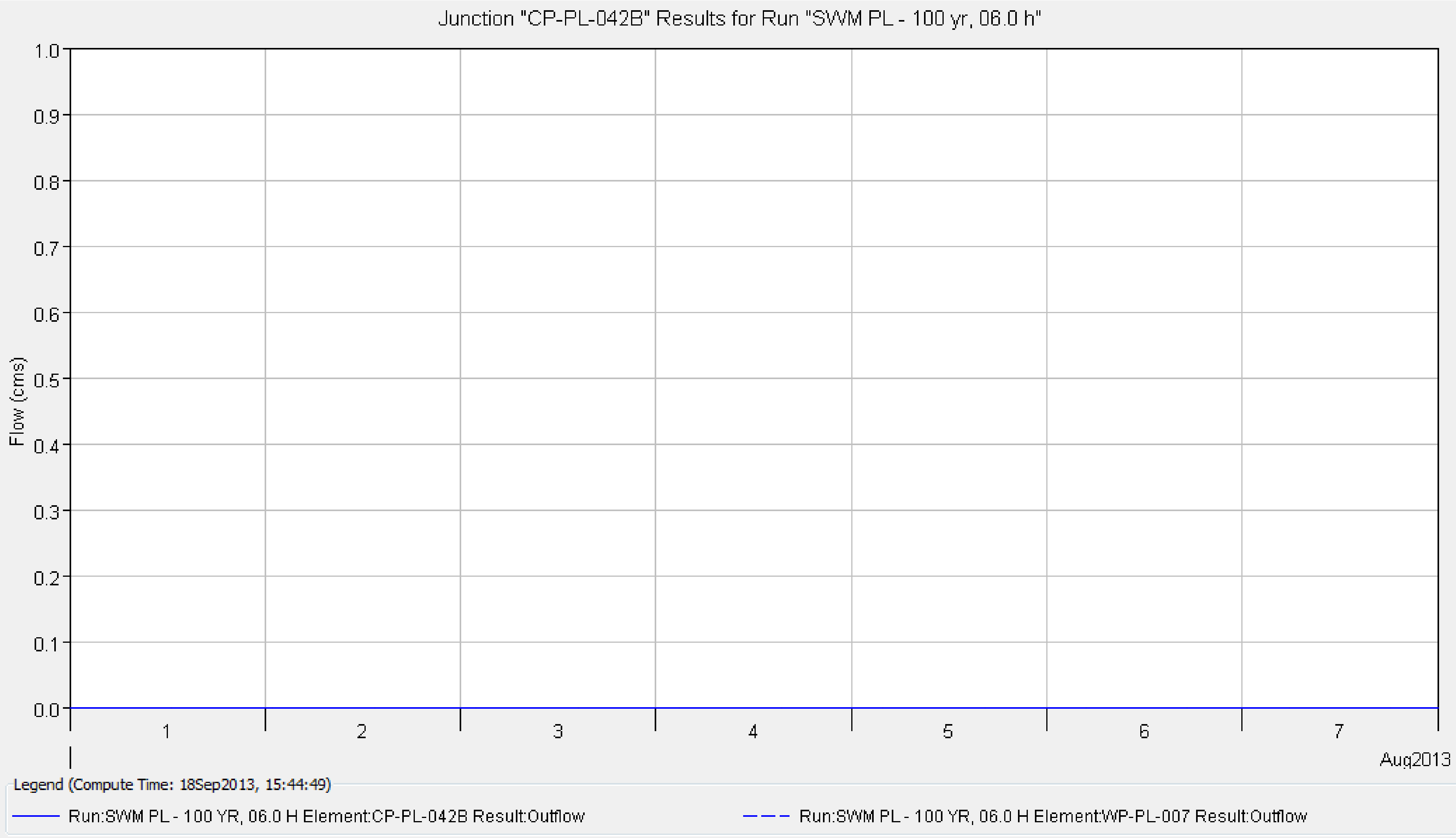
Junction "CP-PL-041A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042C Result:Outflow

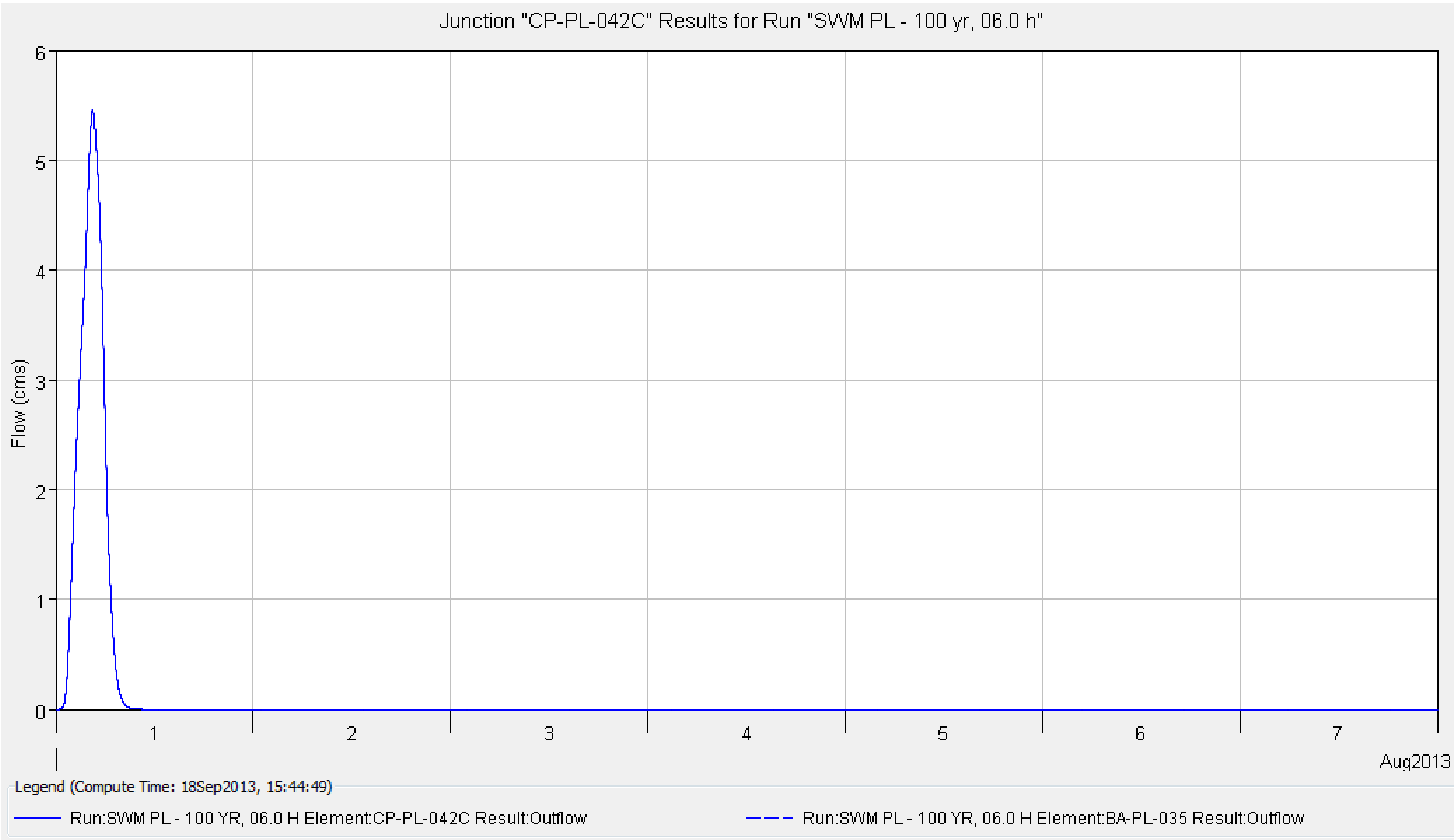


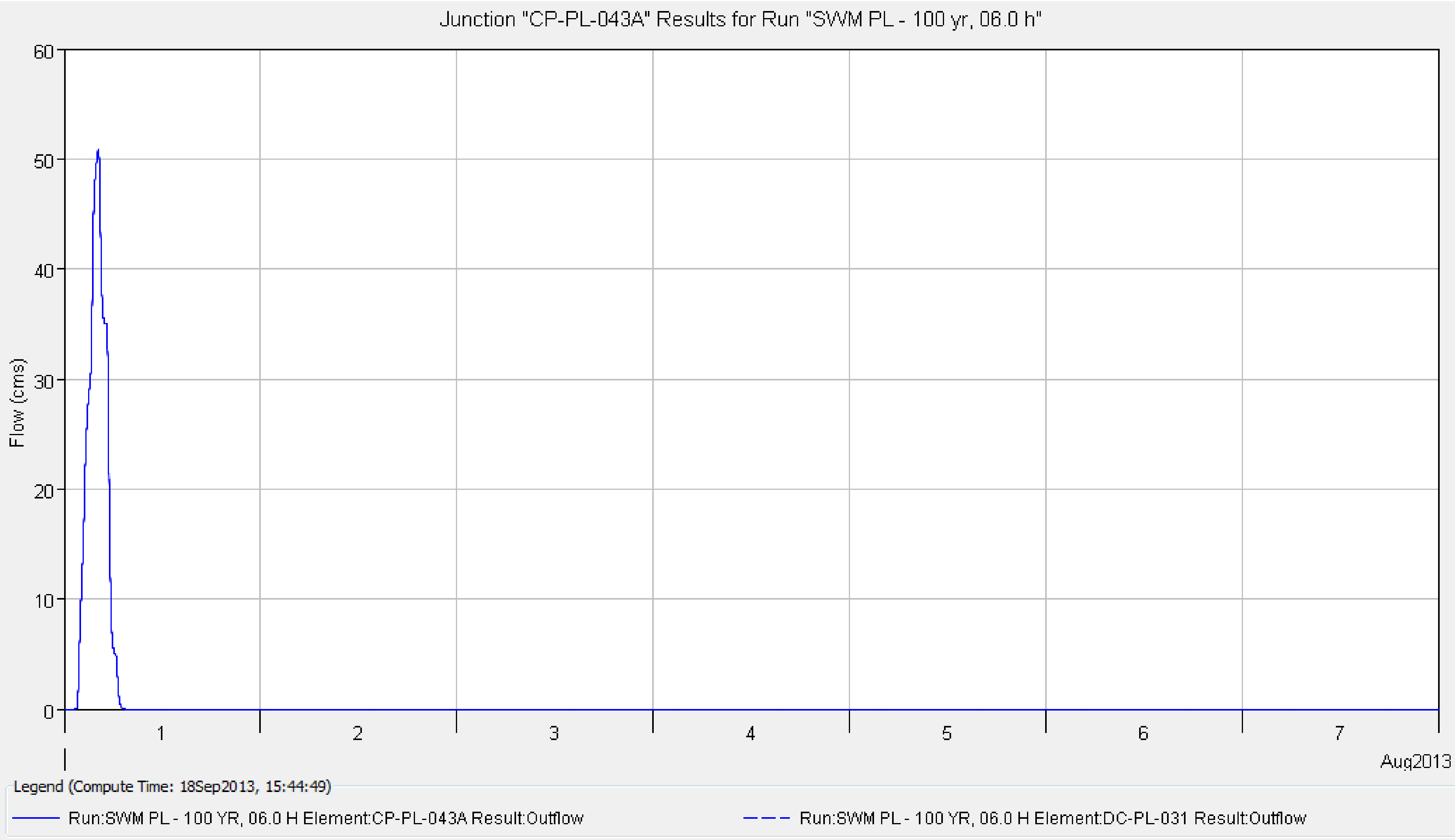
Junction "CP-PL-041B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-033 Result:Outflow

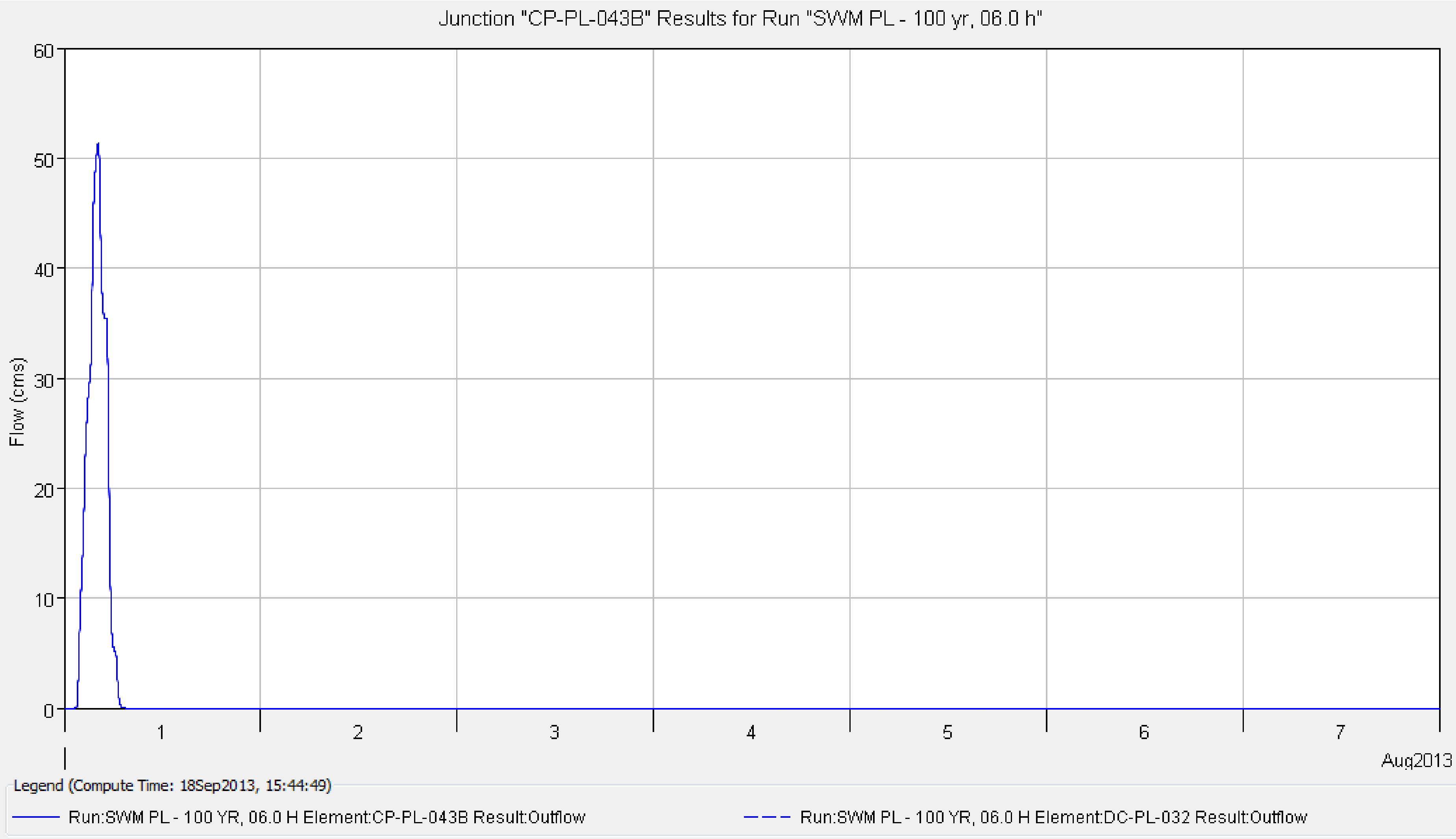

Junction "CP-PL-041C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-041C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-061 Result:Outflow


Junction "CP-PL-042A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-032 Result:Outflow

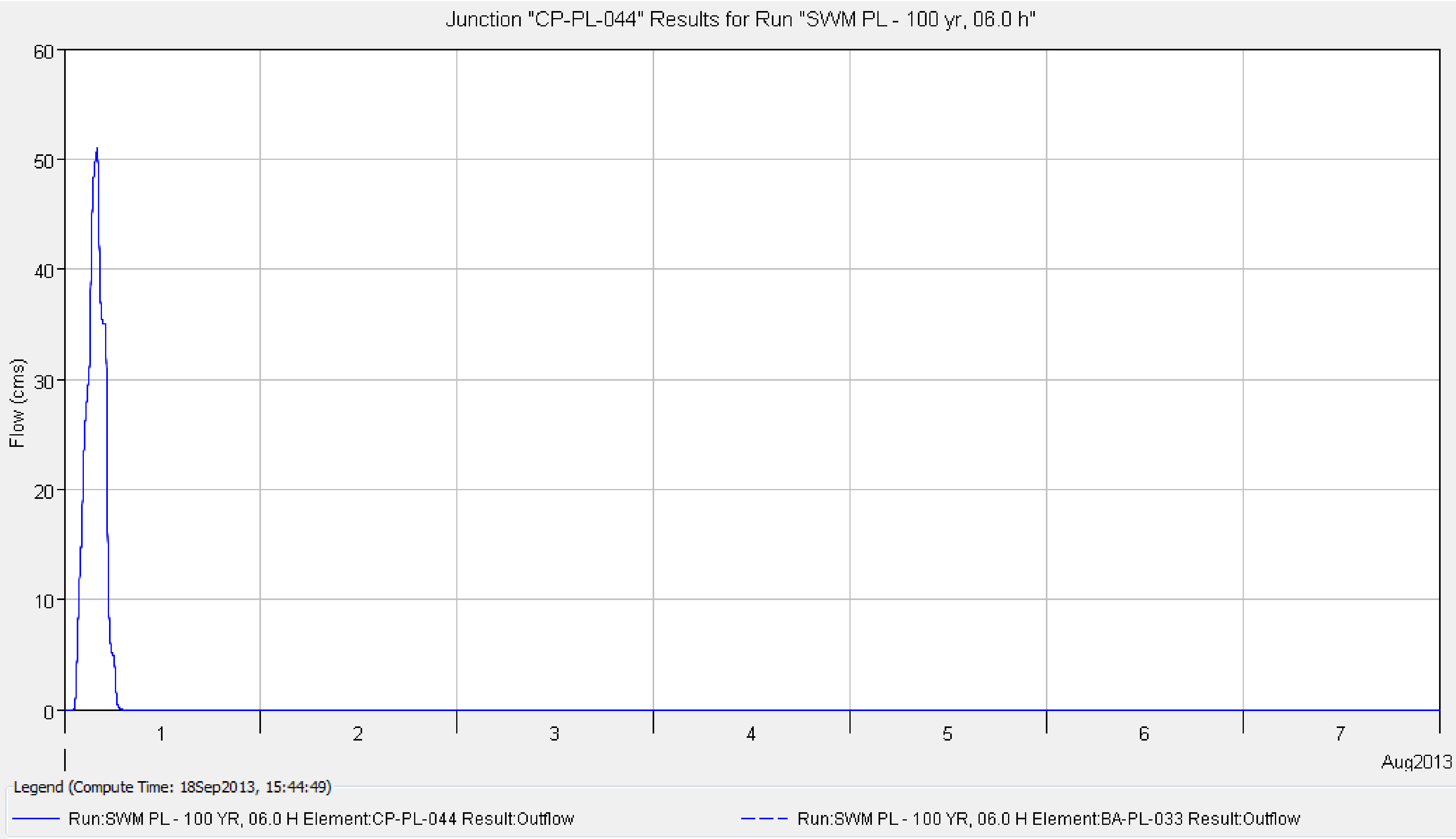

Junction "CP-PL-042B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Outflow

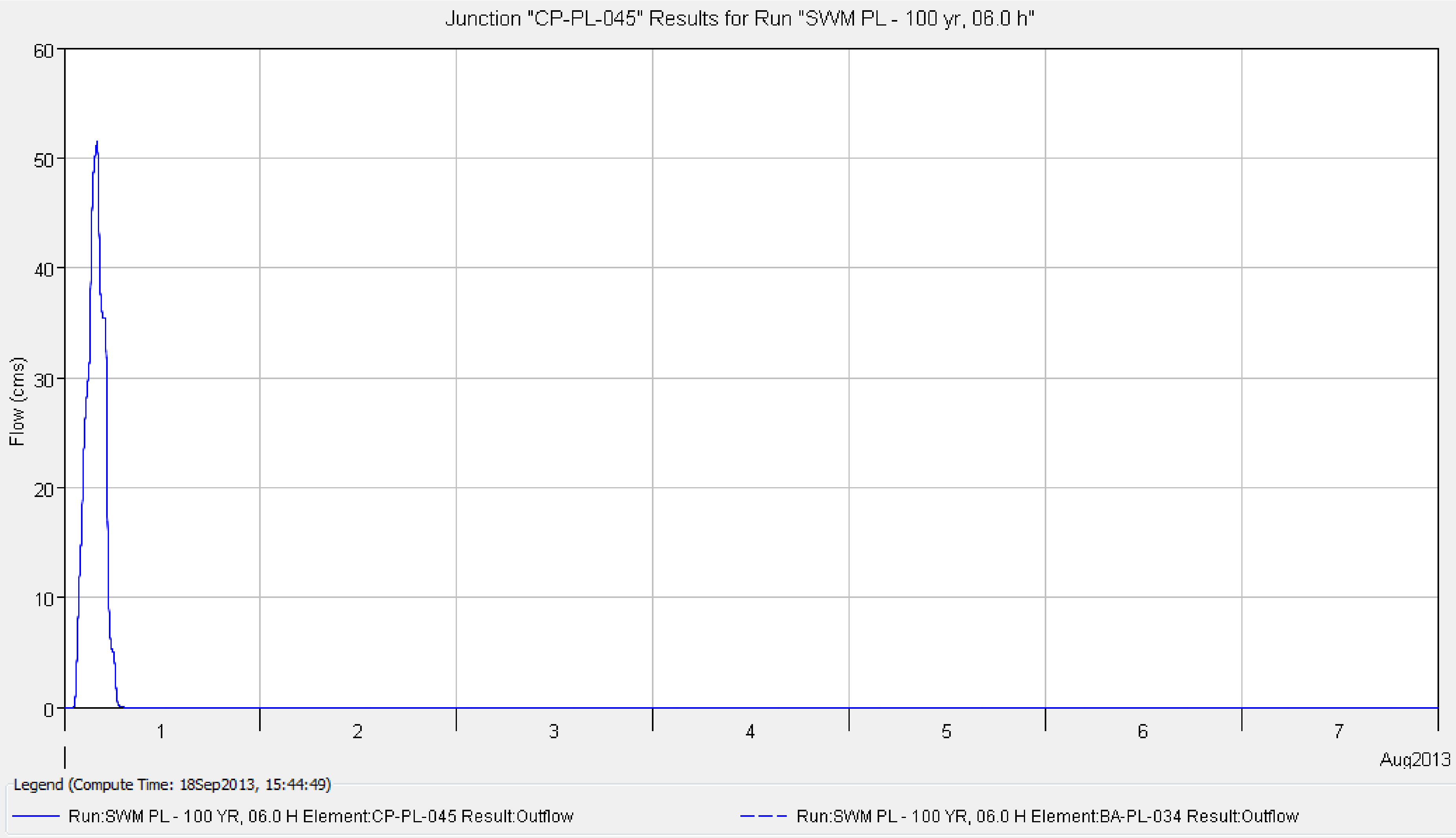

Junction "CP-PL-042C" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-042C Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-035 Result:Outflow

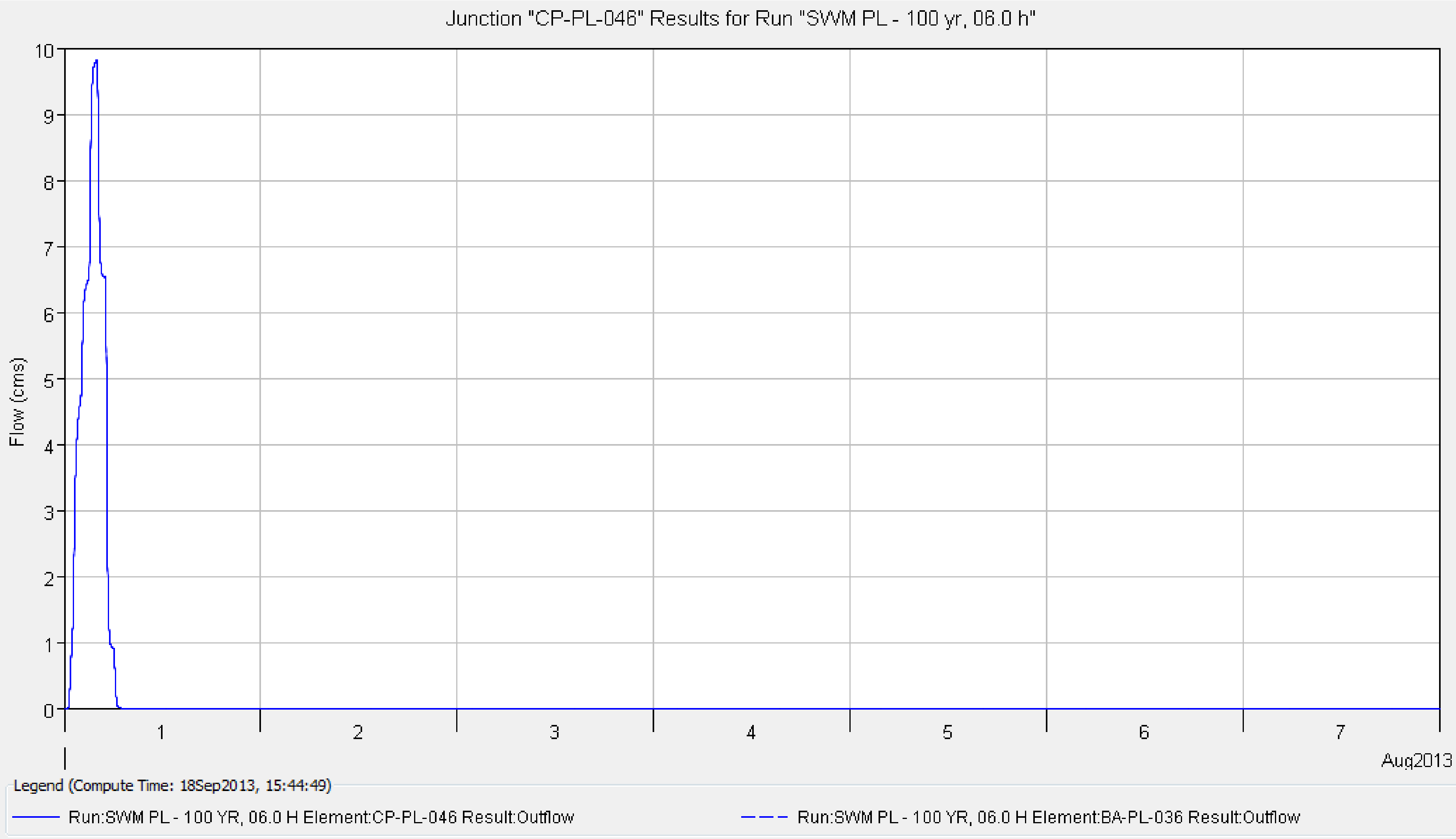

Junction "CP-PL-043A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-043A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-031 Result:Outflow

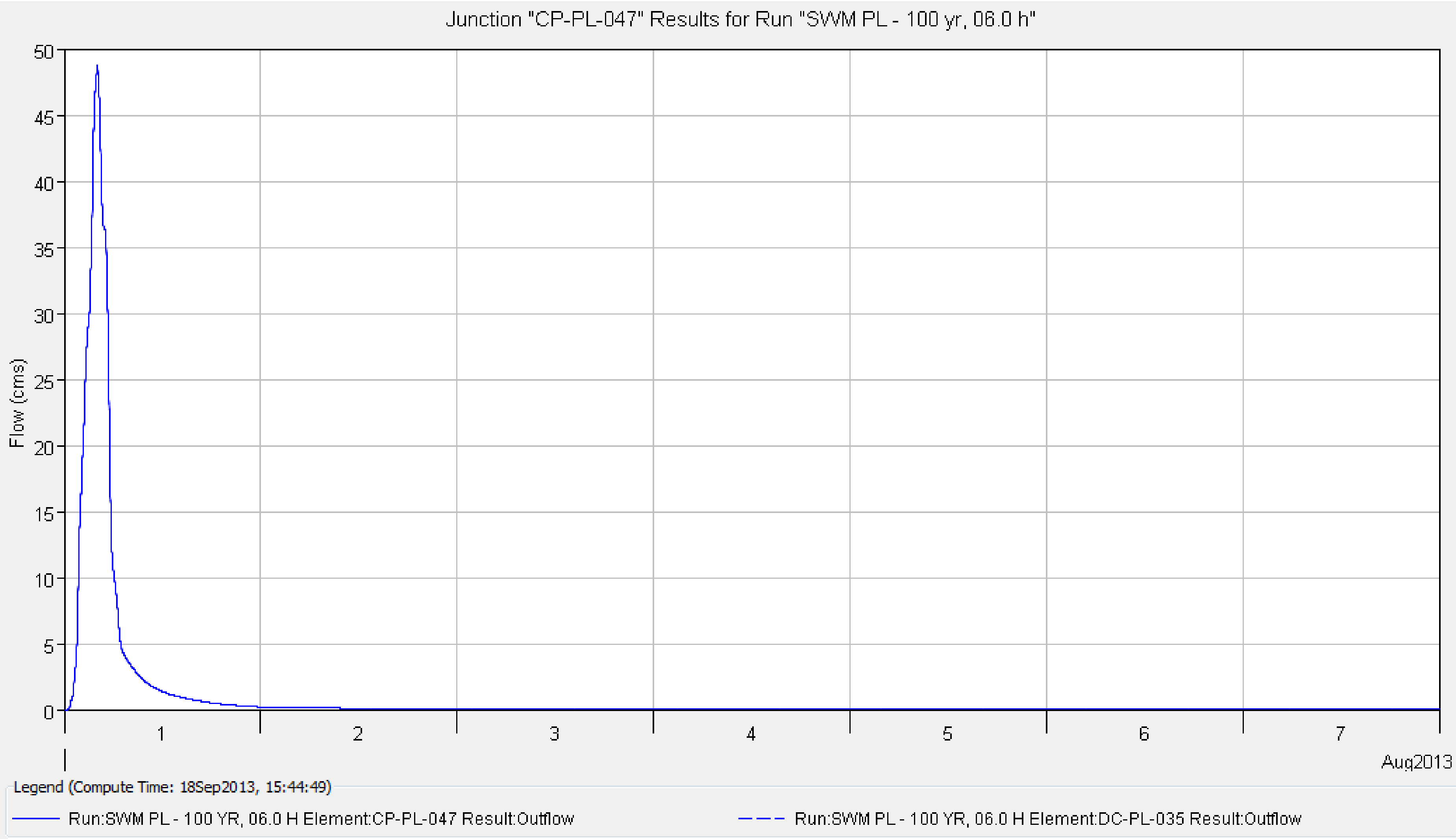


Junction "CP-PL-043B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-043B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-032 Result:Outflow

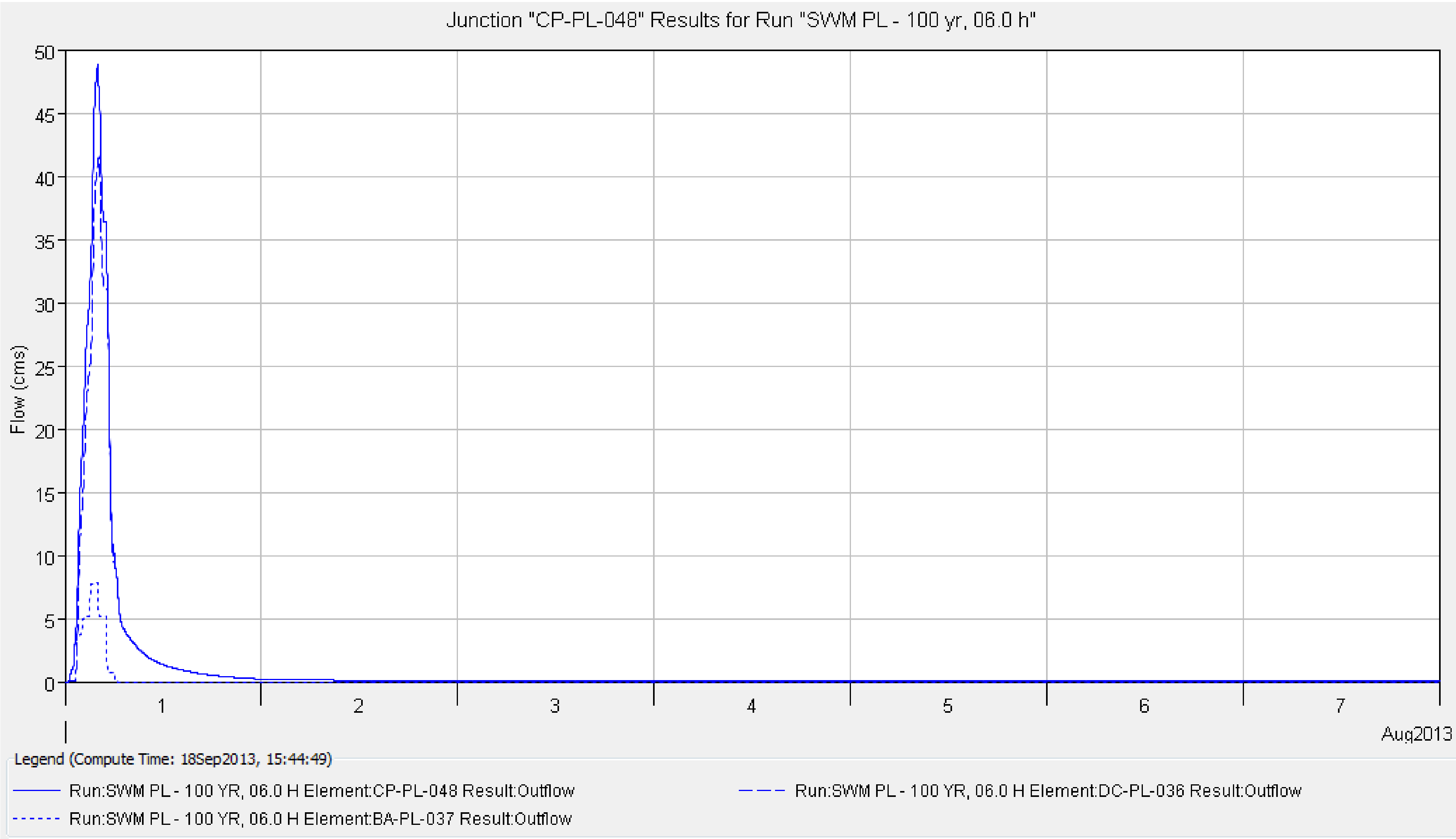

Junction "CP-PL-044" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-033 Result:Outflow

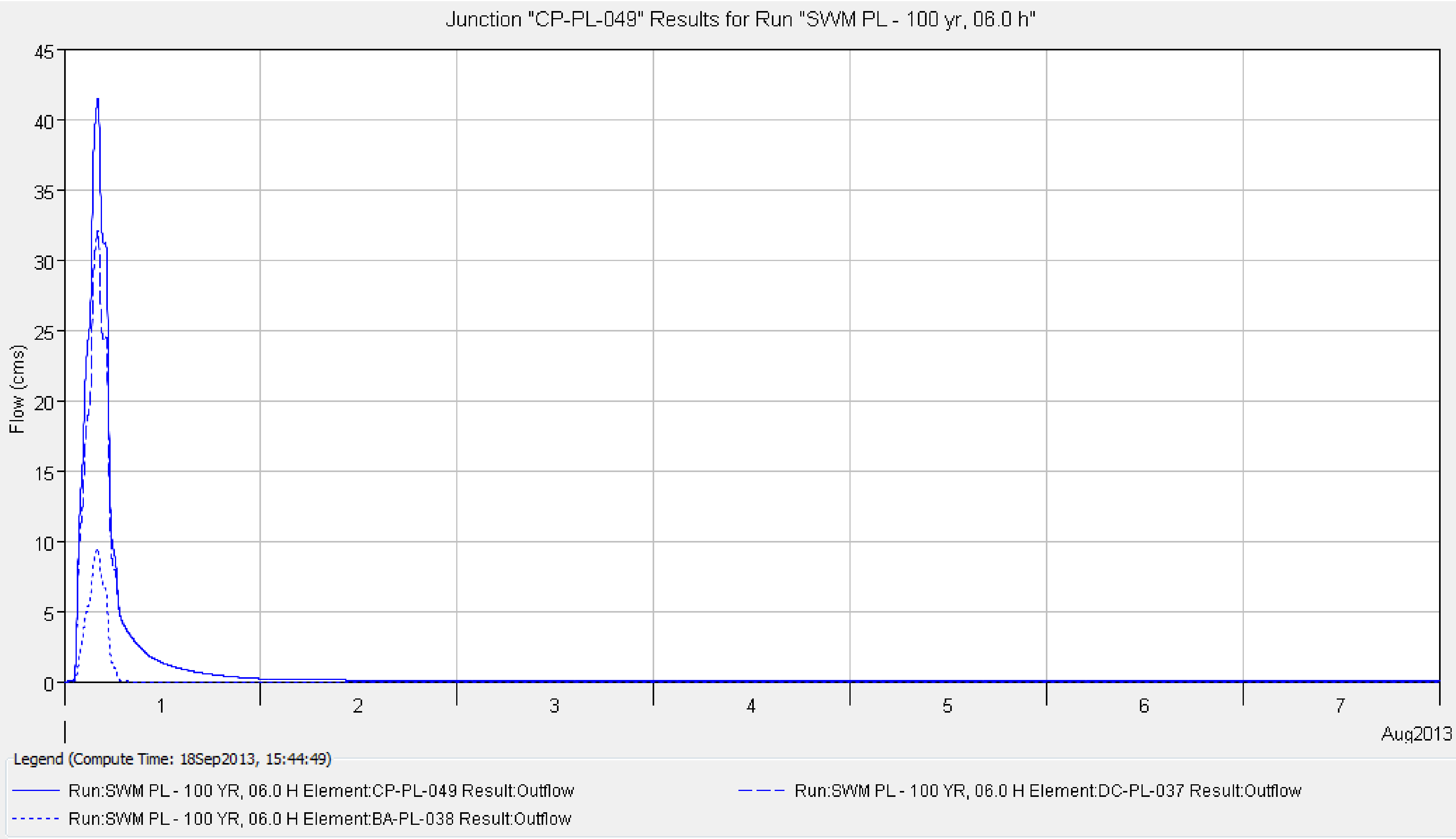

Junction "CP-PL-045" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-034 Result:Outflow

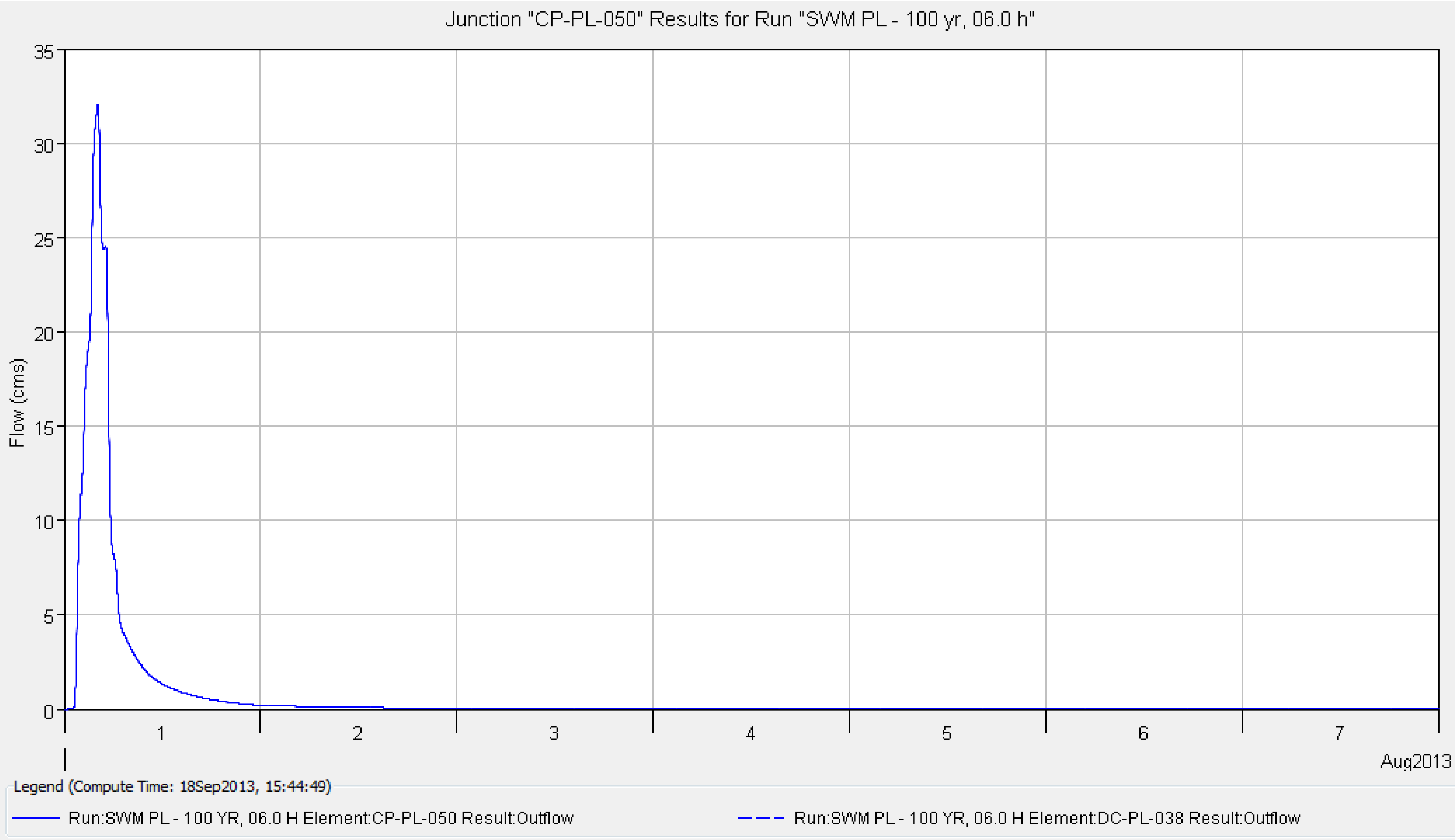

Junction "CP-PL-046" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-036 Result:Outflow

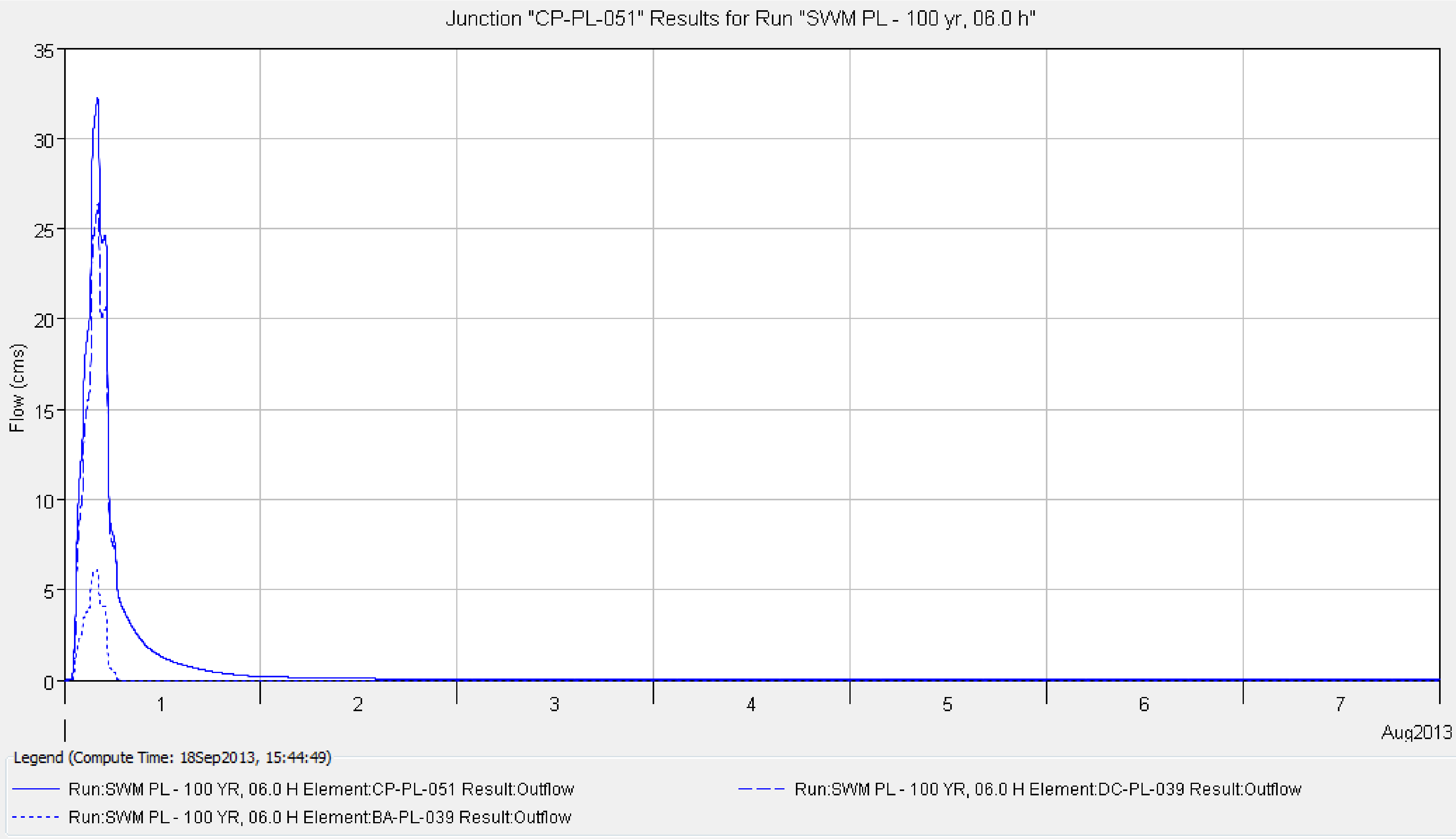


Junction "CP-PL-047" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-035 Result:Outflow

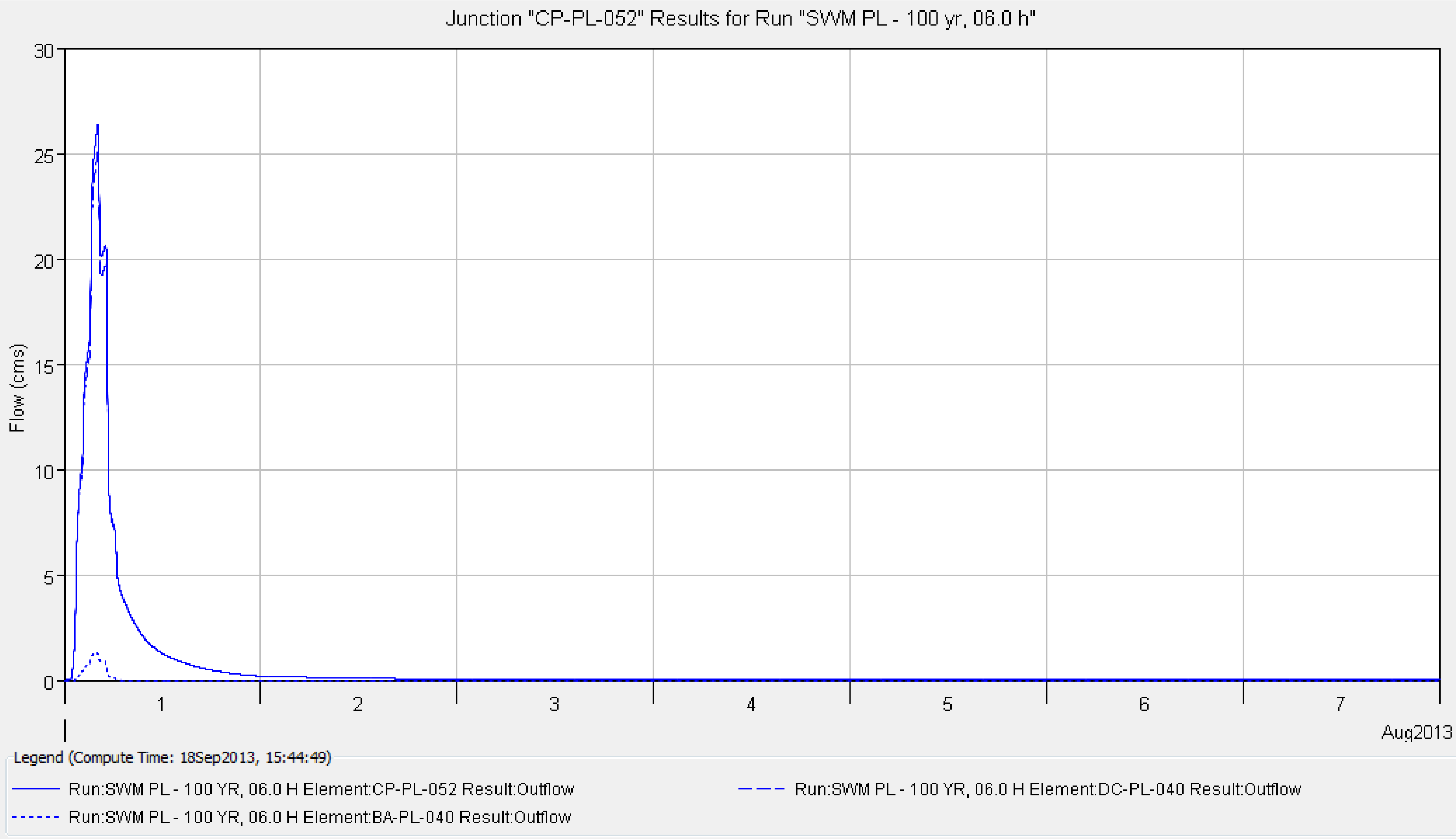

Junction "CP-PL-048" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-048 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-037 Result:Outflow


Junction "CP-PL-049" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-038 Result:Outflow

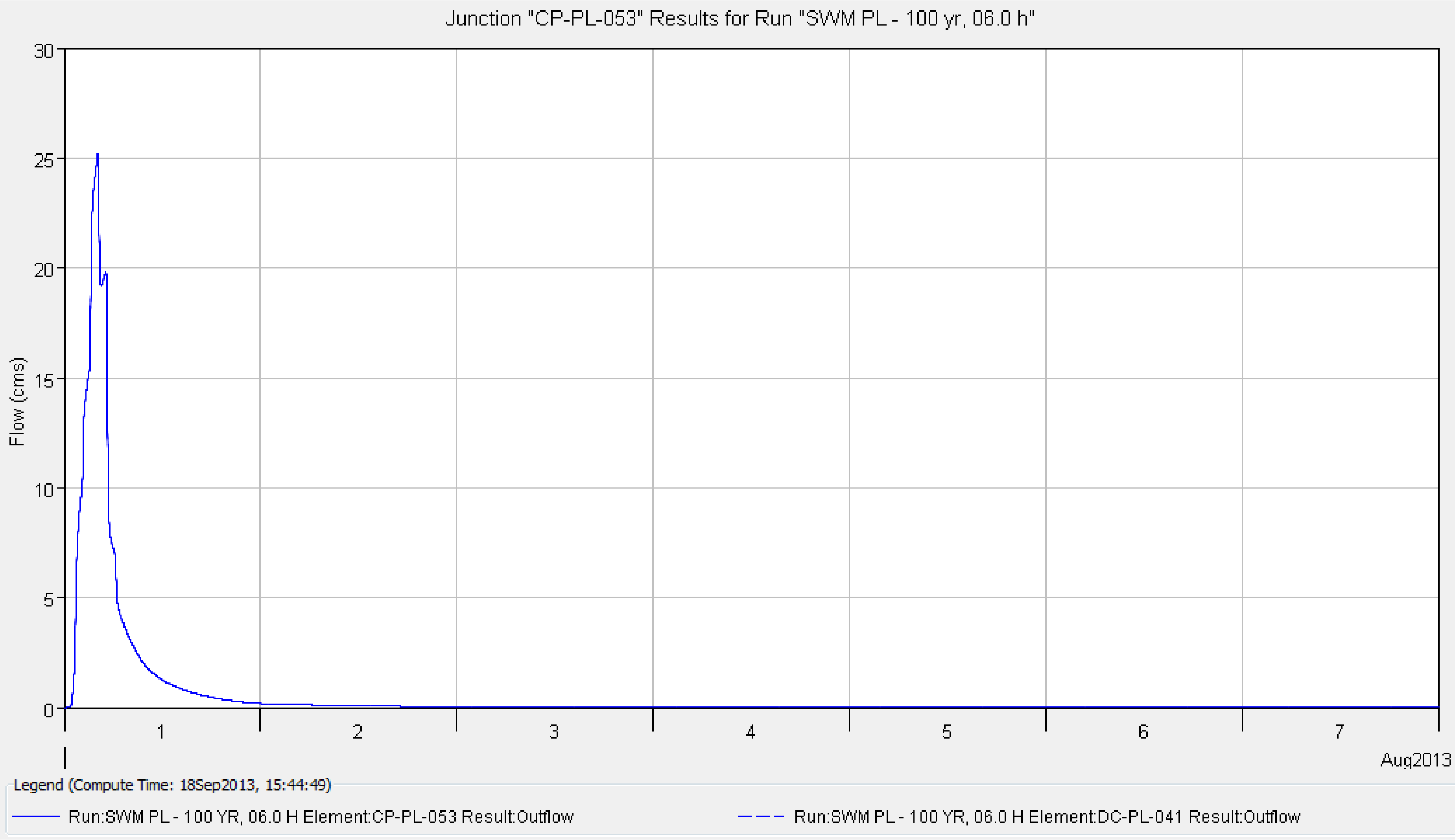

Junction "CP-PL-050" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-050 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-038 Result:Outflow



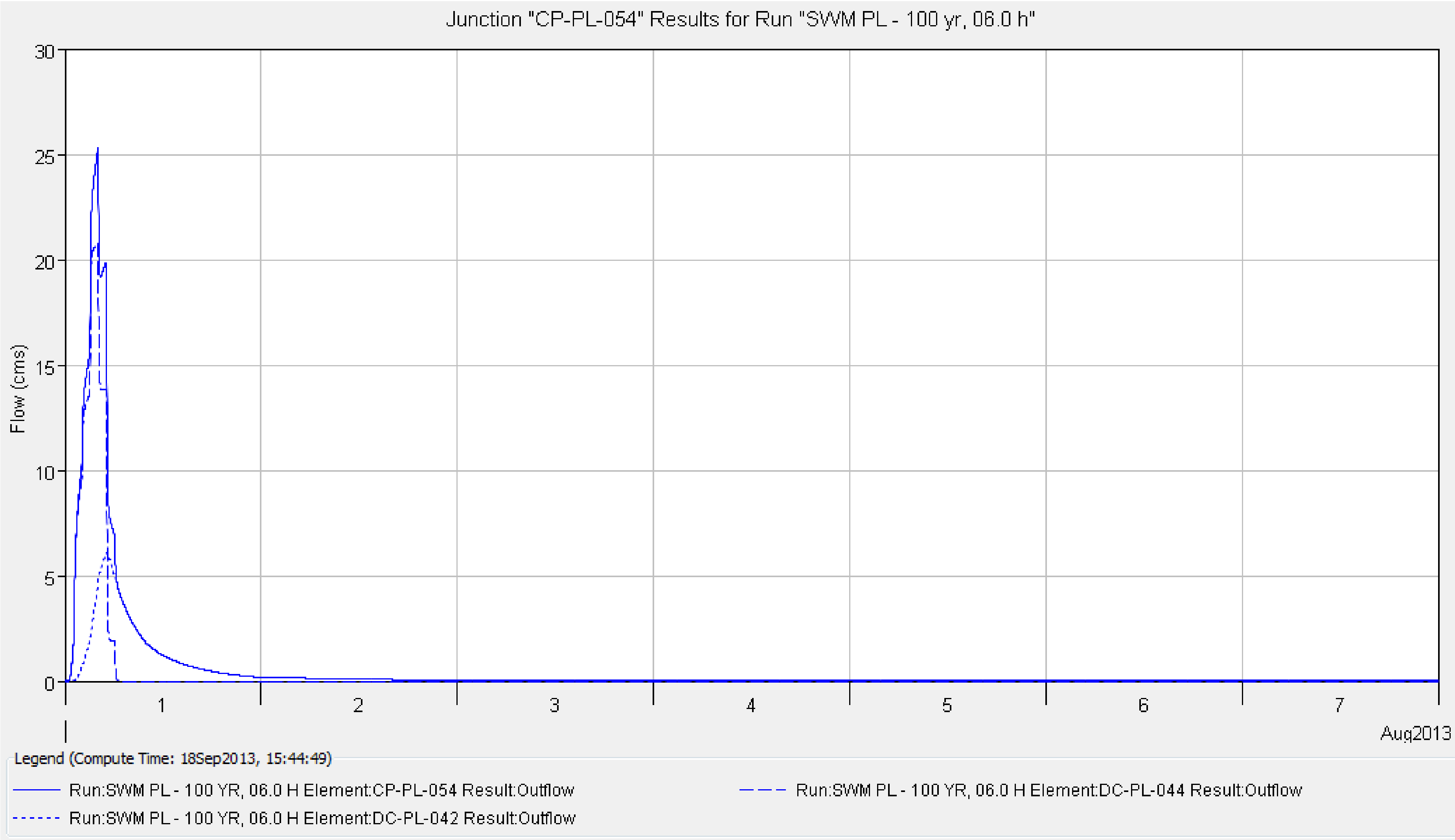
Junction "CP-PL-051" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-051 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-039 Result:Outflow

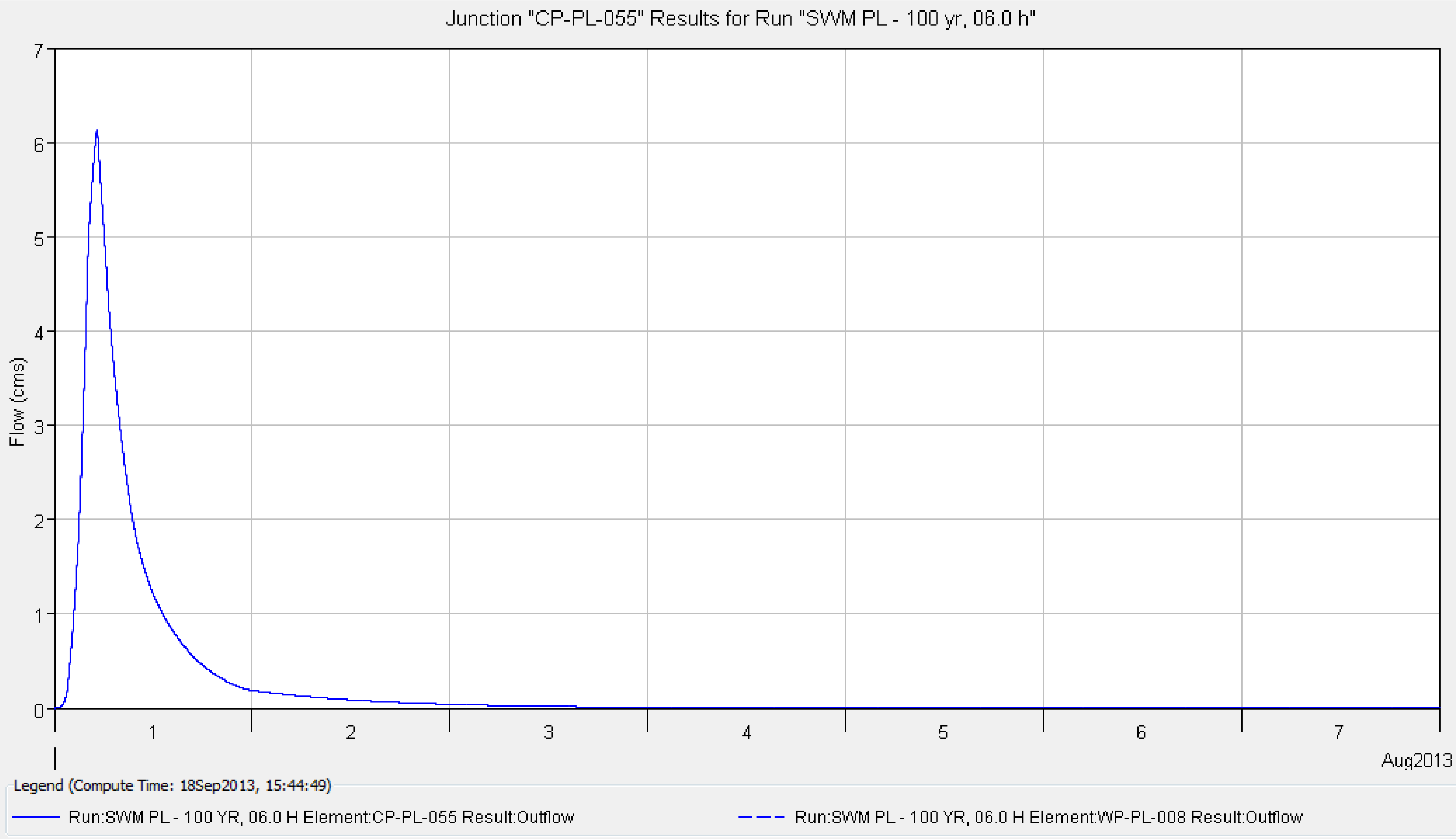


Junction "CP-PL-052" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-040 Result:Outflow

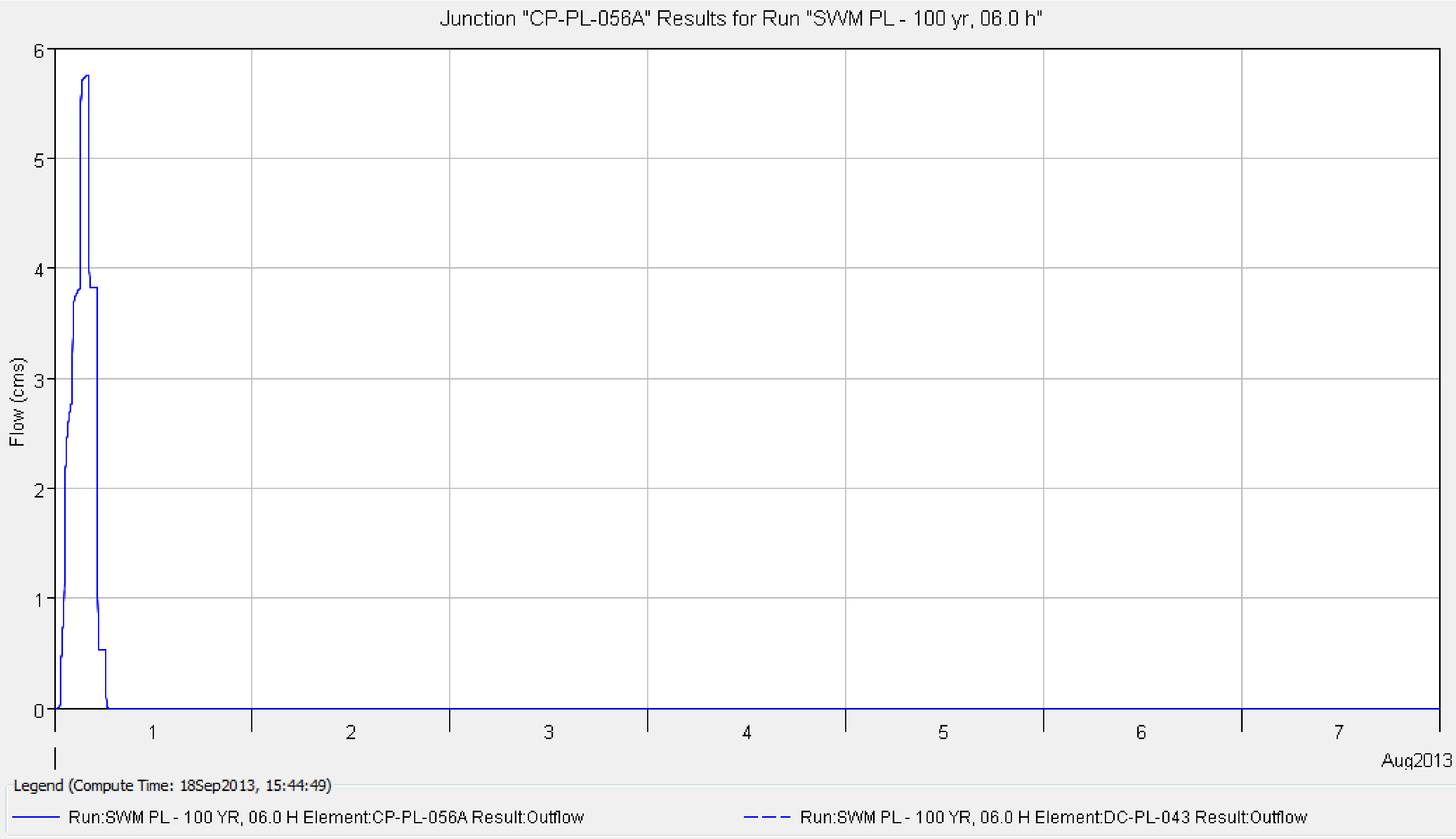


Junction "CP-PL-053" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-041 Result:Outflow

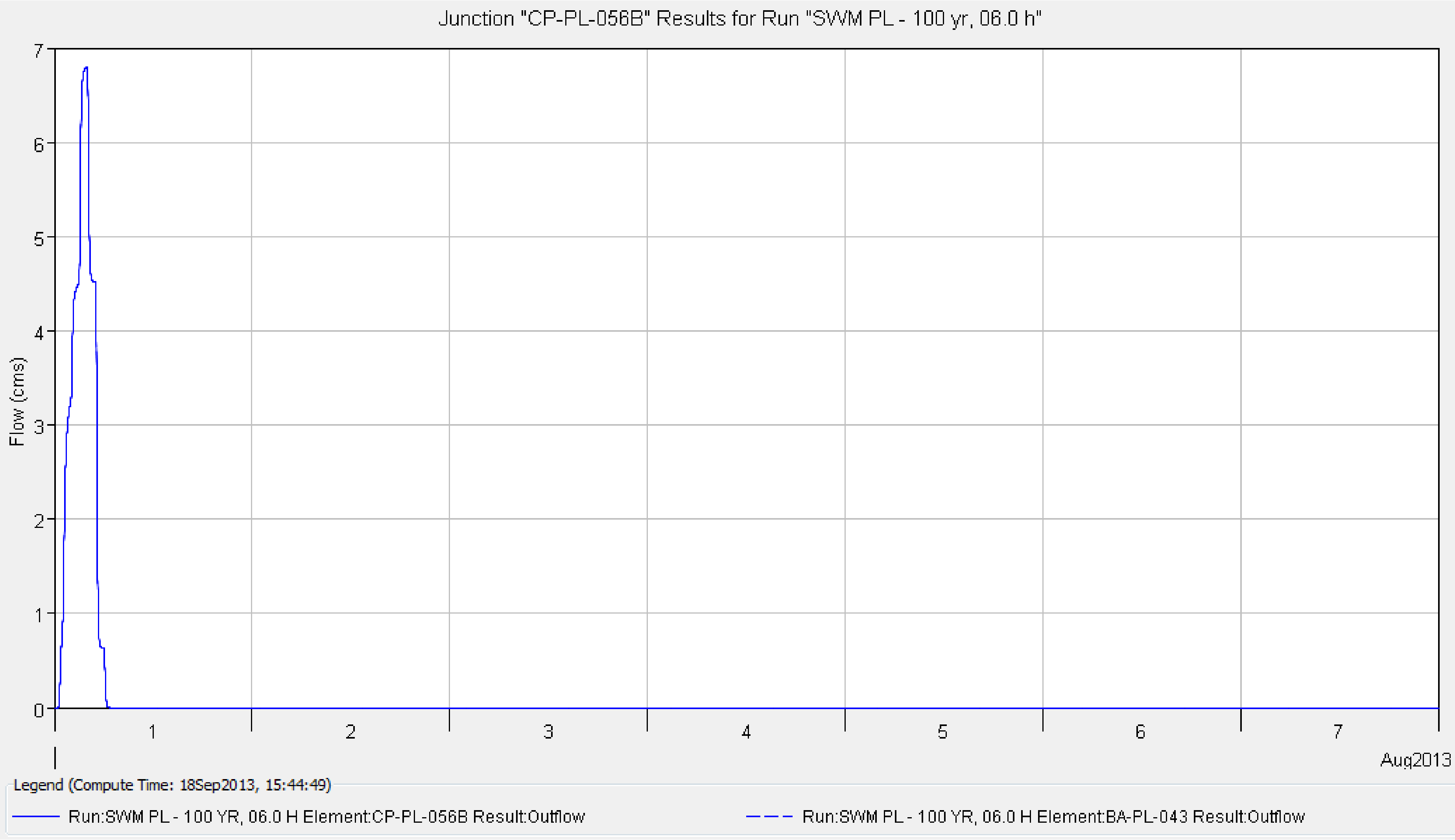

Junction "CP-PL-054" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-042 Result:Outflow



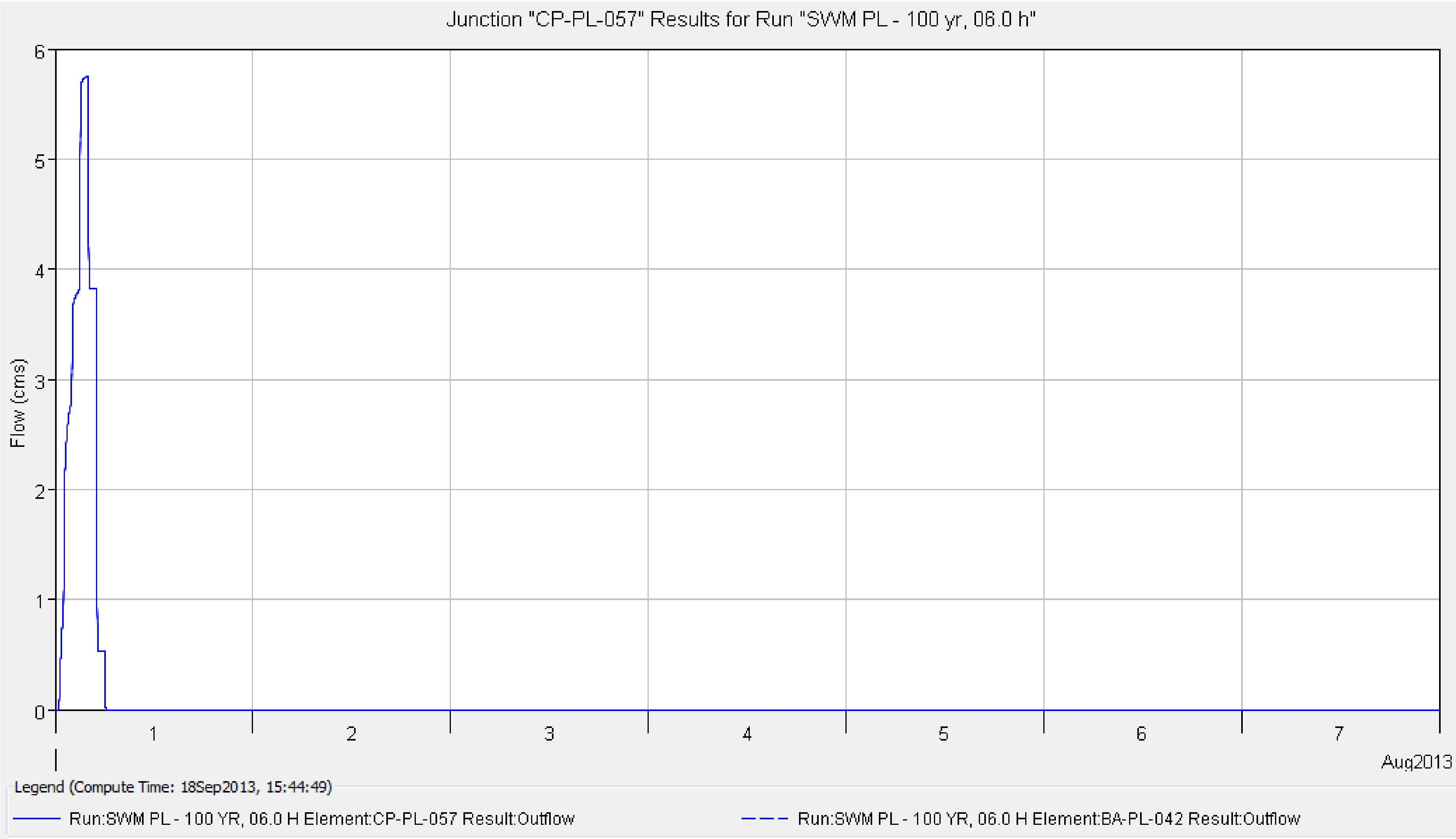
Junction "CP-PL-055" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Outflow

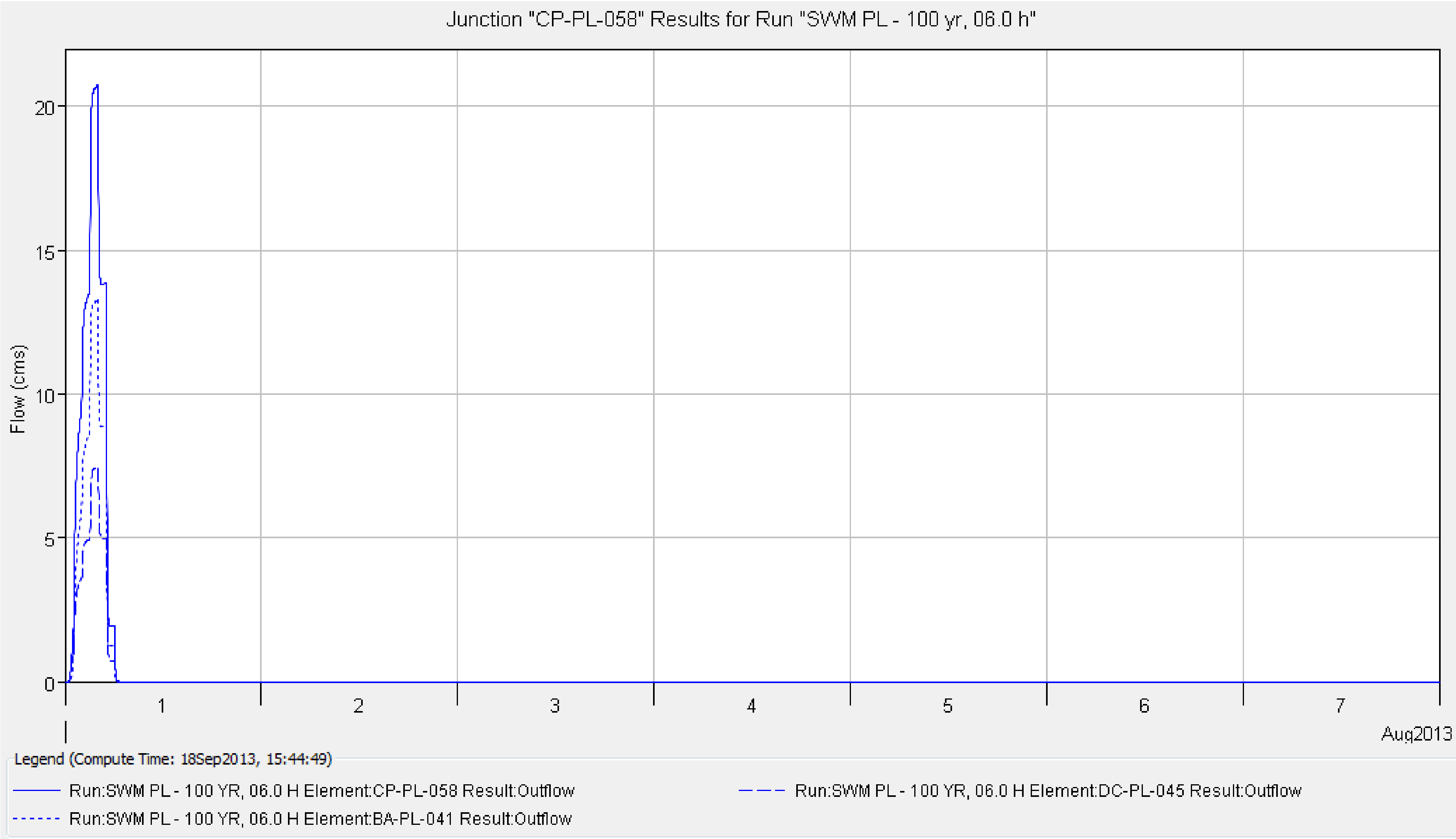


Junction "CP-PL-056A" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-056A Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-043 Result:Outflow

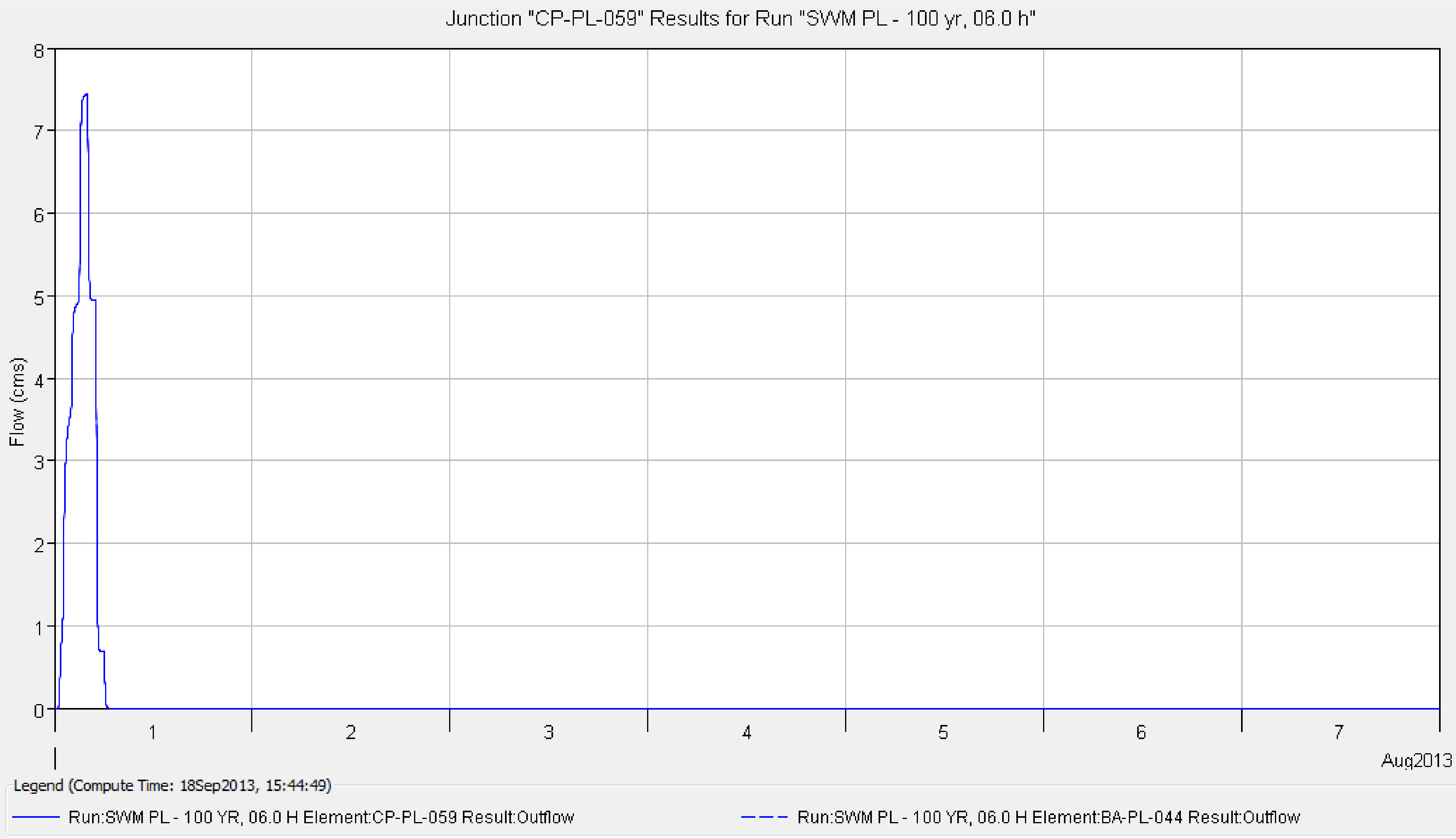


Junction "CP-PL-056B" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-056B Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-043 Result:Outflow

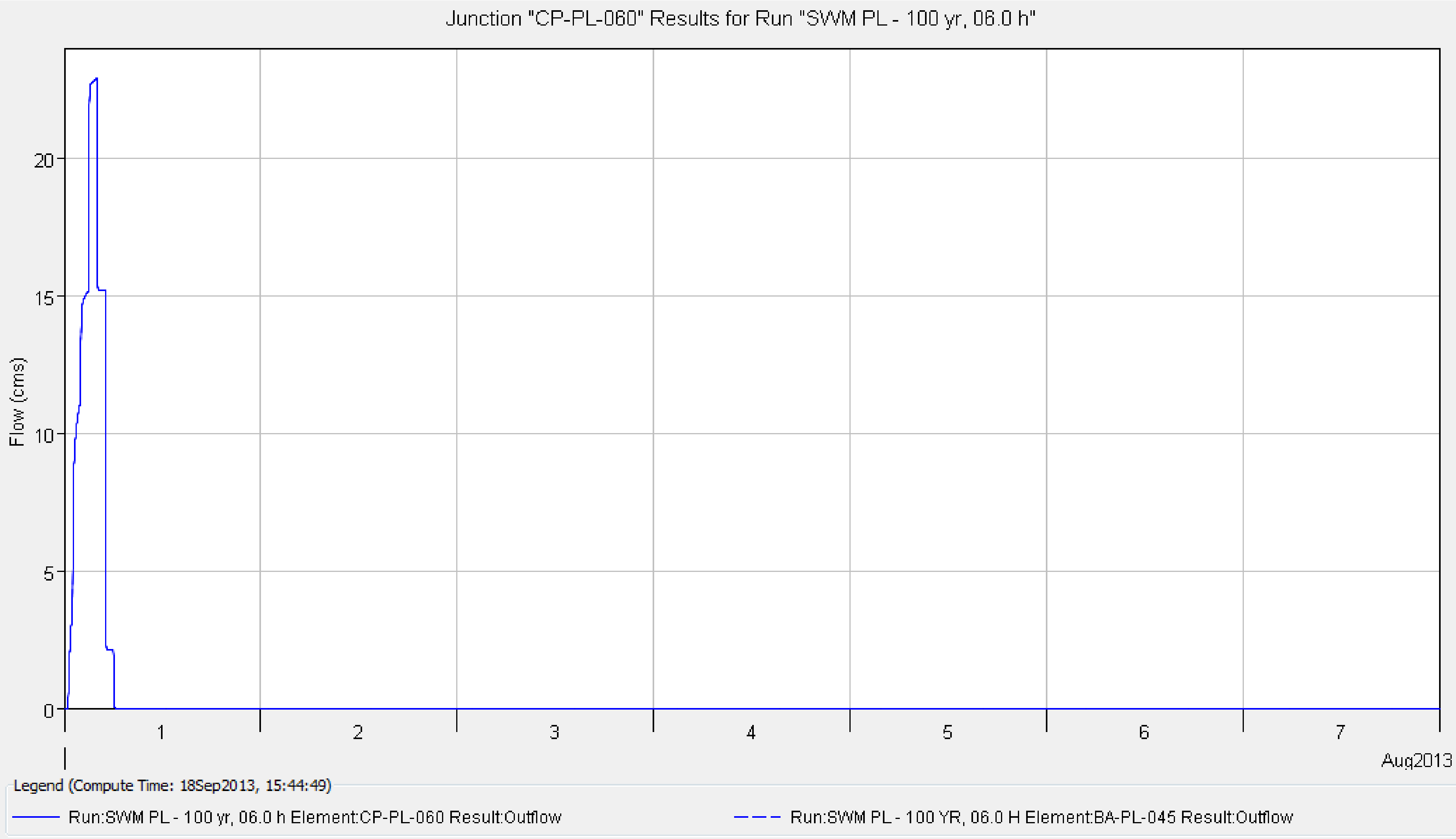

Junction "CP-PL-057" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-042 Result:Outflow



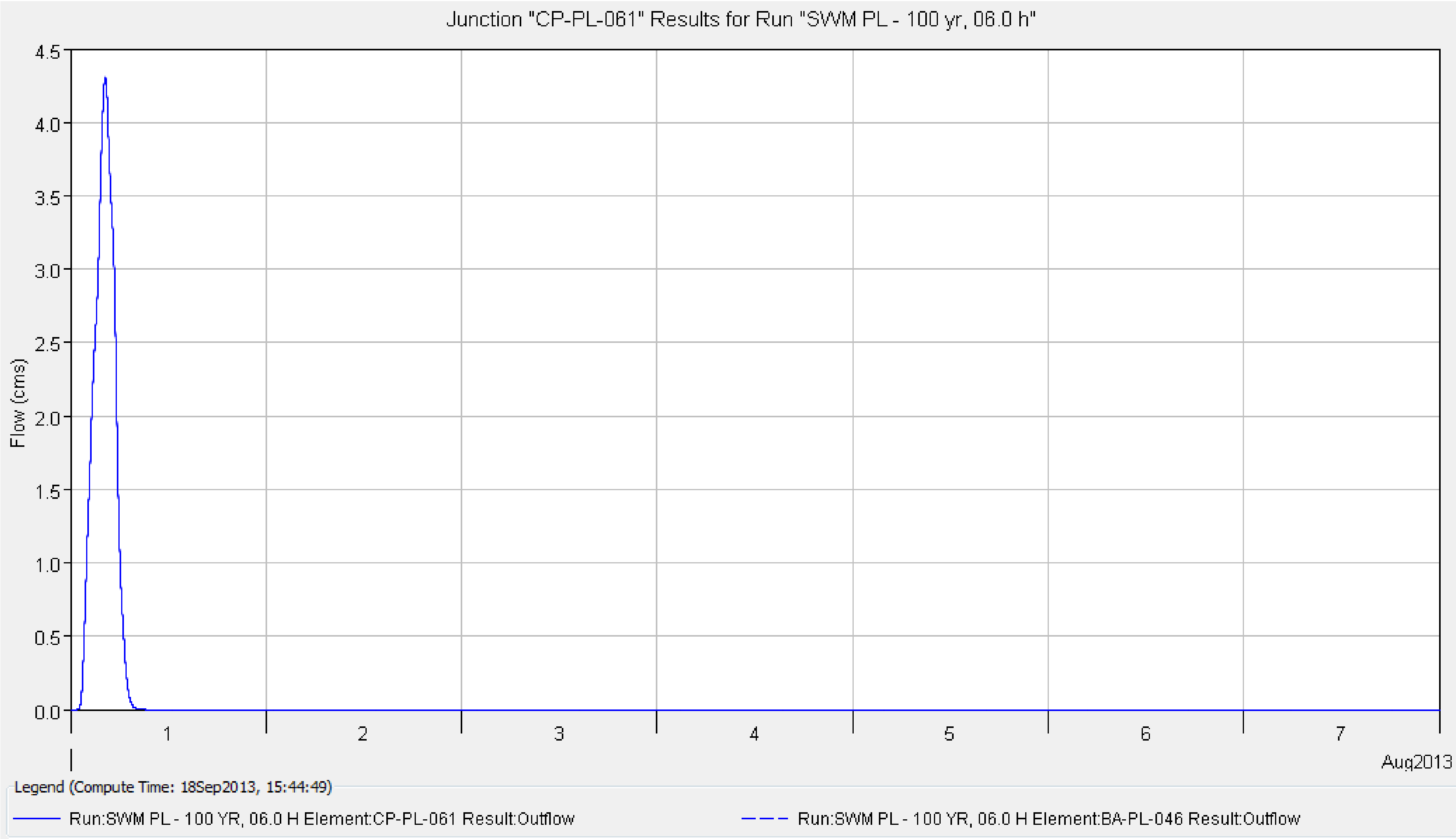
Junction "CP-PL-058" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-041 Result:Outflow



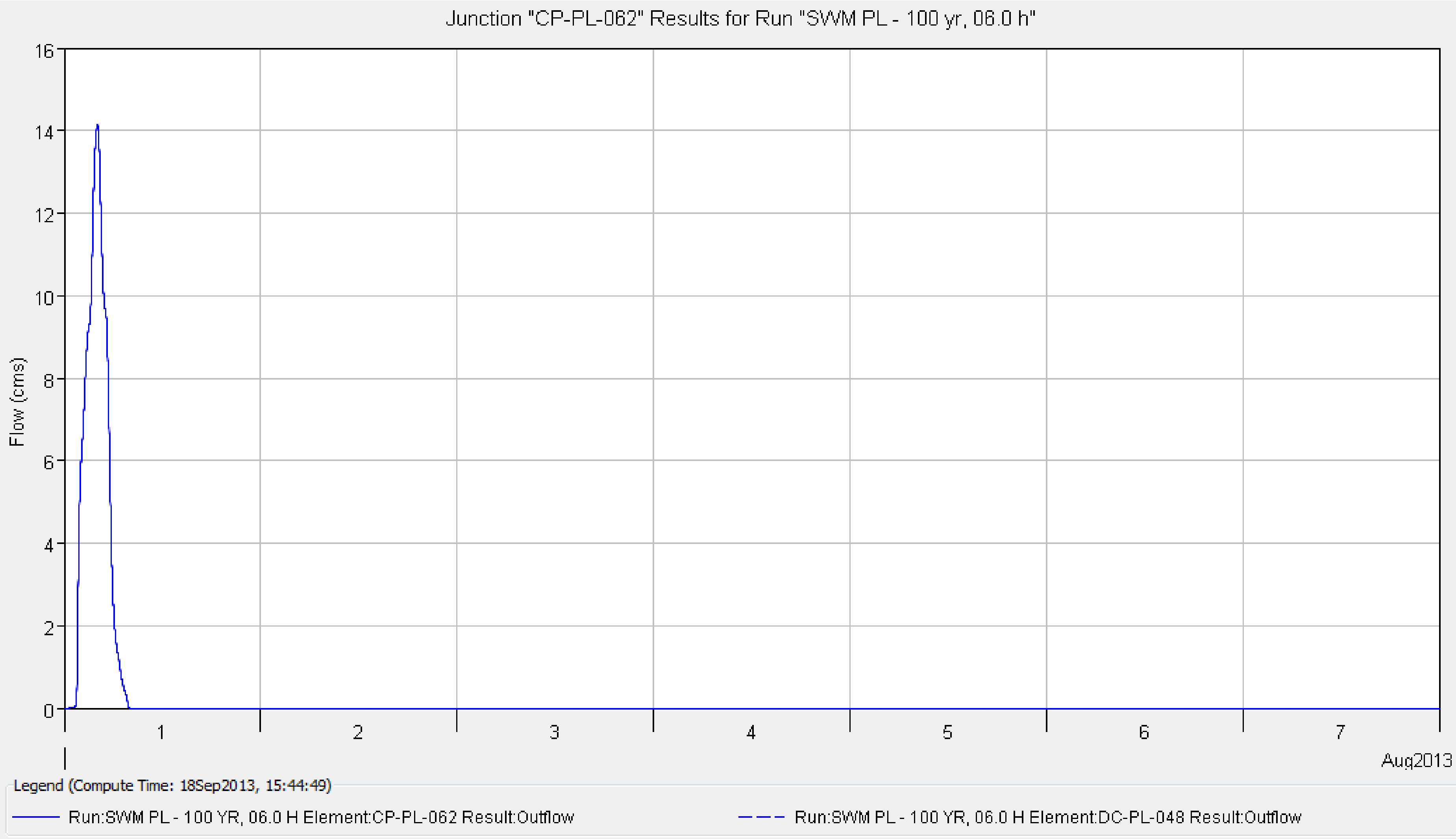
Junction "CP-PL-059" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-059 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-044 Result:Outflow



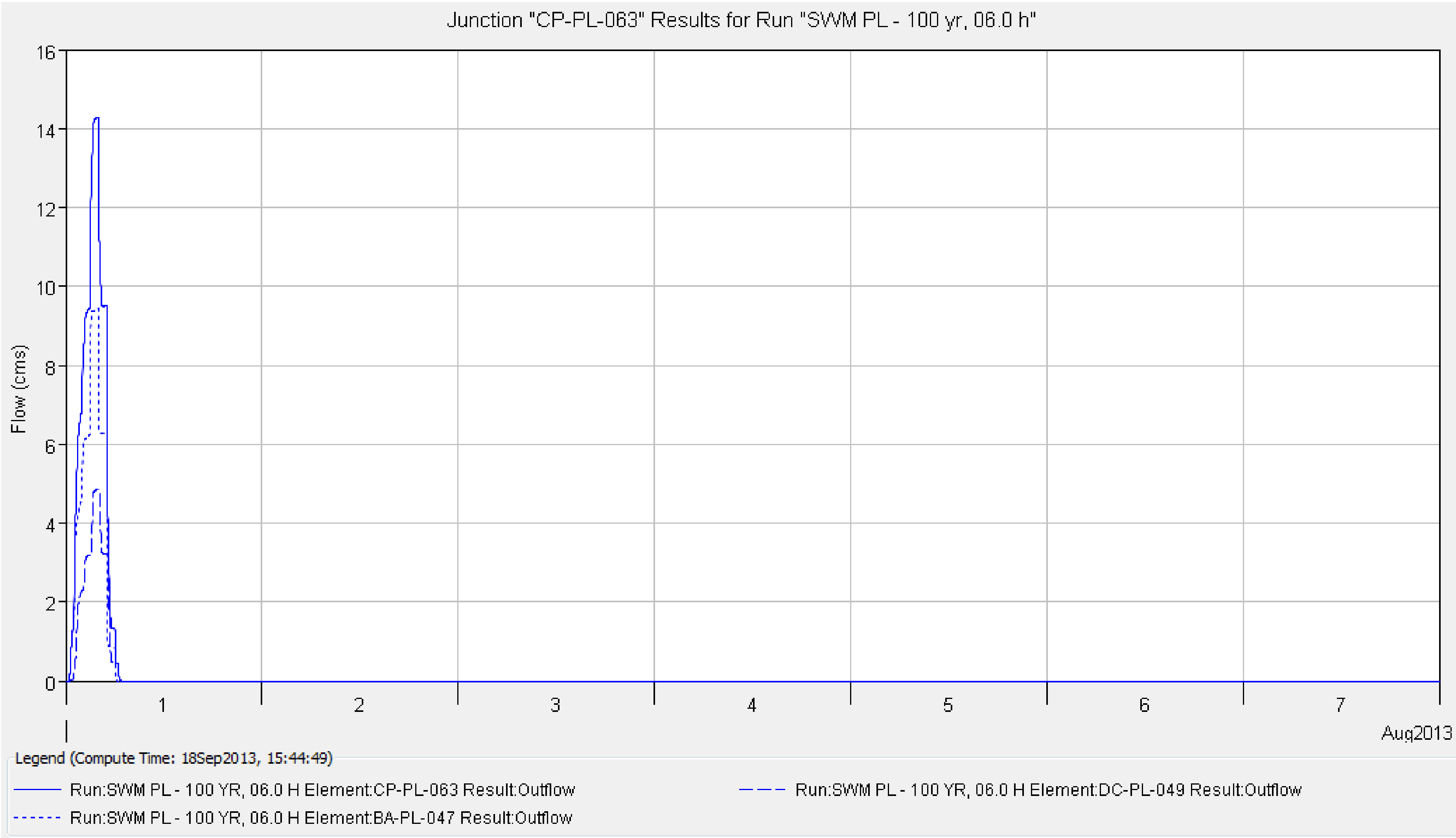
Junction "CP-PL-060" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-045 Result:Outflow

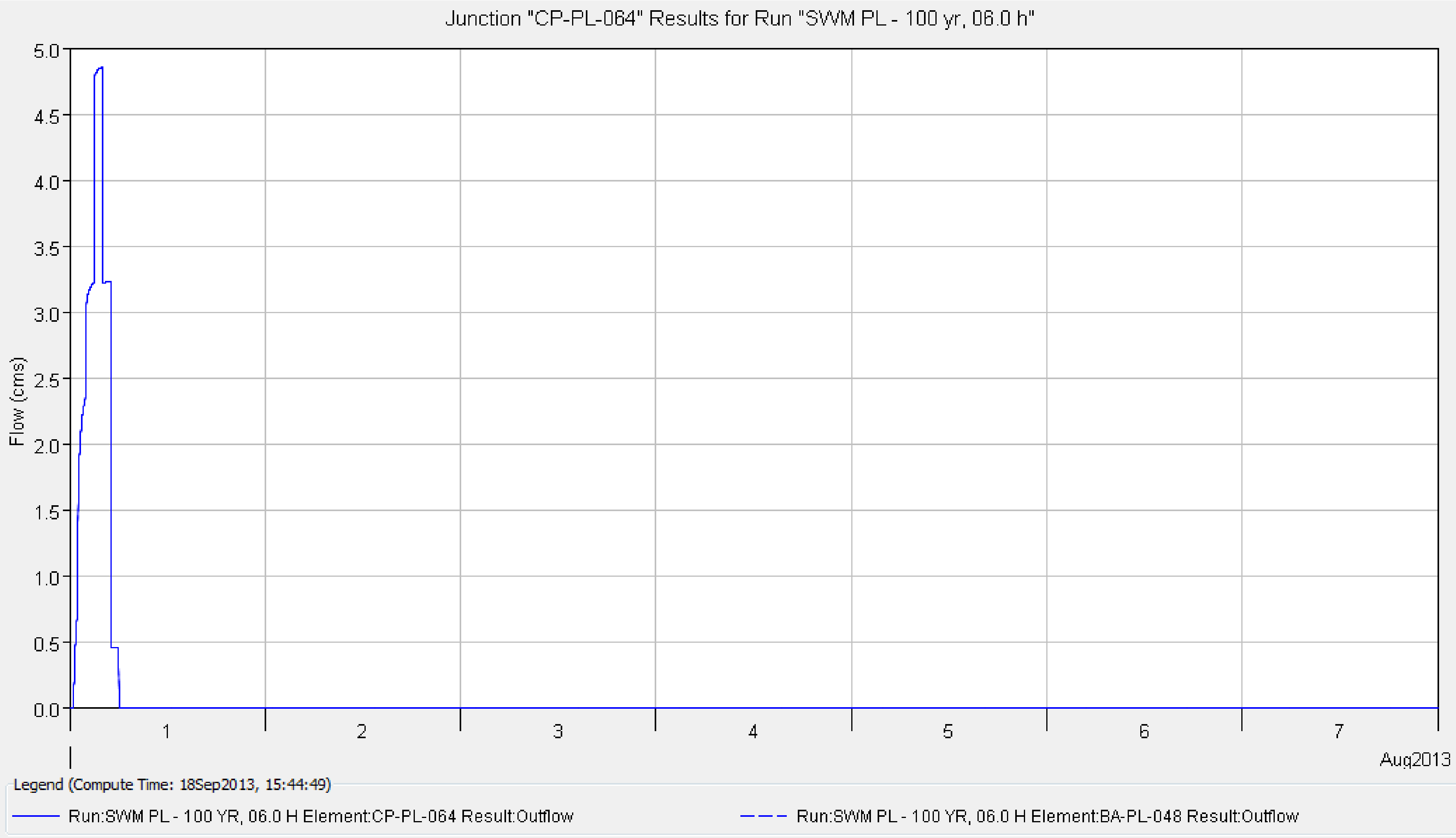


Junction "CP-PL-061" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-061 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-046 Result:Outflow

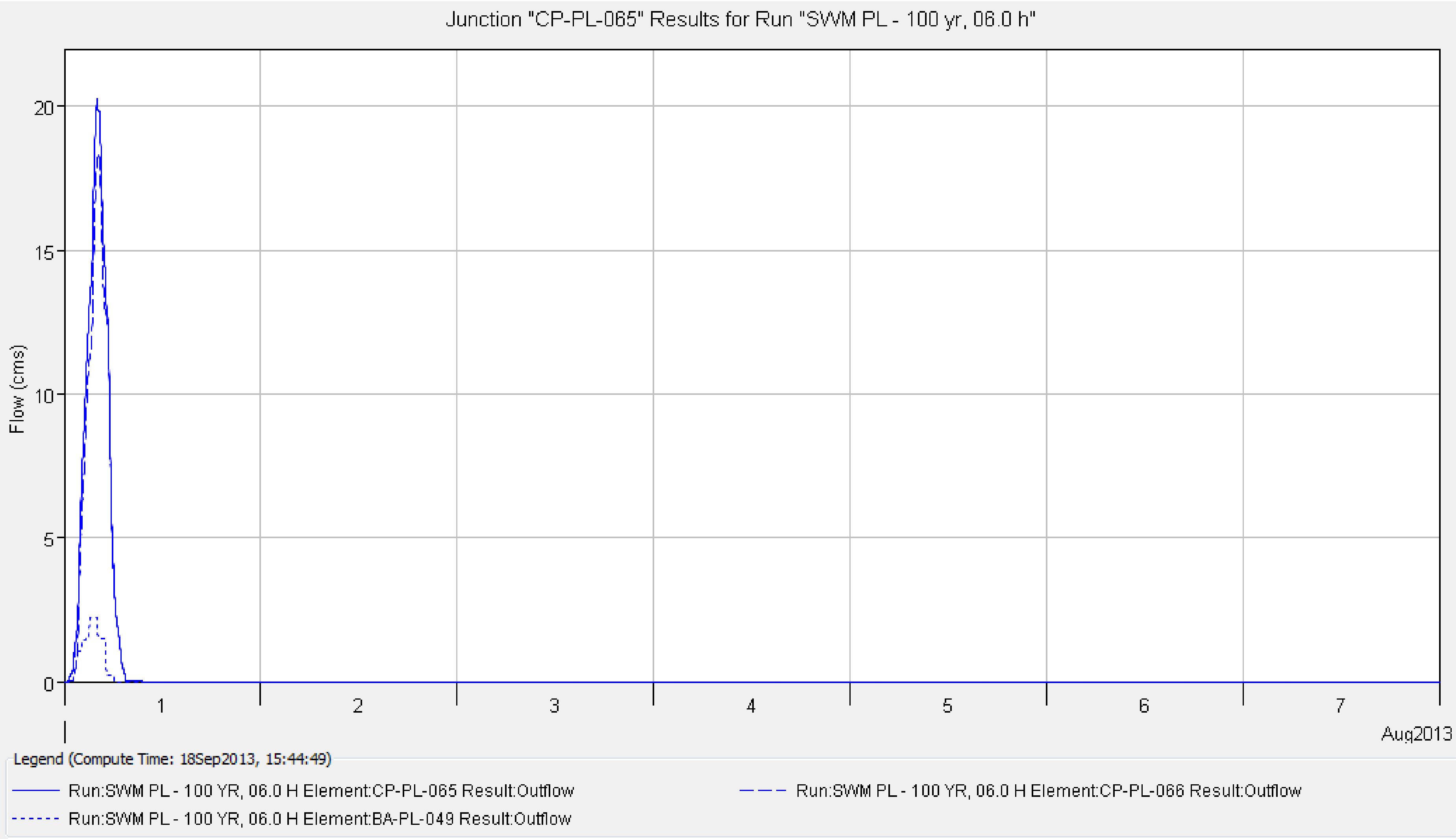


Junction "CP-PL-062" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-062 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-048 Result:Outflow

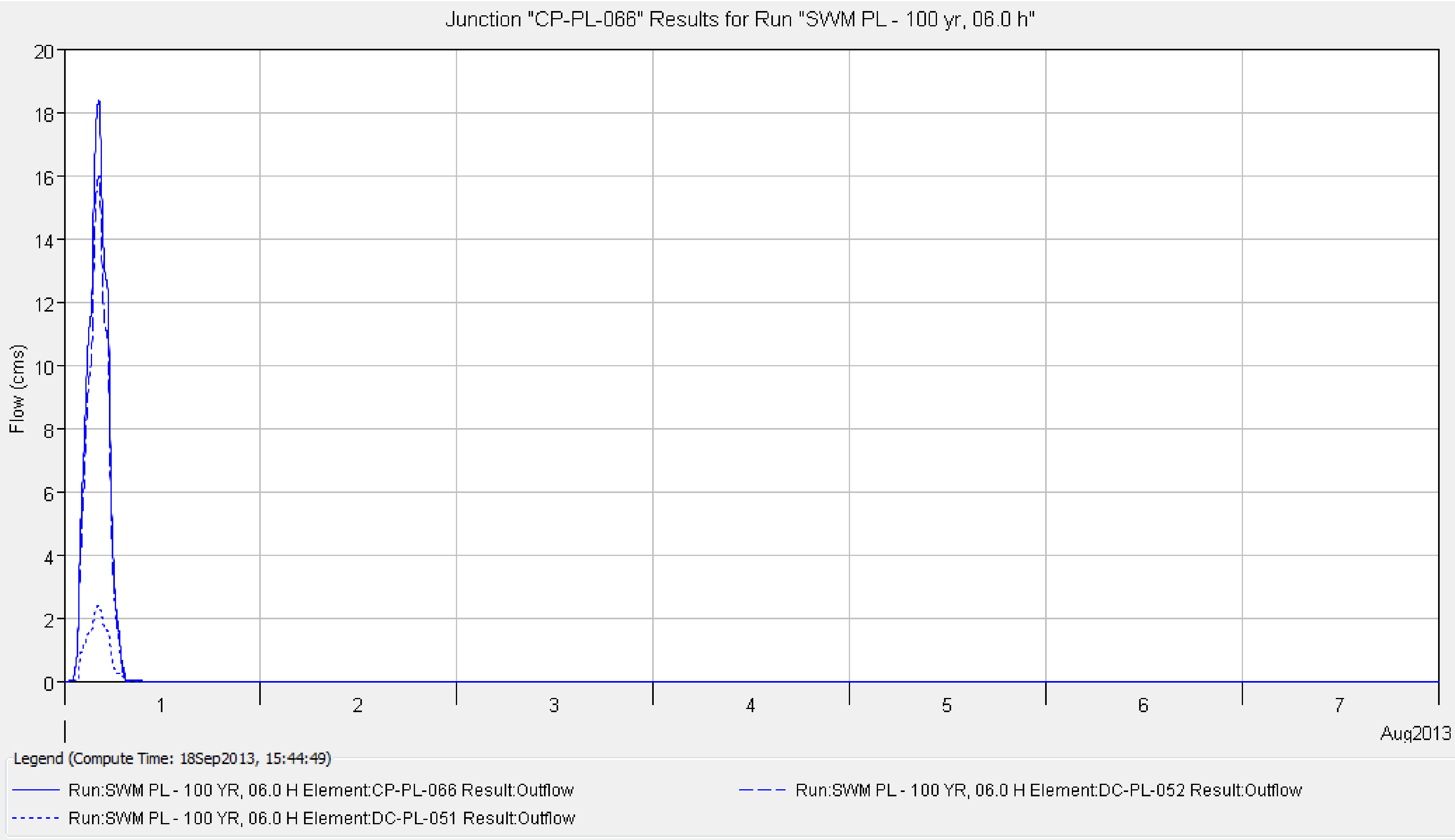

Junction "CP-PL-063" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-047 Result:Outflow

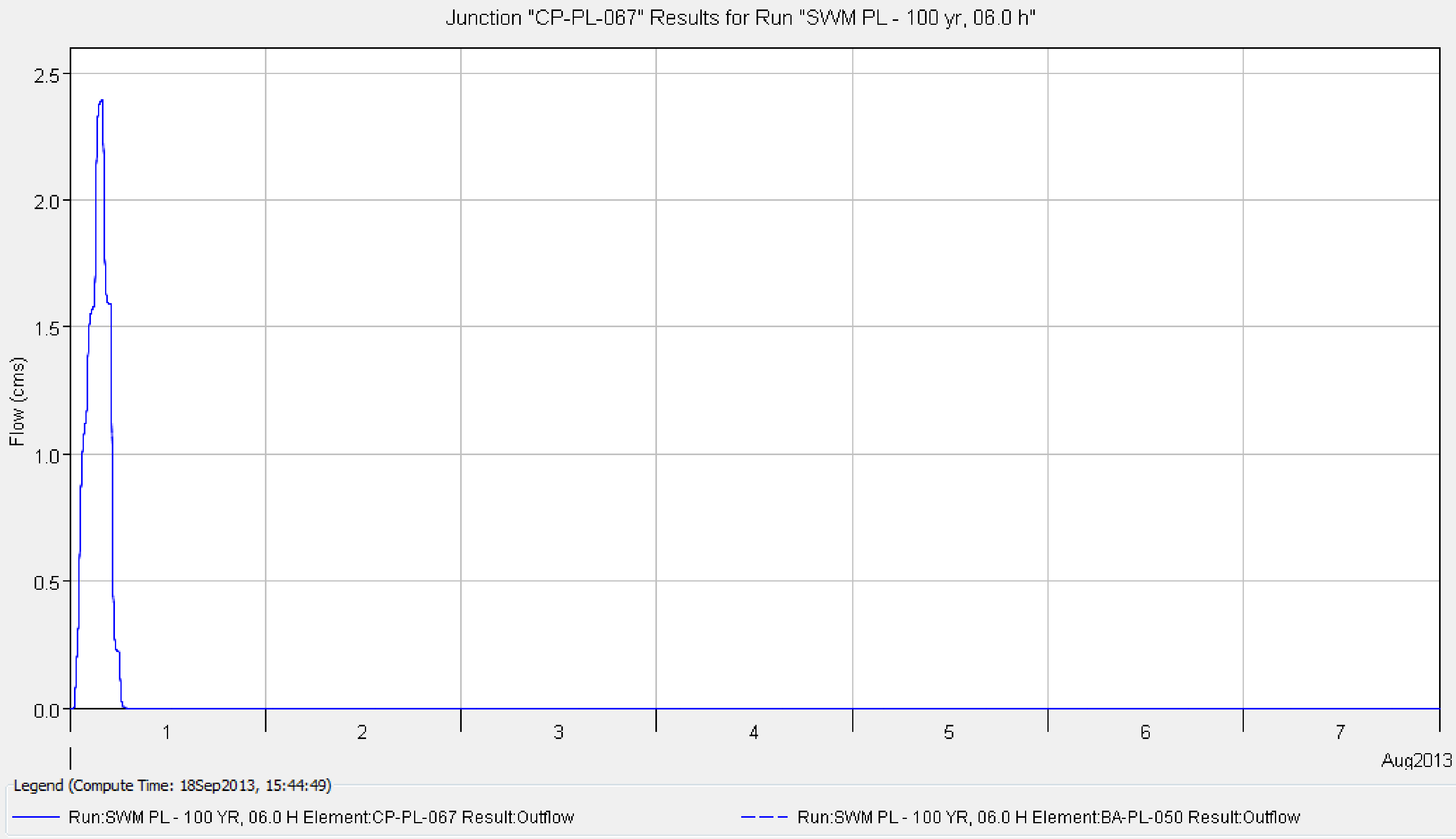


Junction "CP-PL-064" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-064 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-048 Result:Outflow

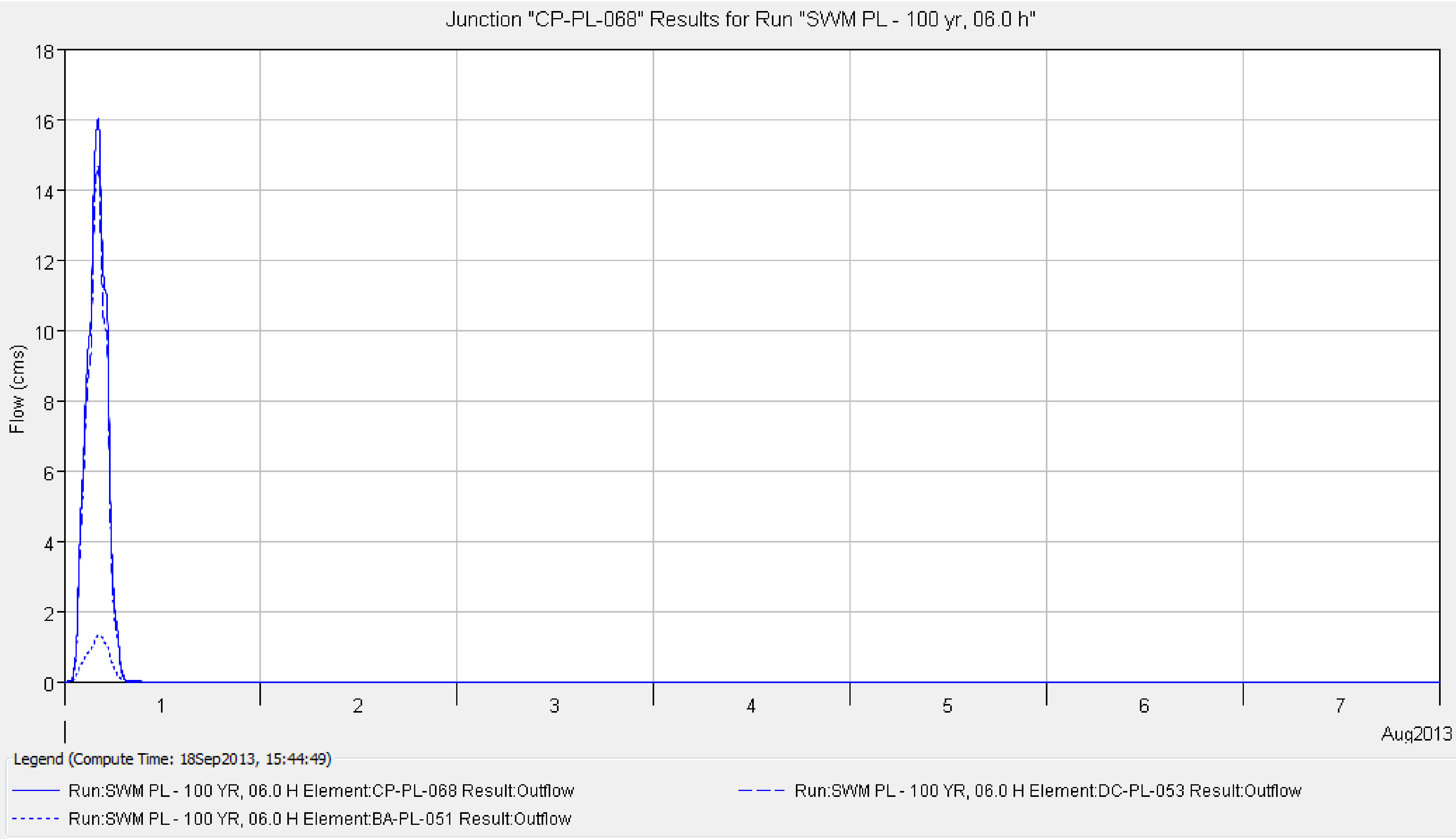


Junction "CP-PL-065" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-065 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-049 Result:Outflow

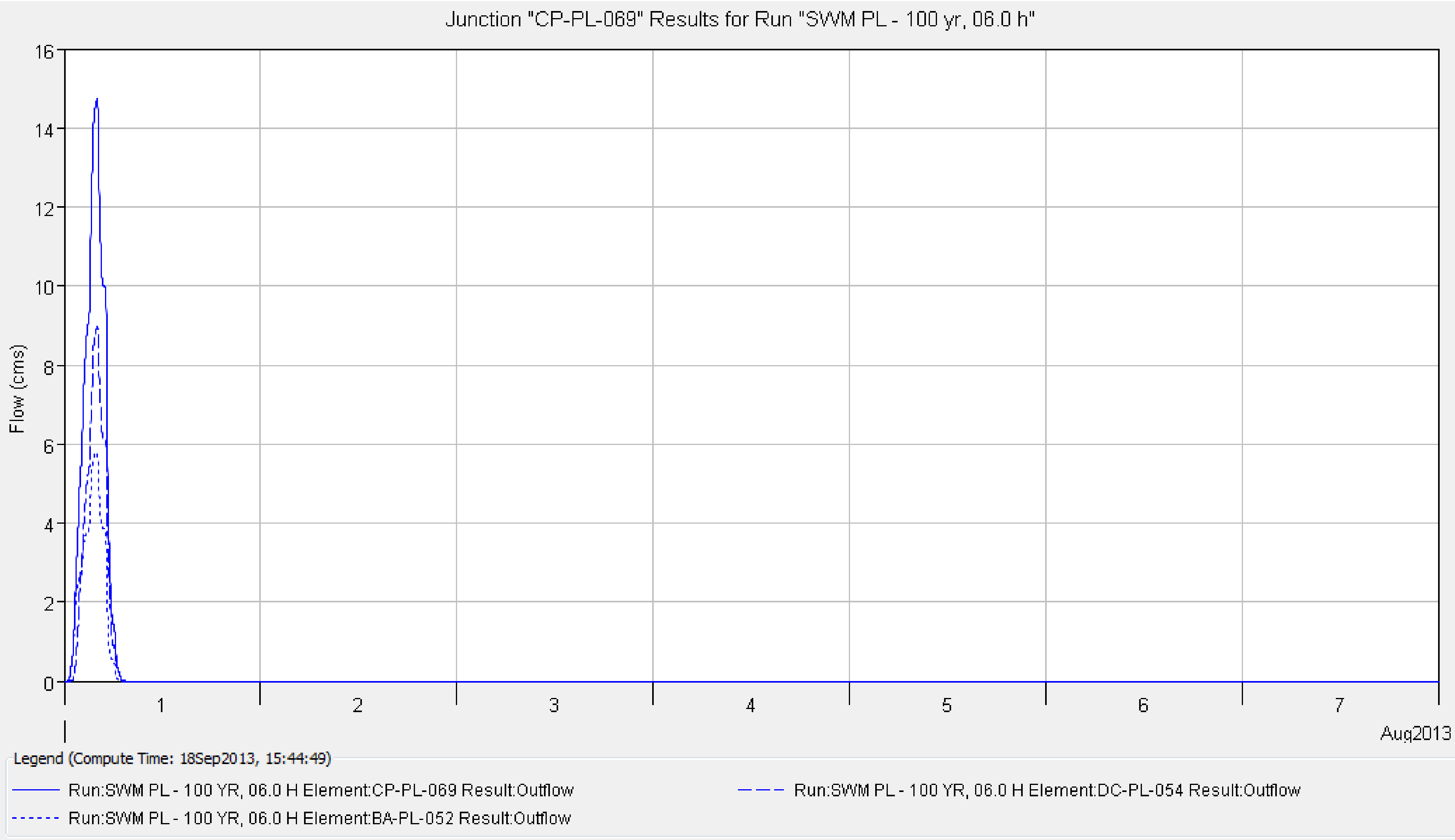

Junction "CP-PL-066" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-051 Result:Outflow

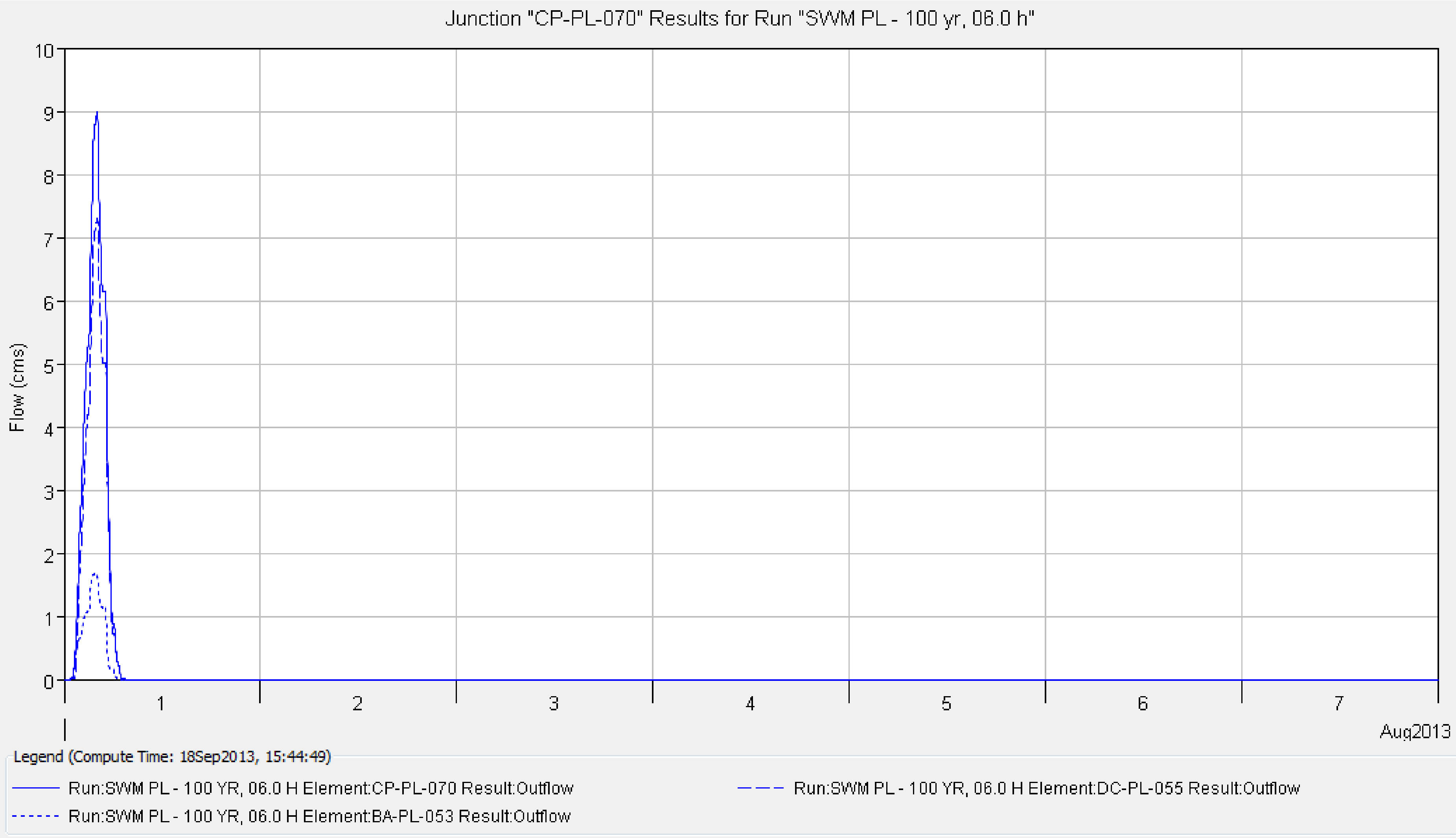


Junction "CP-PL-067" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-067 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-050 Result:Outflow

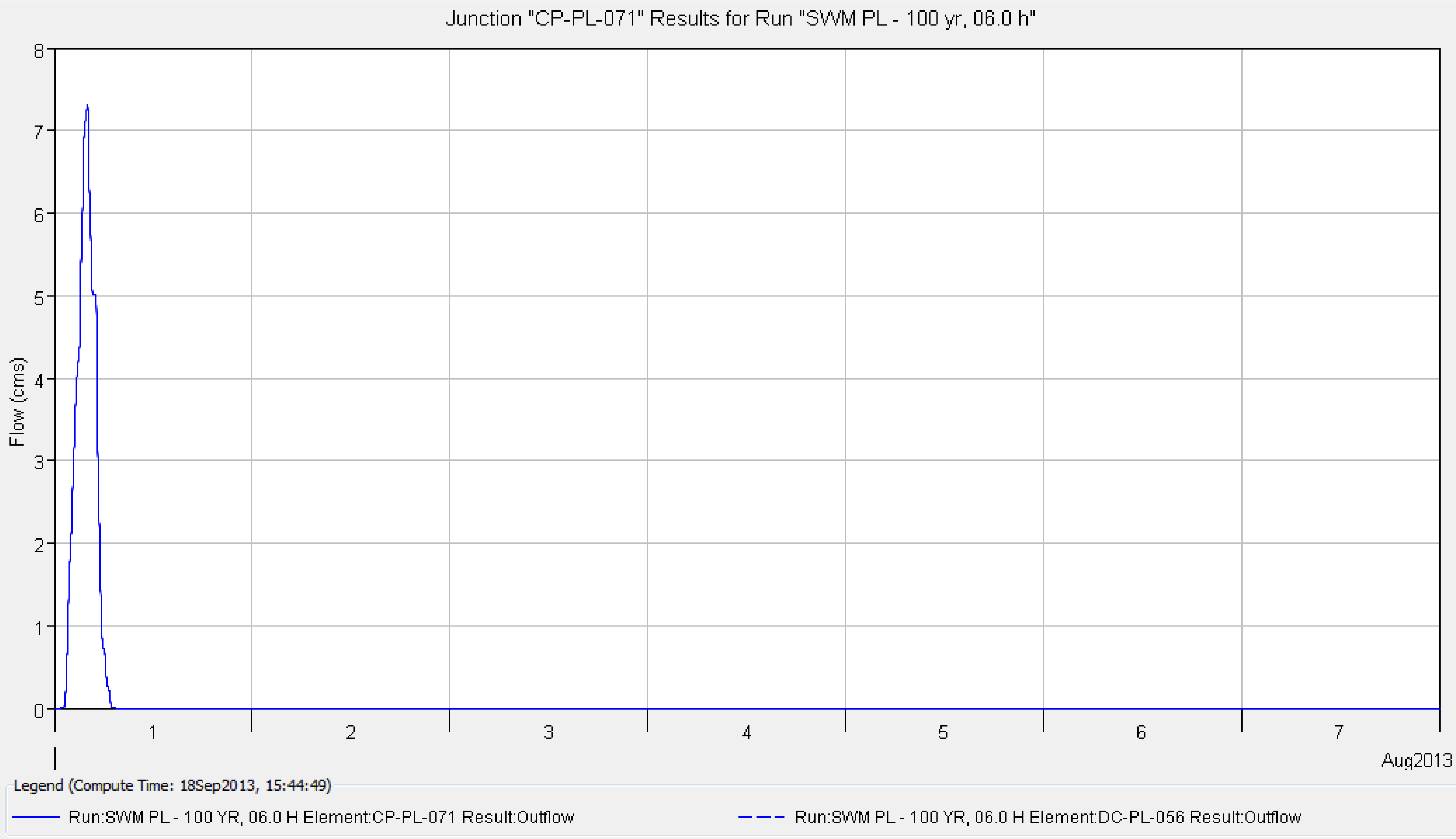


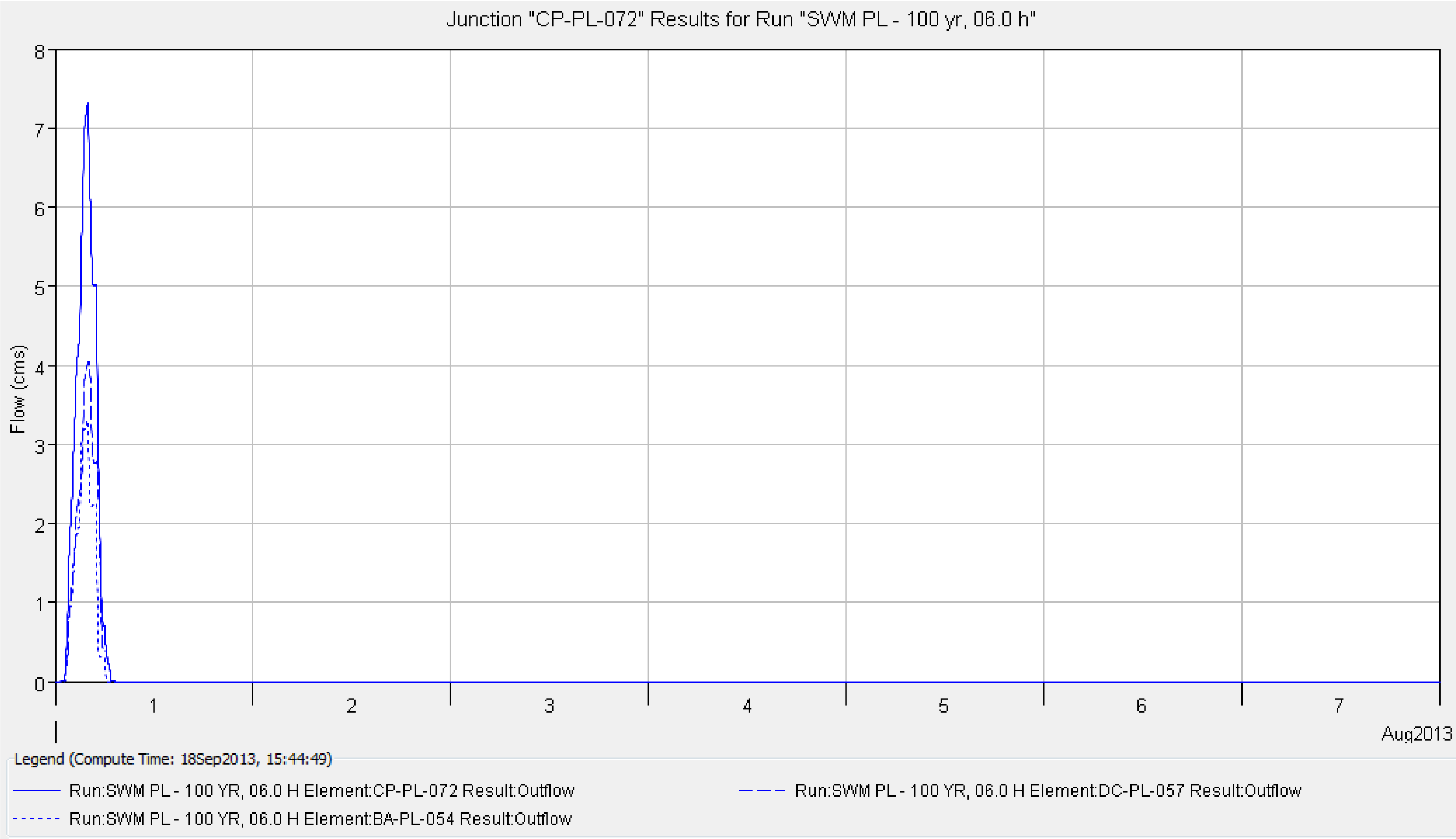
Junction "CP-PL-068" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-068 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-051 Result:Outflow

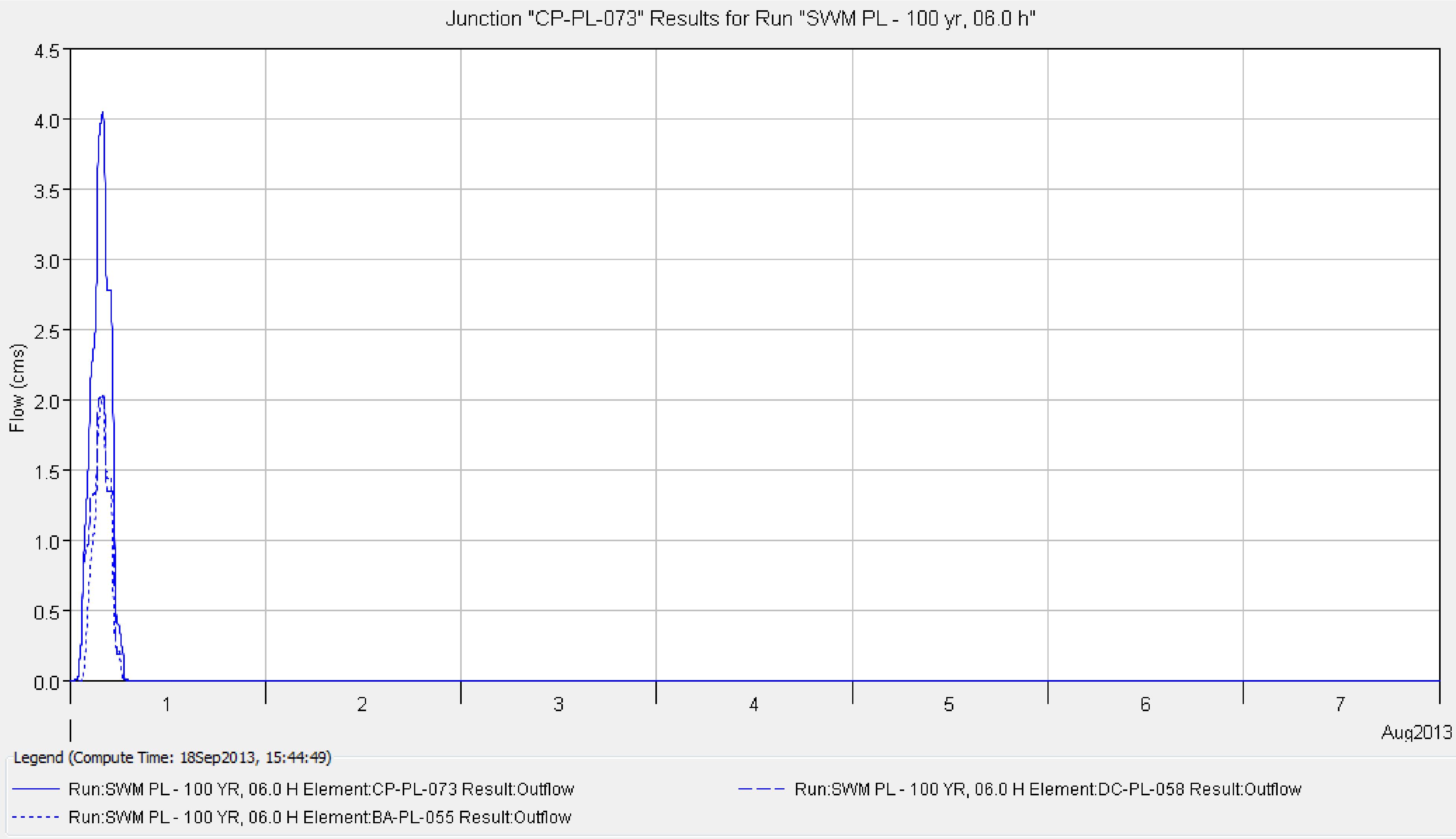

Junction "CP-PL-069" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-069 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-052 Result:Outflow



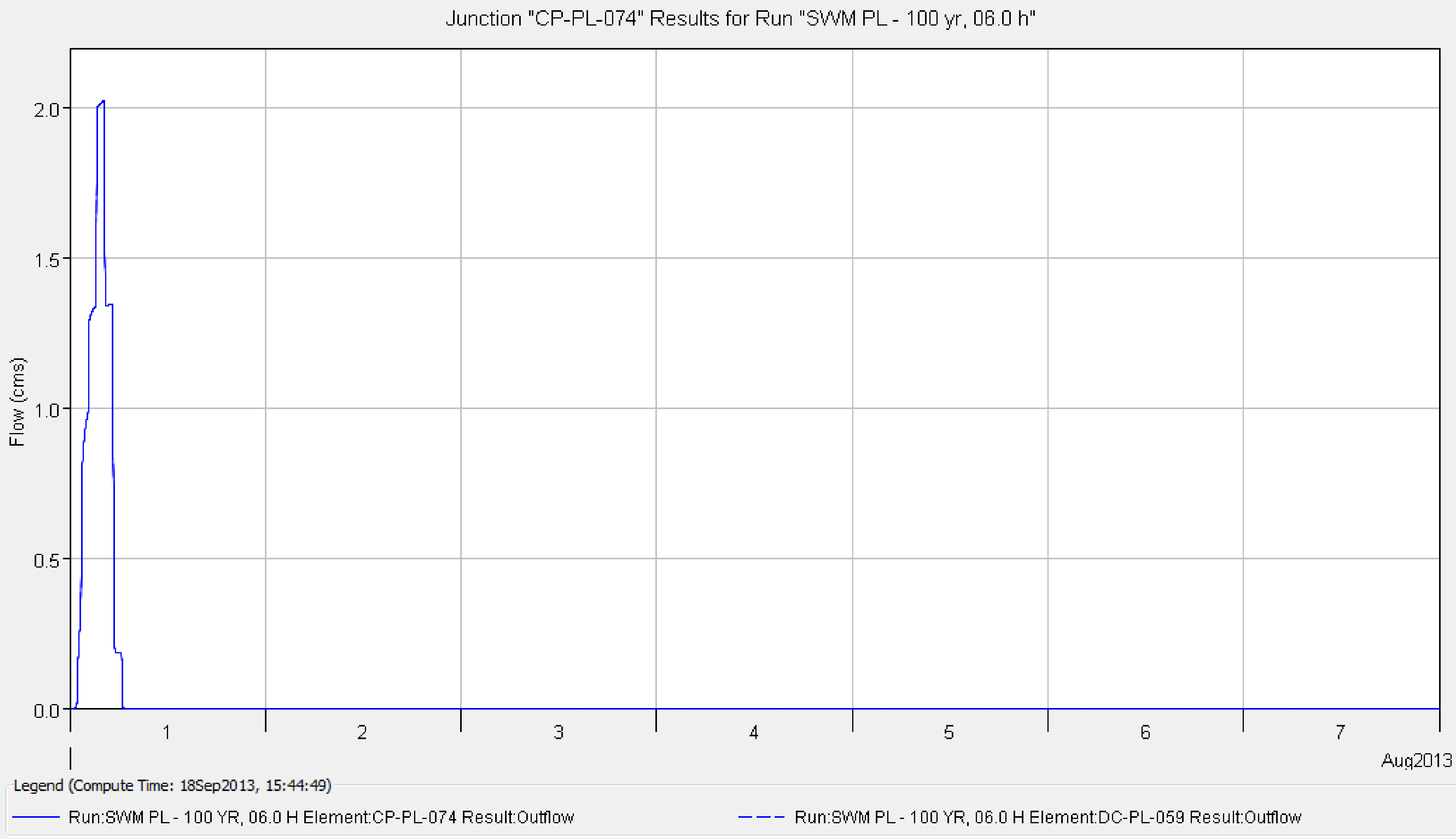
Junction "CP-PL-070" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-070 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-053 Result:Outflow


Junction "CP-PL-071" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-071 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-056 Result:Outflow

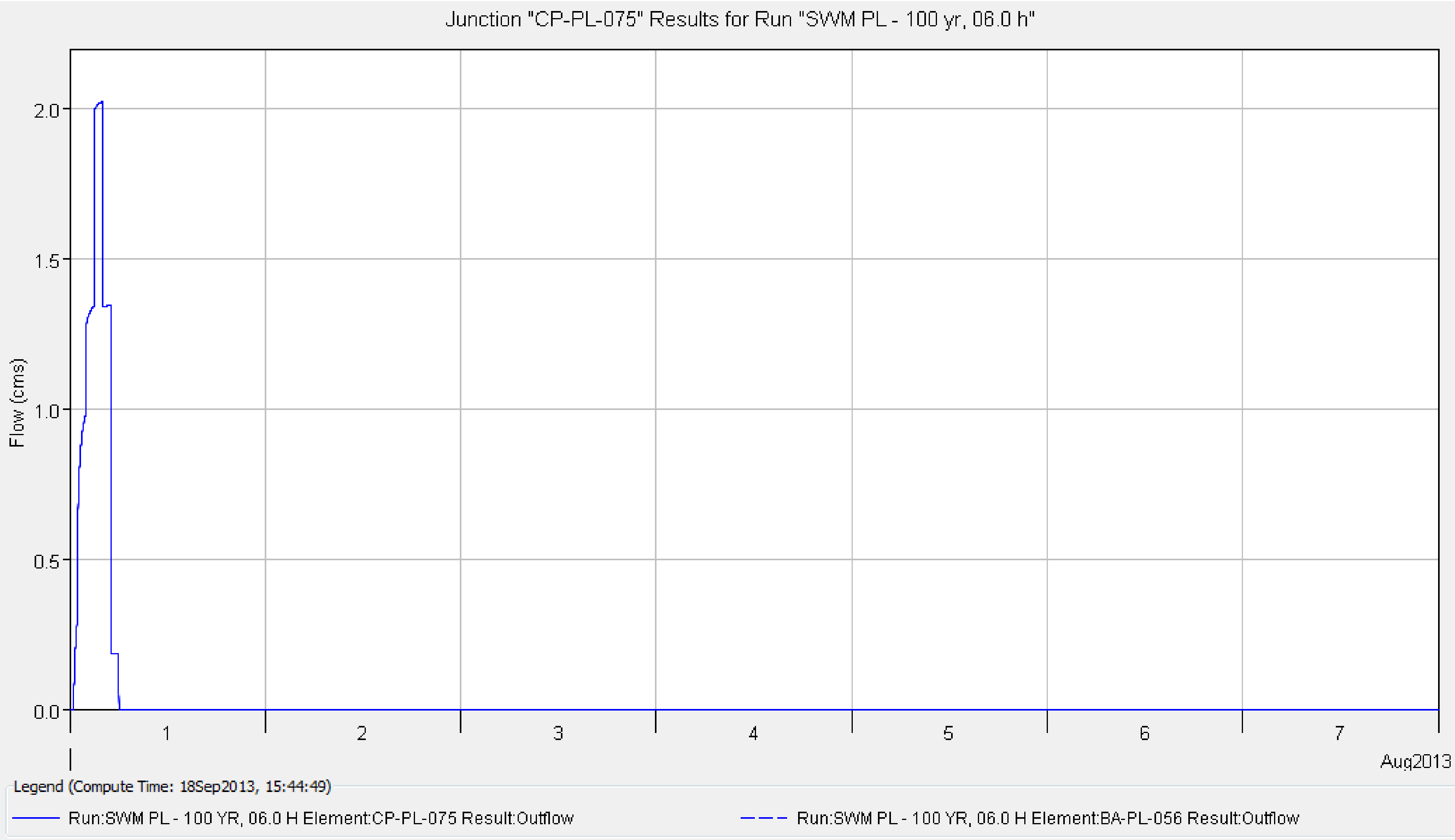

Junction "CP-PL-072" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-072 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-054 Result:Outflow



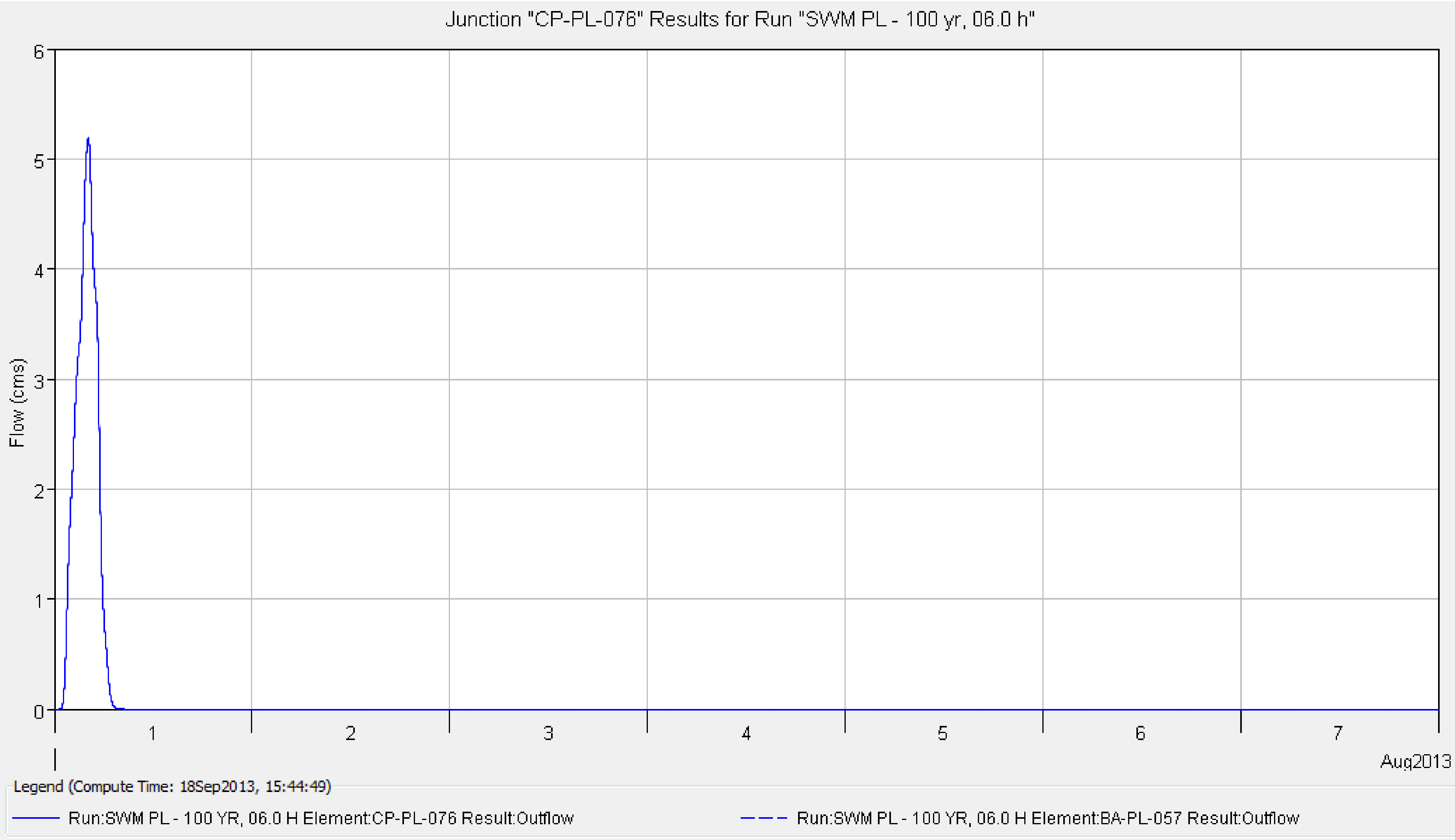
Junction "CP-PL-073" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-073 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-055 Result:Outflow

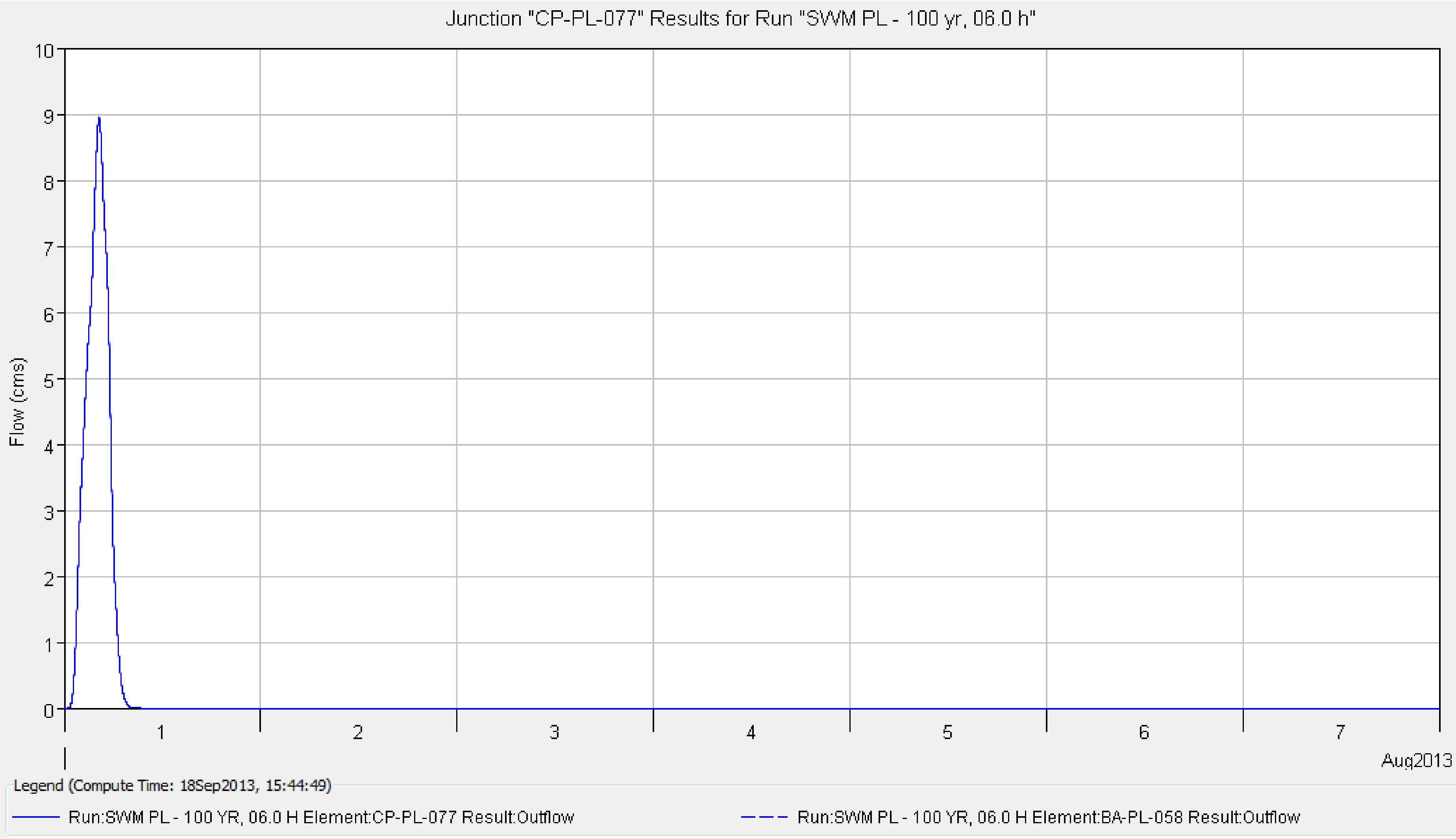


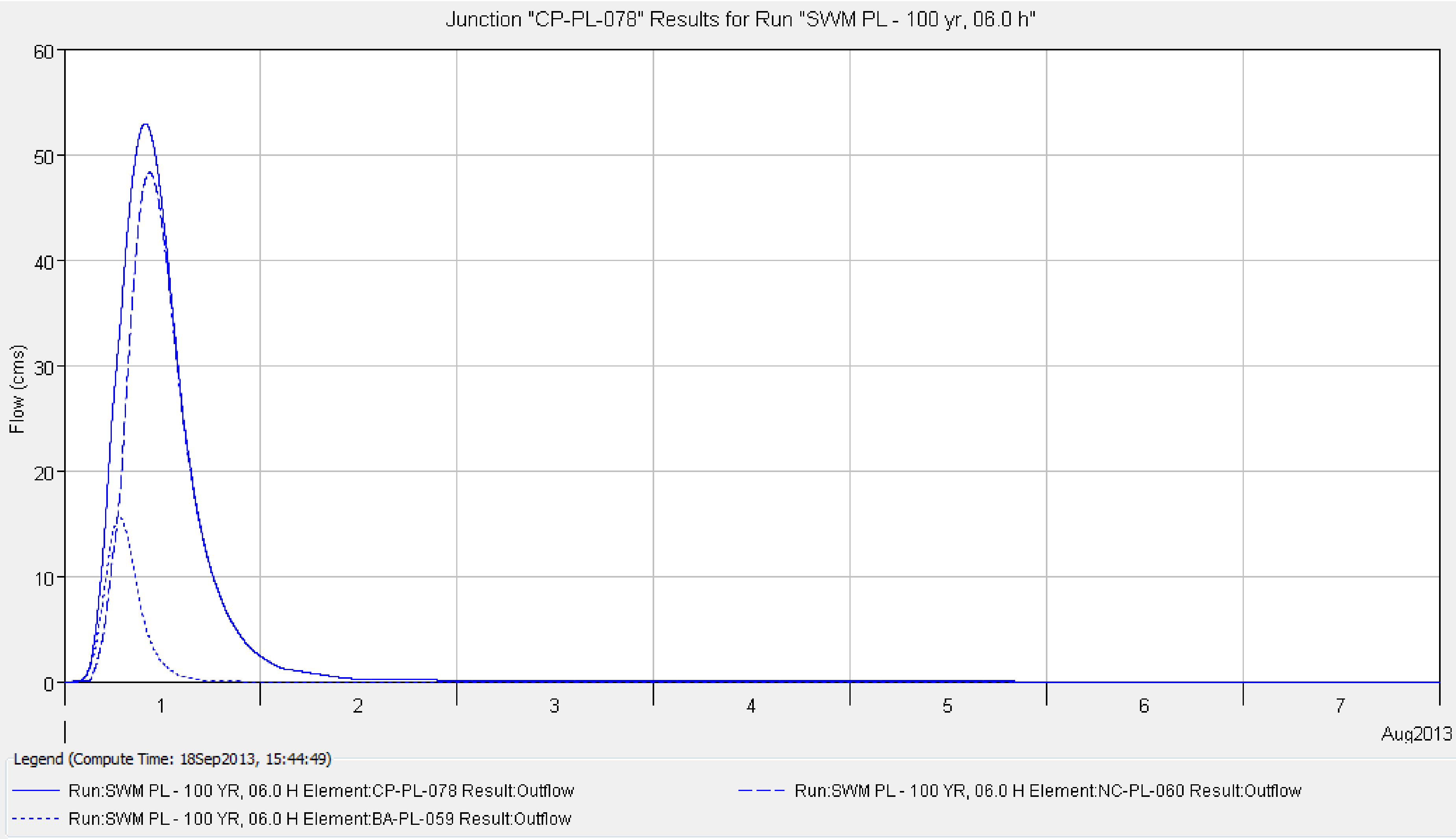
Junction "CP-PL-074" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-074 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-059 Result:Outflow

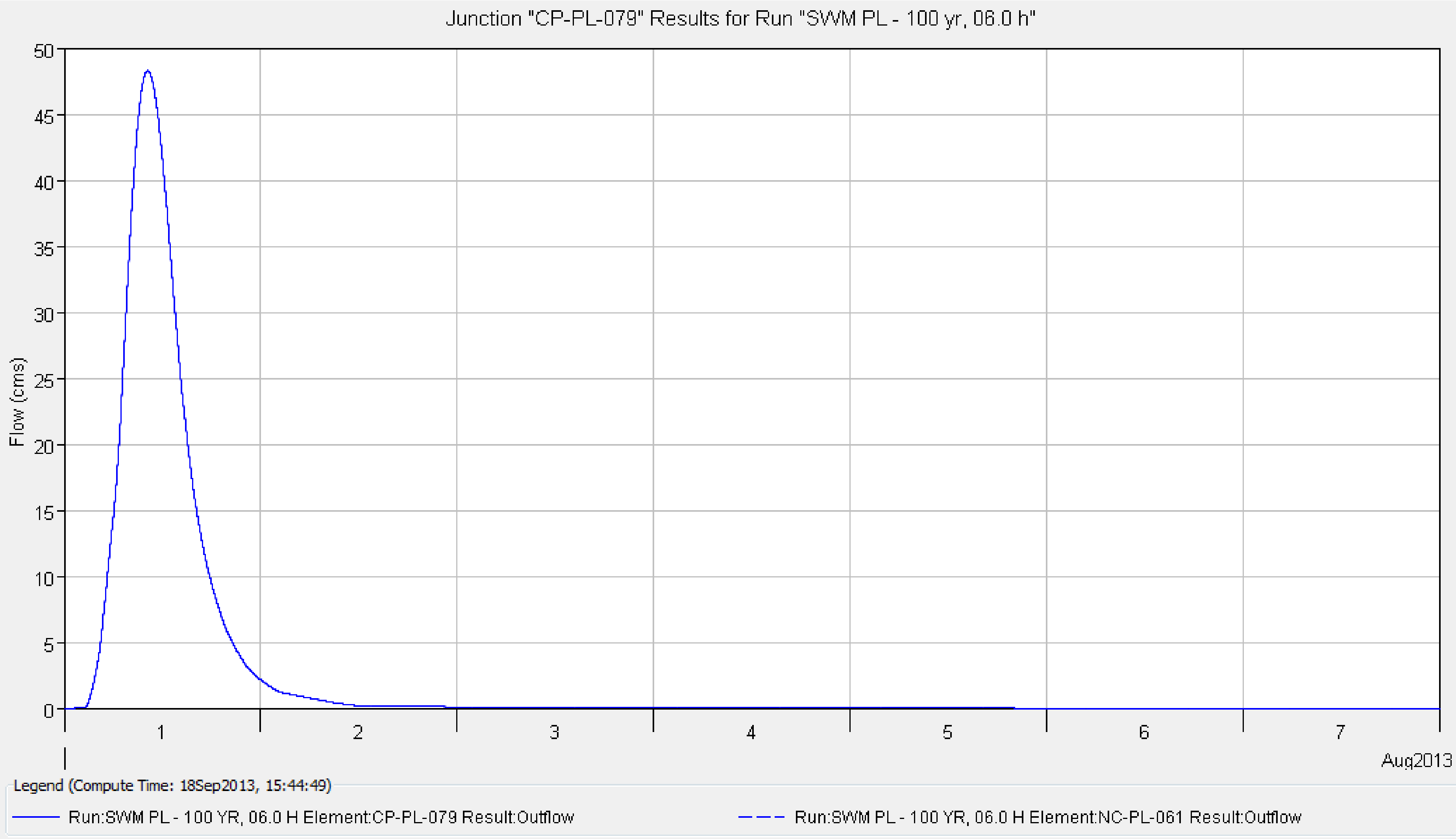


Junction "CP-PL-075" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-075 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-056 Result:Outflow

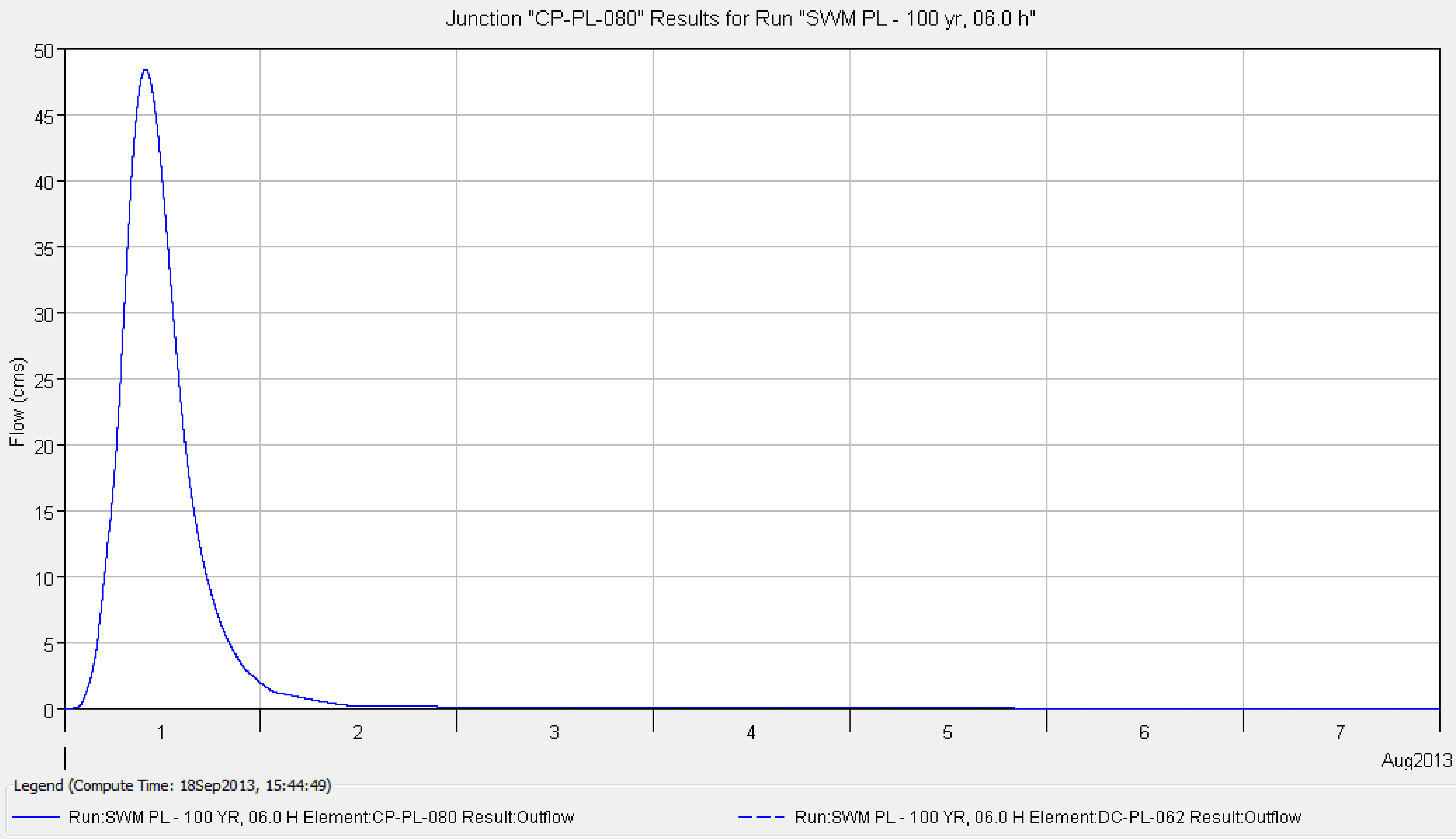

Junction "CP-PL-076" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-076 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-057 Result:Outflow

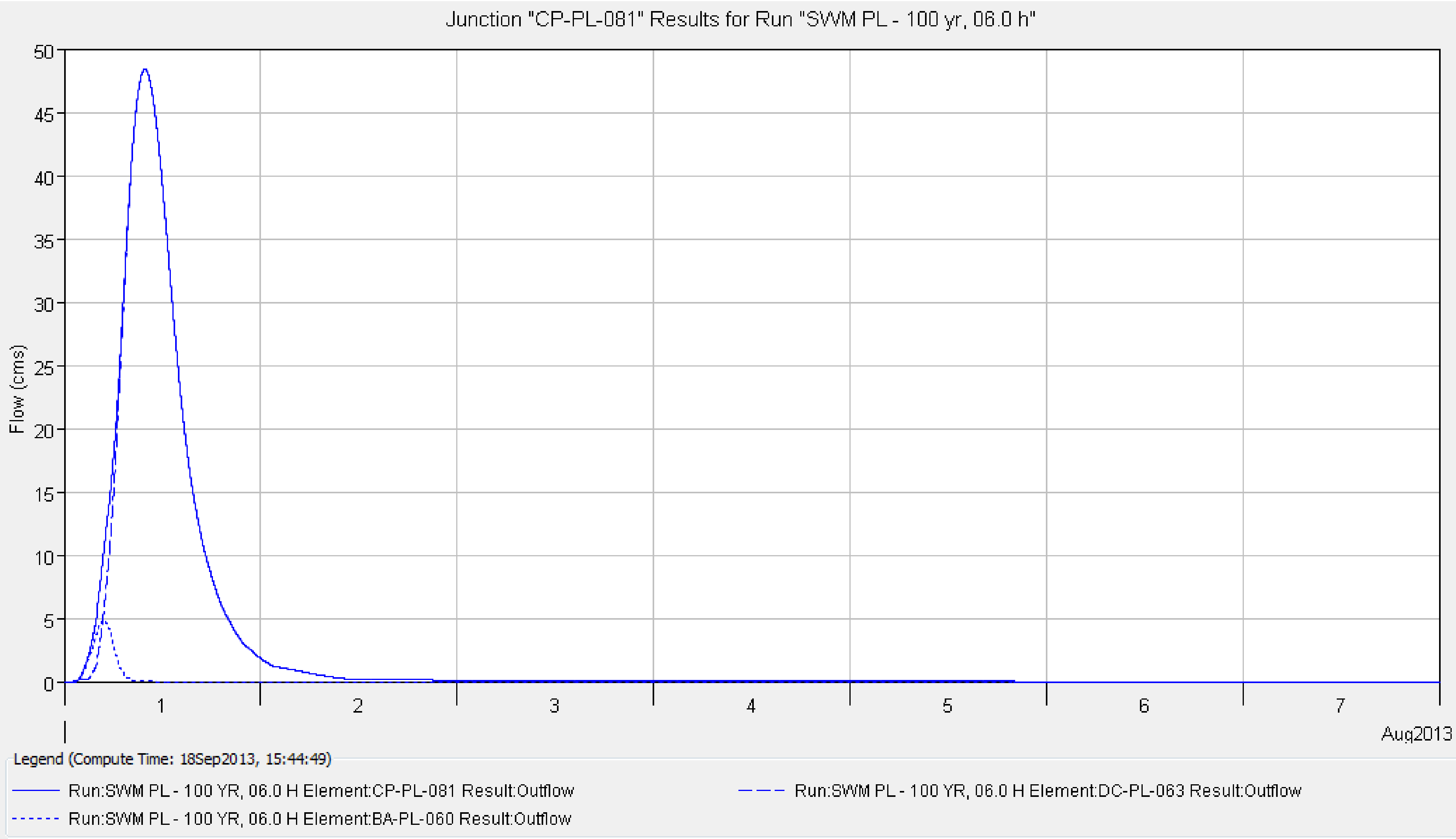

Junction "CP-PL-077" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-058 Result:Outflow

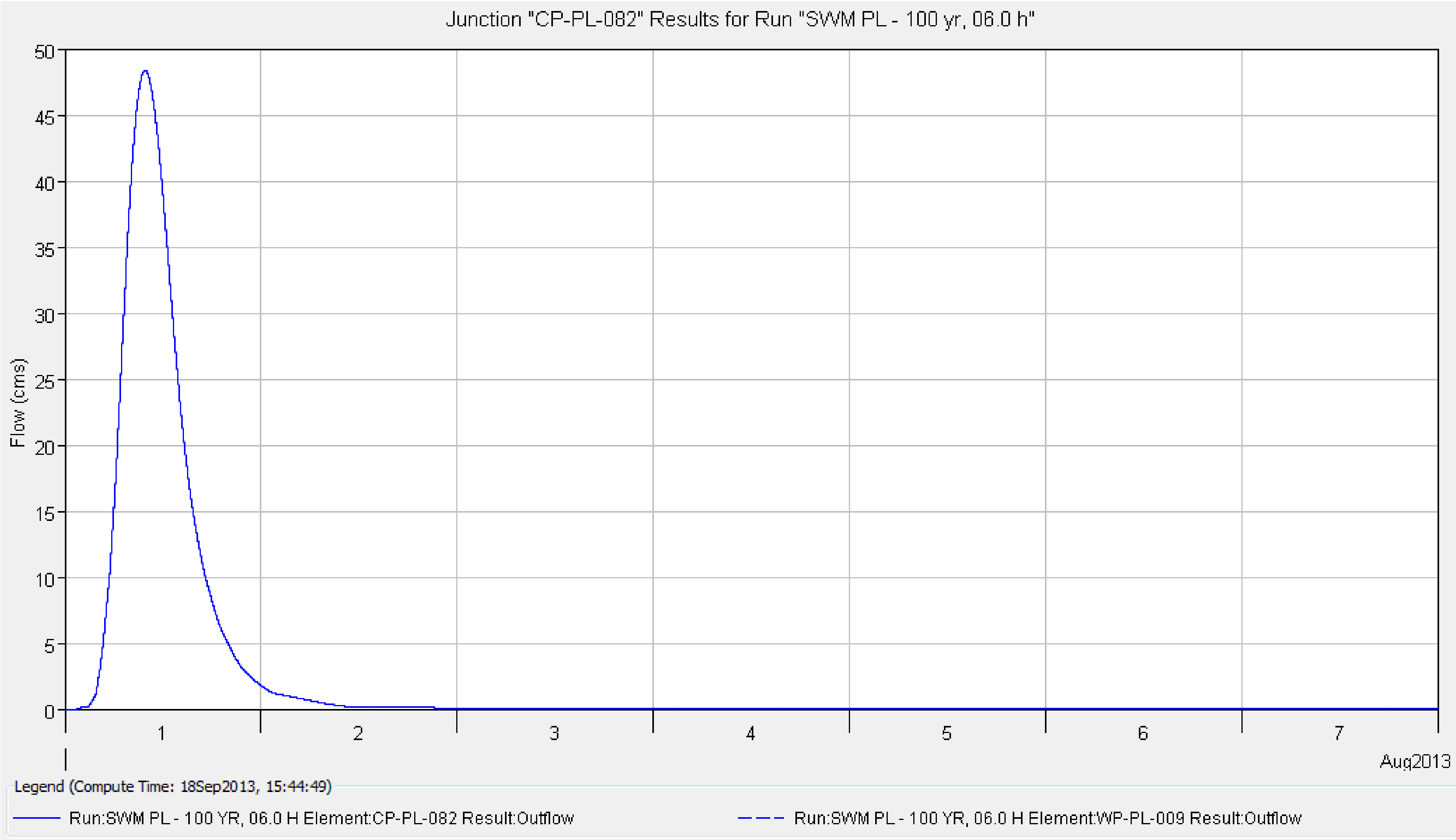

Junction "CP-PL-078" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-059 Result:Outflow

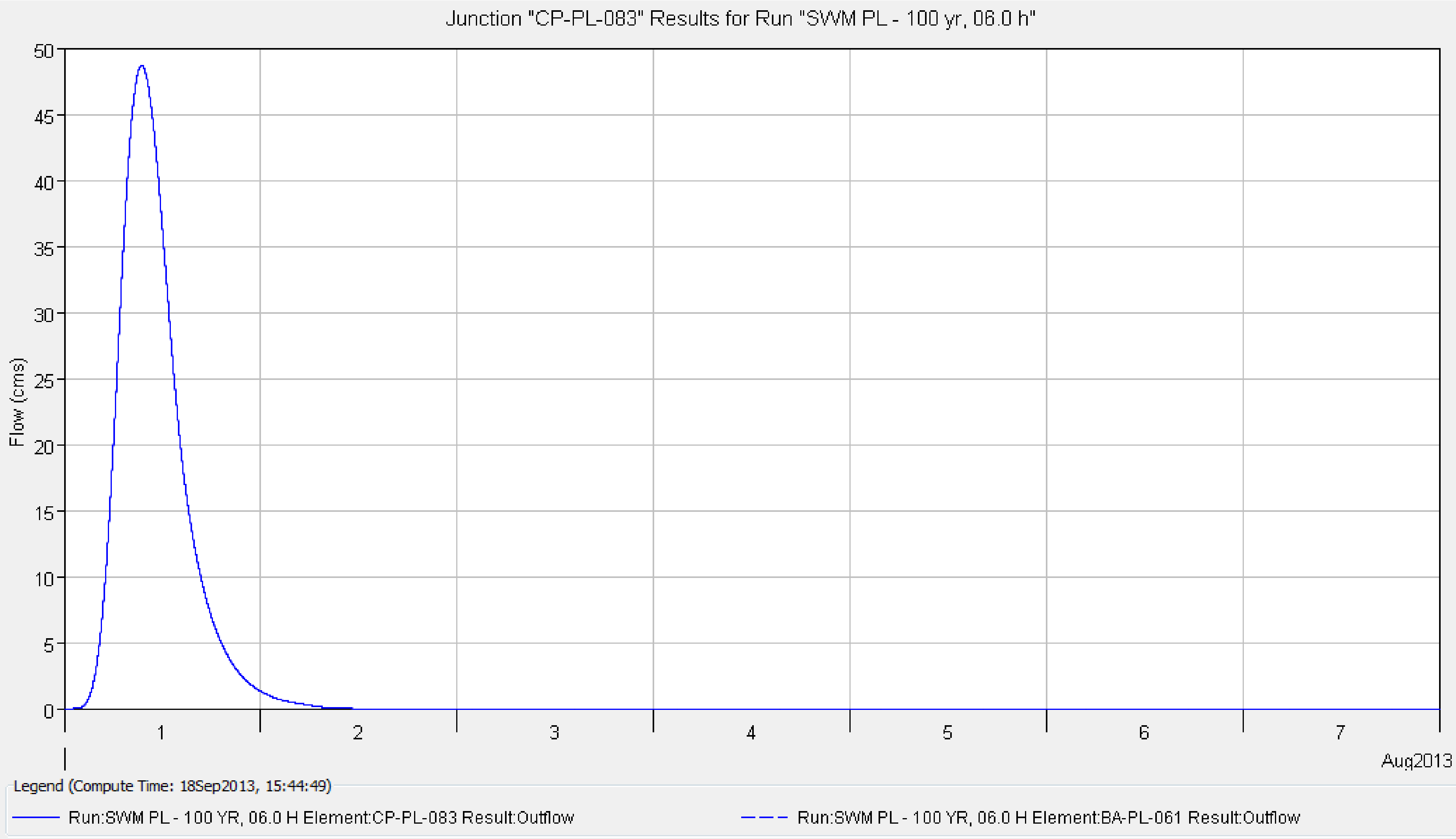


Junction "CP-PL-079" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-079 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:NC-PL-061 Result:Outflow

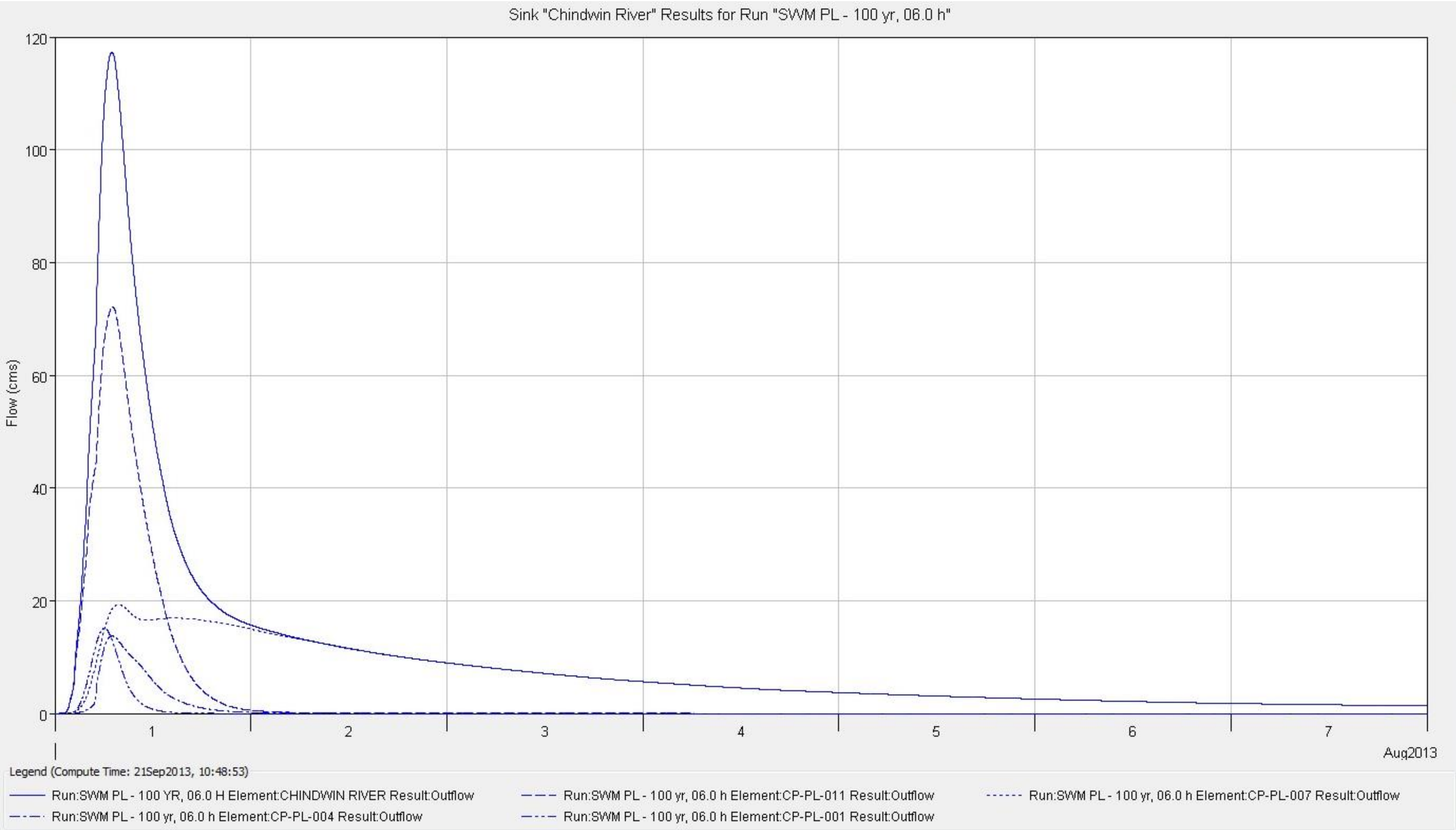

Junction "CP-PL-080" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-080 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-062 Result:Outflow


Junction "CP-PL-081" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-081 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:DC-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-060 Result:Outflow

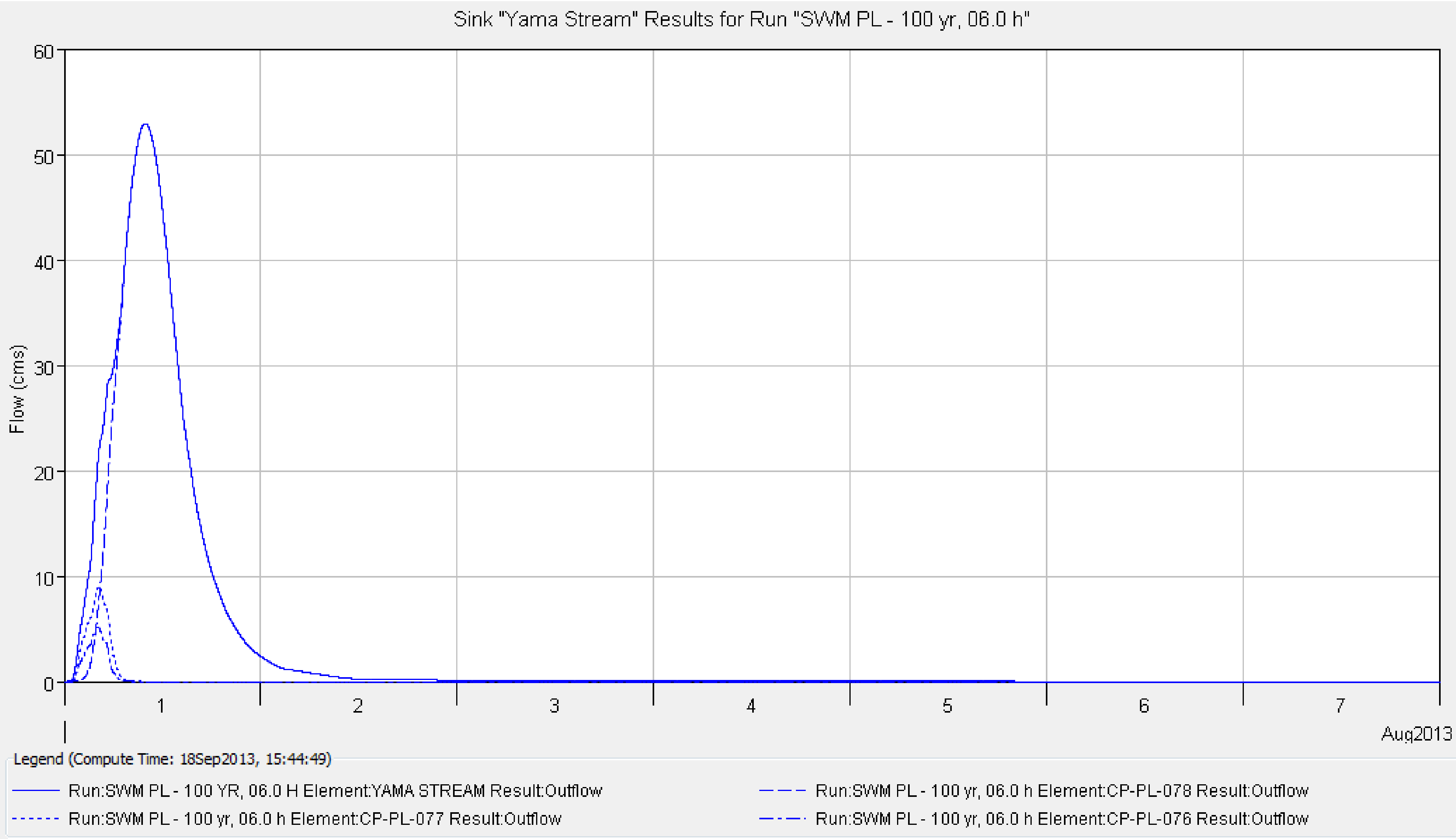

Junction "CP-PL-082" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-082 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Outflow



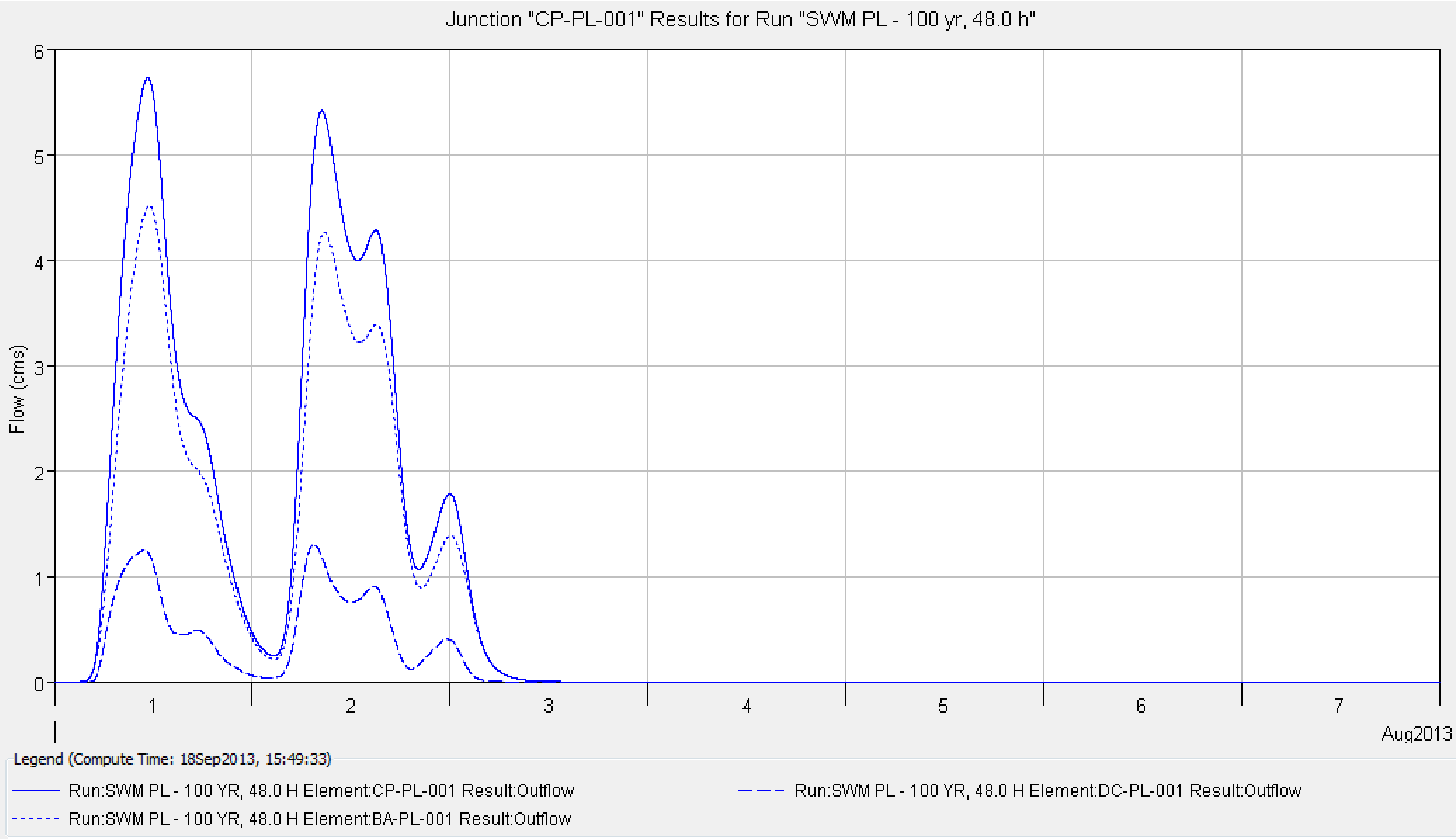
Junction "CP-PL-083" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:CP-PL-083 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:BA-PL-061 Result:Outflow



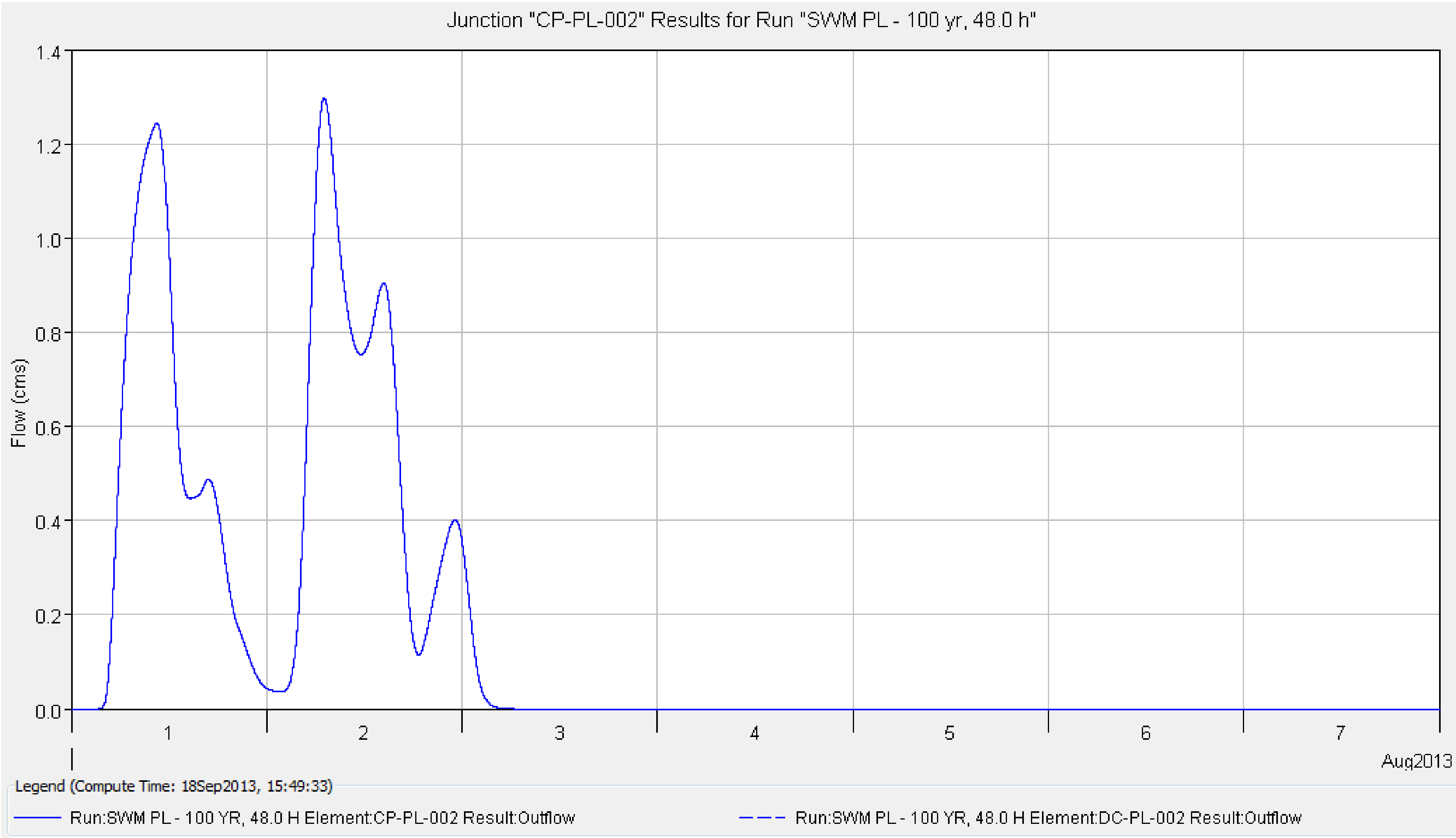
Sink "Chindwin River" Results for Run "SWM PL - 100 yr, 06.0 h"
120
100
80
60
40
20
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 21Sep2013, 10:48:53)
Run:SWM PL - 100 YR, 06.0 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-001 Result:Outflow

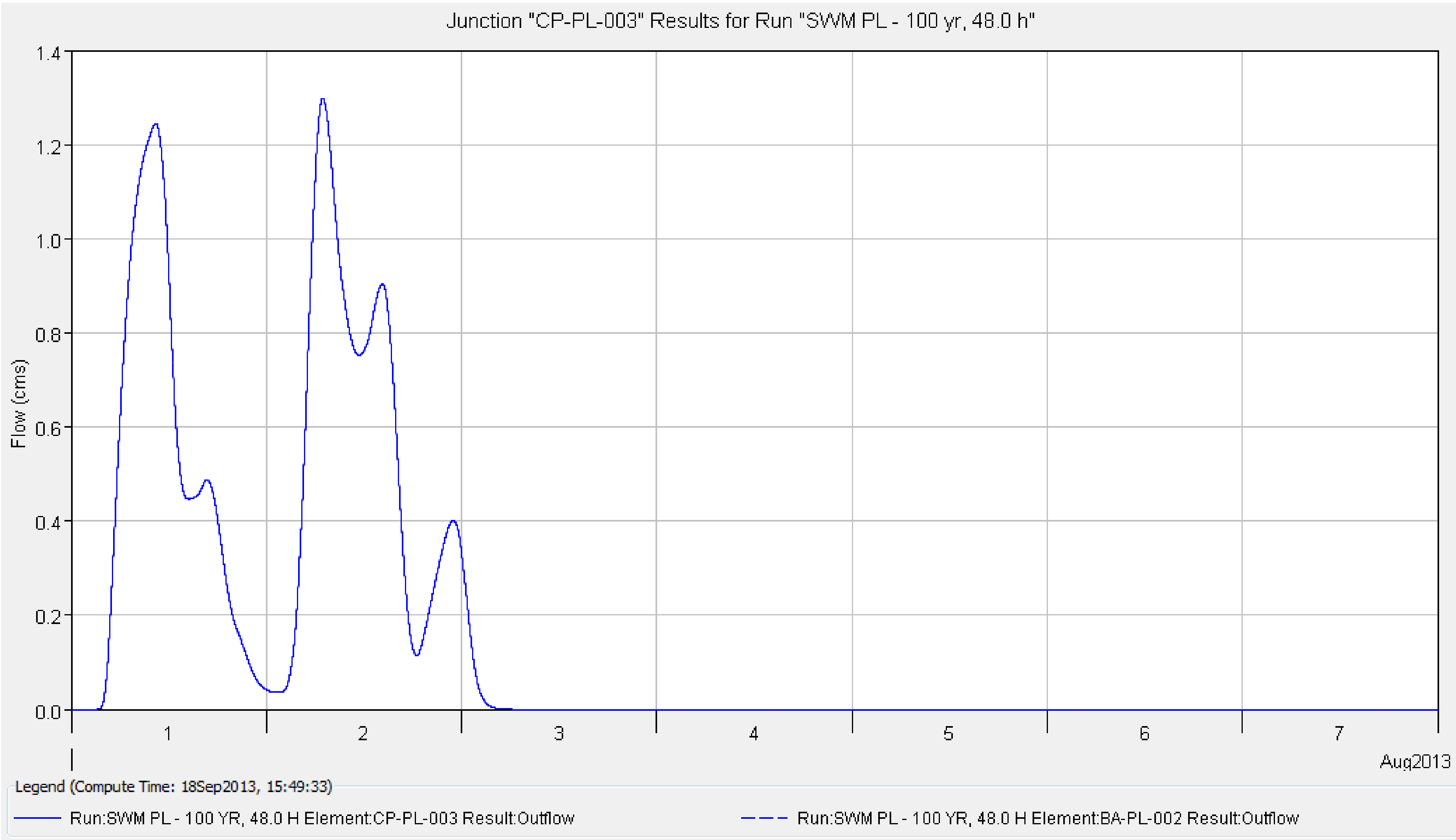


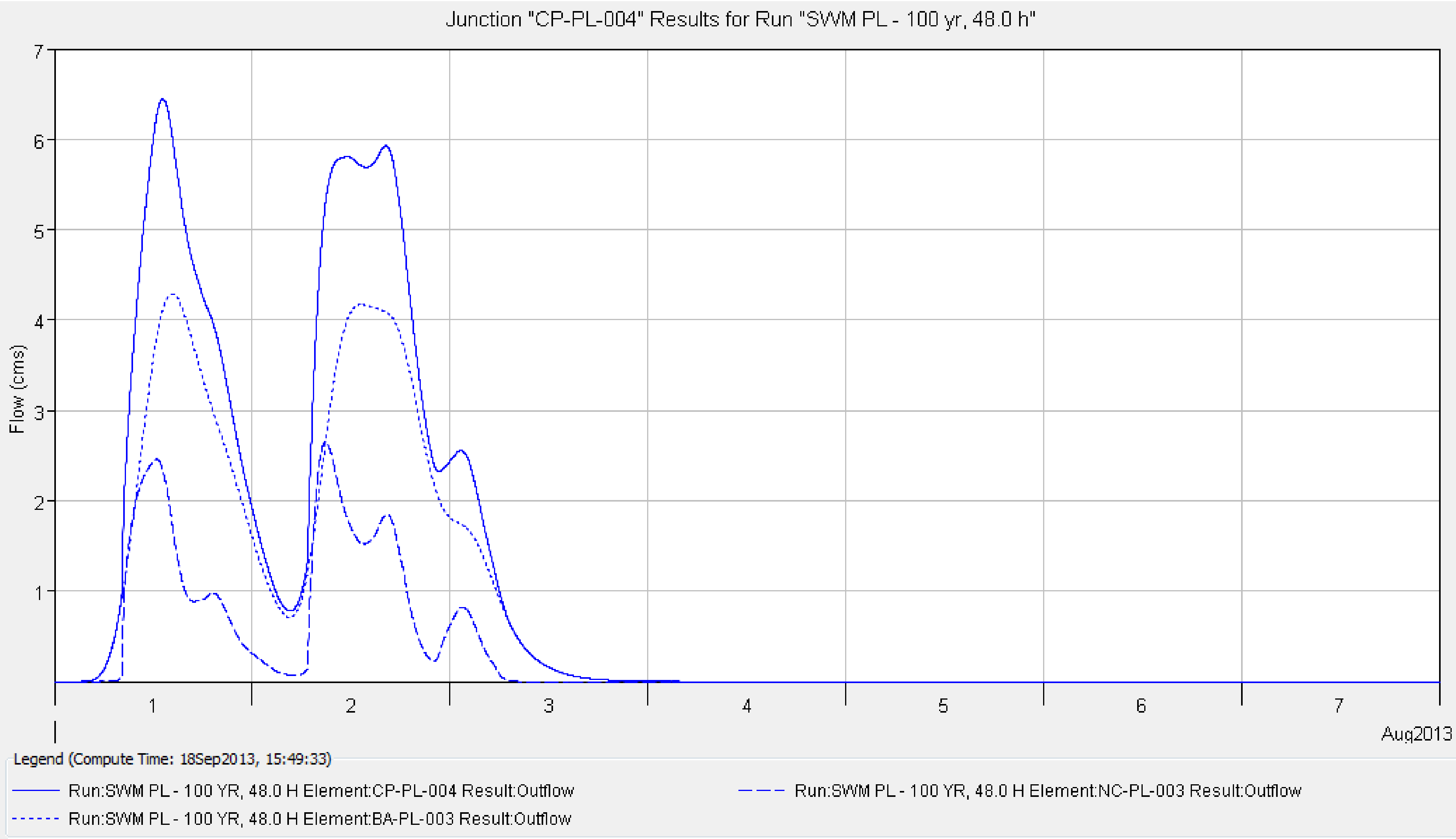
Sink "Yama Stream" Results for Run "SWM PL - 100 yr, 06.0 h"
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:44:49)
Run:SWM PL - 100 YR, 06.0 H Element:YAMA STREAM Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:CP-PL-076 Result:Outflow



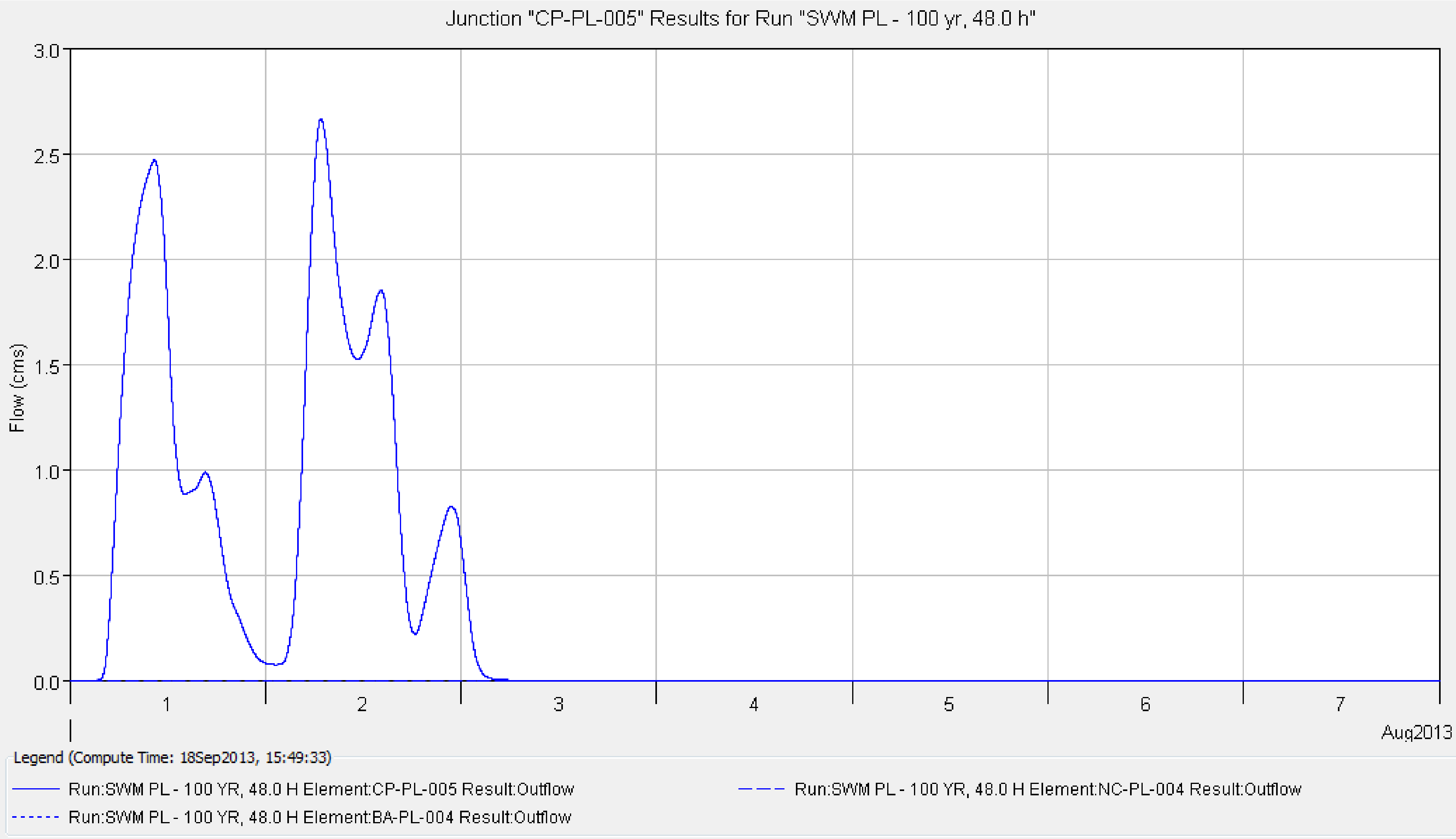
Junction "CP-PL-001" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-001 Result:Outflow


Junction "CP-PL-002" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-002 Result:Outflow

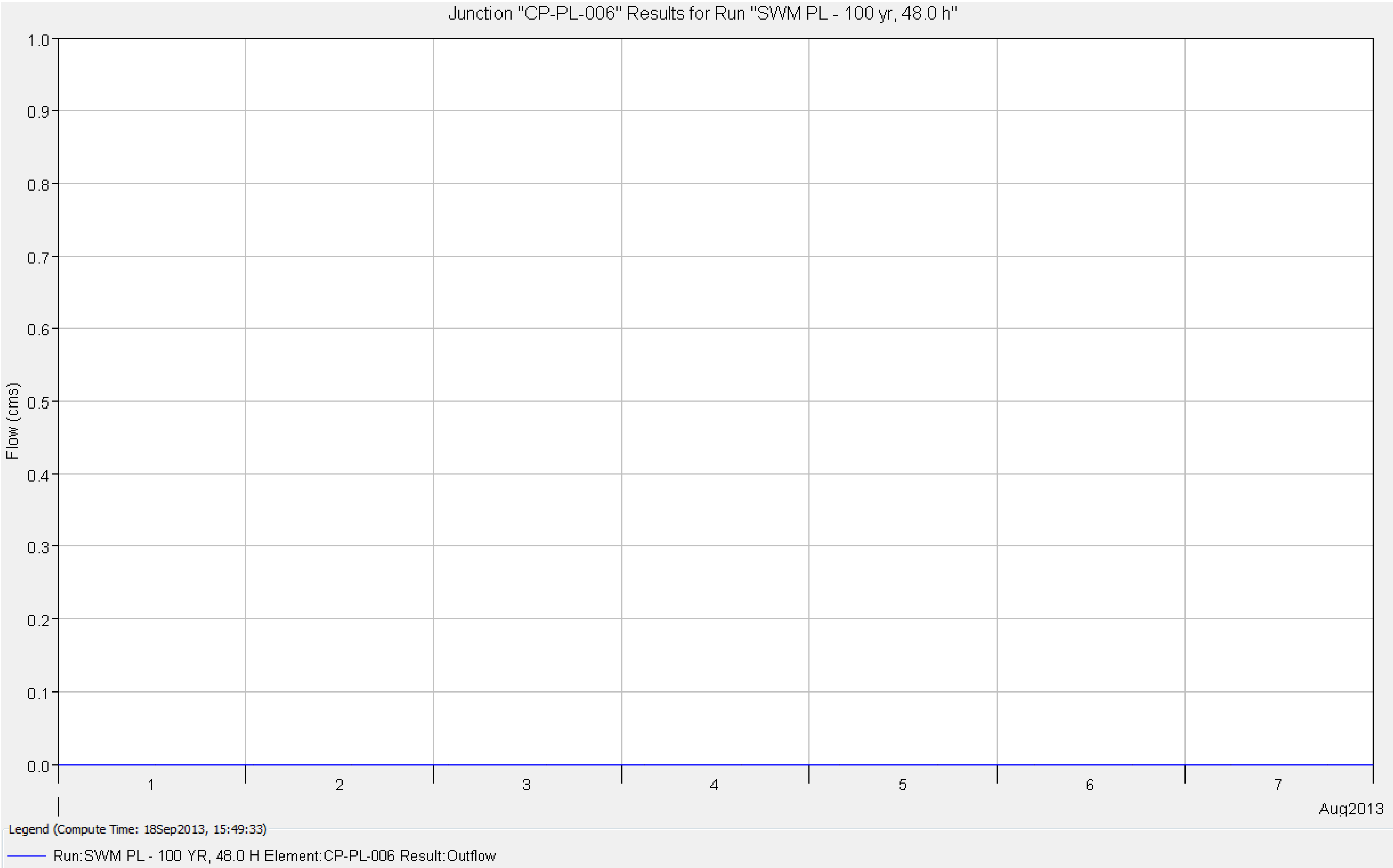

Junction "CP-PL-003" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-002 Result:Outflow



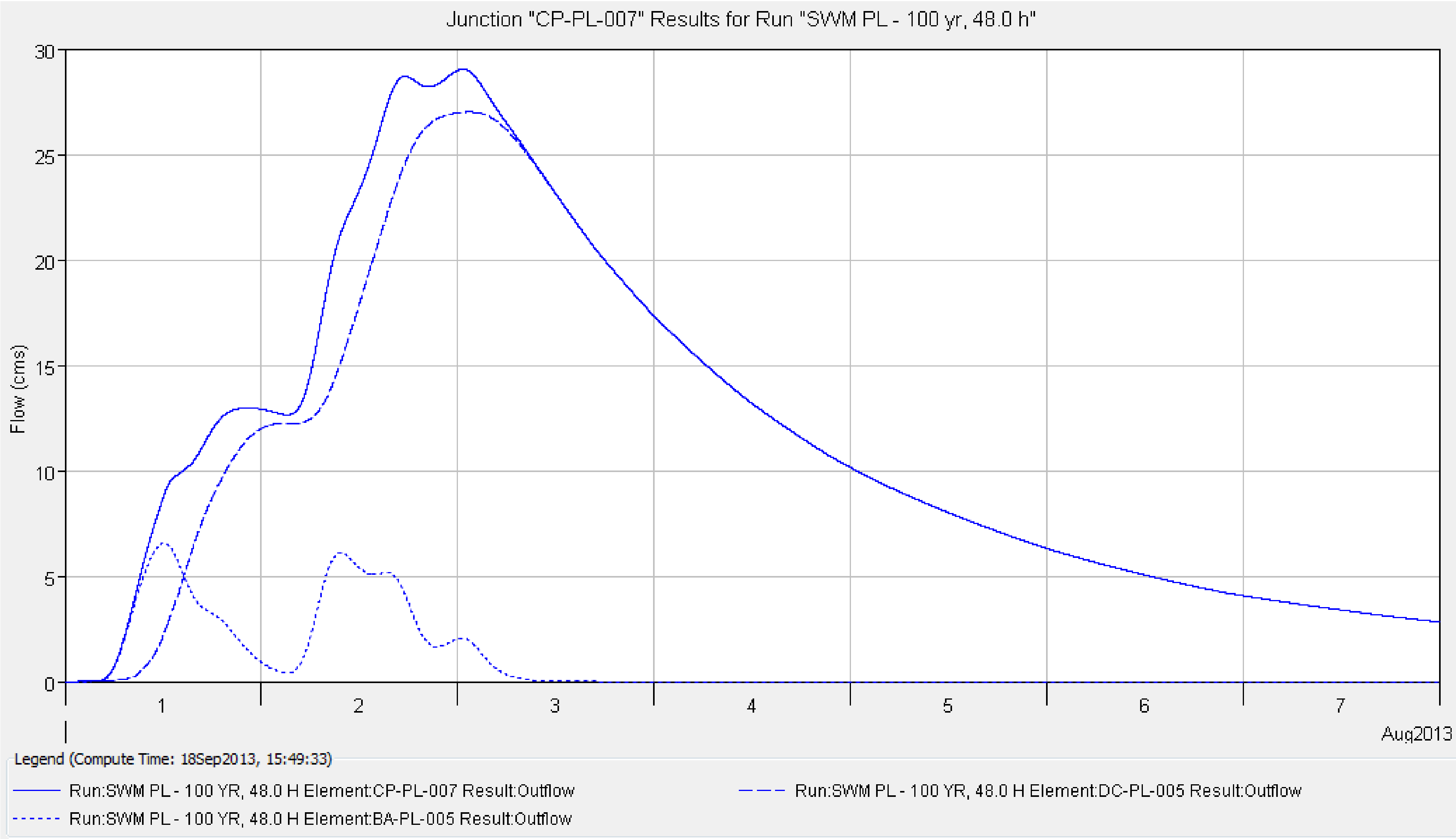
Junction "CP-PL-004" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
7
6
5
4
3
2
1
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-003 Result:Outflow



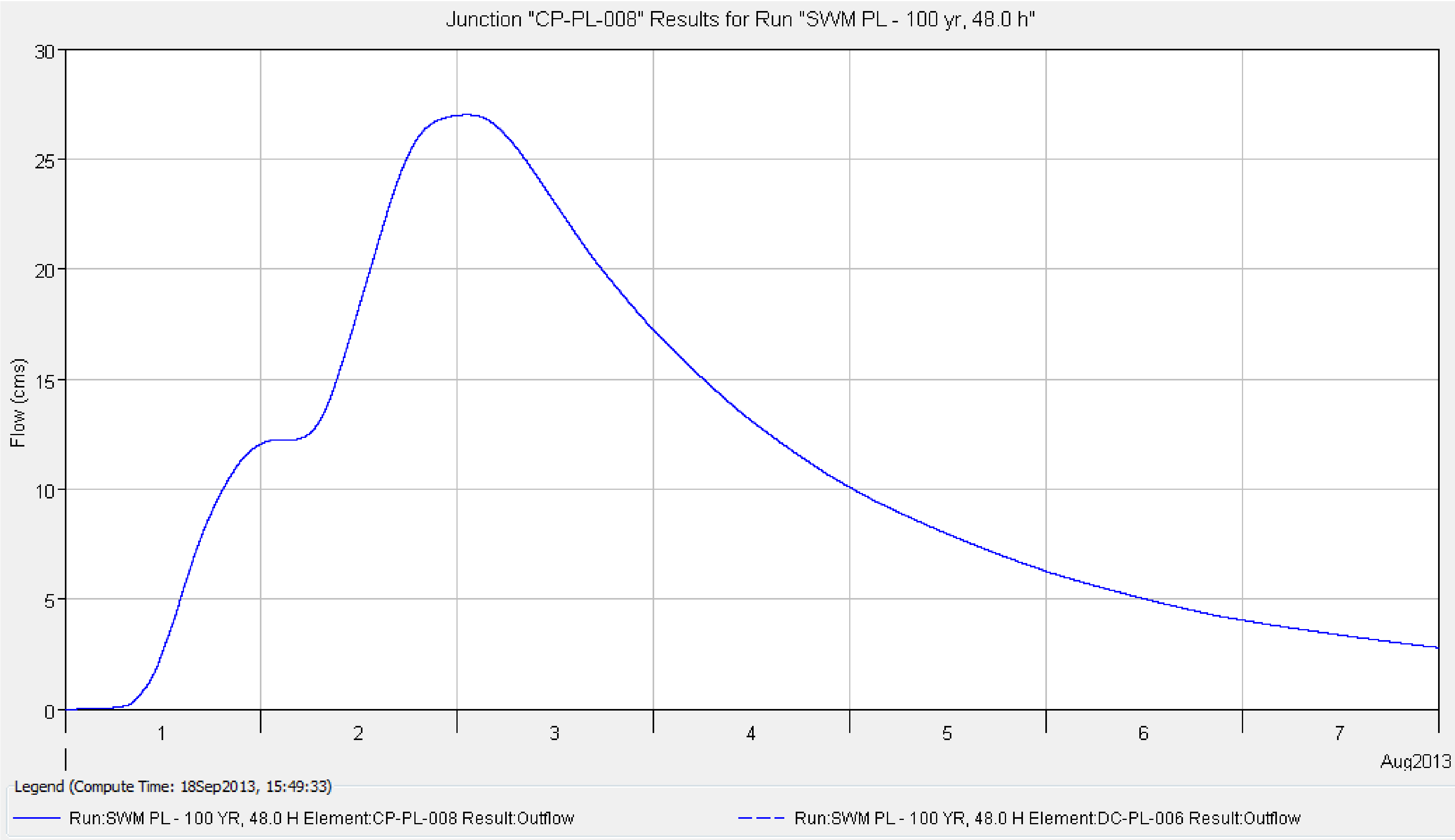
Junction "CP-PL-005" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-004 Result:Outflow



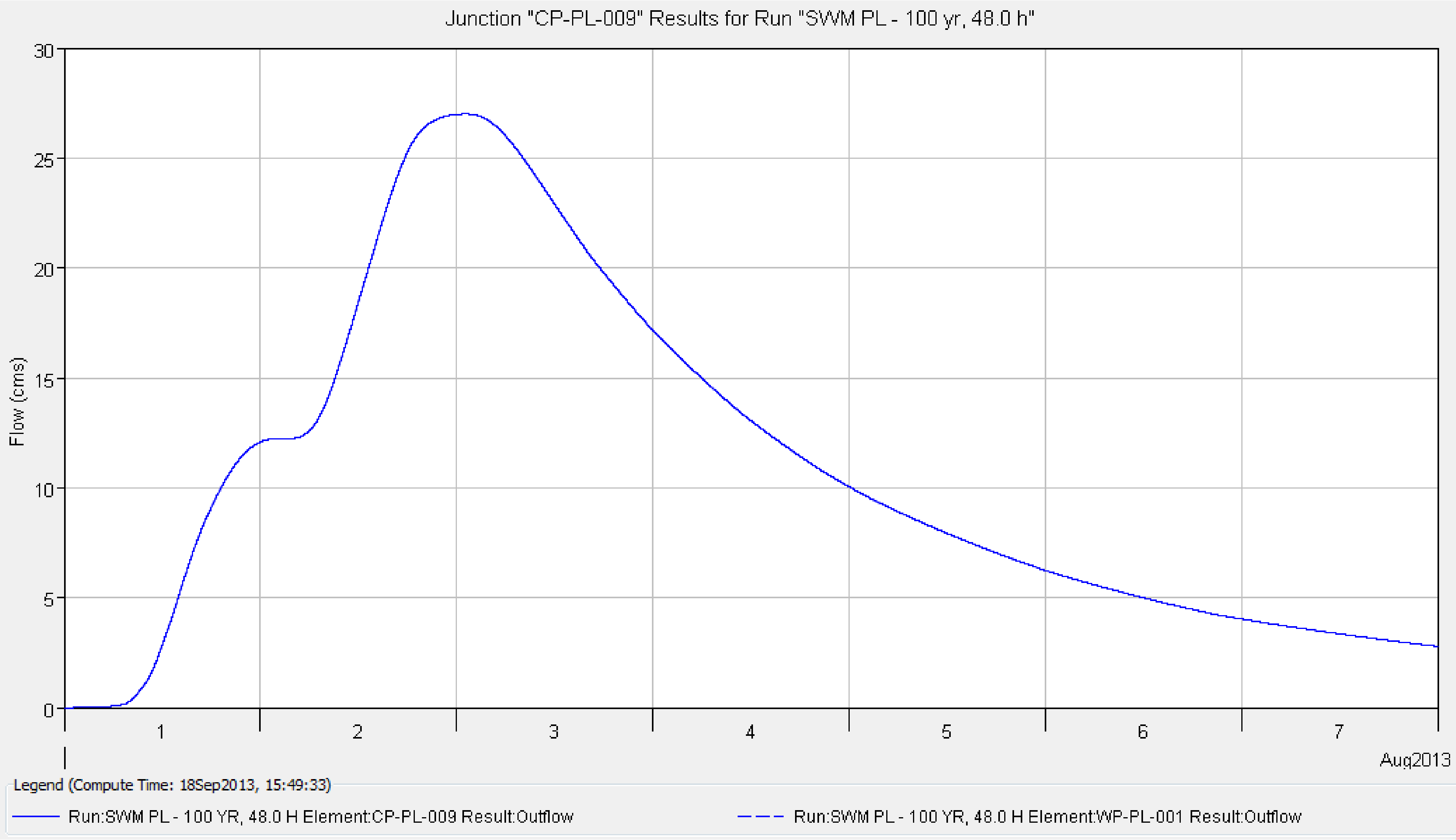
Junction "CP-PL-006" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-006 Result:Outflow



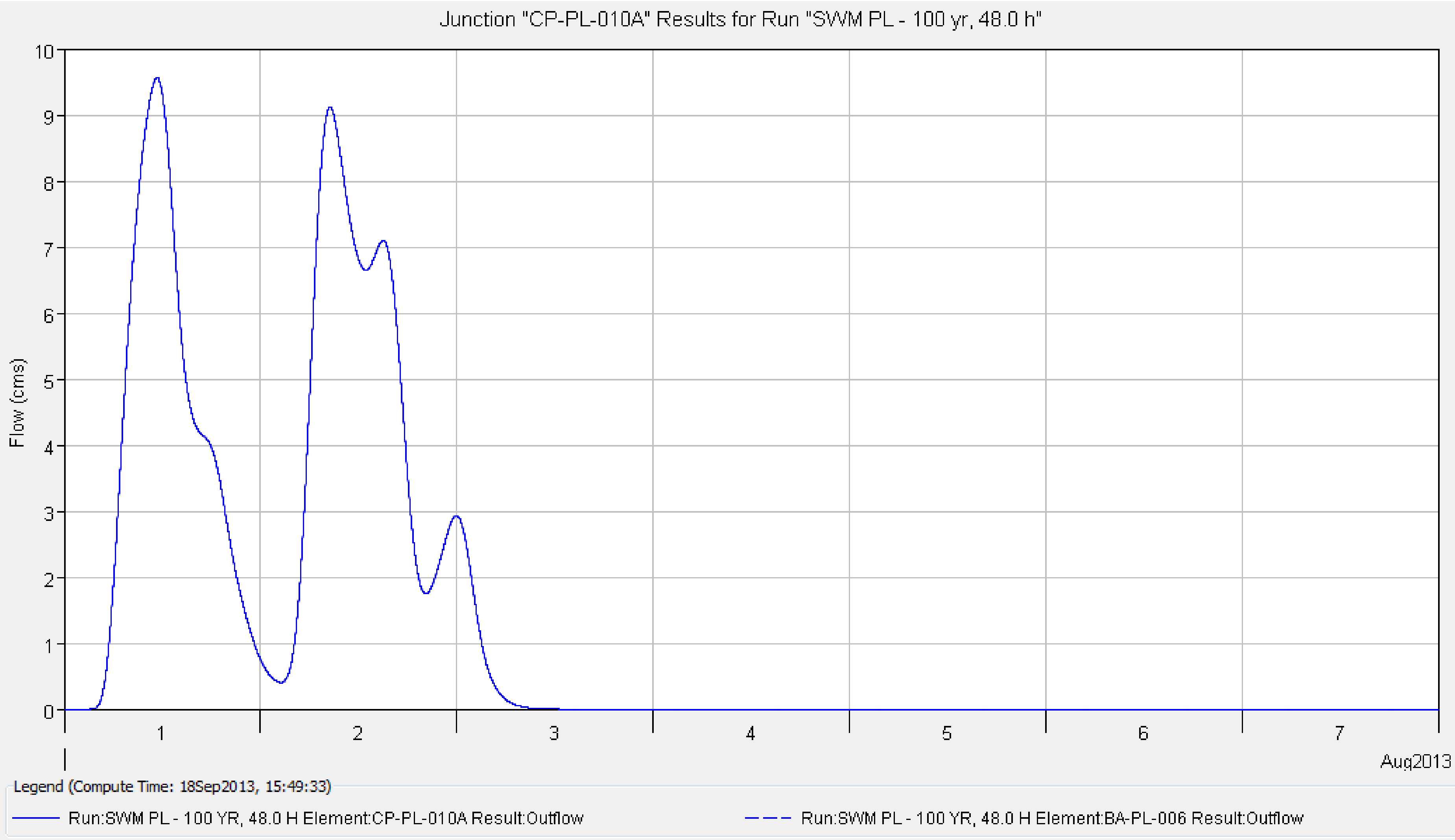
Junction "CP-PL-007" Results for Run "SWM PL - 100 yr, 48.0 h"
30
25
20
15
10
5
0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-005 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-005 Result:Outflow



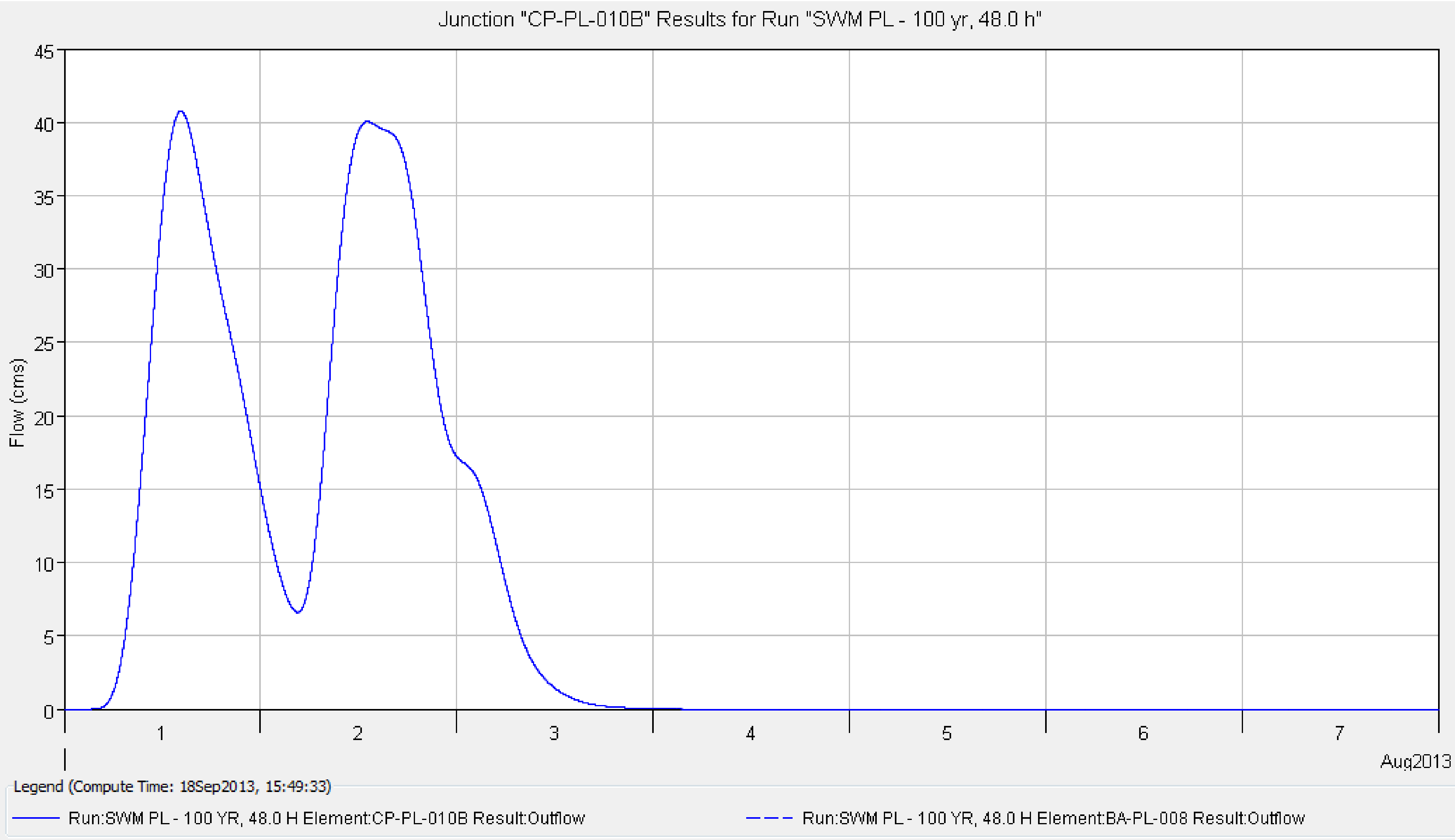
Junction "CP-PL-008" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-006 Result:Outflow



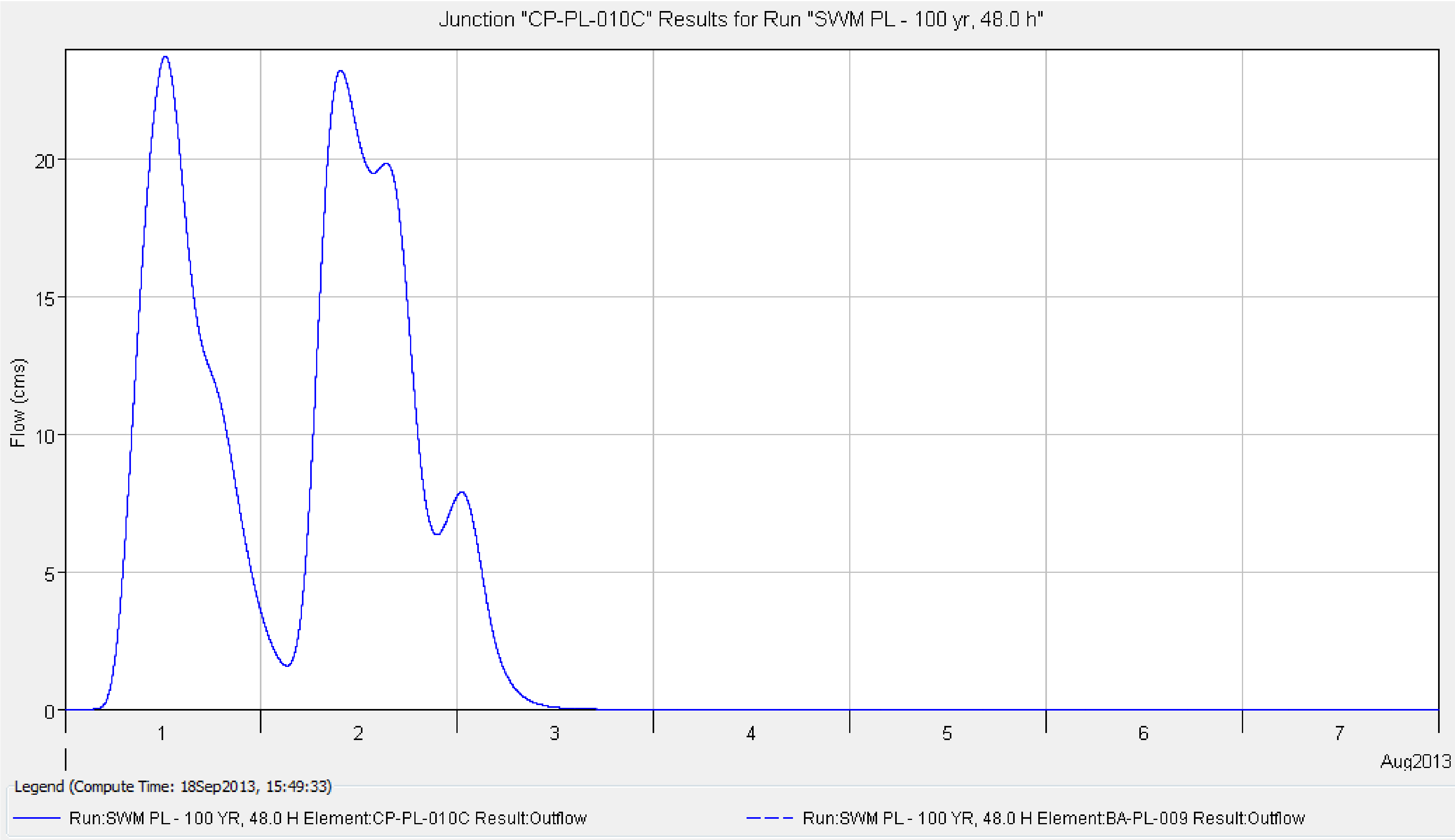
Junction "CP-PL-009" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Outflow



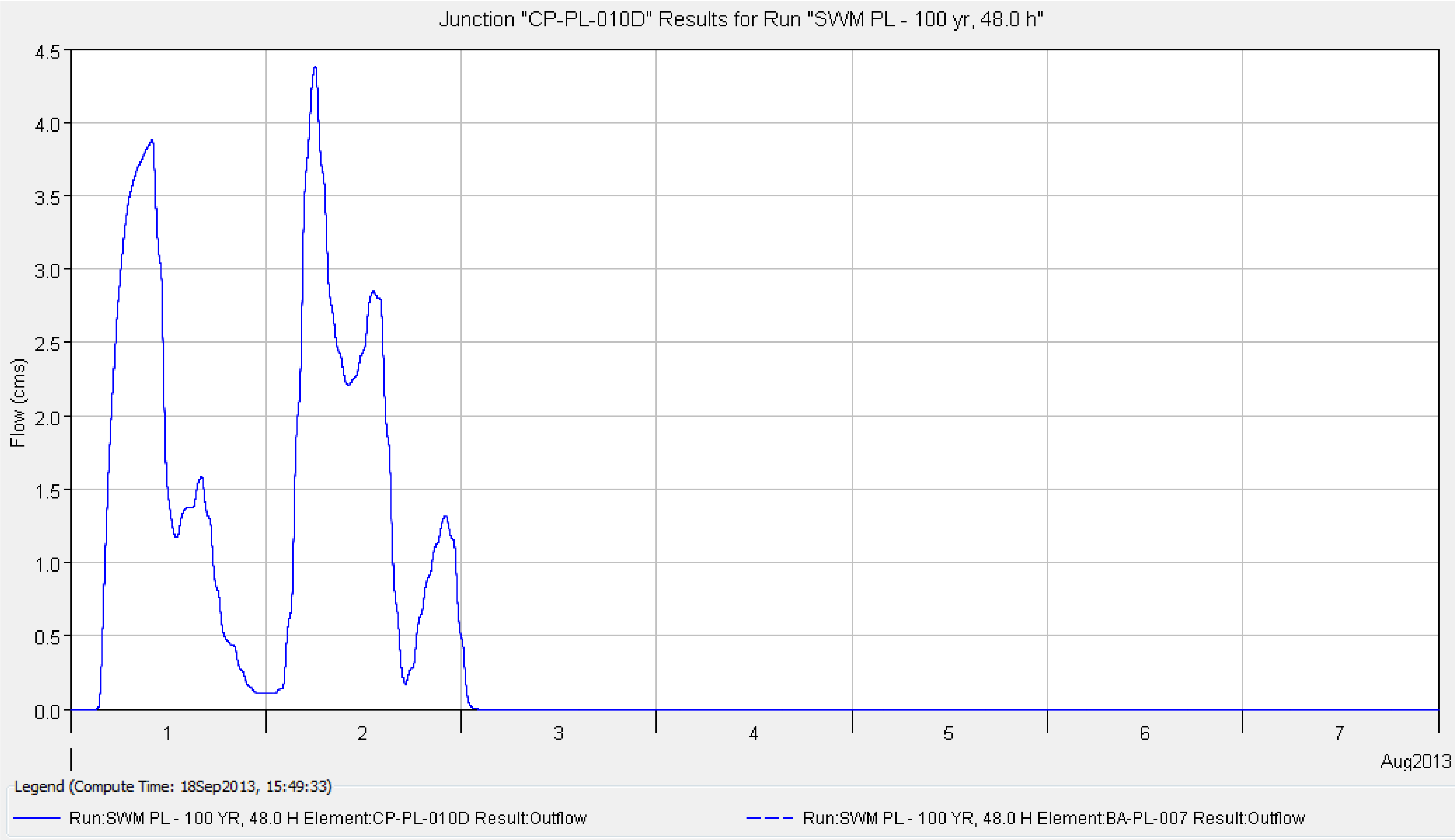
Junction "CP-PL-010A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-006 Result:Outflow



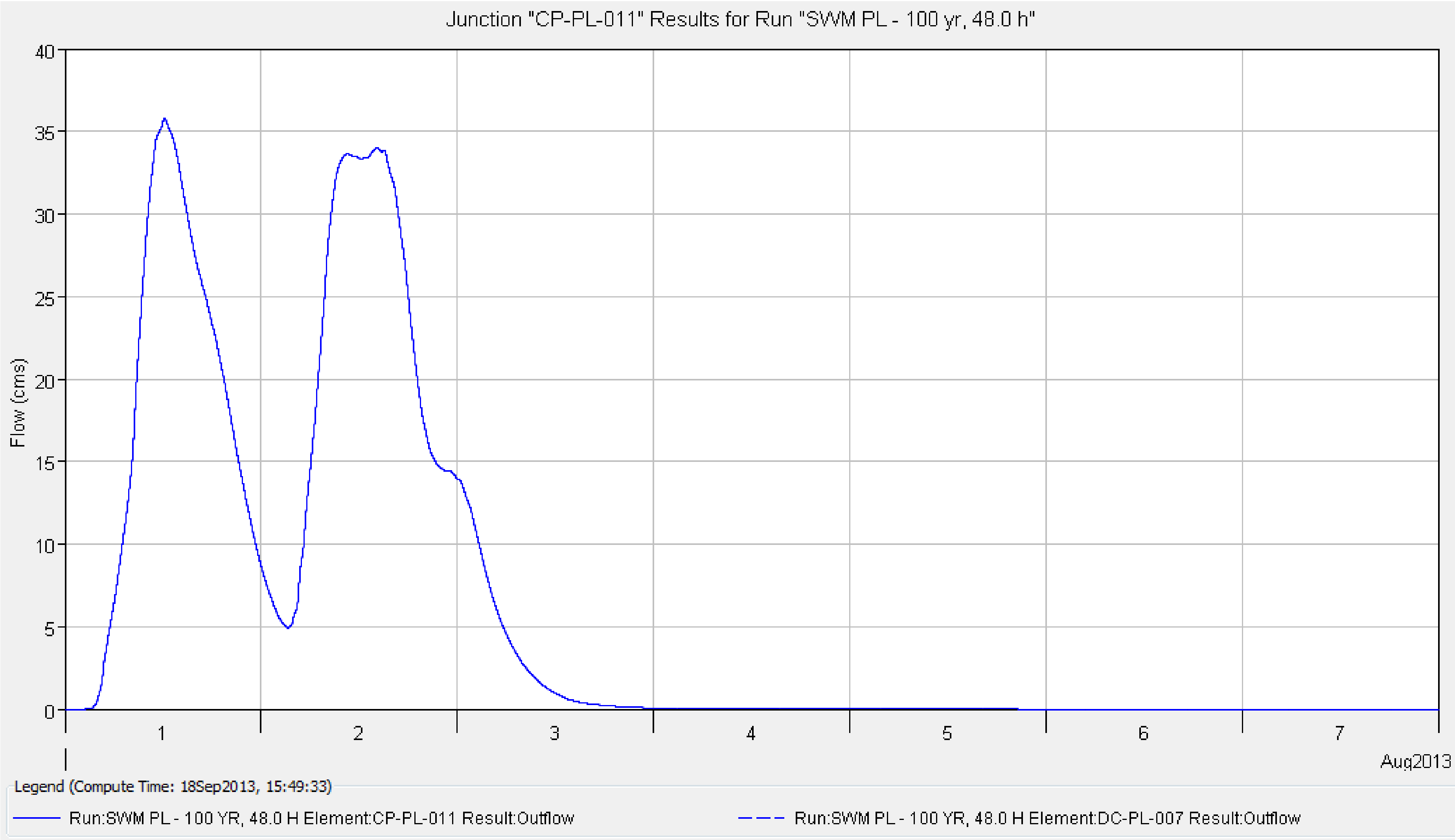
Junction "CP-PL-010B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-008 Result:Outflow

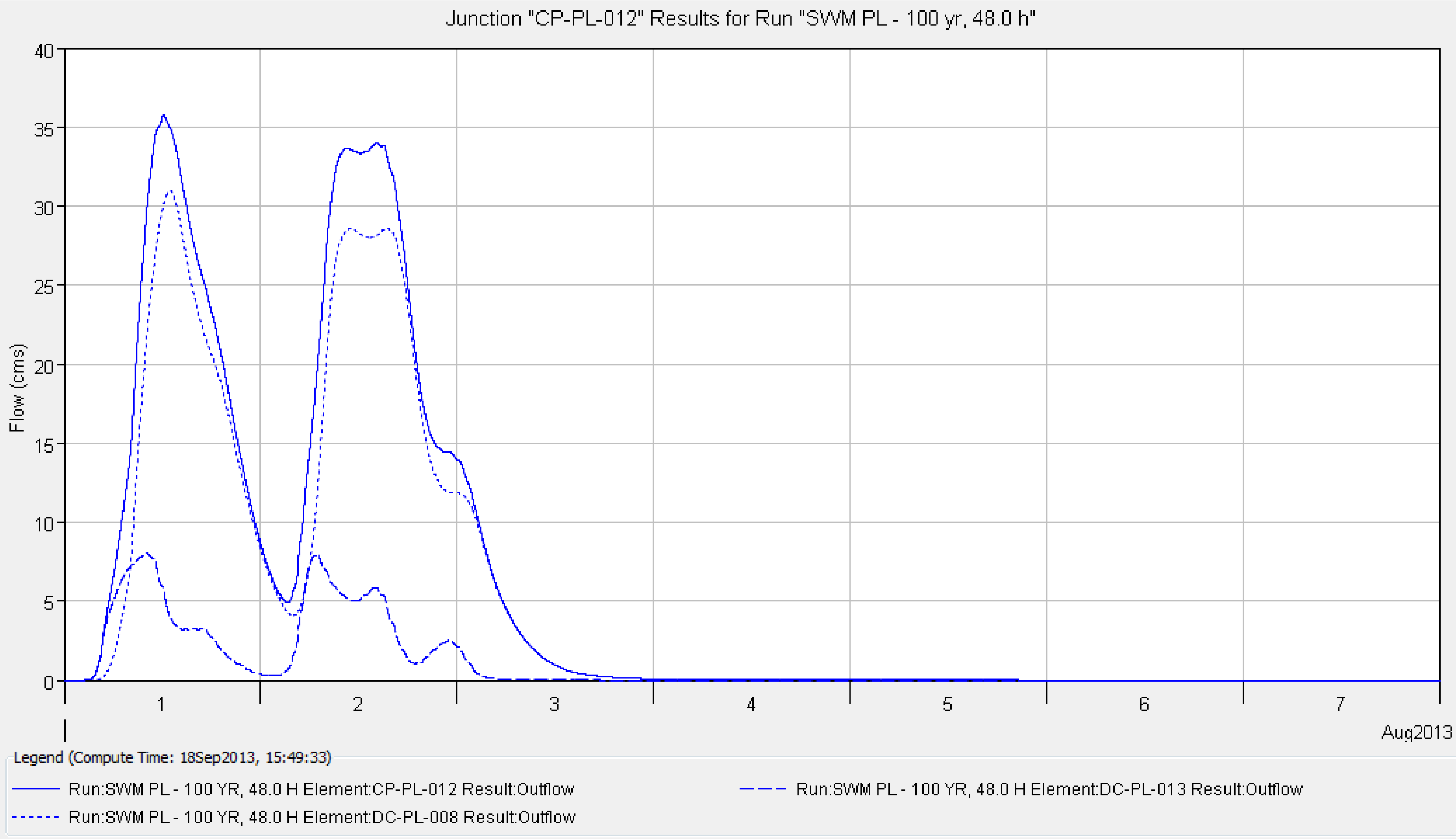


Junction "CP-PL-010C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-009 Result:Outflow

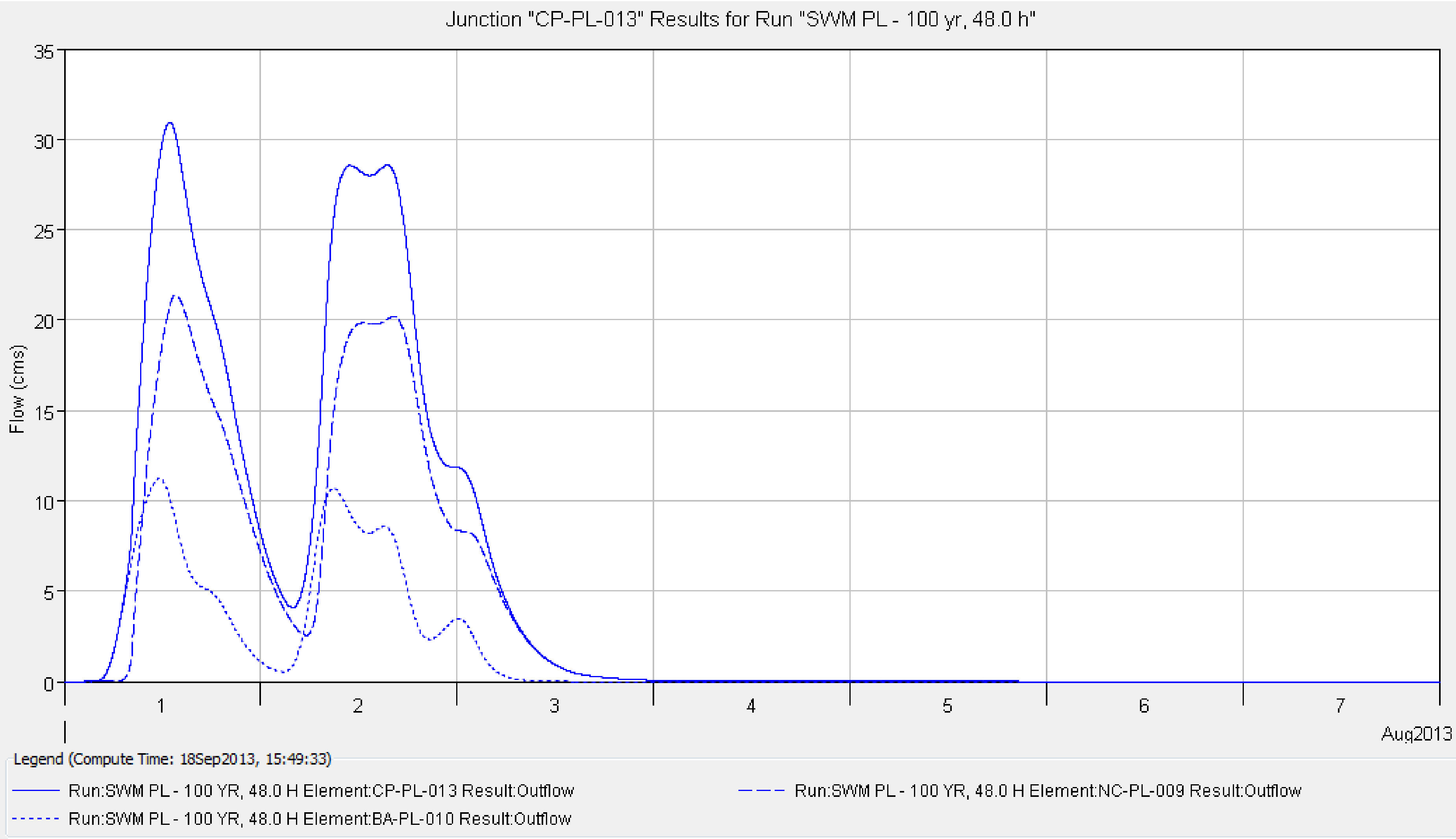


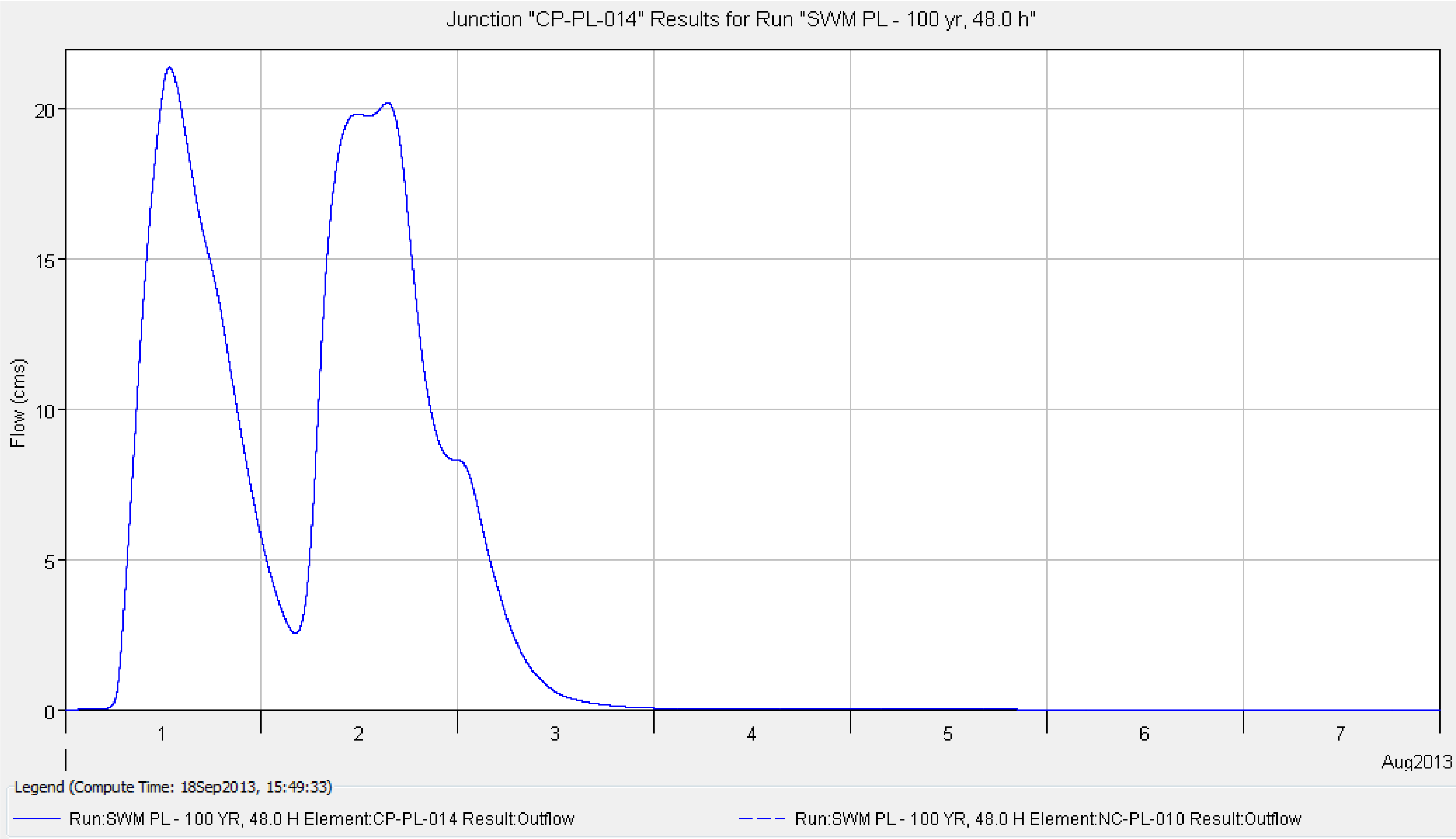
Junction "CP-PL-010D" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-010D Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-007 Result:Outflow


Junction "CP-PL-011" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-007 Result:Outflow

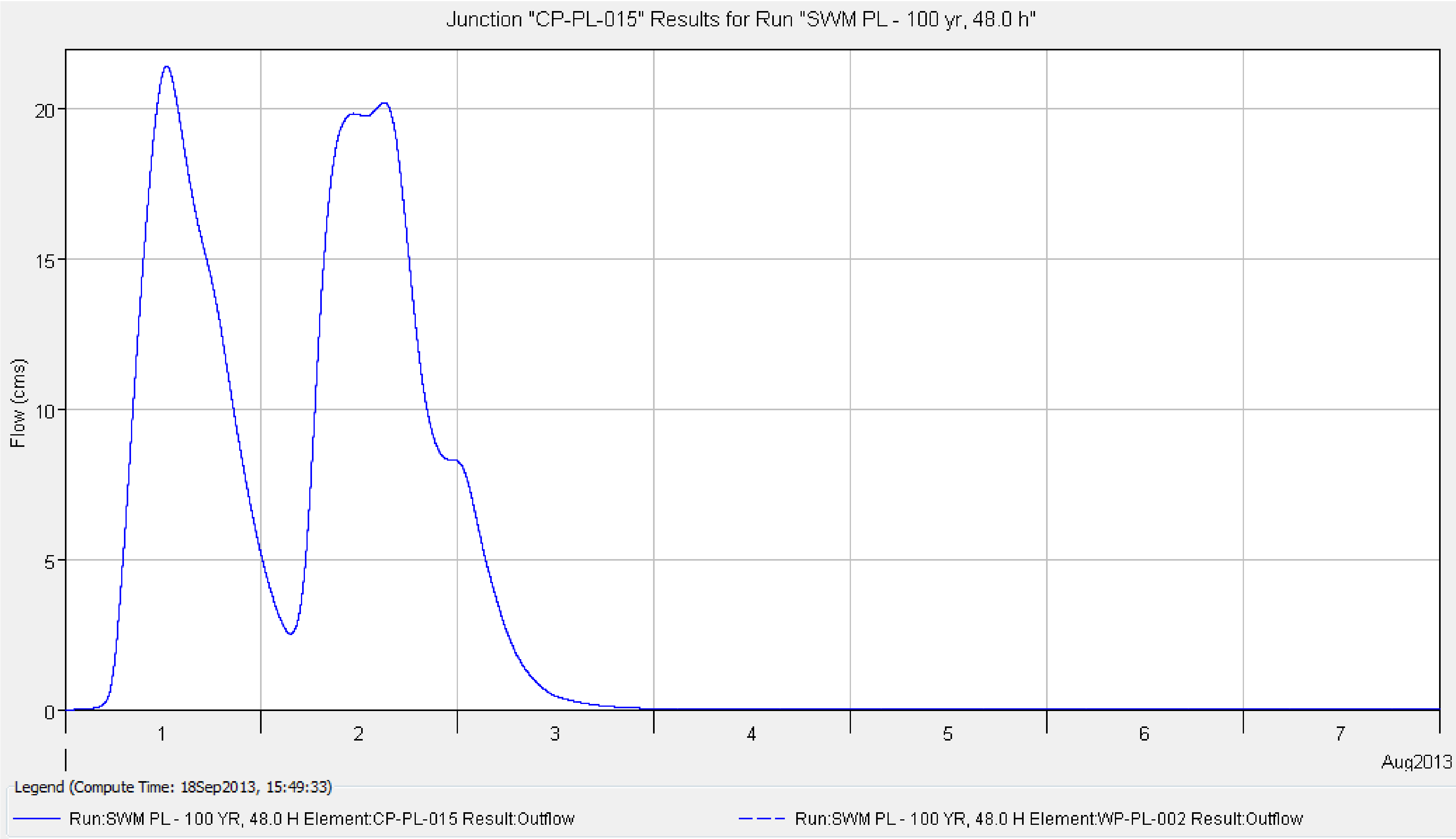


Junction "CP-PL-012" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-008 Result:Outflow

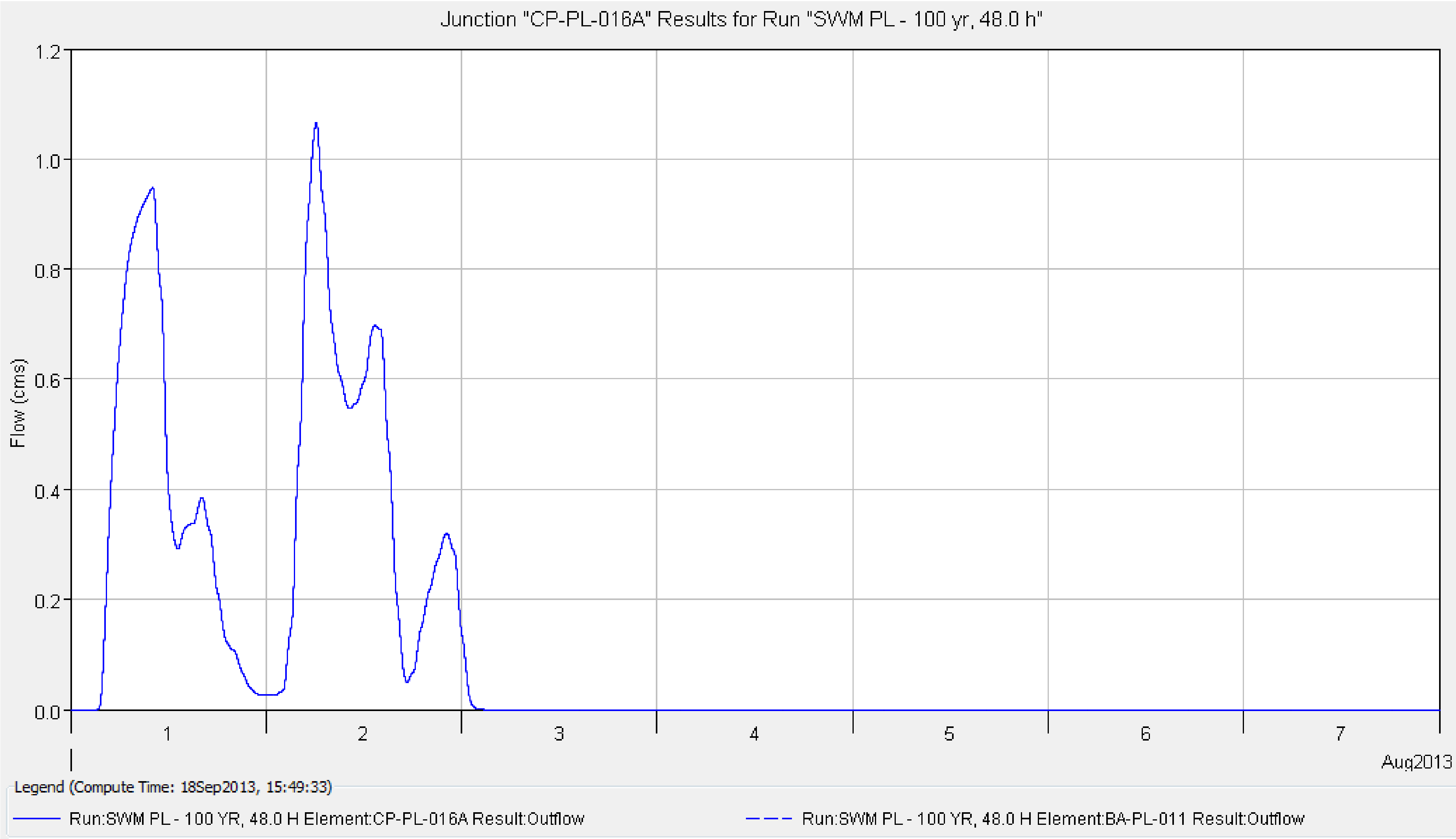

Junction "CP-PL-013" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-013 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-010 Result:Outflow



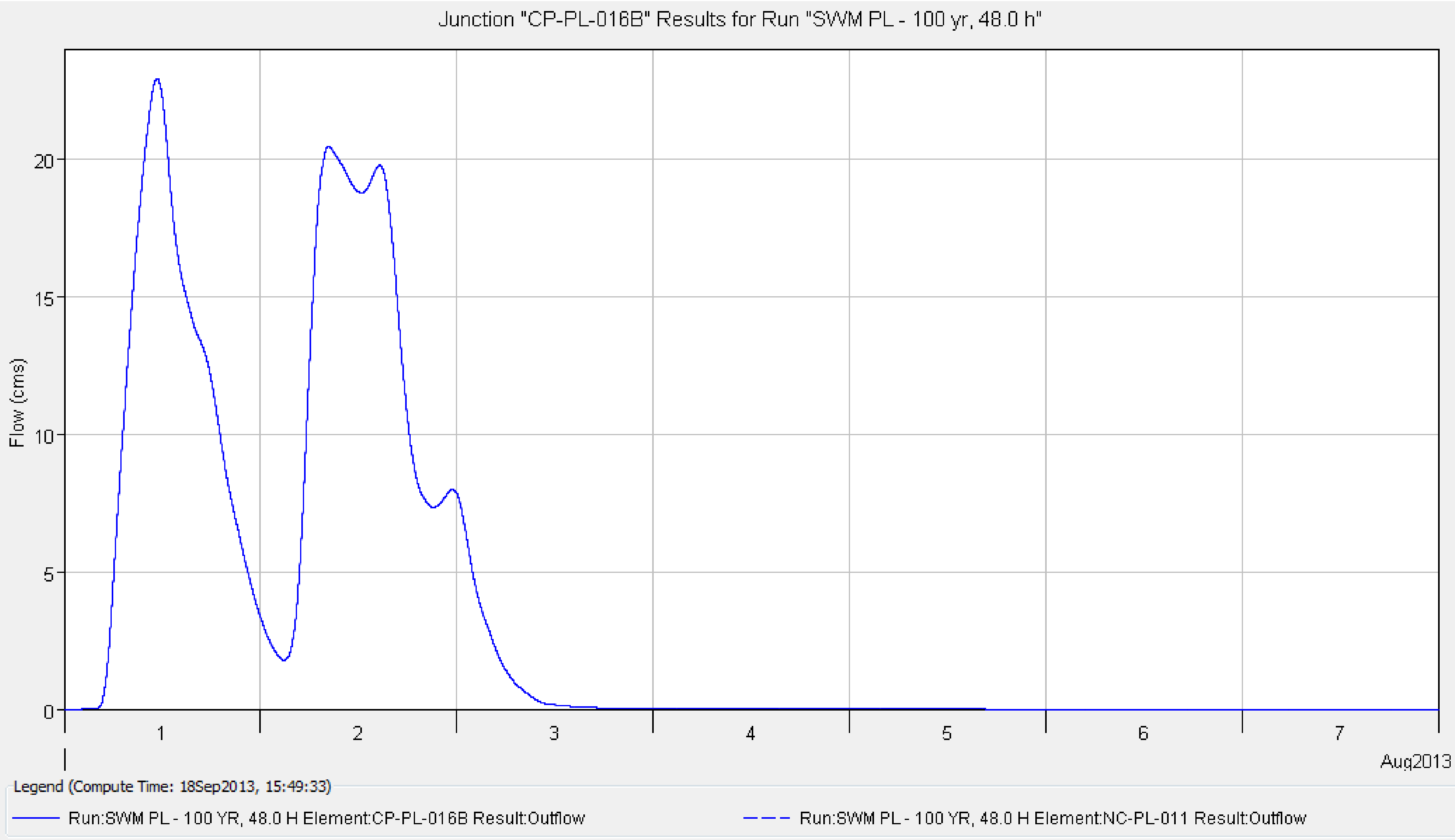
Junction "CP-PL-014" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-010 Result:Outflow



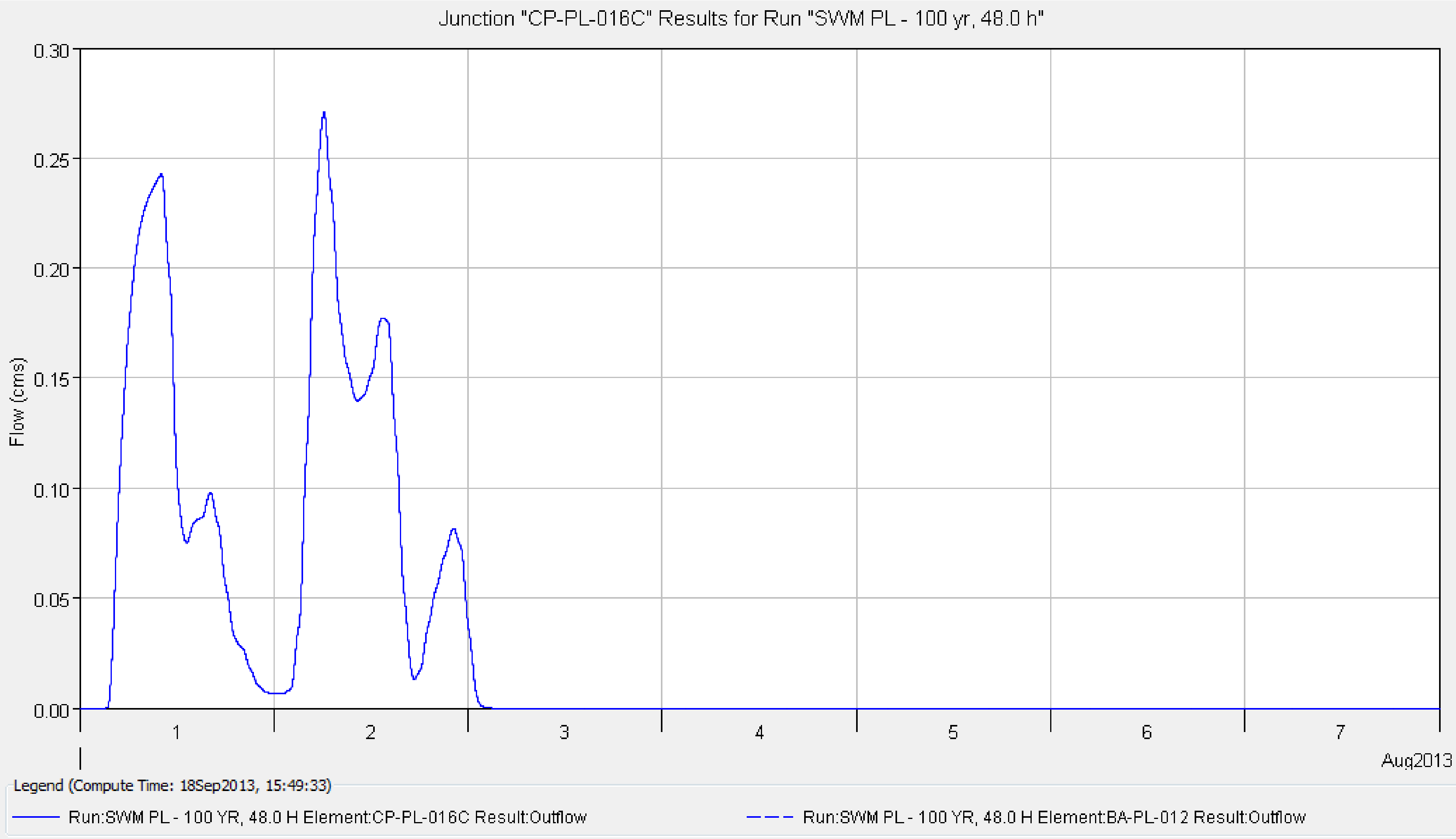
Junction "CP-PL-015" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-015 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Outflow

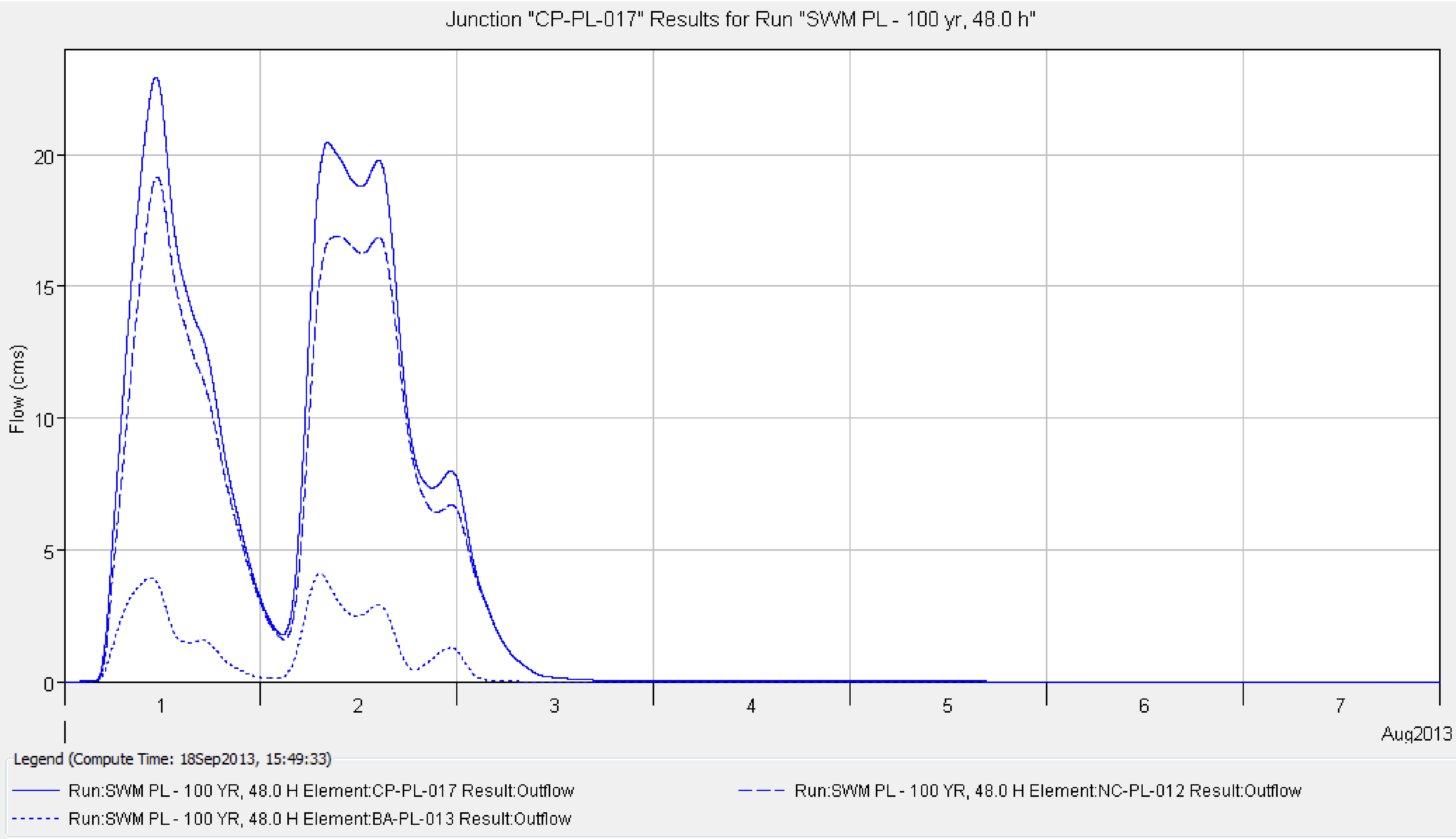


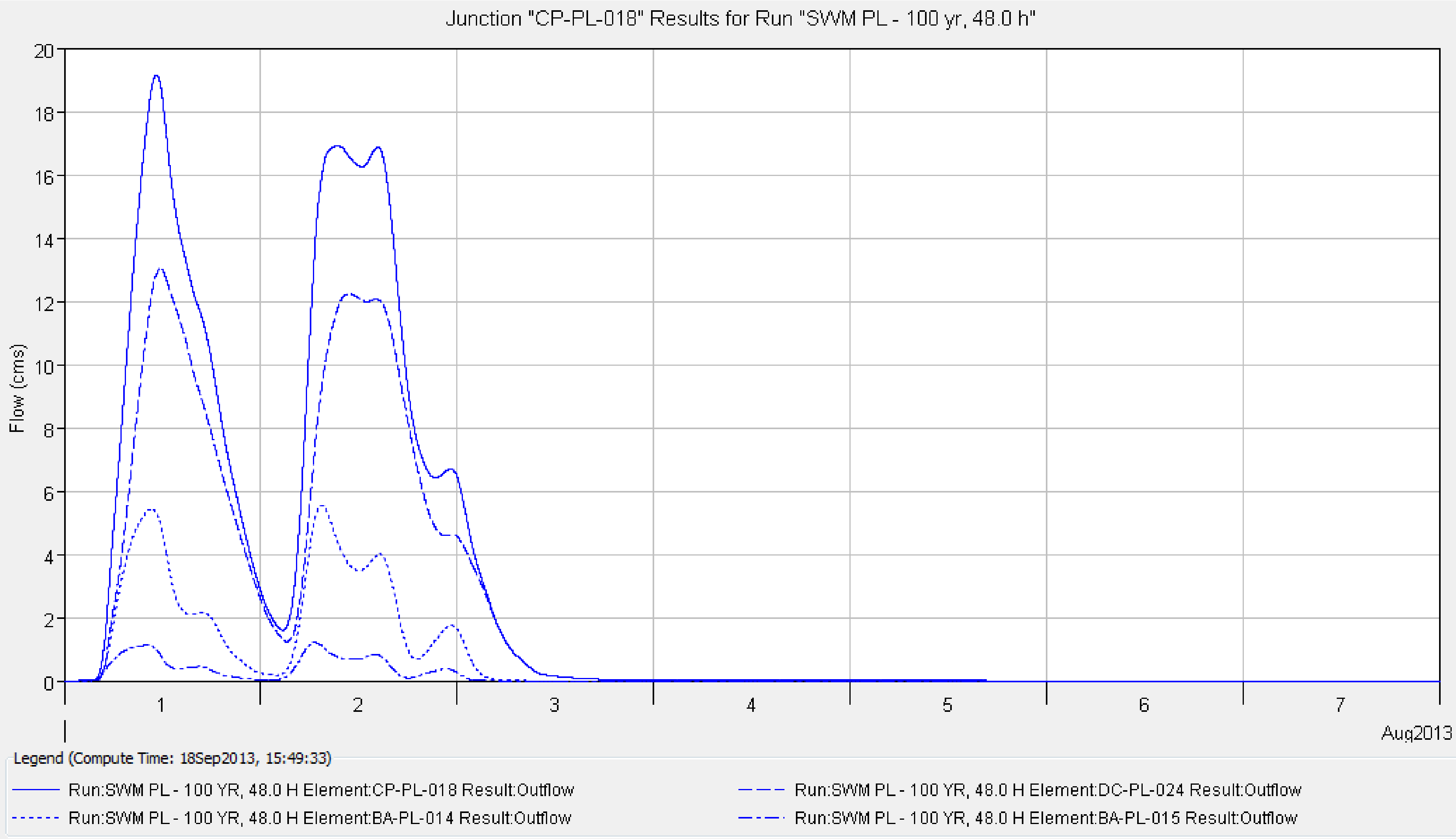
Junction "CP-PL-016A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-011 Result:Outflow



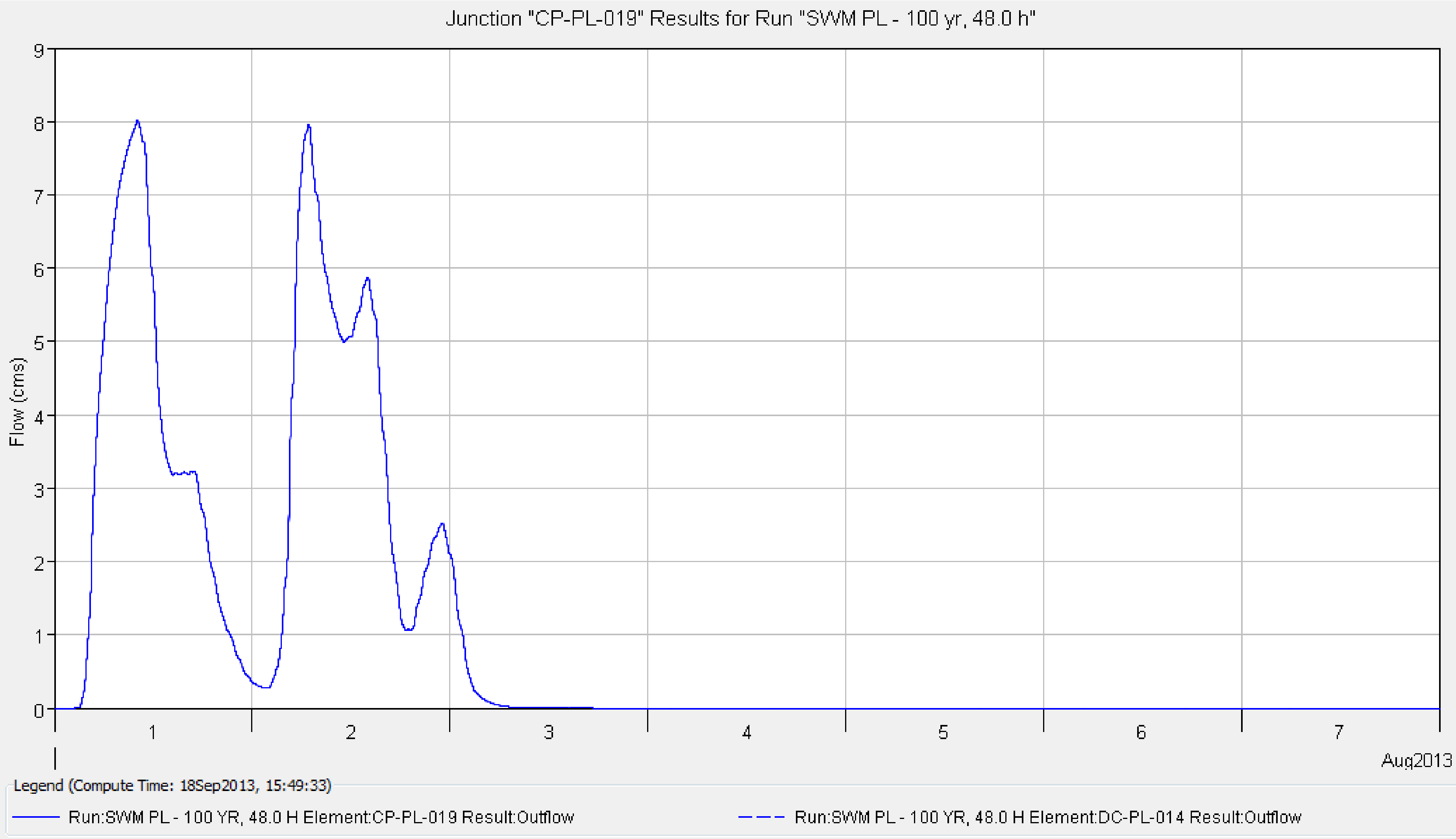
Junction "CP-PL-016B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-011 Result:Outflow

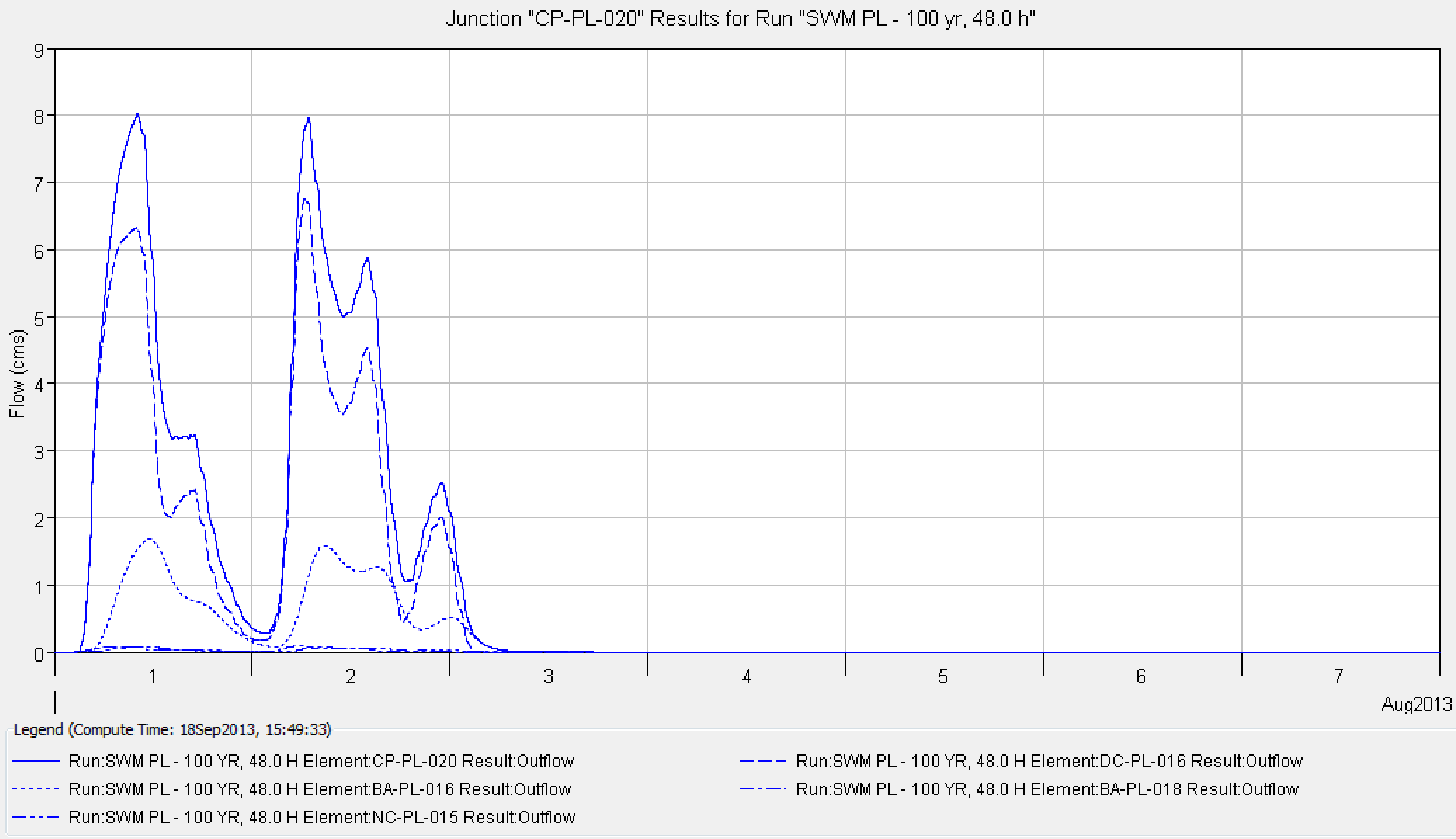

Junction "CP-PL-016C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-016C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-012 Result:Outflow


Junction "CP-PL-017" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
5
10
15
20
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-012 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-013 Result:Outflow

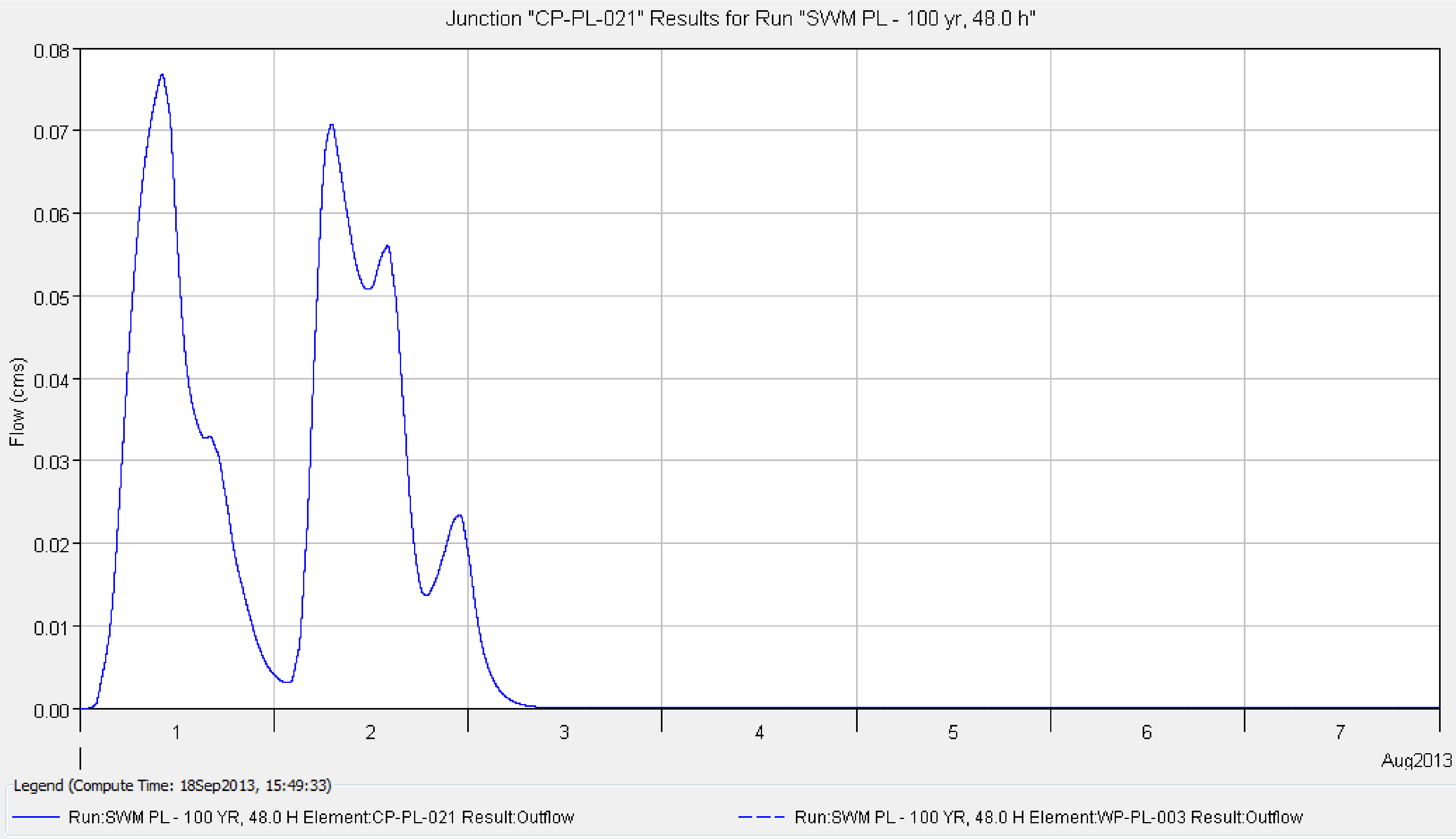


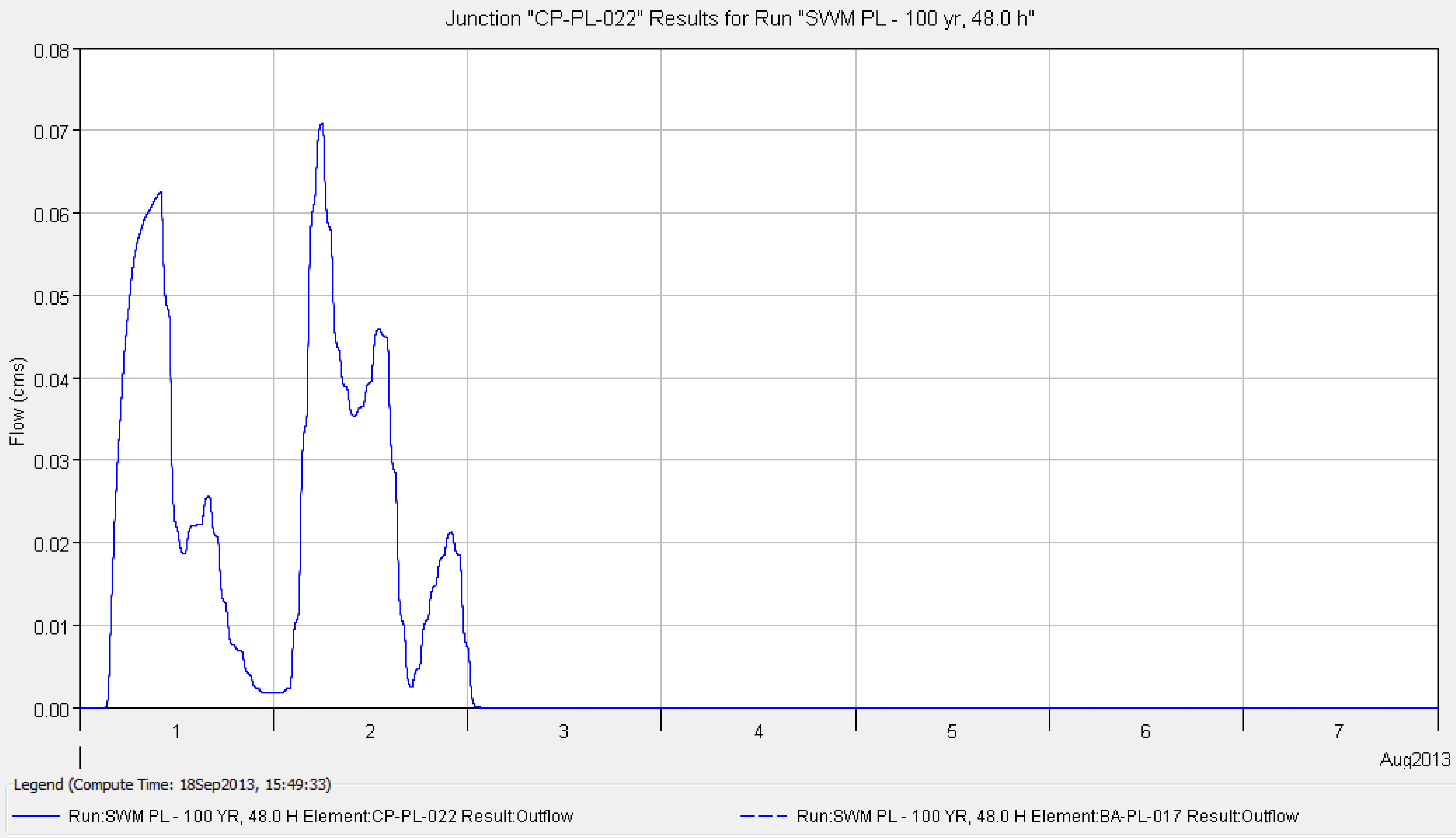
Junction "CP-PL-018" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-014 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-015 Result:Outflow


Junction "CP-PL-019" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-014 Result:Outflow

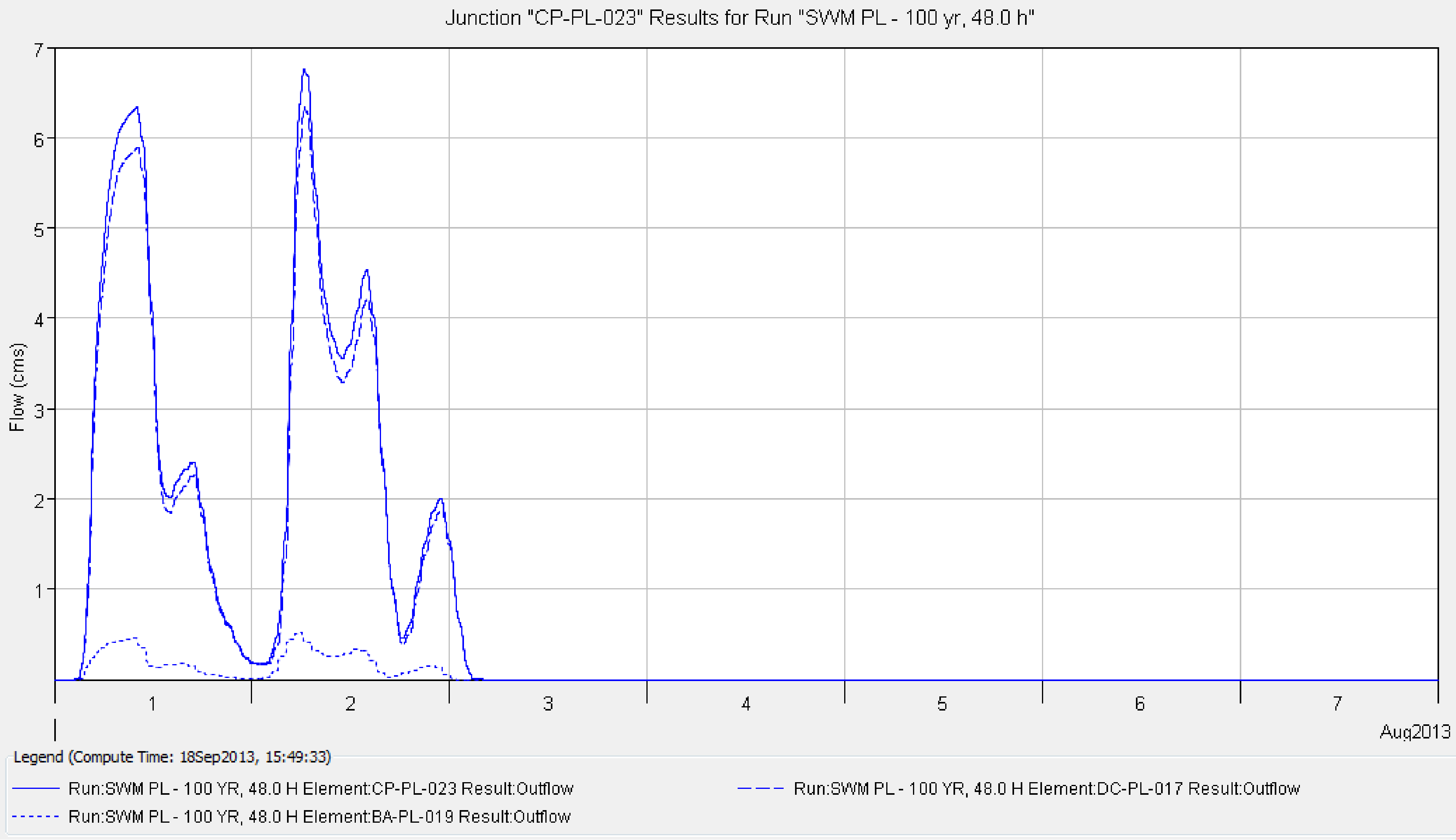


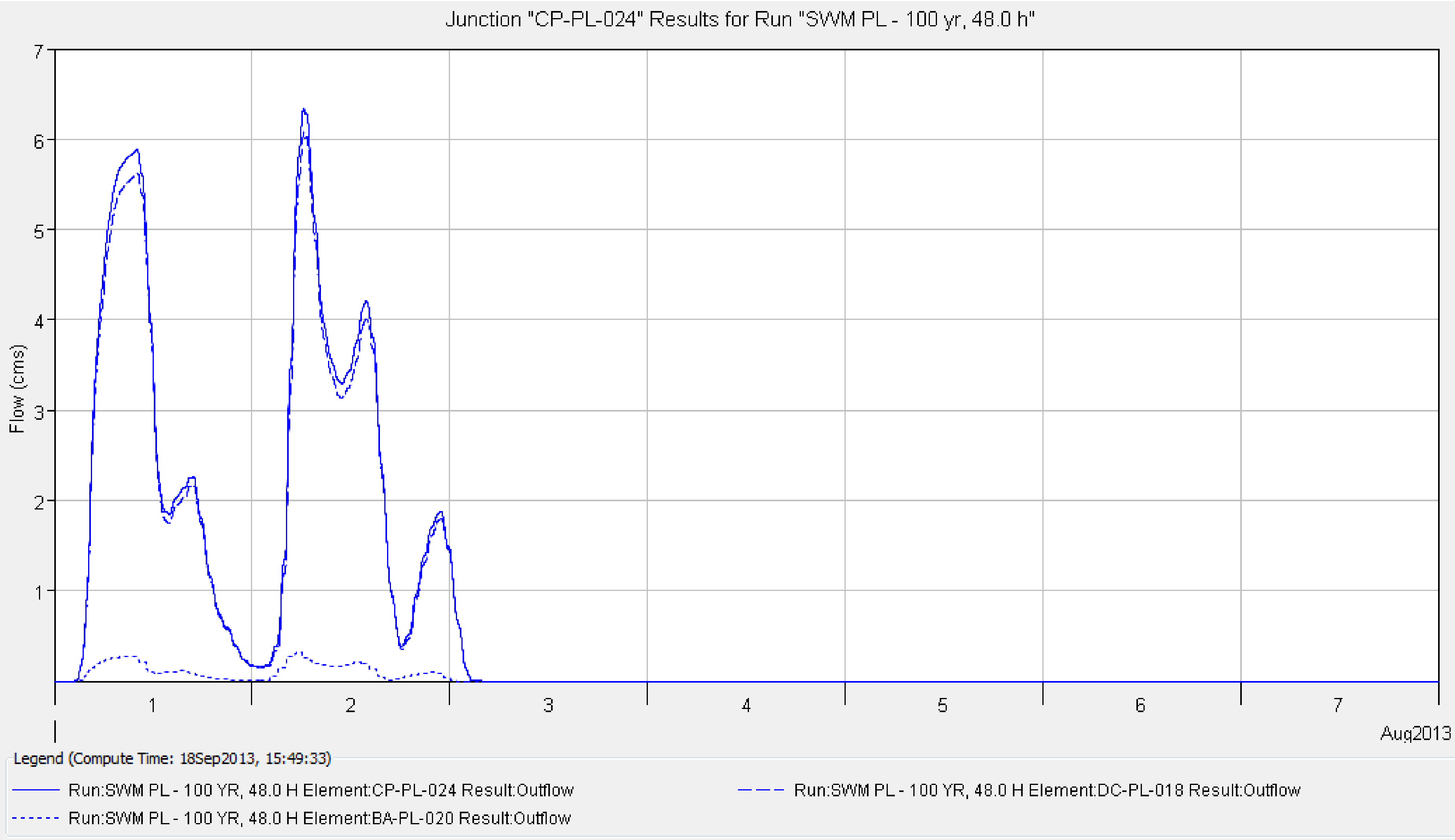
Junction "CP-PL-020" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-016 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-015 Result:Outflow

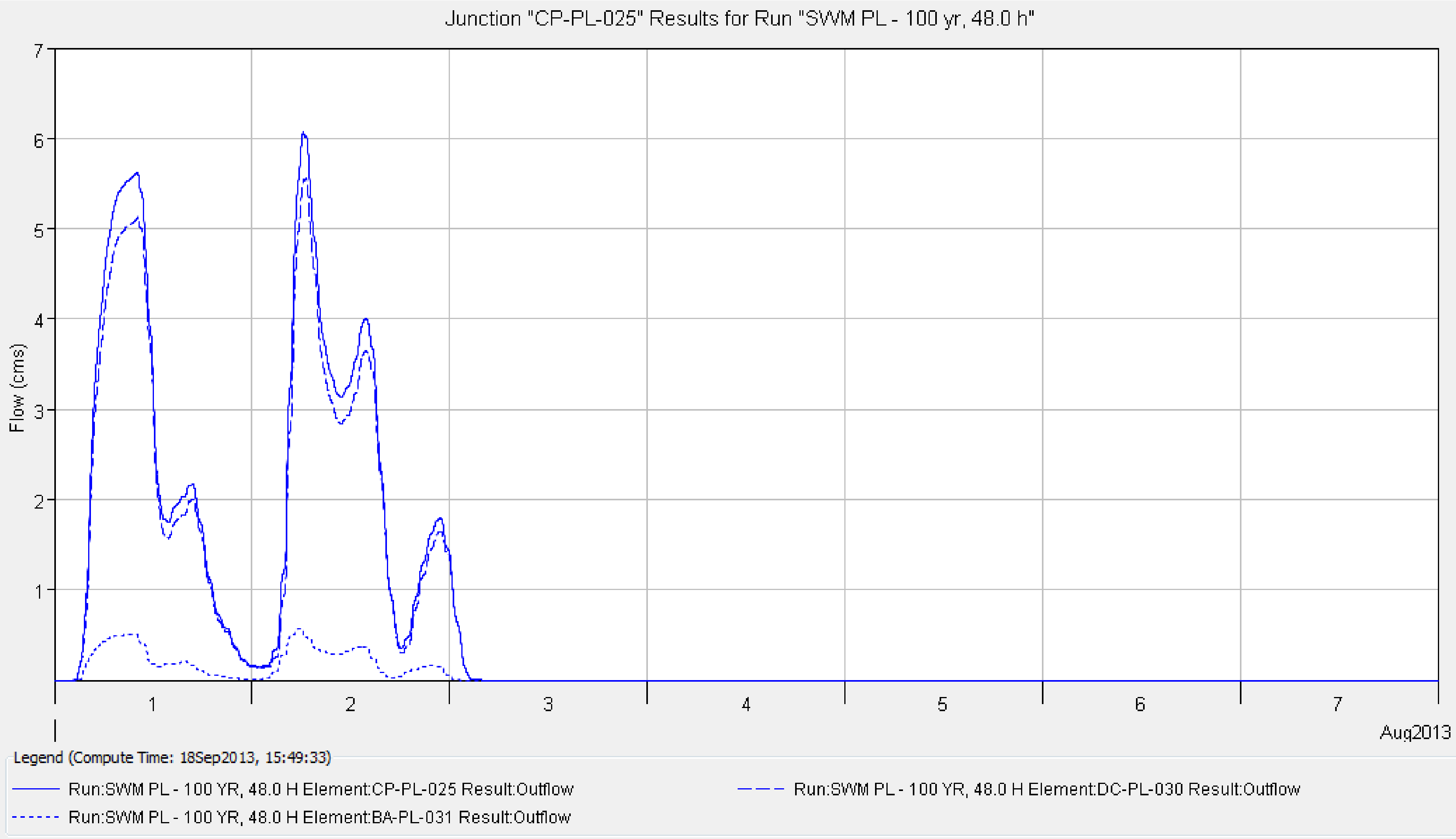

Junction "CP-PL-021" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Outflow

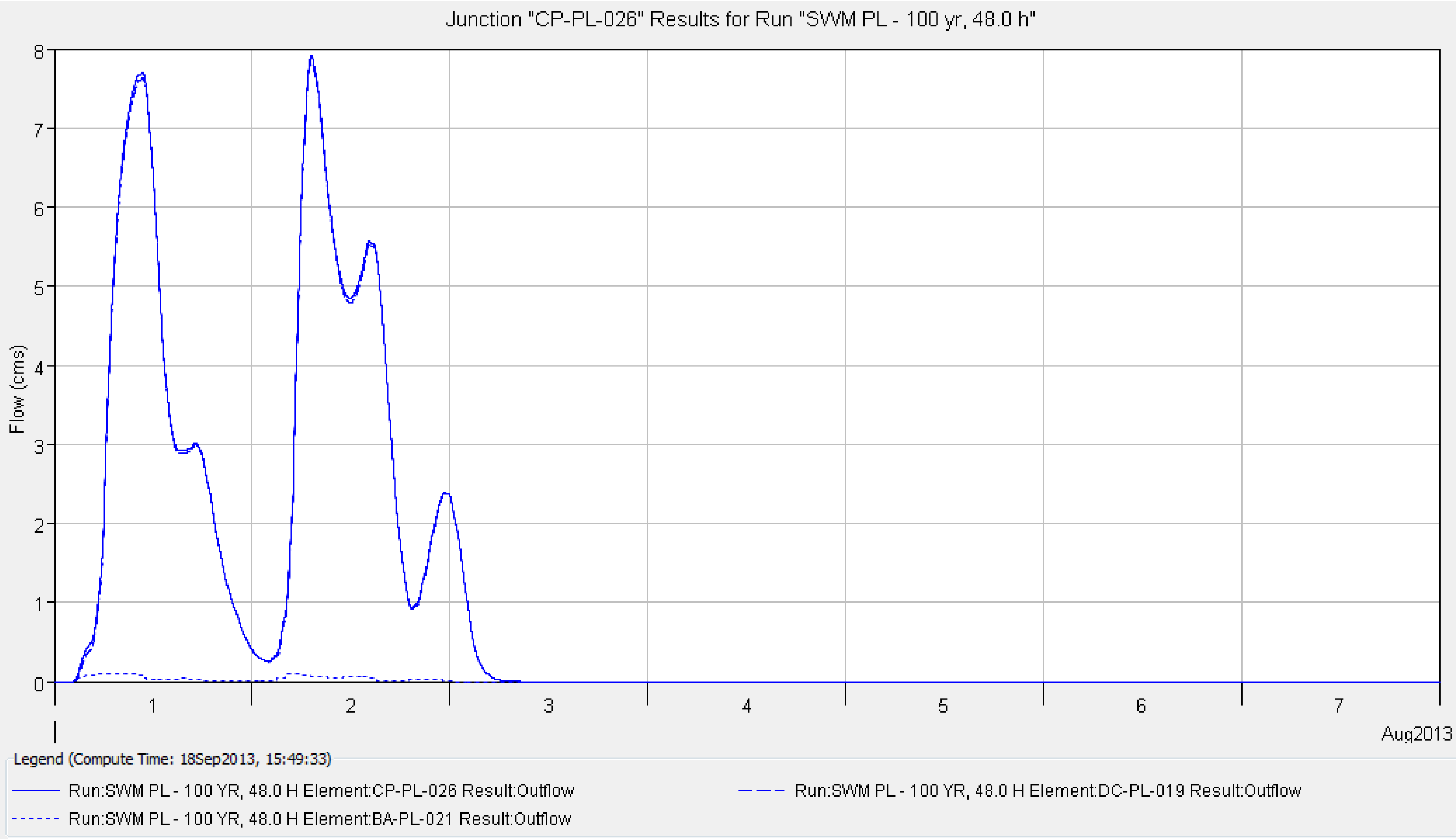


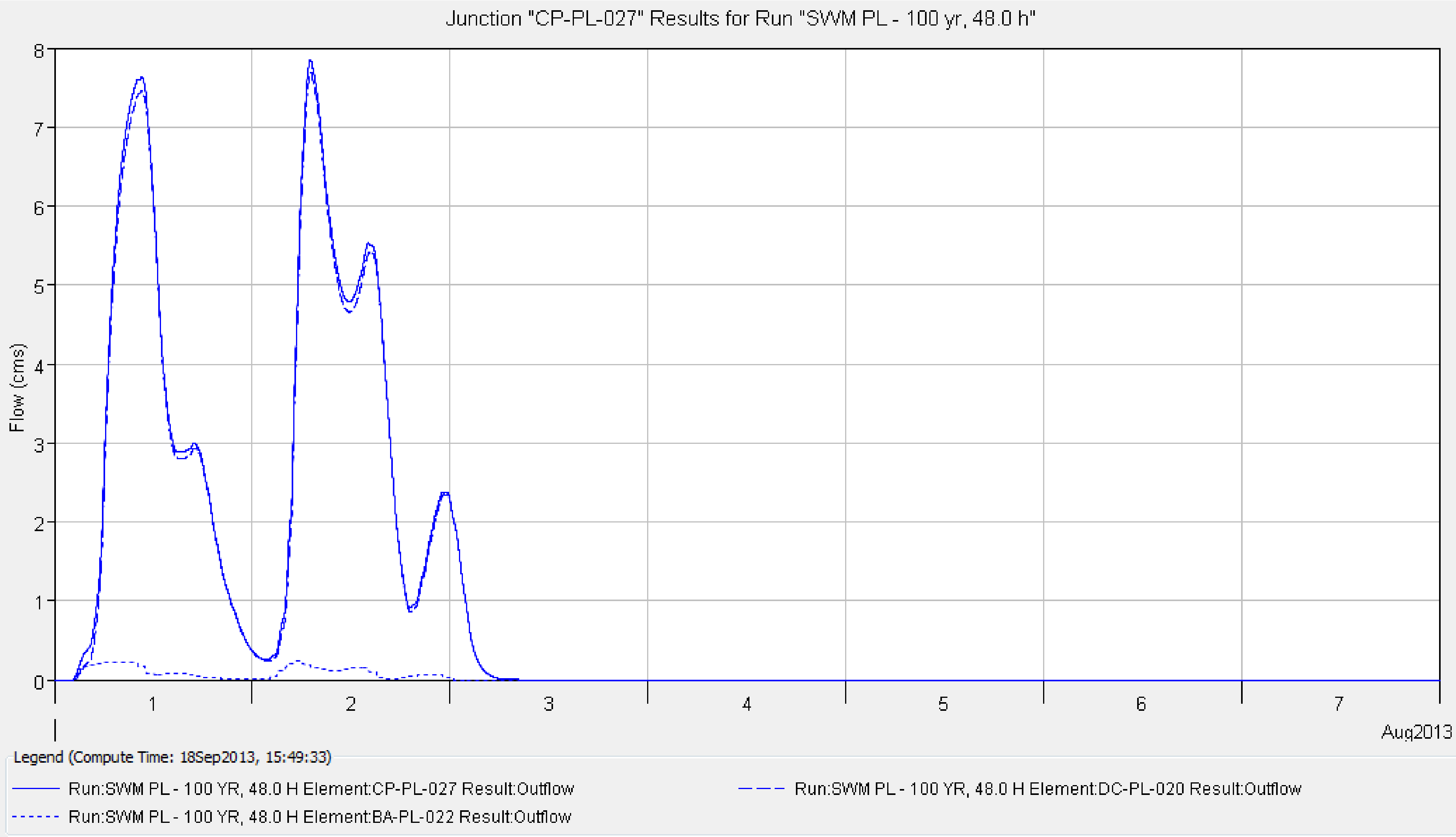
Junction "CP-PL-022" Results for Run "SWM PL - 100 yr, 48.0 h"
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-017 Result:Outflow

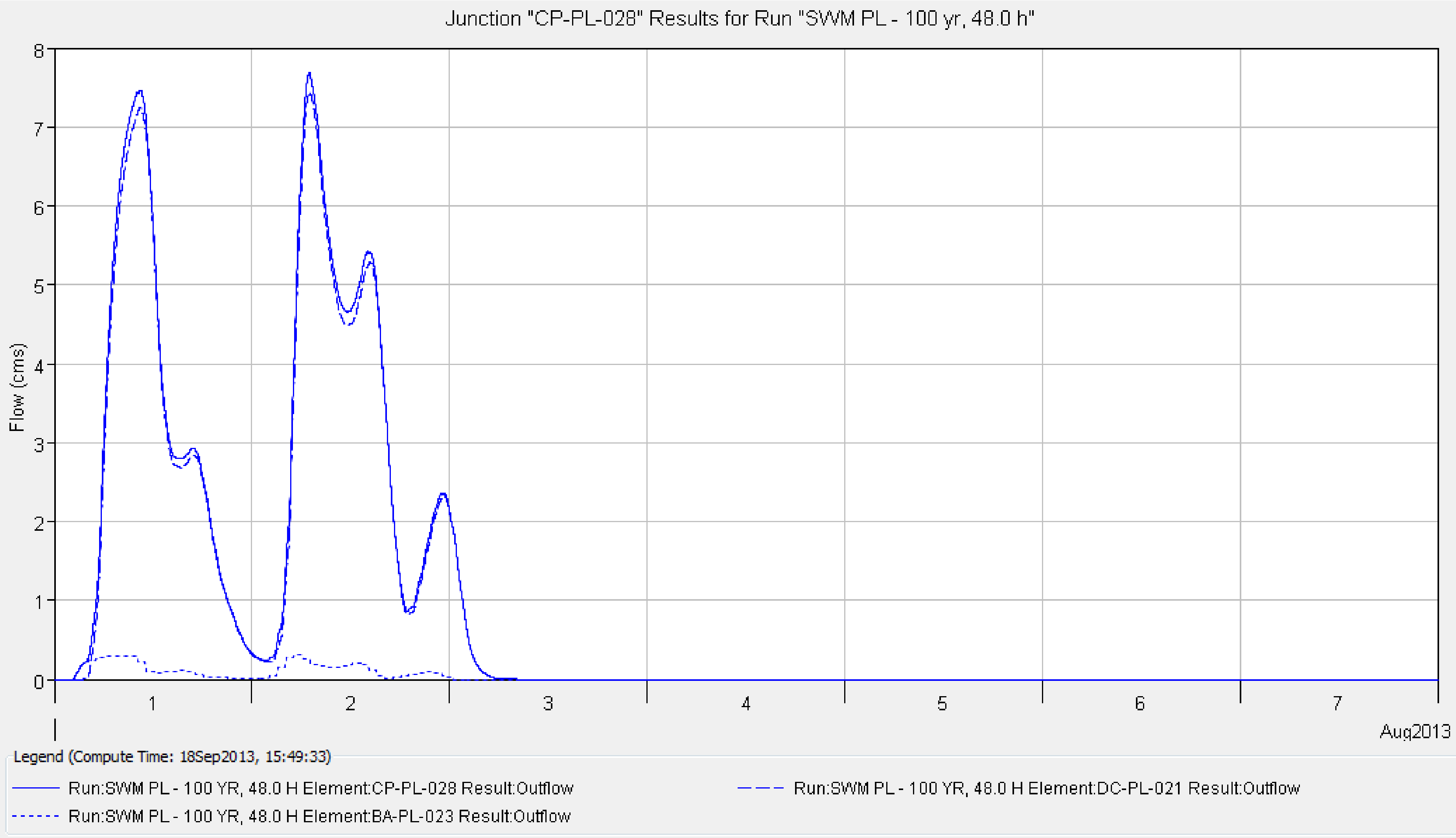

Junction "CP-PL-023" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
7
6
5
4
3
2
1
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-017 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-019 Result:Outflow

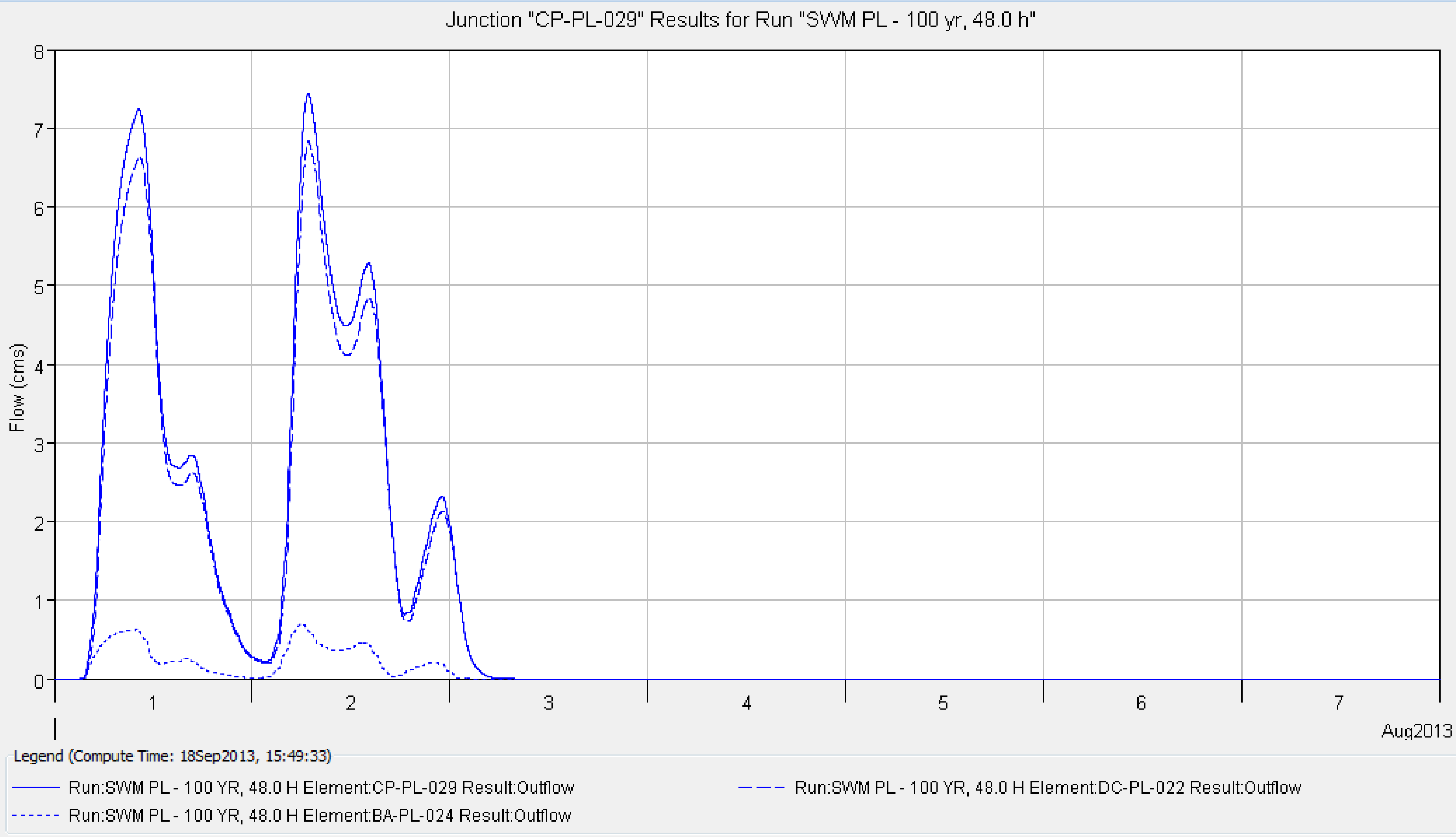

Junction "CP-PL-024" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
7
6
5
4
3
2
1
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-024 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-018 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-020 Result:Outflow

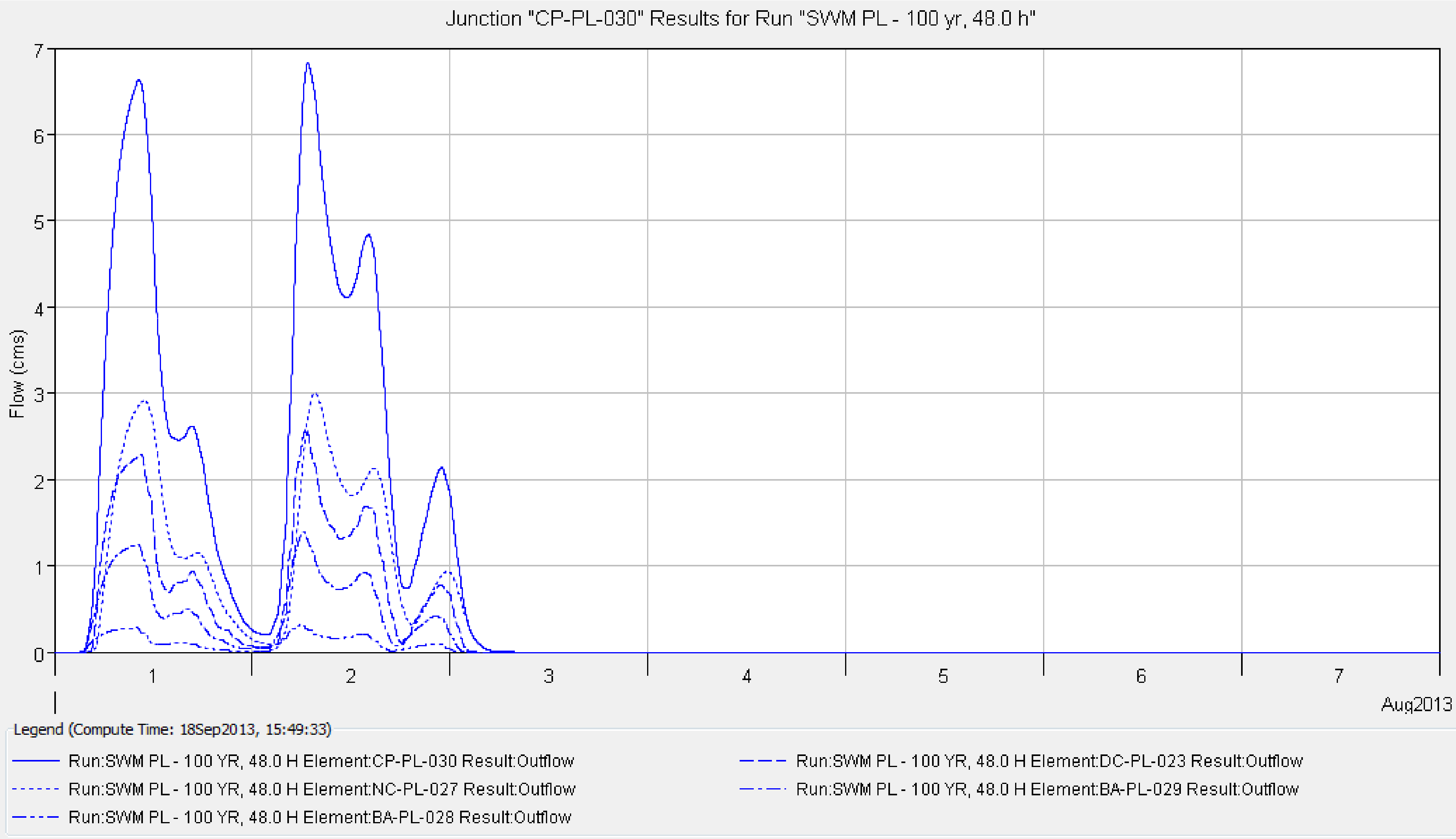

Junction "CP-PL-025" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
7
6
5
4
3
2
1
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-025 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-031 Result:Outflow


Junction "CP-PL-026" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-019 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-021 Result:Outflow

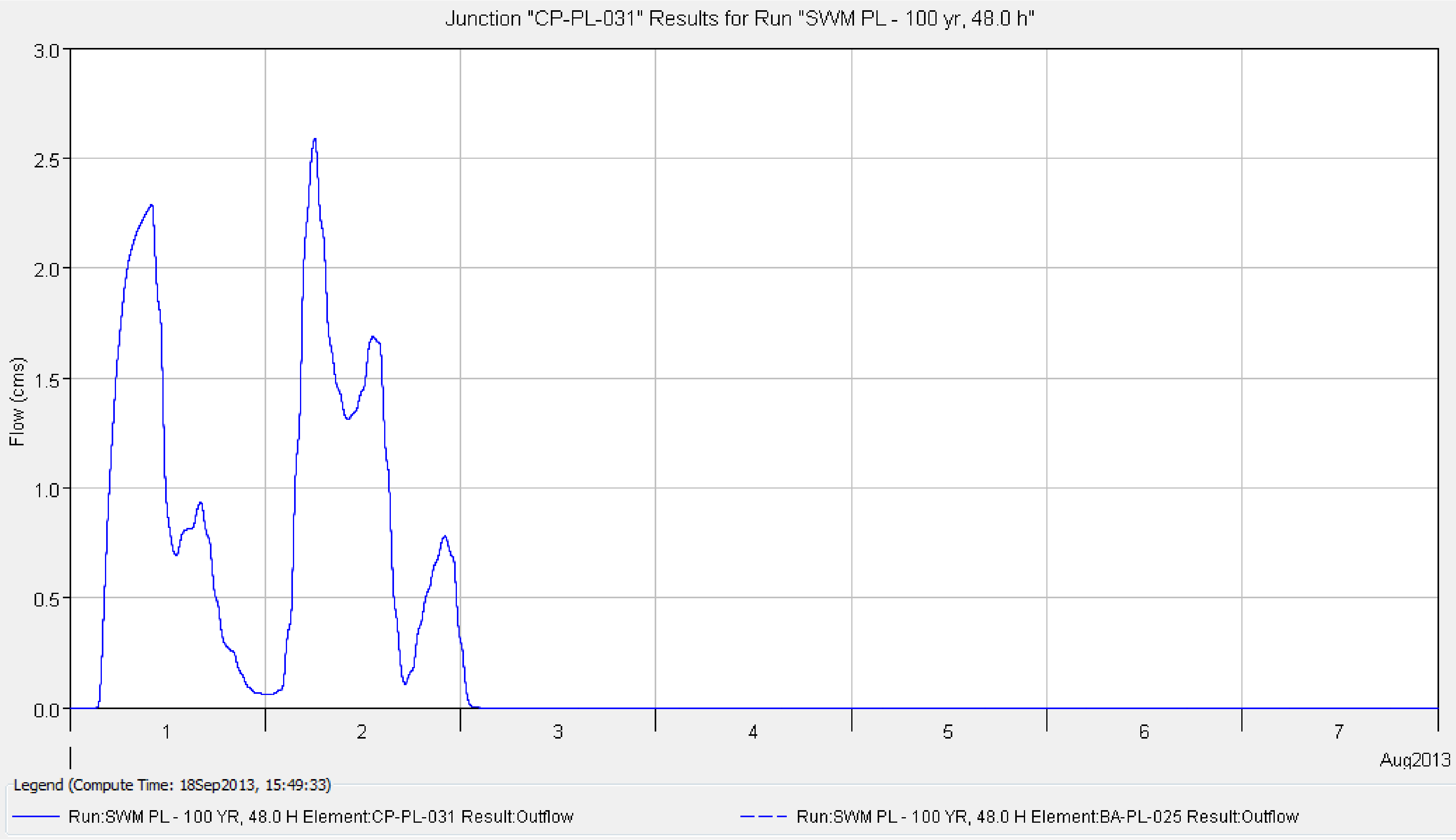

Junction "CP-PL-027" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-020 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-022 Result:Outflow

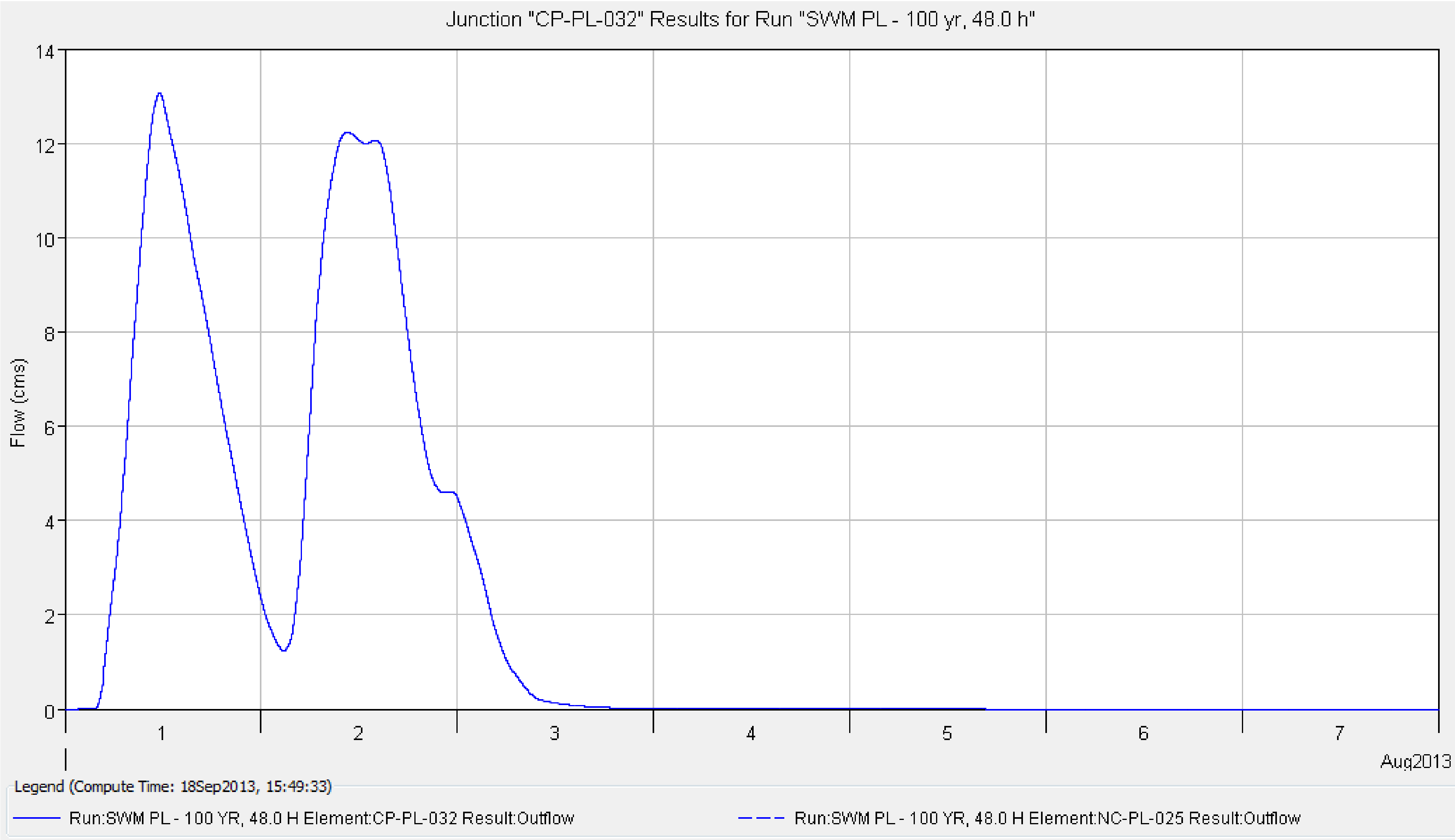

Junction "CP-PL-028" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-028 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-021 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-023 Result:Outflow


Junction "CP-PL-029" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-022 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-024 Result:Outflow

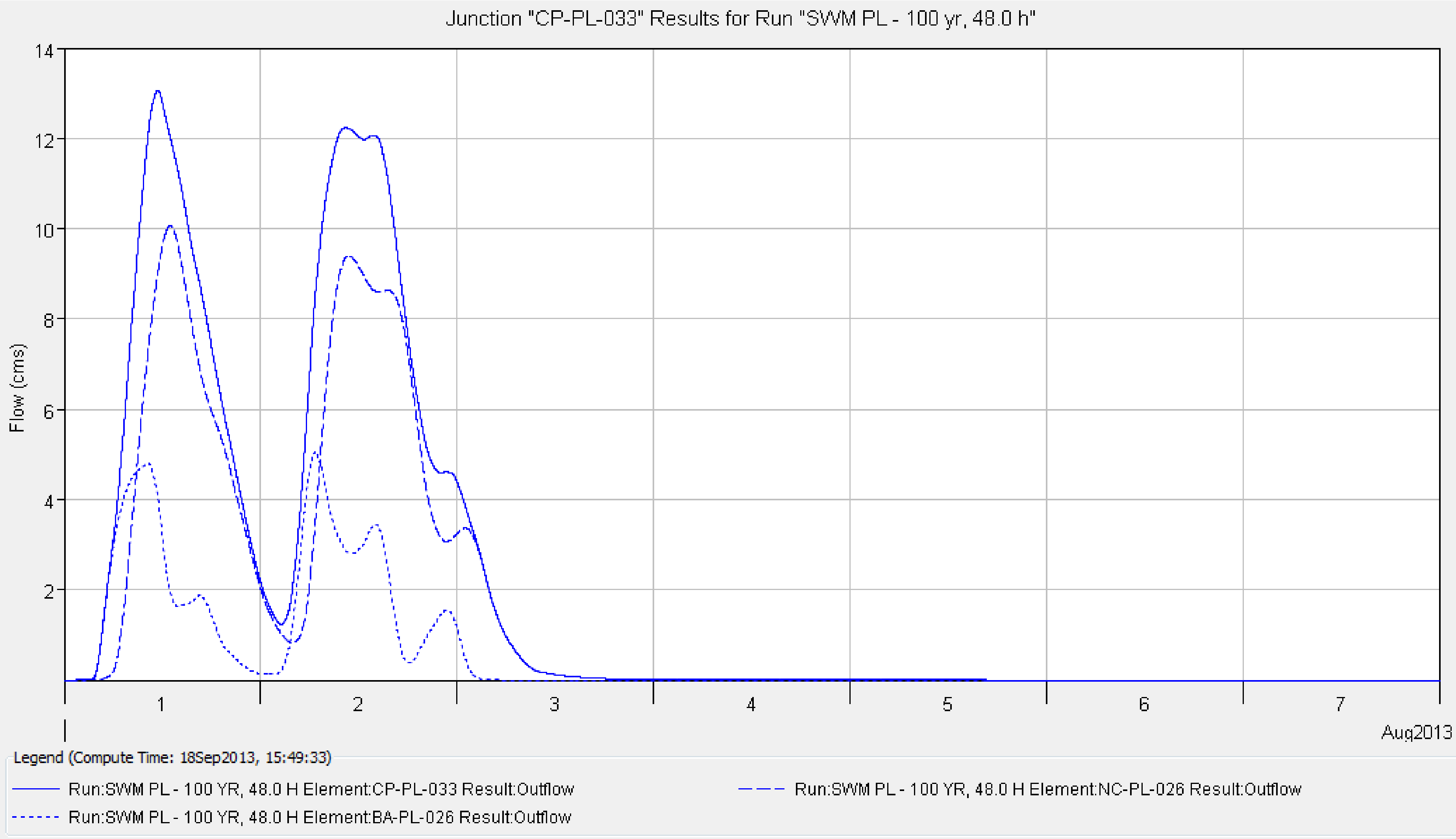


Junction "CP-PL-030" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-030 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-023 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-027 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-029 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-028 Result:Outflow

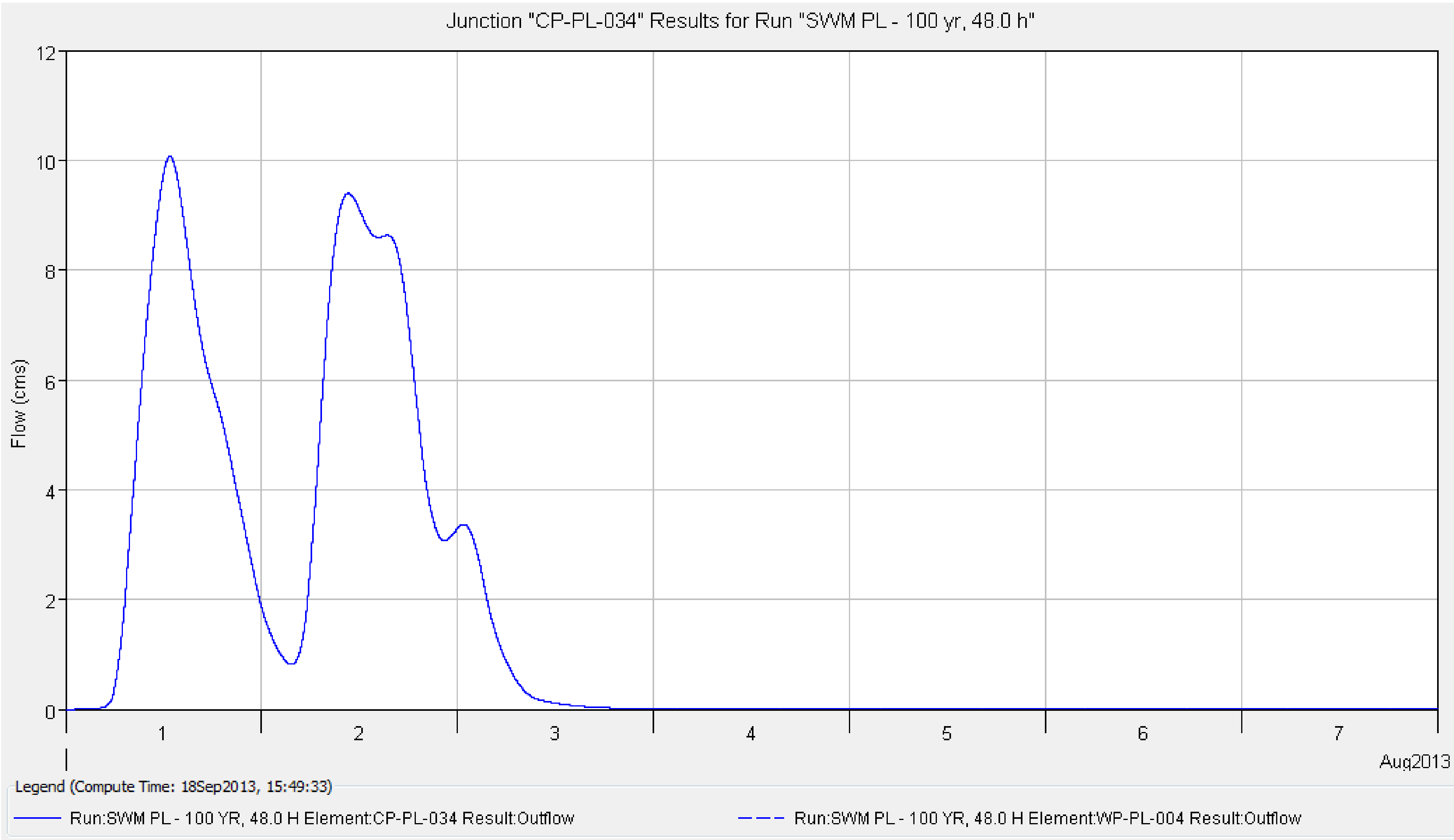

Junction "CP-PL-031" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-031 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-025 Result:Outflow



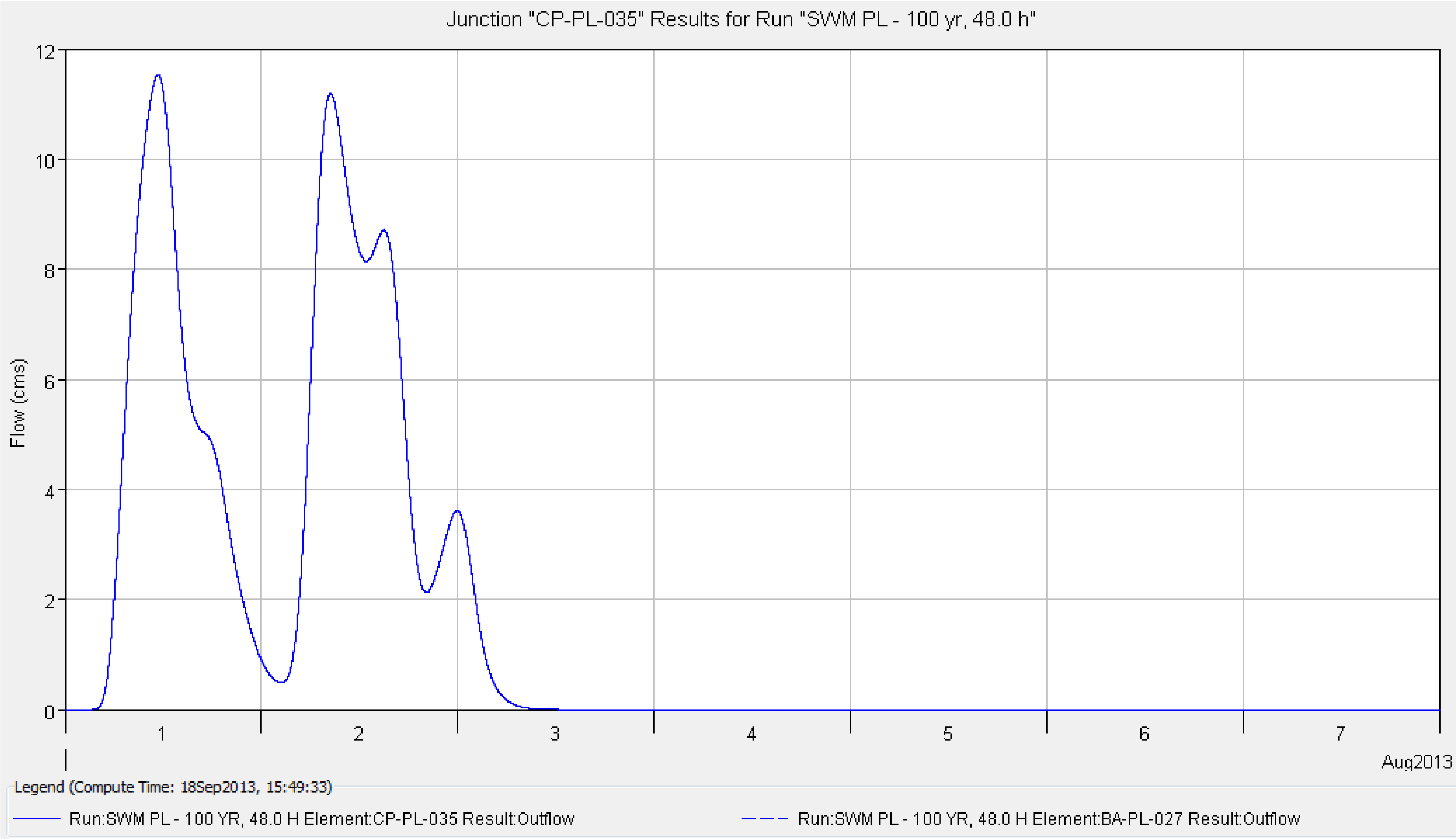
Junction "CP-PL-032" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-032 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-025 Result:Outflow



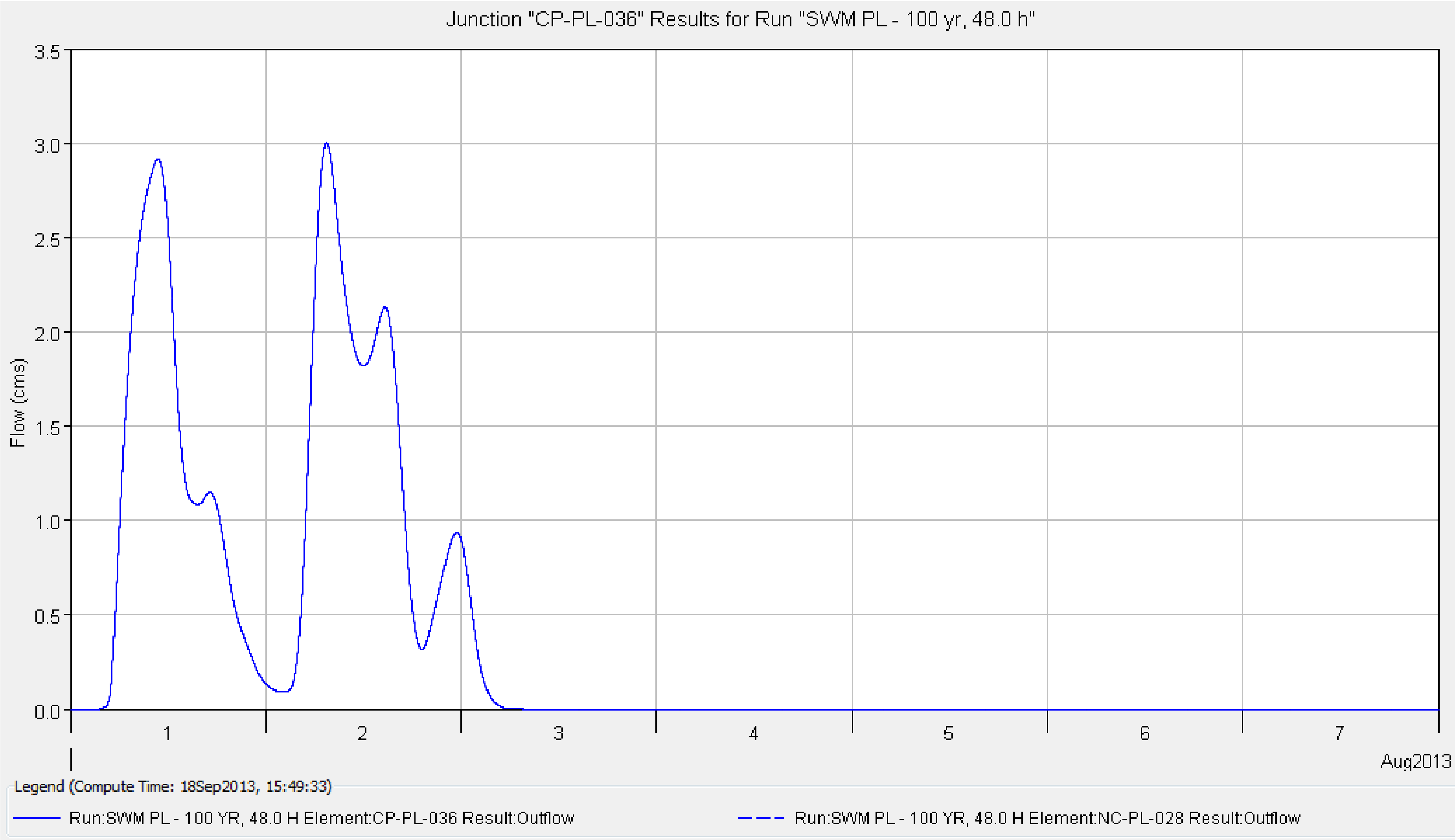
Junction "CP-PL-033" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-033 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-026 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-026 Result:Outflow

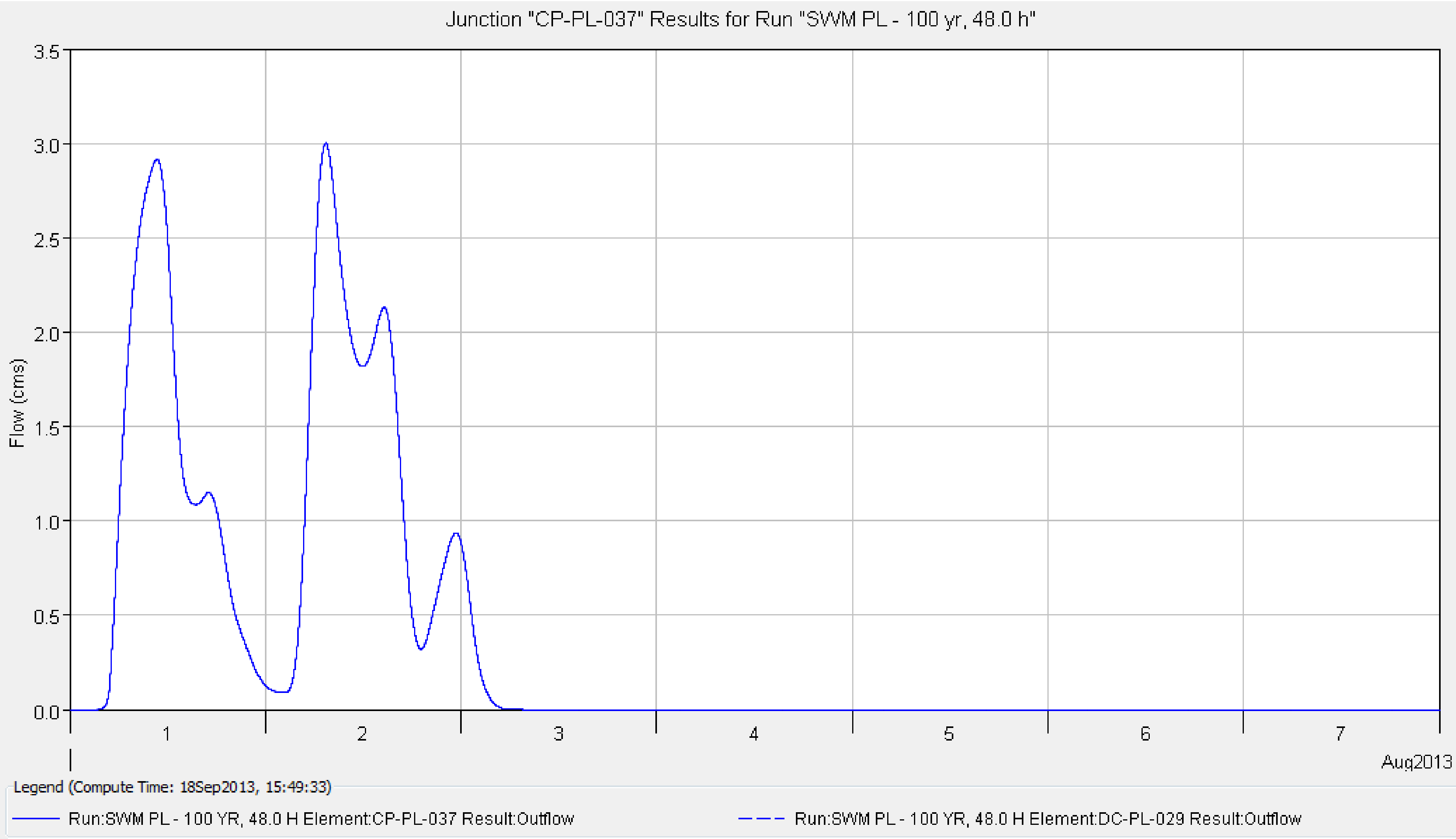


Junction "CP-PL-034" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Outflow

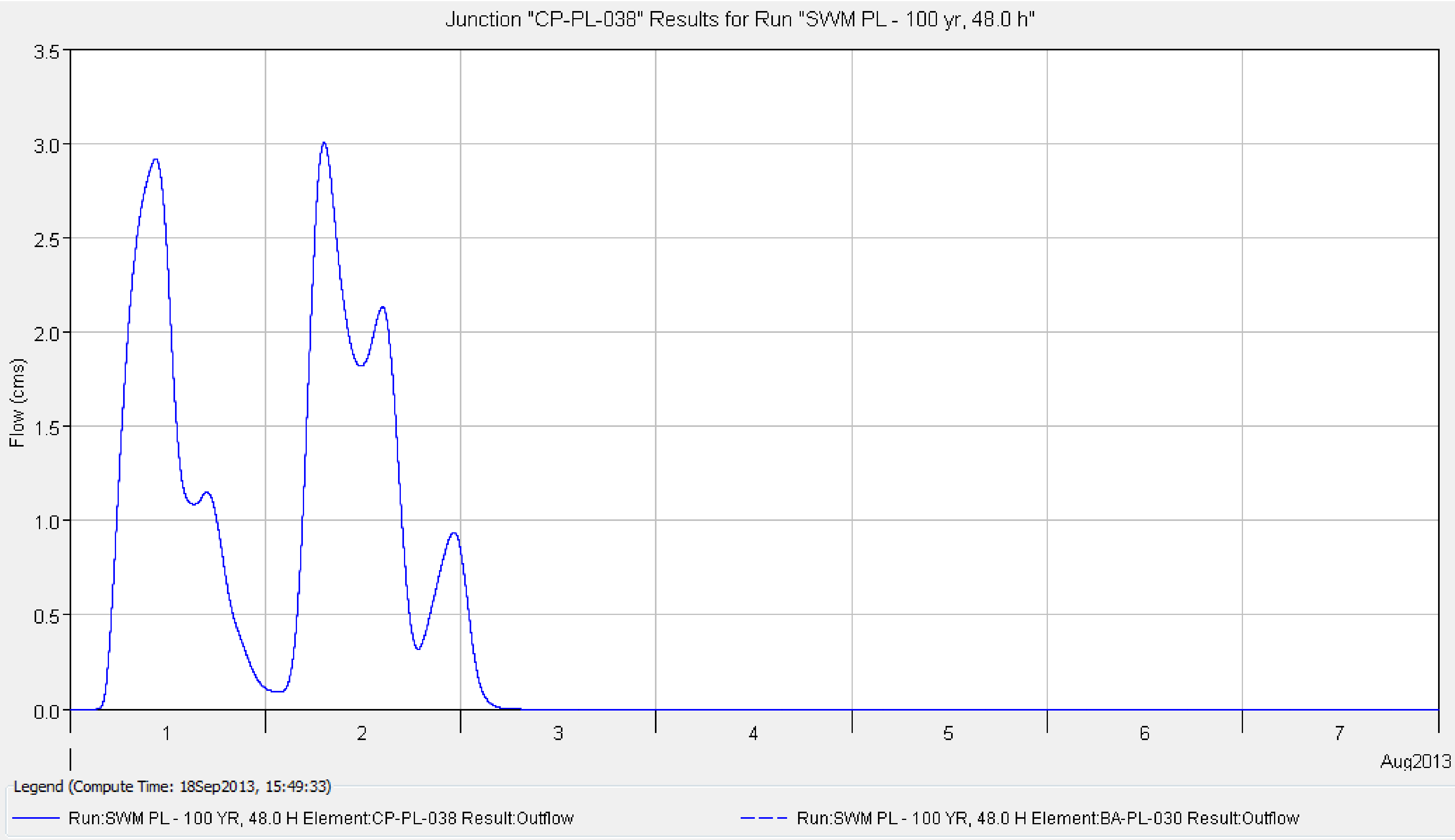


Junction "CP-PL-035" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-035 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-027 Result:Outflow

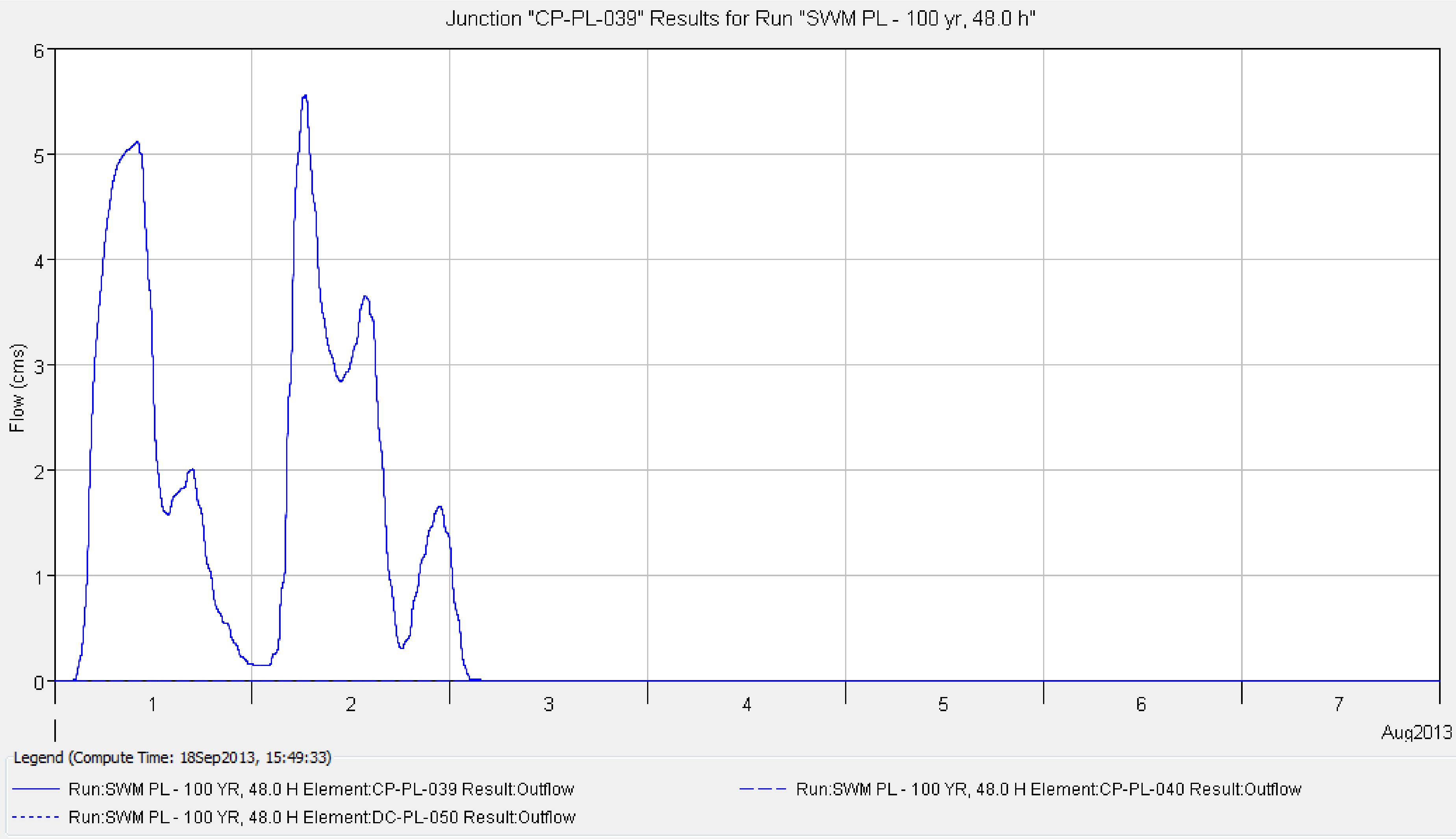

Junction "CP-PL-036" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-028 Result:Outflow



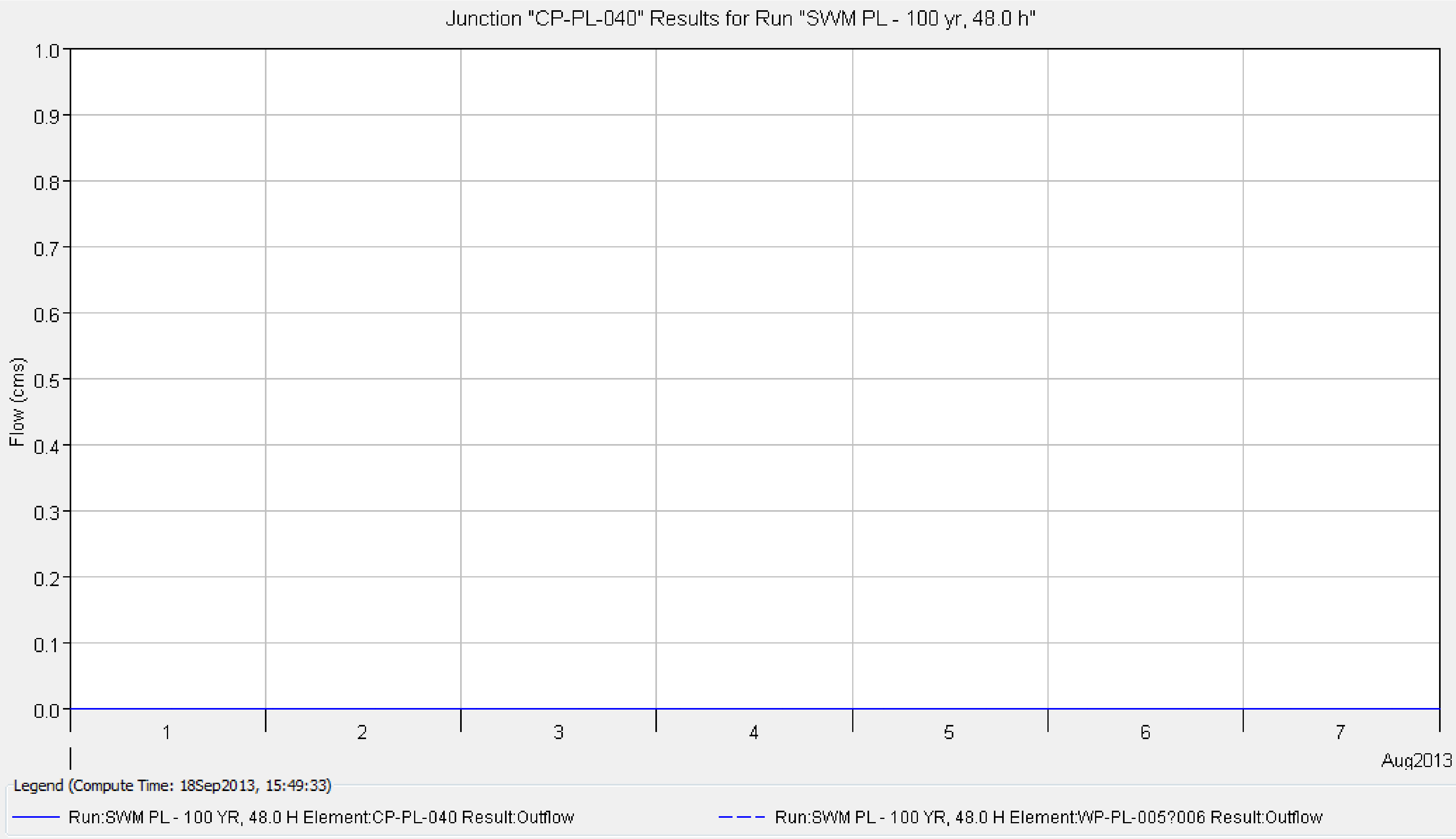
Junction "CP-PL-037" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-029 Result:Outflow



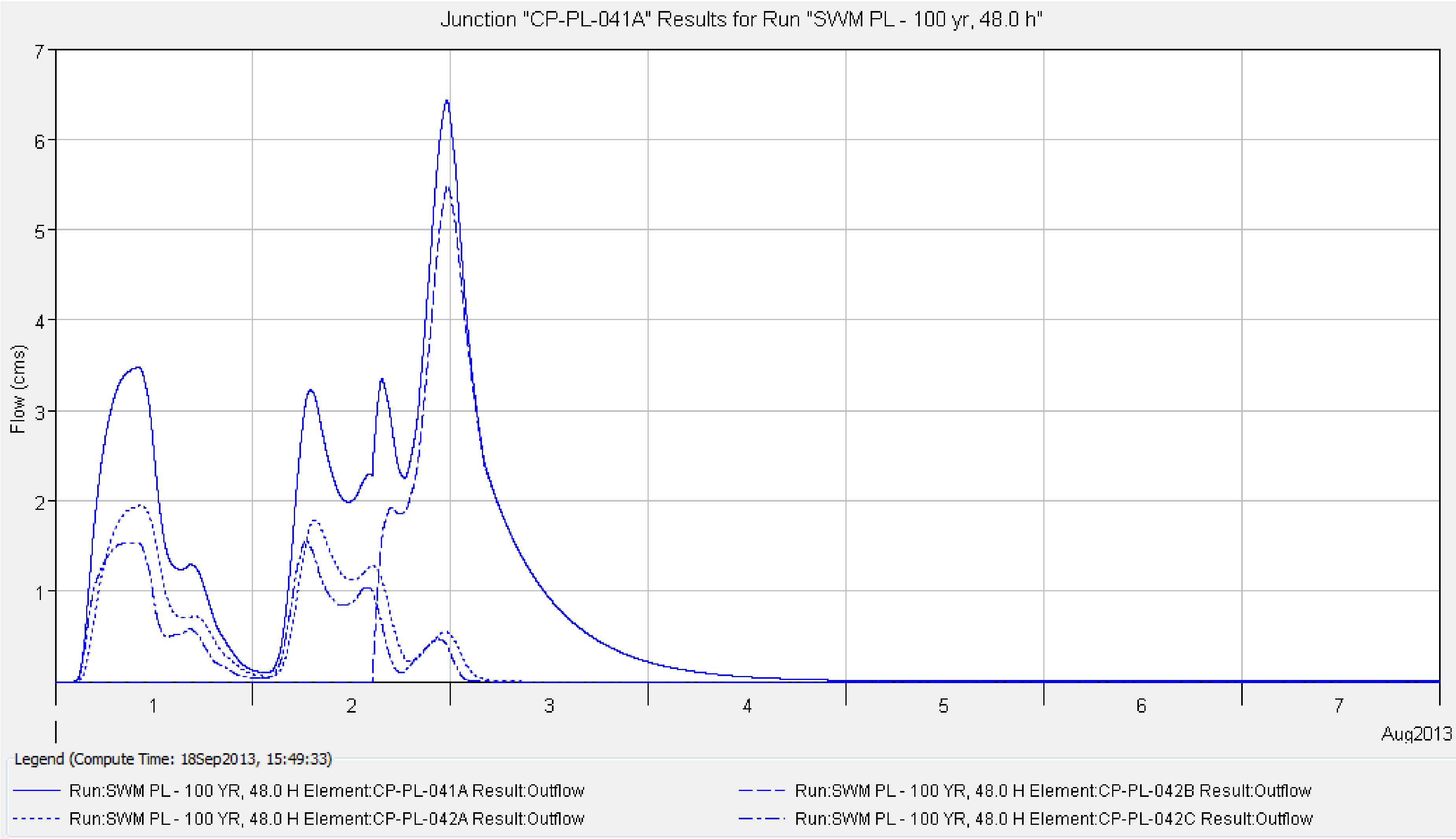
Junction "CP-PL-038" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-038 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-030 Result:Outflow

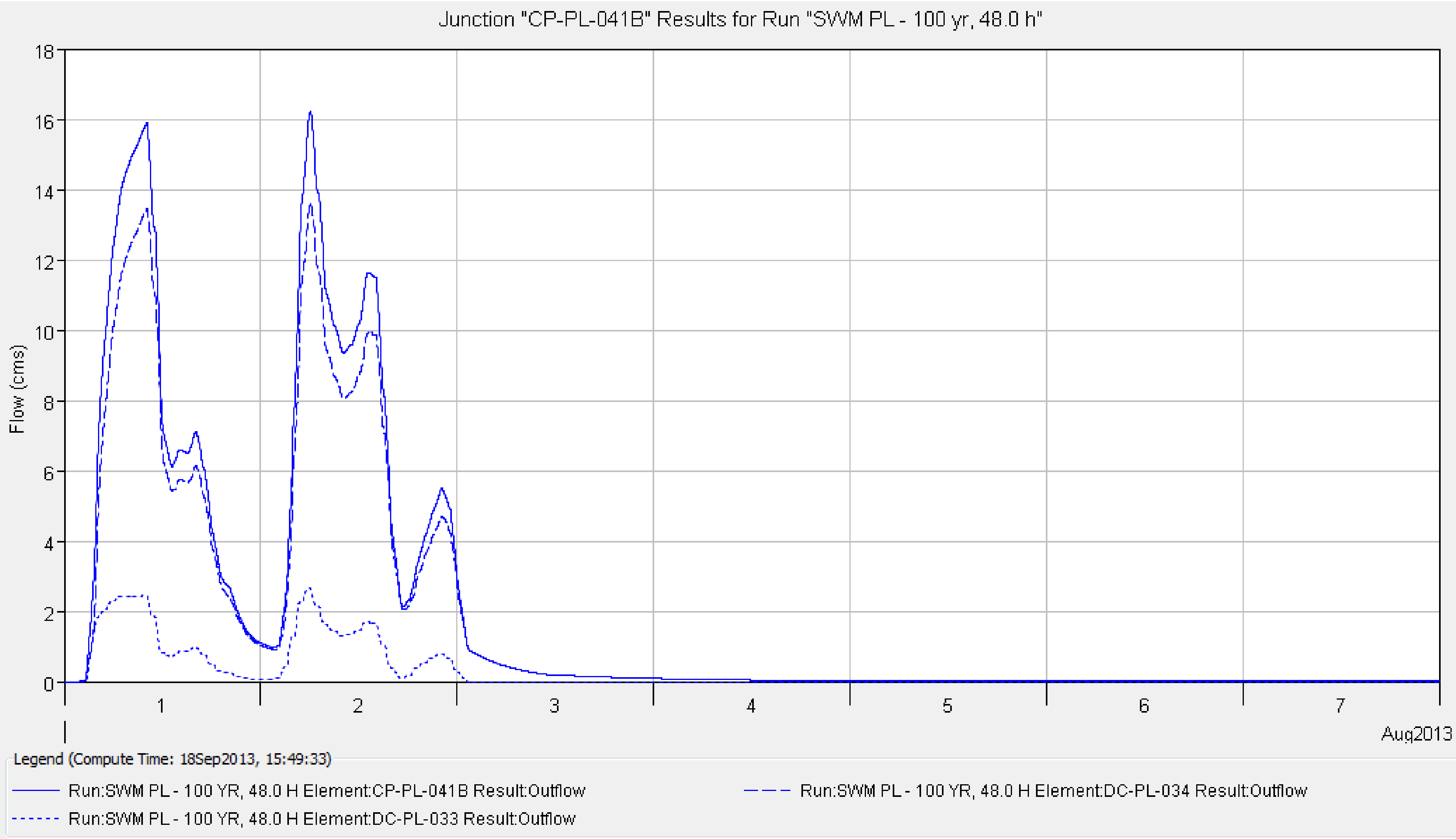


Junction "CP-PL-039" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-050 Result:Outflow

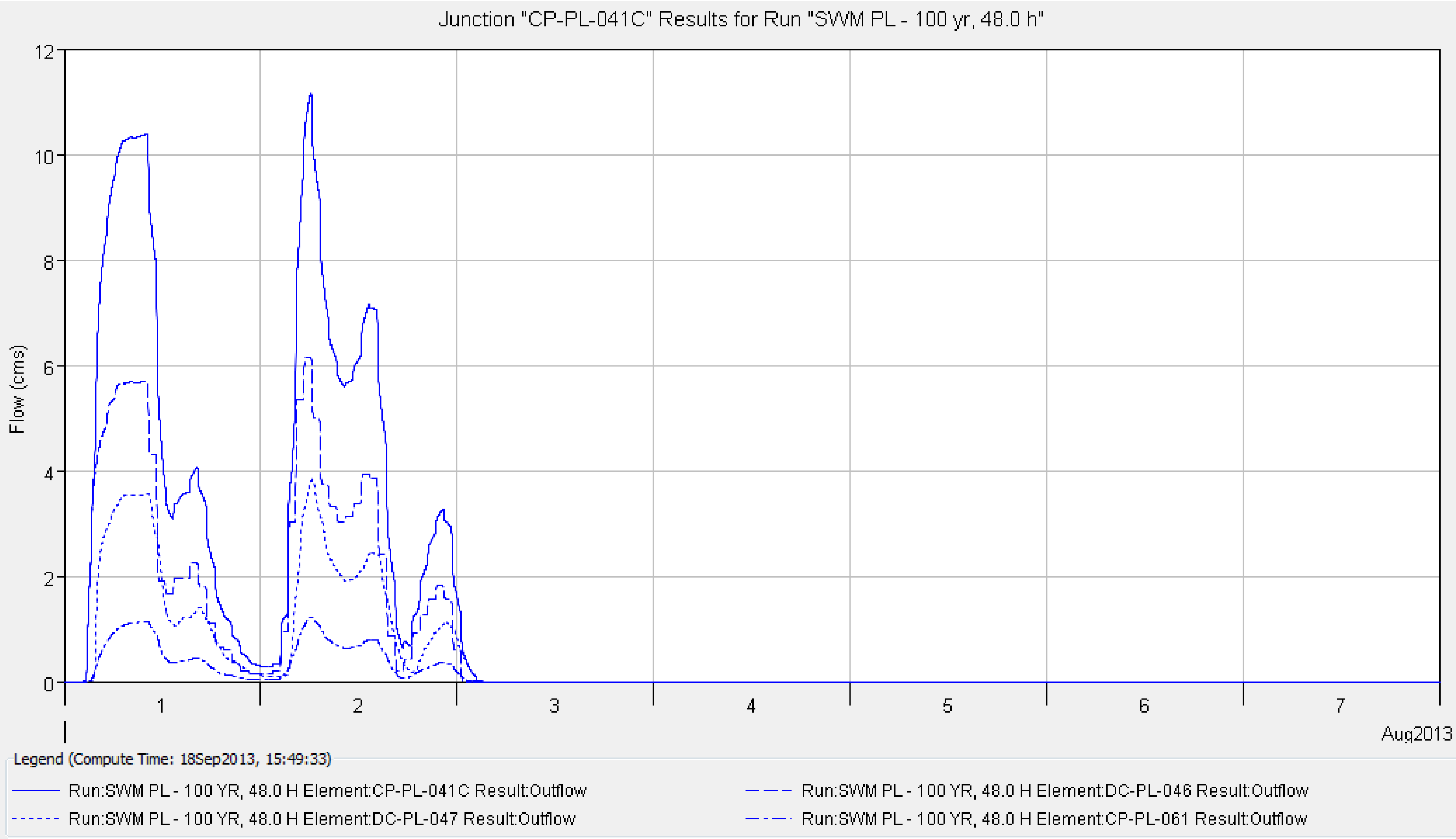


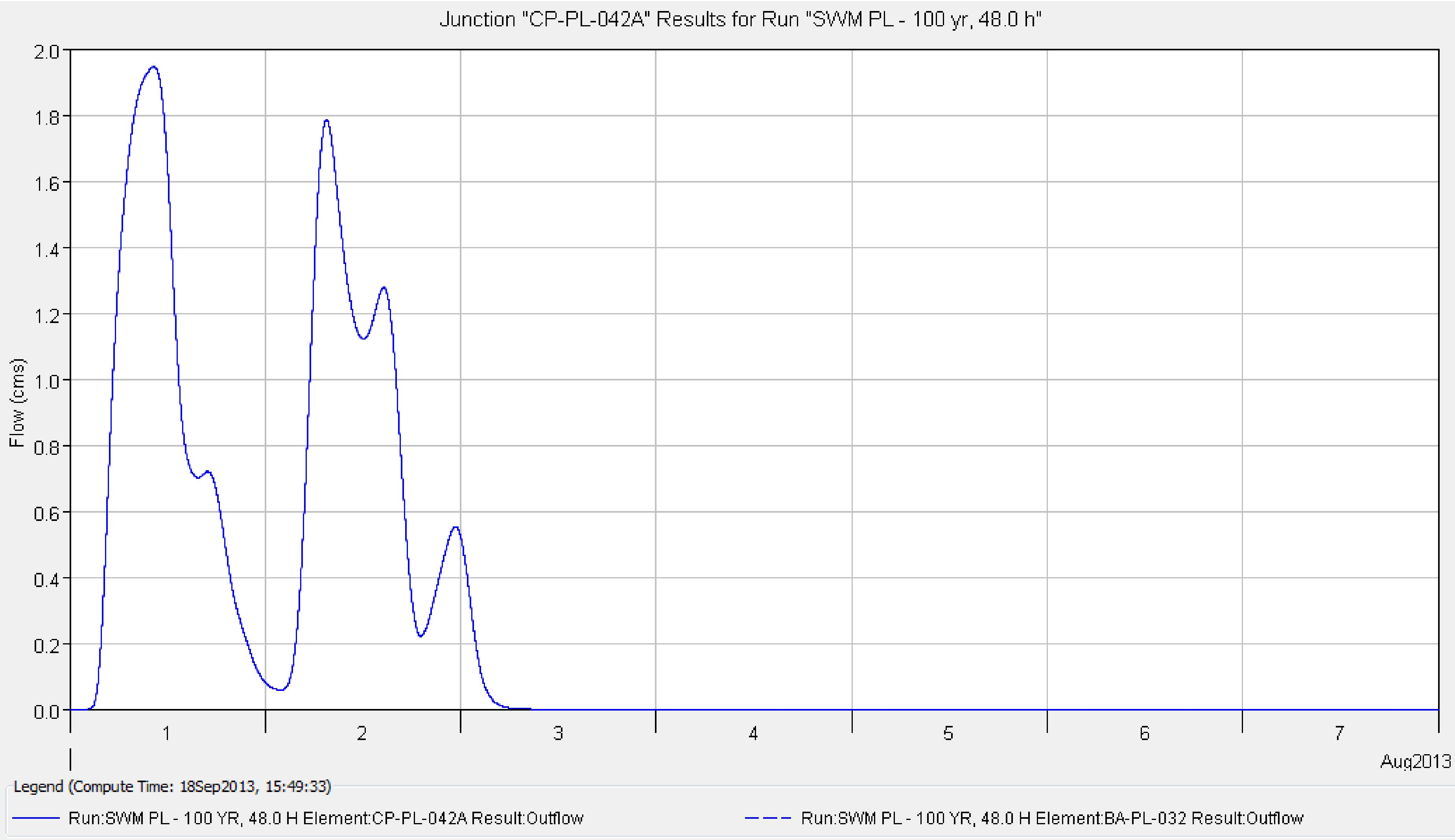
Junction "CP-PL-040" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Outflow


Junction "CP-PL-041A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
7
6
5
4
3
2
1
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042C Result:Outflow

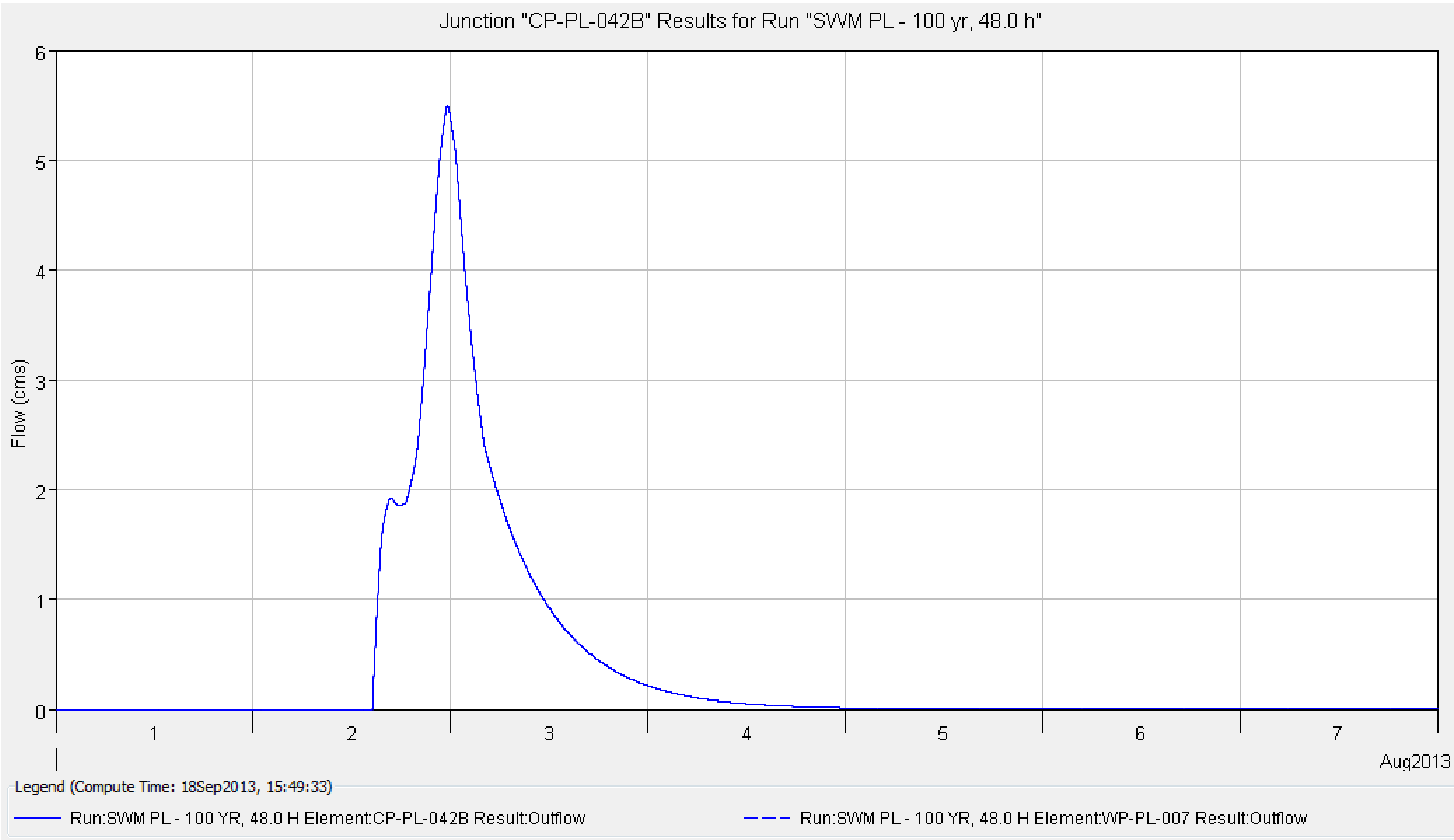


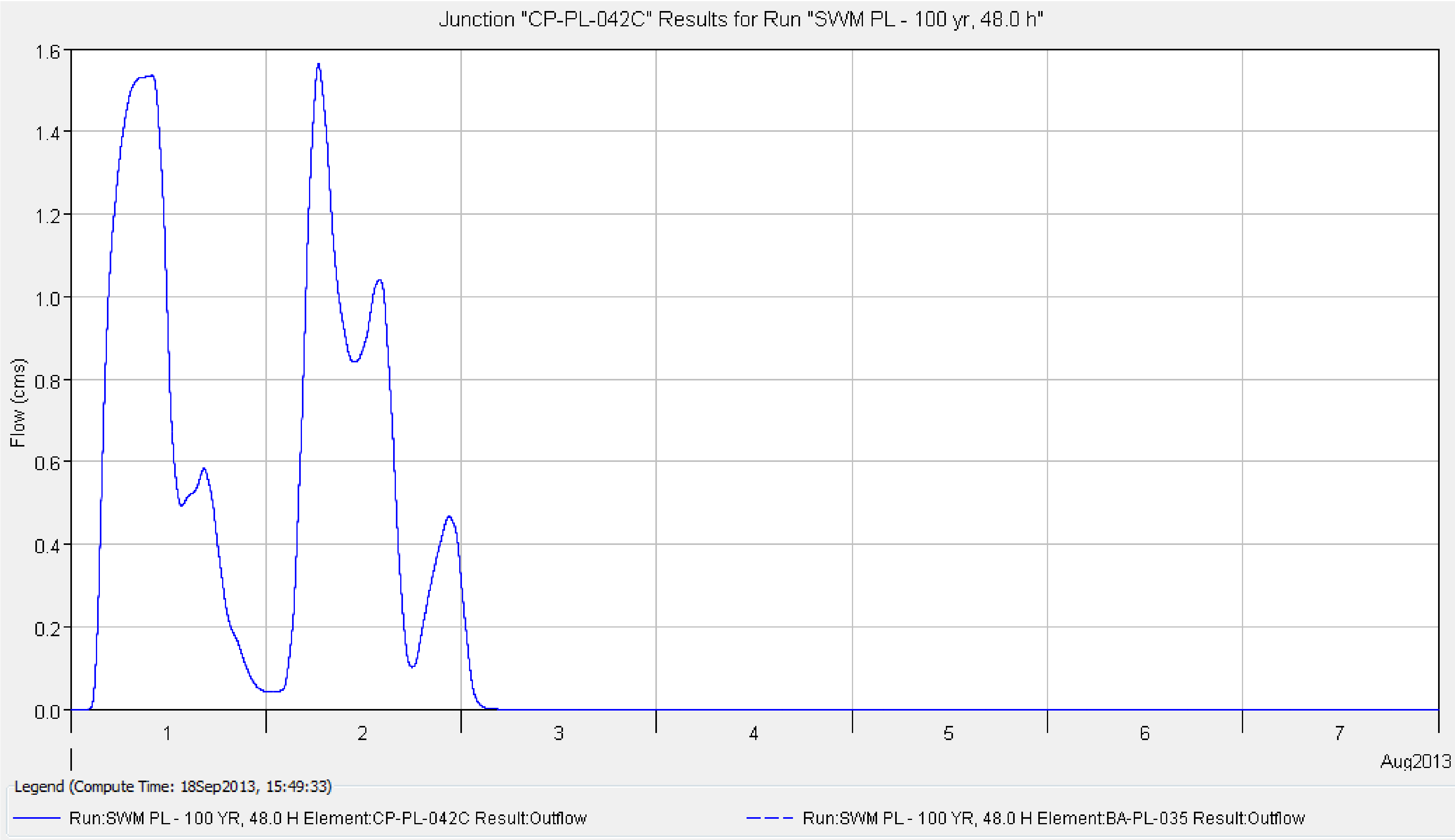
Junction "CP-PL-041B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
18
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-034 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-033 Result:Outflow


Junction "CP-PL-041C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-041C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-061 Result:Outflow

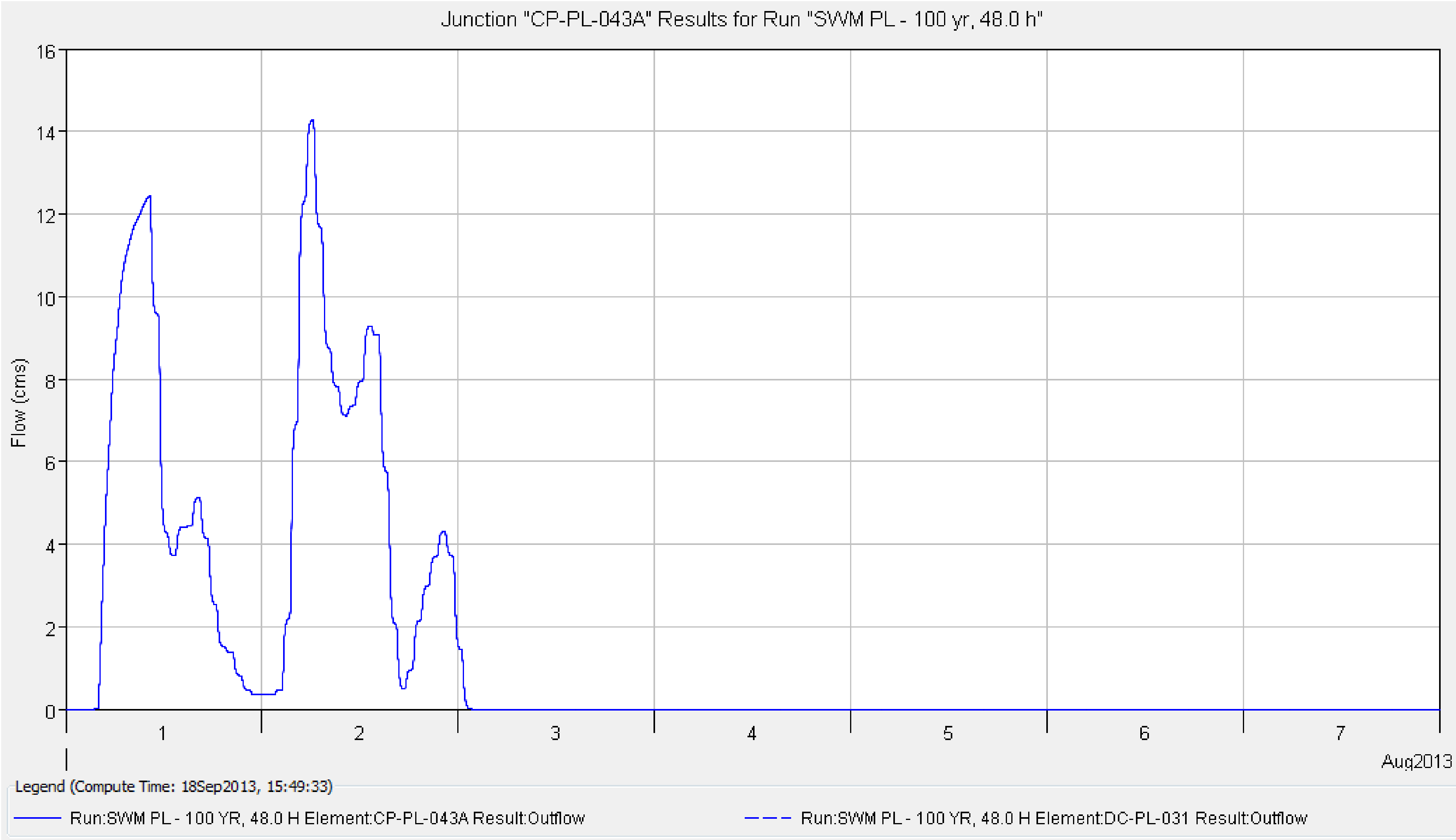


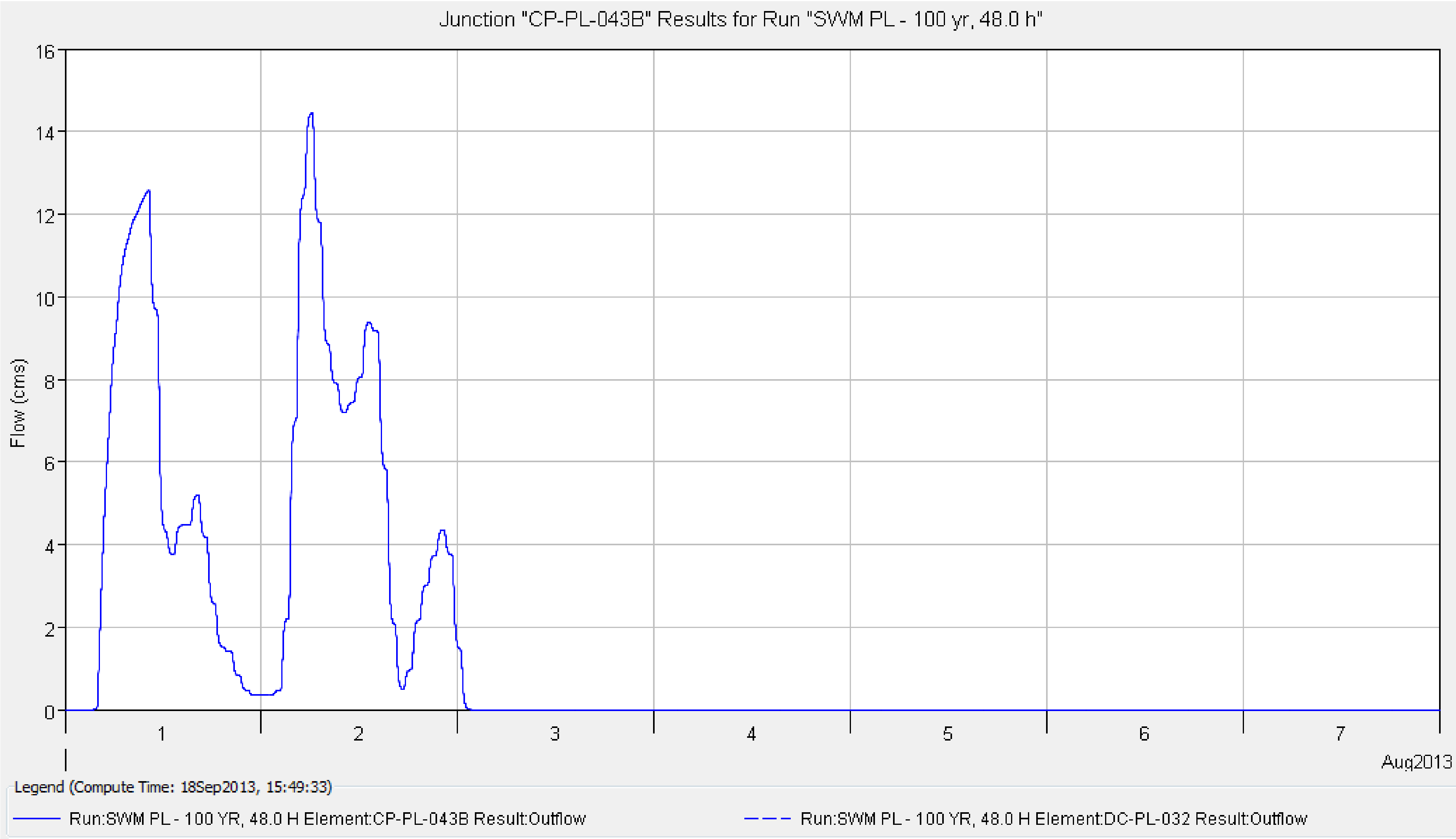
Junction "CP-PL-042A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-032 Result:Outflow

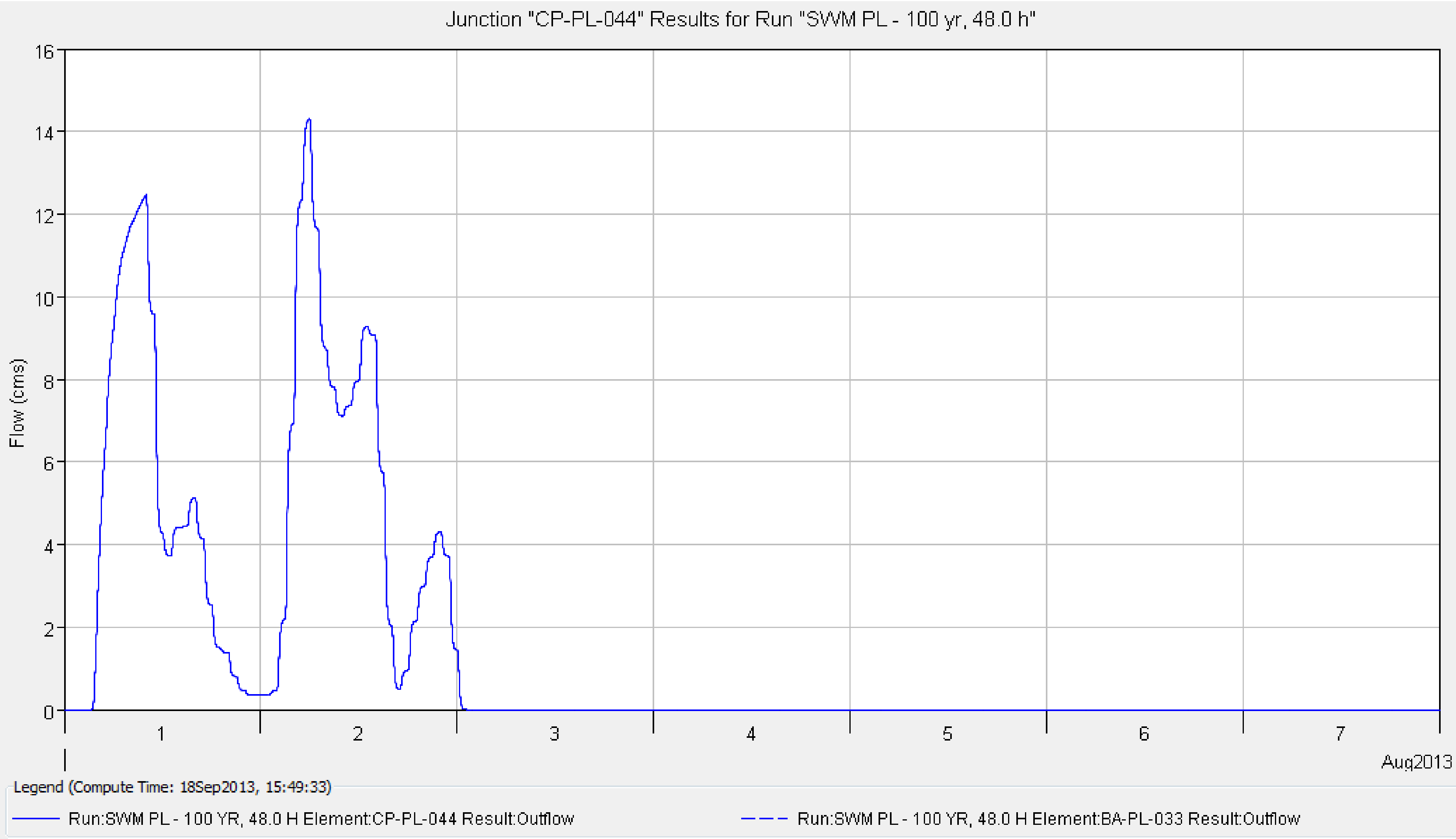

Junction "CP-PL-042B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Outflow



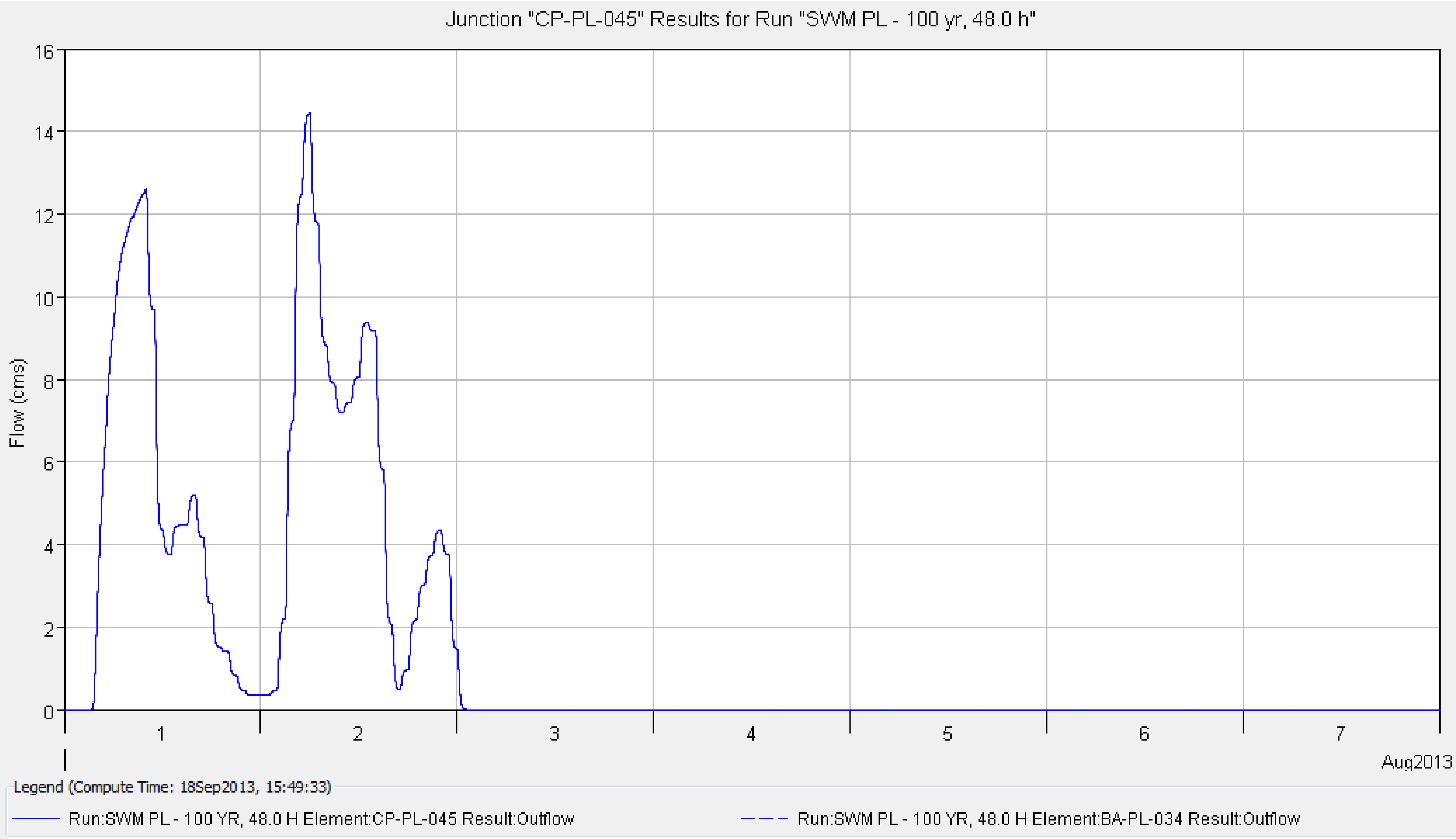
Junction "CP-PL-042C" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-042C Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-035 Result:Outflow

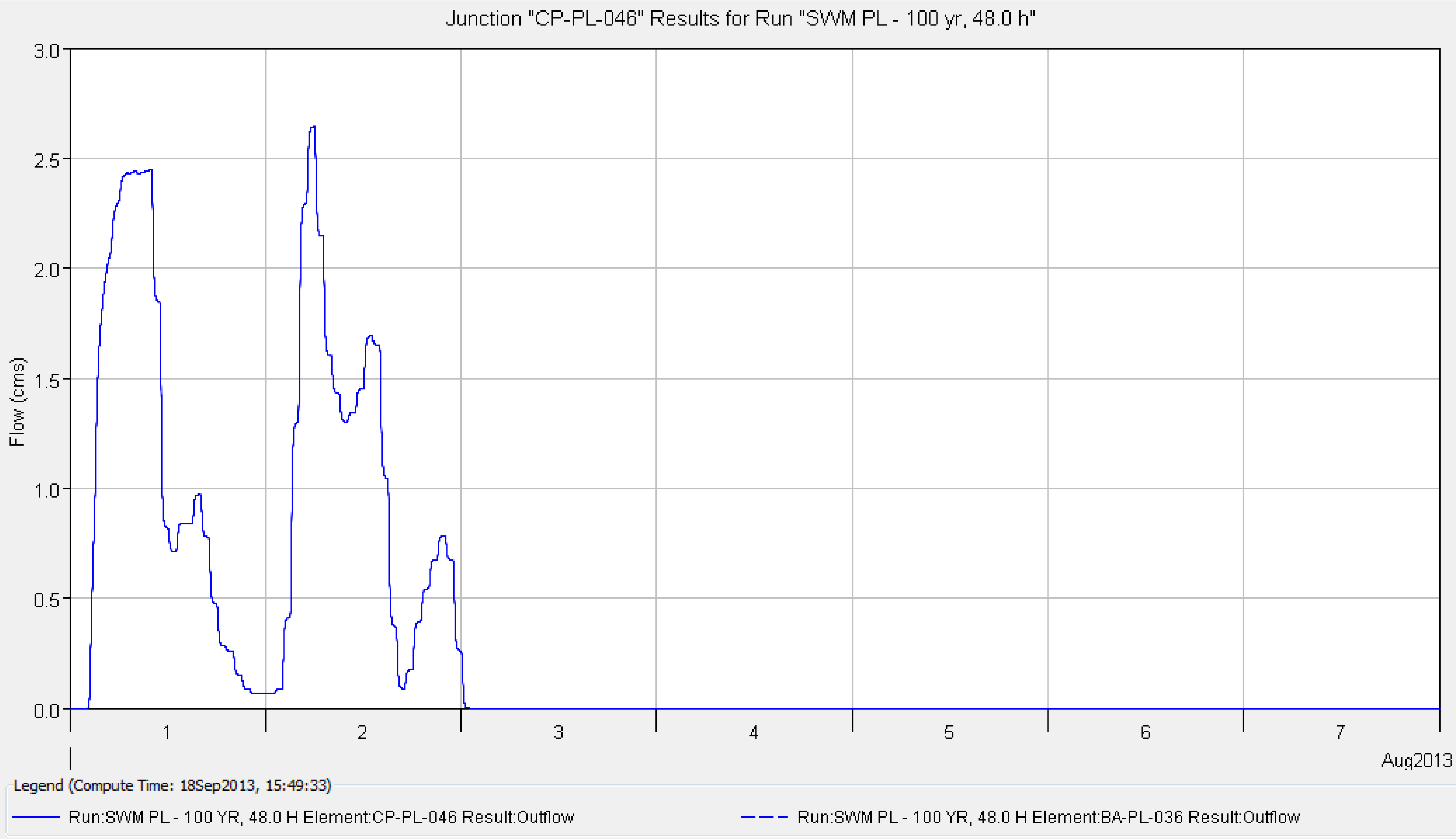

Junction "CP-PL-043A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-043A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-031 Result:Outflow

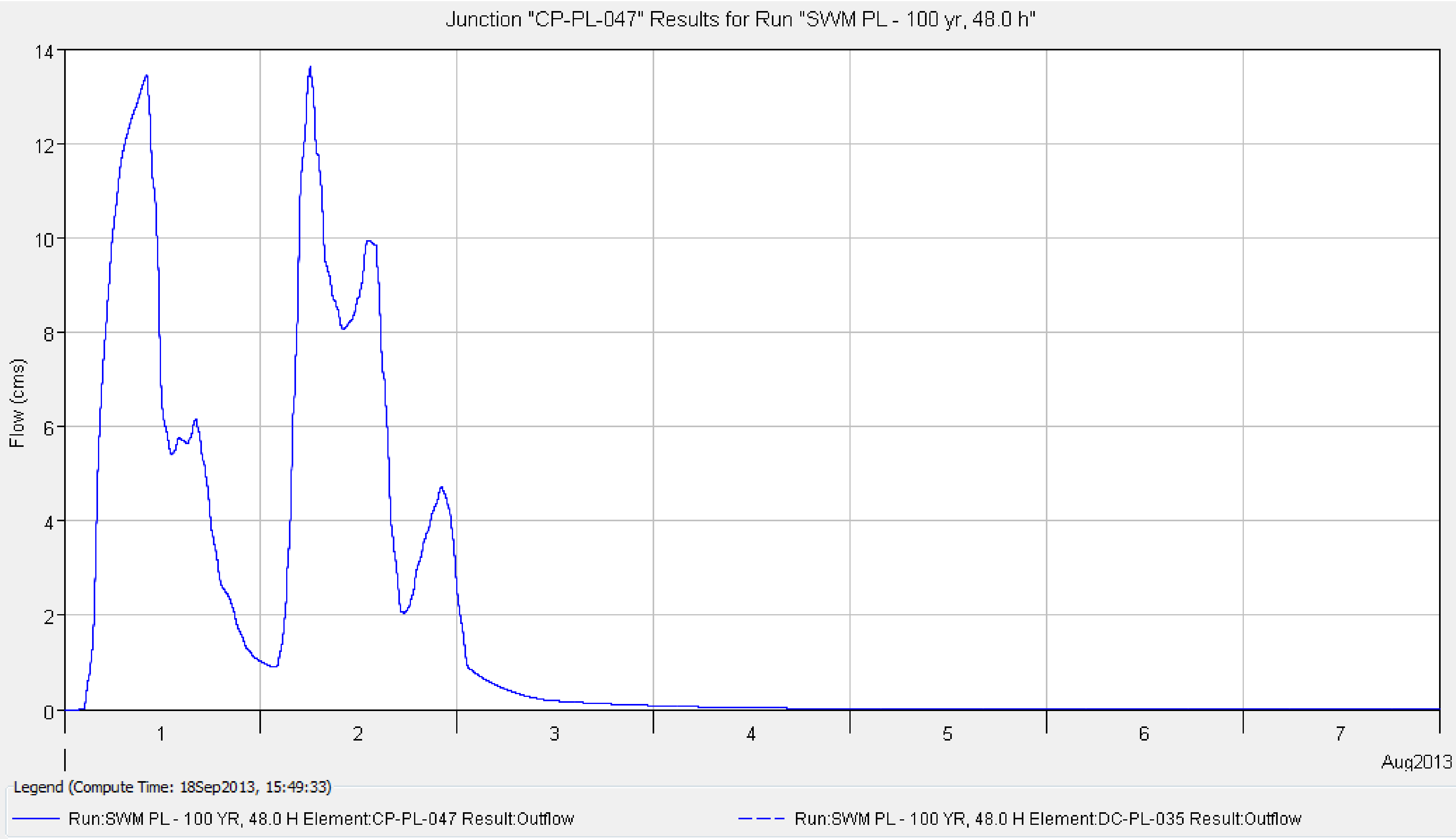

Junction "CP-PL-043B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-043B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-032 Result:Outflow



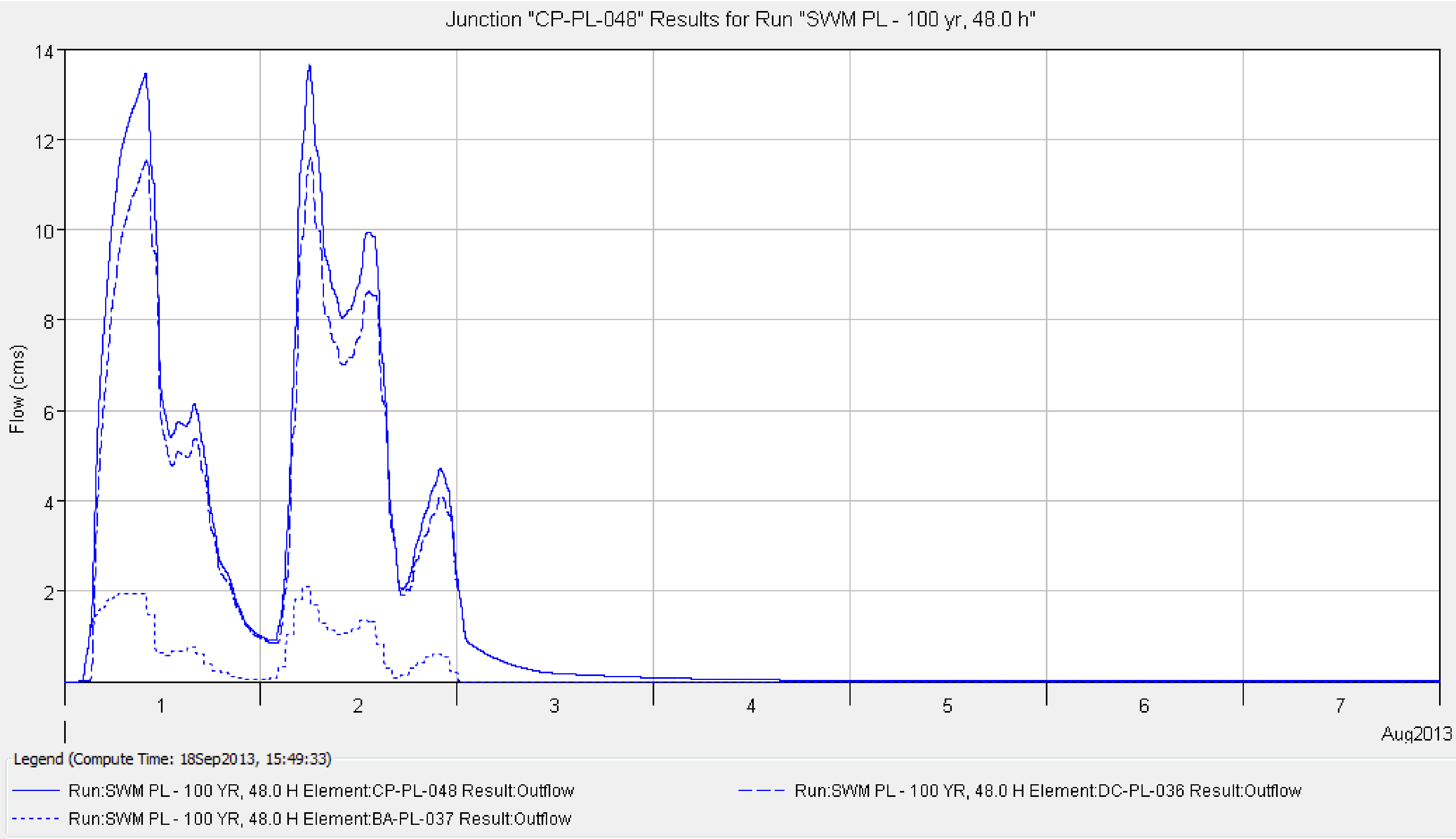
Junction "CP-PL-044" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-033 Result:Outflow

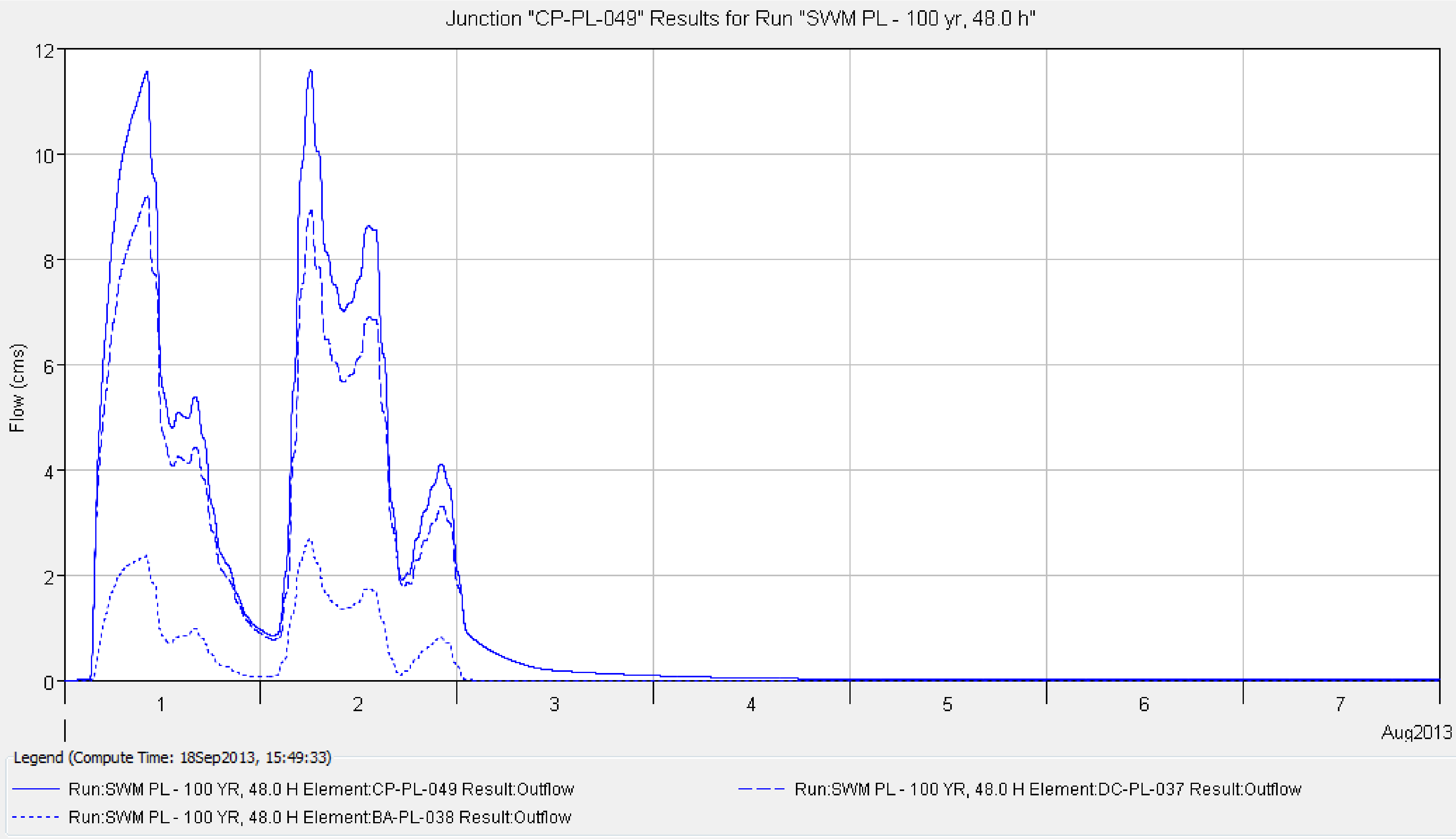

Junction "CP-PL-045" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
2
4
6
8
10
12
14
16
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-034 Result:Outflow

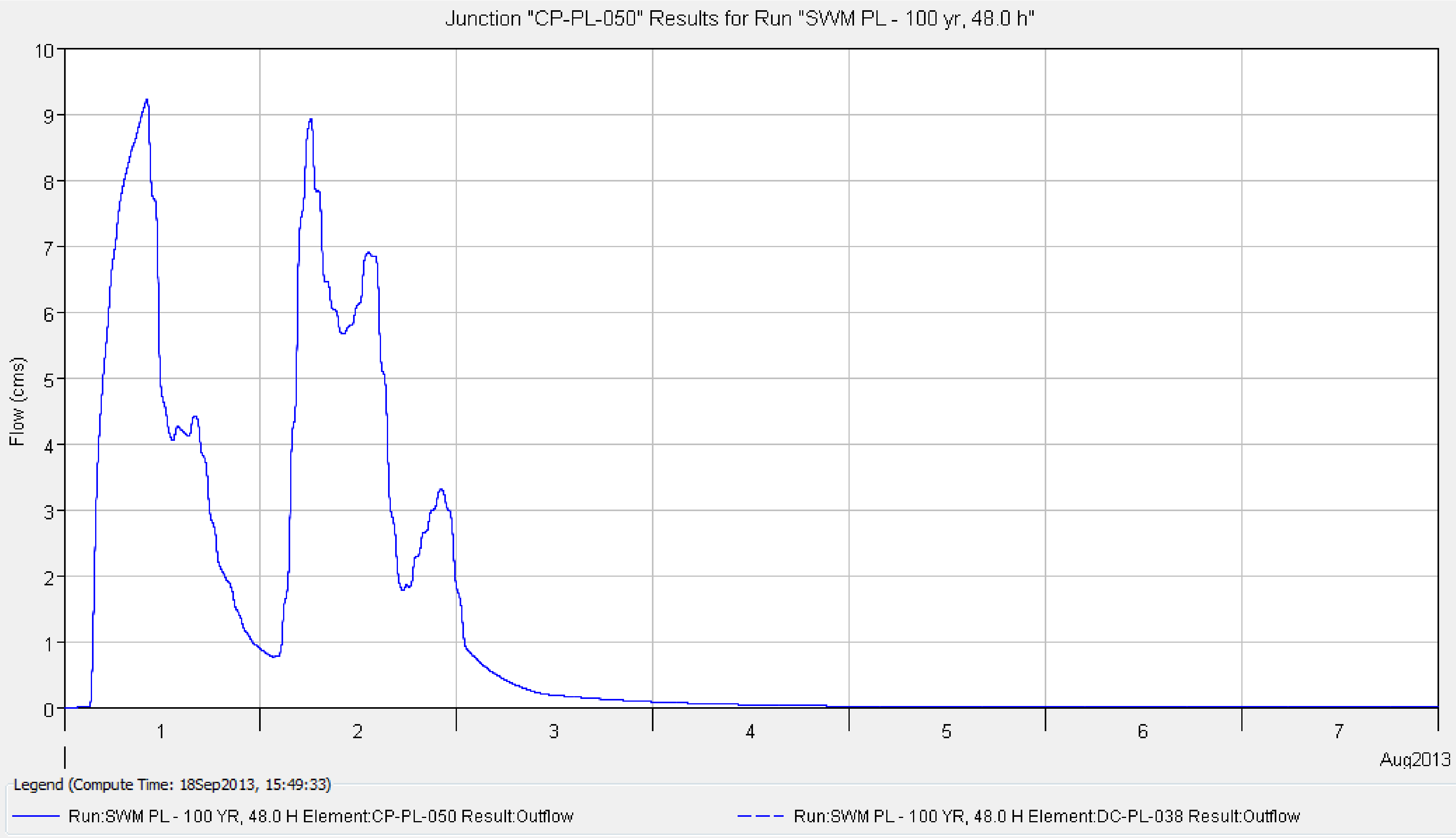

Junction "CP-PL-046" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-046 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-036 Result:Outflow

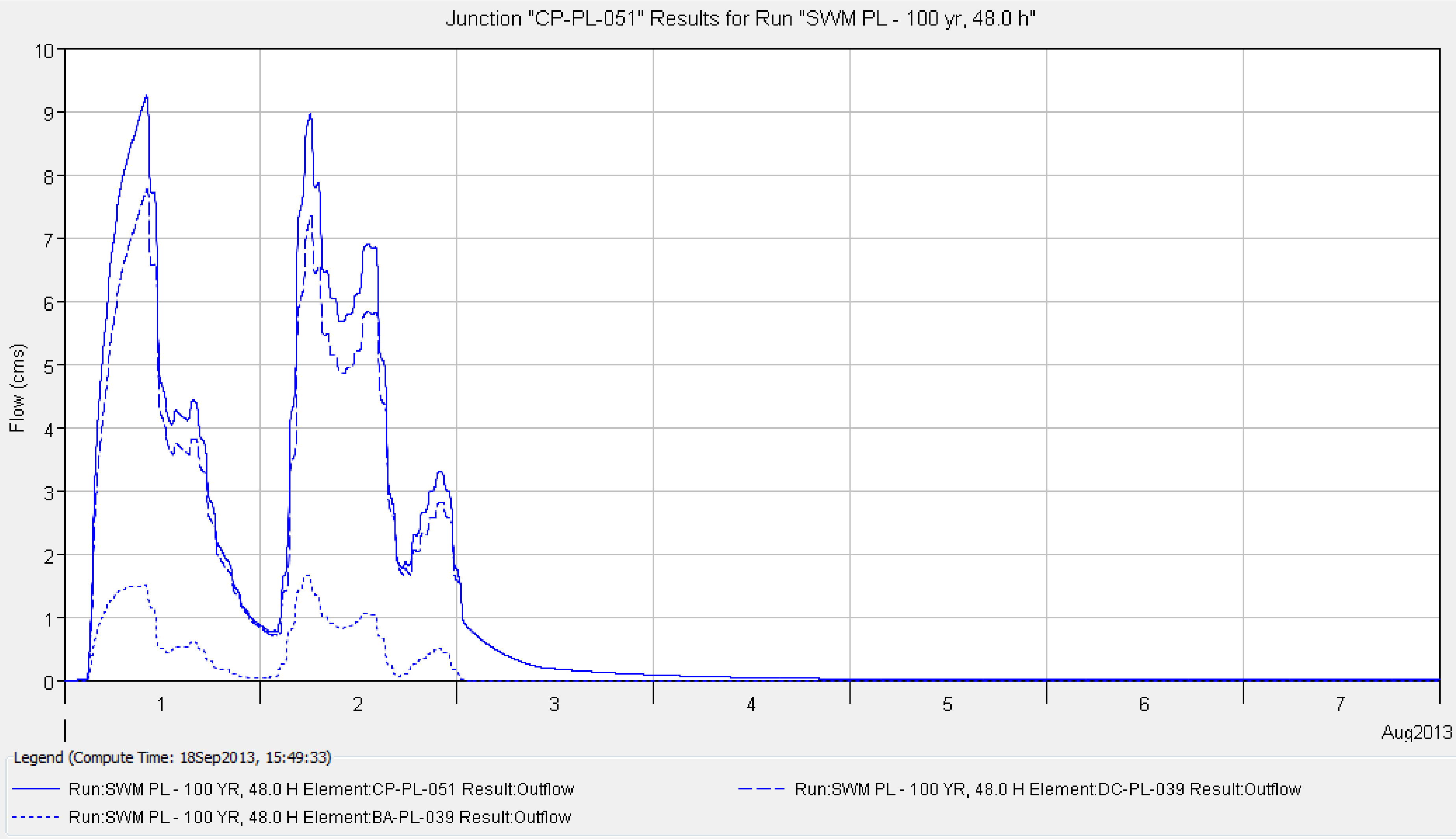


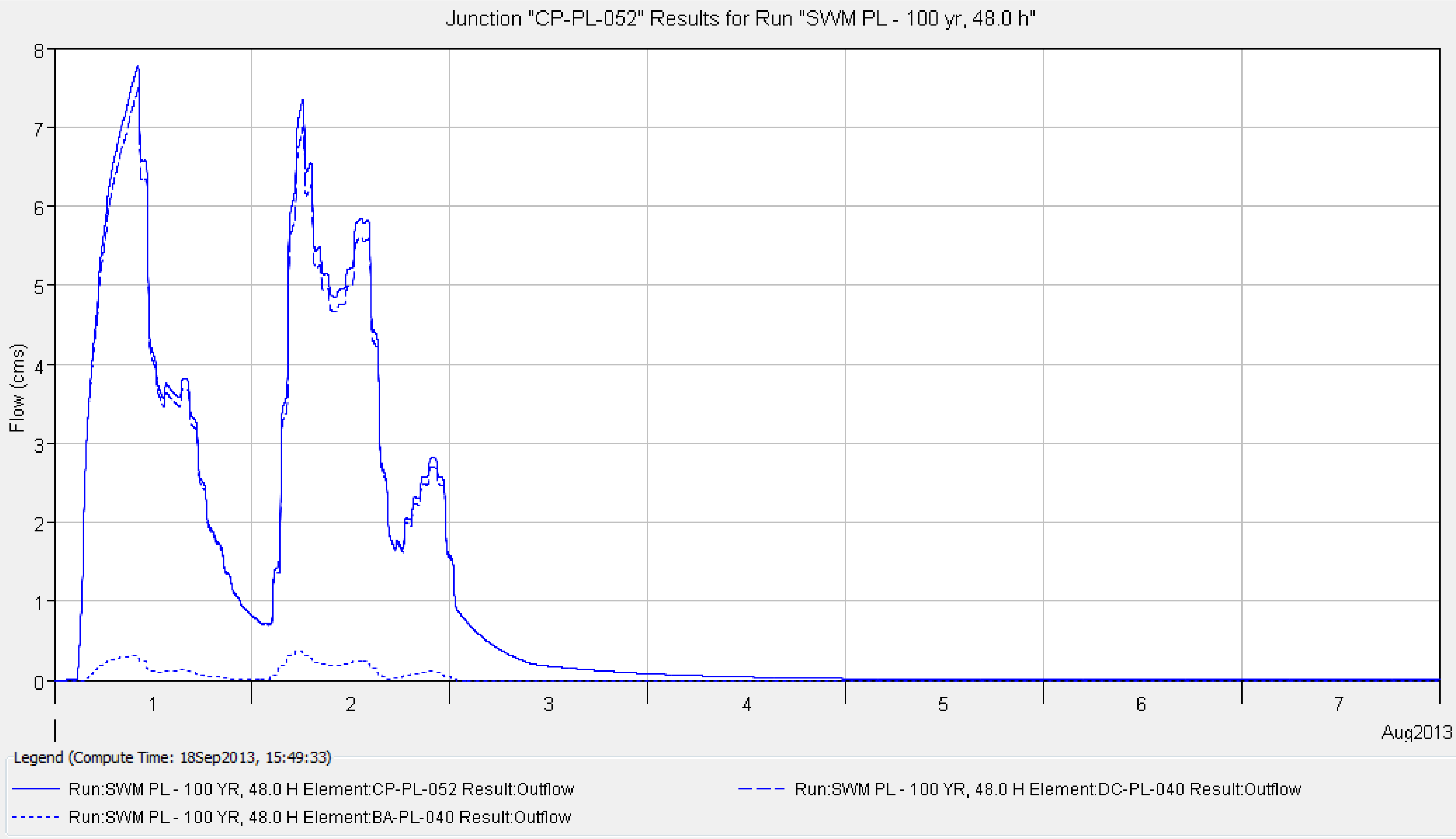
Junction "CP-PL-047" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-047 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-035 Result:Outflow


Junction "CP-PL-048" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
14
12
10
8
6
4
2
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-048 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-036 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-037 Result:Outflow

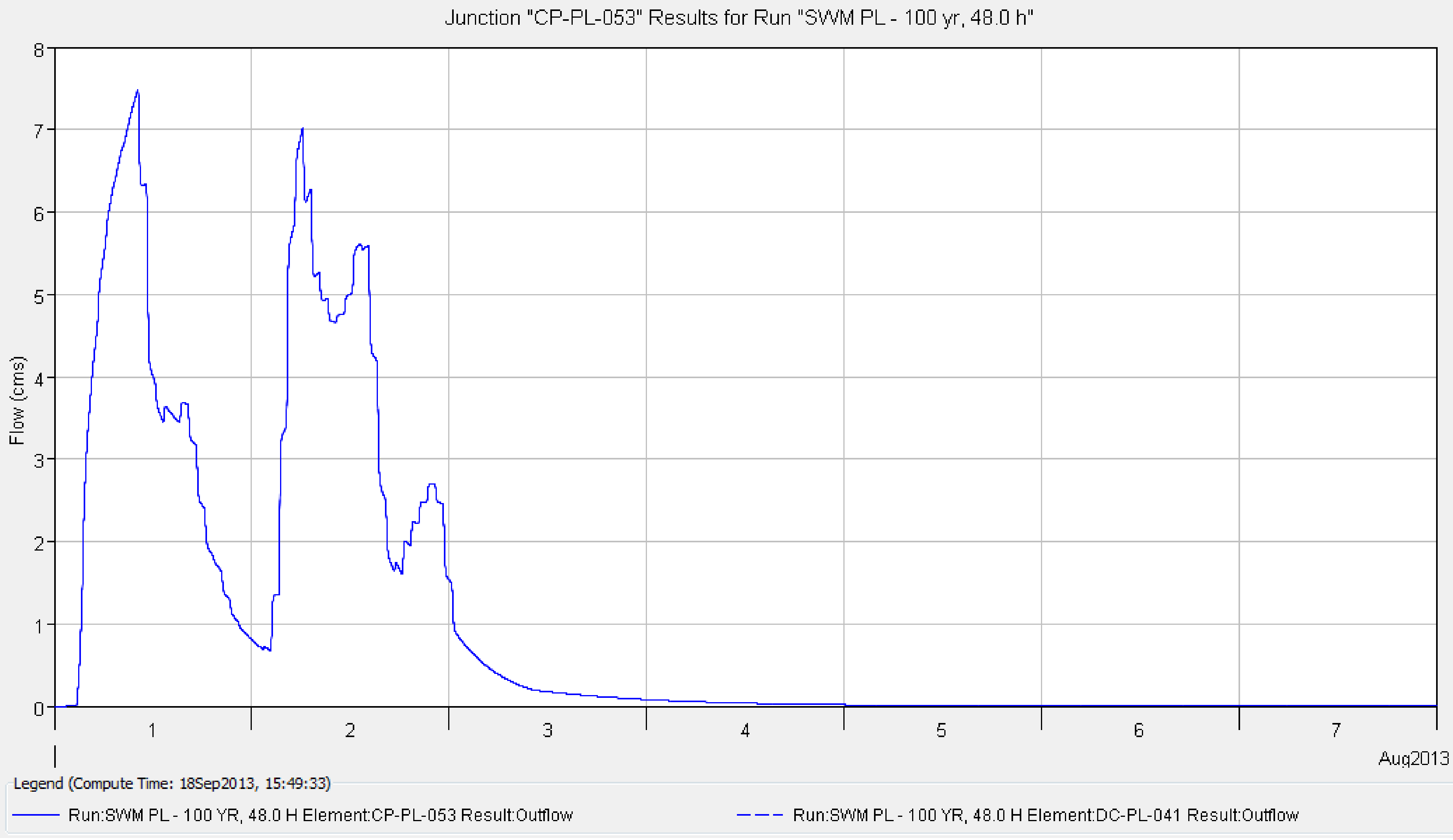

Junction "CP-PL-049" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-037 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-038 Result:Outflow


Junction "CP-PL-050" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-050 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-038 Result:Outflow

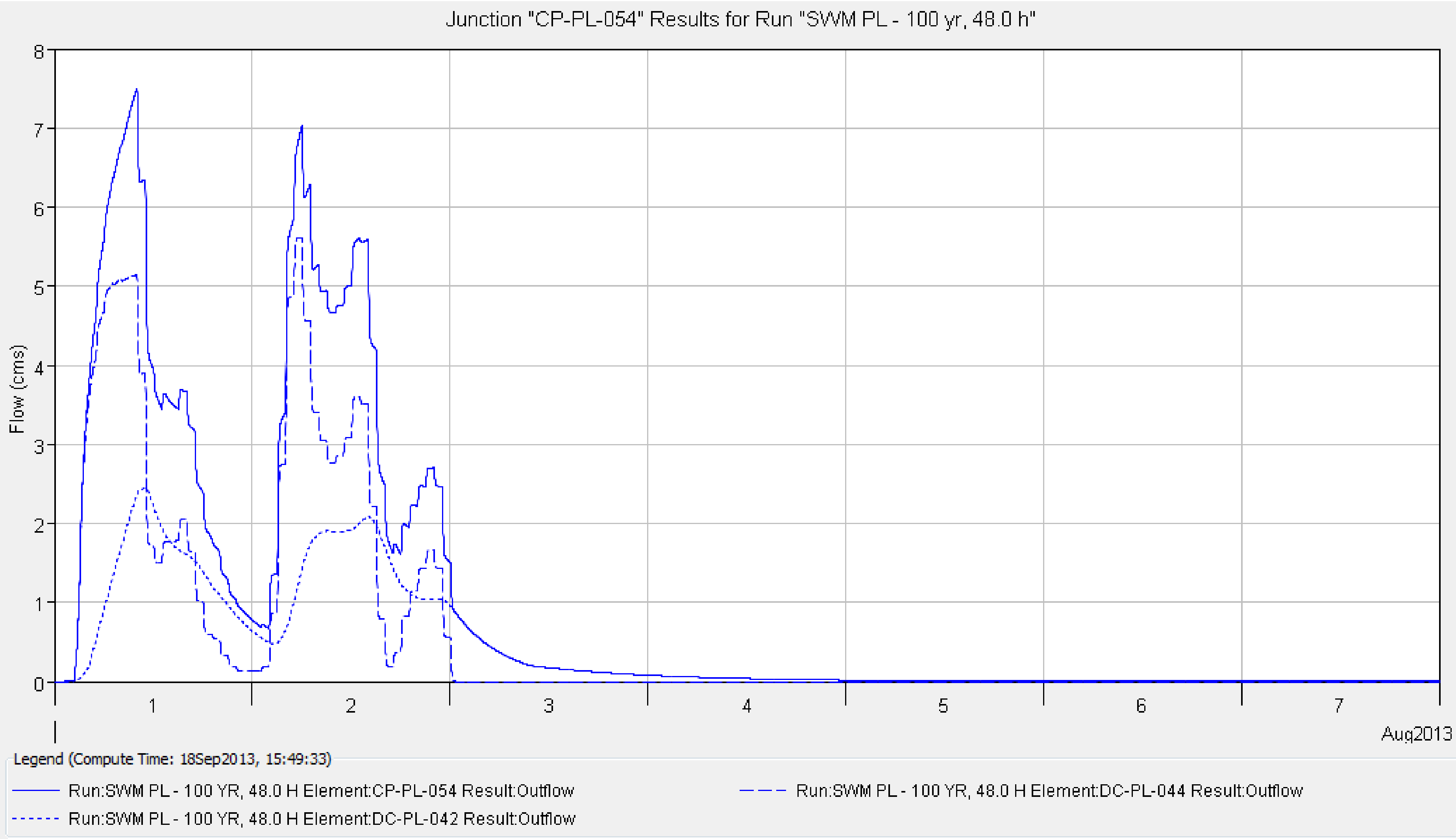

Junction "CP-PL-051" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-051 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-039 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-039 Result:Outflow



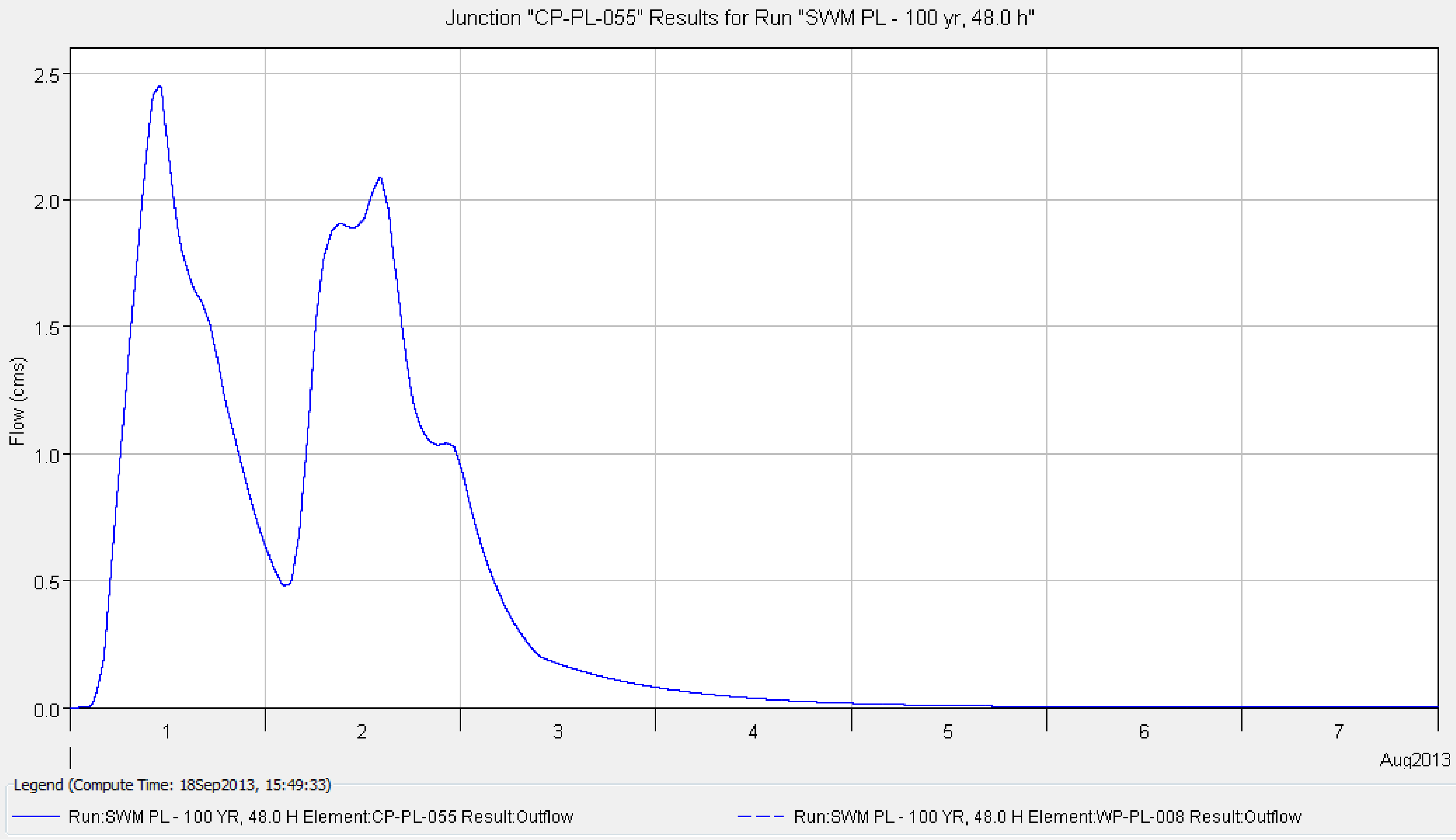
Junction "CP-PL-052" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-040 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-040 Result:Outflow



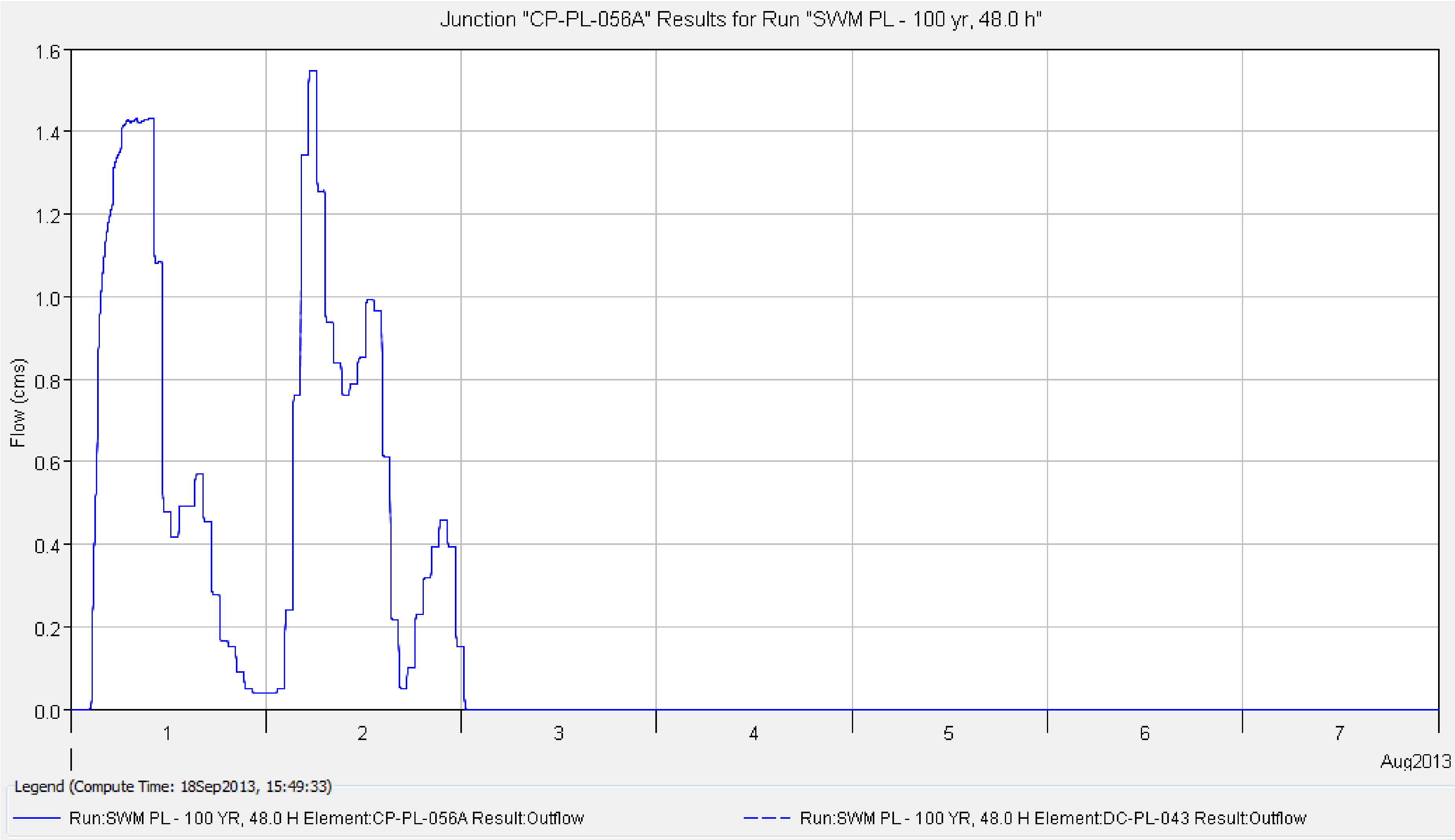
Junction "CP-PL-053" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-041 Result:Outflow



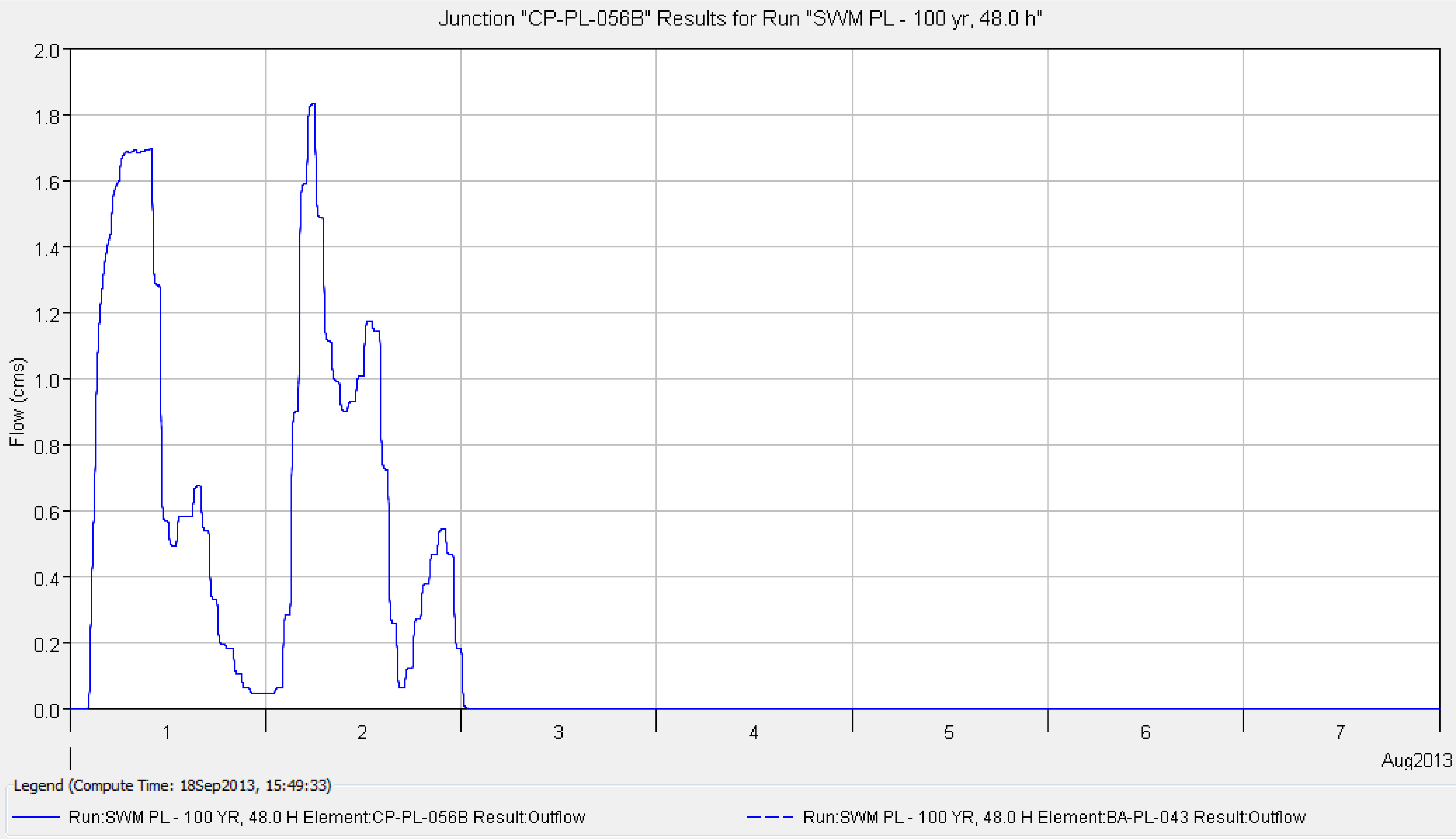
Junction "CP-PL-054" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-044 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-042 Result:Outflow



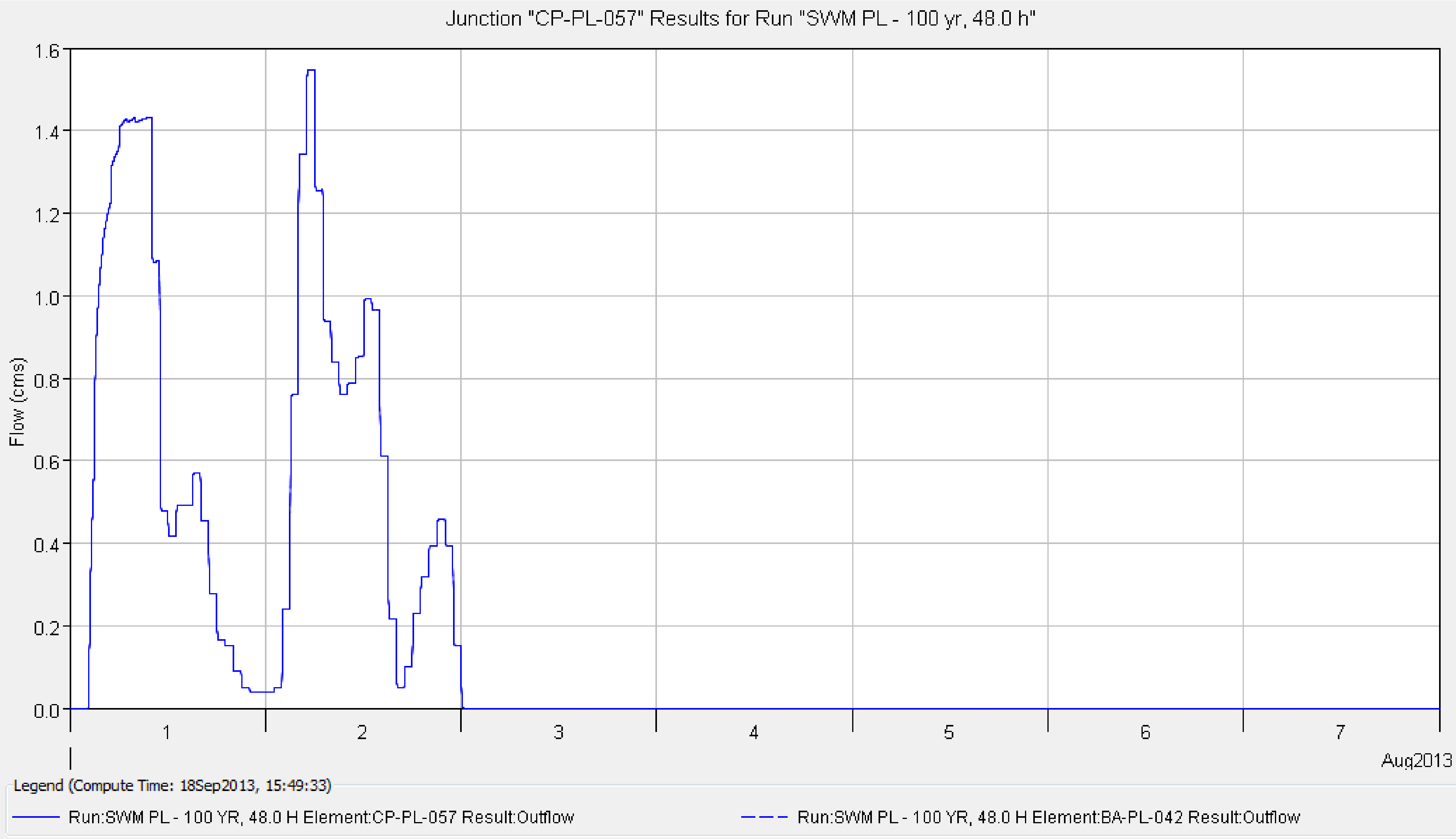
Junction "CP-PL-055" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Outflow



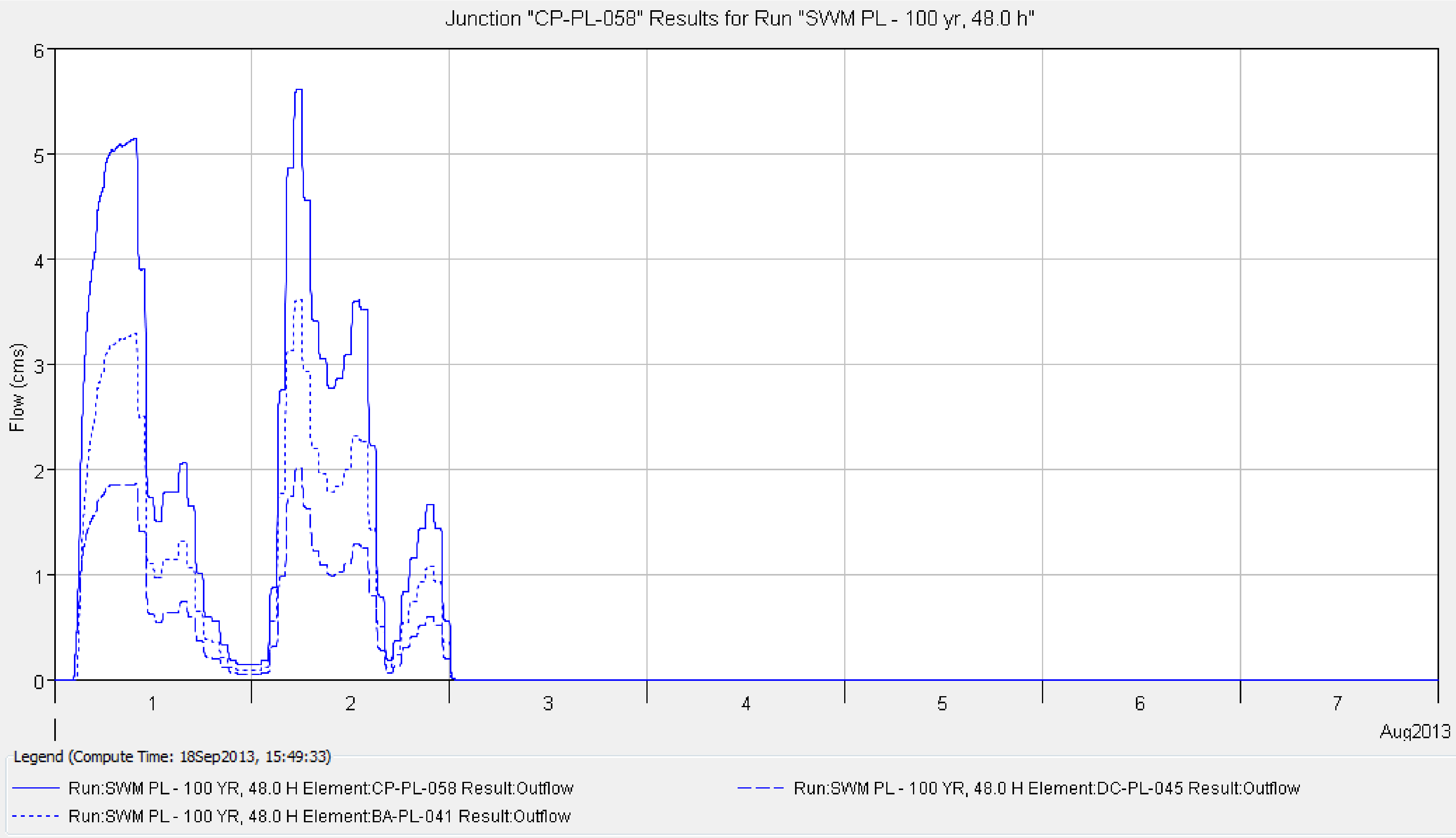
Junction "CP-PL-056A" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-056A Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-043 Result:Outflow



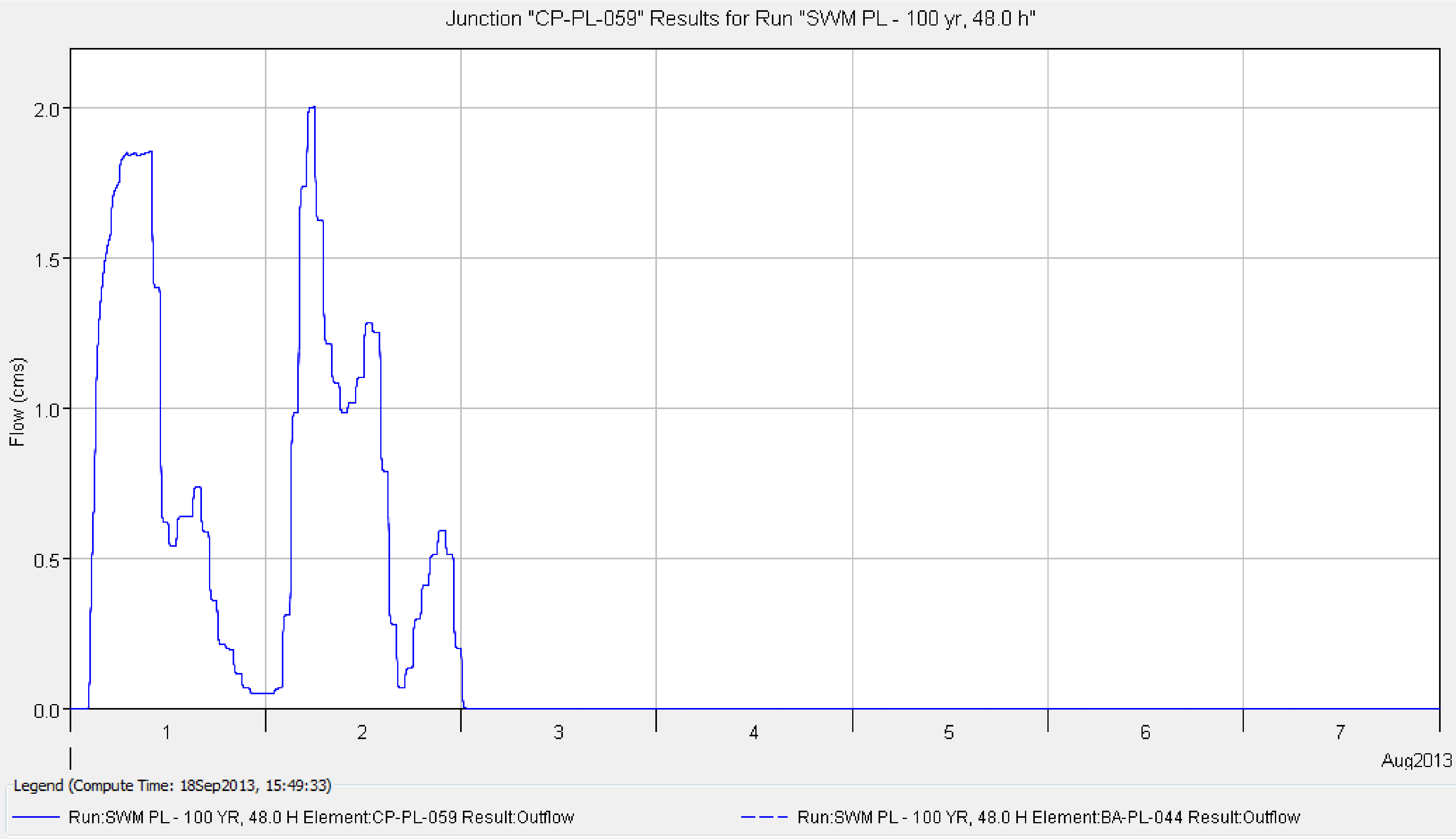
Junction "CP-PL-056B" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-056B Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-043 Result:Outflow

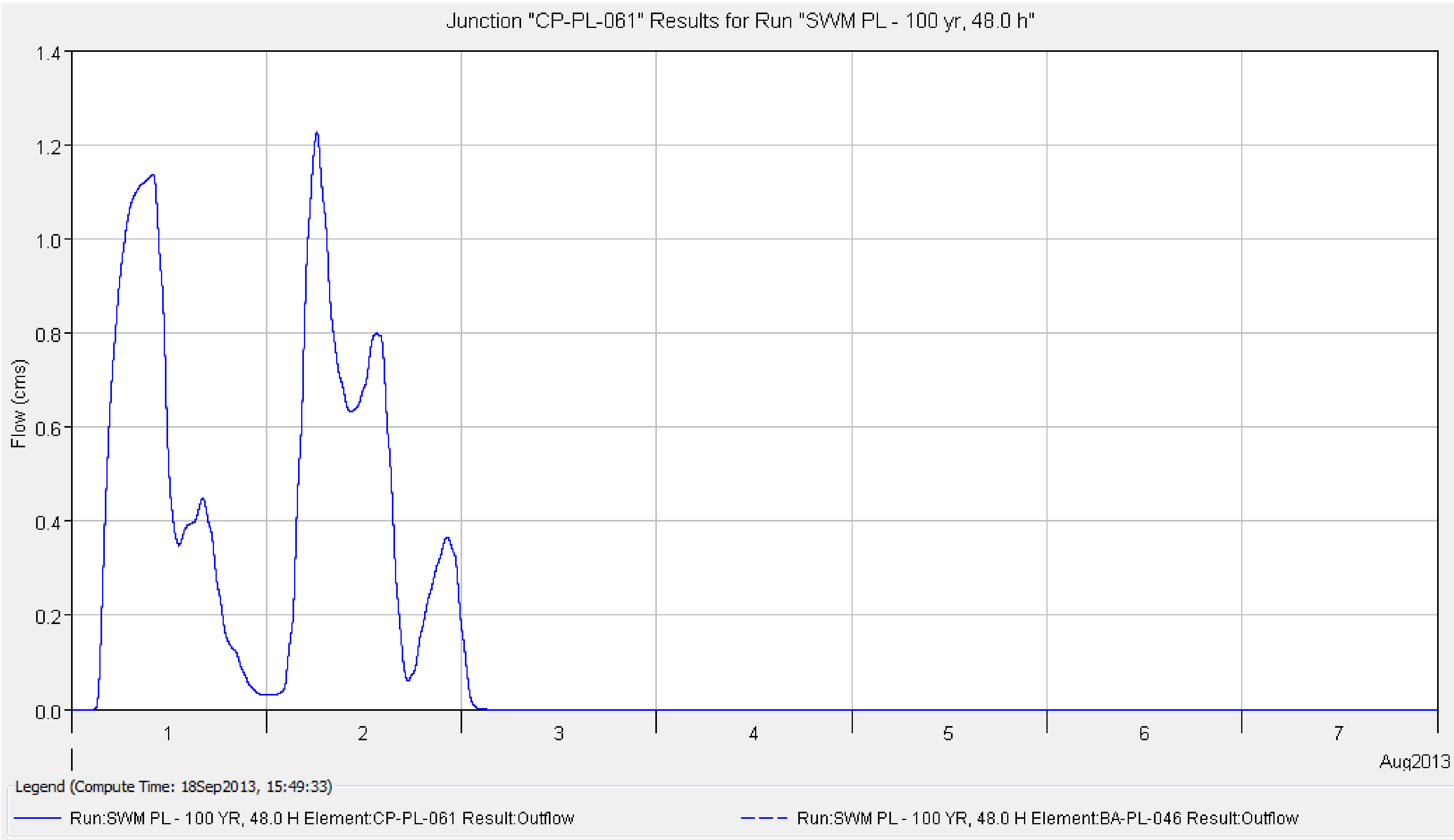


Junction "CP-PL-057" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-042 Result:Outflow

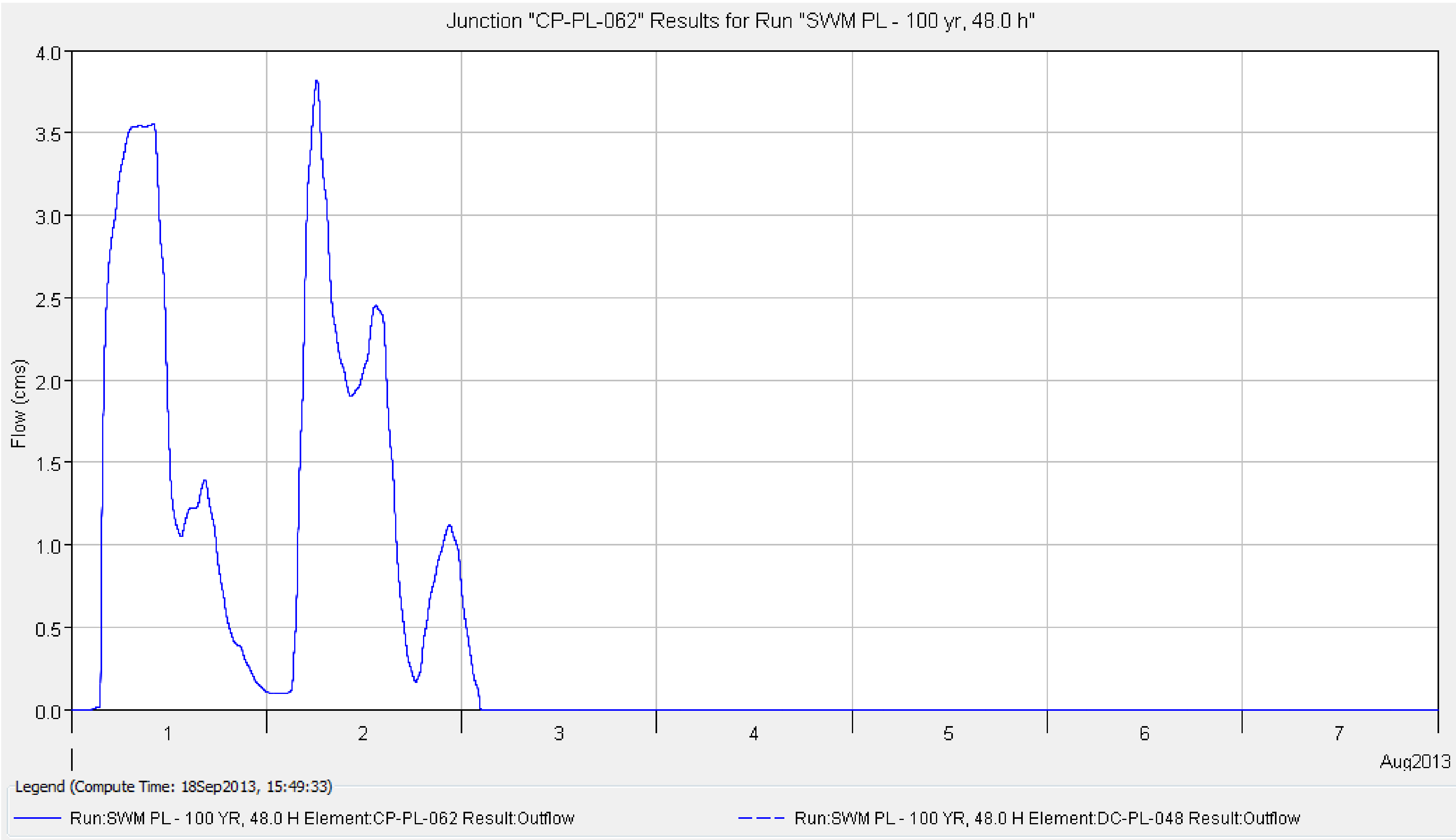


Junction "CP-PL-058" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-045 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-041 Result:Outflow

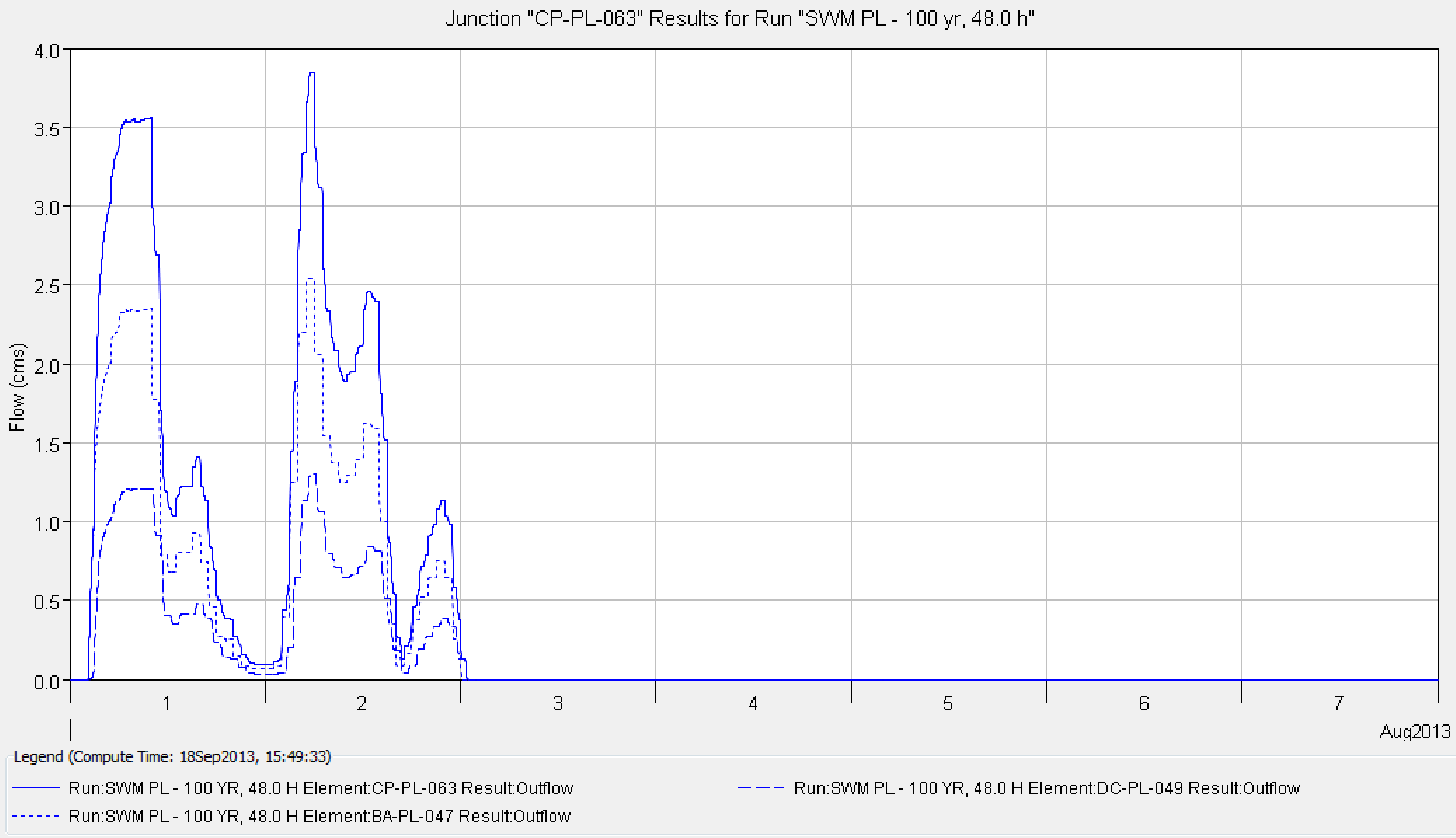

Junction "CP-PL-059" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-059 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-044 Result:Outflow

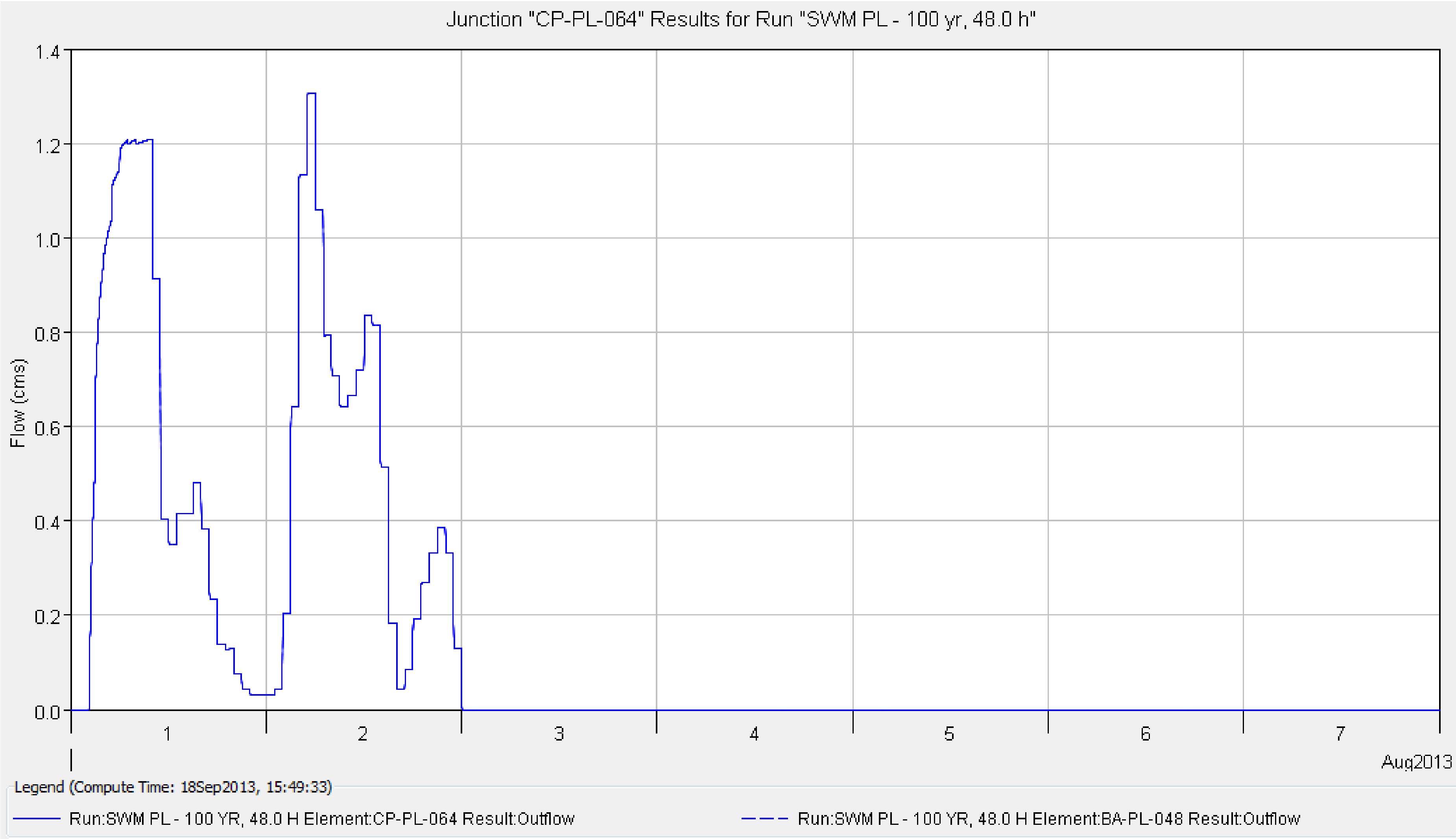


Junction "CP-PL-061" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-061 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-046 Result:Outflow

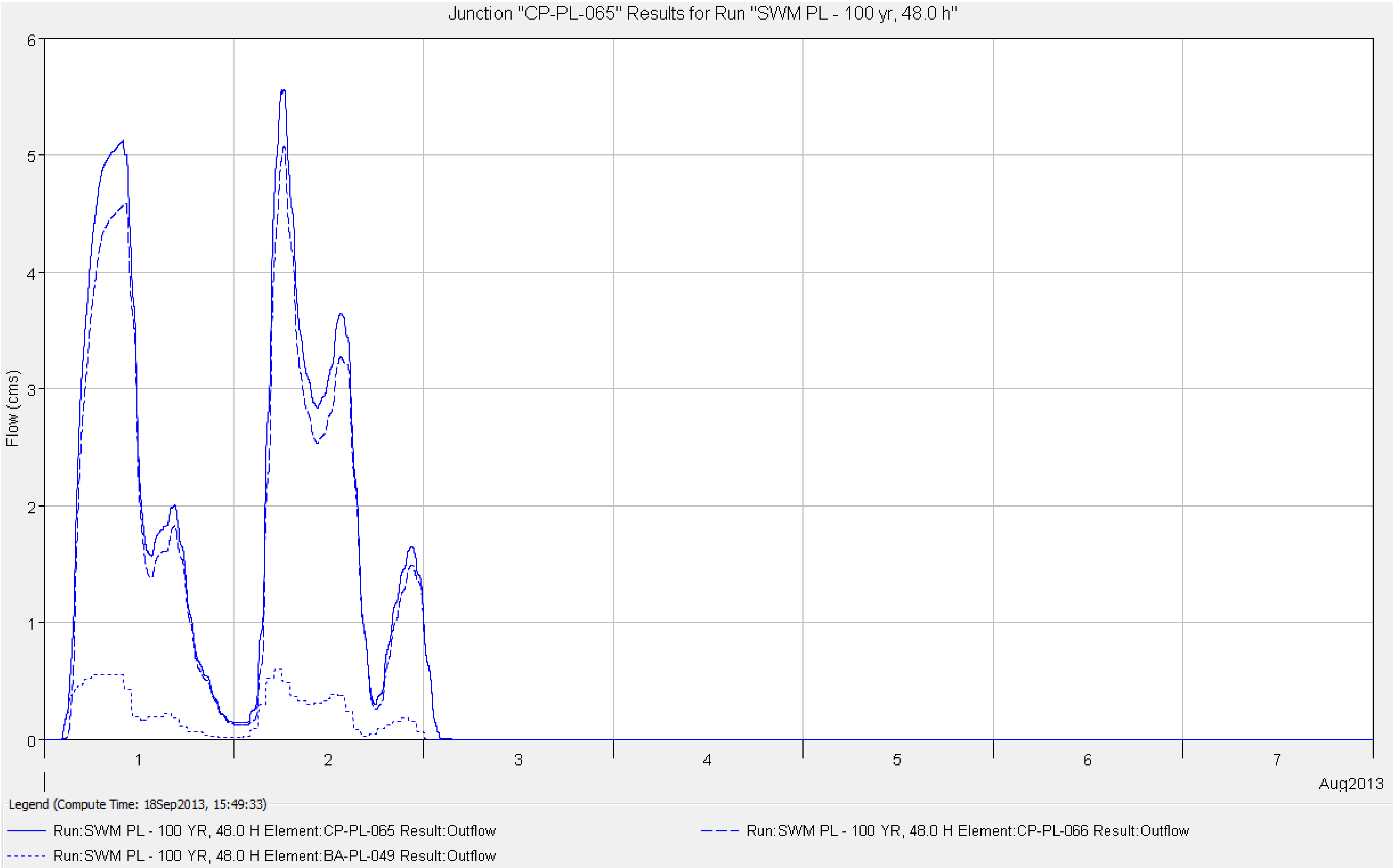


Junction "CP-PL-062" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-062 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-048 Result:Outflow

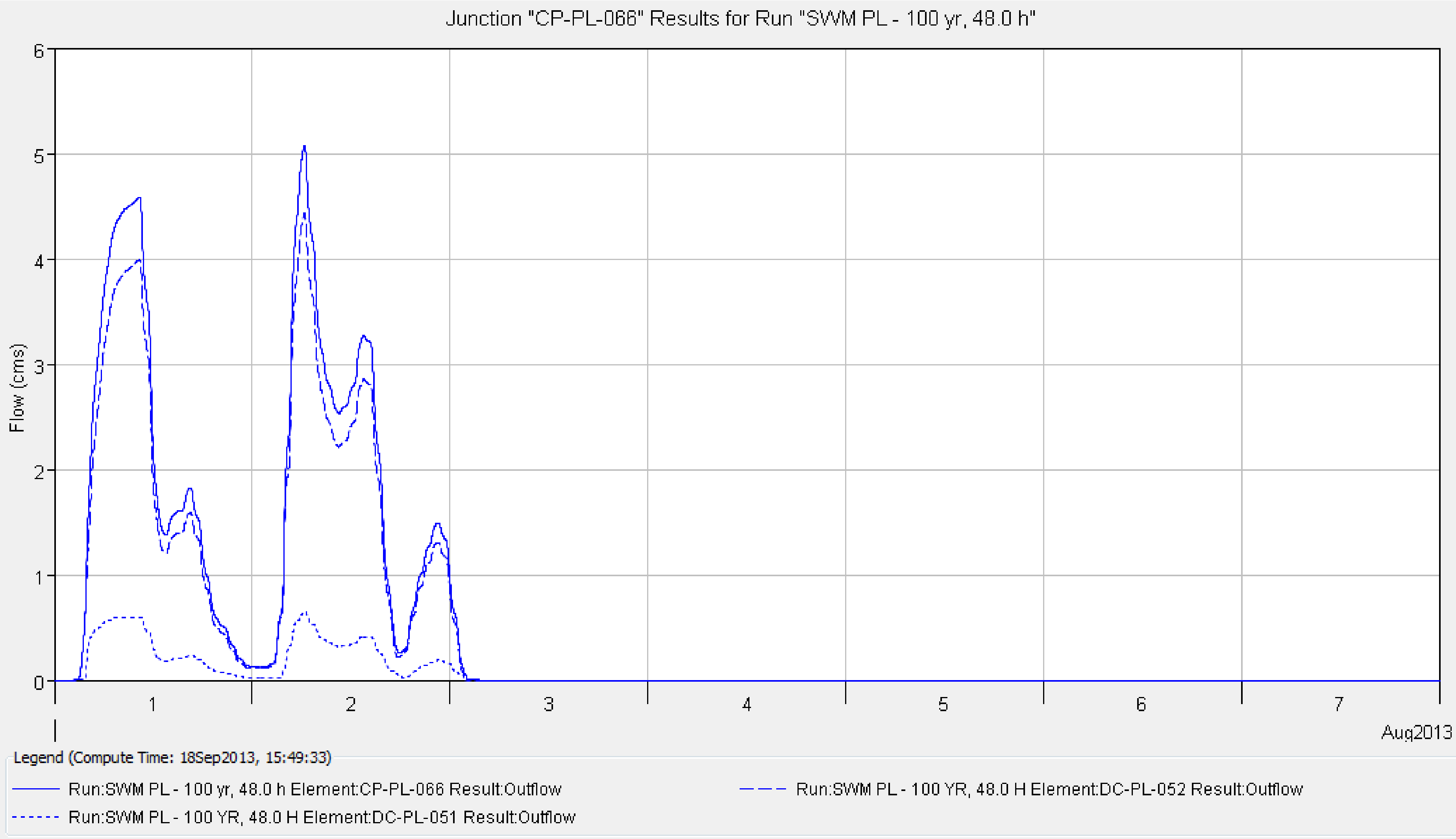

Junction "CP-PL-063" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-049 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-047 Result:Outflow



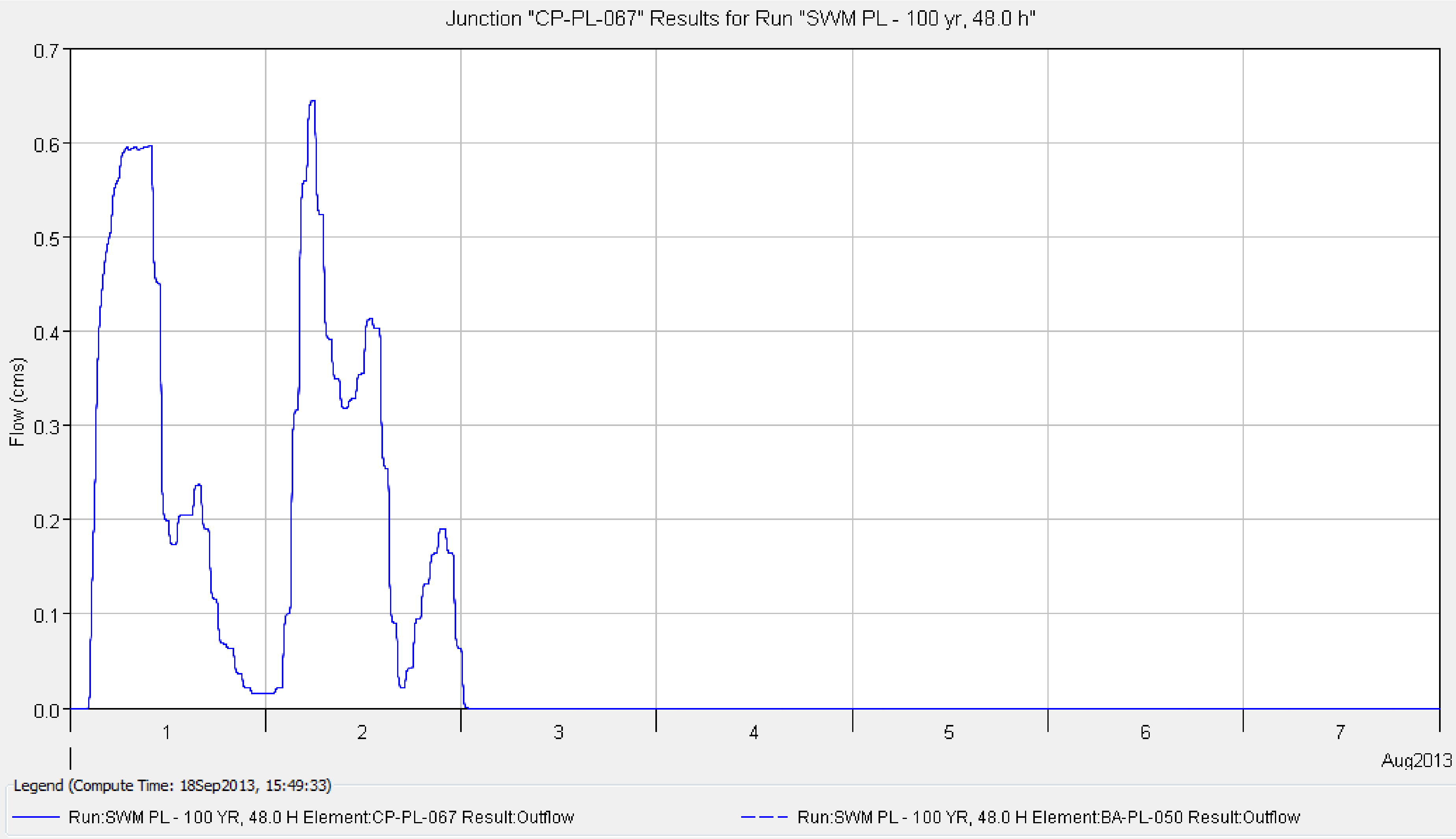
Junction "CP-PL-064" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-064 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-048 Result:Outflow



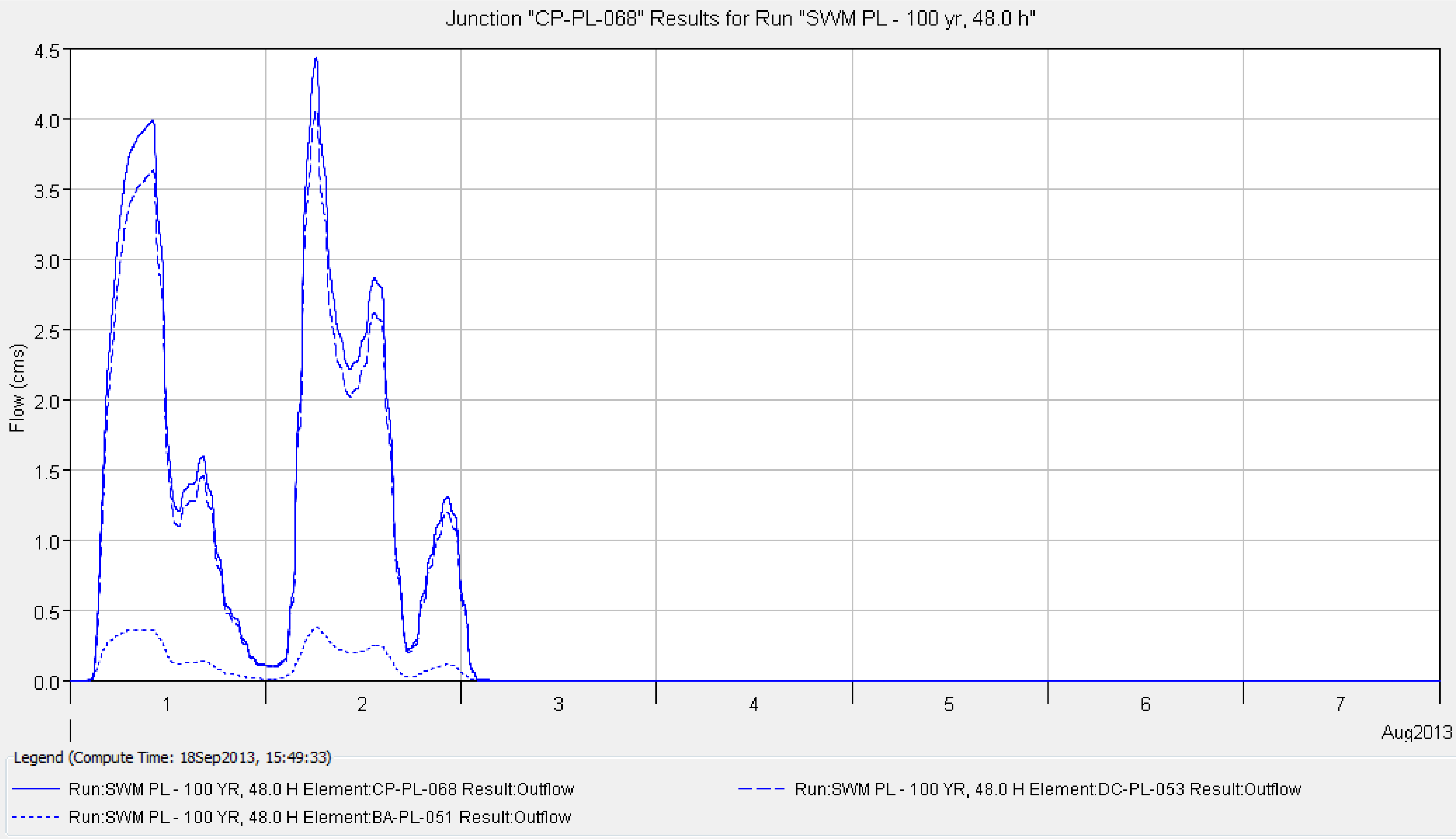
Junction "CP-PL-065" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-065 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-049 Result:Outflow



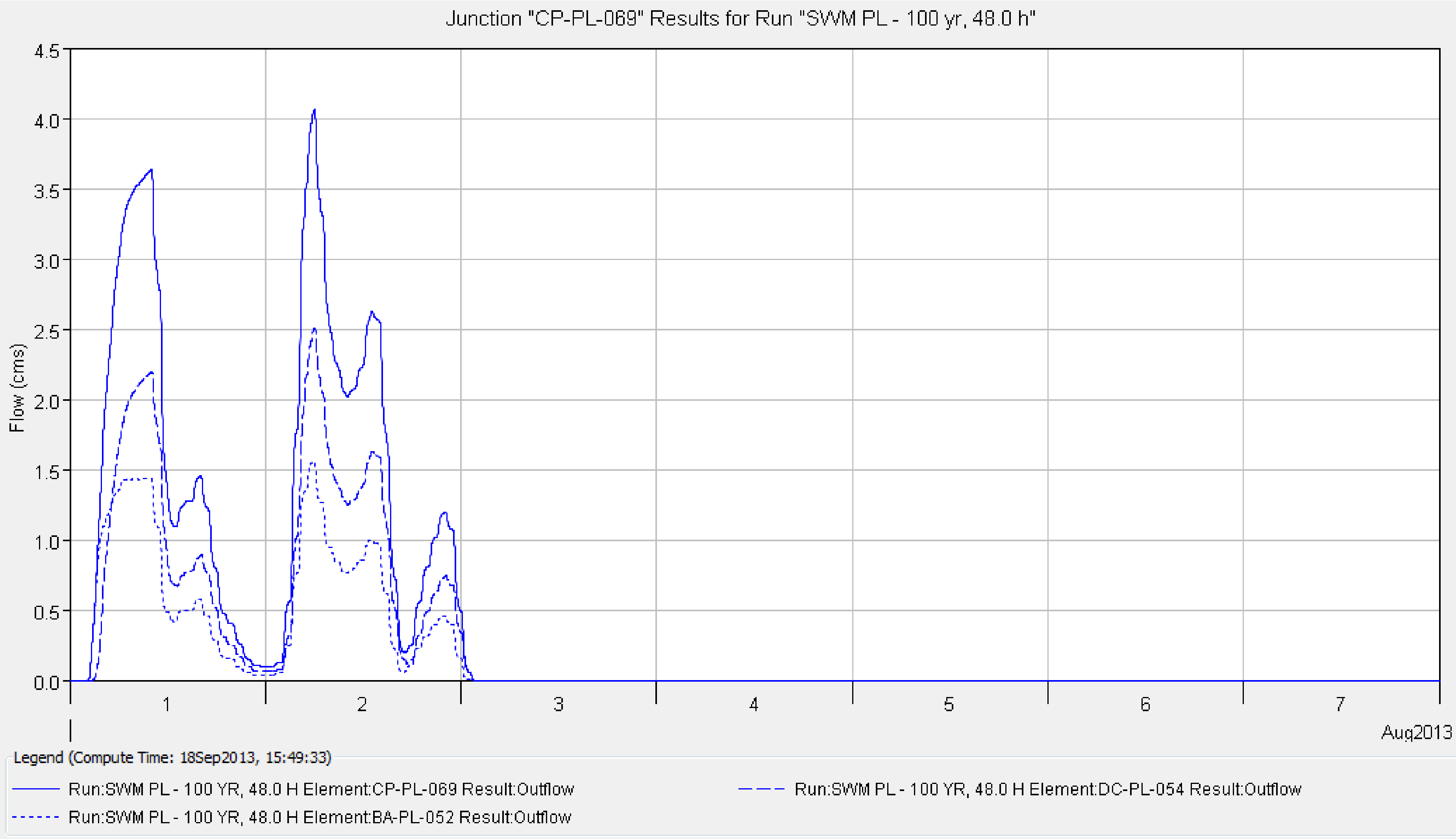
Junction "CP-PL-066" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-066 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-052 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-051 Result:Outflow



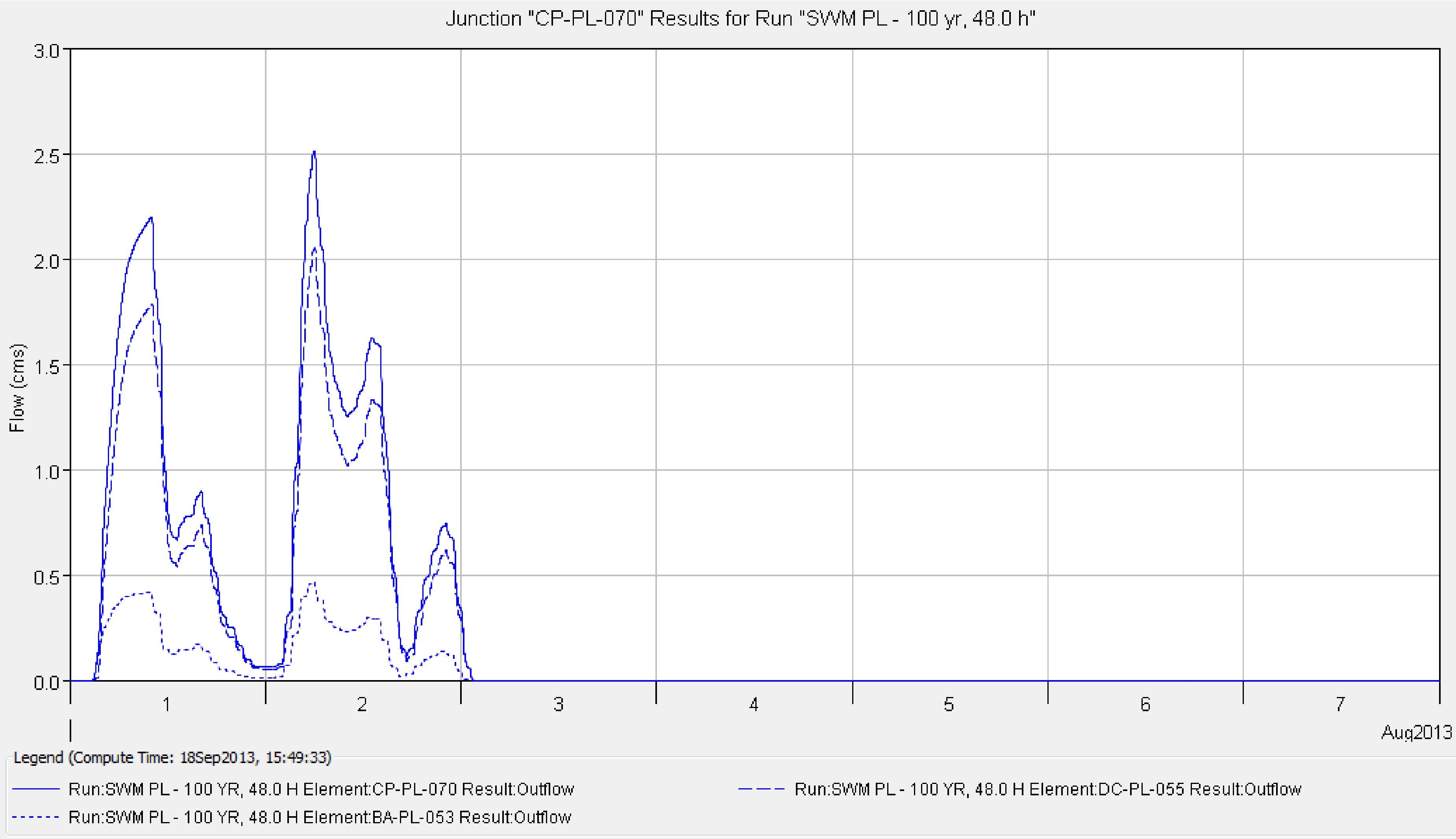
Junction "CP-PL-067" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-067 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-050 Result:Outflow



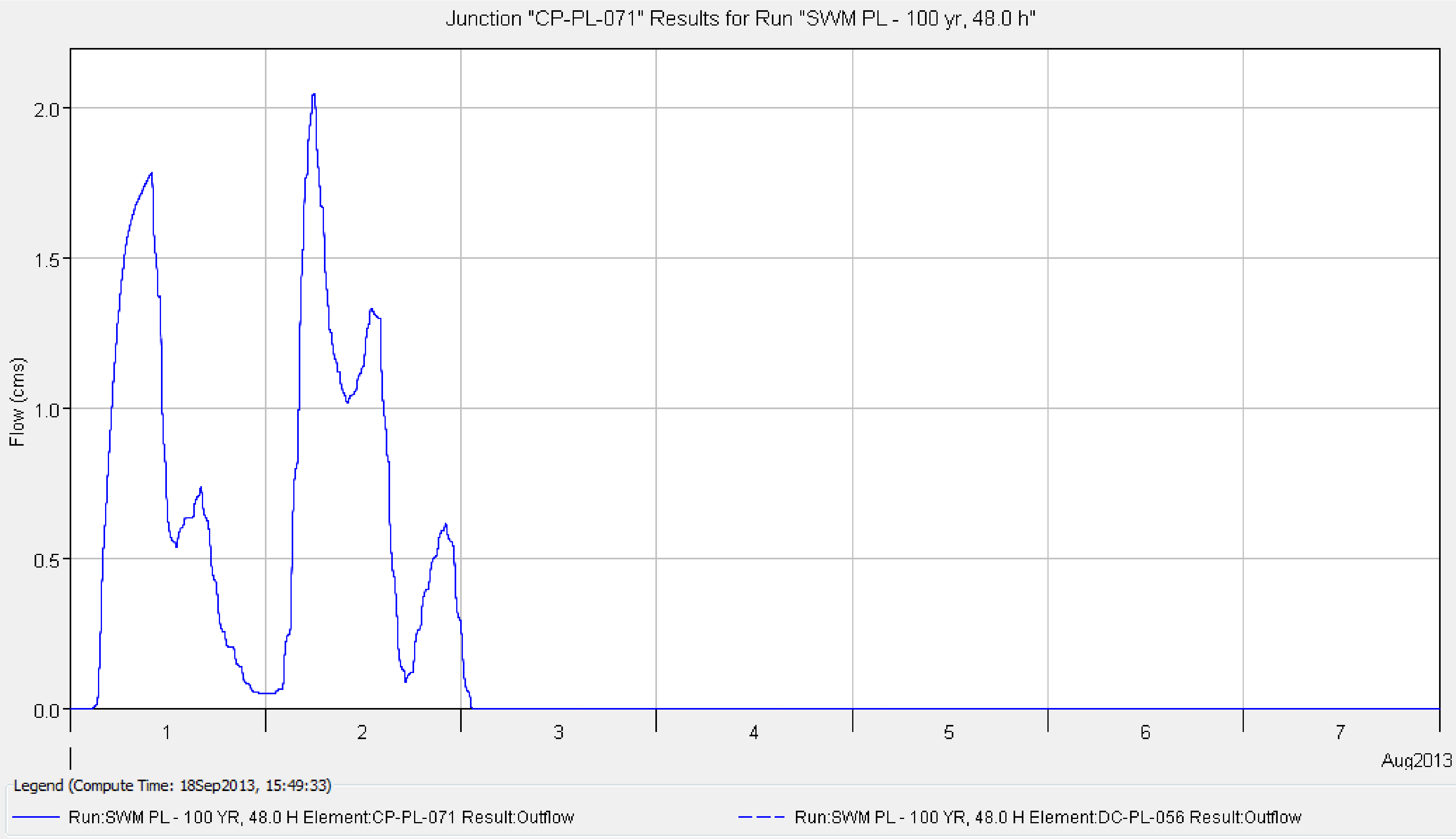
Junction "CP-PL-068" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-068 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-053 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-051 Result:Outflow

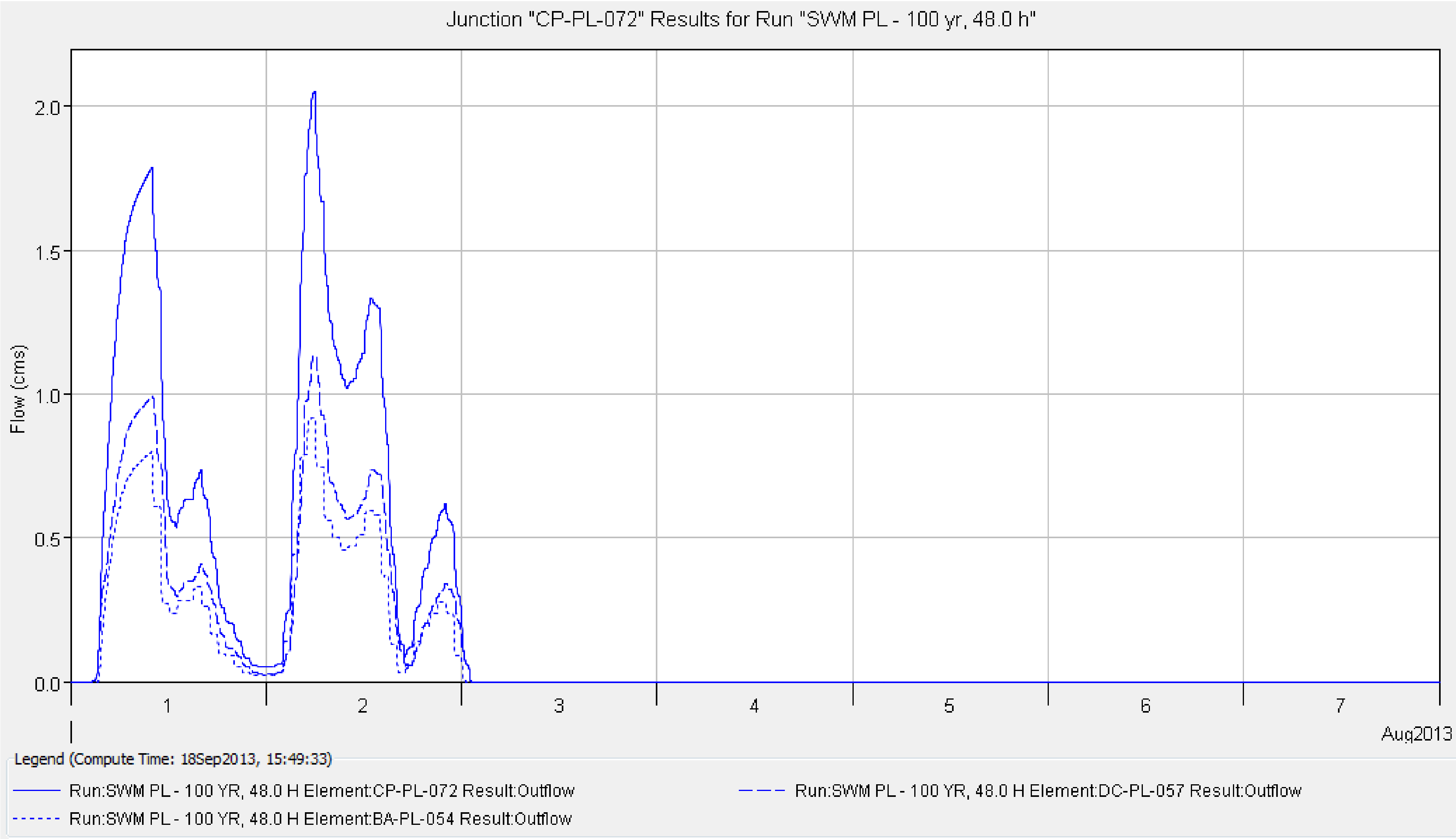


Junction "CP-PL-069" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-069 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-054 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-052 Result:Outflow

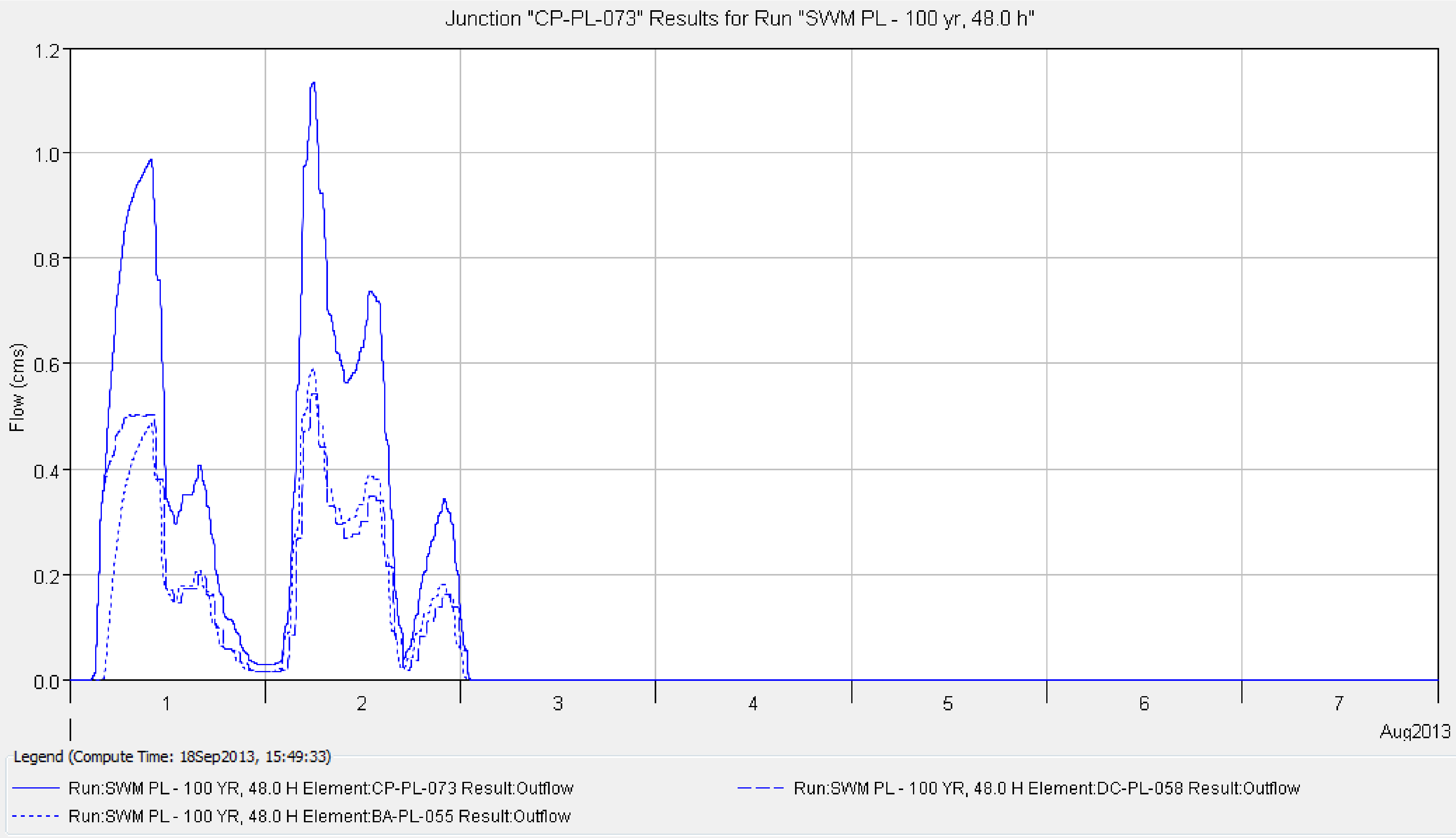


Junction "CP-PL-070" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-070 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-055 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-053 Result:Outflow

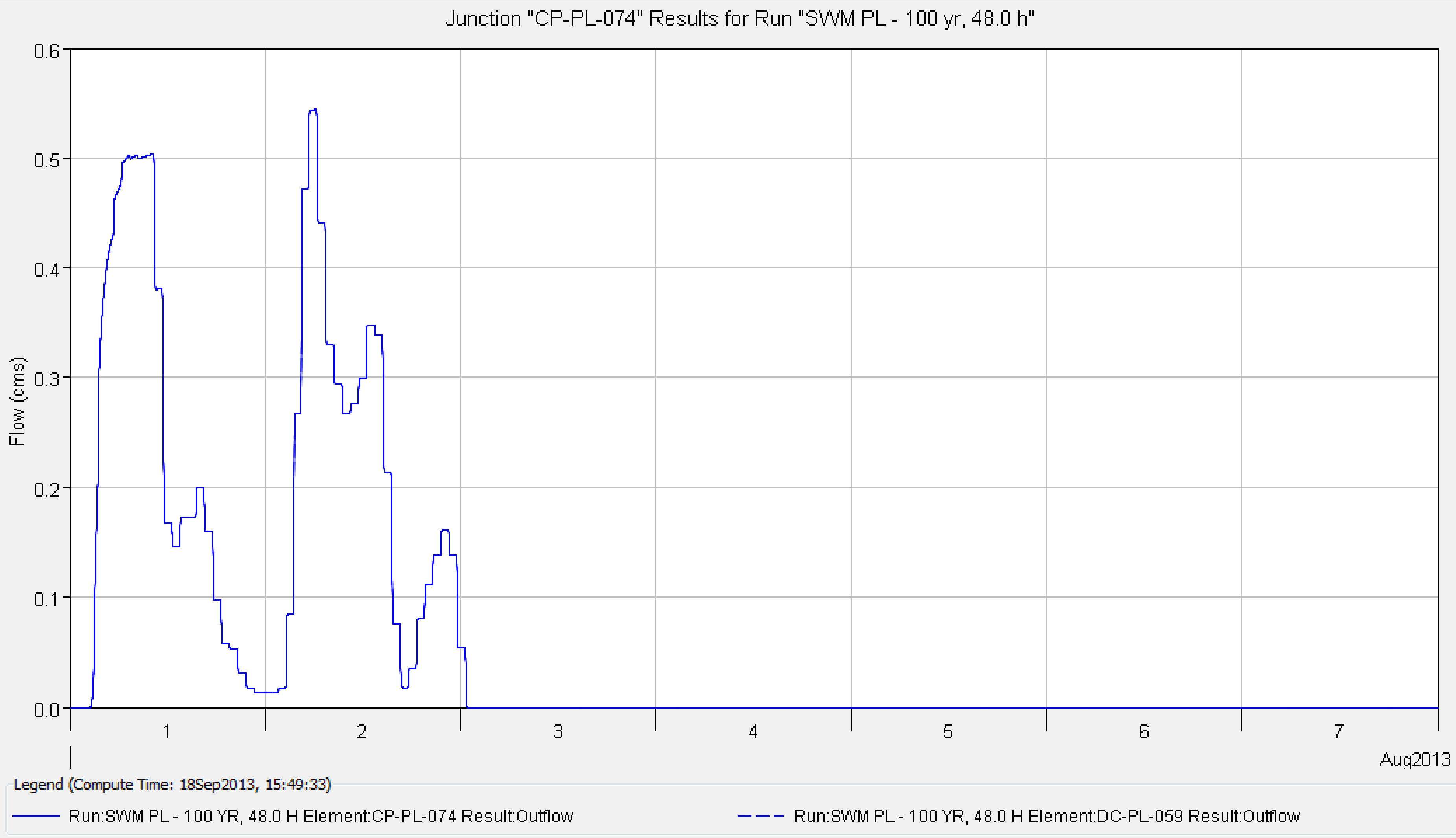

Junction "CP-PL-071" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-071 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-056 Result:Outflow



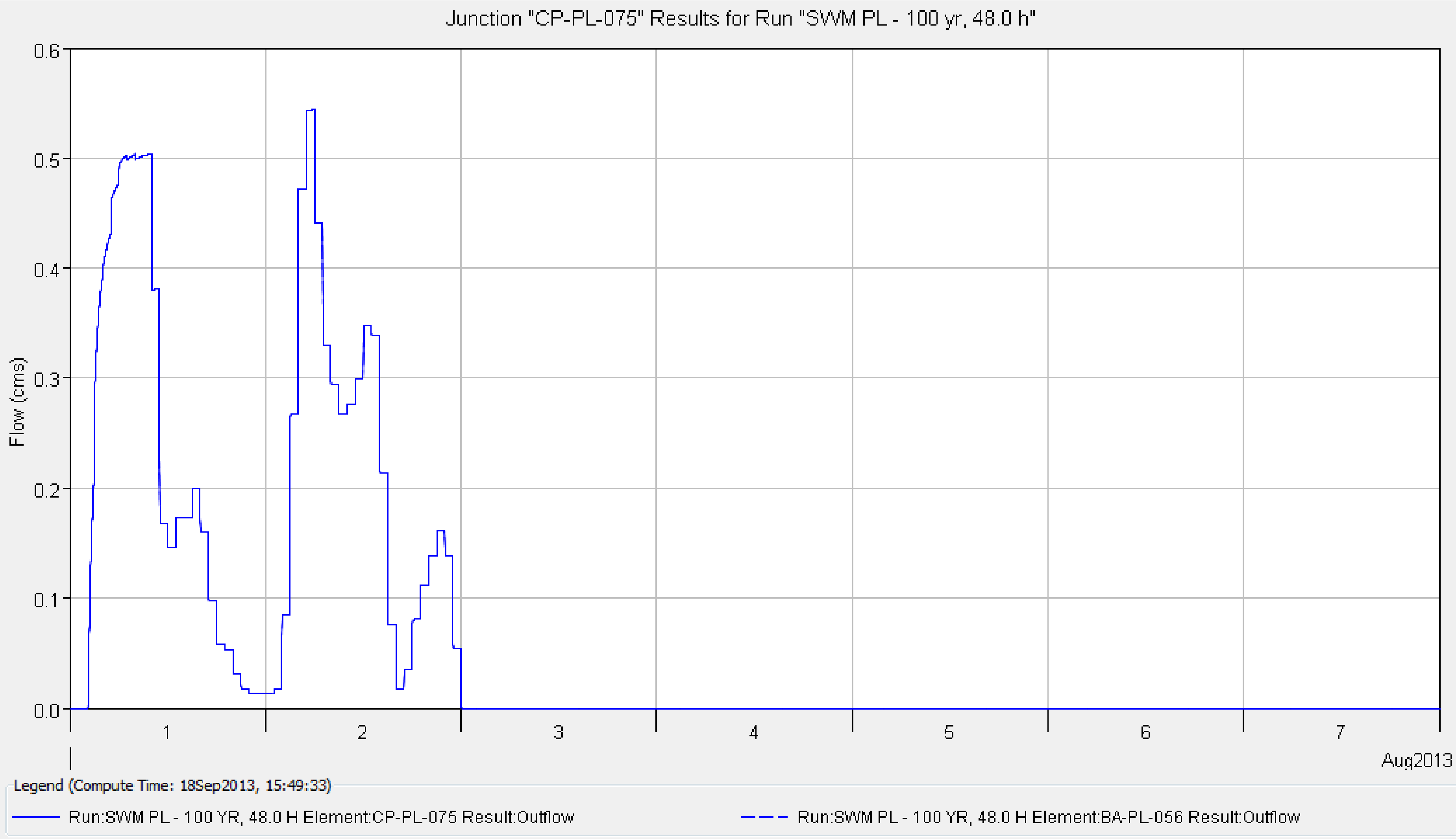
Junction "CP-PL-072" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-072 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-057 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-054 Result:Outflow



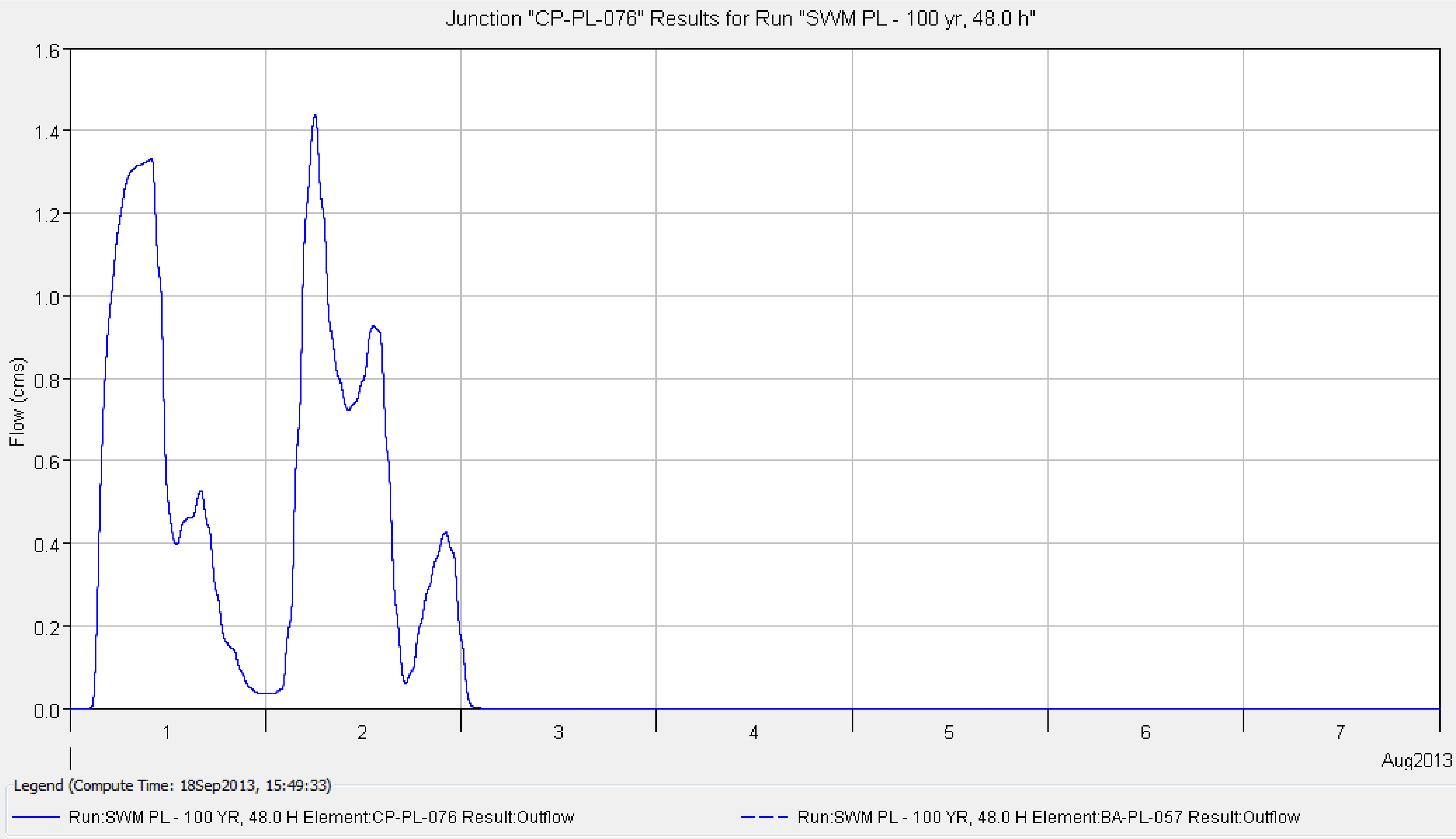
Junction "CP-PL-073" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-073 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-058 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-055 Result:Outflow



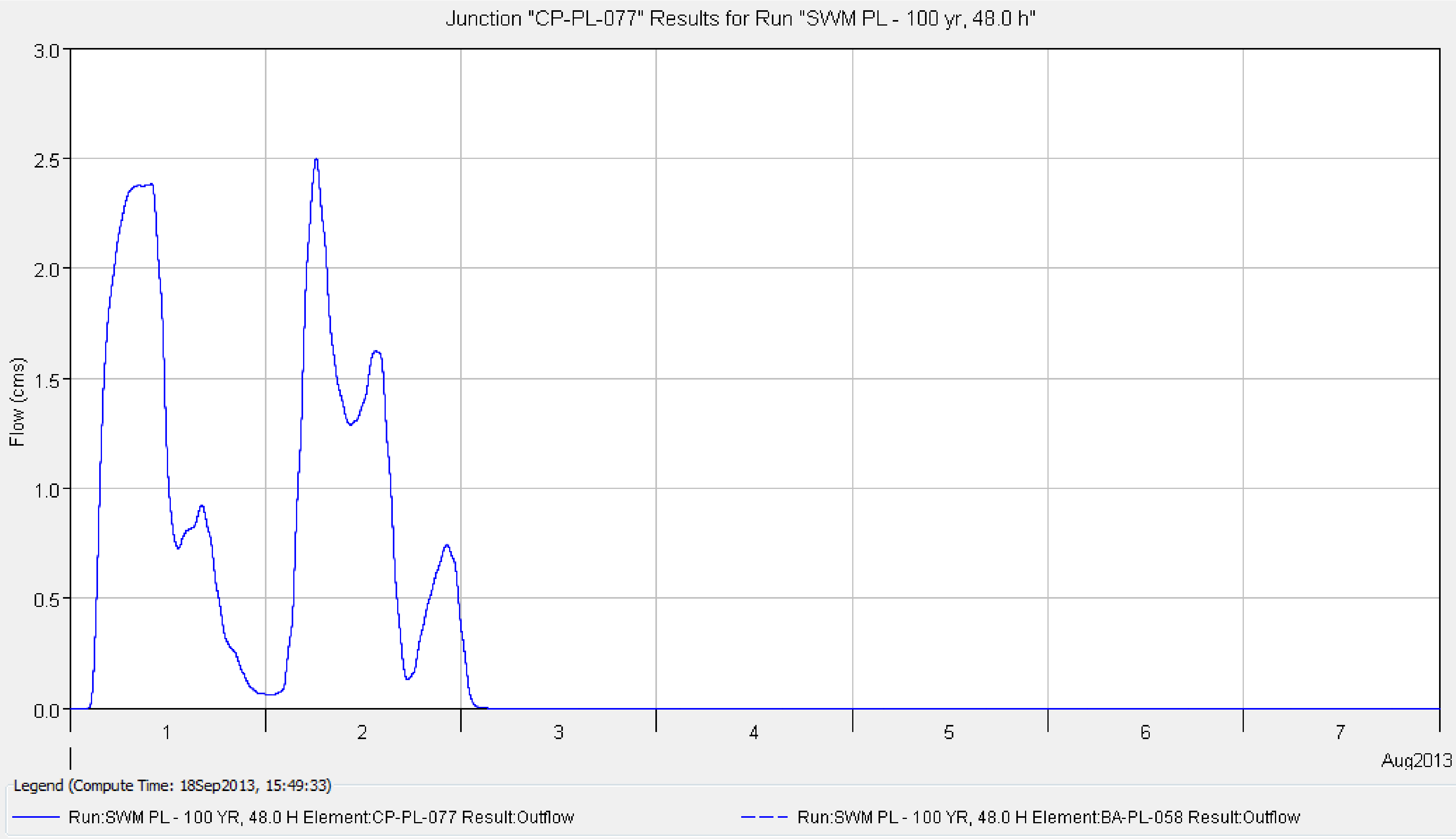
Junction "CP-PL-074" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-074 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-059 Result:Outflow



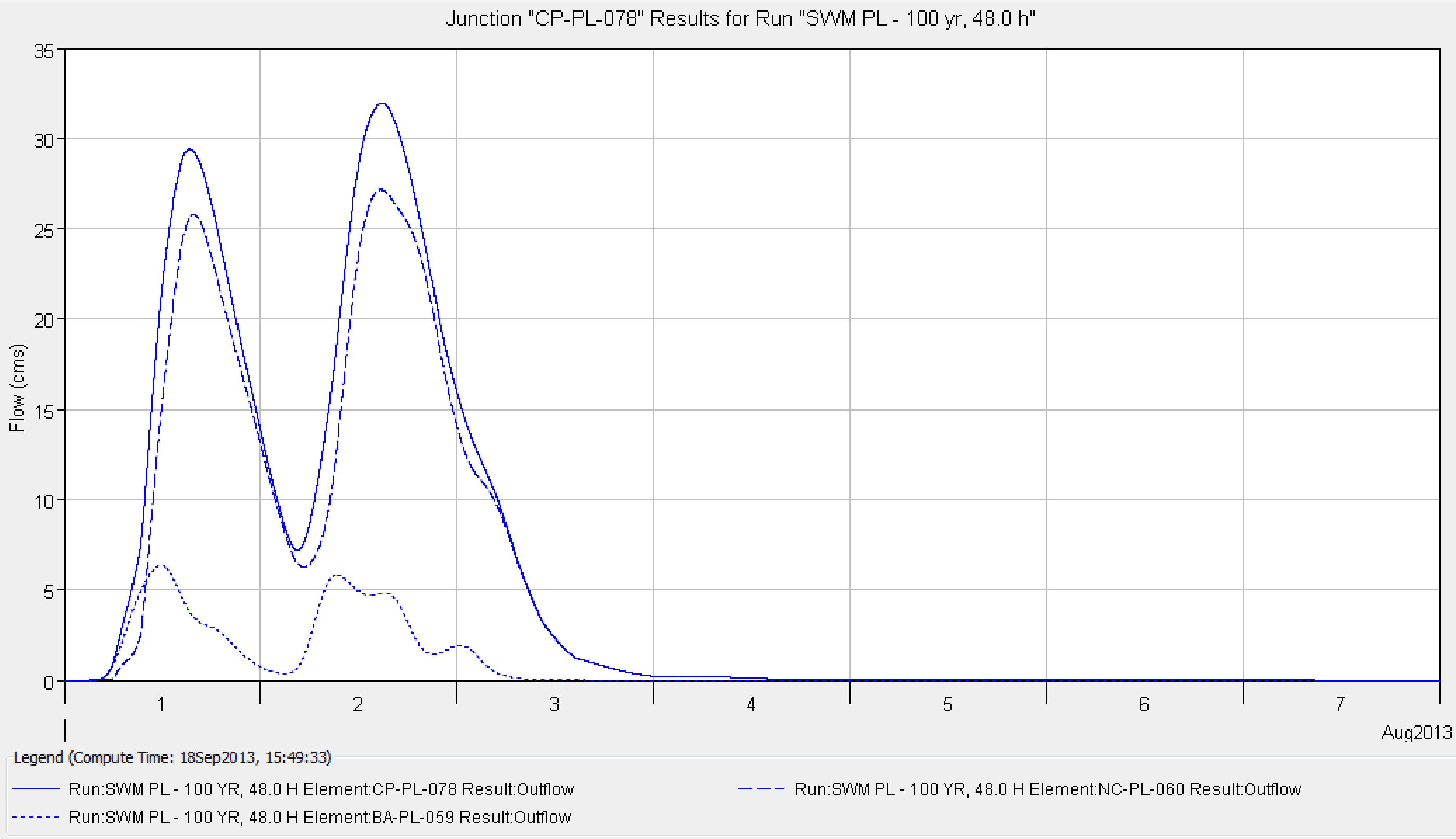
Junction "CP-PL-075" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-075 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-056 Result:Outflow



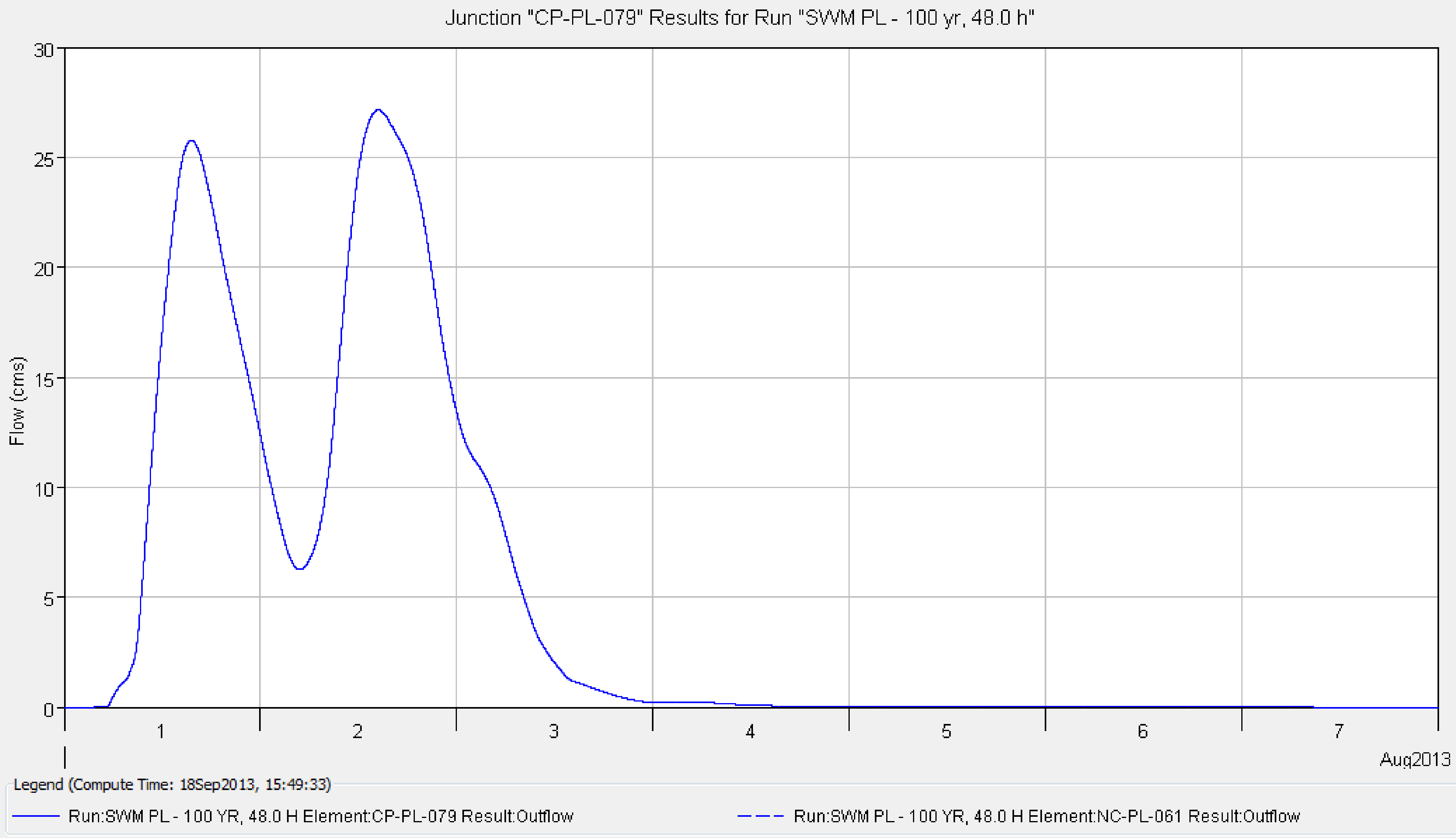
Junction "CP-PL-076" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-076 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-057 Result:Outflow



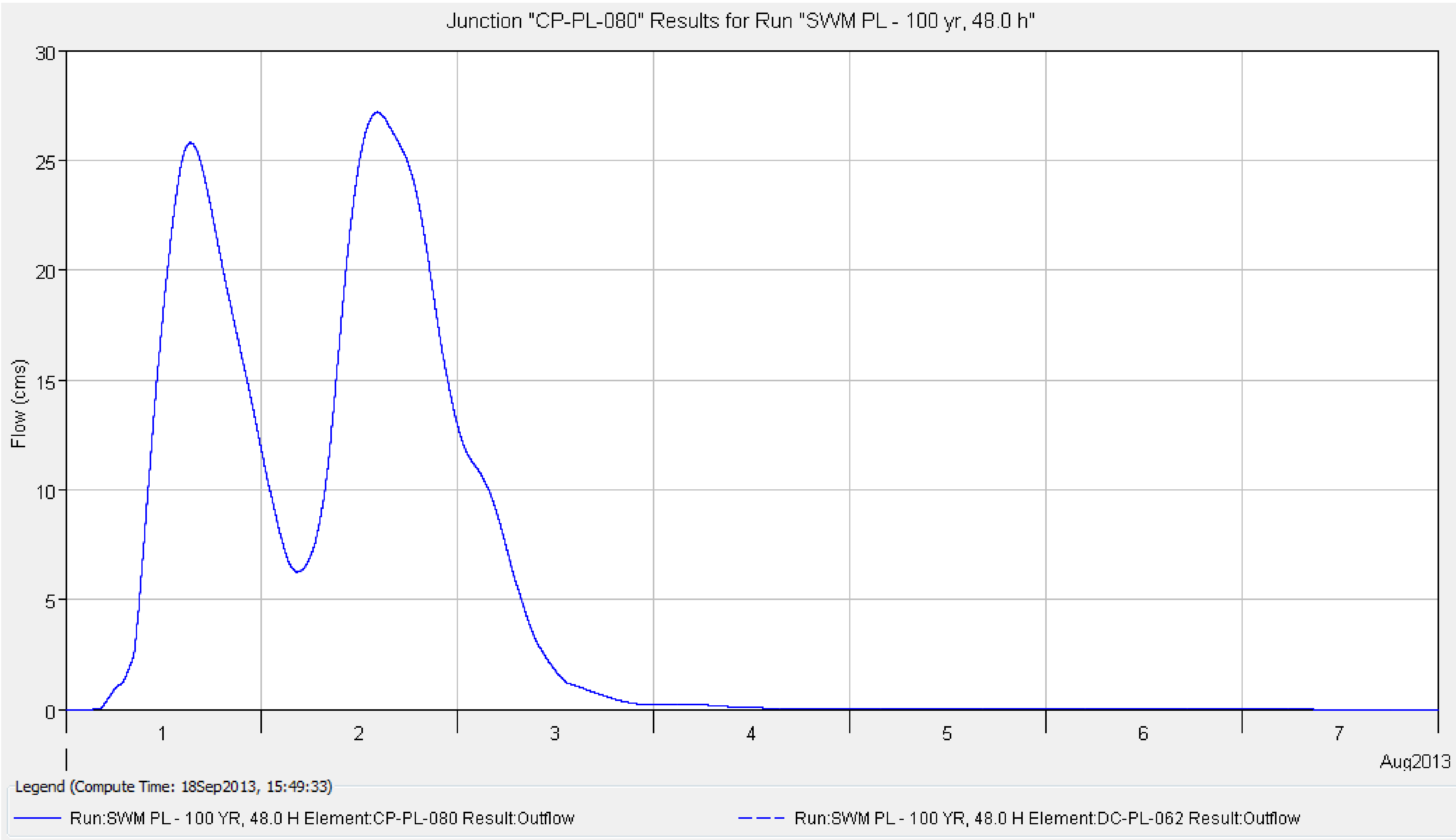
Junction "CP-PL-077" Results for Run "SWM PL - 100 yr, 48.0 h"
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Flow (cms)
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-058 Result:Outflow



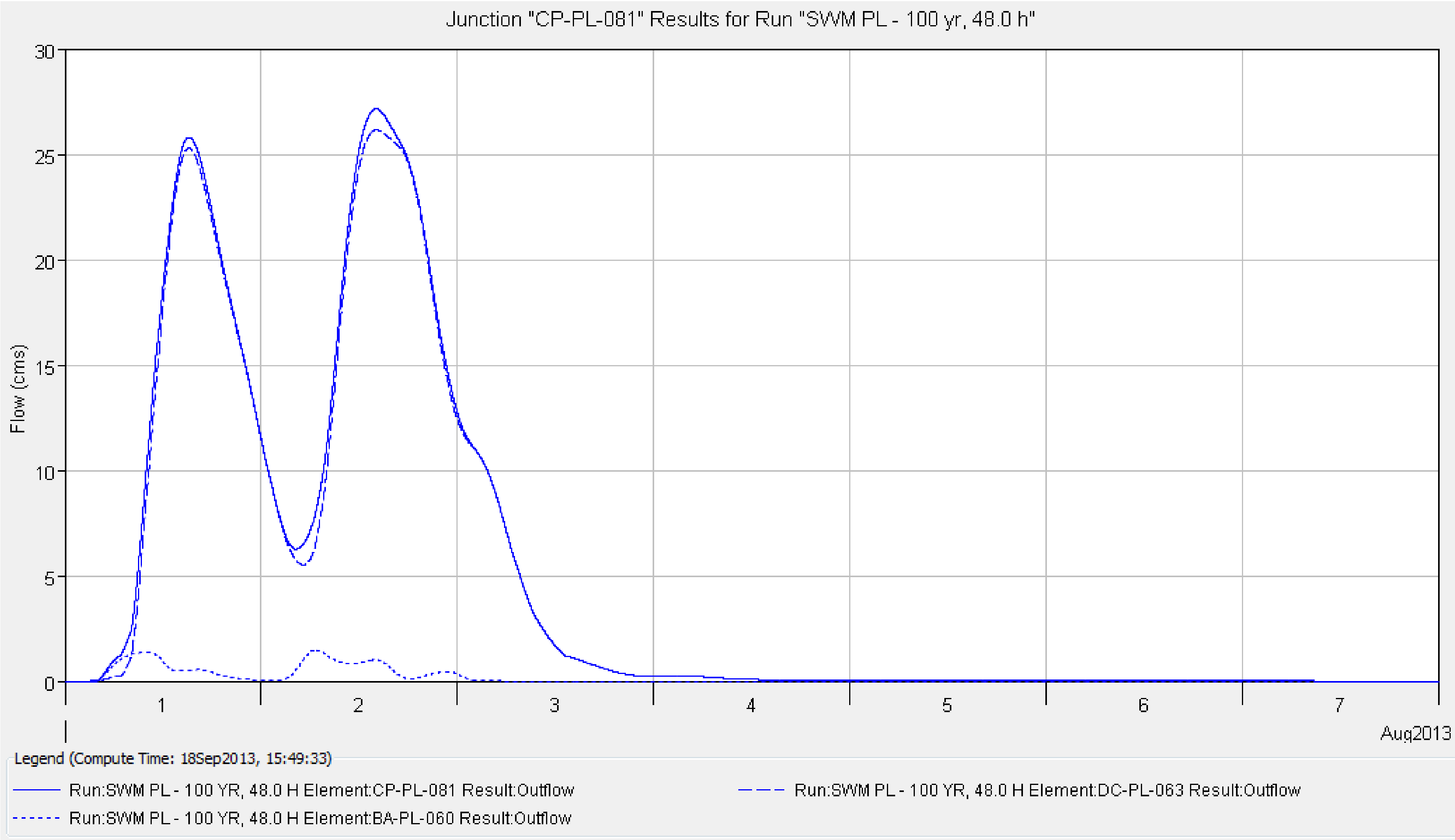
Junction "CP-PL-078" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-060 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-059 Result:Outflow



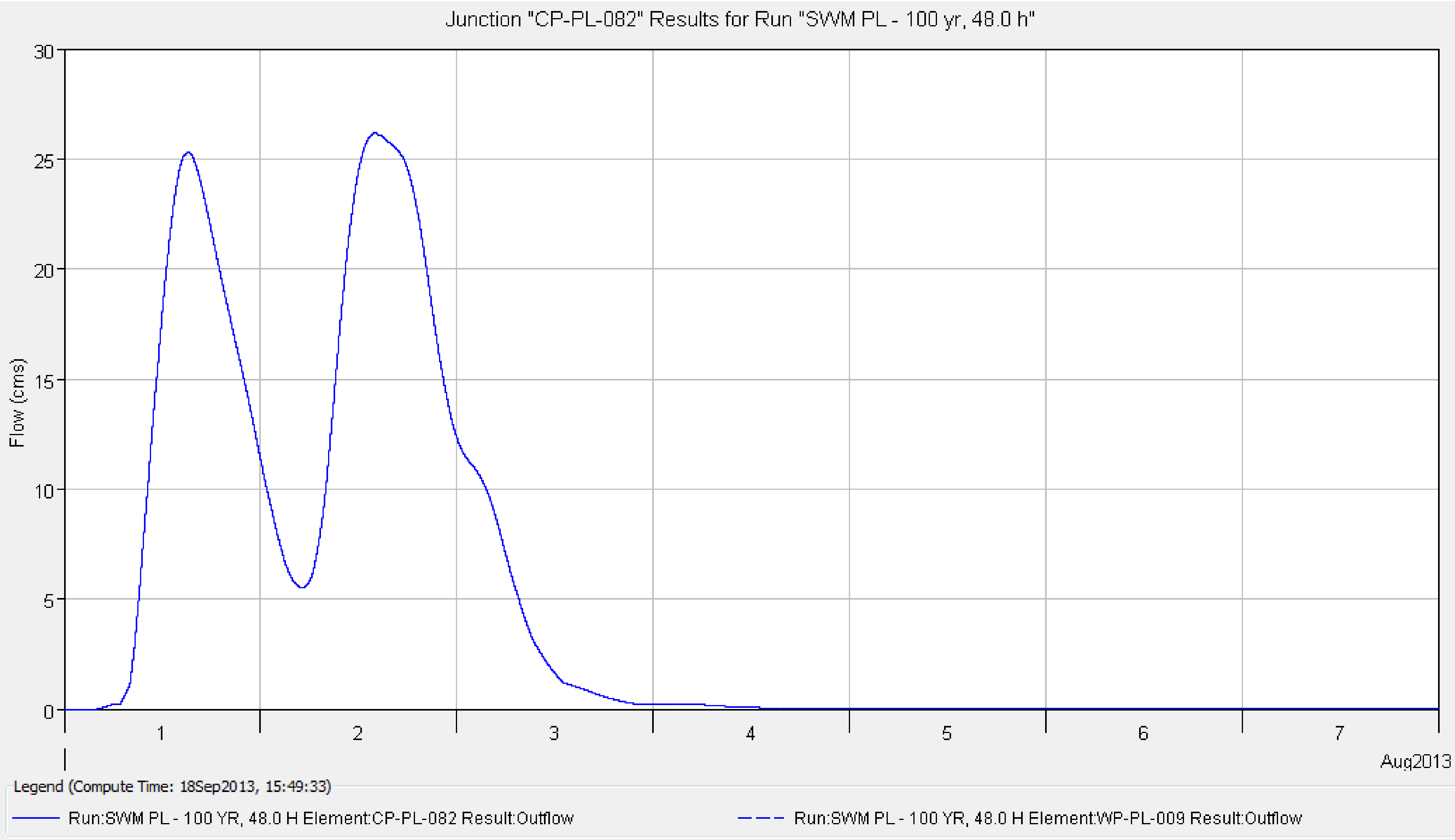
Junction "CP-PL-079" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-079 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:NC-PL-061 Result:Outflow



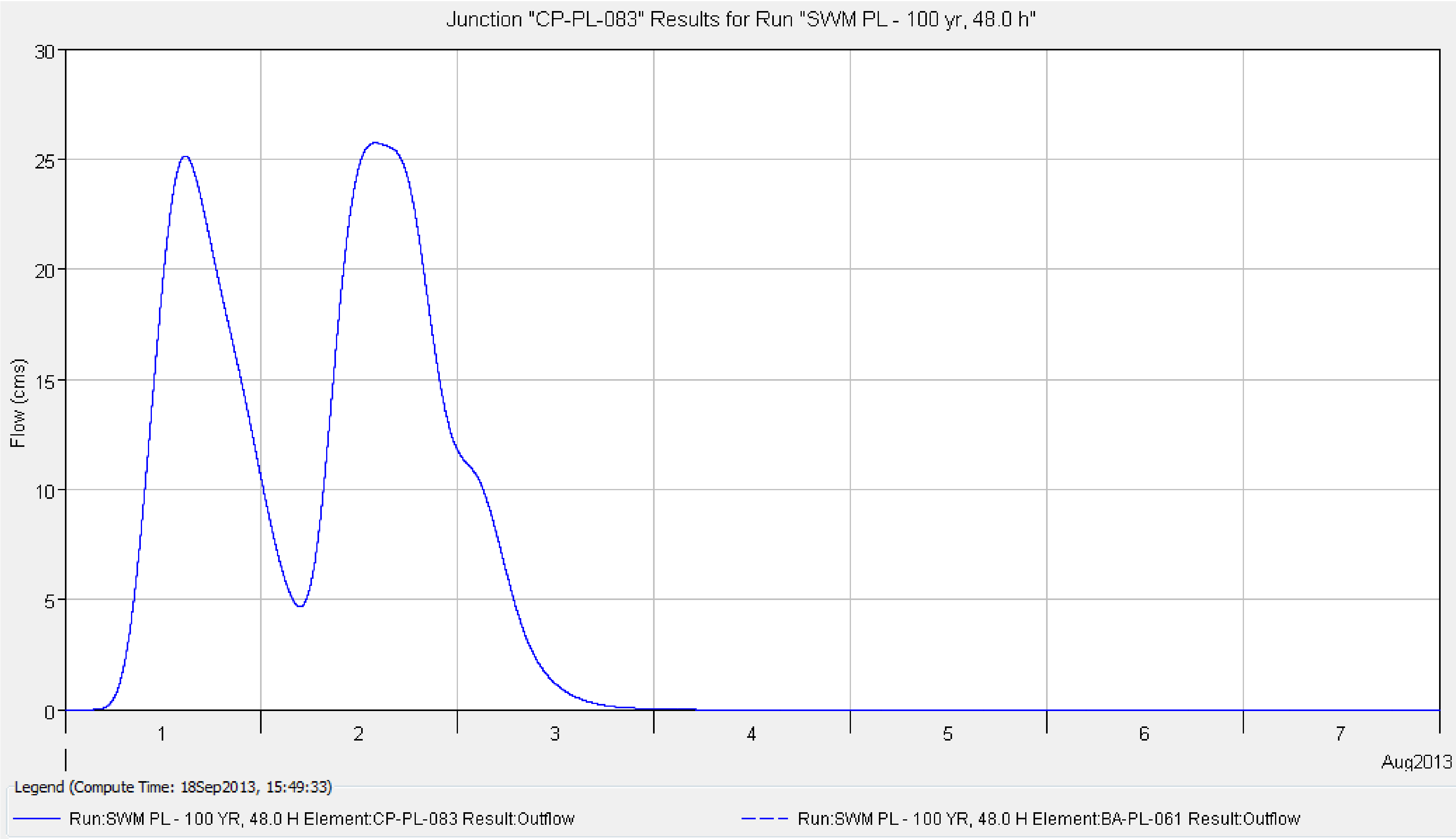
Junction "CP-PL-080" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-080 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-062 Result:Outflow



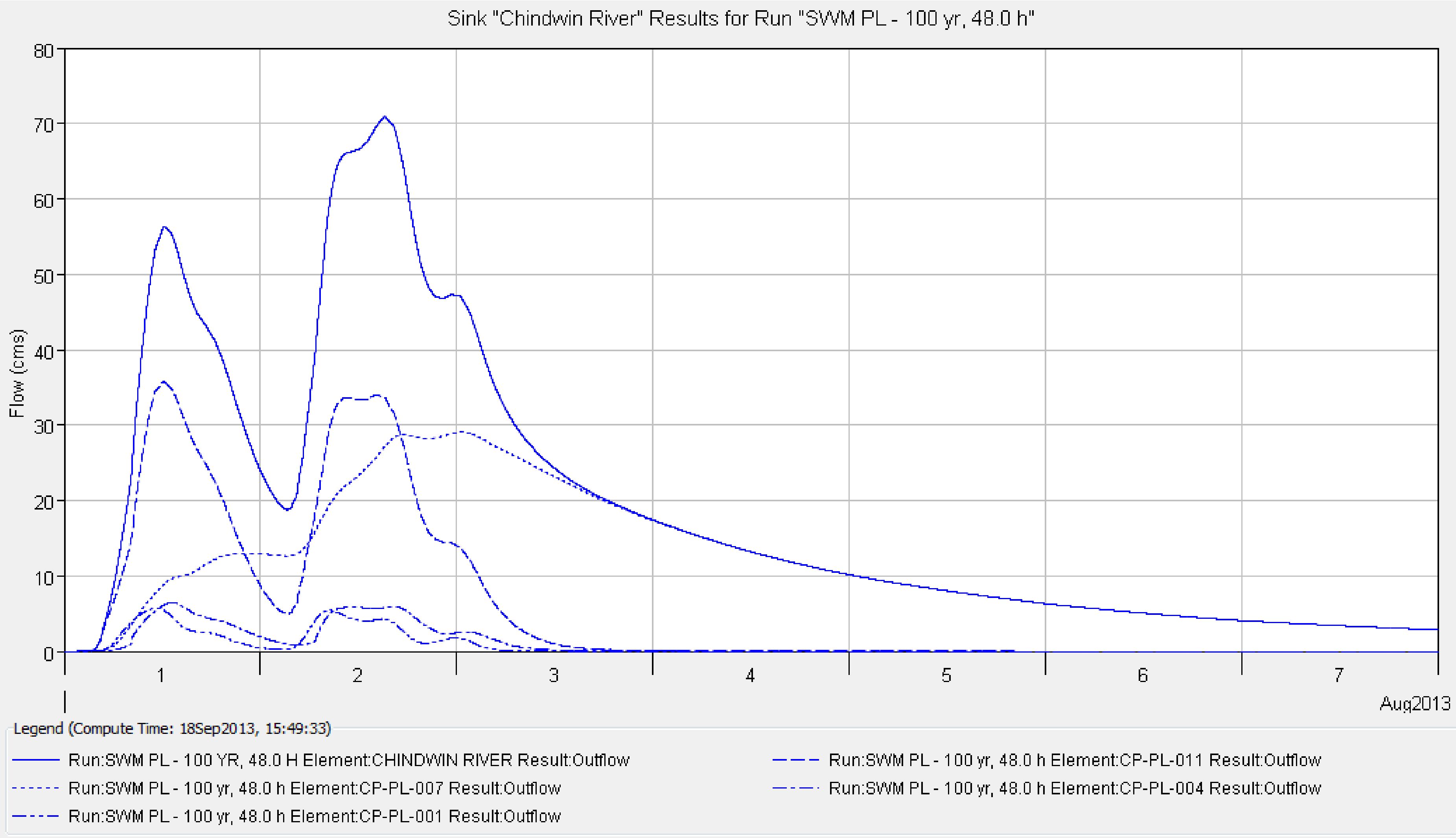
Junction "CP-PL-081" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-081 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:DC-PL-063 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-060 Result:Outflow



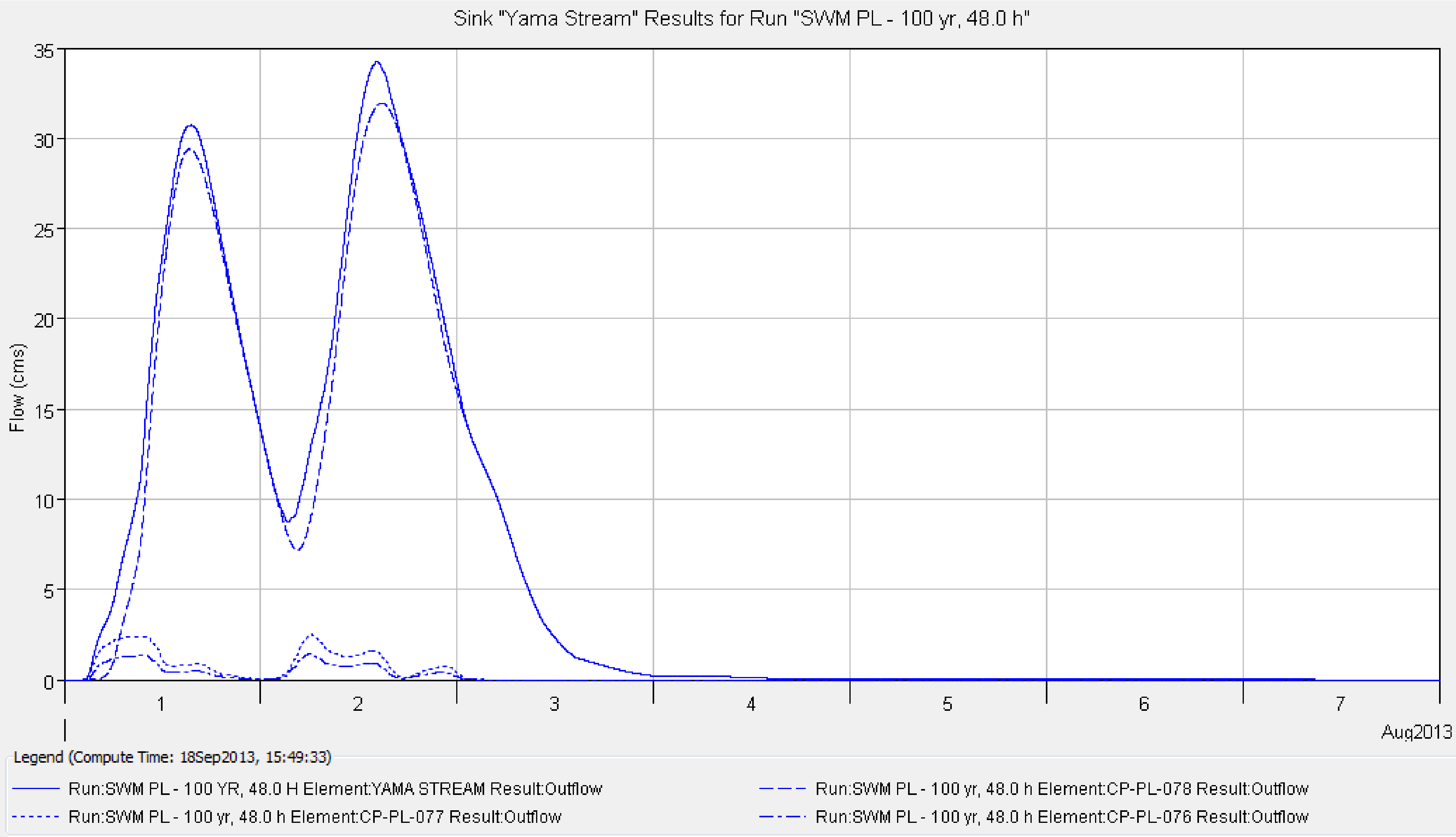
Junction "CP-PL-082" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-082 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Outflow



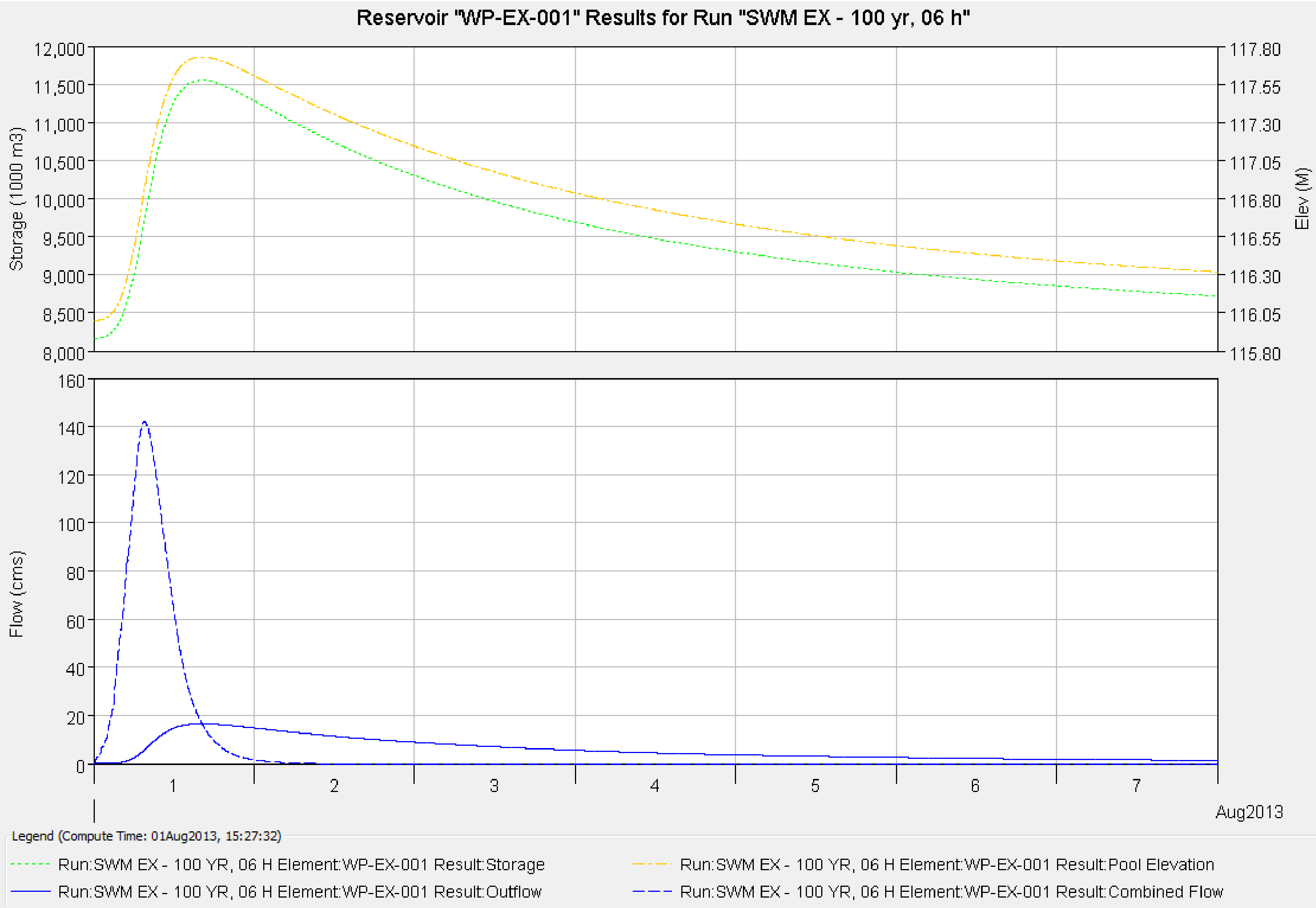
Junction "CP-PL-083" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CP-PL-083 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:BA-PL-061 Result:Outflow



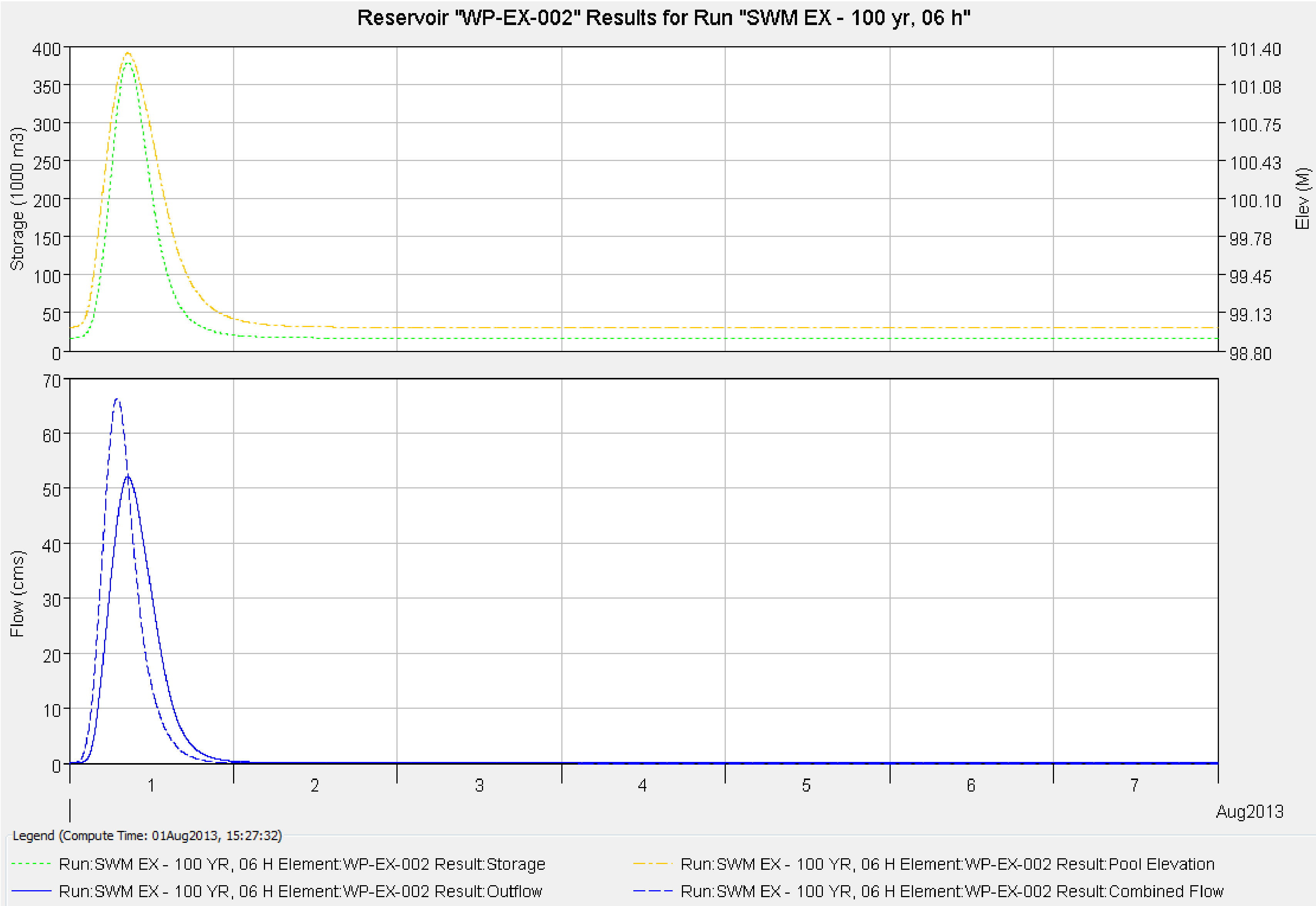
Sink "Chindwin River" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:CHINDWIN RIVER Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-007 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-001 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-011 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-004 Result:Outflow

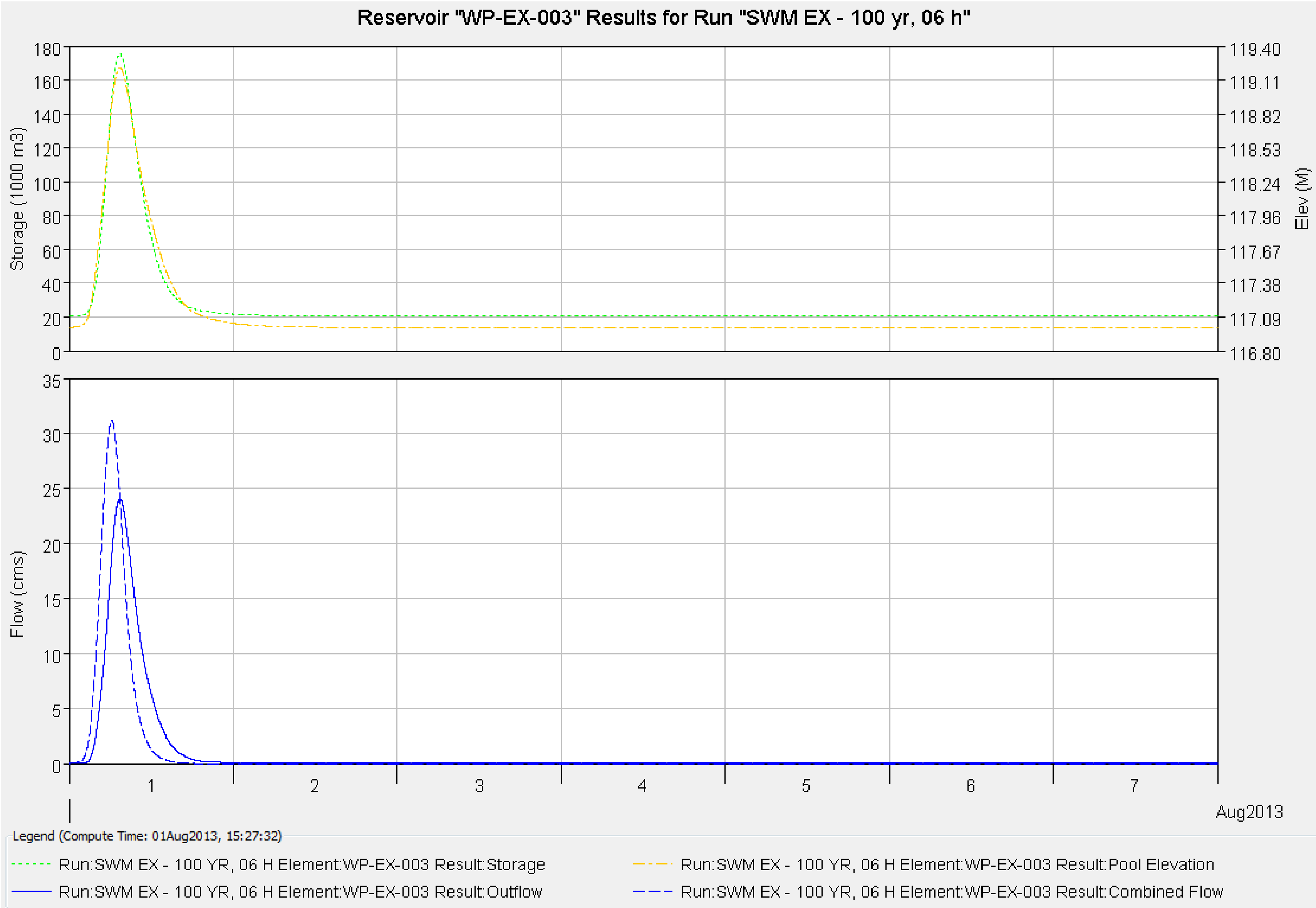


Sink "Yama Stream" Results for Run "SWM PL - 100 yr, 48.0 h"
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:YAMA STREAM Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-078 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-077 Result:Outflow
Run:SWM PL - 100 yr, 48.0 h Element:CP-PL-076 Result:Outflow

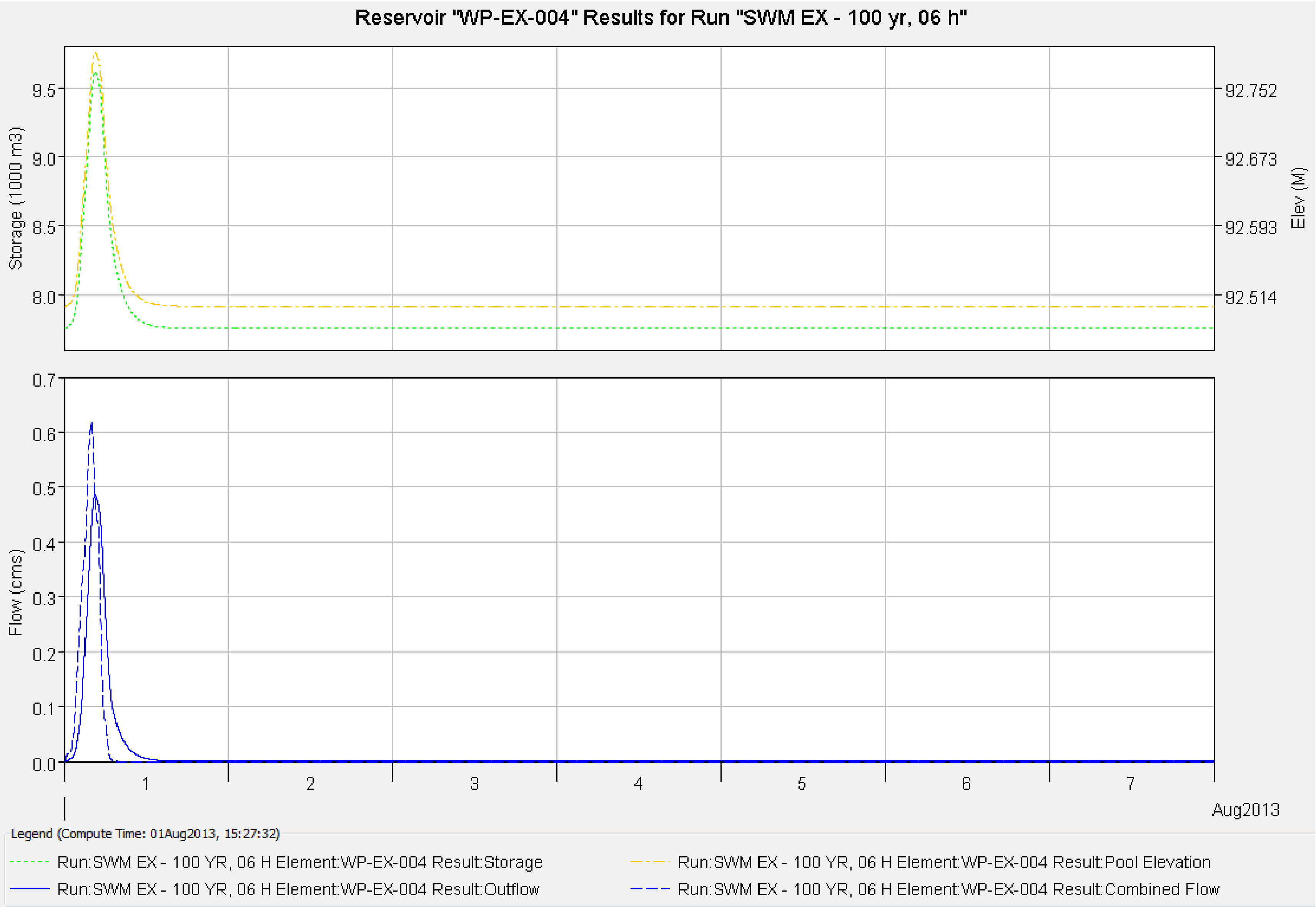


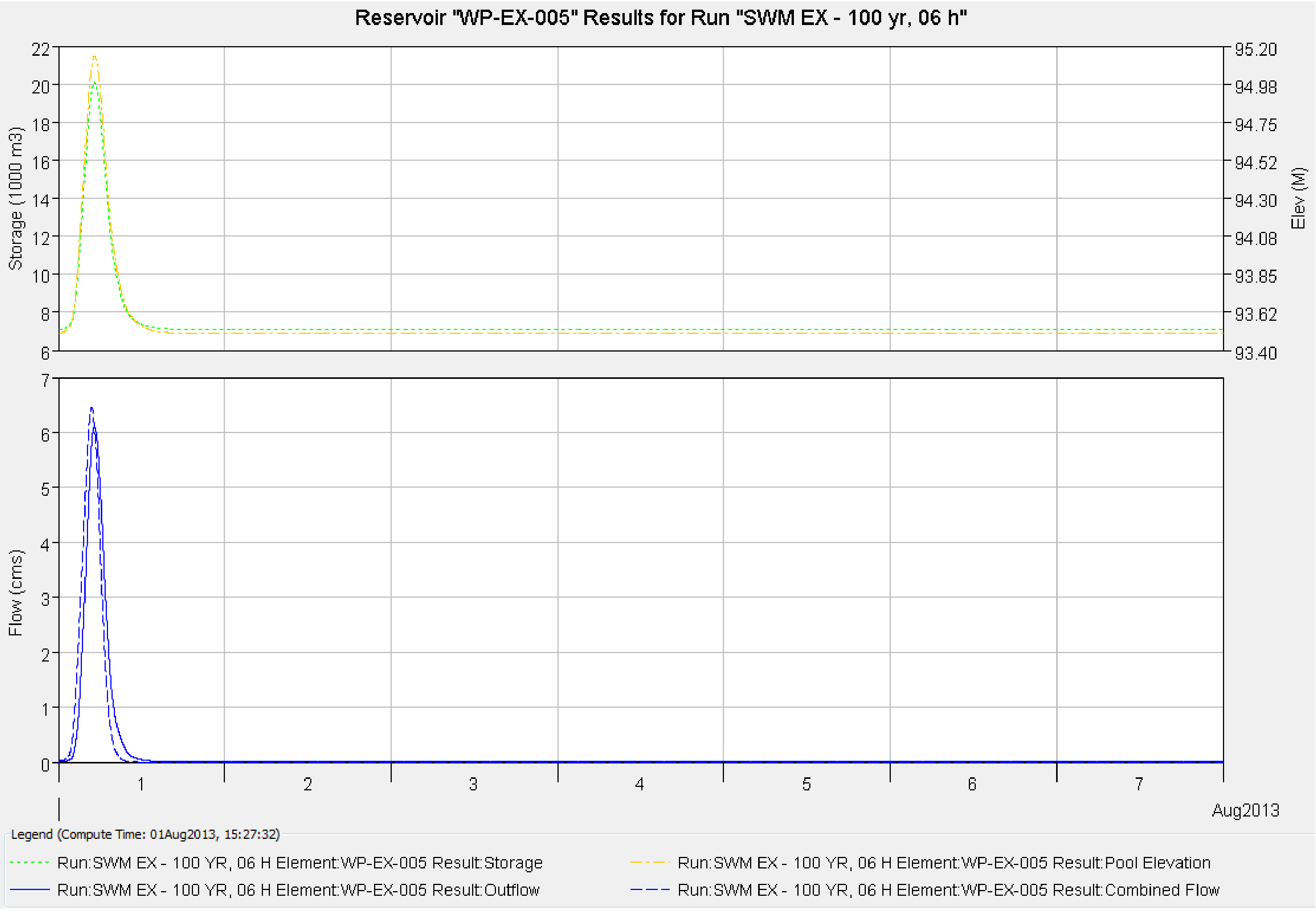
Reservoir "WP-EX-001" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
12,000
11,500
11,000
10,500
10,000
9,500
9,000
8,500
8,000
Elev (M)
117.80
117.55
117.30
117.05
116.80
116.55
116.30
116.05
115.80
Flow (cms)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-001 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-001 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-001 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-001 Result:Combined Flow


Reservoir "WP-EX-002" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
400
350
300
250
200
150
100
50
0
101.40
101.08
100.75
100.43
100.10
99.78
99.45
99.13
98.80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-002 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-002 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-002 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-002 Result:Combined Flow

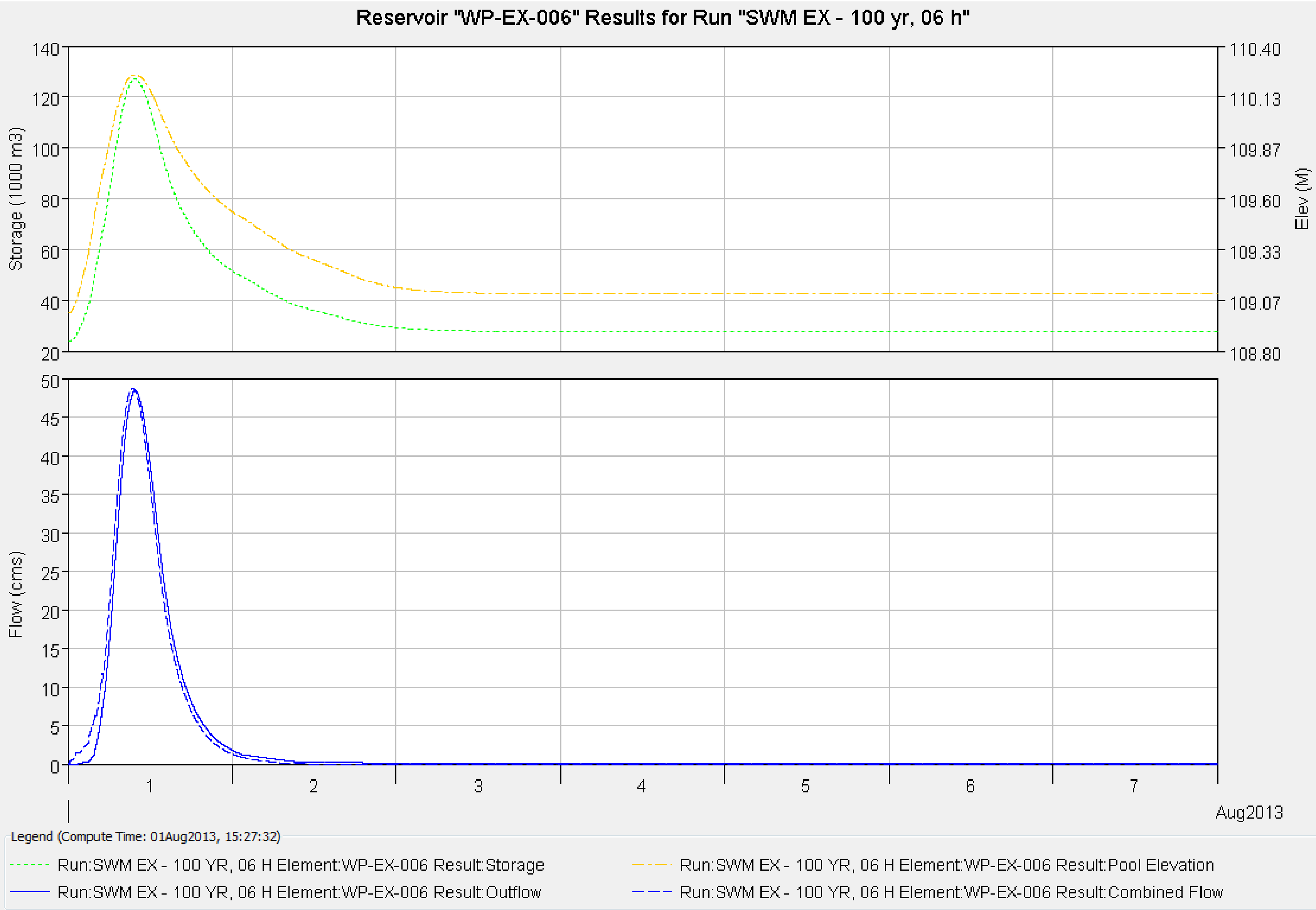


Reservoir "WP-EX-003" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
180
160
140
120
100
80
60
40
20
0
119.40
119.11
118.82
118.53
118.24
117.96
117.67
117.38
117.09
116.80
Elev (M)
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-003 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-003 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-003 Result:Combined Flow

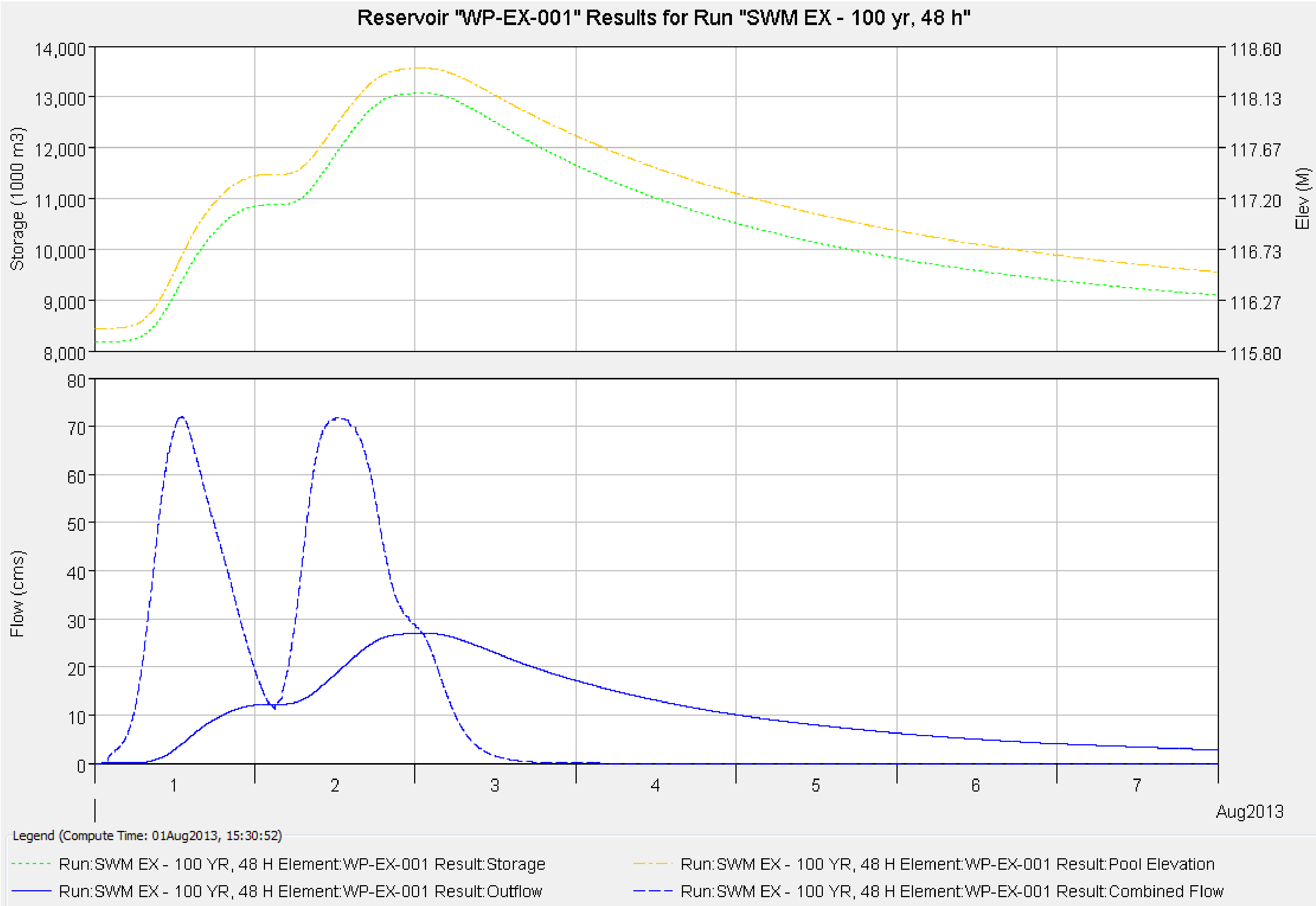

Reservoir "WP-EX-004" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
9.5
9.0
8.5
8.0
Elev (M)
92.752
92.673
92.593
92.514
Flow (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-004 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-004 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-004 Result:Combined Flow



Reservoir "WP-EX-005" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
22
20
18
16
14
12
10
8
6
95.20
94.98
94.75
94.52
94.30
94.08
93.85
93.62
93.40
Elev (M)
Flow (cms)
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-005 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-005 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-005 Result:Combined Flow



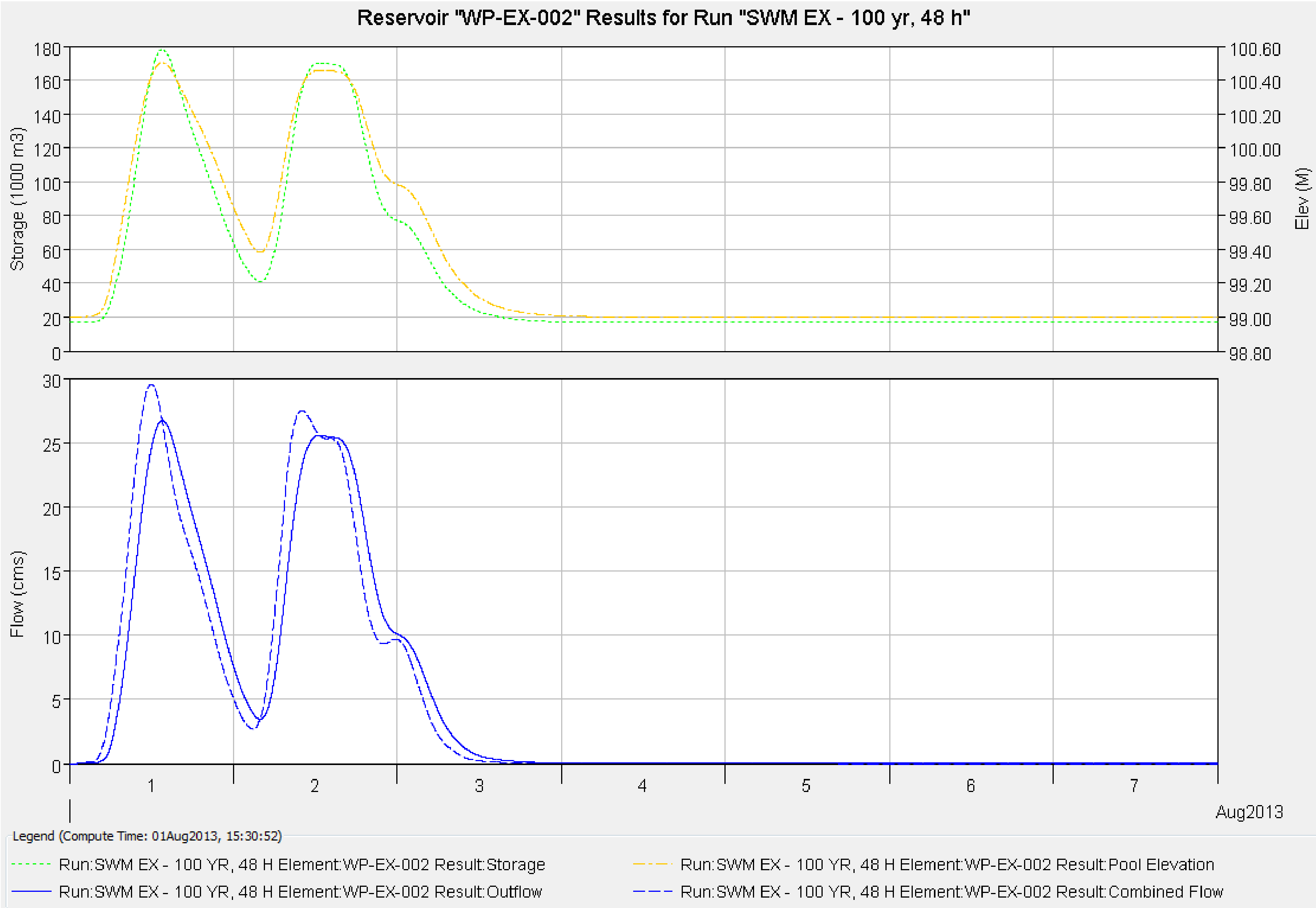
Reservoir "WP-EX-006" Results for Run "SWM EX - 100 yr, 06 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
Aug2013
Legend (Compute Time: 01Aug2013, 15:27:32)
Run:SWM EX - 100 YR, 06 H Element:WP-EX-006 Result:Storage
Run:SWM EX - 100 YR, 06 H Element:WP-EX-006 Result:Pool Elevation
Run:SWM EX - 100 YR, 06 H Element:WP-EX-006 Result:Outflow
Run:SWM EX - 100 YR, 06 H Element:WP-EX-006 Result:Combined Flow



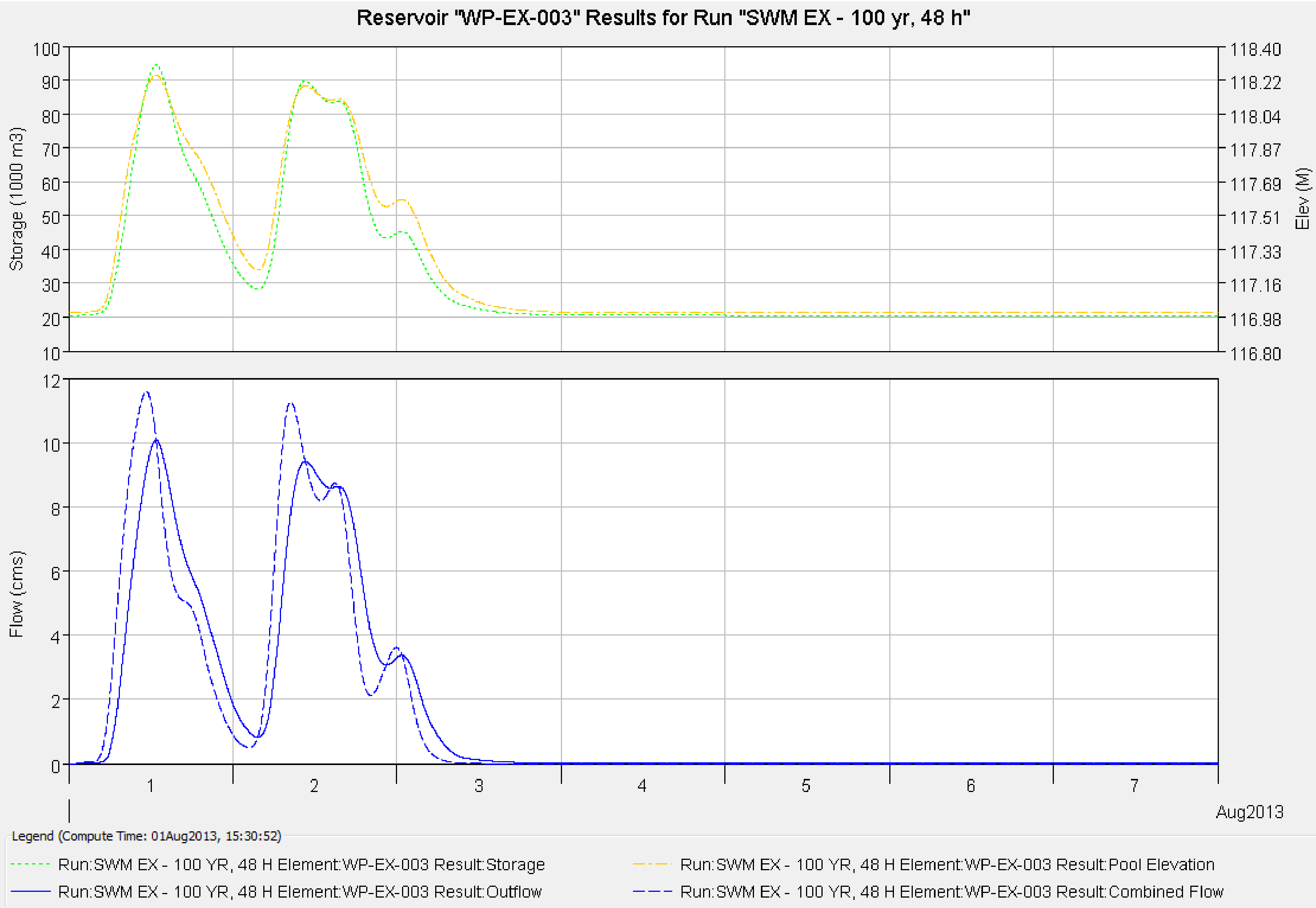
Knight Piésold CONSULTING

LETPADAUNG COPPER PROJECT
SITE WATER MANAGEMENT PLAN
SIMULATION RESULTS - TIME SERIES PLOTS AT WATER PONDS

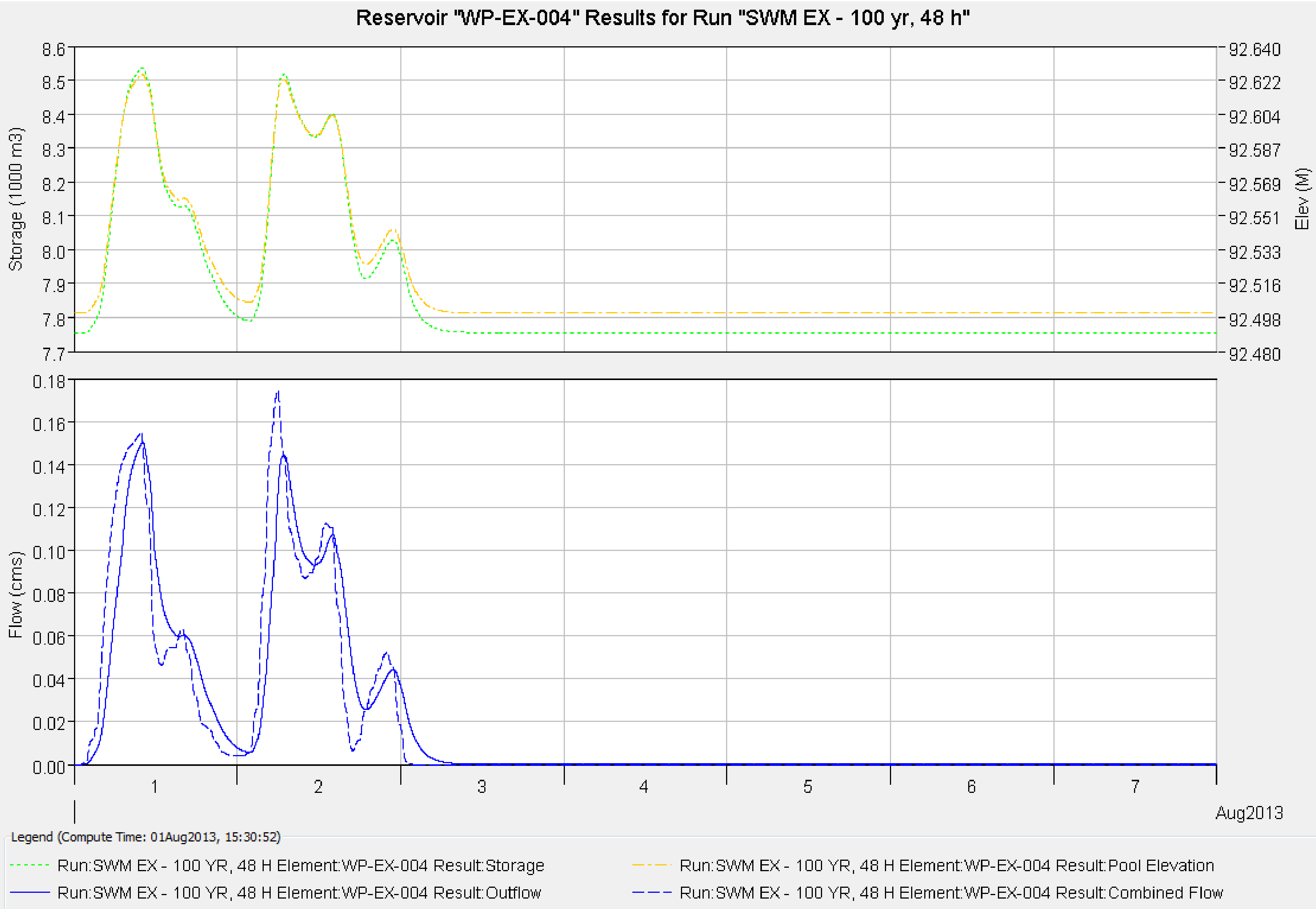
Ref: PE701-00022/18
Appendix B.9



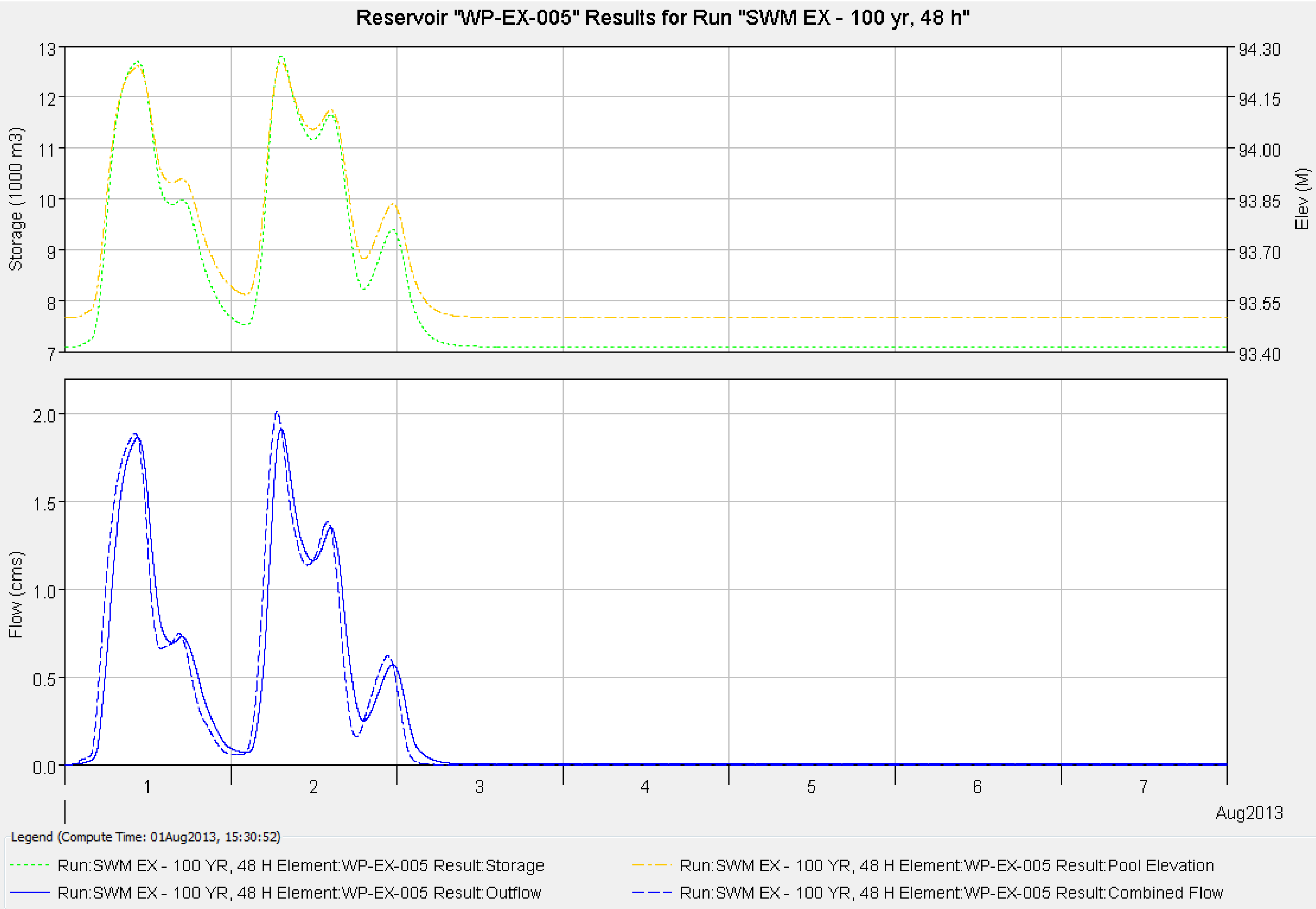
Reservoir "WP-EX-002" Results for Run "SWM EX - 100 yr, 48 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:WP-EX-002 Result:Storage
Run:SWM EX - 100 YR, 48 H Element:WP-EX-002 Result:Pool Elevation
Run:SWM EX - 100 YR, 48 H Element:WP-EX-002 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-002 Result:Combined Flow



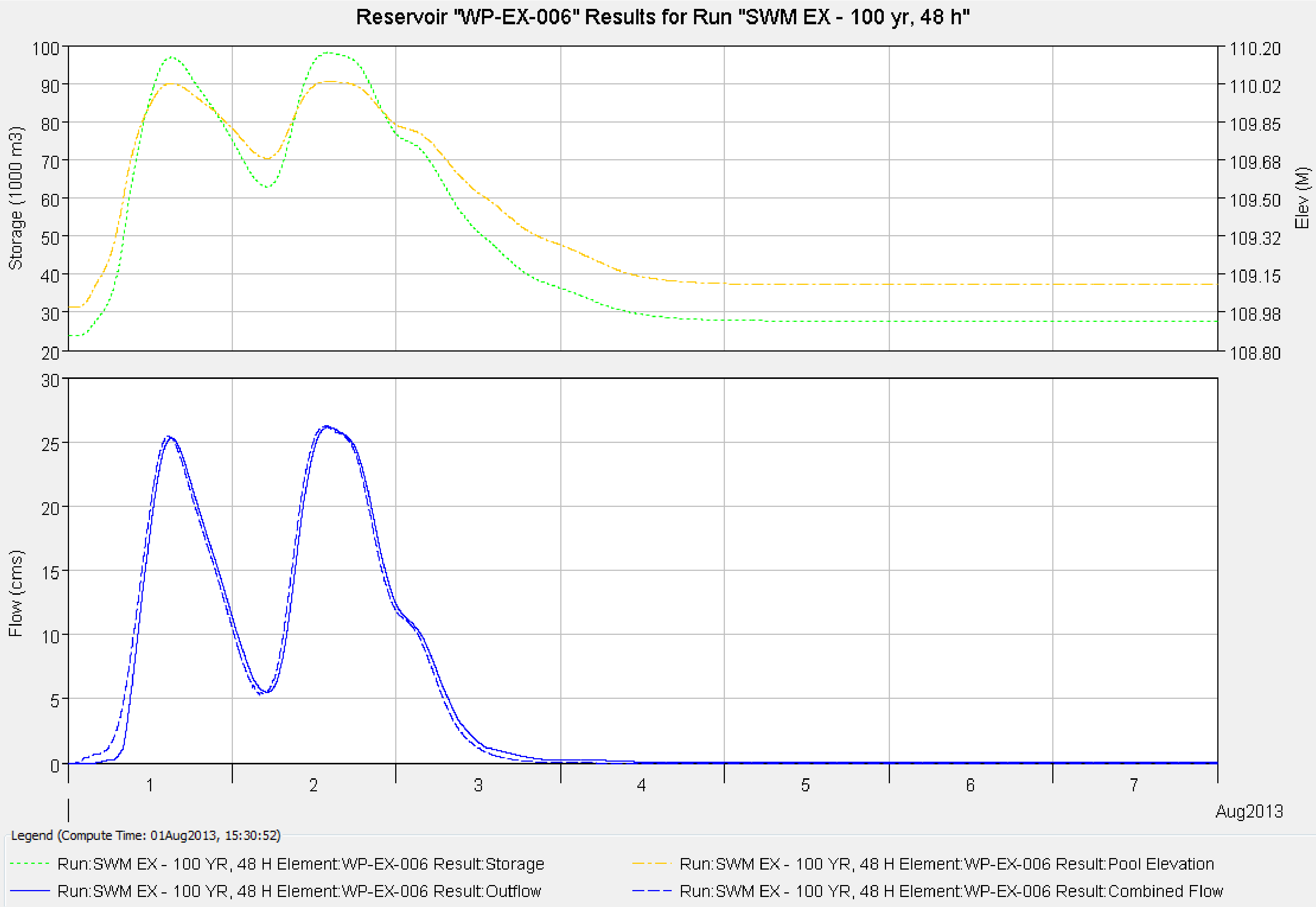
Reservoir "WP-EX-003" Results for Run "SWM EX - 100 yr, 48 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
10
118.40
118.22
118.04
117.87
117.69
117.51
117.33
117.16
116.98
116.80
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:WP-EX-003 Result:Storage
Run:SWM EX - 100 YR, 48 H Element:WP-EX-003 Result:Pool Elevation
Run:SWM EX - 100 YR, 48 H Element:WP-EX-003 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-003 Result:Combined Flow



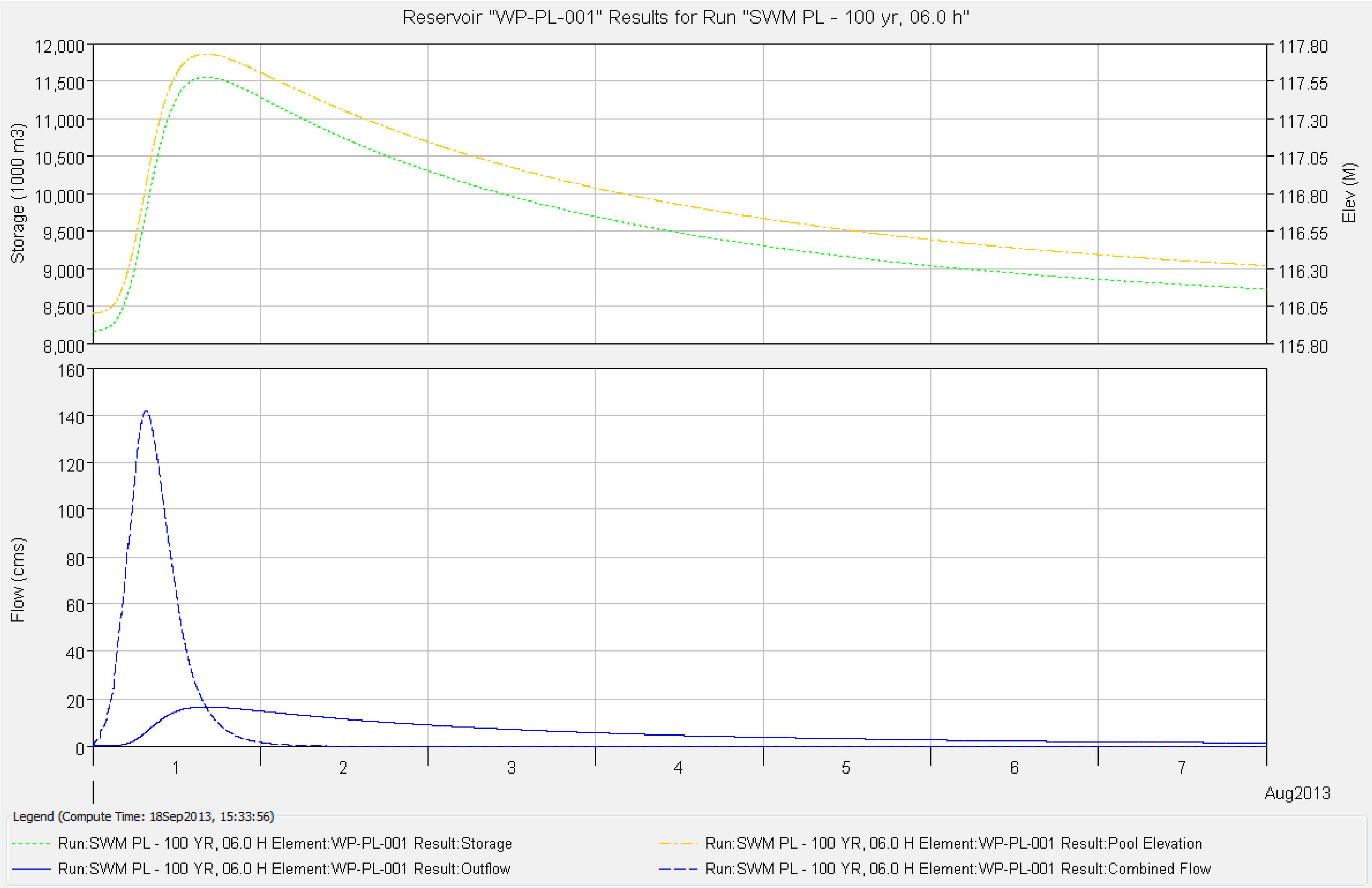
Reservoir "WP-EX-004" Results for Run "SWM EX - 100 yr, 48 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
8.6
8.5
8.4
8.3
8.2
8.1
8.0
7.9
7.8
7.7
92.640
92.622
92.604
92.587
92.569
92.551
92.533
92.516
92.498
92.480
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:WP-EX-004 Result:Storage
Run:SWM EX - 100 YR, 48 H Element:WP-EX-004 Result:Pool Elevation
Run:SWM EX - 100 YR, 48 H Element:WP-EX-004 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-004 Result:Combined Flow

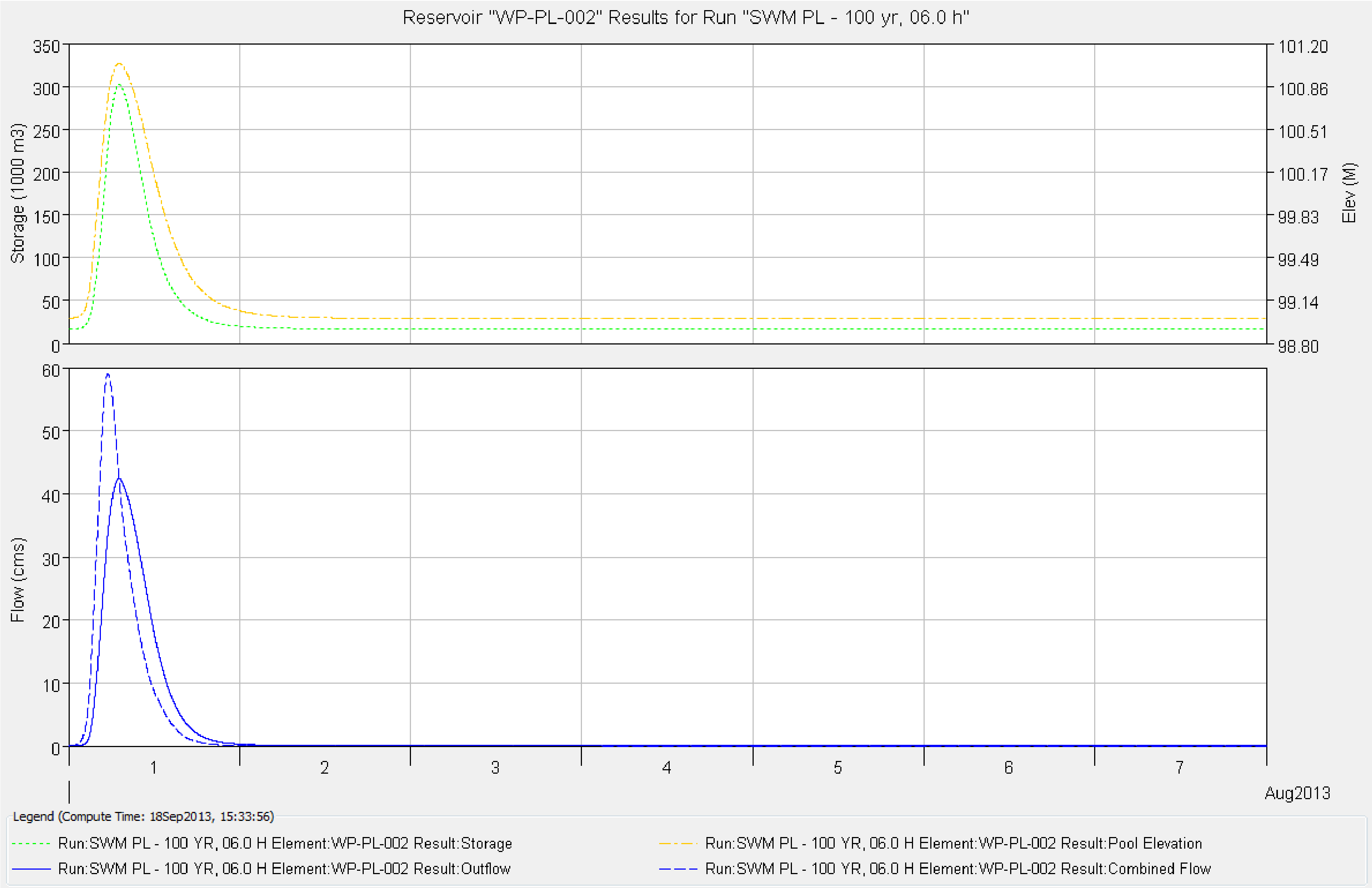


Reservoir "WP-EX-005" Results for Run "SWM EX - 100 yr, 48 h"
Storage (1000 m3)
Elev (M)
13
12
11
10
9
8
7
94.30
94.15
94.00
93.85
93.70
93.55
93.40
Flow (cms)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:WP-EX-005 Result:Storage
Run:SWM EX - 100 YR, 48 H Element:WP-EX-005 Result:Pool Elevation
Run:SWM EX - 100 YR, 48 H Element:WP-EX-005 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-005 Result:Combined Flow

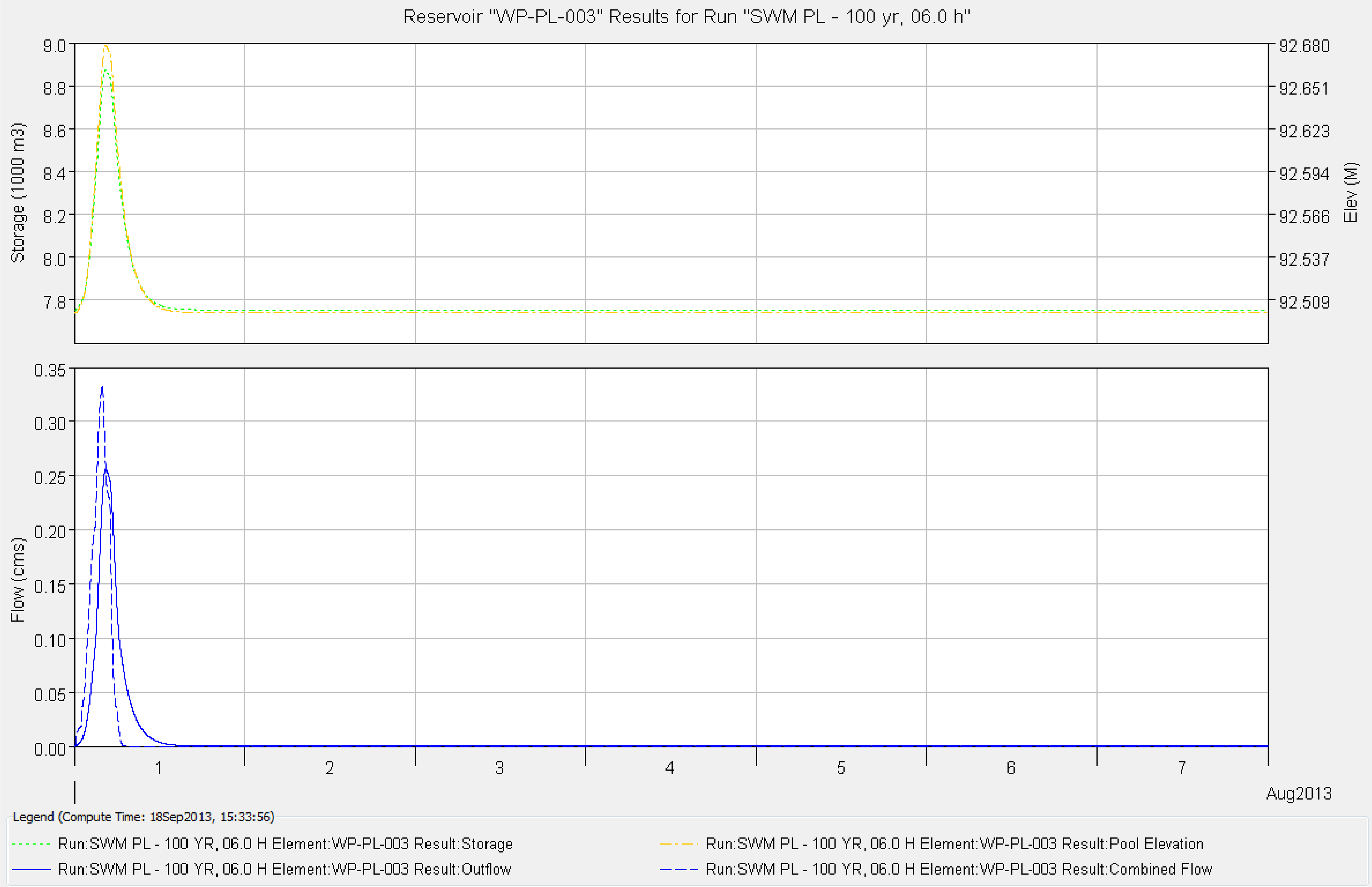


Reservoir "WP-EX-006" Results for Run "SWM EX - 100 yr, 48 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
110.20
110.02
109.85
109.68
109.50
109.32
109.15
108.98
108.80
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 01Aug2013, 15:30:52)
Run:SWM EX - 100 YR, 48 H Element:WP-EX-006 Result:Storage
Run:SWM EX - 100 YR, 48 H Element:WP-EX-006 Result:Pool Elevation
Run:SWM EX - 100 YR, 48 H Element:WP-EX-006 Result:Outflow
Run:SWM EX - 100 YR, 48 H Element:WP-EX-006 Result:Combined Flow

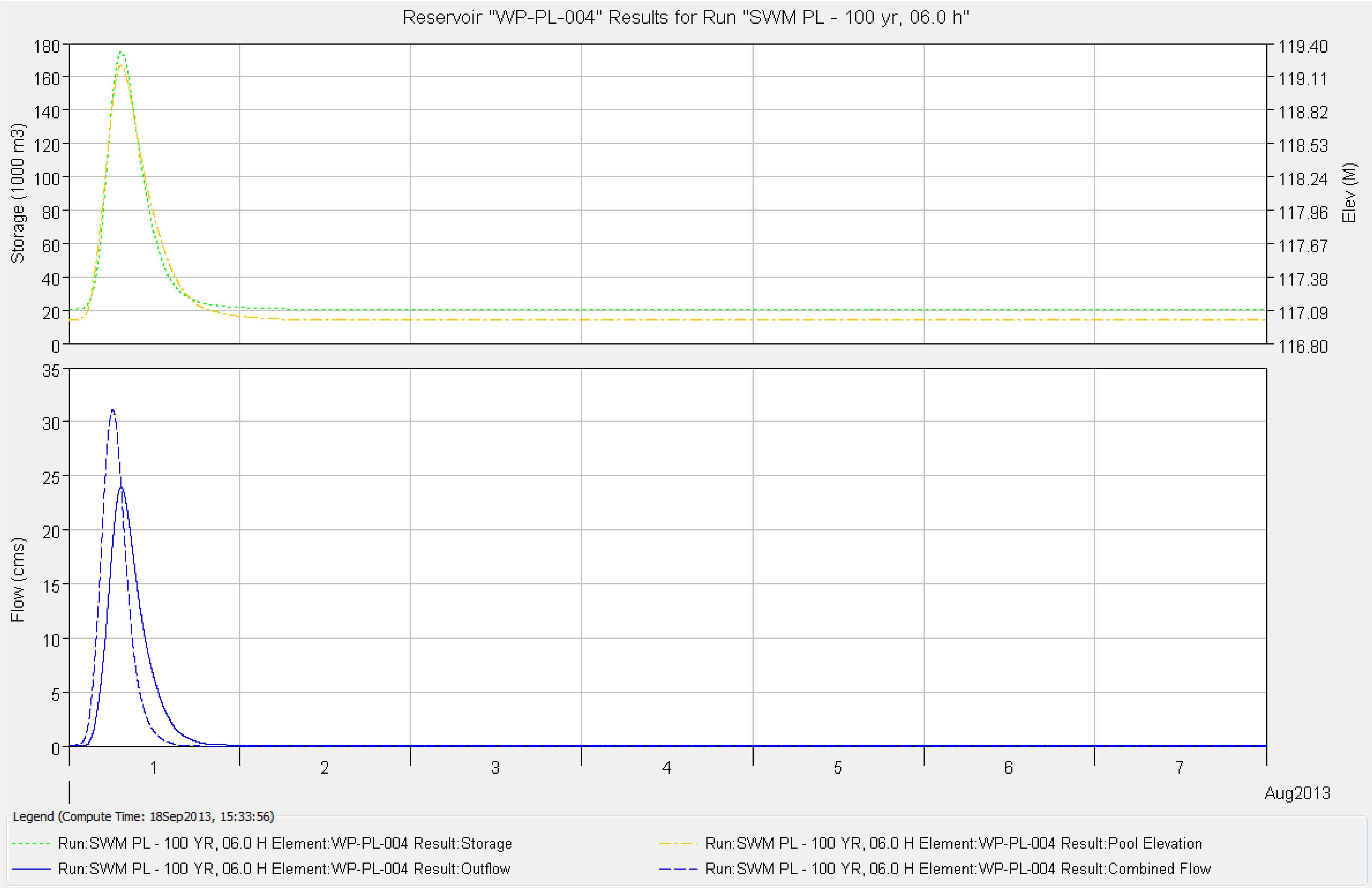

Reservoir "WP-PL-001" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
12,000
11,500
11,000
10,500
10,000
9,500
9,000
8,500
8,000
117.80
117.55
117.30
117.05
116.80
116.55
116.30
116.05
115.80
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Combined Flow



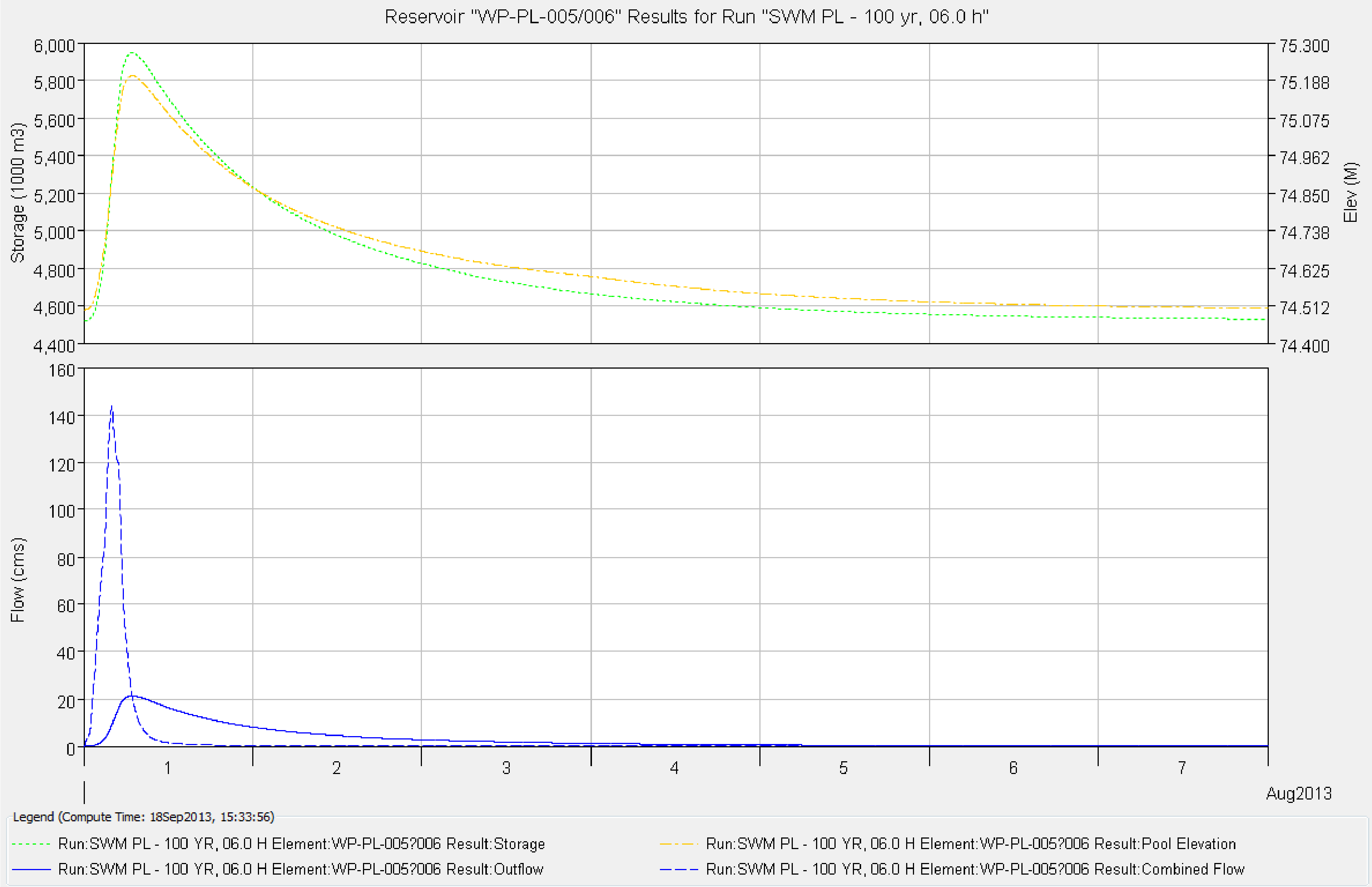
Reservoir "WP-PL-002" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
350
300
250
200
150
100
50
0
101.20
100.86
100.51
100.17
99.83
99.49
99.14
98.80
Flow (cms)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Combined Flow

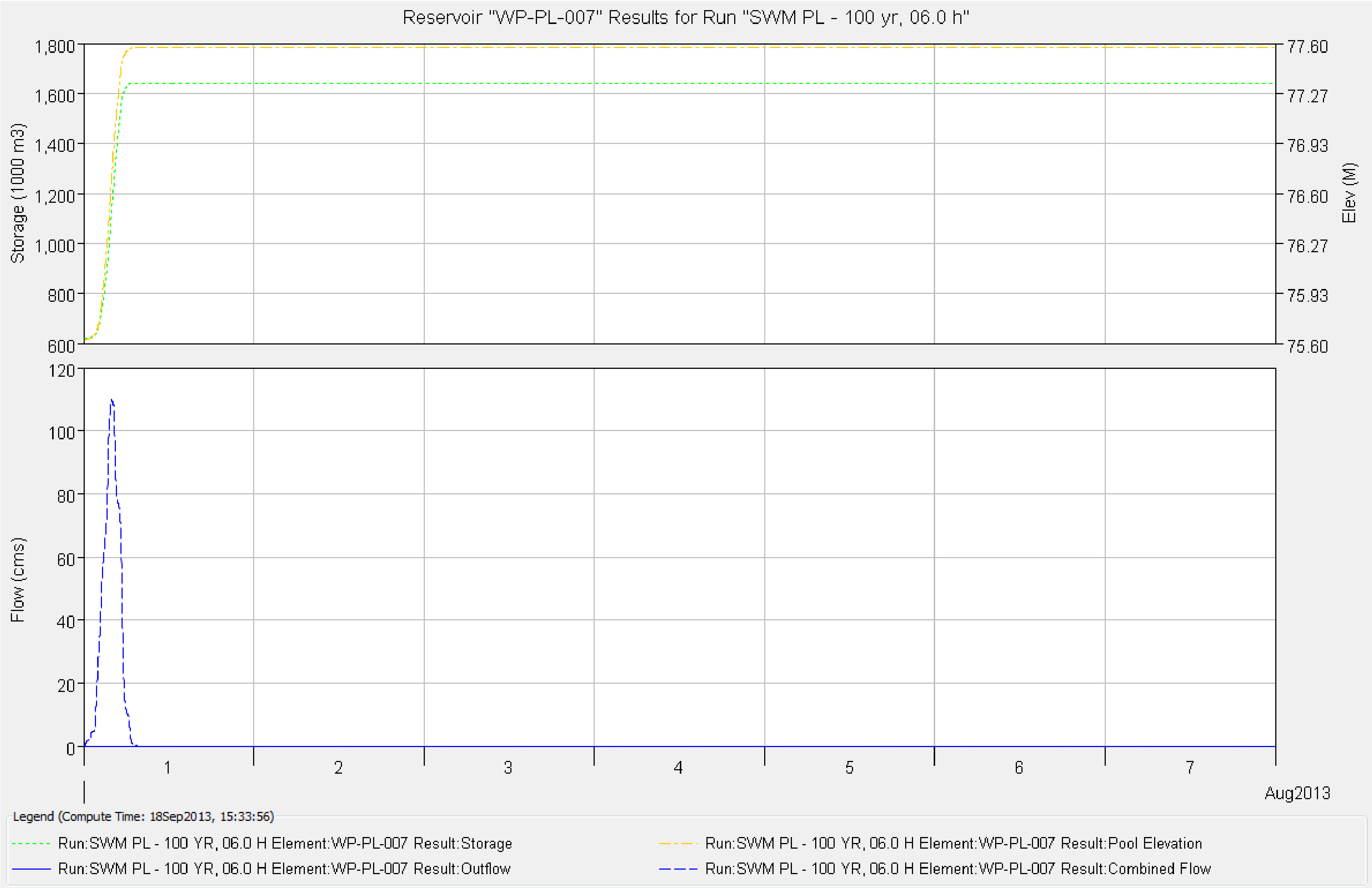


Reservoir "WP-PL-003" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
9.0
8.8
8.6
8.4
8.2
8.0
7.8
Elev (M)
92.680
92.651
92.623
92.594
92.566
92.537
92.509
Flow (cms)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Combined Flow

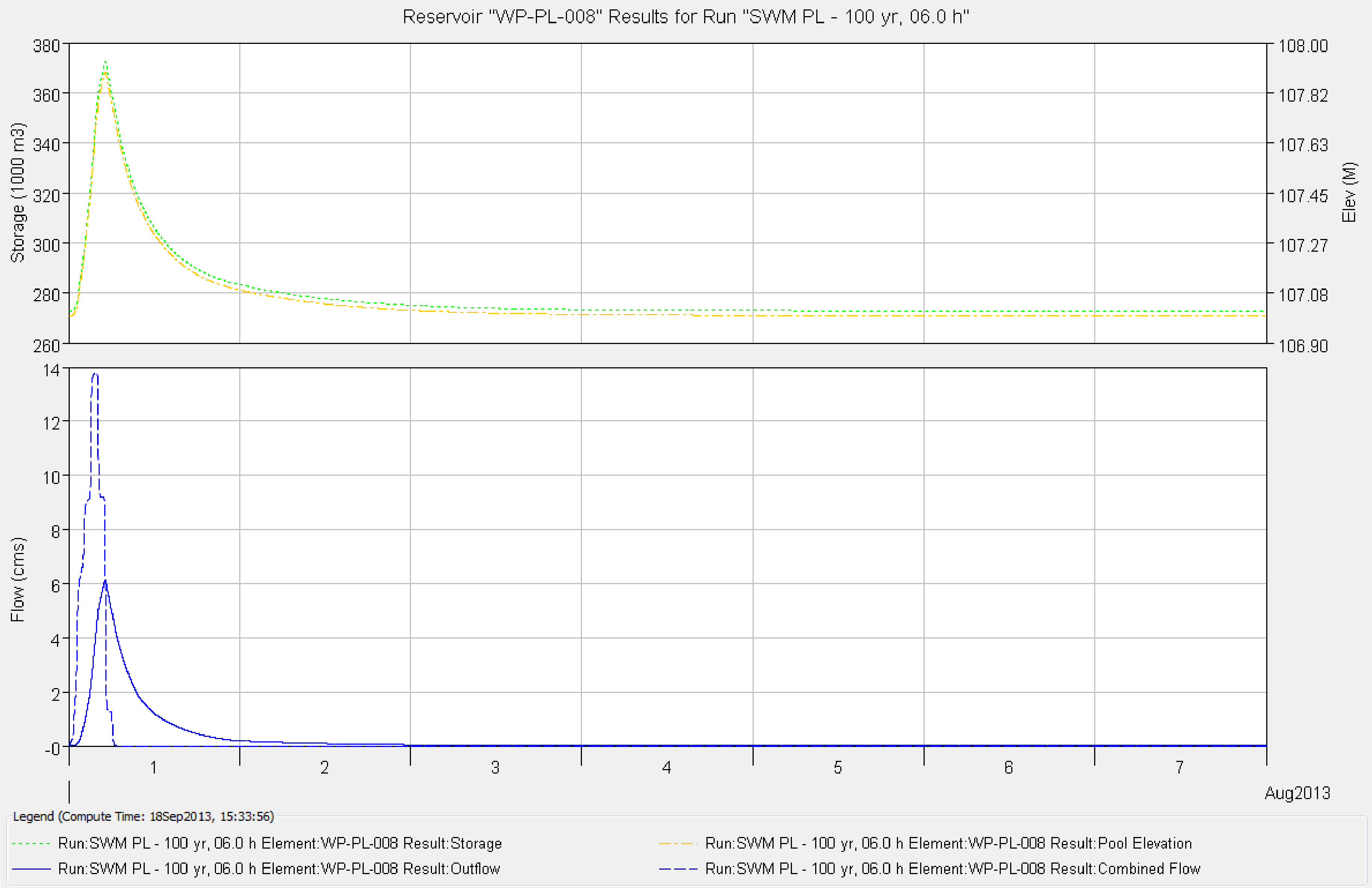


Reservoir "WP-PL-004" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
180
160
140
120
100
80
60
40
20
0
Elev (M)
119.40
119.11
118.82
118.53
118.24
117.96
117.67
117.38
117.09
116.80
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Combined Flow

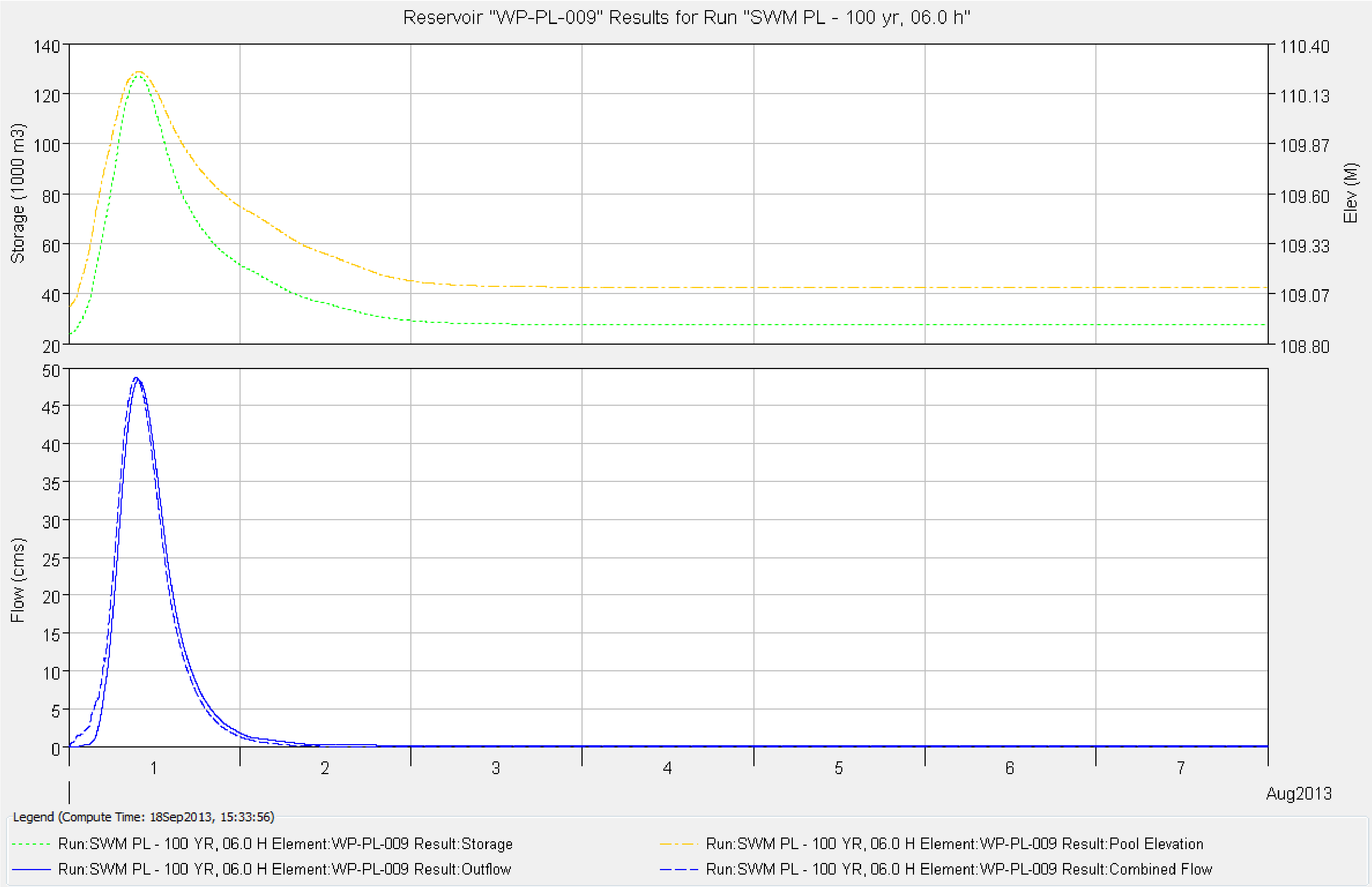

Reservoir "WP-PL-005/006" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
6,000
5,800
5,600
5,400
5,200
5,000
4,800
4,600
4,400
Elev (M)
75.300
75.188
75.075
74.962
74.850
74.738
74.625
74.512
74.400
Flow (cms)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Combined Flow



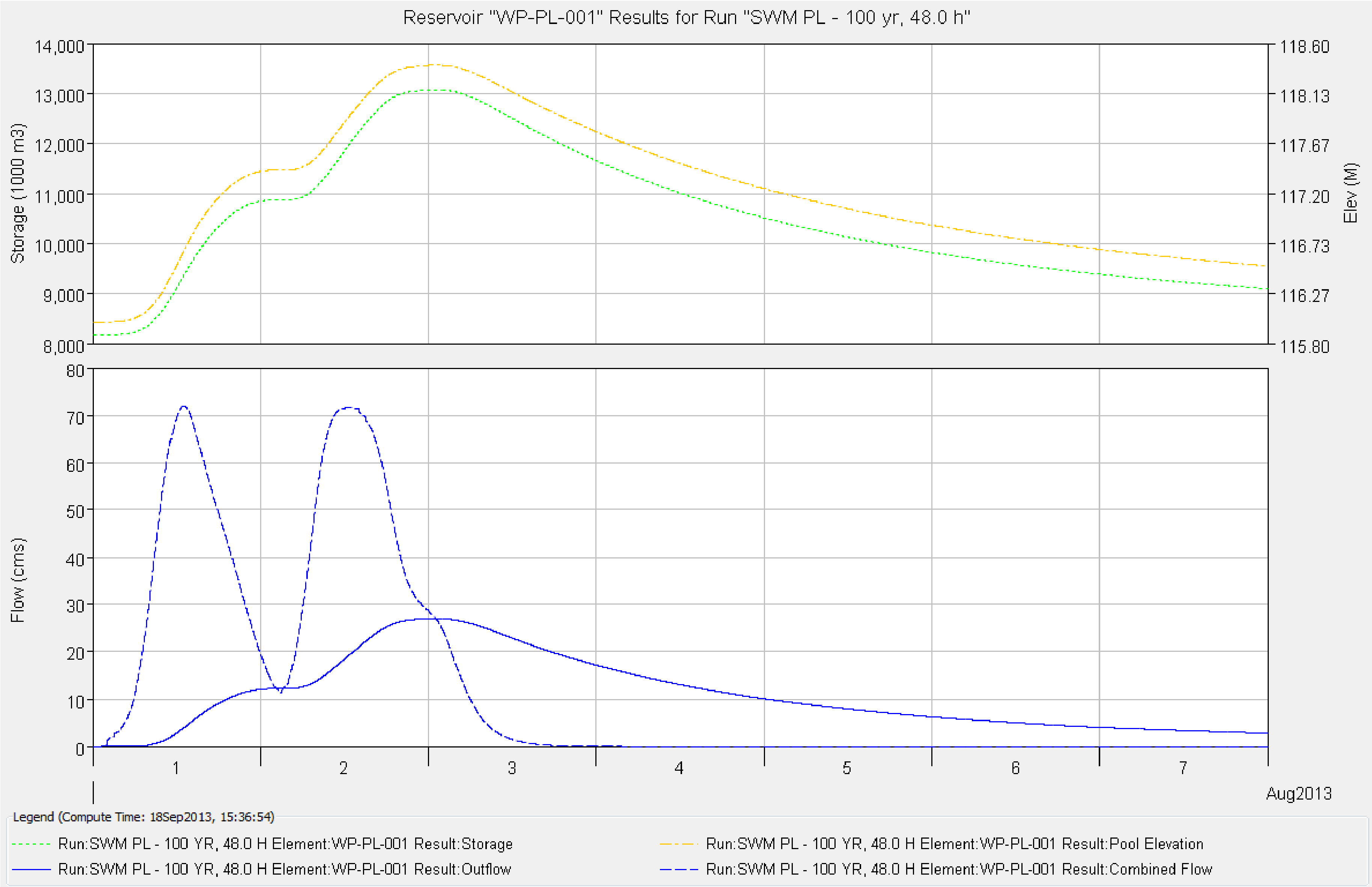
Reservoir "WP-PL-007" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
1,800
1,600
1,400
1,200
1,000
800
600
77.60
77.27
76.93
76.60
76.27
75.93
75.60
Elev (M)
Flow (cms)
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Combined Flow



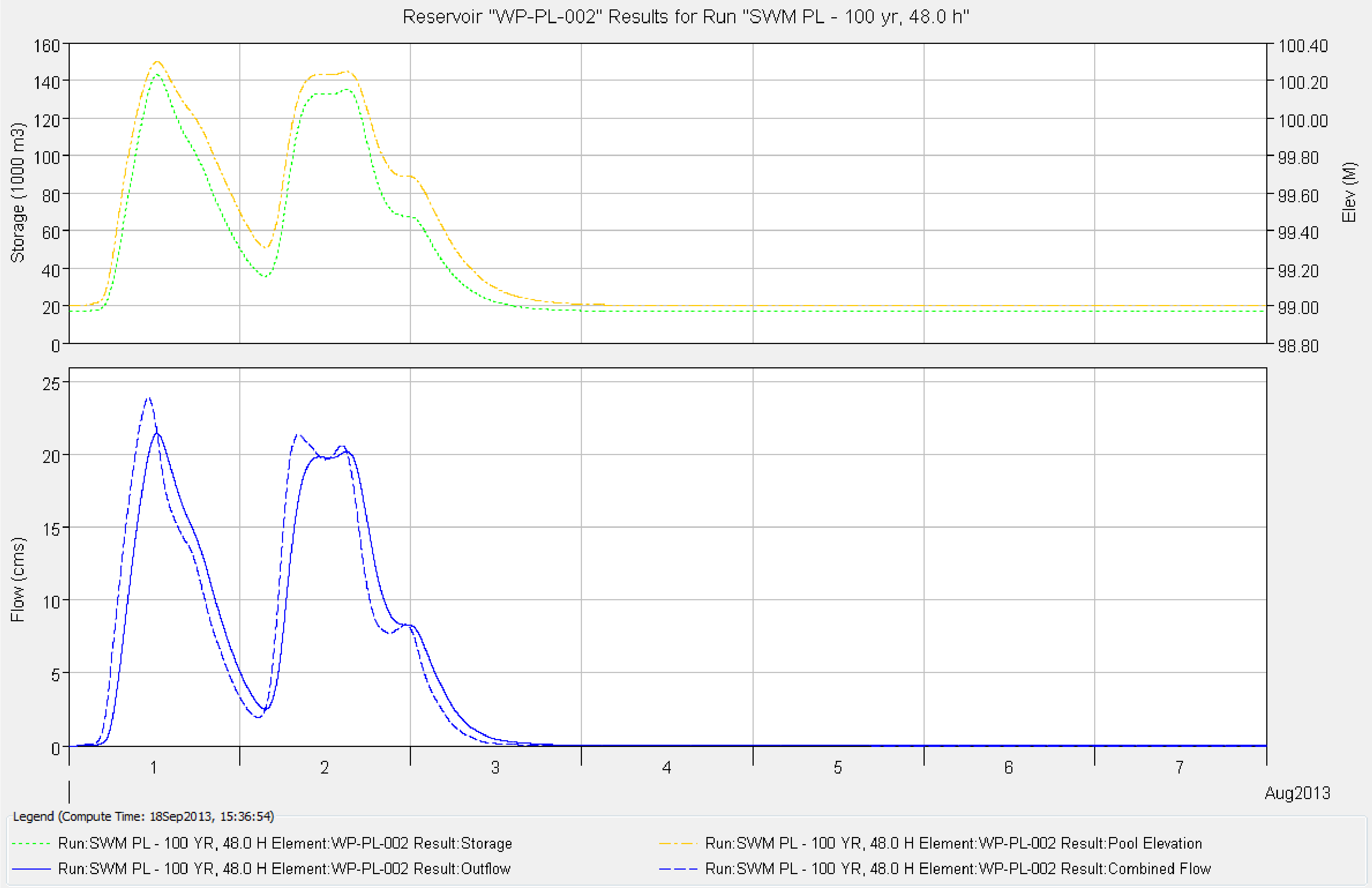
Reservoir "WP-PL-008" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
380
360
340
320
300
280
260
Elev (M)
108.00
107.82
107.63
107.45
107.27
107.08
106.90
Flow (cms)
14
12
10
8
6
4
2
-0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 yr, 06.0 h Element:WP-PL-008 Result:Storage
Run:SWM PL - 100 yr, 06.0 h Element:WP-PL-008 Result:Pool Elevation
Run:SWM PL - 100 yr, 06.0 h Element:WP-PL-008 Result:Outflow
Run:SWM PL - 100 yr, 06.0 h Element:WP-PL-008 Result:Combined Flow

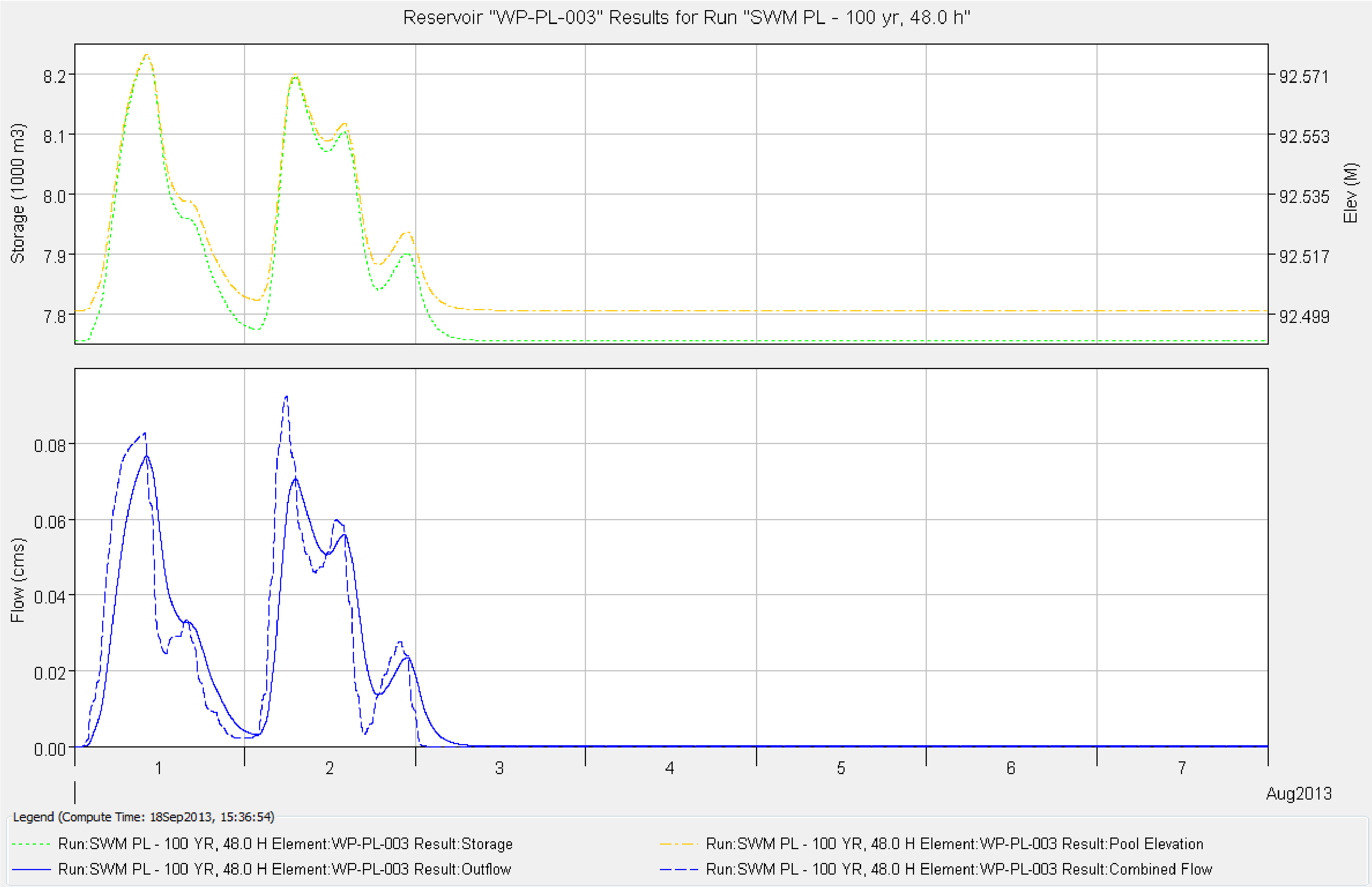


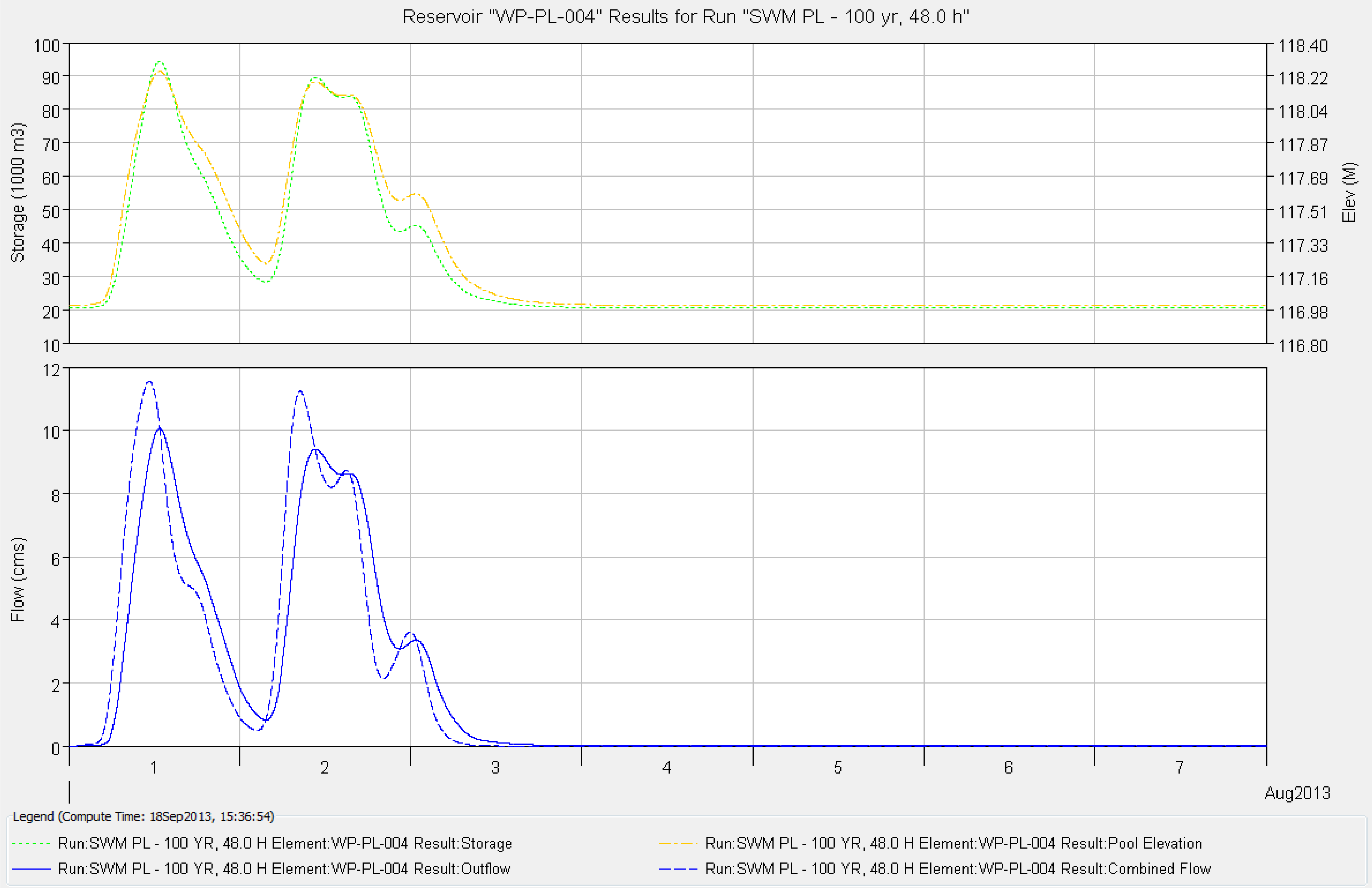
Reservoir "WP-PL-009" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
140
120
100
80
60
40
20
110.40
110.13
109.87
109.60
109.33
109.07
108.80
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:33:56)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Combined Flow



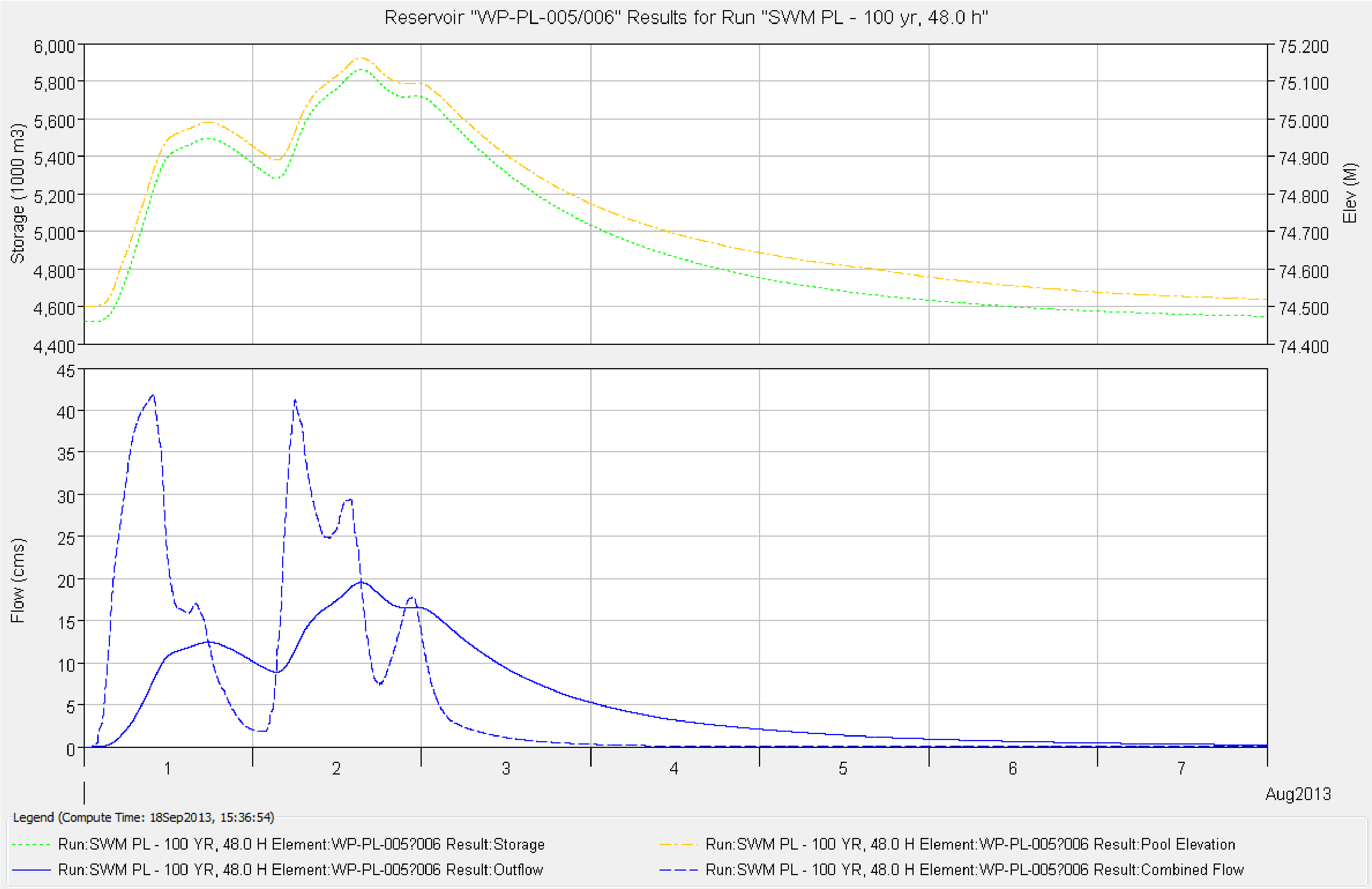
Reservoir "WP-PL-001" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
14,000
13,000
12,000
11,000
10,000
9,000
8,000
Elev (M)
118.60
118.13
117.67
117.20
116.73
116.27
115.80
Flow (cms)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Combined Flow


Reservoir "WP-PL-002" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
160
140
120
100
80
60
40
20
0
100.40
100.20
100.00
99.80
99.60
99.40
99.20
99.00
98.80
Flow (cms)
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Combined Flow

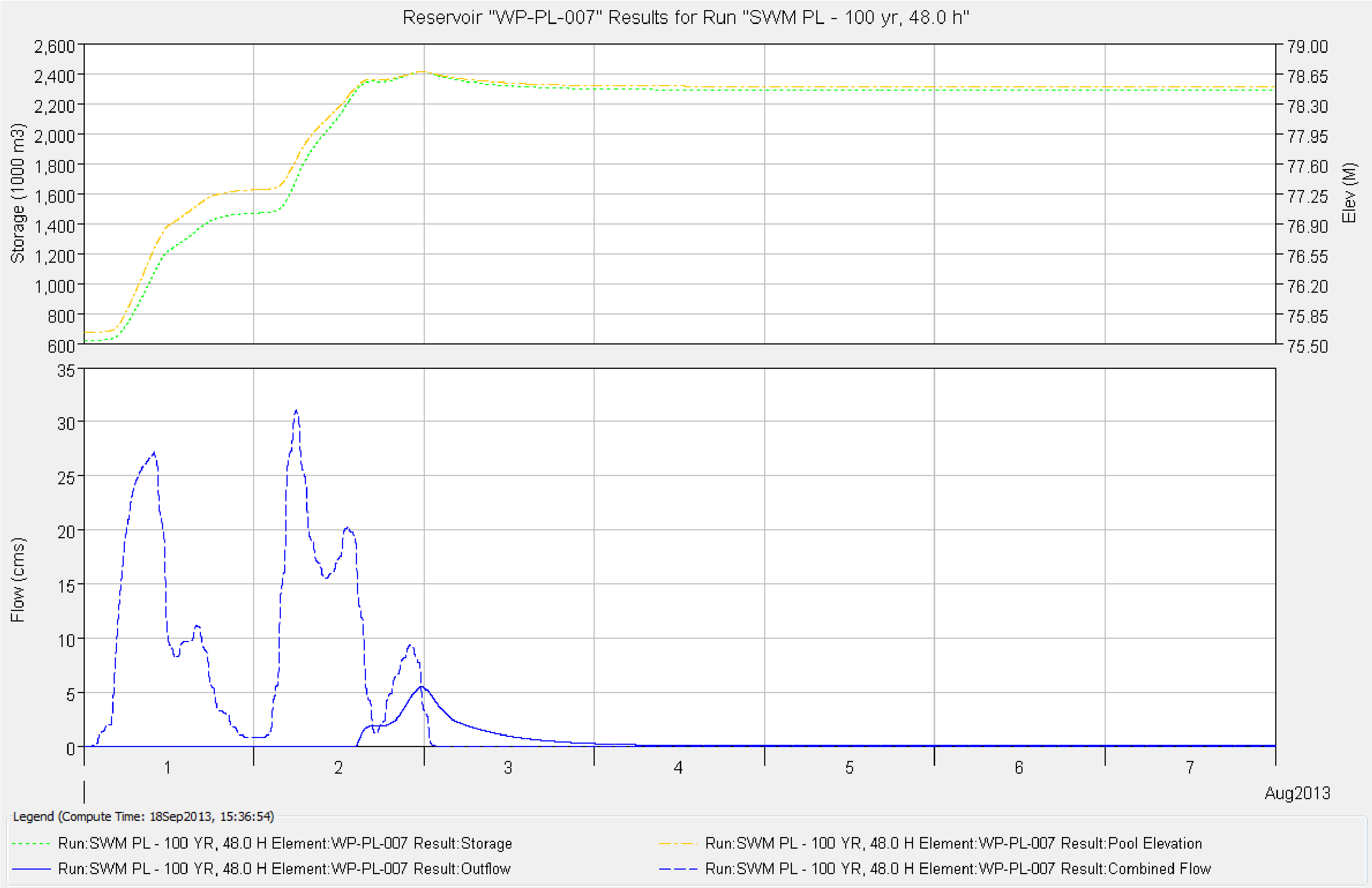

Reservoir "WP-PL-003" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
8.2
8.1
8.0
7.9
7.8
Elev (M)
92.571
92.553
92.535
92.517
92.499
Flow (cms)
0.08
0.06
0.04
0.02
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Combined Flow

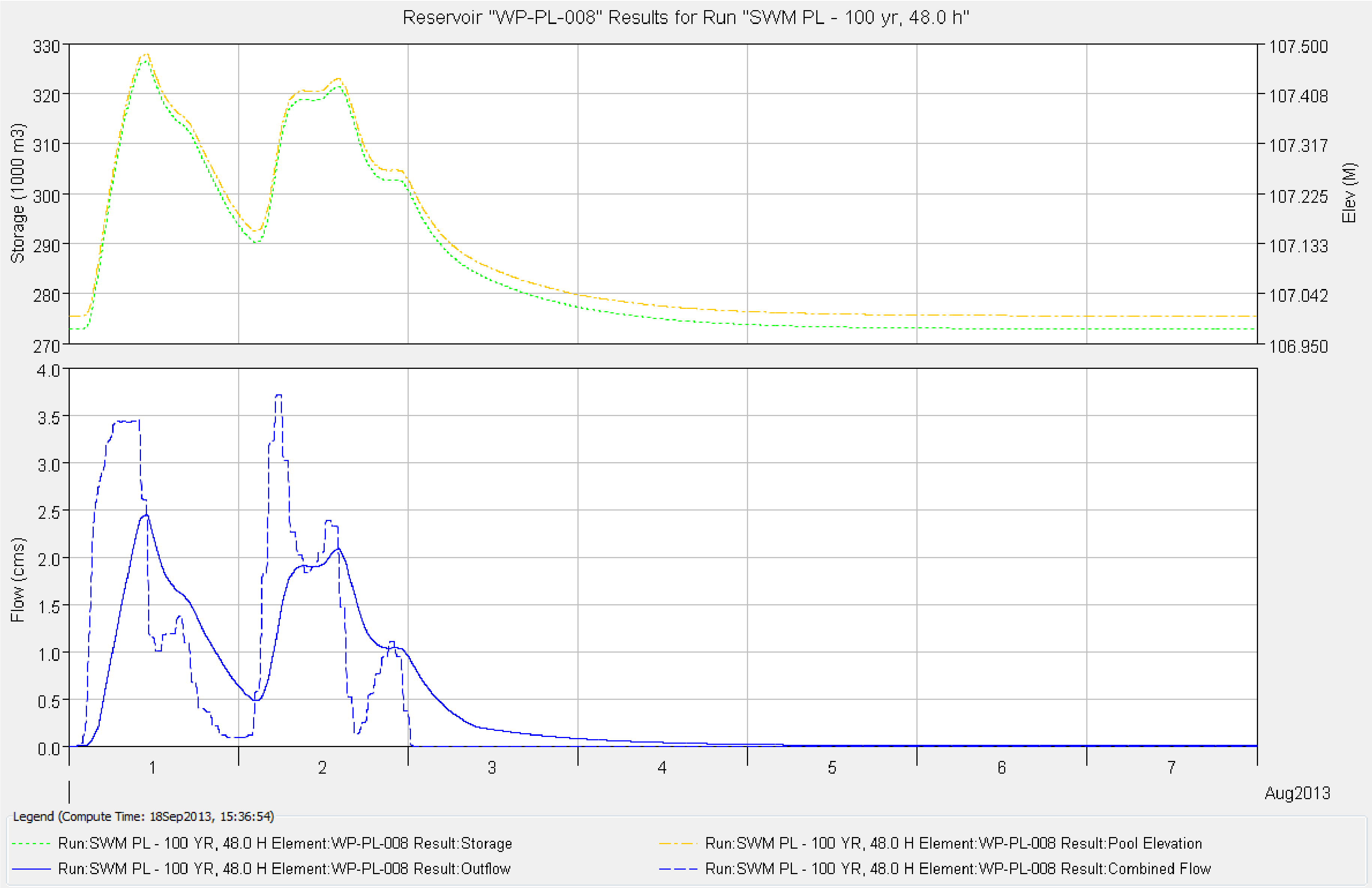


Reservoir "WP-PL-004" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
10
118.40
118.22
118.04
117.87
117.69
117.51
117.33
117.16
116.98
116.80
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Combined Flow

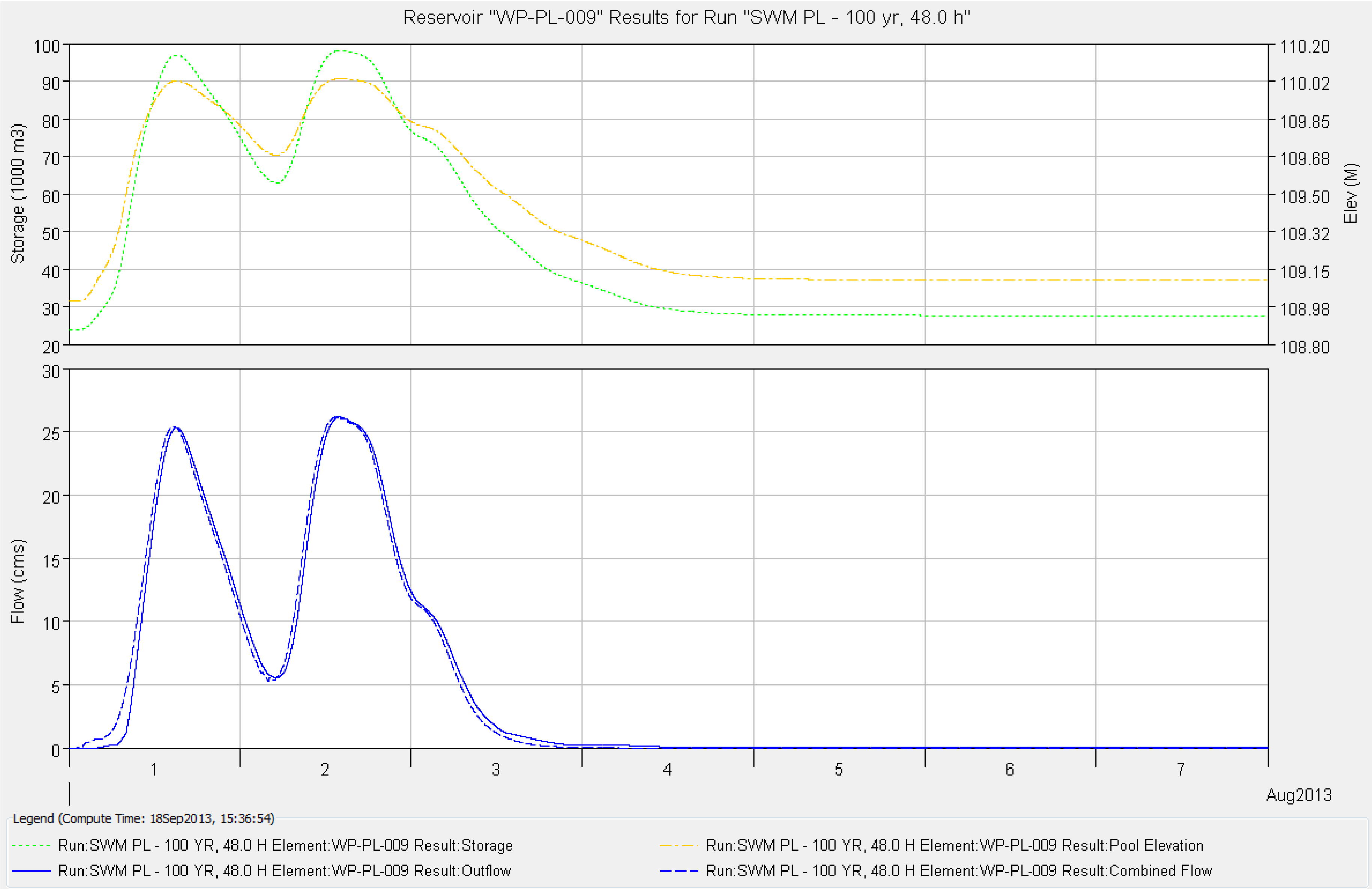


Reservoir "WP-PL-005/006" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
6,000
5,800
5,600
5,400
5,200
5,000
4,800
4,600
4,400
75.200
75.100
75.000
74.900
74.800
74.700
74.600
74.500
74.400
Elev (M)
Flow (cms)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Combined Flow

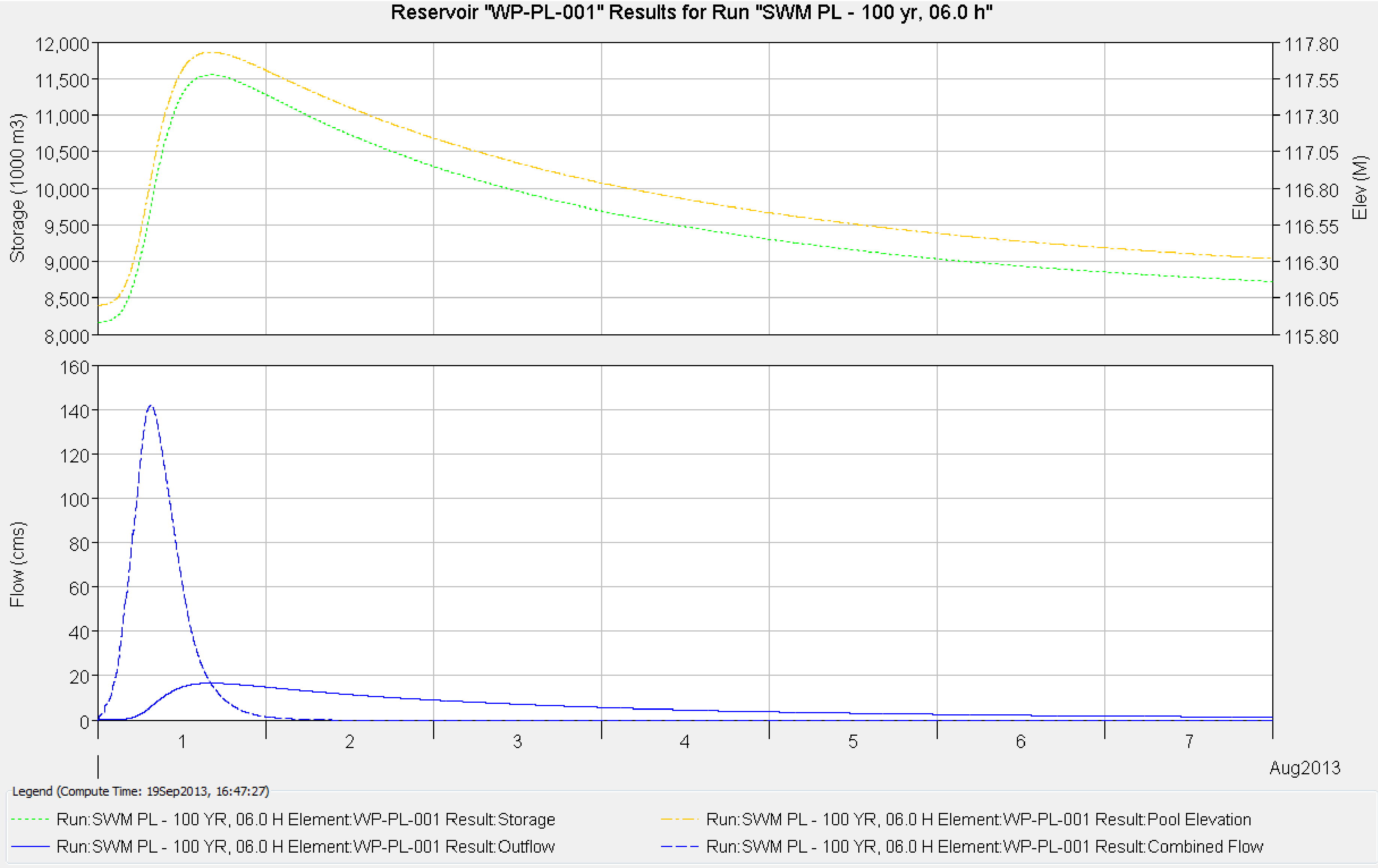

Reservoir "WP-PL-007" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
79.00
78.65
78.30
77.95
77.60
77.25
76.90
76.55
76.20
75.85
75.50
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Combined Flow

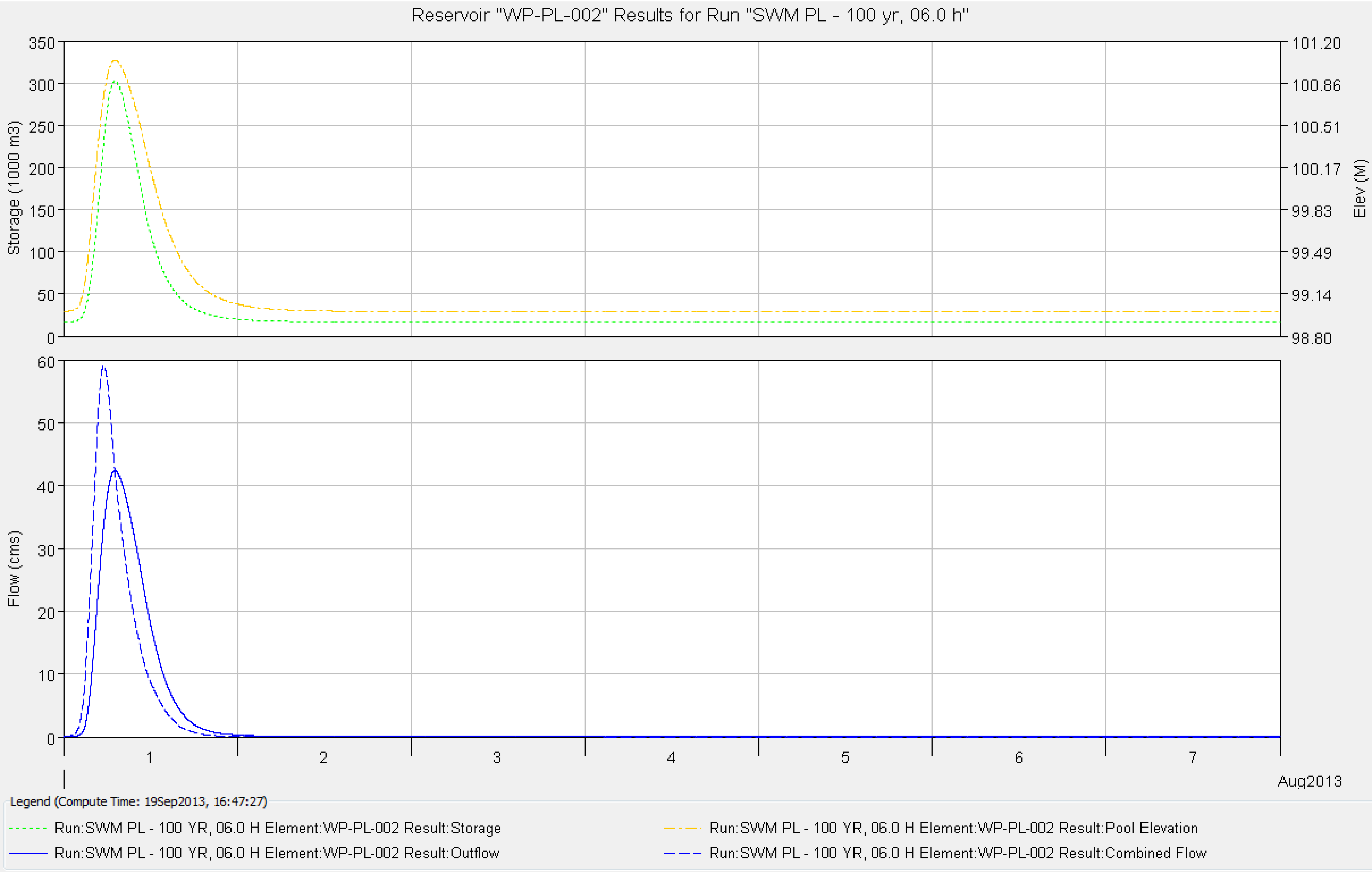


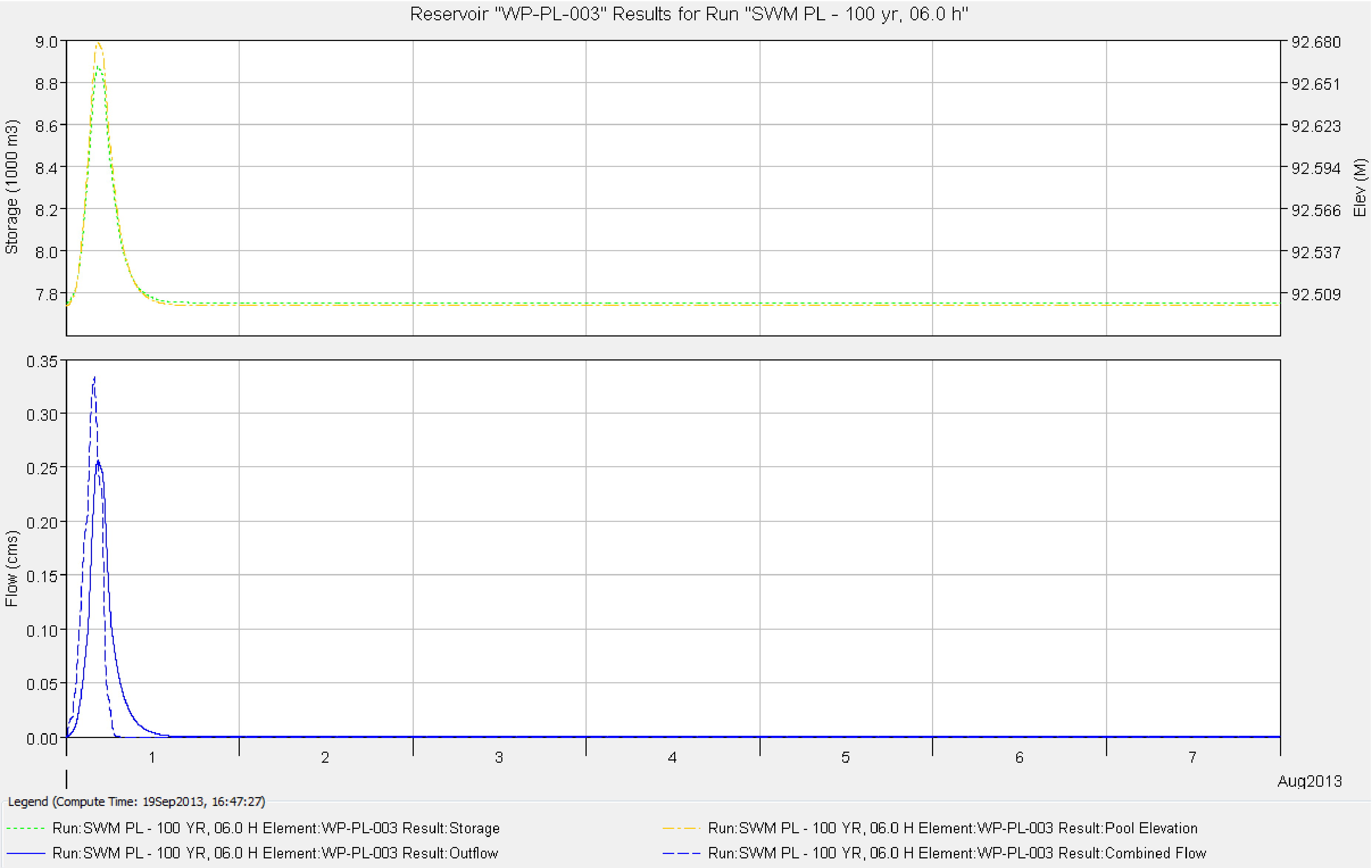
Reservoir "WP-PL-008" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
330
320
310
300
290
280
270
107.500
107.408
107.317
107.225
107.133
107.042
106.950
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Combined Flow



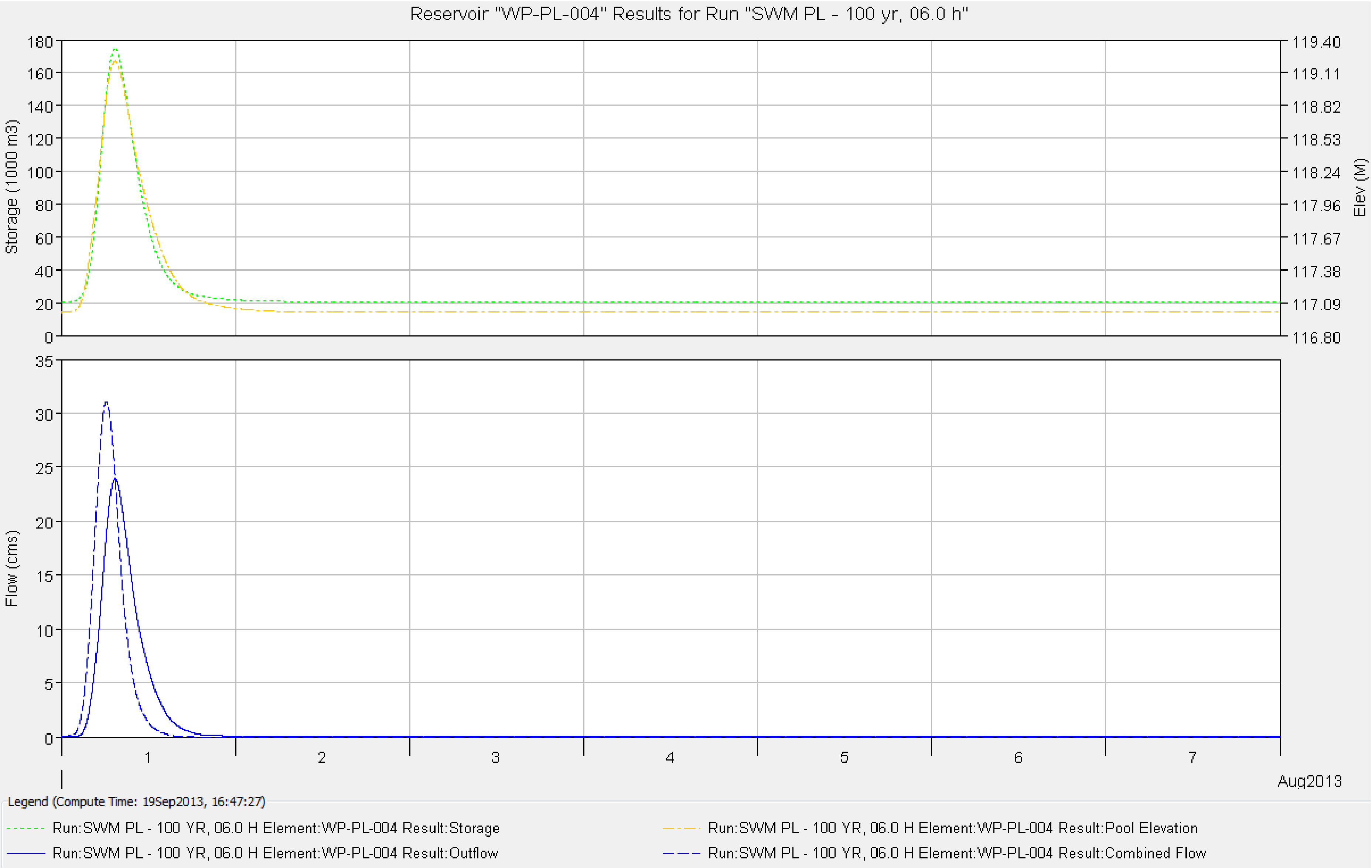
Reservoir "WP-PL-009" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
110.20
110.02
109.85
109.68
109.50
109.32
109.15
108.98
108.80
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:36:54)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Combined Flow

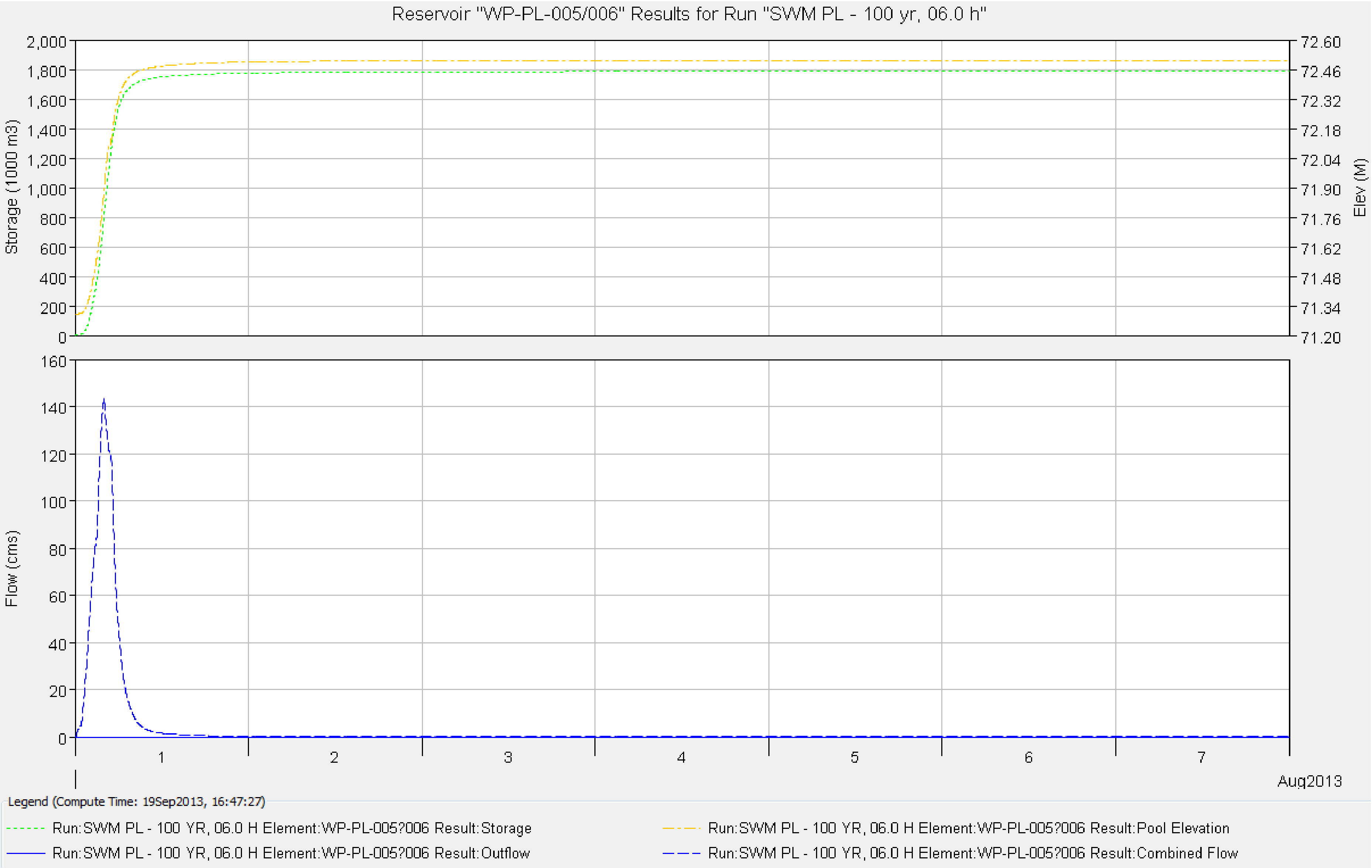

Reservoir "WP-PL-001" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
12,000
11,500
11,000
10,500
10,000
9,500
9,000
8,500
8,000
Elev (M)
117.80
117.55
117.30
117.05
116.80
116.55
116.30
116.05
115.80
Flow (cms)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-001 Result:Combined Flow


Reservoir "WP-PL-002" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
350
300
250
200
150
100
50
0
101.20
100.86
100.51
100.17
99.83
99.49
99.14
98.80
60
50
40
30
20
10
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-002 Result:Combined Flow



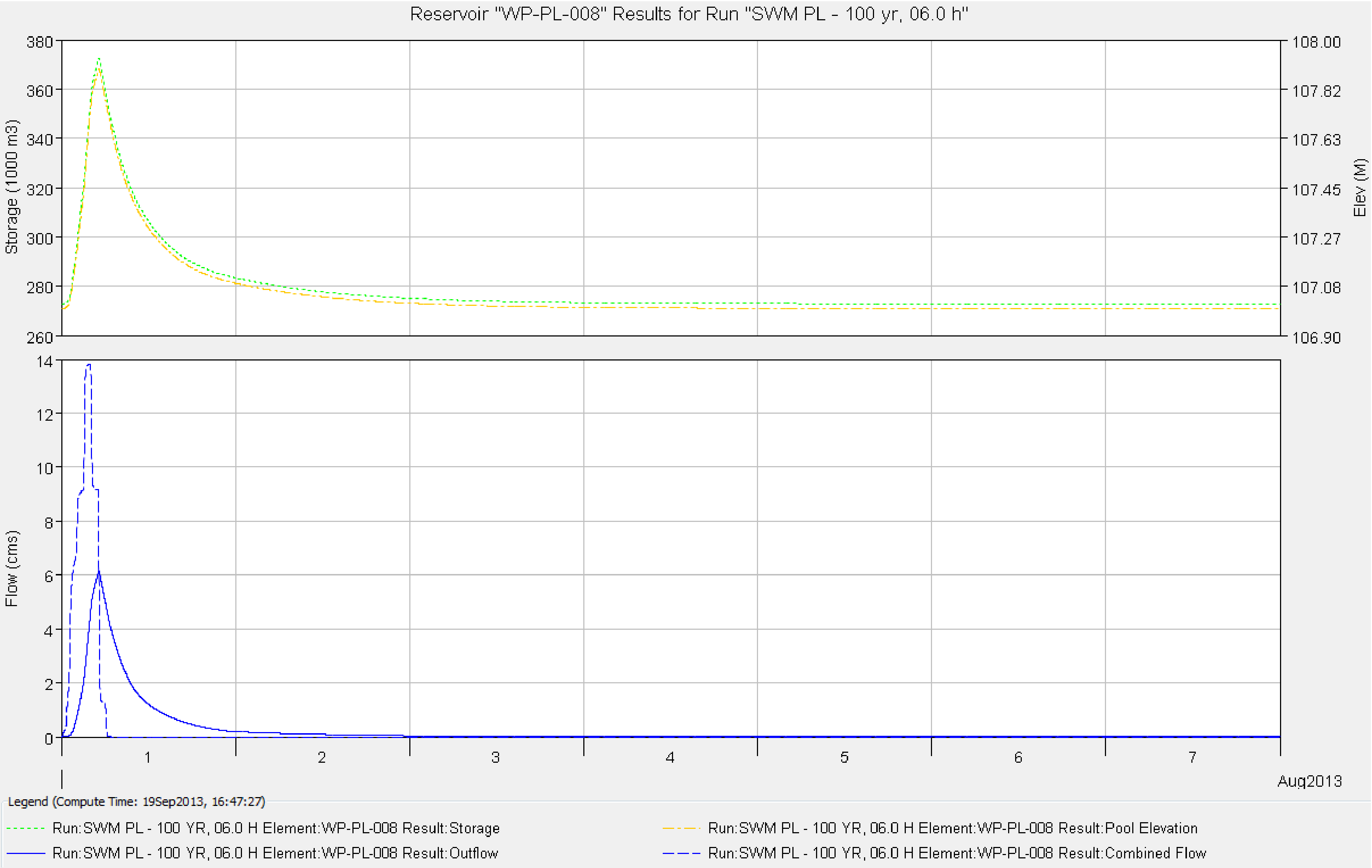
Reservoir "WP-PL-003" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
9.0
8.8
8.6
8.4
8.2
8.0
7.8
Elev (M)
92.680
92.651
92.623
92.594
92.566
92.537
92.509
Flow (cms)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-003 Result:Combined Flow


Reservoir "WP-PL-004" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
180
160
140
120
100
80
60
40
20
0
119.40
119.11
118.82
118.53
118.24
117.96
117.67
117.38
117.09
116.80
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-004 Result:Combined Flow

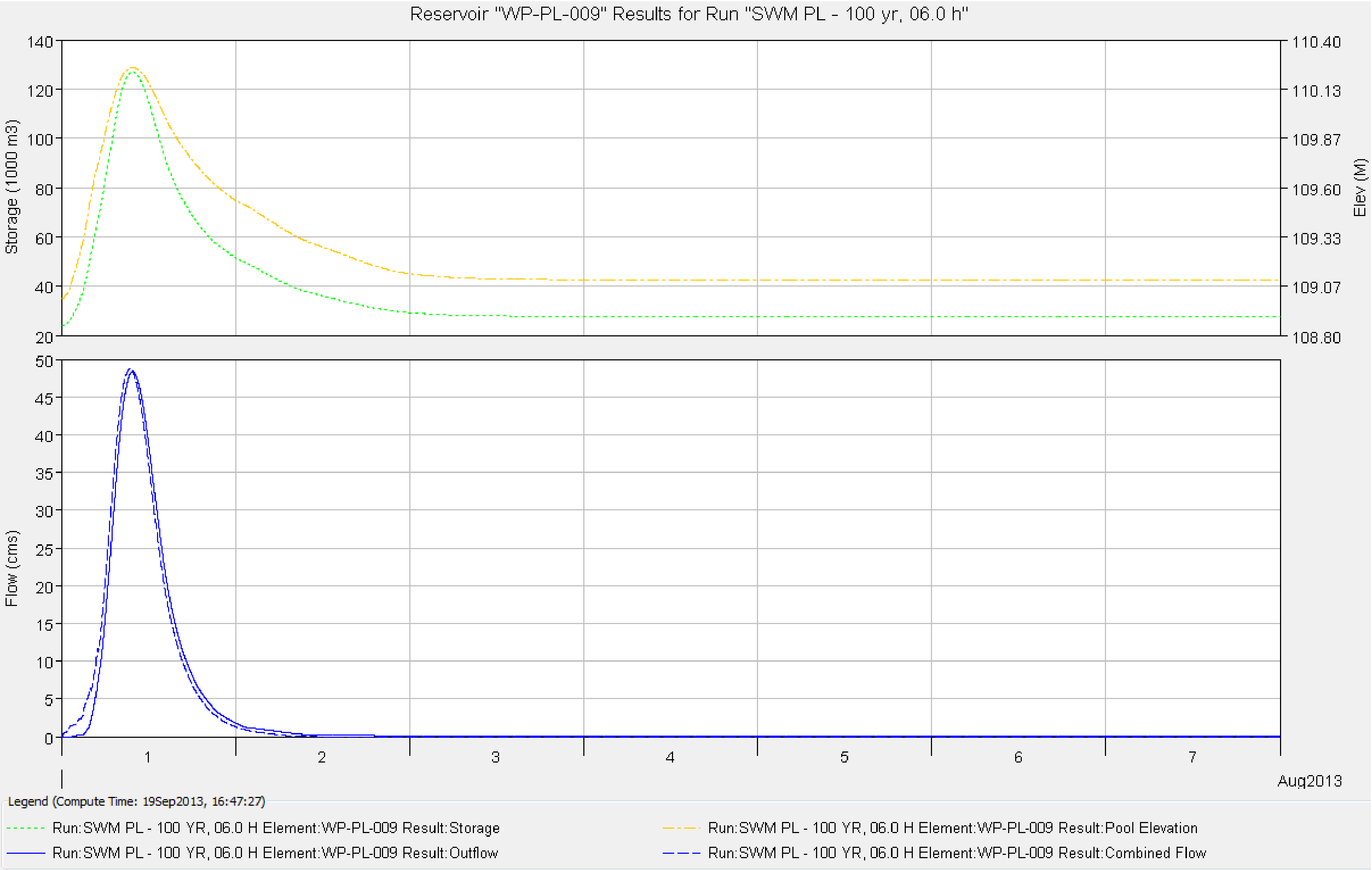


Reservoir "WP-PL-005/006" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
72.60
72.46
72.32
72.18
72.04
71.90
71.76
71.62
71.48
71.34
71.20
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-005?006 Result:Combined Flow

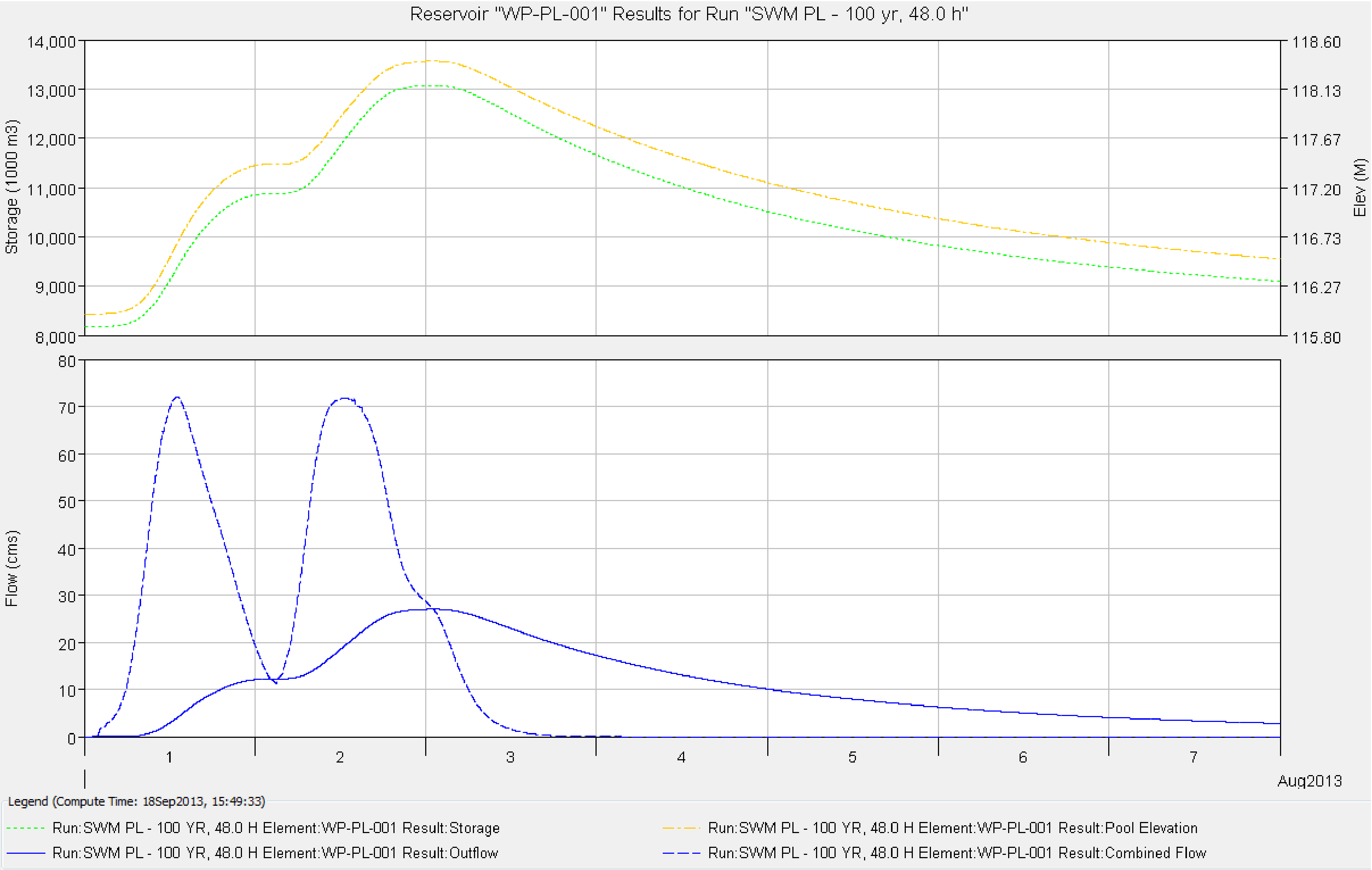
Reservoir "WP-PL-007" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
1,800
1,600
1,400
1,200
1,000
800
600
Elev (M)
77.60
77.27
76.93
76.60
76.27
75.93
75.60
Flow (cms)
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-007 Result:Combined Flow



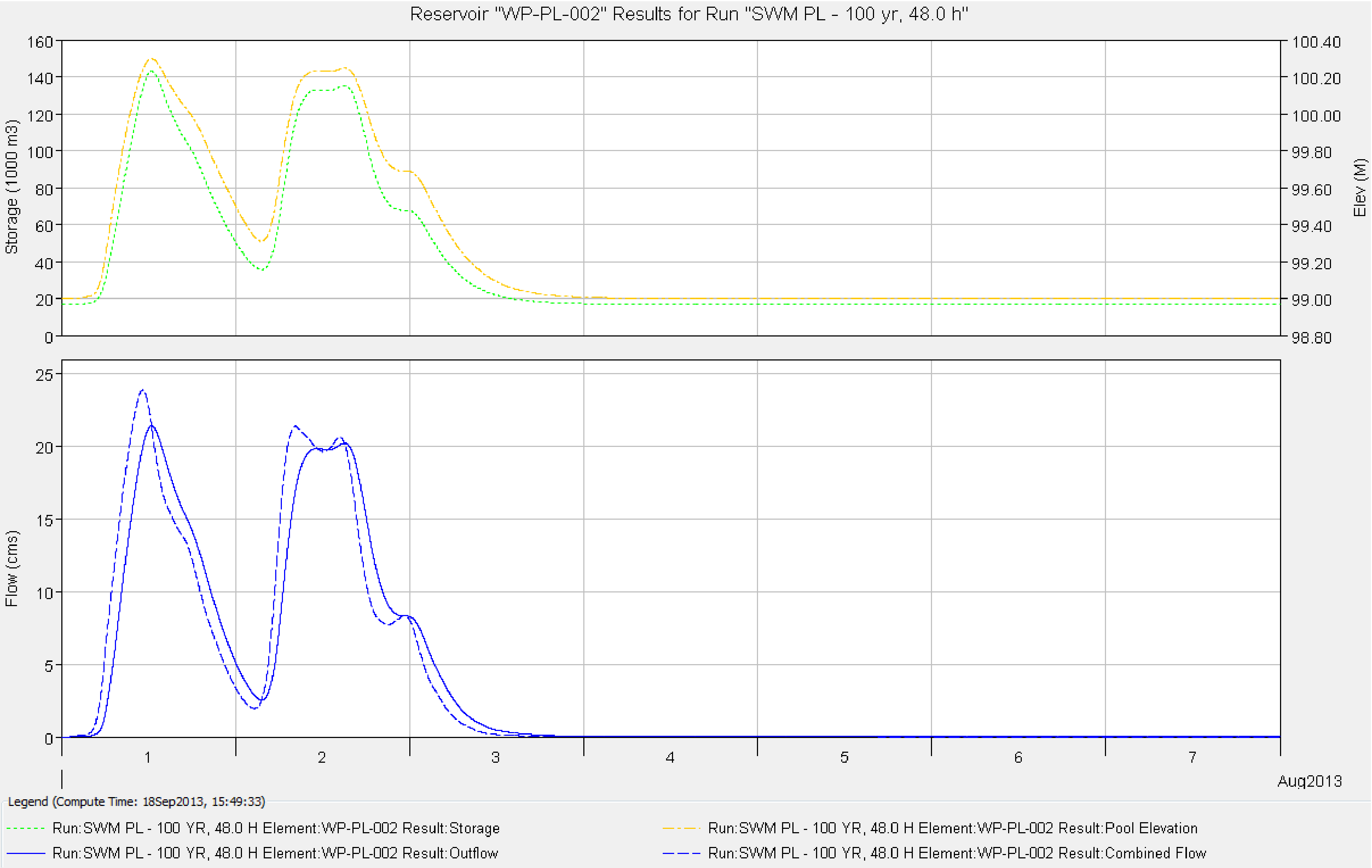
Reservoir "WP-PL-008" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
380
360
340
320
300
280
260
Elev (M)
108.00
107.82
107.63
107.45
107.27
107.08
106.90
Flow (cms)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-008 Result:Combined Flow

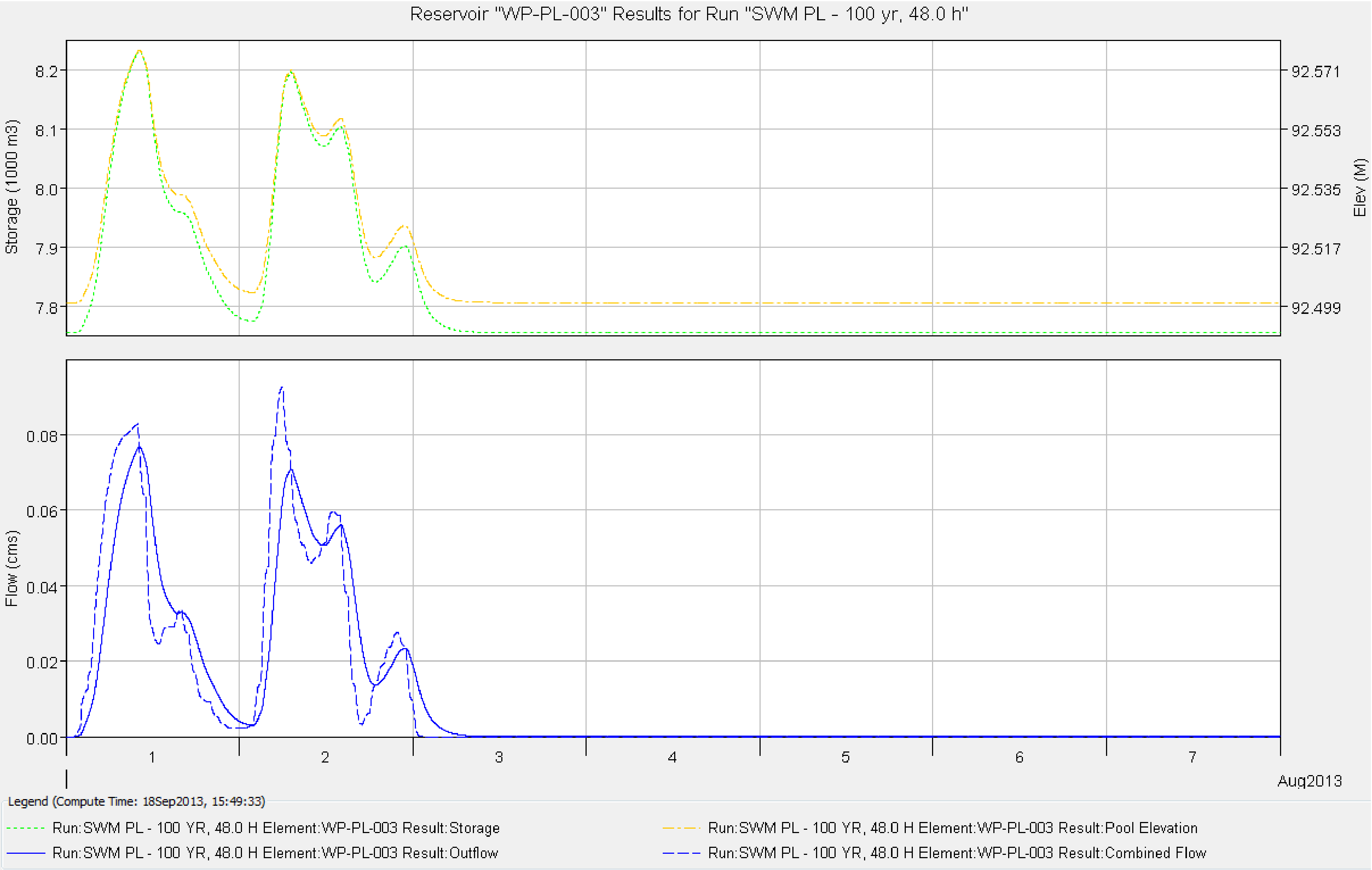


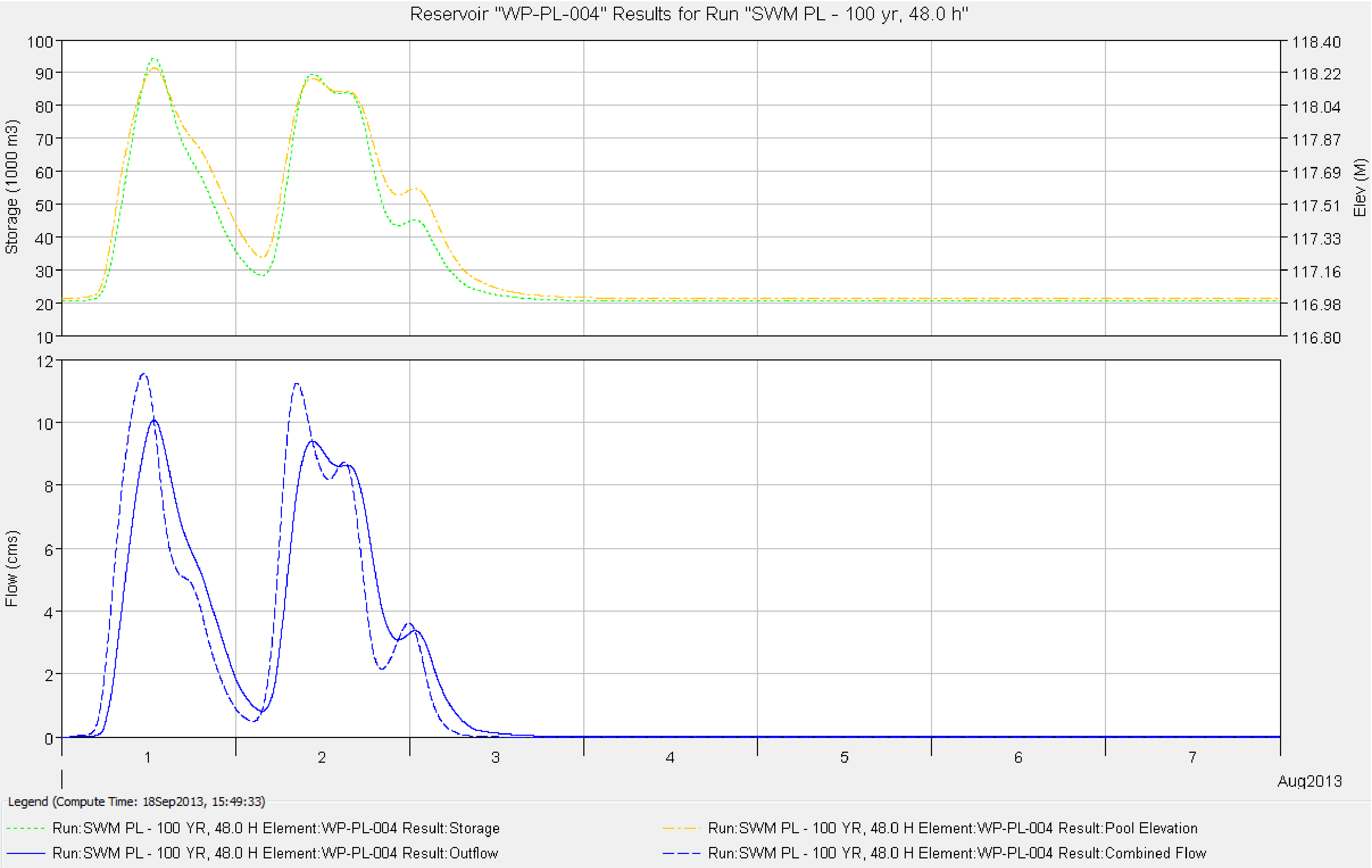
Reservoir "WP-PL-009" Results for Run "SWM PL - 100 yr, 06.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
140
120
100
80
60
40
20
110.40
110.13
109.87
109.60
109.33
109.07
108.80
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 19Sep2013, 16:47:27)
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Storage
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Pool Elevation
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 06.0 H Element:WP-PL-009 Result:Combined Flow

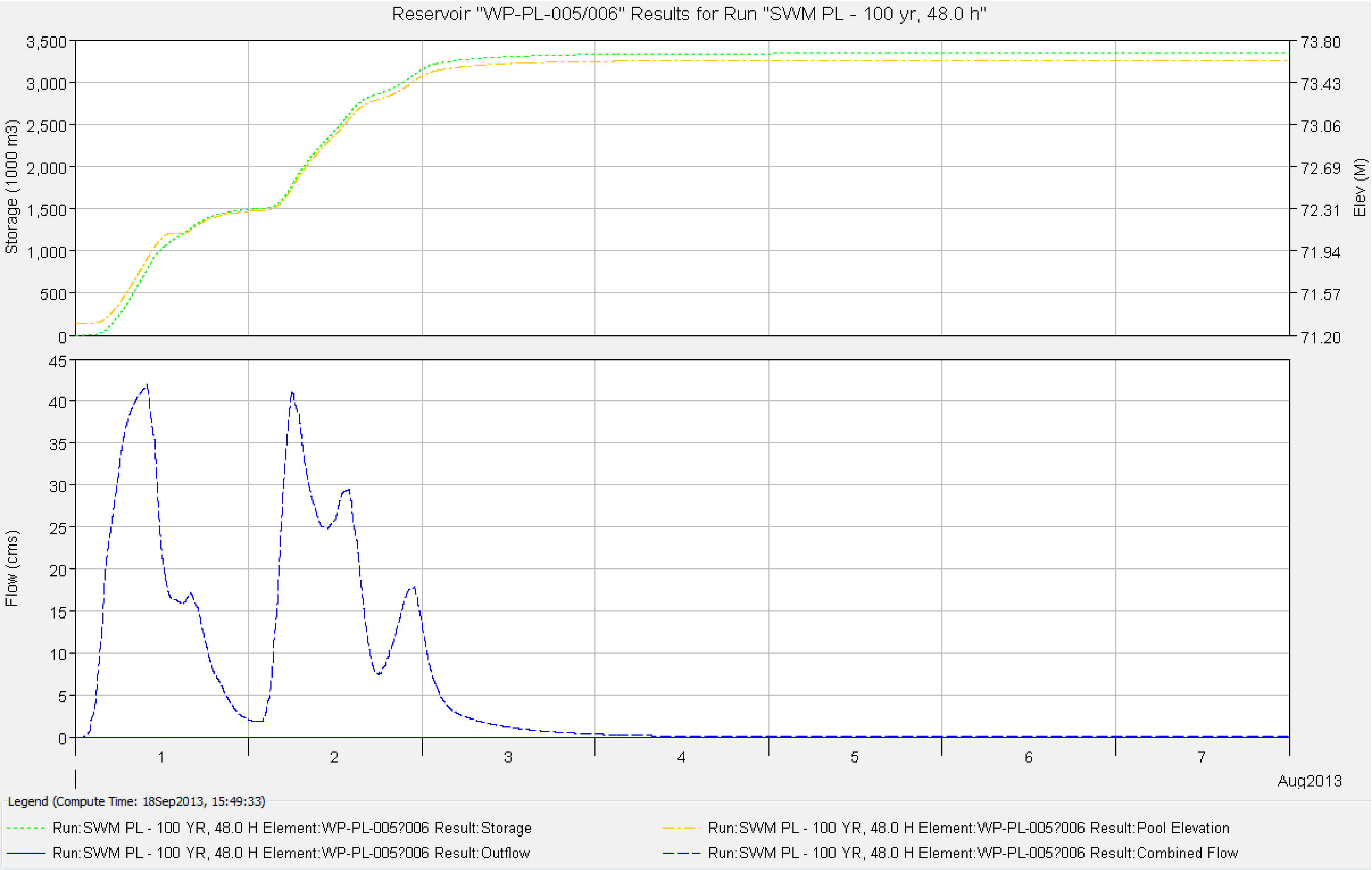


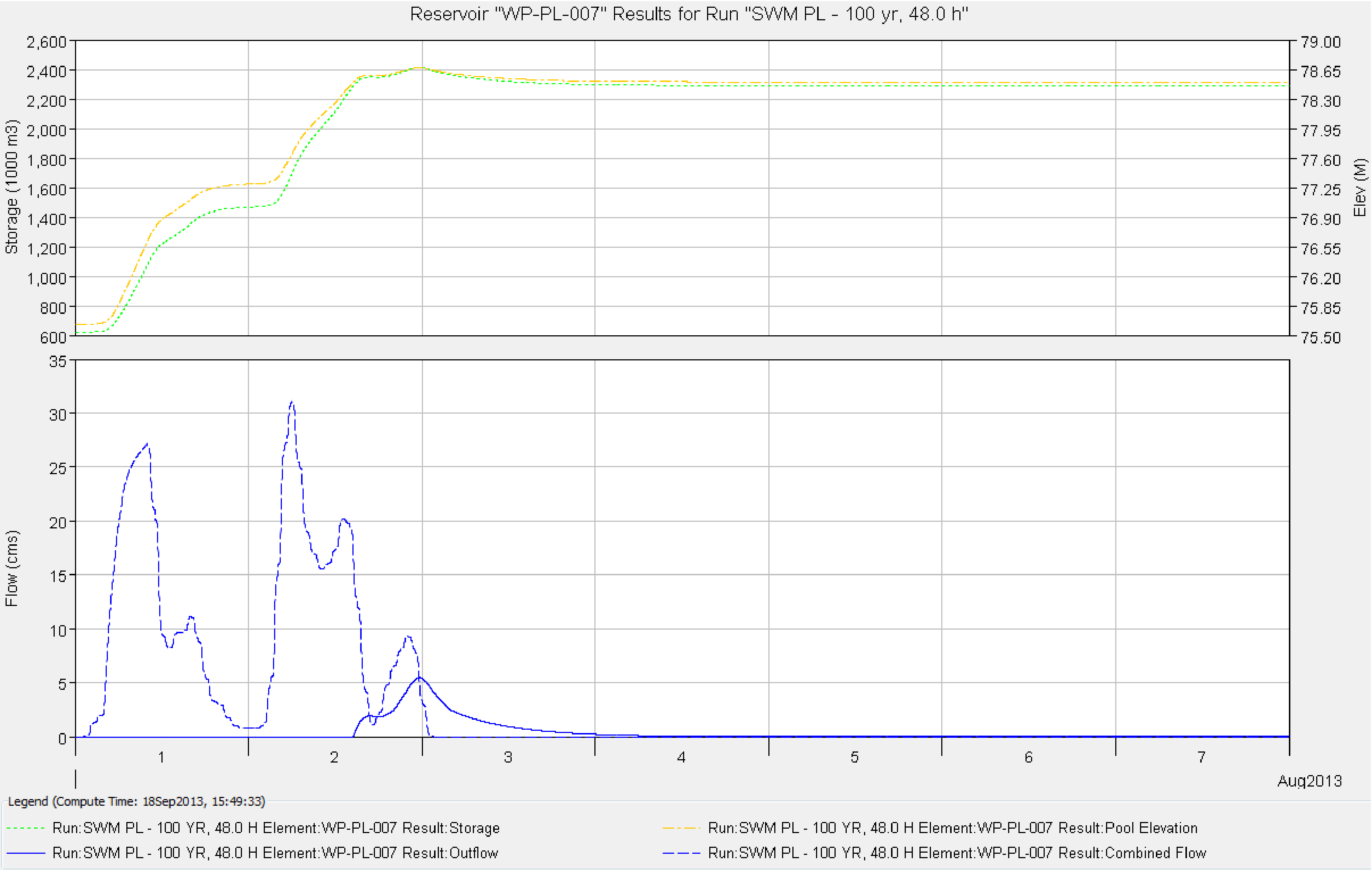
Reservoir "WP-PL-001" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
14,000
13,000
12,000
11,000
10,000
9,000
8,000
Elev (M)
118.60
118.13
117.67
117.20
116.73
116.27
115.80
Flow (cms)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-001 Result:Combined Flow


Reservoir "WP-PL-002" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
160
140
120
100
80
60
40
20
0
100.40
100.20
100.00
99.80
99.60
99.40
99.20
99.00
98.80
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-002 Result:Combined Flow

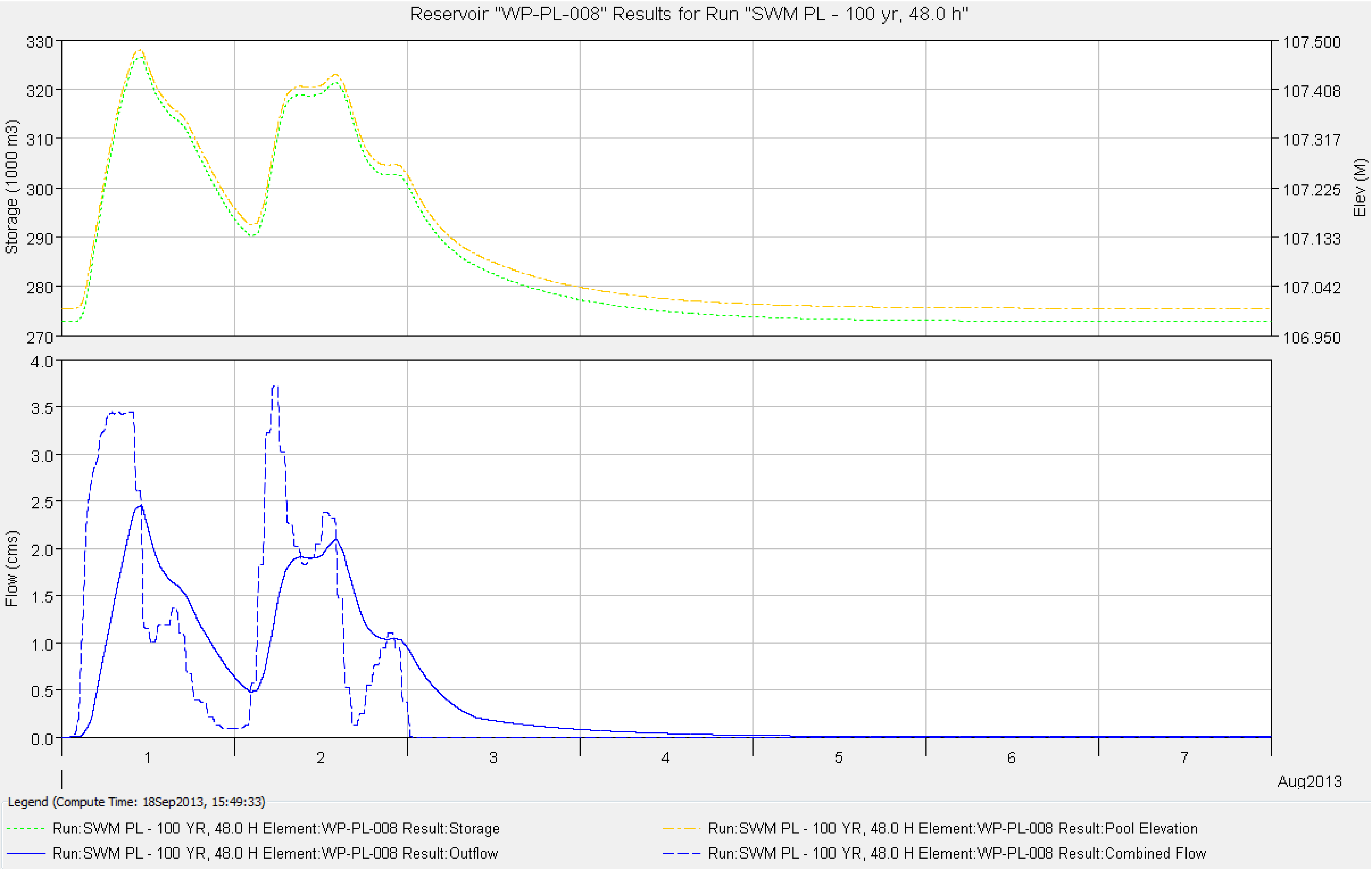

Reservoir "WP-PL-003" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
8.2
8.1
8.0
7.9
7.8
92.571
92.553
92.535
92.517
92.499
Elev (M)
Flow (cms)
0.08
0.06
0.04
0.02
0.00
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-003 Result:Combined Flow


Reservoir "WP-PL-004" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
10
118.40
118.22
118.04
117.87
117.69
117.51
117.33
117.16
116.98
116.80
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-004 Result:Combined Flow

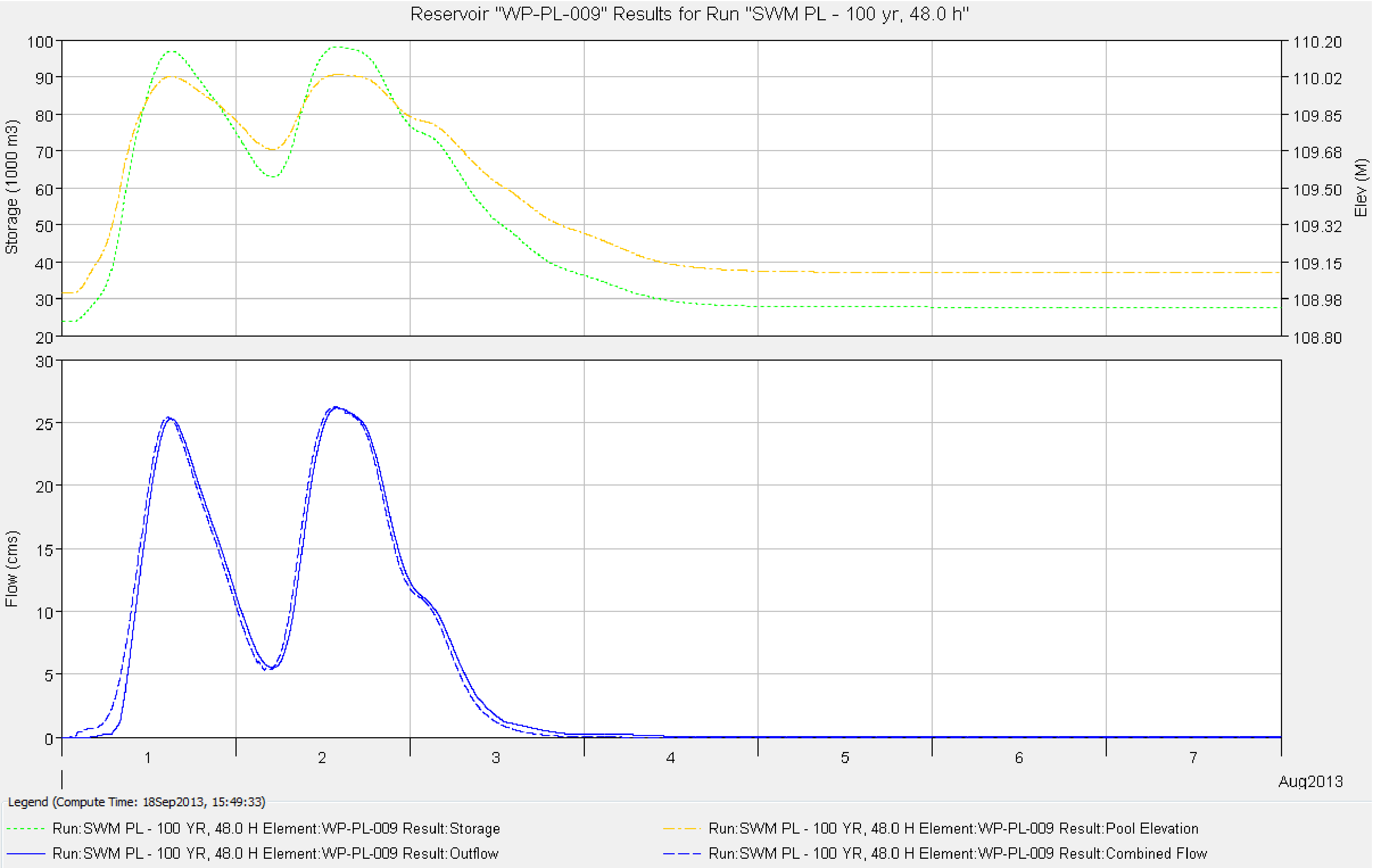

Reservoir "WP-PL-005/006" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
73.80
73.43
73.06
72.69
72.31
71.94
71.57
71.20
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-005?006 Result:Combined Flow



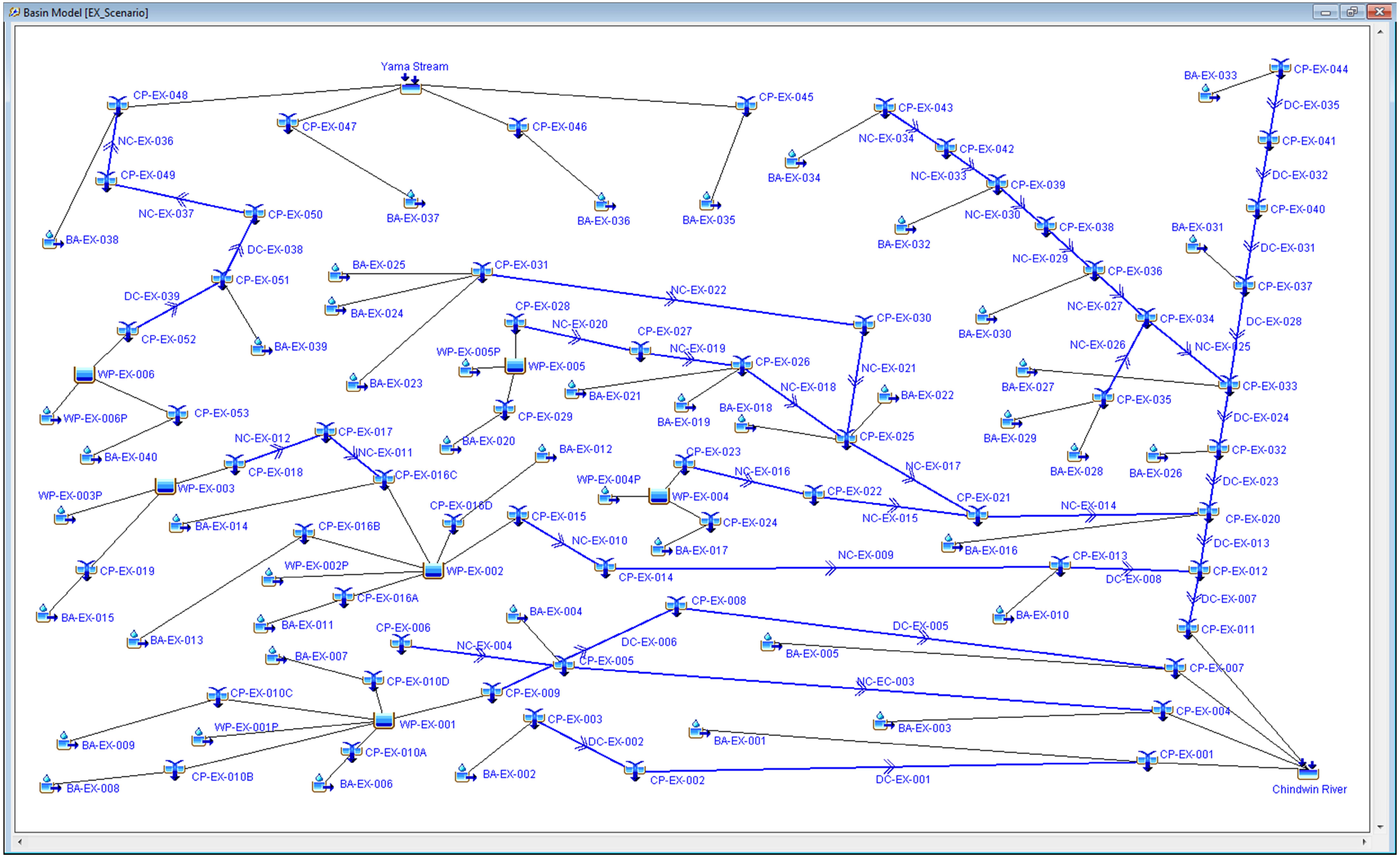
Reservoir "WP-PL-007" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
Elev (M)
79.00
78.65
78.30
77.95
77.60
77.25
76.90
76.55
76.20
75.85
75.50
Flow (cms)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-007 Result:Combined Flow

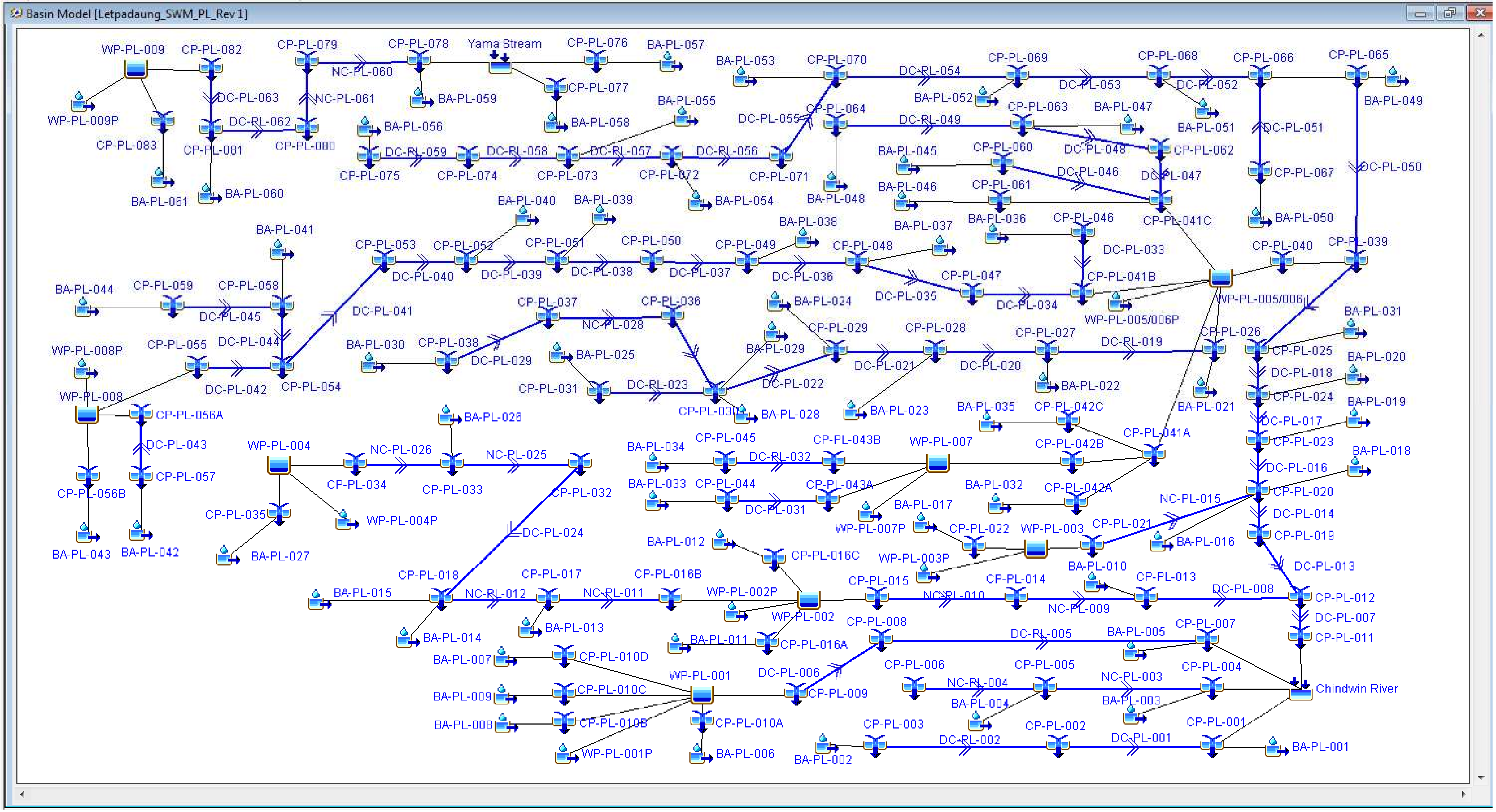


Reservoir "WP-PL-008" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
330
320
310
300
290
280
270
107.500
107.408
107.317
107.225
107.133
107.042
106.950
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-008 Result:Combined Flow



Reservoir "WP-PL-009" Results for Run "SWM PL - 100 yr, 48.0 h"
Storage (1000 m3)
Elev (M)
Flow (cms)
100
90
80
70
60
50
40
30
20
110.20
110.02
109.85
109.68
109.50
109.32
109.15
108.98
108.80
30
25
20
15
10
5
0
1
2
3
4
5
6
7
Aug2013
Legend (Compute Time: 18Sep2013, 15:49:33)
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Storage
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Pool Elevation
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Outflow
Run:SWM PL - 100 YR, 48.0 H Element:WP-PL-009 Result:Combined Flow


Basin Model [EX_Scenario]
Yama Stream
CP-EX-048
CP-EX-045
CP-EX-047
CP-EX-046
NC-EX-036
CP-EX-049
NC-EX-037
CP-EX-050
BA-EX-038
BA-EX-037
BA-EX-036
BA-EX-035
DC-EX-038
CP-EX-051
DC-EX-039
CP-EX-052
BA-EX-039
WP-EX-006
WP-EX-006P
CP-EX-053
BA-EX-040
BA-EX-025
BA-EX-024
CP-EX-031
NC-EX-022
BA-EX-023
CP-EX-028
NC-EX-020
CP-EX-027
NC-EX-019
WP-EX-005P
WP-EX-005
CP-EX-026
BA-EX-021
CP-EX-029
BA-EX-020
BA-EX-019
BA-EX-018
NC-EX-018
CP-EX-030
NC-EX-021
BA-EX-022
CP-EX-025
BA-EX-012
NC-EX-012
CP-EX-017
NC-EX-011
CP-EX-018
CP-EX-016C
WP-EX-003
WP-EX-003P
BA-EX-014
CP-EX-016B
CP-EX-016D
CP-EX-015
CP-EX-019
BA-EX-015
WP-EX-002P
WP-EX-002
CP-EX-016A
BA-EX-013
BA-EX-011
CP-EX-023
NC-EX-016
WP-EX-004P
WP-EX-004
CP-EX-024
BA-EX-017
CP-EX-022
NC-EX-015
NC-EX-017
CP-EX-021
NC-EX-010
CP-EX-014
NC-EX-009
BA-EX-034
CP-EX-043
NC-EX-034
CP-EX-042
NC-EX-033
CP-EX-039
BA-EX-032
NC-EX-030
CP-EX-038
NC-EX-029
CP-EX-036
BA-EX-030
NC-EX-027
CP-EX-034
NC-EX-026
NC-EX-025
BA-EX-027
CP-EX-035
BA-EX-029
BA-EX-028
BA-EX-033
CP-EX-044
DC-EX-035
CP-EX-041
DC-EX-032
CP-EX-040
BA-EX-031
DC-EX-031
CP-EX-037
DC-EX-028
CP-EX-033
DC-EX-024
BA-EX-026
CP-EX-032
DC-EX-023
NC-EX-014
CP-EX-020
DC-EX-013
BA-EX-016
CP-EX-013
DC-EX-008
CP-EX-012
BA-EX-010
DC-EX-007
CP-EX-011
BA-EX-004
CP-EX-008
CP-EX-006
NC-EX-004
DC-EX-006
DC-EX-005
BA-EX-005
CP-EX-005
CP-EX-007
BA-EX-007
CP-EX-010D
CP-EX-009
NC-EC-003
CP-EX-010C
WP-EX-001P
WP-EX-001
CP-EX-003
DC-EX-002
BA-EX-001
BA-EX-003
CP-EX-004
BA-EX-009
CP-EX-010A
BA-EX-008
CP-EX-010B
BA-EX-006
BA-EX-002
CP-EX-002
DC-EX-001
CP-EX-001
Chindwin River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Yama Stream
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CP-PL-016A
BA-PL-007
CP-PL-010D
CP-PL-006
CP-PL-005
CP-PL-004
DC-PL-006
WP-PL-001
NC-PL-004
NC-PL-003
Chindwin River
BA-PL-009
CP-PL-010C
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BA-PL-003
BA-PL-008
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CP-PL-003
CP-PL-002
CP-PL-001
DC-PL-002
DC-PL-001
WP-PL-001P
BA-PL-006
BA-PL-002
BA-PL-001

APPENDIX L

Conceptual Closure Plan

Knight Piésold
CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT

CONCEPTUAL CLOSURE PLAN

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

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Knight Piésold
CONSULTING
www.knightpiesold.com

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MYANMAR WANBAO MINING COPPER LTD (MWMCL)

LETPADAUNG COPPER PROJECT

CONCEPTUAL CLOSURE PLAN

KP Report No. PE701-00022/04

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A	MWMCL, MONYWA SITE OFFICE, SALINGYI TOWNSHIP SAGAING REGION	0	1

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FIGURES

EXECUTIVE SUMMARY

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a concept closure plan for the site has been developed which addresses closure and rehabilitation of the following areas:

- Open Pit
- Waste Dumps
- Heap Leach Pads
- Plant, Equipment and Infrastructure
- Process and Stormwater Ponds
- Accommodation Camps

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

In developing the concept closure plan reference has been made to Myanmar regulations as well as international standards, guidelines and best practice including IFC Guidelines, Chinese standards, European Commission 'Best Available Techniques' and Western Australian guidelines.

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;
- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;

- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

The Conceptual Closure Plan presented here allows integration with the design concepts and ensures that the design and operation of the site are compatible with the closure plan. After commissioning a Detailed Closure Plan will be developed.

An outline closure land-use plan has been developed for the site. On closure the open pit will remain as a void with a permanent pit lake. The remaining areas will be rehabilitated to one of four land-use categories, namely:

i. Scrub/grazing
ii. Agriculture
iii. Pond or wetland areas
iv. Landfill

Progressive rehabilitation will be undertaken wherever possible. All equipment and infrastructure will be removed from site unless there is a beneficial use to the community such as buildings or roads.

Due to the potential for long-term environmental pollution, both the waste dumps and heap leach pads are to be covered with low or very low permeability capping systems to reduce infiltration.

Surface water run-off and leachate from waste dumps and heap leach pads will be controlled via a surface water management system that separates clean from potentially contaminated

water, provides settling areas to reduce suspended load prior to discharge, and allows treatment of water which doesn't reach the necessary standards before release from the site.

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that two landfills will be constructed on the site so that wastes are contained within the site boundary. One facility will accept inert/non-hazardous waste whilst the other will be a hazardous waste landfill.

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

Closure costs will be developed concurrent with the Closure Plan and financial provision will be made to ensure that adequate funds are available for final closure.

1. INTRODUCTION

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a closure plan for the site needs to be developed.

Closure and rehabilitation of the following areas will be required:

- Open Pit.
- Waste Dumps.
- Heap Leach Pads.
- Plant, Equipment and Infrastructure.
- Process and Stormwater Ponds.
- Accommodation Camps.

This report presents the concept closure plan for the whole site.

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

The Mine Closure Management Plan will cover the full range of closure events which include:

- Unexpected mine closure (either temporary or permanent);
- Progressive rehabilitation through the life of the mine; and
- Permanent closure.

2. MYANMAR REGULATORY REQUIREMENTS

2.1 EXISTING ENVIRONMENTAL LEGISLATION

Though Myanmar does have some legislation related to protecting people and the environment, the country lacks the necessary adequate administrative and legal structures, standards, safeguards and political will to enforce such provisions. In addition, while Myanmar is party to several international treaties such as the Convention on Biological Diversity (CBD), in the past, Myanmar has not incorporated the provisions contained in these agreements into domestic law. For example, national laws did not require specific environmental and social impact assessments (ESIA) or public participation by local communities in the decision-making processes of large-scale development projects. However, to address the environmental expectations of the laws described below, an ESIA would be required to establish the mechanisms for preventing such actions from occurring. There are no specific laws that comprehensively regulate pollution, no standards to adequately protect biodiversity, develop resettlement plans, or provide compensation. There are, however, the 1995 Community Forest Instructions (CFI), the March 2012 Environmental Conservation Law, the November 2012 Foreign Investment Law, Rules and Notification by Myanmar Investment Commission (2013), Rules of the Conservation of Water Resources and Rivers Law (2013) and the Land Acquisition Act that, if systematically enforced, would improve environmental protection and the land-based rights of local populations. Myanmar became a party to the CBD in 1994. Article 14(1)(a) of the Convention requires an EIA and Article 8(j) mandates indigenous participation where there is a significant impact on biodiversity. Section 54 of the 2012 Foreign Investment Law provides that "If any provision of this Law is contrary with any matter of the International Treaty and Agreement adopted by the Republic of the Union of Myanmar, the matters contained in the International Treaty and Agreement shall be abided by.

2.2 THE ENVIRONMENTAL CONSERVATION LAW 2012 (ECL)

2.2.1 Objectives

The ECL, the landmark law specifically dedicated to address environmental conservation, was enacted:

a) to implement the national environmental policy;

b) to lay down basic principles and provide guidance to systematically integrate environmental conservation matters with the sustainable development works;

c) to build a healthy and clean environment and to conserve natural and cultural heritage for the benefit of current and future generations;

d) to restore the deteriorating and disappearing ecosystem to the fullest extent possible;

e) to enable to manage and implement for the decrease and loss of natural resources and for enabling the benefits of sustainable use;

f) to enable promotion of public awareness and cooperation in the matters of environmental conservation;

g) to enable promotion of international, regional, and bilateral cooperation in the matters of environmental conservation; and

h) to co-operate with the government departments and organisations, international organisations, non-governmental organisations and private individuals on environmental conservation matters.[1]

2.2.2 Current Position

Though the ECL paves the way for the use of EIA and/or SIA in evaluation of issuing a prior permission for prescribed businesses, the prior permission scheme itself is discretionary and there is currently no basis in the law for the Ministry to determine whether or not to issue a permit, and whether to impose environmental compliance conditions on the user. Also, some of the Ministry of Environmental Conservation and Forestry's (MOECAF) broad powers granted under the law require the approval of the Union Government and the Environmental Conservation Council (ECC) but without the clear power and basis of the approval.

There are no regulatory guidelines and rules specified to enable the ECL to be operable in practice: such as setting the environmental quality standards, emission standards, and classes of hazardous waste and substances. In addition, there is a need to cover the non-point sources of pollution that is not discussed in the ECL.

The ECL provides for integration with sectoral policies and co-ordination amongst the Ministries and departments.[2] It is expected that the Environmental Conservation Rules (ECR) of the ECL which is underway would provide regulatory guidelines to implement the ECL.

2.2.3 Obligations of Business Owners and Occupiers

The polluter at source has obligations to clean, discharge, dispose, or keep pollutants in accordance with the prescribed standards[3].

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[1] ECL Section 3
[2] ECL Section 18
[3] ECL Section 14

The owner or occupier of business activities, materials or places that are source of the pollution must install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If this is not possible, it must be arranged to dispose the wastes in accordance with environmentally sound methods[4].

The individuals or organisations carrying on the businesses in the industrial zones, or special economic zones or businesses set by the government ministries have responsibilities to contribute either in cash or in kind and carry out the management of pollutants and environmental conservations including the treatment of wastes collectively[5]; must give the fees for the usage and expenses incurred in connection with management of environmental conservation by the relevant industrial zones, special economic zones and business organisations[6]; and must comply with the environmental conservation directives published by the relevant industrial zone, special economic zone or the business organisations[7].

2.3 FOREIGN INVESTMENT LAW 2012 (FIL)

The FIL, in its Basic Principles, states that the investment shall be allowed based upon principles including “protection and conservation of the environment”[8].

The duties of the investor requires the carrying out of business in a manner not to cause environmental pollution or damage in accord with existing laws in respect of investment business[9].

2.4 NOTIFICATION OF MIC 1/2013

The list of Economic Activities under Prohibition includes:

- Installation of Factory in Myanmar utilizing of the imported wastes
- Manufacturing of hazardous material which are not in compliance with the Environmental and Conservation Law, Rules and Procedures promulgated from time to time.
- Activities which may emit hazardous chemicals, minerals, rays, noise, particles etc., and may cause earth/water/air pollution which affect public health.
- Exploitation of minerals including gold in the revering and water way.

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[4] ECL Section15
[5] ECL Section 16(a)
[6] ECL Section 16(b)
[7] ECL Section 16(c)
[8] Fill Clause 8(l)
[9] Fill Clause 17(h)

The list of Economic Activities Permitted with Specific Conditions includes at No (3) includes Economics activities which required Environmental Impact Assessment.

Exploration and production of minerals, manufacturing of iron, steel and minerals and operation in cultural heritage, archaeological and prominent geographical symbolical sites, etc., all require that it will be allowed subject to the need for Environmental Impact and Social Impact, or Environmental Impact, alone being carried out for initial study of environment.

Clause 37 of the Rules of the FIL states "In order to scrutinize accepted proposals sector by sector, a Proposal Review Group, composed of high ranking officers from the Environmental Conservation Department, is to be formed to perform preliminary scrutiny.

Section 47 states that the Commission shall scrutinise investment proposals in the following manners:

- Scrutinising remarks from the Ministry of Environmental Protection and Forestry on the protection measures of social and environmental impact.

Notification No 1/2013 of MIC dated 29th January, 2013 List of Economic Activities requiring environmental impact assessments:

- Exploration and production of minerals – Depending upon the business activity, to avoid environmental and social impacts, or to minimise environmental and social impacts, it will be allowed only after conducting initial study and assessment upon environmental and social impacts.

2.5 MINES LAW (1994) (MML) AND ASSOCIATED MINES RULES

The Mines Law (1994) aims to protect the environment from mining operations that may be detrimental to conservation of environmental quality.

Section (3) of the Mine Law states the objectives as follows:

- To carry out for the development of conservation, utilisation and research works of mineral resources;
- To protect the environmental conservation works that may have detrimental effects due to mining operations.

Under duties of the holder of Permit, it is stated that the holder of permit shall comply with the rules prescribed under this Law in respect of the following matters:

- Making provisions for safety and the prevention of accidents in a mine and their implementation;

- Making and implementation of plans relating to the welfare, health, sanitation and discipline of personnel and workers in a mine;
- Making provisions for the environmental conservation works that may have detrimental effects due to mining operation;
- Reporting of accidents, loss of life and bodily injury received due to such accidents in the mine; and
- Submission to the inspection of the Chief Inspector and inspectors[10].

Rules 69 to 73 govern the rights of utilisation of land and water for mineral production which includes the provisions of the responsibility of the mineral permit holder so that there is no pollution of the environment due to the use of land and water.

The holder of a mineral exploration permit or a mineral production permit must backfill or otherwise make safe bore holes, excavations, surface of land damaged during the course of underground mining operations to the satisfaction of the Ministry or the Department. The holder must also establish forest plantations or pay compensation to the Ministry of Forestry, if trees were cut and cleared for mineral exploration or mineral production within a forest land or in a land area covered with forests.

In disposing of liquids, wastes, tailings and fumes which have resulted from mineral production, the holder of a mineral production permit must undertake laboratory tests as may be necessary for the prevention of pollution of water, air and land in the environment and for the safety of living beings. If toxic materials are found in the waste products, which are harmful to living beings, degradation shall be made by chemical means and systematic disposal shall be made only when it is assured that there is no danger.

The holder of a permit for mineral production within an area under the Ministry's administrative control or which does not lie within the Mineral Reserve Area or Gemstone Tract, shall carry out such production only after co-ordinating and receiving agreement from the individual or organisation having the right of cultivation, right of possession, right of use and occupancy, beneficial enjoyment, right of succession or transfer of the said land[11].

Chapter XXI of the Myanmar Mining Rules (MMR) describes "making provisions to prevent detrimental effects due to mining operations on the environmental conservation works". The requirements include:

[10] MML Section 13
[11] MML Section 14

- Backfilling or making safe bore holes, excavations or surface of the land damaged during the course of underground mining[12]; and
- Undertaking laboratory tests, as necessary, to prevent pollution of water, air and land[13].

2.6 ENVIRONMENTAL POLICIES

A national environmental policy was drafted by the NCEA in 1994. The National Environment Policy is as follows:

"To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources."

The objective of Myanmar's environmental policy is aimed at achieving harmony and balance between people, the environment, heritage and natural resources through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilise its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations.

The development of the environmental policy was followed by the drafting of 'Myanmar Agenda 21' in 1997, which follows a UN framework for a multi-pronged approach to sustainable development. The Myanmar Agenda 21 recognises the need for Environmental Impact Assessments. Myanmar, in its Agenda 21, calls for integrated management of natural resources and provides a blueprint for achieving sustainable development.

The ECL provides more institutional space to regulate environmental quality and conduct EIA's and SIA's for infrastructure and investment projects funded by the government and private sector.

[12] MML Section 105
[13] MML Section 106

2.7 MYANMAR INVESTMENT COMMISSION (MIC)

The MIC issued a Notification on 30 June 1994 on Protection of Environment stating that:

1. The Myanmar Investment Commission, at its meeting 8/94 held on 17 June 1994 has resolved that all projects established with the permission of the Commission shall be responsible for the preservation of the environment at and around the area of the project site. The enterprises are entirely responsible that they shall be able to control pollution or air, water and land, and other environmental degradation, and that they can keep the project site environmentally friendly.
2. Consequently, it is hereby notified that treatment plant, industrial waste water treatment plant and other pollution control procedures should be promptly implemented and abide with the sanitary and hygienic rules and regulations set by the authorities concerned.
3. In the future proposals that are to be submitted to the Commission, either under the Union of Myanmar Foreign Investment Law or the Myanmar Citizens Investment Law, shall incorporate the provision in their contracts that they shall undertake proper sewage and industrial wastewater treatment systems and other environmental control systems. The system so used shall be in accordance with the rules and regulations specified by the respective development committees and local authorities.

3. INTERNATIONAL GUIDELINES AND STANDARDS

3.1 GENERAL

In addition to adherence with applicable local legal obligations, Letpadaung is committed to conducting project mine closure and reclamation activities in line with international good practices. Relevant standards and guidelines consulted during the development of the Letpadaung Concept Closure Plan are outlined below.

3.2 INTERNATIONAL FINANCE CORPORATION GUIDELINES

3.2.1 General

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines relevant to the Letpadaung project comprise general environmental guidelines as well as mining-specific guidelines.

3.2.2 Environmental

IFC EHS General Environmental Guidelines[14] include a number of sections relevant to closure and rehabilitation of the site. These sections include:

- Waste Water and Ambient Water Quality.
- Waste Management.

Relevant best practice recommendations from these guidelines include:

- Plan and implement the segregation of liquid effluents in order to limit the volume of water requiring specialized treatment.
- Assess compliance of wastewater discharges with the applicable discharge standards.
- Establish waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences.
- Where waste cannot be recovered or reused, it should be treated, destroyed, and disposed of in an environmentally sound manner.
- Where offsite disposal in not possible, facilities should be constructed that will provide for the environmental sound long-term storage of wastes on-site.

[14] Environmental Health & Safety Guidelines: Environmental, International Finance Corporation

3.2.3 Mining

IFC EHS Guidelines for Mining[15] include the following best practice recommendations for mine closure:

- The Mine Reclamation and Closure Plan should incorporate both physical rehabilitation and socio-economic considerations.
- Preparation of a Mine Reclamation and Closure Plan in draft form prior to the start of production with annual updates during the mine life.
- Finalise the plan during the last five years of forecasted operations.
- The Mine Reclamation and Closure Plan will be designed so that:
  - Future public health and safety are not compromised;
  - The after-use of the site is beneficial and sustainable to the affected communities in the long term; and
  - Adverse socio-economic impacts are minimised and socio-economic benefits are maximised.

The Mine Reclamation and Closure Plan will clearly identify allocated and sustainable funding sources to implement closure at any stage in the mine life including the provision for early or temporary closure. Funding should be by either cash accrual or a financial guarantee.

Closure and post closure plans will include appropriate aftercare and continued monitoring of the site, pollutant emissions, and related potential impacts. The duration of post closure monitoring will be defined on a risk basis. However, site conditions typically require a minimum period of five years after closure or longer.

3.3 CHINESE STANDARDS

In preparing this closure plan, reference has been made to the Code for Waste Dump Design of Nonferrous Metal Mines[16]. The standard is assumed to apply to waste dumps and heap leach pads as well as application of general principles to overall site closure. Amongst others, it requires that:

- The reclamation plan for the waste dump be prepared at the same time as the waste disposal plan;

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[15] IFC (2007). Environmental Health & Safety Guidelines for Mining, International Finance Corporation, 10 December 2007

[16] Code for Waste Dump Design of Nonferrous Metal Mines (2007). National Standard of the People's Republic of China, GB 504421-2007. Implemented 01 October 2007.

- The final landform be in keeping with the local natural environment with vegetation coverage no less than the original coverage;
- The end land use of arable or agricultural land be the main priority;
- Slopes be slackened appropriately for stability, development and utilisation of the site;
- Reclamation be completed within three years of completion of waste disposal (one year for engineering and two years for habitat/vegetation establishment);
- The design shall include measures to prevent waste residue, dust and water pollution influencing the environment; and
- Waste dumps containing heavy metals, sulfides or other toxic soluble waste shall have waterproof and leakproof measures to prevent release of contaminants to the environment.

3.4 EUROPEAN COMMISSION BEST AVAILABLE TECHNIQUES (BAT)

The European Commission Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities (January 2009) provides details of current good practice relating to waste rock management. Recommendations relevant to the Letpadaung project include:

- The site should be designed for closure. This implies that the closure of the site is taken into account in the feasibility study of a new mine site and is then continuously monitored and updated during the life cycle of the mine.
- Closure costs are included in the assessment of alternatives.
- Facilities are designed to facilitate premature closure if necessary.
- After-care design should minimise the need for active management.
- Life-cycle management: A reduction of the risk of any failures can be assisted by a commitment of the operator to the adequate and rigorous application of appropriate available engineering techniques for the design, operation and closure of tailings and waste rock management facilities over the entire period of their operating life. Some tools elemental to good engineering are the establishment of an environmental baseline, the characterisation of tailings and waste-rock, the use of dam safety manuals and audits, as well as applying planning for closure from the outset.
- Upon closure, ARD generating .waste-rock heaps should be covered with engineered dry covers that aim to prevent ARD generation.

- Progressive restoration/revegetation: Heaps and dams are often restored/revegetated during operation. Amongst other advantages, this allows a shorter closure period.
- Development of a monitoring plan that includes inspections and audits.

3.5 WESTERN AUSTRALIA MINE CLOSURE GUIDELINES

The Guidelines for Preparing Mine Closure Plans, produced by the Government of Western Australia (June 2011) provide further good practice guidance. Recommendations include:

- At all stages, from the project approval stage onwards, the Mine Closure Plan should demonstrate that ecologically sustainable mine closure can be achieved consistent with agreed post-mining outcomes and land uses, and without unacceptable liability.
- Planning for mine closure should be fully integrated in the life of mine planning, and should start as early as possible and continue through to final closure and relinquishment. For new projects, closure planning should start in the project feasibility stage (before project approvals).
- Mine closure plans must be site-specific. Generic "off-the-shelf" closure plans will not be acceptable.
- Closure planning should be risk-based taking into account results of materials characterisation, data on the local environmental and climatic conditions, and consideration of potential impacts through contaminant pathways and environmental receptors.
- Consultation should take place between proponents and stakeholders which should include acknowledging and responding to stakeholder's concerns. Information from consultation is central to closure planning and risk management.
- Post-mining land uses should be identified and agreed upon through consultation before approval of new projects. This should take into account the operational life span of the project, and should include consideration of opportunities to improve management outcomes of the wider environmental setting and landscape, and possibilities for multiple land uses. For existing mining projects, post-mining land uses should be agreed as soon as practicable.
- Characterisation of materials needs to be carried out prior to project approval to a sufficient level of detail to develop a workable closure plan. This is fundamental to effective closure planning. Characterisation of materials should

include the identification of materials with potential to produce acid, metalliferous or saline drainage, dispersive materials, fibrous and asbestiform materials, and radioactive materials, as well as benign materials intended for use in mine rehabilitation activities.

- Closure planning should be based on adaptive management. Closure plans should identify relevant experience and research, and how lessons learned from these are to be applied.
- Closure plans should demonstrate that appropriate systems for closure performance monitoring and maintenance, and for record keeping and management are in place.

4. CLOSURE CONSIDERATIONS

4.1 DEFINITIONS

For the purposes of this closure plan, the following terminology has been adopted:

CLOSURE – Life of mine process which culminates in tenement relinquishment. It includes decommissioning and rehabilitation.

DECOMMISSIONING – The process that begins near, or at, the cessation of mineral production and ends with the removal of all unwanted infrastructure and services.

REHABILITATION – The return of disturbed land to a stable, productive, and self-sustaining condition.

RELINQUISHMENT – Formal approval by the regulating authority that completion criteria have been achieved.

4.2 CLOSURE PRINCIPLES

Current good mining practice suggests that mine planning should be undertaken with mine closure at the forefront of consideration. Some key principles and elements related to mine closure include:

- Integrate sustainable development considerations within the corporate decision-making process,
- Plan, design, operate and close operations that enhance sustainable development;
- Implement risk management strategies based on valid data and sound science,
- Consult with interested and affected parties in the identification, assessment and management of all social, health, safety, environmental and economic impacts associated with closure activities, and
- Inform potentially affected parties of significant risks from mining, minerals and metals operations and of the measures that will be taken to manage potential closure risks effectively;
- Seek continual improvement in environmental performance,
  - Assess the positive, negative, indirect and cumulative impacts of new projects from exploration through closure,
  - Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses, and
  - Design and plan all operations so that adequate resources are available to meet closure requirements of operations;

- Contribute to the social, economic and institutional development of the communities in which the project operates,
- Contribute to community development from project development through closure in collaboration with host communities and their representatives; and,
- Implement effective and transparent engagement, communications and independently verified reporting arrangements with stakeholders.

4.3 SHORT-TERM OBJECTIVES

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

4.4 LONG-TERM OBJECTIVES

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;

- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;
- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

As part of the closure plans, a set of rehabilitation standards will be developed and agreed with the relevant authorities, which when achieved will demonstrate successful rehabilitation. They will be inclusive of legislative requirement, recognitions of final land use requirement and quantified through consultation with relevant stakeholders.

4.5 SOCIAL CONSIDERATIONS

During development of the closure plan, consideration should be given to the impact that the scheme will have on the local population. Issues to be addressed include (DITR, 2006b):

- Ensuring future public health and safety of the community is not compromised;
- An early and effective communication strategy should be established and the community engaged throughout the life of the operation, including through decommissioning and closure;
- Community development should include strategies for sustaining the socio-economic state of the community without the support of the mine;
- Develop capacity to maintain certain infrastructure services and facilities for future community or local government ownership or as part of arising business development opportunities;

- Provide appropriate skills transfer and employment opportunities through the development of local business enterprises;
- Community development should be driven by the needs of the community with the aim of contributing to the building of the long-term strength of community viability; and
- Develop the formal and informal processes, systems, structures and relationships within the community that actively supports the capacity of current and future generations to create a range of healthy and liveable communities.

It should be noted that consultations have not yet commenced but will be undertaken in later stages of the feasibility design. The concept closure plan presented here provides an engineered solution for land use that has been adopted on similar schemes elsewhere. Refinement of the design will be completed following the consultation process.

4.6 PRE-CLOSURE STUDIES AND CONSULTATIONS

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

4.7 DEVELOPMENT OF THE CLOSURE PLAN

A dynamic rehabilitation plan will be developed which has the flexibility to evolve as results from investigations, research, on-site trials and detailed mine planning become available. The development schedule for the closure plan will consist of the following stages:

1. The Conceptual Closure Plan will be prepared during the design stage (this report). This will allow integration with the design concepts and ensure that the design and operation of the site are compatible with the closure plan.
2. After commissioning the Detailed Closure Plan will be developed which incorporates the following:

a) A closure plan for each specific area / type of facility and structure on site.

b) Rehabilitation completion standards for approval with the regulators.

c) Testing program for assessment of short term and long term physical and chemical stability of waste dump and heap leach materials.

d) Rehabilitation trials to assess the viability of the closure concept plan.

e) Progressive rehabilitation plans for areas of the site which are no longer required for the ongoing operation.

3. During mine operation the closure plan will be updated every five years based on the results of the testwork programme and the changes in the operation and mine planning.

4. A minimum of five years before closure of the mine, a Final Closure Plan will be developed and approved with the regulators.

Key activities that will be undertaken to develop the Plan include:

- **Options workshops**: to identify closure options and develop a strategy to identify and develop the preferred closure option taking into account social, environmental and economic implications;
- **Risk assessment workshops**: to identify risks associated with the preferred closure option(s) and to develop a mitigation programme to manage risks to acceptable levels;
- **Closure cost estimation**: to develop an estimate of mine closure costs, including the construction, demobilisation, demolition, removal and remediation of all plant facilities as well as all other ongoing remediation activities.

An outline of the level of detail to be included in the closure plan in relation to the time before closure works commence is provided in Table 4.1 (Government of WA Guidelines for Closure Plans).

Table 4.1: Anticipated level of closure detail

Life of Mine	Post-mining Land use	Identification and Management of Key Environmental Issues	Closure Outcomes	Closure Costing	Closure Implementation and Monitoring Plans
Long term (25+ years)	Provisional targets unless agreed to by all key stakeholders as being final	High risk components completed	Indicative except for high risk operations	Indicative	Preliminary except for high risk operations
Medium term (10 to 25 years)	Well advanced	Completed	Well advanced	Increased accuracy	Well advanced
Short term (Up to 10 years)	Well advanced to Completed	Completed	Well advanced to Completed	Accurate	Completed
Existing operations	Determined on a case by case basis depending on mine life and risk	Completed	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk

5. CONCEPTUAL CLOSURE DESIGN

5.1 OVERVIEW

The following sections describe the conceptual design for the key physical elements of the mine site. The closure concepts for each component are based on the best engineering interpretation of the data available currently with verification of the assumptions to be part of the ongoing closure plan testing program.

A closure land-use plan is provided as Figure 5.1 which shows the principal mine areas and proposed final land-uses.

5.2 TOPSOIL RECOVERY

As part of the site clearance and preparation prior to construction of the mine, topsoil and other suitable subsoils will be recovered from all areas to be disturbed with sufficient volume recovery to ensure effective rehabilitation of the site on closure. The soils will be stockpiled at various locations around the site and will be protected throughout the mine life. The recovery and storage of the soils will conserve valuable nutrients and enhance the future viability of native seed and micro-organisms. As such efficient recovery and management of the resource is critical to rehabilitation.

Initial assessments of ground conditions suggest that some 7 Mm^3 of topsoil and subsoil can be recovered from the disturbed footprint of the mine with an average thickness of 400 mm. The stockpiles will have a maximum height of 4 m which is a balance between optimising storage volumes whilst trying to maintain low stockpile heights which assists with preserving viability of the soils. Preliminary stockpile locations are shown on Figure 5.1.

5.3 OPEN PIT

5.3.1 General

The key factor in closure of the open pit is the maintenance of the safety of the public and the environment.

The key risks are:

- Steep sloping side walls of the pit;
- Collapse of sides and creation of zones of instability; and
- Accumulation of water in the pit which will generally be of poor water quality due to acid rock drainage and accumulation of metals and salts in the water associated with evaporation and/or changes in water chemistry.

The closure design will ensure that the risk of harm to humans, fauna or domestic animals is reduced as far as reasonably practicable. Measures will also be included to reduce the likelihood of contamination of groundwater or surface water by the mine pit after closure.

5.3.2 Post-Closure Land-Use

The mine pit will be partially backfilled during the later stages of operation as waste rock from one section of the pit is placed in other sections where resources have been fully exploited. It is not practical to completely backfill the pit and a void will be left on completion of mining operations.

Due to the potential for acid generation in the pit walls and waste rock within the pit, it is proposed that the pit be flooded to reduce oxygen exposure to the potentially reactive rock.

The mine pit area will not have a post-closure use other than to act as a sump for potentially contaminated contact surface run-off from the site. Some non-contaminated water from the waste dump areas may also be routed to the pit in order to maintain pit lake levels sufficiently high to reduce acid generation in the base of the pit.

5.3.3 Decommissioning and Reclamation

On closure, all equipment will be removed from the Open Pit and any areas with a high risk of ongoing instability will be backfilled and/or re-profiled. Access to the pit will be blocked at the access ramps.

The dewatering system will be decommissioned and the Open Pit will be allowed to fill with inflows from direct rainfall, runoff from pit walls, groundwater inflows, and surface water inflows from the upslope catchment areas which will include potentially contaminated contact water from the waste dumps.

An abandonment bund wall, constructed of NAF mine waste to a minimum height of 2 m, will be constructed around the full pit perimeter outside of the area of potential future instability in order to restrict access to the pit. Warnings signs will also be installed.

5.3.4 Water Management

The pit lake will be managed through a combination of adjusting surface run-off inflows and evaporation areas to ensure acid-generating materials are continuously below the waterline and not subject to oxidation whilst also maintaining the pit lake water levels below the pit rim baseline groundwater level to reduce seepage to local groundwater.

Surface water discharges from the Open Pit will be prevented in perpetuity unless the water is demonstrated to be consistently of a suitable quality for release.

Pit Lake water quality will be monitored after closure, and any requirements for passive or active water treatment of Pit Lake inflows will be determined according to water use objectives.

5.4 WASTE ROCK DUMPS

5.4.1 General

The waste rock dumps (WRDs) will be constructed during operations to provide structures which are safe and stable whilst also providing landforms that are appropriate for rehabilitation and the final land use. Due to the significant quantities of PAF waste that will be produced from the pit, the dumps will be constructed to encapsulate the PAF waste concurrent with mining and also allow progressive rehabilitation of the dumps.

It is noted that geochemistry evaluations have not yet been fully completed and therefore the concepts presented herewith are based on the available data which suggest a significant potential for acid generation and metals leaching.

5.4.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the WRDs compared to the surrounding topography combined with minimal flat areas and low rainfall experienced in the area are unlikely to make the WRDs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.4.3 Decommissioning and Reclamation

The waste rock dumps will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H. Some reprofiling may be required to reduce slope angles to enable effective rehabilitation and for the slopes to be grazed by animals. This will be confirmed during detailed design. The outer walls will be finished with a cover system (described below).

The top of the waste rock dump will be shaped to shed water to drainage channels located on the final top surface that direct flows to drop drains. The benches of the waste rock dump will be graded to direct water also to the drop drains. The drop drains will be lined with heavy fresh benign NAF rock with drain stop boards constructed every five metres down the slope to control the flow speed of the water down the slope. At

the base of each drop drain an energy dissipater and sediment trap with the capacity to hold runoff from a 1 in 10 year storm of 1 hour duration will be constructed to control flows and contain runoff prior to release to the general site surface water management system.

After all the batter slopes have been covered, they should be seeded/planted with a mixture of local grass seed and the seeds or plants of shrubs and trees local to the area.

The rehabilitation of waste rock dump batters should occur progressively during the mining process, after each berm is established and the outer walls shaped, to enable the success of the rehabilitation techniques to be reviewed and refined. This will allow a fully developed and assured method of revegetation and batter treatment, as well as drainage structures, to be developed and minimise the level of maintenance required after closure works are complete.

5.4.4 Cover System

Cover systems are an integral design component for the successful reclamation and closure of the Project. At the surface of the cover system, direct precipitation will either run off the cover, be removed through evapotranspiration or infiltrate into the active zone. Water that infiltrates is typically stored in the active zone and can exfiltrate to the surface and evaporate. A portion of the water that infiltrates can also percolate into the underlying waste, which is intended to be reduced by the placement of the cover system. The objectives of the cover systems considered for the Project include:

- Physical stabilization to provide dust and erosion control, particularly wind and water erosion of waste materials, and to act as a barrier to prevent direct contact of the waste by flora and fauna
- Chemical stabilization through control of oxygen or water ingress; and contaminant release control through reduced infiltration, and
- Meeting land use objectives and other societal values by providing a growth medium for establishment of sustainable vegetation; and reclaiming the area for post-closure land uses.

A combination of cover system efficiency and saturation conditions can help to reduce oxygen ingress and the subsequent oxidization of waste materials which typically results in ARD production.

The proposed cover system concept aims to maximize use of the climate, cover material characteristics, cover material availability, hydrogeologic setting and waste

material physical properties to minimize potential effects related to the waste material chemical properties.

In consideration of the anticipated chemistry of the waste rock combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses, a low Infiltration cover system (50-90 % reduction of net infiltration) is proposed for the WRDs in order to reduce the risk of acid generation in the waste dumps and the associated release of low-pH leachate to the environment. Release of solubilised heavy metals will also be reduced.

A low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-8} m/s would be required to construct a cover system capable of reducing net infiltration to approximately 50 to 90% of the infiltration rate expected for a bare surface. Considering the characteristics and availability of materials on site, the cover system would be constructed from a minimum 1 m thick compacted low permeability soil layer, overlain by a 2 m thick gravelly store and release layer, and finished with a re-vegetated subsoil/topsoil layer some 400 mm thick comprising 250 mm of subsoil over which 150 mm of topsoil is place. A typical section through the cover system is provided on Figure 5.2.

Additionally, prior to placement of the cover system, some localised grading may be required to promote positive surface drainage thereby minimizing the likelihood of standing water and saturation of the materials in the cover system. Sloped areas must be protected from surface erosion through re-vegetation and development of drainage structures, to reduce infiltration and to prevent breakthrough of flow into the underlying tailings.

It is anticipated that the low permeability materials and the store and release layer will be sourced from overburden strip from the mine pit during operations. Alternatively borrow areas may need to be established if insufficient material is available locally and/or mine scheduling isn't compatible with the waste dump construction.

5.4.5 Water Management

A surface water management system will be progressively established concurrent to waste dump development. Major flowpaths are shown on Figure 5.1. Provision is made in the design for separate systems to manage non-contaminated contact water and potentially contaminated contact water. Non-contaminated contact water will be suitable for release into watercourses downstream of the site following basic settling to reduce suspended sediment loads. Potentially contaminated contact water will be directed initially to the mine pit dewatering system and, once the pit is

decommissioned, the water will flow to the pit lake to prevent release of the potentially-contaminated water to the wider environment.

Runoff and drainage water from the waste dumps will be analysed during the closure phase to determine the water quality characteristics. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated, while seepage from the waste rock may be of poorer quality. If water treatment is found to be necessary, a suitably designed passive water treatment wetland system will be designed to enable improvement of water quality to be undertaken prior to release into the environment.

5.4.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.5 HEAP LEACH PADS

5.5.1 General

The heap leach pads (HLPs) will contain acid-generating material as well as residual acidity from the leaching process. The HLPs must be closed and rehabilitated in such a way that the waste is not exposed to the environment and that infiltration of water is reduced to a level where long-term leachate generation is negligible.

The HLPs should also be reshaped to provide landforms that are stable in the long-term and do not pose a hazard to personnel undertaking rehabilitation or the local population post-closure.

5.5.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the HLPs compared to the surrounding topography combined with the low rainfall experienced in the area are unlikely to make the HLPs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.5.3 Decommissioning and Reclamation

Once all viable resource has been recovered from the HLPs, the pads are to be flushed with fresh water to reduce the amount of free acid in the heaps.

The principal aspects of the outline HLP closure are:

- Perimeter slopes to be reshaped to a grade that ensures long-term stability and that is appropriate for machinery to safely operate during the rehabilitation and future maintenance works.
- Surplus material is to be placed as fill between HLP 1 and 2 to infill the valley and create a single large landform for rehabilitation.
- Final top surface to be reshaped to provide positive drainage to the closure surface water management system.
- Placement of an appropriate cover system to reduce infiltration into the HLPs and provide a growing medium suitable for rehabilitation.
- Revegetation of the closure surface.

The reshaping and filling exercise is illustrated on Figure 5.3.

5.5.4 Cover System

In consideration of the anticipated chemistry of the HLP material on closure, combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses very low infiltration cover systems (>90 % reduction of net infiltration) are proposed for the HLPs. Reducing infiltration into the heaps will reduce further acid generation and quantities of leachate produced.

A very low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-9} m/s would be required to construct a cover system capable of reducing net infiltration to greater than 90% of the infiltration rate to be expected for a bare waste rock surface.

The main elements of the cover will be:

- Low permeability soil (1 m thick) or synthetic liner to prevent ingress of water;
- Protective fill layer (0.6 to 1.5 m thick depending on liner system adopted) which may also act as ‘store and release’ capping;
- Topsoil to allow revegetation (approximately 400 mm).

The cover options are illustrated in Figure 5.2. Studies into the most appropriate cover system shall be undertaken during the operational phase of the mine. Considerations in the studies will include availability of suitable fill materials.

5.5.5 Water Management

The HLPs should be reshaped to positively drain all run-off to perimeter channels that convey the non-contaminated contact water to the site surface water management system with subsequent release in to watercourses downstream of the site.

Any leachate generated from the heaps will be routed into a closed (potentially-contaminated contact water) system for treatment prior to release. During initial drawdown, the leachate will be passed through the process plant to ensure that the water quality is suitable for discharge. Once the drawdown phase is complete and leachate quantity and quality have reduced to manageable levels, leachate will be passed through passive treatment systems to render the water suitable for release.

The passive treatment systems will be developed during operations when leachate chemistry is better understood. Possible options, which may be combined, include sediment control, wetlands, or limestone-filled ‘polishing’ channels.

5.5.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with grasses and small native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.6 PLANT, EQUIPMENT AND INFRASTRUCTURE

5.6.1 General

All plant, equipment and infrastructure on the site shall be recovered, removed and re-used wherever possible. The primary objective is to ensure the site is safe and does not generate hazards for the community.

As a general rule, where facilities are of no use to the community:

- All structures shall be removed;
- All waste shall be buried at least three metres below a finished surface;
- Concrete should be broken up and buried;
- All batters should be flattened to at least a 1V:4H slope for public safety;
- All areas should be ripped, scarified, topsoiled and then seeded to encourage a vegetated cover, unless otherwise agreed with the local community.

5.6.2 Post-Closure Land-Use

Buildings on the site should be made available to the local community, if they have no value and cannot be economically removed and re-used elsewhere. Such opportunities can assist communities to adjust the socio-economic effects of closure and allow the development of new enterprises and provision of alternative local employment.

Where practicable, areas that are rehabilitated will be returned to the pre-mine land use. Discussions may be held with regulatory agencies and stakeholders to determine

the potential to create small water storage structures to improve water availability for post-closure land use in agriculture and livestock rearing.

The future of any water supply bores associated with the project should be discussed with local authorities and the community. The presence of a water supply may provide much needed infrastructure to the community as well as providing commercial and industrial opportunities which are not currently available, due to the cost of establishing such facilities. Transfer of these assets to the community may also offset some of the socio-economic losses that arise due to closure of the mine.

5.6.3 Decommissioning and Reclamation

All process tanks, pipes and water lines should be flushed free of any solids or residual fluids prior to removal. Materials that constituted these facilities should be recovered for reuse or recycling or otherwise buried at least three (3) metres deep within the site. Opportunities for burial may arise in some of the process water ponds to be closed.

All fixed and mobile equipment with marketable value will be removed from site and sold. Equipment that cannot be sold or is deemed to be hazardous will be disposed of in an appropriate manner.

Fuels and lubricants will be required during the closure phase. Additional fuels will only be provided on an as-needed basis to reduce the materials remaining on site. Fuels remaining at the end of the active closure phase will be returned to the original supplier or possibly sold to a third party user. Fuel storage tanks and associated pipework should be recovered for reuse or recycling or otherwise be disposed of as hazardous waste.

Unused explosives and detonation devices stored on site will be checked for condition and either returned to the supplier for credit, shipped to another third party user, or destroyed through appropriate procedures. In all cases the explosives will be handled, transported and disposed of in compliance with the appropriate legislation. The explosives magazines will be returned to the supplier or to a third party.

During the initial closure stage, power generation requirements will be reduced and only those generators required for on-going activities will remain operational. Excess generators will be removed from the power plant and poles and distribution lines will be salvaged or buried in a landfill. At the end of the closure phase when the mine no longer has any power requirements, the remaining generators will be removed from the site and the remaining poles distribution lines will be salvaged or buried in the landfill.

Roads required for access during the rehabilitation phase and for post-closure monitoring and maintenance will be left in place. After these roads are no longer

required for Project use, they will be left in place for use by local communities. Site roads not needed for the closure works will be broken up, resoiled and re-vegetated unless the local communities would prefer that the roads are left in place.

Where buildings and structures are to be removed, they should be demolished with reusable or recyclable waste removed from site. Rubble and other inert waste can be buried in designated locations at least three (3) metres below final ground surface. Any contaminated soils will be treated and disposed of appropriately. Hazardous waste is to be disposed of in an on-site hazardous waste facility.

Reuse of items, such as HDPE pipe, should be considered as part of the closure plan. HDPE pipe, for example, can be used as fence posts for barricading areas with public safety issues or used as posts for fencing associated with local cropping and grazing activities.

5.6.4 Water Management

Following demolition, the disturbed areas will be shaped to prevent ponding of water and to provide positive drainage into the site surface water management system.

5.6.5 Waste Management

Reusable or recyclable waste should be removed from site. Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.6.6 Rehabilitation

Disturbed areas will be reshaped for drainage, topsoil applied and will then be re-vegetated using grass and shrub species native to the region to encourage vegetation to re-establish in the area.

5.7 PROCESS AND WASTE WATER PONDS

5.7.1 General

There are a number of ponds located to the east and south east of the site. These include HLP stormwater ponds, process water ponds and surface water stormwater ponds. It is proposed that these ponds be used on closure for treatment of run-off and storage of wastes.

5.7.2 Post-Closure Land-Use

Uses of the former ponds include:

- Settling ponds for uncontaminated surface run-off water to reduce sediment loads prior to discharge off site.

- Wetlands and/or polishing ponds for the passive treatment of water with low levels of contamination prior to discharge.
- HDPE-lined ponds to be utilised for the construction of a hazardous waste landfill to store decommission wastes.

Any pond areas not required for the above uses should be infilled and returned to agricultural use.

5.7.3 Decommissioning and Reclamation

Process and waste water ponds shall be completely drained until only residual solids/sludge are present.

Once drained, any residual sludge is to be sampled and tested. Sludges which are considered 'hazardous' should be disposed of in the site hazardous waste landfill. Inert or non-hazardous wastes will either be disposed of in an appropriate storage area or, if physical and chemical characteristics are suitable, be used as fill in the reclamation process.

The pond base will then be prepared according to the final end use. Any HDPE liner, or similar, where not required will be removed and disposed of. Clay liners for ponds will be retained unless the area is to be used for agriculture in which case the liner will be ripped prior to backfilling to promote through drainage.

Where ponds are to be retained as ponds or wetlands, hydraulic control structures will be built to control flows in and out as well as retained water levels.

5.7.4 Water Management

The former pond areas will be used to manage run-off water from the site with collection channels routed to the pond areas. Hydraulic control structures will be constructed as necessary to maintain or prevent ponding of water.

5.7.5 Waste Management

Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.7.6 Rehabilitation

Disturbed areas will be reshaped where necessary for drainage, topsoil applied and will then be re-vegetated. Wetland areas will either be re-vegetated with reed beds or, if water chemistry is acceptable, be provided to the local community as rice paddies. Areas designated for agriculture should be handed over to the local community to vegetate.

5.8 SURFACE WATER MANAGEMENT

5.8.1 Routing

At closure, contaminated mine contact water will continue to be allowed to drain to the open pit, and non-contaminated water will be directed to the surrounding natural aquatic environment. Diversion and collection ditches that are no longer required will be decommissioned (backfilled) and re-vegetated. In general, collection ponds accepting non-contact water will be reclaimed through re-vegetation and allowed to collect and store water for use by the local communities. Collection ponds accepting mine contact water will not be decommissioned directly after closure, and will continue to function to direct mine-contact water into the Pit.

The operational surface water management system will be adjusted to convey flows generated by the closure land forms and land uses.

It is envisaged that the majority of run-off generated post closure will be uncontaminated and will only require settlement to reduce suspended loads prior to discharge. It is the intention that as much water as possible is returned to the surrounding environment. However there is provision in the design to direct some of the run-off water to the open pit. A pit lake will need to be maintained to reduce acid generation in the pit walls and buried waste. If the detailed hydrogeological modelling, and/or experience on site, shows that recharge of the pit lake is insufficient to maintain appropriate water levels then run-off from Waste Rock Dump 1 can be directed to the pit.

An outline design for surface water routing is provided on Figure 5.1.

5.8.2 Chemistry

It is envisaged that during initial stages of HLP drawdown, a substantial volume of contaminated leachate will still be produced by the heaps. The process plant, potentially with adaptions, will be used to treat this water until concentrations reach a level where other, less onerous, treatment options can be successfully adopted.

Runoff collected in the collection ponds will be analysed in the closure phase to determine if water quality characteristics meet applicable standards. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated. When water quality meets acceptable standards, the mine contact collection ponds will be backfilled and re-vegetated.

Where surface run-off and/or leachate from areas such as the waste rock dumps and heap leach pads is not suitable for release then treatment systems should be implemented.

The first level of treatment is sedimentation through sedimentation ponds or wetland areas to reduce the suspended load. In many cases this is likely to be sufficient to improve the water to meet the relevant release criteria.

Water treatment methods used to eliminate or reduce acidity and heavy metals precipitation from impacted waters can be grouped into two types: (1) active and (2) passive treatment:

Active treatment involves neutralising acid-polluted waters with alkaline chemicals. However, the chemicals can be expensive and the treatment facility is expensive to construct and operate.

Passive treatment involves the construction of a treatment system that employs naturally occurring chemical and biological reactions that aid acid rock drainage treatment and which require little maintenance. Passive control measures include anoxic drains, limestone rock channels, alkaline recharges of groundwater, and the diversion of drainage through man-made wetlands or other settling structures.

There is also a possibility to combine active and passive treatment techniques (e.g. liming and constructed wetlands)

An evaluation of water chemistry, potential environmental impacts, and whether or not water treatment will be required will be undertaken as part of the ongoing closure planning during the mine life. If necessary the design will be updated to include additional water treatment.

5.9 WASTE MANAGEMENT

5.9.1 Waste Streams

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

Waste generated by the decommissioning and rehabilitation of the site will be one of three different categories of waste:

Inert Waste. This is waste which is neither chemically or biologically reactive and will not decompose. It includes concrete, bricks and uncontaminated sediment/sludge from stormwater ponds.

Non-Hazardous Waste. This is waste which is not inert but does not have properties that pose a substantial threat to public health or the environment (and therefore

classifies as hazardous waste). Types of waste will include plastic liner, plastic pipes, metals, and timber.

Hazardous Waste. This is waste that poses substantial or potential threats to public health or the environment by exhibiting one or four of the following properties:

i. Ignitability

ii. Reactivity

iii. Corrosivity

iv. Toxicity

Hazardous wastes are likely to include fuels, oils, contaminated soils and sludges, and components of equipment and machinery.

5.9.2 Hierarchy of Waste Management

Waste generated from the decommissioning activities will be managed to reduce the environmental impact. MWMCL will seek to treat the wastes in the following order of priorities:

i. Reuse

ii. Recycle

iii. Dispose

If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that landfills will be constructed on the site so that wastes are contained within the site boundary. Disposal options are discussed in more detail below.

5.9.3 Disposal Options

Two landfill facilities will be constructed to handle decommissioning wastes. An inert and non-hazardous facility will be constructed on the western side of Waste Rock Dump No. 3. The facility will be constructed in cells to separate different types of waste

and also to reduce the exposed tip head to a manageable size. The waste will be regularly covered with a soil cover to reduce dust generation. On completion the whole landfill will be capped with a 1 m thick low permeability soil cover, 2 m of store and release fill and finished with topsoil. The cover will be shaped to shed water.

The HDPE-lined base of the HLP stormwater pond will form the basis of the hazardous waste landfill. After draining and de-sludging, the HDPE liner will be inspected and repaired if necessary. Intermediate bund walls will be constructed to provide cells for different waste types, a leachate collection system will be installed and a second HDPE liner placed to provide double containment of the wastes.

As waste is placed, daily cover will be applied to reduce dust and minimise the risk of release of hazardous material to the environment. The landfill cover will comprise a very low permeability (HDPE or similar) cover to reduce infiltration and associated soil and topsoil cover. The landfill area will be revegetated with grass, fenced to restrict access and signage erected to warn the local population of the hazard.

Monitoring of the landfills will form part of the overall site monitoring programme with maintenance undertaken as necessary. It is envisaged that satisfactory closure and handover of the landfills will be one of the closure criteria adopted.

6. SOCIO-ECONOMIC INITIATIVES AT CLOSURE

The Mine Closure Management Plan will set out:

- Initiatives with local communities;
- Broader economic initiatives; and
- Plans to maximise local and regional opportunities at closure.

These initiatives will be developed during the mine life in consultation with the relevant stakeholders and local communities.

7. CLOSURE SCHEDULE

A detailed Closure Schedule will be developed during the mine life to manage the various stages of decommissioning and rehabilitation. The following summary schedule highlights the key areas of work anticipated:

Period	Activity
Yr 1 to 20	Stage 1 Mining Ongoing recovery of topsoil and rehabilitation materials from the disturbed footprint with construction and progressive rehabilitation of WRDs 1 to 3. Heap Leach Pads 1 and 2 in operation.
Yr 21 to 30	Stage 2 Mining Completion of WRD rehabilitation (Yr 23). Mine waste deposited in-pit. HLP 3 in operation.
Yr 31 to 35	Decommissioning and Rehabilitation Decommissioning of pit and ore recovery/processing infrastructure. Flushing of HLPs, installation of cover system and rehabilitation. Removal of copper recovery plant and conversion of waste water ponds to closure land-use.
Yr 36 to 40	Monitoring and Maintenance Ongoing performance monitoring of the site. Relinquishment of lease when closure criteria are achieved.

8. PROGRESSIVE CLOSURE AND REHABILITATION

Progressive restoration/revegetation during operation has the following advantages:

- Costs are spread over a longer period and may be recovered from mining revenues.
- Closure activities can be integrated into the daily operational activities of the mine.
- A shorter closure implementation period will result.
- Monitoring programmes are integrated into routine environmental management
- Techniques can be trialled and refined in localised areas with successful techniques can be incorporated into the final closure plan.
- Potential for better rehabilitation outcomes through the use of recently disturbed topsoil.
- Adverse environmental effects such as dust generation and contamination are minimised.
- The amount of time required for monitoring and maintenance post mine life is reduced.

The closure plan will be developed to enable progressive rehabilitation during the mine life. The principal focus will be rehabilitation of the waste rock dumps as capping and revegetation can be implemented throughout the WRD development. Because of in-pit disposal in Stage 2 of the mining plan, no further waste is to be placed in the dumps after about Year 20 allowing ample time to fully close the dumps during the operational period of the open pit.

9. CARE AND MAINTENANCE PLAN

Whilst design of the closure landforms will seek to reduce care and maintenance requirements, there will be ongoing aftercare liabilities for a number of years. A care and maintenance plan will be developed as part of the Closure Plan to ensure that closure objectives are achieved and so that efficient and relatively rapid rehabilitation can take place.

10. POST-CLOSURE MONITORING

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

The Monitoring Plan will include as a minimum:

- Physical stability monitoring:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps;
  - Heap leach pad;
  - Site security features.
- Chemical stability:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps; and
  - Heap leach pad.
- Water Quality:
  - Pit lake
  - Surface run-off
  - Leachate generation.
- Environmental impacts and anticipated mitigation, management measures and associated monitoring;
- Expected maintenance requirements;
- Monitoring of community initiatives;
- Monitoring of community health and safety;
- Monitoring of socio-economic activities; and
- Land resettlement, use and management.

11. PROVISIONS FOR EARLY OR TEMPORARY CLOSURE

Mining operations may be forced to close prematurely (referred to as *early* closure) or on care and maintenance (referred to as *temporary* closure).

In the event of *early* closure, the closure process should be accelerated. Immediate review of the pre-existing Mine Closure Plan to include a detailed Decommissioning Plan would be undertaken.

If a *temporary* closure is imminent, a detailed Care and Maintenance Plan would be prepared and implemented, based on the pre-existing Mine Closure Plan. The Care and Maintenance Plan would demonstrate that on-going environmental obligations will be met during the period of temporary closure.

12. RISKS AND OPPORTUNITIES

12.1 RISKS

In preparing this concept closure plan a number of risks were identified. As the closure plan is developed over the mine life these risks will be mitigated where possible. Potential risks at the current time include:

i. Insufficient topsoil and subsoil recovered from disturbed areas, and stored appropriately, for adequate rehabilitation of the disturbed areas.

ii. Insufficient low permeability soil sources on site for WRD liner system.

iii. Insufficient NAF waste and/or borrow sources within the site area for adequate cover depth to WRDs and HLPs.

iv. Restricted footprints for WRDs and HLPs resulting in steep slopes that are difficult and expensive to cover and revegetate.

v. Lack of agreement of closure objectives and end land-use between the operator, regulatory authorities and other relevant stakeholders.

vi. Difficult to manage acid and metals generation from WRDs and HLPs and thereby ensure protection of the downstream environment.

vii. Ongoing liabilities for MWMCL in regards to treatment of run-off prior to discharge if chemical concentrations in surface water remain higher than release criteria.

12.2 OPPORTUNITIES

With the development of the closure plan during the mine life, operational designs can be adapted to reduce the work required to close the site thereby saving time and cost on closure. Potential opportunities to be explored include:

i. Optimising HLP design, potentially through use of the valleys between the heaps, to reduce footprint, increase leaching efficient and adopt closure batter angles for operational purposes.

ii. Optimise HLP stacking and leaching to exhaust cells and allow progressive rehabilitation rather than operating all the HLPs simultaneously until closure.

iii. Optimise WRD design to adopt closure batter angles for operational purposes and reduce the volume of earthworks needed to achieve the necessary profiles on closure.

13. CLOSURE COSTS AND FUNDING PROVISION

13.1 GENERAL

Closure costs will be accounted for in line with the corporate accounting practices. Letpadaung will estimate mine closure costs throughout the operational life of the Project and will accrue mine closure cost provisions on an annual basis. This will ensure that the accrued closure provision meets the costs of a planned closure event, whether permanent or otherwise, at such time as it occurs. In the event of temporary and/or unplanned mine closure, Letpadaung will develop and agree with the applicable Myanmar regulatory authorities a care and maintenance regime, the costs for which would be covered by Letpadaung's own cash reserves and cash flows.

The closure cost estimate, as reported in the Project financial statements, will be updated annually during the operational life to reflect known developments, including scope changes, the effect of a further year's inflation, exchange rate differentials and new regulatory requirements. Closure cost estimation procedures will ensure that identified post-closure costs, whether ongoing or one-off, are realistically estimated and incorporated into the estimate.

Progressive rehabilitation will be built into operations plans and budgets and will also be subject to annual planning, budgeting and permitting.

13.2 COST PROVISIONS FOR FINAL MINE CLOSURE

Letpadaung's approach to the estimation and management of costs related to the final closure of the Letpadaung copper mine at the end of the operational mine life comprises the following:

- A provision for mine closure costs on Letpadaung's balance sheet to be determined in accordance with International Financial Reporting Standards including appropriate actuarial assumptions;
- A Letpadaung commitment to review, monitor and update mine closure plans and costs on a yearly basis (Annual Mine Closure Assessment¨). The Annual Mine Closure Assessment will provide (i) an ongoing estimated date of closure (Mine Closure Date) (ii) an update of the estimated cost of mine closure (Mine Closure Cost¨) and (iii) as presented further below an assessment of the date by which Letpadaung will start setting aside cash contributions against the Mine Closure Cost (Closure Contribution Date);
  - The Closure Contribution Date will be the earlier of (i) 7 years before the Mine Closure Date and (ii) the date on which Letpadaung forecasts

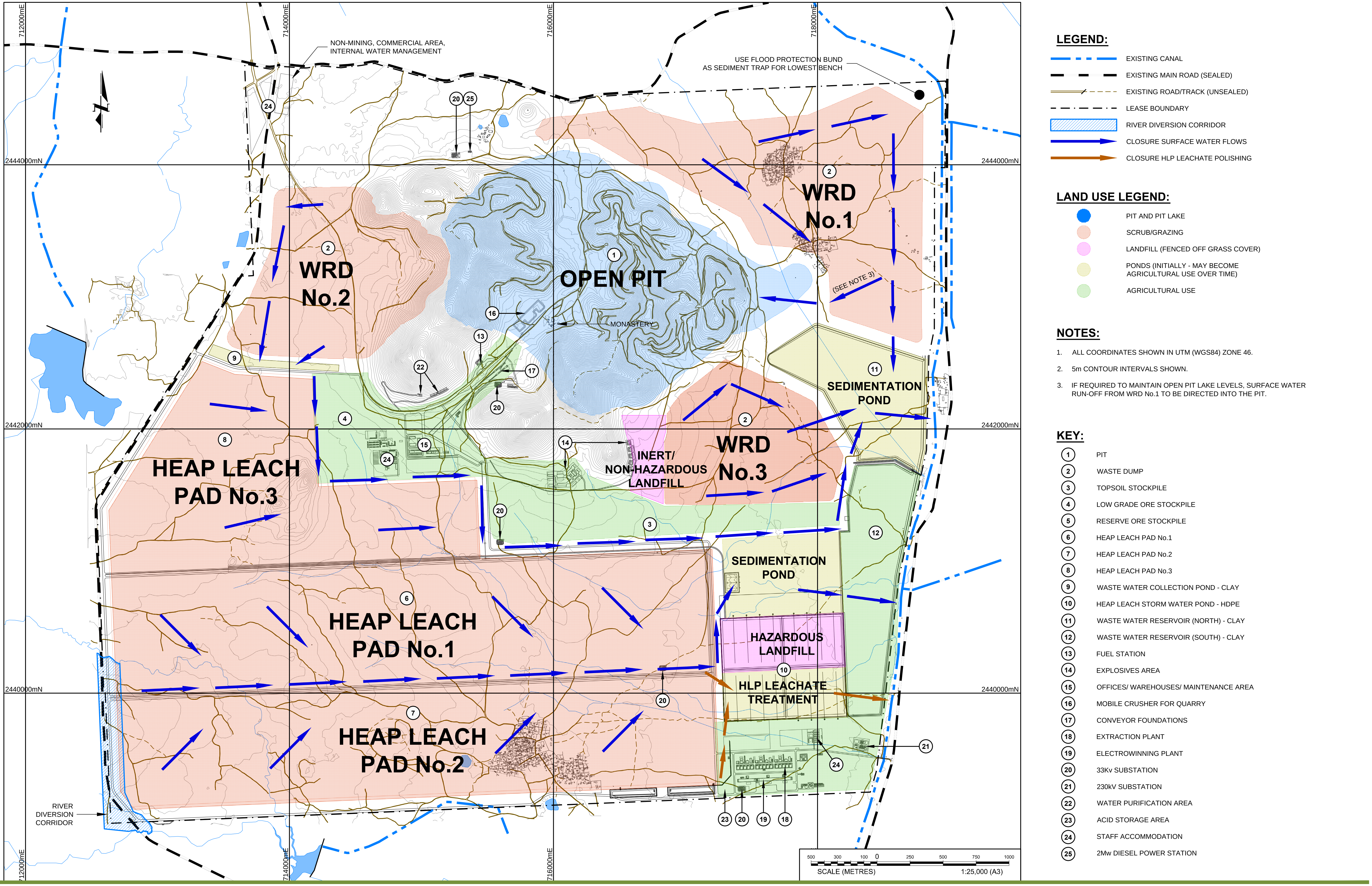
aggregate post finance cash flows from such date to the Mine Closure Date falls below twice the Mine Closure Costs; and

- From the Closure Contribution Date, Letpadaung will commit to making cash contributions in priority to shareholder dividend payments ensuring that a dedicated mine closure reserve account is funded by the Mine Closure Date in an amount equal to the Mine Closure Cost by making equal annual cash contributions (the determination of which will take account of interest on the funds in the mine closure reserve account). To the extent that cash flow in any year is insufficient to meet the required annual contribution, any shortfall shall be made up in the following year. The cash contribution shall also be adjusted to reflect any change to the Mine Closure Cost.

13.3 TEMPORARY/ UNPLANNED MINE CLOSURE

Letpadaung will give a commitment to comply with an agreed care and maintenance regime if there is an unplanned closure of the mine at any time. From a financial perspective, it is expected that there will be sufficient cash within Letpadaung (e.g. from cash balances and payments received on sales made before closure) not only to cover care and maintenance obligations but also, together with proceeds from the sale of Letpadaung's realisable assets, to meet any closure costs. Letpadaung will ensure that any spending on care and maintenance and closure costs is prioritised, ahead of other costs, in the event of an unplanned closure.

FIGURES



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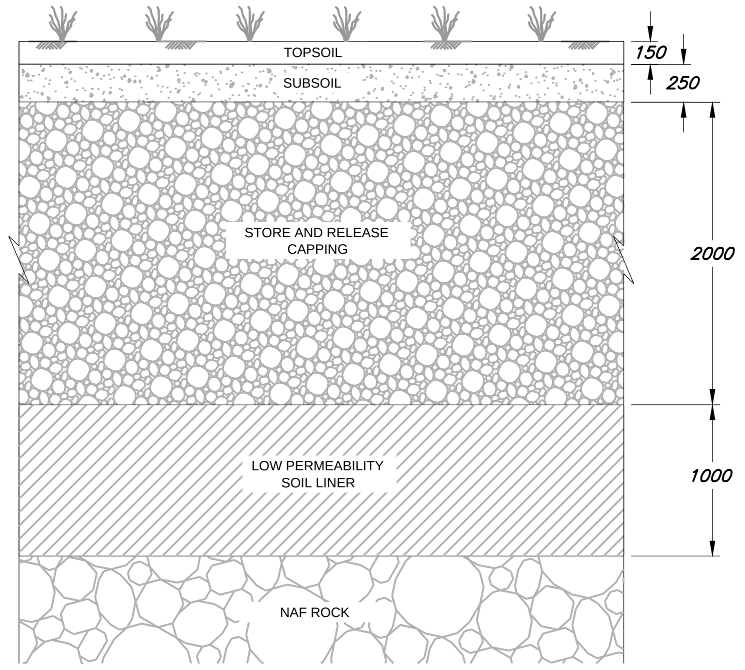
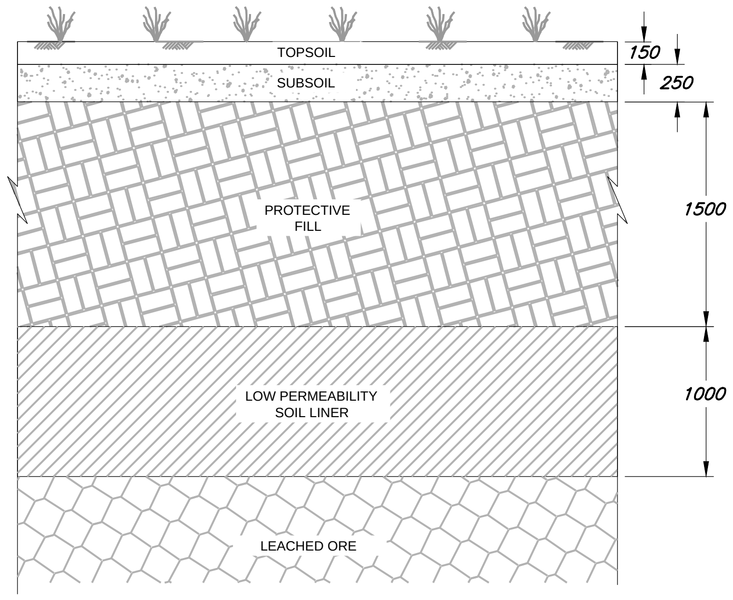
LETPADUANG PROJECT
CONCEPT CLOSURE PLAN
LAND-USE AND SURFACE WATER MANAGEMENT

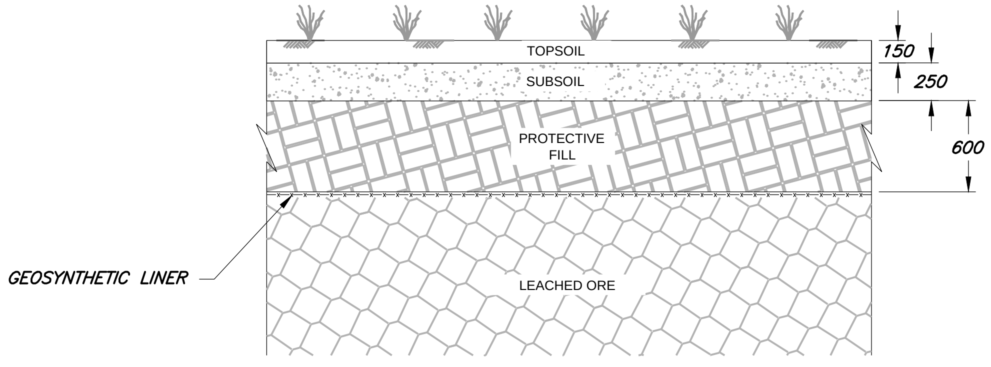
Ref: PE701-00022/20
Figure 5.1



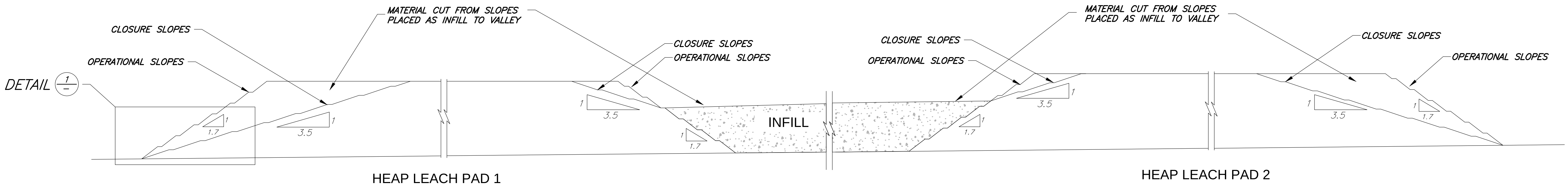
WASTE ROCK DUMPS

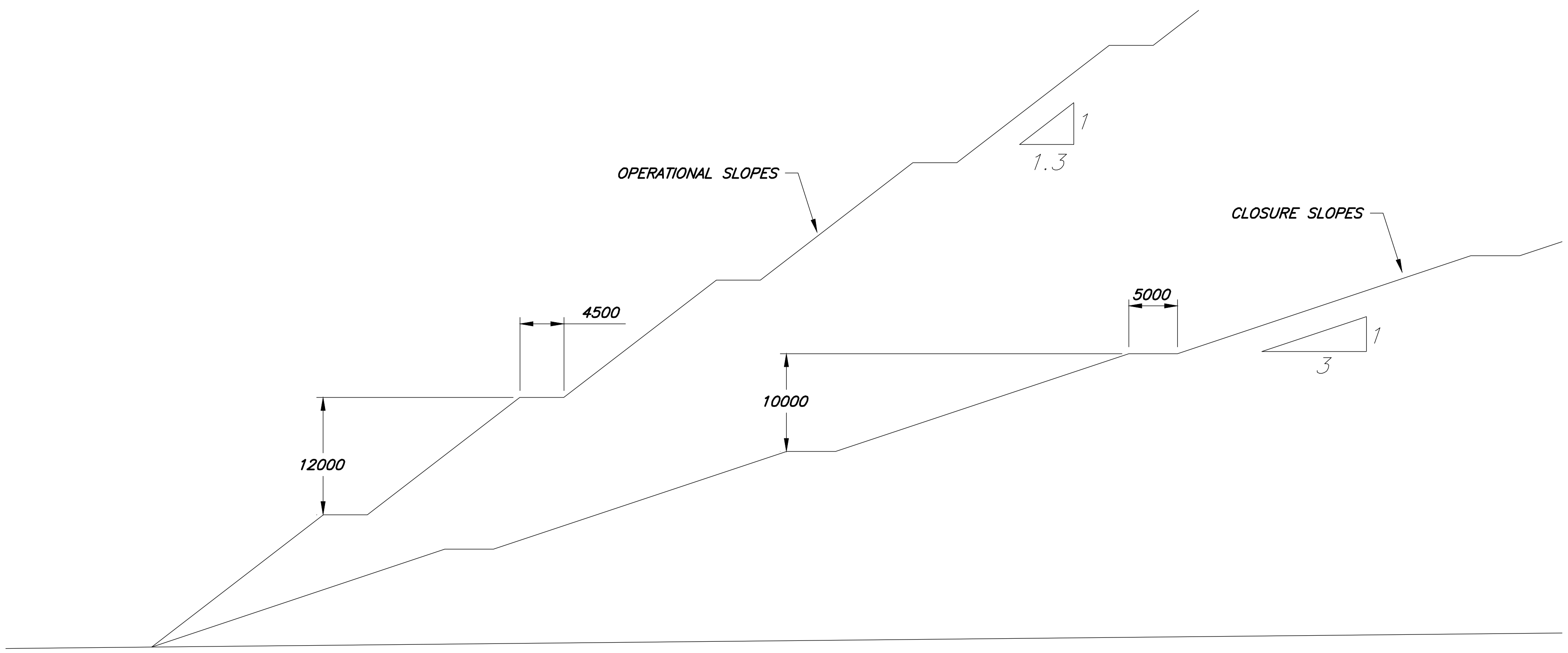


HEAP LEACH PADS
(LOW PERMEABILITY SOIL LINER)



HEAPS LEACH PADS
(GEOSYNTHETIC LINER)





DETAIL 1 BATTER PROFILE
SCALE N.T.S.

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LETPADAUNG COPPER PROJECT
CONCEPT HEAP LEACH PADS CLOSURE DESIGN
REPROFILING OF BATTERS

Ref: PE401-00022/20
Figure 5.3

APPENDIX K

Air Quality, Noise and Vibration Modeling

MYANMAR WANBAO COPPER MINING LIMITED
LETPADAUNG PROJECT



AIR QUALITY, NOISE AND VIBRATION MODELING LETPADAUNG PROJECT

PREPARED FOR:

Knight Piésold Pty. Ltd
Level 1/ 184 Adelaide Terrace, East Perth
Perth, Western Australia, Australia, 6004

PREPARED BY:

Knight Piésold Consultores S.A.
Calle Aricota 106, Piso 5,
Santiago de Surco, Lima 33, Peru

Knight Piésold
CONSULTING
www.knightpiesold.com

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MYANMAR WANBAO COPPER MINING LIMIT

LETPADAUNG COPPER PROJECT

AIR QUALITY, NOISE AND VIBRATION MODELING

DRAFT REPORT

KP Job No. LI201-00239/05

CONTRACT
PROPOSAL APPROVED PEL-0225-2013

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B	Issued for Ckient Review				
0	Issued for Use				
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1. INTRODUCTION

The Letpadaung Copper Project is located at Letpadaung in the Sagaing Division and is part of a larger project known as the Monywa Copper Project, which is developing the Sabetaung & Kyisintaung (S&K) deposits within the Monywa Copper Geological Complex. Myanmar Wanbao Mining Copper Limited (MWMCL), which will be responsible for the complete development of the Letpadaung deposit, has adopted the Environmental and Social assessments reviewed by AATA International Inc. in 1996.

As part of the Environmental Impact Assessment (EIA) of the Letpadaung Project, particulate matter dispersion as well as noise and vibration propagation have been modelled, which has allowed quantifying impacts caused by the project within the environmental baseline area. This area has been delimited in coordination with Knight Piésold Pty. Ltd and comprises the sites of the noise, vibration and air quality sampling stations.

The input information used for estimating particulate matter, noise and vibration emissions, and specific for this project was provided by the company Myanmar Wanbao Mining Copper Limited in coordination with Knight Piésold Pty. Ltd (Knight Piésold Australia). In terms of methodology, the computer programs used for modelling air quality dispersion (particulate matter) as well as noise and vibration propagation were AERMOD View, version 8.2, and SoundPLAN, version 7.2; which allowed a quantification of impacts produced by project activities during the construction and operation phases.

2. OBJECTIVES

The specific objectives of this study are presented below:

- To prepare an inventory of particulate matter, noise and vibration emissions produced by the project's construction and operation phases.
- To quantify impacts on air quality caused by the project's construction and operation phases; this is to be achieved by modelling particulate matter dispersion (PM_{10}).
- To quantify impacts on noise and vibration quality induced by activities to be executed during the project's construction and operation phases; this is to be accomplished by modelling noise and vibrations.

3. LETPADAUNG PROJECT DESCRIPTION

The Letpadaung Project is located 5.3 km from the city of Monywa, on the western bank of the Chindwin River and south of the Yama Stream, a Chindwin tributary. The company Myanmar Wanbao Mining Copper Limited (MWMCL) is responsible for developing the project. This project is part of the Monywa Copper Project, which is developing the Sabetaung and Kyisintaung copper deposits, located 6 km northwest from the Letpadaung deposit.

The project's construction phase will include the execution of all activities required for the operation, as well as the construction and operation of complementary facilities. Construction activities will take place during the day; these activities consist of earthworks, land grading, facility construction, facility assembly, drilling and blasting, excavations, materials transportation, consumables transportation, and road improvement.

The project's operation phase is the one during which copper ore exploitation, processing and dressing take place. Figure 1 shows the location of the project and the facilities considered during year 5 of the mining plan, which include the execution of an open pit, waste rock dumps, crushing facilities, pump station, conveyor belt, and heap leach piles. During this phase, typical operation activities and improvements are considered, which will ensure their normal execution through implementation of mitigation measures for dust and noise control, in order to comply with MWMCL's environmental standards. According to information provided by the company Knight Piésold Pty. Ltd in coordination with MWMCL, Table 1 presents the project-related production of copper ore concentrate and waste rock throughout the first 10 years.

Table 1: Letpadaung Project Mining Plan

Mining plan	Material handling (1)		
	Ore	Waste rock	Total
Year 1	27,600	41,400	69,000
Year 2	27,000	42,000	69,000
Year 3	28,000	41,000	69,000
Year 4	33,000	36,000	69,000
Year 5	30,000	39,000	69,000
Year 6	32,000	37,000	69,000
Year 7	30,000	39,000	69,000
Year 8	30,100	39,200	69,300
Year 9	30,700	38,700	69,400
Year 10	30,200	38,800	69,000

Source: MWMCL
Note :(1) Units in kt (kiloton)

4. METHODOLOGY

4.1 NOISE AND AIR QUALITY BACKGROUND

This section provides a brief summary of results obtained through air and noise quality samplings, which were executed as part of the Environmental Baseline section of the Letpadaung Copper Project's Environmental and Social Impact Assessment (ESIA), performed by the company Knight Piésold Pty.

4.1.1 Air Quality Baseline

In order to characterize environmental baseline conditions for Letpadaung Project's EIA, 8 air quality stations were sampled during the dry and wet season of 2013. The samplings comprised measurements of particulate matter (PM_{10} and $PM_{2.5}$) and gases (SO_2, NO_2 and CO), which were determined with an Environmental Perimeter Air Monitoring Station (EPAS – Haz-Scanner) equipment.

Based on results shown in Table 2, it was determined that background concentrations for PM_{10} vary between 7.1 and 20 µg/m^3, depending on each air quality station's location.

The measurement lasted 24 hours; this period presents continuous hourly records measured at a height of 3 m above ground level, a height that was chosen in order to obtain values that represent the human exposure level. Figure 1 shows the location of air quality sampling stations.

Table 2: Summary of pollutant concentration - Air quality baseline

Pollutant (µg/m³)		Season (2013)	Sampling period	Points of air quality sampling								AQS according to WHO (µg/m³)			
				Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	IT-1	IT-2	IT-3	AQG
Particulate matter	Small particles less than 10 micrometers - PM_{10}	Dry	24 hour average	14.3	12.7	11.4	17.6	22.3	9.5	19.2	10.4	150	100	75	50
		Wet	24 hour average	8.3	2.7	4.2	11.0	17.7	4.7	10.8	4.4	150	100	75	50
		Average	**24 hour average**	**11.3**	**7.7**	**7.8**	**14.3**	**20.0**	**7.1**	**15.0**	**7.4**	150	100	75	50
	Fine particles less than 2,5 micrometers - $PM_{2,5}$	Dry	24 hour average	11.0	8.5	8.2	11.1	14.2	8.5	11.3	7.8	75	50	37,5	25
		Wet	24 hour average	6.0	1.7	2.4	5.6	8.8	2.6	5.2	2.6	75	50	37,5	25
		Average	**24 hour average**	**8.5**	**5.1**	**5.3**	**8.4**	**11.5**	**5.5**	**8.3**	**5.2**	75	50	37,5	25
	Inhalable coarse particles - $PM_{10-2.5}$	Dry	24 hour average	3.3	4.15	3.2	6.5	8.1	1	7.9	2.6	-	-	-	-
		Wet	24 hour average	2.3	1.0	1.8	5.3	8.9	2.1	5.6	1.8	-	-	-	-
		Average	**24 hour average**	**2.8**	**2.6**	**2.5**	**5.9**	**8.5**	**1.6**	**6.8**	**2.2**	-	-	-	-
Gases	Carbone monoxide - CO	Dry	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.4	-	-	-	10 000
		Wet	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	10 000
		Average	**Maximum 8 hour mean**	**0.3**	**0.3**	**0.4**	**0.4**	**0.5**	**0.4**	**0.4**	**0.4**	-	-	-	10 000
	Nitrogen dioxide - NO_2	Dry	1 hour average	28.1	25.2	32.7	28.7	23.1	20.7	9.7	14.6	-	-	-	200
		Wet	1 hour average	26.0	24.1	34.8	29.3	22.0	19.7	9.5	13.2	-	-	-	200
		Average	**1 hour average**	**27.1**	**24.7**	**33.7**	**29.0**	**22.6**	**20.2**	**9.6**	**13.9**	-	-	-	200
	Sulphur dioxide - SO_2	Dry	24 hour average	2.6	2.3	2.5	2.4	3.0	2.5	2.5	2.5	125	50	-	20
		Wet	24 hour average	2.5	2.4	2.5	2.4	2.5	2.5	2.5	2.5	125	50	-	20
		Average	**24 hour average**	**2.6**	**2.4**	**2.5**	**2.4**	**2.8**	**2.5**	**2.5**	**2.5**	125	50	-	20

Elaborated by Knight Piésold.
Source: MWMCL
Notes:
"AQS": Air Quality Standards.
"WHO": World Health Organization.
"AQG": Air Quality Guideline.
"IT": Interim Target. According to Vahlsing, C., & Smith, K. R. (2011) developing countries, with higher levels of air pollution, could select an interim target level achievable based on their own air quality management infrastructure, and progress towards the AQG value.
Pollutant concentrations greater than Air quality Standards:
IT-1
IT-2
IT-3
AQG

According to information provided by the company Knight Piésold Pty. Ltd, results obtained during measurements at the 8 air quality stations (Table 2) present particulate matter (PM_{10} and $PM_{2.5}$) and gas (CO, NO_2 and SO_2) concentrations that do not exceed air quality standards established by World Health Organization (WHO). Furthermore, measurement results for meteorological parameters were also obtained during air quality samplings, which are shown in Table 3.

Table 3: Meteorological conditions during air quality sampling

Parameters	**Season (2013)**	
	Dry	**Wet**
Temperature	31ºC	26ºC
Relative humidity	56%	86%
Wind speed	10 km/hr	10 km/hr
Wind direction	104º (ESE)	106º (ESE)

Source: MWMCL

4.1.2 Noise Quality Baseline

For the purpose of characterizing the environmental baseline conditions of the Letpadaung Project's EIA, 10 noise stations were sampled during the dry and wet seasons of 2013, whose locations are shown in Figure 1. Based on information provided and shown in Table 4, noise equivalent values have been determined per period (daytime and night-time); consequently, during the dry season, noise levels for the daytime period varied between 41.3 and 46.6 dB(A), while they varied between 41.5 and 46.3 dB(A) for the night-time period. It is important to point out that, except for the value determined for Station 3 during the night-time period, the remaining recorded values do not exceed international noise standards established by the IFC (2007).

On the other hand, values exceeding IFC standards were recorded during the wet season. These values range from 59.9 to 85.5 dB (A) during the daytime period, and from 66.7 to 74.6 dB(A) during the night-time period.

The criterion considered for assessing the results obtained at sampling stations close to vehicle traffic and built-up areas was the one established by the OECD (Organisation for Economic Cooperation and Development). This standard considers a value below 65 dB(A) to be an acceptable noise level for the daytime period, and a value below 55 dB(A) to be acceptable for the night-time period.

Table 4: Noise quality baseline around area of Letpadaung Project

Period	Time	Noise level measured in $L_{Aeq(1h)}$ dB(A)																			
		Dry season										Wet season									
		Nº Stations										Nº Stations									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Daytime	07:00-08:00	45.7	47.7	43.7	45.7	43.7	44.5	46.5	41.2	39.4	40.3	65.0	73.0	61.0	49.1	82.0	65.0	97.0	74.0	61.0	55.0
	08:00-09:00	41.5	44.3	44.3	44.7	41.3	46.6	46.6	41.6	40.7	41.7	67.0	76.0	56.0	49.1	74.0	69.0	78.0	75.0	56.0	55.0
	09:00-10:00	43.2	43.5	45.1	50.5	42.4	42.4	48.4	45.4	47.8	43.8	74.0	79.0	61.0	73.0	71.0	61.0	70.0	72.0	58.0	50.0
	10:00-11:00	45.1	40.1	43.1	48.1	48.1	46.1	47.1	42.1	45.3	45.3	67.0	78.0	62.0	62.0	63.0	64.0	53.0	68.0	56.0	44.1
	11:00-12:00	45.1	42.9	42.9	45.9	44.7	44.7	44.7	44.7	44.7	41.3	71.0	73.0	62.0	61.0	68.0	65.0	67.0	61.0	78.0	46.1
	12:00-13:00	38.7	41.8	44.8	45.8	45.8	45.8	45.8	44.8	42.8	42.8	67.0	71.0	55.0	53.0	84.0	67.0	61.0	62.0	71.0	37.6
	13:00-14:00	40.1	40.6	45.6	46.6	46.6	46.5	46.5	41.5	41.5	42.1	67.0	69.0	55.0	54.0	75.0	68.0	73.0	65.0	67.0	54.0
	14:00-15:00	41.2	43.5	42.5	42.5	42.5	42.5	42.5	42.5	39.5	39.5	69.0	71.0	52.0	50.1	64.0	61.0	74.0	66.0	62.0	53.0
	15:00-16:00	45.6	44.2	47.2	45.2	45.2	40.3	40.3	40.3	40.3	39.4	65.0	70.0	44.0	74.0	74.0	67.0	62.0	61.0	60.0	68.0
	16:00-17:00	39.5	39.2	44.0	47.5	43.8	43.8	43.8	39.8	39.8	40.6	64.0	74.0	47.0	69.4	60.0	56.0	54.0	64.0	58.0	59.0
	17:00-18:00	39.0	41.7	45.7	47.7	42.3	42.3	47.3	42.3	39.0	39.0	66.0	65.0	46.0	66.2	53.1	47.5	81.0	53.0	63.0	60.0
	18:00-19:00	40.5	39.8	43.8	43.8	40.8	41.8	41.8	41.8	41.8	41.8	56.2	55.1	54.0	61.0	60.0	44.4	54.0	43.6	51.0	64.0
	19:00-20:00	38.0	40.9	43.9	47.9	39.3	37.8	38.7	38.7	38.7	38.7	66.0	47.4	56.0	62.4	58.0	45.9	51.1	42.6	58.0	61.0
	20:00-21:00	39.4	42.5	47.5	43.5	36.5	41.2	41.2	41.2	41.2	38.1	51.6	46.8	68.0	61.8	50.2	43.4	43.2	49.1	39.2	59.0
	21:00-22:00	37.5	41.3	43.1	47.1	42.1	42.1	38.1	38.1	38.1	36.8	58.1	61.0	59.0	62.1	58.0	45.8	48.3	41.4	38.4	60.0
	LAeq-Daytime	**42.2**	**42.8**	**44.7**	**46.6**	**43.9**	**43.8**	**45.0**	**42.2**	**42.3**	**41.3**	**67.5**	**72.9**	**59.9**	**66.5**	**75.4**	**63.8**	**85.5**	**67.9**	**67.8**	**60.0**
	Noise Level Guidelines (1)	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**
Night-time	22:00-23:00	38.5	41.5	42.5	43.6	47.5	47.5	44.5	41.5	41.5	39.4	64.0	70.0	76.0	59.0	47.6	63.0	42.7	42.8	38.7	76.0
	23:00-24:00	40.3	39.8	45.8	45.8	45.8	45.8	45.8	38.8	38.8	38.8	64.9	67.0	56.0	68.0	63.0	66.0	44.9	45.4	60.0	56.0
	24:00-01:00	40.5	43.9	43.9	43.9	43.9	43.9	43.9	43.1	43.1	40.5	69.0	68.0	58.0	66.0	69.0	62.0	56.0	63.0	61.0	63.0
	01:00-02:00	41.2	42.9	42.9	42.9	42.9	41.7	47.7	41.7	41.7	37.9	75.0	69.0	63.0	74.0	61.0	64.0	58.0	60.0	68.0	51.0
	02:00-03:00	46.7	43.3	43.3	43.3	43.3	43.3	43.3	43.3	44.3	44.3	69.0	70.0	67.0	74.0	60.0	81.0	58.0	65.0	71.0	67.0
	03:00-04:00	39.8	41.6	39.6	45.6	42.6	42.6	42.6	42.6	42.6	42.6	73.0	70.0	57.0	82.0	69.0	72.0	77.0	62.0	72.0	56.0
	04:00-05:00	42.7	41.1	45.1	42.7	45.1	43.5	43.5	43.5	43.5	43.5	74.0	46.8	56.0	75.0	62.0	74.0	76.0	63.0	49.1	58.0
	05:00-06:00	43.7	43.2	49.2	45.2	45.2	45.2	38.2	38.2	38.2	38.2	72.0	70.0	63.0	69.0	73.0	73.2	77.0	75.0	53.1	62.0
	06:00-07:00	41.7	42.5	51.5	41.5	42.5	42.8	42.8	42.8	42.8	42.8	67.0	70.0	67.0	63.0	42.8	74.1	73.0	74.0	69.0	62.0
	LAeq-Night time	**42.4**	**42.4**	**46.3**	**44.0**	**44.6**	**44.4**	**44.2**	**42.0**	**42.2**	**41.5**	**71.2**	**68.9**	**67.9**	**74.6**	**66.7**	**74.0**	**72.5**	**68.7**	**67.0**	**67.6**
	Noise Level Guidelines (1)	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**

Prepared by Knight Piésold.

Source: MWMCL

Notes:

(1) Noise Level Guidelines according to IFC (2007). Noise impacts should not exceed the levels or result in a maximum increase in background levels of 3 dB at the nearest location off-site.

Noise level guidelines according to WHO (1999):

Receptor	Daytime / Night-time	Noise exceedance
Residential (IFC criteria)	55 / 45	(light shading)
Residential close to highway (OECD criteria)	65 / 55	(orange shading)

Furthermore, the samplings also provided measurement results for meteorological parameters, which are shown in Table 5.

Table 5: Meteorological conditions during noise quality sampling

Season (2013)	Station	Parameters			
		Temperature ºC	**Relative humidity (%)**	**Wind speed (m/s)**	**Wind direction**
Dry	1	29-31	41-63	2.5-3.3	167 (S)
	2	29-31	40-64	2.6-3.5	178 (S)
	3	26-42	41-63	2.5-3.4	158 (S)
	4	25-42	41-63	2.4-3.8	169 (S)
	5	26-45	41-60	2.8-3.9	175 (S)
	6	23-40	40-61	2.3-3.5	164 (S)
	7	23-38	40-65	2.3-3.5	165 (S)
	8	23-37	40-68	2.3-3.5	172 (S)
	9	23-41	40-66	2.5-3.6	164 (S)
	10	24-41	41-67	2.6-3.8	172 (S)
Wet	1	29.9-30.4	36-93	0.5-3.3	177 (S)
	2	30.4-31.1	40-91	0.6-3.5	174 (S)
	3	34.8-41.7	41-83	0.5-3.4	168 (S)
	4	34.8-41.9	41-83	0.4-3.8	175 (S)
	5	34.8-42.4	41-90	0.8-3.9	176 (S)
	6	35.8-44.6	40-81	0.3-3.5	168 (S)
	7	37.6-39.4	40-85	0.3-3.5	167 (S)
	8	35.3-37.8	40-90	0.3-3.5	173 (S)
	9	35.1-36.9	40-96	0.5-3.6	166 (S)
	10	37.4-41	41-87	0.6-3.8	177 (S)

Source: MWMCL

4.1.3 Vibration Quality Baseline

Vibration measurements conducted within the project's environmental baseline area were recorded in mm/s and are given in Table 6.

Table 6: Vibration levels around Letpadaung Project area

Location	Vibration levels (mm/s)						Safe level according to DIN 4150-3 (mm/s)[1]		
	Hot dry season			Wet season			MSB	RB	IB
	Mean	Max	Min	Mean	Max	Min			
Station 1	0.371	1.400	0.000	0.360	1.500	0.000	3	5	20
Station 2	0.510	3.000	0.100	0.515	3.000	0.100	3	5	20
Station 3	1.383	4.800	0.400	1.410	5.900	0.400	3	5	20
Station 4	0.298	0.800	0.100	0.294	0.700	0.100	3	5	20
Station 5	0.229	1.200	0.100	0.225	1.200	0.100	3	5	20
Station 6	0.958	4.500	0.200	0.990	4.500	0.200	3	5	20
Station 7	0.360	1.500	0.000	0.373	1.500	0.000	3	5	20
Station 8	0.329	1.400	0.100	0.338	1.500	0.100	3	5	20
Station 9	0.279	1.300	0.100	0.271	1.200	0.100	3	5	20
Station 10	0.233	1.100	0.100	0.223	1.200	0.100	3	5	20

Prepared by Knight Piésold.
Source: MWMCL
Notes:
(1) Safe level for frequency less than 10 Hz
(2) MSB = More sensitive buildings
(3) RB = Residential buildings
(4) IB = Industrial buildings. Commercial, Industrial or Similar
Legend:

x	Values greater than MSB standard
x	Values greater than RB standard
x	Values greater than IB standard

In order to assess the mean records obtained at stations close to roads (stations 1, 2, 3 and 5), it has been considered to compare them to standards established by the Federal Transit Administration (FTA) of the U.S. Department of Transit. Based on mean vibration level records, expressed in mm/s, the velocity level was determined in $Lv_{ref\ 1\ \mu inches}$ (VdB) units. The velocity level (L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref\,1\frac{micro\ in.}{sec}} = 20 \times \log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is the RMS (Root Mean Square) of velocity amplitude, and v_{ref} is the reference velocity amplitude.

Table 7: General assessment of vibration levels recorded close to roads

Location	Vibration levels in VdB ref 1 micro inch/sec		General assessment according to FTA[1]		
	Season		Category		
	Hot dry	Wet	C1[2]	C2[3]	C3[4]
Station 1	**83.3**	**83.0**	65	72	75
Station 2	**86.1**	**86.1**	65	72	75
Station 3	**94.7**	**94.9**	65	72	75
Station 5	**79.1**	**78.9**	65	72	75

Prepared by Knight Piésold.

Notes:

(1) Standard values for frequent events are defined as more than 70 vibration events of the same source per day (FTA, 2006). Most rapid transit projects fall into this category.

(2) C1 = Category 1. Buildings where vibration would interfere with interior operations

(3) C2 = Category 2. Residences and buildings where people normally sleep

(4) C3 = Category 3. Institutional land use, mainly during daytime

Legend:

x	Values greater than C1 standard
x	Values greater than C2 standard
x	Values greater than C3 standard

According to results shown in Table 7, vibrations are clearly felt by inhabitants who are close to the referred stations. According to FTA criteria (2006), the area close to these stations is suitable for dwellings that present resistant structures rather than for sensitive buildings.

4.2 METEOROLOGICAL INFORMATION

In order to model air quality dispersion (AERMOD View v. 8.2) and noise propagation (Sound PLAN v. 7.2), weather data generated by the MM5 model[1] has been used. This model contains hourly ground-level and vertical data. This data comprises the period from January 2010 to December 2012 and is representative for an area of 144 km^2 (MM5 model grid area), which is where the Letpadaung Project lies. The information generated by the MM5 model is based on global reanalysis climate data provided by the National Center for Environmental Protection (NCEP). This information has a resolution of 2.5 degrees for the entire planet, with records for every 6 hours. Table 8 shows the characteristics of information generated by the MM5 model.

[1]Developed by Pennsylvania State University (PSU) and National Center for Atmospheric Research (NCAR). MM5 meteorological model is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation.

Table 8: Surface & Upper air met data pre-processed from MM5 meteorological model

Met data information	
Met data type: Star-End date: Latitude: Longitude: Datum: Site time zone Place:	AERMET-Ready (Surface &Upper air data) Jan 01, 2010 – Dec 31, 2012 22.084864 N 95.090047 E WGS84 UTC/GMT UTC + 6 hour(s) Letpadaung Project
Calculated pseudo met station parameters	
Anemometer height: Station base elevation: Upper air adjustment:	14 m 98 m -6 hour(s)
MM5-Processed grid cell	
Grid cell center (Lat, Lon): Grid cell dimension: Information of MM5 model:	22.084864 N, 9.090047 E 12 km x 12 km http://www.mmm.ucar.edu/mm5/mm5-home.html
Hourly surface met data (*.sam)	
Format: Output interval: File format description:	SAMSON (surface met data for preprocessing by AERMET) Hourly http://www.webmet.com/MetGuide/Samson.html
Upper air data (*.ua)	
Format: Data reported: Output interval: File format description:	TD-6201 – Fixed Length (upper air met data for pre-processing by AERMET). UTC/GMT 00Z and 12Z http://www.webmet.com/MetGuide/TD6200.html

Prepared by Knight Piésold
Source: Lakes Environmental Software

The hourly surface parameters that have been pre-processed by AERMET are:

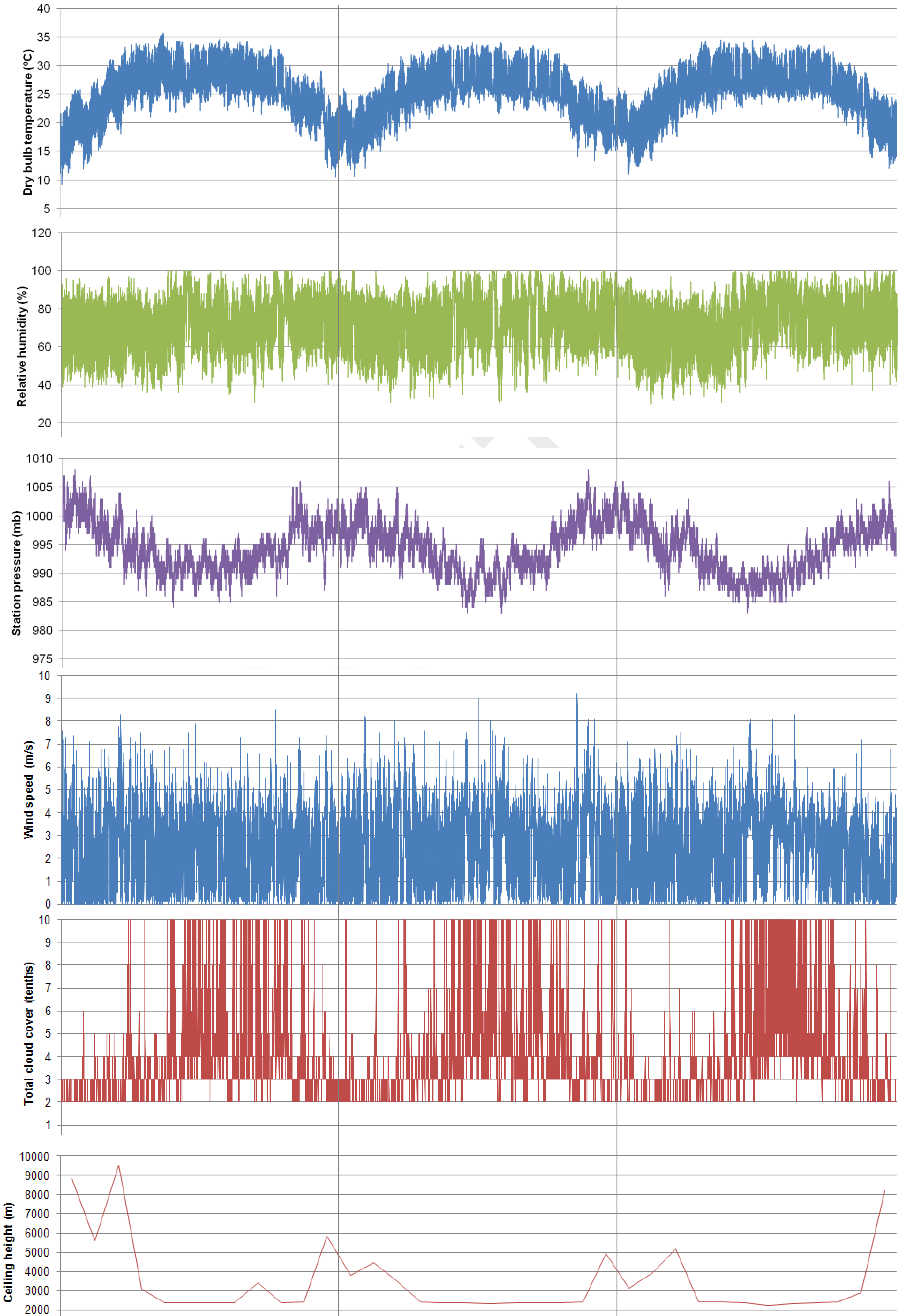
- Total cloud cover (tenths)
- Dry bulb temperature (ºC)
- Dew point temperature (ºC)
- Relative humidity (%)
- Station pressure (mb)
- Wind direction (deg)
- Wind speed (meter/second)
- Ceiling height (m): 77777 = unlimited ceiling height
- Hourly precipitation quantity (hundreds of inches)

Graph 1 shows the variations of each meteorological parameter throughout the period 2010-2012, where one can see each parameter's variation. It also allows distinguishing the dry[2] (November to April) and wet season (May to October). Considering the information period 2010-2012, one can observe that temperatures vary between 10 and 35 °C; relative humidity, between 40 and 100%; atmospheric pressure, between 985 and 1005 mbar; wind speed, between calms (0 m/s) and 9 m/s; cloud cover, between partly clear sky (2-5 tenths) and cloudy sky (6-10 tenths); and cloud altitude is higher during the dry season (3,000-9,000 m) and lower during the wet season (2,500 m approximately).

Regarding wind speed (Graph 2), one can see that 2 directions predominate: the northern winds (September to May) and the southern ones (June to September); this behaviour seems to be influenced by monsoons, due to transportation of moist air masses that come from the south and dry air masses from the north. With respect to precipitation, Graph 3 shows the variation of this parameter throughout the months between 2010 and 2012; one can make out that monthly cumulative precipitation is higher during July, reaching a maximum of 384.81 mm in 2012. Table 9 shows daily precipitation values throughout the assessment period (2010-2012).

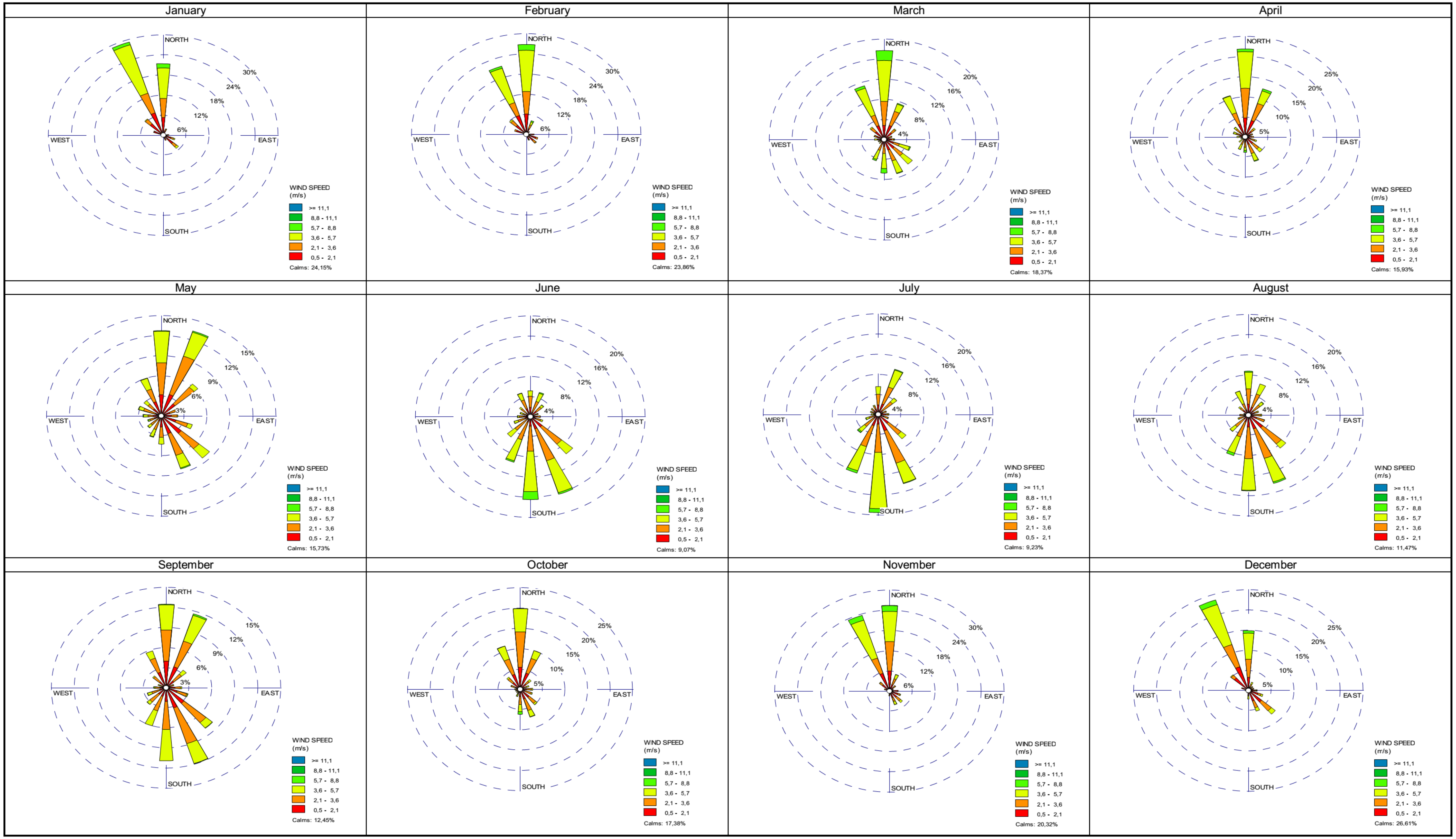
[2] The dry season is divided into a cold-dry period (November to February) and a warm-dry one (March to April).

Graph 1: Hourly surface met data from January 2010 to December 2012


Dry bulb temperature (ºC)
40
35
30
25
20
15
10
5
Relative humidity (%)
120
100
80
60
40
20
Station pressure (mb)
1010
1005
1000
995
990
985
980
975
Wind speed (m/s)
10
9
8
7
6
5
4
3
2
1
0
Total cloud cover (tenths)
10
9
8
7
6
5
4
3
2
1
Ceiling height (m)
10000
9000
8000
7000
6000
5000
4000
3000
2000

Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

Graph 2: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

Table 9: Daily precipitation amount (mm) by year (2010 - 2012) - Letpadaung Project

Day	2010 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	2.79	0	0	13.46	1.524	0	0	0	0
2	0	0	0	0	0	0	12.45	2.794	4.826	0	0	0
3	0	0	0	0	3.302	0	3.556	28.45	61.47	2.032	0	0
4	0	0	0	0	0	0	0	57.66	2.286	3.048	0	0
5	0	0	0	0	0	0.254	3.81	1.27	1.016	0	0	0
6	0	0	0	0	0	2.794	0	1.524	0	12.45	0	0
7	0	0	0	0	0	0	0	5.588	0	7.874	0	0
8	0	0	0	0	0	0	0.508	0	0.762	13.72	0	0
9	0	0	0	0	0	40.13	0	0	7.62	25.4	0	0
10	0	0	0	0	0	2.286	0	0	0.508	6.35	0	0
11	0	0	0	0	0.254	44.96	9.398	0	0	19.3	0	0
12	0	0	0	0	0.254	27.94	0.254	0	0	0	0	0
13	0	0	0	0	0	7.366	5.08	0	7.874	0	0	0
14	0	0	0	0	0	5.842	1.27	1.524	1.778	2.54	0	0
15	0	0	0	0	0	23.62	2.54	0.254	0	11.68	0	0
16	0	0	0	0	2.032	11.43	0	1.016	4.318	0.762	0	0
17	0	0	0	0	0	22.1	0.254	0	0	1.27	0	0
18	0	0	0	0	0	2.794	0	0	1.27	0	0	0
19	0	0	0	0	8.636	35.31	0	6.858	26.16	2.54	0	0
20	0	0	0	0	36.07	1.27	5.334	2.54	0	6.858	0	0
21	0	0	0	7.62	11.68	2.54	0	0	0	0.762	0	0
22	0	0	0	0	1.016	0	0	0	0	22.61	0	0
23	0	0	0	0	3.556	5.334	3.048	0	0.508	24.13	0	0
24	0	0	0	0	39.37	25.91	0	1.778	7.62	4.572	0	0
25	0	0	0	1.02	29.97	38.35	0	10.16	0	0	0	0
26	0	0	0	0	4.318	0.508	0	2.032	8.89	0.254	0	0
27	0	0	3.3	0	12.95	10.41	2.286	0.508	0	0	0	0
28	0	0	23.6	0	5.08	7.62	13.46	4.318	0.254	0	0	0
29	0		19.8	0	3.302	0	88.9	3.556	0	0.508	0	0
30	0		8.13	0	22.86	0	22.1	5.08	0	26.42	0	0
31	0		9.91		2.794		6.096	1.27		0		0
Total	**0**	**0**	**64.8**	**11.4**	**187.5**	**318.8**	**193.8**	**139.7**	**137.2**	**195.1**	**0**	**0**

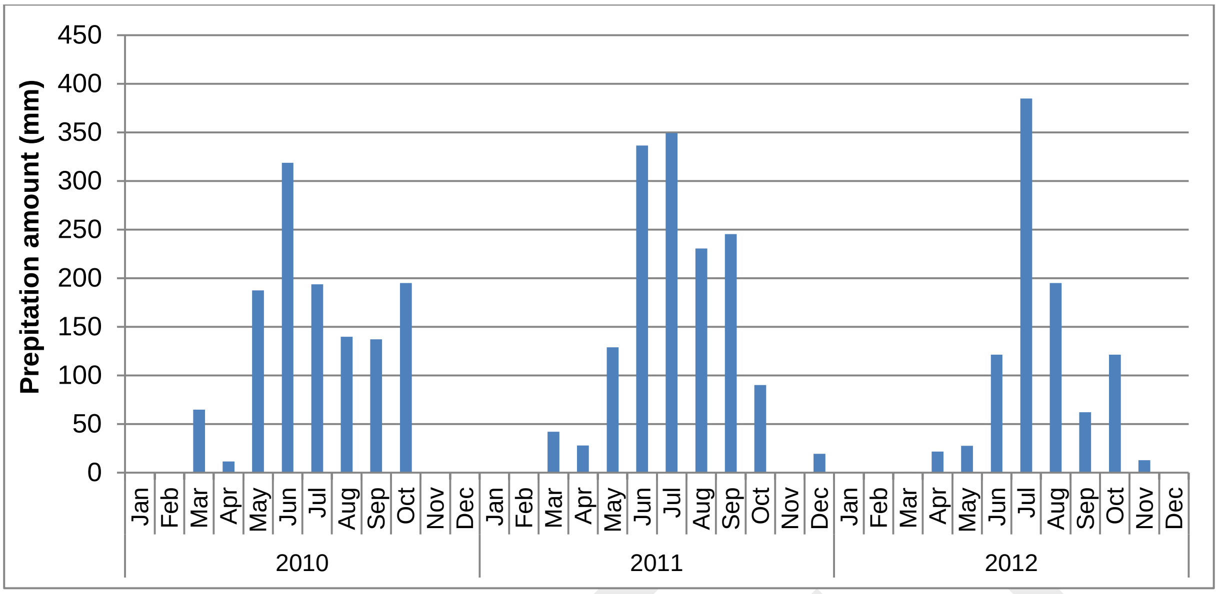
Day	2011 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0	32.5	5.08	1.02	0	0	0	0
2	0	0	0	0	0	0	3.05	5.84	0	0	0	0
3	0	0	0	0	0	0	1.02	0	0	3.81	0	0
4	0	0	0	0	0	0	3.3	7.11	0	1.02	0	0
5	0	0	0	0	0	0	7.11	5.84	12.7	0	0	0
6	0	0	0	0	2.29	4.57	2.54	2.29	14	16.5	0	0
7	0	0	0	0	0	2.79	0	16.8	20.6	7.62	0	0
8	0	0	0	0	0.25	24.6	0	37.1	14.2	6.6	0	0
9	0	0	0	0	0	24.9	0	20.6	0	0	0	0
10	0	0	0	0	0	0	0	32	20.3	0	0	0
11	0	0	0	0	0	0	0	2.29	0	0	0	0.76
12	0	0	0	0	0	0	4.57	8.64	0	0	0	0.76
13	0	0	0	0	0	0	0	13.7	10.7	0	0	0
14	0	0	0	0	0	5.59	0	1.52	6.6	0	0	0
15	0	0	0	0	0	24.9	0	0	12.7	0	0	0
16	0	0	0.76	0	0.25	9.14	15.5	1.02	22.1	4.83	0	0
17	0	0	0	0	0	13.2	2.29	0	42.7	14.2	0	0
18	0	0	0	0	4.32	64	2.29	0	5.33	25.7	0	0
19	0	0	0	0	0	3.3	24.1	3.81	2.03	0	0	0
20	0	0	0	0	1.27	41.7	102	0	0	6.86	0	0
21	0	0	0	14.2	0	0.25	87.1	0.76	56.4	0.25	0	0
22	0	0	0	0	0	1.27	19.1	10.2	5.08	0	0	0
23	0	0	0	0.25	0	0	0.51	0	0	0	0	0
24	0	0	0	0.76	0	0	33.8	0	0	0	0	0
25	0	0	0	9.91	0	3.05	26.4	0	0	0	0	0
26	0	0	3.81	1.02	0.51	30.7	9.4	1.78	0	0	0	0
27	0	0	2.03	0	5.84	9.65	0.25	27.4	0	0	0	9.4
28	0	0	19.6	1.78	4.57	16	0	1.78	0	2.79	0	8.38
29	0		4.06	0	21.3	20.1	0	5.59	0	0	0	0
30	0		11.7	0	34	4.06	0	8.38	0	0	0	0
31	0		0		54.1		0	15		0		0
Total	**0**	**0**	**41.9**	**27.9**	**129**	**336**	**349**	**230**	**245**	**90.2**	**0**	**19.3**

Day	2012 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	9.65	13.7	2.54	7.37	0	0.76	1.27	0
2	0	0	0	0.51	0	7.11	2.29	7.87	0	0.25	0	0
3	0	0	0.51	0	0	8.38	2.29	0	0	0	0	0
4	0	0	0	0	0	1.02	3.56	31.8	27.7	0	0	0
5	0	0	0	3.56	0	0	1.78	0.51	2.03	3.3	0	0
6	0	0	0	0	0	0	2.79	10.7	1.52	0	0	0
7	0	0	0	0.51	0	0	5.33	12.2	14	28.7	0.25	0
8	0	0	0	2.54	0	0	4.83	1.27	5.59	4.06	4.32	0
9	0	0	0	7.62	0	5.33	8.13	4.32	3.56	3.56	2.29	0
10	0	0	0	0.51	0	3.56	2.54	8.64	0	22.6	0	0
11	0	0	0	2.54	0	0	2.03	15.5	0	52.8	0	0
12	0	0	0	1.02	0.51	1.52	3.05	15	0	0.76	0	0
13	0	0	0	0	0	0	2.54	7.37	0	0	0	0
14	0	0	0	0	0.51	0.25	4.83	2.54	0	0	0	0
15	0	0	0	0	0.25	0	26.2	4.83	0	0	0	0
16	0	0	0	0	0	1.52	0	0	0	0	0	0
17	0	0	0	0	0	1.52	2.29	0.76	0	4.57	0	0
18	0	0	0	0	0	6.35	4.83	0	0	0	3.3	0
19	0	0	0	0	0	0	6.86	5.84	0	0	0	0
20	0	0	0	0	0	30.5	0	24.9	0	0	0.51	0
21	0	0	0	0	0	0.76	0	9.14	0	0	0.76	0
22	0	0	0	0	0	2.03	0	1.52	0	0	0	0
23	0	0	0	0	0	9.65	3.81	1.27	0	0	0	0
24	0	0	0	0	0	7.87	4.06	0	0.25	0	0	0
25	0	0	0	0	0.25	4.32	9.4	7.11	0	0	0	0
26	0	0	0	0	0	4.32	13	0	4.57	0	0	0
27	0	0	0	0	0	4.83	62.2	0	0	0	0	0
28	0	0	0	2.79	0.76	0.25	29.5	2.29	1.02	0	0	0
29	0	0	0	0	0	0	106	5.84	0	0	0	0
30	0		0	0	13.7	6.6	57.4	6.6	1.78	0	0	0
31	0		0		1.78		10.9	0		0		0
Total	**0**	**0**	**0.51**	**21.6**	**27.4**	**121**	**385**	**195**	**62**	**121**	**12.7**	**0**

Prepared by Knight Piésold.

Source: Lakes Environmental Software.

Graph 3: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold
Source: MWMCL

As part of complementary information to estimate the inventory of emissions due to wind erosion, weather data shown in Table 10 was used. This weather data was recorded between July 1995 and April 2007 by the weather station located in the project area.

Table 10: Maximum wind speed (July 1995 to April 18, 2007)

Month	Year/ maximum wind speed[1]									Maximum
	1995	**1996**	**1997**	**2001**	**2003**	**2004**	**2005**	**2006**	**2007**	
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6

Prepared by Knight Piésold
Source: MWMCL
Notes:
(1) Weather station collapsed and broke into pieces due to strong wind (April 18, 2007, 16:35 hr).

4.3 AIR QUALITY DISPERSION MODELING

Air quality dispersion modelling took place for the project's construction and operation phases, taking into account the influence of changes caused by the dry and wet season (mainly wind speed variations due to monsoon influence).

Considering the project's extractive characteristics, dust emissions (PM_{10} and $PM_{2.5}$) have been inventoried; of these emissions, it was considered modelling PM_{10} emission dispersion, given that it is seen as an air quality impact indicator for extractive open pit mining activities (Vallero, 2008).

4.3.1 Particulate Matter Emission Inventory

Estimation of emission factors[3] (*EF*) for particulate matter ($PM_{10}$and $PM_{2.5}$), based on each assessed activity, was performed by applying standardized methods approved by the United States Environmental Protection Agency (USEPA), which are published in the AP-42 Guide, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (USEPA, 1995-2011). Moreover, the parameters used for estimating the *EF* were based on the specific project characteristics for the construction and operation phases. These parameters were provided by MWMCL, while meteorological parameters were based on weather data generated by the MM5 model and weather station records about maximum wind speed:

- Total blast area (m^2)
- Relative humidity content of material (%)
- Material drop height from excavators (m)
- Fine particle content of material (%)
- Mean vehicle weight (Mg)
- Fines load on paved road surface (g/m^2)
- Mean wind speed in project area (m/s)
- Number of days and hours with precipitation above 0.254 mm

[3]According to USEPA, an emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity linked with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of material handled).

- Sulphur content in diesel fuel[4]
- Vehicle fleet power in kW units

After estimating *EF* per activity, PM_{10} and $PM_{2.5}$ (units: kg/year and g/s) were estimated by applying the general emission estimation equation (USEPA, 1995-2011):

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where *E* is emission, *A* is activity rate, *EF* is emission factor, and *ER* is overall emission reduction efficiency in percent. Estimation of activity levels (A) was based on available project-related information for the construction and operation phases:

- Area of each component
- Number of drilling and blasting events per month
- Material volume obtained per blast
- Number of front loaders (loader and dozer), trucks (light and heavy) and vehicles (pickup trucks)
- Load capacity of loaders and trucks, in tons
- Tons of topsoil removed (tons/month)
- Machinery operation time per day (hours)
- Kilometres covered by machinery per day
- Monthly excavated material volume
- Material hauling by trucks (tons/month)
- Material unloading by trucks (tons/month)
- Length of paved and unpaved roads (km)
- Mean annual evaporation level in inches
- Frequency of hours watering unpaved roads
- Watering intensity on unpaved roads (gallons per square yard)
- Maximum monthly wind speed (m/s)
- Soil texture characteristics and fines content at surface (%)
- Waste rock dump sizes (m^2)

[4]A sulfur content value of 2,000 ppm has been assumed, based on information from the United Nations Environment Programme (UNEP) – Diesel Fuel Sulphur Levels: Global Status December 2012, available at: www.unep.org/transport/pcfv

The construction phase includes activities that will be performed within the area comprising the mine, access roads, and the road close to the project site. Table 11 shows a list of activities that will be carried out during the construction phase.

Table 11: Activities during construction phase

Component	Activity
Mining area	Drilling Blasting Bulldozing (removing topsoil) Bulldozing (travel mode) Crawler dozer and grading Digging Loading trucks Unloading trucks in waste rock dumps Fuel consumption (diesel)
Unpaved roads	Travel of mining dump truck from digging area to waste rock dumps Travel of light trucks Fuel consumption (diesel)
Paved roads (highway near to mining area)	Travel of light vehicles Fuel consumption (diesel)

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The operation phase includes activities that will take place within the area comprising the pit, material haul roads, waste rock dumps, crushers and road close to project area. Table 12 shows a list of activities that will be performed during this phase.

Table 12: Activities during operation phase

Component	Activity
Open pit	Drilling Blasting Earthmoving in blast area (loader, crawler dozer and ballgrader) Loading of dump trucks delivering ore and waste rock Loader travel in blast area Fuel consumption by equipment (trucks, dozer, and others) Haul truck travel in blast area to crushers (dust from wheeled) Haul truck travel in blast area to crushers (dust from exhaust)
Road from open pit to waste rock areas	Haul truck travel to waste rock storage area (dust from wheeled) Haul truck travel to waste rock storage area (dust from exhaust)
Waste rock storage areas (WRD1 and WRD2)	Haul truck unloading at waste rock areas Dozer activity in waste rock areas Wind erosion in WRDs, applied to maximum wind speed
Crushers semi-mobile	Unloading to each semi-mobile crusher Primary crushing (High-moisture ore) Material handling and transfer for each point (High-moisture ore)
Highway near to mining area	Light duty vehicles (dust from wheeled) Light duty vehicles (dust from exhaust)

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<u>Construction Phase</u>

During the construction phase, activities related to drilling and blasting, earthworks (topsoil removal, excavations and land grading), loading and unloading of materials by trucks, and light and heavy vehicle traffic on paved and unpaved roads will take place.

Table 13 shows the assessed activities and their emission factors, for which equations including a scaling factor representing a particle-size dependent emission magnitude have been used. Based on an activity-level assignment, emissions have been determined according to their source. Table 14 shows emissions according to source type.

Table 13: Emission factors during construction phase

Activity	Description	Scaling Factors (k)		Emission factor equations by activity (1, 2, 3)		Emission factor (EF)			Reference (1)
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Drilling for blasting	-	0.52	0.03	EF = k*0.59	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
Blasting	-	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	0.10349	0.00597	kg/blast	AP-42 Blasting - Section 11.9
Earthmoving (overburden, removing topsoil)	Bulldozing (removing top soil)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	1.67006	1.83253	kg/hr	AP-42 Dozer equation - Section 11.9
	Bulldozing travel mode	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	3.00776	0.30078	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Crawler dozer and grading	0.25	0.025	EF = k*0.029	EF	0.00725	0.00073	kg/Mg	AP-42 Dozer equation - Section 11.9
	Excavator	0.75	0.017	$k*0.0029 (d)^{0.7}/(M)^{0.3}$	$k*0.0046 (d)^{1.1}/(M)^{0.3}$	0.00547	0.00012	kg/m^3	NERDDC (1988) & SPCC (1983), cited by NPI (2012)
	Fuel consumption - earthmoving	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
Trucks loading	Digging area	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Loading equation - Section 13.2.4
Trucks unloading	Waste dump	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Unloading equation - Section 13.2.4
Material transport - roads	Unpaved roads - Mining dump truck	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.28337	0.12834	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Unpaved roads - Light trucks	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.65094	0.06509	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Paved roads	0.62	0.15	$EF = [k (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.1
	Fuel consumption - light truck and light duty vehicles	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
	Fuel consumption - Mining dump truck	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*0.473-S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor (2)

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(1) Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

(2) Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

(3) Symbols for equations:	Value	Description
A: Area per blast (m^2)	93.5	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	10	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	21.1	Moisture content of overburden, material handling by excavator and bulldozers.
M: Material moisture content (%)	17	Moisture content of overburden, material handling by loading and unloading.
d: drop height (m)	13.8	Excavator.
s: Material silt content (%)	10	Silt content of material on unpaved roads.
s: Material silt content (%)	50	Silt content of material overburden.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer
W: Mean vehicle weight (Mg)	113	Dump Truck (TR100, TEREX). Average weight between net weight and net load.
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Representative value, source: Table 13.2.1-3, Section 13.2.1 Paved Roads.
P: Precipitation with at least 0,254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0,254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 14: Construction phase – Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Mining area	116,354.3	3.6896	67,658.0	2.1454
Line	Paved roads – Highway	30,212.9	0.9580	11,170.1	0.3542
	Unpaved roads - Mining Dump truck	105,052.2	3.3312	40,190.2	1.2744
	Unpaved Roads - Light trucks	16,392.3	0.5198	4,637.8	0.1471
Total		268,011.6	8.4986	123,656.0	3.9211

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Below, calculation of PM_{10} and $PM_{2.5}$ emissions is detailed for each activity.

Drilling and Blasting

Drilling and blasting activities are considered for extracting construction materials, rock removal and preparing the land for setting up facilities and/or building infrastructure. Calculation of particulate matter emissions due to drilling considers the number of drilling events to be performed, while the calculation corresponding to blasting events considers the number of blasting events to be conducted and the horizontal area removed by each blast. It is worth highlighting that no particulate matter emission reduction control measures have been considered for these activities. Table 15 shows emission estimation results for drilling and blasting activities. Equations considered for emission estimation are the following:

$$E = EF \times N$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor, and *N* is the number of drilling events performed per year.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is a scaling factor based on size of emitted particles, *N* is the number of blasting events per year, and *A* is the horizontal area removed by blasting (m^2). Total blasting area considered was 24,693.08 m^2 per year, while 22 blasting events equivalent to a volume of 180,000 m^3 were considered per month. Based on this information, a value of *A* = 93.5 m^2 per blast was determined.

Table 15: Construction phase - Drilling, blasting, earthmoving and handling

Activity	Installation/Sub activity	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
Drilling	Mining area	10,800	hole/yr	0.30680	0.01770	kg/hole	3 313.4	0.105	191.2	0.006
Blasting	Mining area	264	blast/yr	0.10349	0.00597	kg/blast	27.3	0.001	1.6	0.000
Bulldozing (removing top soil)	Mining area	29,200	hr/yr	1.67006	1.83253	kg/hr	48,765.9	1.546	53 509.8	1.697
Bulldozing travel mode	Mining area	3,650	VKT/yr	3.00776	0.30078	kg/VKT	10,978.3	0.348	1 097.8	0.035
Crawler dozer and grading	Mining area	3 600,000	Mg/yr	0.00725	0.00073	kg/Mg	26,100.0	0.828	2 610.0	0.083
Digging by excavator	Mining area	3 000,000	m^3/yr	0.00547	0.00012	kg/m^3	16,413.9	0.520	372.0	0.012
Loading trucks	Mining area	12 000,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	378.1	0.012	57.3	0.002
Unloading trucks	Waste Dump	9 600,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	302.5	0.010	45.8	0.001
Fuel consumption (diesel)	Drilling and blasting	16 060,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,916.4	0.092	2 828.9	0.090
	Bulldozing (loader, dozer, crawler and grader)	26 280,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	4,772.2	0.151	4 629.1	0.147
	Excavator in mining area	13 140,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,386.1	0.076	2 314.5	0.073
Total							**116,354**	**3.690**	**67,658**	**2.145**

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Data input used to estimate activity rates:

Description	Value	Notes	Source
Number of hole by month	900	Depth of 10,350 m	Myanmar Wanbao Mining Copper Limited
Number of blast by month	22	Quantity = 180,000 m^3	Myanmar Wanbao Mining Copper Limited
Number of loader and dozer for bulldozing	10	Models: LW800K, ZL50G, MD32	Myanmar Wanbao Mining Copper Limited
Removing topsoil (tonnes/month)	300,000	2 Grader and 6 crawler dozer.	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Kilometer travelled per loader	1	km/day from 8:00 a.m. - 6:00 p.m.	Value estimated by extension area of the project.
Material handling	250,000	Volume of material in m^3/month for digging.	Myanmar Wanbao Mining Copper Limited
Material handling	1000,000	Material loading tonnes/month.	Myanmar Wanbao Mining Copper Limited
Material handling	800,000	Material unloading tonnes/month.	Myanmar Wanbao Mining Copper Limited

Earthmoving

Estimation of particulate matter emission due to earthmoving activities comprises piling up and arranging materials, stripping, filling, machinery traffic, grading and excavation. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 15 shows emission results for the mentioned activities.

Equations considered for estimating emissions based on each activity are detailed below.

Bulldozing (Removing Topsoil)

Equations from USEPA's Guide AP-42, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation that determines PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation to calculate $PM_{2.5}$ emissions is the one below:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is the scaling factor based on size of emitted particles, *s* is fine particle content (%), *M* is the material's moisture content (%) and *T* is machinery operation time (hours). Values assigned are *s* = 50%, *M* = 21.1% and *T*= 29,200 h/year.

Bulldozing Travel Mode

Particulate matter emissions caused by earthmoving machinery travel were estimated through the following equations (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor in kg/VKT units, *VKT* is total kilometres covered by machinery per year (km/year), *k* is a scaling factor constant based on size of emitted particles in lb/VMT units, *s* is fine particle content (%), *W* is mean weight of all machinery (tons), and *P* is number of days with

precipitation above 0.254 mm per year. Values assigned are *VKT* = 3,650 km/year, *s* = 50%, *M* = 21.1% and P= 110 days/year (Lakes Environmental, 2013).

Crawler Dozer and Grading

Particulate matter emissions generated by using machinery for grading and moving topsoil were estimated through the following equation (USEPA, 1995-2011):

$$E = A \times k \times EF$$

Where *E* is PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/Mg units, and *k* is scaling factor based on size of emitted particles. Values assigned are *EF* = 0.029 kg/Mg (Table 11.9-4, Section 11.9, AP-42, USEPA) and *A* = 3600,000 Mg/year equivalent to 300,000 tons/month.

Excavating

PM_{10} emissions generated by excavator use were estimated through the following equation:

$$E = k \times 0.0029 \times \frac{d^{0.7}}{M^{0.3}} \times V$$

While the equation that determines $PM_{2.5}$ emissions is as follows:

$$E = k \times 0.0046 \times \frac{d^{1.1}}{M^{0.3}} \times V$$

Where E are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *d* is material drop height (m), *M* is the material's moisture content (%), and *V* is material volume to be removed. Values assigned are *d* = 13.8 m, *M* = 21.1% and *V* = 3,000,000 m^3/year, equivalent to 250,000 m^3/month.

Loading and Unloading of Material

Activities related to loading and unloading of material take place in different project execution areas. Haul trucks are loaded with power shovels, while the material is directly unloaded at the work fronts and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 15 shows emission estimation results for the mentioned activities.

Emissions due to loading and unloading of material were based on USEPA's Guide *AP-42*. It is worth pointing out that the same equation is used for estimating both activities' emissions:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *U* is mean wind speed (m/s), *M* is the material's moisture content (%), and *Q* is quantity of material that will be loaded or unloaded per year. Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 17% and *Q* = 12,000,000 Mg/yr (loading) and 9,600,000 Mg/yr (unloading).

Vehicle Traffic on Paved and Unpaved Roads

Considerations are that particulate matter emissions produced by vehicle traffic will have its origin in unpaved haul roads, as well as in light vehicle traffic on paved roads close to the project area. Table 16 shows particulate matter emission results.

Below, criteria considered for estimating emissions are detailed.

Table 16: Construction phase - Material transporting

Activity	Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM10 Emissions		PM2,5 Emissions	
		Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
Travel of mining dump truck on unpaved roads	Digging area to waste dump	105,495	Vehicles/yr	1 265,934	VKT/yr	1.28337	0.12834	kg/VKT	96	70 932	2.249	7,093	0.225
Travel of light trucks on unpaved roads	Mining area	37,960	Vehicles/yr	455,520	VKT/yr	0.65094	0.06509	kg/VKT	96	12 946	0.411	1,295	0.041
Travel of light duty vehicles on paved roads	Highway near to mining area	58,400	Vehicles/yr	876,000	VKT/yr	0.02844	0.00688	kg/VKT	-	24 910	0.790	6,027	0.191
Fuel consumption (diesel)	Digging area to waste dump	105,495	hr/yr	110 769,231	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	34 121	1.082	33,097	1.049
	Mining area	37,960	hr/yr	18 980,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	3 447	0.109	3,343	0.106
	Highway near to mining area	58,400	hr/yr	29 200,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	5 302	0.168	5,143	0.163
Total										**142 908**	**4.532**	**47 511**	**1.507**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	35	Route from digging area to waste dump. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Number of other trucks	13	Refuelling truck, light truck, truck with crane, and maintenance truck.	Myanmar Wanbao Mining Copper Limited
Number of light duty vehicle by hour	20	Weight vehicle between1.8 to 20 tonnes.	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	91	91 tonnes per dump truck. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Length of unpaved roads (km)	6	Digging area (open pit) to waste dumps, averaged value.	Value estimated by extension area of the project.
Length of paved roads (km)	15	Paved roads near to mining area.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	36	Vehicles per hour for dump truck	Value calculated.
Time between water application in hours (T)	3	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.2	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

Dust Entrainment from Unpaved Roads

Different routes are considered for hauling material between work fronts and WRDs. Particulate matter emissions caused by hauling material on considered routes were based on Section 13.2.2, Unpaved Roads of USEPA's AP-42 Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by trucks per year (km/year), *k* is scaling factor constant based on size of emitted particles lb/VMT units, *s* is fine particle content (%), *W* is mean weight (tons) of heavy trucks or light vehicles, and *P* is number of days with precipitation above 0.254 mm per year. Values assigned were *VKT* = 1,265,934 km/year for heavy trucks and 455,520 km/year for light vehicles, *s* = 10%, *W* =113 Mg (heavy trucks) and 25 Mg (light vehicles) and P= 110 days/year (Lakes Environmental, 2013). Length of assigned road route was 6 km and includes the area between the excavation area and WRDs. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (TEREX T100).

On the other hand, as a mitigation measure on dirt roads that will be used for hauling material, road watering by tank trucks is considered. Efficiency percentage of emission reduction, *ER*, has been determined by applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Where *ER* is dust reduction efficiency of watering roads with tank trucks, *A* is annual evaporation level (inches), *D* is mean vehicle traffic per hour, *T* is time between two road watering events (hours), and *I* is watering intensity (gal/yd^2). Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 36 trucks/hour, *T* = 3 hours, *I* = 2.2 gal/yd^2. Using these values in the above dust emission reduction equation yields an *ER* value of 96%.

<u>Dust Entrainment from Paved Roads</u>

Paved roads closest to the study area have been considered as possible routes for construction material transportation and light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1000}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by vehicles per year (km/year), *k* is scaling factor constant based on size of emitted particles in g/VKT units, *sL* is road surface fines load (g/m^2), *W* is mean vehicle weight (tons), and *P* is number of hours with precipitation over 0.254 mm per year. Values assigned are *VKT* = 876,000 km/year, *sL* = 2 g/m^2 (conservative value), *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons.

Fuel Consumption by Equipment and Vehicles

Emissions due to fuel consumption have been assumed to depend on percentage of sulfur in fuel, fuel type, machinery and vehicle power, load factor, and mean machinery and vehicle lifespan. Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to the following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Where $EF_{adj(PM)}$ is a sulfur content-adjusted emission factor, *AR* is the activity level (hp-hr/yr), EF_{ss} is zero-hour steady-state emission factor (g/hp-hr), *TAF* is transient adjustment factor (unitless), *DF* is deterioration factor (unitless), and S_{PMadj} is the emission factor's adjustment factor, which depends on fuel sulfur content (g/hp-hr).

Values assigned for determining emission factor are EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery) and 2.37 (heavy trucks), *DF* = 1.116, S_{PMadj} = 0.03438 (vehicles and machinery) and 0.040167 (heavy trucks).

Operation Phase

During the operation phase, activities related to drilling and blasting, earthmoving, material loading and unloading, heavy vehicle traffic on paved roads between the pit and the WRDs (haul roads), wind erosion of stockpiles at WRDs, unloading at semi-mobile crushers, materials crushing, ore handling, ore transfer to heap leach piles (HLPs), and vehicle traffic along paved roads will take place.

Table 17 shows assessed activities and their emission factors, for which equations that include a scaling factor representing emission magnitude based on particle size, have been used. According to activity level assignment, emissions were determined based on their source. Table 18 shows emissions based on source type.

Table 17: Emission factors for mine operations

Activity		Scaling factors (k)		Equations of emission factor by activity (1, 2, 3)		Emission factor (EF)			Reference (1)
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Open pit									
1	Drilling	0.52	0.03	$EF = k*0.59$	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
2	Blasting	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	3.61765	0.20871	kg/blast	AP-42 Blasting - Section 11.9
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	1.16153	kg/hr	AP-42 Dozer equation - Section 11.9
4	Loading of dump trucks delivering ore and waste rock	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Loading equation - Section 13.2.4
5	Loader travel in blast area	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.70659	0.07066	kg/VKT	AP-42 Travel on unpaved roads - Section 13
6	Fuel consumption by equipment (trucks, dozer, and others)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
7	Haul truck travel in blast area to crushers (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
8	Haul truck travel in blast area to crushers (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor (2)
Road from open pit to waste rock areas (waste road)									
9	Haul truck travel to waste rock storage area (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
10	Haul truck travel to waste rock storage area (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
Waste rock storage areas (WRD1 and WRD2)									
11	Haul truck unloading at waste rock areas	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Unloading equation - Section 13.2.4
12	Dozer activity in waste rock areas	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	2.31756	kg/hr	AP-42 Dozer equation - Section 11.9
13	Wind erosion in WRDs, applied to maximum wind speed.	0.5	0.075	$EF = k \sum_{1}^{N} P_i$ $P = 58 (u^*-u_t^*)^2 + 25(u^*-u_t^*); P = 0 \text{ if } u^* \leq u_t^*$	EF	0.014	0.0011	$g/m^2.hr$	AP-42 Industrial wind erosion - Section 13.2.
Crushers semi-mobile									
14	Unloading to each crusher semi-movil	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.0004	0.0001	kg/Mg	AP-42 Unloading equation - Section 13.2.4
15	Primary crushing (High-moisture ore)	-	0.2	$EF = 0.004$	k*EF	0.004	0.0008	kg/Mg	AP-42 Primary crushing - Section 11.24
16	Material handling and transfer for each point (High-moisture ore)	-	0.3	$EF = 0.002$	k*EF	0.002	0.0006	kg/Mg	AP-42 Material handling and transfer - Sectio
Highway near to mining area									
17	Light duty vehicles (dust from wheeled)	0.62	0.15	$EF = [k\ (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.
18	Light duty vehicles (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)

Prepared by Knight Piésold.
(1)Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).
(2) Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

(2) Symbols for equations:	Value	Description
A: Area per blast (m^2)	1,000	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	2.75	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	2.75	Moisture content of overburden, material handling by loading and unloading.
s: Material silt content (%)	10	Silt content in % by weight.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer and loader.
W: Mean vehicle weight (Mg)	153.1	Dump Truck TEREX (TR100, NTE260). Average weight (net weight and net load).
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Assumed as conservative value (AP-42, Table 13.2.1-3, Section 13.2.1 Paved Roads).
P: Precipitation with at least 0.254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0.254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv.
Horsepower by equipment	500	Representative value for earthmoving equipment and light vehicles (load factor = 0,59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 18: Operation phase - Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Open pit	157,889	5.0066	56,488	1,7912
Line	Open pit	202,039	6.4066	57,178	1,8131
Line	Open pit to WRD#1	46,949	1.4887	4,746	0,1505
Line	Open pit to WRD#2	4,107	0.1302	436	0,0138
Area	WRD#1	28,884	0.9159	15,118	0,4794
Area	WRD#2	2,512	0.0796	1,315	0,0417
Area	WRD#1 - wind erosion	22,241	0.7053	1,668	0,0529
Area	WRD#2 - wind erosion	1,820	0.0577	136	0,0043
Area	Crushed ore #1	14,862	0.4713	2,906	0,0922
Area	Crushed ore #2	14,862	0.4713	2,906	0,0922
Area	Transfer #1	13,500	0.4281	4,050	0,1284
Area	Transfer #2	13,500	0.4281	4,050	0,1284
Line	Highway 1	25,069	0.7949	6,181	0,1960
Line	Highway 2	35,097	1.1129	8,653	0,2744
Total		583,333	18.4974	165,832	5.2585

Prepared by Knight Piésold.

Open Pit

In the pit area, considerations are that activities related to drilling, blasting, earthmoving, material loading, truck and machinery travel along roads, and fuel consumption will take place. Tables 19 and 20 show calculation results for particulate matter emissions from the pit.

Table 19: Emission sources in open pit - Drilling, blasting, earthmoving and loading

Activity		Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	**Units**	**PM_{10}**	**$PM_{2,5}$**	**Units**	**kg/year**	**g/s**	**kg/year**	**g/s**
1	Drilling	13,416	hole/yr	0.30680	0.01770	kg/hole	4 116.0	0.131	237.5	0.008
2	Blasting	604	blast/yr	3.61765	0.20871	kg/blast	2 185.1	0.069	126.1	0.004
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	43,800	hr/yr	2.58945	1.16153	kg/hr	113 418.0	3.596	50 875.0	1.613
4	Loading of dump trucks delivering ore and waste rock	69 000,000	Mg/yr	0.00040	0.00006	kg/Mg	27 853.9	0.883	4 217.9	0.134
5	Loader travel in blast area	14,600	VKT/yr	0.70659	0.07066	kg/VKT	10 316.3	0.327	1 031.6	0.033
6	Fuel consumption by equipment (trucks, dozer, and others)	21 900,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	3 976.9	0.126	3 857.6	0.122
Total							**157,889**	**5.007**	**56,488**	**1.791**

Prepared by Knight Piésold.
Source: Myanmar Wanbao Mining Copper Limited.
Parameters used:

Description	Value	Notes
Number of hole by month	1,118	Total depth of 19 000 m (17 m per hole)
Number of blast by year	604	Quantity = 3.5 million tonne/month
Number of loader	5	Model: LW800K, ZL50G (XCMG).
Number of dozer	5	Model: MD32 (Inner Mongolia)
Number of crawler dozer	3	Model: CAT D9R and D475A-EO (KOMATSU).
Number of ballgrader.	2	Model: 14M (CAT).
Kilometre travelled per loader in blast area	1	km/day from 8:00 a.m. - 6:00 p.m.
Material handling in kt (kilo tonne by year)	69,000	Mining plan for year 5 (ore and waste rock).
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.

Table 20: Emission sources in open pit - Haul truck travel in open pit

Activity		Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
7	Haul truck travel in blast area to crushers (dust from wheeled)	Blast area	559,964	Vehicles/yr	1 119,928	VKT/yr	1.47112	0.14711	kg/VKT	90	159.540	5.059	15,954	0.506
8	Haul truck travel in blast area to crushers (dust from exhaust)	Blast area	8	worked hrs/Veh-day	137 970,000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	42.499	1.348	41,224	1.307
Total											**202,039**	**6.407**	**57,178**	**1.813**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Haulage routes average per truck (km)	1	Material transport on unpaved roads in open pit.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	128	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

<u>Drilling and Blasting</u>

During the operation phase, drilling and blasting activities are considered necessary for ore extraction. Calculation of particulate matter emissions due to drilling considers the number of drilling events, which was estimated based on information provided by MWMCL related to drilling depth for each blasting event (17 m per hole) and total drilling distance per month (19,000 m). Furthermore, for the calculation corresponding to blasting events, MWMCL information has been taken into account, which considers a total blasting area of 603,900 m^2 per year, equivalent to a quantity of 3.5 million tons per month. It is worth noting that no particulate matter emission reduction control measures have been considered for these activities. Table 19 shows emission results for the mentioned activities.

Equations considered for estimating emissions were the following:

$$E = EF \times N$$

Value assigned for emission calculation was for *N* = 13,412 holes/yr.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

According to information provided by MWMCL, total blasting area amounts to 603,900 m^2 per year and generates 3.5 million tons per month. Based on this information, the following values were determined: *A* = 1,000 m^2 per blast and *N* = 604 blasting events per year.

<u>Earthmoving</u>

Estimation of particulate matter emissions due to earthmoving activities comprises material stockpiling and arrangement, stripping, filling, machinery traffic, and grading. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 19 shows emission results for the mentioned activities.

Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation for calculating PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation used for calculating $PM_{2.5}$ emissions is as follows:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are *s* = 10%, *M* = 2.75% and *T*= 43,800 h/year.

Loading of Dump Trucks Delivering Ore and Waste Rock

Trucks are loaded with material at the pit. These materials are then transported to crusher or WRDs. Truck loading is performed by power shovels, while unloading takes place directly at semi-mobile crushers and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 19 shows emission results for material loading activities.

Material loading emissions were based on USEPA's *AP-42* Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 69,000 kt/yr (load).

Loader Travel in Blast Area

Equation considered for estimating front loader emissions within blasting area is the following:

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned are *VKT* = 14,600 km/year, *s* = 10%, *M* = 2.75% and P= 110 days/year (Lakes Environmental, 2013). Table 19 shows emission results for activities related to machinery traffic.

Fuel Consumption by Equipment

Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010), according to the following equations:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{SS} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining the emission factor are *NA* = 21,900,000 hp-hr/yr, EF_{SS}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), *DF* = 1.116, S_{PMadj}= 0.03438 (vehicles and machinery).

Haul Truck Travel in Blasting Area to Crushers

Particulate matter emissions caused by hauling material between blasting area and crushers were based on Section 13.2.2, Unpaved Roads, of USEPA's *AP-42* Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned were *VKT* = 1 119,928 km/year, *s* = 10%, *W* =153.1 Mg and P = 110 days/year (Lakes Environmental, 2013). Assigned road route length was 1 km. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (123 tons).

Emission estimation was also considered, due to the trucks' fuel consumption. This estimation was made by applying the equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{SS} \times TAF \times DF - S_{PMadj}$$

On the other hand, as a mitigation measure for dirt roads that will be used for hauling materials, road watering using tank trucks is considered. The efficiency percentage of emission reduction, *ER*, has been determined applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 128 trucks/hour, *T* = 2 hours, and *I* = 2.34 gal/yd^2. Applying these values in the above dust emission reduction equation one obtains *ER* = 90%. Emission estimation results are shown in Table 20.

Road from Open Pit to Waste Rock Areas

Roads that go from the pit boundary to waste rock dumps 1 and 2 (WRDs) generate emissions due to re-suspension of particulate matter from unpaved road surface, as well as particulate matter emissions due to the trucks' fuel combustion. These emission sources have been estimated using the following equations:

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

As control measure, it has been considered to water the roads using tank trucks. Emission reduction efficiency has been determined through the equation below:

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 72 trucks/hour, *T* = 2 hours (8:00-10:00 a.m., 3:00-5:00 p.m.), and *I* = 2.34 gal/yd^2. Inserting these values in the above dust emission reduction equation yields *ER* = 95%.

Table 21 shows calculation results for particulate matter emissions generated along the route between pit boundary and waste rock dumps (WRDs).

Table 21: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

	Activity	Line sources	Length	Data (conservative value)		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			km	Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
9	Haul truck travel to waste rock storage area (dust from wheeled)	Open pit to WRD #1	1	291 181	Veh/yr	582 362	VKT/yr	1.47112	0.14711	kg/VKT	95	46 891	1.487	4 689	0.149
		Open pit to WRD #2	1	25 320	Veh/yr	50 640	VKT/yr	1.47112	0.14711	kg/VKT	95	4 077	0.129	408	0.013
10	Haul truck travel to waste rock storage area (dust from exhaust)	Open pit to WRD #1	1	4	worked hrs/Veh-day	189 000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	58	0.002	56	0.002
		Open pit to WRD #2	1	2	worked hrs/Veh-day	94 500	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	29	0.001	28	0.001
Total												**51 056**	**1.619**	**5 182**	**0.164**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0.59)	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	39,000	Mining plan for year 5 (WRD 1 & 2).	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	72	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

Waste Rock Storage Areas (WRD1 and WRD2)

At the waste rock dumps, activities related to material unloading, earthmoving, and wind erosion exposure will take place.

Below, details of the calculation conducted for estimating emissions are provided (Table 22).

Haul Truck Unloading at Waste Rock Areas

Material unloading activities consist of directly unloading trucks at areas where waste rock dumps are located (WRDs). Table 22 shows emission results for material unloading activities. Calculation for estimating emissions generated by material unloading is based on USEPA's AP-42 Guide, applying the following mathematical expression:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 35,880 kt/yr (WRD1) and 3,120 kt/yr (WRD2).

Table 22: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
11	Haul truck unloading at waste rock areas	WRD #1	35 880,000	Mg/yr	0.00040	0.00006	kg/Mg	14,484.0	0.4593	2,193.3	0.0695
		WRD #2	3 120,000	Mg/yr	0.00040	0.00006	kg/Mg	1,259.5	0.0399	190.7	0.0060
12	Dozer activity in waste rock areas	WRD #1	5,373	hr/yr	2.58945	2.31756	kg/hr	13,912.6	0.4412	12,451.8	0.3948
		WRD #2	467	hr/yr	2.58945	2.31756	kg/hr	1,209.8	0.0384	1,082.8	0.0343
	Dozer activity in waste rock areas (dust from exhaust)	WRD #1	2 686,400	hp-hr/yr	0.18159	0.17614	g/hp-hr	487.8	0.0155	473.2	0.0150
		WRD #2	233,600	hp-hr/yr	0.18159	0.17614	g/hp-hr	42.4	0.0013	41.1	0.0013
Total								**31 396**	**0,9956**	**16 433**	**0.5211**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Number of dozer	4	Model: MD32 (Inner Mongolia)	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	4	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

Dozer Activity in Waste Rock Areas

Machinery linked to this type of activity for earthmoving is caterpillar tractors and graders. Table 22 shows emission results for the mentioned activities. Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) have been considered.

Calculation of PM_{10} emissions is based on the following expression:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the expression below has been used for calculating $PM_{2.5}$ emissions:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are s = 10%, *M* = 2.75% and *T*= 5,373 hr/year (WRD1) and 467 hr/year (WRD2).

Moreover, emissions generated by fuel consumption have been estimated through the following equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining emission factor are *NA* = 2 686,400 hp-hr/yr (WRD1) and 233,600 hp-hr/yr (WRD2), EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), and *DF* = 1.116, and S_{PMadj}= 0.03438 (vehicles and machinery).

Wind Erosion in WRDs

Estimation of emissions caused by wind erosion has been determined based on monthly weather data recorded by the weather station located in the study area between July 1995 and April 2007. Based on this information, friction velocity values have been determined, which are influenced by roughness height of the surface to be eroded. The procedure for calculating particulate matter emissions was based on USEPA's AP-42 Guide, Section 13.2.5, Industrial Wind Erosion.

Friction velocity has been estimated using the following equation (USEPA, 1995-2011):

$$u(z) = \frac{u^*}{0,4} \ln \frac{z}{z_o} (z > z_o)$$

Where *u* is wind speed, *u** is friction velocity, *z* is height above test surface, and z_o is roughness length. Upon calculating friction velocity, erosion potential was determined based on exposed surface (fine material) by applying the following expression (USEPA, 1995-2011):

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 0 \text{ for } u^* \leq u_t^*$$

Where *P* is erosion potential in g/m^2, and u_t^* is threshold friction velocity, which depends on the type of exposed material. A value of 0.58 m/s was considered for u_t^*, which represents fine material for *s* = 10%. Furthermore, based on a frequency distribution analysis of weather data generated by the MM5 model, it was determined that wind speeds above 5.7 m/s present a frequency of 2.4% (Lakes Environmental, 2013). Table 23 shows calculation results for monthly erosion potential based on wind speed frequency.

Subsequently, emissions were estimated by applying the following equation:

$$E = k \times \sum_{i=1}^{N} P_i \times A$$

Where *N* is number of perturbations, P_i is potential erosion corresponding to maximum speed for period *i* between perturbations, and *A* is surface area that presents wind-erodible material. It should be pointed out that according to hourly weather data generated by MM5 model, maximum mean wind speeds correspond to 8.8 m/s; hence, it is estimated that wind speed perturbations above 11 m/s occur for time periods of less than 1 hour. Table 24 shows calculation results for emissions due to wind erosion events at waste rock dumps.

Table 23: Erosion potential emission factors

Month	Maximum wind speed (January 1995 to 18-Apr-2007) (1)									Max - u (m/s)	Friction velocity u* (m/s)	Erosion potential - P (g/m^2)	Emission factor $g/(m^2.hr)$	
	1995	1996	1997	2001	2003	2004	2005	2006	2007			PM	EF - PM_{10}	EF - $PM_{2,5}$
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6	0.29	0.00	0.00	0.00
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8	0.36	0.00	0.00	0.00
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1	0.43	0.00	0.00	0.00
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3	0.54	0.00	0.00	0.00
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6	0.61	0.82	0.01	0.00
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2	0.54	0.00	0.00	0.00
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1	0.48	0.00	0.00	0.00
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6	0.40	0.00	0.00	0.00
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8	0.62	1.17	0.01	0.00
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0	0.32	0.00	0.00	0.00
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2	0.33	0.00	0.00	0.00
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6	0.35	0.00	0.00	0.00

Prepared by Knight Piésold.

Notes:

(1) Weather station was fall down and damaged into pieces by strong wind (18 April 2007, 16:35 hr).

Parameters	Value	Units	Source
Threshold friction velocity - u_t* (m/s)	0.58	m/s	AP-42, Table 13.2.5-1 (Tyler sieve No. 32)
Roughness height for open terrain (m)	0.005	m	AP-42, Industrial wind erosion.
Scaling factor k ≤ 10 μm	0.5	-	AP-42, Table 13.2.5-2
Scaling factor k ≤ 2,5 μm	0.075	-	AP-42, Table 13.2.5-3
Hourly wind class frequency distribution > 5,7 m/s	2.4	%	Lakes environmental (2013).

Table 24: Wind erosion emissions in Waste Rock Dumps (WRDs)

Month	Emission factor g/(m^2.hr)		Emissions (g/s)				Scaling factor
			WRD #1		WRD #2		
	EF - PM_{10}	EF - $PM_{2,5}$	PM_{10}	$PM_{2,5}$	PM_{10}	$PM_{2,5}$	
Jan	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0
May	0.0098	0.0007	0.290	0.022	0.024	0.002	0.4
Jun	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0
Sep	0.0140	0.0011	0.416	0.031	0.034	0.003	0.6
Oct	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0
Total			**0.705**	**0.053**	**0.058**	**0.004**	**1**

Prepared by Knight Piésold.

Assumptions:
Control efficiency for water spray assumed to be 50% (NPI, 2012).
2.4% of time that wind speed is greater than 5.7 m/s (Lakes Environmental, 2013).
Disturbed area for WRDs assumed to be 10% of silt content, due to soil texture analysis (Gravel Clay Silty Sandy) according to Knight Piésold (2000).

Parameters	Value	Disturbed area	Units
Total area of WRD #1 - 92.44%	2 132,700	213,270	m^2
Total area of WRD #2 - 17.45%	174,500	17,450	m^2
Total area - 100%	2 307,200	230,720	m^2

Semi-Mobile Crushers

Considerations are that activities related to material unloading, material crushing and transfer from conveyor belt to heap leach piles will take place at crusher area. Table 25 shows calculation results for particulate matter emissions resulting from the mentioned activities.

Table 25: Emission sources at semi-mobile crushers - Unloading, Crushing and Material Handling

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
14	Unloading to each crusher semi-movil	Crushed ore #1	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
		Crushed ore #2	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
15	Crushing ore and wet suppression systems (spray nozzles)	Crushed ore #1	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
		Crushed ore #2	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
16	Material handling and transfer for each point	Transfer #1	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
		Transfer #2	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
Total								**56,725**	**1.7987**	**13,913**	**0.4412**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	30,000	Mining plan for ore (year 5).	Myanmar Wanbao Mining Copper Limited
Controlled emissions by wet suppression systems (spray nozzles)	77.5	Percentage (controlled EF by wet suppression/uncontrolled EF)	AP-42, Section 11.19.2, Table 11.19.2-1.

Unloading of Material

Materials will be directly unloaded from trucks at areas where crushers are located. Emissions generated by unloading material were based on USEPA's AP-42 Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 30,000 kt/yr. Moreover, application of water-spraying systems (spray nozzles) has been considered as emission reduction measure. These systems achieve emission reduction (*ER*) efficiency close to 77.5% (USEPA AP-42, Section 11.19.2, Table 11.19.2-1).

Primary Crushing

Estimation of emissions caused by crushing material was based on the following equation:

$$E = k \times 0.004 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned for calculating emissions are *Q* = 30,000 kt/yr and *ER* = 77.5%.

Material Handling and Transfer (Conveyors)

Estimation of emissions due to ore transfer to conveyor belt was based on following equation:

$$E = N \times k \times 0.002 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Where *N* is number of transfer points. Values assigned to each parameter were *N* = 2, *Q* = 30,000 kt/yr and *ER* = 77.5%.

Highway near to Mining Area

Paved roads closest to the study area have been considered as possible routes for light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1{,}000}$$

Values assigned are *VKT* = 2,102,400 km/year, *sL* = 2 g/m^2, *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons. Furthermore, emissions due to fuel consumption have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Table 26 shows calculation results for particulate matter emissions produced by the mentioned activities.

Table 26: Emission sources on road close to mining area

Activity		Line sources	No. of vehicle passes/year	Length [(1)]	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
				km	Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
17	Light duty vehicles (dust from wheeled)	Highway 1	58,400	15	876,000	VKT/yr	0.02844	0.00688	kg/VKT	24,910	0.790	6,027	0.191
		Highway 2	58,400	21	1 226,400	VKT/yr	0.02844	0.00688	kg/VKT	34,875	1.106	8,437	0.268
18	Light duty vehicles (dust from exhaust)	Highway 1	58,400	15	876,000	VKT/yr	0.18159	0.17614	g/hp-hr	159	0.005	154	0,005
		Highway 2	58,400	21	1 226,400	VKT/yr	0.18159	0.17614	g/hp-hr	223	0.007	216	0,007
Total										**60,167**	**1.908**	**14,834**	**0.470**

Prepared by Knight Piésold.
[(1)] Length of paved roads until boundary environmental baseline area.
Parameters used:

Description	Value	Notes	Source
Nº of light duty vehicle by hour	20	Representative value.	Myanmar Wanbao Mining Copper Limited
Average daily traffic (ADT)	160	Assumed equivalent to 34 vehicles.	-
Horsepower of equipment	187.7	Value for light duty vehicle (load factor = 0.59).	Myanmar Wanbao Mining Copper Limited

4.3.2 AERMOD Model Configuration

Assessment of emission sources corresponding to different activities during the construction and operation phases has been performed using the AERMOD model, which can simulate atmospheric dispersion of particle and gas emissions from one or several sources on flat and complex terrain. To this effect, hourly weather data is used (surface and altitude data), as well as the ground's geophysical characteristics, together determining parameters that characterize the atmospheric stability of the area of interest and are included in the equations governing the model (Cimorelli *et al.*, 2005). Parameters included in dispersion calculations have been determined by AERMOD pre-processors (AERMET for meteorological and ground parameters, and AERMAP for parameters related to terrain relief).

Surface and altitude weather data obtained as results from MM5 meteorological model (Lakes Environmental, 2013) has been entered in AERMET meteorological pre-processor. Regarding topographic information, it corresponds to the end of the construction phase and year 5 of the operation phase (Stage I).

<u>Sectors and Surface Parameters for Letpadaung Project Area</u>

Among the setup options represented by ground characteristics, the AERMET processor requires surface parameters such as Albedo, Bowen ratio[5] (H/λE), and roughness length (m). These parameters are considered in AERMET's processing since they influence atmospheric turbulence characterization and, hence, pollutant dispersion (Cimorelli *et al.*, 2005).

With regard to the Letpadaung Project, surface parameter information entered in AERMET's pre-processor comes from NASA reanalysis satellite data generated by the Giovanni[6] Interactive Visualization and Analysis project - GES DISC (Goddard Earth Sciences, Data and Information Services Center). Downloaded information corresponds to the period between January 2010 and December 2012; the selected area comprises southeast (SE) and northwest coordinates (NW): latitude (22.06379, 22.10488) and longitude (95.0636, 95.112749). Table 27 shows mean values throughout the months entered in AERMET's pre-processor, which were determined

[5] The Bowen ratio is used to describe the type of heat transfer. It is calculated by the equation $B = H/\lambda E$; where H is sensible hating and λE is latent heating.
[6] Retrieved in http://disc.sci.gsfc.nasa.gov/giovanni

based on information downloaded from the Giovanni project – GES DISC (Appendix A and Table 28).

Table 27: Mean surface parameters for Letpadaung Project area

Month	Albedo	Bowen ratio	Roughness length (m)
January	0.175	0.646	0.618
February	0.178	1.383	0.525
March	0.175	3.254	0.391
April	0.169	1.434	0.316
May	0.166	0.649	0.342
June	0.165	0.099	0.422
July	0.164	0.065	0.497
August	0.163	0.051	0.540
September	0.159	0.043	0.569
October	0.160	0.079	0.609
November	0.166	0.189	0.641
December	0.167	0.307	0.646

Prepared by Knight Piésold
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center.

Table 28: Surface parameters for Letpadaung Project

Year	Month	Roughness length (m)		Latent heat flux (λE) from land (W/m^2)	Sensible heat flux (H) from land (W/m^2)	Bowen ratio (H/λE)	Surface albedo (fraction)
		Sensible heat	Momentum				
2010	January	0.6	0.635	50.5	45.2	0.89	0.175
	February	0.482	0.567	35.9	69.6	1.94	0.178
	March	0.322	0.46	14.9	90.7	6.10	0.175
	April	0.237	0.394	30.5	84.2	2.76	0.168
	May	0.267	0.418	83.9	52.0	0.62	0.165
	June	0.357	0.486	131.6	12.5	0.09	0.165
	July	0.447	0.546	130.3	8.4	0.06	0.164
	August	0.501	0.579	129.2	6.2	0.05	0.164
	September	0.537	0.601	107.6	5.4	0.05	0.16
	October	0.587	0.63	95.5	4.0	0.04	0.157
	November	0.629	0.652	98.5	20.0	0.20	0.167
	December	0.636	0.656	69.8	21.5	0.31	0.167
2011	January	0.6	0.635	66.7	32.7	0.49	0.176
	February	0.482	0.567	56.4	58.1	1.03	0.178
	March	0.323	0.46	59.4	58.1	0.98	0.174
	April	0.238	0.394	88.7	37.1	0.42	0.169
	May	0.267	0.418	125.2	22.6	0.18	0.167
	June	0.357	0.486	135.6	11.5	0.08	0.165
	July	0.448	0.546	134.7	7.2	0.05	0.165
	August	0.501	0.579	130.3	7.0	0.05	0.163
	September	0.537	0.601	117.2	6.0	0.05	0.16
	October	0.587	0.63	105.4	9.8	0.09	0.161
	November	0.629	0.652	95.2	21.0	0.22	0.168
	December	0.636	0.656	72.6	20.3	0.28	0.166
2012	January	0.6	0.636	64.1	35.4	0.55	0.175
	February	0.482	0.567	49.6	58.6	1.18	0.179
	March	0.322	0.46	31.4	84.3	2.68	0.175
	April	0.238	0.394	56.3	63.2	1.12	0.169
	May	0.266	0.418	62.1	71.2	1.15	0.166
	June	0.357	0.486	130.3	15.3	0.12	0.166
	July	0.447	0.546	141.7	10.9	0.08	0.164
	August	0.501	0.579	130.3	6.6	0.05	0.163
	September	0.537	0.601	98.1	2.5	0.03	0.158
	October	0.587	0.63	108.1	11.1	0.10	0.163
	November	0.629	0.652	89.6	12.7	0.14	0.163
	December	0.637	0.656	69.9	23.4	0.34	0.169

Prepared by Knight Piésold.
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences. Data and Information Services Center.

Notes:
The MERRA is a NASA reanalysis for the satellite era using a major new version (V5) of the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS). The MERRA focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales. This MERRA Instance of Giovanni focuses on visualizing and analysing the MERRA hourly 2D data from the MERRA HISTORY COLLECTIONS. All data used here are at GEOS-5 native resolution of 2/3 longitude by 1/2 latitude degrees.
Selected time period: Jan 2010 - Dec 2012
Selected area for averaging: Lat (22.06379. 22.10488). Lon (95.0636. 95.112749).

<u>Receptor Locations</u>

Points for which the model calculates concentration level contributions resulting from emissions generated by the different assessed activities are called receptors.

PM_{10} dispersion modeling used a total of 9 discrete receptors located within the study area; of which 8 correspond to air quality sampling sites, while 1 is located in the city of Monywa (Table 29).

Table 29: Discrete Cartesian receptors of air quality modeling

Location	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	715,252.18	2,442,082.56	127
Station 2	719,251.74	2,438,468.46	80
Station 3	713,421.56	2,444,860.13	90
Station 4	715,622.86	2,448,138.15	78
Station 5	709,895.01	2,450,963.14	83
Station 6	711,883.05	2,440,896.18	120
Station 7	707,251.93	2,438,634.96	149
Station 8	705,617.76	2,442,419.11	175
Monywa	720,911.88	2,446,350.66	81

Prepared by Knight Piésold.

Moreover, a Cartesian receptor grid was set up, comprising an area of 216 km^2 (Table 30), which considers the final range of PM_{10} dispersion generated by construction activities. Figure 2 shows the receptor grid entered in the model corresponding to the project's construction phase.

Table 30: Uniform Cartesian grid receptor network – Construction phase

Description	X Axis	Y Axis	Units
Origin (SW corner) (X, Y)	705,529.84	2,437,860.72	UTM WGS84 (m)
No. of points	65	55	-
Spacing (Dx, Dy)	250	250	m
Length	16	13.5	km
Number of receptors	3,575		-

Prepared by Knight Piésold.

In relation to the operation phase, a nested receptor grid comprising an area of 506.25 km^2 (22.5 km x 22.5 km) has been set up, shown in Table 31. Figure 3 shows the receptor grid considered for the project's operation phase.

Table 31: Nested receptor grids – Operation phase

Bounding box		
Origin (SW corner) (X, Y)	714,759.58 m	2,441,933.91 m
Size (Width, Height)	2,500 m	2,500 m
Receptor spacing	150 m	
Number of receptors	1,804	
Nested grids		
Number of nested grid	**Distance from Bounding Box**	**Receptor spacing**
1	2,500 m	300 m
2	5,000 m	500 m
3	20,000 m	2,000 m

Prepared by Knight Piésold.

4.4 NOISE AND VIBRATION MODELLING

Noise level propagation during construction and operation activities was determined with the computer simulation program SoundPLAN, version 7.2, which includes physical variables and acoustic characteristics of sound sources. Regarding the determination of projections of vibrations caused by activities (blasting, machinery and vehicle traffic) towards the location of sensitive receptors, mathematical formulations proposed by Devine (1962; quoted by López Jimeno *et al.*, 2003) and the Federal Transit Administration (FTA) of the U.S. Department of Transit (2006) have been used.

4.4.1 Noise Modelling Input

Modelling methodology is based on ISO 9613 standard, which uses divergent attenuation principles along with extra attenuation caused by obstacles and air attenuation. The model's input variables are the sound powers of noise sources for each considered phase. The exclusive contribution generated by assessed project sources was modelled; this contribution was based on information related to the sources' spatial geometry.

Temperature was set at 25°C and relative humidity at 80%, which are considered meteorological values that are representative for the study area. Also, wind speed has been assumed to vary between 1 and 5 m/s, according to what is established in ISO 9613, Part 2, and the noise propagation direction is towards the receptors.

During the construction and operation phases (Stage 1), activities will take place that are categorized into stationary, linear, and impulsive (blasting), depending on the noise sources.

Noise Emission Inventory

Stationary and Linear Sources in Mining Area

The noise emission characteristics in L_{AeqT} dB(A) of each piece of machinery are based on values published by the British Standard (BS 5228) "Update of Noise database for prediction of noise on construction and open sites" (contained in Annex C) (DEFRA; 2005, 2008). Table 32 shows global acoustic powers assigned to each piece of machinery that will be used, determined through the equation that relates a stationary noise emission source to a specific distance [L_{AeqT} in dB(A)] and acoustic power (Lw), which applies for an obstacle-free ground-level propagation direction:

$$Lw = Lp + 20\log(r) + 8$$

Where Lw is projected acoustic power, Lp is sound pressure level in L_{Aeq} dB(A), and r is the distance between receptor and source.

Upon assigning powers to each piece of machinery, the global acoustic power level representing a noise emission area was determined, for which the following mathematical expression was used:

$$L_T = 10\log\sum_i^n 10^{\frac{L_i}{10}}$$

Where L_T is the sum of all sound radiation sources, n is the number of sources, and L_i are each source's noise levels, expressed in dB(A).

Table 32: Acoustic power (Lw) in dB(A) of equipment used during construction and operation phases - Stationary sources

Scenario	Operating Route	Designation[(1)]	Model[(1)]	Amount[(1)]	Engine power (kW)	Operation weight (tons)	Octave band sound pressure levels @ 10 m (Hz)[(2)]								A-weighted sound pressure level, LAeq, dB @ 10 m[(2)]	Acoustic power level
							63	125	250	500	1k	2k	4k	8k		
Construction & Operation (Stage I)	Blasting Zone	Hole Pumping Truck	PP-150	1	199	17	77	83	82	84	85	85	84	79	91	119
		Hole Stemming Machine	ZL50F-II	2	162	17	77	83	82	84	85	85	84	79	91	119
	Drilling Area	Drilling Rig	T35	1	142	15.1	83	84	79	85	82	79	75	71	87	115
		Drilling Rig	ROC L6 (25)	2	287	21.7	94	95	90	91	87	85	80	73	92	120
		Drilling Rig	HCR1500-20 II	1	261	17.3	77	83	82	84	85	85	84	79	91	119
	Digging Area	Excavator	EX1900-6BH	1	810	383	82	78	82	81	81	78	72	64	85	113
		Excavator	EX1200-6LD	2	567	223	82	78	82	81	81	78	72	64	86	114
		Excavator	PC2000-8	5	728	204.1	89	92	83	81	82	78	73	65	86	114
	Mining Area	Excavator	XE370C	1	184	36.6	81	80	80	83	82	79	76	73	86	114
		Loader	LW800K	2	250	28.5	91	81	73	71	71	72	62	59	77	105
		Loader	ZL50G	3	162	16	86	82	77	74	70	66	62	55	76	104
		Dozer	MD32	5	235	45	89	90	81	73	74	70	68	64	80	108
		Roller	W2601	2	174	18	80	75	77	72	67	62	54	46	73	101
		Crawler Dozer	CAT D9R	6	350	48	80	84	76	77	79	81	69	59	85	113
		Ballgrader	14M	2	221	25	88	87	83	79	84	78	74	65	86	114
		Refuelling Truck	ND5318GJYZ(20T)	2	235	20	91	81	76	77	73	72	70	62	79	107
		Light Truck	BJ1138VJPHG	2	140	13.2	84	81	74	73	72	68	61	53	76	104
		Truck with Crane	ND1250A50J	2	235	13.6	85	73	67	71	72	69	63	56	76	104
		Fire-Fighting Truck	ND1310D35J	2	235	20	85	80	77	72	74	70	65	58	78	106
		Maintenance Truck	ND1160A45J	2	235	10	85	73	67	71	72	69	63	56	76	104
		Sprinkler Truck	TR50W	3	392	45	92	91	86	85	84	85	77	77	90	118
		AN Mixing-Loading Truck	NCHA-15	2	247	15	85	73	67	71	72	69	63	56	76	104
		Heavy ANFO Mixing-Loading Truck	NCHZ-15	2	447	15	88	93	84	84	83	81	79	69	88	116
	Digging area to WRD	Mining Dump Truck	TR100	35	783	113	89	94	89	85	83	81	76	71	89	117
Operation (Stage I)	Digging Area	Excavator (front shovel)	PC4000	2	1,400	391	91	86	80	81	80	78	77	70	85	113
	Drilling Area	Rotary Rig	DML	5	460	27.2	86	92	85	88	84	83	78	77	90	118
	Mining Area	Crawler Dozer	D475A-EO	1	728	108.4	80	84	76	77	79	81	69	59	85	113
	Digging area to WRD and Leaching Pad	Mining Dump Truck	NTE260	10	1,865	236	97	95	91	91	86	84	79	75	92	120
	Crushing area	Tracked Semi-Mobile Crusher	--	2	310	90	91	91	88	87	85	83	78	68	90	118

Prepared by Knight Piésold
(1) Source: Mining Plan according to Myanmar Wanbao Mining Copper Limited
(2) Sound levels according to DEFRA (2005, 2008)

Linear Sources on Paved Roads

During construction and operation phases, noise generation due to vehicle traffic on roads close to project has been considered. For this reason, in a conservative approach a flow of 20 light vehicles and 14 heavy vehicles has been considered per hour, equivalent to 816 vehicles per day during 24 hours. For this linear source, it has been considered to set up the model by applying the noise propagation method based on the German RLS 90 standard[7], which considers that noise emission on a road corresponds to a point located 25 m from the centerline (called LM25) and 4 m above ground level. Thus, the speeds considered are a maximum vehicle speed of 48 km/h and a speed of 40 km/h when vehicles pass built-up areas.

Subsequently, the RLS 90 method calculates sound propagation from the emission line using the LM25 value.

Blasting

Modelling methodology is based on sound field propagation standard ISO 9613, Part I & II, "Attenuation of sound during propagation outdoors", which uses divergent attenuation principles along with extra attenuation caused by obstacles and attenuation due to air effects. The used software is SoundPLAN, version 7.2, which includes all physical variables related to the noise sources' geomorphology and sound power.

Table 33 shows the octave frequency band spectrum (Hz) that corresponds to noise emission for a surface blasting event. This information is representative for blasting activities in mining projects and has been used as part of the environmental impact assessments conducted by Knight Piésold for open pit mining projects (Knight Piésold; 2010, 2011).

Table 33: Acoustic power (Lw) in dB(C) for blasting events

Source	Central Frequency in Octave Bands (Hz)								Lw in dB(C)
	63	125	250	500	1k	2k	4k	8k	
Surface blast	144.0	137.0	133.0	129.0	124.0	116.0	110.0	107.0	145.0

Prepared by Knight Piésold
Source: Data measured by Control Acústico Ltda for blasting events in northern Chile during 2003

[7] German Noise Classification System

Acoustic power shown in Table 33 is related to SEL (Sound Exposure Level), a parameter that represents the total energy produced by a single noise event with a duration of 1 second, a time period considered representative for blasting events (Afeni & Osasan, 2009).

Receptor Locations

The SoundPLAN v. 7.2 model receptors were set up considering a calculation area that comprises the noise sampling stations, whose locations are shown in Table 34.

Table 34: Discrete Cartesian receptors of noise quality modeling

Description	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	713,421.56	2,444,860.13	91
Station 2	716,226.37	2,444,500.06	81
Station 3	719,184.44	2,443,299.27	79
Station 4	719,251.74	2,438,468.46	78
Station 5	717,231.75	2,445,136.04	81
Station 6	715,622.86	2,448,138.15	82
Station 7	709,895.01	2,450,963.14	89
Station 8	711,883.05	2,440,896.18	120
Station 9	707,251.93	2,438,634.96	148
Station 10	705,617.76	2,442,419.11	81

Prepared by Knight Piésold

4.4.2 Vibration Modeling Input

The main activities of interest capable of generating major impact due to vibrations during the construction and operation phases are blasting events, truck and construction machinery traffic (drills, vibratory roller, grader, bulldozer). Such activities have been assessed in this study by applying mathematical models that project vibration at a given point, for which available formulations related to each activity were revised.

Blasting

In order to forecast vibrations produced by blasting, the mathematical formulation proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) for representing vibration behaviour in open pit mining operations was proposed.

$$PPV = K \times \left(\frac{d}{W^{1/2}}\right)^{-\alpha}$$

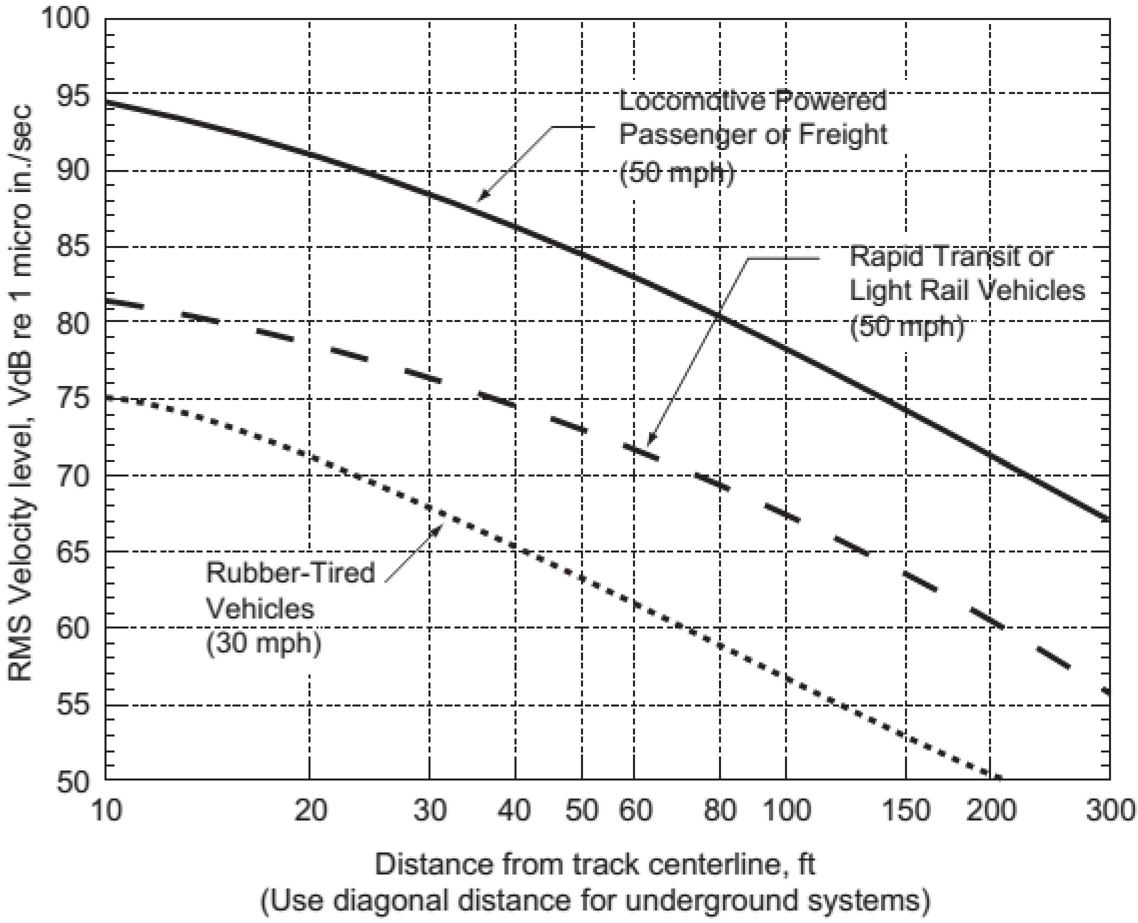
Where *PPV* is particle peak velocity (mm/s), *W* is explosive charge weight (kg), *d* is the distance between detonation area and receptor of interest (m), *K* is velocity factor, and α is attenuation factor. It is worth mentioning that the values *K* and α are variables that have been statistically determined and depend on the soil's geological conditions. Thus, the mean factors considered were the theory-based *K* = 357 and α = 2.07, which had been proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) and determined from field measurements and theoretical calculations based on studied soil type.

Regarding this study, it has been considered to use between 600 and 1,200 kg of explosive charge for each blasting event during the project's construction and operation phases. It should be pointed out that when an explosive charge is detonated, a pressure wave that displaces particles surrounding the detonation area is generated. The elasticity of the transmitted wave is directly proportional to the particle's velocity. The same amount of explosive charge detonated and measured at a fixed distance does not necessarily produce the same vibration magnitude if performed at different sites. In general, blast-induced vibrations take very short time according to the short duration of typical production blast at less than 2 seconds (Kuzu, 2008; Afeni & Osasan, 2009). Human reactions to blast-induced vibration start at particle velocities of generally about 10 mm/s (Siskind *et al.*, 1980 as cited in Kuzu, 2008).

<u>Truck Traffic</u>

Vibrations generated by truck traffic within the study area have been estimated by using criteria proposed by the Federal Transit Administration (FTA) of the U.S. Department of Transit in 2006, which are based on maximum vibration levels for one-time events. According to Graph 4, maximum vibration level values expected at each receptor are estimated, based on the distance between the track's centerline and the receptor. In this case, it corresponds to the graph's lower dotted curve (rubber-tired vehicles).

Graph 4: Generalized ground surface vibration curves



Source: FTA (2006)

The velocity level (RMS L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref1:\frac{micro\ in.}{sec}} = 20\log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is RMS (Root Mean Square) of velocity amplitude, and v_{ref} is reference velocity amplitude. Projections of vibration levels Lv at a distance (D) have been estimated through the following mathematical expression (FTA, 2006):

$$L_v(D) = L_v(25\ ft) - 30\log\left(\frac{D}{25}\right)$$

According to the FTA (2006), background vibrations in residential areas are usually 50 VdB or less, far below the human perception threshold, which is around 65 VdB. Larger vibrations that exceed 70 VdB generate significant responses, such as a reaction of discomfort.

According to the abovementioned, it has been considered to assess vibrations generated by truck traffic based on the FTA criterion shown in Table 35.

Table 35: Ground-borne vibration (GBV) impact criteria for general assessment

Land Use Category	**GBV Impact levels (VdB ref. 1 micro-inch/sec)**	
	Frequent events(1)	**Infrequent events(2)**
Category 1:Buildings where vibration would interfere with interior operations	65 VdB	65 VdB
Category 2: Dwellings and buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land primarily with daytime use	75 VdB	83 VdB

Source FTA (2006)
Notes:
(1) "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
(2) "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

In this case, receptors located within the project area correspond mainly to dwellings, which is why the criterion for Category 2 will be applied.

Construction Machinery

For the case of construction machinery, the FTA criterion establishes a maximum of 100 VdB for fragile buildings, or 95 VdB for fragile historical buildings.

Vibration level sources[8] corresponding to equipment used during the construction phase vary between 86 L_v (front loader) and 94 L_v (vibratory roller), for which from a conservative point of view a value of 94 L_v was chosen. Furthermore, for modelling the vibrations of vehicles travelling close to the roads, a maximum speed of 48 km/h has been considered (30 mph).

[8] RMS velocity in decibels (VdB) ref 1 micro-inch/second at 25 ft

5. MODELING RESULTS

The results produced by the AERMOD View v. 8.2 and SoundPLAN v. 7.2 modelling systems allowed quantifying the impact produced by project activities. Moreover, these results have been added to the information provided by baseline sampling related to air and noise quality.

5.1 PARTICULATE MATTER CONCENTRATIONS - PM_{10}

5.1.1 Construction Phase

In Figures 4 and 5 one can see the impact of dispersion of PM_{10} emissions generated by construction activities. Table 36 shows the results generated by the model (PM_{10} impacts) at each receptor depending on sampling station location. These results were added to the background concentrations obtained during baseline sampling. Hence, total PM_{10} concentration results that do not exceed international standards established by the WHO were obtained.

Table 36: Impact analysis of PM_{10} concentration – Construction phase

Receptor	Impacts of PM_{10} (µg/m^3)		Background concentration of PM_{10} (µg/m^3)$^{(1)}$		Total PM_{10} (µg/m^3)	
	Annual	24 hours$^{(2)}$	Annual	24 hours$^{(2)}$	Annual	24 hours$^{(2)}$
Station 1	1.5	13.3	11.3	14.3	12.8	27.6
Station 2	0.3	11.4	7.7	12.65	8	24.05
Station 3	2.2	21.4	7.8	11.4	10	32.8
Station 4	0.4	12.8	14.3	17.6	14.7	30.4
Station 5	0.2	3.7	20.0	22.3	20.2	26
Station 6	0.2	5.1	7.1	9.5	7.3	14.6
Station 7	0.1	1.8	15.0	19.2	15.1	21
Station 8	0.1	1.9	7.4	10.4	7.5	12.3
Monywa	0.2	11.9	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.1.2 Operation Phase

In Figures 6 and 7 one can see the impact of dispersion of PM_{10} emissions generated by mine operation activities. Table 37 shows the results provided by the model (PM_{10} impacts) for each receptor depending on sampling station location. These results have been added to the background concentrations obtained during

baseline sampling. Thus, total PM_{10} concentration results that do not exceed international standards established by the WHO have been obtained.

Table 37: Impact analysis of PM_{10} concentration – Operation phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)(1)		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	2.3	33.3	11.3	14.3	13.6	47.6
Station 2	1.2	15.6	7.7	12.65	8.9	28.3
Station 3	2.7	29.3	7.8	11.4	10.5	40.7
Station 4	1.0	14.4	14.3	17.6	15.3	32.0
Station 5	0.8	19.2	20.0	22.3	20.8	41.5
Station 6	0.4	10.3	7.1	9.5	7.5	19.8
Station 7	0.1	6.6	15.0	19.2	15.1	25.8
Station 8	0.2	6.1	7.4	10.4	7.6	16.5
Monywa	0.3	6.1	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.2 NOISE AND VIBRATIONS

5.2.1 Noise

This section shows results provided by SoundPLAN v. 7.2 noise modelling system related to noise propagation in the study area and noise levels at receptors. It is worth mentioning that the shown noise levels represent an exclusive contribution generated by noise sources considered by the project.

Construction Phase

Figure 8 shows propagation of noise generated by noise sources considered during the construction phase. Tables 38 and 39 show projected noise levels at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC. Subsequently, the total noise of the evaluated stations was determined by the energetic sum of noise generated by the project and the background noise, applying the following mathematical expression:

$$L_T = 10\log\sum_{i}^{n} 10^{\frac{L_i}{10}}$$

According to the results of total noise, for all sampling stations the noise background increment is lower than 10.2 dB (A). The largest increases of noise were observed for station 1 and 2, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 38: Assessment of noise modelling results for construction phase – Daytime

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.2	67.5	52.4	67.6	65 (4)
Station 2	49	42.8	72.9	49.9	73.0	65 (4)
Station 3	29.2	44.7	59.9	44.9	59.9	55 (5)
Station 4	16	46.6	66.5	46.6	66.5	55 (5)
Station 5	31.6	43.9	75.4	44.1	75.4	65 (4)
Station 6	20.7	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	35.5	42.2	67.9	43.0	67.9	55 (5)
Station 9	0	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Prepared by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 65 dB(A) according to OECD.
(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 39: Assessment of noise modelling results for construction phase – Night-time

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	23.7	46.3	67.9	46.4	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	27.7	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	0	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 55 dB(A) according to OECD.
(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 40 shows noise levels projected at receptors due to blasting events within the mine area, which do not exceed reference values according to the North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901"., which in Section 901.109 establishes a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Furthermore, Figure 9 shows the propagation of noise produced by blasting events in the study area in LeqT units in dB(C) for T = 24 hours.

Table 40: Assessment of noise modelling results for construction phase - Blasting events

Location	Sound Exposure level (SEL) for 1 second(1)	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	85.2	107.0	112.0
Station 2	104.8	107.0	112.0
Station 3	99.8	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	103.6	107.0	112.0
Station 6	95.7	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
(1)Values determined based on values in L_{eqT} units in dB(C), where T = 1 hour.

Operation Phase

Figure 10 shows propagation of noise generated by noise sources considered during the operation phase. Tables 41 and 42 show noise levels projected at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC.

According to the results of total noise, for all sampling stations, the noise background increment is lower than 11.3 dB (A). The largest increases of noise were observed for station 1, 2 and 5, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 41: Assessment of noise modeling results for operation phase – Daytime

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	53.2	42.2	67.5	53.5	67.6	65 (4)
Station 2	51.7	42.8	72.9	52.2	73.0	65 (4)
Station 3	48.4	44.7	59.9	50.0	60.2	55 (5)
Station 4	16.5	46.6	66.5	46.6	66.5	55 (5)
Station 5	52.1	43.9	75.4	52.7	75.4	65 (4)
Station 6	16.5	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	43.2	42.2	67.9	45.7	67.9	55 (5)
Station 9	Not perceptible	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modeling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 65 dB(A) according to OECD.
(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 42: Assessment of noise modeling results for operation phase – Night-time

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	45	46.3	67.9	48.7	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	28.5	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	Not perceptible	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modeling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 55 dB(A) according to OECD.
(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 43 shows noise levels projected at receptors due to blasting events in mine area, which do not exceed reference values according to North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901," which establishes in Section 901.109 a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Moreover, Figure 11 shows the propagation of noise produced by blasting events in the study area in L_{eqT} units in dB(C) for T = 24 hours.

Table 43: Assessment of noise modelling results for operation phase - Blasting events

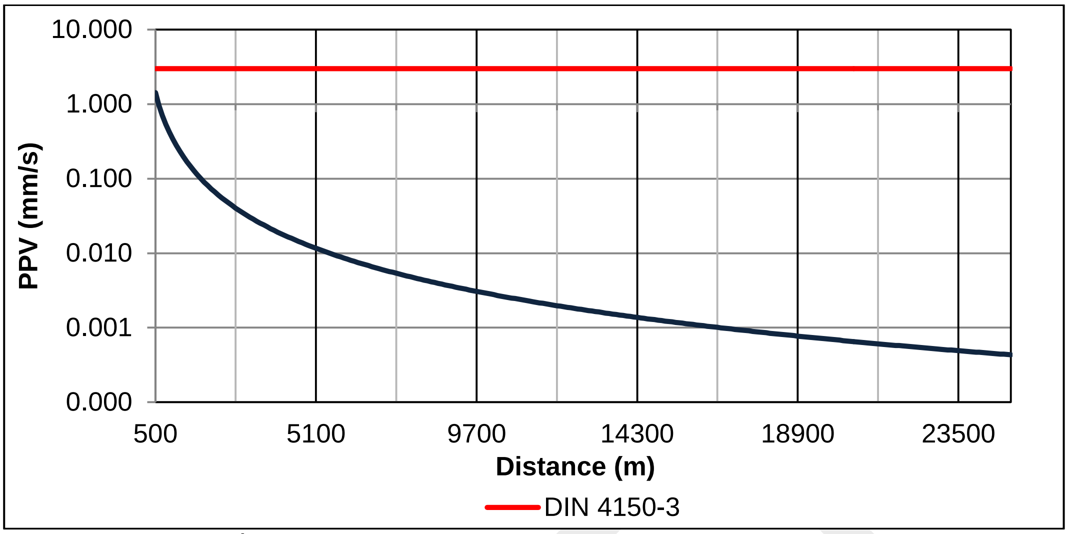
Location	**Sound Exposure level (SEL) for 1 second** [(1)]	**Standard - SEL in dB(C)**	
		Class A	**Class B**
Station 1	93.5	107.0	112.0
Station 2	94.0	107.0	112.0
Station 3	83.5	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	102.4	107.0	112.0
Station 6	95.8	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
[(1)] Values determined based on values in LeqT units in dB(C), where T = 1 hour.

5.2.2 Vibrations

Graph 5 shows PPV values for distances ranging from 0.5 km to 250 km, considering a blasting event. These PPV values were calculated by applying the mathematical expression proposed by Devine (1962; quoted by López Jimeno *et al.*, 1987). Furthermore, it shows a 3 mm/s protection standard corresponding to sensitive buildings based on German DIN standard No. 4150-3 (DIN = Deutsches Institut für Normung). According to Kuzu (2008), human reactions due to vibrations caused by blasting events start at particle peak velocities close to 10 mm/s. For this reason, the 3 mm/s standard proposed by the DIN 4150-3 standard is considered the most demanding one.

Graph 5: Prediction of blast-induced vibration level



Prepared by Knight Piésold

Table 44 shows modelling results for vibrations caused by blasting events at nearby sensitive receptors. These vibrations do not exceed safety limits suggested by German DIN standard No. 4150-3.

Table 44: Modelling results of vibrations caused by blasting at receptor sites

Location	Distance from blasting area to receptor (km)	PPV (mm/s)	Safe level according to DIN 4150-3 (mm/s)
Station 1	2.5	0.0508	3
Station 2	1.13	0.2629	3
Station 3	2.67	0.0443	3
Station 4	5.03	0.0120	3
Station 5	1.96	0.0841	3
Station 6	4.71	0.0137	3
Station 7	9.39	0.0033	3
Station 8	3.67	0.0229	3
Station 9	8.84	0.0037	3
Station 10	9.54	0.0032	3

Prepared by Knight Piésold

Vibrations caused by vehicle traffic along paved roads do not exceed the FTA's allowed limit of 65 VdB. Table 45 shows results for vibration levels projected at the distance where dwellings are located with regard to the vehicle's route.

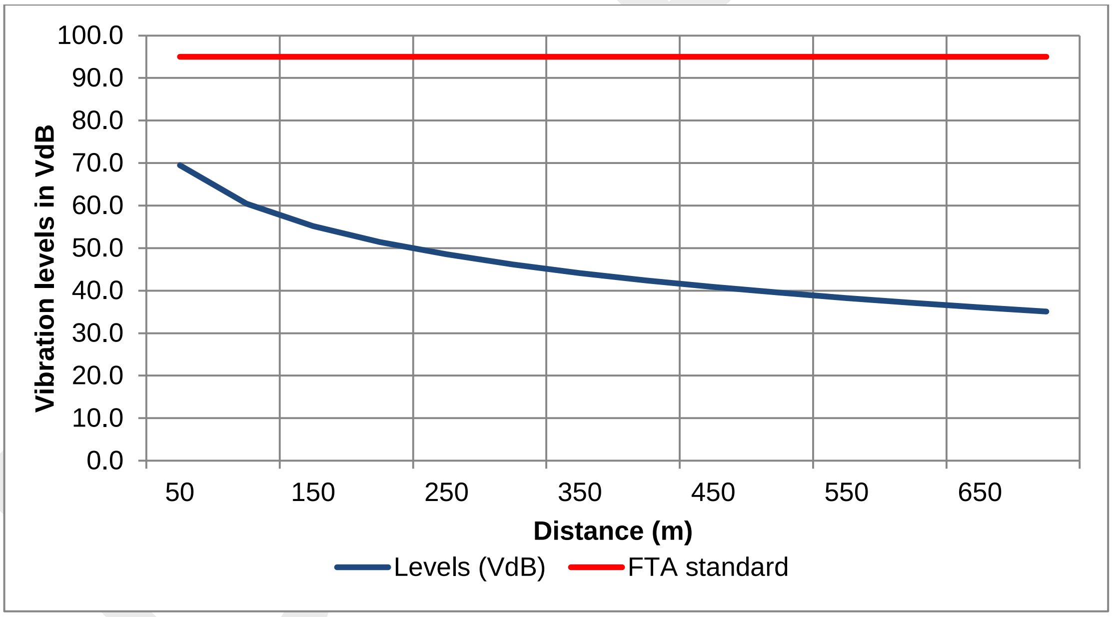
Table 45: Modeling results of vibrations caused by vehicles on road close to receptor sites

Location	Distance from track centerline (m)	Lv (ref 1 micro-inches/s) (VdB)	FTA Standard Category I
1	14	64	65 VdB
2	16	63	
3	199	26	
5	22	59	

Prepared by Knight Piésold

Regarding activities resulting from heavy machinery operation during the construction phase, Graph 6 shows Lv values projected at a specific distance. According to the results, the vibration levels generated by machinery do not exceed the limit of 95 VdB recommended by the FTA for sensitive structures.

Graph 6: Modelling results of vibrations caused by construction equipment at receptor sites



Prepared by Knight Piésold

6. CONCLUSIONS

Inventories of particulate matter (PM_{10} and $PM_{2.5}$), noise and vibrations were developed for construction and operation phases. According to results, it is evident that operation phase generates more dust and noise than construction phase.

According to results provided by computer programs Aermod View 8.2 and SoundPLAN 7.2, the impact caused by emissions of particulate matter, noise and vibrations during the construction and operation phases does not exceed environmental quality standards established by the IFC/WHO and OECD. The sites that present the highest concentrations of particulate matter, as well as the highest noise and vibration levels are within project area facilities, such as the pit and the waste rock dumps.

Regarding the impact on air quality, during the construction phase Station 3 (air quality) is the one receiving the highest contributions of PM_{10} concentration (21.4 $\mu g/m^3$ for mean maximum 24-hour value and 2.2 $\mu g/m^3$ for mean maximum annual value) resulting from dispersion of particulate matter. Furthermore, during the operation phase, stations 1 and 3 receive larger PM_{10} concentration contributions, which range from 29.3 to 33.3 $\mu g/m^3$ (mean maximum 24-hour value) and from 2.3 to 2.7 $\mu g/m^3$ (mean maximum annual value).

With regard to impact on noise quality, one can see that during the construction and operation phases the stations 1, 2, 3, 5 and 8 are the ones receiving the largest noise contributions, due to the proximity of these stations to vehicle traffic on the roads surrounding the project area.

Finally, vibrations caused by project activities during its various phases comply with standards established by DIN standard 4150-3 and by FTA criteria.

7. RECOMMENDATIONS

Regarding the impact on air quality, it is recommended to permanently monitor PM_{10} and $PM_{2.5}$ at stations 1 and 3 during the project's construction and operation phases, as part of the environmental monitoring plan.

Regarding the impact on noise quality due to the proximity of urban areas and roads surrounding the project area, it can be reduce to some extent by adopting mitigation measures such the implementation of noise barriers and suitable traffic management. According to FTA (2006), Section 6.8.1 Noise Mitigation Measures, noise barriers are effective in mitigating noise when they break the line-of-sight between source and receiver. Where the barrier is very close to the transit vehicle or where the vehicles travel between sets of parallel barriers, barrier effectiveness can be increased by as much as 5 decibels by applying sound-absorbing material to the inner surface of the barrier (FTA, 2006). The normal minimum requirement is a surface density of 4 pounds per square foot (FTA, 2006).

Finally, it is recommended to permanently monitor noise and vibration at stations 1, 2, 3, 5 and 8 during the project's construction and operation phases considering a quarterly frequency, as part of the environmental monitoring plan to verify the mitigation actions implemented.

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FIGURES

APPENDIX A

Merra Monthly History Data Collections – Giovanni Project

APPENDIX B

Maximun 24 hour mean concentrations for PM_{10} impacts during dry-cold, dry-hot and wet seasons

APPENDIX C

Baseline Studies - Flora

Knight Piésold CONSULTING

BASELINE SURVEY ON FLORA OF LETPADAUNG COPPER MINE PROJECT AREA

Cool Dry Season

(February, 2013)

Environment Myanmar Cooperative Co. Ltd. (EMC)

2013

Flora

Methodology

Data collection

A Global Positioning System was used to navigate and mark coordinates between sample plots around the mining area. In order to obtain essential ecological data for predicting flora of scrubs, 2x2m quadrats (total 75) were laid down and observed. In each plot every plant species were listed and counted. For the tree species 10x10m quadrats (total 10) were subjectively chosen and observed. In each sample plot every living tree of girth at breast height (gbh) $\geq$10cm was measured, listed and counted. Care has been taken to cover different elevation, slope, aspects, drainage and density gradients to study overall spectrum of species diversity. In addition all trees, shrubs, and herbs around the Lepadaung taung area were recorded and listed. The families were identified by using key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer *et a*l., 1963, and Kress *et al*. 2003 and confirmed at Herbarium in Department of Botany, University of Yangon.

Data analysis

Quantitative analysis of scrub species, density, relative density, frequency, and relative frequency were calculated. For the tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

Result (1) Scrub species in Letpadaung area

Frequency and Relative Frequency

Among the scrub species, Blepharis boerhaviefolia Pers., has highest relative frequency value (12.40%), *Melhania hamiltoniana* Wall. takes second highest relatively frequency value (10.54%), and *Atalantia monophylla* A. DC. possesses third relatively frequency value (8.88%) see table (1), figure (1). These species are most frequently occurred in belt transect (1).

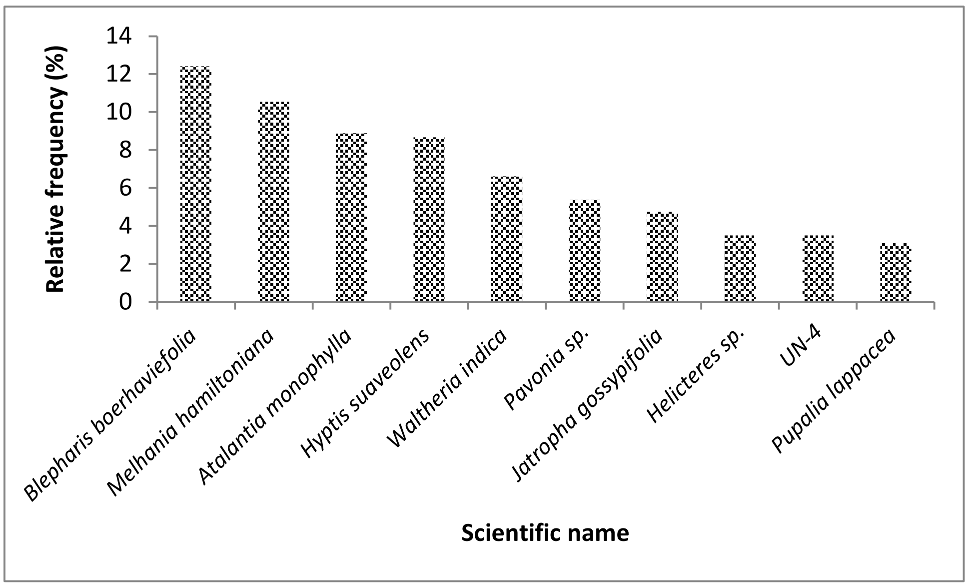

Figure (1) Relative frequency of scrubs in belt transect (1)

Table (1) Ranking of frequency and relative frequency of scrub species

No.	Scientific name	Frequency	Relative frequency (%)
1	*Blepharis boerhaviefolia* Pers.	0.80	12.40
2	*Melhania hamiltoniana* Wall.	0.68	10.54
3	*Atalantia monophylla* A. DC.	0.57	8.88
4	*Hyptis suaveolens* (L.) Poit.	0.56	8.68
5	*Waltheria indica* L.	0.43	6.61
6	*Pavonia* sp.	0.35	5.37
7	*Jatropha gossypifolia* L.	0.31	4.75
8	*Helicteres* sp.	0.23	3.51
9	UN-4	0.23	3.51
10	*Pupalia lappacea* Moq.	0.20	3.10
11	*Atylosia scarabaeoides* Benth.	0.19	2.89
12	*Abutilon indicum* (L.) Sweet	0.17	2.69
13	*Cocculus villosus* DC.	0.17	2.69
14	*Capparis zeylanica* L.	0.15	2.27
15	*Indigofera* sp.	0.13	2.07
16	*Grewia humilis* Wall.	0.12	1.86
17	UN-3	0.12	1.86
18	*Azadirachta indica* A. Juss.	0.11	1.65
19	*Capparis glauca* Wall.	0.11	1.65
20	*Cymbopogon* sp.	0.09	1.45
21	*Ehretia rigida* (Thunb.) Druce	0.09	1.45
22	*Ziziphus oenoplia* Mill.	0.08	1.24
23	*Hymenopramis brachiata* Wall.	0.05	0.83
24	*Tridax procumbens* L.	0.05	0.83
25	UN-2	0.05	0.83
26	*Desmodium triflorum* (L.) DC.	0.04	0.62
27	*Euphorbia antiquarum* L.	0.04	0.62
28	*Ipomoea* sp.	0.04	0.62
29	*Leptadenia* sp.	0.04	0.62
30	*Phyllanthus* sp.	0.04	0.62
31	*Streptocaulon tomentosum* Wight & Arn.	0.04	0.62
32	*Acacia catechu* Willd.	0.01	0.21
33	*Acacia pennata* (L.) Willd.	0.01	0.21
34	*Acalypha* sp.	0.01	0.21
35	*Achyranthes aspera* L.	0.01	0.21
36	*Barleria prionitis* L.	0.01	0.21
37	*Capparis* sp.	0.01	0.21
38	*Cardiospermum corindum* L.	0.01	0.21
39	*Gardenia* sp.	0.01	0.21
40	*Hesperethusa crenulata* (Roxb.) Roem.	0.01	0.21
41	*Leptadenia reticulata* Wight & Arn.	0.01	0.21
42	*Phyllanthus simplex* Retz.	0.01	0.21
43	*Prosopis juliflora* DC.	0.01	0.21
44	*Tectona hamiltoniana* Wall.	0.01	0.21

Density and Relative Density of Belt transect (1)

In belt transect (1) *Hyptis suaveolens* (L.) Poit. has highest relative density value (33.89%), *Blepharis boerhaviefolia* takes second highest relatively density value (20. 15%), and *Melhania hamiltoniana* Wall. holds third relatively density value (14.81%) see table (2), figure (2). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

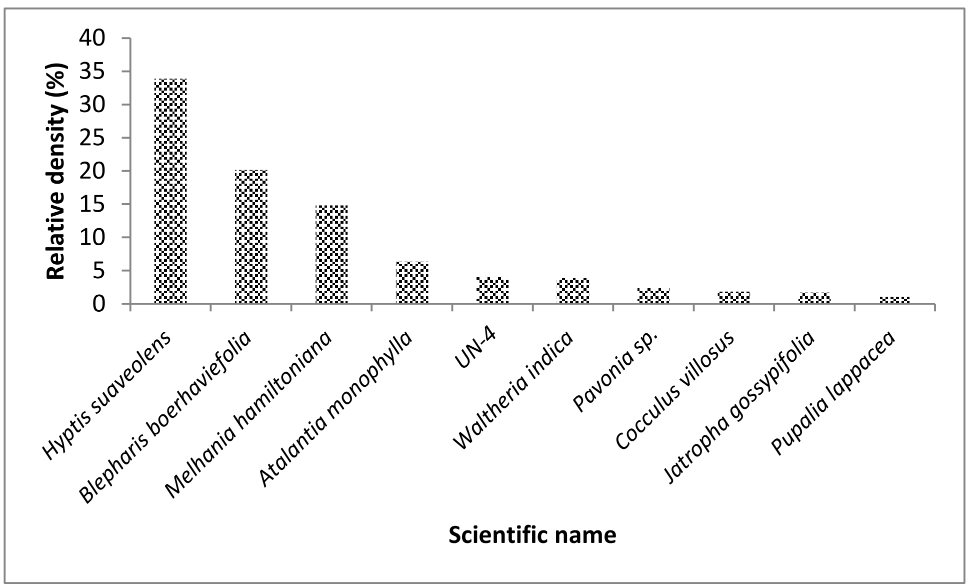

Figure (2) Relative density of scrubs

Table (2) Ranking of density and relative density of scrub species

No.	Scientific name	Density	Relative density (%)
1	*Hyptis suaveolens* (L.) Poit.	12.36	33.89
2	*Blepharis boerhaviefolia* Pers.	7.35	20.15
3	*Melhania hamiltoniana* Wall.	5.40	14.81
4	*Atalantia monophylla* A. DC.	2.32	6.36
5	UN-4	1.48	4.06
6	*Waltheria indica* L.	1.43	3.91
7	*Pavonia* sp.	0.88	2.41
8	*Cocculus villosus* DC.	0.68	1.86
9	*Jatropha gossypifolia* L.	0.63	1.72
10	*Pupalia lappacea* Moq.	0.40	1.10
11	*Atylosia scarabaeoides* Benth.	0.39	1.06
12	*Helicteres* sp.	0.37	1.02
13	*Abutilon indicum* (L.) Sweet	0.36	0.99
14	*Cymbopogon* sp.	0.33	0.91
15	*Indigofera* sp.	0.29	0.80
16	*Capparis zeylanica* L.	0.20	0.55
17	*Grewia humilis* Wall.	0.17	0.48
18	UN-3	0.16	0.44
19	*Capparis glauca* Wall.	0.15	0.40
20	*Azadirachta indica* A. Juss.	0.13	0.37
21	*Ehretia rigida* (Thunb.) Druce	0.11	0.29
22	*Tridax procumbens* L.	0.09	0.26
23	*Ipomoea* sp.	0.08	0.22
24	*Ziziphus oenoplia* Mill.	0.08	0.22
25	UN-2	0.08	0.22
26	*Desmodium triflorum* (L.) DC.	0.07	0.18
27	*Hymenopramis brachiata* Wall.	0.07	0.18
28	*Euphorbia antiquarum* L.	0.05	0.15
29	*Leptadenia* sp.	0.05	0.15
30	*Phyllanthus* sp.	0.05	0.15
31	*Streptocaulon tomentosum* Wight & Arn.	0.05	0.15
32	*Acacia pennata* (L.) Willd.	0.03	0.07
33	*Hesperethusa crenulata* (Roxb.) Roem.	0.03	0.07
34	*Acacia catechu* Willd.	0.01	0.04
35	*Acalypha* sp.	0.01	0.04
36	*Achyranthes aspera* L.	0.01	0.04
37	*Barleria prionitis* L.	0.01	0.04
38	*Capparis* sp.	0.01	0.04
39	*Cardiospermum corindum* L.	0.01	0.04
40	*Gardenia* sp.	0.01	0.04
41	*Leptadenia reticulata* Wight & Arn.	0.01	0.04
42	*Phyllanthus simplex* Retz.	0.01	0.04
43	*Prosopis juliflora* DC.	0.01	0.04
44	*Tectona hamiltoniana* Wall.	0.01	0.04

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 88.64% of the total number of species was in lower frequency classes, A and B, while 11.36% was observed only in higher frequency class C and D (Table 3, Figure 3). No species was found in highest frequency class (E). It indicates that the scrubs in study area is floristically heterogeneous, according to Lamprecht (1989). The species which fall in higher frequency class D was *Blepharis boerhaviefolia* Pers. This species can be considered as the most common species in the study area.

Table (3) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	35	79.55
B	21-40%	4	9.09
C	41-60%	3	6.82
D	61-80%	2	4.55
E	81-100%	0	0.00

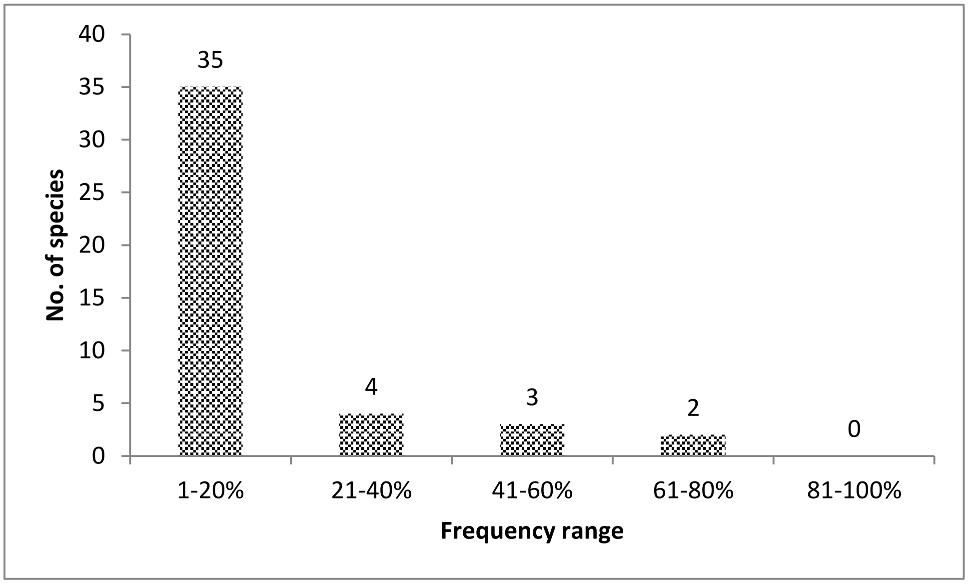

Figure (3) Scrub species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the scrub species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (4) and (5). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (4) Scrub species diversity in study area

Sample	H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Q-1	1.41	0.01669	2.673	3.301	1.263
Q-2	1.723	0.03327	4.667	4.47	1.402
Q-3	1.482	0.01851	2.8	3.416	1.318
Q-4	1.786	0.01439	3.992	3.753	1.604
Q-5	1.798	0.02131	4.195	4.134	1.557
Q-6	1.269	0.01215	2.429	2.918	1.156
Q-7	1.838	0.01016	5.561	3.3	1.64
Q-8	1.717	0.01017	4.624	2.412	1.542
Q-9	1.419	0.01188	3.457	1.726	1.27
Q-10	1.216	0.03193	2.725	2.297	1.01
Q-11	0.9158	0.03139	1.961	1.297	0.7649
Q-12	1.735	0.0115	7.037	2.906	1.401
Q-13	1.782	0.03505	5.676	4.717	1.4
Q-14	1.546	0.02535	4.065	2.872	1.29
Q-15	1.539	0.01805	3.698	2.714	1.344
Q-16	1.81	0.03365	8.273	5.571	1.345
Q-17	1.54	0.05799	5.077	4.775	1.117
Q-18	1.806	0.03416	5.833	4.717	1.419
Q-19	0.466	0.02202	1.447	0.5884	0.3837
Q-20	1.332	0.02113	3.375	1.805	1.122
Q-21	1.236	0.03734	3.054	2.212	0.9871
Q-22	1.333	0.01138	4.444	1.712	1.077
Q-23	1.352	0.03902	7	3.879	0.9208
Q-24	1.787	0.01792	6.794	3.544	1.442
Q-25	1.792	0.04753	8.25	7.029	1.285
Q-26	1.146	0.01692	2.425	1.392	1.017
Q-27	0.921	0.01759	1.649	2.42	0.8153
Q-28	0.8559	0.01786	1.637	1.53	0.7604
Q-29	1.004	0.01984	1.967	1.669	0.885
Q-30	1.328	0.02488	3.016	2.114	1.129
Q-31	1.15	0.01715	2.464	1.426	1.017
Q-32	1.324	0.01941	2.541	2.382	1.173
Q-33	1.246	0.01836	2.102	2.795	1.114
Q-34	0.7921	0.01726	1.516	1.782	0.6998
Q-35	0.9806	0.01862	1.98	1.679	0.8663
Q-36	1.603	0.02249	3.777	3.343	1.378
Q-37	1.246	0.02008	2.725	1.54	1.083
Q-38	1.67	0.02292	3.848	3.343	1.436
Q-39	1.368	0.01595	3.436	1.957	1.192
Q-40	0.4473	0.01011	1.299	0.6354	0.4031

Sample	H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Q-41	1.214	0.03387	2.455	2.18	1.014
Q-42	1.661	0.02983	5.25	3.677	1.323
Q-43	1.534	0.03329	4.857	3.305	1.197
Q-44	1.626	0.04067	6	4.322	1.207
Q-45	1.494	0.02454	5.353	2.782	1.152
Q-46	1.186	0.02061	3.326	1.594	0.9678
Q-47	0.9433	0.03163	2.813	1.453	0.7139
Q-48	0.7595	0.05808	1.897	1.359	0.5641
Q-49	1.633	0.02117	4.559	2.816	1.372
Q-50	1.208	0.04212	2.377	2.343	0.9865
Q-51	1.344	0.04604	2.518	3.424	1.092
Q-52	1.816	0.02601	5.221	4.164	1.502
Q-53	1.431	0.01855	4.419	2.14	1.168
Q-54	1.457	0.06471	3.255	4.208	1.106
Q-55	1.336	0.03752	2.696	2.765	1.105
Q-56	1.46	0.04979	3.254	3.544	1.15
Q-57	1.619	0.01155	5.273	2.297	1.373
Q-58	1.037	0.07045	2.143	2.496	0.7798
Q-59	0.8982	0.02215	2.528	1.171	0.7205
Q-60	1.599	0.0226	3.832	2.967	1.369
Q-61	0.5623	0.02233	1.692	0.6852	0.4495
Q-62	0.8877	0.03181	2.444	1.284	0.6903
Q-63	0.9003	0.0592	2.545	1.743	0.6405
Q-64	1.895	0.01533	9.714	4.451	1.468
Q-65	1.415	0.02194	4.275	2.212	1.145
Q-66	1.498	0.04261	4.121	3.305	1.16
Q-67	1.38	0.0143	3.551	1.616	1.198
Q-68	1.326	0.04051	2.669	2.872	1.087
Q-69	1.852	0.03185	5.603	4.876	1.489
Q-70	1.542	0.02688	4.565	2.807	1.244
Q-71	1.168	0.05206	3.462	2.471	0.8525
Q-72	1.779	0.02041	6.417	3.544	1.432
Q-73	1.443	0.01342	3.47	2.095	1.287
Q-74	1.257	0.01155	2.758	1.856	1.143
Q-75	1.402	0.03103	4.375	2.626	1.09
All Sample Index	2.207		5.368	7.452	2.176
Jackknife Std Error	0.07111		0.5425	0.6729	0.06916

Table (5) Scrub species evenness in study area

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Q-1	2.398	0.6101	0.243	0.5768
Q-2	2.197	1.163	0.5185	0.7767
Q-3	2.398	0.6516	0.2546	0.6063
Q-4	2.485	0.6765	0.3326	0.7107
Q-5	2.398	0.8928	0.3814	0.7405
Q-6	2.398	0.466	0.2209	0.5175
Q-7	2.303	0.7064	0.5561	0.7967
Q-8	2.079	0.558	0.578	0.8202
Q-9	1.792	0.4575	0.5761	0.7839
Q-10	1.792	0.7372	0.4541	0.6635
Q-11	1.386	0.4709	0.4902	0.6374
Q-12	1.792	0.9647	1.173	0.9723
Q-13	2.079	1.285	0.7095	0.8561
Q-14	1.946	0.8588	0.5808	0.7865
Q-15	2.079	0.6881	0.4623	0.7317
Q-16	1.946	1.451	1.182	0.9261
Q-17	1.792	1.35	0.8462	0.8471
Q-18	2.079	1.285	0.7292	0.8679
Q-19	0.6931	0.2237	0.7234	0.6458
Q-20	1.609	0.6249	0.675	0.8182
Q-21	1.609	0.8065	0.6107	0.7551
Q-22	1.386	0.6886	1.111	0.9591
Q-23	1.386	1.154	1.75	1
Q-24	1.946	1.075	0.9706	0.9186
Q-25	1.946	1.589	1.179	0.9335
Q-26	1.609	0.3959	0.4849	0.6985
Q-27	2.197	0.4563	0.1833	0.401
Q-28	1.792	0.3485	0.2728	0.4585
Q-29	1.792	0.4266	0.3278	0.5427
Q-30	1.792	0.6543	0.5027	0.7289
Q-31	1.609	0.416	0.4929	0.702
Q-32	2.079	0.5446	0.3177	0.623
Q-33	2.303	0.5128	0.2102	0.5252
Q-34	1.946	0.3677	0.2166	0.387
Q-35	1.792	0.4324	0.3299	0.532
Q-36	2.197	0.8237	0.4197	0.7199
Q-37	1.609	0.4824	0.545	0.7607
Q-38	2.197	0.8237	0.4275	0.7501
Q-39	1.792	0.5779	0.5727	0.7562

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Q-40	1.099	0.1478	0.433	0.3892
Q-41	1.792	0.6849	0.4092	0.6591
Q-42	1.946	1.11	0.75	0.8463
Q-43	1.792	1.079	0.8095	0.853
Q-44	1.792	1.285	1	0.9069
Q-45	1.609	0.9944	1.071	0.9305
Q-46	1.386	0.6337	0.8315	0.8512
Q-47	1.099	0.639	0.9375	0.8557
Q-48	1.099	0.6002	0.6322	0.6633
Q-49	1.946	0.8381	0.6513	0.8336
Q-50	1.792	0.7566	0.3962	0.6517
Q-51	2.079	0.951	0.3147	0.6225
Q-52	2.197	1.082	0.5801	0.8218
Q-53	1.609	0.7777	0.8837	0.8833
Q-54	1.946	1.234	0.465	0.7332
Q-55	1.946	0.8185	0.3851	0.6686
Q-56	1.946	1.075	0.4648	0.7326
Q-57	1.792	0.7372	0.8788	0.902
Q-58	1.609	0.9089	0.4286	0.6138
Q-59	1.099	0.5091	0.8426	0.811
Q-60	2.079	0.7893	0.479	0.759
Q-61	0.6931	0.2868	0.8462	0.7898
Q-62	1.099	0.5661	0.8148	0.7925
Q-63	1.099	0.7356	0.8485	0.8097
Q-64	1.946	1.282	1.388	0.984
Q-65	1.609	0.8065	0.855	0.8758
Q-66	1.792	1.079	0.6869	0.8268
Q-67	1.609	0.5253	0.7101	0.8502
Q-68	1.946	0.8588	0.3812	0.6627
Q-69	2.197	1.257	0.6226	0.8371
Q-70	1.792	0.9321	0.7609	0.8571
Q-71	1.386	0.9404	0.8654	0.8412
Q-72	1.946	1.075	0.9167	0.9122
Q-73	1.946	0.5251	0.4957	0.7336
Q-74	1.946	0.4048	0.394	0.6369
Q-75	1.609	0.9496	0.875	0.8632
All Sample Index	3.784	0.14	0.122	0.5821
Jackknife Std Error	0.07486	0.01477	0.01542	0.02089

Result (2) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 16 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (6). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 114.51%, the second most dominant species is *Acasia* sp. (IVI=35.43%) and *Dalbergia paniculata* Roxb. (IVI = 32.45%) is third (figure-4). The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of study area.

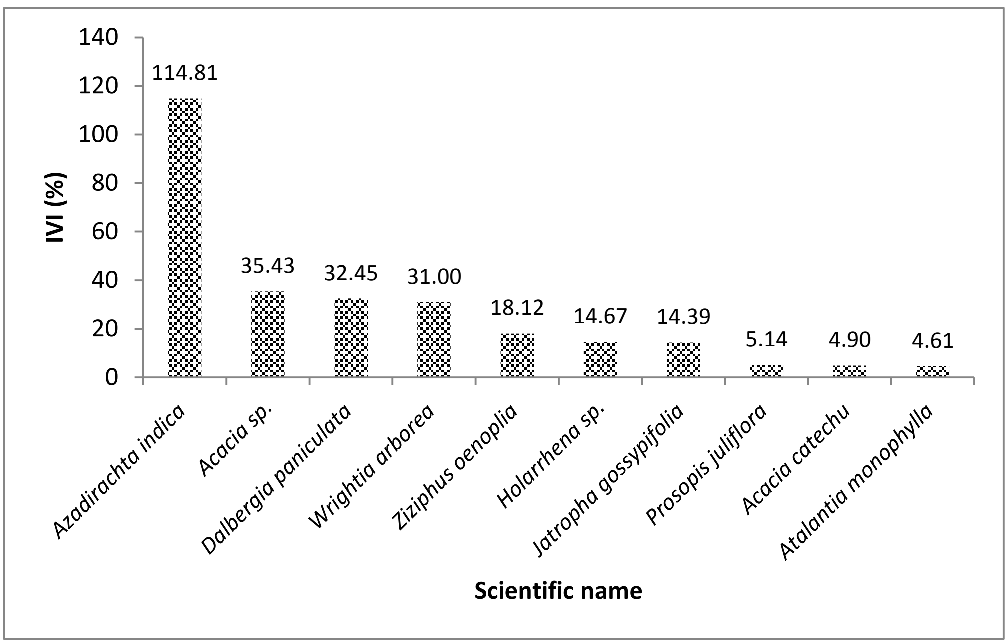

Figure (4) Important Value Index of top ten species in the Letpadaung taung area

Table (6) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientific name	RD (%)	RF (%)	RDm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	44.79	25.00	45.03	114.81
2	*Acacia* sp.	3.68	6.25	25.50	35.43
3	*Dalbergia paniculata* Roxb.	14.72	6.25	11.48	32.45
4	*Wrightia arborea* (Dennst.) Mabb.	15.95	9.38	5.68	31.00
5	*Ziziphus oenoplia* Mill.	4.29	12.50	1.32	18.12
6	*Holarrhena* sp.	7.98	3.13	3.57	14.67
7	*Jatropha gossypifolia* L.	3.07	9.38	1.95	14.39
8	*Prosopis juliflora* DC.	0.61	3.13	1.40	5.14
9	*Acacia catechu* Willd.	0.61	3.13	1.16	4.90
10	*Atalantia monophylla* A. DC.	0.61	3.13	0.87	4.61
11	*Goniothalamus* sp.	0.61	3.13	0.55	4.29
12	*Hymenopramis brachiata* Wall.	0.61	3.13	0.48	4.22
13	*Tectona hamiltoniana* Wall.	0.61	3.13	0.38	4.12
14	Un-1	0.61	3.13	0.33	4.07
15	*Gardinia* sp.	0.61	3.13	0.15	3.89
16	*Boscia variabilis* Collett & Hemsl.	0.61	3.13	0.15	3.88
Total		100.00	100.00	100.00	300.00

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 93.75% of the total number of species was in lower frequency classes, A and B, while low value was observed only in highest frequency class D (Table 7, Figure 5). It indicates that the forest area is floristically heterogeneous, according to Lamprecht (1989). The species which fall in highest frequency class D was

Azadirachta indica A. Juss.. This species can be considered as the most common species in the study area.

Table (7) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	12	75.00
B	21-40%	3	18.75
C	41-60%	0	0.00
D	61-80%	1	6.25
E	81-100%	0	0.00

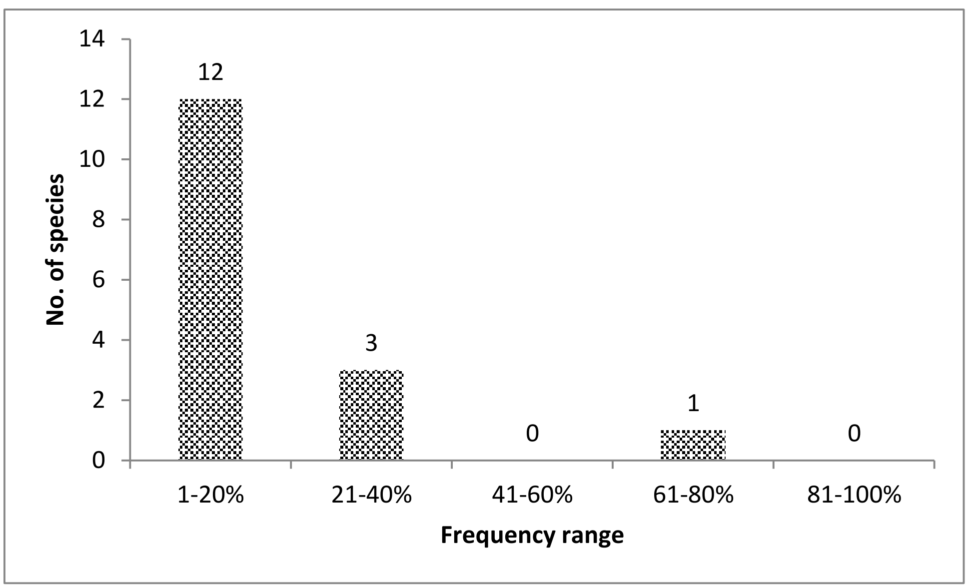

Figure (5) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (8) and (9). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (8) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Pl-1	0.656	0.0518	1.625	1.171	0.4997
Pl-2	0	0	1	0.428	-6.43E-09
Pl-3	1.04	0.09253	6	5.453	0.6212
Pl-4	0.4101	0.06636	1.4	0.9356	0.278
Pl-5	0.7775	0.03222	1.967	1.09	0.6245
Pl-6	0.5297	0.01661	1.577	0.5753	0.4459
Pl-7	1.212	0.01495	3.083	1.596	1.054
Pl-8	0.6238	0.04405	1.445	1.37	0.4898
Pl-9	1.059	0.02595	2.52	1.772	0.8888
Pl-10	0.9372	0.06784	2.108	1.974	0.6967
All Sample Index	1.781		3.902	3.53	1.701
Jackknife Std Error	0.08453		0.5461	0.7428	0.0932

Table (9) Evenness indices in the Letpadaung taung area

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Pl-1	1.099	0.5091	0.5417	0.5624
Pl-2	0	0	1	0
Pl-3	1.099	1.04	2	1
Pl-4	0.6931	0.4101	0.7	0.5473
Pl-5	1.099	0.4634	0.6557	0.6882
Pl-6	0.6931	0.2146	0.7887	0.7437
Pl-7	1.609	0.5138	0.6166	0.7452
Pl-8	1.386	0.5141	0.3613	0.413
Pl-9	1.609	0.6082	0.504	0.6451
Pl-10	1.386	0.7937	0.527	0.647
All Sample Index	2.773	0.3112	0.2439	0.6383
Jackknife Std Error	0	0.2118	0.03413	0.03129

Forest structure

Stem density of ≥10cm was 1630 ha^{-1} and basal area was 3.74 m^2/ha in the study area Table (10). Among the 10sample plots studies,16 tree species were recorded, 9 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 82.01% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 45.03%, followed by *Acasia* sp. 25.50%, and *Dalbergia paniculata* Roxb. 11.48% of the total basal area table (11), figure (6).

Table (10) Consolidated detail of species inventory in the study area

Description	Results
No. of sampling point	10
No. of tree species	16
Density (stem/ha)	1630
Basal area (m^2/ha)	3.74
Total no. of unique species	9

Table (11) Ranking of relative basal area by species in the study area

No.	Scientific name	Stem/ha	Basal area (m^2/ha)	Basal area (%)
1	*Azadirachta indica* A. Juss.	730	1.68	45.03
2	*Acacia* sp.	60	0.95	25.50
3	*Dalbergia paniculata* Roxb.	240	0.43	11.48
4	*Wrightia arborea* (Dennst.) Mabb.	260	0.21	5.68
5	*Holarrhena* sp.	130	0.13	3.57
6	*Jatropha gossypifolia* L.	50	0.07	1.95
7	*Prosopis juliflora* DC.	10	0.05	1.40
8	*Ziziphus oenoplia* Mill.	70	0.05	1.32
9	*Acacia catechu* Willd.	10	0.04	1.16
10	*Atalantia monophylla* A. DC.	10	0.03	0.87
11	*Goniothalamus* sp.	10	0.02	0.55
12	*Hymenopramis brachiata* Wall.	10	0.02	0.48
13	*Tectona hamiltoniana* Wall.	10	0.01	0.38
14	UN	10	0.01	0.33
15	*Gardinia* sp.	10	0.01	0.15
16	*Boscia variabilis* Collett & Hemsl.	10	0.01	0.15
Total		1630	3.74	100.00

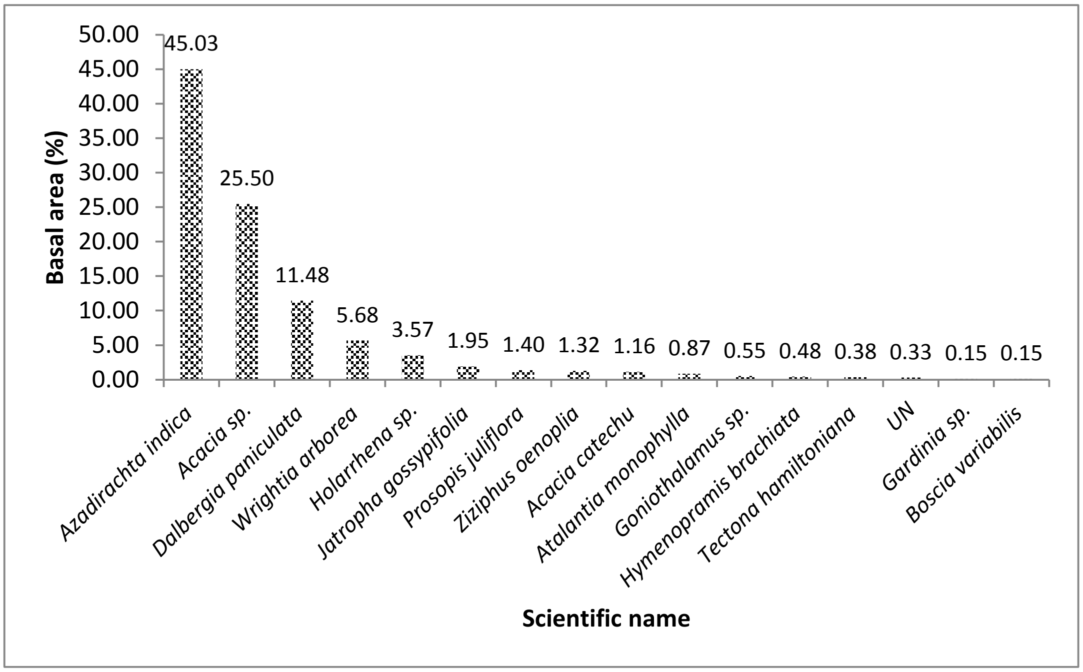

Figure (6) Relative basal area by species in the study area

Discussion and conclusion

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A total of 90 species representing 71 genera and 38 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 114.81%, the second most dominant species is *Acacia sp.* (IVI = 35.43%) and *Dalbergia paniculata* Roxb. (IVI= 32.45%) is third. The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Scrub and tree species distribution by frequency classes in study area showed that high percent of the total number of species was in lower frequency classes, A and B, while low percent was observed only in higher frequency class C and D. It indicates that the forest of study area is floristically heterogeneous. The value of diversity indices and evenness indices for scrubs and tree species were very low in study area.

Stem density of ≥10cm was 1630 ha^{-1} and basal area was 3.74 m^2/ha in the study area. Among the 10sample plots studies, 16 tree species were recorded, 9 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 82.01% of the total, of which *Azadirachta indica* A. Juss.was the most dominant species in the study area with 45.03%, followed by *Acasia* sp. 25.50%, and *Dalbergia paniculata* Roxb. 11.48% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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Flora (Hot Dry Season)

Methodology

Data collection

A Global Positioning System was used to navigate and mark coordinates between sample plots around the mining area. In order to obtain essential ecological data for predicting flora of trees, 4 sample plots (each sample plot was 15mx 15m) were subjectively laid down and observed. To account overall species diversity four subplots 1mx 1m were divided in four corners and study for herbs in the plot (fig. 1). In each sample plot every living tree of girth at breast height (gbh) ≥10cm was measured, listed and counted. Care has been taken to cover different elevation, slope, aspects, drainage and density gradients to study overall spectrum of species diversity. In addition all trees, shrubs, and herbs around the Lepadaung taung area were recorded and listed. The families were identified by using key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer *et a*l., 1963, and Kress *et al*. 2003 and confirmed at Herbarium in Department of Botany, University of Yangon.

Data analysis

Quantitative analysis of tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. For the herb species, density, relative density, frequency, and relative frequency were calculated. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

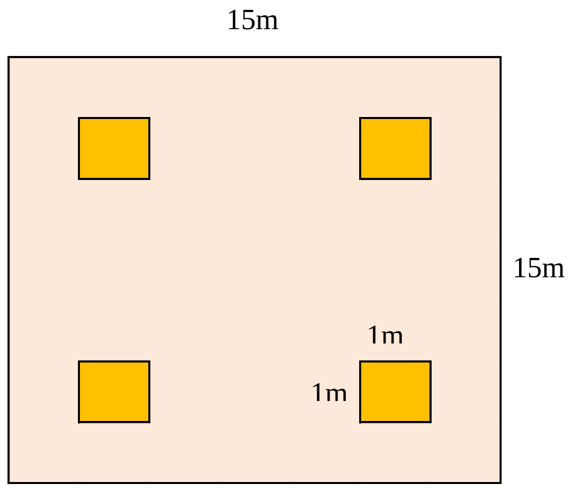

Figure (1) Lay out design of sample plot

Result (1) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 14 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 54.47%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI=53.41%) and *Tectona hamiltoniana* Wall. (IVI = 34.65%) is third (figure-2). The number of species greater than 10% IVI value was eight species. Those species could be considered as ecological indicator species of study area.

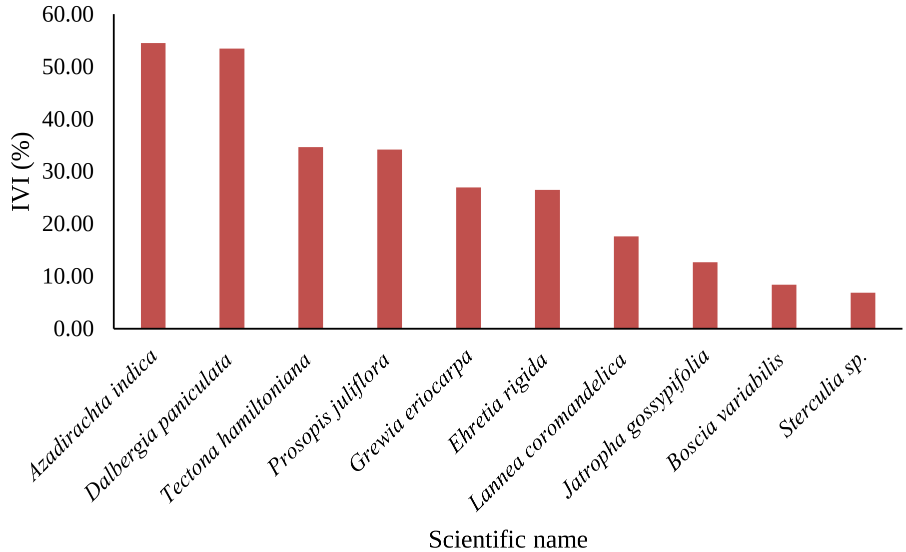

Figure (2) Important Value Index of top ten species in the Letpadaung taung area

Table (1) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientific name	RD (%)	RF (%)	R.Dm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	21.19	12.50	20.78	54.47
2	*Dalbergia paniculata* Roxb.	25.42	8.33	19.65	53.41
3	*Tectona hamiltoniana* Wall.	14.41	12.50	7.75	34.65
4	*Prosopis juliflora* DC.	6.78	4.17	23.24	34.19
5	*Grewia eriocarpa* Juss.	6.78	16.67	3.48	26.92
6	*Ehretia rigida* (Thunb.) Druce	11.86	8.33	6.27	26.46
7	*Lannea coromandelica* (Houtt.) Merr.	0.85	4.17	12.61	17.62
8	*Jatropha gossypifolia* L.	3.39	8.33	0.95	12.67
9	*Boscia variabilis* Collett & Hemsl.	3.39	4.17	0.80	8.36
10	*Sterculia* sp.	0.85	4.17	1.84	6.86
11	*Acacia* sp.	0.85	4.17	1.38	6.39
12	*Bridelia* sp.	1.69	4.17	0.40	6.27
13	*Ziziphus oenoplia* Mill.	1.69	4.17	0.37	6.23
14	*Hymenopramis brachiata* Wall.	0.85	4.17	0.48	5.50
Total		100.00	100.00	100.00	300.00

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 57.14% of the total number of species was in lower frequency classes, B, while 42.86% was observed only in highest frequency class C, D, and E (Table 2, Figure 3). The species which fall in highest frequency class E was *Grewia eriocarpa* Juss.. This species can be considered as the most common species in the study area.

Table (2) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	0	0.00
B	21-40%	8	57.14
C	41-60%	3	21.43
D	61-80%	2	14
E	81-100%	1	7.14

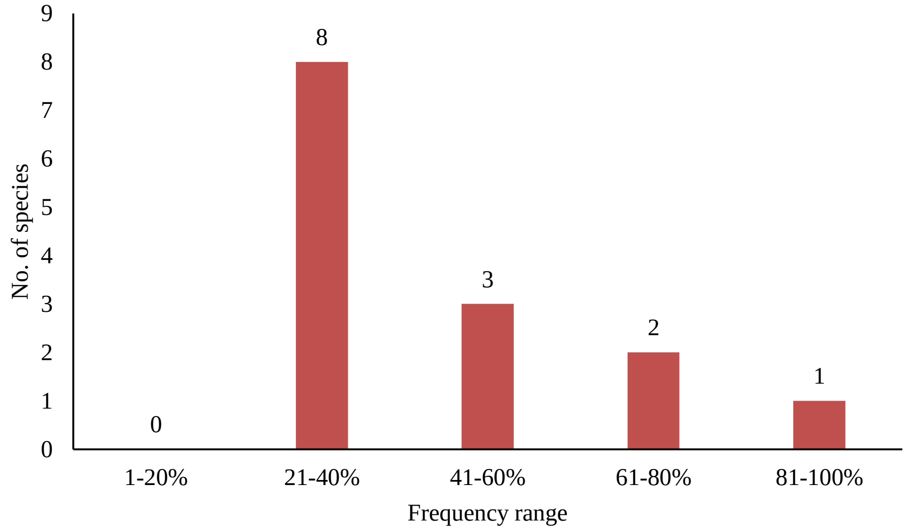

Figure (3) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Simpson (E), and Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (3) and (4). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (3) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.197	3.31	2.458	1.043	1.841
Q2	0.5783	1.783	1.478	0.4483	1.057
Q3	1.852	6.371	5.667	1.549	3.997
Q4	1.539	4.66	4.667	1.244	2.807
All Sample Index	2.103		6.689	1.932	4.133
Jackknife Std Error	0.1326		0.8236	0.1297	1.051

Table (4) Evenness indices in the Letpadaung taung area

Sample	Shannon maximum	Shannon minimium	Simpson E	Brillion E
Q1	1.792	0.5187	0.4097	0.653
Q2	1.099	0.4438	0.4928	0.4898
Q3	2.197	1.035	0.6296	0.8392
Q4	1.792	0.9321	0.7778	0.8571
All Sample Index	2.639	0.6294	0.4778	0.7953
Jackknife Std Error	0.1856	0.1904	0.07786	0.03634

Forest structure

Stem density of ≥10cm was 1311 ha^{-1} and basal area was 6.22 m^2/ha in the study area Table (5). Among the 4 sample plots studies, 14 tree species were recorded, 4 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 63.70% of the total, of which *Prosopis juliflora* DC. was the most dominant species in the study area with 23.25%, followed by *Azadirachta indica* A. Juss. 20.79%, and *Dalbergia paniculata* Roxb. 19.66% of the total basal area table (6), figure (4).

Table (5) Consolidated detail of species inventory in the study area

Description	Results
No. of sampling point	10
No. of tree species	12
Density (stem/ha)	810
Basal area (m^2/ha)	9.24

Table (6) Ranking of relative basal area by species in the study area

No.	Scientific name	Stem/ha	Basa area (m^2/ha)	Basal area (%)
1	*Prosopis juliflora*	89	1.45	23.25
2	*Azadirachta indica*	278	1.29	20.79
3	*Dalbergia paniculata*	333	1.22	19.66
4	*Lannea coromandelica*	11	0.78	12.61
5	*Tectona hamiltoniana*	189	0.48	7.75
6	*Ehretia rigida*	156	0.39	6.27
7	*Grewia eriocarpa*	89	0.22	3.48
8	*Sterculia* sp.	11	0.11	1.84
9	*Acacia* sp.	11	0.09	1.38
10	*Jatropha gossypifolia*	44	0.06	0.95
11	*Boscia variabilis*	44	0.05	0.80
12	*Hymenopramis brachiata*	11	0.03	0.48
13	*Bridelia* sp.	22	0.03	0.40
14	*Ziziphus oenoplia*	22	0.02	0.37
Total		1311	6.22	100

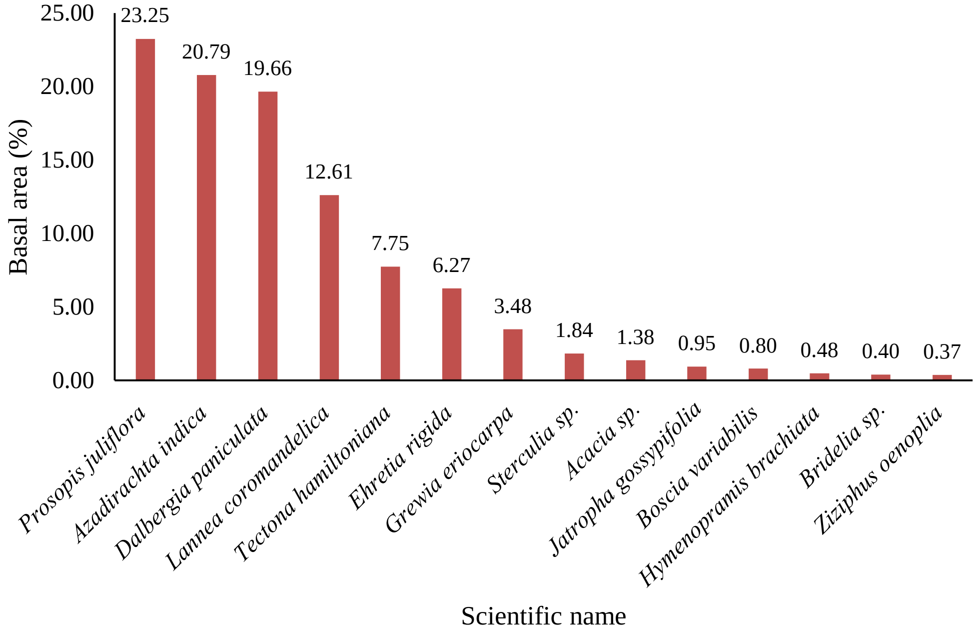

Figure (4) Relative basal area by species in the study area

Result (2) Herb species in Letpadaung taung area

Frequency and Relative Frequency

Hibiscus sp. has highest relative frequency value (11.27%), UN-1 takes second highest relatively frequency value (9.86%), and *Azadirachta indica* A. Juss. and *Blepharis boerhaviefolia* Pers. possess third relatively frequency value (8.45%) see table (7), figure (5). These species are most frequently occurred in the study area.

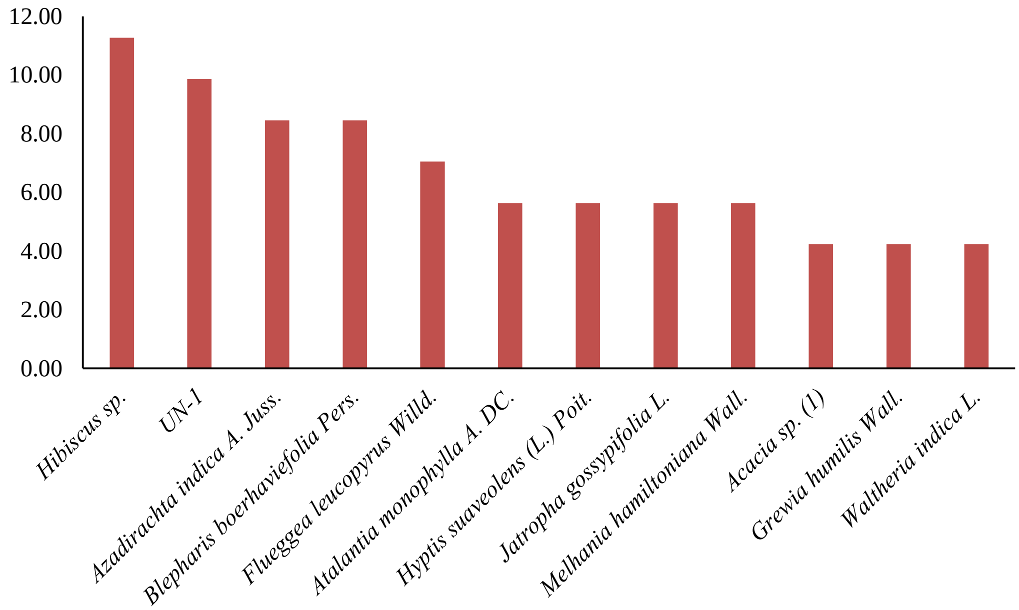

Figure (5) Relative frequency of top ten species

Table (7) Ranking of frequency and relative frequency of herb species

No.	Scientific Name	Frequency	Relative frequency (%)
1	*Hibiscus* sp.	0.50	11.27
2	UN-1	0.44	9.86
3	*Azadirachta indica* A. Juss.	0.38	8.45
4	*Blepharis boerhaviefolia* Pers.	0.38	8.45
5	*Flueggea leucopyrus* Willd.	0.31	7.04
6	*Atalantia monophylla* A. DC.	0.25	5.63
7	*Hyptis suaveolens* (L.) Poit.	0.25	5.63
8	*Jatropha gossypifolia* L.	0.25	5.63
9	*Melhania hamiltoniana* Wall.	0.25	5.63
10	*Acacia* sp. (1)	0.19	4.23
11	*Grewia humilis* Wall.	0.19	4.23
12	*Waltheria indica* L.	0.19	4.23
13	*Bridelia* sp.	0.13	2.82
14	*Capparis zeylanica* L.	0.13	2.82
15	*Cocculus villosus* DC.	0.13	2.82
16	*Cyperus* sp.	0.13	2.82
17	*Ehretia rigida* (Thunb.) Druce	0.13	2.82
18	*Poa annua* L.	0.06	1.41
19	*Tephrosia purpurea* Pers.	0.06	1.41
20	UN-2	0.06	1.41
21	*Ziziphus oenoplia* Mill.	0.06	1.41

Density and Relative Density of Belt transect

Hyptis suaveolens (L.) Poit. has highest relative density value (88.87%), UN-1 takes second highest relatively density value (3.57%), and *Hibiscus* sp. holds third relatively density value (1.19%) see table (8), figure (6). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

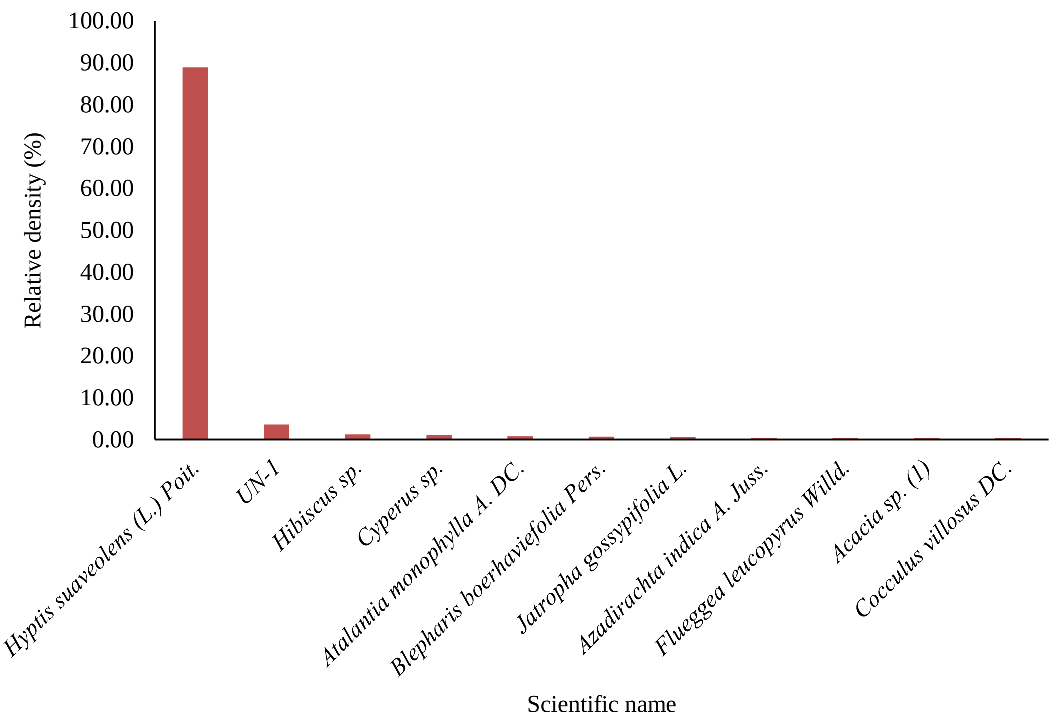

Figure (6) Relative density of herb species

Table (8) Ranking of d and relative density of herb species

No.	Scientific Name	Density	Relative Density (%)
1	*Hyptis suaveolens* (L.) Poit.	93.31	88.87
2	UN-1	3.75	3.57
3	*Hibiscus* sp.	1.25	1.19
4	*Cyperus* sp.	1.13	1.07
5	*Atalantia monophylla* A. DC.	0.81	0.77
6	*Blepharis boerhaviefolia* Pers.	0.75	0.71
7	*Jatropha gossypifolia* L.	0.56	0.54
8	*Azadirachta indica* A. Juss.	0.44	0.42
9	*Flueggea leucopyrus* Willd.	0.44	0.42
10	*Acacia* sp. (1)	0.38	0.36
11	*Cocculus villosus* DC.	0.38	0.36
12	*Melhania hamiltoniana* Wall.	0.31	0.30
13	*Grewia humilis* Wall.	0.25	0.24
14	*Bridelia* sp.	0.19	0.18
15	*Capparis zeylanica* L.	0.19	0.18
16	*Ehretia rigida* (Thunb.) Druce	0.19	0.18
17	*Poa annua* L.	0.19	0.18
18	*Tephrosia purpurea* Pers.	0.19	0.18
19	*Waltheria indica* L.	0.19	0.18
20	UN-2	0.06	0.06
21	*Ziziphus oenoplia* Mill.	0.06	0.06

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 90.48% of the total number of herb species was in lower frequency classes, A and B, while 9.52% was observed only in higher frequency class C (Table 9, Figure 7). It indicates that the herb species in study area is floristically heterogeneous, according to Lamprecht (1989).

Table (9) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	12	57.14
B	21-40%	7	33.33
C	41-60%	2	9.52
D	61-80%	0	0
E	81-100%	0	0

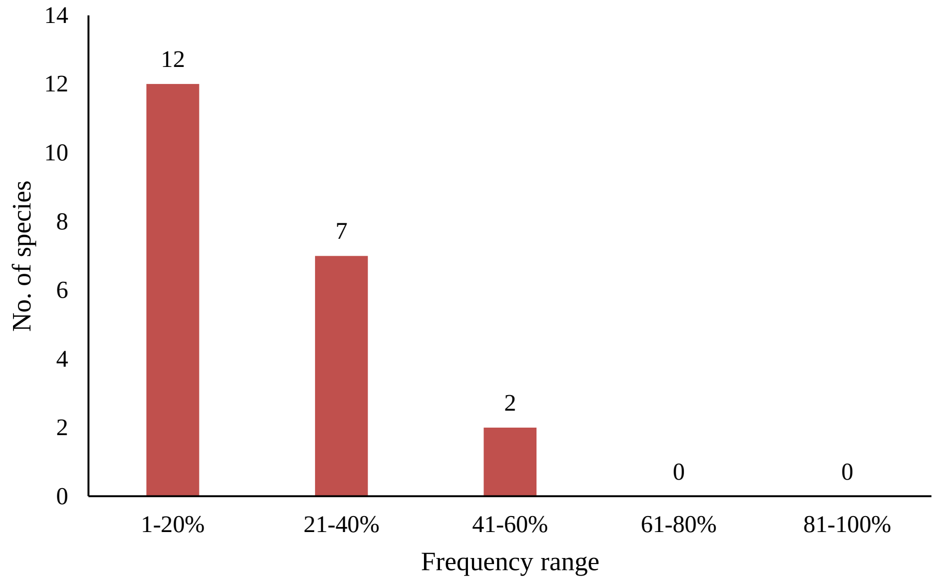

Figure (7) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the herb species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Brillouin (D), Fisher's Alpha, Shannon maximum and minimum evenness (E), Simpson (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (10) and (11). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (10) Species diversity in the study area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.206	3.341	2.731	1.003	1.84
Q2	1.894	6.644	13.75	1.339	8.286
Q3	1.494	4.456	7	1.015	5.705
Q4	0.6005	1.823	1.531	0.4996	0.8897
Q5	0.6931	2	2	0.3466	2.00E+06
Q6	0	1	1	-1.01E-09	0.7959
Q7	0.6931	2	2	0.3466	2.00E+06
Q8	0.9503	2.586	3.333	0.5991	3.167
Q9	1.414	4.114	4.583	1.03	3.538
Q10	1.223	3.397	3.477	0.9977	1.594
Q11	1.586	4.883	5.571	1.175	4.322
Q12	1.16	3.191	2.553	0.8863	2.496
Q13	0.1813	1.199	1.067	0.1695	0.9218
Q14	0.2118	1.236	1.078	0.1958	0.9748
Q15	0.2085	1.232	1.075	0.1801	1.17
Q16	0.09952	1.105	1.031	0.0844	0.876
All Sample Index	0.6204		1.264	0.599	3.384
Jackknife Std Error	0.2487		0.1774	0.2376	0.3135

Table (11) Species evenness in the study area

Sample	Shannon maximum	Shanno	Simpson E	Brillion E
Q1	1.609	0.643	0.5462	0.7343
Q2	1.946	1.666	1.964	1
Q3	1.609	1.386	1.4	0.9524
Q4	1.099	0.334	0.5102	0.5206
Q5	0.6931	0.693	1	1
Q6	0	0	1	0
Q7	0.6931	0.693	1	1
Q8	1.099	0.95	1.111	0.8808
Q9	1.609	1.16	0.9167	0.8756
Q10	1.386	0.634	0.8693	0.8776
Q11	1.792	1.285	0.9286	0.8835
Q12	1.609	0.909	0.5106	0.6977
Q13	1.792	0.06	0.1779	0.09595
Q14	1.792	0.077	0.1797	0.1113
Q15	1.792	0.159	0.1792	0.1042
Q16	1.609	0.1	0.2062	0.05381
All Sample Index	3.045	0.1	0.06017	0.1991
Jackknife Std Error	0.08182	0.047	0.01221	0.08405

Discussion and conclusion

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A total of 71 species representing 60 genera and 33 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 54.47%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 53.41%) and *Tectona hamiltoniana* Wall. (IVI= 34.65%) is third. The number of species greater than 10% IVI value was eight species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that high percent of the total number of species was in lower frequency classes, A and B, while low percent was observed only in higher frequency class C. It indicates that the herb species of study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species were very low in study area.

Stem density of ≥10cm was 1311 ha^{-1} and basal area was 6.22 m^2/ha in the study area. Among the 4 sample plots studies, 14 tree species were recorded, 4 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 63.70% of the total, of which *Prosopis juliflora* DC. was the most dominant species in the study area with 23.25%, followed by *Azadirachta indica* A. Juss. 20.79%, and *Dalbergia paniculata* Roxb. 19.66% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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Baseline Flora Wet Season

Methodology

Data collection

In order to obtain essential ecological data for predicting flora of trees, 4 permanent plots (each sample plot was 15mx 15m) in different sites were subjectively laid down and observed. To account overall species diversity four subplots 1mx 1m were divided in four corners and study for herbs in the plot (fig. 1). After plot set up enumeration was conducted. Within each sub-plot, every living tree with a minimum girth at breast height (gbh) of 10cm was mapped to the nearest 0.1m and its coordinates were recorded using different symbols, each tree was labeled with a number. The trees were permanently marked with a uniquely numbered aluminum tag.

Tags were attached to the tree with nylon fishing line using a slip-knot system to allow the sling to increase its size as the tree grows. Only in the case of very large trees, is the tag nailed to the tree. The point of measurement is marked by a permanent marker pen at 1.3m above the ground (or above any buttresses; the size of a tree at the point of measurement will then still be referred to as the gbh, i.e. this term is equivalent to a reference height) and trees are measured for gbh to the nearest mm over the paint mark.

Botanical specimens are taken – except for very common and in the field reliably identified species. The families were identified by using a key to the families of the flowering plants, issued by the Department of Botany, Yangon University (1994). Specimen identification was performed with the use of the following references: Backer *et a*l., (1963, 1965, 1968), Hooker, Sir J.D. Vol.(I-VII), (1897) and Hundley, H.G. and Chit Ko Ko (1961).

Data analysis

Quantitative analysis of tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. For the herb species, density, relative density, frequency, and relative frequency were calculated. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

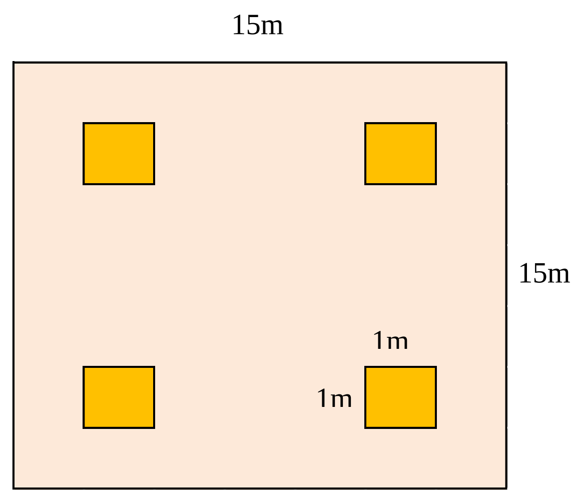

Figure (1) Lay out design of sample plot

Result (1) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 16 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 66.83%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI=44.22%) and *Prosopis juliflora* DC. (IVI = 31.60%) is third (figure-2). The number of species greater than 10% IVI value was ten species. Those species could be considered as ecological indicator species of study area.

Table (1) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientifics name	RD (%)	RF (%)	R.Dm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	31.97	11.11	23.74	66.83
2	*Dalbergia paniculata* Roxb.	18.37	7.41	18.45	44.22
3	*Prosopis juliflora* DC.	5.44	3.70	22.45	31.60
4	*Tectona hamiltoniana* Wall.	10.88	11.11	6.53	28.53
5	*Ehretia rigida* (Thunb.) Druce	8.84	7.41	6.65	22.90
6	*Grewia eriocarpa* Juss.	4.08	11.11	3.18	18.37
7	*Lannea coromandelica* (Houtt.) Merr.	0.68	3.70	11.69	16.08
8	*Ziziphus oenoplia* Mill.	5.44	7.41	1.31	14.16
9	*Boscia variabilis* Collett & Hemsl.	4.76	7.41	1.18	13.35
10	*Jatropha gossypifolia* L.	3.40	7.41	1.12	11.93
11	*Sterculia* sp.	0.68	3.70	1.74	6.13
12	*Hymenopramis brachiata* Wall.	1.36	3.70	1.03	6.09
13	*Bridelia* sp.	1.36	3.70	0.43	5.50
14	*Wrightia arborea* (Dennst.) Mabb.	1.36	3.70	0.25	5.31
15	*Grewia humilis* Wall.	0.68	3.70	0.16	4.55
16	*Holarrhena pubescens* Wall. ex. G. Don	0.68	3.70	0.07	4.46
Total		100.00	100.00	100.00	300.00

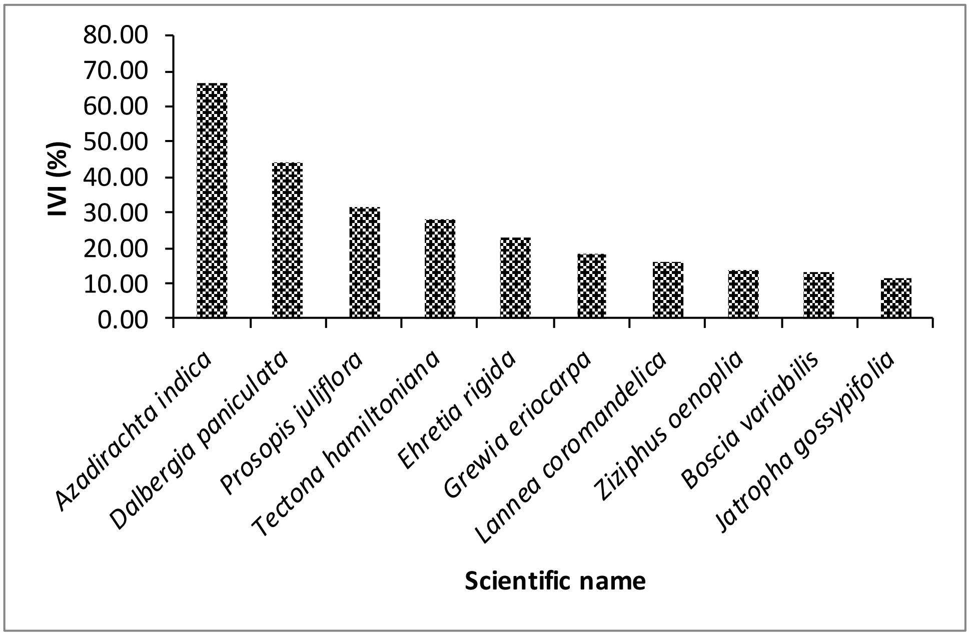

Figure (2) Important Value Index of top ten species in the Letpadaung taung area

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 50% of the total number of species was in lower frequency classes B, while 50% was observed only in highest frequency class C and D, (Table 2, Figure 3). The species which fall in higher frequency class D was *Azadirachta indica* A. Juss., *Grewia eriocarpa* Juss., and *Tectona hamiltoniana* Wall.. Those species can be considered as the most common species in the study area.

Table (2) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	0	0.00
B	21-40%	8	50.00
C	41-60%	5	31.25
D	61-80%	3	19
E	81-100%	0	0

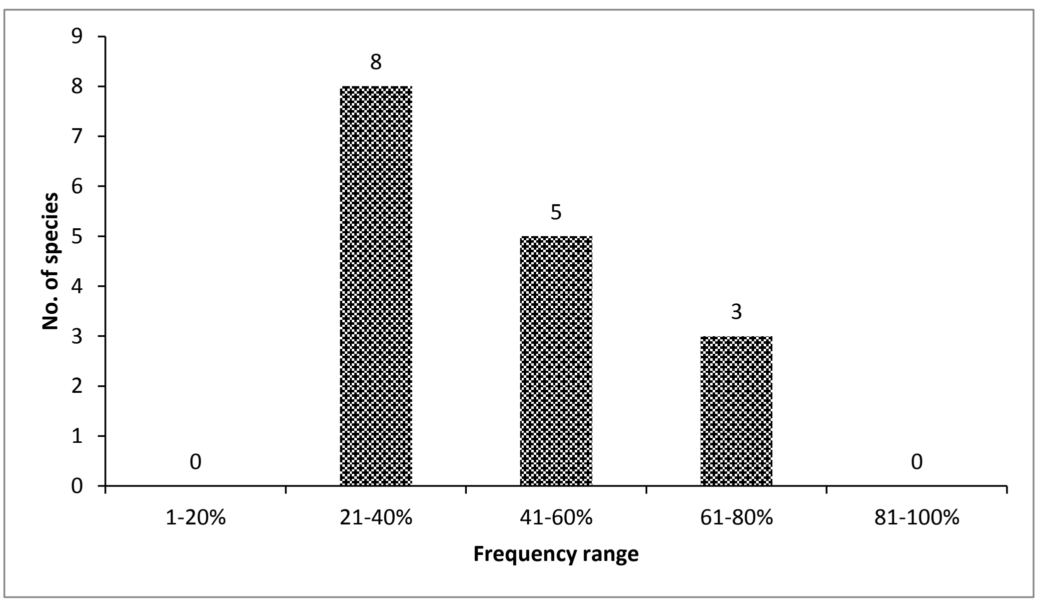

Figure (3) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Simpson (E), and Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (3) and (4). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (3) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.313	3.718	2.791	1.144	1.877
Q2	0.8996	2.459	1.81	0.7779	1.438
Q3	1.847	6.338	5.667	1.551	3.922
Q4	1.639	5.151	4.865	1.322	3.426
All Sample Index	2.15		6.185	1.988	4.566
Jackknife Std Error	0.17		1.979	0.1621	0.7267

Table (4) Evenness indices in the Letpadaung taung area

Sample	Shannon maximum	Shannon minimium	Simpson E	Brillion E
Q1	1.792	0.5369	0.4651	0.7193
Q2	1.609	0.4232	0.362	0.5376
Q3	2.197	1.013	0.6296	0.836
Q4	1.946	1.041	0.6951	0.8376
All Sample Index	2.773	0.6059	0.3866	0.7726
Jackknife Std Error	0.08766	0.1271	0.155	0.07758

Forest structure

Stem density of ≥10cm was 1633 ha^{-1} and basal area was 6.76 m^2/ha in the study area Table (5). Among the 4 sample plots studies, 16 tree species were recorded, 4 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 64.65% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 23.74%, followed by *Prosopis juliflora* DC. 22.45%, and *Dalbergia paniculata* Roxb. 18.45% of the total basal area table (5), figure (4).

Table (5) Ranking of relative basal area by species in the study area

No.	Scientifics name	Stem/ha	Basal area m^2/ha)	Basal area (%)
1	*Azadirachta indica* A. Juss.	522	1.61	23.74
2	*Prosopis juliflora* DC.	89	1.52	22.45
3	*Dalbergia paniculata* Roxb.	300	1.25	18.45
4	*Lannea coromandelica* (Houtt.) Merr.	11	0.79	11.69
5	*Ehretia rigida* (Thunb.) Druce	144	0.45	6.65
6	*Tectona hamiltoniana* Wall.	178	0.44	6.53
7	*Grewia eriocarpa* Juss.	67	0.22	3.18
8	*Sterculia* sp.	11	0.12	1.74
9	*Ziziphus oenoplia* Mill.	89	0.09	1.31
10	*Boscia variabilis* Collett & Hemsl.	78	0.08	1.18
11	*Jatropha gossypifolia* L.	56	0.08	1.12
12	*Hymenopramis brachiata* Wall.	22	0.07	1.03
13	*Bridelia* sp.	22	0.03	0.43
14	*Wrightia arborea* (Dennst.) Mabb.	22	0.02	0.25
15	*Grewia humilis* Wall.	11	0.01	0.16
16	*Holarrhena pubescens* Wall. ex. G. Don	11	0.00	0.07
Total		1633	6.76	100

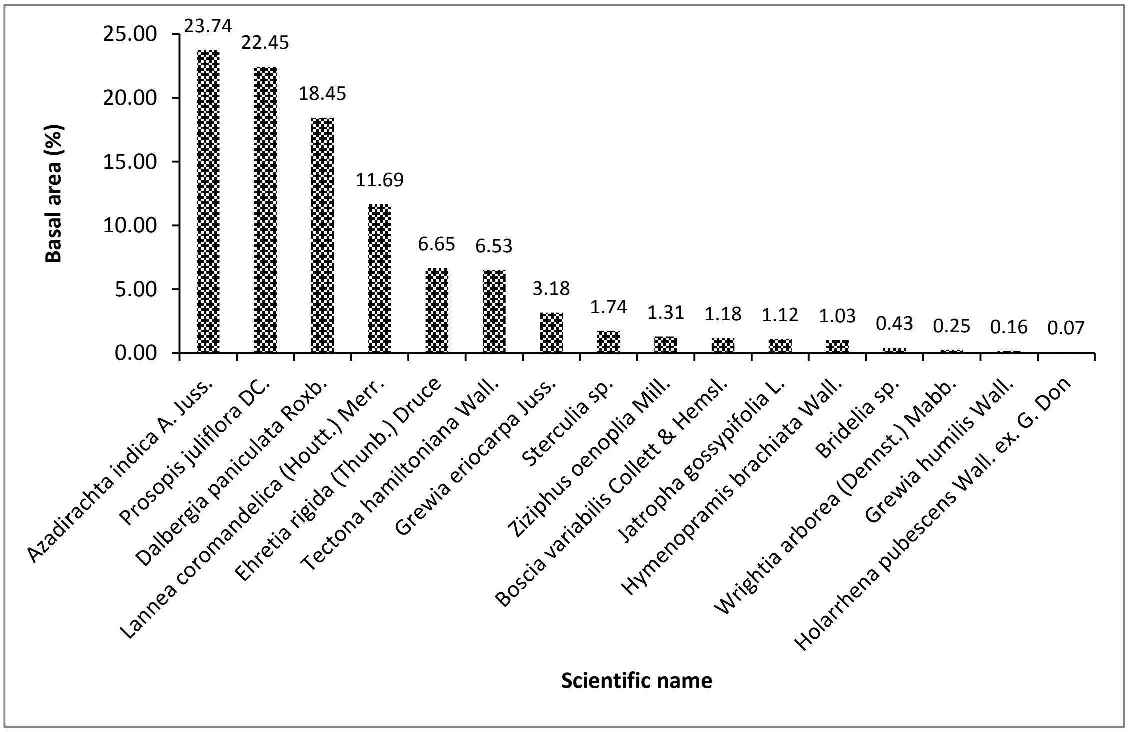

Figure (4) Relative basal area by species in the study area

Result (2) Herb species in Letpadaung taung area

Frequency and Relative Frequency

Rhynchosia sp. has highest relative frequency value (15.24%), *Blepharis boerhaviefolia* Pers. takes second highest relatively frequency value (11.43%), and *Hyptis suaveolens* (L.) Poit. possesses third relatively frequency value (7.62%) see table (6), figure (5). These species are most frequently occurred in the study area.

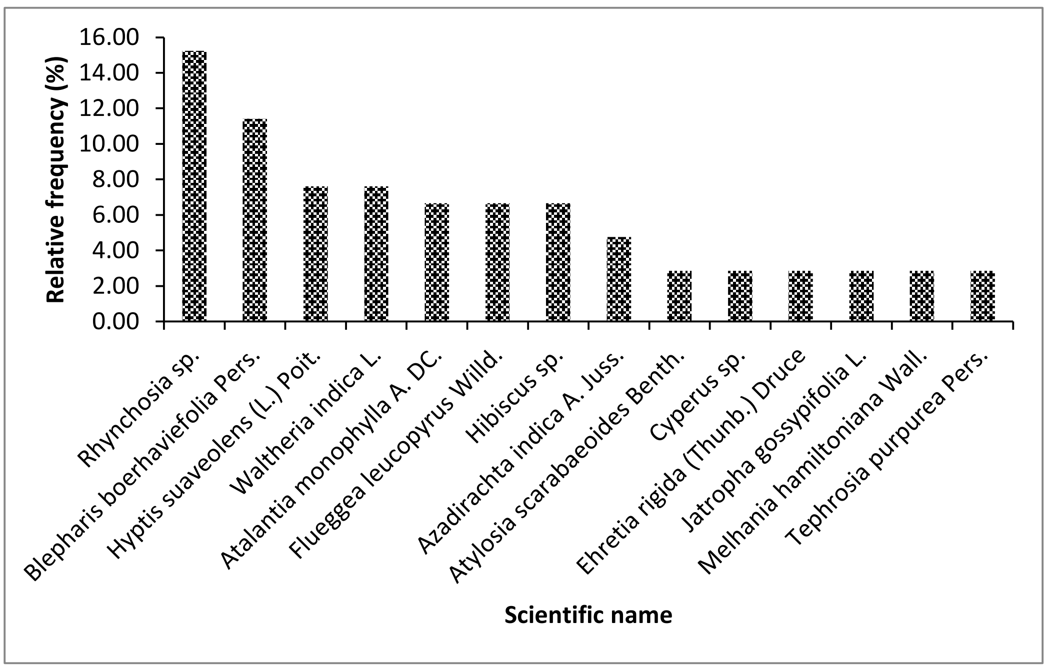

Figure (5) Relative frequency of top ten species

Table (6) Ranking of frequency and relative frequency of herb species

No.	Scientifics name	Frequency	Relative frequency (%)
1	*Rhynchosia* sp.	1.00	15.24
2	*Blepharis boerhaviefolia* Pers.	0.75	11.43
3	*Hyptis suaveolens* (L.) Poit.	0.50	7.62
4	*Waltheria indica* L.	0.50	7.62
5	*Atalantia monophylla* A. DC.	0.44	6.67
6	*Flueggea leucopyrus* Willd.	0.44	6.67
7	*Hibiscus* sp.	0.44	6.67
8	*Azadirachta indica* A. Juss.	0.31	4.76
9	*Atylosia scarabaeoides* Benth.	0.19	2.86
10	*Cyperus* sp.	0.19	2.86
11	*Ehretia rigida* (Thunb.) Druce	0.19	2.86
12	*Jatropha gossypifolia* L.	0.19	2.86
13	*Melhania hamiltoniana* Wall.	0.19	2.86
14	*Tephrosia purpurea* Pers.	0.19	2.86
15	*Bridelia* sp.	0.13	1.90
16	*Cocculus villosus* DC.	0.13	1.90
17	*Grewia humilis* Wall.	0.13	1.90
18	*Abutilon indicum* (L.) Sweet	0.06	0.95
19	*Holarrhena pubescens* Wall. ex. G. Don	0.06	0.95
20	*Ipomoea* sp.	0.06	0.95
21	*Leptadenia reticulata* Wight & Arn.	0.06	0.95
22	*Phyllanthus simplex* Retz.	0.06	0.95
23	*Phyllanthus* sp.	0.06	0.95
24	*Poa annua* L.	0.06	0.95
25	UN-1	0.06	0.95
26	UN-2	0.06	0.95
27	*Wrightia arborea* (Dennst.) Mabb.	0.06	0.95
28	*Ziziphus oenoplia* Mill.	0.06	0.95

Density and Relative Density of Belt transect

Hyptis suaveolens (L.) Poit. has highest relative density value (29.37%), Rhynchosia sp. takes second highest relatively density value (27.33%), and *Waltheria indica* L. holds third relatively density value (21.69%) see table (7), figure (6). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

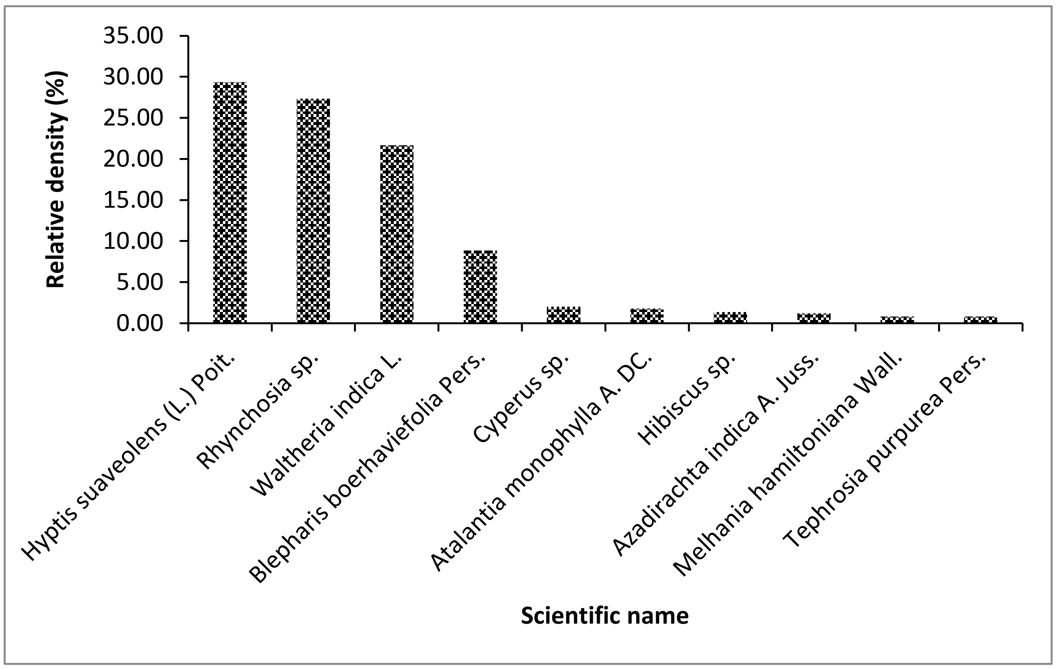

Figure (6) Relative density of herb species

Table (7) Ranking of d and relative density of herb species

No.	Scientifics name	Density	Relative density(%)
1	*Hyptis suaveolens* (L.) Poit.	24.38	29.37
2	*Rhynchosia* sp.	22.69	27.33
3	*Waltheria indica* L.	18.00	21.69
4	*Blepharis boerhaviefolia* Pers.	7.38	8.89
5	*Cyperus* sp.	1.69	2.03
6	*Atalantia monophylla* A. DC.	1.50	1.81
7	*Hibiscus* sp.	1.13	1.36
8	*Azadirachta indica* A. Juss.	1.00	1.20
9	*Melhania hamiltoniana* Wall.	0.69	0.83
10	*Tephrosia purpurea* Pers.	0.69	0.83
11	*Flueggea leucopyrus* Willd.	0.63	0.75
12	*Atylosia scarabaeoides* Benth.	0.44	0.53
13	*Jatropha gossypifolia* L.	0.44	0.53
14	*Poa annua* L.	0.44	0.53
15	*Ehretia rigida* (Thunb.) Druce	0.31	0.38
16	*Grewia humilis* Wall.	0.31	0.38
17	*Bridelia* sp.	0.25	0.30
18	*Cocculus villosus* DC.	0.19	0.23
19	*Phyllanthus simplex* Retz.	0.19	0.23
20	*Abutilon indicum* (L.) Sweet	0.13	0.15
21	UN-2	0.13	0.15
22	*Holarrhena pubescens* Wall. ex. G. Don	0.06	0.08
23	*Ipomoea* sp.	0.06	0.08
24	*Leptadenia reticulata* Wight & Arn.	0.06	0.08
25	*Phyllanthus* sp.	0.06	0.08
26	UN-1	0.06	0.08
27	*Wrightia arborea* (Dennst.) Mabb.	0.06	0.08
28	*Ziziphus oenoplia* Mill.	0.06	0.08

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 75% of the total number of herb species was in lower frequency classes, A while 25% was observed only in higher frequency class C, D, and E (Table 8, Figure 7). It indicates that the herb species in study area is floristically heterogeneous, according to Lamprecht (1989).

Table (8) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	21	75.00
B	21-40%	0	0.00
C	41-60%	5	17.86
D	61-80%	1	4
E	81-100%	1	4

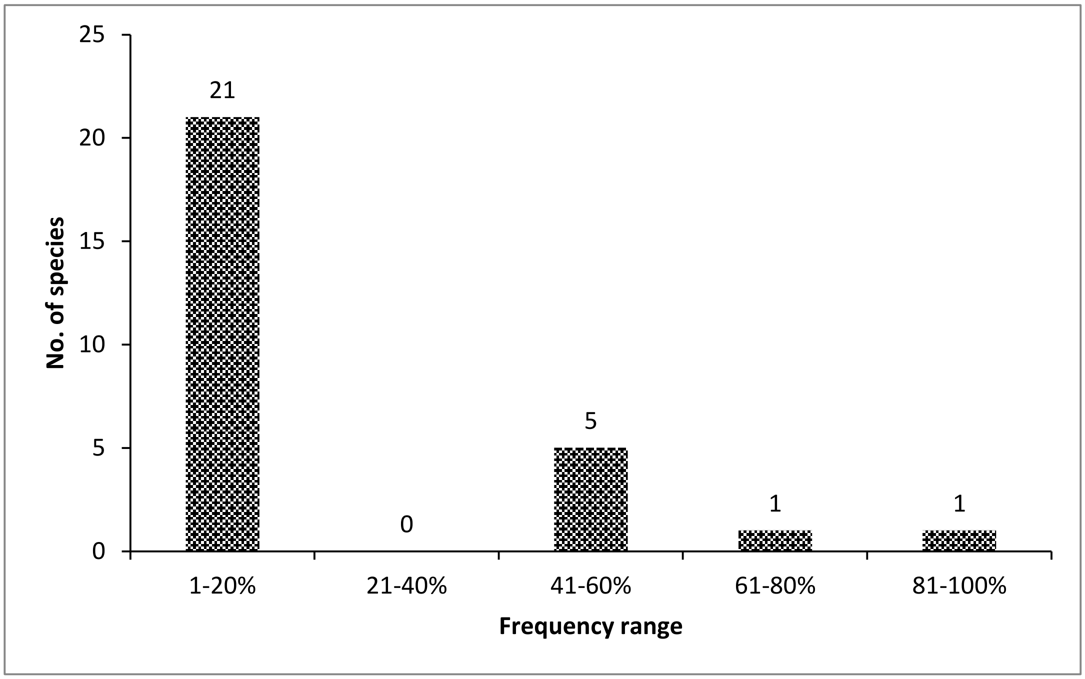

Figure (7) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the herb species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Brillouin (D), Fisher's Alpha, Shannon maximum and minimum evenness (E), Simpson (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (9) and (10). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (9) Species diversity in the study area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.505	4.506	3.62	1.392	2.029
Q2	1.654	5.228	4.315	1.399	3.189
Q3	0.8806	2.412	1.755	0.7388	1.576
Q4	1.267	3.551	3.083	1.105	1.558
Q5	1.061	2.89	2.382	1.018	1.156
Q6	1.328	3.774	3.016	1.262	1.259
Q7	1.053	2.867	2.581	0.8986	1.297
Q8	1.306	3.69	2.878	1.191	1.848
Q9	1.767	5.851	5.25	1.395	4.523
Q10	1.545	4.69	6.6	1.16	3.218
Q11	1.32	3.742	4.25	1.075	1.649
Q12	2.023	7.56	16.5	1.435	10.49
Q13	1.294	3.648	2.773	1.185	2.063
Q14	0.5828	1.791	1.57	0.5643	0.6709
Q15	1.277	3.587	2.486	1.203	2.009
Q16	1.908	6.738	6.068	1.682	3.513
All Sample Index	1.868		4.615	1.83	5.02
Jackknife Std Error	0.1363		0.5498	0.1279	0.6431

Table (10) Species evenness in the study area

Sample	Shannon maximum	Shanno	Simpson E	Brillion E
Q1	0.3806	2.079	0.4525	0.7179
Q2	0.871	2.079	0.5394	0.7885
Q3	0.5029	1.609	0.351	0.5214
Q4	0.4924	1.609	0.6167	0.7778
Q5	0.1527	1.792	0.397	0.5883
Q6	0.2032	1.792	0.5027	0.737
Q7	0.4709	1.386	0.6452	0.7488
Q8	0.4008	1.946	0.4111	0.6631
Q9	1.245	2.079	0.6562	0.8449
Q10	1.099	1.609	1.32	0.9717
Q11	0.6599	1.386	1.063	0.9522
Q12	1.814	2.079	2.063	1
Q13	0.3963	2.079	0.3466	0.6128
Q14	0.07539	1.386	0.3925	0.4166
Q15	0.2794	2.197	0.2762	0.5744
Q16	0.7831	2.303	0.6068	0.8266
All Sample Index	0.1663	3.332	0.1648	0.5588
Jackknife Std Error	0.03762	0.11	0.02506	0.04334

Discussion and conclusion

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A total of 117 species representing 94 genera and 44 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 66.83%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 44.22%) and *Prosopis juliflora* DC. (IVI= 31.60%) is third. The number of species greater than 10% IVI value was ten species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that high percent of the total number of species was in lowest frequency classes, A and while low percent was observed only in higher frequency class C, D, and E. It indicates that the herb species of study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species were very low in study area.

Stem density of ≥10cm was 1633 ha^{-1} and basal area was 6.76 m^2/ha in the study area. Among the 4 sample plots studies, 16 tree species were recorded, 4 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 64.65% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 23.74%, followed by *Prosopis juliflora* DC. 22.45%, and *Dalbergia paniculata* Roxb. 18.45% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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APPENDIX D

Baseline Studies - Fauna

Knight Piésold
CONSULTING

BASELINE STUDY - FAUNA

Letpadaung Copper Mine Project

LETPADAUNG COPPER MINE PROJECT

Baseline Study – Fauna

Prepared for: Myanmar Wanbao Mining Copper Limited

70(I) Bo Chein Street

Pyay Road, Hiaing Township

Yangon, Myanmar

Document Number/ Revision Number	Prepared by	Reviewed by	Date
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Contents

Executive Summary

EXECUTIVE SUMMARY

Environment Myanmar Cooperative Company Limited (EMC) has undertaken a survey of the fauna within and around the site of the Letpadaung Copper Project for Myanmar Wanbao Mining Copper Limited (MWMCL). The survey was undertaken in three campaigns over the period from September 2012 until late June 2013 to take into account the seasonal variation and the effect on species abundance and diversity and habitat condition. .

The survey was undertaken through the use of fixed location points that were frequently revisited and observations recorded, transects that were inspected for tracks, scats and calls and wandering transects where observations were made, potential habitat inspected and evidence of presence/absence recorded. Identification was confirmed according to historic collections, recordings and identification specimens using local and international references.

Historical studies in the Project area indicated that the fauna composition was depauperate in numbers and that state could likely be attributed to the habitat condition in the area. Indeed the habitat condition has declined over the last 20 years as a result of the harvesting of vegetation for its resources and more substantial trees have been removed both from natural vegetation in the Letpadaung hills as well as plantations in the surrounding area. Thus much of the protection offered by those habitats is no longer available nor is the nesting, roosting or burrowing opportunities they provided.

Recordings were made of mammals, birds, reptiles, amphibians, butterflies and odonates. Statistical analysis of the recordings made suggested there was very little difference in species abundance and diversity across the seasons.

Two mammal species, Eld's Deer and the Myanmar Hare, were observed directly or reported in interviews as occurring in the Project area. Individuals of these species in the project would be considered to be under threat as their ability to move unhindered across open fields to other areas of protection is doubtful. It is considered that the provision of an offset for the lost habitat to accommodate the needs of these mammals and a possible capture/release programme should be considered for these species.

Other species of animal are less threatened due to their mobility (birds), ability to survive in small patches or ability to move to other sites away from the Letpadaung site inconspicuously will enable them to survive the habitat loss through disturbance of the site.

1 INTRODUCTION

1.1 Background

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of fauna in the project area of the Letpadaung Copper Project ("the Project"). The survey was undertaken in three campaigns over the period from September 2012 until late June 2013 to enable the evaluation of the fauna in the three seasons experienced in the Project area.

The proponent, MWMCL, aims to promote survey work that is uniform and of sufficient rigour to contribute to a more systematic inventory of the Myanmar and Salingyi district's fauna. This will result in a consolidated and readily accessible database of environmental information.

The Environmental and Social Impact Assessment (ESIA) is a systematic study and process to determine the impacts and effects of a project on the environment during its various phases of construction, commissioning, operation, and abandonment. As such, its objectives are to ensure that the project is sound and maximises the social and environmental standpoint benefit to be derived, and that any issues of concern relating to the biological, physical, or socio-economic environments or applicable national or international regulations or guidelines are recognised early and considered in the project design. This allows incorporation into the Project design of appropriate mitigation measures to avoid, eliminate or compensate for potential adverse effects (impacts), as well as including the costs of these measures into the project economics.

This study, the baseline fauna study, is designed to gather data and, through analysis of that data, identify any significant issues associated with the Project that have significance to the fauna living within the area. The study will propose management and monitoring options to mitigate any issues related to fauna that are identified, and provide the base information for inclusion in the ESIA.

1.2 The Project

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The Project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic centre of central Myanmar and 722 km north of Yangon. The Project is focused around Letpadaung Hill. The Project location within Myanmar is shown at Figure 1.1.

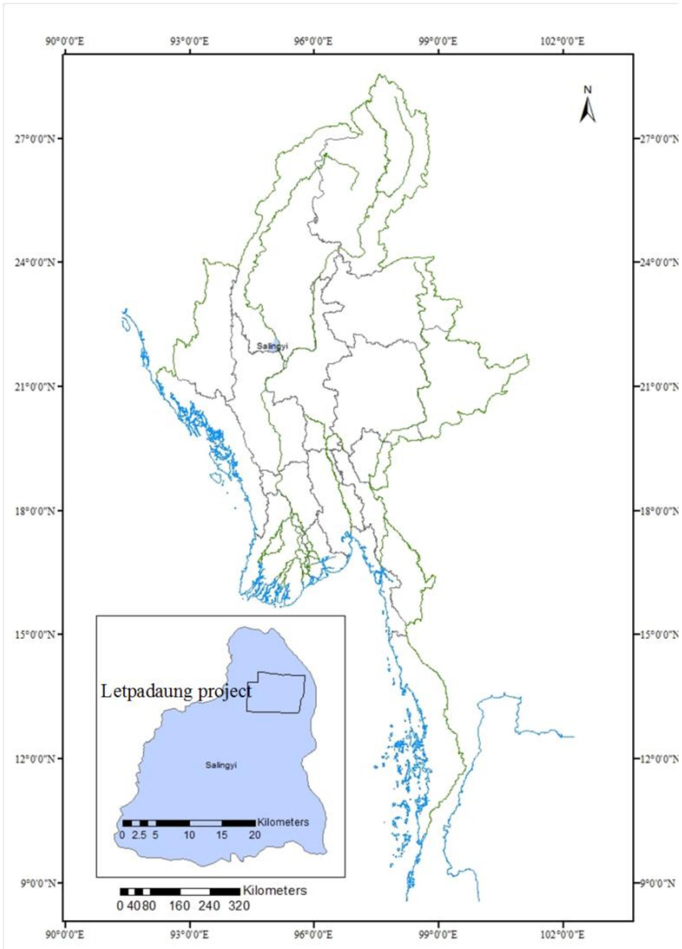

Figure 1.1: Site Locality Plan

Letpadaung Hill is situated in Salingyi Township, west of the Chindwin River, right across Monywa. In the vicinity area, Sabe Taung, Myayeik Taung, Kyae Sin Taung, and Phone Win Taung are located side by side on the west bank of Chindwin. Letpadaung Hill includes twelve small hills forming ridges and valleys. The hill is covered with scrub forest with dry zone plant species and stunted tree species. The Letpadaung hill is bounded by the Chindwin River on the east, where Nyaungbingyi port is one of the transportation routes between east bank and west bank of Chindwin River. It is also bounded by Nyaungbingyi-Gangaw Road and Taungbalu village, Kyawywar and Aungchansi villages on the north, Moegyobyin (south), Moegyobyin (central) and Moegyobyin (south) villages on the west, and Ton village, Phaunggadar village, and Seide-Zeedaw (new village) on the south. The Project location is shown in Figure 1.2.

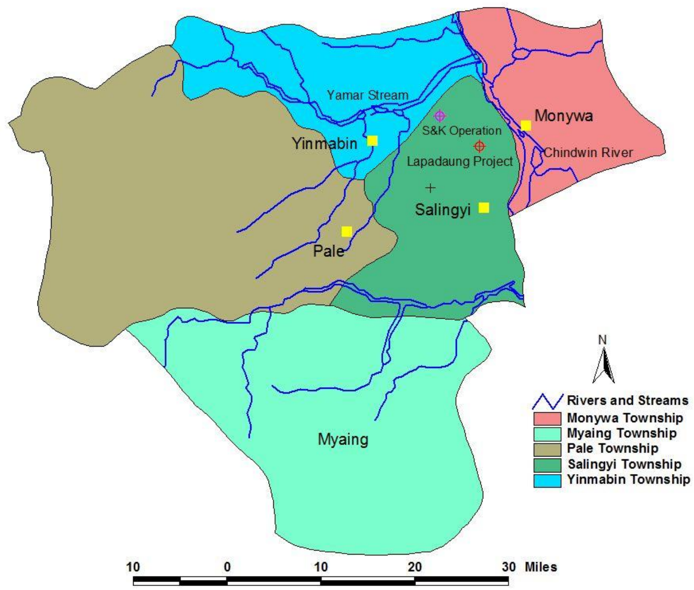

Figure 1.2: Project Location Plan

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung (which are mined by Myanmar Yang Tse Copper Ltd as the S&K operation) and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).[1] The Project area is shown in Figure 1.3.

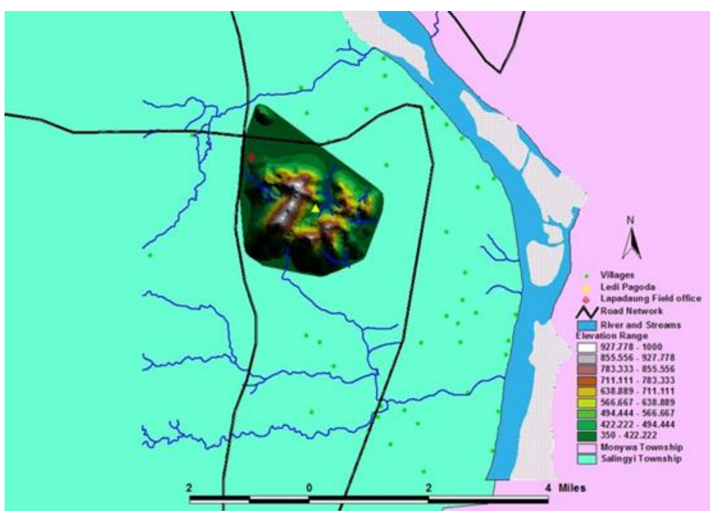

Figure 1.3: Site Location Plan

MWMCL proposes to mine and process copper bearing ore for a period of 30 years to produce 100,000 tonnes per annum of copper cathode. The ore will be mined by an open pit method and processed through a series of heap leach pads with the leachate being collected and processed in a solvent extraction – electro-winning plant to produce the copper cathode.

Certain fauna baseline data were collected at the mine site in support of the 1997 Environmental Impact Assessment (EIA) Feasibility Study Report for a project similar in nature to that being considered by MWMCL.

[1] China Nerin Engineering Co., Ltd, 2011; Myanmar Monywa Letpadaung Copper Project – Basic Design, Volume 1 - Specification; Prepared for Myanmar Wanbao Mining Copper Limited; June 2011.

The data collected in the 1997 report will also enable comparison of past and present conditions to be made to identify changes that have occurred/are occurring without a mine being in place at Letpadaung.[2]

1.3 This Document

This document has been prepared consistent with a terms of reference (TOR) provided to EMC by MWMCL (included at Appendix 1). The document comprises the following sections in response to the TOR:

- Section 1 – Introduction to the document;
- Section 2 – A description of the legal framework associated with fauna protection in Myanmar;
- Section 3 – Discussion of the TOR and variations made during field investigations. This section also describes the methodologies used in field studies and data analysis from observations made;
- Section 4 – Literature Review;
- Section 5 – Presentation of findings of field studies;
- Section 6 – Analysis of data gathered during the field studies and its implications;
- Section 7 – Discussion of the potential impacts arising from project implementation that will affect the baseline fauna in the Project area and possible mitigation strategies;
- Section 8 – Proposes recommendations for management of fauna on the site and provides a conclusion regarding the study findings in relation to local and regional knowledge of the fauna;
- Appendix – The appendix will include the Terms of Reference; and
- Figures – Figures will include site location plans and study location plan.

[2] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme Volume 1 - Report Final Draft , Letpadaung Copper Project, Myanmar for Ivanhoe Myanmar Holdings; Report No ME96-056-001; 17 February 1997; In Volume 8, Appendix 10, Feasibility Study Letpadaung Copper project, Monywa, Union of Myanmar commissioned by Ivanhoe Myanmar Holdings; Presented to No1 Mining Enterprise, Ministry of Mines, Government of the Union of Myanmar; Minproc Engineers Limited ACN 008 992 694; March 1997

2 LEGAL FRAMEWORK AND INDUSTRY GUIDELINES

The section describes the legal framework and policy context within which fauna is managed in Myanmar. It also describes the international treaties that are designed to protect fauna, to which Myanmar is a signatory.

Industry guidelines are also described which aspire to minimize the impact of the industries activities on fauna and biodiversity.

2.1 Legislation and Regulations

Myanmar has a long history of formal protected area management, dating back to the designation of a wildlife sanctuary near Mandalay. For most of the 20th Century, the Forest Act of 1902 and the Wildlife Protection Act of 1936 provided the legal basis for wildlife protection and protected area management in Myanmar.

In 1994, wildlife protection and protected area management regulations were overhauled with the passing of the Protection of Wildlife and Protected Areas Law. The objectives of this law included protecting wild animals and plants, conserve natural areas, and fulfill Myanmar's obligations under international agreements. The law recognised seven categories of protected area: scientific nature reserve; national park; marine national park; nature reserve; wildlife sanctuary; reserve of geophysical significance; and other nature reserve designated by the Minister.

Another piece of recent legislation related to biodiversity conservation is the Forest Act of 1992, which explicitly links forestry management with social and environmental considerations. The Forest Act is complemented by the 1995 National Forest Policy, which emphasises the need to integrate the goals of timber production, and wildlife and environmental conservation.

Myanmar is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed according to the degree of protection they need. The classes of listing include:

- Species threatened with extinction;
- Species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival; and
- Species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

A list describes those species covered by CITES and includes species of fauna from Myanmar.

2.2 Guidelines

The International Finance Corporation (IFC) has a Performance Standard 6 (PS6) – Biological Conservation and Sustainable Natural Resource Management which has been developed around the international Convention on Biological Diversity. The performance standard addresses the opportunities that exist for operations to avoid and mitigate threats to biodiversity.

The key requirements of PS6 in relation to fauna are:

- Assessment of impacts of the Project on fauna;
- Account for the differing values of stakeholders in that assessment;

- Consider the effects of habitat destruction and the potential for introduction of invasive alien species; and
- Use qualified and experienced external experts to assist in data collection and assessment.

PS6 also considers options for mitigation including:

- Restoring impacted areas with appropriate native species and consistent with local ecological conditions;
- Offsetting biodiversity losses through the creation of ecologically comparable area(s) elsewhere (comparable in size, quality and function) that is managed for biodiversity; and
- Financial or in-kind compensation to direct users of biodiversity.

3 TERMS OF REFERENCE

The objectives of this TOR (are to ensure that:

- There is clarity for MWMCL on the scale of the fauna and faunal assemblage survey appropriate for different areas;
- The fauna and faunal assemblage survey, analysis, interpretation and reporting undertaken for the ESIA is of a suitable quality and of consistent methodology to enable judgement of the impacts of the Project on fauna and faunal assemblages;
- The environment, in particular significant fauna and faunal assemblages, is identified and protected through good practice in the conduct and reporting of fauna and faunal assemblage surveys for the ESIA;
- Myanmar's knowledge base of fauna and faunal assemblages and biogeography are developed and enhanced over time at both the local and regional scale to the benefit of future decision making; and
- Survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes (especially as this pertains to completion criteria for the Project).

The timing of the survey was specified to consider the cool-dry, hot-dry and wet seasons and, as a result, fieldwork was undertaken during these three (3) periods to address the seasonal variations that are expected to occur.

The TOR also specified the area in which the fauna study should extend and included areas beyond the immediate Project site.

3.1 Variations to the TOR

During the study period, particularly in the cool-dry and hot-dry monitoring periods, it was difficult to implement a full scale capture and release program as access to the site and security of personnel, equipment and trapped fauna could not be assured, due to the dissatisfaction of the local community with the Project and the limitations on land access and disputed land compensation. As a result, modifications were made to the methodology used as described in Section 3.2 below.

3.2 Methodology Adopted in Surveys

3.2.1 Birds

Birds were observed with binoculars and identified with the aid of a field guide. As many factors can affect bird activity and behaviour, time of day, season and the weather were included as more important factors. Many birds are more active and vocal early in the morning. Selection of the bird watching season is also an important factor because bird's movements and migration are especially related to the seasonal food source and physical surroundings. Nocturnal birds were observed at dusk. Transect method; point count and opportunistic method were used to census the species richness. The survey was conducted to cover all kinds of vegetation and elevation ranges. Point counting involved walking to, and usually marking, a particular spot,

and then recording all bird contacts for a pre-determined period (15 minutes) before moving on to the next point. Birds were identified according to Smythies (1953)[3] Robson (2000)[4] and Robson (2005)[5].

3.2.2 Mammals

Distribution and presence of large mammals were examined by conducting track and sign surveys. Sighting of prey species, tracks, scats, droppings were undertaken as data gathering in the field. Voucher specimens of tracks were taken in the forms of plaster casts, photographs or tracings. Questionnaire surveys were conducted. The results of questioning each individual informant were treated as a distinct sample.

The tracks and signs of small mammals were observed along the proposed project area. Small mammal traps were set up in systematic randomization design and left to cover night and day hours and checked the trapped animals. The small mammal species were identified following after Tun Yin (1976)[6] and Francis (2001)[7]. Interview survey was made in villages around Letpadaung hills. The results of questioning each individual informant were treated as a distinct sample.

3.2.3 Reptiles and Amphibians

In the present study, methodology of the study on reptilian and amphibian species was based on active search and trapping method. Stratification of the habitat was relatively similar to that of mammal study. Reptilian and amphibian species were actively searched during the survey period. The collected specimens were preserved in 10% formalin for further identification in the laboratory. Reptiles were identified according to Win Maung and Win Ko Ko (2002)[8] and Das (2010)[9].

3.2.4 Butterflies and Odonates

Butterflies and odonates were caught using the hand net. The captured insects were immobilized quickly by pinching the underside of the thorax or immediately anesthetized by placing them in a killing bottle with chloroform, soaked cotton wool to prevent excessive flapping of the wings which lead to mechanical injuries. The anesthetized specimens were transferred into triangular paper envelopes. The dead specimens were mounted on setting board. The dead specimens need to be pinned and spread before their muscles become rigid. Since the butterflies are small and not fleshy, they can be dry-preserved. These specimens were photographed. Dead specimens were also kept in an insect box. Identification of the butterfly species was followed after Bingham (1905 and 1907)[10] and Talbot (1939 and 1947)[11].

[3] Smythies, B.E (1953). The Birds of Burma, London: Oliver and Boyd. Survey of India.
[4] Robson, C (2000). A Field Guide to the Birds of South East Asia, UK: New Holland Publisher
[5] Robson, C (2005). Birds of South-East Asia: Thailand Peninsular, Malaysia, Singapore, Vietnam, Cambodia, Laos, Myanmar
[6] Tun Yin,(1976) Wild Mammals of Myanmar. Nyunt Printing Press, Forest Department, Myanmar. Pp.329
[7] Francis, C.M.(2001) Mammals of South-East Asia including Thailand, Malaysia, Singapore, Myanmar, Laos, Cambodia, *Vietnam, Java, Sumatra, Bali, and Borneo
[8]
[9] Das, I. (2010)A Field Guide to the Reptiles of Thailand and South-East Asia
[10] Bingham, C. T. (1905). The fauna of British India including Ceylon and Burma. Butterflies. Volume I. Taylor and Francis Company, London. 511pp. and
[11]Bingham, C.T. (1907). The fauna of British India including Ceylon and Burma. Butterflies. Volume II. Taylor and Francis Company, London. 480pp.

4 LITERATURE REVIEW

AATA (1996)[12] briefly describes the fauna of the Central Myanmar region and the fauna that may be present in the Monywa area. They note that of the 334 resident and migratory bird species likely to be found in the region only 45 common resident bird species are expected to be found in the Monywa area. The bird species, *Crypsirina cucualta* (Family Corvidae) is an endangered species.

Whilst a number of large mammals could be found in the Central Myanmar region, only the Thamin or Eld's Deer, *Cervus eldy*, is expected to be found in the Monywa area.

Muir Environmental (1997)[13] suggested that avifauna in the Project area represented only about 23% of the regional avifauna (based on the 38 species of bird observed in the Project area) which indicated the area does not support a large number or diversity of species. It also suggested the hills do not offer refuge to less common species.

The presence of omnivorous birds suggested that the limited habitats did not suit specialist species. However, nearly all birds observed had some agricultural significance either for their significance in pest control or their potential to harm either people or local agriculture.

Muir observed four (4) mammal species and received reports of another 4 being present in the Project area.

Frogs and reptiles were considered to be low in abundance and diversity and this characteristic may have accounted for the scarcity of raptors in the Project area.

In the wet season of 2003 and at the end of the hot-dry season in 2004, surveys by staff from the Department of Zoology at the University of Yangon, established the following information regarding bird and mammal species in the Project area.

Table 4.1: Bird Data 2003/2004 Surveys

Location	Species Wet Season	Species Hot-dry Season
Saddle	13	14
Lower slopes	9	11
Valley sides	3	3
Total	14	16

During the survey at the end of the hot-dry season, the Asian barred owlet *Glaucidium cuculoides* was recorded in the broad saddle of the two hills.

A survey of mammals was also undertaken over the same period. Eld's deer (Shwethamin) *Cervus eldi* thamin and the hare *Lepus peguensis* were recorded during both survey periods.

[12] AATA, 1996; Environmental Assessment – Monywa Copper Project, Volume 1;In Feasibility Study Sabetaung – Kyisintaung Copper Project, Monywa, Union of Myanmar – Volume 5 Appendices , prepared for Ivanhoe Myanmar Holdings Ltd by Mincorp Engineers and Constructors; AATA International Inc., Fort Collins, Colorado USA; March 1996
[13] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme – Volume 1 – Final Draft; Appendix 10, Volume 8 in Feasibility Study, Letpadaung Copper Project, Monywa, Union of Myanmar for Ivanhoe Myanmar Holdings Limited by Minproc Engineers Ltd; March 1997.

5 FIELD SURVEY RESULTS

5.1 Birds

5.1.1 Cool-Dry Season

A total of 19 bird species were recorded during the survey period (see Table 5.1). The recorded species belong to 13 Families of the Order Passeriformes.

The birds, Spotted Dove *Streptopelia chinensis*, Red-vented Bulbul *Pycnonotus cafer*, Indian Roller *Coracias benghalensis*, Chinese Francolin *Francolinus pintadeanus* and White Wagtail *Motacilla alba* were mostly common at the lower slopes and foothill areas.
The broad saddles between the hills, steeply sided valley and hill crest are normally inhabited by the Black-Shouldered Kite *Elanus caeruleus*, Shikra *Accipiter badius* and Mountain Tailor Bird *Orthotomus cuculatus.*

Common bird species which inhabit mainly foothill areas, lower slopes and flat areas are the Common Myna *Acridotheres tristis*, Pied bush chat *Saxicola caprata*, White throated babblers *Turdoides gularis* and Red vented bulbul *Pycnonotus cafer* (Plate 5.1).

Table 5.1: Bird species recorded during the cool-dry season survey.

Sr.No.	Scientific name	Common name	Family	IUCN Red List Status
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL
2	*Streptopelia chinensis*	Spotted Dove		NL
3	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	NL
4	*P.blanfordi*	Streak-eared Bulbul		NL
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL
7	*Turdoides gularis*	White-throated Babbler	Timaliidae	NL
8	*Lanius collurioides*	Burmese Shrike		NL
9	*Accipiter badius*	Shikra		NL
10	*Acridotheres tristis*	Common Myna	Sturnidae	NL
11	*Sturnus burmanicus*	Vinous-breasted Starling		NL
12	*Upupa epops*	Hoopoe	Upupidae	NL
13	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL
14	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL
15	*Orthotomus cuculatus*	Mountain Tailorbird		NL
16	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL
17	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL
18	*Motacilla alba*	White Wagtail	Motacillidae	NL
19	*Elanus caeruleus*	Black-shouldered Kite	Accipitridae	NL

NL=Not Listed

Plate 5.2: Red-vented Bulbul *Pycnonotus cafer*

5.1.2 Hot-Dry Season

A total of 18 bird species were recorded during the survey period (Table 5.2). The recorded species belong to 13 Families of the Order Passeriformes.

The Spotted Dove *Streptopelia chinensis*, Red-vented Bulbul *Pycnonotus cafer*, and Indian Roller *Coracias benghalensis*, were mostly common at the lower slopes and foothill areas.

The broad saddles between the hills, steeply sided valley and hill crest are normally inhabited by the Black-shouldered Kite *Elanus caeruleus*, Shikra *Accipiter badius* and Mountain Tailorbird *Orthotomus cuculatus.*

Common bird species which inhabit mainly foothill areas, lower slopes and flat areas are Common Myna *Acridotheres tristis*, Pied Bush Chat *Saxicola caprata*, White-throated Babblers *Turdoides gularis* and Red-vented Bulbul *Pycnonotus cafer* (Plate 5.2).

Table 5.2: Bird species recorded during the hot-dry season survey

Sr.No.	Scientific name	Common name	Family	IUCN Red List Status
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL
2	*Streptopelia chinensis*	Spotted Dove	Ploceidae	NL
3	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	NL
4	*P.blanfordi*	Streak-eared Bulbul	Pycnonotidae	NL
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL
7	*Turdoides gularis*	White-throated Babblers	Timaliidae	NL
8	*Accipiter badius*	Shikra		NL
9	*Acridotheres tristis*	Common Myna	Sturnidae	NL
10	*Sturnus burmanicus*	Vinous-breasted Starling		NL
11	*Upupa epops*	Hoopoe	Upupidae	NL
12	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL
13	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL
14	*Orthotomus cuculatus*	Mountain Tailorbird		NL
15	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL
16	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL
17	*Motacilla alba*	White Wagtail	Motacillidae	NL
18	*Elanus caeruleus*	Black-shouldered Kite	Accipitridae	NL

NL-Not Listed

5.1.3 Wet Season

A total of 18 bird species were recorded during the survey period (Table 5.3). The recorded species belong to 11 Families of the Order Passeriformes.

The broad saddles between the hills are inhabited by 7 bird species of 6 Families; 16 bird species recorded at the lower slopes, 11 species at the steeply sided valley of Letpadaung hill and 4 species at the hill crest.

Table 5.3: Bird species recorded during the wet season survey.

Sr. No.	Scientific name	Common name	Family	IUCN Red List/ Endemic Status	Remark
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL	Observed
2	*Streptopelia chinensis*	Spotted Dove	Columbidae	NL	Observed
3	*Pycnonotus cafer*	Red Vented Bulbul	Pycnonotidae	NL	Observed
4	*Pycnonotus blanfordi*	Streak-eared Bulbul	Pycnonotidae	NL	Observed
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL	Observed
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL	Observed
7	*Turdoides gularis*	White-throated Babblers	Timaliidae	Endemic	Observed
8	*Accipiter badius*	Shikra	Accipitridae	NL	Observed
9	*Acridotheres tristis*	Common Myna	Sturnidae	NL	Observed
10	*Sturnus burmanicus*	Vinous-breasted Starling	Sturnidae	NL	Observed
11	*Upupa epops*	Hoopoe	Upupidae	NL	Observed
12	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL	Observed
13	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL	Observed
14	*Orthotomus cuculatus*	Mountain Tailorbird	Sylviidae	NL	Observed
15	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL	Observed
16	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL	Observed
17	*Motacilla alba*	White Wagtail	Motacillidae	NL	Observed
18	*Mirafra microptera*	Burmese Bushlark	Alaudidae	Endemic	Observed

NL-Not Listed

5.2 Mammals

5.2.1 Cool-dry season

The Myanmar Hare *Lepus peguensis* was observed during the survey period (Table 5.4). Individuals were observed in foothill areas of the Letpadaung hills. Also scats of the hare were also observed as evidence. They have a large range, moving between scrubland and cultivated areas at the base of the Letpadaung hill. According to the interview survey and foot-prints observed, Eld's deer (Shwethamin) *Cervus eldii thamin* (*Rucervus eldii*) was listed as a frequent visitor to the Project area. Barking deer *Muntiacus muntjak* were also noted with track and sign evidence in the Project area.

Table 5.4: Mammals recorded during the cool-dry season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status
1	Lepus peguensis	Myanmar Hare	Leporidae	NL
2	Paradoxurus hermaphroditus	Common Palm Civet	Viverridae	NL
3	Muntiacus muntjak	Barking Deer	Cervidae	NL
4	Cervus eldi thamin	Eld's Deer	Cervidae	Endemic / Endangered

NL-Not Listed

5.2.2 Hot-dry season

Myanmar Hare *Lepus peguensis* was observed during the hot-dry season survey (Table 5.5). Individuals were observed in foothill areas of the Letpadaung hills. Additionally, Myanmar hare scat was also observed. They have a large range, moving between scrubland and cultivated areas at the base of the Letpadaung Hill. The foot-prints of Eld's Deer (Shwethamin) *Cervus eldii thamin* (*Rucervus eldii*) and that of the Barking Deer *Muntiacus muntjak* were not observed in the Project area. This may be due to scarcity of food sources and hiding places during the hot-dry season. Only two mammal species were recorded based on track and sign survey.

Table 5.5: Mammals recorded during the hot-dry season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status
1	*Lepus peguensis*	Myanmar Hare	Leporidae	NL
2	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	NL

NL-Not Listed

5.2.3 Wet season

Myanmar Hare *Lepus peguensis* was recorded during the survey period. Individuals were observed on the flatlands. They have large range, moving between scrubland and cultivated areas at the base of the Letpadaung hill. According to the interview survey, Eld's deer (Shwethamin) *Cervus eldi thamin* was listed as a frequent visitor to the Project area.

Table 5.6: Mammals recorded during the wet season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status	Remark
1	*Lepus peguensis*	Myanmar Hare	Leporidae	NL	Observed
2	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	NL	Scat
3	*Callosciurus pygerythrus*	Grey squirrel	Sciuridae	Lc	Observed
4	*Niviventer fulvscens*	White-belleyed Rat	Muridae	Lc	Observed

Lc - Least Concern, NL-Not Listed

5.3 Reptiles and Amphibians

5.3.1 Cool-dry season

A total of three reptile species, *Calotes versicolor*, *Mabuya multifasciata*, *Ptyas korros*, and one amphibian species, *Bufo melanostatus* were recorded for the cool dry season during the survey period (Table 5.7). The most common species among them was the Garden Fence Lizard *Calotes versicolar*. The Garden Fence Lizard is a very common species in the Project area. The Sun Skink *Mabuya multifasciata* was also observed as a common species in the Project area. As all recorded species are not included on the IUCN Red List, no threatened reptile and amphibian species are likely to occur in the Project area.

Table 5.7: Reptile and amphibian species recorded during the cool-dry season survey

Sr. No.	Species	Common name	Family	Taxonomic group
1	*Calotes versicolor*	Garden Fence Lizard	Agamidae	Reptile
2	*Mabuya multifasciata*	Many-lined Sun Skink	Scincidae	Reptile
3	*Ptyas korros*	Rat Snake	Colubridae	Reptile
4	*Bufo melanostatus*	Common Toad	Bufonidae	Amphibian

5.3.2 Hot-dry season

A total of three reptile species, *Calotes versicolor*, *Mabuya multifasciata*, *Ptyas korros*, and one amphibian species, *Bufo melanostatus* were recorded during the survey period (Table 5.8). The most common species observed was the Garden Fence Lizard *Calotes versicolar*, which is very common in and around the Project area. The Sun Skink *Mabuya multifasciata* was also observed as a common species in the Project area.

Table 5.8: Reptile and amphibian species recorded during the hot-dry season survey

Sr. No.	Species	Common name	Family	Taxonomic group
1	*Calotes versicolor*	Garden fence lizard	Agamidae	Reptile
2	*Mabuya multifasciata*	Many-lined sun skink	Scincidae	Reptile
3	*Ptyas korros*	rat snake	Colubridae	Reptile
4	*Bufo melanostatus*	Common toad	Bufonidae	Amphibian

5.3.3 Wet season

The wet season survey identified a range of reptile and amphibian species not observed during the dry season as shown in Table 5.9. This change is likely to be a result of an increase in food sources during this season and the development of environmental conditions that provided opportunity for observation of the species.

Table 5.9: Reptile and amphibian species recorded during the wet season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status	Remark
1	*Bungarus fasciatus*	Banded krait	Elapidae	Lc	Interviewed
2	*Daboia russellii siamensis*	Russell's Viper	Viperidae	Lc	Interviewed
3	*Ptyas korros*	Indo-chinese Rat Snake	Colubridae	Lc	Interviewed
4	*Eutropis carinatus*	Common Sun Skink	Scincidae	Lc	Observed
5	*Calotes versicolor*	Garden Fence Lizard	Agamidae	Lc	Observed
6	*Calotes emma*	Tree Lizard	Agamidae	Lc	Observed
7	*Fejervarya l. limnocharis*	Paddy Frog	Dicroglossidae	Lc	Observed
8	*Polypedates leucomystax*	Common Tree Frog	Rhacophoridae	Lc	Interviewed
9	*Duttaphrynus melanostictus*	Common Toad	Bufonidae	Lc	Observed
10	*Kaloula pulchra*	Painted Bull Frog	Microhylidae	Lc	Interviewed
11	*Holobatrachus tigerinus*	Indian Bull Frog	Dicroglossidae	Lc	Interviewed

Lc = Least Concern

5.4 Butterflies and odonates

5.4.1 Cool-dry season

Seven butterfly species were recorded during the survey period (Table 5.10). The most common species among them were *Ixias marianne* and *Appias libythea* species. The lower slope and foothill habitats were found to have the highest diversity of butterfly species and the highest population density.

Regarding the odonate species, five species namely *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded (Table 5.11). Damselfly species were not observed in the Project area during the survey period.

No threatened species of butterfly or odonates were observed in the Project area.

Table 5.10: Butterfly species recorded during the cool-dry season survey

Sr. No.	Family	Species	Status
1	Papilionidae	*Graphium agamemnon*	Common
2	Pieridae	*Ixias marianne*	Very Common
3	Pieridae	*Catopsilia pomona*	Common
4	Pieridae	*Appias libythea*	Very Common
5	Danaidae	*Danaus chrysippus*	Common
6	Satyridae	*Mycalesis perseidoes*	Common
7	Lycaenidae	*Catochrysops rosimon*	Common

Table 5.11: Odonate species recorded during the cool-dry season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening Skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green Skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common Glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	Common Flangetail	Gomphidae	Common

5.4.2 Hot-dry season

The seven butterfly species recorded during the cool-dry season survey period (Table 5.12) were also observed during the hot-dry season. The most common species among them *were Ixias marianne* and *Appias libythea* species. Most of the butterfly species and the highest numbers were observed in the lower slope and foothill habitats.

Five odonate species, *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded as shown in Table 5.13. Damselfly species were not observed in the Project area during the survey period.

Table 5.12: Butterfly species recorded during the hot-dry season survey

Sr. No.	Family	Species	Status
1	Papilionidae	*Graphium agamemnon*	Common
2	Pieridae	*Ixias marianne*	Very Common
3	Pieridae	*Catopsilia pomona*	Common
4	Pieridae	*Appias libythea*	Very Common
5	Danaidae	*Danaus chrysippus*	Common
6	Satyridae	*Mycalesis perseidoes*	Common
7	Lycaenidae	*Catochrysops rosimon*	Common

Table 5.13: Odonate species recorded during the hot-dry season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	*Common* Flangetail	Gomphidae	Common

5.4.3 Wet season

Twelve butterfly species were recorded during the survey period (Table 5.14). The most common species among them were *Eurema hecabe* and *Catopsilia pomona pomona* species. Most of the butterfly species and greatest numbers were observed in the lower slope habitat.

Table 5.14: Butterfly species recorded during the wet season survey

Sr. No.	Species	Family	Common Name	Status
1	*Papilio polytes romulus*	Papilionidae	Common Mormon	Common
2	*Papilio demolius*	Papilionidae	Lime Butterfly	Common
3	*Catopsilia pomona pomona*	Pieridae	Lemon Emigrant	Very Common
4	*Eurema hecabe*	Pieridae	Common Grass Yellow	Very Common
5	*Ixias pyrene verna*	Pieridae	Yellow Orange Tip	Uncommon
6	*Appias libythea olferna*	Pieridae	Striped Albatross	Very Common
7	*Danaus limniace limniace*	Danaidae	Blue Tiger	Uncommon
8	*Danaus chrysippus*	Danaidae	Plain Tiger	Common
9	*Danaus genutia genutia*	Danaidae	Common Tiger	Uncommon
10	*Junonia hierta*	Nymphalidae	Yellow Pansy	Common
11	*Junonia almana almana*	Nymphalidae	Peacock Pansy	Uncommon
12	*Junonia atlites*	Nymphalidae	The Gray Pansy	Common

Regarding the odonate species, five species namely *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded as shown in Table 5.15. Damselfly species were not observed in the Project area during the survey period.

Table 5.15: Odonate species recorded during the wet season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	*Common* Flangetail	Gomphidae	Common

6 ANALYSIS OF DATA

6.1 Species Identified

It is considered that there were insufficient numbers of mammals, reptiles and amphibians observed to enable robust statistical analysis of the seasonal variation to be completed. However, the study team did note the large variation between dry and wet season numbers. However, this variation is considered to be strongly influenced by the methods of sampling available given the time and security constraints placed on the sampling methodology. For example, if night observations and the setting of traps were able to be utilized it is expected that species such as bats, nocturnal foraging species and species with energy constrained habits would have been observed.

The number of bird species observed did not display significant seasonal variations, as shown in Table 6.1, when subjected to statistical scrutiny. It is considered this lack of variation reflects the level of degradation within the environment. This degradation has reduced the overall environmental diversity which subsequently affects the ability of more specialized species to remain sustainable while their specialized resource requirements are diminished.

Table 6.1: Comparison of the recorded parameters among three seasons in avifauna studies

Item	Season			X2 test	Remark
	Cool dry	**Hot dry**	**Wet season**		
No. of bird species	19	18	18	p>0.05; X2=0.036; df=2	NS
Diversity (H') value	3.56	3.749	3.494	p>0.05; X2=0.182; df=2	NS

NS = Not significant

The number of species of butterfly recorded across the three seasons of survey showed no significant statistically variability. Given the tendency for the butterflies to be found on the lower slopes of the hills and the restricted habitat types present in those areas and the dependence on diversity of habitats, it is not unexpected that this level of variability is found.

Table 6.2: Comparison of the recorded parameters among three seasons in butterfly studies

Item	Season			X2 test	Remark
	Cool dry	Hot dry	Wet season		
No. of butterfly species	7	7	12	$p>0.05$; $X2=1.923$; df=2	NS
Diversity (H') value	1.537	2.095	3.299	$p>0.05$; $X2=0.281$; df=2	NS

6.2 Species diversity

6.2.1 Indices Used[14]

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analysed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals.

The Shannon-Weiner index is a measure of the likelihood that the next individual will be the same species as the previous sample. It combines two quantifiable measures:

- The species richness (the number of species in the community); and
- Species evenness (how even are the numbers of individuals of each species).

For instance, say we have a sample of 100 fish containing only 2 species. We would say that the species are even if there were 50 of each species. Conversely, if there were 99 of 1 species and only 1 of the other, there would be no evenness. Given this second scenario, we would be pretty confident in our prediction that if we were to sample 1 more individual that it would be the same as the 99 in that sample. Conversely, in the previous scenario, we would have a 50/50 chance at predicting the next species sampled.

Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

Fisher's Alpha is a parametric index of diversity that assumes that the abundance of species follows the log series distribution.

The Brillouin index measures the diversity of a collection, as opposed to the Shannon index which measures a sample. Pielou (1975) recommends this index in all situations where a collection is made, sampling was non-random or the full composition of the community is known.

The value obtained rarely exceeds 4.5 and both the Brillouin and Shannon Indices tend to give similar comparative measures. This information measure should be used in favour of the Shannon index when the species differ in their capture rates.

Shannon maximum is simply the maximum value the Shannon-Wiener index could produce for the given data set and is given by ln(S), where S is the total number of species. The Shannon minimum is simply the minimum value the Shannon-Wiener index could produce for the given data set.

[14] As described at www.pisces-conservation.com/sdrhelp

The Bruillioun evenness index is an index based on Bruillouin's HB, it is not an estimate but an accurate statistic. This index reduces the sensitivity of the estimate to the species density.

6.2.2 Birds

6.2.2.1 COOL-DRY SEASON

Shannon diversity index value (H') was 3.560 and Simpson's Index value was 0.896; both of the index values showed the relatively high diversity of bird species in the Project area in thecool-dry season (Table 6.3). The number of equally common species was 16 and a total of 157 individuals were observed during the survey period. Evenness value (E') was noted as 0.500, which showed the evenly distribution of the birds in the Project area.

Table 6.3: Diversity and evenness of the bird species – cool-dry season

Index/Item	Value
Shannon Diversity H' (range)	3.560 (3.381-3.723)
Simpson's Index (1-D)	0.896 (0.876-0.0.913)
Brillouin's H	3.300 (3.135-3.449)
Evenness E'	0.500
Number of equally common species	16
No. of species	19
N	157

6.2.2.2 HOT-DRY SEASON

Shannon diversity index value (H') was 3.749 and Simpson's Index value was 0.921; both of the index values showed the relatively high diversity of bird species in the Project area in hot dry season (Table 6.4). Number of equally common species was 15 and a total of 92 individuals were observed during the survey period. Evenness value (E') was noted as 0.664, which showed the evenly distribution of the birds in the Project area.

Table 6.4: Diversity and evenness of the bird species – hot-dry season

Index/Item	Value
Shannon Diversity H' (range)	3.749(3.555-3.920)
Simpson's Index (1-D)	0.921(0.901-0.0.936)
Brillouin's H	3.357 (3.190-3.503)
Evenness E'	0.664
Number of equally common species	15
No. of species	18
N	92

6.2.2.3 WET SEASON

Shannon diversity index value (H') was 3.494 and Simpson's Index value was 0.905; both of the index values showed the relatively high diversity of bird species in the Project area in hot dry season (Table 6.5). Number of equally common species was 13 and a total of 67 individuals were observed during the survey period. Evenness value (E') was noted as 0.573, which showed the evenly distribution of the birds in the Project area.

Table 6.5: Diversity and evenness of the bird species – wet season

Index/Item	Value
Shannon Diversity H' (range)	3.494(3.231-3.718)
Simpson's Index (1-D)	0.905(0.875-0.926)
Brillouin's H	3.061(2.848-3.244)
Evenness E'	0.573
Number of equally common species	13
No. of species	18
N	67

6.2.3 Butterflies

6.2.3.1 COOL-DRY SEASON

Shannon's species diversity index (H') value of the butterfly species was 1.537 and Sampson's diversity index (1-D) value was 0.566. Both of the index values showed the moderate species diversity of butterflies during the cool dry season in the Project area (Table 6.6). Equally common species was 3 and evenness (E') value was 0.346 and these also show the relatively even distribution of the butterflies in the Project area.

Table 6.6: Diversity and evenness of the butterfly species – cool-dry season

Index/Item	Value
Shannon Diversity H' (range)	1.537 (1.335-1.734)
Simpson's Index (1-D)	0.566(0.503-0.0.623)
Brillouin's H	1.447 (1.258-1.633)
Evenness E'	0.346
Number of equally common species	3
No. of species	7
N	138

6.2.3.2 HOT-DRY SEASON

Shannon's species diversity index (H') value of the butterfly species was 2.095 and Sampson's diversity index (1-D) value was 0.705. Both of the index values showed the moderate species diversity of butterflies during hot dry season in the project area (Table 6.7). Equally common species was 5 and Evenness (E') value was 0.526, these also show the relatively even distribution of the butterflies in the Project area.

Table 6.7: Diversity and Evenness of the butterfly species – hot-dry season

Index/Item	Value
Shannon Diversity H' (range)	2.095 (1.776-2.378)
Simpson's Index (1-D)	0.705(0.606-0.0.782)
Brillouin's H	1.871 (1.582-2.130)
Evenness E'	0.526
Number of equally common species	5
No. of species	7
N	56

6.2.3.3 WET SEASON

Shannon's species diversity index (H') value of the butterfly species was 3.299 and Sampson's diversity index (1-D) value was 0.896. Both of the index values showed the high species diversity of butterflies during wet season in the project area (Table 6.8). Equally common species was 11 and evenness (E') value was 0.723, these also show the relatively even distribution of the butterflies in the Project area.

Table 6.8: Diversity and Evenness of the butterfly species – wet season

Index/Item	Value
Shannon Diversity H' (range)	3.299(3.151-3.422)
Simpson's Index (1-D)	0.896(0.875-0.910)
Brillouin's H	3.011(2.877-3.121)
Evenness E'	0.732
Number of equally common species	11
No. of species	12
N	93

6.3 Inter-Seasonal Comparison

6.3.1 Birds

The diversity and evenness of bird species remains constant across the seasons suggesting there is little migration of bird species into the area with seasonal changes. This is confirmed by a review of the species recorded and the statistical analysis of the results obtained.

The number of bird species recorded was only about 40% of the number expected to occur in the Monywa area which suggests the habitat condition in the area is degraded.

6.3.2 Butterflies and Odonates

It appears the diversity and evenness of distribution of butterflies and odonates improves during the wet season as both diversity and evenness indices rise in comparison to dry season statistics. However the improvement is not statistically significant.

7 IMPACTS AND MITIGATION

7.1 Impacts

The Project area appears to be undergoing a continuous decline in numbers of species present as time has progressed from studies undertaken in 1996/97 to 2003/04 and now into 2012/13. Across all fauna groups assessed there has been a decline in species diversity which is most likely linked to demands on ecosystem services that have increased as population in the areas around the Project area has risen. Indeed, the review of changes in flora and vegetation (and subsequently in fauna habitat) suggests that any mature forest or plantation in the area in 1997 has been harvested. Current studies suggest that seasonal harvesting of plants for traditional use, firewood and stockfeed reduces stocks of plant species and restricts the ability of habitats to mature and provide the diversity of resources needed to sustain the levels of fauna diversity that may otherwise be expected from studies such as those reported here.

The Project development is expected to further reduce opportunities for those fauna that move between the lower hills and adjacent farmed lands. Much of the areas currently cropped and grazed on the plains surrounding the Letpadaung hills will be used to accommodate the leaching, processing and infrastructure facilities used to process the ore mined in the hills. Remnant areas will be fragmented and offer little benefit as fauna habitat.

The future of any individuals of the Eld's Deer and Myanmar Hare in the Project area is highly threatened by the proposed habitat fragmentation and mining activities that will occur in the area. These mammals are unlikely to be able to migrate to another area of habitat successfully without a formal capture/release programme due to the lack of cover offered in the intervening lands.

During the Project operations, the progressive rehabilitation of disturbed areas will provide a habitat that is well resourced in regard to variety of food and evolving habitat. As a result, it is expected the diversity of species may gradually increase compared to that which is currently observed if the fauna behaviour replicates that in mining sites in other countries.

The proposed Project plan will fragment and remove about 70% of the current area of 'natural' vegetation on the Letpadaung hills. The impact of mining, such as dust noise and vibration will extend over the whole site. In addition, the increase in movements of light and heavy vehicles is likely to give rise to fatalities of fauna moving around or seeking to leave the site. This fragmentation is a long-term effect of mining as it will remain for the mine life and beyond as the core area, the open pit, will not be able to be revegetated at closure. Even when rehabilitated waste rock dumps are included in the total area of vegetation, the level of fragmentation will persist and the edge effects through an increased boundary between vegetated and cleared land will add to the residual impact on fauna.

The current fauna diversity and evenness is strongly influenced by local environmental pressures. The historical decrease in fauna abundance and diversity would be expected to continue without the impact of mining, albeit over many decades. The lack of specialized species amongst those identified, which are predominantly omnivorous species, is a clear indicator of the impact of current disturbance. Any reversal will need a change in the way the land around the Letpadaung hills is traditionally used.

Mining will accelerate the loss of habitat in the short term but has the potential to improve fauna diversity in the medium to long term, especially if site access is controlled after mine closure.

7.2 Mitigation

Prior to the further clearing of natural vegetation on the Project site, a formal capture and release programme for the Eld's Deer and Myanmar Hare should be undertaken. The captured animals should be released in an area of protected habitat for their long term conservation. Identification of this area, as an offset for the area to be cleared for mining and processing at the Project site, should be considered a condition of project approval by the Government.

During construction of the mine and clearing of 'natural' vegetation, fauna spotters should be used to allow the identification of fauna under threat from the clearing processes. These spotters should either collect and remove the fauna to a safe site or move them out of the way of any harm.

Staff should be trained to maintain a good line of site to enable fauna fatalities on Project roads to be avoided. This may require the enforcement of site speed limits and development of a presence/absence warning system where animal movement is frequent.

A key to the long term survival and use of the area by fauna is the progressive rehabilitation of disturbed areas and the assisted colonization by common fauna species. Generally, the establishment of 'natural' vegetation on disturbed areas will see a progressive re-colonization by fauna as cover and micro-habitats are developed.

Any increase in fauna diversity over the pre-mining conditions will require both an improved, undisturbed level of vegetation cover. To achieve this outcome, it may be necessary to provide plantations of plant material traditionally used by villages so that harvesting does not occur on rehabilitated lands. Initially these resources could be established in the visual buffers of vegetation established around the site.

8 CONCLUSION AND RECOMMENDATIONS

The following activities were completed in the conduct of this baseline survey:

- A review of previous studies conducted in the area;
- Surveys of fauna in the study area over the cool-dry, hot-dry and wet season;
- An analysis of the findings; and
- Identification of impacts that arise from mining the Letpadaung hills and possible their mitigation options.

No listed rare or endangered fauna species will be significantly affected by the Project although the Project will restrict the grazing areas for Eld's Deer and the Myanmar Hare.

The surveys did not identify any listed rare or endangered species. They did confirm earlier conclusions by AATA (1996) and Muir Environmental (1997) that the fauna in the area is depleted as a result of land clearing on the plains surrounding the hills and the heavy demand on the ecosystem services derived from the hills by the surrounding communities.

The number of species identified has declined over the period from 1996 to 2013 as shown from the collections made in surveys in 1996/97, 2003/04 and 2012/13. This decline is expected to continue due to the unconstrained use of the vegetated hills area by the ever growing surrounding communities.

The likely impact of the proposed copper mining project on the fauna is a further decrease in the diversity of fauna in the area, at a rate exceeding that currently occurring. However, the mining is also likely to provide a long term opportunity for existing habitat to recover (due to its isolation within the mine site) and the revegetation of disturbed land should lead to new areas of vegetation being created over the course of the mine life.

An issue will be the provision for ecosystem services lost. From the perspective of fauna populations, this loss will be relatively small and can be accommodated by buffer plantings in and around the mine site.

8.1 Recommendations

No provision is required to offset habitat loss or relocate rare or endangered species.

Management plans should be prepared and implemented to accommodate:

- Spotting of fauna and removal of animals found during clearing operations;
- Control of vehicle movements to minimize the loss of fauna through road kills; and
- The unlawful capture and removal of fauna by Project staff.

Monitoring of rehabilitation works undertaken on the site should include the monitoring of fauna using the rehabilitated areas as habitat. Rehabilitation works should include provision of habitat opportunities (old logs, retention of large trees and rock and stone cover) where they can be made available. Progressive improvement in levels of use by fauna should be examined through analysis of monitoring results.

APPENDIX 1

TERMS OF REFERENCE – FAUNA BASELINE STUDIES

APPENDIX E

Baseline Studies – Aquatic Ecology

BASELINE STUDY – AQUATIC FAUNA

Letpadaung Copper Mine Project

Baseline study – Aquatic Fauna

LETPADAUNG COPPER MINE PROJECT

LETPADAUNG COPPER MINE PROJECT

Baseline Study – Aquatic Fauna

Prepared for: Myanmar Wanbao Mining Copper Limited

70(I) Bo Chein Street

Pyay Road, Hiaing Township

Yangon, Myanmar

Document Number/ Revision Number	Prepared by	Reviewed by	Date

CONTENTS

APPENDIX 1

EXECUTIVE SUMMARY

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of the aquatic life in the Project area of the Letpadaung Copper Mine Project (“the Project”). The work was undertaken over the hot-dry season, the cool-dry season and the wet season of 2013 to enable the evaluation of the aquatic fauna in the three seasons experienced in the Project area.

The survey was undertaken through the use of 8 sampling locations that were located upstream, downstream and parallel to the Project site. Identification was confirmed according to historic collections, recordings and identification specimens using local and international references.

During the surveys no threatened fish species were found in either the Chindwin River or Yamar Creek. All recorded fish species are considered to be common species and as such are not listed under the protected species list of Myanmar.

1 INTRODUCTION

1.1 Background

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of the aquatic life in the Project area of the Letpadaung Copper Mine Project ("the Project"). The work was undertaken over the hot-dry season, the cool-dry season and the wet season of 2013 to enable the evaluation of the aquatic fauna in the three seasons experienced in the Project area.

The proponent, MWMCL, aims to promote survey work that is uniform and of sufficient rigour to contribute to a more systematic inventory of the Myanmar and Salingyi district's aquatic fauna. This will result in a consolidated and readily accessible database of environmental information.

The Environmental and Social Impact Assessment (ESIA) is a systematic study and process to determine the impacts and effects of a project on the environment during its various phases of construction, commissioning, operation, and closure. As such, its objectives are to ensure that the project is sound and maximizes the social and environmental standpoint benefit to be derived. This includes early recognition of any issues of concern relating to the biological, physical, or socio-economic environments or applicable national or international regulations or guidelines which can then be considered in the project design. This allows incorporation into the project design of appropriate mitigation measures to avoid, eliminate or compensate for potential adverse effects (impacts), as well as including the costs of these measures into the project economics.

This study, the baseline aquatic fauna study, is designed to gather data and through analysis of the data identify any significant issues associated with the Project relating to the aquatic ecosystem of the area. The study will propose management and monitoring options to mitigate any issues related to aquatic fauna that are identified, and provide the base information for inclusion in the ESIA.

1.2 The Project

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The Project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic center of central Myanmar and 722 km north of Yangon. The project is focused around Letpadaung Hill. The Project location within Myanmar is shown at Figure 1.1.

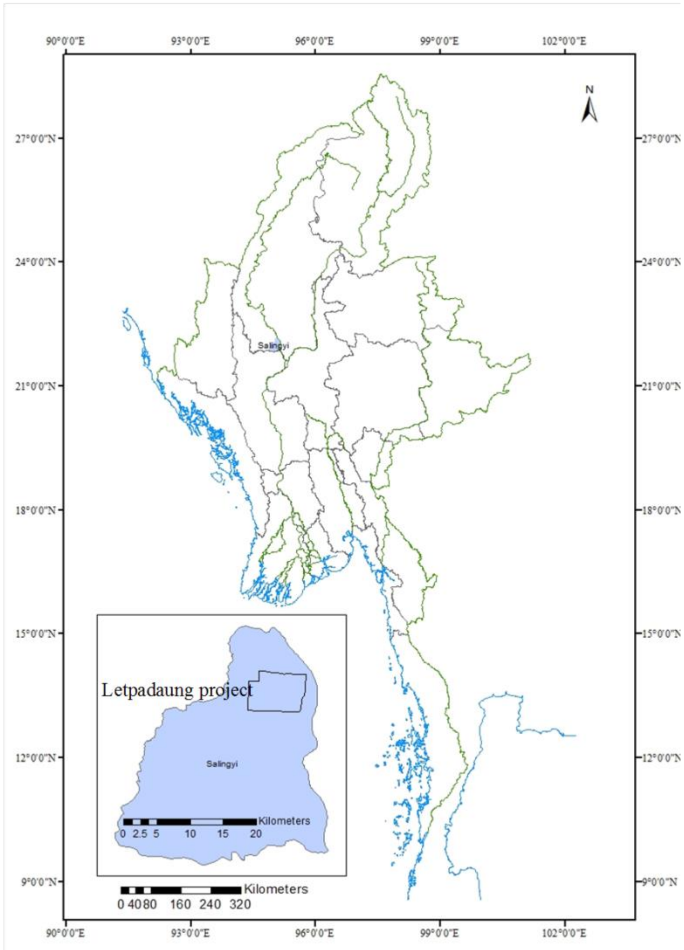

Figure 1.1: Site Locality Plan

Letpadaung Hill is situated in Salingyi Township, west of the Chindwin River, right across the river from Monywa. In the immediate area, Sabe Taung, Myayeik Taung, Kyae Sin Taung, and Phone Win Taung are located side by side on the west bank of Chindwin. Letpadaung Hill includes twelve small hills forming ridges and valleys. The hill is covered with the scrub forest with dry zone plant species and stunted tree species were observed. The Letpadaung hill is bounded by Chindwin River on the east, where Nyaungbingyi port is one of the transportation routes between the east bank and the west bank of the Chindwin River. It is also bounded by Nyaungbingyi-Gangaw Road and Taungbalu village, Kyawywar and Aungchansi villages on the north, Moegyobyin (south), Moegyobyin (central) and Moegyobyin (south) villages on the west, and Ton village, Phaunggadar village, and Seide-Zeedaw (new village) on the south. The Project location is shown in Figure 1.2.

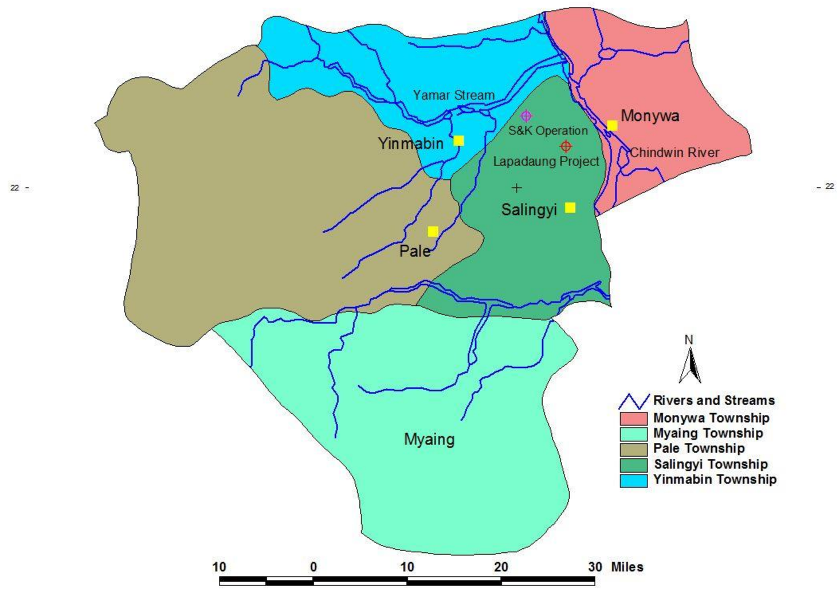

Figure 1.2: Project Location Plan

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung (which are mined by Myanmar Yang Tse Copper Ltd as the S&K operation) and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).[1] The project area is shown in Figure 1.3.

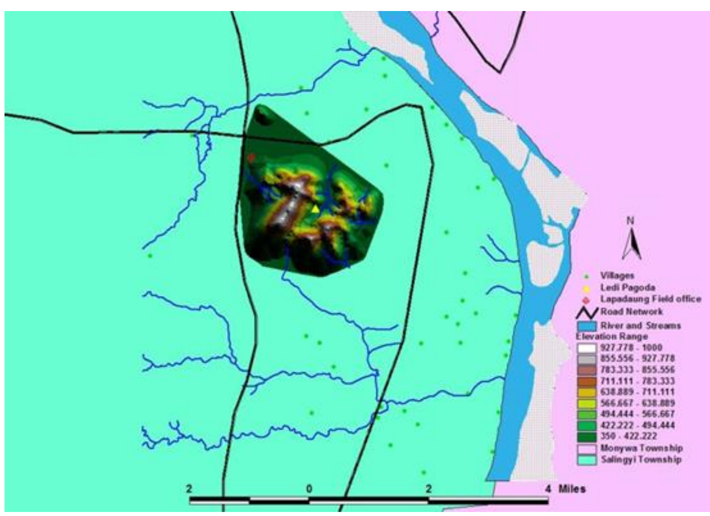

Figure 1.3: Site Location Plan

MWMCL proposes to mine and process copper bearing ore for a period of 30 years to produce 100,000 tonnes per annum of copper cathode. The ore will be mined by an open pit method and processed through a series of heap leach pads with the leachate being collected and processed in a solvent extraction – electro-winning plant to produce the copper cathode.

[1] China Nerin Engineering Co., Ltd, 2011; Myanmar Monywa Letpadaung Copper Project – Basic Design, Volume 1 - Specification; Prepared for Myanmar Wanbao Mining Copper Limited; June 2011.

Certain aquatic baseline data were collected from the aquatic habitats surrounding the mine site in support of the 1997 Environmental Impact Assessment (EIA) Feasibility Study Report for a project similar in nature to that being considered by MWMCL. The data collected in the 1997 report will also enable comparison of past and present conditions to be made to identify changes that have occurred/are occurring without a mine being in place at Letpadaung.[2]

1.3 This Document

This document has been prepared consistent with a terms of reference (TOR) provided to EMC by MWMCL (included at Appendix 2). The document comprises the following sections in response to the TOR:

- Section 1 – Introduction to the document;
- Section 2 – A description of the legal framework associated with flora and vegetation protection in Myanmar;
- Section 3 – Discussion of the TOR and variations made during field investigations. This section also describes the methodologies used in field studies and data analysis from observations made;
- Section 4 – Presentation of findings of field studies;
- Section 5 – Analysis of data gathered during the field studies and its implications;
- Section 6 – Discussion of the potential impacts arising from Project implementation that will affect the baseline aquatic condition in the Project area;
- Appendices – The appendices includes will include the Terms of Reference and species proportional abundance for each observation point utilised.
- Figures – Figures will include site location plans, study location plans and a site vegetation map.

[2] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme Volume 1 - Report Final Draft , Letpadaung Copper Project, Myanmar for Ivanhoe Myanmar Holdings; Report No ME96-056-001; 17 February 1997; In Volume 8, Appendix 10, Feasibility Study Letpadaung Copper project, Monywa, Union of Myanmar commissioned by Ivanhoe Myanmar Holdings; Presented to No1 Mining Enterprise, Ministry of Mines, Government of the Union of Myanmar; Minproc Engineers Limited ACN 008 992 694; March 1997

2 LEGAL FRAMEWORK AND INDUSTRY GUIDELINES

The section describes the legal framework and policy context within which aquatic fauna is managed in Myanmar. It also describes the international treaties that are designed to protect aquatic fauna, to which Myanmar is a signatory.

Industry guidelines are also described which aspire to minimize the impact of the industries activities on aquatic fauna and biodiversity.

2.1 Legislation and Regulations

Myanmar has a long history of formal fishery management. The Fisheries Act of 1905 was the only legislation regulating fishery management and the fishing industry of Myanmar until amended in 1954, and was finally repealed by "Law relating to the fishing rights of foreign fishing vessels" in 1989. After that, the government promulgated three other fisheries laws, namely "Aquaculture fisheries law" in 1989, "Myanmar marine fisheries law" in 1990, and "Freshwater fisheries law in 1991. This law protects sexually mature adults and fingerlings of freshwater fish, specifying those species that it is forbidden to catch, export, kill or keep in captivity in the months of May, June, July and August without permission of the Director General of Department of Fishery (DoF). These prohibit trade in sexually mature adults and fingerlings of the freshwater prawns *Macrobrachium rosenbergii*, and M. *malcolnsonii*, which cannot be caught, exported, sold, killed or kept in captivity in the months of May, June and July, unless permitted by the Director General of the DoF. The regulation lists all the species of fish and mammals that are protected, including the dugong, whale, whale shark, dolphin, giant clam and turtle, and included in the list of endangered species in the Convention on International Trade of Endangered Species (CITES).

Myanmar is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed according to the degree of protection they need. The classes of listing include:

- Species threatened with extinction;
- Species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival; and
- Species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

A list describes those species covered by CITES and includes species of fauna from Myanmar.

2.2 Guidelines

The International Finance Corporation (IFC) has a Performance Standard 6 (PS6)– Biological Conservation and Sustainable Natural Resource Management which has been developed around the international Convention on Biological Diversity. The performance standard addresses the opportunities that exist for operations to avoid and mitigate threats to biodiversity.

PS6 suggests requirements to:

- Protect and conserve biodiversity in:
  - Habitats;

- Natural habitat;
- Modified habitat; and
- Critical habitat;
- Legally protected area, such as national parks, conservation reserves and designated forests; and
- Relation to invasive alien species;

Manage and use of renewable natural resources such as:

- Natural and plantation forests; and
- Freshwater and Marine Systems.

The key requirements of PS6 in relation to fauna are:

- Assessment of impacts of the project on the fauna;
- Account for the differing values of stakeholders in that assessment;
- Consider the effects of habitat destruction and the potential for introduction of invasive alien species; and
- Use qualified and experienced external experts to assist in data collection and assessment.

PS6 also considers options for mitigation including:

- Restoring impacted areas with appropriate native species and consistent with local ecological conditions;
- Offsetting biodiversity losses through the creation of ecologically comparable area(s) elsewhere (comparable in size, quality and function) that is managed for biodiversity; and
- Financial or in-kind compensation to direct users of biodiversity.

3 TERMS OF REFERENCE

The objectives of this Terms of Reference (TOR) (in Appendix 2) are to ensure that:

- There is clarity for MWMCL on the scale of the aquatic fauna assemblage survey appropriate for different areas;
- The aquatic fauna assemblage survey, analysis, interpretation and reporting undertaken for the ESIA is of a suitable quality and of consistent methodology to enable judgment of the impacts of the project on the aquatic fauna assemblage;
- The environment, in particular significant aquatic fauna assemblages, is identified and protected through good practice in the conduct and reporting of aquatic fauna assemblage surveys for the ESIA;
- Myanmar's knowledge base of fauna and faunal assemblages and biogeography are developed and enhanced over time at both the local and regional scale to the benefit of future decision making; and
- Survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes (especially as this pertains to completion criteria for the Project).

The timing of the survey was specified to consider the cool-dry, hot-dry and wet seasons and, as a result, fieldwork will be undertaken during these three (3) periods to address the seasonal variations that are expected to occur.

The TOR also specified the area in which the fauna study should extend and included areas beyond the immediate Project site.

3.1 Sampling Sites for Surveys

The upstream, downstream sites and a site parallel with the Project area of the Chindwin River were selected as sampling sites. Upstream and downstream sites of the Yamar creek in were also selected as sampling sites. The location of the sampling sites is shown in Figure 3.1

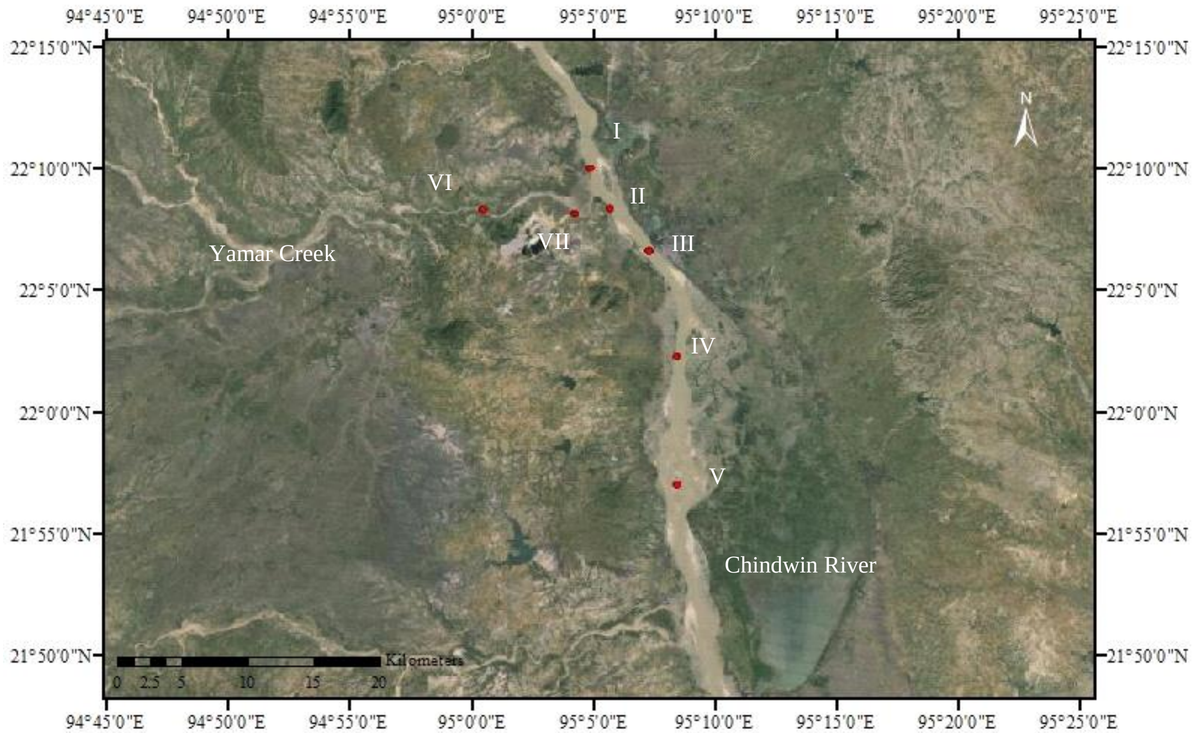

Figure 3.1: Sampling Site Locations

Table 3.1: Sampling Site Locations

Sampling station	Site	Coordinates			
		X (m)	Y (m)	Latitude	Longitude
I	CHR up 1	714537	2452844	22˚ 10' 4.80"	95˚ 04' 48.00"
II	CHR up 2	715987	2449834	22˚ 08' 27.60"	95˚ 05' 34.80"
III	CHR site 3	718764	2446648	22˚ 06' 43.20"	95˚ 07' 12.00"
IV	CHR down 1	720837	2438703	22˚ 02' 24.00"	95˚ 8' 20.40"
V	CHR down 2	720988	2428988	21˚ 57' 7.20"	95˚ 08' 24.00"
VI	YAM up	706994	2449619	22˚ 08' 24.00"	95˚ 00' 25.20"
VII	YAM down	713461	2449392	22˚ 08' 13.20"	95˚ 04' 8.40"

CHR – Chindwin River

YAM- Yamar Creek

3.2 Methodology Adopted in Surveys

3.2.1 Fish

Fish were collected with the help of the fishermen during the survey period. Fishing methods and gear were selected according to Munprasit et al. (1989)[3]. The cast nets, dip-net and traps were used in collecting the fish in the study sites. Traps were also used to get various types of fish, like surface dwellers and bottom

[3] Munprasit et al. (1989). Fishing Gear and Methods in Southeast Asia Malaysia Training Department Southeast Asian Fisheries Development Center. 324pp

dwellers. The fish were photographed soon after the collection and measurements were also taken for key characteristics. The fish were then preserved in 10% formalin solution for further identification in the laboratory. The fish were then identified according to Lagler (1956)[4], F.A.O (1974)[5], Jayaram (1981)[6], Day (1987)[7] and Carpenter and F.A.O (1997)[8]. Ecological methodology was followed after Welcomme (1979)[9] and Begon et al (1996)[10].

3.2.2 Zooplankton and Phytoplankton

Plankton sampling was conducted using a plankton net. Five sampling stations along the river were defined with equal interval. Plankton were collected using a motorboat. Plankton were sampled from surface layer and middle layer at each sampling station. The collected samples were fixed with Lugols Iodine solution for further identification in the laboratory. The plankton samples were then identified under a binocular microscope. Zooplankton species were collected and prepared according to Harris et. al (2000)[11].

3.2.3 Benthos

Benthos species were collected by digging, sieving, and dragging (using a drag-net). Twenty quadrats (2x2ft) were set up at the water's edge along the river, and dug using a small shovel and sieved. The benthos species were also collected by dragging along the water's edge using a drag-net. The collected benthos specimens were preserved in ethyl alcohol for further identification in the laboratory. The specimens were then identified under the binocular microscope in the laboratory.

[4] Lagler, K.C, Bardach, J.E. and Miller, R.R. (1962). The study of fish. Jon Wiley and son, Inc., Toppan Printing Co., Ltd. New York.545pp

[5] F.A.O (1974). Species identification sheets for fishery families from A to Z in four volumes.

[6] Jayaram, K.C. (1981). The freshwater fish of India, Pakistan, Bangladesh, Burma and Sri Lanka. Zoological

[7] Day, F. (1987). The fishes of India, being a natural history of the fish known to inhibit to seas and freshwaters of India, Burma and Ceylon. Vol. 1 & 2. New Delhi

[8] Carpenter and F.A.O (1997). Species identification field guide for fishery purpose. 49pp.

[9] Welcomme , R.L (1979). Fisheries ecology of floodplain rivers. Longman London and New York. 317pp.

[10] Begon, M., Harper, J.L., Townsend, C.R. (1996). Ecology: Individuals, Populations, and Communities. Blackwell Science Ltd. Oxford, London

[11] Harris , R.P., Wiebe, P.H., Lenz, J., Skjoldal, H.H., and Huntley, M. (2000). Zooplankton Methodology Manual. Printed in Great Britain by MPG BooksLtd, Bodmin, Cornwall

4 FIELD SURVEY RESULTS

4.1 Fish

4.1.1 Cool-Dry Season

A total of 21 fish species belonging to 12 families were recorded in Chindwin River and Yamar Creek during the study period in the cool-dry season. The recorded fish species mainly included species of the family Cyprinidae (Table 4.1).

Among the recorded fish species, the population sizes of *Glossogobius giuris* and *Labeo* sp. exceed those of the remaining recorded species.

Table 4.1: Fish species recorded during the cool-dry season, hot-dry season and wet season.

Sr. No.	Scientific name	Local name	Family	IUCN Red List Status
1	*Puntius chola*	Ngakhonema	Cyprinidae	NL
2	*Chela sardinella*	Yinbaungzar		NL
3	*Cirrhina mrigala*	Ngagyinbyu		NL
4	*Labeo calbasu*	Nganet pyah		NL
5	*Labeo angra*	Ngalu		NL
6	*Labeo rohita*	Ngagyin		NL
7	*Labeo boga*	Ngalu		NL
8	*Esomus altus*	Ngamautort		NL
9	*Rhinomugil corsula*	Ngazinlone	Mugilidae	NL
10	*Lepidocephalus thermalis*	Ngathaledoe	Cobitidae	NL
11	*Mastacembelus armatus*	Ngamwedoegyar	Mastacembelidae	NL
12	*Mastacembelus zebranus*	Ngamwedoebaygyar		NL
13	*Chanda ranga*	Ngazinzat	Channidae	NL
14	*Glossogobius giuris*	Kathaboe	Gobiidae	NL
15	*Mystus aor*	Nga-gyaung	Siluridae	NL
16	*Ompok bimaculatus*	Nganuthan		NL
17	*Silonia silondia*	Ngamyin	Schilbeidae	NL
18	*Mystus cavasius*	Ngazinyaingbyu	Bagridae	NL
19	*Notopterus notopterus*	Ngaphe	Notopteridae	NL
20	*Gudusia variegata*	Ngalabi	Clupeidae	NL
21	*Channa orientalis*	Ngayantgaungdoe	Channidae	NL

NL = Not Listed

4.1.2 Hot-Dry Season

A total of 21 fish species belonging to 12 families were recorded in Chindwin River and Yamar Creek during the survey in hot-dry season. The recorded fish species mainly included species of the family Cyprinidae (Table 4.1).

Among the recorded fish species, the species *Chanda ranga* and *Glossogobius giuris* were very common in all sampling sites. Although a small number of the species were not found in some sampling sites during the

survey period, it can be assumed that all recorded species exist in the studied segment since the fish were mobile species.

4.1.3 Wet Season

A total of 21 fish species belonging to 12 families were recorded in the Chindwin River and Yamar Creek during the survey in the wet season (Table 4.1). The members of the family Cyprinidae was largest in number and it was followed by those of the family Mastacembelidae and Siluridae. Among the recorded fish species, the species *Chanra ranga* and *Glossogobius giurus* were very common in all sampling sites.

4.2 Zooplankton

A total of 15 zooplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool-dry, hot-dry and wet seasons (Table 4.2). Members of the Arthropod group predominate in zooplankton composition. Second-most common species were found from the Rotifer group. A small number of zooplankton species were absent at some of the sampling sites, but overall composition of the Chindwin River and Yamar Creek indicated the existence of all recorded zooplankton species.

Table 4.2: Species composition of Zooplankton in the Chindwin River and Yamar Creek.

Sr. No.	Species	Phylum	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Astramoeba radiosa*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Spirostomum minus*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Monostyla lunaris*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Monostyla bulla*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
5	*Brachionus diversicornis*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Brachionus havanaensis*	Rotifer	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
7	*Lecane ungulata*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Daphnia sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
9	*Daphnia pulex*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
10	*Bosminopsis sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Chydorus sp*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
12	*Cyclops vicinus*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Stenocypris malcolmsoni*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
14	*Eucypris virens*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Entacythere donaldsonensis*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI

4.3 Phytoplankton

A total of 21 phytoplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool-dry, hot-dry and wet seasons (Table 4.3). Members of the class Cyanophyceae predominate in phytoplankton composition. Members of the class Chlorophyceae were the second most abundant. A small number of phytoplankton species were absent at some of the sampling sites, but overall composition of the Chindwin River and Yamar Creek indicated the existence of all recorded phytoplankton species.

Table 4.3: Species composition of Phytoplankton in the Chindwin River and Yamar Creek.

Sr. No.	Species	Class	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Synedra affinis*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Dinobryon divergens*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Diatoma elongaum*	Bacillariophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Campsopogan caeruleus*	Rhodophyceae	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
5	*Staurastrum leptopus*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Mougeotia nummuloides*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
7	*Spirogyra protecta*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Spirogyra microspora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
9	*Spirogyra cylindrospora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
10	*Spiroyra prolifica*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Spirogyra azygospora*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
12	*Oscillatoria laete-virens*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Oscillatoria subbrevis*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
14	*Lyngbya martensiana*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Lyngbya truncicola*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
16	*Lyngbya contorta*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
17	*Phormidium ambiguum*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
18	*Planktothrix raciborskii*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
19	*Treubaria crassispina*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
20	Synedra acus var. angustissima	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
21	*Synedra acus* var. radians	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII

4.4 Benthos

Five benthos species; *Crocothemis servilia, Orthetrum glaucaum, Rhyothemis Phyllis, Tramea basilaris*, and *Ictinogomphus rapax* were recorded in Chindwin River; all of them are nymphs of dragonfly species. Six benthos species; *Crocothemis servilia, Orthetrum glaucaum, Rhyothemis Phyllis, Tramea basilaris,*and *Macrodiplax cora* and *Ictinogomphus rapax* were found in Yamar Creek. Similarly to the survey of the Chindwin River, all of the aforementioned species recorded were dragonfly nymphs.

5 ANALYSIS OF DATA

5.1 Species seasonal diversity

5.1.1 Fish

Shannon species diversity index (H') values of fishes were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50: NS) (Table 5.1, 5.2 and 5.3). The results showed that there was no significant difference in species diversity in relation to environmental conditions of upstream and downstream sites showing relatively similar aquatic habitat quality.

Table 5.1: Comparison of fish species diversity (H') values between upstream and downstream of Chindwin River and Yamar Creek in the cool-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.7984	3.7737	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6819	3.714	p=1.00; Binomial test; obs. prop.=0.50	NS

NS- non-significant

Table 5.2: Comparison of fish species diversity (H') values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.826	3.7754	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6924	3.6964	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.3: Comparison of fish species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.829	3.7797	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.7353	3.6975	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.2 Zooplankton

Shannon species diversity index (H') values of zooplanktons were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50) (Table 5.4, 5.5 and 5.6). The results showed that there was no significant difference in species diversity in relation to environmental conditions indicating the relatively similar aquatic habitat quality of upstream and downstream sites.

Table 5.4: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the cold-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.5266	3.5029	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6181	2.897	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.5: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.4748	3.6089	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.4993	2.9473	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.6: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.4111	3.5859	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.3093	2.9624	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.3 Phytoplankton

Shannon species diversity index (H') values of phytoplankton were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50) (Table 5.7, 5.8 and 5.9). The results showed that there was no significant difference in

species diversity in relation to environmental conditions indicating the relatively similar aquatic habitat quality of upstream and downstream sites.

Table 5.7: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the cold-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.8067	3.9603	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.7275	3.9126	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.8: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.8337	3.8551	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6197	3.9333	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.9: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.6479	3.9082	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.4086	3.9504	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.4 Margalef's species richness and Shannon's Evenness

The Margalef's species richness index values show relatively similar values of upstream and downstream sites both in Chindwin River and Yamar Creek for fishes and planktons (Table 5.10, 5.11and 5.12). A significant difference was not found between upstream and downstream sites in all three seasons (p=1.00; Binomial test; obs. prop.=0.50; NS) (Table 5.10, 5.11 and 5.12). Evenness index values found for all sites in three seasons indicated the even distribution of the existing organisms along the river and creek.

Table 5.10: Margalef's species richness index values and Shannon Evenness values of fish.

Item		Cool dry season		Hot Dry Season		Wet Season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	5.479	5.4261	5.457	5.4098	5.4224	5.3641
	Shannon Evenness (J')	0.865	0.859	0.871	0.86	0.872	0.861
Yamar Creek	Margalef's Species Richness index	5.5724	5.6429	5.5483	5.6515	5.5589	5.6264
	Shannon Evenness (J')	0.838	0.846	0.841	0.842	0.85	0.842
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

Table 5.11: Margalef's species richness index values and Shannon Evenness values of zooplankton in three seasons

Item		Cool dry season		Hot dry season		Wet season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	7.3153	6.8193	7.2754	6.7454	7.1641	6.6546
	Shannon Evenness (J')	0.903	0.897	0.889	0.924	0.873	0.918
Yamar Creek	Margalef's Species Richness index	7.0789	5.2851	7.129	5.3499	7.237	5.1829
	Shannon Evenness (J')	0.847	0.856	0.847	0.856	0.847	0.856
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

Table 5.12: Margalef's species richness index values and Shannon Evenness values of phytoplankton in three seasons

Item		Cool dry season		Hot dry season		Wet season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	9.4054	8.7677	9.3541	8.6726	9.2109	8.5559
	Shannon Evenness (J')	0.896	0.932	0.903	0.921	0.859	0.92
Yamar Creek	Margalef's Species Richness index	10.1128	10.0418	10.1843	10.1648	10.3386	9.8476
	Shannon Evenness (J')	0.849	0.905	0.824	0.91	0.776	0.914
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

6 DISCUSSION AND MITIGATION MEASURES

During the surveys, no threatened fish species were found in either the Chindwin River or Yamar Creek. All recorded fish species are considered to be common species and as such are not listed under the protected species list of Myanmar. However, fishing activities are prohibited during the spawning season by the Fisheries Department; people associated with the Project should be informed of this restriction.

6.1 Species conservation

There is concern that toxic minerals and chemicals, particularly those resulting from acid rock drainage (ARD) from the waste rock dumps and the pit may make their way into the water bodies of the river and creek; particularly in the wet season. Bioaccumulation of the toxic minerals in aquatic organisms may cause harmful effect on the aquatic population and consequently it may cause adverse impacts on the people, which consume the aquatic organisms including fish.

ARD formation can result in soil and water contamination. ARD may easily occur because the ore and waste rocks contain high concentrations of sulphur. High ambient temperature and rain water greatly support the occurrence of ARD.

The Project will use the water from the river for the workers accommodation and for the processing operation. In pumping the water from the Chindwin River, fish eggs, larvae and fry may be incidentally included in the pumped water causing the fish population to decline. Fish are important for the local people, because some people generate their income by fishing, and fish make up an important part of the diet of the local community. It is therefore recommended that suitable devices and systems are used to reduce the intake of fish when water is being drawn from the Chindwin River.

Aquatic fauna including fish and plankton species should be regularly monitored in both the Chindwin River and Yamar creek during all phases of the Project including the construction phase, operation phase, and mine closure phase. The results of the monitoring should be analysed in order to identify any changes to the population dynamics of the aquatic fauna. Fish of both the Chindwin River and Yamar Creek can be used as indicator species in monitoring the direct and indirect impacts from the Project.

Regarding indirect impacts, the water bodies and aquatic fauna may be disturbed, and aquatic organisms may be overexploited by both the workers from the Letpadaung Project and the locals as well. Illegal fishing during spawning season and using illegal methods such as poisoning and use of explosive could occur.

It is recommended that MWMCL should release native fish fingerlings into the river and creek and into seasonal floodplains, to support the livelihood of the community.

6.2 Population change and decline

Population change and decline of aquatic species are related to changes of environment and habitat quality. Change of index values and proportional abundance of the aquatic community, specifically fish, zooplankton and phytoplankton can be used as indicators. Zooplankton and phytoplankton species are primary food sources of larger species like fish and prawns. As such, impacts on the plankton population may cause adverse impacts on the aquatic vertebrates like fish. In addition, pollution of the water bodies could result in the increase in the population of certain phytoplankton species as well as other species that are able to take advantage of the polluted water.

APPENDIX 1 –SPECIES PROPORTIONAL ABUNDANCE

1 SPECIES PROPORTIONAL ABUNDANCE

1.1 Fish Species

A total of 21 fish species were recorded in the upstream site of Chindwin River during the survey period in cool-dry season. The species *Chanda ranga* was found to have the highest proportional abundance (0.1765), followed by *Glossogobius giuris*, *Chela sardinella* and *Rhinomugil corsula* (Table 1.1). The species diversity (H') index value of Chindwin River upstream site in cool-dry season was 3.794, which showed that the fish species were in moderately diverse condition in the upstream site in cool dry season.

Table 1.1: Fish species abundance and diversity index values in Chindwin River upstream area in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.176510067	
2	*Glossogobius giuris*	0.146979866	
3	*Chela sardinella*	0.118568233	
4	*Rhinomugil corsula*	0.106487696	
5	*Labeo calbasu*	0.057270694	
6	*Labeo rohita*	0.051454139	
7	*Lepidocephalus thermalis*	0.049440716	
8	*Puntius chola*	0.046979866	
9	*Cirrhina mrigala*	0.035794183	
10	*Mystus cavasius*	0.035123043	
11	*Mastacembelus armatus*	0.029082774	
12	*Ompok bimaculatus*	0.026845638	
13	*Labeo angra*	0.021923937	
14	*Notopterus notopterus*	0.019463087	
15	*Mastacembelus zebranus*	0.017002237	
16	*Labeo boga*	0.014541387	
17	*Gudusia variegata*	0.012527964	
18	*Esomus altus*	0.010067114	
19	*Mystus aor*	0.008277405	
20	*Silonia silondia*	0.008053691	
21	*Channa orientalis*	0.007606264	
			3.798477361

A total of 21 fish species were recorded in the downstream site of Chindwin River during the survey period. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1545), followed by *Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.2). The species diversity (H') index value of Chindwin River downstream site in cool dry season was 3.7737, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.2: Fish species abundance and diversity index values in Chindwin River downstream site in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	Glossogobius giuris	0.154575433	
2	Chanda ranga	0.13911789	
3	Labeo rohita	0.134789777	
4	Rhinomugil corsula	0.126133553	
5	Chela sardinella	0.075638912	
6	Puntius chola	0.048433636	
7	Lepidocephalus thermalis	0.045342127	
8	Labeo calbasu	0.044723825	
9	Cirrhina mrigala	0.029472383	
10	Mystus cavasius	0.029472383	
11	Labeo angra	0.026793075	
12	Ompok bimaculatus	0.026380874	
13	Mastacembelus zebranus	0.024732069	
14	Notopterus notopterus	0.024732069	
15	Mastacembelus armatus	0.01793075	
16	Gudusia variegata	0.011129431	
17	Channa orientalis	0.009480627	
18	Labeo boga	0.009274526	
19	Silonia silondia	0.009274526	
20	Esomus altus	0.007419621	
21	Mystus aor	0.005152514	
			3.773695181

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in cool-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1977), followed *by Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.3). The species diversity (H') index value of Yamar Creek upstream site in cool dry season was 3.6819, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.3: Fish species abundance and diversity index values in Yamar Creek upstream site in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.197785218	
2	*Chanda ranga*	0.161730621	
3	*Labeo rohita*	0.123100695	
4	*Rhinomugil corsula*	0.114859645	
5	*Lepidocephalus thermalis*	0.054081895	
6	*Puntius chola*	0.048673706	
7	*Chela sardinella*	0.043007984	
8	*Mastacembelus armatus*	0.034766933	

9	*Mystus cavasius*	0.032964203	
10	*Labeo calbasu*	0.031676539	
11	*Mastacembelus zebranus*	0.025753284	
12	*Ompok bimaculatus*	0.022405357	
13	*Notopterus notopterus*	0.019314963	
14	*Labeo angra*	0.017769766	
15	*Cirrhina mrigala*	0.017512233	
16	*Channa orientalis*	0.014164306	
17	*Gudusia variegata*	0.011073912	
18	*Esomus altus*	0.009013649	
19	*Silonia silondia*	0.009013649	
20	*Labeo boga*	0.005923255	
21	*Mystus aor*	0.00540819	
			3.681937336

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1836), followed by *Chanda ranga*, *Rhinomugil corsula* and *Labeo rohita* (Table 1.4). The species diversity (H') index value of Yamar Creek downstream site in cool dry season was 3.714, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.4: Fish species abundance and diversity index values in Yamar Creek downstream in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.183609366	
2	*Chanda ranga*	0.159908624	
3	*Rhinomugil corsula*	0.122215877	
4	*Labeo rohita*	0.089948601	
5	*Lepidocephalus thermalis*	0.067675614	
6	*Chela sardinella*	0.062821245	
7	*Puntius chola*	0.056253569	
8	*Mastacembelus armatus*	0.036550543	
9	*Ompok bimaculatus*	0.036550543	
10	*Labeo calbasu*	0.03597944	
11	*Mystus cavasius*	0.03597944	
12	*Notopterus notopterus*	0.019417476	
13	*Labeo angra*	0.017704169	
14	*Channa orientalis*	0.013135351	
15	*Cirrhina mrigala*	0.011993147	
16	*Esomus altus*	0.01027984	
17	*Gudusia variegata*	0.009994289	
18	*Silonia silondia*	0.009423187	
19	*Labeo boga*	0.007138778	
20	*Mystus aor*	0.007138778	
21	*Mastacembelus zebranus*	0.006282125	
			3.714065812

A total of 21 fish species were recorded in the upstream site of the Chindwin River during the survey period in hot-dry season. The species *Chanda ranga* was found to have the highest proportional abundance (0.1643), followed by *Glossogobius giuris* and *Chela sardinella* (Table 1.5). The species diversity (H') index value of Chindwin River upstream site in hot-dry season was 3.826, which showed that the fish species were moderately diverse condition in the upstream site.

Table 1.5: Fish species abundance and diversity index values in Chindwin River upstream site in hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.164359862	
2	*Glossogobius giuris*	0.150951557	
3	*Chela sardinella*	0.121107266	
4	*Rhinomugil corsula*	0.105752595	
5	*Puntius chola*	0.060553633	
6	*Labeo calbasu*	0.051903114	
7	*Labeo rohita*	0.045415225	
8	*Lepidocephalus thermalis*	0.045415225	
9	*Cirrhina mrigala*	0.036764706	
10	*Mystus cavasius*	0.036548443	
11	*Ompok bimaculatus*	0.024221453	
12	*Mastacembelus armatus*	0.023788927	
13	*Labeo angra*	0.021626298	
14	*Mastacembelus zebranus*	0.021193772	
15	*Notopterus notopterus*	0.021193772	
16	*Labeo boga*	0.018382353	
17	*Gudusia variegata*	0.014057093	
18	*Esomus altus*	0.012543253	
19	*Silonia silondia*	0.01016436	
20	*Mystus aor*	0.007569204	
21	*Channa orientalis*	0.006487889	
			3.826014963

A total of 21 fish species were recorded in the upstream site of Chindwin River downstream site during the survey period in hot-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1566), followed by *Chanda ranga* and *Labeo rohita* (Table 1.6). The species diversity (H') index value of Chindwin River downstream site in hot dry season was 3.7759, which showed that the fish species were moderately diverse condition in the downstream site in hot-dry season.

Table 1.6: Fish species abundance and diversity index values in Chindwin River downstream area in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.156689434	
2	*Chanda ranga*	0.136601045	
3	*Labeo rohita*	0.135596625	
4	*Rhinomugil corsula*	0.124548011	
5	*Chela sardinella*	0.076335878	
6	*Puntius chola*	0.049216553	
7	*Lepidocephalus thermalis*	0.046203294	
8	*Labeo calbasu*	0.044194456	
9	*Cirrhina mrigala*	0.030936119	
10	*Mystus cavasius*	0.028726396	
11	*Ompok bimaculatus*	0.026918441	
12	*Notopterus notopterus*	0.024708718	
13	*Labeo angra*	0.024106067	
14	*Mastacembelus zebranus*	0.022097228	
15	*Mastacembelus armatus*	0.019686621	
16	*Labeo boga*	0.011249498	
17	*Gudusia variegata*	0.011249498	
18	*Silonia silondia*	0.009642427	
19	*Channa orientalis*	0.009441543	
20	*Esomus altus*	0.006830052	
21	*Mystus aor*	0.005022097	
			3.775881729

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in hot-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.197), followed by *Chanda ranga* and *Labeo rohita* (Table 1.7). The species diversity (H') index value of Yamar Creek upstream site in hot dry season was 3.6924, which showed that the fish species were in moderately diverse condition in the upstream site in hot-dry season.

Table 1.7: Fish species abundance and diversity index values in Yamar Creek upstream in hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.197018634	
2	*Chanda ranga*	0.162484472	
3	*Labeo rohita*	0.123726708	
4	*Rhinomugil corsula*	0.109565217	
5	*Lepidocephalus thermalis*	0.052670807	
6	*Puntius chola*	0.048447205	
7	*Chela sardinella*	0.044223602	
8	*Mastacembelus armatus*	0.036024845	
9	*Labeo calbasu*	0.032298137	
10	*Mystus cavasius*	0.032298137	

11	*Mastacembelus zebranus*	0.027329193	
12	*Ompok bimaculatus*	0.023602484	
13	*Cirrhina mrigala*	0.018881988	
14	*Labeo angra*	0.018881988	
15	*Notopterus notopterus*	0.018881988	
16	*Channa orientalis*	0.013416149	
17	*Gudusia variegata*	0.011428571	
18	*Silonia silondia*	0.009192547	
19	*Esomus altus*	0.007950311	
20	*Mystus aor*	0.006459627	
21	*Labeo boga*	0.005217391	
			3.692393222

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1879) and that was followed by those of *Chanda ranga* and *Rhinomugil corsula* (Table 1.8). The species diversity (H') index value of Yamar Creek downstream site in hot dry season was 3.6964, which showed that the fish species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.8: Fish species abundance and diversity index values in Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.187915583	
2	*Chanda ranga*	0.157849089	
3	*Rhinomugil corsula*	0.126047991	
4	*Labeo rohita*	0.092512287	
5	*Lepidocephalus thermalis*	0.07082972	
6	*Chela sardinella*	0.060711188	
7	*Puntius chola*	0.052327262	
8	*Mastacembelus armatus*	0.037583117	
9	*Ompok bimaculatus*	0.037583117	
10	*Mystus cavasius*	0.03555941	
11	*Labeo calbasu*	0.029777392	
12	*Notopterus notopterus*	0.020237063	
13	*Labeo angra*	0.01618965	
14	*Cirrhina mrigala*	0.012431339	
15	*Channa orientalis*	0.012431339	
16	*Esomus altus*	0.00982943	
17	*Silonia silondia*	0.00982943	
18	*Gudusia variegata*	0.00982943	
19	*Mastacembelus zebranus*	0.007227522	
20	*Labeo boga*	0.006649321	
21	*Mystus aor*	0.006649321	
			3.696353394

A total of 21 fish species were recorded in the upstream site of Chindwin River upstream site during the survey period in the wet season. The species *Chanda ranga* was found with highest proportional abundance (0.1598) and that was followed by those of *Glossogobius giuris* and *Chela sardinella* (Table 1.9). The species diversity (H') index value of Chindwin River upstream site in wet season was 3.829, which showed that the fish species were in moderately diverse condition in the upstream site.

Table 1.9: Fish species abundance and diversity index values in Chindwin River upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.159836066	
2	*Glossogobius giuris*	0.153688525	
3	*Chela sardinella*	0.116803279	
4	*Rhinomugil corsula*	0.114754098	
5	*Puntius chola*	0.06147541	
6	*Labeo calbasu*	0.047131148	
7	*Labeo rohita*	0.047131148	
8	*Lepidocephalus thermalis*	0.047131148	
9	*Cirrhina mrigala*	0.034836066	
10	*Mystus cavasius*	0.032786885	
11	*Mastacembelus armatus*	0.024590164	
12	*Labeo angra*	0.022540984	
13	*Mastacembelus zebranus*	0.022540984	
14	*Ompok bimaculatus*	0.022540984	
15	*Notopterus notopterus*	0.020491803	
16	*Labeo boga*	0.018442623	
17	*Gudusia variegata*	0.014344262	
18	*Esomus altus*	0.012295082	
19	*Silonia silondia*	0.010245902	
20	*Mystus aor*	0.008196721	
21	*Channa orientalis*	0.008196721	
			3.829038482

A total of 21 fish species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1513) and that was followed by those of *Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.10). The species diversity (H') index value of Chindwin River downstream site in cool dry season was 3.7797, which showed that the fish species were in moderately diverse condition in the upstream site in the wet season.

Table 1.10: Fish species abundance and diversity index value in Chindwin River downstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.151345291	
2	*Chanda ranga*	0.147047833	
3	*Labeo rohita*	0.130792227	
4	*Rhinomugil corsula*	0.116405082	
5	*Chela sardinella*	0.087817638	

6	*Puntius chola*	0.052316891	
7	*Lepidocephalus thermalis*	0.044843049	
8	*Labeo calbasu*	0.039237668	
9	*Cirrhina mrigala*	0.033632287	
10	*Mystus cavasius*	0.028026906	
11	*Labeo angra*	0.024289985	
12	*Mastacembelus zebranus*	0.022421525	
13	*Ompok bimaculatus*	0.022421525	
14	*Notopterus notopterus*	0.022421525	
15	*Mastacembelus armatus*	0.020553064	
16	*Labeo boga*	0.012518685	
17	*Gudusia variegata*	0.011210762	
18	*Channa orientalis*	0.010089686	
19	*Silonia silondia*	0.008594918	
20	*Esomus altus*	0.008408072	
21	*Mystus aor*	0.005605381	
			3.779659813

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1792) and that was followed by those of *Chanda ranga* and *Labeo rohita* (Table 1.11). The species diversity (H') index value of Yamar Creek upstream site in wet season was 3.7353, which showed that the fish species were in moderately diverse condition in the upstream site in the wet season.

Table 1.11: Fish species abundance and diversity index values in Yamar Creek upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.179247665	
2	*Chanda ranga*	0.159555668	
3	*Labeo rohita*	0.12623075	
4	*Rhinomugil corsula*	0.109063368	
5	*Chela sardinella*	0.053016915	
6	*Lepidocephalus thermalis*	0.053016915	
7	*Puntius chola*	0.04544307	
8	*Mastacembelus armatus*	0.037869225	
9	*Mystus cavasius*	0.03534461	
10	*Labeo calbasu*	0.03029538	
11	*Mastacembelus zebranus*	0.03029538	
12	*Ompok bimaculatus*	0.027770765	
13	*Cirrhina mrigala*	0.022721535	
14	*Labeo angra*	0.02019692	
15	*Notopterus notopterus*	0.02019692	
16	*Gudusia variegata*	0.012623075	
17	*Silonia silondia*	0.009088614	
18	*Esomus altus*	0.008583691	
19	*Channa orientalis*	0.008583691	
20	*Labeo boga*	0.005806614	
21	*Mystus aor*	0.00504923	
			3.7353051

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.189) and that was followed by those of *Chanda ranga* and *Rhinomugil corsula* (Table 1.12). The species diversity (H') index value of Yamar Creek downstream site in wet season was 3.6975, which showed that the fish species were in moderately diverse condition in the downstream site in the wet season.

Table 1.12: Fish species abundance and diversity index values in Yamar Creek downstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.189015891	
2	*Chanda ranga*	0.161137441	
3	*Rhinomugil corsula*	0.127125732	
4	*Labeo rohita*	0.09478673	
5	*Lepidocephalus thermalis*	0.066350711	
6	*Chela sardinella*	0.064120435	
7	*Puntius chola*	0.047393365	
8	*Mystus cavasius*	0.036241985	
9	*Mastacembelus armatus*	0.03345414	
10	*Ompok bimaculatus*	0.03345414	
11	*Labeo calbasu*	0.027320881	
12	*Notopterus notopterus*	0.01672707	
13	*Esomus altus*	0.015611932	
14	*Gudusia variegata*	0.015611932	
15	*Cirrhina mrigala*	0.013939225	
16	*Labeo angra*	0.013939225	
17	*Silonia silondia*	0.012545302	
18	*Channa orientalis*	0.010036242	
19	*Labeo boga*	0.009478673	
20	*Mastacembelus zebranus*	0.008363535	
21	*Mystus aor*	0.003345414	
			3.697526027

1.2 Zooplankton Species

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1951) and that was followed by those of *Chydorus sp*, *Brachionus havanaensis* and *Eucypris virens* (Table 1.13). The species diversity (H') index value of Chindwin River upstream site in the cool-dry season was 3.5266, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.13: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.195121951	
2	*Chydorus sp*	0.134146341	
3	*Brachionus havanaensis*	0.134146341	
4	*Eucypris virens*	0.085365854	
5	*Monostyla lunaris*	0.085365854	
6	*Spirostomum minus*	0.06097561	
7	*Stenocypris malcolmsoni*	0.06097561	
8	*Brachionus diversicornis*	0.048780488	
9	*Daphnia sp*	0.048780488	
10	*Cyclops vicinus*	0.036585366	
11	*Monostyla bulla*	0.036585366	
12	*Entacythere donaldsonensis*	0.024390244	
13	*Lecane ungulata*	0.024390244	
14	*Bosminopsis sp*	0.012195122	
15	*Daphnia pulex*	0.012195122	
			3.526582243

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1946) and that was followed by those of *Monostyla lunaris*, *Spirostomum minus* and *Daphnia pulex* (Table 1.14). The species diversity (H') index value of Chindwin River downstream site in the cool-dry season was 3.5029, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.14: Zooplankton species and Shannon diversity index values of Chindwin River downstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.194690265	
2	*Monostyla lunaris*	0.132743363	
3	*Spirostomum minus*	0.115044248	
4	*Daphnia pulex*	0.115044248	
5	*Brachionus diversicornis*	0.097345133	
6	*Brachionus havanaensis*	0.07079646	
7	*Entacythere donaldsonensis*	0.053097345	
8	*Stenocypris malcolmsoni*	0.044247788	
9	*Lecane ungulata*	0.03539823	
10	*Eucypris virens*	0.03539823	
11	*Bosminopsis sp*	0.03539823	
12	*Cyclops vicinus*	0.026548673	
13	*Daphnia sp*	0.017699115	
14	*Chydorus sp*	0.017699115	
15	*Monostyla bulla*	0.008849558	
			3.502919334

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1684) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Daphnia sp* (Table 1.15). The species diversity (H') index value of Yamar Creek upstream site in the cool-dry season was 3.6181, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.15: Zooplankton species and Shannon diversity index values of Yamar Creek upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.168421053	
2	*Eucypris virens*	0.147368421	
3	*Entacythere donaldsonensis*	0.136842105	
4	*Daphnia sp*	0.073684211	
5	*Monostyla bulla*	0.063157895	
6	*Lecane ungulata*	0.063157895	
7	*Monostyla lunaris*	0.052631579	
8	*Bosminopsis sp*	0.052631579	
9	*Stenocypris malcolmsoni*	0.052631579	
10	*Brachionus havanaensis*	0.042105263	
11	*Cyclops vicinus*	0.042105263	
12	*Spirostomum minus*	0.031578947	
13	*Daphnia pulex*	0.031578947	
14	*Brachionus diversicornis*	0.021052632	
15	*Chydorus sp*	0.021052632	
			3.618082807

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.3205) and that was followed by those of *Daphnia sp*, *Cyclops vicinus* and *Spirostomum minus* (Table 1.16). The species diversity (H') index value of Yamar Creek downstream site in the cool-dry season was 2.897, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the cool-dry season although it was relatively low when compared to other sites.

Table 1.16: Zooplankton species and Shannon diversity index values of Yamar Creek downstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.320512821	
2	*Daphnia sp*	0.179487179	
3	*Cyclops vicinus*	0.153846154	
4	*Spirostomum minus*	0.076923077	
5	*Monostyla bulla*	0.064102564	
6	*Lecane ungulata*	0.051282051	
7	*Eucycpris virens*	0.051282051	
8	*Daphnis pulex*	0.038461538	
9	*Bosminopsis sp*	0.025641026	
10	*Brachionus diversicornis*	0.025641026	
11	*Monostyla lunaris*	0.012820513	
			2.897027518

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2023) and that was followed by those of *Brachionus havanaensis*, *Chydorus sp* and *Eucypris virens* (Table 1.17). The species diversity (H') index value of Chindwin River upstream site in the hot-dry season was 3.4748, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.17: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.202380952	
2	*Brachionus havanaensis*	0.166666667	
3	*Chydorus sp*	0.142857143	
4	*Eucypris virens*	0.071428571	
5	*Spirostomum minus*	0.071428571	
6	*Monostyla lunaris*	0.05952381	
7	*Stenocypris malcolmsoni*	0.05952381	

8	*Entacythere donaldsonensis*	0.035714286	
9	*Brachionus diversicornis*	0.035714286	
10	*Lecane ungulata*	0.035714286	
11	*Bosminopsis sp*	0.035714286	
12	*Cyclops vicinus*	0.023809524	
13	*Daphnia sp*	0.023809524	
14	*Daphnia pulex*	0.023809524	
15	*Monostyla bulla*	0.011904762	
			3.474843992

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1764) and that was followed by those of *Spirostomum minus*, *Monostyla lunaris* and *Daphnia pulex* (Table 1.18). The species diversity (H') index value of Chindwin River downstream site in the hot-dry season was 3.6089, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.18: Zooplankton species and Shannon diversity index values of Chindwin River downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.176470588	
2	*Spirostomum minus*	0.12605042	
3	*Monostyla lunaris*	0.109243697	
4	*Daphnia pulex*	0.100840336	
5	*Brachionus diversicornis*	0.100840336	
6	*Brachionus havanaensis*	0.058823529	
7	*Eucypris virens*	0.058823529	
8	*Lecane ungulata*	0.050420168	
9	*Cyclops vicinus*	0.042016807	
10	*Bosminopsis sp*	0.042016807	
11	*Daphnia sp*	0.033613445	
12	*Stenocypris malcolmsoni*	0.033613445	
13	*Entacythere donaldsonensis*	0.033613445	
14	*Monostyla bulla*	0.016806723	
15	*Chydorus sp*	0.016806723	
			3.60894494

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2065) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Monostyla bulla* (Table 1.19). The species diversity (H') index value of Yamar Creek upstream site in the hot-dry season was 3.4993, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.19: Zooplankton species and Shannon diversity index values of Yamar Creek upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.206521739	
2	*Eucypris virens*	0.163043478	
3	*Entacythere donaldsonensis*	0.130434783	
4	*Monostyla bulla*	0.076086957	
5	*Daphnia sp*	0.065217391	
6	*Spirostomum minus*	0.054347826	
7	*Lecane ungulata*	0.054347826	
8	*Monostyla lunaris*	0.043478261	
9	*Bosminopsis sp*	0.043478261	
10	*Stenocypris malcolmsoni*	0.043478261	
11	*Brachionus diversicornis*	0.032608696	
12	*Cyclops vicinus*	0.032608696	
13	*Brachionus havanaensis*	0.02173913	
14	*Daphnia pulex*	0.02173913	
15	*Chydorus sp*	0.010869565	
			3.499389705

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2837) and that was followed by those of *Cyclops vicinus*, *Daphnia sp* and *Spirostomum minus* (Table 1.20). The species diversity (H') index value of Yamar Creek downstream site in the hot-dry season was 2.9473, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.20: Zooplankton species and Shannon diversity index values of Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.283783784	
2	*Cyclops vicinus*	0.175675676	
3	*Daphnia sp*	0.162162162	
4	*Spirostomum minus*	0.121621622	
5	*Monostyla bulla*	0.054054054	
6	*Brachionus diversicornis*	0.054054054	
7	*Lecane ungulata*	0.040540541	
8	*Bosminopsis sp*	0.040540541	
9	*Monostyla lunaris*	0.027027027	
10	*Daphnis pulex*	0.027027027	
11	*Eucycpris virens*	0.013513514	
			2.947250227

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2444) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Cyclops vicinus* (Table 1.21). The species diversity (H') index value of Chindwin River upstream site in the wet season was 3.4111, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.21: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.244444444	
2	*Eucypris virens*	0.155555556	
3	*Entacythere donaldsonensis*	0.144444444	
4	*Cyclops vicinus*	0.066666667	
5	*Spirostomum minus*	0.055555556	
6	*Brachionus diversicornis*	0.055555556	
7	*Monostyla lunaris*	0.044444444	
8	*Lecane ungulata*	0.044444444	
9	*Monostyla bulla*	0.033333333	
10	*Daphnia sp*	0.033333333	
11	*Bosminopsis sp*	0.033333333	
12	*Stenocypris malcolmsoni*	0.033333333	
13	*Daphnia pulex*	0.022222222	
14	*Chydorus sp*	0.022222222	
15	*Brachionus havanaensis*	0.011111111	
			3.411133243

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1968) and that was followed by those of *Spirostomum minus*, *Daphnia sp* and *Lecane ungulata* (Table 1.22). The species diversity (H') index value of Chindwin River downstream site in the wet season was 3.5859, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.22: Zooplankton species and Shannon diversity index values of Chindwin River downstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.196850394	
2	*Spirostomum minus*	0.11023622	
3	*Daphnia sp*	0.102362205	
4	*Lecane ungulata*	0.094488189	
5	*Brachionus havanaensis*	0.086614173	

6	*Daphnia pulex*	0.086614173	
7	*Monostyla lunaris*	0.062992126	
8	*Eucypris virens*	0.05511811	
9	*Brachionus diversicornis*	0.047244094	
10	*Stenocypris malcolmsoni*	0.039370079	
11	*Monostyla bulla*	0.031496063	
12	*Cyclops vicinus*	0.031496063	
13	*Chydorus sp*	0.023622047	
14	*Bosminopsis sp*	0.015748031	
15	*Entacythere donaldsonensis*	0.015748031	
			3.585866395

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2325) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Monostyla lunaris* (Table 1.23). The species diversity (H') index value of Yamar Creek upstream site in the wet season was 3.3093, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.23: Zooplankton species and Shannon diversity index values of Yamar Creek upstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.23255814	
2	*Eucypris virens*	0.186046512	
3	*Entacythere donaldsonensis*	0.174418605	
4	*Monostyla lunaris*	0.069767442	
5	*Spirostomum minus*	0.046511628	
6	*Brachionus diversicornis*	0.046511628	
7	*Cyclops vicinus*	0.046511628	
8	*Lecane ungulata*	0.034883721	
9	*Chydorus sp*	0.034883721	
10	*Monostyla bulla*	0.023255814	
11	*Brachionus havanaensis*	0.023255814	
12	*Daphnia sp*	0.023255814	
13	*Bosminopsis sp*	0.023255814	
14	*Stenocypris malcolmsoni*	0.023255814	
15	*Daphnia pulex*	0.011627907	
			3.309270908

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.3411) and that was followed by those of *Spirostomum minus*, *Monostyla lunaris* and *Monostyla bulla* (Table 1.24). The species diversity (H') index value of Yamar Creek downstream site in the wet season was

2.9624, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.24: Zooplankton species and Shannon diversity index values of Yamar Creek downstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.341176471	
2	*Spirostomum minus*	0.141176471	
3	*Monostyla lunaris*	0.082352941	
4	*Monostyla bulla*	0.035294118	
5	*Lecane ungulata*	0.058823529	
6	*Daphnia sp*	0.047058824	
7	*Bosminopsis sp*	0.023529412	
8	*Cyclops vicinus*	0.129411765	
9	*Daphnis pulex*	0.035294118	
10	*Eucycpris virens*	0.070588235	
11	*Brachionus diversicornis*	0.035294118	
			2.962446123

1.3 Phytoplankton Species

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the cool-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2456) and that was followed by those of *Synedra acus var. angustissima*, *Spirogyra protecta* and *Mougeotia nummuloides* (Table 1.25). The species diversity (H') index value of Chindwin River upstream site in the cool-dry season was 3.8067, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.25: Phytoplankton species and Shannon diversity index values of Chindwin River upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.245614035	
2	*Synedra acus var. angustissima*	0.114035088	
3	*Spirogyra protecta*	0.061403509	
4	*Mougeotia nummuloides*	0.061403509	
5	*Lyngbya contorta*	0.052631579	
6	*Oscillatoria subbrevis*	0.052631579	
7	*Staurastrum leptopus*	0.043859649	
8	*Campsopogan caeruleus*	0.043859649	
9	*Planktothrix raciborskii*	0.043859649	
10	*Lyngbya martensiana*	0.043859649	
11	*Phormidium ambiguum*	0.035087719	
12	*Oscillatoria laete-virens*	0.035087719	
13	*Treubaria crassispina*	0.035087719	

14	*Spiroyra prolifica*	0.035087719	
15	*Diatoma elongaum*	0.026315789	
16	*Dinobryon divergens*	0.026315789	
17	*Synedra acus var. radians*	0.01754386	
18	*Spirogyra azygospora*	0.01754386	
19	*Lyngbya truncicola*	0.00877193	
			3.806727646

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the cool-dry season. The species *Synedra affinis* had the highest proportional abundance (0.1729) and that was followed by those of *Oscillatoria laetevirens*, *Lyngbya martensiana* and *Staurastrum leptopus* (Table 1.26). The species diversity (H') index value of Chindwin River downstream site in the cool-dry season was 3.9603, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.26: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the cool-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.172932331	
2	*Oscillatoria laetevirens*	0.090225564	
3	*Lyngbya martensiana*	0.082706767	
4	*Staurastrum leptopus*	0.067669173	
5	*Dinobryon divergens*	0.060150376	
6	*Planktothrix raciborskii*	0.060150376	
7	*Oscillatoria subbrevis*	0.060150376	
8	*Spirogyra protecta*	0.052631579	
9	*Mougeotia nummuloides*	0.052631579	
10	*Lyngbya contorta*	0.052631579	
11	*Diatoma elongaum*	0.052631579	
12	*Phormidium ambiguum*	0.045112782	
13	*Spiroyra prolifica*	0.037593985	
14	Synedra acus var. angustissima	0.022556391	
15	*Treubaria crassispina*	0.022556391	
16	*Spirogyra azygospora*	0.022556391	
17	Synedra acus var. radians	0.015037594	
18	*Lyngbya truncicola*	0.015037594	
19	*Campsopogan caeruleus*	0.015037594	
			3.960285717

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the cool-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2734) and that was followed by those of Synedra acus var. radians, *Diatoma elongaum* and *Oscillatoria laetevirens* (Table 1.27). The species diversity (H') index value of Yamar Creek upstream site in the cool-dry

season was 3.7275, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.27: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.273381295	
2	Synedra acus var. radians	0.129496403	
3	*Diatoma elongaum*	0.086330935	
4	*Oscillatoria laete-virens*	0.057553957	
5	*Spiroyra prolifica*	0.050359712	
6	*Lyngbya martensiana*	0.050359712	
7	*Mougeotia nummuloides*	0.043165468	
8	*Campsopogan caeruleus*	0.035971223	
9	*Spirogyra microspora*	0.035971223	
10	*Lyngbya contorta*	0.035971223	
11	*Dinobryon divergens*	0.028776978	
12	*Spirogyra azygospora*	0.028776978	
13	*Staurastrum leptopus*	0.021582734	
14	*Spirogyra protecta*	0.021582734	
15	*Phormidium ambiguum*	0.021582734	
16	*Spirogyra cylindrospora*	0.014388489	
17	*Oscillatoria subbrevis*	0.014388489	
18	*Lyngbya truncicola*	0.014388489	
19	*Planktothrix raciborskii*	0.014388489	
20	Synedra acus var. angustissima	0.014388489	
21	*Treubaria crassispina*	0.007194245	
			3.727532631

A total of 21 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the cool-dry season. The species *Synedra affinis* was found with the highest proportional abundance (0.1503) and that was followed by those of Synedra acus var. angustissima, *Spirogyra microspora* and *Planktothrix raciborskii* (Table 1.28). The species diversity (H') index value of Yamar Creek downstream site in the cool-dry season was 3.9126, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.28: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream in the cool-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.150326797	
2	Synedra acus var. angustissima	0.137254902	
3	*Spirogyra microspora*	0.111111111	
4	*Planktothrix raciborskii*	0.08496732	

5	*Spirogyra protecta*	0.071895425	
6	*Oscillatoria laete-virens*	0.071895425	
7	*Lyngbya martensiana*	0.045751634	
8	*Rhizoclonium hieroglyphicum*	0.039215686	
9	*Spirogyra azygospora*	0.039215686	
10	*Dinobryon divergens*	0.032679739	
11	*Lyngbya contorta*	0.032679739	
12	Synedra acus var. radians	0.032679739	
13	*Spiroyra prolifica*	0.026143791	
14	*Lyngbya truncicola*	0.026143791	
15	*Diatoma elongaum*	0.019607843	
16	*Ulothrix tenerrima*	0.019607843	
17	*Phormidium ambiguum*	0.019607843	
18	*Staurastrum leptopus*	0.013071895	
19	*Spirogyra cylindrospora*	0.013071895	
20	Treubaria crassispina	0.013071895	
			3.912647388

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2424) and that was followed by those of *Synedra acus var. angustissima*, *Planktothrix raciborskii* and *Campsopogan caeruleus* (Table 1.29). The species diversity (H') index value of Chindwin River upstream site in the hot-dry season was 3.8337, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.29: Phytoplankton species and Shannon diversity index values of Chindwin River upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.242424242	
2	*Synedra acus var. angustissima*	0.106060606	
3	*Planktothrix raciborskii*	0.068181818	
4	*Campsopogan caeruleus*	0.060606061	
5	*Lyngbya contorta*	0.053030303	
6	*Spiroyra prolifica*	0.053030303	
7	*Synedra acus var. radians*	0.045454545	
8	*Spirogyra protecta*	0.045454545	
9	*Mougeotia nummuloides*	0.045454545	
10	*Lyngbya martensiana*	0.045454545	
11	*Dinobryon divergens*	0.037878788	
12	*Diatoma elongaum*	0.03030303	
13	*Spirogyra azygospora*	0.03030303	
14	*Oscillatoria subbrevis*	0.03030303	
15	*Phormidium ambiguum*	0.022727273	
16	*Oscillatoria laete-virens*	0.022727273	
17	*Staurastrum leptopus*	0.022727273	
18	*Treubaria crassispina*	0.022727273	

19	*Lyngbya truncicola*	0.015151515	
			3.83376114

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.1926) and that was followed by those of *Oscillatoria laetevirens*, *Lyngbya martensiana* and *Dinobryon divergens* (Table 1.30). The species diversity (H') index value of Chindwin River downstream site in the hot-dry season was 3.8551, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.30: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the hot-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.192592593	
2	*Oscillatoria laete-virens*	0.081481481	
3	*Lyngbya martensiana*	0.074074074	
4	*Dinobryon divergens*	0.066666667	
5	*Spirogyra protecta*	0.059259259	
6	*Staurastrum leptopus*	0.059259259	
7	*Diatoma elongaum*	0.059259259	
8	*Oscillatoria subbrevis*	0.059259259	
9	*Planktothrix raciborskii*	0.051851852	
10	*Mougeotia nummuloides*	0.044444444	
11	*Lyngbya contorta*	0.044444444	
12	*Spiroyra prolifica*	0.044444444	
13	*Treubaria crassispina*	0.02962963	
14	*Phormidium ambiguum*	0.02962963	
15	Synedra acus var. radians	0.022222222	
16	*Campsopogan caeruleus*	0.022222222	
17	Synedra acus var. angustissima	0.014814815	
18	*Spirogyra azygospora*	0.014814815	
19	*Lyngbya truncicola*	0.007407407	
			3.855076207

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.24) and that was followed by those of *Synedra acus var. angustissima*, Synedra acus var. radians and *Diatoma elongaum* (Table 1.31). The species diversity (H') index value of Yamar Creek upstream site in the hot-dry season was 3.6197, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.31: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.24	
2	Synedra acus var. angustissima	0.153333333	
3	Synedra acus var. radians	0.146666667	
4	*Diatoma elongaum*	0.086666667	
5	*Lyngbya martensiana*	0.053333333	
6	*Oscillatoria laete-virens*	0.033333333	
7	*Lyngbya contorta*	0.033333333	
8	*Campsopogan caeruleus*	0.026666667	
9	*Spirogyra microspora*	0.026666667	
10	*Planktothrix raciborskii*	0.026666667	
11	*Dinobryon divergens*	0.02	
12	*Mougeotia nummuloides*	0.02	
13	*Spirogyra azygospora*	0.02	
14	*Oscillatoria subbrevis*	0.02	
15	*Lyngbya truncicola*	0.02	
16	*Staurastrum leptopus*	0.013333333	
17	*Spirogyra protecta*	0.013333333	
18	*Spiroyra prolifica*	0.013333333	
19	*Phormidium ambiguum*	0.013333333	
20	*Treubaria crassispina*	0.013333333	
21	*Spirogyra cylindrospora*	0.006666667	
			3.619710988

A total of 20 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species Synedra acus var. angustissima was found with highest proportional abundance (0.1517) and that was followed by those of *Synedra affinis*, *Spirogyra microspora* and *Spirogyra protecta* (Table 1.32). The species diversity (H') index value of Yamar Creek downstream site in the hot-dry season was 3.9333, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.32: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	Synedra acus var. angustissima	0.151724138	
2	*Synedra affinis*	0.137931034	
3	*Spirogyra microspora*	0.103448276	
4	*Spirogyra protecta*	0.082758621	
5	*Oscillatoria laete-virens*	0.068965517	
6	*Planktothrix raciborskii*	0.068965517	
7	Synedra acus var. radians	0.048275862	
8	*Diatoma elongaum*	0.04137931	
9	*Lyngbya martensiana*	0.04137931	
10	*Staurastrum leptopus*	0.034482759	

11	*Spirogyra azygospora*	0.034482759	
12	*Dinobryon divergens*	0.027586207	
13	*Spiroyra prolifica*	0.027586207	
14	*Lyngbya contorta*	0.027586207	
15	*Spirogyra cylindrospora*	0.020689655	
16	*Lyngbya truncicola*	0.020689655	
17	Treubaria crassispina	0.020689655	
18	*Rhizoclonium hieroglyphicum*	0.013793103	
19	*Ulothrix tenerrima*	0.013793103	
20	*Phormidium ambiguum*	0.013793103	
			3.933271116

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.2984) and that was followed by those of *Diatoma elongaum*, *Synedra acus var. angustissima, Phormidium ambiguum* and *Synedra acus var. radians* (Table 1.33). The species diversity (H') index value of Chindwin River upstream site in the wet season was 3.6479, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.33: Phytoplankton species and Shannon diversity index values of Chindwin River upstream area in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.298387097	
2	*Diatoma elongaum*	0.088709677	
3	*Synedra acus var. angustissima*	0.072580645	
4	*Phormidium ambiguum*	0.064516129	
5	*Synedra acus var. radians*	0.064516129	
6	Oscillatoria laete-virens	0.056451613	
7	*Spirogyra azygospora*	0.048387097	
8	*Staurastrum leptopus*	0.040322581	
9	*Lyngbya contorta*	0.040322581	
10	*Campsopogan caeruleus*	0.032258065	
11	*Lyngbya truncicola*	0.032258065	
12	*Treubaria crassispina*	0.032258065	
13	*Dinobryon divergens*	0.024193548	
14	*Spirogyra protecta*	0.024193548	
15	*Planktothrix raciborskii*	0.024193548	
16	*Mougeotia nummuloides*	0.016129032	
17	*Spiroyra prolifica*	0.016129032	
18	*Lyngbya martensiana*	0.016129032	
19	Oscillatoria subbrevis	0.008064516	
			3.647921712

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.1926) and that was followed by those of *Spirogyra protecta*, Synedra acus var. angustissima and Synedra

acus var. radians (Table 1.34). The species diversity (H') index value of Chindwin River downstream site in the wet season was 3.9082, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.34: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the wet season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.192592593	
2	*Spirogyra protecta*	0.081481481	
3	*Synedra acus* var. angustissima	0.081481481	
4	*Synedra acus* var. radians	0.074074074	
5	*Mougeotia nummuloides*	0.066666667	
6	*Dinobryon divergens*	0.059259259	
7	*Oscillatoria laete-virens*	0.059259259	
8	*Treubaria crassispina*	0.059259259	
9	*Lyngbya contorta*	0.051851852	
10	*Staurastrum leptopus*	0.044444444	
11	*Spirogyra azygospora*	0.044444444	
12	*Lyngbya truncicola*	0.044444444	
13	*Spiroyra prolifica*	0.02962963	
14	*Planktothrix raciborskii*	0.02962963	
15	*Campsopogan caeruleus*	0.022222222	
16	*Phormidium ambiguum*	0.022222222	
17	*Diatoma elongaum*	0.014814815	
18	*Oscillatoria subbrevis*	0.014814815	
19	*Lyngbya martensiana*	0.007407407	
			3.90823694

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.2727) and that was followed by those of *Synedra acus var. angustissima*, Synedra acus var. radians and *Diatoma elongaum* (Table 1.35). The species diversity (H') index value of Yamar Creek upstream site in the wet season was 3.4086, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.35: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream area in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.272727273	
2	Synedra acus var. angustissima	0.204545455	
3	Synedra acus var. radians	0.136363636	
4	*Diatoma elongaum*	0.068181818	
5	*Oscillatoria subbrevis*	0.039772727	
6	*Spiroyra prolifica*	0.034090909	
7	*Planktothrix raciborskii*	0.034090909	
8	*Mougeotia nummuloides*	0.022727273	

9	*Oscillatoria laete-virens*	0.022727273	
10	*Lyngbya contorta*	0.022727273	
11	*Campsopogan caeruleus*	0.017045455	
12	*Spirogyra microspora*	0.017045455	
13	*Lyngbya martensiana*	0.017045455	
14	*Treubaria crassispina*	0.017045455	
15	*Dinobryon divergens*	0.011363636	
16	*Staurastrum leptopus*	0.011363636	
17	*Spirogyra cylindrospora*	0.011363636	
18	*Spirogyra azygospora*	0.011363636	
19	*Lyngbya truncicola*	0.011363636	
20	*Phormidium ambiguum*	0.011363636	
21	*Spirogyra protecta*	0.005681818	
			3.408609263

A total of 20 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.1317) and that was followed by those of Synedra acus var. angustissima, *Spirogyra protecta* and *Treubaria crassispina* (Table 1.36). The species diversity (H') index value of Yamar Creek downstream site in the wet season was 3.9504, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.36: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream site in the wet season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.131736527	
2	Synedra acus var. angustissima	0.125748503	
3	*Spirogyra protecta*	0.089820359	
4	Treubaria crassispina	0.089820359	
5	*Spirogyra microspora*	0.071856287	
6	*Planktothrix raciborskii*	0.071856287	
7	Oscillatoria laete-virens	0.065868263	
8	Synedra acus var. radians	0.053892216	
9	*Diatoma elongaum*	0.041916168	
10	*Staurastrum leptopus*	0.041916168	
11	*Spiroyra prolifica*	0.041916168	
12	*Rhizoclonium hieroglyphicum*	0.035928144	
13	*Spirogyra cylindrospora*	0.02994012	
14	*Lyngbya martensiana*	0.02994012	
15	*Dinobryon divergens*	0.017964072	
16	*Ulothrix tenerrima*	0.017964072	
17	*Spirogyra azygospora*	0.011976048	
18	*Lyngbya truncicola*	0.011976048	
19	*Lyngbya contorta*	0.011976048	
20	*Phormidium ambiguum*	0.005988024	
			3.95036096

APPENDIX 2 – TERMS OF REFERENCE FOR AQUATIC SURVEYS

APPENDIX F

Baseline Study – Socio Economic

Prepared by EMC

Knight Piésold
CONSULTING

Socio-Economic Aspects of the Letpadaung copper mining project

General aspect

The villages that are closed to the project site were studied for their socio-economic status and to get their opinions towards the project. Almost all of the studied villages are from potential project affected areas. Most of the villages which are more closed to the project site are small in household number and population size (Table 1). The data were recorded based on the information given by the Heads of the villages, which may vary from the secondary data. A total of 215 interviewees from 15 villages were used in the interview survey. Out of the total interviewees, 90 are males and 125 are females.

Table 1 Household numbers of the potentially project affected villages

No.	Village	Township	Distric	No. HH	Population
1	Phaung Kar (N)	Sarlingyi	Monywa	200	1200
2	Taung Pa Lu	Sarlingyi	Monywa	170	867
3	Kyaw Ywa	Sarlingyi	Monywa	110	650
4	Wet Hmae	Sarlingyi	Monywa	52	250
5	Kan Taw	Sarlingyi	Monywa	97	582
6	Wet Hmae (New)	Sarlingyi	Monywa	62	350
7	Sel Tal	Sarlingyi	Monywa	30	180
8	Zee Taw (New)	Sarlingyi	Monywa	67	350
9	Phaung Kar (Mid)	Sarlingyi	Monywa	157	628
10	Phaung Kar (S)	Sarlingyi	Monywa	67	450
11	Moe Gyo Pyin (S)	Sarlingyi	Monywa	160	700
12	Moe Gyo Pyin (Mid)	Sarlingyi	Monywa	110	550
13	Doon Taw	Sarlingyi	Monywa	325	1600
14	Kan Kone	Sarlingyi	Monywa	3881	656
15	Hta Naung Kone	Sarlingyi	Monywa	575	115
	Total			6063	9128

Majority of the people in the project area are farmers (43%) (Fig.1) and followed by waged labor and others. Most of the waged laborers are noted as seasonal workers employed during the cultivation seasons of rice, sesame, beams and peas. Some of the waged laborers work in other sectors operated in Monywa city. Two per cent of the respondents are found as government staff.

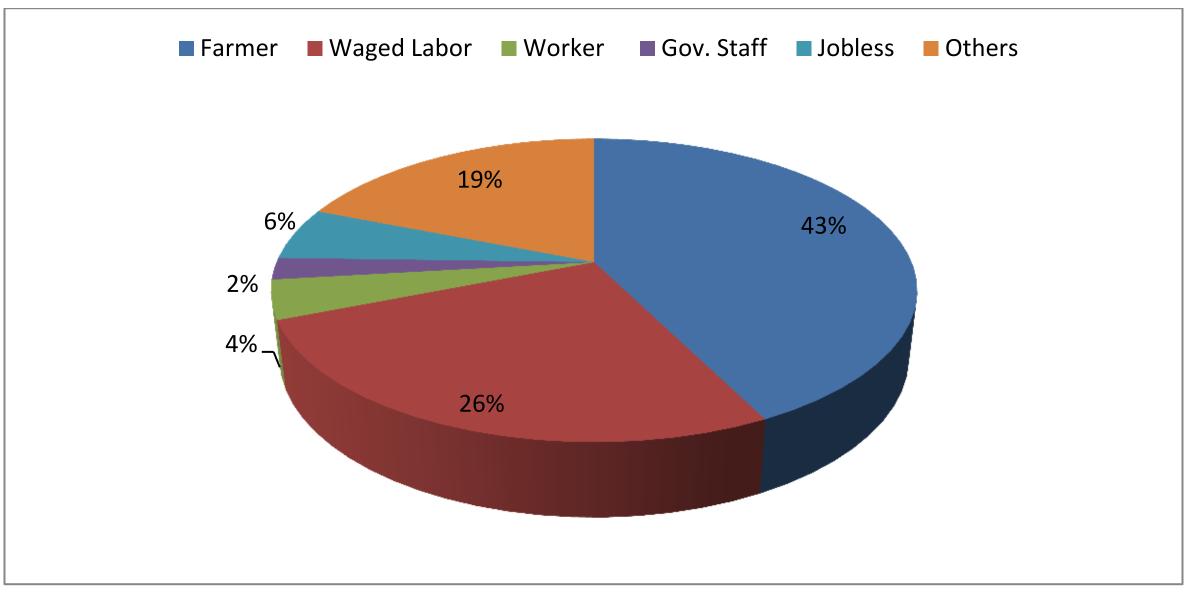

Fig. 1 proportions of occupation among the respondents

Level of Education

Level of education is an important factor for the community in all aspects like improvement of livelihood, health, sanitation, conceptual thinking and personal behavior etc.. Based on the interview survey, 5 categories can be as education levels; Illiterate, Primary and monastic school level, Middle school level, High school level and graduate levels. The results showed that 71.6 per cent of the total respondents had primary or Monastic school level education, 11.6 per cent is high school level, 9.8 per cent is middle school level, and 1.9 per cent is illiterate (Fig.2). Among the respondents, 5.1 per cent are found as graduates from different Universities.

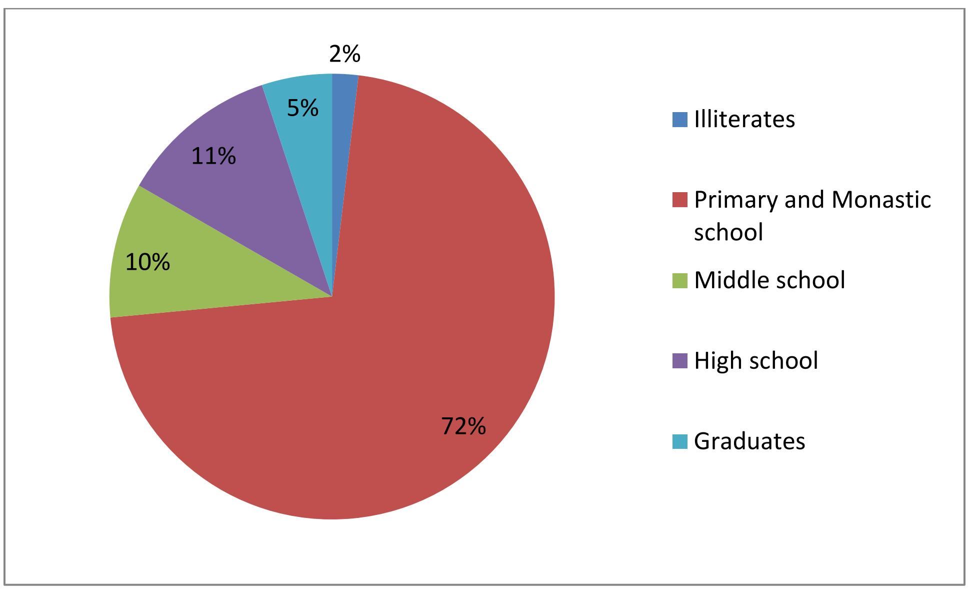

Fig.2 Education levels of the respondents

Health problems and Treatment

In the studied community, most people suffer from hypertension and second most is general sickness due to bacterial infection and gastro-intestinal diseases because of the limited knowledge in health and poor sanitation facilities. Some villages have rural health clinic which are opened in weekly basis. Most of the sickness recorded from the health assistance and

midwifes are common cold, cough, headache, and dizziness. Pregnant women and children are also paid attention by the mobile government health service team. Eighty percent of the respondents also said that medical mobile team from Yantse and Wanpaung projects also visit the villages to give necessary assistance for health (Fig 3). Most villagers mainly depend on the private drug store and private health clinic to solve their health problems. If they suffer serious illness, they are admitted to Monywa hospital or private clinics located in Monywa city. Sometimes the villagers visit the Township Hospital located in Mine Town of the Yantse copper mine project, which was established since the time of Government-Yugoslav joint mining project.

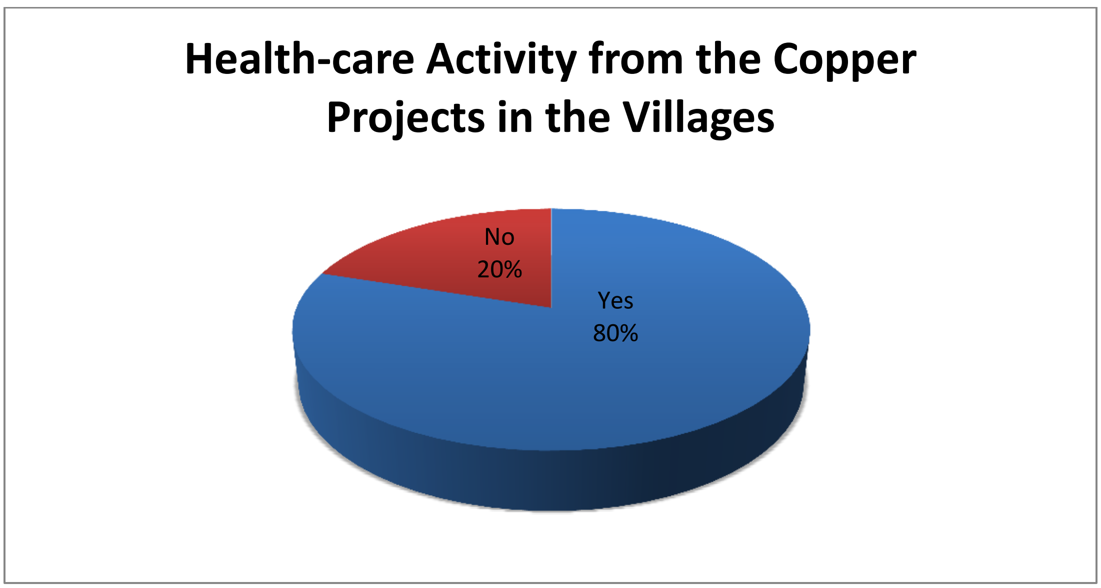

Fig. 3 Health-care activity from the copper projects, Yantse and Wanpaung

Solid waste and waste water system

In the nearby project area, solid waste management is not focused by the people due to inadequate knowledge. The villages have not access to the improved sanitation facilities. Only a few numbers of the houses have fly-proof toilet system showing the lack of improved sanitation system within the community.

Drinking water system

Source of the water and drinking water systems is mainly from the rain-fed weir/dam and shallow wells (Fig.4). A few numbers of tube-well are also observed in some villages. Some villages like Phaunga, and Mogyobyin depend on rain water which is kept in Phaunga weir and sub-earthen pond near the villages. There are three weirs at southern part of the project site, which keep the rain water during wet season and the kept rain water is used both for cultivation and for daily usage of the villagers.

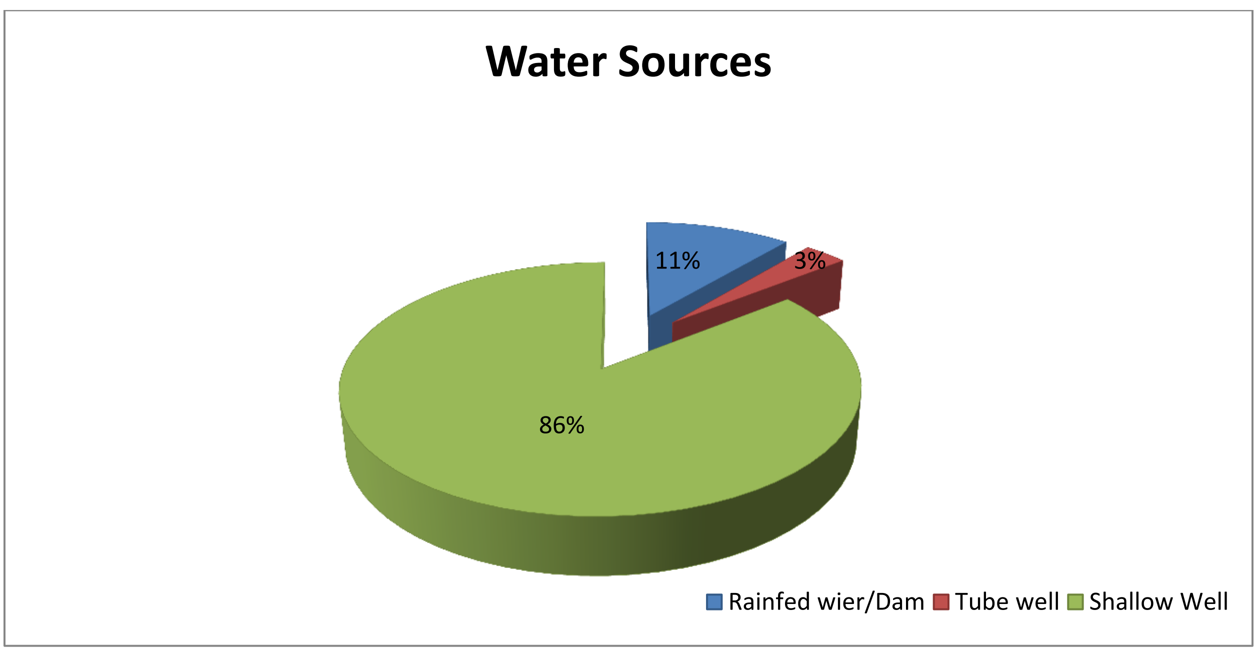

Fig.4 Used water sources of the community

Ethnicity and Religion

Most of the villagers in the community are Bamar, and thay all believe in Theravada Buddhism. At least a Monastery is established in every village. A meditation center exists near the project site and one historical temple and monastery exist within the Letpadaung project site. Tradition and culture of the community are closely related to the Buddhism and the attitude and concept on the current life are based on the religion and education level of the people.

Basic Infrastructure and Social Facilities

Taungbalu, Kyawywar and some villages have access to electricity in the area, but some villages like Moegyobyin have no access to electricity. Although there is an access to electricity, some households cannot afford to use the electricity due to the constraint of their insufficient income. Around 11 per cent of the households have own shallow wells, which is used for general house work and for drinking. But most of the shallow wells have water shortage in hot dry season. Some shallow wells of the villages, e.g Taungbalu village, which are closed to the Letpadaung project site cannot provide good quality water because the aquifer may be connected to the underground mineral sources of the Letpadaung hills. In this case the villagers use the water from the tube-wells which exist closely to the seasonal flooded lake and the tube well has relatively large depth in meters.

Resources in the project area

The important natural resources that people utilize are mainly from the Letpadaung hills, which provide fuel wood, and vegetables from natural vegetation, medicinal plants and herbs and grass as cattle feed. During wet season, some families generate the income by seasonal fisheries. Some villagers also hunt the small animal like Myanmar hare at the Letpadaung hills. Bamboo

shoots, mushroom and some medicinal herbs form the Letpadaung hills are collected by the villagers for their consumption and also for the local market to generate family income.

Existing Socio-Economic Conditions

The villages located closed to the Letpadaung copper project were focused in the interview survey. The people from these villages are project affected people (PAPs), which have also right to give their view, opinion, and comments on the project since major development project like copper mining project has to perform in sustainable manner balancing the economy, environment and social security.

To understand their existing situation, attitudes and opinion towards the project are examined by interview survey and using questionnaires. The questionnaires cover the basic information, economy, education, occupation, perception and health.

Basic information

Almost all of the people from the surveyed villages are Bamar nationality. They speak Myanmar language as mother language and Buddhism is their religion in the whole community. The household has relatively large family size, varied from 4 to 9 persons. More than half of them are within an average of 4-6 size. The ratio of males to females shows the female bias ratio.

A total of 131 respondents are in the age group of over 40 years while the rest of them are under 40 years of age. The youngest respondent is 17 and the oldest respondents are over 70 of age. As the ages of the respondents varied, the education levels were also in different levels.

In terms of education, most of the interviewees finished primary school and monastic education. A few numbers of the people have higher education level and very few number of the people are illiterates.

Housing condition

Types of house are 1-storey house constructed with mixed bamboo and palm leaves (House/Home Type 1), 2-storey house constructed with wood and roofed with GI sheets (House/Home Type 2) and 2-storey house constructed with brick and wood and roofed with GI sheets (House/Home Type 3) (Fig. 5), where the house yards are different even in a single village. Average house size is 20’x50’, 30’x60’ and 40’x60’. Most of their houses are constructed by wood, bamboo and palm leaves. A few numbers of houses are constructed using brick. Banana, mangoes, papaya, lemon and guava trees are normally grown in the yards.

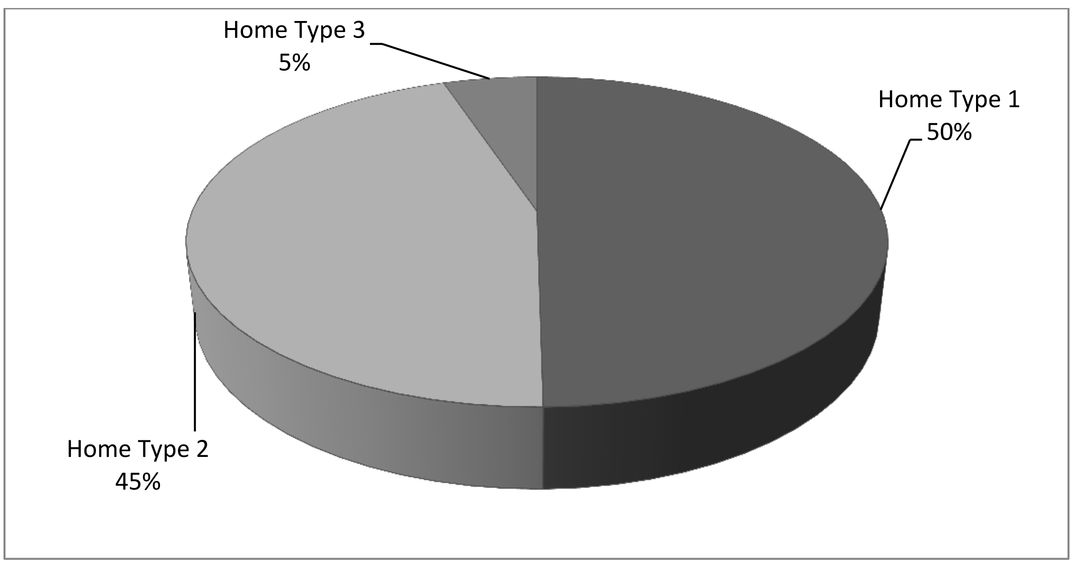

Fig. 5 Proportions of the three different house types

Most of the respondents said they have drinking water problem in the community. Water shortage problem mainly occurs in hot dry season. More than 90 to 99 percent of the households of the villages have toilets, but only 80 per cent of the toilets are improved or fly-proof toilets. Most of the families own bicycles, motorcycles, and almost all families have radio units.

Economic conditions of the household

Occupation and sources of income

Most of the villagers are relying on the agriculture; where most of the agricultural lands are lost due to the copper mine project because most of the lands are located around the Letpadaung copper mining project. The sizes of agricultural lands of the locals are different in size normally from 0.5 to 4 hectares. Cultivated crops include rice, sesame, peas, beams, sunflower, and vegetable like cabbage and chili.

Economic conditions

Agriculture is major concern of the main occupation of the people living around the project site and in all project affected villages. Some villages have livestock breeding like goats and sheep. The range of total annual income is about 12-30 lakh kyats per household (one lakh=100,000 kyats) (Fig. 8), while the average expenses are nearly the same as the income rate, which shows their poverty and living status. An average land holding size is 0.5-4 hectares per farmer.

Beside cultivation, the people work for daily wages in various sectors in the area, which also include agriculture. Some people raise the cattle like cows, sheep and goats. Cattle are also used in land preparation of the farms. For family consumption, some families breed chickens, and pigs.

In wet season, some villagers earn their living harvesting the fishes in the flooded areas of the Chindwin River and in some creeks like Yama and other small creeks. A few numbers of the peoples are found as government workers and some are employed by the Yantse copper mining project and Wanpaung copper mining project (Fig. 1).

Income Level

Income level is different from place to place and from village to village (Fig. 6). Findings of the interview survey show that monthly income of respondents ranges from 1-3 lakhs of kyats in the studied villages (Fig. 7).

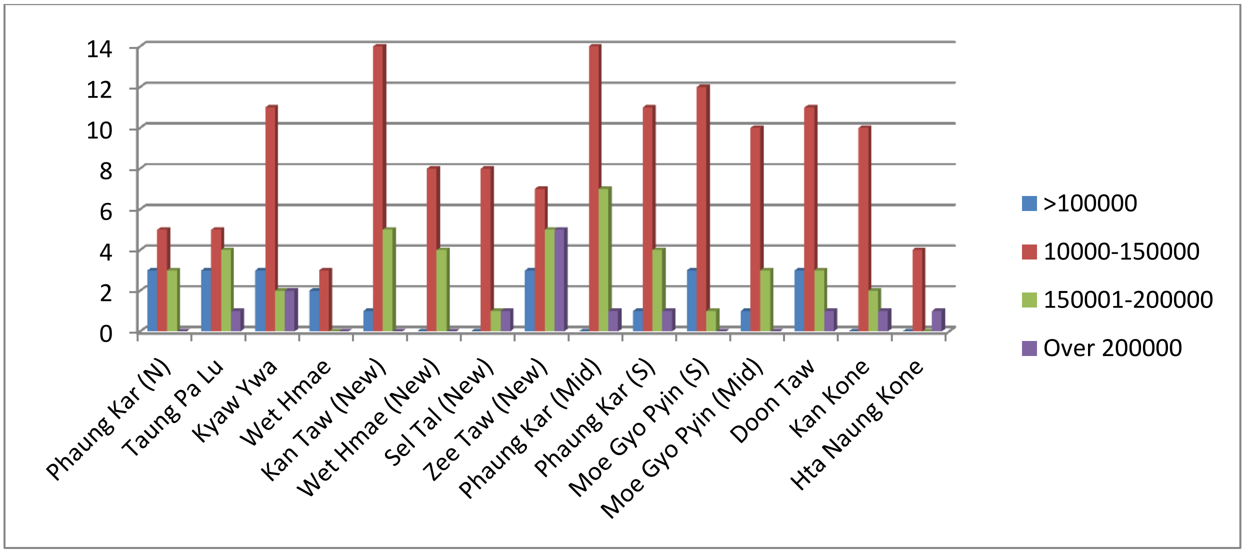

Fig.6 Monthly income levels of the surveyed villages

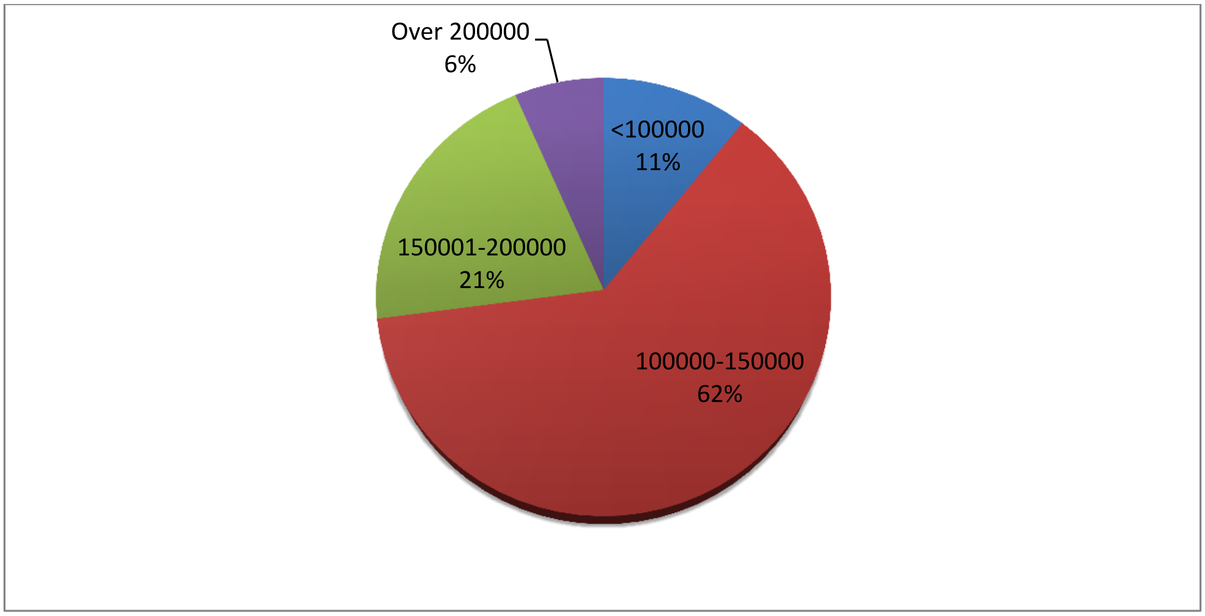

Fig.7 Proportions of groups of monthly income ranges

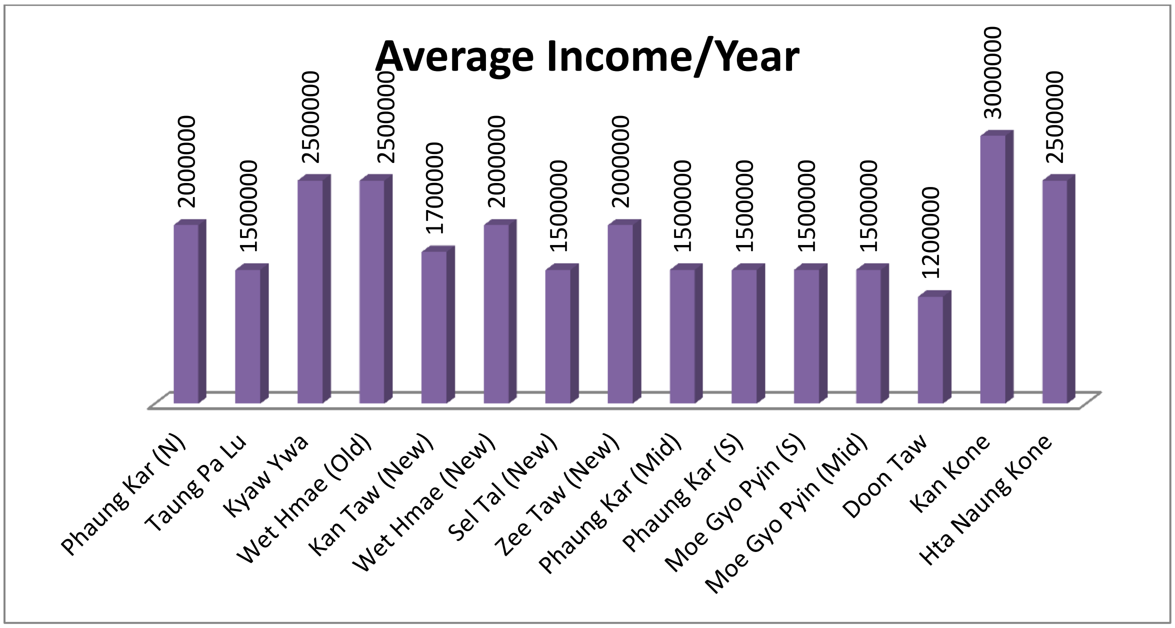

Fig.8 Annual income levels of the surveyed villages

Expenditure

Almost all respondents said that their incomes are not adequate for the livelihood of the families and they are living with many constraints in daily life.

Sufficiency of Income

They use almost all of their monthly income and some families have to borrow the money in some cases like in health problems. Therefore some people are living in debt waiting the better job opportunity.

Satisfaction with existing living conditions

Most of the people said that they have to be satisfied with the present conditions although they are trying to improve the livelihood and infrastructure as their best. But they are worried with the unforeseen adverse impacts of the Letpadaung copper mining project.

Opinions towards the project development

Fifty two per cent of the people from the surveyed villages, particularly from the villages which are closed to the project site, do not like the project because they are worried on the adverse impacts of the project related to soil contamination, air pollution and noise and dust problems (Fig.9). The villagers from Kyawywa village make complaint on the dust problems; they said the wind carry the dusts from Letpadaung mining site to Kyawywa. The farmers, who lost their land due to the copper mining project, seriously disagree with the copper mining project. The villagers, who live in village which is relatively far from Letpadaung copper mining project like Htanaunggone village, said that they have no comments and would like to stay in neutral line. Forty six per cent of the respondents stay in neutral line (Fig. 9). Some families of the surveyed villages rely on the Letpadaung hill because they collect the vegetables and medicinal plants and send to the markets for their family incomes; they also collect the bamboo shoots, mushrooms and other edible herbs for family consumption. These factors are also why they don’t like the copper mining project, which give indirect negative impacts on their families.

The common opinion on the Letpadaung copper mining project is that if the project has to be anyway constructed and operated, they expect the jobs from the project and if available jobs are not adequate for the locals, government and Wanpaung company should create other possible job opportunities for the locals, and Chinese workers should be replaced with Myanmar people. The villagers are also worried from the likely shortage of water sources in the long term operation of the copper mining project, and wish government and the Wanpaung to take precaution measures for the social security of the community.

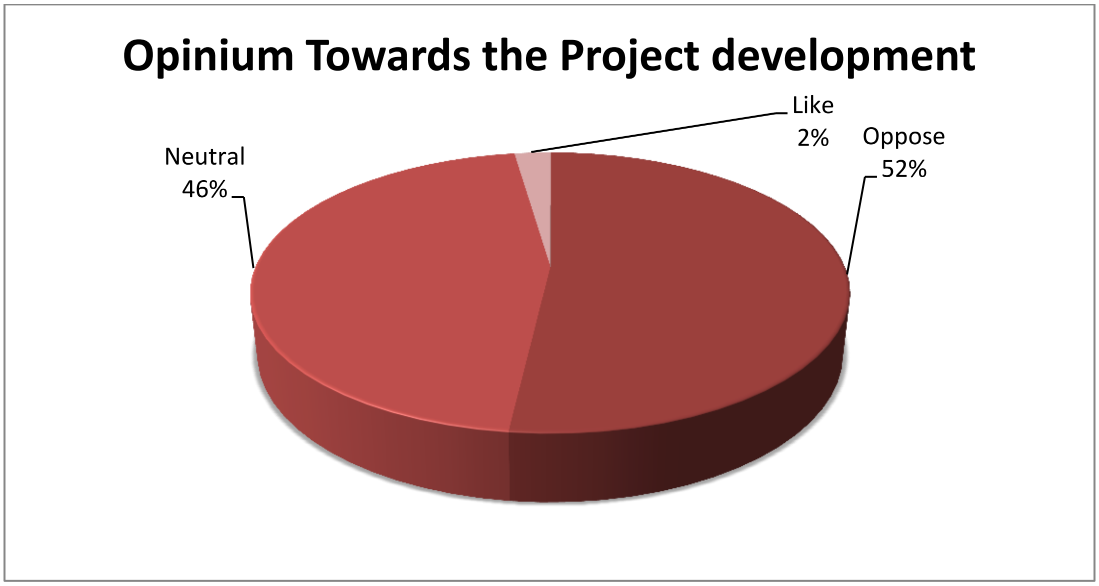

Fig. 8 Proportions of the respondents showing their opinion towards the project

Recommendation and Mitigation measures

The findings reveal possible problems of direct and indirect impacts on the community of the Letpadaung project. Direct impacts are concerned with the loss of farmland, potential noise, dust and air pollution problems. Revegetation plan should be undertaken to establish the buffer zone to prevent the impacts like noise and dust. Soil and water conservation are also important issues among the local people. Long-term plan should be drawn for the access to improved water within the community.

Indirect impacts are concerned with natural resources available from Letpadaung hills, which play important role for the livelihood of some local families, who extract the vegetables, medicinal plants and other edible herbs for family consumption and also family income. More job opportunity should be created for these families. Effective Coporate Social Responsibility (CSR) programme should be extended in the community.

To compensate the loss of natural vegetation of Letpadaung hills and to conserve the ground water, nearby watershed areas and watershed hills like Khamauk-taung, Kyadwin-taung, Hninsi-taung, Phowun-taung and other hill rages should be managed by revegetation.

APPENDIX G

Socio Economic Survey Data Sheets

To be provided by EMC

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APPENDIX H

Health Table

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Appendix H Table 1: Disease prevalence in the villages near the Project area (number or presentations in para).

Village Tract	Village Name	Viral Infections	Hypertension	Arthritis	Gastric Diseases	Skin complaints	Respiratory Diseases	Vitamin Deficiency	Eye Diseases	Dental Diseases	Female Issues
Moe Gyoe Pyin	Moe Gyoe Pyin No	7.5 (48)	13.8 (88)	7.4 (47)	3.4 (22)	3.4 (22)	2.0 (13)	1.4 (9)	0.78 (5)	0.78 (5)	0.78 (5)
	Moe Gyoe Pyin So	1.4 (10)	4.1 (29)	1.1 (8)	2.1 (15)	0.86 (6)	1.0 (7)	2.9 (20)	1.1 (8)	0.0 (0)	0.14 (1)
	War Dan	41.5 (263)	15.8 (100)	10.4 (66)	16.1 (102)	7.6 (48)	5.7 (36)	4.7 (30)	1.6 (10)	4.4 (28)	2.5 (16)
	Phaung Kar No	15.8 (99)	20.1 (126)	15.1 (95)	5.4 (34)	5.3 (33)	1.6 (10)	5.1 (32)	3.2 (20)	1.9 (12)	1.1 (7)
	Phaung Kar Ce	7.1 (85)	2.3 (27)	3.1 (37)	2.8 (33)	1.5 (18)	1.1 (13)	0.33 (4)	1.7 (20)	1.6 (19)	0.33 (4)
	Phaung Kar So	1.3 (6)	4.2 (19)	2.2 (10)	0.44 (2)	0.0 (0)	1.1 (5)	2.0 (9)	0.89 (4)	0.0 (0)	0.44 (2)
Doon Taw	Doon Taw	30.9 (495)	6.6 (105)	7.9 (122)	6.3 (100)	6.1 (98)	6.1 (98)	2.3 (36)	1.6 (26)	1.4 (23)	10.0 (16)
	Ywar Thar Ywar	82.8 (318)	19.0 (73)	25.3 (97)	18.8 (72)	15.1 (58)	7.3 (28)	7.6 (29)	4.9 (19)	8.1 (31)	5.2 (20)
Shwe Pan Khaing	Shwe Pan Khaing	14.0 (118)	16.8 (142)	7.8 (66)	5.1 (43)	3.6 (30)	3.7 (31)	3.8 (32)	3.3 (28)	1.8 (15)	2.1 (18)
	Tal Pin Kan	32.3 (140)	27.9 (121)	16.2 (70)	18.5 (80)	9.7 (42)	8.1 (35)	5.3 (23)	6.7 (29)	4.4 (19)	6.2 (27)
	The' Taw Gyi	8.7 (32)	26.1 (96)	10.1 (37)	6.5 (24)	6.0 (22)	2.2 (8)	3.0 (11)	2.7 (10)	1.6 (6)	3.0 (11)
Taung Palu	Taung Palu	15.5 (134)	7.2 (62)	3.2 (28)	5.8 (50)	1.6 (14)	5.2 (45)	1.4 (12)	1.0 (9)	1.4 (12)	1.6 (16)

Village Tract	Village Name	Viral Infections	Hypertension	Arthritis	Gastric Diseases	Skin complaints	Respiratory Diseases	Vitamin Deficiency	Eye Diseases	Dental Diseases	Female Issues
	Kyaw Ywar	3.8 (25)	4.0 (26)	1.1 (7)	2.0 (13)	0.92 (6)	0.77 (5)	0.31 (2)	0.46 (3)	1.2 (8)	0.15 (1)
Paung Ga Da	Phaung Kadar S.	9.6 (93)	10.8 (104)	9.1 (88)	5.8 (56)	2.5 (24)	2.8 (27)	1.9 (18)	3.1 (30)	1.5 (14)	1.1 (11)
	Kyaut Phyu Dine	2.9 (16)	10.1 (55)	1.8 (10)	3.5 (19)	2.0 (11)	0.9 (5)	1.5 (8)	1.1 (6)	0.37 (2)	0.91 (5)
	Zee Taw & Sei Te'	4.3 (23)	5.3 (28)	2.6 (14)	5.3 (28)	1.9 (10)	1.5 (8)	2.8 (15)	1.5 (8)	1.7 (9)	0.0 (0)
Latpataung	Shwe Hlay	15.4 (41)	12.1 (32)	10.6 (28)	4.9 (13)	17.0 (45)	7.5 (20)	3.4 (9)	3.0 (8)	1.1 (3)	0.75 (2)
Ywar Shwe	Ywar Shay	4.2 (61)	8.1 (117)	4.6 (66)	1.9 (28)	1.0 (15)	0.55 (8)	0.55 (8)	1.0 (14)	0.55 (8)	0.75 (11)
	Palaung	7.9 (76)	9.2 (88)	6.4 (61)	2.6 (25)	3.7 (35)	1.3 (12)	2.0 (19)	2.2 (21)	1.4 (13)	0.31 (3)
	Wet Hmay	7.4 (26)	4.6 (16)	0.57 (2)	0.57 (2)	0.0 (0)	3.4 (12)	0.57 (2)	2.0 (7)	0.0 (0)	0.57 (2)
	Kan Daw	1.7 (10)	4.0 (23)	1.5 (9)	0.69 (4)	1.0 (6)	2.7 (16)	1.0 (6)	0.5 (3)	0.69 (4)	0.0 (0)
Ton	Lei Ti	0.71 (4)	1.6 (9)	1.8 (10)	0.5 (3)	0.89 (5)	0.36 (2)	0.36 (2)	0.5 (3)	0.0 (0)	0.18 (1)
Nyaung Pin Gyi	Nyaung Pin Gyi	4.7 (73)	8.1 (125)	3.9 (60)	1.0 (16)	1.3 (20)	0.9 (14)	0.7 (11)	1.0 (16)	0.59 (9)	0.45 (7)
	Yone Pin Yoe	3.4 (25)	4.1 (30)	4.3 (31)	1.5 (11)	0.55 (4)	0.55 (4)	0.55 (4)	0.55 (4)	0.41 (3)	2.5 (16)
	Aung Chan See	3.7 (25)	10.3 (69)	3.9 (26)	0.15 (1)	0.15 (1)	1.2 (8)	0.0 (0)	0.75 (5)	0.45 (3)	0.30 (2)

APPENDIX I

Preliminary Waste Dump Design

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT

WASTE ROCK DUMPS PRELIMINARY DESIGN

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

Knight Piésold
CONSULTING
www.knightpiesold.com

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MYANMAR WANBAO MINING COPPER LTD (MWMCL)

LETPADAUNG COPPER PROJECT

WASTE ROCK DUMPS

PRELIMINARY DESIGN

KP Job No. PE701-00022/04

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EXECUTIVE SUMMARY

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake preliminary design of the above-surface waste rock dumps for the proposed Letpadaung Copper Project. The Letpadaung Copper Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

Knight Piésold (KP) conducted a review of the waste rock dump development plan proposed by MWMCL, while considering the acid generating potential of the rock mass to estimate the potential for acid rock drainage and metal leaching from the dumps. Specific aspects addressed in this report include the following:

- Site characteristics including setting, climate and seismicity;
- Geotechnical conditions at the waste dumps;
- Waste characterization methodology and results;
- Principals of surface and storm water management, including rock drains, diversion channels, water collection and sediment control measures;
- Layout and design features of the waste dumps, including the incorporation of PAF waste within the dumps;
- Waste dump stability;
- Operation and monitoring considerations;
- Reclamation and closure.

Note that this report only considers the above-ground disposal of waste rock. In-pit disposal is addressed separately by MWMCL.

The main conclusions of the work are:

i. Geotechnical conditions in the proposed waste dump areas are poorly understood due to a lack of site investigation. Preliminary stability analyses

using available data have not shown any significant issues under static loading conditions, but further investigation is needed to confirm design assumptions.

ii. Simplified pseudostatic analyses show that stability during Operational Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE) seismic events is marginal. These loading cases need to be analysed in more detail using more advance methodologies such as FLAC or PLAXIS software.

iii. Data on the physical and geochemical properties of the waste are limited and further investigation of the open pit area is needed to confirm design assumptions.

iv. The available data suggest a significant acid-generating and metal leaching potential for a large proportion of the waste that will be produced. The PAF and metal leaching waste will need to be encapsulated during operations with intermediate and final engineered covers comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The final encapsulation material will need to be covered by a store and release cover constructed from benign waste or borrow material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the low permeability cover.

v. The data collected to date on composition of waste suggests a high proportion of PAF and metal leaching and a small quantity of NAF will be generated. This may result in a shortfall of materials for encapsulation of wastes and for construction of the closure cover system. A materials balance based on up-to-date site investigation is urgently needed as materials may need to be borrowed from the footprints of the heap leach pads and/or the waste rock dumps prior to construction.

vi. There are some uncertainties regarding the ability to store the total amount of waste within the footprints currently designated when the recommendations of this report are considered and a more appropriate bulk density is adopted for waste dump design. Optimisation of storage volumes and necessary footprint areas is urgently needed.

vii. Assessments suggest the current design profile of 1V:2.5H local slopes and 1V:2.9H slopes will be geotechnically stable but that consideration needs to be given to flattening these slopes in order to reduce overall life of mine costs as

construction of the cover system and rehabilitation costs will increase significantly for local slopes steeper than 1V:3H.

The waste dump design now needs to be progressed to detailed design. In order to achieve this we make the following recommendations:

i. Undertake site investigations in the WRD foundation areas to assess geotechnical properties.

ii. Update the stability analyses with the new data and undertake a more detailed analysis of performance under SEE loading conditions using FLAC or PLAXIS software.

iii. Undertake site investigations around the site to identify construction material resources and prepare a materials balance for the site.

iv. Additional geochemical assessment should be conducted to better quantify the amount of potentially acid-generating and/or metal-leaching material which will be encountered during the first year(s) of operations to allow detailed waste management planning.

v. Undertake kinetic testing of waste rock samples to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.

vi. Agreement on the final land use of the WRD areas after closure to facilitate construction of the dumps consistent with the agreed end land use to reduce closure costs.

vii. Complete an optimisation of the WRD design that incorporates encapsulation of PAF and metal leaching waste, addresses issues with final land use, appropriate slope angles and potential construction materials shortfall, and provides a suitable footprint layout within the site constraints.

1. INTRODUCTION

1.1 LOCATION AND PROJECT DESCRIPTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake preliminary design of the above-surface waste rock dumps for the proposed Letpadaung Copper Project. The Letpadaung Copper Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit; and
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

1.2 SCOPE

The overall site general arrangement plan, including locations, footprints and volumetric determinations of the proposed waste rock dumps, has been prepared by MWMCL. The preliminary layout for the dumps is shown on Figure 1.1.

Knight Piésold (KP) conducted a review of the waste rock dump development plan proposed by MWMCL, while considering the acid generating potential of the rock mass to estimate the potential for acid rock drainage and metal leaching from the dumps. Specific aspects addressed in this report include the following:

- Site characteristics including setting, climate and seismicity;
- Geotechnical conditions at the waste dumps;
- Waste characterisation methodology and results;
- Principles of surface and storm water management, including rock drains, diversion channels, water collection and sediment control measures;
- Layout and design features of the waste dumps, including the incorporation of PAF waste within the dumps;
- Waste dump stability;
- Operation and monitoring considerations; and

- Reclamation and closure.

As a preliminary design, this report considers the main design principles to address physical and chemical stability and makes recommendations for further work considered necessary to complete a detailed design. Incorporation of these design features into the overall waste dump design with optimisation for stored volume is the responsibility of MWMCL.

Note that this report only considers the above-ground disposal of waste rock. In-pit disposal is addressed separately by MWMCL.

2. SITE CONDITIONS

2.1 CLIMATE

2.1.1 General

A complete baseline design climatology study (KP Ref. PE13-00538, included as Appendix A) was conducted prior to the preparation of this report in order to define the preliminary hydrologic basis for on-going and future design work. The following sub-sections outline key results from this previously released document. For additional details, please refer to Appendix A.

2.1.2 Data Sources

Four different sources of historic climate data were used to derive baseline design climate estimates:

- Daily historic data spanning the period (1961-2013) from the Monywa Township climate station, located 5.6 km northeast of Letpadaung Hill, was employed for deriving precipitation estimates;
- Monthly historic pan evaporation data spanning the period (2000-2013) from the Yangtse climate station, located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kysintaung (S&K) operations site was employed for deriving evaporation estimates;
- Daily temperature data spanning the period (1981-2012) from the World Meteorological Organization (WMO) climate station number 48037, located 4.7 km northeast of Letpadaung Hill was used for determining temperature normal; and
- Hourly wind speed, wind direction and precipitation data spanning the period (2010-2012) derived from the MM5 (5^{th} generation Mesoscale Model) and SAMSON hourly surface meteorological datasets at a sampling location 0.9 km northwest of Letpadaung Hill was used for characterisation of prevailing wind normals and in developing precipitation temporal distributions.

2.1.3 Precipitation

The historic precipitation dataset was aggregated on annual and monthly time scales and used to compute sampling statistics to define normal precipitation patterns at Letpadaung Hill. The resulting normal pattern of monthly precipitation is presented in Table 2.1.

Table 2.1: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0
Feb	3	0	15	0	102	0
Mar	5	1	14	0	96	1
Apr	26	21	22	0	100	4
May	102	94	70	12	386	9
Jun	100	72	79	0	342	9
Jul	67	59	43	2	182	8
Aug	121	103	80	0	356	10
Sep	166	150	89	47	496	11
Oct	142	136	95	15	513	10
Nov	33	12	44	0	186	3
Dec	6	0	17	0	85	1

*1 Incomplete data from 1995 (Jan – Jun), 1999 (Jan – Apr) and 2013 (Jun – Dec) were excluded from this analysis.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for six months, from May through the end of October. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

Intensity / Frequency / Duration (IDF) relationships were determined from the dataset. The results are provided in Table 2.2.

Table 2.2: Letpadaung intensity / frequency / duration results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16
18 h	5	6	7	8	9	10	10	11
24 h	4	5	6	6	7	8	8	9
48 h	2	3	3	4	5	5	6	6
72 h	2	2	3	3	4	4	5	6

2.1.4 Evaporation

The historic evaporation dataset was aggregated on annual and monthly time scales and used to compute sampling statistics. The resulting normal pattern of monthly evaporation is presented in Table 2.3.

Table 2.3: Monthly pan evaporation statistics – MYTCL climate station (2000-2006)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)
Jan	123	121	5	119	134
Feb	149	151	13	130	166
Mar	210	213	14	188	224
Apr	228	236	21	191	248
May	202	205	43	118	256
Jun	203	187	36	165	270
Jul	172	174	12	153	187
Aug	184	175	38	133	248
Sep	160	150	27	128	208
Oct	145	148	27	102	184
Nov	125	130	17	102	146
Dec	117	112	12	98	131

Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to calculated annual average pan evaporation (2,017 mm).

2.1.5 Comparison of Precipitation and Evaporation

Average monthly values of precipitation and pan evaporation were compared to determine if the site is expected to run under annual water surplus or deficit conditions. The comparison is provided in Table 2.4.

Table 2.4: Comparison of monthly average precipitation and evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake[*1] Evaporation (mm)	Precip. minus Pan Evap. (mm)
Jan	2	123	86	-121
Feb	3	149	105	-146
Mar	5	210	147	-205
Apr	26	228	160	-202
May	102	202	142	-100
Jun	100	203	142	-103
Jul	67	172	121	-105
Aug	121	184	129	-63
Sep	166	160	112	6
Oct	142	145	101	-3
Nov	33	125	87	-92
Dec	6	117	82	-111
Totals	773	2,017	1,412	-1,344

*1 Assumed pan coefficient = 0.7.

As Table 2.4 clearly shows, the Letpadaung site is expected to run a strong water deficit on average. The only month where a positive balance is indicated is September.

2.1.6 Temperature

The historic temperature dataset was aggregated on annual and monthly time scales and used to compute sampling statistics. The resulting normal pattern of monthly average temperature is provided in Table 2.5.

Table 2.5: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month	Average (°C)	Median (°C)	Std. Dev. (°C)	Min. (°C)	Max. (°C)
Jan	21.9	21.9	1.9	18.4	28.0
Feb	24.0	23.6	2.3	21.1	32.9
Mar	28.1	28.0	2.3	23.1	35.5
Apr	30.9	30.9	1.4	25.9	33.1
May	31.0	31.0	1.4	28.1	33.8
Jun	30.6	30.5	1.1	27.8	32.9
Jul	30.5	30.8	1.2	26.8	32.5
Aug	29.9	29.8	1.0	28.4	32.1
Sep	29.3	29.3	0.7	27.8	30.4
Oct	28.0	28.0	0.7	26.5	29.8
Nov	25.1	25.3	1.1	23.0	27.6
Dec	22.2	22.0	1.9	18.4	28.0

2.1.7 Wind

The wind speed and direction dataset was analysed statistically using WindRose Pro 3.01 software to produce a series of wind rose plots for the Letpadaung site.

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average speed of 3.0 m/s, with a maximum speed of 9.2 m/s. These correspond to Beaufort scale readings of 2 "light breeze" to 5 "fresh breeze". The direction the wind blows from tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available data indicates that high wind storms are unlikely at the Letpadaung site.

Seasonal variability was also considered. The dataset was divided into the Wet (May through October) and Dry (November through April) Seasons. During the Wet Season, winds generally blow along the North / South cardinal directions, with the preponderance of statistical data suggesting that winds blow from the South (180°) to South by Southeast (157.5°). In the Dry Season, the wind blows predominantly from the North (0°) to North by Northwest (337.5°).

2.2 SURFACE WATER

2.2.1 Water Source

The Chindwin River lies approximately 3 km east of the Letpadaung deposit, with a maximum flow rate of 24,850 m^3/s and an average flow rate of 3,860 m^3/s. The river depth ranges from 1.5 to 10.25 m with an average depth over the year of 5 m. The 20-year flood water level is RL75.1 m and 100-year flood water level is RL75.65 m.

2.2.2 Water Quality

Water quality in the Chindwin River changes over the course of the year. Table 2.6 presents a series of water quality indicators monitored during various months over the year 2000.

Table 2.6: Water quality monitoring data – Chindwin River (Muir, 1997)

Month	Temp. (°C)	Total Dissolved Solids (mg/l)	Total Suspended Solids (mg/l)	Total Hardness (mg/l)	Dissolved Oxygen (mg/l)	$CaCO_3$ (mg/l)	Sulphate (mg/l)	Ca (mg/l)	Mg (mg/l)
Feb	22.6	146.7	70	90	3.8	107.4	9.2	18.5	10.7
May	34.5	186	11.9	93	-	113	4.8	18.5	11.3
Jun	29	399	1,438	-	4.2	51.6	6.0	21	-
Aug	30.6	98	404	58	3.5	43	2.0	11.6	7
Nov	28.4	79	528	43	3.3	57	10	10.3	4.2
Dec	21	117	190	85	4.6	90	2.4	19.1	9

The results indicate that the indices are generally stable (except water turbidity which increases markedly in the rainy season) and meet the surface water standard of class IV water[1], and as such can be used for common industrial purposes.

2.3 GEOLOGY

The Project comprises four copper deposits distributed in a north-west direction among which Sabetaung, Sabetaung South and Kyisintaung are located in close proximity to one another. The Letpadaung deposit is located 7 km to the southeast of the Sabetaung deposit, and is the largest one of the four deposits (Figure 2.1).

The Project is located along an Inner Volcanic Arc within the Central Myanmar Subsidence Belt in Late Tertiary pyroclastics and late stage andesite dacite on the western flood plain of the Chindwin River. The deposits are high sulphidation copper deposits formed by weathering, leaching and supergene enrichment of porphyry copper ores. Mineralisation is hosted by dykes and sills of porphyritic biotite andesite and minor dacite, by minor rhyolite dykes and by the folded Upper Pegu Group. The predominant copper sulphides are chalcocite, and digenite with subordinate covellite invariably accompanied by pyrite. Mineralization extends downwards from the base of oxidation to a depth which locally exceeds 540 m at Letpadaung. The Letpadaung deposit is overlain by a barren leached cap that is locally 200 m thick and forms hills rising to 185 to 249 m above the plain[2].

[1] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.
[2] Mitchell. A.H.G.. Win Myint, Kyi Lynn, Yint Thein Htay, Maw oo, and Thein Zaw (2008) The Monywas Copper Deposits, Myanmar: Chalccite-covellite Veins and Breccia Dykes in Late Miocene Epithermal System. Proceedings of the International Symposia on Geoscience Resources and Environments of Asian Terranes (GREST 2008), 4th IGCP 516, and 5th APSEG: Nov 24-26 2008, Bangkok, Thailand.

At the Letpadaung deposit there are numerous faults predominantly striking northeast and northwest (Figure 2.2). Mineralisation and hydrothermal alteration is significantly controlled by faulting[3]. The main faults are the Chindwin Basic Fault (F1), the Monastery Fault (F2), and secondary interconnecting faults f1, f2, f3 and f4. The Monastery Fault (F1) bounds the north eastern margin of the Letpadaung deposit and is the main ore-controlling structure. The Monastery Fault (F2) runs sub parallel to the Chindwin Basic Fault (F1) about 1.3 km to the southwest. The faults have the same hanging wall and footwall lithology with no obvious fracture zones but some sections show signs of compression fractures with significant hydrothermal alteration.

2.4 HYDROGEOLOGY AND GROUNDWATER QUALITY

2.4.1 Pre-Mining

Proposed Waste Rock Dumps 1, 2 and 3 will be located on the Chindwin River alluvial plain. The Quaternary alluvial deposits form an aquifer that is in hydraulic contact with the Chindwin River. The aquifer comprises river alluvium of medium to fine sand, sand gravel and clay. The upper part is clay, with a thickness of 4 to 6 m; the lower part is a medium to fine sand, sand gravel and cobble gravel, with a thickness of 12.1 to 50.1 m (25.7 m on average). It has high permeability and aquifer storage properties. The permeability ranges between 18.4 m/d and 43.6 m/d, with an average of 23.6 m/d (i.e. very high permeability). On the alluvial plain the depth to groundwater in the dry season ranges between 0.65 m to 19.12 m, with an average of 4.86 m. If it is continuous the upper clay layer may protect the aquifer from contamination, otherwise the shallow depth to groundwater may make it vulnerable to contamination.

Groundwater level data given in MWMCL (2011)[4] have been combined with baseline monitoring data from monitor bores installed around the heap leach pads to generate indicative groundwater level contours. The groundwater contours indicate pre-mining groundwater flow radiating out from the Letpadaung Hill and broadly from the southwest towards the north-east and the Chindwin River. The groundwater flow direction indicates that prior to mining groundwater is providing base flow to the Chindwin River.

MWMCL summarised the pre-mining surface water and groundwater quality as follows:

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[3] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

[4] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

- Surface Water: (Chindwin River): Water chemistry type: HCO_3-Na-Mg; salinity: about 500 mg/L; total hardness: about 160 mg/L; total alkalinity: 300 mg/L; pH: about 8;
- Quaternary Aquifer: Water chemistry type: $HCO_3 \cdot SO_4 \cdot Cl$—Ca·Mg·Na; salinity: 390 to 2,350 mg/L; total hardness: 150 to 940 mg/L; total alkalinity: 590 to 780 mg/L; pH: 7.2 to 7.4; and
- Andesite-Dacite Rock Fissure Weak Aquifer: Water chemistry type $HCO_3 \cdot SO_4 \cdot Cl$- Ca·Na·Mg; salinity: 960 to 1,878 mg/L; total hardness: 340 to 421 mg/L; total alkalinity: 20 to 144 mg/L; pH: 3.30 to 8.30. Trace metals (As, Cr, Cu, Fe and Mn) occur at higher than guideline values.

Groundwater in the alluvium is shown by Coffey[5] to contain brackish to saline (2,600 to 2,700 mg/L TDS), pH neutral, NaCl dominated water near to the mine site and is said to contain fresher water close to the Chindwin River and in association with the floodway. A sharp increase in salinity after pumping at bore LWB01 located at the foot of Letpadaung hill is consistent with a fresh water layer or lens over saline water with the freshwater lens being depleted by pumping.

Coffey also indicate the presence of strontium within the alluvium and volcanics at concentrations of between 1 and 3 mg/L.

Baseline groundwater chemistry for December 2011 (end of wet season) and February 2013 (end of dry season) collected from monitor bores around the proposed Heap Leach Pads 1 and 2 are summarised as follows:

- The groundwater samples are neutral to slightly basic ranging between pH 6.9 and 8.7 with an average value of 7.8;
- Total dissolved solids (TDS) concentrations range between fresh to saline, 1,016 mg/L to 19,386 mg/L TDS with an average value of 4,368 mg/L TDS; and
- TDS, hardness, sulphate, lead and manganese values occur above the guideline values.

In summary, the baseline groundwater chemistry beneath the Waste Rock Dumps is likely to be saline, slightly alkaline and may contain heavy metals and possibly strontium above guideline values.

[5] Letpadaung Copper Project Feasibility Study – Water Management and Environmental Monitoring, Coffey Partners Int. Pty Ltd, Report G7024/4-A, dated February 1997.

2.4.2 Operational Phase

If continuous, the upper Quaternary clay layer may hydraulically isolate and protect the aquifer from contaminated seepage emanating from the waste rock dumps; otherwise the shallow depth to groundwater may make it vulnerable to contamination.

Mining below the groundwater table will result in a localised steepening and reversal of the groundwater flow direction towards the Letpadaung pit. Based on the current pit design the main eastern ramp will intersect the high permeability Quaternary alluvium which will result in higher groundwater inflows to the pit and a steepening and reversal of the groundwater flow direction towards the pit that will extend under the south of Waste Rock Dump 1, Waste Rock Dump 2 and Waste Rock Dump 3. It is possible that not all groundwater flowing beneath the waste rock dumps will be captured by the pit dewatering operation and that some groundwater may continue to flow northeast towards the Chindwin River. The villages of Nyaungbingyi, Gadogone and Palaung to the east of the Letpadaung deposit may have water bores/wells and are potentially at risk from changes in groundwater quality that may result from the seepage from the waste rock dumps.

2.4.3 Post Mine Closure

Following mine closure the dewatering system will be decommissioned and the Letpadaung Pit will be allowed to fill from direct rainfall, runoff from pit walls, groundwater inflows, and surface water inflows from the upslope catchment areas which will include potentially contaminated contact water from the waste rock dumps.

The pit lake water is likely be brackish to saline water affected by acid rock drainage resulting in low pH and high dissolved metals (Fe and Cu) concentrations; and the accumulation of metals and salts in the water due to evaporation. Water quality from Sabetaung Pit bore (GW050) was shown by Coffey[6] to be low pH (pH 3.2) of moderately high salinity (TDS 4,050 mg/L) and very high copper concentrations (550 mg/L). The main hydraulic contact between the pit and the regional groundwater flow is likely to be where the pit cuts the alluvium at the eastern pit wall/ramp area. Pit in flows and lake levels are likely to be strongly influenced by inflows from the alluvium in the eastern wall. Whilst the pit lake will act as a groundwater sink as a result of evaporation it is possible that not all groundwater flowing beneath the waste rock dumps will be captured by the pit and that some groundwater may flow northeast towards the Chindwin River.

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[6] Coffey, 1997. Letpadaung Copper Project Feasibility Study – Water Management and Environmental Monitoring. Report G7024/4-A, dated February 1997.

2.5 SEISMICITY

The project area is located in an earthquake active area. A search of the USGS database earthquake lists 406 earthquakes that have been recorded between 1973 and 2013, within 200 km of the Letpadaung site including one M7.0 and M6.8, and 44 events at magnitudes between M5.0 and M5.9. The most recent earthquake was a M4.7 event that occurred on the 20th July 2013, about 70 km south-west from Letpadaung. The closest earthquakes in proximity of the site were a M4.0 event that occurred approximately 3.6 km from the site and a M4.1 that was approximately 9.1 km of the site.

A seismic hazard assessment has been undertaken. Existing seismic and tectonic information and historical data, including earthquake catalogues and technical publications have been collected and reviewed. Preliminary seismic ground motion parameters for the project area have also been determined.

The computer program EZ-FRISK was used to develop a seismic hazard model for Letpadaung. The seismic hazard analysis module available with EZ-FRISK includes a database provided by Risk Engineering Inc. of faults and areal seismic sources pertinent to the study area.

Seismic sources defined in the hazard model include Sagaing Fault, which is the closest fault located approximately 96 km east of Letpadaung. The Sagaing Fault is an active strike-slip fault that separates the Burma plate extending west of the Sagaing Fault to the Bay of Bengal and the Shan-Thai block that contains the Eastern Highlands Belt extending east. Other faults and areal seismic sources defined in the EZ-FRISK seismic source zone and within 500 km of Letpadaung are listed in Table 2.7.

Table 2.7: EZ-FRISK seismic source zones

Source	Deterministic distance (km)	Fault Magnitude	Mechanism	Site Lies to
Sagaing SE	95.88	7.6	Strike-Slip	West
Kabaw SE	105.57	7.75	Strike-Slip	East
Arakan Trench Arakan Trench	325.66 331.2	7.25 7.5	Reverse Strike-Slip	North North-East
Myanmar Margin	372.98	6.75	Strike-Slip	North-West
Mae Saraing	393.28	6.8	Strike-Slip	North-West
Mae Chan	495.73	7.3	Strike-Slip	North-West

For shallow crustal earthquakes a set of five ground motion attenuation models, known as the Next Generation Attenuation (NGA) relations were used (Earthquake Spectra, 2008). These include the ground motion relationships of Abrahamson and Silva, Boore and Atkinson, Campbell and Bozorgnia, Chiou and Youngs These ground motion attenuation relationships are applicable to shallow crustal earthquakes in western North American and similar tectonic regions of the world. The reported peak ground accelerations for shallow crustal earthquakes are average values calculated using the four attenuation relationships (equal weighting). Appropriate NGA attenuation relationships for normal faulting have been used in the probabilistic and deterministic analyses.

Table 2.8 lists the annual return periods for several events, probability of exceedance depending on anticipated mine life, and peak ground accelerations for the Letpadaung Copper Project based on the NGA relations.

Table 2.8: Summary of probabilistic hazard analysis

Return Period (Years)	Probability of Exceedance (%)				Median Peak Ground Acceleration (PGA)
	Design Life = 10 years	Design Life = 15 years	Design Life = 20 years	Design Life = 25 years	
50	18	26	33	39	0.027
100	10	14	18	22	0.043
200	4.9	7	10	12	0.059
500	1.98	3.0	4	5	0.083
1000	1.0	1.5	2	2	0.101
2500	0.40	0.60	1	1	0.124
5000	0.20	0.30	0	0	0.145
10000	0.10	0.15	0.2	0	0.170
20000	0.05	0.07	0.1	0.1	0.199

3. GEOTECHNICAL CONDITIONS

Geotechnical investigation in the areas of the proposed waste dumps is very limited and it is recommended that further investigation and laboratory tests be undertaken in advance of any further design development.

From the available information it is determined that Waste Rock Dumps 1, 2 and 3 overlie Quaternary alluvial deposits that comprise top organic soil, fill, clay silty sand, gravelly sand. The upper part is silty clay with sand, with a thickness of 0.3 to 9.5 m; the lower part is a medium to fine sand, sandy gravel and cobble gravel, with a thickness of 0.4 m to 23.45 m. MWMCL[7] groundwater investigation hole LS007 located adjacent to the south western corner of Waste Rock Dump 1 encountered alluvium to 25 m over highly weathered base rock with a groundwater level of at 2.2 m below ground level (mbgl). Borehole LS008 located adjacent to the north western corner of Waste Rock Dump 1 encountered alluvium to 13 m over highly weathered base rock with a groundwater level of at 5.2 mbgl. The average ground water level in Waste Rock Dump 1 area is about 2.83 mbgl. The upper Quaternary clay layer has the potential to form a low permeability base and hydraulically isolate and protect the alluvial sands and gravels aquifer from contaminated seepage emanating from the waste rock dumps.

[7] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

4. WASTE CHARACTERISATION

4.1 GENERAL

An assessment of the likely geochemistry of the waste was undertaken previously as is reported in KP Report PE701-00077/16. A copy of that report is included in Appendix B. The following sections present a summary of the findings and implications for design.

Physical characterisation of the waste is taken from the Nerin Basic Design Report[8].

4.2 BACKGROUND

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for the study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

4.3 GEOCHEMICAL ANALYSIS RESULTS

The concentration of sulfur in the waste rock was elevated, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

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[8] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Three types of waste rock will need to be managed during the mine life. These are:

i. PAF (with or without high leachable metal concentrations)

ii. NAF with high leachable metals

iii. NAF with low leachable metals.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

4.4 IMPLICATIONS FOR DESIGN AND OPERATION

The geo-chemical characteristics of the waste rock should be considered an extreme risk to the integrity of the natural environment around the Project site. The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas;
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps;
- Full encapsulation of all waste with a suitable compacted soil liner;
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material; and
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height; and
- Installation of interim covers.

4.5 PHYSICAL CHARACTERISTICS

To date there has been no testing of mine waste samples to determine physical characteristics so engineering parameters can only be inferred from field observations and inspection of core from a few representative boreholes. The degree of weathering, and hence material strength and grading vary with depth.

A shear strength of the waste rock of 2.01 t/m^3 has been provided by Myanmar Wanbao Mining Copper Limited (MWMCL). It is our opinion that this value seems on the upper bound based our past experience on adjacent and similar sites. However, for stability analysis, this represents the worst case scenario and it was adopted for the analysis. The shear strength parameters for the waste rock were assumed based on typical values obtained in the literature such as Breitenbach[9] and Leps[10]. As seen, it is stress dependent, decreasing with the increase of overburden pressure, which is more realistic to reflect the waste rock shearing behaviour in such high embankments than a single constant value. The basic geotechnical parameters for waste rock are listed in Table 4.1.

Table 4.1: Geotechnical parameters for waste rock

Average bulk density (t/m^3)	Cohesion c' (kPa)	Angle of friction Φ' (°)
2.01	0	Φ = 42° to 32° for σ'n = 100 to 3000 kPa

[9] Breitenback, A.J., AB Engineering Inc., Littleton, Colorado, USA, *"Improvement in Slope Stability Performance of Lined Heap Leach Pads from Design to Operation and Closure"*, 2004.

[10] Leps, T.M., Journal of the Soil Mechanics and Foundations Division, Proceeding of the American Society of Civil Engineers, *"Review of Shearing Strength of Rockfill"*,. 1970.

5. DESIGN BASIS

5.1 GENERAL

The principal objective of the waste dump design is to provide waste rock storage while ensuring protection of the environment during operations and post closure. The waste dump design has taken the following requirements into account:

- Permanent and secure storage of all waste rock within engineered facilities;
- Waste dump placement and development scheduling to minimize equipment requirements, achieve stable slopes at closure and reduce closure measures;
- Control of drainage and runoff from the waste dumps during operations to the maximum practical extent;
- Collection of sediment from the waste dumps to the maximum practical extent;
- Treatment (if required) and discharge of excess drainage and runoff from the waste dumps; and
- Monitoring for all aspects of the waste dumps to the maximum practical extent to ensure performance goals are achieved and design objectives are met.

Construction will be scheduled to ensure that there is always sufficient waste rock storage capacity available. The designs provide flow and drainage control measures to safely pass the design storm event to the environment during both operations and at closure.

5.2 GENERAL DESIGN STANDARDS

For the design of the waste rock dumps, the Chinese Code for Waste Dump Design of Nonferrous Metal Mines[11] was adopted as the minimum standard. Reference was also made to international guidelines and standards in order to ensure that good practice is considered in all aspects of the design. The guidance included:

- Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007;
- Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009;
- British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia;

[11] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

- Environment Australia (1998). Best practice Environmental Management in Mining – Landform Design for Rehabilitation;
- Australian Government, Department of Industry, Tourism and Resources (October 2006). Mine Rehabilitation;
- Australian Government, Department of Industry, Tourism and Resources (February 2007). Managing Acid and Metalliferous Drainage;
- Hollingsworth ID (2010). Mine Landform Design Using Natural Analogues. Ph.D. thesis submitted to the Faculty of Agriculture, Food and Natural Resources, University of Sydney;
- IFC (July 2004). IFC Environmental, Health and Safety Guidelines for Precious Metal Mining (Draft); and
- IFC (December 2007). IFC Environmental, Health and Safety Guidelines for Mining.

For project-specific input data such as mine waste tonnages, the China Nerin Engineering (June 2011) Basic Design Report was used as the main source of information.

5.3 HAZARD ASSESSMENT

The principal failure mechanism considered was global slope instability leading to movement of waste outside of the waste dump footprint. A preliminary assessment was made of the potential impact of this on:

- Population (Mine staff and local population);
- Infrastructure (Mine and public); and
- Environment.

The main impacts could be as follows:

<u>WRD 1</u>

i. Population at risk who live around the mine site perimeter in towns, villages or isolated settlements.
ii. Instability of open pit wall placing workers at risk and affecting mining operations.
iii. Debris deposited in the river/canal potentially blocking flows.
iv. Debris deposited on public road.

v. Damage to Waste Water Storage Reservoir (North) potentially allowing release of contaminated water to the environment.

vi. Damage to the site flood protection bund.

vii. Damage to site access roads and surface water management infrastructure

WRD 2

i. Population at risk who live around the mine site perimeter in towns, villages or isolated settlements.

ii. Debris deposited on public road.

iii. Damage to site access roads and surface water management infrastructure.

WRD 3

i. Instability of open pit wall placing workers at risk and affecting mining operations.

ii. Damage to Waste Water Storage Reservoirs potentially allowing release of contaminated water to the environment.

iii. Damage to site access roads and surface water management infrastructure.

iv. Risk to explosives storage area.

Failure of a waste rock dump would place population at risk, affect private and public infrastructure as well as potentially causing environmental damage if debris reaches watercourses. As such, the design of the dumps should provide for adequate factors of safety for stability under operating and closure conditions as well as provide for appropriate offset distances from critical locations such as houses, rivers or public infrastructure.

Waste rock dumps in excess of 10 Mm^3 in volume are classified as a design Grade I[12].

5.4 DESIGN CRITERIA

The Waste Rock Dump design criteria are summarised in Table 5.1.

For seismic design criteria it was assumed that the minimum offset distances, as listed in Table 5.1, would be adopted in order to reduce the risk to and impact on population and infrastructure in the event of waste dump instability. The Operational Basis Earthquake (OBE) was selected as a 100 year ARI event as instability during the mine

[12] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

operation would impact the waste dumps but presents a low risk to population or infrastructure due to the significant offset distances. Damage could be easily repaired through earthworks operations to restabilise the slopes. The Safety Evaluation Earthquake (SEE) is used to assess longer-term stability which includes post-closure when population and/or infrastructure may be placed closer to the WRDs and therefore a 10,000 year ARI event was selected.

Table 5.1: Waste rock dump design criteria

Item	Criteria	Source
Mine Production	Mine Life – 31 years Ore – 954 Mt Waste – 946 Mt	Nerin[13]
Waste Rock Production	WRD 1 – 335 Mt (Yr 1 to 20) WRD 2 – 195 Mt (Yr 1 to 20) WRD 3 – 157 Mt (Yr 7 to 20) Total Above Ground – 687 Mt	MWMCL
Design Grade	For WRD >10 Mm^3 in volume – Grade I	NSPRC[14]
WRD Offset Distances	The minimum offset distances from the WRD toe shall be: • Public infrastructure including railways, roads and rivers – 1.0 to 1.5 x WRD height • Mine infrastructure – 0.75 x WRD height • Open Pit – 30 m or greater as determined by pit stability assessment. • Residential areas, towns and industrial sites - >2.0 x WRD height	NSPRC NSPRC NSPRC NSPRC
Static Stability	The minimum factors of safety to be as follows: • Local Slope (Operations) – 1.0 • Local Slope (Closure) – 1.3 • Global Stability (Operations) – 1.3 • Global Stability (Closure) – 1.5	KP assessed KP assessed KP assessed KP assessed
Seismic Stability	Operations – 1.3 for 1 in 100 yr ARI = 0.04g Closure – 1.1 for SEE = 0.17g	KP assessed KP assessed
Hydraulic Design	Surface water management systems (Operations) – 25 yr ARI event. Surface water management systems (Closure) – 100 yr ARI event.	NSPRC KP assessed

[13] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.
[14] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

6. WASTE ROCK DUMP STABILITY

6.1 GENERAL

Stability of the WRDs was assessed for three main criteria namely:

1. Static stability.
2. Stability under seismic loading.
3. Long-term stability of the rehabilitated surface against soil loss.

6.2 GROUND MODEL AND DESIGN PARAMETERS

As available geotechnical information for the waste dump stability analysis is very limited. The sub soil profiles of the three waste dumps were assumed based on the geotechnical investigation report completed by Southwest Nonferrous Kunming Design Institute (西南有色昆明勘测设计院) in 2012[15]. The report indicates that the subsurface materials are very variable. For the stability analyses, assumed average subsurface material profiles are as follows:

- 7 m of silty clay / clayey silt overlying;
- 23 m of silty sand with clay overlying;
- 20 m of residual soil/extremely weathered rock overlying;
- Highly to moderately weathered rock.

The average ground water depth of 2.83 m was adopted for WRD 1 and average ground water depth of 6.65 m was used for WRD 2 and 3.

Based on Standard Penetration Test (SPT) values and descriptions in the geotechnical report, the average subsurface material shear strength parameters were assessed and are summarised Table 6.1. The density and shear strength of waste rock are discussed in Section 4.5.

[15] Southwest Nonferrous Kunming Design Institute (西南有色昆明勘测设计院) (2012) “Geotechnical and geohydrological investigation report for proposed waste dumps and embankments at Letpadaung Copper Mine”, Myanmar.

Table 6.1: Estimated geotechnical design parameters for waste rock dump analysis

Material	γ (kN/m^3)	c' (kPa)	Φ' (°)	Undrained shear strength
Waste Rock	20.0	Φ = 42° to 32° for σ'$_n$ = 100 to 3000 kPa		
Silty clay / clayey silt	19.3	10	28	Minimum 75kPa ,0.30σ'_v
Silty sand with clay	20.8	3	32	
Sand	21.0	3	33	

6.3 WASTE DUMP GEOMETRY

The current design for operations provided by MWMCL is that waste rock dumps will be constructed as a series of lifts with 5.4 m wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 22° and overall angles of 19°. Waste dump geometry used in the analyses is summarised in Table 6.2.

Table 6.2: Waste dump geometry

	WRD1	WRD2	WRD3
Total height(m)	150	75	125
Bench slope angle	22°	22°	22°
Overall slope angle	19°	19°	19°
Bench width (m)	5.4	5.4	5.4

6.4 STATIC AND SEISMIC STABILITY

"SLOPE/W", developed by GEO-SLOPE International Ltd. in Canada[16], was used for the stability analysis. It is a limit equilibrium program based on the rigid-plastic theory for material shearing behaviour. The slope stability analysis was performed using the modified Morgenstern-Price method.

Seismic stability analyses were completed using a pseudo-static method. This is a simplified seismic analysis that represents the effects of an earthquake event by applying constant horizontal and/or vertical accelerations on the potential sliding mass. The accelerations are associated with a design earthquake and expressed as seismic coefficients. The pseudo-static assessment presented herein uses the Hynes-Griffin and Franklin formulation[17]. In addition to the seismic coefficient detailed above, the

[16] GEO-SLOPE International Ltd., *"SLOPE/W"*, 2007.
[17] Hynes-Griffin, M. E. and Franklin, A. G., Department of the Army Waterways Experiment Station, Corps of Engineers, *"Rationalizing the Seismic Coefficient Method"*, July 1984.

formulation utilises reduction of undrained shear strength to 80% of the static shear strength values.

The following seismic parameters were selected:

- Operating Base Earthquake (OBE) (100 year ARI event): pga = 0.04g; and
- Standard Evaluation Earthquake (SEE) (10,000 year ARI event): pga = 0.17g.

Both local and global stability were assessed for WRD1, WRD2 and WRD3 embankment under static and seismic loading conditions. A summary of stability analysis for all WRD's are presented in Table 6.3. A detailed report of the stability assessment is provided in Appendix C.

Table 6.3: Stability assessment results for all waste rock dump embankments

Embankment	Loading Condition	Failure Mode	Factor of Safety
WRD1	Static	Global	2.0
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.3
		Local (upper part)	1.9
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.6
WRD2	Static	Global	2.2
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.3
		Local (upper part)	1.7
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.4
WRD3	Static	Global	2.1
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.4
		Local (upper part)	1.9
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.6

The assessment results indicate that the factors of safety for static loading cases meet the minimum stability requirement as discussed in Section 5.4.

For the seismic assessment, the analyses suggest that the stability is marginal during OBE and SEE events where factors of safety of 1.2 and 1.0 were determined respectively. The pseudo-static analysis method is generally considered to be a conservative approach for stability analysis and it is likely that slopes will be stable but this needs to be confirmed by analysis with more sophisticated approaches, such as FLAC or PLAXIS software, in the next design stage.

6.5 SOIL EROSION ASSESSMENT

6.5.1 Methodology

The methodology employed for estimating long-term soil erosion rates is the Revised Universal Soil Loss Equation (RUSLE) as originally derived by Renard et. al[18] and subsequently adapted for conditions on the Australian continent[19]. There is no specific adaptation for Myanmar. Consideration was given to the prevailing climates in Australian and Myanmar in terms of total precipitation and annual rainfall distribution and it was considered that the climates were sufficiently similar to apply the adapted method for this preliminary assessment of soil loss.

RUSLE takes the form of a simple linear equation:

$$Y_J = R_J \cdot K \cdot L \cdot S \cdot C_J \cdot P$$

where:

Y_J = average soil loss rate for a given month (t / (ha·mo));

R_J = rainfall erosivity factor for a given month ((MJ·mm) / (ha·h·mo));

K = soil erodibility factor ((t·ha·h) / (ha·MJ·mm));

L = slope length factor (dimensionless);

S = slope steepness factor (dimensionless);

C_J = ground cover factor for a given month (dimensionless);

P = conservation practice factor (dimensionless); and

J = currently selected month (Jan = 1, Feb = 2 … Dec = 12).

[18] Renard, K.G. et al. *“Predicting Soil Erosion by Water – A Guide to Conservation Planning with the Revised Universal Soil Loss Equation RUSLE”*, U.S. Department of Agriculture, 2010. Washington, DC. USA.

[19] CSIRO Land and Water. *“Prediction of Sheet and Rill Erosion Over the Australian Continent, Incorporating Monthly Soil Loss Distribution”,* CSIRO Technical Report 13/01, 2001. Canberra, Australia

It was assumed that the topsoil properties were as follows:

- P_{125} = 50 to 75%;
- Bulk unit weight = 1.3 t/m^3;
- Organic carbon content = 0%;
- Bare soil / minimal vegetation.

The calculations included a sensitivity analysis on slope angle and rainfall patterns. Both 1V:2.5H and 1V:3.5H local slopes were considered with a slope height of 12.5 m i.e. slope lengths of 33.7 and 45.5 m respectively. From available historical data, the likely erosion during the driest and wettest years was calculated as well as that for years with total annual rainfall that represented the 25^{th} centile, median and 75^{th} centile of the available data.

6.5.2 Results

The results of the analyses are presented in Table 6.4.

Table 6.4: Estimated annual soil erosion

Scenario	Slope Length (m)	Slope Angle (°)	Estimated Annual Soil Loss per meter of WRD slope area (t/m^2) for given Historical Rainfall Scenario				
			Driest Year (1982) 411 mm	25th % Year (1997) 610 mm	Median Year (1989) 722 mm	75th % Year (1963) 896 mm	Wettest Year (1973) 1,370 mm
Scenario 1 (2.5 H:1V)	33.7	21.8	0.012	0.020	0.032	0.042	0.068
Scenario 2 (3.5 H:1V)	45.5	15.9	0.011	0.018	0.029	0.038	0.062

The results show that average soil loss would be approximately 30 kg per m^2 per year. There is approximately 10% difference in the magnitude of soil loss between the two slope angles assessed.

6.6 CONCLUSIONS

From the assessment of the WRD stability, the following conclusions are reached:

i. The proposed operational geometry of 1V:2.5H local slopes and 1V:2.9H global slopes has adequate factor of safety for global stability under static loading conditions.

ii. Pseudo-static analyses suggest that stability is marginal under OBE and SEE loading conditions. These loading cases should be analysed in more detail using FLAC or PLAXIS software.

iii. Erosion of soil cover is expected to be relatively high immediately after placement prior to full revegetation. In more detailed design of the closure cover system, consideration needs to be given to protection of this valuable resource in order to achieve a stable closure landform.

iv. Whilst geotechnically stable, the proposed local slope angles are relatively steep which will make placement of compacted soil liners and other earthwork capping to the WRD slopes more difficult and costly than if flatter slopes are utilised. Slopes steeper than approximately 1V:3H will require cover to be placed using benched fill rather than direct placement onto the surface.

7. WASTE ROCK MANAGEMENT AND ENCAPSULATION

7.1 OBJECTIVES

As discussed above, the geochemistry of the waste rock is such that there is a significant risk of acid generation and/or metal leaching. Waste which poses a risk to the environment must be encapsulated within the waste dumps to:

1. Reduce oxygen ingress.
2. Reduce water ingress.
3. Protect shallow groundwater.
4. Protect surface water.

7.2 WASTE ZONE IDENTIFICATION

Testing will need to be conducted on grade control or blast hole samples to define the acid formation and metal leaching potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF/metal leaching and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify the different waste blocks. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types.

7.3 SELECTIVE HANDING

Material will need to be selectively handled to allow separation of PAF/metal leaching and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated. As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

7.4 WASTE PLACEMENT METHODS FOR PAF MATERIAL

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

This should be achieved through the placement of waste in lifts of no greater than 3 m to 5 m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement. The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement.

It should be noted that PAF low grade ore shall be treated in the same manner as PAF waste and stored in compacted encapsulation cells if not placed directly on a heap leach pad and processed immediately following excavation from the pit.

7.5 NAF WASTE PLACEMENT

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated.

7.6 ENCAPSULATION OF WASTE

All waste rock that has the potential to generate acid of metal leachate will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. Material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

Cells should be sized to accommodate 4 to 6 weeks production of PAF material. The procedure for encapsulating the waste is presented on Figures 7.1 to 7.4 inclusive.

7.7 INTERNAL DRAINAGE

Internal drainage will need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to

be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

7.8 AS-BUILT RECORDS

Once waste rock is assigned as PAF or NAF, its quantity and dumping location should be recorded on a layout plan. An inventory of material quantities and accurate as-built surveys should be maintained.

8. SURFACE WATER MANAGEMENT

8.1 GENERAL

Careful surface water management for the WRDs will be necessary to limit uncontrolled water flow into the open pit, reduce erosion, and to prevent release of contaminated drainage from the site. Some surface water run-off needs to be collected and stored to supplement process water supplies and the infrastructure needs to direct the necessary flows to the process reservoirs.

The most significant cause of erosion and sediment transport from the project areas is anticipated to be uncontrolled surface water runoff. Accordingly, a key component of the surface water management needs to comprise a system of channels to collect and divert surface water, in a controlled manner, away from exposed overburden and ore surfaces. These structures will, during the active mine life; replace the natural drainage existing within the disturbed areas which will be lost upon commencement of project development.

The channel network can be subdivided into diversion structures and collection structures. The diversion structures comprise channels located along the uphill side of mine components that are designed to direct surface runoff away from the component. The collection structures are located along the downstream side of mine components and are designed to collect the surface water runoff from each component and route the flow into a sedimentation basin for the removal of sediment contained within the flow.

Depending upon the velocity of the peak flows within each channel section, a liner may be required to prevent erosion and degradation of the channel. However the design should seek to reduce the amount of lined channels, both to reduce costs and to minimise the long-term maintenance requirements, by configuring the channels to produce lower velocities that can be accommodated by either exposed soil or vegetated channels whenever possible.

8.2 DESIGN APPROACH

The potential occurrence of soil or waste erosion and subsequent transport by surface water runoff from project areas can be reduced through the incorporation of proper water management into the mine plan. It is anticipated that ongoing incorporation of water management measures will be required until the successful re-establishment of a vegetative cover over the disturbed project areas, when the vegetation will provide the required erosion protection.

Water management measures should comprise a network of ditches, channels, sedimentation basins and discharge structures designed to reduce the potential for erosion of soil and waste dump materials and to remove eroded sediment from surface water prior to discharge from disturbed project areas. A series of perimeter diversion ditches will also be installed around the WRDs to intercept expected surface flows up to the design event and direct them into collection ponds.

A preliminary surface water layout plan has been prepared as part of the overall surface water management report (KP Report PE701-00022/18) a copy of which is provided in Appendix D. The general principles adopted are:

i. Diversion channels to be used to reduce the amount of upstream flow which reaches the WRD toe.

ii. Benches and WRD profile to be used to convey run-off around the outside of the WRDs to a selected number of rock chutes at key locations.

iii. Rock chutes will provide an erosion-protected channel for flows off the dumps and into carrier channels.

iv. Carrier channels to convey flows to ponds for sedimentation and potential use of the water in the process.

v. In some locations, pumped systems may be employed where gravity systems are not practical.

vi. Flows from WRD No 1 will be directed to Waste Water Reservoir (North).

vii. Surface water from WRD No 2 will flow to a collection pond along the southern edge of the dump. If below water quality threshold values, the water can be released to adjacent watercourses. If above threshold then an outlet channel from the pond will convey run-off to the Waste Water Reservoirs.

viii. Flows from WRD No 1 will be directed to the Waste Water Reservoirs.

8.3 SURFACE WATER RUNOFF DESIGN FLOWS

The following extreme rainfall event return periods are recommended for component design:

- The 1 in 25 year for operational measures; and
- The 1 in 100 year for closure measures.

The peak surface water runoff flow reporting to each component is to be determined by the Engineer using the Rational Method. This is an empirical-deterministic approach

that has been successfully applied worldwide to estimate peak surface water runoff flows resulting from extreme rainfall events. It is particularly suitable for urban runoff or small rural catchments with high rates of runoff. The Rational Method equation takes the form:

$$Q_P = 0.00278 * C * I * A \text{ (metric)}$$

Where:

- 'Q_P' is the peak flow in m^3/s;
- 'C' is a dimensionless runoff coefficient representative of the catchment;
- 'i' is the effective rainfall intensity in mm/hour; and
- 'A' is the catchment area in ha.

The run-off coefficient accounts for the anticipated disturbed surface conditions and numerous shallow depressions in the mining and disturbed surfaces, as well as the vegetative cover. An appropriate coefficient should be selected for each design element that reflects the surface conditions and design storm event.

8.4 SEDIMENT CONTROL MEASURES

Good international management practices have been applied to comply with project sediment discharge guidelines (as stated in the project environmental management plan). Good management practices typically require engineered structures to mitigate erosion and reduce sediment loads:

The sediment control measures have to be designed to remove sediment particles eroded from disturbed project areas during pre-development, mining and reclamation activities. The measures should comprise sediment barriers, traps, sedimentation basins and sediment control dams (SCDs) located downstream of the disturbed areas. The sediment barriers and traps consist of structures located within the surface water runoff collection and diversion, and control channels and are intended to remove coarser fraction, (i.e. sand and larger particles) from the runoff flows, in addition to reducing peak flow velocities within the channels.

The sedimentation basins and dams should be located at the downstream terminus of the runoff collection channels and should be designed to ensure compliance with project environmental commitments.

Further details of erosion and sediment control measures are provided in KP Report PE701-00022/21 Erosion and Sediment Control Guidelines, Rev A dated 22nd July 2013. A summary of principal components is provided below.

8.5 SEDIMENT BARRIERS AND TRAPS

Sediment barriers consist of brushwood barriers, silt fences, check dams, sediment weirs and rock filter dams which will be constructed within the surface water diversion and collection channels. The barriers locally reduce flow velocities within these channels thereby allowing suspended sediment to settle. Due to the limited length of channel affected by each sediment barrier, these measures are only effective for coarser sediment particle size, typically coarse sand and larger particles.

The reduction in runoff collection and diversion channel flow velocities caused by the sediment barriers will also assist in the stabilisation of the channel liner(s) from erosional forces and may actually reduce channel liner requirements for erosion protection.

Sediment traps comprise a local deepening and/or widening within the diversion or collection channels creating a local reduction in the flow velocity. This causes the coarser fraction of any suspended sediment to be deposited into the trap. Sediment traps are to be incorporated into the shorter-term drainage and collection ditches located within active areas. This will trap and retain the coarse sediment fraction within the area it is derived from, and will reduce the overall sediment loading on the longer-term perimeter erosion control measures, leading to a reduction in operation and maintenance costs.

It is not anticipated that any formal design will be required for sizing or locating of sedimentation barriers and traps to meet any specific particle size retention requirements. It is expected that those will be sized to fit within and pass the design flow of the existing channel or ditch configuration in which they will be installed and act largely as shorter-term measure.

8.6 SEDIMENTATION BASINS

Sedimentation basins should be used to augment SCDs. Sedimentation basins should be located downstream of active project areas and are therefore considered to be longer-term structures.

It should be noted that there is a practical limit for gravity settlement of suspended particles. A portion of the fine sediment (typical less than 0.02 mm in size) will be trapped by vegetation within the receiving environment, particularly the Environmental Buffer Zones. However a significant amount of the finer portion will be discharged from the project. Discharge of the finer portion of the sediment will need to be compared with baseline conditions as well as regulatory requirements. During heavy rainfalls, the main

receiving river and its tributaries experience natural sediment loads which should be established prior to the commencement of the project and used as baseline data.

The basins should be designed with an allowance of up to 2 metres of sediment storage capacity. The frequency of sediment removal for the basins will depend upon the efficiency of the upstream sediment barriers and traps, actual rainfall peak flow velocities and the rate of sediment erosion.

Maintaining the basins in a drained state, except during runoff events, allows the sediment to dry and consolidate within the basin, thereby reducing the sediment storage requirements. The sand filter material should be cleaned or replaced periodically, as necessary, to prevent plugging of the drain. In addition, this design approach eliminates the need for an internal filter zone within the containment embankment and reduces failure risks and consequences as compared with a basin designed to remain flooded. It will also eliminate a standing water body in which mosquitoes can breed.

An overflow spillway should be incorporated into each sedimentation basin to allow peak design flows associated with a 1 in 50 year recurrence interval storm event to be safely passed. The overflow spillways should incorporate a pervious zone constructed with clean rock filled gabion baskets designed to drain all impounded water from the basin and allow the settled sediment to de-water after a storm event. Settled sediment is prevented from passing through the pervious base by incorporating a non-woven geotextile over the upstream entrance of the pervious base.

9. CONCEPTUAL CLOSURE PLAN

9.7 GENERAL

The waste rock dumps (WRDs) will be constructed during operations to provide structures which are safe and stable whilst also providing landforms that are appropriate for rehabilitation and the final land use. Due to the significant quantities of PAF waste that will be produced from the pit, the dumps will be constructed to encapsulate the PAF waste concurrent with mining and also allow progressive rehabilitation of the dumps.

It is noted that geochemistry evaluations have not yet been fully completed and therefore the concepts presented herewith are based on the available data which suggest a significant potential for acid generation and metals leaching.

9.8 POST-CLOSURE LAND-USE

Whilst there will be a large area of revegetated land on closure, the elevation of the WRDs compared to the surrounding topography combined with minimal flat areas and low rainfall experienced in the area are unlikely to make the WRDs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

9.9 DECOMMISSIONING AND RECLAMATION

The waste rock dumps will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H. Some reprofiling may be required to reduce slope angles to enable effective rehabilitation and for the slopes to be grazed by animals. This will be confirmed during detailed design. The outer walls will be finished with a cover system (described below).

The top of the waste rock dump will be shaped to shed water to drainage channels located on the final top surface that direct flows to drop drains. The benches of the waste rock dump will be graded to direct water also to the drop drains. The drop drains will be lined with heavy fresh benign NAF rock with drain stop boards constructed every five metres down the slope to control the flow speed of the water down the slope. At the base of each drop drain an energy dissipater and sediment trap with the capacity to hold runoff from a 1 in 10 year storm of 1 hour duration will be constructed to control flows and contain runoff prior to release to the general site surface water management system.

After all the batter slopes have been covered, they should be seeded/planted with a mixture of local grass seed and the seeds or plants of shrubs with a maximum height of 1 m that are local to the area.

The rehabilitation of waste rock dump batters should occur progressively during the mining process, after each berm is established and the outer walls shaped, to enable the success of the rehabilitation techniques to be reviewed and refined. This will allow a fully developed and assured method of revegetation and batter treatment, as well as drainage structures, to be developed and minimise the level of maintenance required after closure works are complete.

9.10 COVER SYSTEM

Cover systems are an integral design component for the successful reclamation and closure of the Project. At the surface of the cover system, direct precipitation will either run off the cover, be removed through evapotranspiration or infiltrate into the active zone. Water that infiltrates is typically stored in the active zone and can exfiltrate to the surface and evaporate. A portion of the water that infiltrates can also percolate into the underlying waste, which is intended to be reduced by the placement of the cover system. The objectives of the cover systems considered for the Project include:

- Physical stabilization to provide dust and erosion control, particularly wind and water erosion of waste materials, and to act as a barrier to prevent direct contact of the waste by flora and fauna
- Chemical stabilization through control of oxygen or water ingress; and contaminant release control through reduced infiltration, and
- Meeting land use objectives and other societal values by providing a growth medium for establishment of sustainable vegetation; and reclaiming the area for post-closure land uses.

A combination of cover system efficiency and saturation conditions can help to reduce oxygen ingress and the subsequent oxidization of waste materials which typically results in ARD production.

The proposed cover system concept aims to maximize use of the climate, cover material characteristics, cover material availability, hydrogeologic setting and waste material physical properties to minimize potential effects related to the waste material chemical properties.

In consideration of the anticipated chemistry of the waste rock combined with the varying proximity of the waste materials to watercourses that are used for domestic,

drinking, irrigation and livestock watering uses, a low Infiltration cover system (50-90 % reduction of net infiltration) is proposed for the WRDs in order to reduce the risk of acid generation in the waste dumps and the associated release of low-pH leachate to the environment. Release of solubilised heavy metals will also be reduced.

A low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-8} m/s would be required to construct a cover system capable of reducing net infiltration to approximately 50 to 90% of the infiltration rate expected for a bare surface. Considering the characteristics and availability of materials on site, the cover system would be constructed from a minimum 1 m thick compacted low permeability soil layer, overlain by a 2 m thick gravelly store and release layer, and finished with a re-vegetated subsoil/topsoil layer some 400 mm thick comprising 250 mm of subsoil over which 150 mm of topsoil is place. A typical section through the cover system is provided on Figure 9.1.

Additionally, prior to placement of the cover system, some localised grading may be required to promote positive surface drainage thereby minimizing the likelihood of standing water and saturation of the materials in the cover system. Sloped areas must be protected from surface erosion through re-vegetation and development of drainage structures, to reduce infiltration and to prevent breakthrough of flow into the underlying tailings.

It is anticipated that the low permeability materials and the store and release layer will be sourced from overburden strip from the mine pit during operations. Alternatively borrow areas may need to be established if insufficient material is available locally and/or mine scheduling isn't compatible with the waste dump construction.

9.11 WATER MANAGEMENT

A surface water management system will be progressively established concurrent to waste dump development. Major flowpaths are shown on Figure 9.2. Provision is made in the design for separate systems to manage non-contaminated contact water and potentially contaminated contact water. Non-contaminated contact water will be suitable for release into watercourses downstream of the site following basic settling to reduce suspended sediment loads. Potentially contaminated contact water will be directed initially to the mine pit dewatering system and, once the pit is decommissioned, the water will flow to the pit lake to prevent release of the potentially-contaminated water to the wider environment.

Runoff and drainage water from the waste dumps will be analysed during the closure phase to determine the water quality characteristics. It is anticipated that the surface

runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated, while seepage from the waste rock may be of poorer quality. If water treatment is found to be necessary, a suitably designed passive water treatment wetland system will be designed to enable improvement of water quality to be undertaken prior to release into the environment.

9.12 REHABILITATION

The construction of the closure cover system will provide a landform suitable for revegetation with native plants with a maximum grown height of 1 m. Seeding and planting across the finished surface will provide long-term erosion protection.

10. WASTE ROCK MANAGEMENT PLAN

10.1 OBJECTIVES

A Waste Rock Management Plan should be developed prior to development of the site. The objectives of the Management Plan are to:

- Establish Standard Operating Procedures (SOPs) for MWMCL WRD activities;
- Define MWMCL requirements and procedures to guide the Project Management Team and Project contractors;
- Define plans/measures for impact mitigation;
- Define roles and responsibilities; and
- Define monitoring and reporting procedures.

10.2 ROLES AND RESPONSIBILITIES

The project team is ultimately responsible for the following key tasks, roles and actions relating to hazardous waste as outlined in the RACI presented in Table 10.1.

Table 10.1: Roles and Responsibilities – Waste Rock

Activity Description	Senior Management Team	MWMCL Mine Planning Team	Contractors Team	Contractors Team	MWMCL Environment Team
Develop appropriate WRD designs	I	R	C/A	C/A	C/A
Construct and install appropriate WRDs	I	C/A	R	C/A	C/A
Develop WRD management plans	I	R	C/A	I	C/A
Introduce WRD management strategies to the workforce	I	C/A	R	I	I
Monitor WRD management across the project	I	I	R	C/A	C/A
Record and report WRD incidents and training of personnel	I	I	R	C/A	I
Develop a tracking system for incidents related to WRDs	R	I	C/A	I	C/A

R = Responsible / Accountable: The person(s) who is ultimately answerable for the execution and results of the activity.

A = Assisting / Attending: The person(s) who assists in the execution of the task and/or attends a meeting.

C = Consulted: The person(s) to be consulted during the decision making process. A two-way communication.

I = Informed: The person(s) who need to be informed after a decision is made or action taken. A one-way communication.

Overall responsibility for the implementation of this Management Plan shall rest with the MWMCL Environment Manager who shall report on progress to the MWMCL General Manager.

10.3 MANAGEMENT ACTIONS

Actions expected from management are as follows:

1. Environmental induction and toolbox meetings will include WRD management and awareness.
2. WRDs will be appropriately designed, constructed and installed.
3. Personnel working with WRDs will be trained to ensure safe handling, transfer, and disposal.
4. Damage to WRD containment and monitoring structures will be inspected immediately and repairs undertaken.
5. Promotion of progressive rehabilitation of WRDs.

11. INSTRUMENTATION AND MONITORING

11.1 INSTRUMENTATION

Instrumentation will be installed prior to WRD construction and progressively through construction, closure and rehabilitation. Instrumentation will include:

i. Survey pins at regular intervals around the WRD perimeter at each bench height to monitor for slope movement.

ii. Piezometers at regular intervals to monitor phreatic surfaces within the dumps.

iii. Monitoring standpipes upstream and downstream of the WRDs to monitor groundwater quality.

iv. V-notch weirs or similar on surface water channels to monitor flow rates.

v. Thermistors at regular intervals to monitor dump temperature.

vi. Air sampling points to measure oxygen concentrations in the materials.

11.2 MONITORING

As part of the WRD construction and operation, extensive monitoring will be undertaken to ensure the WRD design intention is met. This monitoring will comprise three basic types. These are:

- Operation monitoring

This will include items such as surface water management infrastructure and adherence to the dumping plan. This level of monitoring is directed at ensuring that the facility is operating smoothly.

- Compliance monitoring

This includes items such as checking survey pins for movement, monitoring bores for contamination, etc. This monitoring is required to ensure that the project is meeting all its commitments in regard to a safe and secure operation.

- Performance monitoring

Regular surveys of the waste rock dumps and reconciliation of the volumes against tipping records will be necessary to maintain 'as-built' plans and to provide updates on densities achieved within the dumps. The data generated will be used to refine the tipping schedule and develop the final waste dump heights.

The monitoring programme for the facility is summarised in Table 11.1 and further details on compliance monitoring are provided in Section 11.3.

Table 11.1: Monitoring programme

Area	Monitoring Requirement	Frequency	Method
Section 1:	Operation monitoring		
Surface Water Management	Visual inspection of run-off collection ditches and ponds	Daily	Manual
WRD Construction	Visual integrity assessment of facility	Daily	Manual
	Visual assessment of adherence to dumping plan.	Daily	Manual
Section 2:	Compliance Monitoring		
WRDs	Survey pins - basic	Monthly	Manual
	Survey - comprehensive	Quarterly or immediately after seismic event	Manual
	Materials testing of encapsulation layers	Daily	Manual
	General inspection by suitably qualified engineer	Annual	Manual
Monitoring Bores	Water level	Monthly	Manual
	Water quality – basic	Monthly	Manual
	Water quality – comprehensive	Quarterly	Manual
Piezometers	Water level	Monthly	Manual
Thermistors	WRD temperature	Monthly	Manual
Air Sampling Points	Oxygen concentrations	Monthly	Manual
Surface Water	Flow rates	Weekly	Manual
	Water quality	Monthly	Manual
Section 3:	Performance Monitoring		
Climatic	Precipitation	Daily	Automatic
	Evaporation	Daily	Automatic
	Maximum - minimum temperatures	Daily	Automatic
	Wind direction and speed	Daily	Automatic
Waste	Waste rock (tonnes)	Daily	Manual
	Waste volume by survey	Quarterly	Manual
Technical Audit	Independent geotechnical engineer.	Annually	Manual

11.3 COMPLIANCE MONITORING

11.3.1 Survey Pins

Survey pins will be installed at regular intervals around the WRD perimeter. As the WRDs are raised, additional survey pins will be added to the benches and slopes. Each pin will be monitored for movement at regular intervals as outlined in the monitoring programme.

Any displacement which is considered excessive or ongoing may indicate stability problems and will require investigation by a qualified geotechnical engineer. Remedial

action will be undertaken if required based on the conclusions drawn from such an investigation.

11.3.2 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis;
- Atterberg Limits;
- Laboratory proctor compaction;
- Field density and moisture content; and
- Particle SG.

11.3.3 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

11.3.4 Piezometers

Piezometers, either vibrating wire or standpipe, will be installed at regular intervals in the waste rock dumps. As the WRDs are raised, additional piezometers will be added at bench level.

The piezometers will be monitored at regular intervals as outlined in the monitoring programme and any rises in water level noted. Increases of greater than 10% of the WRD height should be referred to a qualified geotechnical engineer for further investigation. The piezometer levels should be monitored to ensure that the phreatic surface does not reduce the overall stability of the WRDs below acceptable levels. Remedial action will be undertaken if increases in pore water pressure are unacceptably high.

11.3.5 Monitoring Bores

Monitoring bores will be installed upstream and downstream of the WRDs to facilitate early detection of changes in groundwater level and/or quality, both during the operating life and following decommissioning.

Each monitoring bore station will consist of one shallow bore and one deep bore in order to monitor impacts at different depths.

Sampling and testing of groundwater will be undertaken at regular intervals as outlined in the monitoring programme and any changes in concentrations noted. Any increases above threshold values or long-term trends of increases in concentration of key elements should be referred to a qualified geotechnical engineer for further investigation.

11.3.6 Surface Water Monitoring

Surface water monitoring points located upstream and downstream of the WRDs will be established and regularly monitored and tested. Any increases above threshold values or long-term trends of increases in concentration of key elements should be referred to a qualified geotechnical engineer for further investigation.

V-notch weirs or similar will be installed in major surface water channels to monitor flow rates.

11.4 TECHNICAL AUDIT

It is important that suitably qualified geotechnical advice is available during the operating life of the facility. The Client should keep the Engineer informed of the operating performance of the facility and raise any questions immediately.

The WRDs will require formal annual audits by a suitably qualified engineer and scientist to ensure that the facility is operating in a safe and efficient manner as well as meeting the necessary requirements for encapsulated storage of PAF and potential metal-leaching waste and development of long term stability of physical and vegetated covers and structures. The audit will include, but not be limited to, the following items:

- Current survey plan of WRD;
- Reconciliation of stored waste volume and calculated densities with the expected values given in the design, and assessment of available capacity remaining in terms of volume and time;
- Validation of storage design, using input parameters derived from site measurements and testing, implications for future storage if present trends are continued, and recommendations for any necessary operational or design modifications;
- Presentation and interpretation of monitoring results, proposals for additional monitoring of identified areas, changes to operational procedures resulting from monitoring results and proposals for any necessary seepage recovery systems;
- General description of facility, complete review of waste and water management practices and operating manual procedures, their problems, failures and successes, and any alteration to the facility or operating procedures that are proposed;
- An assessment of the slope stability monitoring undertaken and an assessment of the slope stability achieved through analysis of the monitoring results and visual inspection of the WRD;
- A complete description of the previous year of waste placement with as-built drawings and design proposals for the following year (as appropriate) based on the recorded data;
- Assessment of water flow and level data, analysis of water quality data obtained from surface and bore water samples and identification of any trends associated with the data;
- Evaluation of the performance of drainage structures and their competence and recommendations for improvement of design or remediation of existing structures; and
- An evaluation of the landscape function achieved by the rehabilitation that has been undertaken.

A comprehensive Audit Report will be prepared and submitted to the Client following each annual audit site visit.

11.5 INCIDENCES AND REPORTING

In the operation of the WRD there are many potential incidences that should be recorded; however, the reporting of such incidences is spilt into two categories:

- Reportable internally – these are incidents that may affect the day to day operations of the facility and are generally relatively minor; and
- Reportable externally – these are serious incidents that impact the environment and the health and safety of employees and the public. These are significant incidents and are reportable by law to the relevant government agency.

As externally reportable incidents are extremely wide ranging, reference should be made to suitable published documents to determine which incidents may be applicable to the facility. Additionally, it is considered that should the licensed conditions be breached then it is likely to be an incident that is externally reportable.

Regardless of the reportable status of an incident, the incident can be split into three general categories:

- Environmental;
- Structural; and
- Health and Safety (Personnel or Public).

Reporting of incidents is an extremely important task as part of the safe construction and operation of waste rock dumps. However, the procedure for reporting should not be one that is prescribed but one that is developed by the Client within the organisation as it is more likely in this way that the procedure will be adopted. However, for general guidance a reporting procedure should include the following:

- Which reporting category is appropriate to the incident;
- If external reporting is appropriate, review specific procedure and implement as appropriate;
- For internal reporting the following should be considered:
  - Which general category is appropriate to the incident;
  - Description of the incident including;
  - Location, date, time, weather conditions, result (damage) and potential cause of the incident.

- Description of remedial actions to be taken to rectify the incident;
- Description of precautionary measures to be taken to prevent re-occurrence of incident; and
- Review of remedial and precautionary measures once initiated, to assess whether they are achieving the desired result.

The intent of the register and the documentation of minor incidents, which will occur during operation, is to assist in preventing the minor incidents from re-occurring and conditions for major incidents developing.

12. IMPLICATIONS FOR CURRENT DESIGN

12.1 GENERAL

The waste rock dump design has been progressed by MWMCL on the basis of a number of assessed and assumed parameters. As more information becomes available and more detailed assessments are made of the waste and its storage, the design should be refined. The following sections highlight elements of the current design that we consider should be reviewed in light of the information gathered and the analyses conducted for this report.

12.2 WASTE GEOCHEMISTRY

Geochemical testing of the waste rock to date has predominantly been from samples from around the pit shell. Data from the centre of the proposed open pit are limited. As such the geochemistry (acid forming and metal leaching potential) of the waste rock is poorly understood. The data that are available show a high acid-producing and metal-leaching potential and as such the waste rock dump design should be amended to provide encapsulation to securely contain the waste.

An encapsulation cell construction methodology has been provided which will meet the international good practice requirements for management of acid-forming and metal-leaching mine waste.

12.3 PROPORTION OF ENVIRONMENTALLY PROBLEMATIC MINE WASTE

Due to the lack of exploratory drilling in the hill areas and centre of the proposed open pit, the ratio of NAF to PAF waste is not clearly defined. The testing conducted to date suggests the waste will comprise approximately 71% PAF and 29% NAF. This has two significant impacts on the current design.

Firstly, a significant volume of PAF would be generated that needs to be managed and encapsulated in the waste dumps. This is time consuming and costly when compared to construction of NAF dumps.

Secondly, benign NAF is required to encapsulated the PAF as well as provide cover materials for the dumps on closure. With such a small relatively percentage of benign NAF, there is a risk of a shortfall in NAF material that will need to be made up by borrow of natural materials. Given that space within the site boundary is limited, consideration may need to be given to establishing external borrows and/or undertaken a major pre-strip operation of the waste dump footprints to win NAF materials in advance of waste dump construction. Both will have major cost implications for the project.

It is therefore recommended that further exploratory drilling be completed as a matter of urgency in order to establish with reasonable certainty the geochemistry of the waste rock and the likely proportions of benign NAF, PAF and metal-leaching NAF materials that will require disposal in the waste dumps.

12.4 AVAILABILITY OF CLOSURE COVER CONSTRUCTION MATERIALS

The current design does not include for cover of the waste dumps other than placement of topsoil. On closure, a store and release cover system is proposed for the WRDs to limit water ingress and therefore reduce the long-term acid and metal generation by the dumps. Some 1 m of low permeability compacted soil liner and 1.5 to 2.0 m of relatively permeable fill will be required to construct the cover, in addition to a 400 mm layer of soil.

As mentioned above, there may be a shortage of benign NAF materials from the open pit and what is available will first be used for WRD construction and encapsulation of PAF waste. There is a risk of a material shortfall on closure which could impact the ability of MWMCL to achieve adequate decommissioning and rehabilitation of the site.

In addition to the further site investigation in the open pit area, identification and investigation of potential borrow sources for low permeability materials and capping should be completed together with a construction materials balance for the site. It is recommended that this be done in advance of establishing the heap leach pads and waste rock dumps as it may be necessary to borrow materials from the footprints of those areas prior to construction.

12.5 VOLUMETRICS AND FOOTPRINTS

The existing waste dump design[20] utilises a bulk density in the waste dumps of approximately 2 t/m^3. Given the materials and experience from similar conditions on other sites, achieving this density is considered unlikely. Overall waste rock management and optimisation of the dumps to take into account a lower density is necessary to ensure that available areas for storage of waste do not impact on MWMCL's ability to extract the economic ore.

We recommend that the design of the waste dumps in 3D be reviewed and revised to incorporate the recommendations in this report and potential lower density for the placed waste. For initial review, we suggest densities in the range 1.6 to 1.8 t/m^3 be considered.

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[20] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.

12.6 BATTER SLOPES

The existing design utilises local slopes of 1V:2.5H and overall waste dump batters of 1V:2.9H. Whilst this has been shown by preliminary analyses to be geotechnically stable there are a number of practical aspects that may warrant flatter slopes.

A closure cover system has to be installed on the WRDs to limit water ingress. To achieve this, a compacted soil liner is to be placed together with a store and release cover. Earthworks equipment cannot work directly on local slopes steeper than about 1V:3H. As such, the closure cover will need to be installed by placing the fill in benches progressively up the slopes. Because of required working widths, additional fill will be needed to achieve this when compared to fill placed on flatter slopes. This fill requirement will place extra demand on an already limited resource and will also significantly increase the closure costs as the placement of fill in this manner is slow and more onerous.

Such steep slopes also limit post-closure land-use options. Grazing is not considered appropriate on slopes steeper than 1V:3H and access also becomes difficult in such terrain.

We therefore recommend that consideration be given to flattening slopes in order to reduce closure costs and also to ensure a more sustainable end land-use for the site.

Note that due to the need to encapsulate PAF waste and also provide progressive rehabilitation, the final slope angles should be fixed and incorporated into construction of the WRDs. It is not something that can be addressed on closure by reshaping of batters due to the cost and footprint requirements.

13. CONCLUSIONS AND RECOMMENDATIONS

Preliminary design of key elements of the waste rock dumps has been completed. The main conclusions of the work are:

i. Geotechnical conditions in the proposed waste dump areas are poorly understood due to a lack of site investigation. Preliminary stability analyses using available data have not shown any significant issues under static loading conditions, but further investigation is needed to confirm design assumptions.

ii. Simplified pseudostatic analyses show that stability during OBE and SEE seismic events is marginal. These loading cases need to be analysed in more detail using more advance methodologies such as FLAC or PLAXIS software.

iii. Data on the physical and geochemical properties of the waste are limited and further investigation of the open pit area is needed to confirm design assumptions.

iv. The available data suggest a significant acid-generating and metal leaching potential for a large proportion of the waste that will be produced. The PAF and metal leaching NAF waste will need to be encapsulated during operations with intermediate and final engineered covers comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The final encapsulation material will need to be covered by a store and release cover constructed from benign waste or borrow material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the low permeability cover.

v. The data collected to date on composition of waste suggests a high proportion of PAF and metal leaching NAF will be generated but only a small quantity of NAF. This may result in a shortfall of materials for encapsulation of wastes and for construction of the closure cover system. A materials balance based on up-to-date site investigation is urgently needed as materials may need to be borrowed from the footprints of the heap leach pads and/or the waste rock dumps prior to construction.

vi. There are some uncertainties regarding the ability to store the total amount of waste within the footprints currently designated when the recommendations of this report are considered and a more appropriate bulk density is adopted for waste dump design. A review of storage volumes and necessary footprint areas is urgently needed.

vii. Assessments suggest the current design profile of 1V:2.5H local slopes and 1V:2.9H slopes will be geotechnically stable but that consideration needs to be given to flattening these slopes in order to reduce overall life of mine costs as construction of the cover system and rehabilitation costs will increase significantly for local slopes steeper than 1V:3H.

The waste dump design now needs to be progressed to detailed design. In order to achieve this we make the following recommendations:

i. Undertake site investigations in the WRD foundation areas to assess geotechnical properties.

ii. Update the stability analyses with the new data and undertake a more detailed analysis of performance under SEE loading conditions using FLAC or PLAXIS software.

iii. Undertake site investigations around the site to identify construction material resources and prepare a materials balance for the site.

iv. Additional geochemical assessment should be conducted to better quantify the amount of potentially acid-generating and/or metal-leaching material which will be encountered during the first year(s) of operations to allow detailed waste management planning.

v. Undertake kinetic testing of waste rock samples to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.

vi. Complete an optimisation of the WRD design that incorporates encapsulation of PAF and metal leaching NAF waste, addresses issues with footprint setbacks, slope angles and potential construction materials shortfall, and provides a suitable footprint layout within the site constraints.

FIGURES

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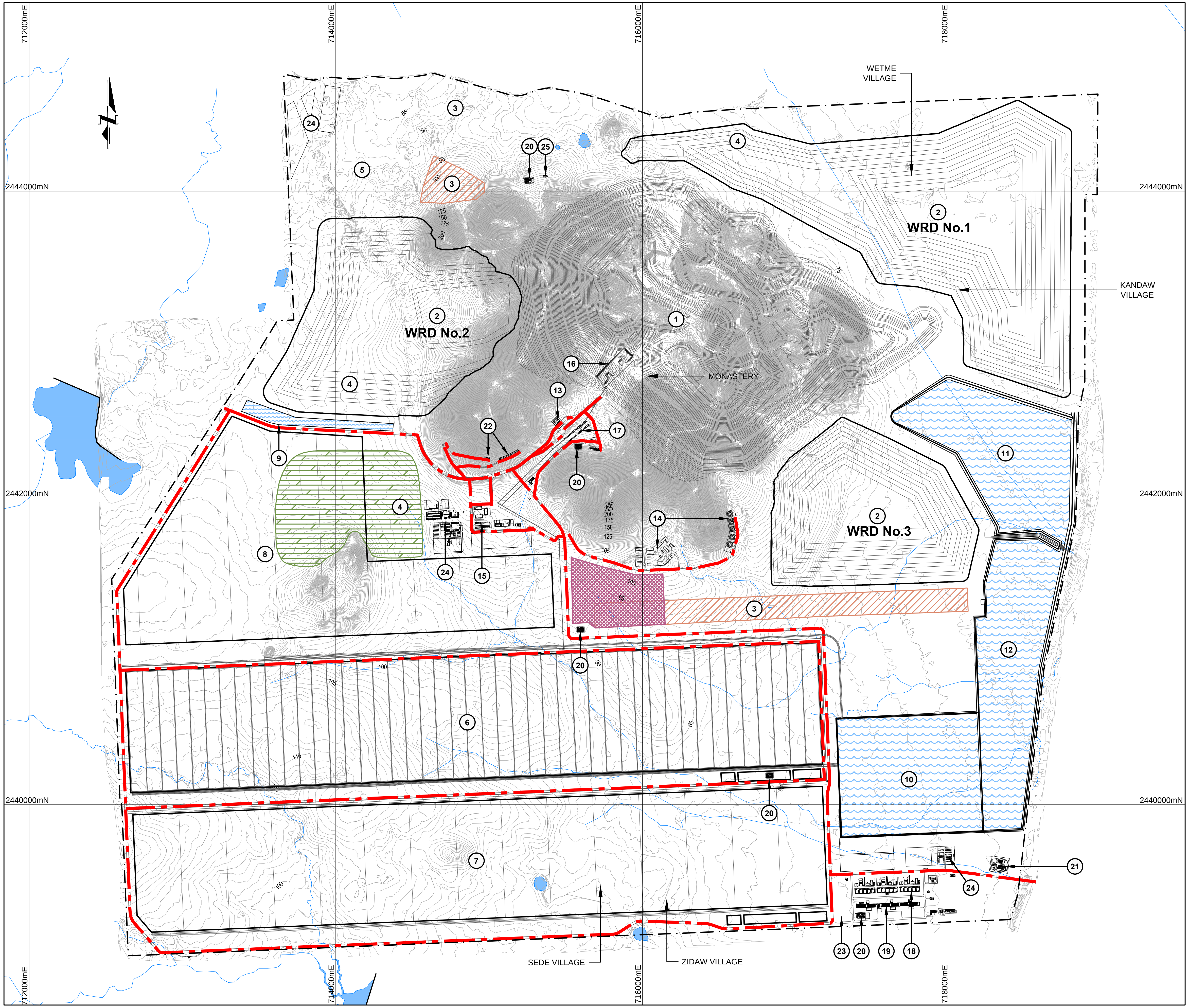

LEGEND:

- EXISTING POWER LINE
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LETPADAUNG LEASE BOUNDARY
- SITE ROAD ALIGNMENT

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 1m CONTOUR INTERVALS SHOWN.

KEY:

1	PIT
2	WASTE DUMP
3	TOPSOIL STOCKPILE
4	LOW GRADE ORE STOCKPILE
5	RESERVE ORE STOCKPILE
6	HEAP LEACH PAD No.1
7	HEAP LEACH PAD No.2
8	HEAP LEACH PAD No.3
9	WASTE WATER COLLECTION POND
10	HEAP LEACH STORM WATER POND
11	WASTE WATER RESERVOIR (NORTH)
12	WASTE WATER RESERVOIR (SOUTH)
13	FUEL STATION
14	EXPLOSIVES AREA
15	OFFICES/ WAREHOUSES/ MAINTENANCE AREA
16	MOBILE CRUSHER FOR QUARRY
17	CONVEYOR FOUNDATIONS
18	EXTRACTION PLANT
19	ELECTROWINNING PLANT
20	33Kv SUBSTATION
21	230kV SUBSTATION
22	WATER PURIFICATION AREA
23	ACID STORAGE AREA
24	STAFF ACCOMMODATION
25	2Mw DIESEL POWER STATION

SCALE (METRES) 1:25,000 (A3)

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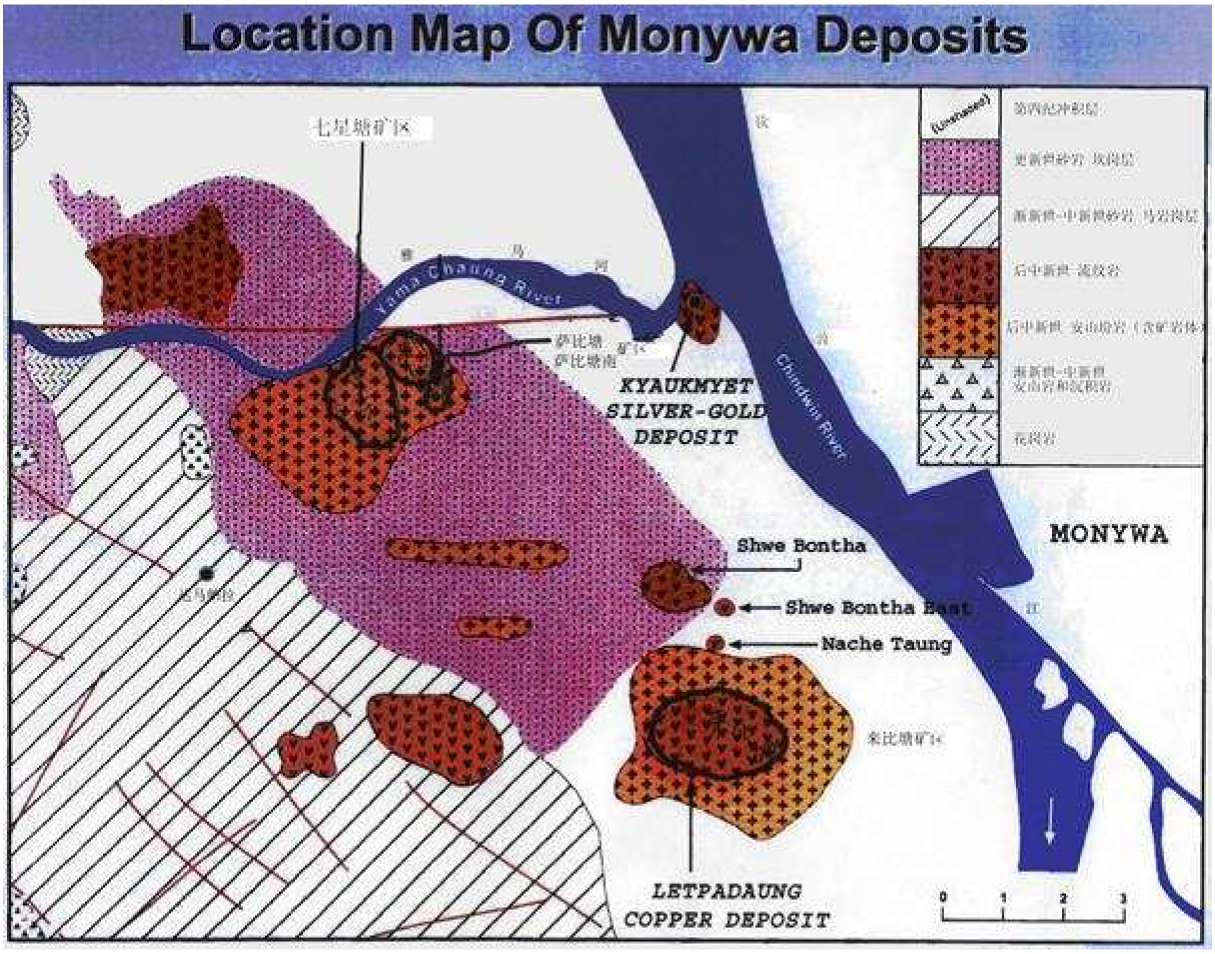
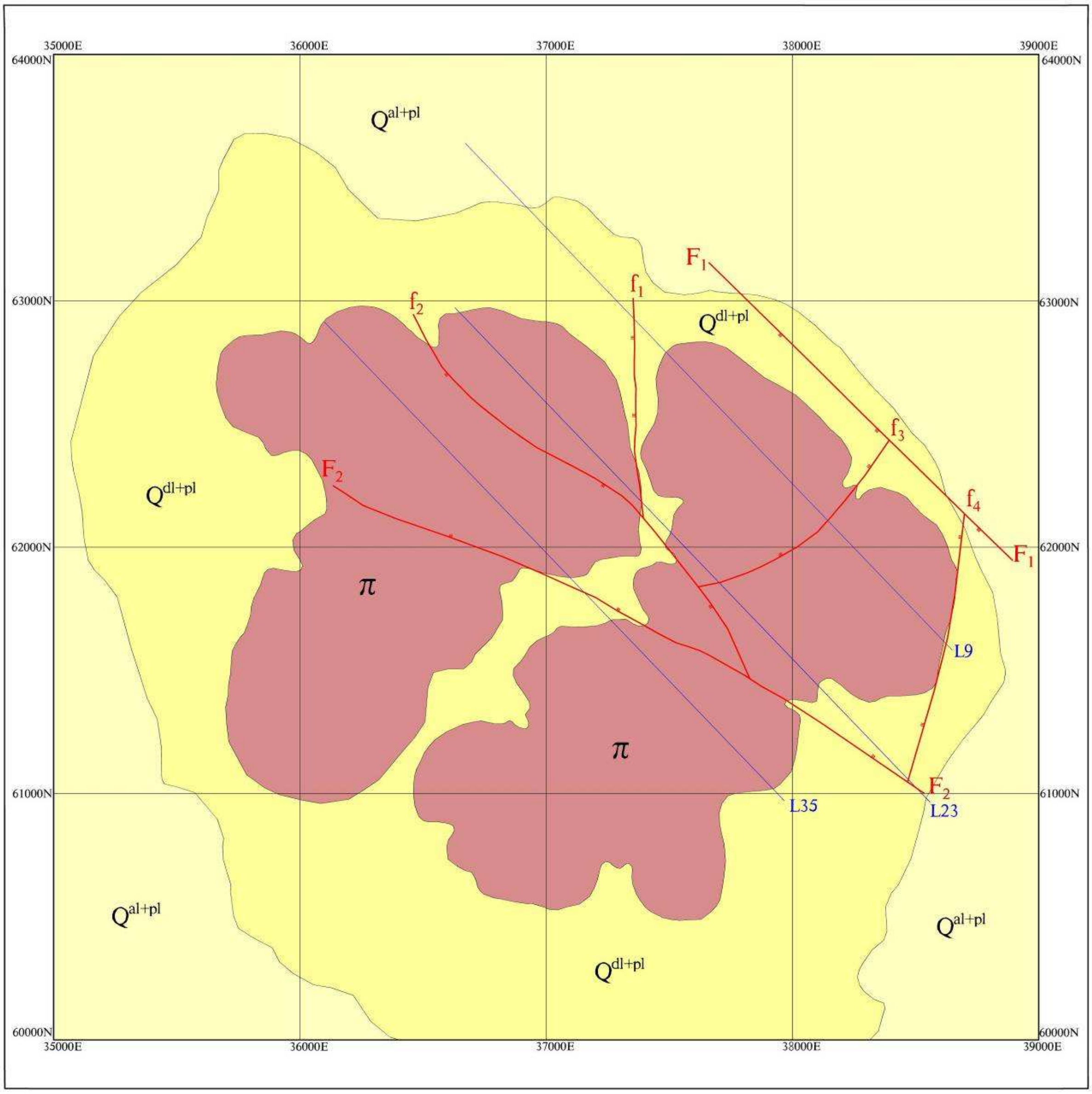
LETPADUANG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
SITE GENERAL ARRANGEMENT

Ref: PE701-00022/19
Figure 1.1

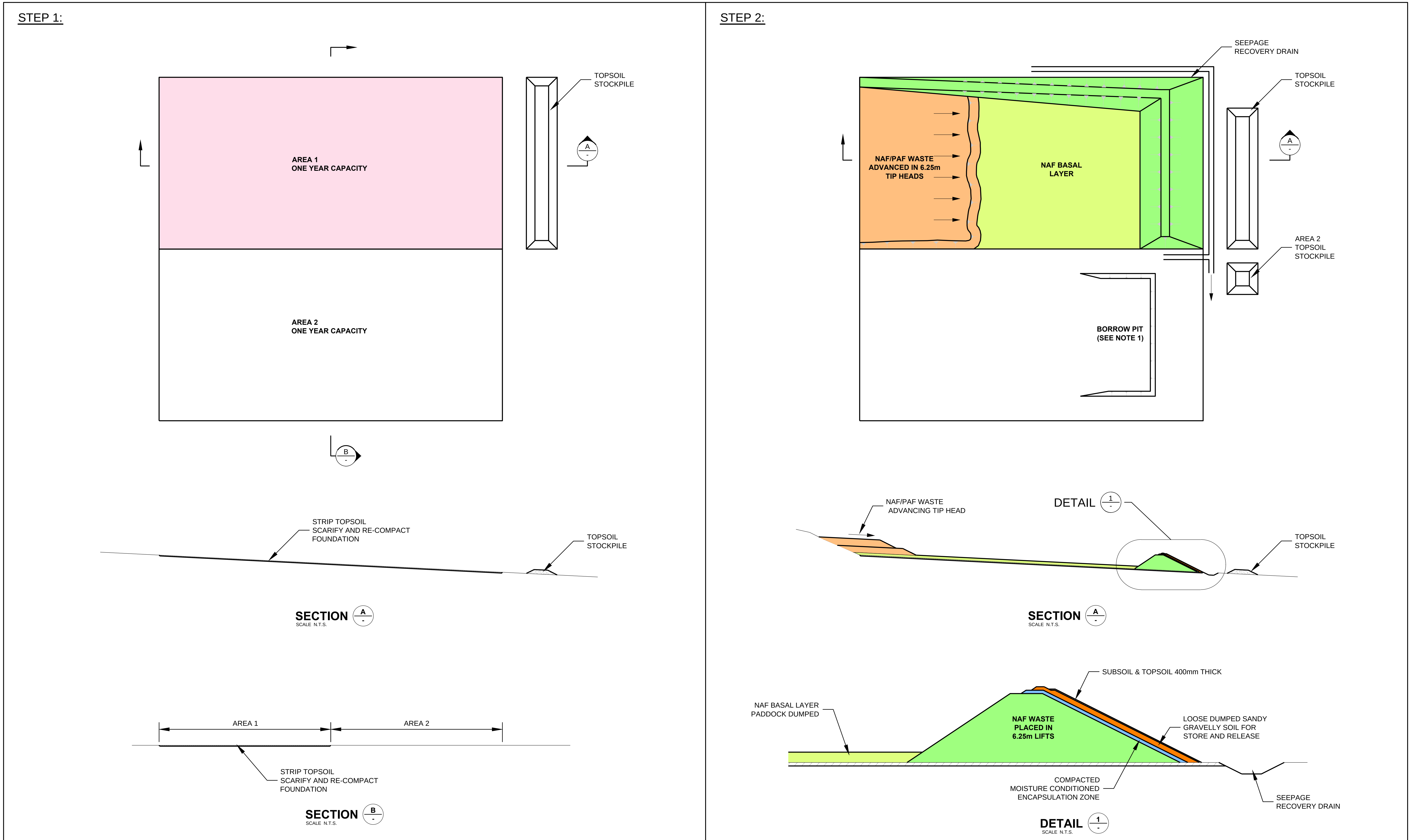


Location Map Of Monywa Deposits
七星塘矿区
Yama Chaung River
Chindwin River
KYAUKMYET
SILVER-GOLD
DEPOSIT
MONYWA
Shwe Bontha
Shwe Bontha East
Nache Taung
LETPADAUNG
COPPER DEPOSIT
0 1 2 3



Q^{al+pl}	Quaternary alluvium	Q^{dl+pl}	Quaternary alluvium	π	Late Neogene Andesite -Dacite Rock Mass		Compression fault

0 50 100 150m



NOTE:

1. BORROW PIT IN NEXT WASTE DUMP AREA TO SUPPLY ENCAPSULATION MATERIAL AND STORE AND RELEASE ZONE.
2. LOCAL OUTER BATTER SLOPE ANGLES TO BE CONFIRMED.

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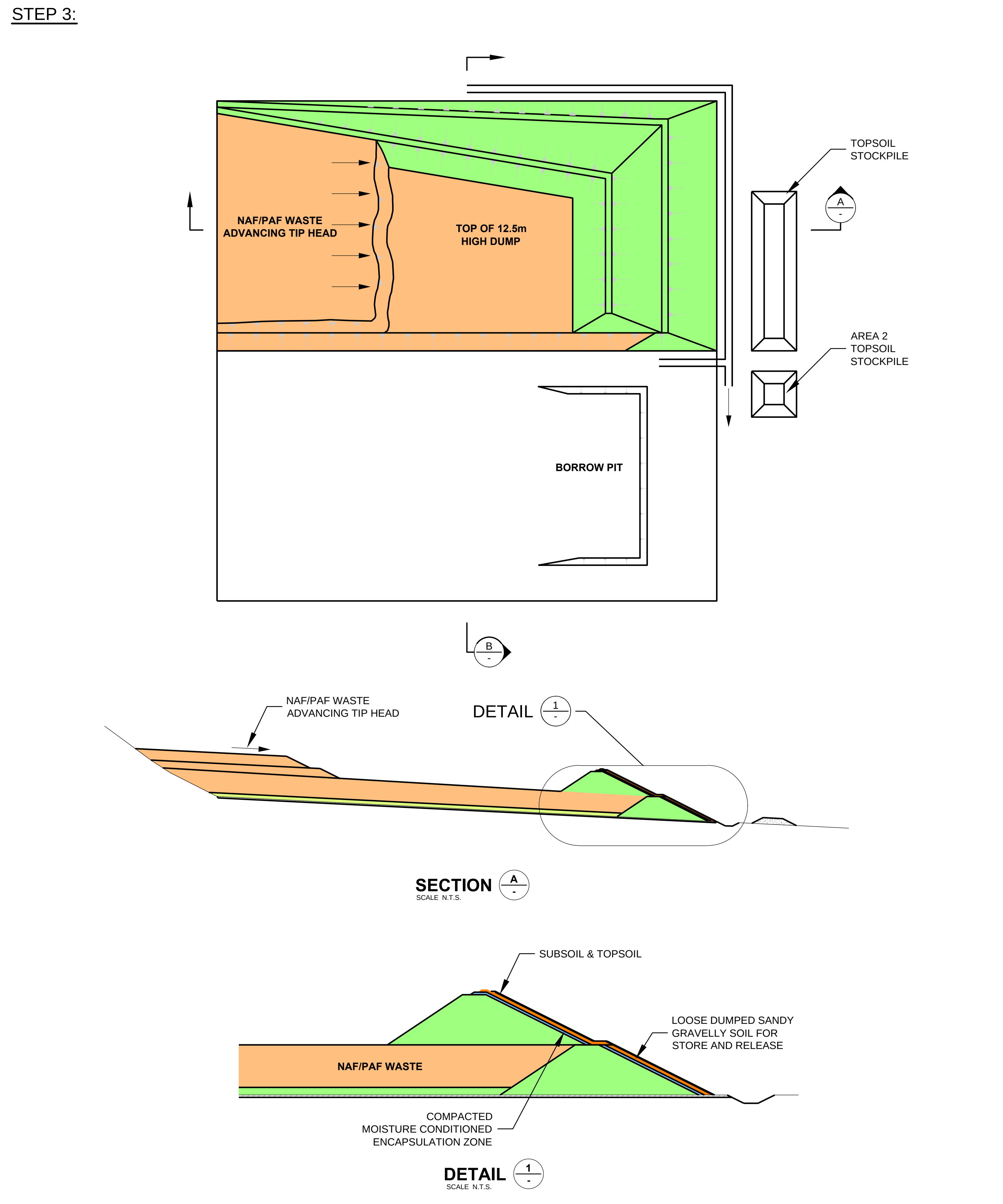
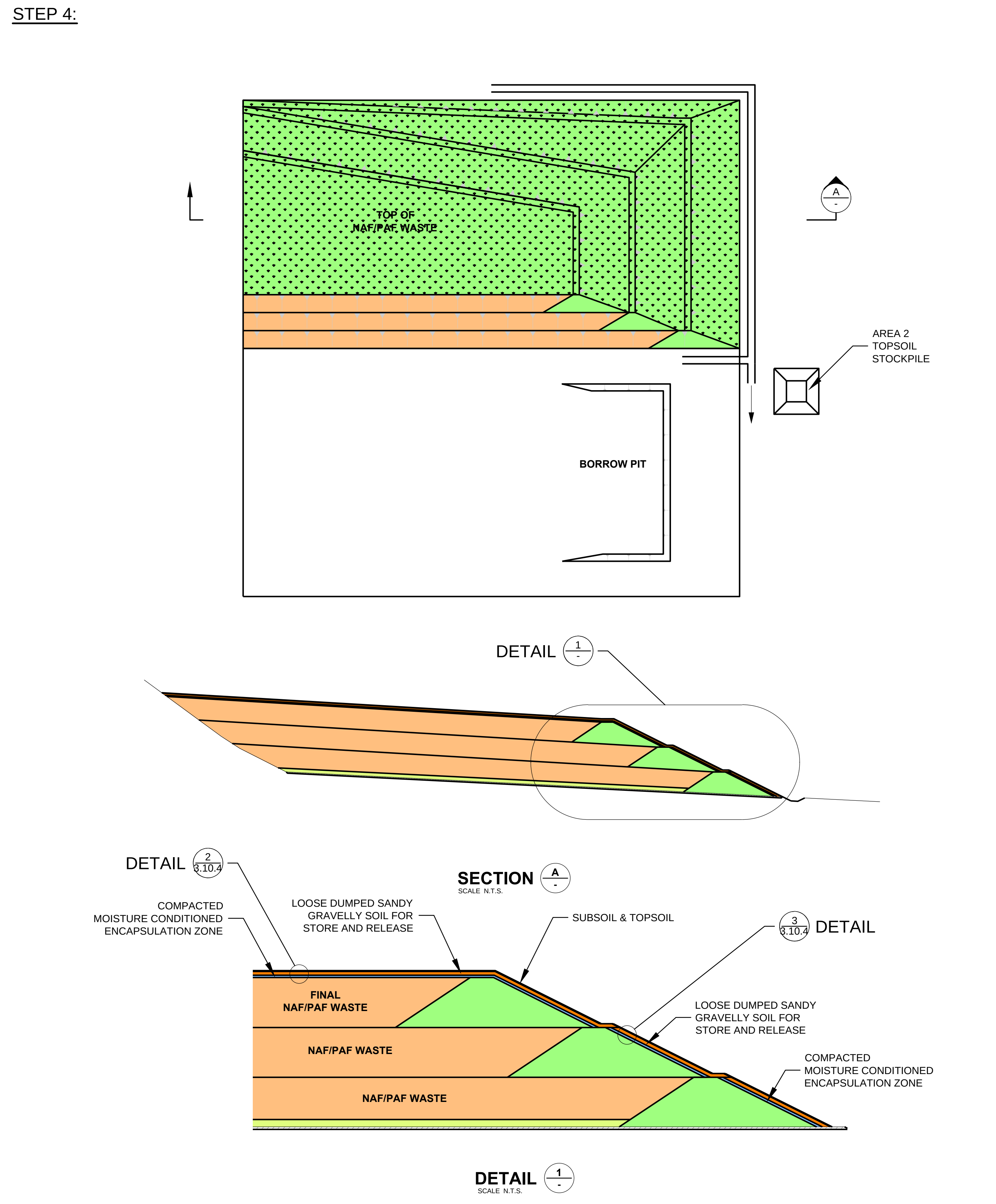
LETPADAUNG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
MINE WASTE MANAGEMENT STRATEGY (STEPS 1 & 2)

Ref: PE701-00022/19
Figure 7.1

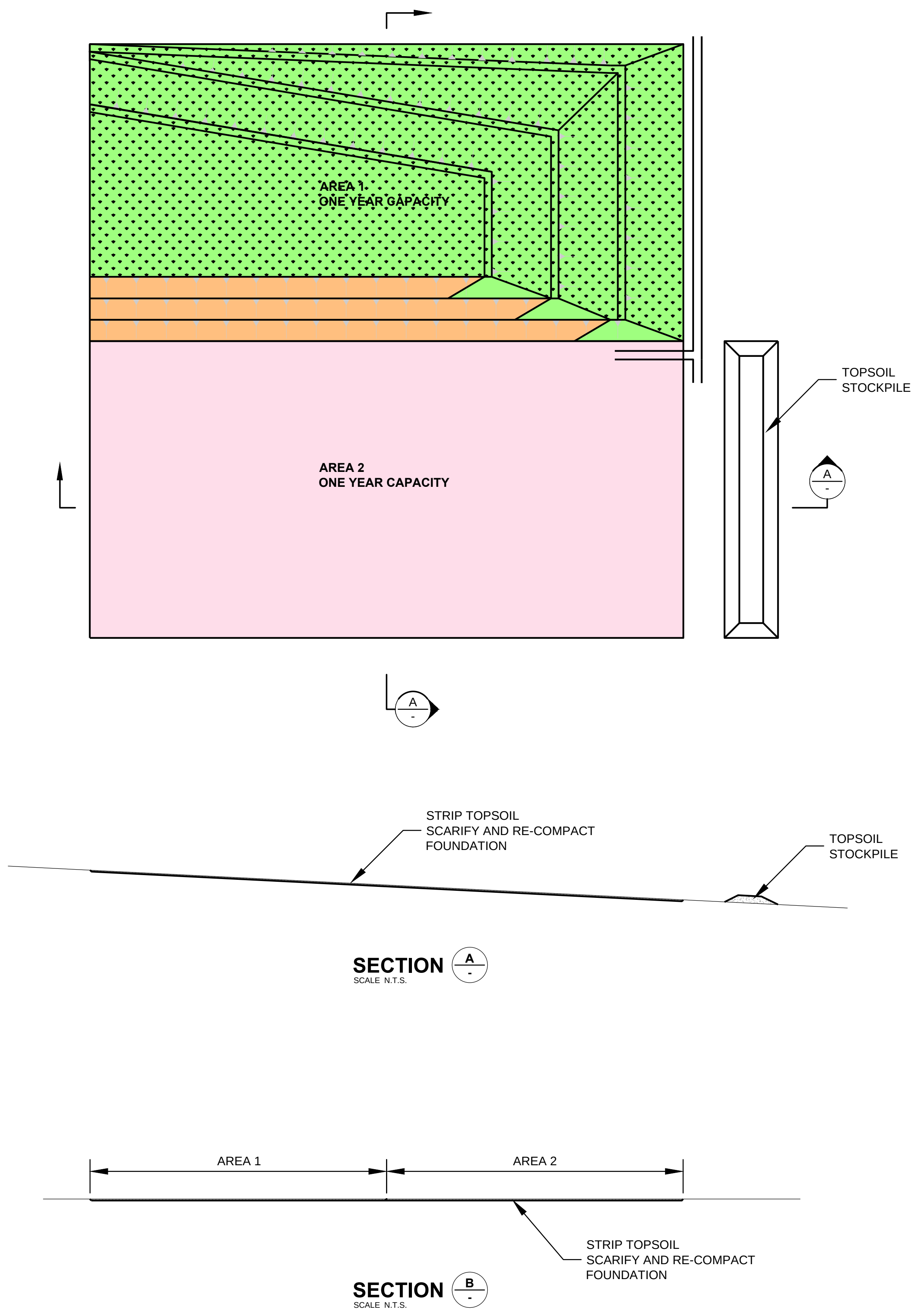


STEP 3:
TOPSOIL STOCKPILE
NAF/PAF WASTE ADVANCING TIP HEAD
TOP OF 12.5m HIGH DUMP
AREA 2 TOPSOIL STOCKPILE
BORROW PIT
NAF/PAF WASTE ADVANCING TIP HEAD
DETAIL 1
SECTION A
SCALE N.T.S.
SUBSOIL & TOPSOIL
LOOSE DUMPED SANDY GRAVELLY SOIL FOR STORE AND RELEASE
NAF/PAF WASTE
COMPACTED MOISTURE CONDITIONED ENCAPSULATION ZONE
DETAIL 1
SCALE N.T.S.

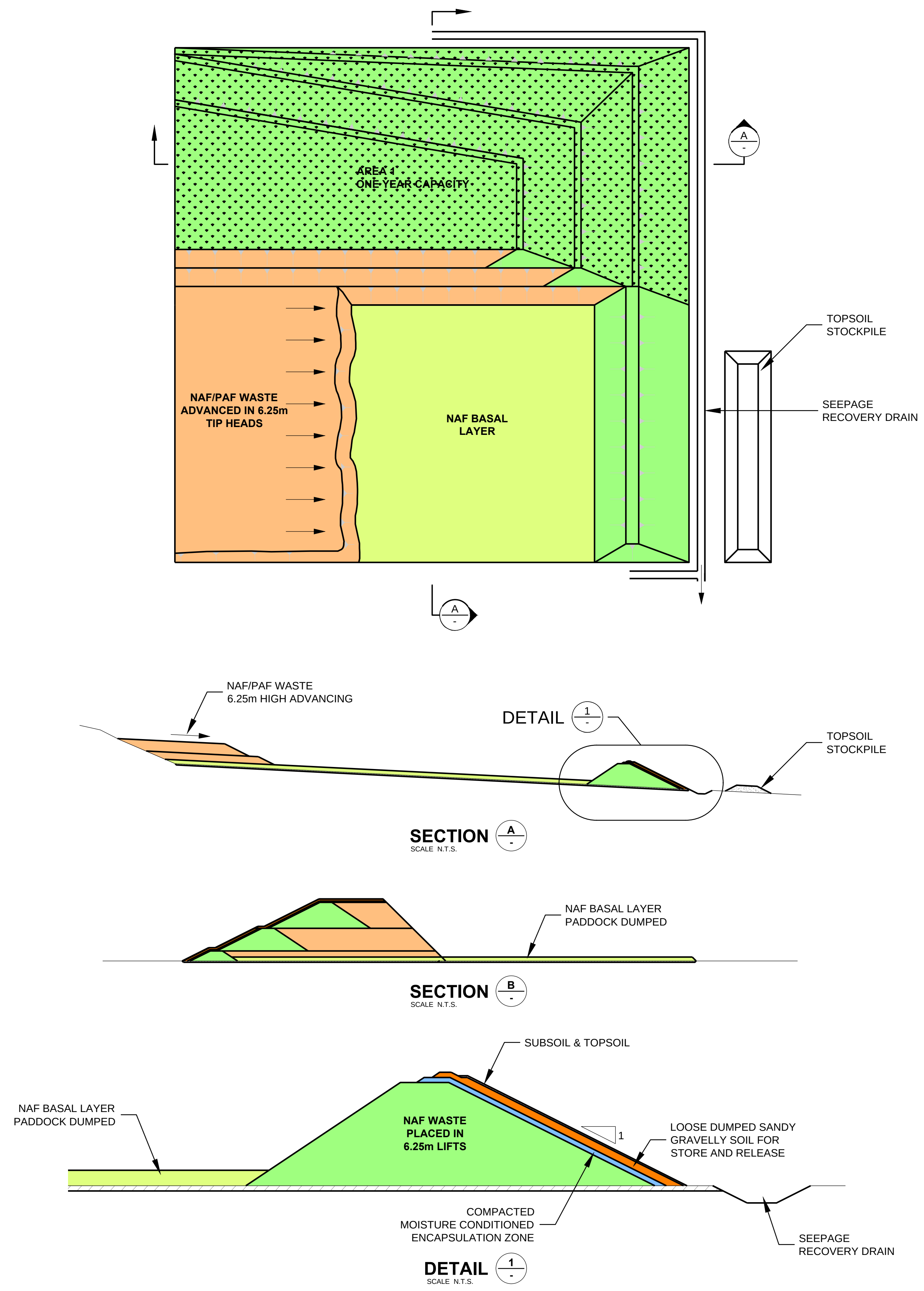


STEP 4:
TOP OF NAF/PAF WASTE
AREA 2 TOPSOIL STOCKPILE
BORROW PIT
DETAIL 1
DETAIL 2 3.10.4
SECTION A
SCALE N.T.S.
COMPACTED MOISTURE CONDITIONED ENCAPSULATION ZONE
LOOSE DUMPED SANDY GRAVELLY SOIL FOR STORE AND RELEASE
SUBSOIL & TOPSOIL
3 3.10.4 DETAIL
FINAL NAF/PAF WASTE
NAF/PAF WASTE
NAF/PAF WASTE
LOOSE DUMPED SANDY GRAVELLY SOIL FOR STORE AND RELEASE
COMPACTED MOISTURE CONDITIONED ENCAPSULATION ZONE
DETAIL 1
SCALE N.T.S.

STEP 5:



STEP 6:



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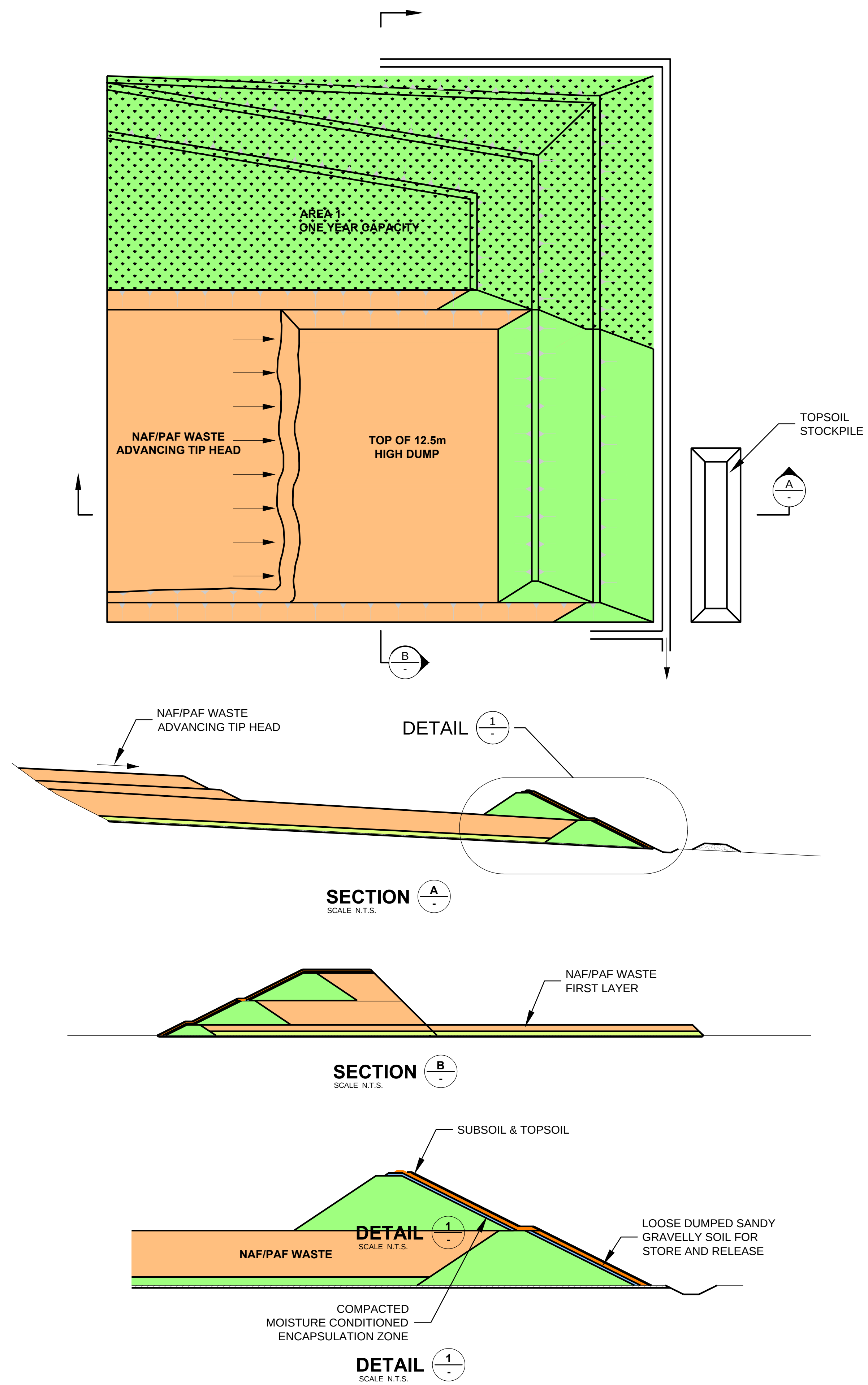
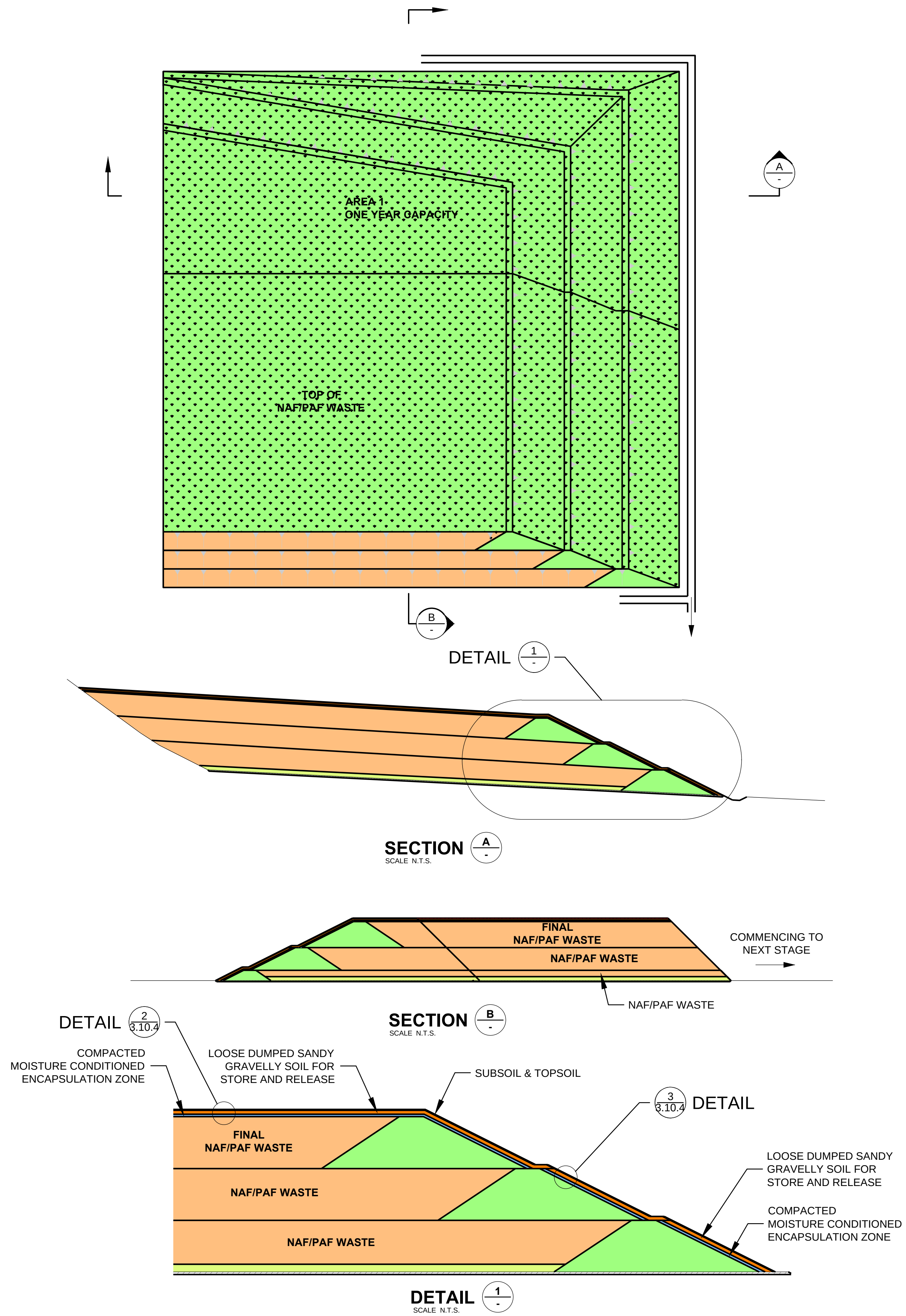
LETPADAUNG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
MINE WASTE MANAGEMENT STRATEGY (STEPS 5 & 6)

Ref: PE701-00022/19
Figure 7.3

STEP 7:



STEP 8:



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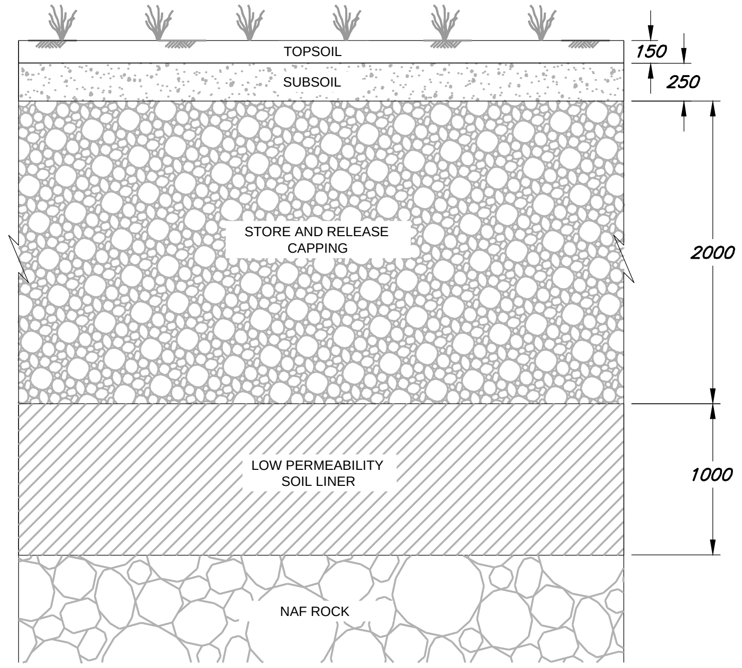
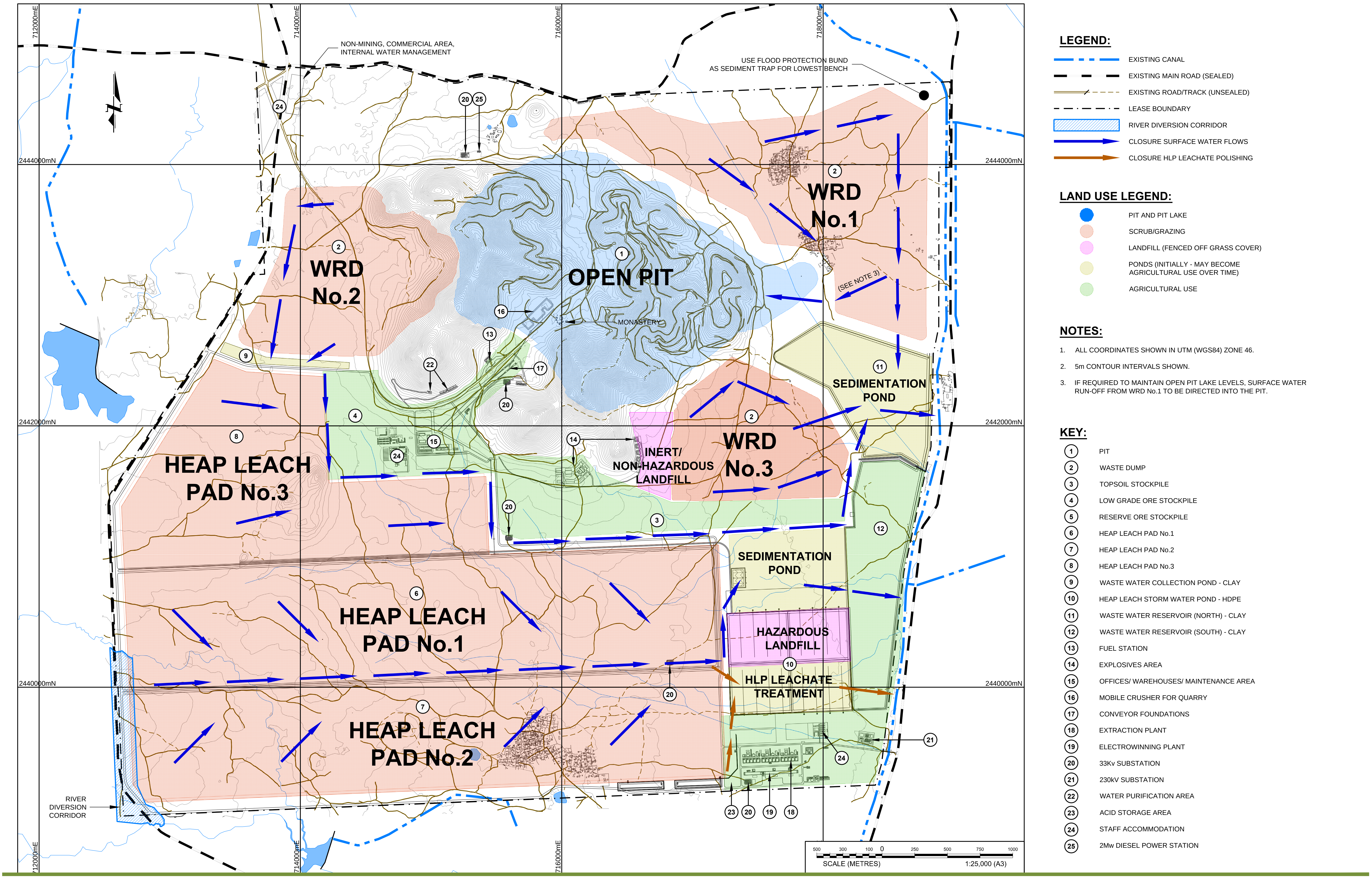
LETPADAUNG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
MINE WASTE MANAGEMENT STRATEGY (STEPS 7 & 8)

Ref: PE701-00022/19
Figure 7.4



WASTE ROCK DUMPS



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LETPADUANG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
CLOSURE LAND-USE AND SURFACE WATER MANAGEMENT

Ref: PE701-00022/19
Figure 9.2

APPENDIX A

Baseline Design Climatology (KP Memo PE13-00538)

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MEMORANDUM

To:	**MYANMAR WANBAO MINING COPPER LTD (MWMCL)**	**Date:**	5th July 2014
Attn:	Glenn Wallis	**Our Ref:**	PE13-00538
		KP File Ref.:	**PE701-22/4-A bl M13010**
cc:		**From:**	Brett Loney

RE: LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY

Please find herein baseline design climatology that has been developed for the Letpadaung project site in Myanmar. The investigation and calculations discussed herein provide the preliminary hydrologic basis for on-going and future design work.

1. DATA SOURCES

Historic climate data from four separate locations were used in deriving baseline design climate estimates. The stations, illustrated on Figure 1.1, are:

- Monywa Township climate station, which is located 5.6 kilometres (km) northeast of Letpadaung Hill. At the time this memorandum was written, Knight Piésold (KP) was unable to confirm the precise location and elevation of this monitoring station; accordingly the location shown in Figure 1.1 was assumed to be within the city of Monywa. Daily precipitation data from this station provided by Myanmar Wanbao Mining Copper Ltd. (MWMCL) cover the period (1961–2013).
- Yangtse climate station, which is located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kyisintaung (S&K) operations site. Monthly pan evaporation data from this station which was previously collected by KP whilst working on the (S&K) project and subsequently extended by MWMCL cover the period (2000-2013).
- World Meteorological Organization (WMO) climate station number 48037, which is located 4.7 km northeast of Letpadaung Hill. Although the location shown on Figure 1.1 accurately depicts WMO records, KP suspects that the actual location of this station is somewhere nearby and not on a sandbar in the Chindwin River as shown. Daily temperature data from this station was sourced by KP from the Research Data Archive (RDA) at the National Center for Atmospheric Research (NCAR), Computational and Information Systems Laboratory (CISL) in Boulder, Colorado USA. The daily temperature data span the period (1981-2012).
- The Wind Rose sampling point, which is located 0.9 km northwest of Letpadaung Hill; this location was used by Lakes Environmental Consultants (LEC) as a sampling point for extracting processed surface and upper air meteorological data from the results of the MM5 (5th generation Mesoscale Model) and SAMSON hourly surface meteorological datasets. More information about these datasets may be reviewed online at:
  - MM5, refer to http://www.mmm.ucar.edu/mm5/mm5-home.html and
  - SAMSON, refer to http://www.webmet.com/MetGuide/Samson.html.

  Hourly wind speed, wind direction and precipitation data from this source span the period (2010-2012).

2. PRECIPITATION ANALYSIS

Precipitation data from the Monywa Township and Wind Rose sampling point datasets were reduced into a standardised format and then analysed on annual, monthly, and daily time scales as appropriate. Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes. Daily data is used to derive design storms for sizing water conveyance infrastructure: spillways, channels, etc. The following sections detail the various analyses conducted and the results achieved.

2.1 ANNUAL PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias from distorting the results. Sampling statistics were computed on these annual sums to provide a broad overview of the variability of annual precipitation in the region surrounding the project site, as given in Table 2.1.

Table 2.1: Annual precipitation statistics – Monywa Township (1961-2013)

Selected Statistic	Statistic*1 Value
Average number of rain days	65
Average (mm)	774
Median (mm)	727
Std. Deviation (mm)	230
Minimum (mm)	411
Maximum (mm)	1,370
25th Percentile (mm)	610
75th Percentile (mm)	894
Count (yr)	50
Distance to site (km)	5.6

*1 Incomplete data from 1995, 1999 and 2013 were excluded from this analysis.

The sample statistics for annual precipitation at this site were also depicted graphically, as a “box and whisker” plot to illustrate the variability of annual precipitation, as shown on Figure 2.1. For each year shown, the “box and whisker” plot is read as follows:

- Top of each “box” indicates the 75th percentile annual precipitation;
- Central line within each “box” indicates the median (or 50th percentile) annual precipitation;
- Bottom of each “box” indicates the 25th percentile annual precipitation;
- Red diamond inside each “box” indicates the average annual precipitation;
- The “whiskers”, each of length 1.5 times the inter-quartile range (which is the 75th minus the 25th percentile values) indicate the range of expected readings above and below each “box”. Values above and below the “whiskers” are considered to be outliers; and
- Individual yearly outlier values are indicated as blue crosses with values adjacent.

Details of the annual precipitation analysis are given in Attachment 2.1.

2.2 MONTHLY PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township dataset were summed in a manner similar to that described in Section 2.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). As described in Section 2.1, data exclusions were made to prevent sampling bias. Sampling statistics were computed on the values to describe the variability of monthly precipitation at the project site, as given in Table 2.2.

Table 2.2: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	25th Pct. (mm)	75th Pct. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0	0	0
Feb	3	0	15	0	102	0	0	0
Mar	5	1	14	0	96	0	5	1
Apr	26	21	22	0	100	9	38	4
May	102	94	70	12	386	54	141	9
Jun	100	72	79	0	342	42	129	9
Jul	67	59	43	2	182	34	83	8
Aug	121	103	80	0	356	64	172	10
Sep	166	150	89	47	496	99	212	11
Oct	142	136	95	15	513	83	180	10
Nov	33	12	44	0	186	0	45	3
Dec	6	0	17	0	85	0	2	1

*1 Incomplete data from 1995 (January – June), 1999 (January – April) and 2013 (June – December) were excluded from this analysis.

The sample statistics for monthly precipitation from the Monywa Township dataset were also depicted as a “box and whisker” plot to illustrate the variability of monthly precipitation at the project site, as shown on Figure 2.2. September is the wettest month of the year onsite and the primary wet season starts (on average) about the beginning of April and finishes at the end of November. Accordingly, the wet season typically lasts 8 months out of each year, with the remaining 4 months experiencing negligible rainfall. Details of the monthly precipitation analysis are given in Attachment 2.2.

2.3 DAILY PRECIPITATION ANALYSIS

KP performed frequency analysis on daily precipitation data (from the Monywa dataset) to estimate the statistical likelihood of experiencing extreme short-duration storms at the project site. A large number of different probability distributions, e.g.: Log-Pearson 3, Generalised Extreme Value (GEV), Generalised Logistic, Wakeby, Burr, etc. were fitted to the annual maxima of the daily precipitation data using EasyFit Professional 5.4 software (Ref. 1).

Three of the best fits were selected for comparison, as shown on Figure 2.3. Based on the comparison, and to maintain compatibility with other *n* day duration frequency analyses, discussed in Section 2.6, KP selected the GEV fit for use at the Letpadaung site. The results of the GEV fit to historic precipitation records are given in Table 2.3 and details of the daily precipitation frequency analysis are given in Attachment 2.3.

KP notes that frequency is generally expressed as Average Recurrence Interval (ARI), measured in years.

Table 2.3: Extreme daily (24-h) design precipitation

Annual Exceedance Probability (AEP)[*1]	Annual Recurrence Interval (ARI) (yr)	24-h Duration Precipitation	
		Uncorrected Depth (mm)	Corrected[*2] Depth (mm)
0.001	1,000	194	222
0.002	500	184	211
0.005	200	170	195
0.010	100	159	182
0.020	50	147	168
0.050	20	131	149
0.100	10	117	134
0.200	5	102	117
0.500	2	79	90

*1 AEP calculated using the Weibull probability plotting formulation.

*2 Values have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

KP utilized the daily design precipitation information in Table 2.3 to derive Intensity / Duration / Frequency (IDF) curves for short duration storms. The rainfall ratio method as given in (Ref. 3) was employed for this purpose. By using tabulated fitting coefficients from (Ref. 4) for the most similar (in climate) listed location (Phnom Penh, Cambodia) and correction factors for 24, 48 and 72 hour duration storms taken from (Ref. 2); KP obtained estimates for the Letpadaung project site, as given in Table 2.4 and illustrated on Figure 2.4.

(KP notes that the world maximum intensity / duration envelope, taken from (Ref. 5) is shown on Figure 2.4 for purposes of comparison.)

Table 2.4: Letpadaung intensity / duration / frequency results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm[*1]							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16

*1 Intensity values are shown rounded to the nearest mm/h.

Table 2.4: Letpadaung intensity / duration / frequency results, cont'd

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm[*1]							
	2	5	10	20	50	100	200	500
18 h	5	6	7	8	9	10	10	11
24 h[*2]	4	5	6	6	7	8	8	9
48 h[*3]	2	3	3	4	5	5	6	6
72 h[*4]	2	2	3	3	4	4	5	6

*1 Intensity values are shown rounded to the nearest mm/h.

*2 Intensity values for 24 hour duration storms have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

*3 Intensity values for 48 hour duration storms have been augmented 6.7% (Ref. 2).

*4 Intensity values for 72 hour duration storms have been augmented 4.4% (Ref. 2).

Details of the IDF curve analysis are given in Attachment 2.4.

2.4 TEMPORAL DISTRIBUTION OF PRECIPITATION

KP analysed the hourly precipitation data from the Wind Rose sampling point dataset (2010-2012) to determine the temporal distributions (i.e. hyetographs) of short-duration storms to be used with the IDF results from Section 2.3 in rainfall-runoff modelling. For candidate storm durations ranging from 2 to 45 hours (the longest storm identified in the historic dataset was 45 hours), the hyetograph analysis entailed the following steps:

- Delineate all storms of *n* duration (where *n* is the candidate duration, measured in integer hours).
- Convert hourly readings within each delineated storm of *n* duration to a cumulative percentage basis; this puts the *n* hour storms on a dimensionless basis.
- Select all *n* hour dimensionless storms with total precipitation equal to or exceeding the 85th percentile of all *n* hour storms; which restricts derived hyetal patterns to those associated with heavy rainfall. Then, compute averages for every hour within the selected subset of *n* hour storms. The results of these computations are the dimensionless design hyetographs to be used in rainfall-runoff modelling.

The results of the analysis for a subset of the storms considered (durations ranging between 2 and 9 hours) are given in Table 2.5, with a typical hyetograph (for 4 hour storms) shown on Figure 2.5. Complete results of the Letpadaung hyetograph analysis (i.e. tabulated patterns for all 24 derived durations with corresponding hyetographs) are given in Attachment 2.5.

Table 2.5: Letpadaung hyetograph results for 2 through 9 hour storms

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	55.3%	22.9%	15.3%	6.6%	8.1%	6.7%	0.9%	3.8%
2	100.0%	77.0%	56.2%	37.2%	24.3%	19.0%	4.7%	13.7%
3		100.0%	90.1%	67.8%	45.3%	43.0%	15.6%	34.9%
4			100.0%	93.7%	76.5%	70.1%	51.5%	63.4%
5				100.0%	97.1%	88.5%	73.8%	81.3%

Table 2.5: Letpadaung hyetograph results for 2 through 9 hour storms, cont'd

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
6					100.0%	98.4%	88.3%	88.9%
7						100.0%	97.5%	93.7%
8							100.0%	97.8%
9								100.0%

KP notes that hyetographs for intermediate durations may be estimated via interpolation, after the bounding storms have been put on a dimensionless temporal basis. Storm hyetographs for durations outside of the range given in Attachment 2.5 may be assumed as follows:

- Durations less than 2 hours should employ the 2 hour duration hyetograph, after scaling to the smaller duration;
- Durations in the range (45 h ≤ n ≤ 72 h) should employ the 45 hour duration hyetograph, after scaling to the larger duration; and
- Durations greater than 72 hours should not employ the derived hyetographs. Additional studies are required to estimate design hyetographs for long duration continuous storms.

2.5 PRECIPITATION TREND ANALYSIS

KP performed trend analysis on annual precipitation totals from the Monywa Township dataset (1961-2013) in order to ascertain potential impacts of trends in precipitation on planned site development. The results of this analysis, illustrated on Figure 2.6, show that there is no statistically significant trend observable in annual precipitation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future precipitation cycles due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 2.6.

2.6 WATER BALANCE SCENARIOS

KP performed frequency analysis on precipitation values for 15 candidate water balance cycle durations to estimate the statistical likelihood of experiencing extremely "Wet" or "Dry" years at the Letpadaung site. The durations considered include:

- Long duration cycles of 1, 2, 3, 4 and 5 years and
- Short duration cycles of 2, 3, 4, 7, 14, 30, 60, 90, 120 and 180 days.

Exceedance and non-exceedance probabilities were assigned to the n (year or day) totals of daily precipitation values, by sorting the values in descending (for the "Wet" series) and ascending (for the "Dry" series) order. The requisite frequency analyses were then conducted in a manner similar to that described in Section 2.3.

For each of the candidate water balance cycle durations, the three best fitting probability distributions were selected for comparison. Based on the comparison, the probability distribution which fits Monywa Township (1961-2013) historical data best for all considered durations is the Generalised Extreme Value (GEV) distribution. Details of the water balance scenario frequency analysis are given in Attachment 2.7.

In order to apportion the statistically-computed climate cycle precipitation totals to daily time series for use in water balance modelling, the wettest (or wettest and driest, in the case of

the 1 year duration cycle) *n* (year or day) continuous records of historical rainfall in the Monywa Township (1963-2013) dataset were identified and converted to series of cumulative daily percentages (of total observed rainfall). These series were then multiplied by the 100 and 500 year ARI depths (for each duration *n*) to derive 32 daily water balance scenarios, which are detailed in Attachment 2.8. A summary of the derived scenarios is given in Table 2.6.

Table 2.6: Letpadaung water balance scenario summary

Scenario	100-yr ARI Total Depth (mm)	500-yr ARI Total Depth (mm)	Temporal Pattern Based on
5 Year Wet	5,479	5,839	1973 – 1979
4 Year Wet	4,630	5,083	1973 – 1976
3 Year Wet	3,644	4,083	1975 – 1977
2 Year Wet	2,544	2,844	2010 – 2011
1 Year Wet	1,555	1,902	1973
1 Year Dry	424	383	1982
180 Day Wet	1,437	1,767	25/05/1973 – 20/11/1973
120 Day Wet	1,067	1,272	2/07/2010 – 29/10/2010
90 Day Wet	921	1,101	30/07/1965 – 27/10/1965
60 Day Wet	740	865	29/08/1965 – 27/10/1965
30 Day Wet	520	596	29/09/2010 – 28/10/2010
14 Day Wet	440	563	9/05/2007 – 22/05/2007
7 Day Wet[*1]	343	447	9/05/2007 – 15/05/2007
4 Day Wet[*2]	308	410	1/06/1984 – 4/06/1984
3 Day Wet[*3]	298	401	1/06/1984 – 3/06/1984
2 Day Wet[*4]	214	249	2/06/1984 – 3/06/1984

*1 Scenario totals for 7 day duration cycles have been augmented 1.8% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily design storm estimates (Ref. 2).

*2 Scenario totals for 4 day duration cycles have been augmented 3.4% (Ref. 2).

*3 Scenario totals for 3 day duration cycles have been augmented 4.4% (Ref. 2).

*4 Scenario totals for 2 day duration cycles have been augmented 6.7% (Ref. 2).

3. EVAPORATION ANALYSIS

Pan evaporation data from the Yangtse climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate.

Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes.

Pan evaporation values may be used to estimate evaporation from natural water bodies (lakes, ponds, etc.). Evaporation from a natural body of water is usually at a lower rate because the body of water does not have metal sides that get hot with the sun. Also, while light penetration in a pan is essentially uniform, light penetration in natural bodies of water decreases with depth. Accordingly, lake evaporation can be estimated by multiplying pan evaporation by a coefficient, which may be assumed as 0.7 in lieu of experimentally calibrated results.

The following sections detail the various analyses conducted and the results achieved.

3.1 ANNUAL EVAPORATION ANALYSIS

Monthly pan evaporation records from the Yangtse climate station were summed to produce annual totals for the entire period of available record. Recorded data from 2007 and onwards was excluded from consideration because the evaporation trend analysis, discussed in Section 3.3, revealed an unexplained shift in recorded values between 2006 and 2007. If the full dataset were to be used "as is", spurious analysis results are likely.

Sampling statistics were computed on these annual sums from the reduced dataset (2000-2006) to provide a broad overview of the typical variability of annual pan evaporation in the region surrounding the project site, as given in Table 3.1.

Table 3.1: Annual pan evaporation statistics – Yangtse climate station (2000-2006)

Selected Statistic	Statistic Value
Average (mm)	2,017
Median (mm)	2,051
Std. Deviation (mm)	75
Minimum (mm)	1,922
Maximum (mm)	2,109
25^{th} Percentile (mm)	1,951
75^{th} Percentile (mm)	2,067
Count (yr)	7
Distance to site (km)	7.6

The sample statistics for annual precipitation at this site were also depicted graphically, as a "box and whisker" plot, as shown on Figure 3.1. Details of the annual pan evaporation analysis are given in Attachment 3.1.

3.2 MONTHLY EVAPORATION ANALYSIS

Monthly pan evaporation from the Yangtse climate station was employed in this analysis. As discussed in Section 3.1, recorded data from 2007 and onwards was excluded from consideration. Sampling statistics were computed on these values to describe the variability of monthly pan evaporation at the project site, as given in Table 3.2.

Table 3.2: Monthly pan evaporation statistics – Yangtse climate station (2000-2006)

Month[*1]	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	123	121	5	119	134	121	122
Feb	149	151	13	130	166	141	158
Mar	210	213	14	188	224	201	220
Apr	228	236	21	191	248	218	242
May	202	205	43	118	256	197	223
Jun	203	187	36	165	270	181	219
Jul	172	174	12	153	187	166	180
Aug	184	175	38	133	248	167	198
Sep	160	150	27	128	208	145	173
Oct	145	148	27	102	184	132	157
Nov	125	130	17	102	146	111	137
Dec	117	112	12	98	131	110	127

*1 All computed pan evaporation statistics are measured in (mm).

The sample statistics for monthly pan evaporation were also depicted as a “box and whisker” plot, as shown on Figure 3.2. A cyclical pattern was observed, with the greatest pan evaporation occurring in April and the smallest in December. Details of the monthly pan evaporation analysis are given in Attachment 3.2.

3.3 EVAPORATION TREND ANALYSIS

KP performed trend analysis on annual pan evaporation totals from the Yangtse climate station dataset (2000-2013) in order to ascertain potential impacts of trends in pan evaporation on planned site development. The results of this analysis, illustrated on Figure 3.3, show a statistically significant negative trend. However, further inspection of the data showed an unexplained downshift of nearly 600 mm in annual average pan evaporation between 2006 and 2007.

A shift this large is highly unusual, if not impossible, in nature. Therefore, an attempt was made to try and find an explanation for this behaviour. As no records of a sudden shift in pan evaporation of this magnitude were found for this period in Myanmar, KP efforts shifted to trying to determine which sub-period in the provided historical dataset, either (2000-2006) or (2007-2012) was most likely.

A contour map of iso-lines of equal lake evaporation for Myanmar was obtained from (Ref. 6). This map, reproduced as Figure 3.4, shows that annual average lake evaporation at Monywa City is approximately 1,600 mm/yr, which converts to an equivalent 2,300 mm/yr after application of a 0.7 pan coefficient, which is considerably closer to the average annual evaporation of the first sub-period rather than the second. Based on this observation, KP selected the (2000-2006) period for estimating site pan evaporation values. The data from the second (2007-2012) period was excluded from further consideration.

Focusing on the (2000-2006) period, there is no statistically significant trend observable in annual pan evaporation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future pan evaporation due to observed climate change.

Details of the pan evaporation trend analysis are given in Attachment 3.3.

3.4 COMPARISON OF PRECIPITATION & EVAPORATION

Average monthly values of precipitation (taken from Section 2.2) and pan evaporation (taken from Section 3.2) were compared to determine if the Letpadaung site is expected to run with a surplus of water from precipitation or if an annual deficit is expected. The results of this comparison are summarised in Table 3.3 and illustrated on Figure 3.5.

Table 3.3: Comparison of monthly average precipitation & evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake[*1] Evaporation (mm)	Precip. minus Lake Evap. (mm)
Jan	2	123	86	-84
Feb	3	149	105	-101
Mar	5	210	147	-142
Apr	26	228	160	-134
May	102	202	142	-40
Jun	100	203	142	-42
Jul	67	172	121	-54
Aug	121	184	129	-7
Sep	166	160	112	54
Oct	142	145	101	50
Nov	33	125	87	-55
Dec	6	117	82	-75
Totals	773	2,017	1,412	-639

*1 Assumed pan coefficient = 0.7.

As Table 3.3 clearly shows, the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Additional details of this comparison are provided in Attachment 3.4.

4. TEMPERATURE ANALYSIS

Average daily temperature data from the WMO 48037 climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate. The following sections detail the various analyses conducted and the results achieved.

4.1 ANNUAL TEMPERATURE ANALYSIS

Daily average temperature records from the WMO 48037 climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias. Sampling statistics were computed on these annual sums, as given in Table 4.1.

Table 4.1: Annual average temperature statistics – WMO 48037 station (1981-2012)

Selected Statistic	Statistic*1 Value
Average (°C)	27.8
Median (°C)	27.8
Std. Deviation (°C)	0.8
Minimum (°C)	26.1
Maximum (°C)	29.7
25th Percentile (°C)	27.2
75th Percentile (°C)	28.2
Count (yr)	25
Distance to site (km)	4.7

*1 Incomplete data from 1981, 1986-1989, 1992 and 2012 were excluded from this analysis.

The sample statistics for annual average precipitation at this site were also depicted graphically, as a "box and whisker" plot, as shown on Figure 4.1.

Details of the annual average temperature analysis are given in Attachment 4.1.

4.2 MONTHLY TEMPERATURE ANALYSIS

Daily temperature records from the WMO 48037 dataset were summed in a manner similar to that described in Section 4.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). This was done to prevent sampling bias. Sampling statistics were computed on these values, as given in Table 4.2.

Table 4.2: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month*1	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	21.9	21.9	1.9	18.4	28.0	21.2	22.5
Feb	24.0	23.6	2.3	21.1	32.9	23.0	24.8
Mar	28.1	28.0	2.3	23.1	35.5	27.0	29.2
Apr	30.9	30.9	1.4	25.9	33.1	30.3	31.7
May	31.0	31.0	1.4	28.1	33.8	30.4	31.7
Jun	30.6	30.5	1.1	27.8	32.9	29.9	31.3
Jul	30.5	30.8	1.2	26.8	32.5	30.1	31.3
Aug	29.9	29.8	1.0	28.4	32.1	29.2	30.6
Sep	29.3	29.3	0.7	27.8	30.4	28.8	29.8
Oct	28.0	28.	0.7	26.5	29.8	27.6	28.4
Nov	25.1	25.3	1.1	23.0	27.6	24.4	25.8
Dec	22.2	22.0	1.9	18.4	28.0	21.3	22.9

*1 All computed temperature statistics are measured in (°C).

The sample statistics for monthly average temperature from the WMO 48037 dataset were also depicted as a "box and whisker" plot, as shown on Figure 4.2. The hottest month (on

average) each year is May, with a cyclical pattern shown. Details of the monthly average temperature analysis are given in Attachment 4.2.

Monthly ranges in temperature were also analysed by computing monthly averages on daily temperature maxima and minima. The results of this analysis are given in Table 4.3 and are illustrated on Figure 4.3.

Table 4.3: Monthly temperature ranges – WMO 48037 station (1981-2012)

Month*1	Max.	Average	Min.
Jan	28.5	21.9	15.4
Feb	31.6	24.0	16.9
Mar	36.0	28.1	20.5
Apr	38.4	30.9	24.0
May	36.8	31.0	25.5
Jun	35.4	30.6	26.0
Jul	35.5	30.5	26.1
Aug	34.3	29.9	25.7
Sep	33.4	29.3	25.3
Oct	32.5	28.0	23.8
Nov	30.4	25.1	19.9
Dec	28.0	22.2	16.4

*1 All computed temperature statistics are measured in (°C).

Temperatures are fairly consistent for six months of the year: April through September. The other four "shoulder" months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January. Details of the monthly temperature range analysis are given in Attachment 4.3.

4.3 TEMPERATURE TREND ANALYSIS

KP performed trend analysis on annual average temperature totals from the WMO 48037 dataset (1981-2012) in order to ascertain potential impacts of trends in temperature on planned site development. The results of this analysis, illustrated on Figure 4.4, show that there is no statistically significant trend observable in annual average temperature values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future temperature due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 4.4.

5. WIND ROSE ANALYSIS

Wind speed and direction data from the Wind Rose sampling point dataset were analysed using WindRose Pro 3.01 software (Ref. 7). Hourly data spanning the historic period (2010-2012) were used as inputs to the program to produce wind rose plots. Each concentric circle on a wind rose plot represents a different frequency, starting at zero in the center and increasing as the circles move outwards. The direction of each "spoke" indicates the cardinal direction that winds are blowing *from* over the historic period analysed. Additionally, the colours of portions of each spoke indicate the speed with which the wind blows from in a particular direction.

The hourly wind data were used to prepare nine wind rose plots, as follows:

- All wind measurements are shown on Figure 5.1;
- Wind measurements for the period (00:00 – 03:00) are shown on Figure 5.2;
- Wind measurements for the period (03:00 – 06:00) are shown on Figure 5.3;
- Wind measurements for the period (06:00 – 09:00) are shown on Figure 5.4;
- Wind measurements for the period (09:00 – 12:00) are shown on Figure 5.5;
- Wind measurements for the period (12:00 – 15:00) are shown on Figure 5.6;
- Wind measurements for the period (15:00 – 18:00) are shown on Figure 5.7;
- Wind measurements for the period (18:00 – 21:00) are shown on Figure 5.8; and
- Wind measurements for the period (21:00 – 00:00) are shown on Figure 5.9.

Wind rose data may be used for noise and dust analysis as well as for siting airstrips and for calculating fetch lengths for wave run-up calculations that are used in pond / dam sizing.

Details of the wind rose analysis are given in Attachment 5.1. The two years of available data indicate that at Letpadaung, winds blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s which, on the Beaufort scale is classified as 2 "light breeze". Maximum recorded wind speed during this period is 9.2 m/s, which corresponds to 5 "fresh breeze" on the Beaufort scale.

The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Generally speaking, the data does not indicate that high wind storms are likely at this site.

6. SUMMARY / CONCLUSIONS

Historic data from four different locations were analysed to derive design values associated with climate parameters of interest: precipitation, evaporation, temperature and wind. The specific design values associated with each climate parameter that have been addressed in this memorandum are listed below.

<u>Precipitation parameters</u>:

- Typical variability of annual precipitation and average number of rain days;
- Typical variability of monthly precipitation and average number of rain days;
- Intensity / Duration / Frequency (IDF) curves for short-duration extreme rainfall events;
- Temporal distributions (i.e. hyetographs) of short-duration precipitation to be used with the IDF curves in rainfall-runoff modelling. Design hyetographs were derived for storm durations ranging from 2 to 45 hours;
- Trend analysis of annual precipitation totals, for ascertaining potential impacts of climate trends on site development; and
- Daily precipitation amounts for 32 climate scenarios (15 durations x 2 storm frequencies for each duration, with the 1 year scenario considered for both Wet and Dry cycles) to be used with water balance modelling, as follows:
  - 500 year Annual Recurrence Interval (ARI), 5 year duration Wet cycle;
  - 100 year ARI, 5 year duration Wet cycle;
  - 500 year ARI, 4 year duration Wet cycle;
  - 100 year ARI, 4 year duration Wet cycle;
  - 500 year ARI, 3 year duration Wet cycle;
  - 100 year ARI, 3 year duration Wet cycle;
  - 500 year ARI, 2 year duration Wet cycle;
  - 100 year ARI, 2 year duration Wet cycle;
  - 500 year ARI, 1 year duration Wet cycle;
  - 100 year ARI, 1 year duration Wet cycle;
  - 500 year ARI, 1 year duration Dry cycle;

- 100 year ARI, 1 year duration Dry cycle;
- 500 year ARI, 180 day duration Wet cycle;
- 100 year ARI, 180 day duration Wet cycle;
- 500 year ARI, 120 day duration Wet cycle;
- 100 year ARI, 120 day duration Wet cycle;
- 500 year ARI, 90 day duration Wet cycle;
- 100 year ARI, 90 day duration Wet cycle;
- 500 year ARI, 60 day duration Wet cycle;
- 100 year ARI, 60 day duration Wet cycle;
- 500 year ARI, 30 day duration Wet cycle;
- 100 year ARI, 30 day duration Wet cycle;
- 500 year ARI, 14 day duration Wet cycle;
- 100 year ARI, 14 day duration Wet cycle;
- 500 year ARI, 7 day duration Wet cycle;
- 100 year ARI, 7 day duration Wet cycle;
- 500 year ARI, 4 day duration Wet cycle;
- 100 year ARI, 4 day duration Wet cycle;
- 500 year ARI, 3 day duration Wet cycle;
- 100 year ARI, 3 day duration Wet cycle;
- 500 year ARI, 2 day duration Wet cycle; and
- 100 year ARI, 2 day duration Wet cycle.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for eight months, from April through the end of November. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

Evaporation parameters:

- Typical variability of annual evaporation;
- Typical variability of monthly evaporation; and
- Trend analysis of annual evaporation totals, for ascertaining potential impacts of climate trends on site development.

Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to calculated annual average pan evaporation (2,017 mm). A comparison of precipitation and lake evaporation indicates that the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Adequate water storage and careful management of available water resources will be critical to successful mining operations at Letpadaung.

Temperature parameters:

- Typical variability of annual mean temperature;
- Typical variability of monthly mean temperature, as well as the range of monthly mean temperature between maximum and minimum; and
- Trend analysis of annual temperature averages, for ascertaining potential impacts of climate trends on site development.

Temperatures are fairly consistent during the six warm months of the year: April through September, when the average value is 30.4°C. The other four “shoulder” months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January, when the average temperature is 22.1°C. Minimum temperature generally occurs in January (15.4°C) and the maximum in April (38.4°C).

Wind parameters:

- Typical variability of wind speed and direction on daily and eight sub-daily time periods (each of 3 hours duration), which are illustrated graphically through the use of wind rose plots.

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s, with a maximum of is 9.2 m/s. These correspond to Beaufort scale readings of 2 "light breeze" to 5 "fresh breeze". The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available wind data indicates that high wind storms are unlikely at the Letpadaung site.

We trust that these results are sufficient for any preliminary design computations.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

TODD LEWIS
Lead Engineer, Hydrology and Hydraulics

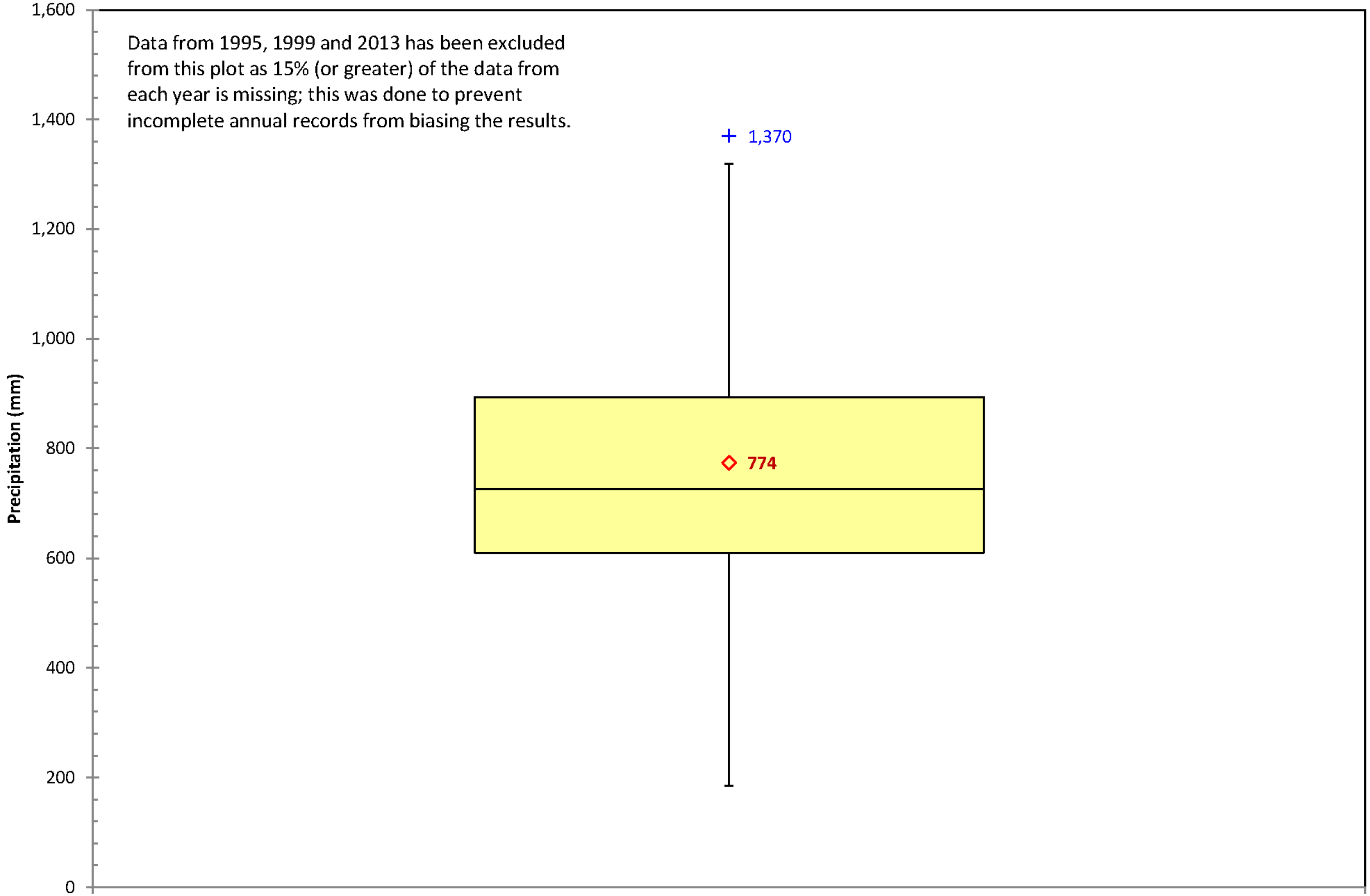
BRETT LONEY
Manager Environmental Services

REFERENCES

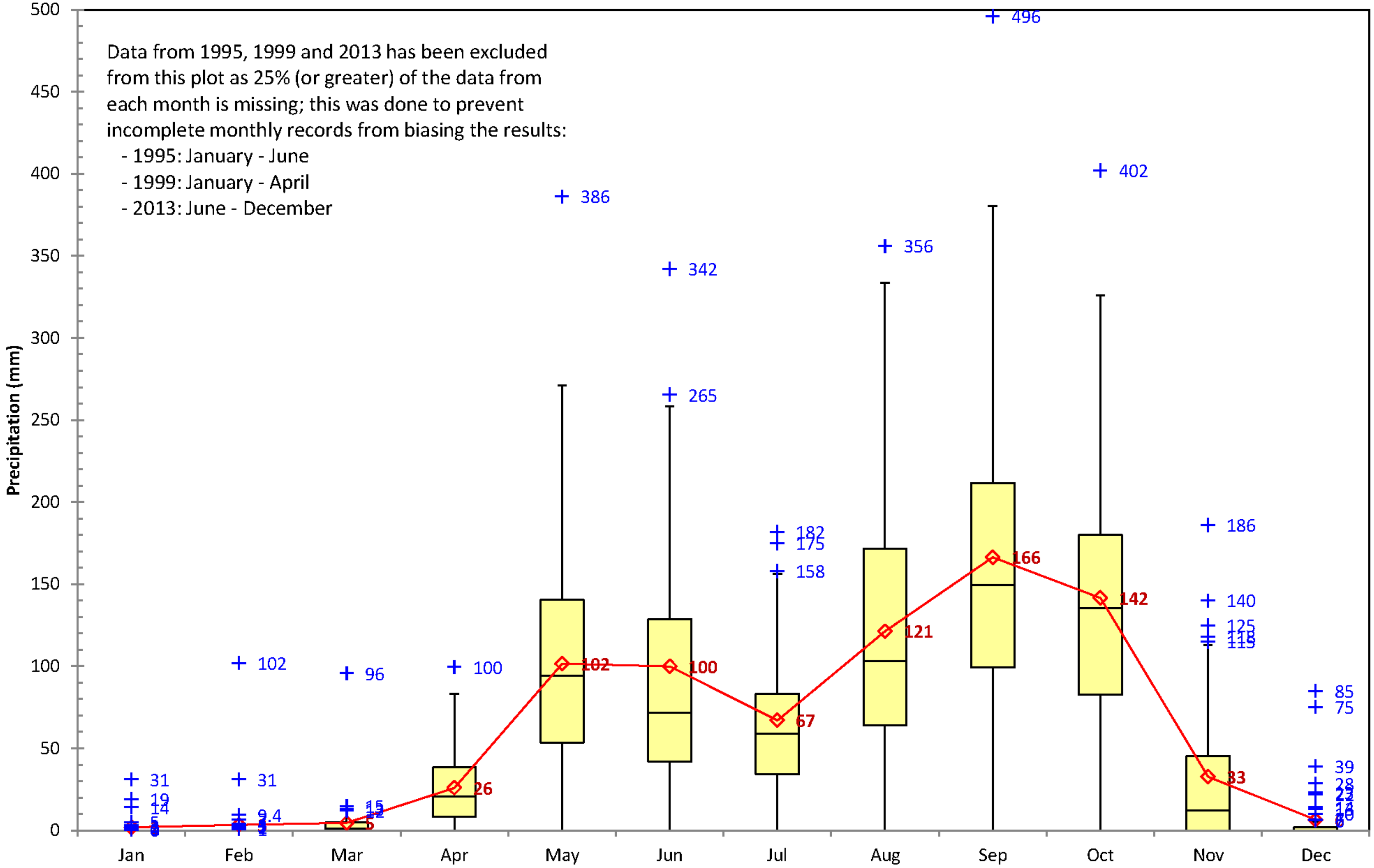
1. MathWave Technologies. *"EasyFit Professional 5.4"*, [computer software], 2010.
2. Weiss, L.L. *"Ratio of true to fixed-interval maximum rainfall"*, American Society of Civil Engineers, Journal of the Hydraulics Division, Volume 90, HY-1, 1964. USA
3. Watkins, L.H & Fiddes, D. *"Highway and Urban Hydrology in the Tropics"*, 1984. London, UK
4. Mekong River Commission. *"Best Practise Guidelines for Flood Risk Assessment"*, 2009. Phnom Penh, Cambodia
5. World Meteorological Organization. *"Manual for estimation of probable maximum precipitation, 2nd edition"*, 1986. Geneva, Switzerland
6. Tun, T. (Myanmar Dept. of Meteorology & Hydrology). *"Satellite Data Utilization in Myanmar for Disaster Prevention and Mitigation"*, Presentation for the 4th Sentinel Asia Joint Project Team Meeting, 2007. Manila, Philippines
7. Enviroware. *"WindRose Pro 3.01.46"*, [computer software], 2013.

FIGURES

LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
LETPADAUNG PROJECT SITE WITH NEARBY CLIMATE STATIONS



1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)
Data from 1995, 1999 and 2013 has been excluded from this plot as 15% (or greater) of the data from each year is missing; this was done to prevent incomplete annual records from biasing the results.
1,370
774



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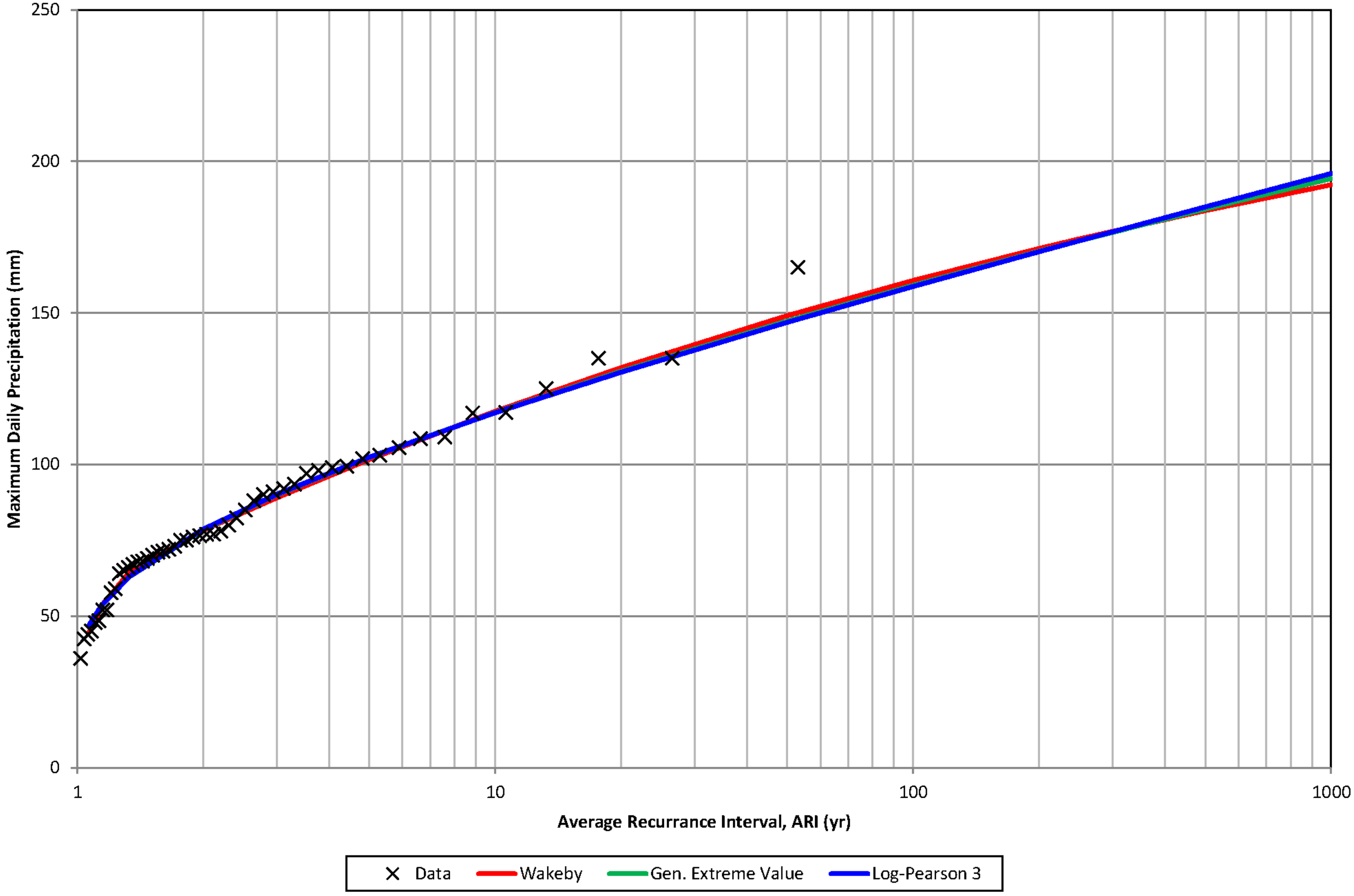
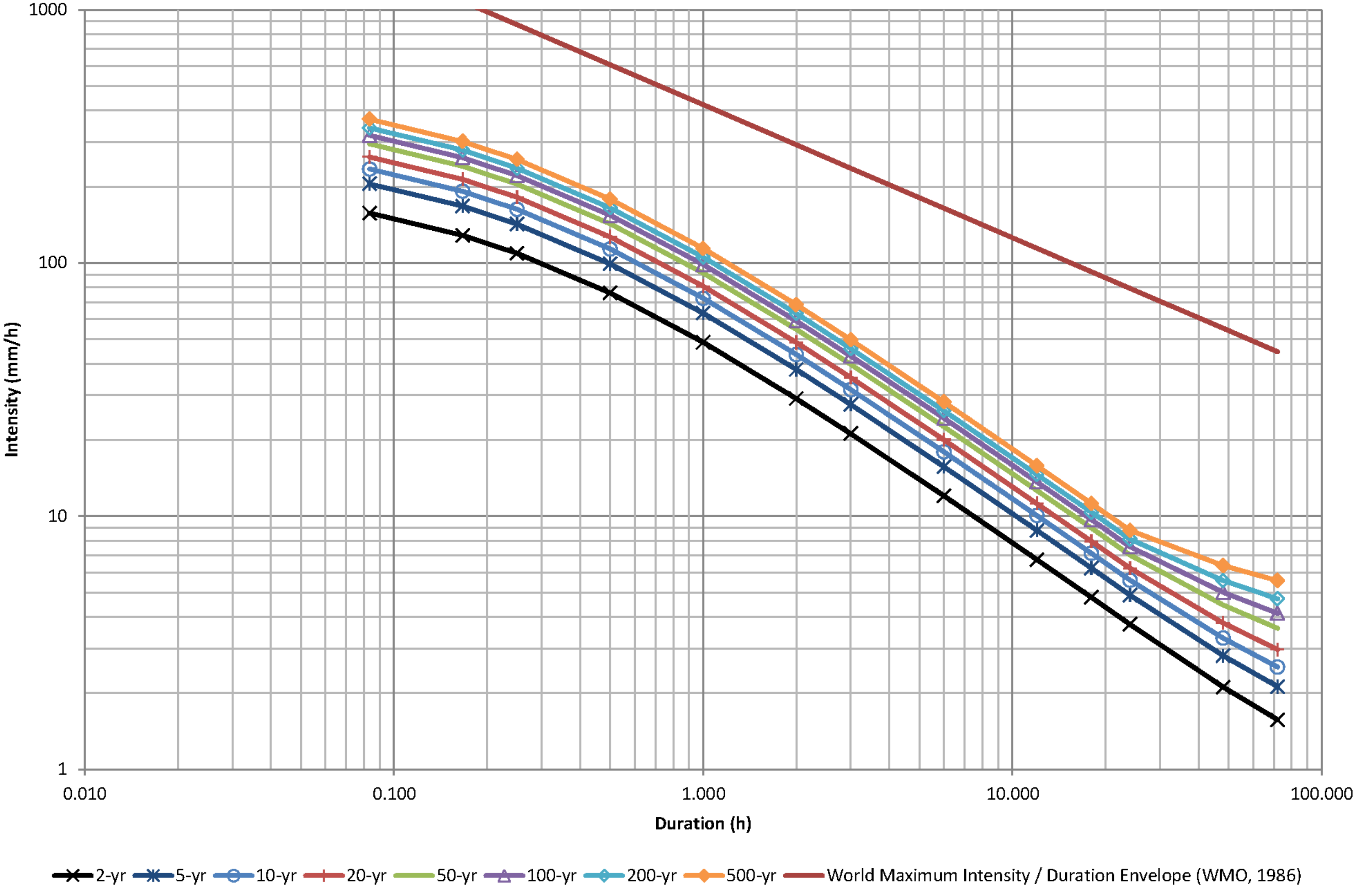
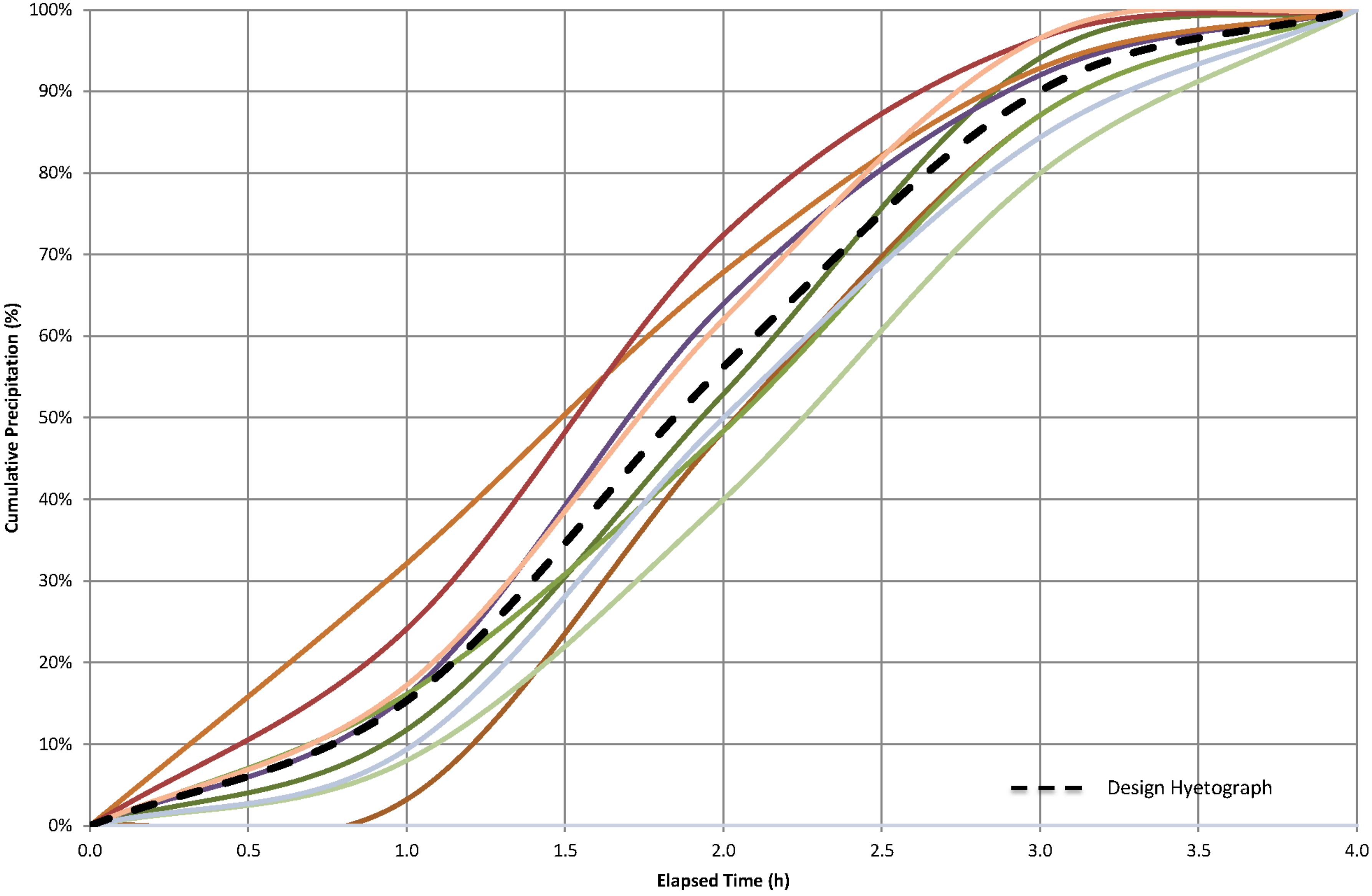
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PRECIPITATION MONTHLY SAMPLE STATISTICS
MONYWA TOWNSHIP (1961-2013)

Ref: PE701-00022 M13010
Figure 2.2


250
200
150
100
50
0
Maximum Daily Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3



1000
100
10
1
0.010
0.100
1.000
10.000
100.000
Intensity (mm/h)
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Intensity / Duration Envelope (WMO, 1986)



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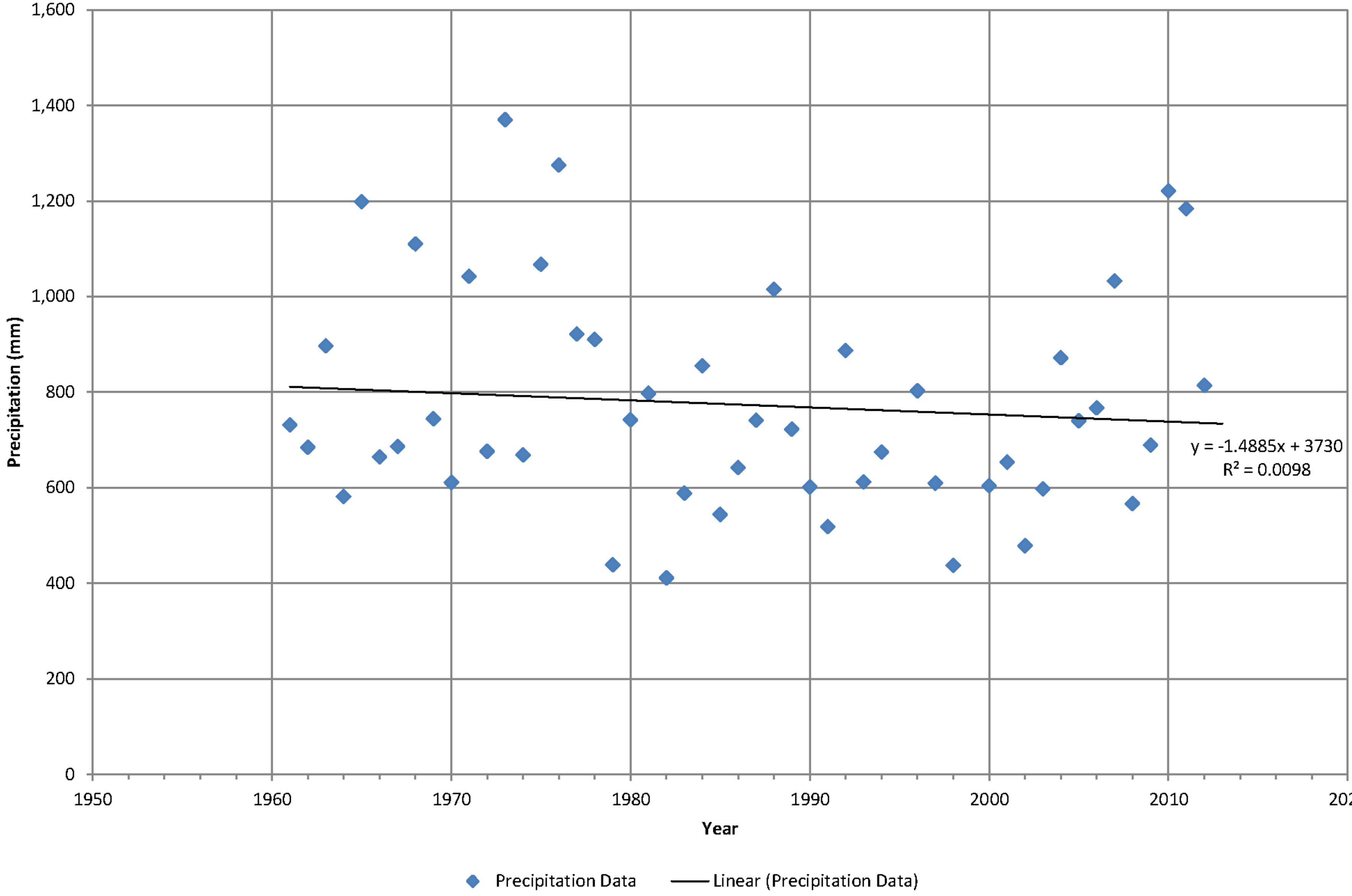
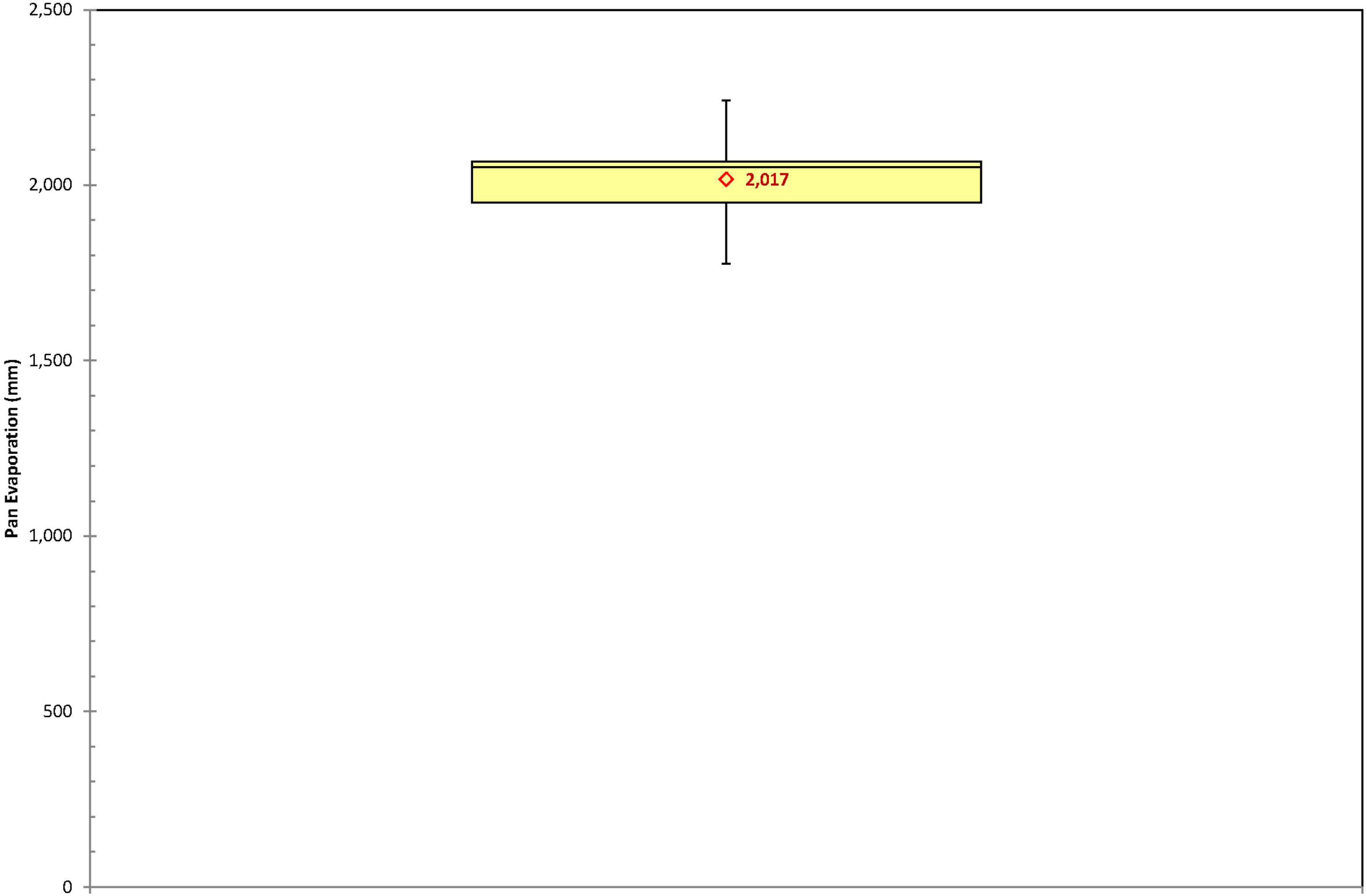
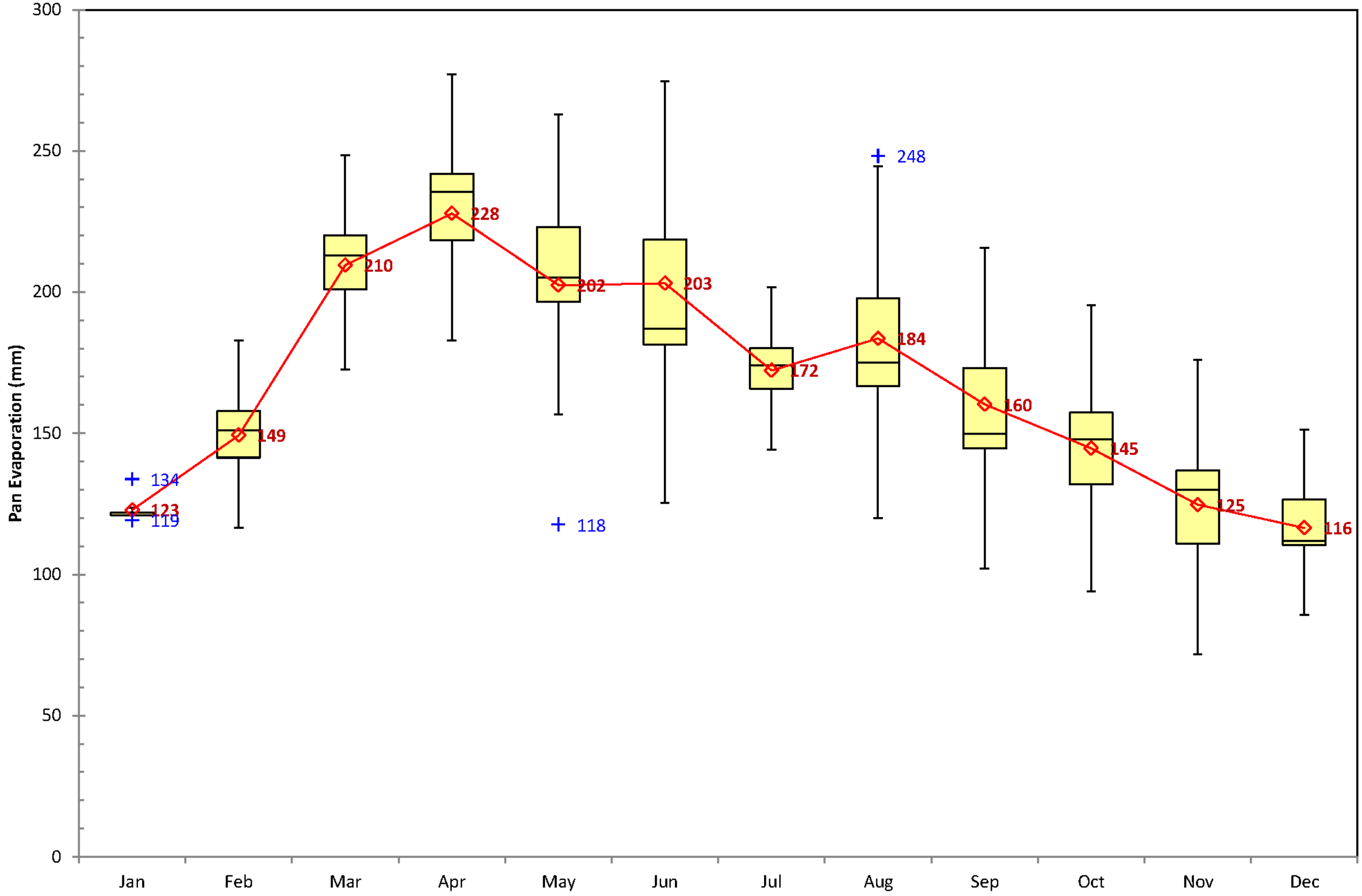
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PRECIPITATION HYETOGRAPH DERIVATION FOR 4 HOUR STORMS
WIND ROSE DATASET (2010-2012)

Ref: PE701-00022 M13010
Figure 2.5



1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)
1950
1960
1970
1980
1990
2000
2010
2020
Year
y = -1.4885x + 3730
R^2 = 0.0098
Precipitation Data
Linear (Precipitation Data)


2,500
2,000
1,500
1,000
500
0
Pan Evaporation (mm)
2,017



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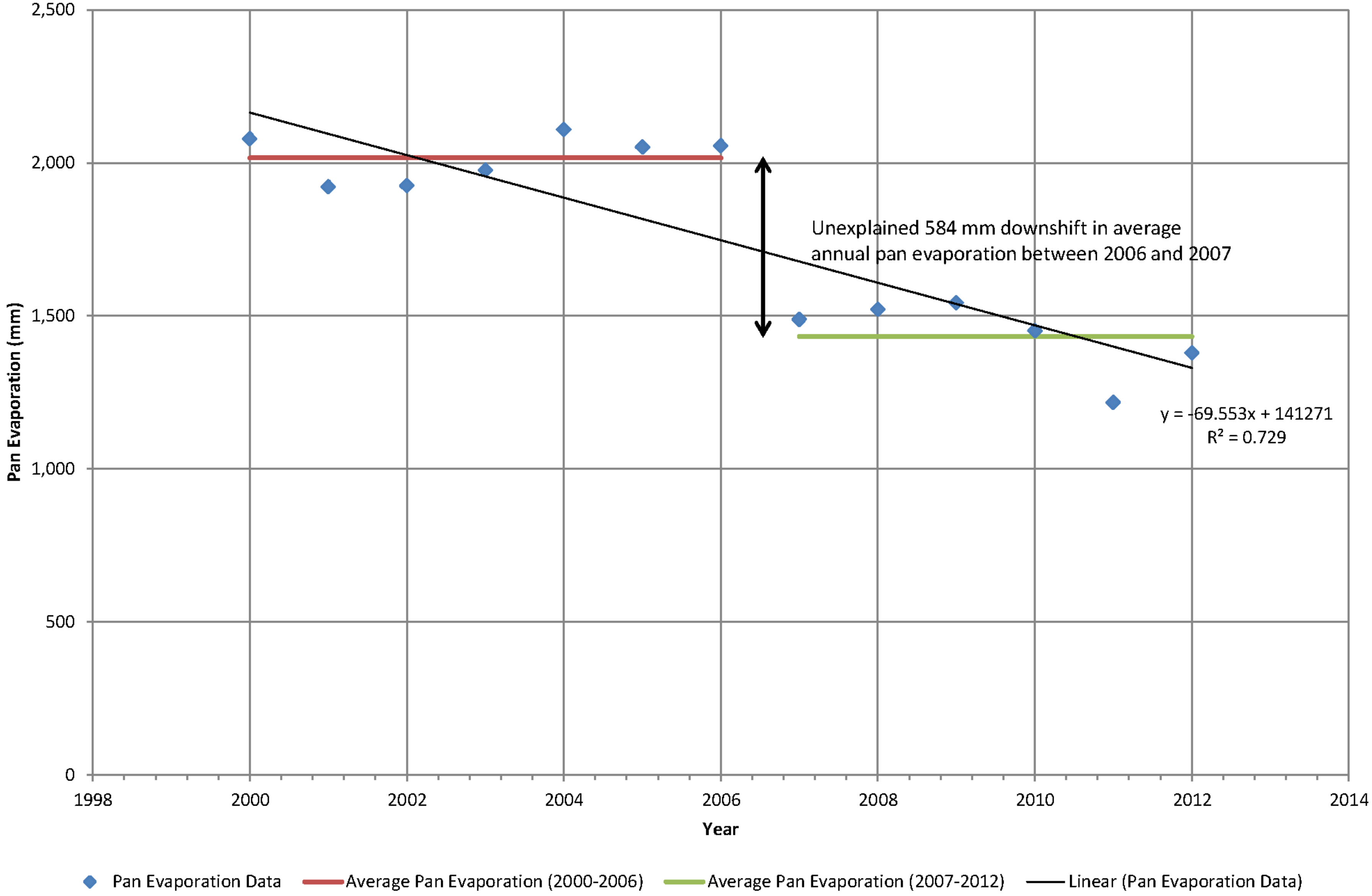
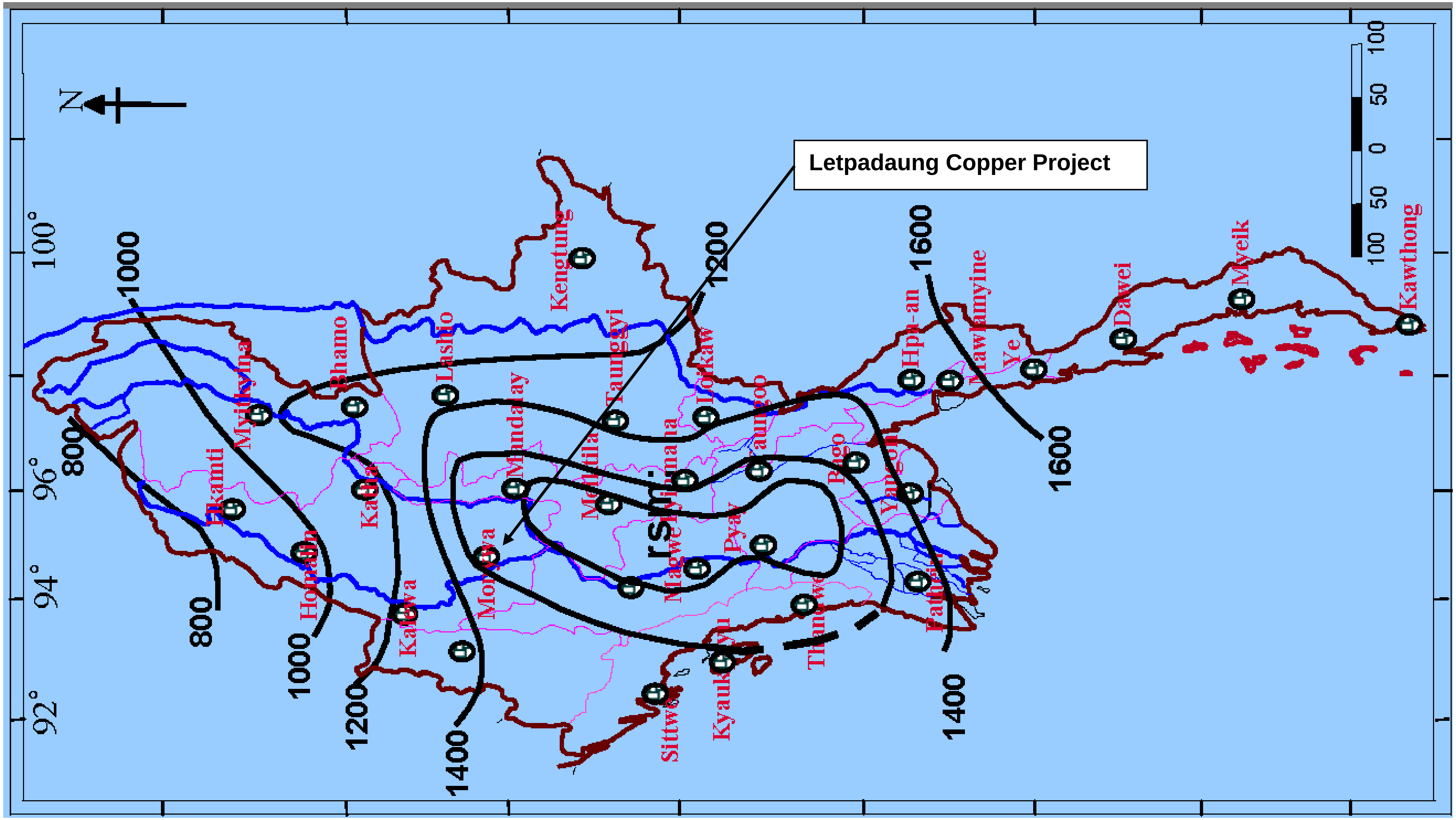
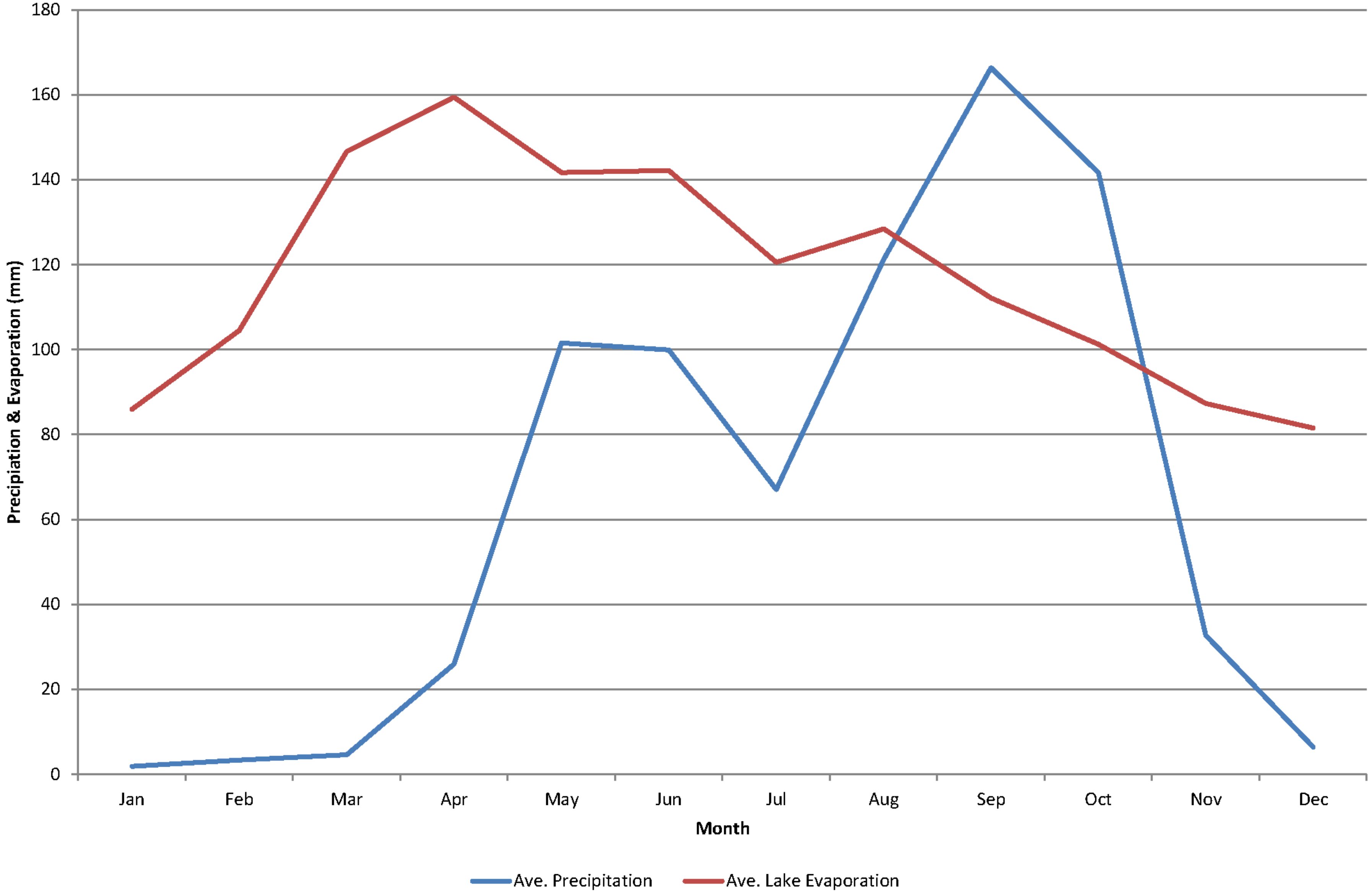
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PAN EVAPORATION MONTHLY SAMPLE STATISTICS
YANGTSE CLIMATE STATION (2000-2006)

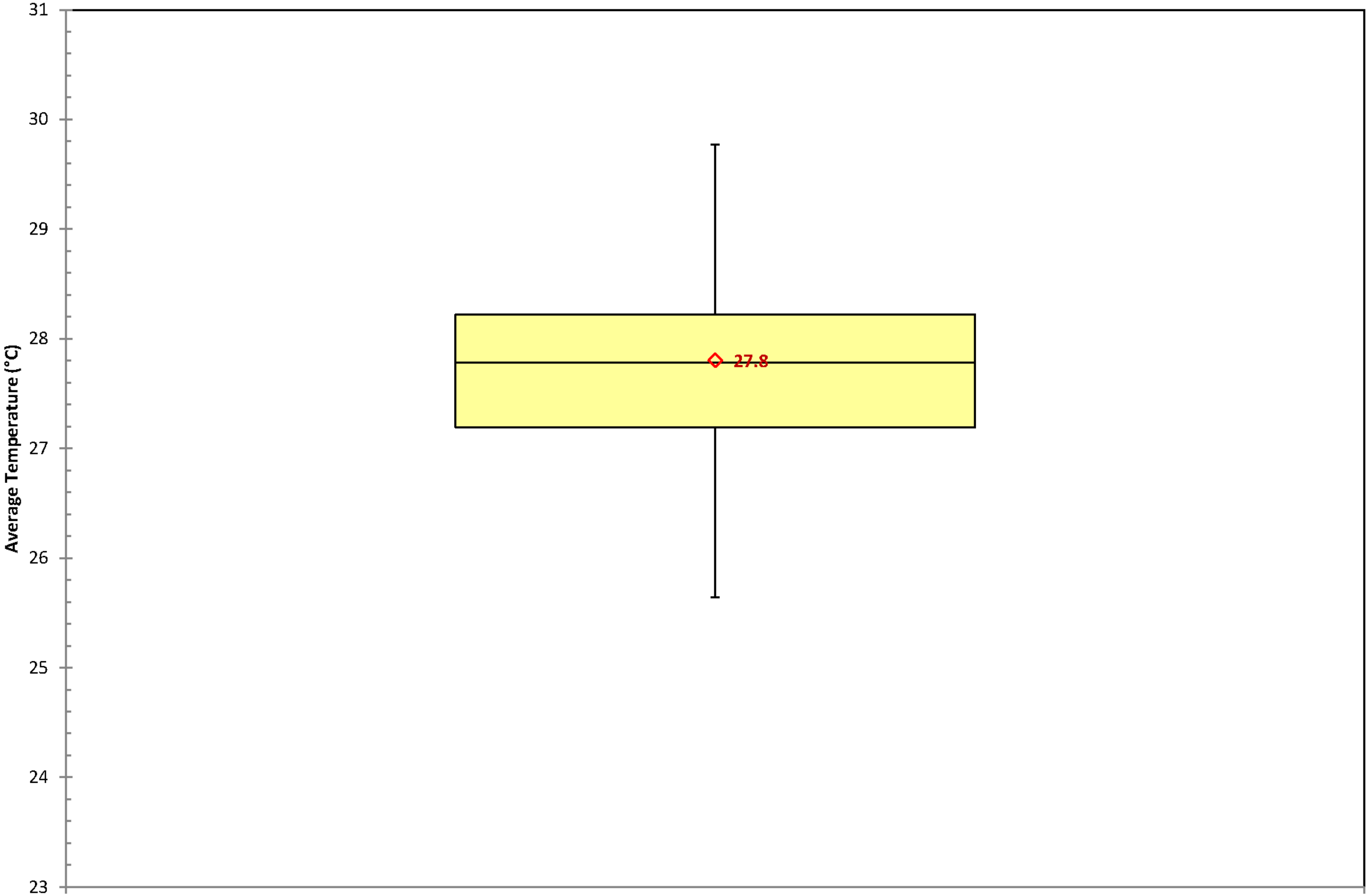
Ref: PE701-00022 M13010
Figure 3.2

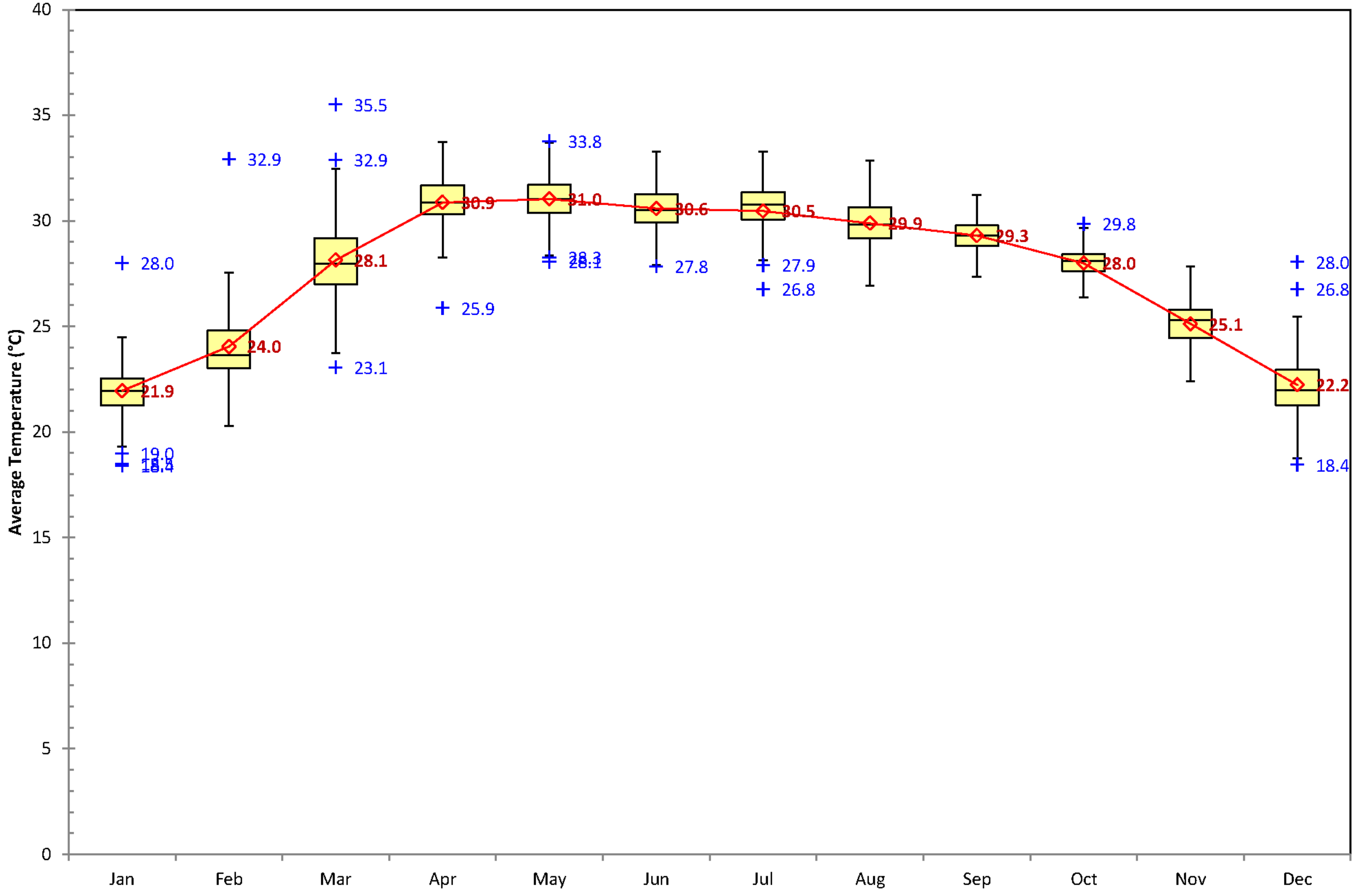


Pan Evaporation (mm)
2,500
2,000
1,500
1,000
500
0
1998
2000
2002
2004
2006
2008
2010
2012
2014
Year
Unexplained 584 mm downshift in average annual pan evaporation between 2006 and 2007
y = -69.553x + 141271
R^2 = 0.729
Pan Evaporation Data
Average Pan Evaporation (2000-2006)
Average Pan Evaporation (2007-2012)
Linear (Pan Evaporation Data)

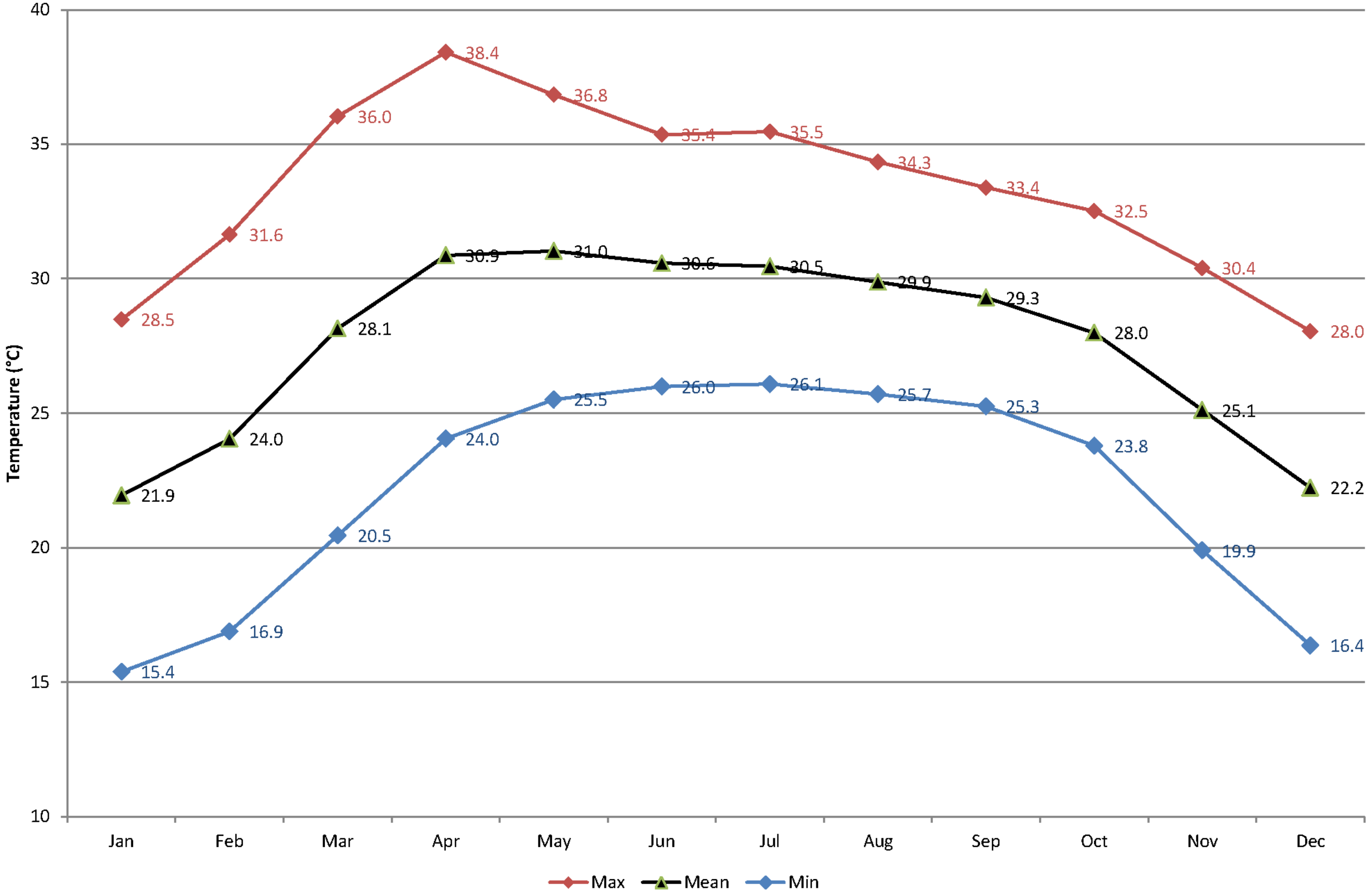

Letpadaung Copper Project
N
100 50 0 50 100
100°
96°
94°
92°
800
1000
1200
1400
1600
Kengtung
Bhamo
Lashio
Mandalay
Taunggyi
Hpa-an
Ye
Dawei
Myeik
Kawthong
Bago
Sittwe
Pyay


180
160
140
120
100
80
60
40
20
0
Precipiation & Evaporation (mm)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Ave. Precipitation
Ave. Lake Evaporation


31
30
29
28
27
26
25
24
23
Average Temperature (°C)
27.8



Average Temperature (°C)
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
28.0
19.0
18.4
32.9
35.5
32.9
23.1
25.9
33.8
28.3
28.1
27.8
27.9
26.8
29.8
28.0
26.8
18.4



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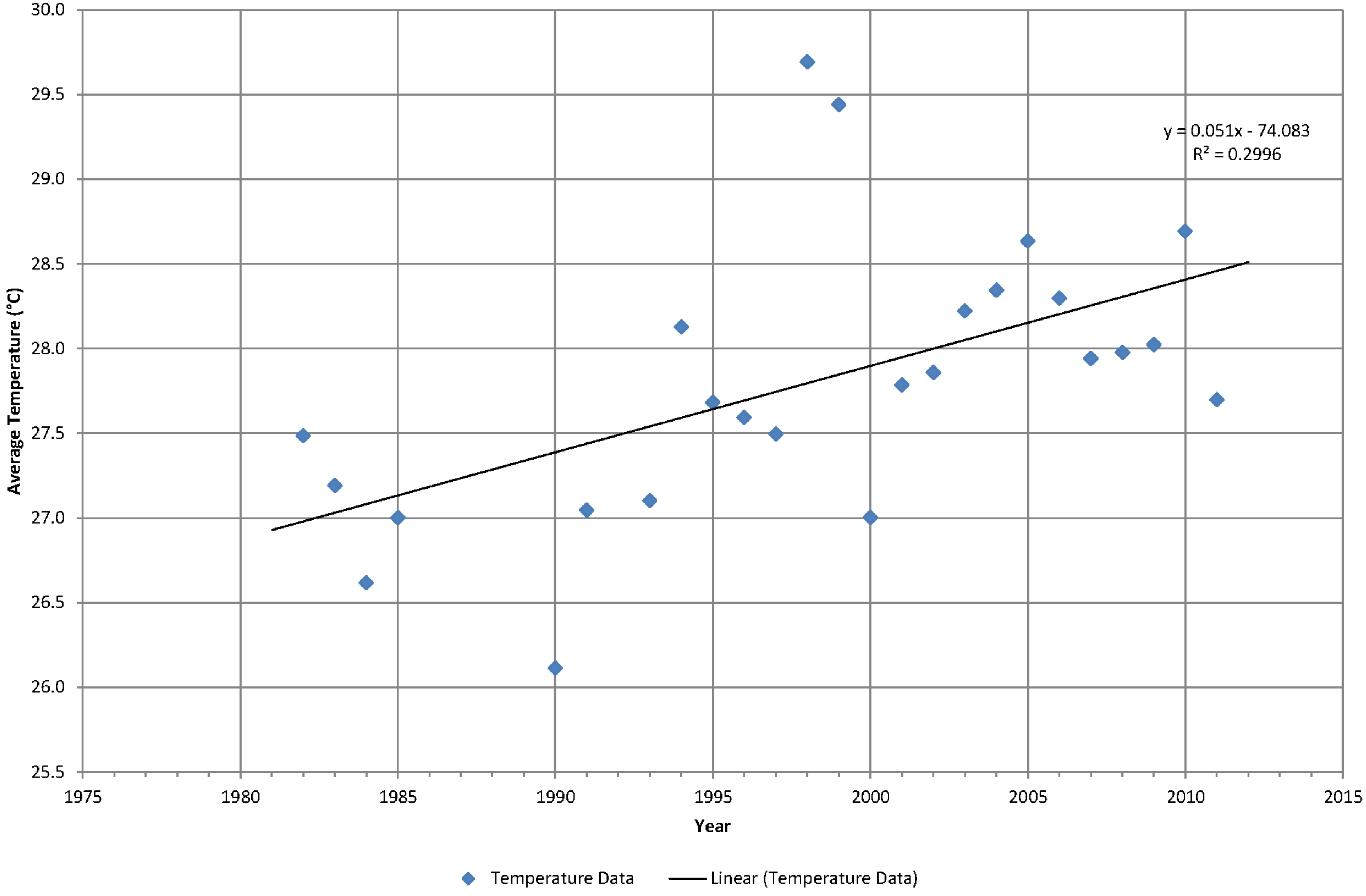
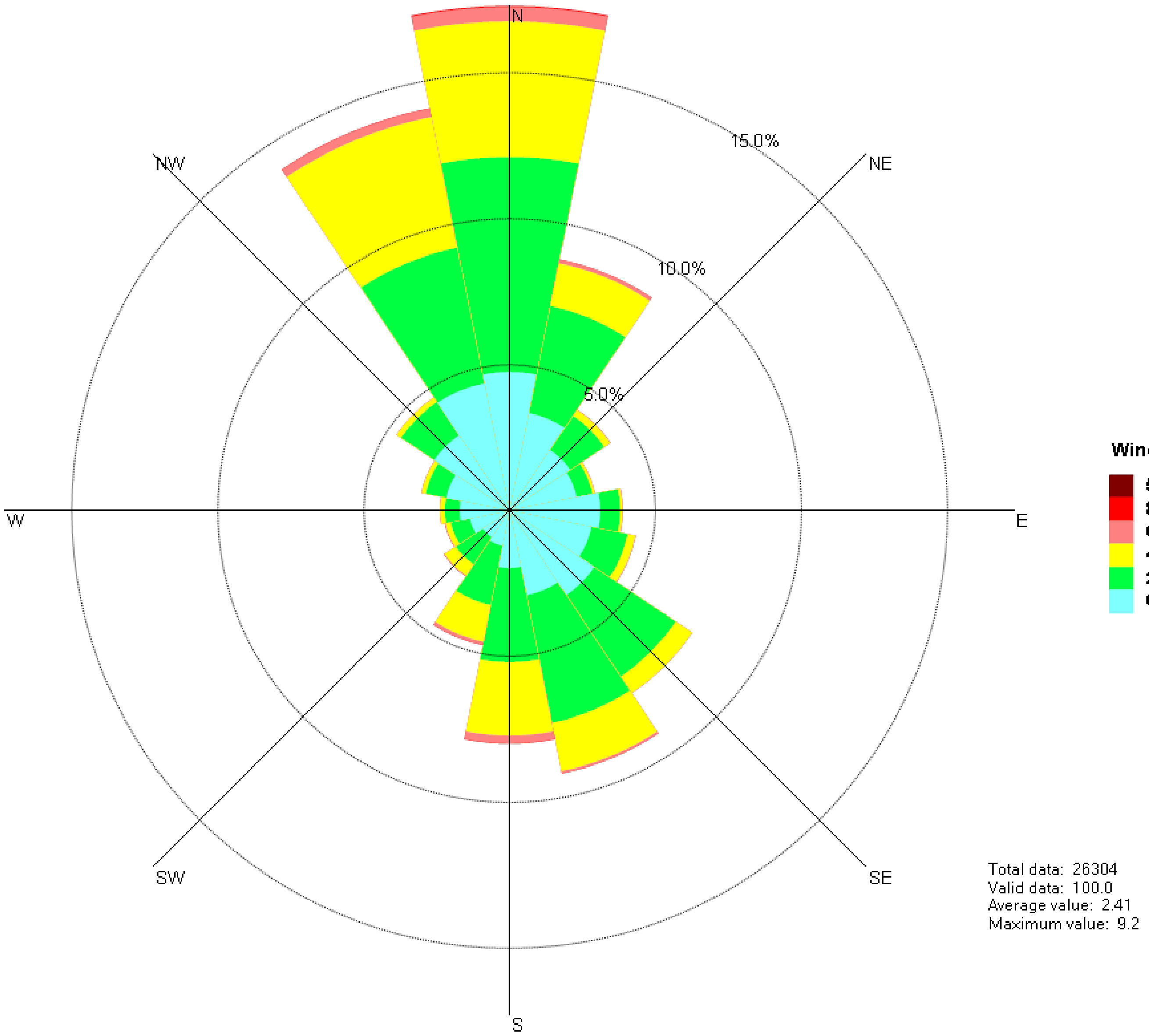
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
MONTHLY TEMPERATURE RANGES
WMO 48037 CLIMATE STATION (1981-2012)

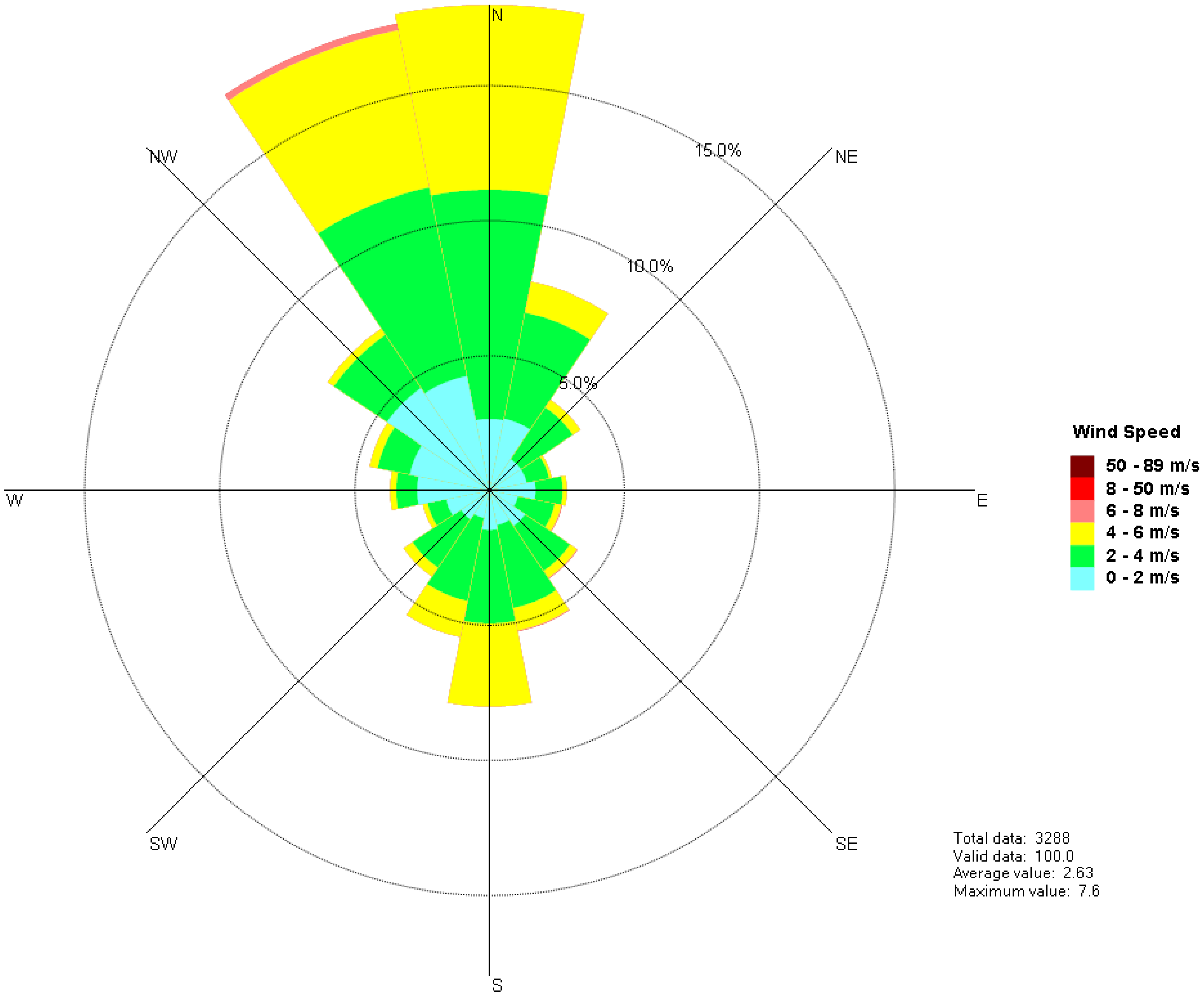
Ref: PE701-00022 M13010
Figure 4.3



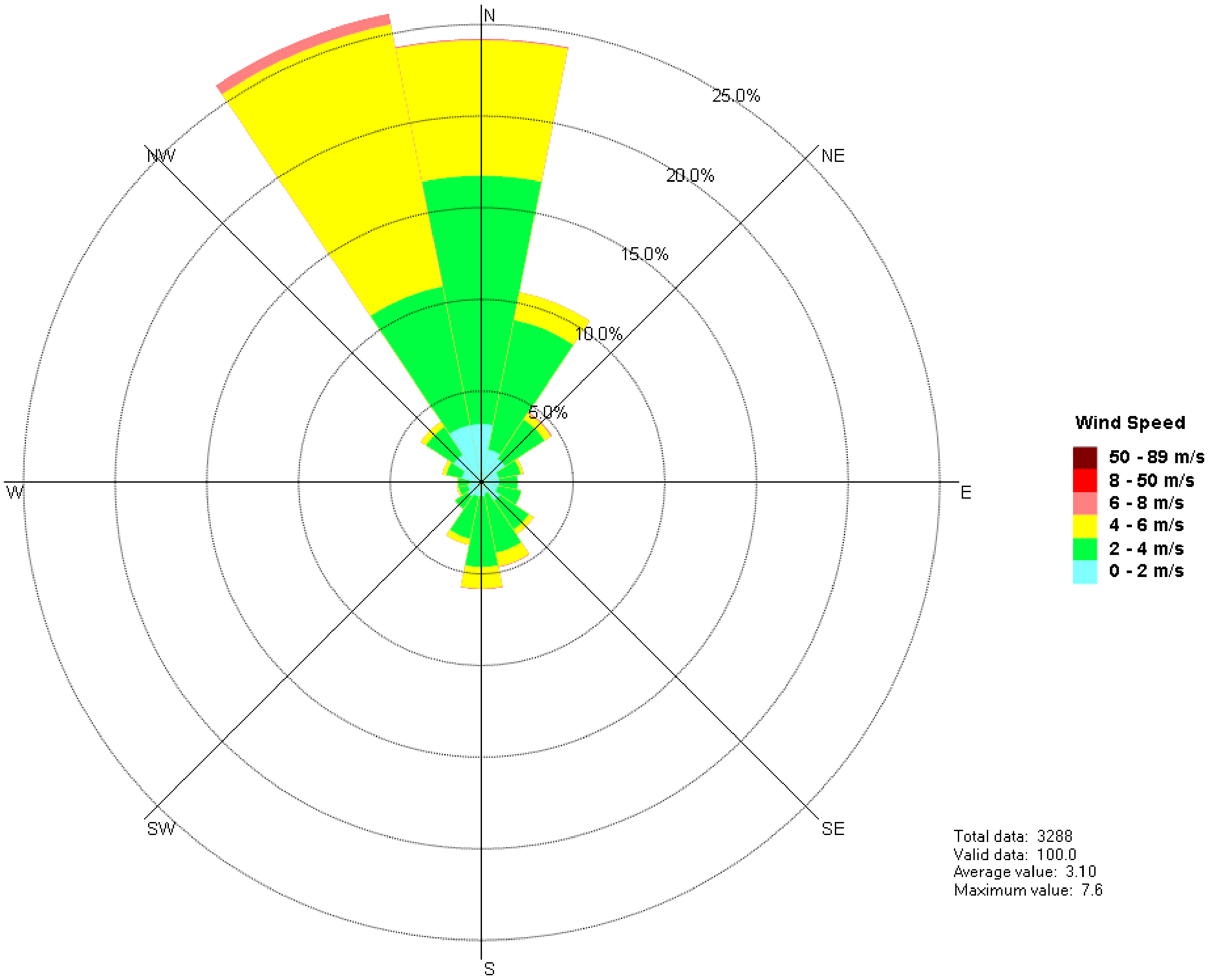
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
Average Temperature (°C)
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
y = 0.051x - 74.083
R² = 0.2996
Temperature Data
Linear (Temperature Data)

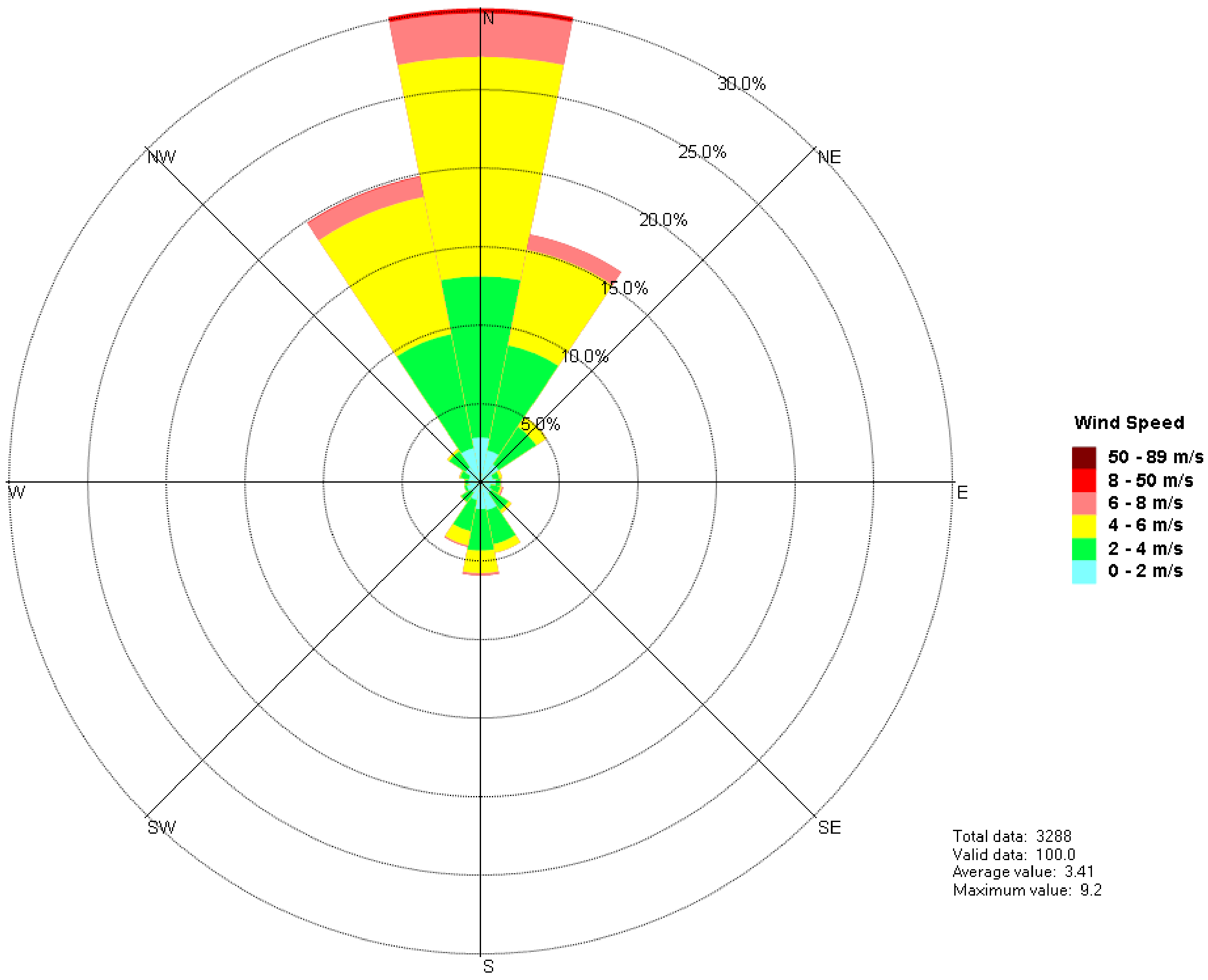


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 26304
Valid data: 100.0
Average value: 2.41
Maximum value: 9.2



LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS – (00:00 – 03:00)
WIND ROSE DATASET (2010-2012)


N
NE
E
SE
S
SW
W
NW
25.0%
20.0%
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 3.10
Maximum value: 7.6



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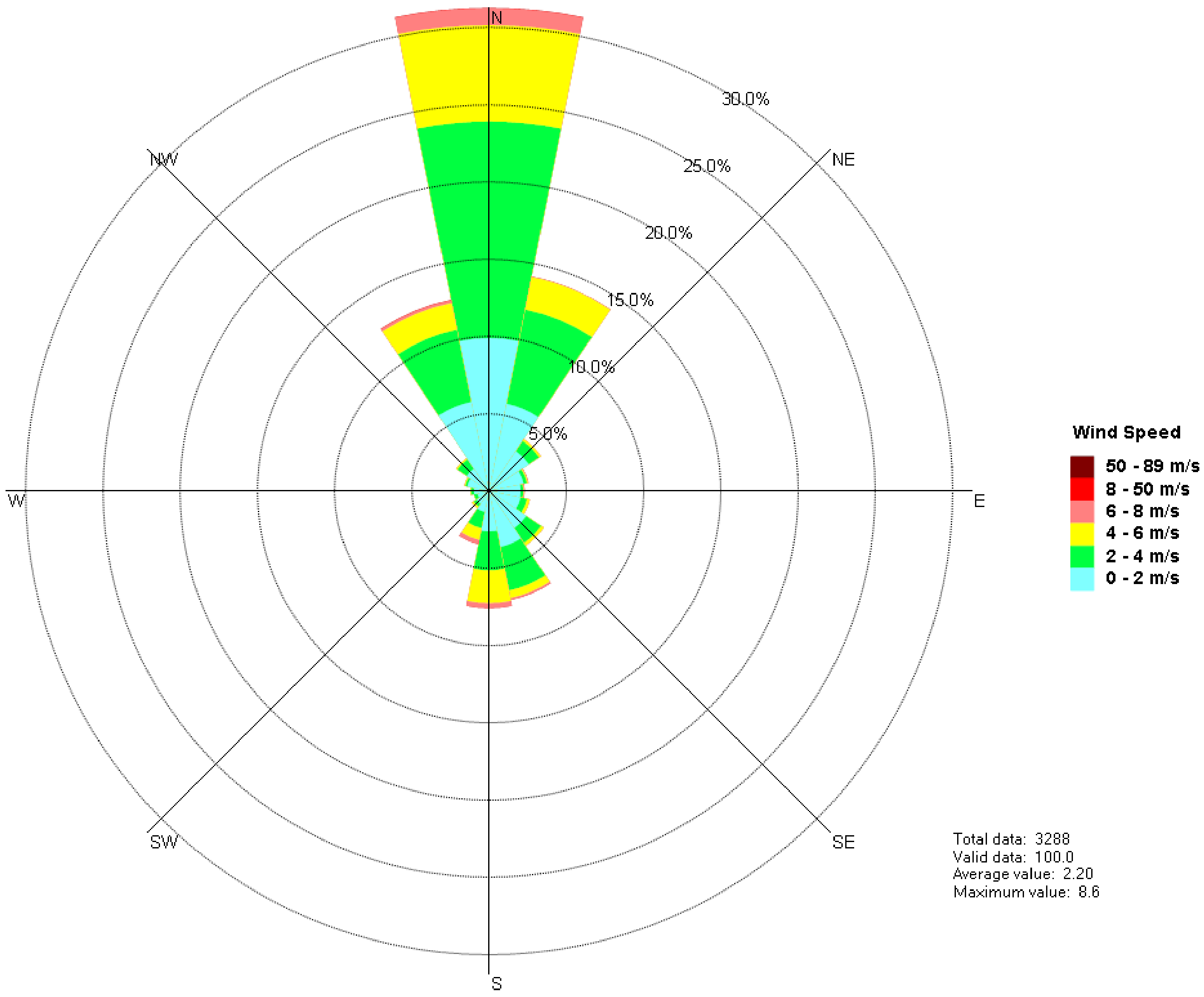
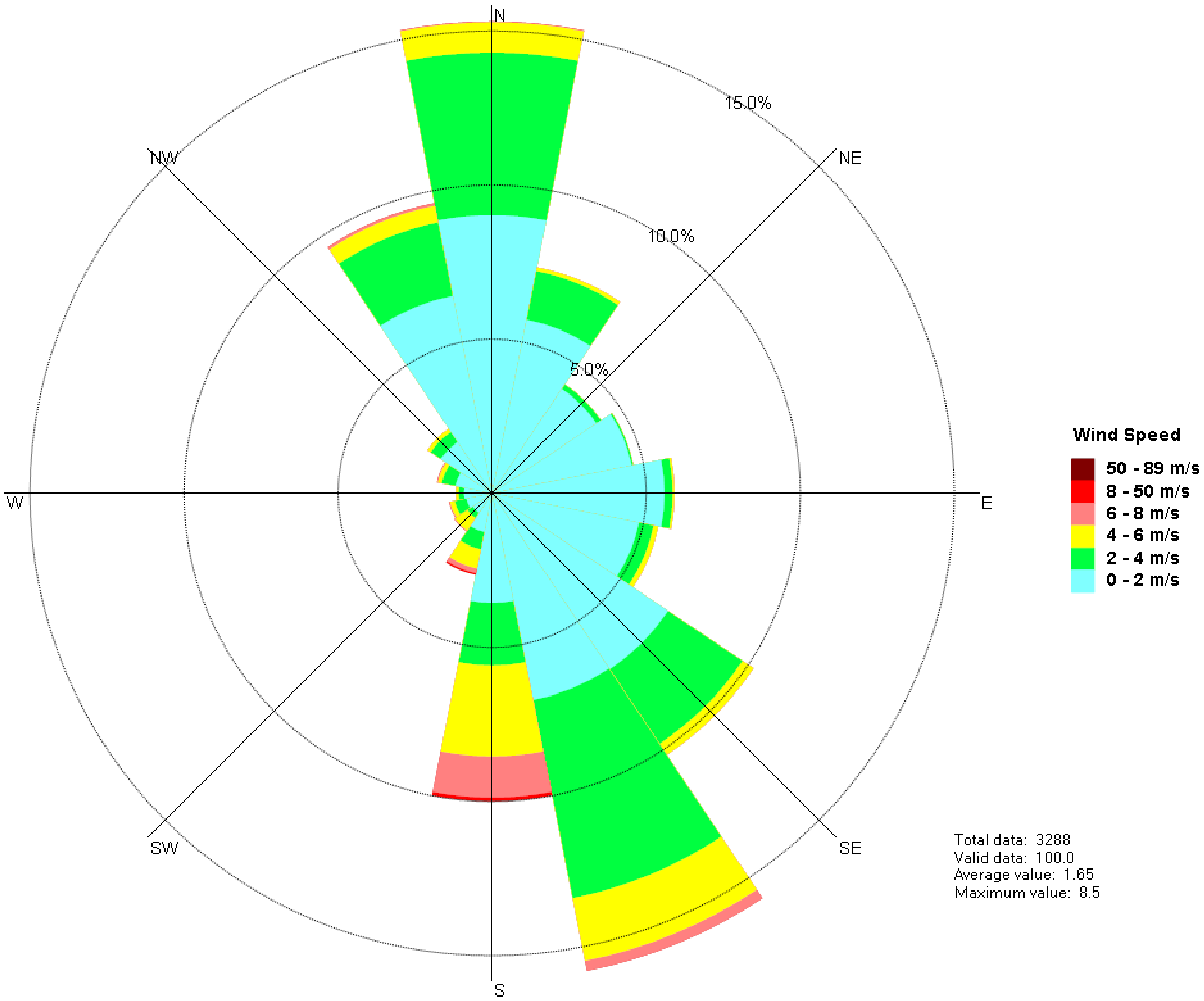
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS – (06:00 – 09:00)
WIND ROSE DATASET (2010-2012)

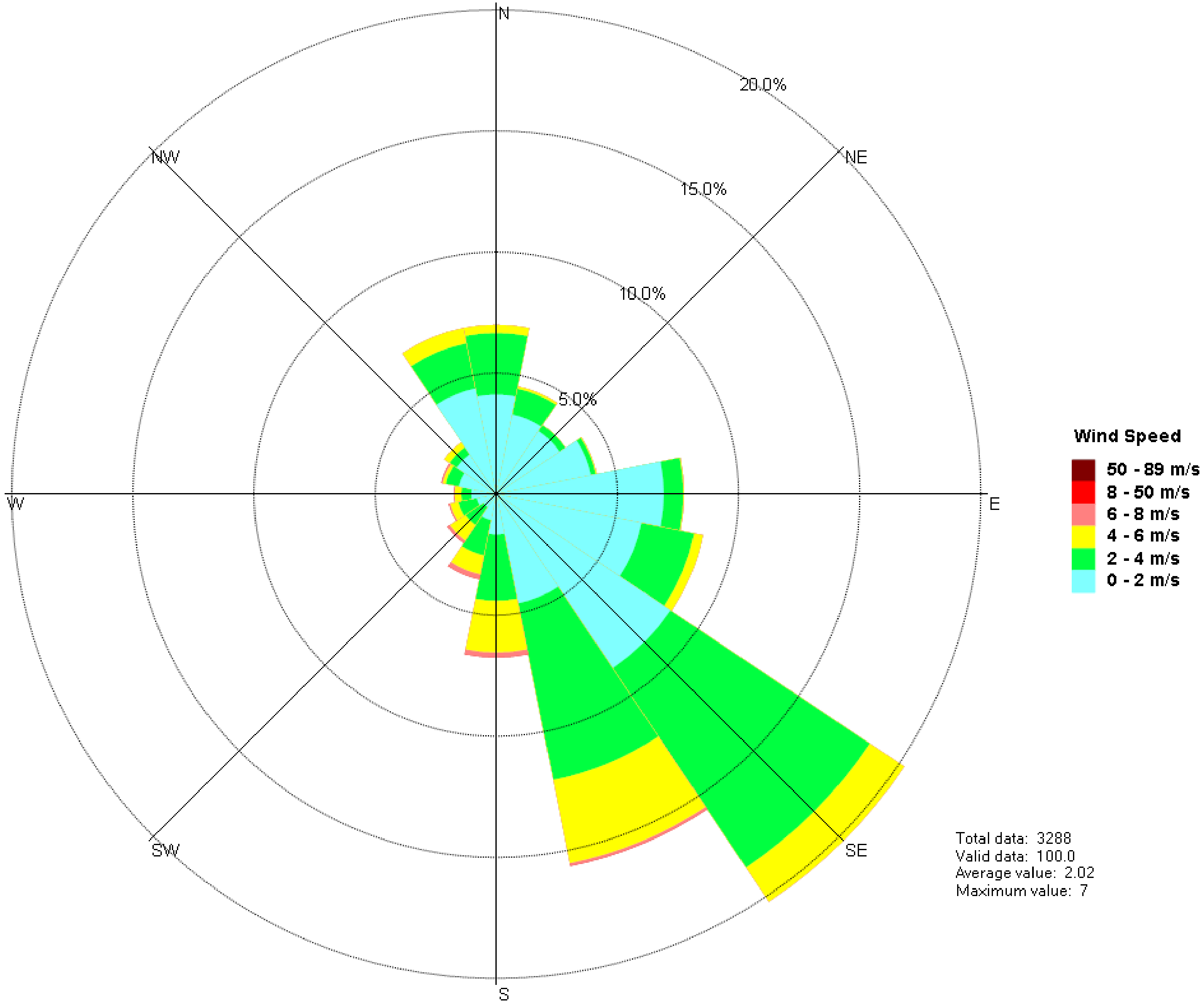
Ref: PE701-00022 M13010
Figure 5.4


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.20
Maximum value: 8.6



N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
15.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 1.65
Maximum value: 8.5

Figure 5.6



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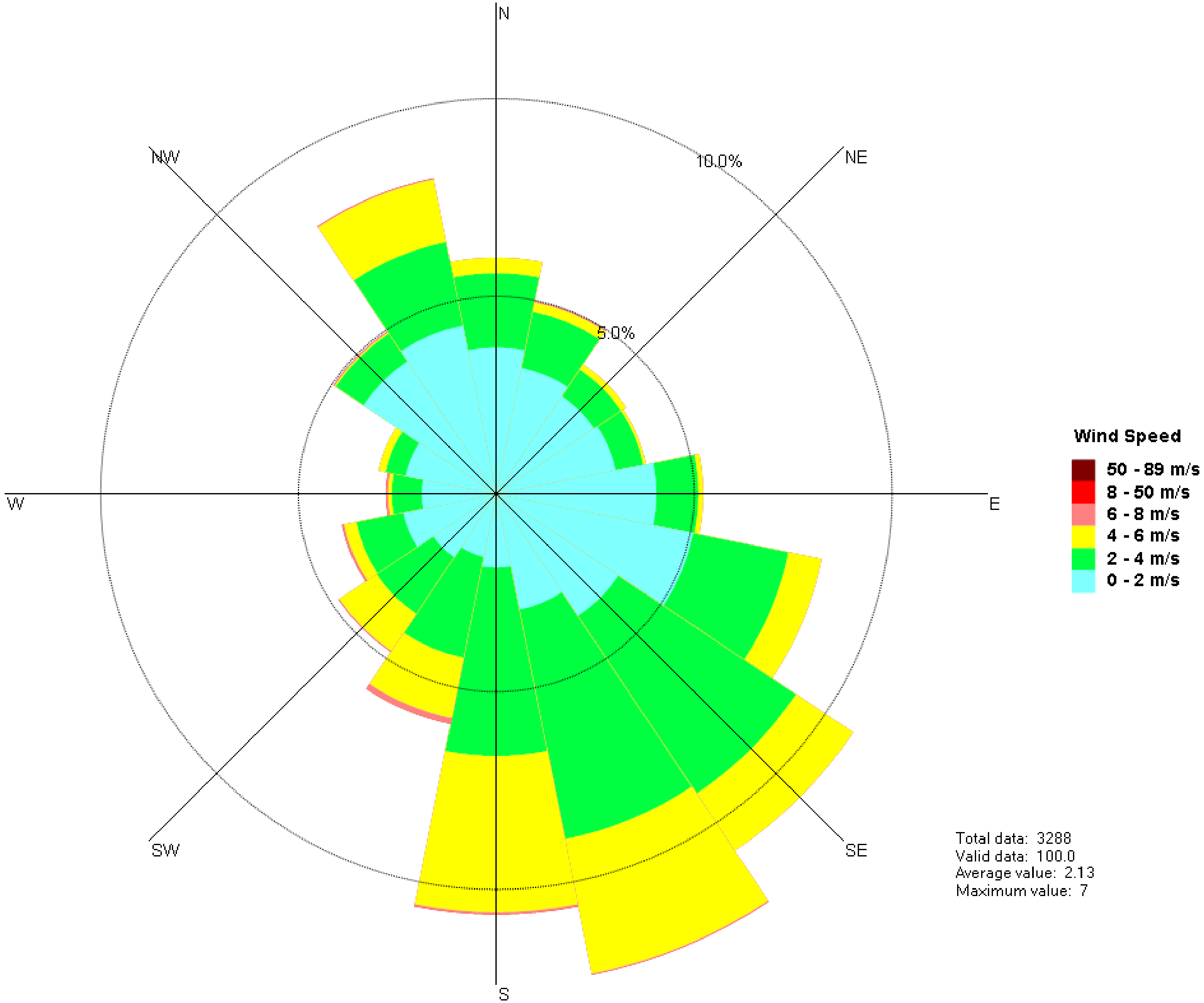
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS – (15:00 – 18:00)
WIND ROSE DATASET (2010-2012)

Ref: PE701-00022 M13010
Figure 5.7



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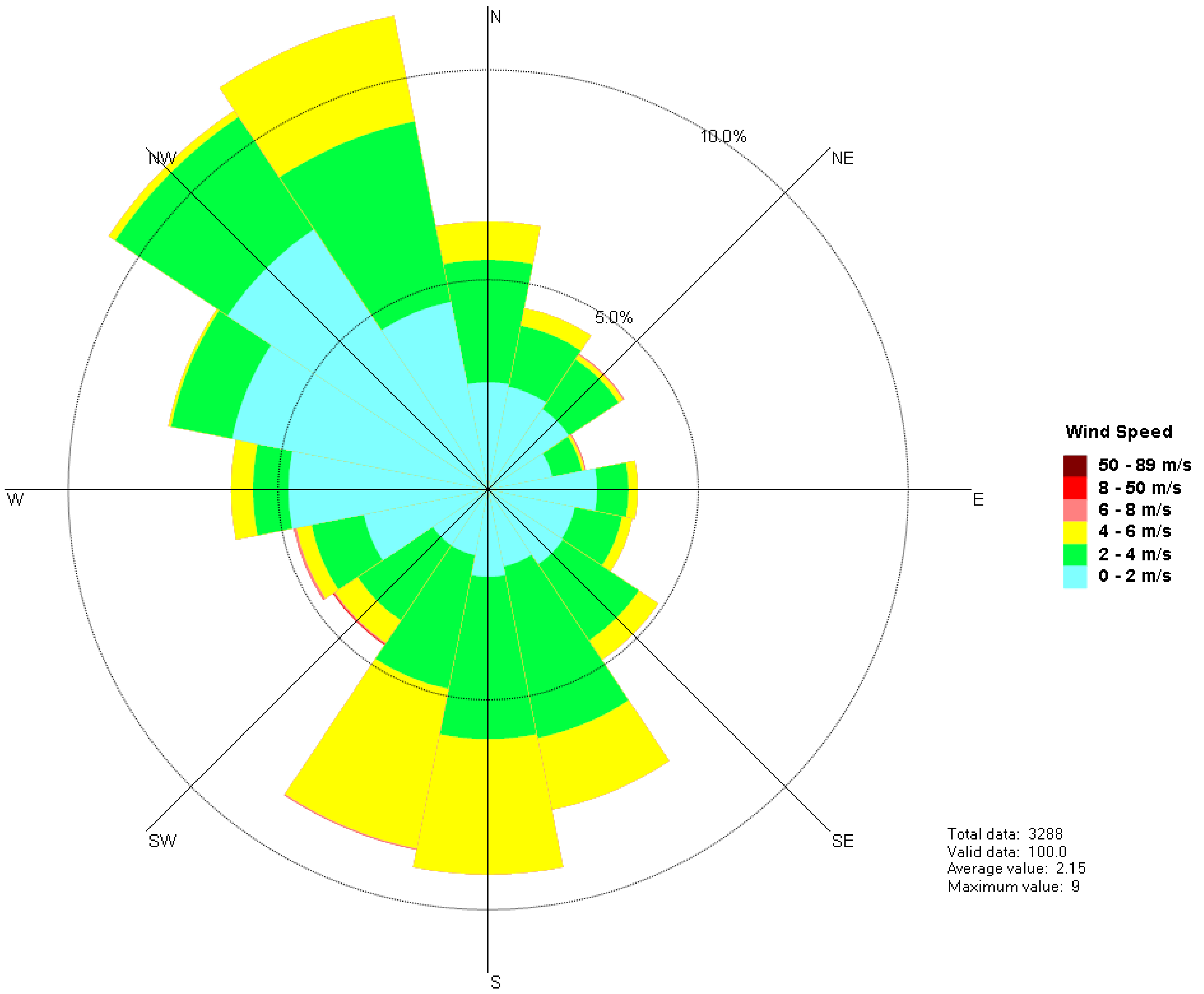
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
WIND ROSE RESULTS – (18:00 – 21:00)
WIND ROSE DATASET (2010-2012)

Ref: PE701-00022 M13010
Figure 5.8


N
NE
E
SE
S
SW
W
NW
5.0%
10.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.15
Maximum value: 9

ATTACHMENT 2.1

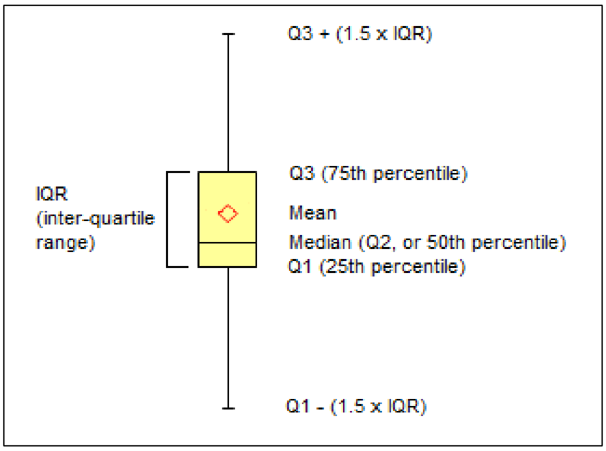
Annual Precipitation Analysis

Annual Precipitation Data: Monywa Township (1961-2013)

Year	Precip. (mm)	Rain Days
1961	731.0	61
1962	684.0	53
1963	896.0	63
1964	581.0	50
1965	1,198.0	91
1966	664.0	60
1967	686.0	67
1968	1,110.0	66
1969	744.0	50
1970	611.0	66
1971	1,042.0	62
1972	676.0	55
1973	1,370.0	99
1974	668.0	61
1975	1,067.0	73
1976	1,275.0	86
1977	921.0	70
1978	910.0	76
1979	438.0	38
1980	742.0	52
1981	797.0	67
1982	411.0	44
1983	588.0	59
1984	855.0	55
1985	544.0	57
1986	642.0	50
1987	741.0	58
1988	1,015.0	62
1989	722.0	49
1990	601.0	50
1991	518.0	55
1992	887.0	68
1993	612.0	60
1994	674.6	58
1995	Exclude	Exclude
1996	802.4	101
1997	609.6	75
1998	437.2	61
1999	Exclude	Exclude
2000	604.2	77
2001	653.3	80
2002	478.2	82
2003	597.4	63
2004	871.6	76
2005	739.9	77
2006	766.8	88
2007	1,032.5	73
2008	566.2	48
2009	689.2	51
2010	1,220.9	64
2011	1,184.2	81
2012	813.7	54
2013	Exclude	Exclude

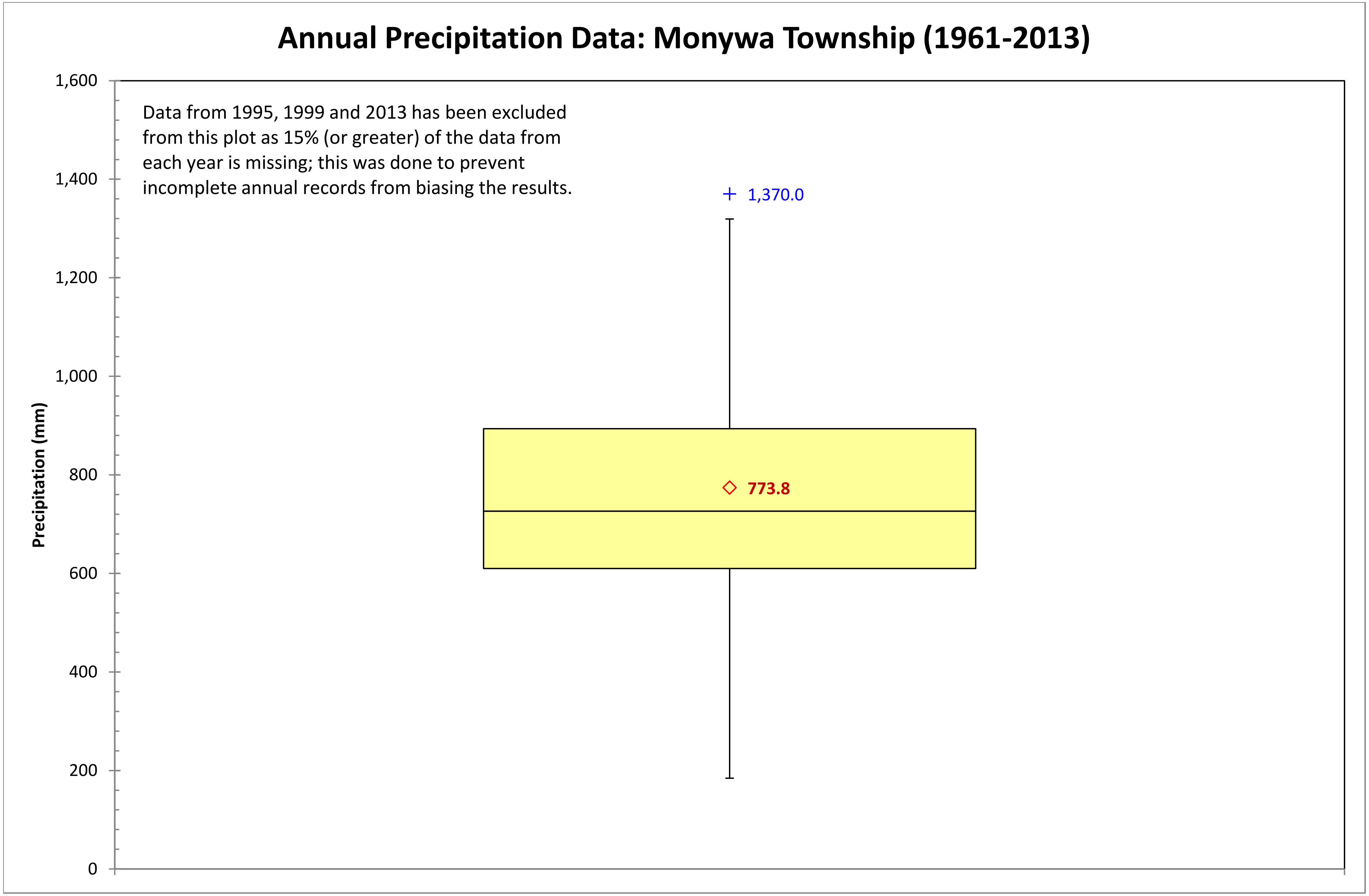
Stat	Precip. (mm)
Mean	773.8
SD	230.0
Median	726.5
Q1	610.0
Q3	893.8
Minimum	411.0
Maximum	1,370.0
Count	50
Ext Max	1,319.4
Ext Min	184.3
25th Pct	610.0
50th Pct	116.5
75th Pct	167.3
1.5 * IQR	425.7

Stat	Rain Days
Mean	64.8



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Precipitation Data: Monywa Township (1961-2013)
Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
Data from 1995, 1999 and 2013 has been excluded from this plot as 15% (or greater) of the data from each year is missing; this was done to prevent incomplete annual records from biasing the results.
1,370.0
773.8

ATTACHMENT 2.2

Monthly Precipitation Analysis

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Precipitation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	0.0	0.0	12.0	60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962	1.0	4.0	0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0	2.0	1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965	5.0	0.0	0.0	2.0	79.0	50.0	69.0	166.0	496.0	236.0	10.0	85.0
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	10.0
1967	19.0	0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968	14.0	3.0	1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	22.0
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0	356.0	64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0	186.0	1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975	31.0	0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0	102.0	13.0	8.0	178.0	193.0	60.0	74.0	124.0	402.0	115.0	6.0
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0	182.0	140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0	158.0	70.0	70.0	28.0	0.0	39.0
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0	13.0	32.0	139.0	243.0	31.0	92.0	47.0	82.0	118.0	0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0	140.0	14.0
1984	0.0	0.0	0.0	83.0	59.0	342.0	80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987	3.0	31.0	1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0	175.0	125.0	63.0	180.0	125.0	0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992	1.0	4.0	0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	23.0
1993	0.0	3.0	2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0	2.0	5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0	2.8	95.8	32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	75.2
1997	0.0	0.8	5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0	14.7	9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0	6.6	7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002	2.3	0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005	0.3	0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	28.4
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0	9.4	0.0	48.3	386.2	60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008	19.0	0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8	512.5	0.0	13.0
2011	0.0	0.0	5.5	99.5	88.5	265.4	85.4	235.2	95.2	303.0	0.0	6.5
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

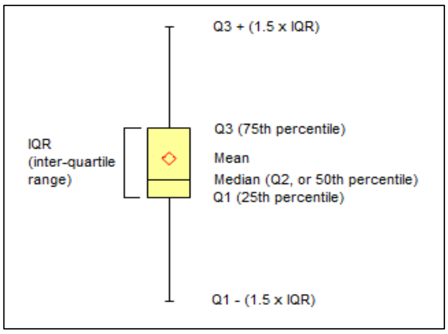
Precipitation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave. # of Rain Days	0	0	1	4	9	9	8	10	11	10	3	1
Mean	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
SD	5.9	14.8	13.7	22.3	69.5	79.4	42.5	80.4	89.1	94.9	44.4	16.9
Median	0.0	0.0	1.0	20.5	94.4	71.5	59.0	103.0	149.5	135.5	12.2	0.0
Q1	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
Q3	0.0	0.0	4.8	38.4	140.5	128.5	83.3	171.8	211.7	180.0	45.3	2.1
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	31.0	102.0	95.8	99.5	386.2	342.0	182.0	356.0	496.0	512.5	186.0	85.0
Count	51	51	51	51	52	51	52	52	52	52	52	52
Ext Max	0.0	0.0	12.0	83.1	271.0	258.3	156.5	333.8	380.4	326.1	113.1	5.3
Ext Min	0.0	0.0	-7.2	-36.3	-77.0	-87.8	-38.9	-98.0	-69.5	-63.5	-67.9	-3.2
25^{th} Pct	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
50^{th} Pct	0.0	0.0	1.0	12.0	40.9	29.5	24.6	39.1	50.3	52.9	12.2	0.0
75^{th} Pct	0.0	0.0	3.8	17.9	46.1	57.0	24.3	68.8	62.1	44.5	33.0	2.1
1.5 * IQR	0.0	0.0	7.2	44.8	130.5	129.8	73.3	161.9	168.7	146.1	67.9	3.2

Note: N/D = No Data Available, N/A = Not Applicable.

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 24/06/2013
	Basic Climatology	Approved	Version No. 2.2

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013)
(Analysis Format | Outliers Removed)

Precipitation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	0.0	0.0		60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962			0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0		1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965		0.0	0.0	2.0	79.0	50.0	69.0	166.0		236.0	10.0	
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	
1967		0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968			1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0		64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0		1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975		0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0			8.0	178.0	193.0	60.0	74.0	124.0			
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0		140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0		70.0	70.0	28.0	0.0	
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0		32.0	139.0	243.0	31.0	92.0	47.0	82.0		0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0		
1984	0.0	0.0	0.0	83.0	59.0		80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987			1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0		125.0	63.0	180.0		0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992			0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	
1993	0.0		2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0		5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0			32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	
1997	0.0		5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0		9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0		7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002		0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005		0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0		0.0	48.3		60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008		0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8		0.0	
2011	0.0	0.0	5.5		88.5		85.4	235.2	95.2	303.0	0.0	
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

Precipitation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain Days	0.3	0.4	1.0	3.8	9.0	8.6	7.7	10.0	11.3	9.5	2.7	1.0
Mean	0.0	0.0	1.8	24.5	96.0	91.6	60.6	116.7	159.9	129.0	21.6	0.3
SD	0.0	0.0	2.9	19.8	57.3	68.6	34.5	73.9	76.6	70.8	28.4	0.7
Median	0.0	0.0	0.0	20.2	92.8	67.0	54.5	98.0	148.1	125.8	9.7	0.0
Q1	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
Q3	0.0	0.0	2.9	35.8	139.5	116.0	80.3	171.2	211.0	176.8	37.3	0.0
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	0.0	0.0	11.0	83.0	263.0	248.0	134.0	315.0	378.0	303.0	107.0	3.0
Count	41	39	46	50	51	49	49	51	51	50	47	41
Ext Max	0.0	0.0	7.2	77.0	270.8	228.5	149.6	333.2	379.9	318.6	93.2	0.0
Ext Min	0.0	0.0	-4.3	-33.0	-79.3	-71.5	-35.4	-98.7	-70.5	-59.6	-55.9	0.0
25th Pct	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
50th Pct	0.0	0.0	0.0	11.9	40.8	26.0	20.5	34.7	49.7	43.6	9.7	0.0
75th Pct	0.0	0.0	2.9	15.6	46.7	49.0	25.8	73.2	62.9	50.9	27.6	0.0
1.5 * IQR	0.0	0.0	4.3	41.3	131.3	112.5	69.4	161.9	168.9	141.8	55.9	0.0

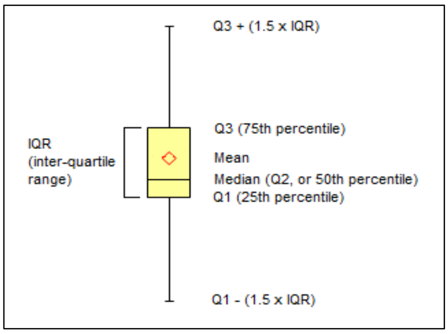
Note: N/D = No Data Available, N/A = Not Applicable.

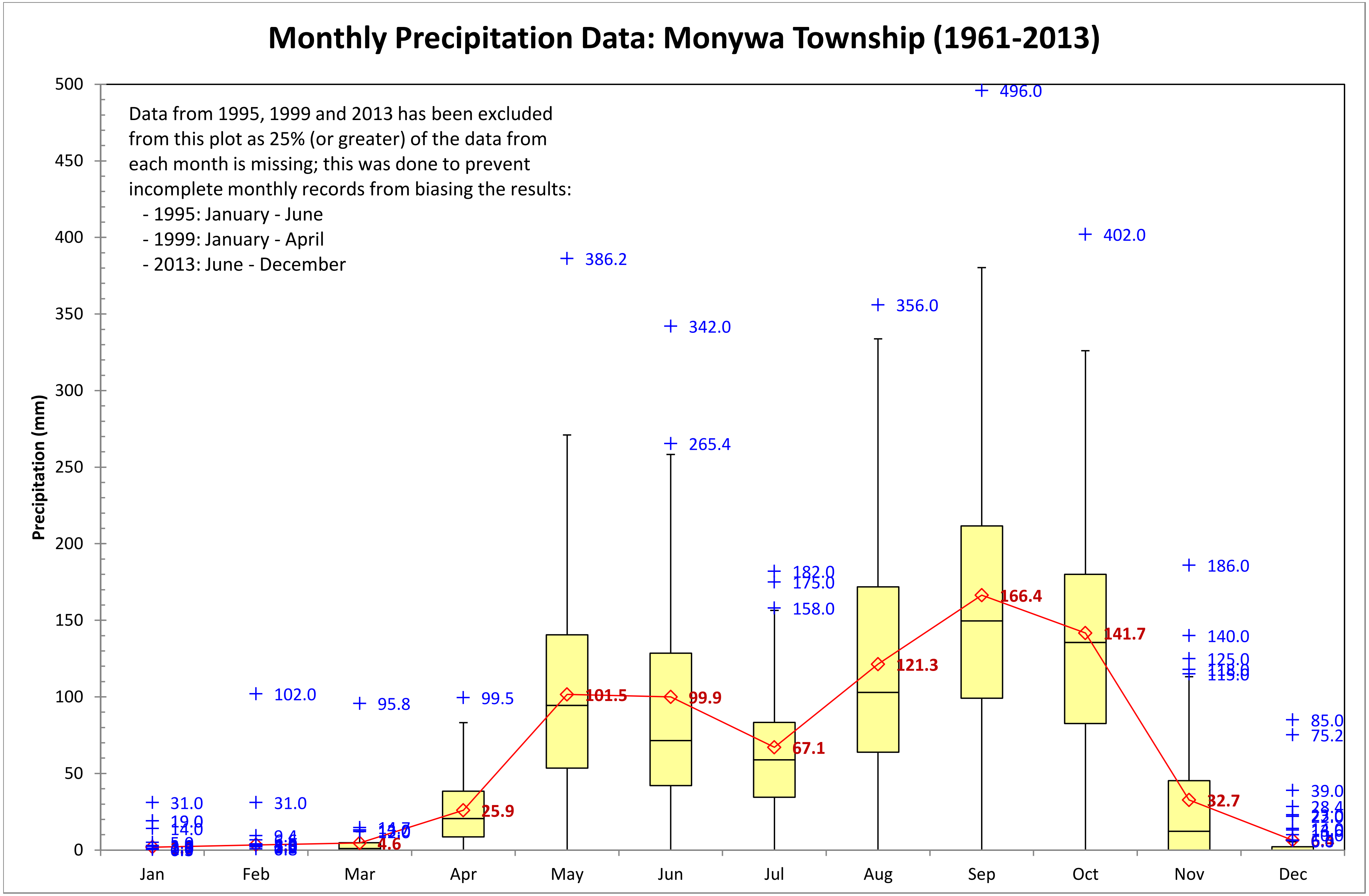
Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 24/06/2013
	Basic Climatology	Approved	Version No. 2.2

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013)
(Analysis Format | Outliers Removed)

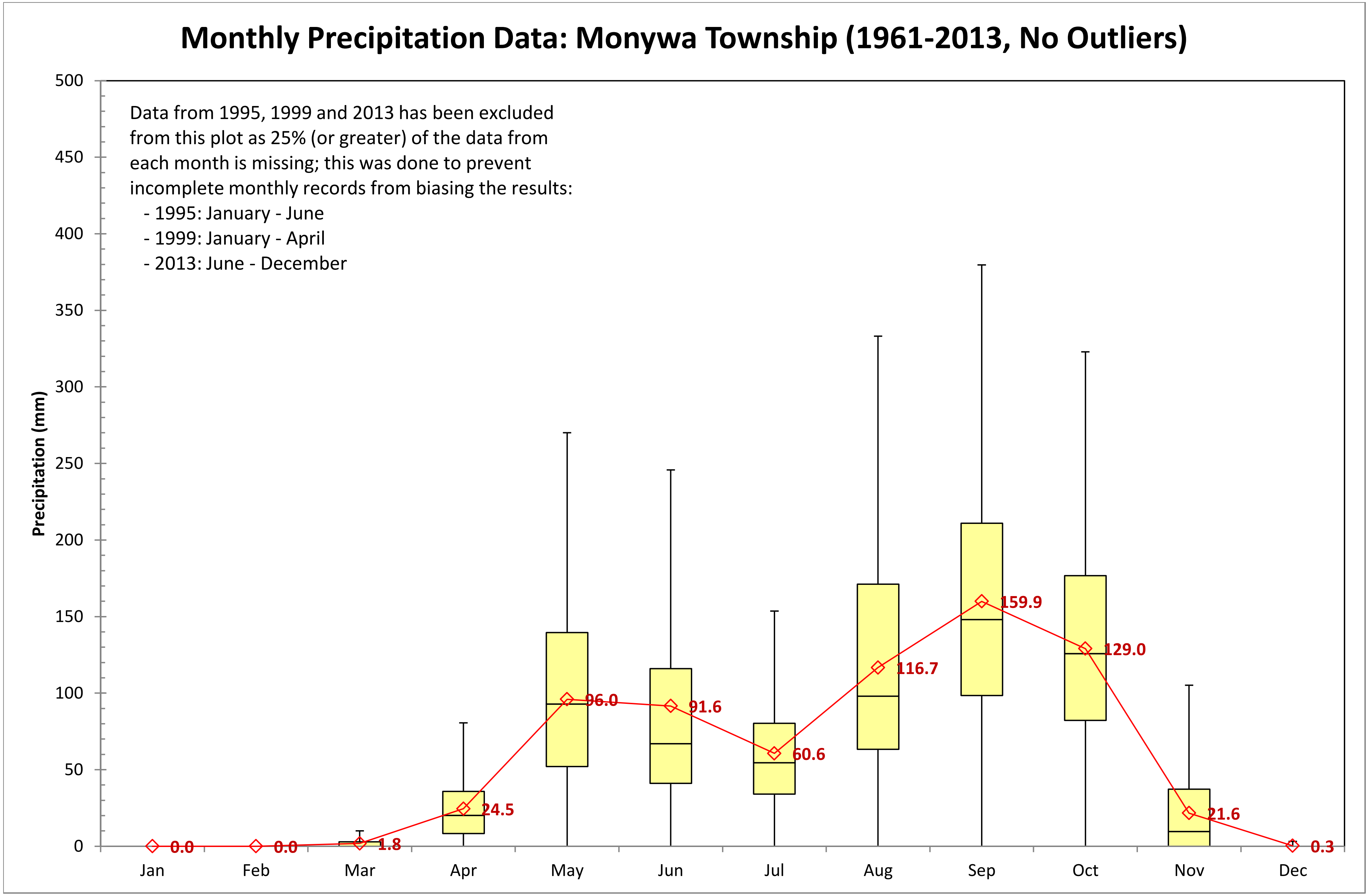
Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers





Monthly Precipitation Data: Monywa Township (1961-2013)
Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
31.0
31.0
102.0
95.8
4.6
99.5
25.9
386.2
101.5
342.0
265.4
99.9
158.0
67.1
356.0
121.3
496.0
166.4
402.0
141.7
186.0
140.0
32.7
85.0
75.2
39.0


Monthly Precipitation Data: Monywa Township (1961-2013, No Outliers)
Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
0.0
0.0
1.8
24.5
96.0
91.6
60.6
116.7
159.9
129.0
21.6
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

ATTACHMENT 2.3

Daily Precipitation Frequency Analysis

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

Max Daily Data		Rank	Weibull	ARI	Ranked
Year	Precip. (mm)	(highest to lowest) m	Exceedance Probability p	(yrs)	Precip (mm)
1961	77.0	1	0.019	53.00	165.0
1962	59.0	2	0.038	26.50	135.0
1963	76.0	3	0.057	17.67	135.0
1964	98.0	4	0.075	13.25	125.0
1965	90.0	5	0.094	10.60	117.1
1966	75.0	6	0.113	8.83	117.0
1967	125.0	7	0.132	7.57	109.0
1968	109.0	8	0.151	6.63	108.5
1969	73.0	9	0.170	5.89	105.5
1970	65.0	10	0.189	5.30	103.0
1971	92.0	11	0.208	4.82	102.0
1972	71.0	12	0.226	4.42	99.3
1973	103.0	13	0.245	4.08	99.0
1974	85.0	14	0.264	3.79	98.0
1975	69.0	15	0.283	3.53	97.0
1976	102.0	16	0.302	3.31	93.5
1977	72.0	17	0.321	3.12	92.0
1978	70.0	18	0.340	2.94	91.0
1979	99.0	19	0.358	2.79	90.0
1980	52.0	20	0.377	2.65	88.0
1981	97.0	21	0.396	2.52	85.0
1982	36.0	22	0.415	2.41	82.3
1983	80.0	23	0.434	2.30	80.0
1984	135.0	24	0.453	2.21	78.0
1985	52.0	25	0.472	2.12	77.0
1986	78.0	26	0.491	2.04	77.0
1987	91.0	27	0.509	1.96	76.5
1988	117.0	28	0.528	1.89	76.0
1989	64.0	29	0.547	1.83	75.0
1990	75.0	30	0.566	1.77	75.0
1991	45.0	31	0.585	1.71	73.0
1992	88.0	32	0.604	1.66	72.0
1993	66.0	33	0.623	1.61	71.4
1994	117.1	34	0.642	1.56	71.0
1995	68.1	35	0.660	1.51	70.0
1996	57.7	36	0.679	1.47	69.0
1997	47.7	37	0.698	1.43	68.1
1998	48.4	38	0.717	1.39	67.8
1999	82.3	39	0.736	1.36	67.0
2000	67.8	40	0.755	1.33	66.0
2001	76.5	41	0.774	1.29	65.0
2002	43.9	42	0.792	1.26	64.0
2003	93.5	43	0.811	1.23	59.0
2004	99.3	44	0.830	1.20	57.7
2005	71.4	45	0.849	1.18	52.0
2006	77.0	46	0.868	1.15	52.0
2007	105.5	47	0.887	1.13	48.4
2008	42.4	48	0.906	1.10	47.7
2009	67.0	49	0.925	1.08	45.0
2010	108.5	50	0.943	1.06	43.9
2011	165.0	51	0.962	1.04	42.4
2012	135.0	52	0.981	1.02	36.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Pearson 5 (3P)	2	5	10
Pearson 6	6	6	36
Gen. Logistic	12	3	36
Burr	18	2	36
Pearson 6 (4P)	5	10	50
Log-Logistic (3P)	4	14	56
Gumbel Max	3	26	78
Gen. Extreme Value	13	7	91
Log-Pearson 3	11	13	143

Three fits were selected for comparison:
1) **Wakeby** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Note that these predictions should be multiplied by **1.143** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

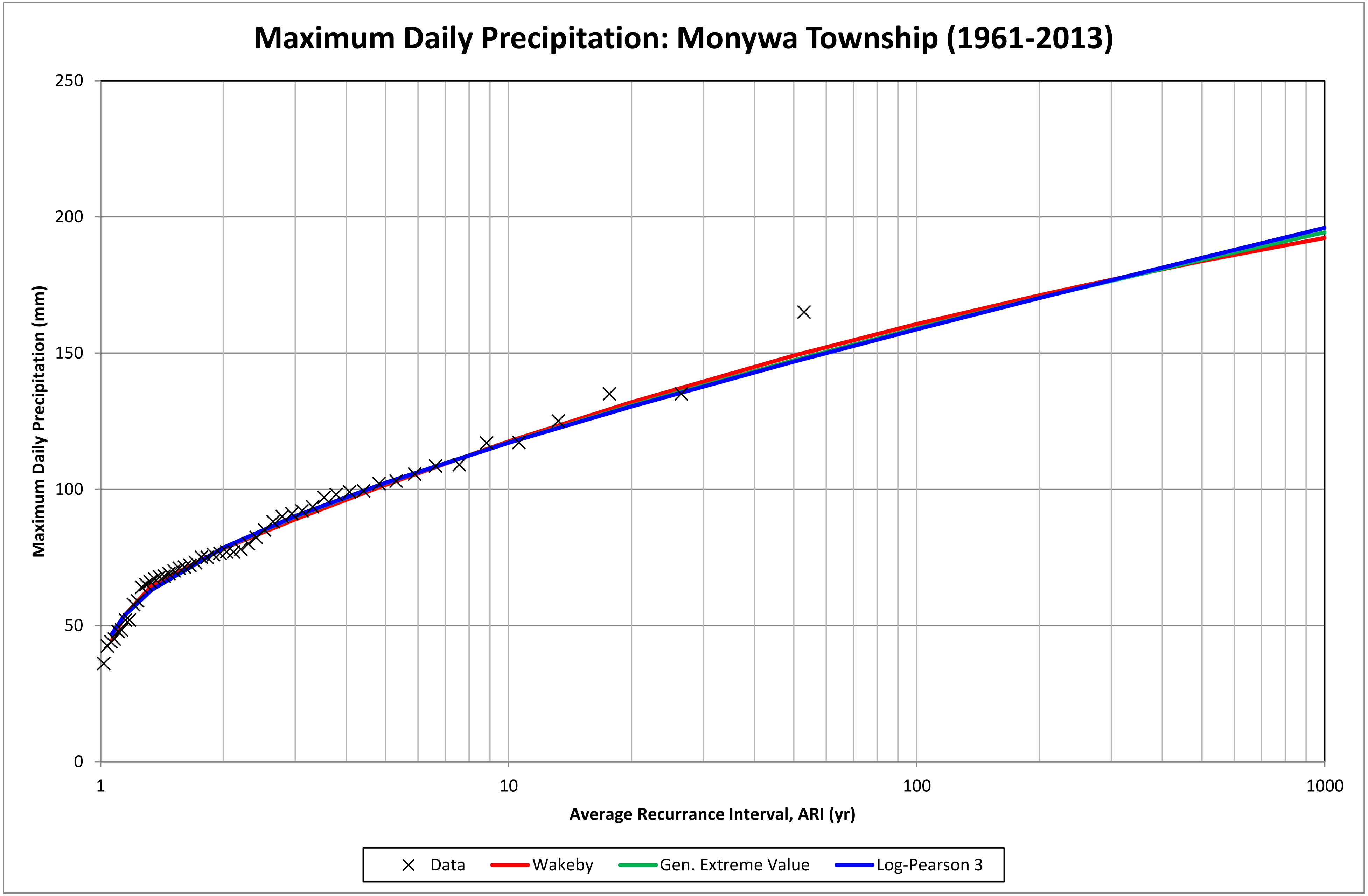
Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

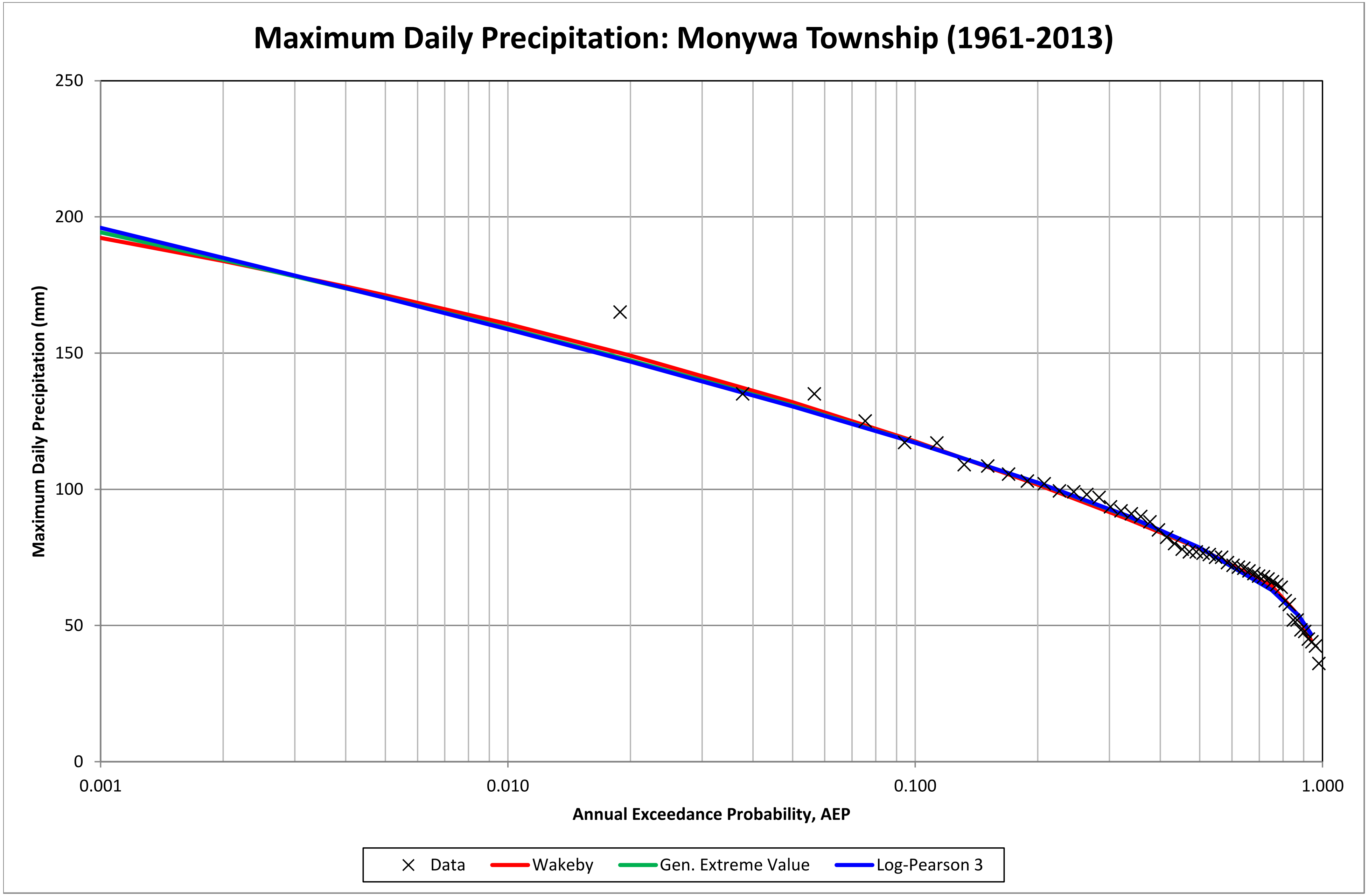
2013 was excluded from this analysis as a significant portion of data from the wet season was missing.

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent short-term storm precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	221.90042	k =	-0.06676115	α =	148.2847421
			β =	8.2130851	σ =	22.3984849	β =	-0.0264996
			γ =	29.8116959	μ =	70.39076611	γ =	8.285147763
			δ =	-0.1356425				
			ξ =	31.5886933				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	192.3	N/A	194.3	26.53	196.0	26.44
0.998	0.002	500	183.8	N/A	184.3	26.53	185.0	26.44
0.996	0.004	250	174.5	N/A	173.8	26.53	173.9	26.44
0.995	0.005	200	171.3	N/A	170.3	26.53	170.2	26.44
0.990	0.010	100	160.7	N/A	159.1	26.53	158.7	26.44
0.980	0.020	50	149.1	N/A	147.3	26.53	146.9	26.44
0.950	0.050	20	132.0	N/A	130.7	26.53	130.4	26.44
0.900	0.100	10	117.6	N/A	117.2	26.53	117.1	26.44
0.800	0.200	5	101.7	N/A	102.4	26.53	102.5	26.44
0.667	0.333	3	89.0	N/A	90.0	26.53	90.2	26.44
0.500	0.500	2.0	78.2	N/A	78.5	26.53	78.6	26.44
0.250	0.750	1.3	64.5	N/A	63.0	26.53	63.0	26.44
0.125	0.875	1.1	53.5	N/A	53.6	26.53	53.6	26.44
0.063	0.937	1.1	44.7	N/A	46.8	26.53	47.0	26.44
Kolmogorov Smirnov (Statistic, Rank)			0.06197	1	0.07306	13	0.07296	11
Anderson Darling (Statistic, Rank)			0.16639	1	0.22384	7	0.22713	13


Maximum Daily Precipitation: Monywa Township (1961-2013)
Maximum Daily Precipitation (mm)
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3



Maximum Daily Precipitation: Monywa Township (1961-2013)
Maximum Daily Precipitation (mm)
250
200
150
100
50
0
0.001
0.010
0.100
1.000
Annual Exceedance Probability, AEP
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.4

Precipitation IDF Curve Analysis

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

IDF curves for the **Letpadaung Copper** project are derived using the Rainfall Ratio method discussed in Chapter 4 of "Highway and Urban Hydrology in the Tropics", 1984, L.H. Watkins and D. Fiddes - London, Great Britain - Pentech Press, Ltd.

Twenty-four hour duration precipitation intensities for various average recurrence interval (ARI) events are used along with empirically-derived coefficients from Table 4.6 of (Watkins & Fiddes, 1984) to construct IDF curves. The fundamental equations used with this technique are:

$I_t = a / (b + t)^n$ and $RR_t = (I_t \cdot t) / (I_{24} \cdot 24)$

where:

I_t = precipitation intensity for a t-hour duration storm (mm/h)

RR_t = rainfall ratio for a t-hour duration storm (mm/mm)

t = precipitation duration (h)

a, b and n = fitting coefficients

by substituting the first expression into the second, the fitting coefficient "a" is eliminated, leaving:

$RR_t = (t / 24) * ((b + 24) / (b + t))^n$

The basic approach then, is using a list of twenty-four hour duration intensities (depth / 24 hours) for various ARI periods and fitting coefficients "b" and "n" selected from Table 4.6 of (Watkins & Fiddes, 1984):

1) Compute the corresponding rainfall ratio (RR_t) for a select duration (t) using the third relationship and then
2) Solve the second relationship for I_t as follows: $I_t = (RR_t * I_{24} * 24) / t$

In this case, the value for Phnom Penh, Cambodia were applied, as given in "Best Practise Guidelines for Flood Risk Assessment", Mekong River Commission, December 2009.

This process is completed for all of the various ARI's and periods selected to construct an IDF curve using the following five-step process.
First, the I_{24} values for the each of the selected ARI's are tabulated:

Annual Exceedance Probability	Average Recurrance Interval (yr)	24-hr Precip. (mm)	24-hr Precip. Factored (mm)	24-hr Intensity I_{24} (mm/h)
50.0%	2	78.5	89.7	3.7
20.0%	5	102.4	117.0	4.9
10.0%	10	117.2	134.0	5.6
5.0%	20	130.7	149.4	6.2
2.0%	50	147.3	168.4	7.0
1.0%	100	159.1	181.9	7.6
0.5%	200	170.3	194.7	8.1
0.2%	500	184.3	210.7	8.8

Second, the fitting coefficient "b" is selected from the aforementioned reference for Phnom Penh, Cambodia: **b =** 0.23

Third, the fitting coefficient "n" is selected from the aforementioned reference for Phnom Penh, Cambodia: **n =** 0.86

Fourth, rainfall ratios (RR_t) and the intensities (I_t) which follow the range of selected durations (t) are computed and tabulated:

Note: IDF and DDF values for 48 and 72 hour storm events were calculated using frequency analysis. Storm depths for 24, 48 and 72 hour events were factored following "Ratio of true to fixed-interval maximum rainfall", ASCE Journal of the Hydraulics Division: Weiss, 1964.

Duration	24	48	72
Factor	1.143	1.067	1.044

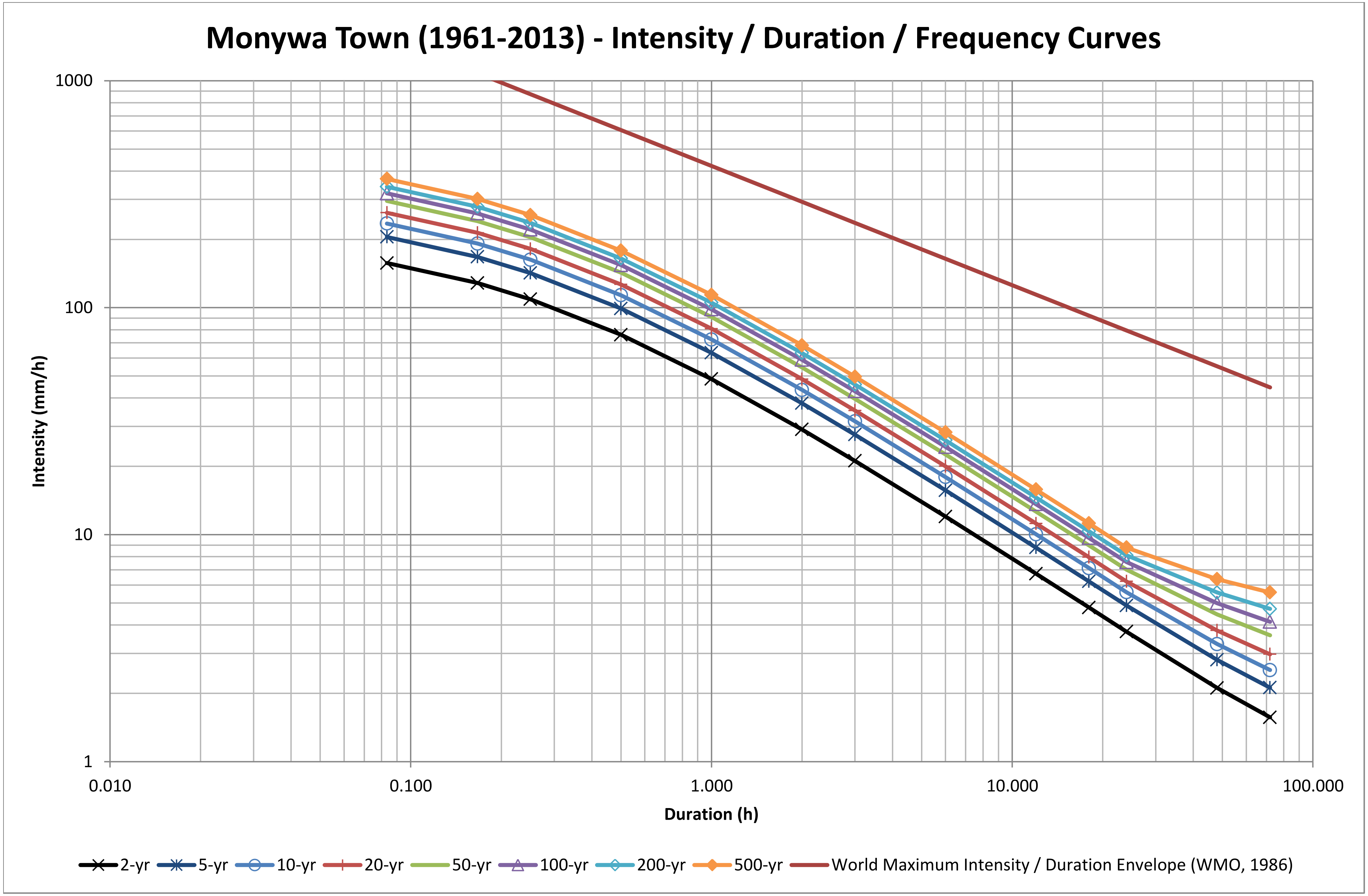
Precipitation Duration t (min)	**(h)**	**Rainfall Ratio RR_t (mm/mm)**	**Precipitation Intensity (I_t) for given AEP (%) or ARI (1 in _ year) Storm (mm/h)**								
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
			I_{24} (mm/h)	3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
5	0.083	0.146		157.3	205.1	234.8	261.9	295.2	318.8	341.2	369.3
10	0.167	0.239		128.4	167.4	191.7	213.9	241.0	260.3	278.6	301.5
15	0.25	0.304		109.0	142.1	162.7	181.5	204.6	220.9	236.5	255.9
30	0.50	0.423		76.0	99.1	113.5	126.6	142.6	154.0	164.9	178.4
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		29.1	37.9	43.4	48.4	54.6	59.0	63.1	68.3
180	3	0.707		21.2	27.6	31.6	35.2	39.7	42.9	45.9	49.7
360	6	0.804		12.0	15.7	17.9	20.0	22.6	24.4	26.1	28.2
720	12	0.900		6.7	8.8	10.0	11.2	12.6	13.6	14.6	15.8
1080	18	0.958		4.8	6.2	7.1	8.0	9.0	9.7	10.4	11.2
1440	24	1.000		3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
2880	48			2.1	2.8	3.3	3.8	4.5	5.0	5.6	6.4
4320	72			1.6	2.1	2.5	3.0	3.6	4.1	4.7	5.6

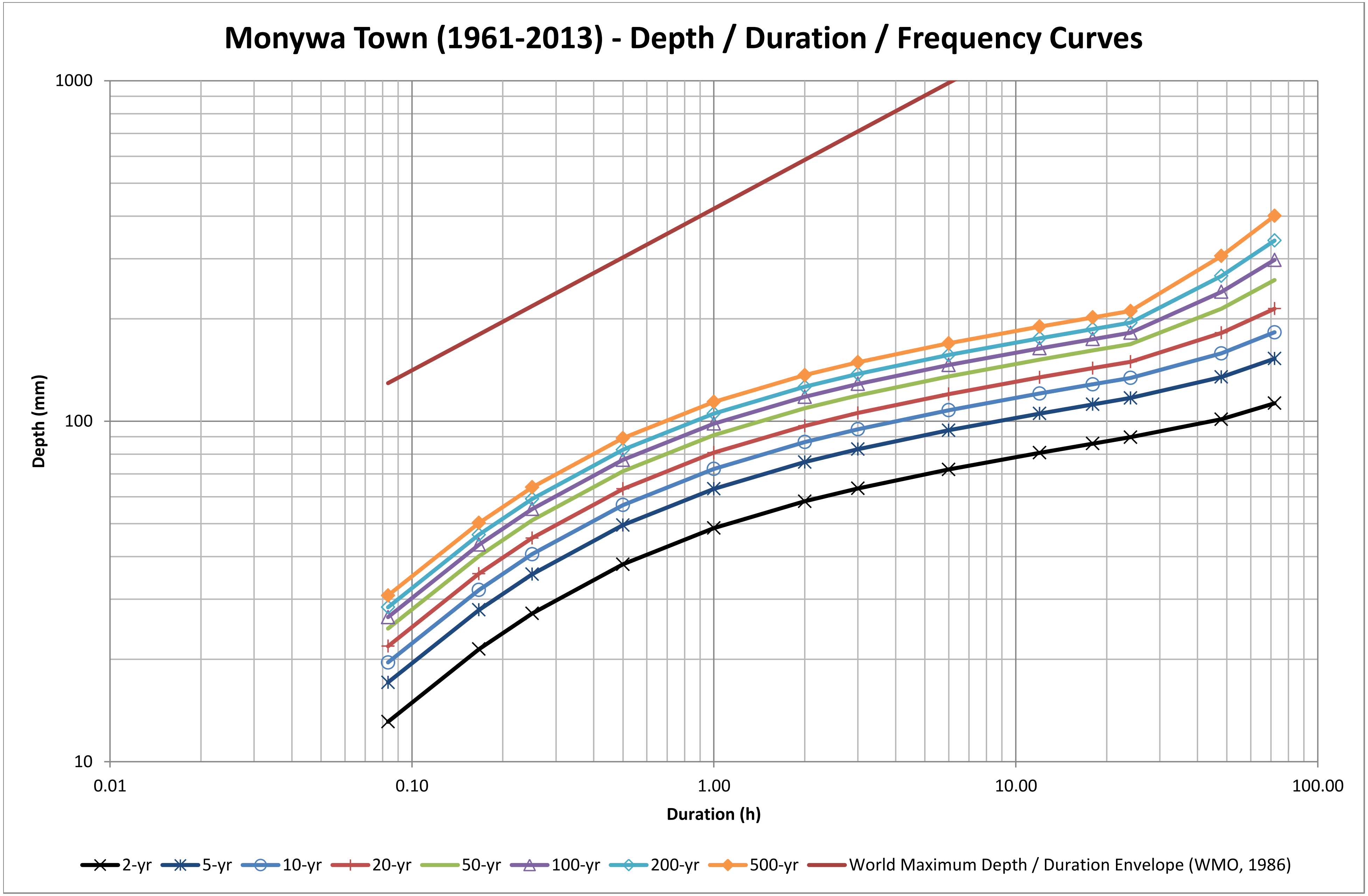
Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining Copper Ltd. | Letpadaung Copper Project	Made by: AB	Job No.: PE701-00022
		Checked: TML	Date: 24/06/2013
	Basic Climatology	Approved:	

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

Also tabulate the total storm depths:

Precipitation Duration t		Rainfall Ratio RR_t	Precipitation Depth (d_t) for given AEP (%) or ARI (1 in _ year) Storm (mm)								
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
(min)	(h)	(mm/mm)	d_{24} (mm)	89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
5	0.083	0.146		13.1	17.1	19.6	21.8	24.6	26.6	28.4	30.8
10	0.167	0.239		21.4	27.9	32.0	35.6	40.2	43.4	46.4	50.2
15	0.25	0.304		27.2	35.5	40.7	45.4	51.1	55.2	59.1	64.0
30	0.50	0.423		38.0	49.5	56.7	63.3	71.3	77.0	82.4	89.2
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		58.2	75.9	86.8	96.9	109.2	117.9	126.2	136.6
180	3	0.707		63.5	82.7	94.7	105.7	119.1	128.6	137.7	149.0
360	6	0.804		72.1	94.1	107.7	120.1	135.4	146.2	156.5	169.4
720	12	0.900		80.8	105.3	120.6	134.5	151.6	163.7	175.2	189.6
1080	18	0.958		86.0	112.1	128.3	143.1	161.3	174.2	186.5	201.8
1440	24	1.000		89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
2880	48			101.3	134.8	158.2	181.7	214.0	239.8	267.0	305.7
4320	72			112.9	152.6	182.4	214.0	259.6	297.7	339.4	400.7


Monywa Town (1961-2013) - Intensity / Duration / Frequency Curves
1000
100
10
1
Intensity (mm/h)
0.010
0.100
1.000
10.000
100.000
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Intensity / Duration Envelope (WMO, 1986)


Monywa Town (1961-2013) - Depth / Duration / Frequency Curves
1000
100
10
Depth (mm)
0.01
0.10
1.00
10.00
100.00
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Depth / Duration Envelope (WMO, 1986)

ATTACHMENT 2.5

Precipitation Hyetograph Analysis

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

2 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	55.3%
2	100.0%

3 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	22.9%
2	77.0%
3	100.0%

4 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	15.3%
2	56.2%
3	90.1%
4	100.0%

5 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	6.6%
2	37.2%
3	67.8%
4	93.7%
5	100.0%

6 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	8.1%
2	24.3%
3	45.3%
4	76.5%
5	97.1%
6	100.0%

7 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	6.7%
2	19.0%
3	43.0%
4	70.1%
5	88.5%
6	98.4%
7	100.0%

8 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	0.9%
2	4.7%
3	15.6%
4	51.5%
5	73.8%
6	88.3%
7	97.5%
8	100.0%

9 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	3.8%
2	13.7%
3	34.9%
4	63.4%
5	81.3%
6	88.9%
7	93.7%
8	97.8%
9	100.0%

10 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	0.4%
2	3.3%
3	7.9%
4	13.6%
5	21.5%
6	45.0%
7	71.5%
8	83.1%
9	97.5%
10	100.0%

11 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	1.8%
2	4.8%
3	12.3%
4	22.4%
5	37.3%
6	52.2%
7	66.2%
8	79.8%
9	91.2%
10	98.2%
11	100.0%

12 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	1.1%
2	4.5%
3	9.0%
4	13.5%
5	18.0%
6	23.6%
7	30.3%
8	42.7%
9	61.8%
10	84.3%
11	96.6%
12	100.0%

13 Hour – Design Hyetograph

Hour	% Cum.
0	0.0%
1	2.8%
2	6.6%
3	11.3%
4	17.9%
5	23.6%
6	32.1%
7	47.2%
8	66.0%
9	84.9%
10	93.4%
11	97.2%
12	99.1%
13	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

14 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	3.0%
2	8.7%
3	13.1%
4	15.4%
5	17.3%
6	20.6%
7	27.6%
8	39.9%
9	55.6%
10	67.8%
11	80.8%
12	92.6%
13	98.8%
14	100.0%

15 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.0%
2	15.1%
3	30.2%
4	41.3%
5	50.0%
6	57.1%
7	63.5%
8	71.4%
9	81.0%
10	88.1%
11	91.3%
12	94.4%
13	97.6%
14	99.2%
15	100.0%

16 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	5.7%
3	12.3%
4	16.0%
5	20.8%
6	34.9%
7	45.3%
8	50.9%
9	62.3%
10	68.9%
11	72.6%
12	74.5%
13	80.2%
14	89.6%
15	97.2%
16	100.0%

18 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	6.2%
3	10.6%
4	14.2%
5	22.1%
6	28.3%
7	34.5%
8	40.7%
9	46.0%
10	52.2%
11	61.1%
12	65.5%
13	70.8%
14	78.8%
15	86.7%
16	95.6%
17	99.1%
18	100.0%

19 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.3%
2	11.4%
3	21.4%
4	31.4%
5	41.4%
6	48.6%
7	58.6%
8	70.0%
9	80.0%
10	85.7%
11	88.6%
12	90.0%
13	91.4%
14	92.9%
15	94.3%
16	95.7%
17	97.1%
18	98.6%
19	100.0%

20 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.7%
2	3.3%
3	5.0%
4	7.5%
5	13.3%
6	22.5%
7	30.0%
8	37.5%
9	41.7%
10	43.3%
11	44.2%
12	51.7%
13	60.0%
14	68.3%
15	75.8%
16	83.3%
17	90.8%
18	95.8%
19	99.2%
20	100.0%

21 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.4%
2	4.3%
3	7.1%
4	11.4%
5	17.1%
6	21.4%
7	25.7%
8	30.0%
9	34.3%
10	37.1%
11	41.4%
12	47.1%
13	52.9%
14	60.0%
15	68.6%
16	77.1%
17	84.3%
18	90.0%
19	95.7%
20	98.6%
21	100.0%

23 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.4%
2	0.8%
3	3.5%
4	6.2%
5	8.1%
6	10.8%
7	15.1%
8	22.4%
9	31.7%
10	40.2%
11	47.5%
12	51.7%
13	53.3%
14	54.4%
15	56.0%
16	57.5%
17	59.8%
18	66.4%
19	79.9%
20	91.5%
21	97.3%
22	99.6%
23	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

27 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	2.1%
2	6.7%
3	23.5%
4	52.5%
5	58.1%
6	59.5%
7	60.1%
8	60.4%
9	61.0%
10	62.5%
11	64.8%
12	67.2%
13	69.5%
14	72.1%
15	74.5%
16	76.2%
17	77.4%
18	78.0%
19	78.3%
20	78.9%
21	83.3%
22	89.7%
23	95.0%
24	97.9%
25	99.1%
26	99.7%
27	100.0%

30 Hour

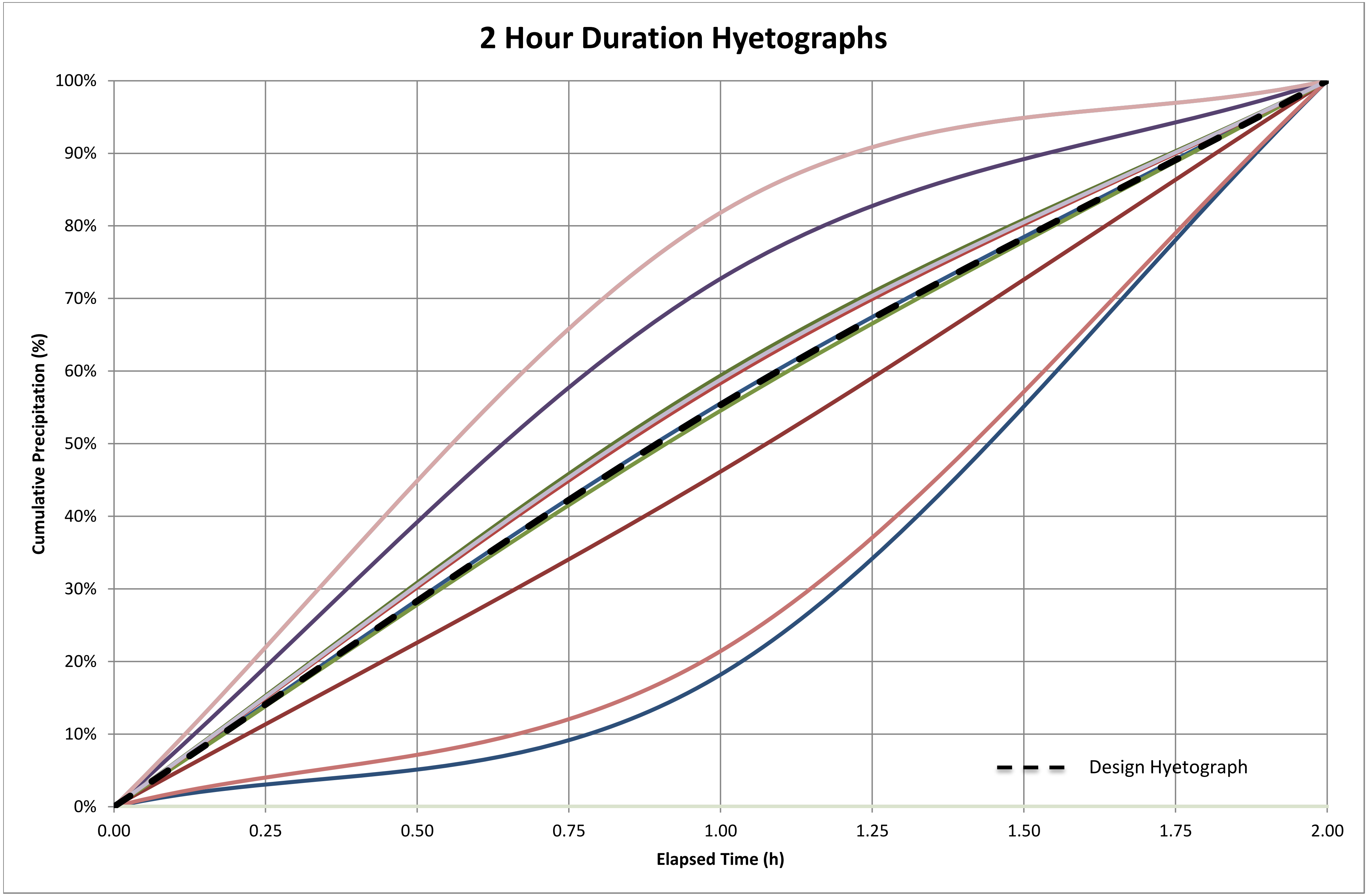
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.1%
2	3.7%
3	7.0%
4	11.2%
5	16.0%
6	20.3%
7	24.1%
8	27.3%
9	29.9%
10	31.6%
11	32.6%
12	33.2%
13	33.7%
14	35.3%
15	38.0%
16	41.2%
17	44.4%
18	48.7%
19	56.7%
20	67.9%
21	73.3%
22	74.9%
23	75.9%
24	77.0%
25	79.1%
26	82.4%
27	85.6%
28	89.3%
29	94.7%
30	100.0%

44 Hour

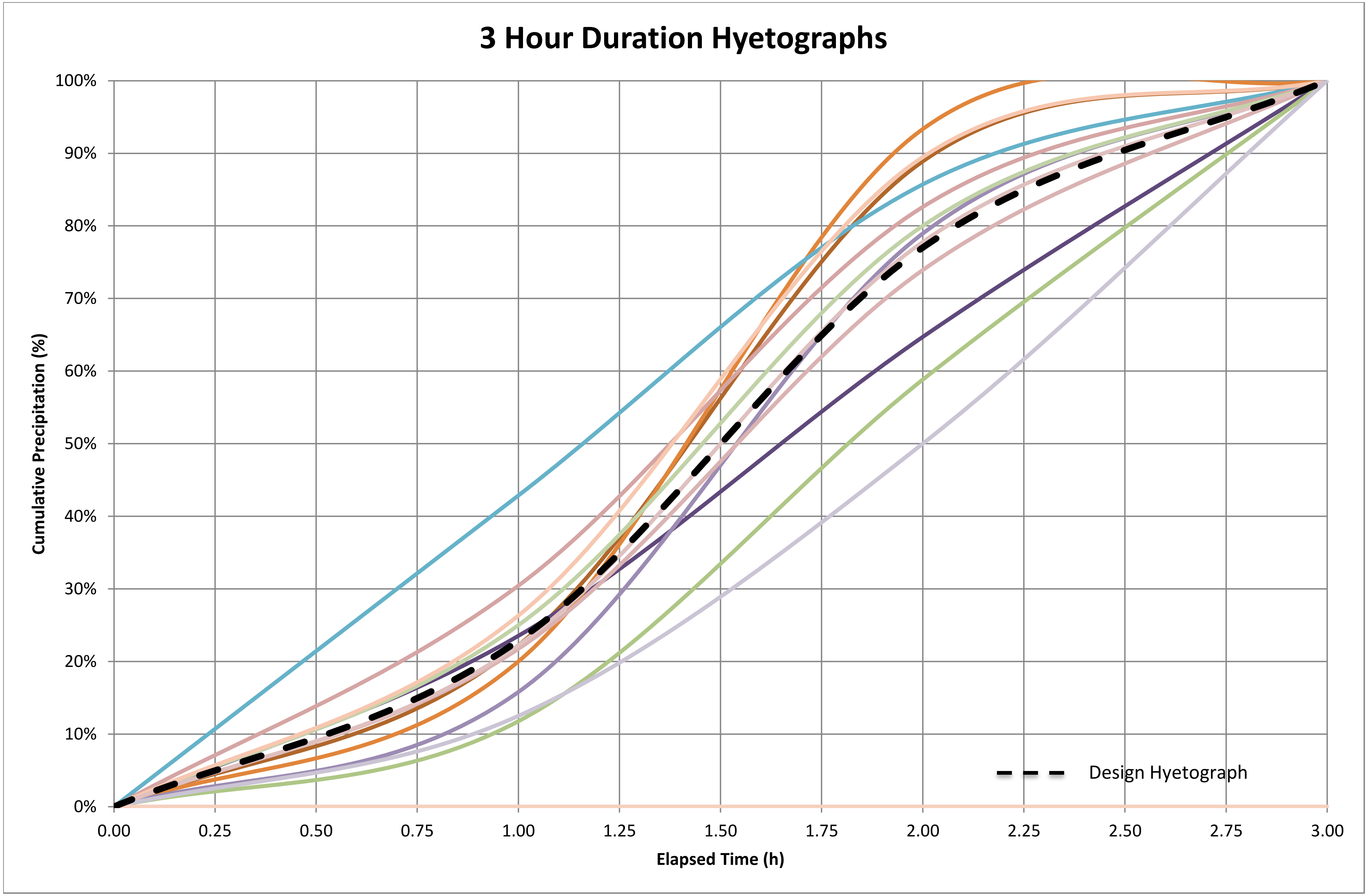
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.0%
3	2.9%
4	4.5%
5	6.2%
6	7.9%
7	10.5%
8	14.0%
9	18.4%
10	23.6%
11	24.7%
12	26.5%
13	29.0%
14	31.4%
15	35.4%
16	40.6%
17	43.9%
18	45.9%
19	47.9%
20	49.8%
21	51.8%
22	53.1%
23	53.6%
24	53.8%
25	54.0%
26	54.1%
27	54.2%
28	54.7%
29	56.7%
30	61.8%
31	68.9%
32	74.9%
33	79.2%
34	82.6%
35	85.6%
36	88.7%
37	91.2%
38	93.1%
39	94.7%
40	96.5%
41	98.0%
42	99.1%
43	99.9%
44	100.0%

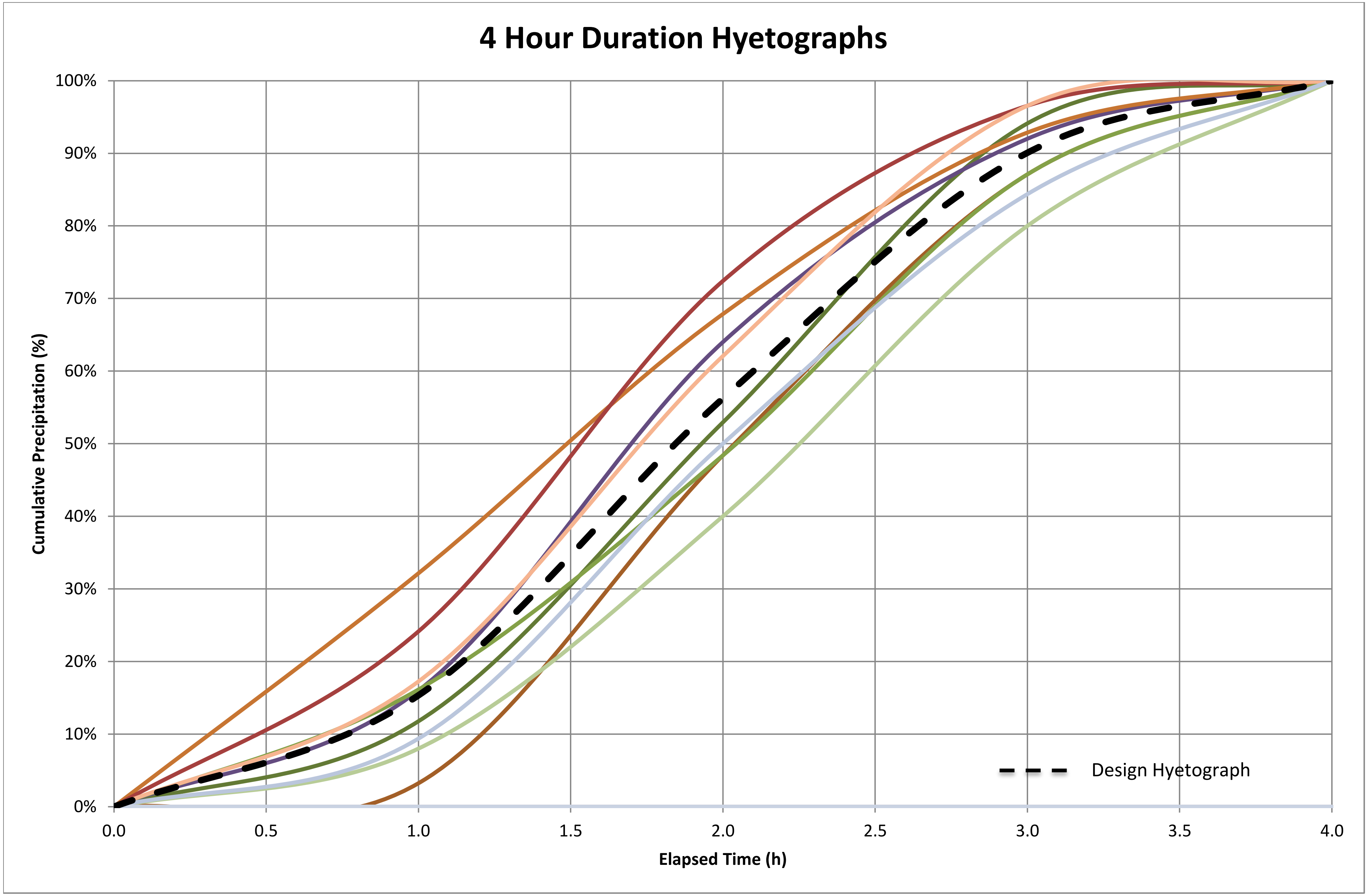
45 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.5%
3	5.4%
4	10.2%
5	14.8%
6	20.0%
7	25.2%
8	30.2%
9	35.4%
10	40.3%
11	42.0%
12	43.4%
13	45.2%
14	46.9%
15	48.9%
16	50.5%
17	51.4%
18	51.9%
19	52.5%
20	52.7%
21	52.8%
22	53.0%
23	53.1%
24	53.2%
25	53.5%
26	55.5%
27	60.0%
28	65.6%
29	70.1%
30	73.4%
31	76.3%
32	78.9%
33	81.7%
34	84.8%
35	88.3%
36	91.7%
37	93.0%
38	93.2%
39	93.4%
40	94.0%
41	95.1%
42	96.4%
43	98.0%
44	99.5%
45	100.0%

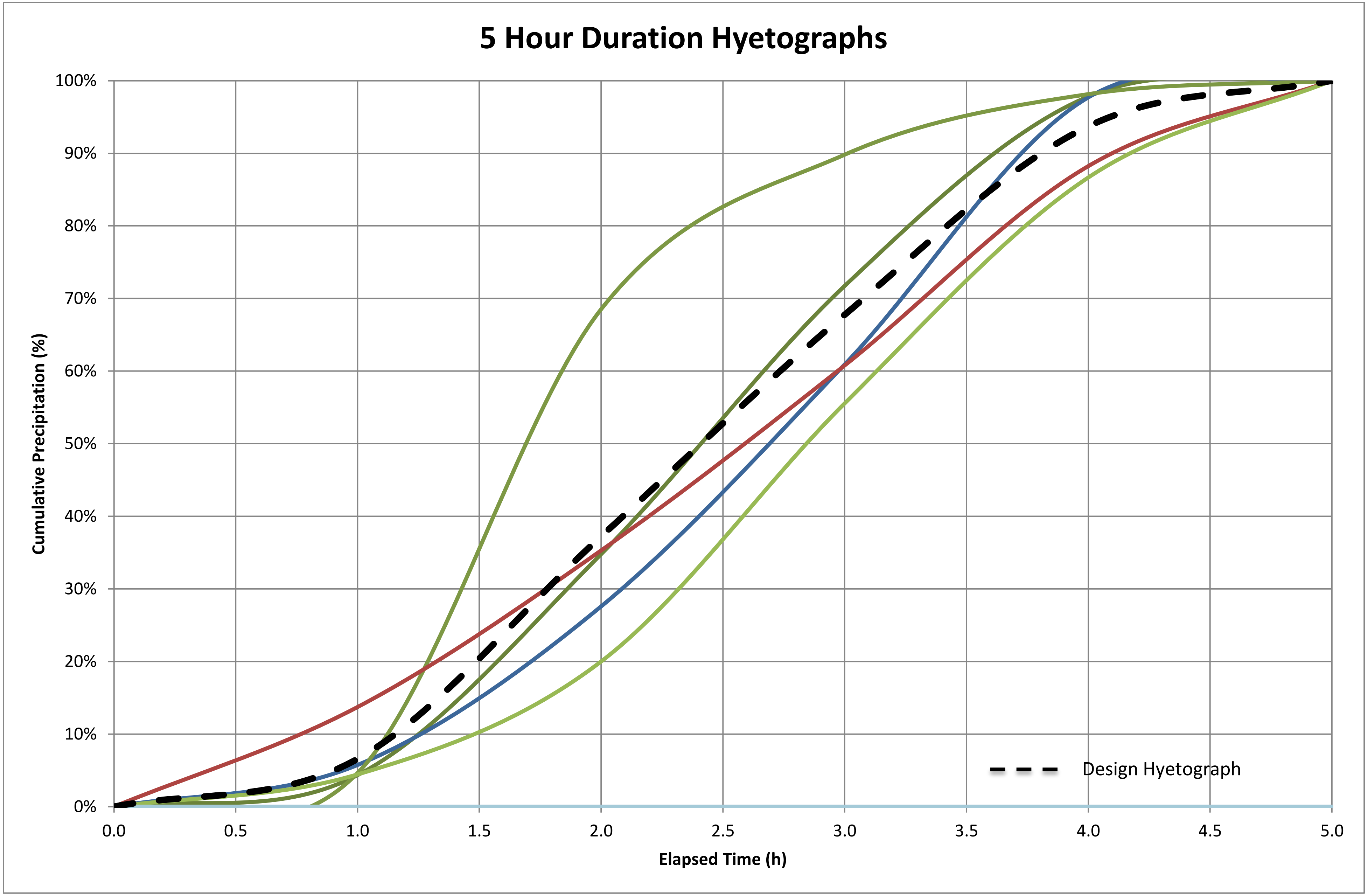


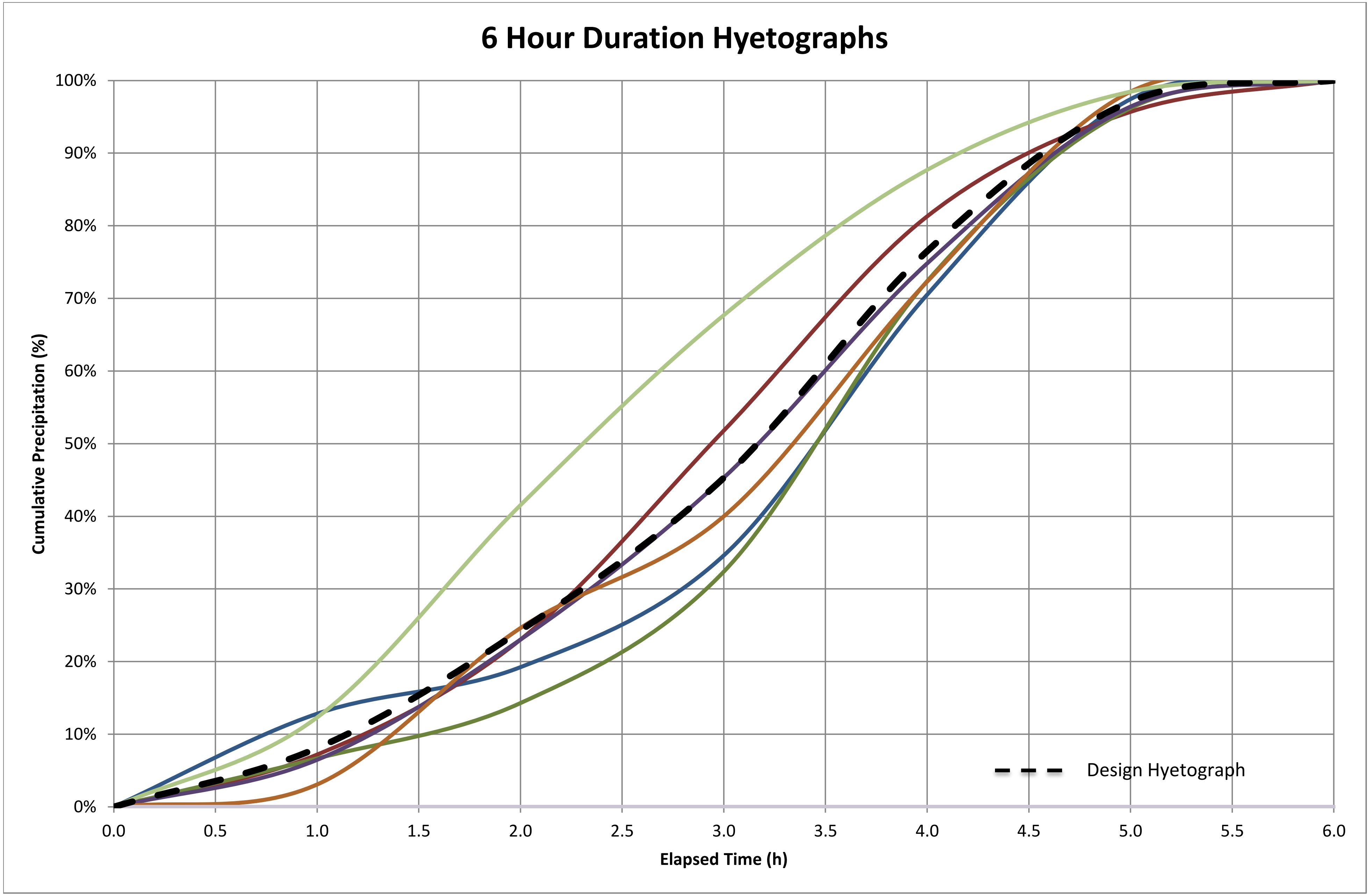
2 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Elapsed Time (h)
Design Hyetograph

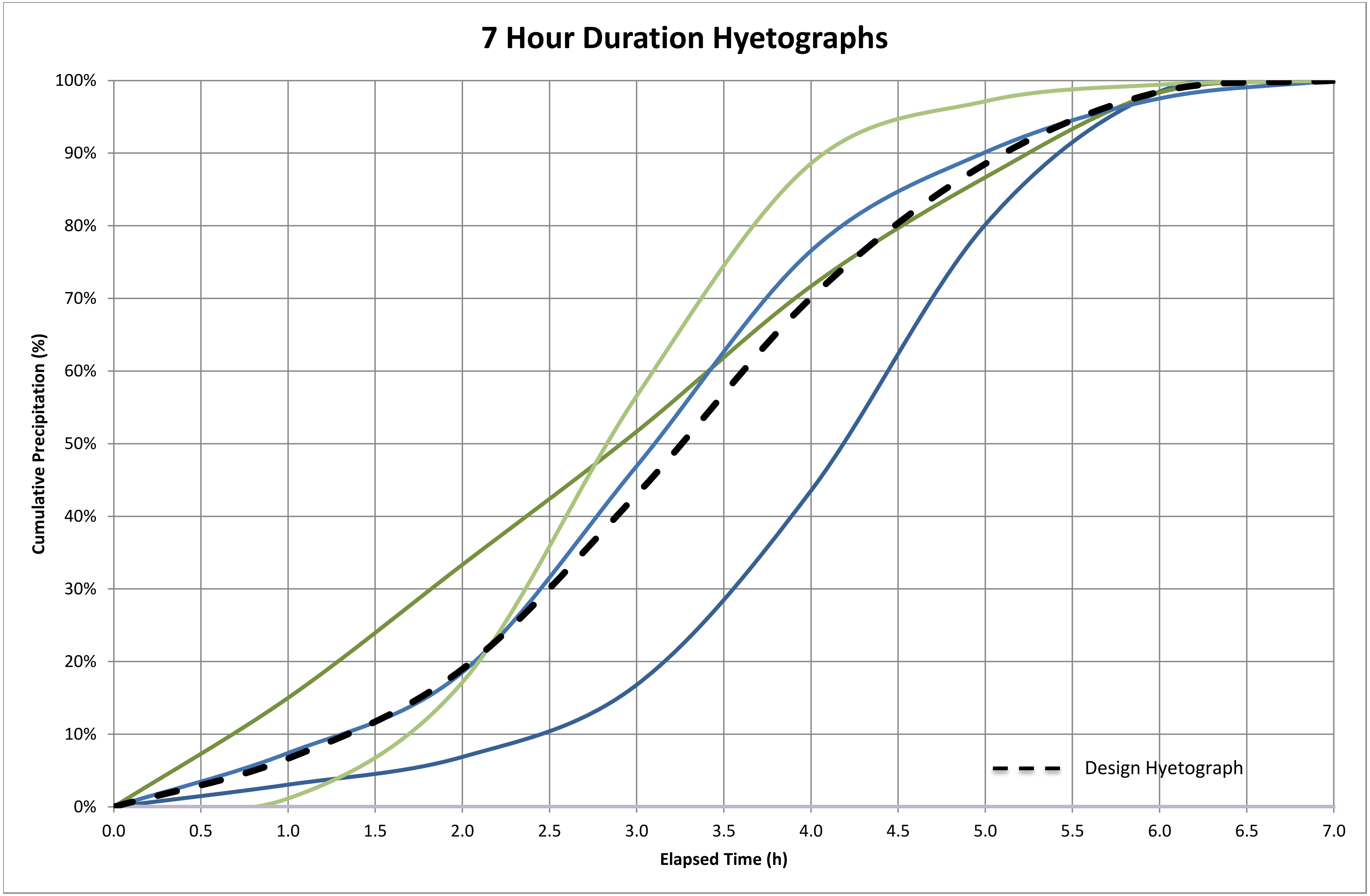

3 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
Elapsed Time (h)
Design Hyetograph

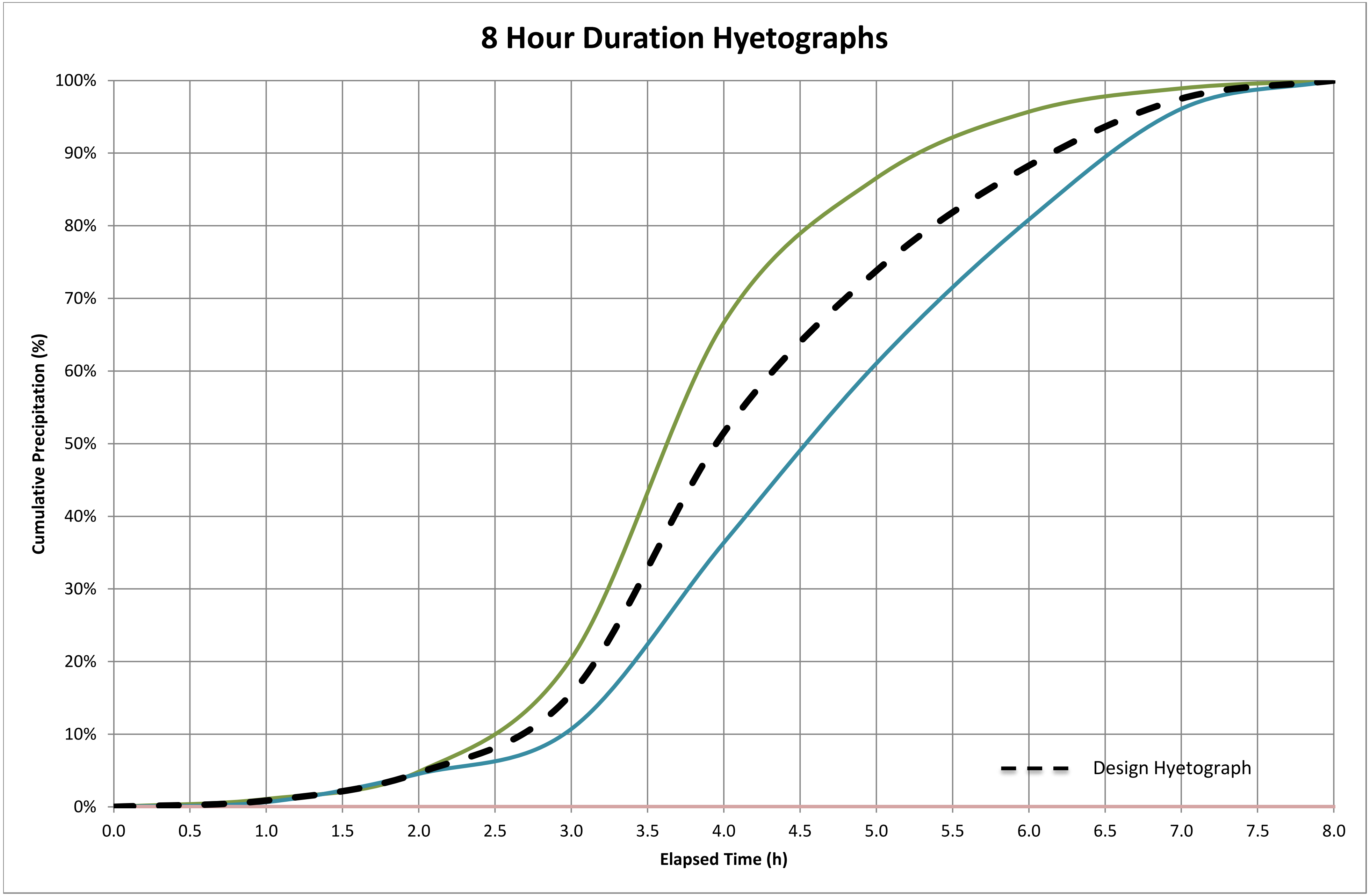


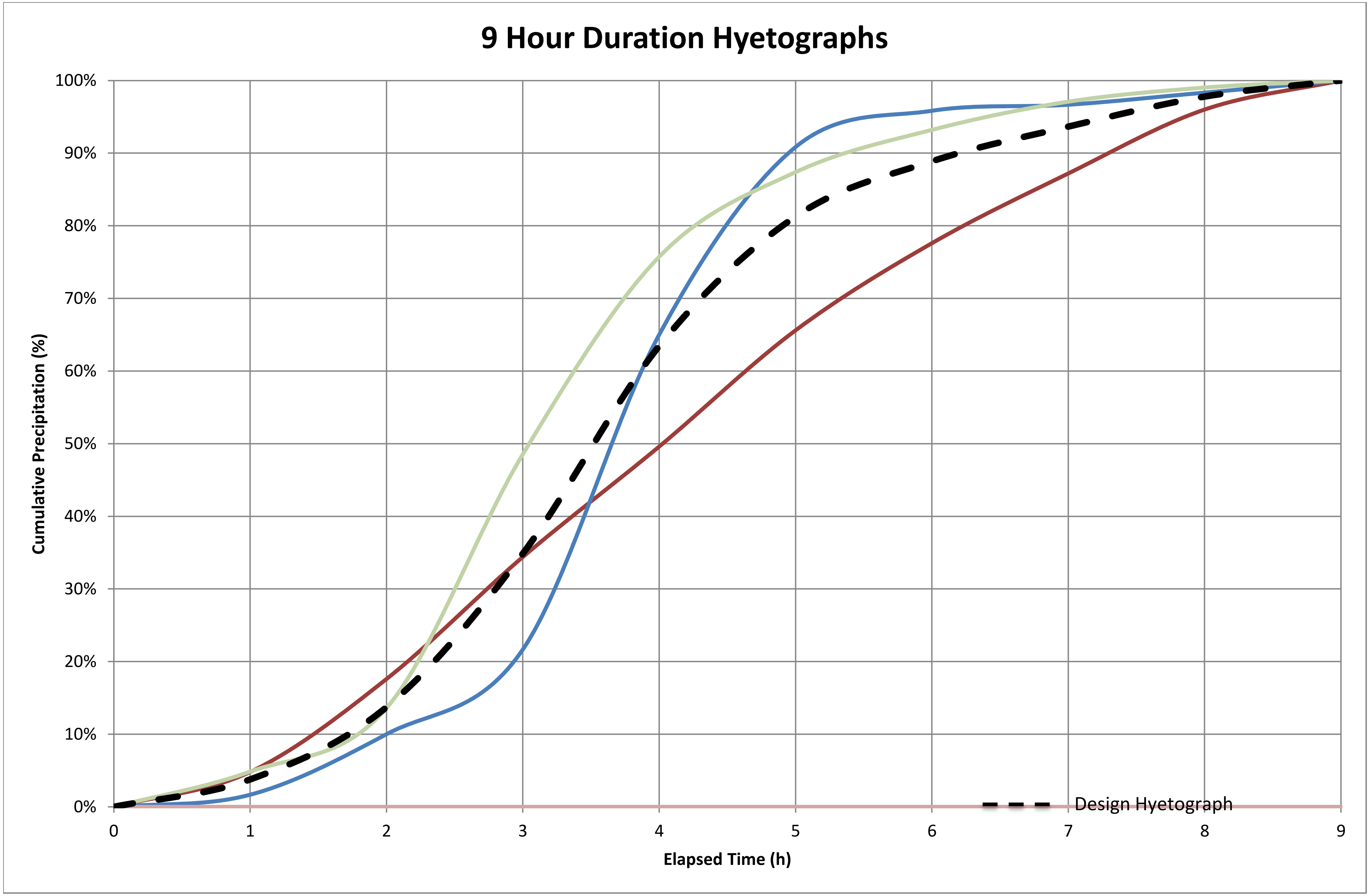
4 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Elapsed Time (h)
Design Hyetograph

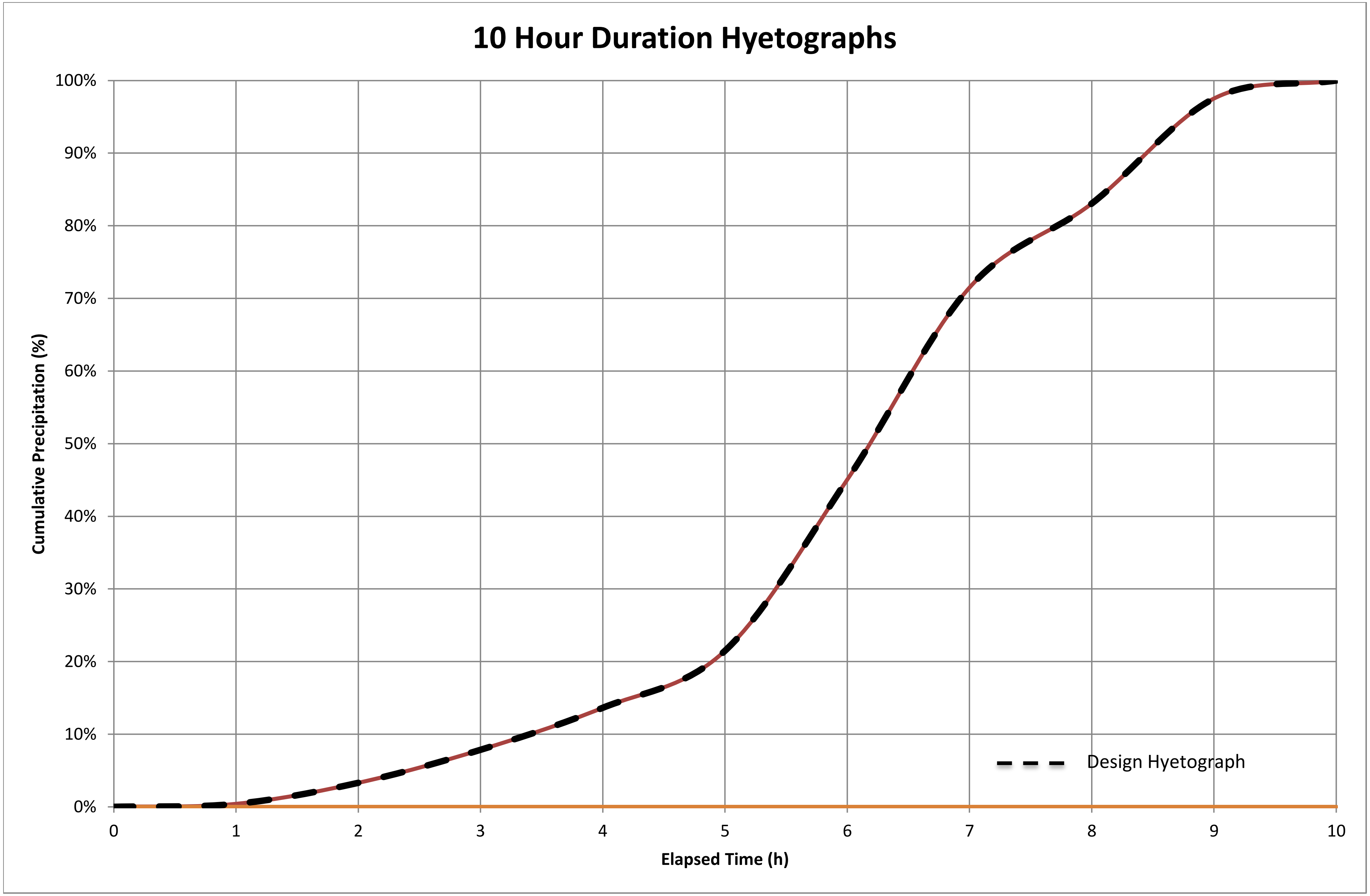

5 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Elapsed Time (h)
Design Hyetograph

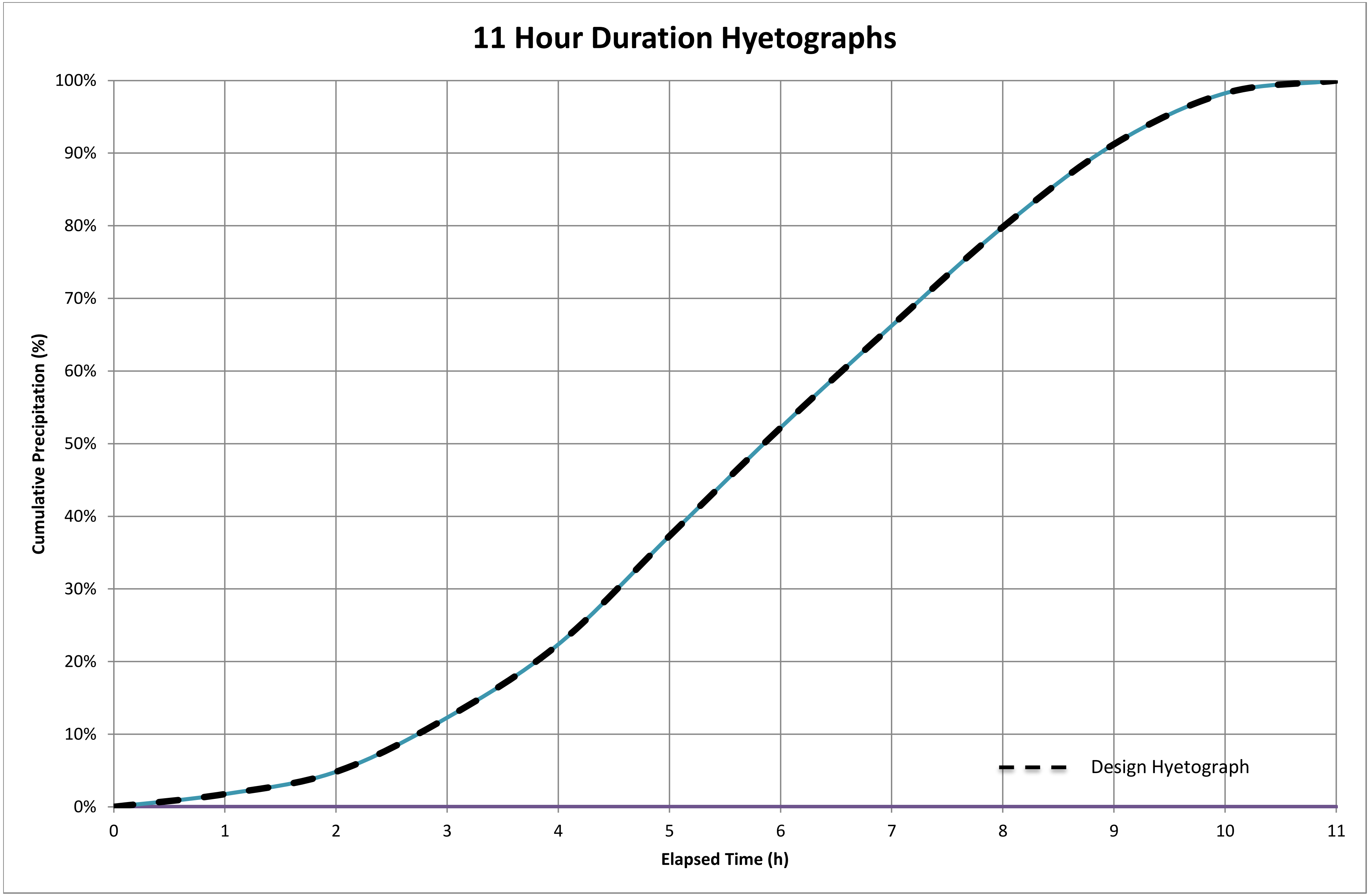

6 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Elapsed Time (h)
Design Hyetograph

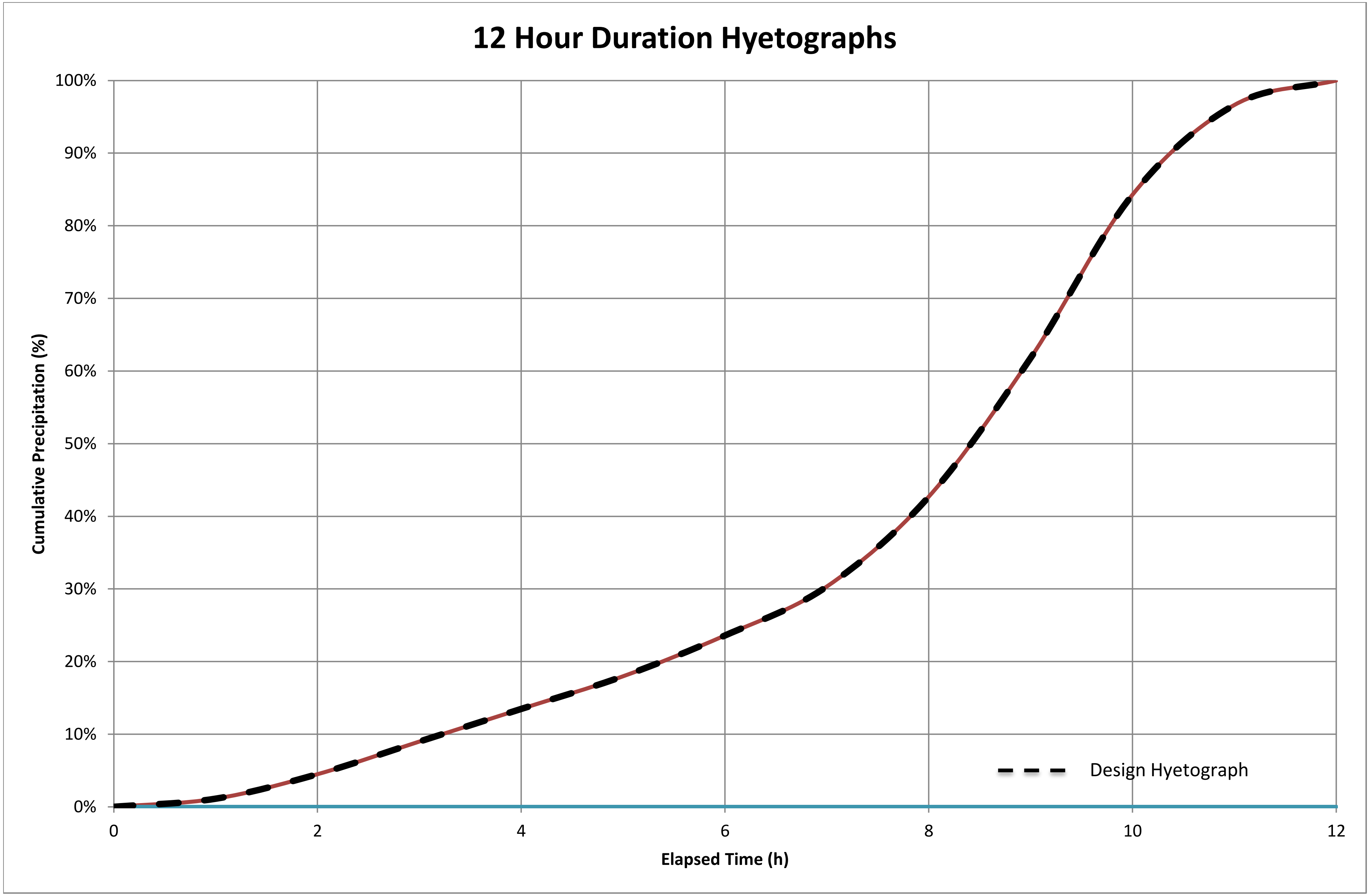

7 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
Elapsed Time (h)
Design Hyetograph

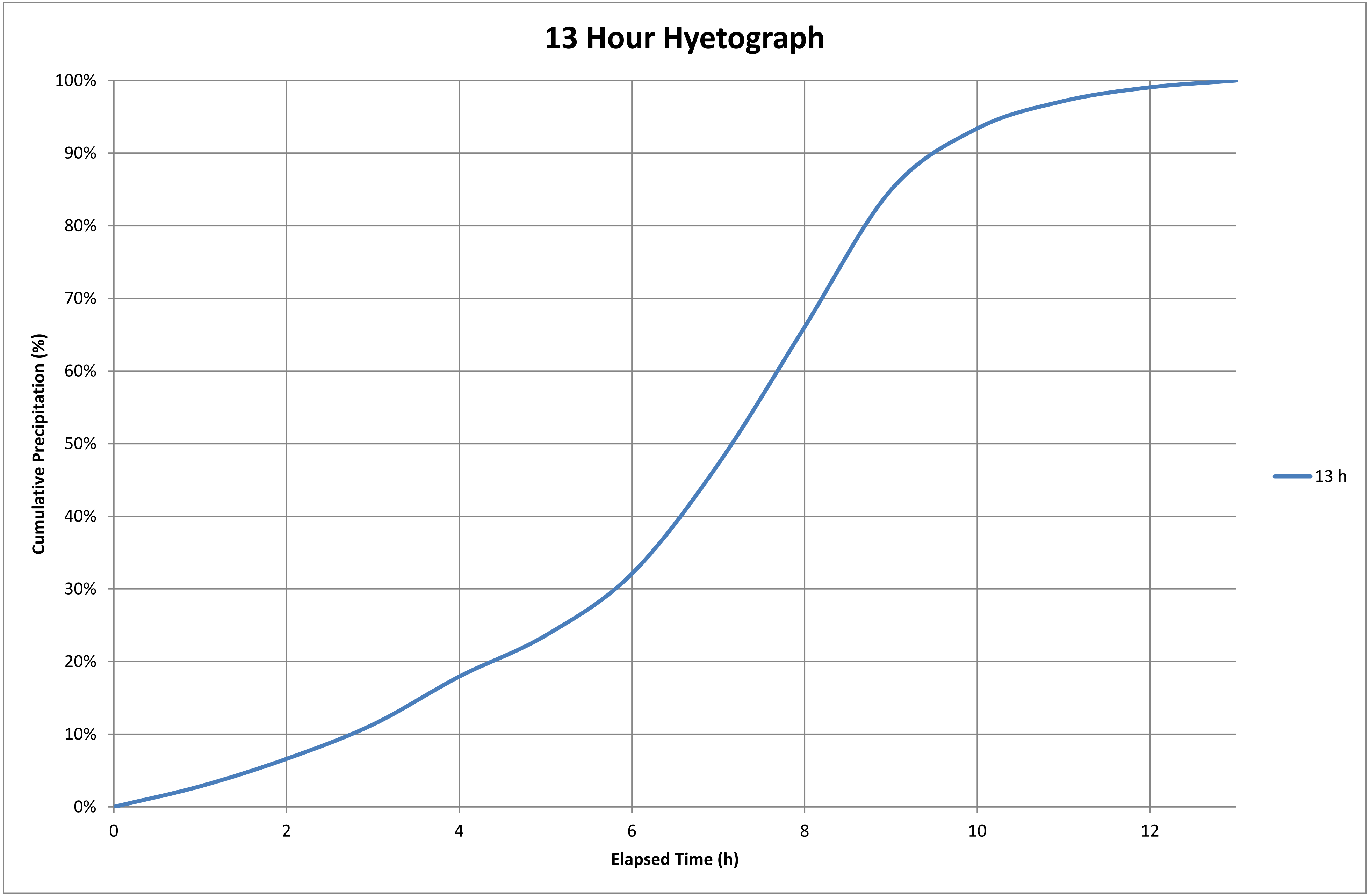

8 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Elapsed Time (h)
Design Hyetograph


9 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
Elapsed Time (h)
Design Hyetograph

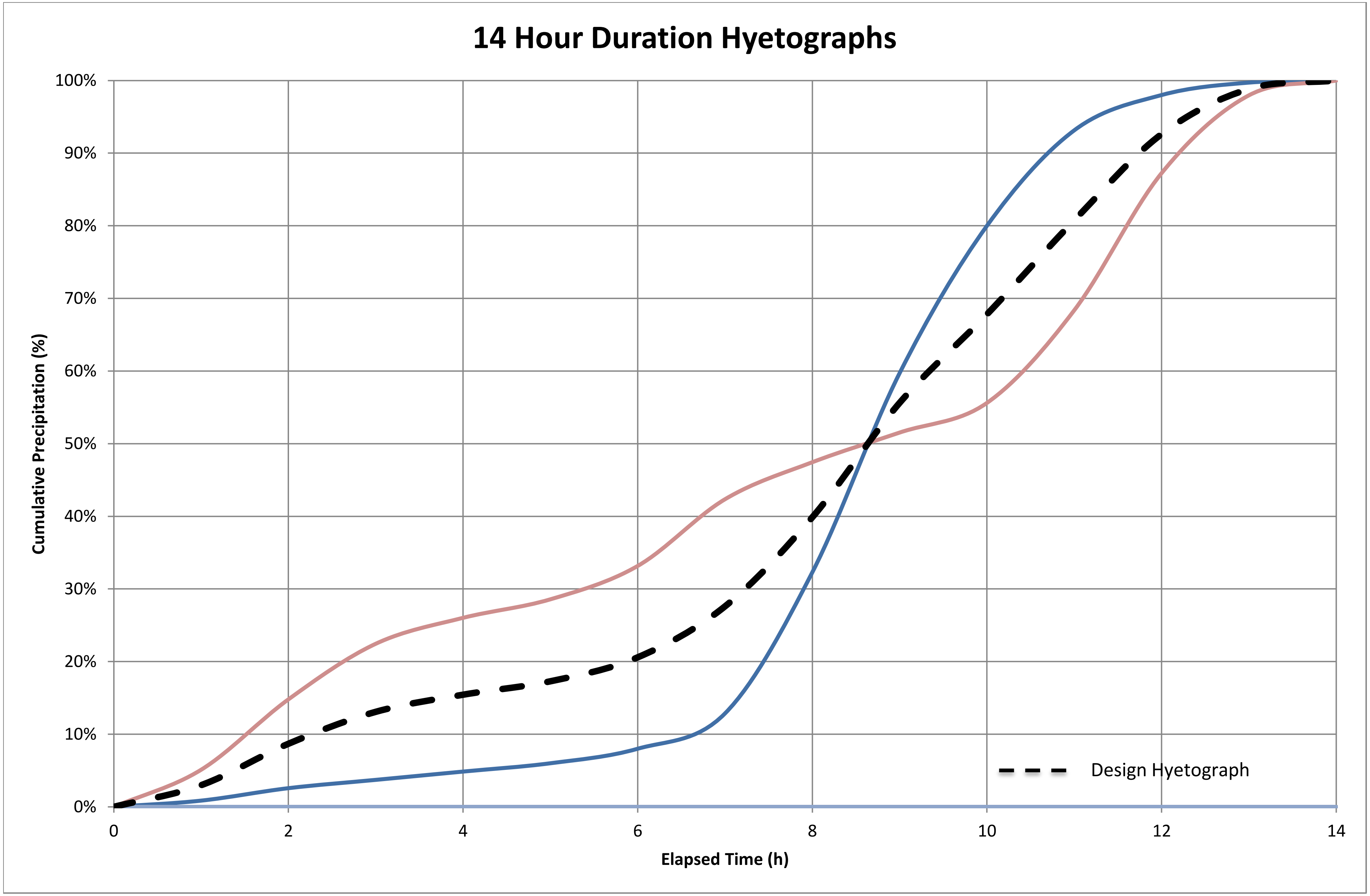

10 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
Elapsed Time (h)
Design Hyetograph

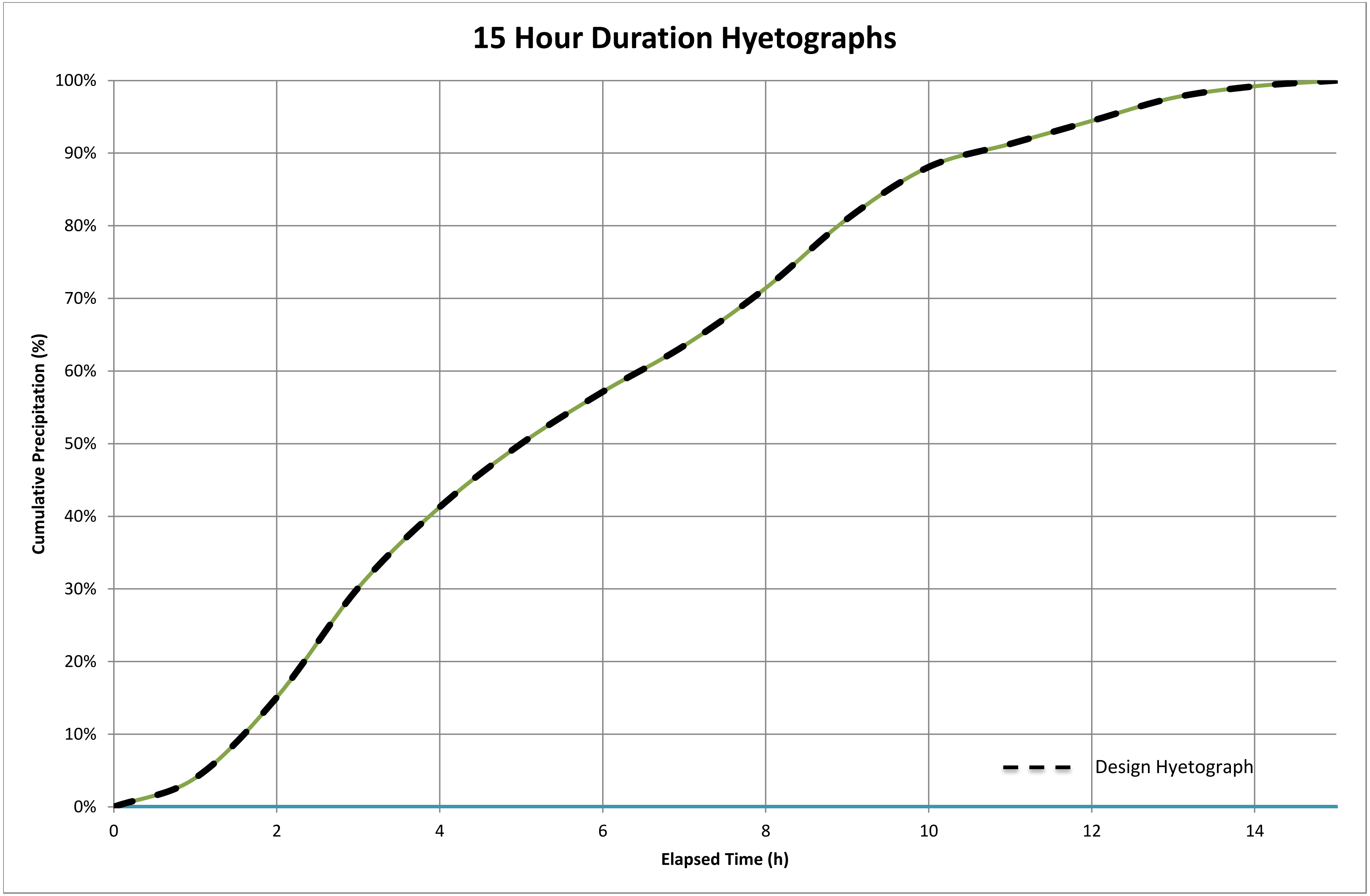

11 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
11
Elapsed Time (h)
Design Hyetograph

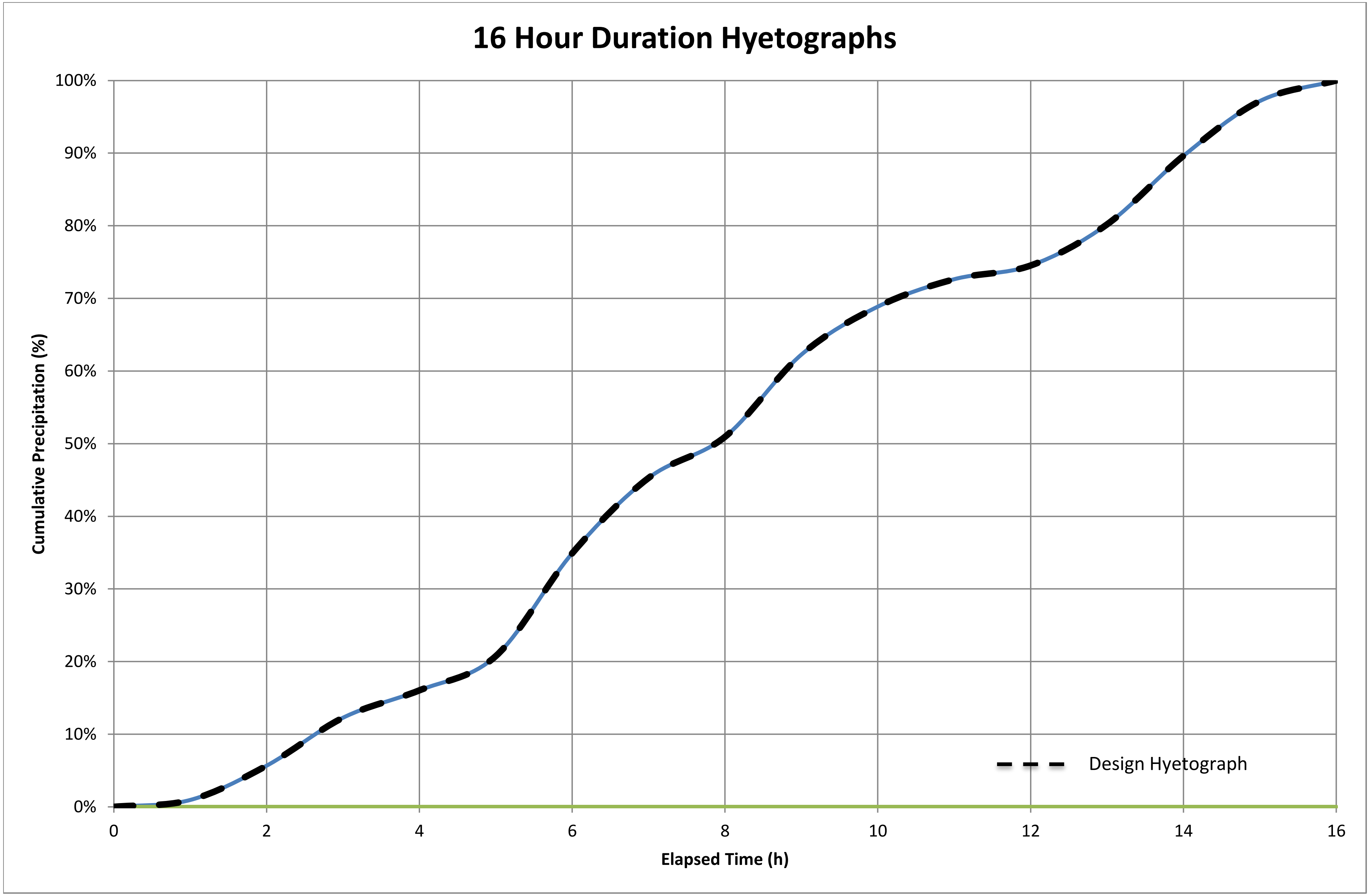

12 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
Elapsed Time (h)
Design Hyetograph

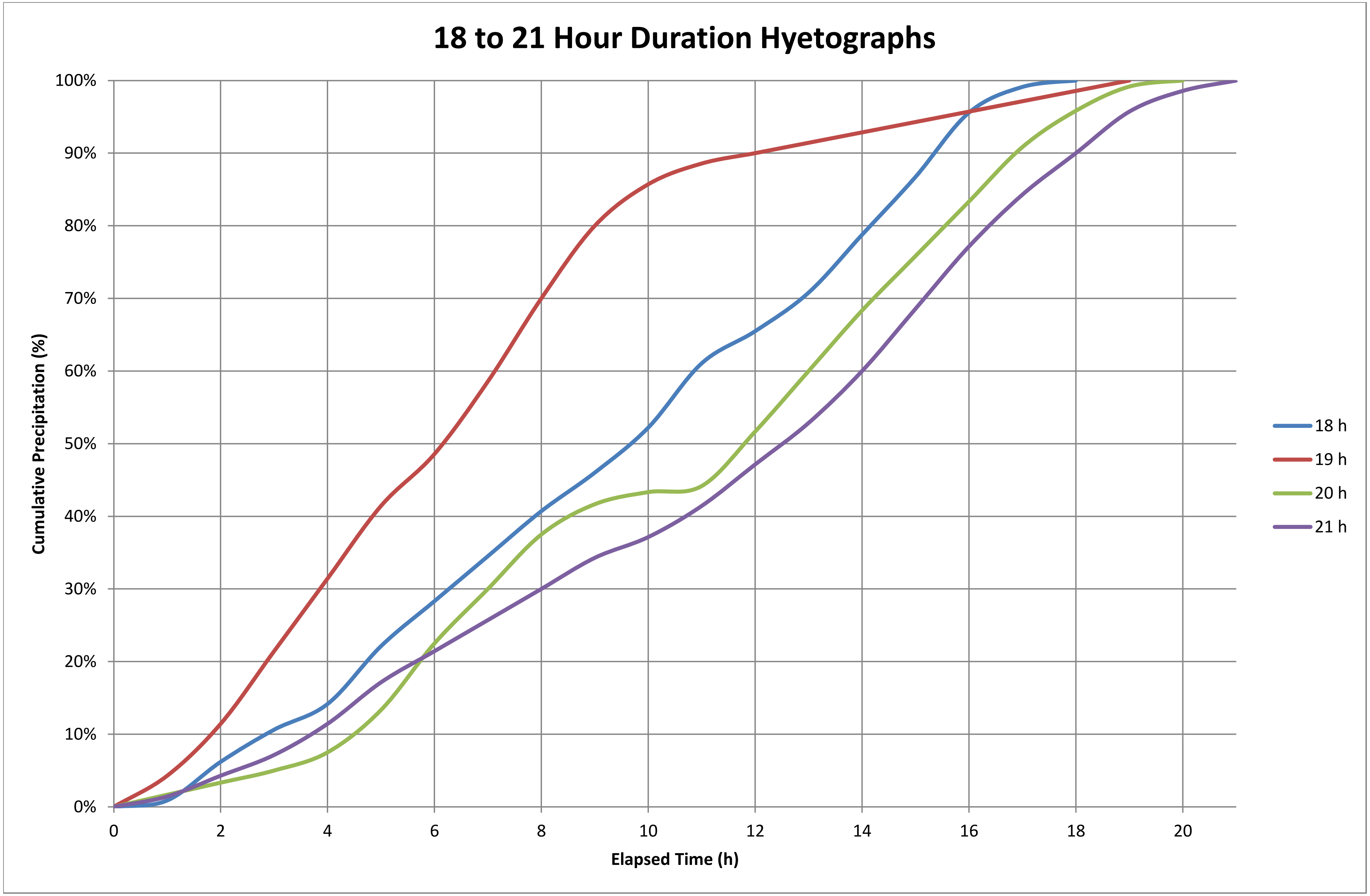


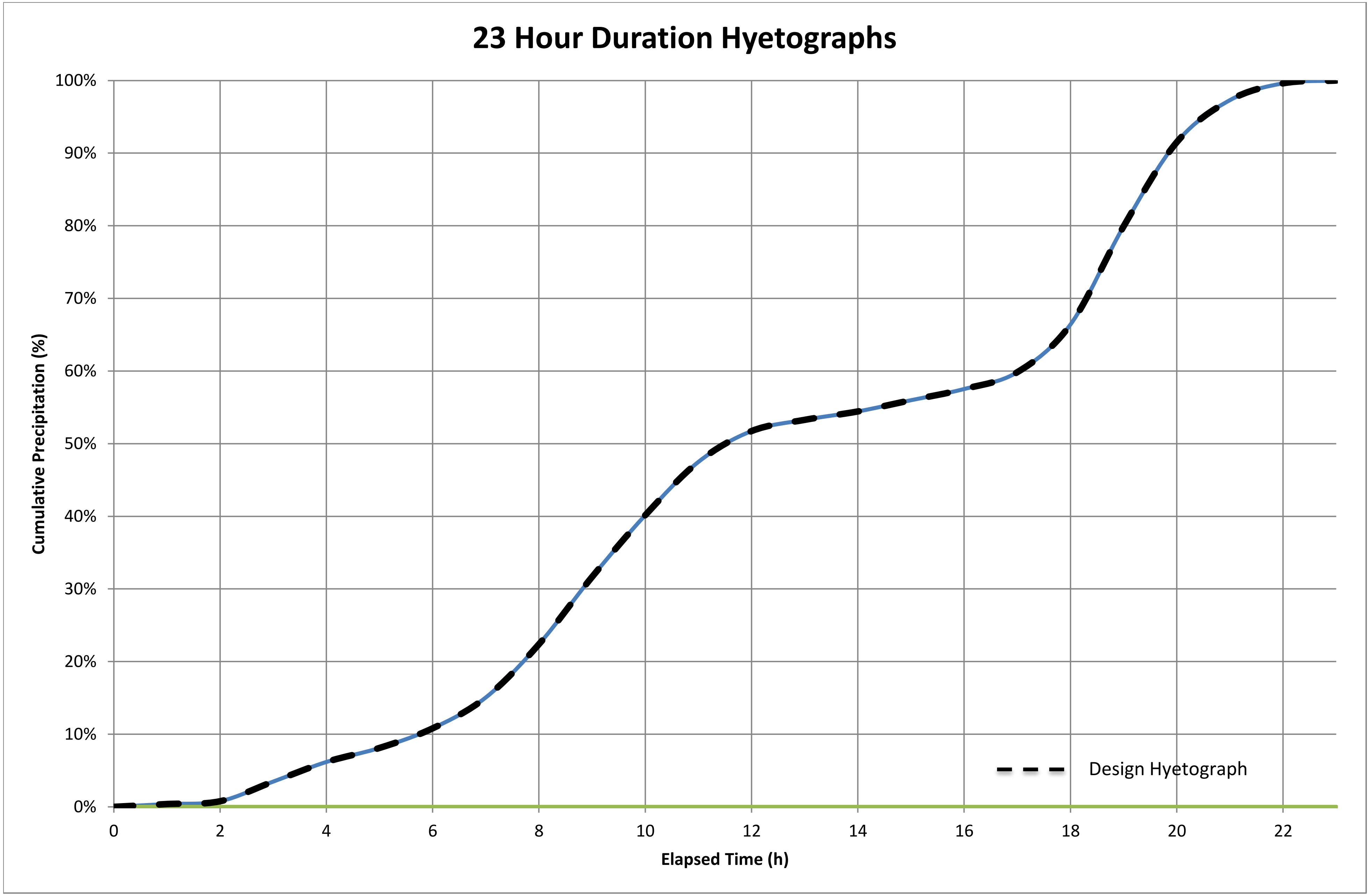
13 Hour Hyetograph
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
Elapsed Time (h)
13 h

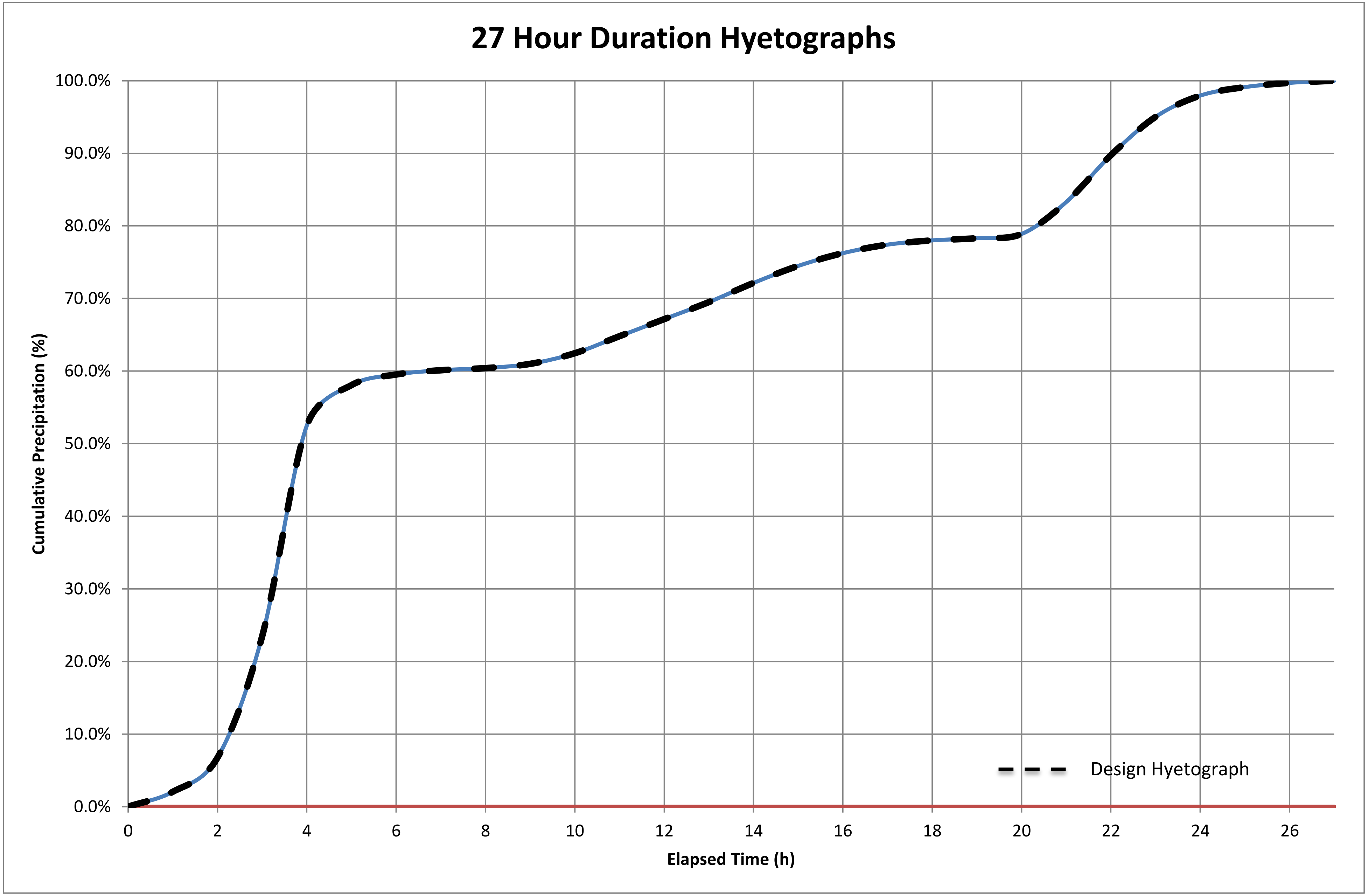

14 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph

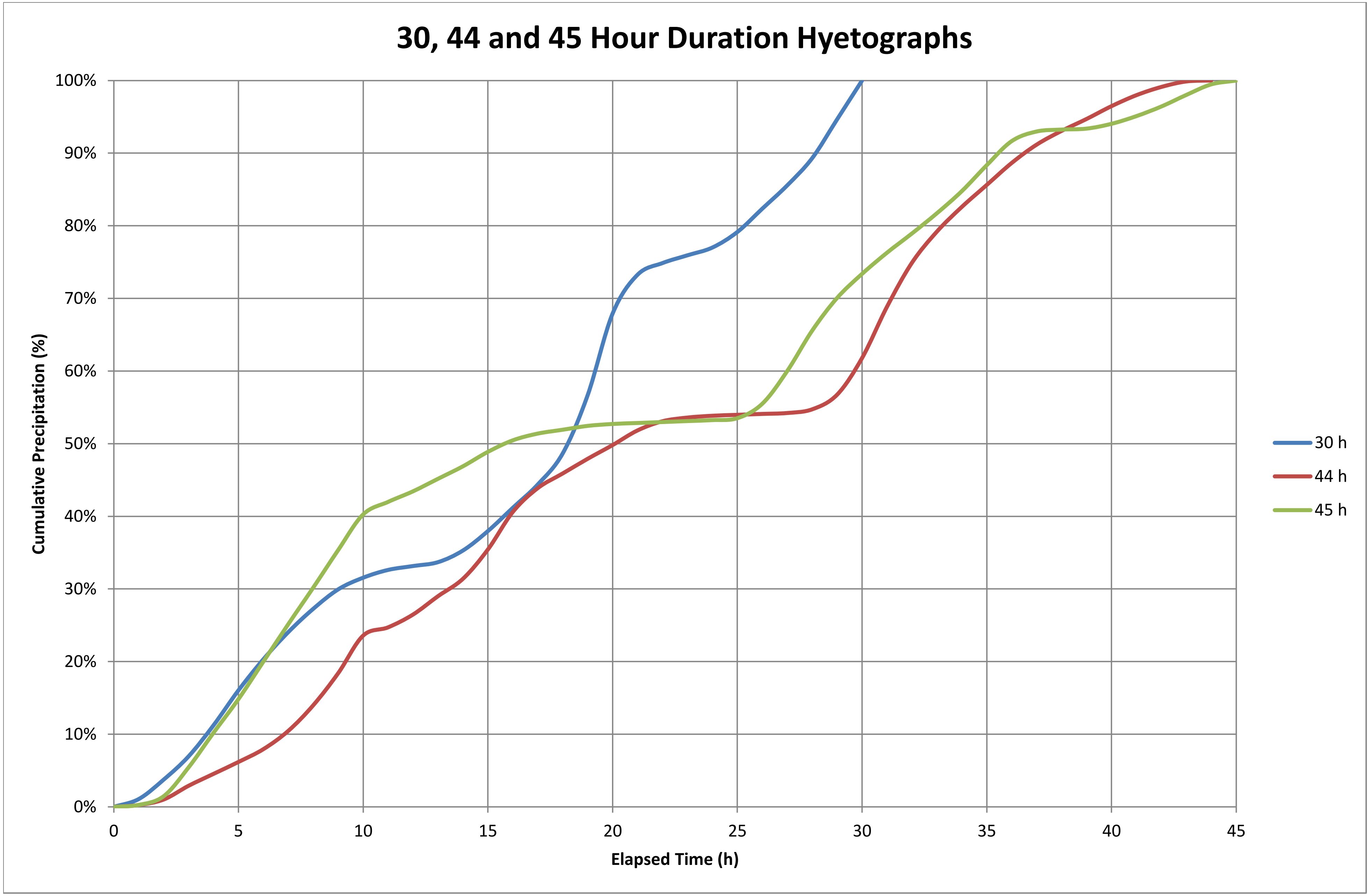

15 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph


16 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
Elapsed Time (h)
Design Hyetograph


18 to 21 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
Elapsed Time (h)
18 h
19 h
20 h
21 h


23 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
22
Elapsed Time (h)
Design Hyetograph


27 Hour Duration Hyetographs
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Elapsed Time (h)
Design Hyetograph



30, 44 and 45 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
Elapsed Time (h)
30 h
44 h
45 h

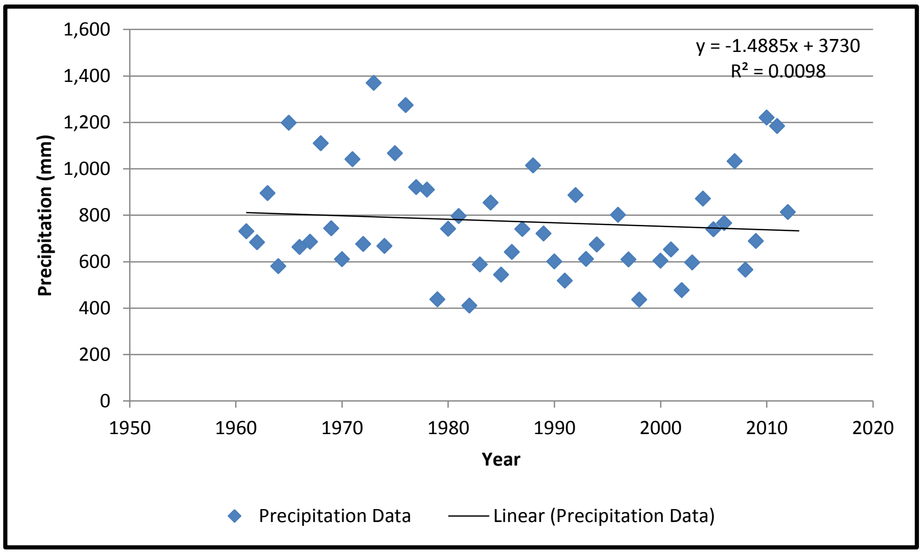
ATTACHMENT 2.6

Precipitation Trend Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 25/06/2013
	Basic Climatology	Approved	

Climatic Trend Analysis: Monywa Township Precipitation (1961-2013)

Year	Precip (mm)
1961	731
1962	684
1963	896
1964	581
1965	1,198
1966	664
1967	686
1968	1,110
1969	744
1970	611
1971	1,042
1972	676
1973	1,370
1974	668
1975	1,067
1976	1,275
1977	921
1978	910
1979	438
1980	742
1981	797
1982	411
1983	588
1984	855
1985	544
1986	642
1987	741
1988	1,015
1989	722
1990	601
1991	518
1992	887
1993	612
1994	675
1995	Exclude
1996	802
1997	610
1998	437
1999	Exclude
2000	604
2001	653
2002	478
2003	597
2004	872
2005	740
2006	767
2007	1,032
2008	566
2009	689
2010	1,221
2011	1,184
2012	814
2013	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual precipitation values at this site.

ATTACHMENT 2.7

Water Balance Scenario Frequency Analysis

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 39

5 Year Data		Rank	Weibull	ARI	Ranked
Years	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**5 yr Wet Precip (mm)**
1961 - 1965	4090.0	1	0.025	40.00	5301.0
1962 - 1966	4023.0	2	0.050	20.00	5056.0
1963 - 1967	4025.0	3	0.075	13.33	4841.0
1964 - 1968	4239.0	4	0.100	10.00	4823.0
1965 - 1969	4402.0	5	0.125	8.00	4693.0
1966 - 1970	3815.0	6	0.150	6.67	4611.0
1967 - 1971	4193.0	7	0.175	5.71	4474.2
1968 - 1972	4183.0	8	0.200	5.00	4443.0
1969 - 1973	4443.0	9	0.225	4.44	4402.0
1970 - 1974	4367.0	10	0.250	4.00	4367.0
1971 - 1975	4823.0	11	0.275	3.64	4286.0
1972 - 1976	5056.0	12	0.300	3.33	4275.6
1973 - 1977	5301.0	13	0.325	3.08	4239.0
1974 - 1978	4841.0	14	0.350	2.86	4193.0
1975 - 1979	4611.0	15	0.375	2.67	4183.0
1976 - 1980	4286.0	16	0.400	2.50	4090.0
1977 - 1981	3808.0	17	0.425	2.35	4025.0
1978 - 1982	3298.0	18	0.450	2.22	4023.0
1979 - 1983	2976.0	19	0.475	2.11	4008.1
1980 - 1984	3393.0	20	0.500	2.00	3976.9
1981 - 1985	3195.0	21	0.525	1.90	3815.0
1982 - 1986	3040.0	22	0.550	1.82	3808.0
1983 - 1987	3370.0	23	0.575	1.74	3797.0
1984 - 1988	3797.0	24	0.600	1.67	3794.6
1985 - 1989	3664.0	25	0.625	1.60	3743.0
1986 - 1990	3721.0	26	0.650	1.54	3721.0
1987 - 1991	3597.0	27	0.675	1.48	3664.0
1988 - 1992	3743.0	28	0.700	1.43	3597.0
1989 - 1993	3340.0	29	0.725	1.38	3453.9
1990 - 1994	3292.6	30	0.750	1.33	3393.0
1991 - 1995	Exclude	31	0.775	1.29	3370.0
1992 - 1996	Exclude	32	0.800	1.25	3340.4
1993 - 1997	Exclude	33	0.825	1.21	3340.0
1994 - 1998	Exclude	34	0.850	1.18	3298.0
1995 - 1999	Exclude	35	0.875	1.14	3292.6
1996 - 2000	Exclude	36	0.900	1.11	3204.7
1997 - 2001	Exclude	37	0.925	1.08	3195.0
1998 - 2002	Exclude	38	0.950	1.05	3040.0
1999 - 2003	Exclude	39	0.975	1.03	2976.0
2000 - 2004	3204.7				
2001 - 2005	3340.4				
2002 - 2006	3453.9				
2003 - 2007	4008.1				
2004 - 2008	3976.9				
2005 - 2009	3794.6				
2006 - 2010	4275.6				
2007 - 2011	4693.0				
2008 - 2012	4474.2				
2009 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Wakeby	1	1	1
Johnson SB	3	2	6
Gen. Extreme Value	6	3	18
Error	5	5	25
Nakagami	9	4	36
Weibull (3P)	8	7	56
Rayleigh (2P)	7	10	70
Beta	2	41	82
Gamma	15	6	90
Log-Pearson 3	18	9	162

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

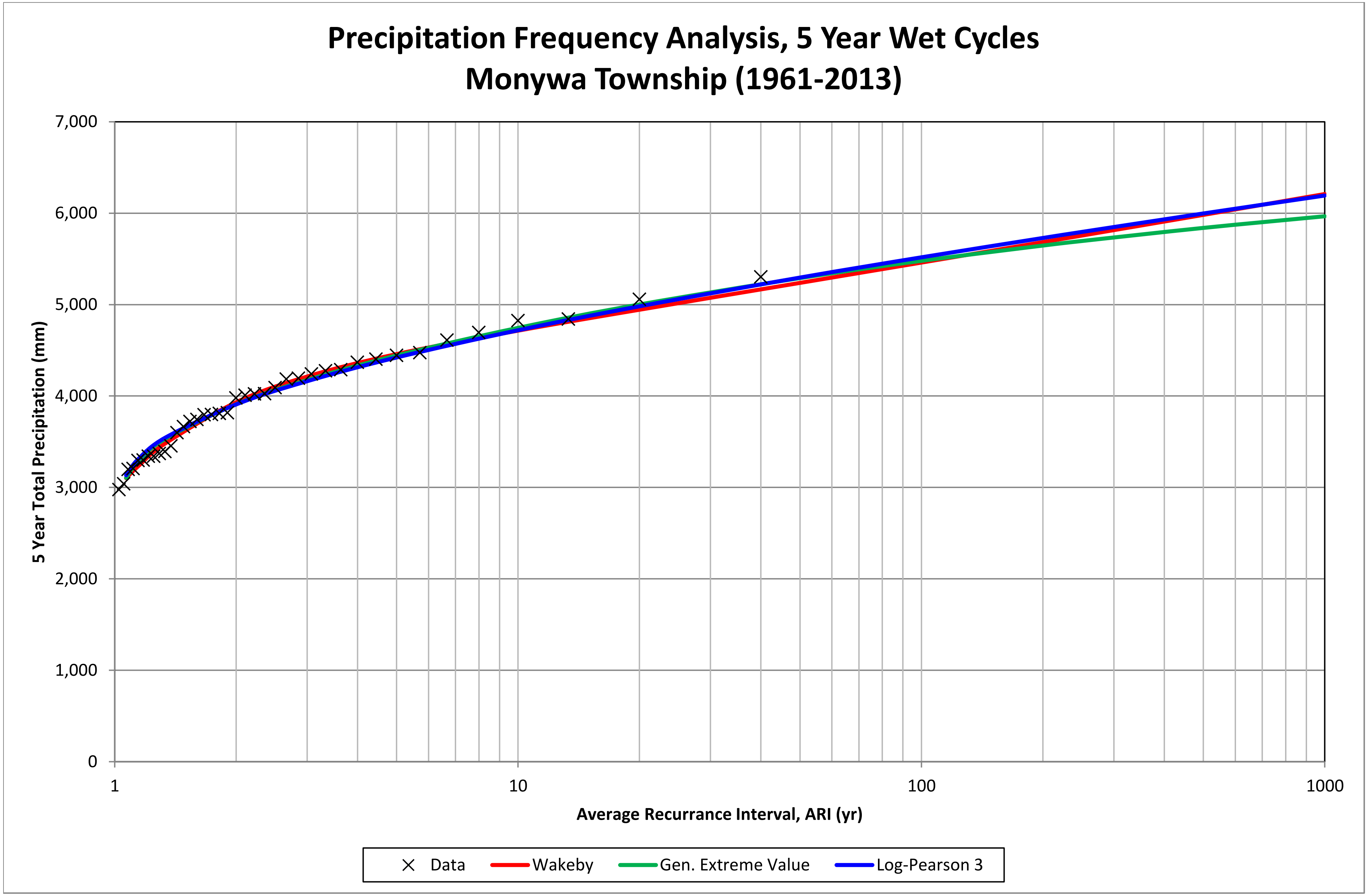
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 5 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 5 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	1911.522	k =	-0.16718292	α =	2422.254636
			β =	1.802226	σ =	549.6462521	β =	0.002964861
			γ =	302.7783	μ =	3714.507579	γ =	1.090119469
			δ =	0.012517				
			ξ =	2963.906				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	6209.2	N/A	5966.2	592.61	6192.9	581.77
0.998	0.002	500	5981.3	N/A	5838.8	592.61	5996.6	581.77
0.996	0.004	250	5755.4	N/A	5695.6	592.61	5794.8	581.77
0.995	0.005	200	5683.1	N/A	5645.8	592.61	5728.4	581.77
0.990	0.010	100	5459.6	N/A	5478.5	592.61	5517.0	581.77
0.980	0.020	50	5237.6	N/A	5289.9	592.61	5295.5	581.77
0.950	0.050	20	4944.0	N/A	5001.3	592.61	4981.4	581.77
0.900	0.100	10	4715.1	N/A	4745.4	592.61	4719.2	581.77
0.800	0.200	5	4458.5	N/A	4443.7	592.61	4421.7	581.77
0.667	0.333	3	4213.6	N/A	4175.6	592.61	4162.8	581.77
0.500	0.500	2.0	3931.2	N/A	3909.9	592.61	3908.0	581.77
0.250	0.750	1.3	3480.3	N/A	3530.0	592.61	3543.3	581.77
0.125	0.875	1.14	3231.2	N/A	3286.5	592.61	3308.5	581.77
0.063	0.937	1.07	3101.0	N/A	3105.2	592.61	3133.3	581.77
Kolmogorov Smirnov (Statistic, Rank)			0.0563	1	0.0822	6	0.0916	18
Anderson Darling (Statistic, Rank)			0.1431	1	0.2045	3	0.2438	9


Precipitation Frequency Analysis, 5 Year Wet Cycles
Monywa Township (1961-2013)
5 Year Total Precipitation (mm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 41

4 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	4 yr Wet Precip (mm)
1961 - 1964	2892.0	1	0.024	42.00	4380.0
1962 - 1965	3359.0	2	0.048	21.00	4173.0
1963 - 1966	3339.0	3	0.071	14.00	3931.0
1964 - 1967	3129.0	4	0.095	10.50	3908.0
1965 - 1968	3658.0	5	0.119	8.40	3781.0
1966 - 1969	3204.0	6	0.143	7.00	3756.0
1967 - 1970	3151.0	7	0.167	6.00	3699.0
1968 - 1971	3507.0	8	0.190	5.25	3660.5
1969 - 1972	3073.0	9	0.214	4.67	3658.0
1970 - 1973	3699.0	10	0.238	4.20	3544.0
1971 - 1974	3756.0	11	0.262	3.82	3508.8
1972 - 1975	3781.0	12	0.286	3.50	3507.0
1973 - 1976	4380.0	13	0.310	3.23	3410.7
1974 - 1977	3931.0	14	0.333	3.00	3359.0
1975 - 1978	4173.0	15	0.357	2.80	3339.0
1976 - 1979	3544.0	16	0.381	2.63	3204.0
1977 - 1980	3011.0	17	0.405	2.47	3151.0
1978 - 1981	2887.0	18	0.429	2.33	3129.0
1979 - 1982	2388.0	19	0.452	2.21	3120.0
1980 - 1983	2538.0	20	0.476	2.10	3105.4
1981 - 1984	2651.0	21	0.500	2.00	3079.0
1982 - 1985	2398.0	22	0.524	1.91	3073.0
1983 - 1986	2629.0	23	0.548	1.83	3054.7
1984 - 1987	2782.0	24	0.571	1.75	3011.0
1985 - 1988	2942.0	25	0.595	1.68	2975.7
1986 - 1989	3120.0	26	0.619	1.62	2942.0
1987 - 1990	3079.0	27	0.643	1.56	2892.0
1988 - 1991	2856.0	28	0.667	1.50	2887.0
1989 - 1992	2728.0	29	0.690	1.45	2856.0
1990 - 1993	2618.0	30	0.714	1.40	2782.0
1991 - 1994	2691.6	31	0.738	1.35	2728.0
1992 - 1995	Exclude	32	0.762	1.31	2691.6
1993 - 1996	Exclude	33	0.786	1.27	2687.1
1994 - 1997	Exclude	34	0.810	1.24	2651.0
1995 - 1998	Exclude	35	0.833	1.20	2629.0
1996 - 1999	Exclude	36	0.857	1.17	2618.0
1997 - 2000	Exclude	37	0.881	1.14	2600.5
1998 - 2001	Exclude	38	0.905	1.11	2538.0
1999 - 2002	Exclude	39	0.929	1.08	2398.0
2000 - 2003	2333.2	40	0.952	1.05	2388.0
2001 - 2004	2600.5				
2002 - 2005	2687.1				
2003 - 2006	2975.7				
2004 - 2007	3410.7				
2005 - 2008	3105.4				
2006 - 2009	3054.7				
2007 - 2010	3508.8				
2008 - 2011	3660.5				
2009 - 2012	3908.0				
2010 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	2	2
Johnson SB	3	1	3
Gen. Extreme Value	4	4	16
Weibull (3P)	6	3	18
Rayleigh (2P)	10	6	60
Gamma (3P)	12	5	60
Log-Pearson 3	8	9	72
Erlang (3P)	7	11	77
Fatigue Life (3P)	13	7	91
Gen. Pareto	2	51	102

Three fits were selected for comparison:
1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

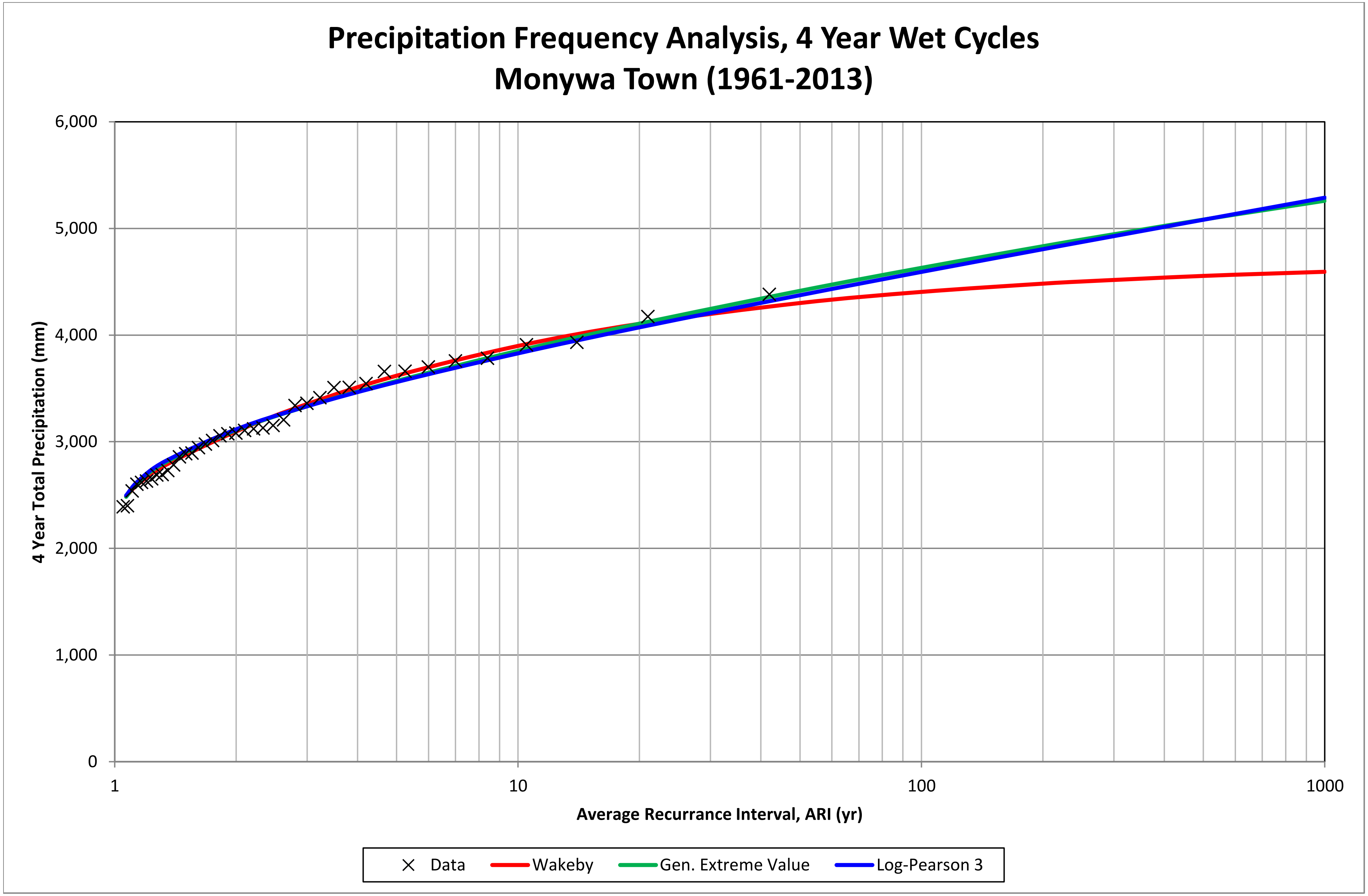
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 4 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	2021.286	k =	-0.083376416	α =	84.55063094
			β =	9.582717	σ =	439.7441449	β =	0.016726578
			γ =	927.1087	μ =	2950.042696	γ =	6.635654783
			δ =	-0.42826				
			ξ =	2330.035				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4593.4	N/A	5259.1	511.81	5287.9	499.12
0.998	0.002	500	4554.6	N/A	5082.6	511.81	5081.2	499.12
0.996	0.004	250	4502.3	N/A	4895.4	511.81	4872.7	499.12
0.995	0.005	200	4481.9	N/A	4832.7	511.81	4804.9	499.12
0.990	0.010	100	4404.5	N/A	4630.2	511.81	4592.1	499.12
0.980	0.020	50	4300.4	N/A	4414.7	511.81	4373.9	499.12
0.950	0.050	20	4105.7	N/A	4107.0	511.81	4072.6	499.12
0.900	0.100	10	3898.2	N/A	3852.3	511.81	3828.5	499.12
0.800	0.200	5	3619.2	N/A	3570.1	511.81	3559.8	499.12
0.667	0.333	3	3354.0	N/A	3332.9	511.81	3332.9	499.12
0.500	0.500	2.0	3096.7	N/A	3108.8	511.81	3116.1	499.12
0.250	0.750	1.3	2778.5	N/A	2804.4	511.81	2816.8	499.12
0.125	0.875	1.14	2602.6	N/A	2618.1	511.81	2631.0	499.12
0.063	0.937	1.07	2487.4	N/A	2483.4	511.81	2495.9	499.12
Kolmogorov Smirnov (Statistic, Rank)			0.0616	1	0.0693	4	0.0733	8
Anderson Darling (Statistic, Rank)			0.1472	2	0.2029	4	0.2365	9



Precipitation Frequency Analysis, 4 Year Wet Cycles
Monywa Town (1961-2013)
6,000
5,000
4,000
3,000
2,000
1,000
0
4 Year Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.   **Count, n:** 44

3 Year Data		Rank	Weibull	ARI	Ranked
Years	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**3 yr Wet Precip (mm)**
1961 - 1963	2311.0	1	0.022	45.00	3263.0
1962 - 1964	2161.0	2	0.044	22.50	3218.8
1963 - 1965	2675.0	3	0.067	15.00	3106.0
1964 - 1966	2443.0	4	0.089	11.25	3105.0
1965 - 1967	2548.0	5	0.111	9.00	3094.3
1966 - 1968	2460.0	6	0.133	7.50	3088.0
1967 - 1969	2540.0	7	0.156	6.43	3010.0
1968 - 1970	2465.0	8	0.178	5.63	2714.0
1969 - 1971	2397.0	9	0.200	5.00	2675.0
1970 - 1972	2329.0	10	0.222	4.50	2548.0
1971 - 1973	3088.0	11	0.244	4.09	2540.0
1972 - 1974	2714.0	12	0.267	3.75	2539.2
1973 - 1975	3105.0	13	0.289	3.46	2478.0
1974 - 1976	3010.0	14	0.311	3.21	2476.3
1975 - 1977	3263.0	15	0.333	3.00	2465.0
1976 - 1978	3106.0	16	0.356	2.81	2460.0
1977 - 1979	2269.0	17	0.378	2.65	2443.0
1978 - 1980	2090.0	18	0.400	2.50	2398.0
1979 - 1981	1977.0	19	0.422	2.37	2397.0
1980 - 1982	1950.0	20	0.444	2.25	2378.3
1981 - 1983	1796.0	21	0.467	2.14	2365.5
1982 - 1984	1854.0	22	0.489	2.05	2338.0
1983 - 1985	1987.0	23	0.511	1.96	2329.0
1984 - 1986	2041.0	24	0.533	1.88	2311.0
1985 - 1987	1927.0	25	0.556	1.80	2287.9
1986 - 1988	2398.0	26	0.578	1.73	2269.0
1987 - 1989	2478.0	27	0.600	1.67	2208.9
1988 - 1990	2338.0	28	0.622	1.61	2173.6
1989 - 1991	1841.0	29	0.644	1.55	2161.0
1990 - 1992	2006.0	30	0.667	1.50	2090.0
1991 - 1993	2017.0	31	0.689	1.45	2041.0
1992 - 1994	2173.6	32	0.711	1.41	2017.0
1993 - 1995	Exclude	33	0.733	1.36	2006.0
1994 - 1996	Exclude	34	0.756	1.32	1987.0
1995 - 1997	Exclude	35	0.778	1.29	1977.0
1996 - 1998	1849.3	36	0.800	1.25	1950.0
1997 - 1999	Exclude	37	0.822	1.22	1947.2
1998 - 2000	Exclude	38	0.844	1.18	1927.0
1999 - 2001	Exclude	39	0.867	1.15	1854.0
2000 - 2002	1735.8	40	0.889	1.13	1849.3
2001 - 2003	1728.9	41	0.911	1.10	1841.0
2002 - 2004	1947.2	42	0.933	1.07	1796.0
2003 - 2005	2208.9	43	0.956	1.05	1735.8
2004 - 2006	2378.3	44	0.978	1.02	1728.9
2005 - 2007	2539.2				
2006 - 2008	2365.5				
2007 - 2009	2287.9				
2008 - 2010	2476.3				
2009 - 2011	3094.3				
2010 - 2012	3218.8				
2011 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Gen. Extreme Value	2	3	6
Pearson 5 (3P)	1	10	10
Wakeby	16	1	16
Frechet (3P)	3	11	33
Weibull (3P)	9	4	36
Johnson SB	22	2	44
Log-Pearson 3	5	9	45
Log-Logistic (3P)	4	12	48
Lognormal (3P)	7	8	56
Inv. Gaussian (3P)	10	6	60

Three fits were selected for comparison:

1) **Pearson 5** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

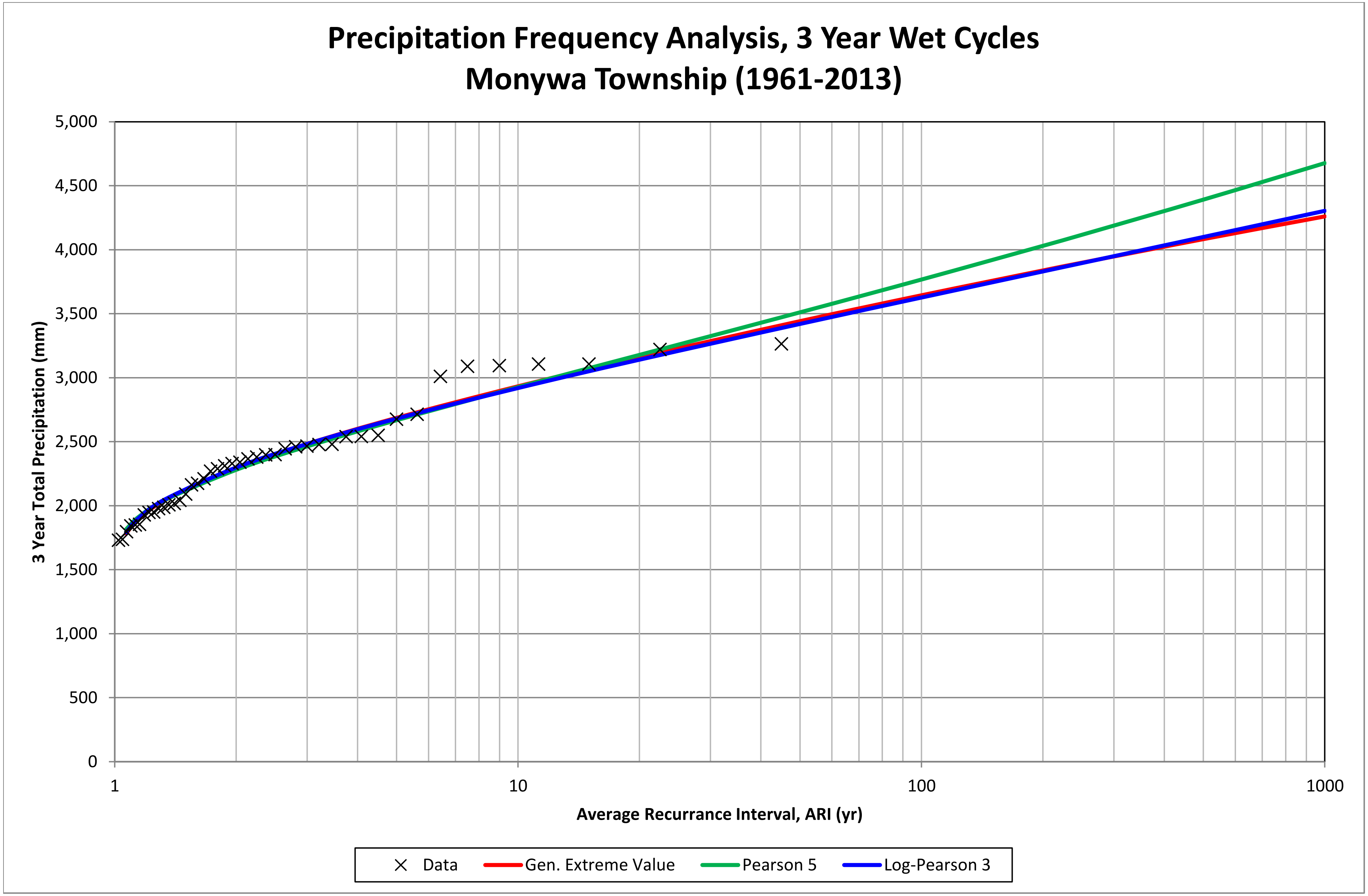
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 3 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Pearson 5		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.05346	α =	13.63980555	α =	46.42243888
			σ =	363.1438	β =	19090.81617	β =	0.025855566
			μ =	2162.971	γ =	845.7300296	γ =	6.548325006
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4260.3	436.49	4676.7	442.70	4304.0	429.50
0.998	0.002	500	4082.9	436.49	4391.5	442.70	4099.6	429.50
0.996	0.004	250	3898.7	436.49	4116.7	442.70	3896.0	429.50
0.995	0.005	200	3837.9	436.49	4030.3	442.70	3830.4	429.50
0.990	0.010	100	3643.9	436.49	3767.1	442.70	3626.4	429.50
0.980	0.020	50	3441.9	436.49	3510.8	442.70	3420.3	429.50
0.950	0.050	20	3160.3	436.49	3178.4	442.70	3141.0	429.50
0.900	0.100	10	2932.9	436.49	2927.1	442.70	2919.5	429.50
0.800	0.200	5	2686.4	436.49	2668.2	442.70	2680.6	429.50
0.667	0.333	3	2483.4	436.49	2463.9	442.70	2483.3	429.50
0.500	0.500	2.0	2294.8	436.49	2280.3	442.70	2298.5	429.50
0.250	0.750	1.3	2043.3	436.49	2045.1	442.70	2049.9	429.50
0.125	0.875	1.14	1891.8	436.49	1909.5	442.70	1899.7	429.50
0.063	0.937	1.07	1783.5	436.49	1815.7	442.70	1792.5	429.50
Kolmogorov Smirnov (Statistic, Rank)			0.0806	2	0.0794	1	0.0834	5
Anderson Darling (Statistic, Rank)			0.4176	3	0.4473	10	0.4428	9


Precipitation Frequency Analysis, 3 Year Wet Cycles
Monywa Township (1961-2013)
3 Year Total Precipitation (mm)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Pearson 5
Log-Pearson 3

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 47

2 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	2 yr Wet Precip (mm)
1961 - 1962	1415.0	1	0.021	48.00	2405.1
1962 - 1963	1580.0	2	0.042	24.00	2342.0
1963 - 1964	1477.0	3	0.063	16.00	2196.0
1964 - 1965	1779.0	4	0.083	12.00	2046.0
1965 - 1966	1862.0	5	0.104	9.60	2038.0
1966 - 1967	1350.0	6	0.125	8.00	1997.9
1967 - 1968	1796.0	7	0.146	6.86	1910.1
1968 - 1969	1854.0	8	0.167	6.00	1862.0
1969 - 1970	1355.0	9	0.188	5.33	1854.0
1970 - 1971	1653.0	10	0.208	4.80	1831.0
1971 - 1972	1718.0	11	0.229	4.36	1799.3
1972 - 1973	2046.0	12	0.250	4.00	1796.0
1973 - 1974	2038.0	13	0.271	3.69	1779.0
1974 - 1975	1735.0	14	0.292	3.43	1756.0
1975 - 1976	2342.0	15	0.313	3.20	1737.0
1976 - 1977	2196.0	16	0.333	3.00	1735.0
1977 - 1978	1831.0	17	0.354	2.82	1718.0
1978 - 1979	1348.0	18	0.375	2.67	1653.0
1979 - 1980	1180.0	19	0.396	2.53	1611.5
1980 - 1981	1539.0	20	0.417	2.40	1598.7
1981 - 1982	1208.0	21	0.438	2.29	1580.0
1982 - 1983	999.0	22	0.458	2.18	1539.0
1983 - 1984	1443.0	23	0.479	2.09	1506.7
1984 - 1985	1399.0	24	0.500	2.00	1499.0
1985 - 1986	1186.0	25	0.521	1.92	1477.0
1986 - 1987	1383.0	26	0.542	1.85	1469.0
1987 - 1988	1756.0	27	0.563	1.78	1443.0
1988 - 1989	1737.0	28	0.583	1.71	1415.0
1989 - 1990	1323.0	29	0.604	1.66	1412.0
1990 - 1991	1119.0	30	0.625	1.60	1405.0
1991 - 1992	1405.0	31	0.646	1.55	1399.0
1992 - 1993	1499.0	32	0.667	1.50	1383.0
1993 - 1994	1286.6	33	0.688	1.45	1355.0
1994 - 1995	Exclude	34	0.708	1.41	1350.0
1995 - 1996	Exclude	35	0.729	1.37	1348.0
1996 - 1997	1412.0	36	0.750	1.33	1323.0
1997 - 1998	1046.9	37	0.771	1.30	1286.6
1998 - 1999	Exclude	38	0.792	1.26	1257.5
1999 - 2000	Exclude	39	0.813	1.23	1255.4
2000 - 2001	1257.5	40	0.833	1.20	1208.0
2001 - 2002	1131.5	41	0.854	1.17	1186.0
2002 - 2003	1075.6	42	0.875	1.14	1180.0
2003 - 2004	1469.0	43	0.896	1.12	1131.5
2004 - 2005	1611.5	44	0.917	1.09	1119.0
2005 - 2006	1506.7	45	0.938	1.07	1075.6
2006 - 2007	1799.3	46	0.958	1.04	1046.9
2007 - 2008	1598.7	47	0.979	1.02	999.0
2008 - 2009	1255.4				
2009 - 2010	1910.1				
2010 - 2011	2405.1				
2011 - 2012	1997.9				
2012 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Gamma (4P)	1	8	8
Rice	2	29	58
Johnson SB	3	1	3
Triangular	4	43	172
Beta	5	41	205
Wakeby	6	2	12
Rayleigh (2P)	7	5	35
Gamma	8	19	152
Gen. Extreme Value	10	4	40
Log-Pearson 3	16	6	96

Three fits were selected for comparison:

1) **Gen. Gamma (4P)** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

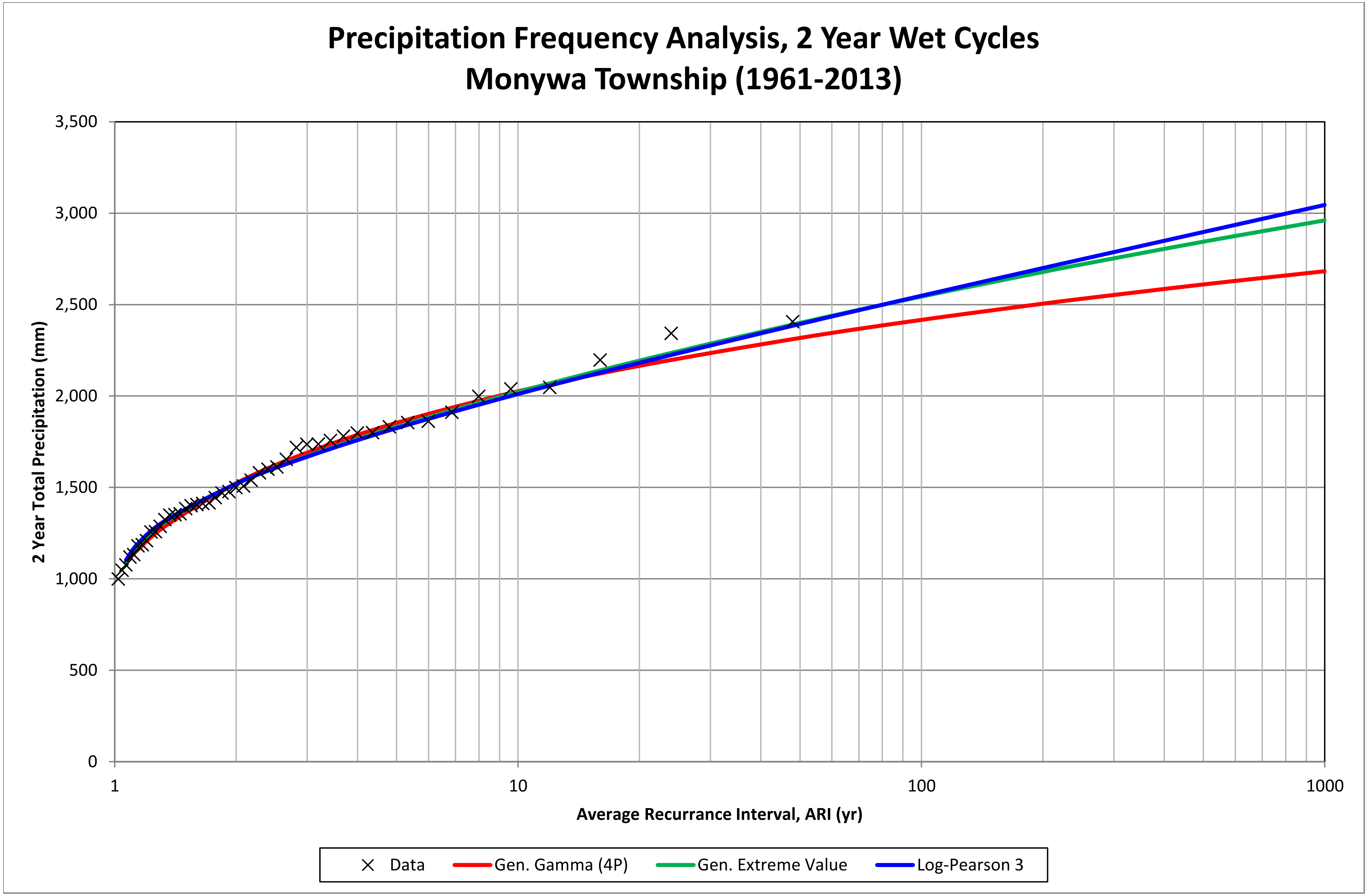
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 2 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	3.002649	k =	-0.087925417	α =	422.6834021
			α =	0.416684	σ =	299.2902393	β =	0.010413888
			β =	982.5662	μ =	1411.245461	γ =	2.928064568
			γ =	991.0833				
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2682.4	338.35	2960.7	346.72	3045.0	341.68
0.998	0.002	500	2610.1	338.35	2844.1	346.72	2896.9	341.68
0.996	0.004	250	2531.8	338.35	2720.0	346.72	2747.9	341.68
0.995	0.005	200	2505.0	338.35	2678.4	346.72	2699.6	341.68
0.990	0.010	100	2416.4	338.35	2543.6	346.72	2548.3	341.68
0.980	0.020	50	2317.5	338.35	2399.8	346.72	2393.8	341.68
0.950	0.050	20	2165.2	338.35	2193.6	346.72	2181.6	341.68
0.900	0.100	10	2025.9	338.35	2022.3	346.72	2010.9	341.68
0.800	0.200	5	1853.3	338.35	1831.8	346.72	1824.3	341.68
0.667	0.333	3	1690.8	338.35	1671.3	346.72	1668.0	341.68
0.500	0.500	2.0	1522.9	338.35	1519.2	346.72	1519.9	341.68
0.250	0.750	1.3	1287.6	338.35	1312.1	346.72	1317.6	341.68
0.125	0.875	1.14	1160.6	338.35	1184.9	346.72	1193.6	341.68
0.063	0.937	1.07	1089.0	338.35	1092.9	346.72	1104.3	341.68
Kolmogorov Smirnov (Statistic, Rank)			0.0580	1	0.0723	10	0.0765	16
Anderson Darling (Statistic, Rank)			0.1597	8	0.1427	4	0.1586	6



Precipitation Frequency Analysis, 2 Year Wet Cycles
Monywa Township (1961-2013)
2 Year Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 50

Annual Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**1 yr Wet Precip (mm)**
1961	731.0	1	0.020	51.00	1370.0
1962	684.0	2	0.039	25.50	1275.0
1963	896.0	3	0.059	17.00	1220.9
1964	581.0	4	0.078	12.75	1198.0
1965	1198.0	5	0.098	10.20	1184.2
1966	664.0	6	0.118	8.50	1110.0
1967	686.0	7	0.137	7.29	1067.0
1968	1110.0	8	0.157	6.38	1042.0
1969	744.0	9	0.176	5.67	1032.5
1970	611.0	10	0.196	5.10	1015.0
1971	1042.0	11	0.216	4.64	921.0
1972	676.0	12	0.235	4.25	910.0
1973	1370.0	13	0.255	3.92	896.0
1974	668.0	14	0.275	3.64	887.0
1975	1067.0	15	0.294	3.40	871.6
1976	1275.0	16	0.314	3.19	855.0
1977	921.0	17	0.333	3.00	813.7
1978	910.0	18	0.353	2.83	802.4
1979	438.0	19	0.373	2.68	797.0
1980	742.0	20	0.392	2.55	766.8
1981	797.0	21	0.412	2.43	744.0
1982	411.0	22	0.431	2.32	742.0
1983	588.0	23	0.451	2.22	741.0
1984	855.0	24	0.471	2.13	739.9
1985	544.0	25	0.490	2.04	731.0
1986	642.0	26	0.510	1.96	722.0
1987	741.0	27	0.529	1.89	689.2
1988	1015.0	28	0.549	1.82	686.0
1989	722.0	29	0.569	1.76	684.0
1990	601.0	30	0.588	1.70	676.0
1991	518.0	31	0.608	1.65	674.6
1992	887.0	32	0.627	1.59	668.0
1993	612.0	33	0.647	1.55	664.0
1994	674.6	34	0.667	1.50	653.3
1995	Exclude	35	0.686	1.46	642.0
1996	802.4	36	0.706	1.42	612.0
1997	609.6	37	0.725	1.38	611.0
1998	437.2	38	0.745	1.34	609.6
1999	Exclude	39	0.765	1.31	604.2
2000	604.2	40	0.784	1.28	601.0
2001	653.3	41	0.804	1.24	597.4
2002	478.2	42	0.824	1.21	588.0
2003	597.4	43	0.843	1.19	581.0
2004	871.6	44	0.863	1.16	566.2
2005	739.9	45	0.882	1.13	544.0
2006	766.8	46	0.902	1.11	518.0
2007	1032.5	47	0.922	1.09	478.2
2008	566.2	48	0.941	1.06	438.0
2009	689.2	49	0.961	1.04	437.2
2010	1220.9	50	0.980	1.02	411.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

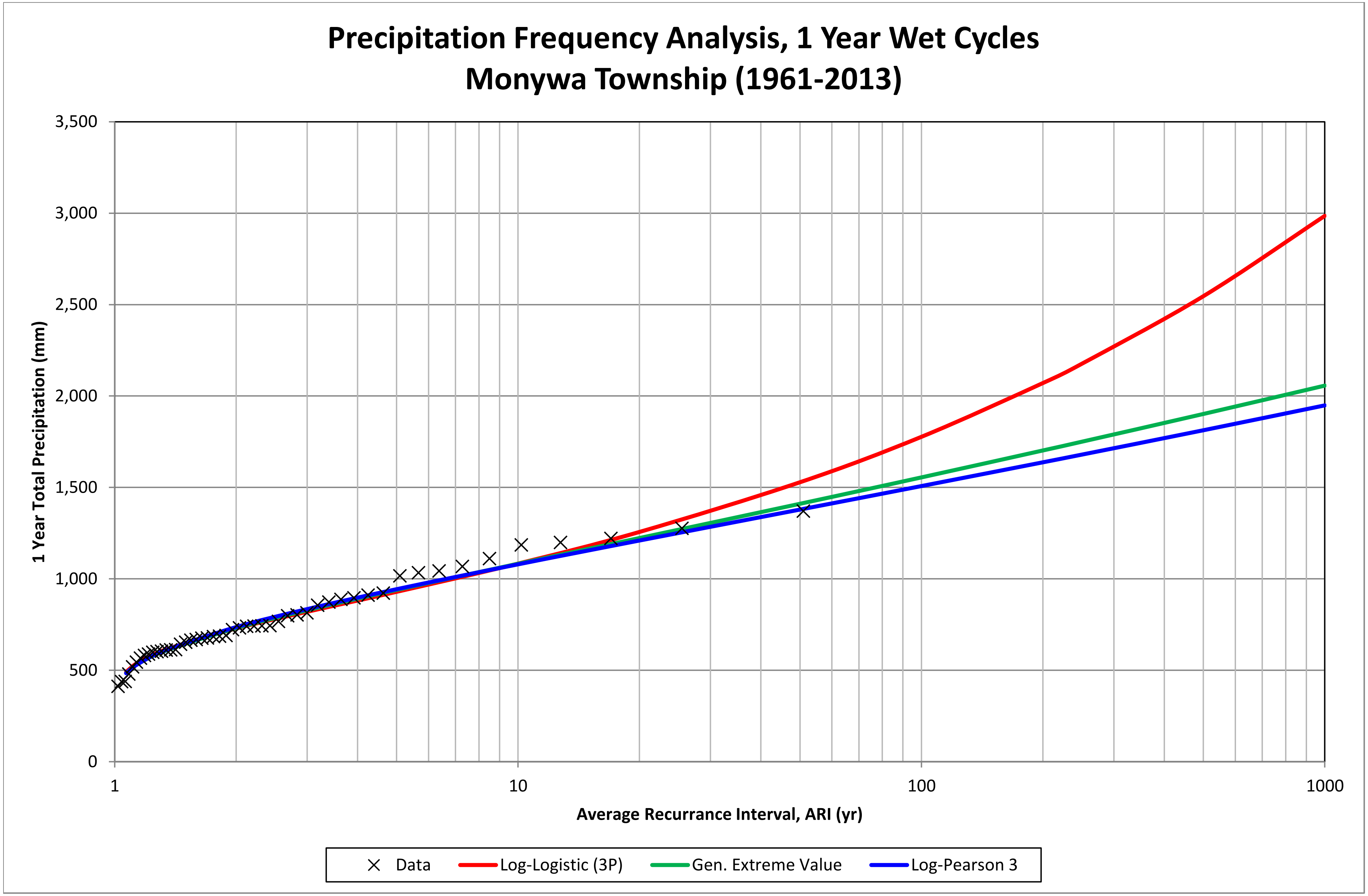
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2985.2	282.20	2056.9	240.34	1948.7	234.14
0.998	0.002	500	2546.0	282.20	1901.8	240.34	1812.7	234.14
0.996	0.004	250	2176.7	282.20	1750.2	240.34	1679.6	234.14
0.995	0.005	200	2070.8	282.20	1702.1	240.34	1637.3	234.14
0.990	0.010	100	1776.7	282.20	1554.9	240.34	1507.4	234.14
0.980	0.020	50	1528.5	282.20	1410.6	240.34	1379.0	234.14
0.950	0.050	20	1256.6	282.20	1223.3	240.34	1209.7	234.14
0.900	0.100	10	1083.5	282.20	1082.6	240.34	1079.5	234.14
0.800	0.200	5	929.1	282.20	939.5	240.34	943.4	234.14
0.667	0.333	3	820.3	282.20	828.5	240.34	834.7	234.14
0.500	0.500	2.0	728.4	282.20	730.3	240.34	736.1	234.14
0.250	0.750	1.3	612.3	282.20	606.2	240.34	608.8	234.14
0.125	0.875	1.14	542.4	282.20	535.0	240.34	535.0	234.14
0.063	0.937	1.07	491.5	282.20	485.6	240.34	483.9	234.14
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11


Precipitation Frequency Analysis, 1 Year Wet Cycles
Monywa Township (1961-2013)
1 Year Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 50

Annual Data Year	Annual Data Precip (mm)	Rank (lowest to highest) m	Weibull Exceedance Probability p	ARI (yr)	Ranked 1 yr Dry Precip (mm)
1961	731.0	1	0.020	51.00	411.0
1962	684.0	2	0.039	25.50	437.2
1963	896.0	3	0.059	17.00	438.0
1964	581.0	4	0.078	12.75	478.2
1965	1198.0	5	0.098	10.20	518.0
1966	664.0	6	0.118	8.50	544.0
1967	686.0	7	0.137	7.29	566.2
1968	1110.0	8	0.157	6.38	581.0
1969	744.0	9	0.176	5.67	588.0
1970	611.0	10	0.196	5.10	597.4
1971	1042.0	11	0.216	4.64	601.0
1972	676.0	12	0.235	4.25	604.2
1973	1370.0	13	0.255	3.92	609.6
1974	668.0	14	0.275	3.64	611.0
1975	1067.0	15	0.294	3.40	612.0
1976	1275.0	16	0.314	3.19	642.0
1977	921.0	17	0.333	3.00	653.3
1978	910.0	18	0.353	2.83	664.0
1979	438.0	19	0.373	2.68	668.0
1980	742.0	20	0.392	2.55	674.6
1981	797.0	21	0.412	2.43	676.0
1982	411.0	22	0.431	2.32	684.0
1983	588.0	23	0.451	2.22	686.0
1984	855.0	24	0.471	2.13	689.2
1985	544.0	25	0.490	2.04	722.0
1986	642.0	26	0.510	1.96	731.0
1987	741.0	27	0.529	1.89	739.9
1988	1015.0	28	0.549	1.82	741.0
1989	722.0	29	0.569	1.76	742.0
1990	601.0	30	0.588	1.70	744.0
1991	518.0	31	0.608	1.65	766.8
1992	887.0	32	0.627	1.59	797.0
1993	612.0	33	0.647	1.55	802.4
1994	674.6	34	0.667	1.50	813.7
1995	Exclude	35	0.686	1.46	855.0
1996	802.4	36	0.706	1.42	871.6
1997	609.6	37	0.725	1.38	887.0
1998	437.2	38	0.745	1.34	896.0
1999	Exclude	39	0.765	1.31	910.0
2000	604.2	40	0.784	1.28	921.0
2001	653.3	41	0.804	1.24	1015.0
2002	478.2	42	0.824	1.21	1032.5
2003	597.4	43	0.843	1.19	1042.0
2004	871.6	44	0.863	1.16	1067.0
2005	739.9	45	0.882	1.13	1110.0
2006	766.8	46	0.902	1.11	1184.2
2007	1032.5	47	0.922	1.09	1198.0
2008	566.2	48	0.941	1.06	1220.9
2009	689.2	49	0.961	1.04	1275.0
2010	1220.9	50	0.980	1.02	1370.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

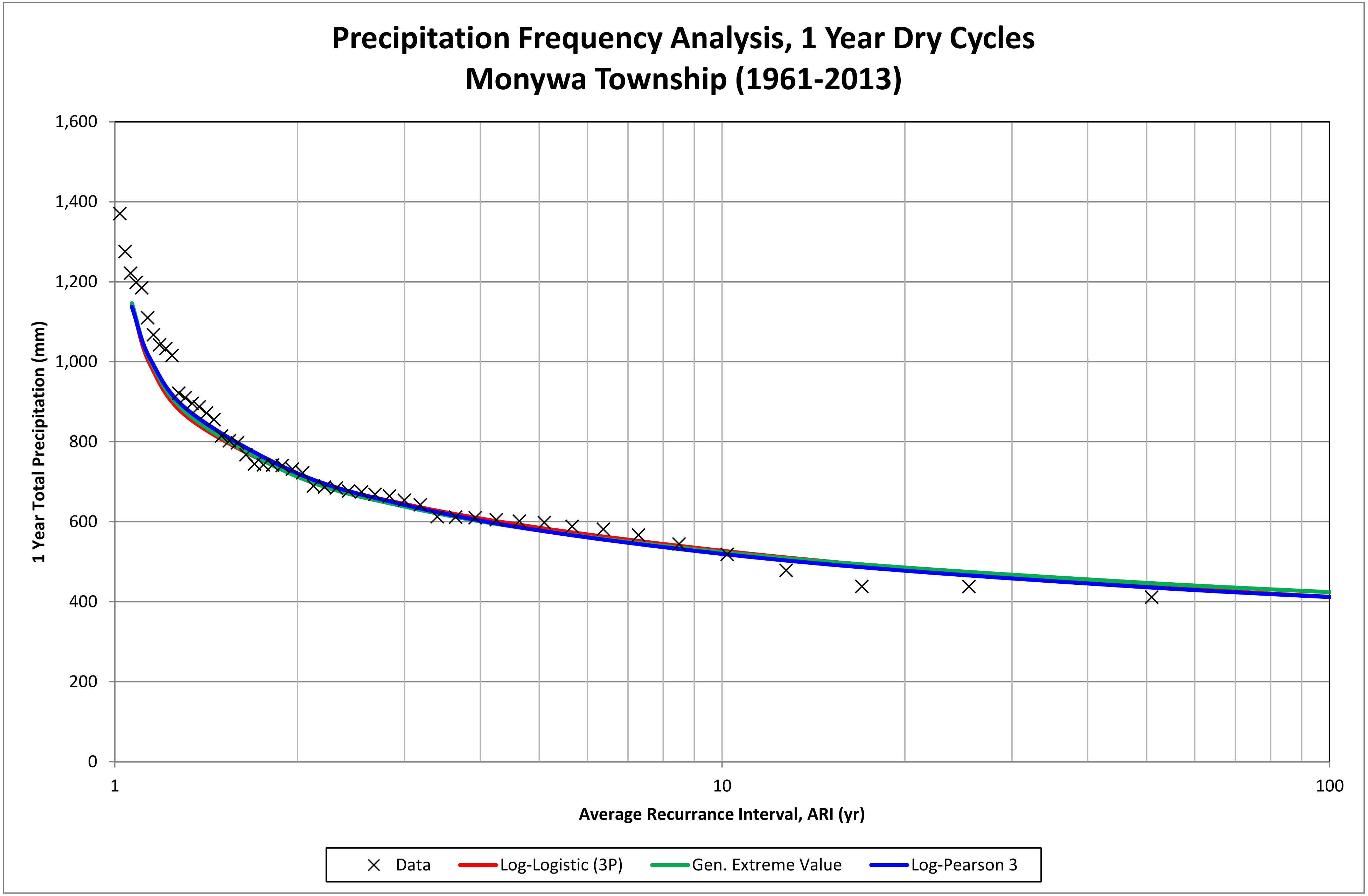
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent dry-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.001	0.999	1000	351.1	259.33	368.2	233.54	354.0	224.66
0.002	0.998	500	365.9	259.33	382.6	233.54	368.6	224.66
0.004	0.996	250	383.5	259.33	398.8	233.54	385.3	224.66
0.005	0.995	200	389.9	259.33	404.5	233.54	391.3	224.66
0.010	0.990	100	412.3	259.33	424.0	233.54	411.8	224.66
0.020	0.980	50	439.1	259.33	447.0	233.54	436.3	224.66
0.050	0.950	20	483.8	259.33	485.4	233.54	477.6	224.66
0.100	0.900	10	527.3	259.33	524.1	233.54	519.6	224.66
0.200	0.800	5	584.8	259.33	578.3	233.54	578.3	224.66
0.333	0.667	3	644.1	259.33	637.7	233.54	642.1	224.66
0.500	0.500	2.0	714.9	259.33	712.5	233.54	720.9	224.66
0.750	0.250	1.3	855.7	259.33	863.4	233.54	873.5	224.66
0.875	0.125	1.14	994.2	259.33	1005.0	233.54	1008.6	224.66
0.937	0.063	1.07	1144.8	259.33	1146.5	233.54	1137.1	224.66
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11



Precipitation Frequency Analysis, 1 Year Dry Cycles
Monywa Township (1961-2013)
1 Year Total Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1
10
100
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

180 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	180 d Wet Precip (mm)
1961	653.0	1	0.019	53.00	1288.0
1962	678.0	2	0.038	26.50	1180.9
1963	837.0	3	0.057	17.67	1139.7
1964	565.0	4	0.075	13.25	1098.0
1965	1098.0	5	0.094	10.60	1046.0
1966	628.0	6	0.113	8.83	1024.0
1967	640.0	7	0.132	7.57	994.0
1968	1024.0	8	0.151	6.63	971.8
1969	713.0	9	0.170	5.89	965.0
1970	560.0	10	0.189	5.30	903.0
1971	965.0	11	0.208	4.82	901.0
1972	600.0	12	0.226	4.42	864.5
1973	1288.0	13	0.245	4.08	863.0
1974	614.0	14	0.264	3.79	851.0
1975	994.0	15	0.283	3.53	837.0
1976	1046.0	16	0.302	3.31	821.0
1977	863.0	17	0.321	3.12	753.7
1978	903.0	18	0.340	2.94	724.2
1979	415.0	19	0.358	2.79	720.0
1980	702.0	20	0.377	2.65	715.2
1981	650.0	21	0.396	2.52	713.0
1982	410.0	22	0.415	2.41	702.0
1983	545.0	23	0.434	2.30	678.0
1984	821.0	24	0.453	2.21	673.6
1985	459.0	25	0.472	2.12	665.0
1986	614.0	26	0.491	2.04	653.0
1987	645.0	27	0.509	1.96	650.0
1988	901.0	28	0.528	1.89	645.7
1989	720.0	29	0.547	1.83	645.0
1990	572.0	30	0.566	1.77	640.0
1991	472.0	31	0.585	1.71	637.8
1992	851.0	32	0.604	1.66	628.0
1993	573.0	33	0.623	1.61	616.5
1994	637.8	34	0.642	1.56	614.0
1995	531.1	35	0.660	1.51	614.0
1996	616.5	36	0.679	1.47	602.3
1997	602.3	37	0.698	1.43	600.0
1998	413.1	38	0.717	1.39	576.3
1999	715.2	39	0.736	1.36	573.0
2000	556.8	40	0.755	1.33	572.0
2001	645.7	41	0.774	1.29	565.0
2002	454.4	42	0.792	1.26	560.0
2003	576.3	43	0.811	1.23	556.8
2004	864.5	44	0.830	1.20	545.0
2005	673.6	45	0.849	1.18	531.1
2006	724.2	46	0.868	1.15	514.9
2007	971.8	47	0.887	1.13	472.0
2008	514.9	48	0.906	1.10	459.0
2009	665.0	49	0.925	1.08	454.4
2010	1180.9	50	0.943	1.06	415.0
2011	1139.7	51	0.962	1.04	413.1
2012	753.7	52	0.981	1.02	410.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	1	3	3
Gen. Extreme Value	3	1	3
Burr	2	2	4
Lognormal (3P)	7	4	28
Pearson 6 (4P)	5	6	30
Pearson 5 (3P)	6	5	30
Frechet (3P)	8	9	72
Log-Logistic	4	19	76
Inv. Gaussian (3P)	11	7	77
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

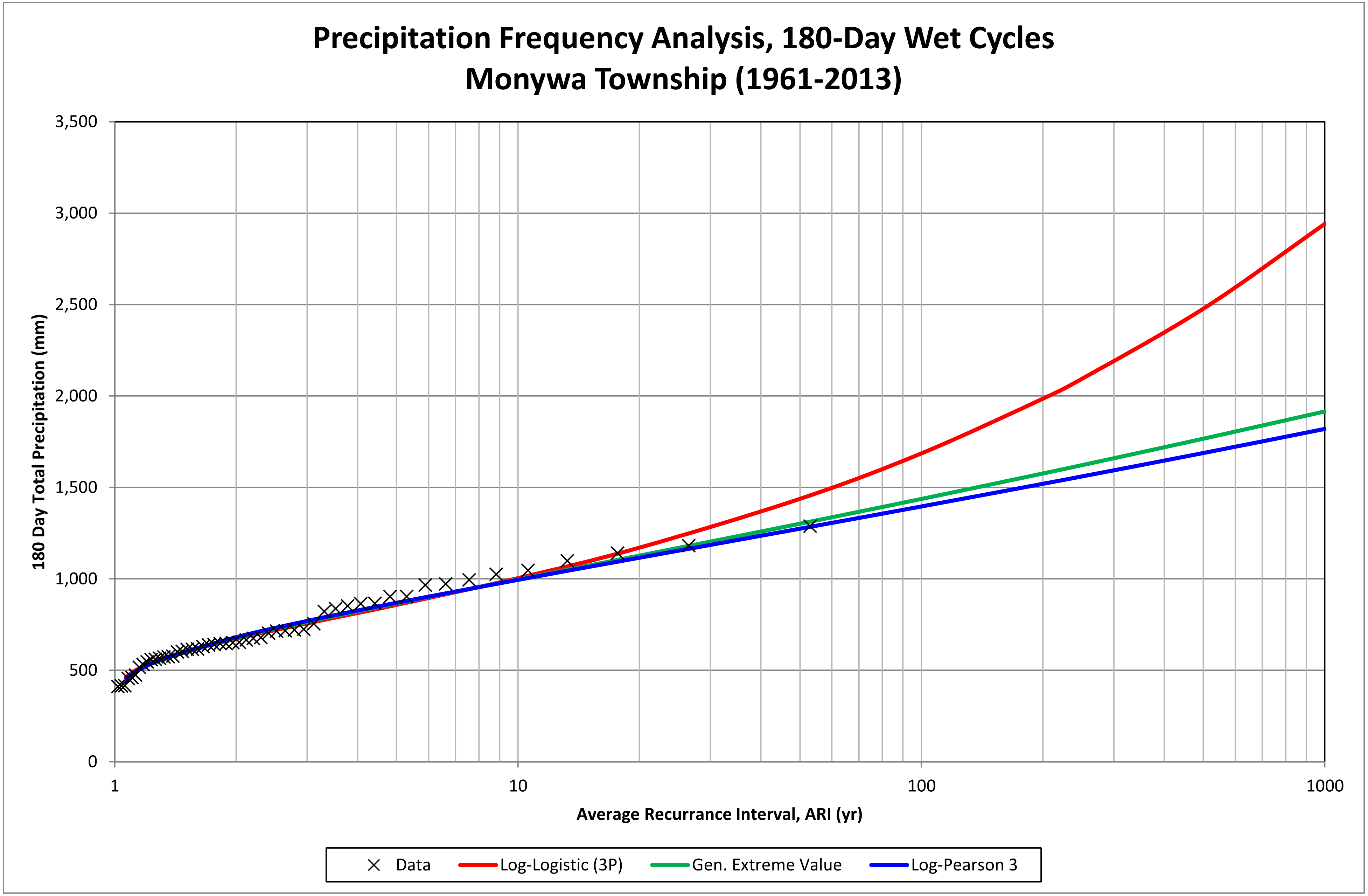
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 180 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α =	3.636479	k =	0.043959129	α =	63.28937577
			β =	399.3156	σ =	160.9920019	β =	0.03539472
			γ =	273.2777	μ =	616.2480698	γ =	4.294614079
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2941.2	270.39	1915.6	219.52	1819.9	213.97
0.998	0.002	500	2477.6	270.39	1766.5	219.52	1688.2	213.97
0.996	0.004	250	2094.0	270.39	1621.9	219.52	1560.2	213.97
0.995	0.005	200	1985.2	270.39	1576.2	219.52	1519.7	213.97
0.990	0.010	100	1686.1	270.39	1437.0	219.52	1395.9	213.97
0.980	0.020	50	1437.7	270.39	1301.5	219.52	1274.4	213.97
0.950	0.050	20	1170.6	270.39	1127.0	219.52	1115.6	213.97
0.900	0.100	10	1004.0	270.39	997.1	219.52	994.6	213.97
0.800	0.200	5	857.9	270.39	865.9	219.52	869.2	213.97
0.667	0.333	3	756.6	270.39	764.7	219.52	769.9	213.97
0.500	0.500	2.0	672.6	270.39	675.7	219.52	680.6	213.97
0.250	0.750	1.3	568.5	270.39	564.0	219.52	566.2	213.97
0.125	0.875	1.14	507.1	270.39	500.3	219.52	500.4	213.97
0.063	0.937	1.07	463.3	270.39	456.1	219.52	455.1	213.97
Kolmogorov Smirnov (Statistic, Rank)			0.0671	1	0.0764	2	0.0863	17
Anderson Darling (Statistic, Rank)			0.3558	2	0.3565	3	0.3842	10


Precipitation Frequency Analysis, 180-Day Wet Cycles
Monywa Township (1961-2013)
180 Day Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

120 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	120 d Wet Precip (mm)
1961	493.0	1	0.019	53.00	980.9
1962	466.0	2	0.038	26.50	977.0
1963	641.0	3	0.057	17.67	928.0
1964	384.0	4	0.075	13.25	802.0
1965	977.0	5	0.094	10.60	781.0
1966	432.0	6	0.113	8.83	754.2
1967	456.0	7	0.132	7.57	718.0
1968	695.0	8	0.151	6.63	717.0
1969	551.0	9	0.170	5.89	712.8
1970	420.0	10	0.189	5.30	703.0
1971	802.0	11	0.208	4.82	695.0
1972	497.0	12	0.226	4.42	673.0
1973	928.0	13	0.245	4.08	654.0
1974	423.0	14	0.264	3.79	653.0
1975	703.0	15	0.283	3.53	641.0
1976	717.0	16	0.302	3.31	640.0
1977	781.0	17	0.321	3.12	636.2
1978	718.0	18	0.340	2.94	632.7
1979	375.0	19	0.358	2.79	597.9
1980	558.0	20	0.377	2.65	589.8
1981	520.0	21	0.396	2.52	577.0
1982	351.0	22	0.415	2.41	558.0
1983	523.0	23	0.434	2.30	551.0
1984	653.0	24	0.453	2.21	544.3
1985	316.0	25	0.472	2.12	537.0
1986	577.0	26	0.491	2.04	532.9
1987	537.0	27	0.509	1.96	531.4
1988	640.0	28	0.528	1.89	523.0
1989	654.0	29	0.547	1.83	520.0
1990	488.0	30	0.566	1.77	505.5
1991	372.0	31	0.585	1.71	497.0
1992	673.0	32	0.604	1.66	496.6
1993	416.0	33	0.623	1.61	493.0
1994	589.8	34	0.642	1.56	488.0
1995	496.6	35	0.660	1.51	466.0
1996	532.9	36	0.679	1.47	465.1
1997	465.1	37	0.698	1.43	456.0
1998	388.7	38	0.717	1.39	452.0
1999	597.9	39	0.736	1.36	432.0
2000	405.1	40	0.755	1.33	431.1
2001	505.5	41	0.774	1.29	423.0
2002	383.2	42	0.792	1.26	420.0
2003	431.1	43	0.811	1.23	416.0
2004	712.8	44	0.830	1.20	405.1
2005	531.4	45	0.849	1.18	388.7
2006	544.3	46	0.868	1.15	384.0
2007	632.7	47	0.887	1.13	383.2
2008	340.1	48	0.906	1.10	375.0
2009	452.0	49	0.925	1.08	372.0
2010	980.9	50	0.943	1.06	351.0
2011	754.2	51	0.962	1.04	340.1
2012	636.2	52	0.981	1.02	316.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Gamma (4P)	1	3	3
Weibull (3P)	5	1	5
Johnson SB	3	2	6
Inv. Gaussian	6	10	60
Gamma (3P)	16	4	64
Gen. Extreme Value	14	5	70
Triangular	2	41	82
Log-Pearson 3	15	8	120
Fatigue Life (3P)	21	6	126
Fatigue Life	8	18	144

Three fits were selected for comparison:
1) **Gen. Gamma (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

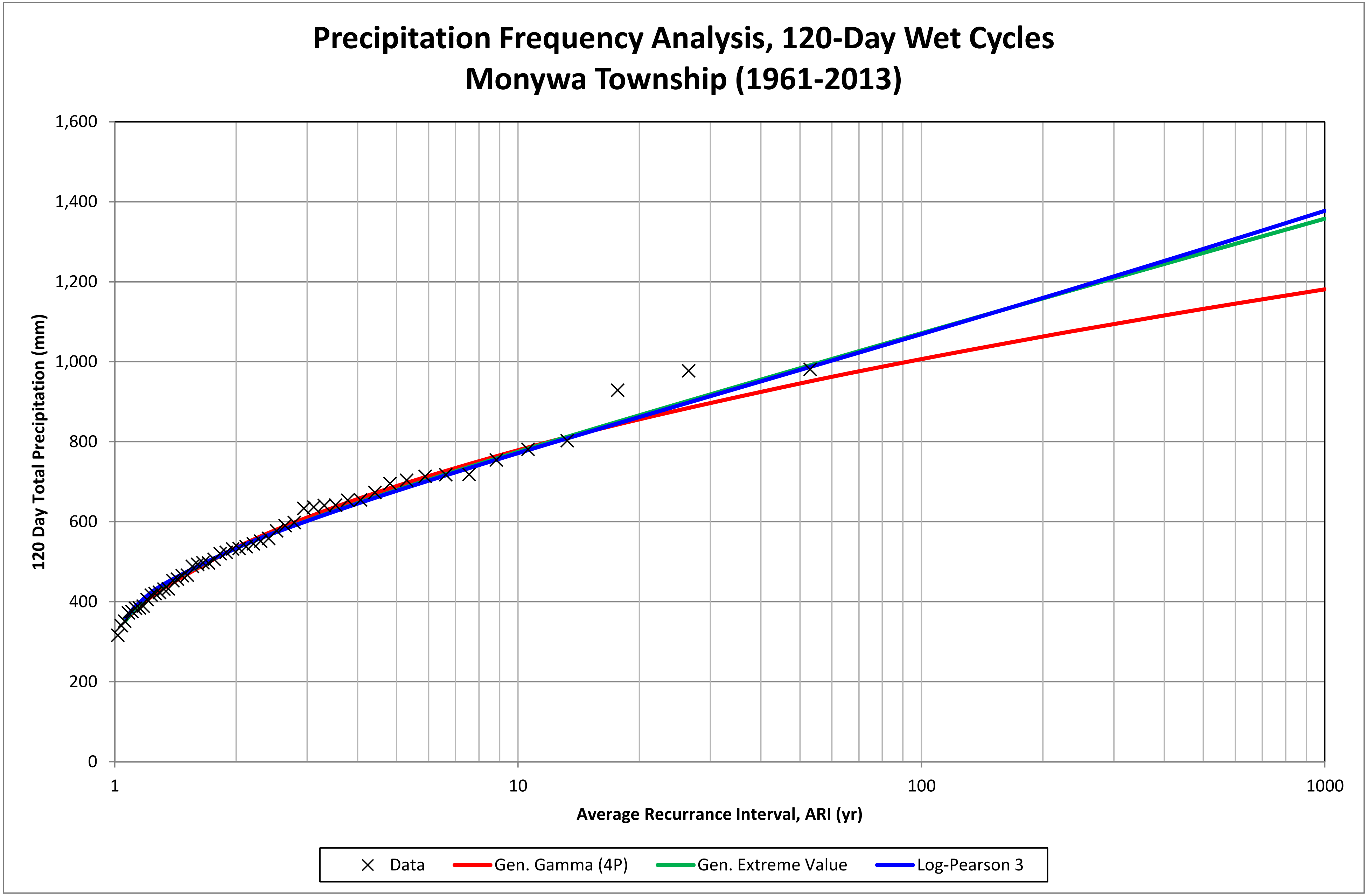
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 120 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	k =	2.014351	k =	-0.007127425	α =	79.44577123
			α =	0.680568	σ =	129.2860825	β =	0.030828944
			β =	357.1653	μ =	486.2314488	γ =	3.840998652
			γ =	311.3739				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1181.0	137.96	1357.6	164.29	1377.3	162.20
0.998	0.002	500	1132.1	137.96	1272.0	164.29	1282.0	162.20
0.996	0.004	250	1080.3	137.96	1186.0	164.29	1189.0	162.20
0.995	0.005	200	1063.0	137.96	1158.1	164.29	1159.5	162.20
0.990	0.010	100	1006.5	137.96	1071.3	164.29	1068.9	162.20
0.980	0.020	50	945.6	137.96	983.7	164.29	979.5	162.20
0.950	0.050	20	856.1	137.96	866.2	164.29	861.8	162.20
0.900	0.100	10	778.8	137.96	774.9	164.29	771.5	162.20
0.800	0.200	5	689.2	137.96	679.1	164.29	677.2	162.20
0.667	0.333	3	610.6	137.96	602.7	164.29	602.0	162.20
0.500	0.500	2.0	535.0	137.96	533.6	164.29	533.8	162.20
0.250	0.750	1.3	436.5	137.96	444.0	164.29	445.7	162.20
0.125	0.875	1.14	385.1	137.96	391.3	164.29	394.7	162.20
0.063	0.937	1.07	355.8	137.96	354.3	164.29	359.3	162.20
Kolmogorov Smirnov (Statistic, Rank)			0.0550	1	0.0719	14	0.0740	15
Anderson Darling (Statistic, Rank)			0.1466	3	0.1704	5	0.1777	8



Precipitation Frequency Analysis, 120-Day Wet Cycles
Monywa Township (1961-2013)
120 Day Total Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

90 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	90 d Wet Precip (mm)
1961	420.0	1	0.019	53.00	899.0
1962	370.0	2	0.038	26.50	864.8
1963	590.0	3	0.057	17.67	738.0
1964	348.0	4	0.075	13.25	718.0
1965	899.0	5	0.094	10.60	683.0
1966	346.0	6	0.113	8.83	654.4
1967	377.0	7	0.132	7.57	605.0
1968	557.0	8	0.151	6.63	596.7
1969	416.0	9	0.170	5.89	594.0
1970	385.0	10	0.189	5.30	590.0
1971	533.0	11	0.208	4.82	585.0
1972	450.0	12	0.226	4.42	561.0
1973	718.0	13	0.245	4.08	557.0
1974	368.0	14	0.264	3.79	555.0
1975	605.0	15	0.283	3.53	536.0
1976	683.0	16	0.302	3.31	533.0
1977	738.0	17	0.321	3.12	517.0
1978	561.0	18	0.340	2.94	515.6
1979	298.0	19	0.358	2.79	503.0
1980	440.0	20	0.377	2.65	503.0
1981	473.0	21	0.396	2.52	486.9
1982	254.0	22	0.415	2.41	473.0
1983	466.0	23	0.434	2.30	470.7
1984	555.0	24	0.453	2.21	466.0
1985	266.0	25	0.472	2.12	465.9
1986	517.0	26	0.491	2.04	465.6
1987	503.0	27	0.509	1.96	463.6
1988	536.0	28	0.528	1.89	460.5
1989	585.0	29	0.547	1.83	450.0
1990	442.0	30	0.566	1.77	445.8
1991	354.0	31	0.585	1.71	443.5
1992	594.0	32	0.604	1.66	442.0
1993	347.0	33	0.623	1.61	440.0
1994	486.9	34	0.642	1.56	420.0
1995	460.5	35	0.660	1.51	416.0
1996	470.7	36	0.679	1.47	396.5
1997	445.8	37	0.698	1.43	394.0
1998	363.0	38	0.717	1.39	385.0
1999	515.6	39	0.736	1.36	380.0
2000	380.0	40	0.755	1.33	377.0
2001	463.6	41	0.774	1.29	370.0
2002	349.5	42	0.792	1.26	368.0
2003	396.5	43	0.811	1.23	363.0
2004	465.9	44	0.830	1.20	354.0
2005	443.5	45	0.849	1.18	349.5
2006	465.6	46	0.868	1.15	348.0
2007	503.0	47	0.887	1.13	347.0
2008	311.6	48	0.906	1.10	346.0
2009	394.0	49	0.925	1.08	311.6
2010	864.8	50	0.943	1.06	298.0
2011	654.4	51	0.962	1.04	266.0
2012	596.7	52	0.981	1.02	254.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	1	1	1
Log-Logistic (3P)	4	2	8
Burr	2	8	16
Log-Gamma	3	13	39
Pearson 5 (3P)	9	5	45
Frechet (3P)	16	3	48
Pearson 6 (4P)	10	6	60
Gumbel Max	18	4	72
Log-Pearson 3	15	10	150
Gen. Extreme Value	22	9	198

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

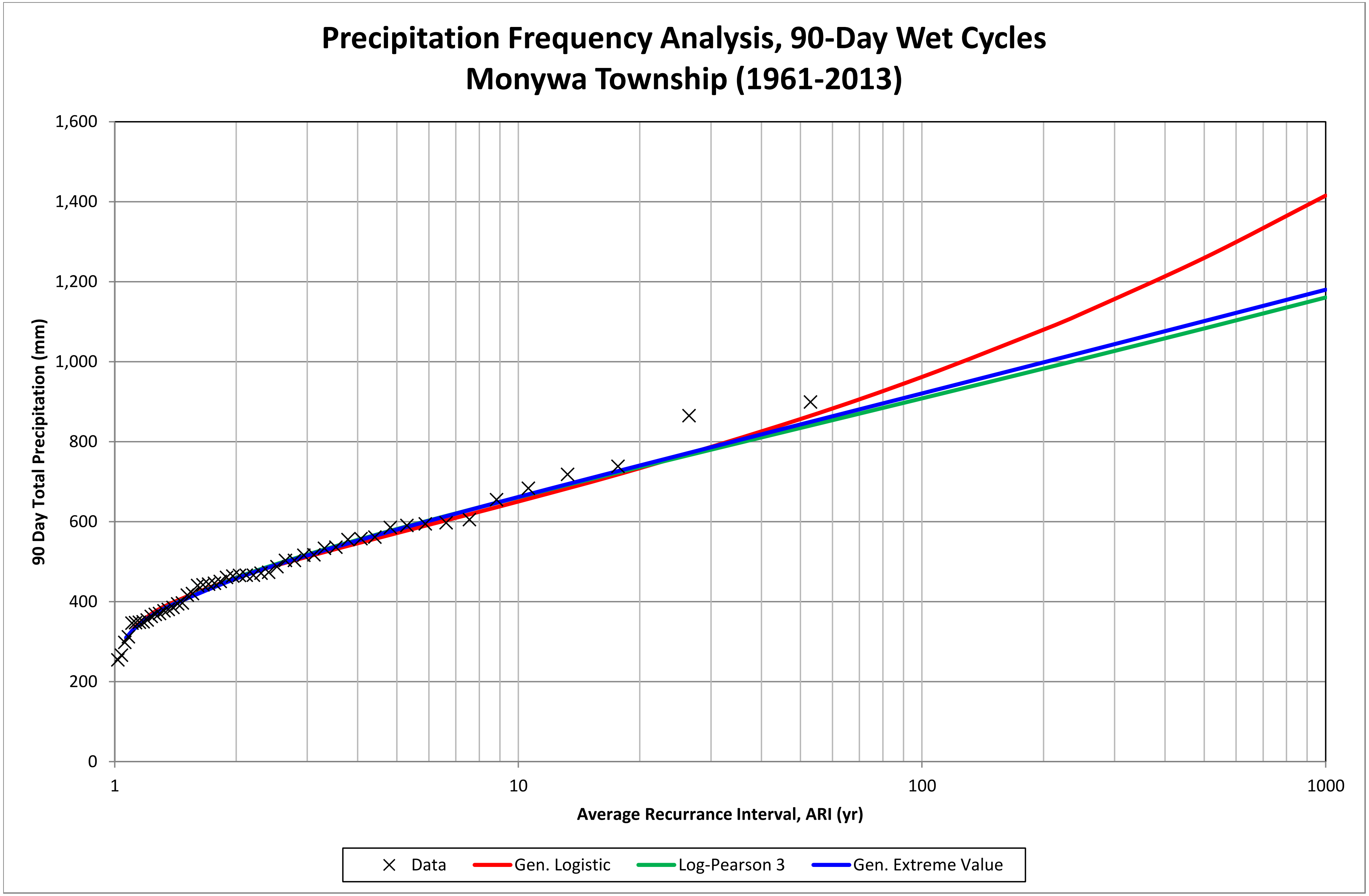
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 90 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α =	0.175342	α =	107.5755695	k =	0.008412194
			β =	71.06012	β =	0.026267129	σ =	107.0507724
			ξ =	460.0164	γ =	3.313707262	μ =	418.5725416
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1415.2	N/A	1160.5	137.46	1179.9	138.84
0.998	0.002	500	1259.3	N/A	1083.0	137.46	1101.4	138.84
0.996	0.004	250	1121.1	N/A	1007.0	137.46	1023.4	138.84
0.995	0.005	200	1080.0	N/A	982.8	137.46	998.3	138.84
0.990	0.010	100	961.9	N/A	908.3	137.46	920.7	138.84
0.980	0.020	50	856.6	N/A	834.4	137.46	843.2	138.84
0.950	0.050	20	733.9	N/A	736.5	137.46	740.5	138.84
0.900	0.100	10	650.5	N/A	661.0	137.46	661.8	138.84
0.800	0.200	5	571.5	N/A	581.6	137.46	580.2	138.84
0.667	0.333	3	512.5	N/A	517.8	137.46	515.7	138.84
0.500	0.500	2.0	460.0	N/A	459.7	137.46	457.9	138.84
0.250	0.750	1.3	389.0	N/A	384.2	137.46	383.7	138.84
0.125	0.875	1.14	342.9	N/A	340.1	137.46	340.4	138.84
0.063	0.937	1.07	307.2	N/A	309.5	137.46	310.2	138.84
Kolmogorov Smirnov (Statistic, Rank)			0.0629	1	0.0702	15	0.0756	22
Anderson Darling (Statistic, Rank)			0.1745	1	0.1825	10	0.1820	9



Precipitation Frequency Analysis, 90-Day Wet Cycles
Monywa Township (1961-2013)
1,600
1,400
1,200
1,000
800
600
400
200
0
90 Day Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

60 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**60 d Wet Precip (mm)**
1961	352.0	1	0.019	53.00	749.0
1962	286.0	2	0.038	26.50	666.3
1963	506.0	3	0.057	17.67	643.0
1964	314.0	4	0.075	13.25	574.0
1965	749.0	5	0.094	10.60	556.7
1966	315.0	6	0.113	8.83	522.0
1967	323.0	7	0.132	7.57	506.0
1968	476.0	8	0.151	6.63	498.0
1969	383.0	9	0.170	5.89	481.0
1970	282.0	10	0.189	5.30	476.0
1971	423.0	11	0.208	4.82	474.6
1972	420.0	12	0.226	4.42	473.0
1973	522.0	13	0.245	4.08	456.2
1974	303.0	14	0.264	3.79	447.0
1975	498.0	15	0.283	3.53	443.0
1976	574.0	16	0.302	3.31	442.0
1977	643.0	17	0.321	3.12	441.7
1978	402.0	18	0.340	2.94	428.0
1979	251.0	19	0.358	2.79	423.0
1980	343.0	20	0.377	2.65	420.0
1981	382.0	21	0.396	2.52	414.1
1982	187.0	22	0.415	2.41	413.0
1983	447.0	23	0.434	2.30	402.0
1984	481.0	24	0.453	2.21	388.4
1985	194.0	25	0.472	2.12	386.8
1986	413.0	26	0.491	2.04	383.5
1987	442.0	27	0.509	1.96	383.0
1988	428.0	28	0.528	1.89	382.0
1989	473.0	29	0.547	1.83	352.8
1990	335.0	30	0.566	1.77	352.0
1991	301.0	31	0.585	1.71	347.2
1992	443.0	32	0.604	1.66	347.2
1993	335.0	33	0.623	1.61	343.0
1994	352.8	34	0.642	1.56	339.8
1995	347.2	35	0.660	1.51	335.0
1996	388.4	36	0.679	1.47	335.0
1997	300.7	37	0.698	1.43	323.6
1998	282.0	38	0.717	1.39	323.0
1999	441.7	39	0.736	1.36	315.0
2000	339.8	40	0.755	1.33	314.0
2001	313.5	41	0.774	1.29	313.5
2002	299.7	42	0.792	1.26	303.0
2003	347.2	43	0.811	1.23	301.0
2004	414.1	44	0.830	1.20	300.7
2005	386.8	45	0.849	1.18	299.7
2006	323.6	46	0.868	1.15	286.0
2007	474.6	47	0.887	1.13	282.0
2008	238.5	48	0.906	1.10	282.0
2009	383.5	49	0.925	1.08	251.0
2010	666.3	50	0.943	1.06	238.5
2011	456.2	51	0.962	1.04	194.0
2012	556.7	52	0.981	1.02	187.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Gen. Extreme Value	2	4	8
Gumbel Max	1	5	5
Log-Logistic (3P)	22	1	22
Lognormal	3	8	24
Gen. Logistic	20	6	120
Pearson 5 (3P)	12	7	84
Log-Gamma	5	2	10
Fatigue Life	6	9	54
Burr	24	3	72
Log-Pearson 3	10	10	100

Three fits were selected for comparison:

1) **Gumbel Max** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

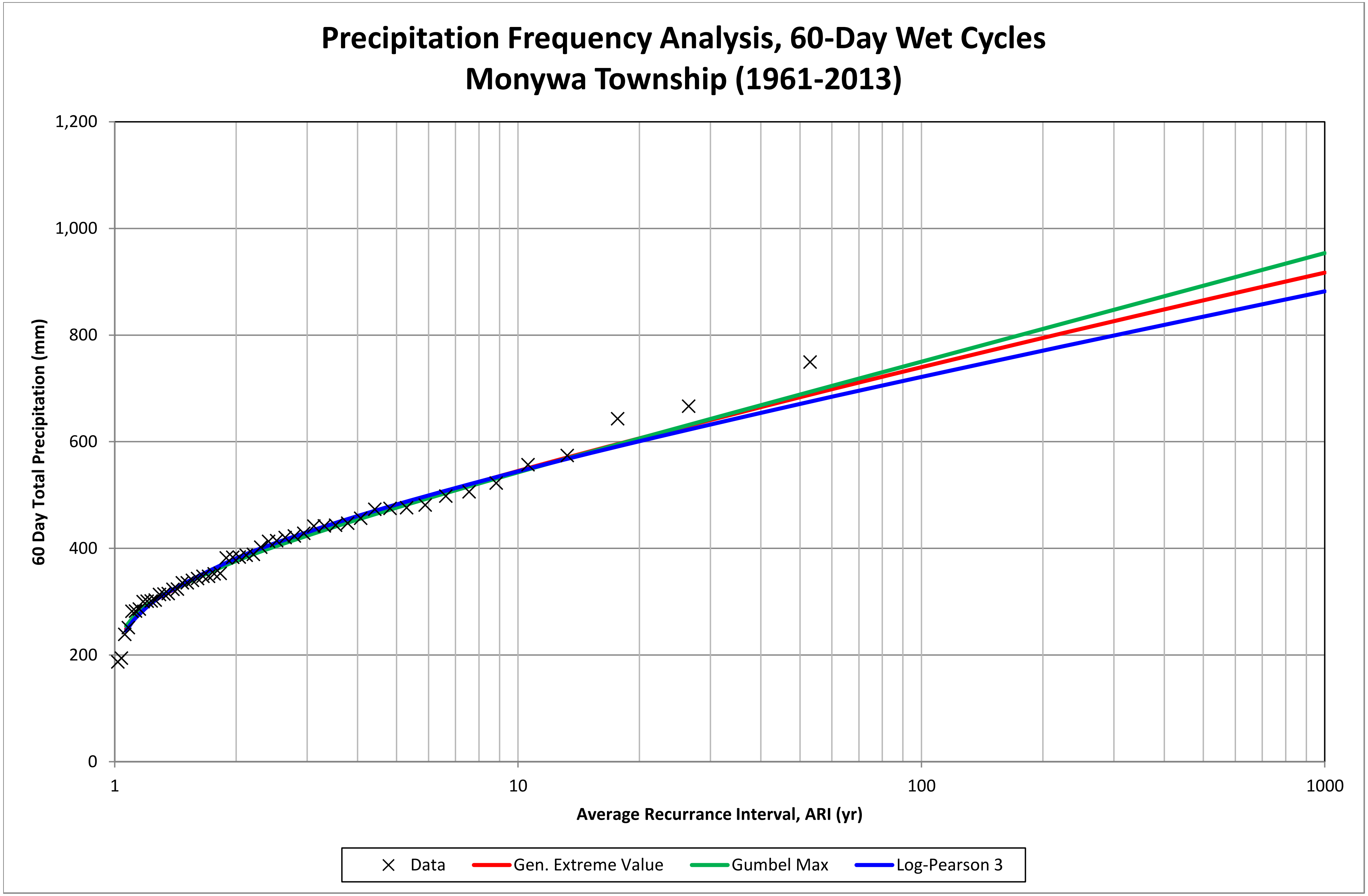
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 60 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Gumbel Max		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.03209	σ =	88.26703134	α =	671.7214009
			σ =	92.41894	μ =	344.0374253	β =	-0.01090416
			μ =	344.491			γ =	13.26444653
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	917.0	113.87	953.7	113.21	882.0	112.70
0.998	0.002	500	865.1	113.87	892.5	113.21	834.5	112.70
0.996	0.004	250	812.0	113.87	831.2	113.21	786.4	112.70
0.995	0.005	200	794.6	113.87	811.5	113.21	770.7	112.70
0.990	0.010	100	739.7	113.87	750.1	113.21	721.4	112.70
0.980	0.020	50	683.4	113.87	688.4	113.21	670.8	112.70
0.950	0.050	20	606.3	113.87	606.2	113.21	600.9	112.70
0.900	0.100	10	545.1	113.87	542.7	113.21	544.4	112.70
0.800	0.200	5	479.8	113.87	476.4	113.21	482.4	112.70
0.667	0.333	3	426.8	113.87	423.8	113.21	430.4	112.70
0.500	0.500	2.0	378.2	113.87	376.4	113.21	381.3	112.70
0.250	0.750	1.3	314.1	113.87	315.2	113.21	314.6	112.70
0.125	0.875	1.14	276.0	113.87	279.4	113.21	274.2	112.70
0.063	0.937	1.07	249.0	113.87	254.3	113.21	245.4	112.70
Kolmogorov Smirnov (Statistic, Rank)			0.0650	2	0.0603	1	0.0694	10
Anderson Darling (Statistic, Rank)			0.2320	6	0.2507	14	0.2444	10



Precipitation Frequency Analysis, 60-Day Wet Cycles
Monywa Township (1961-2013)
1,200
1,000
800
600
400
200
0
60 Day Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Gumbel Max
Log-Pearson 3

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

30 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	30 d Wet Precip (mm)
1961	259.0	1	0.019	53.00	518.0
1962	194.0	2	0.038	26.50	496.0
1963	342.0	3	0.057	17.67	415.0
1964	205.0	4	0.075	13.25	394.2
1965	496.0	5	0.094	10.60	388.0
1966	232.0	6	0.113	8.83	372.0
1967	223.0	7	0.132	7.57	365.0
1968	320.0	8	0.151	6.63	357.0
1969	230.0	9	0.170	5.89	353.2
1970	229.0	10	0.189	5.30	351.0
1971	298.0	11	0.208	4.82	347.0
1972	357.0	12	0.226	4.42	342.0
1973	312.0	13	0.245	4.08	340.0
1974	240.0	14	0.264	3.79	334.0
1975	347.0	15	0.283	3.53	321.0
1976	415.0	16	0.302	3.31	320.0
1977	365.0	17	0.321	3.12	312.0
1978	272.0	18	0.340	2.94	306.0
1979	178.0	19	0.358	2.79	301.0
1980	222.0	20	0.377	2.65	298.0
1981	340.0	21	0.396	2.52	294.9
1982	142.0	22	0.415	2.41	292.0
1983	306.0	23	0.434	2.30	285.2
1984	372.0	24	0.453	2.21	272.0
1985	127.0	25	0.472	2.12	272.0
1986	239.0	26	0.491	2.04	269.0
1987	334.0	27	0.509	1.96	261.1
1988	292.0	28	0.528	1.89	259.0
1989	321.0	29	0.547	1.83	252.0
1990	240.0	30	0.566	1.77	242.0
1991	172.0	31	0.585	1.71	240.0
1992	227.0	32	0.604	1.66	240.0
1993	242.0	33	0.623	1.61	239.0
1994	272.0	34	0.642	1.56	232.0
1995	230.9	35	0.660	1.51	230.9
1996	269.0	36	0.679	1.47	230.0
1997	188.7	37	0.698	1.43	229.0
1998	195.1	38	0.717	1.39	227.0
1999	294.9	39	0.736	1.36	223.0
2000	261.1	40	0.755	1.33	222.0
2001	180.9	41	0.774	1.29	217.2
2002	171.0	42	0.792	1.26	205.0
2003	301.0	43	0.811	1.23	195.1
2004	351.0	44	0.830	1.20	194.0
2005	285.2	45	0.849	1.18	188.7
2006	217.2	46	0.868	1.15	180.9
2007	394.2	47	0.887	1.13	178.7
2008	178.7	48	0.906	1.10	178.0
2009	252.0	49	0.925	1.08	172.0
2010	518.0	50	0.943	1.06	171.0
2011	353.2	51	0.962	1.04	142.0
2012	388.0	52	0.981	1.02	127.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Johnson SB	11	1	11
Log-Gamma	1	19	19
Fatigue Life	3	11	33
Log-Pearson 3	17	2	34
Gamma (3P)	10	4	40
Frechet (3P)	2	20	40
Gen. Extreme Value	16	3	48
Gen. Gamma (4P)	12	5	60
Lognormal	5	14	70
Rayleigh (2P)	4	18	72

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

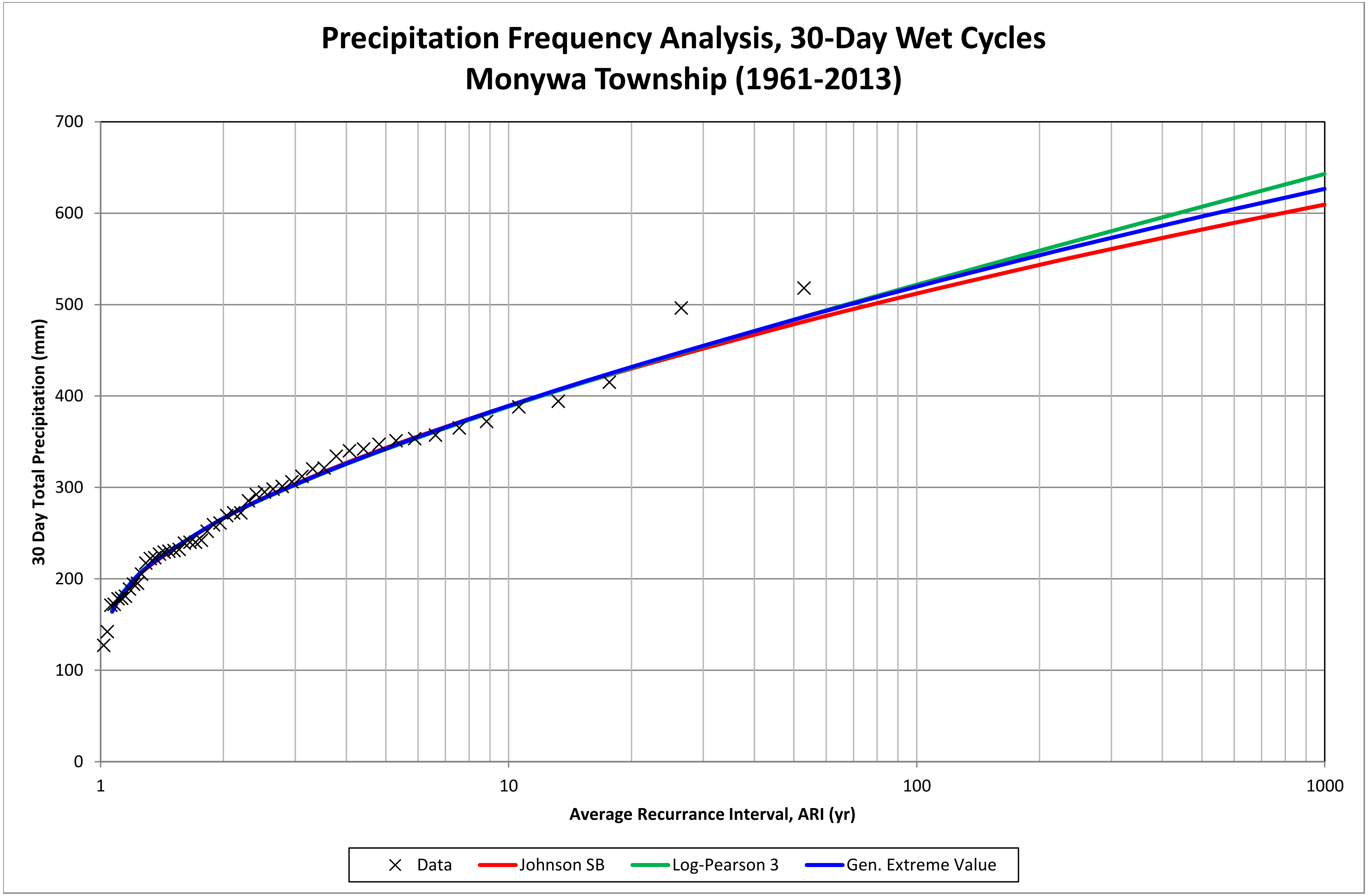
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 30 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Johnson SB		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	γ =	3.1891087	α =	373.2489569	k =	-0.07695247
			δ =	2.282648	β =	-0.015596338	σ =	72.10509295
			λ =	1179.23	γ =	11.40050618	μ =	240.2813801
			ξ =	32.561480				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	609.4	N/A	643.0	84.04	626.6	84.48
0.998	0.002	500	582.1	N/A	607.1	84.04	596.4	84.48
0.996	0.004	250	553.1	N/A	570.7	84.04	564.5	84.48
0.995	0.005	200	543.4	N/A	558.9	84.04	553.9	84.48
0.990	0.010	100	512.1	N/A	521.7	84.04	519.6	84.48
0.980	0.020	50	478.5	N/A	483.6	84.04	483.3	84.48
0.950	0.050	20	430.0	N/A	430.9	84.04	431.7	84.48
0.900	0.100	10	389.2	N/A	388.3	84.04	389.3	84.48
0.800	0.200	5	343.2	N/A	341.8	84.04	342.4	84.48
0.667	0.333	3	303.8	N/A	302.9	84.04	303.2	84.48
0.500	0.500	2.0	266.4	N/A	266.2	84.04	266.3	84.48
0.250	0.750	1.3	215.9	N/A	216.8	84.04	216.4	84.48
0.125	0.875	1.14	185.8	N/A	187.0	84.04	186.0	84.48
0.063	0.937	1.07	165.0	N/A	165.9	84.04	164.0	84.48
Kolmogorov Smirnov (Statistic, Rank)			0.0638	11	0.0660	17	0.0657	16
Anderson Darling (Statistic, Rank)			0.1768	1	0.1804	2	0.1808	3



Precipitation Frequency Analysis, 30-Day Wet Cycles
Monywa Township (1961-2013)
30 Day Total Precipitation (mm)
0
100
200
300
400
500
600
700
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Johnson SB
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

14 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**14 d Wet Precip (mm)**
1961	169.0	1	0.019	53.00	365.9
1962	145.0	2	0.038	26.50	359.0
1963	270.0	3	0.057	17.67	338.0
1964	166.0	4	0.075	13.25	333.0
1965	297.0	5	0.094	10.60	324.5
1966	171.0	6	0.113	8.83	297.0
1967	153.0	7	0.132	7.57	285.0
1968	245.0	8	0.151	6.63	280.0
1969	167.0	9	0.170	5.89	270.0
1970	173.0	10	0.189	5.30	247.0
1971	227.0	11	0.208	4.82	245.0
1972	280.0	12	0.226	4.42	244.0
1973	210.0	13	0.245	4.08	235.0
1974	193.0	14	0.264	3.79	230.0
1975	221.0	15	0.283	3.53	227.0
1976	359.0	16	0.302	3.31	224.5
1977	197.0	17	0.321	3.12	221.0
1978	199.0	18	0.340	2.94	210.0
1979	133.0	19	0.358	2.79	203.5
1980	146.0	20	0.377	2.65	203.0
1981	203.0	21	0.396	2.52	199.0
1982	118.0	22	0.415	2.41	197.9
1983	244.0	23	0.434	2.30	197.0
1984	338.0	24	0.453	2.21	193.0
1985	93.0	25	0.472	2.12	182.0
1986	182.0	26	0.491	2.04	173.0
1987	230.0	27	0.509	1.96	172.5
1988	235.0	28	0.528	1.89	171.0
1989	247.0	29	0.547	1.83	169.0
1990	139.0	30	0.566	1.77	168.4
1991	115.0	31	0.585	1.71	168.1
1992	164.0	32	0.604	1.66	167.0
1993	161.0	33	0.623	1.61	166.0
1994	154.9	34	0.642	1.56	164.0
1995	149.9	35	0.660	1.51	161.0
1996	172.5	36	0.679	1.47	155.7
1997	132.3	37	0.698	1.43	154.9
1998	168.1	38	0.717	1.39	153.5
1999	203.5	39	0.736	1.36	153.0
2000	141.5	40	0.755	1.33	149.9
2001	155.7	41	0.774	1.29	146.0
2002	112.2	42	0.792	1.26	145.0
2003	197.9	43	0.811	1.23	141.5
2004	333.0	44	0.830	1.20	139.7
2005	168.4	45	0.849	1.18	139.0
2006	139.7	46	0.868	1.15	133.0
2007	365.9	47	0.887	1.13	132.3
2008	121.5	48	0.906	1.10	121.5
2009	153.5	49	0.925	1.08	118.0
2010	285.0	50	0.943	1.06	115.0
2011	224.5	51	0.962	1.04	112.2
2012	324.5	52	0.981	1.02	93.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Gen. Extreme Value	10	1	10
Log-Logistic (3P)	1	16	16
Wakeby	12	2	24
Pearson 5 (3P)	11	3	33
Frechet	9	4	36
Pearson 6 (4P)	2	25	50
Lognormal (3P)	8	7	56
Burr	13	5	65
Erlang (3P)	6	14	84
Log-Pearson 3	16	9	144

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

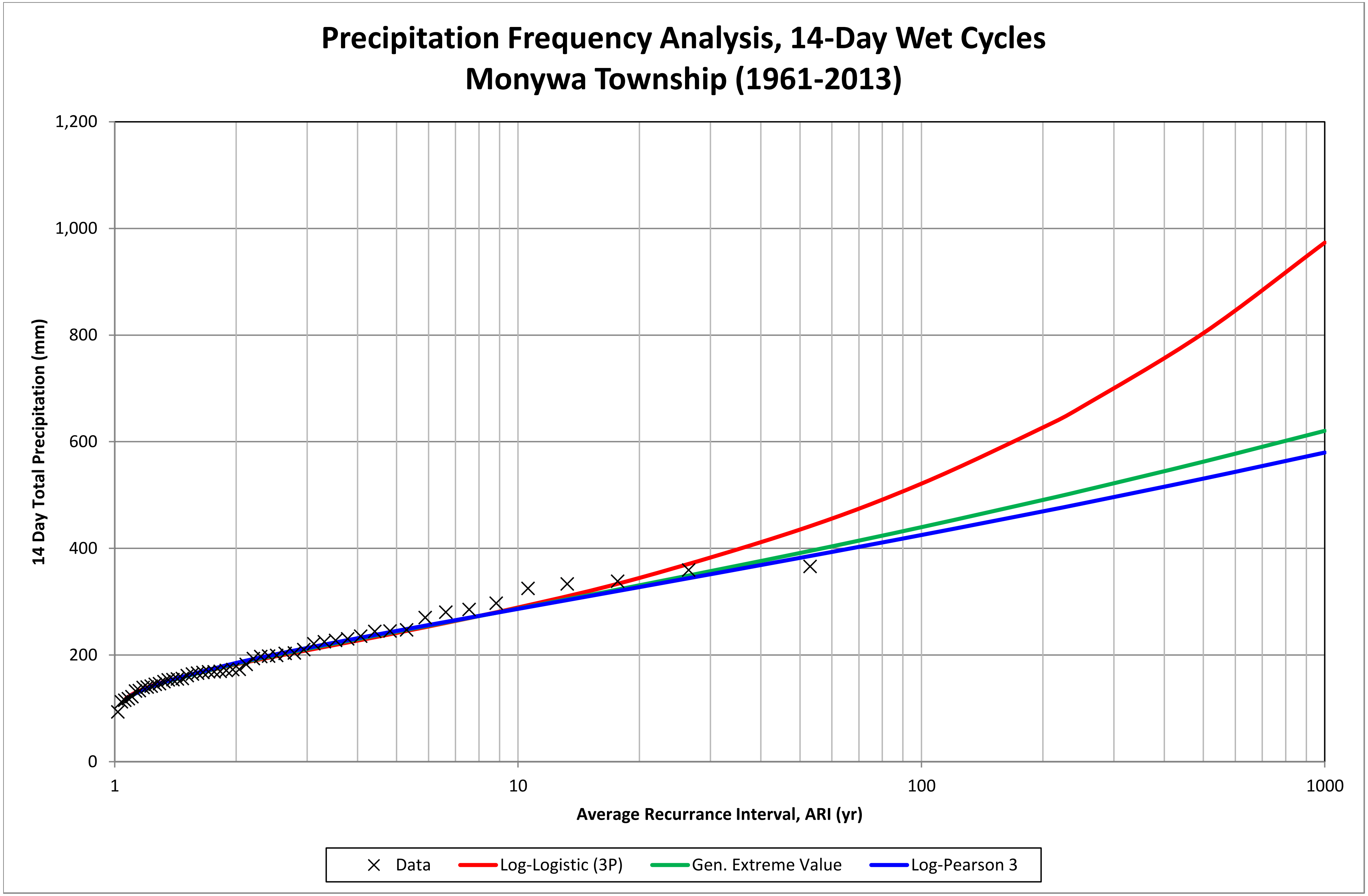
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 14 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Log-Logistic (3P)		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.079888	α =	3.342476125	α =	51.89373803
			σ =	49.38084	β =	114.6736834	β =	0.044826575
			μ =	165.2531	γ =	67.8774572	γ =	2.909563599
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	620.4	71.22	973.3	90.18	579.7	69.03
0.998	0.002	500	562.6	71.22	803.5	90.18	530.8	69.03
0.996	0.004	250	507.8	71.22	665.4	90.18	484.0	69.03
0.995	0.005	200	490.8	71.22	626.6	90.18	469.4	69.03
0.990	0.010	100	439.8	71.22	521.3	90.18	425.0	69.03
0.980	0.020	50	391.3	71.22	435.3	90.18	382.2	69.03
0.950	0.050	20	330.8	71.22	344.6	90.18	327.4	69.03
0.900	0.100	10	287.0	71.22	289.2	90.18	286.6	69.03
0.800	0.200	5	243.9	71.22	241.5	90.18	245.3	69.03
0.667	0.333	3	211.5	71.22	209.0	90.18	213.3	69.03
0.500	0.500	2.0	183.6	71.22	182.6	90.18	185.1	69.03
0.250	0.750	1.3	149.3	71.22	150.4	90.18	150.0	69.03
0.125	0.875	1.14	130.1	71.22	131.9	90.18	130.4	69.03
0.063	0.937	1.07	117.0	71.22	119.0	90.18	117.1	69.03
Kolmogorov Smirnov (Statistic, Rank)			0.0942	8	0.0914	7	0.1032	19
Anderson Darling (Statistic, Rank)			0.2409	1	0.2425	2	0.2683	10


Precipitation Frequency Analysis, 14-Day Wet Cycles
Monywa Township (1961-2013)
14 Day Total Precipitation (mm)
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

7 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	7 d Wet Precip (mm)
1961	122.0	1	0.019	53.00	319.4
1962	116.0	2	0.038	26.50	309.0
1963	165.0	3	0.057	17.67	232.7
1964	141.0	4	0.075	13.25	225.5
1965	178.0	5	0.094	10.60	221.0
1966	141.0	6	0.113	8.83	212.0
1967	144.0	7	0.132	7.57	208.0
1968	203.0	8	0.151	6.63	206.5
1969	112.0	9	0.170	5.89	203.0
1970	96.0	10	0.189	5.30	186.0
1971	159.0	11	0.208	4.82	183.0
1972	162.0	12	0.226	4.42	178.0
1973	183.0	13	0.245	4.08	174.0
1974	186.0	14	0.264	3.79	173.0
1975	166.0	15	0.283	3.53	172.0
1976	221.0	16	0.302	3.31	166.0
1977	150.0	17	0.321	3.12	165.0
1978	131.0	18	0.340	2.94	162.0
1979	119.0	19	0.358	2.79	159.0
1980	109.0	20	0.377	2.65	157.0
1981	132.0	21	0.396	2.52	150.0
1982	89.0	22	0.415	2.41	149.4
1983	174.0	23	0.434	2.30	145.0
1984	309.0	24	0.453	2.21	144.0
1985	92.0	25	0.472	2.12	141.7
1986	172.0	26	0.491	2.04	141.0
1987	157.0	27	0.509	1.96	141.0
1988	208.0	28	0.528	1.89	132.0
1989	212.0	29	0.547	1.83	131.0
1990	98.0	30	0.566	1.77	129.5
1991	108.0	31	0.585	1.71	128.5
1992	145.0	32	0.604	1.66	125.2
1993	118.0	33	0.623	1.61	122.0
1994	120.1	34	0.642	1.56	120.1
1995	132.3	35	0.660	1.51	119.0
1996	128.5	36	0.679	1.47	118.0
1997	91.9	37	0.698	1.43	116.0
1998	100.3	38	0.717	1.39	115.5
1999	141.7	39	0.736	1.36	112.0
2000	125.2	40	0.755	1.33	109.0
2001	107.4	41	0.774	1.29	108.0
2002	99.0	42	0.792	1.26	107.4
2003	149.4	43	0.811	1.23	100.6
2004	232.7	44	0.830	1.20	100.3
2005	129.5	45	0.849	1.18	99.0
2006	100.6	46	0.868	1.15	98.0
2007	319.4	47	0.887	1.13	96.0
2008	84.9	48	0.906	1.10	92.0
2009	115.5	49	0.925	1.08	91.9
2010	225.5	50	0.943	1.06	89.0
2011	173.0	51	0.962	1.04	84.9
2012	206.5	52	0.981	1.02	80.8
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Weibull (3P)	2	3	6
Johnson SB	5	2	10
Phased Bi-Weibull	3	6	18
Gen. Extreme Value	4	7	28
Gamma (3P)	7	4	28
Log-Pearson 3	6	5	30
Lognormal (3P)	12	10	120
Inv. Gaussian (3P)	14	9	126
Gen. Logistic	8	16	128

Three fits were selected for comparison:

1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

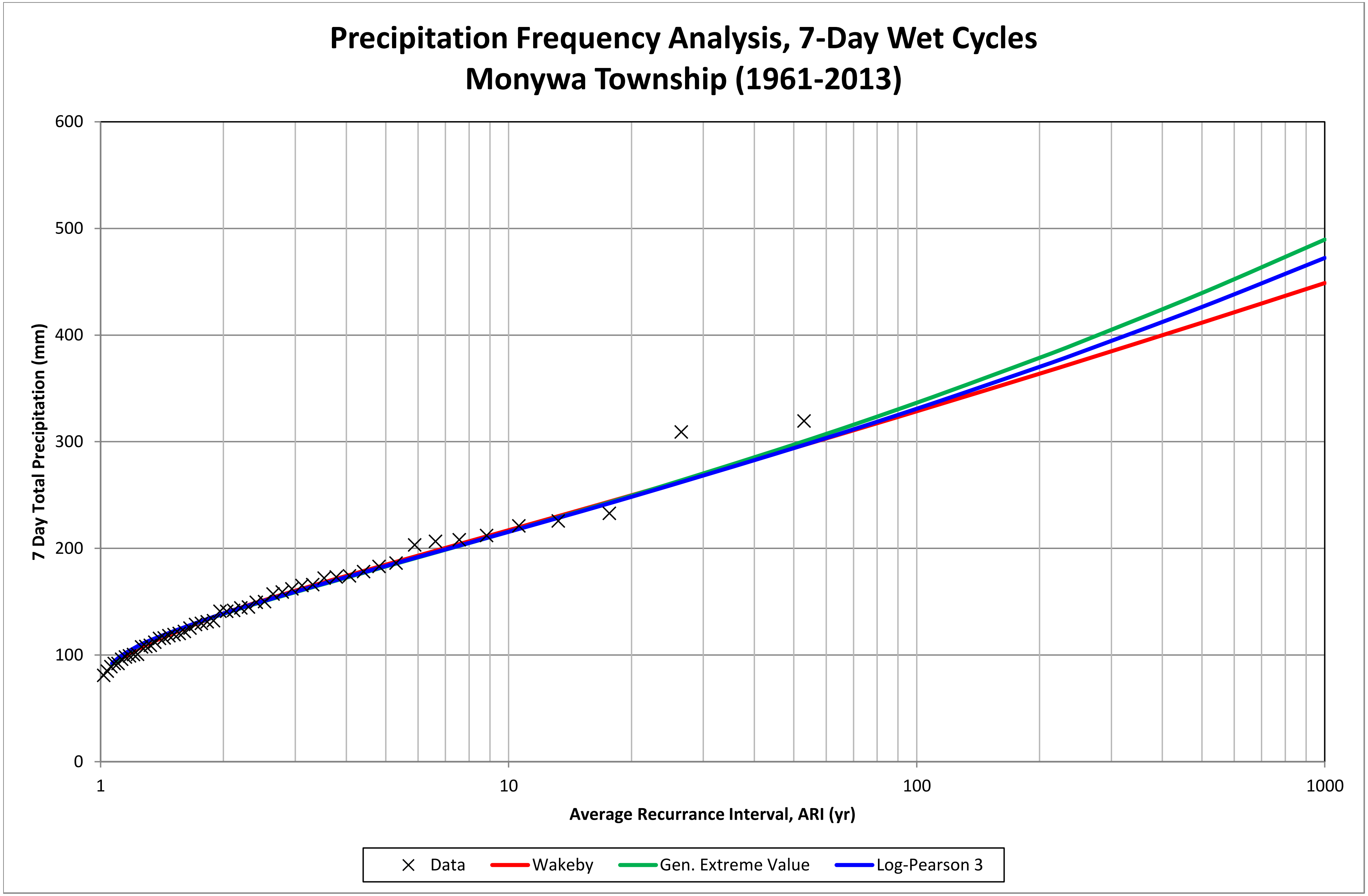
Note that these predictions should be multiplied by **1.018** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 7 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	73.72227	k =	0.108755469	α =	14.5565948
			β =	2.488256	σ =	35.37236791	β =	0.08155159
			γ =	43.14648	μ =	125.3784974	γ =	3.773859131
			δ =	0.033106				
			ξ =	84.27241				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	448.8	N/A	489.5	53.60	472.3	52.50
0.998	0.002	500	411.6	N/A	439.4	53.60	426.3	52.50
0.996	0.004	250	375.3	N/A	392.9	53.60	383.4	52.50
0.995	0.005	200	363.8	N/A	378.7	53.60	370.2	52.50
0.990	0.010	100	328.5	N/A	336.5	53.60	330.9	52.50
0.980	0.020	50	294.1	N/A	297.3	53.60	294.0	52.50
0.950	0.050	20	249.8	N/A	249.4	53.60	248.3	52.50
0.900	0.100	10	217.0	N/A	215.6	53.60	215.5	52.50
0.800	0.200	5	184.7	N/A	183.0	53.60	183.4	52.50
0.667	0.333	3	160.3	N/A	159.0	53.60	159.4	52.50
0.500	0.500	2.0	138.9	N/A	138.6	53.60	138.9	52.50
0.250	0.750	1.3	111.9	N/A	114.0	53.60	114.3	52.50
0.125	0.875	1.14	98.4	N/A	100.5	53.60	101.1	52.50
0.063	0.937	1.07	91.5	N/A	91.3	53.60	92.3	52.50
Kolmogorov Smirnov (Statistic, Rank)			0.0392	1	0.0473	4	0.0520	6
Anderson Darling (Statistic, Rank)			0.1049	1	0.1532	7	0.1465	5


Precipitation Frequency Analysis, 7-Day Wet Cycles
Monywa Township (1961-2013)
7 Day Total Precipitation (mm)
0
100
200
300
400
500
600
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

4 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**4 d Wet Precip (mm)**
1961	96.0	1	0.019	53.00	294.0
1962	116.0	2	0.038	26.50	288.0
1963	128.0	3	0.057	17.67	216.0
1964	109.0	4	0.075	13.25	204.0
1965	152.0	5	0.094	10.60	190.0
1966	141.0	6	0.113	8.83	174.0
1967	144.0	7	0.132	7.57	168.0
1968	168.0	8	0.151	6.63	158.0
1969	108.0	9	0.170	5.89	154.0
1970	96.0	10	0.189	5.30	153.0
1971	158.0	11	0.208	4.82	152.0
1972	125.0	12	0.226	4.42	147.6
1973	124.0	13	0.245	4.08	145.0
1974	154.0	14	0.264	3.79	144.0
1975	145.0	15	0.283	3.53	143.0
1976	128.0	16	0.302	3.31	141.7
1977	127.0	17	0.321	3.12	141.0
1978	85.0	18	0.340	2.94	139.0
1979	112.0	19	0.358	2.79	128.8
1980	97.0	20	0.377	2.65	128.0
1981	108.0	21	0.396	2.52	128.0
1982	55.0	22	0.415	2.41	127.0
1983	108.0	23	0.434	2.30	125.0
1984	294.0	24	0.453	2.21	124.0
1985	72.0	25	0.472	2.12	119.1
1986	143.0	26	0.491	2.04	116.0
1987	114.0	27	0.509	1.96	115.5
1988	153.0	28	0.528	1.89	114.0
1989	174.0	29	0.547	1.83	112.0
1990	87.0	30	0.566	1.77	109.0
1991	107.0	31	0.585	1.71	108.0
1992	106.0	32	0.604	1.66	108.0
1993	90.0	33	0.623	1.61	108.0
1994	119.1	34	0.642	1.56	107.0
1995	87.1	35	0.660	1.51	106.0
1996	95.8	36	0.679	1.47	97.0
1997	73.9	37	0.698	1.43	96.3
1998	96.3	38	0.717	1.39	96.0
1999	141.7	39	0.736	1.36	96.0
2000	72.1	40	0.755	1.33	95.8
2001	90.2	41	0.774	1.29	90.2
2002	87.6	42	0.792	1.26	90.0
2003	147.6	43	0.811	1.23	87.6
2004	204.0	44	0.830	1.20	87.1
2005	128.8	45	0.849	1.18	87.0
2006	86.6	46	0.868	1.15	86.6
2007	288.0	47	0.887	1.13	85.0
2008	69.6	48	0.906	1.10	73.9
2009	115.5	49	0.925	1.08	72.1
2010	216.0	50	0.943	1.06	72.0
2011	139.0	51	0.962	1.04	69.6
2012	190.0	52	0.981	1.02	55.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Dagum (4P)	1	6	6
Gen. Logistic	7	1	7
Burr (4P)	3	3	9
Frechet (3P)	2	7	14
Log-Logistic (3P)	10	2	20
Dagum	9	4	36
Pearson 6	4	11	44
Pearson 5 (3P)	6	9	54
Gen. Extreme Value	14	8	112
Log-Pearson 3	13	14	182

Three fits were selected for comparison:

1) **Dagum (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

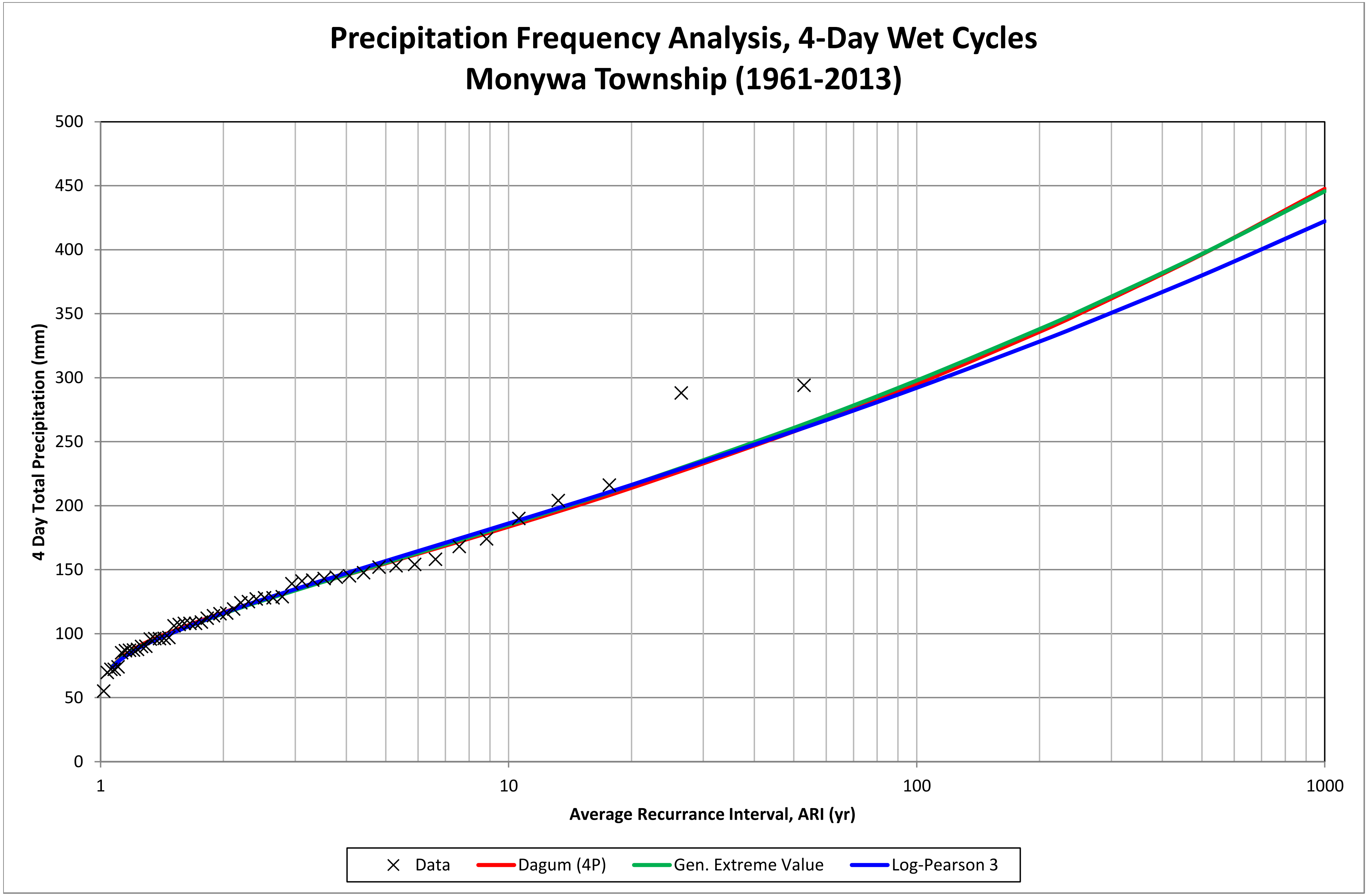
Note that these predictions should be multiplied by **1.034** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods. The correction factor for 4 day durations was linearly interpolated from values given in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Dagum (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	k =	5.96752	k =	0.124568917	α =	19.47467782
			α =	6.967524	σ =	31.19983548	β =	0.076595668
			β =	155.2871	μ =	104.0418997	γ =	3.288776571
			γ =	-93.1777				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	447.6	48.07	445.7	48.66	422.3	48.01
0.998	0.002	500	396.3	48.07	396.7	48.66	379.9	48.01
0.996	0.004	250	349.9	48.07	351.7	48.66	340.4	48.01
0.995	0.005	200	335.9	48.07	338.0	48.66	328.3	48.01
0.990	0.010	100	295.1	48.07	297.8	48.66	292.1	48.01
0.980	0.020	50	258.0	48.07	260.8	48.66	258.2	48.01
0.950	0.050	20	214.0	48.07	216.2	48.66	216.3	48.01
0.900	0.100	10	183.6	48.07	185.1	48.66	186.2	48.01
0.800	0.200	5	155.0	48.07	155.5	48.66	156.8	48.01
0.667	0.333	3	134.2	48.07	133.9	48.66	134.9	48.01
0.500	0.500	2.0	116.6	48.07	115.7	48.66	116.2	48.01
0.250	0.750	1.3	95.1	48.07	94.1	48.66	93.8	48.01
0.125	0.875	1.14	82.9	48.07	82.2	48.66	81.7	48.01
0.063	0.937	1.07	74.4	48.07	74.2	48.66	73.8	48.01
Kolmogorov Smirnov (Statistic, Rank)			0.0547	1	0.0639	14	0.0630	13
Anderson Darling (Statistic, Rank)			0.1956	6	0.2235	8	0.2428	14


Precipitation Frequency Analysis, 4-Day Wet Cycles
Monywa Township (1961-2013)
4 Day Total Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Dagum (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional. **Count, n:** 52

3 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	3 d Wet Precip (mm)
1961	92.0	1	0.019	53.00	279.0
1962	116.0	2	0.038	26.50	265.0
1963	123.0	3	0.057	17.67	216.0
1964	104.0	4	0.075	13.25	195.3
1965	137.0	5	0.094	10.60	185.5
1966	139.0	6	0.113	8.83	165.0
1967	144.0	7	0.132	7.57	160.0
1968	165.0	8	0.151	6.63	144.0
1969	106.0	9	0.170	5.89	142.0
1970	88.0	10	0.189	5.30	141.0
1971	134.0	11	0.208	4.82	140.5
1972	107.0	12	0.226	4.42	139.0
1973	111.0	13	0.245	4.08	137.0
1974	129.0	14	0.264	3.79	135.0
1975	141.0	15	0.283	3.53	134.0
1976	120.0	16	0.302	3.31	130.0
1977	127.0	17	0.321	3.12	129.0
1978	79.0	18	0.340	2.94	128.8
1979	112.0	19	0.358	2.79	127.0
1980	97.0	20	0.377	2.65	123.0
1981	99.0	21	0.396	2.52	120.0
1982	54.0	22	0.415	2.41	119.1
1983	99.0	23	0.434	2.30	116.0
1984	279.0	24	0.453	2.21	114.0
1985	70.0	25	0.472	2.12	112.0
1986	142.0	26	0.491	2.04	112.0
1987	114.0	27	0.509	1.96	111.0
1988	130.0	28	0.528	1.89	107.0
1989	160.0	29	0.547	1.83	106.0
1990	75.0	30	0.566	1.77	106.0
1991	79.0	31	0.585	1.71	104.0
1992	106.0	32	0.604	1.66	99.0
1993	87.0	33	0.623	1.61	99.0
1994	119.1	34	0.642	1.56	97.0
1995	83.6	35	0.660	1.51	95.8
1996	95.8	36	0.679	1.47	92.0
1997	65.3	37	0.698	1.43	90.2
1998	82.5	38	0.717	1.39	88.0
1999	82.6	39	0.736	1.36	87.1
2000	68.1	40	0.755	1.33	87.0
2001	90.2	41	0.774	1.29	83.6
2002	87.1	42	0.792	1.26	82.8
2003	140.5	43	0.811	1.23	82.6
2004	195.3	44	0.830	1.20	82.5
2005	128.8	45	0.849	1.18	79.0
2006	82.8	46	0.868	1.15	79.0
2007	265.0	47	0.887	1.13	75.0
2008	68.1	48	0.906	1.10	70.0
2009	112.0	49	0.925	1.08	68.1
2010	216.0	50	0.943	1.06	68.1
2011	135.0	51	0.962	1.04	65.3
2012	185.5	52	0.981	1.02	54.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	4	1	4
Log-Logistic (3P)	5	2	10
Burr	2	9	18
Dagum (4P)	7	3	21
Dagum	6	5	30
Frechet (3P)	8	4	32
Log-Logistic	3	13	39
Wakeby	1	45	45
Gen. Extreme Value	9	6	54
Log-Pearson 3	13	11	143

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

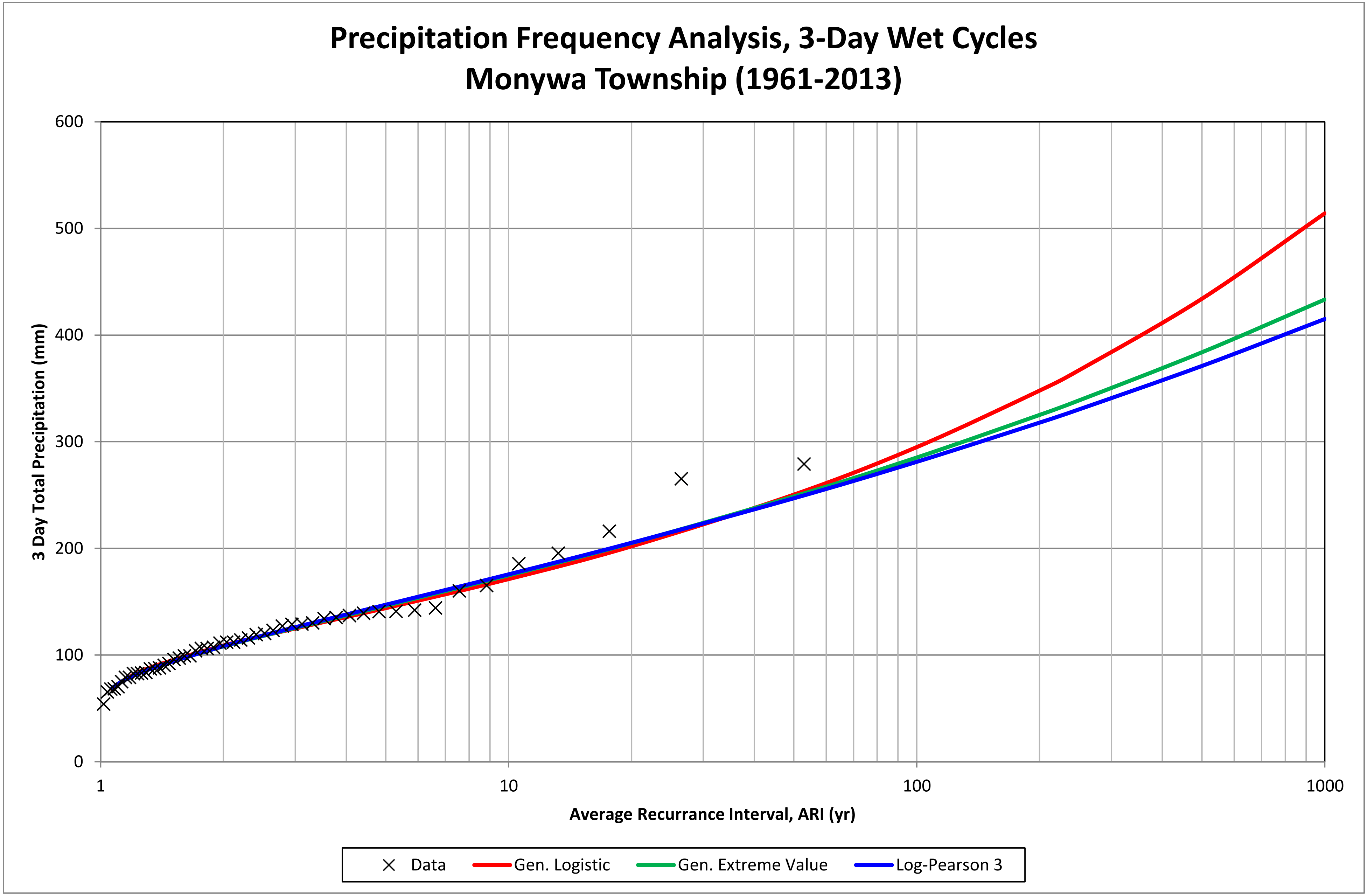
Note that these predictions should be multiplied by **1.044** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.259058	k =	0.134098497	α =	15.06559838
			σ =	21.05745	σ =	29.56566364	β =	0.088278212
			μ =	108.9025	μ =	97.07074459	γ =	3.384985514
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	514.1	N/A	433.3	46.96	415.0	46.38
0.998	0.002	500	434.0	N/A	383.9	46.96	371.0	46.38
0.996	0.004	250	367.1	N/A	338.8	46.96	330.3	46.38
0.995	0.005	200	347.9	N/A	325.1	46.96	317.9	46.38
0.990	0.010	100	294.9	N/A	285.2	46.96	281.1	46.38
0.980	0.020	50	250.4	N/A	248.6	46.96	247.0	46.38
0.950	0.050	20	201.9	N/A	204.9	46.96	205.2	46.38
0.900	0.100	10	171.2	N/A	174.7	46.96	175.7	46.38
0.800	0.200	5	144.0	N/A	146.2	46.96	147.2	46.38
0.667	0.333	3	124.9	N/A	125.5	46.96	126.1	46.38
0.500	0.500	2.0	108.9	N/A	108.2	46.96	108.4	46.38
0.250	0.750	1.3	88.8	N/A	87.6	46.96	87.4	46.38
0.125	0.875	1.14	76.7	N/A	76.5	46.96	76.3	46.38
0.063	0.937	1.07	68.0	N/A	69.0	46.96	69.0	46.38
Kolmogorov Smirnov (Statistic, Rank)			0.0655	4	0.0765	9	0.0814	13
Anderson Darling (Statistic, Rank)			0.1778	1	0.1925	6	0.2033	11


Precipitation Frequency Analysis, 3-Day Wet Cycles
Monywa Township (1961-2013)
3 Day Total Precipitation (mm)
600
500
400
300
200
100
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

2 Day Data		Rank	Weibull	ARI	Ranked
Year	**Precip (mm)**	**(highest to lowest) m**	**Exceedance Probability p**	**(yr)**	**2 d Wet Precip (mm)**
1961	92.0	1	0.019	53.00	204.0
1962	95.0	2	0.038	26.50	197.8
1963	90.0	3	0.057	17.67	183.5
1964	104.0	4	0.075	13.25	164.0
1965	114.0	5	0.094	10.60	144.3
1966	75.0	6	0.113	8.83	139.0
1967	139.0	7	0.132	7.57	128.8
1968	122.0	8	0.151	6.63	124.0
1969	104.0	9	0.170	5.89	124.0
1970	78.0	10	0.189	5.30	123.0
1971	109.0	11	0.208	4.82	122.0
1972	98.0	12	0.226	4.42	122.0
1973	104.0	13	0.245	4.08	120.7
1974	105.0	14	0.264	3.79	119.1
1975	123.0	15	0.283	3.53	117.0
1976	102.0	16	0.302	3.31	114.0
1977	124.0	17	0.321	3.12	113.0
1978	76.0	18	0.340	2.94	109.0
1979	106.0	19	0.358	2.79	107.0
1980	77.0	20	0.377	2.65	106.0
1981	97.0	21	0.396	2.52	105.0
1982	41.0	22	0.415	2.41	105.0
1983	99.0	23	0.434	2.30	104.0
1984	204.0	24	0.453	2.21	104.0
1985	63.0	25	0.472	2.12	104.0
1986	107.0	26	0.491	2.04	103.0
1987	113.0	27	0.509	1.96	102.0
1988	117.0	28	0.528	1.89	99.0
1989	122.0	29	0.547	1.83	98.0
1990	75.0	30	0.566	1.77	97.0
1991	73.0	31	0.585	1.71	95.3
1992	105.0	32	0.604	1.66	95.0
1993	87.0	33	0.623	1.61	92.0
1994	119.1	34	0.642	1.56	90.0
1995	70.6	35	0.660	1.51	89.2
1996	95.3	36	0.679	1.47	87.0
1997	57.9	37	0.698	1.43	82.3
1998	67.8	38	0.717	1.39	79.5
1999	82.3	39	0.736	1.36	78.0
2000	68.1	40	0.755	1.33	77.0
2001	89.2	41	0.774	1.29	76.0
2002	52.1	42	0.792	1.26	75.0
2003	120.7	43	0.811	1.23	75.0
2004	144.3	44	0.830	1.20	73.0
2005	128.8	45	0.849	1.18	70.6
2006	79.5	46	0.868	1.15	68.1
2007	197.8	47	0.887	1.13	67.8
2008	42.5	48	0.906	1.10	63.0
2009	103.0	49	0.925	1.08	57.9
2010	164.0	50	0.943	1.06	52.1
2011	124.0	51	0.962	1.04	42.5
2012	183.5	52	0.981	1.02	41.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	**Kolmogorov Smirnov Ranking**	**Anderson Darling Ranking**	**Weighted Ranking**
Wakeby	1	1	1
Log-Logistic (3P)	2	3	6
Gen. Logistic	4	2	8
Burr	3	4	12
Pearson 5 (3P)	16	5	80
Gumbel Max	6	15	90
Pearson 6 (4P)	15	6	90
Gen. Extreme Value	14	8	112
Cauchy	5	26	130
Log-Pearson 3	27	14	378

Three fits were selected for comparison:

1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

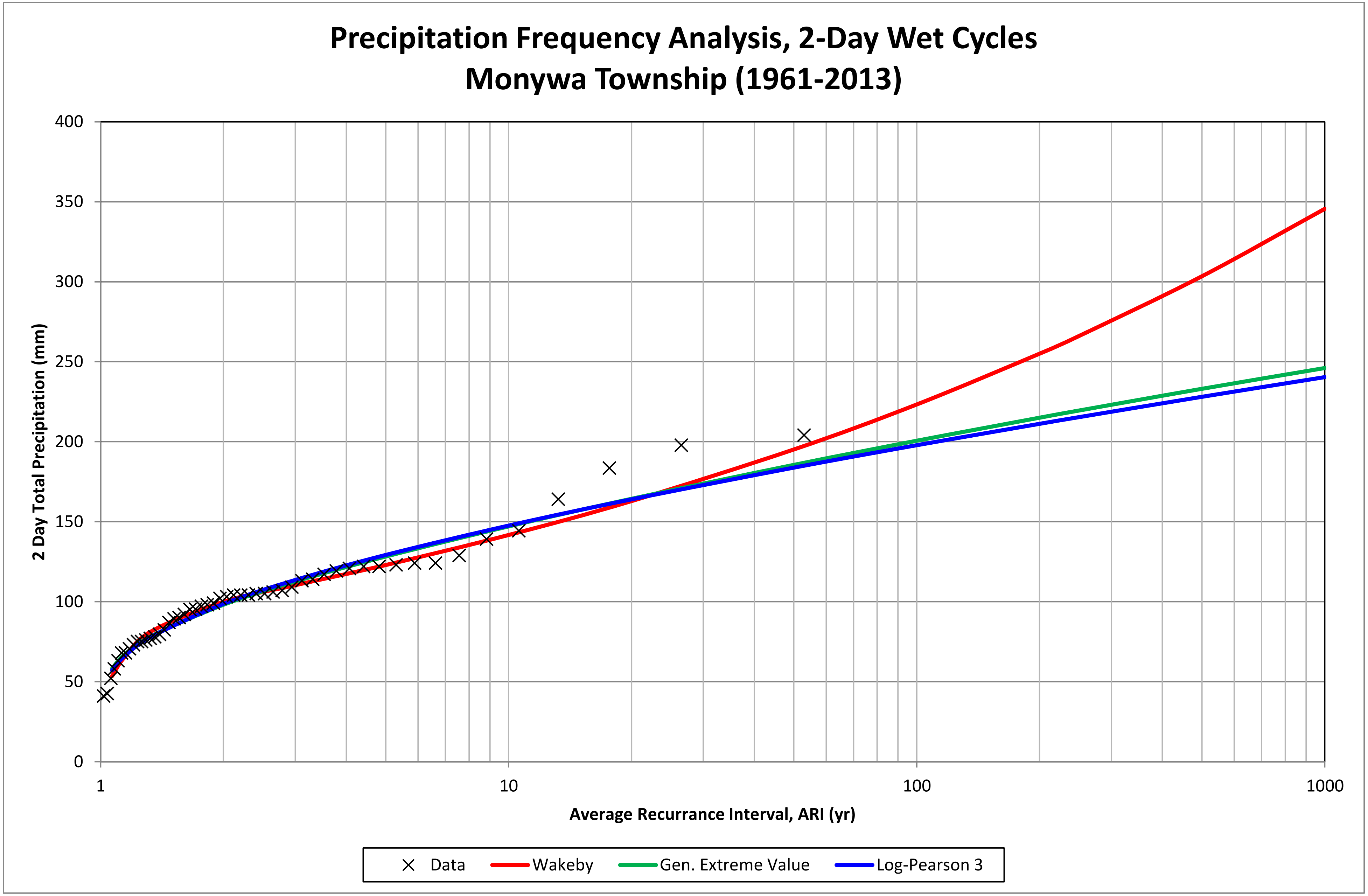
Note that these predictions should be multiplied by **1.067** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	245.3084	k =	-0.062569239	α =	53.52555281
			β =	5.045338	σ =	28.20174054	β =	-0.0457566
			γ =	19.16715	μ =	87.88256944	γ =	7.02549131
			δ =	0.175864				
			ξ =	38.67424				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	345.6	N/A	246.0	33.56	240.4	33.72
0.998	0.002	500	303.4	N/A	233.1	33.56	228.1	33.72
0.996	0.004	250	266.1	N/A	219.5	33.56	215.4	33.72
0.995	0.005	200	255.0	N/A	215.0	33.56	211.2	33.72
0.990	0.010	100	223.3	N/A	200.6	33.56	197.8	33.72
0.980	0.020	50	195.2	N/A	185.5	33.56	183.8	33.72
0.950	0.050	20	162.9	N/A	164.3	33.56	164.0	33.72
0.900	0.100	10	141.7	N/A	147.1	33.56	147.6	33.72
0.800	0.200	5	122.9	N/A	128.3	33.56	129.2	33.72
0.667	0.333	3	110.4	N/A	112.7	33.56	113.6	33.72
0.500	0.500	2.0	100.0	N/A	98.1	33.56	98.7	33.72
0.250	0.750	1.3	81.6	N/A	78.6	33.56	78.2	33.72
0.125	0.875	1.14	65.1	N/A	66.8	33.56	65.9	33.72
0.063	0.937	1.07	53.5	N/A	58.3	33.56	57.1	33.72
Kolmogorov Smirnov (Statistic, Rank)			0.0577	1	0.0968	14	0.1047	27
Anderson Darling (Statistic, Rank)			0.2143	1	0.4281	8	0.4728	14


Precipitation Frequency Analysis, 2-Day Wet Cycles
Monywa Township (1961-2013)
400
350
300
250
200
150
100
50
0
2 Day Total Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.8

Water Balance Scenarios

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.1	0.0	0.0
11	0.0	0.0	28.9	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	105.4	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.3	0.0	0.0
11	0.0	0.0	30.8	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	112.3	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.2	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.4	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0	0.0
82	0.0	3.1	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0	4.1
93	0.0	4.1	0.0	0.0	3.1
94	0.0	0.0	0.0	0.0	1.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.1	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.1	8.3
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	16.5	0.0	0.0	0.0	6.2
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.0
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.2
110	0.0	0.0	0.0	4.1	0.0
111	0.0	0.0	8.3	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.0
114	0.0	0.0	0.0	0.0	0.0
115	3.1	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.0	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	34.1	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.0	0.0
125	0.0	0.0	11.4	0.0	0.0
126	0.0	0.0	0.0	0.0	5.2
127	0.0	0.0	0.0	0.0	2.1
128	0.0	0.0	0.0	1.0	0.0
129	1.0	0.0	0.0	0.0	0.0
130	6.2	0.0	0.0	42.4	0.0
131	8.3	1.0	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.1
133	0.0	0.0	0.0	47.5	6.2
134	0.0	0.0	11.4	0.0	2.1
135	0.0	0.0	0.0	15.5	0.0
136	2.1	0.0	0.0	0.0	0.0
137	0.0	0.0	27.9	3.1	0.0
138	1.0	7.2	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.0
140	6.2	0.0	0.0	0.0	0.0
141	0.0	0.0	8.3	40.3	0.0
142	0.0	12.4	0.0	0.0	0.0
143	2.1	0.0	0.0	6.2	0.0
144	1.0	20.7	11.4	0.0	0.0
145	6.2	87.8	13.4	14.5	10.3
146	1.0	6.2	50.6	12.4	4.1
147	1.0	24.8	19.6	0.0	0.0
148	9.3	40.3	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	14.3	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.2	0.0	0.0	0.0
82	0.0	3.3	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.2	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.2	0.0	4.4
93	0.0	4.4	0.0	0.0	3.3
94	0.0	0.0	0.0	0.0	1.1
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.4	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.3	8.8
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	17.6	0.0	0.0	0.0	6.6
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.1
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.5
110	0.0	0.0	0.0	4.4	0.0
111	0.0	0.0	8.8	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.1
114	0.0	0.0	0.0	0.0	0.0
115	3.3	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	36.3	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1	0.0
125	0.0	0.0	12.1	0.0	0.0
126	0.0	0.0	0.0	0.0	5.5
127	0.0	0.0	0.0	0.0	2.2
128	0.0	0.0	0.0	1.1	0.0
129	1.1	0.0	0.0	0.0	0.0
130	6.6	0.0	0.0	45.2	0.0
131	8.8	1.1	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.3
133	0.0	0.0	0.0	50.7	6.6
134	0.0	0.0	12.1	0.0	2.2
135	0.0	0.0	0.0	16.5	0.0
136	2.2	0.0	0.0	0.0	0.0
137	0.0	0.0	29.7	3.3	0.0
138	1.1	7.7	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.1
140	6.6	0.0	0.0	0.0	0.0
141	0.0	0.0	8.8	43.0	0.0
142	0.0	13.2	0.0	0.0	0.0
143	2.2	0.0	0.0	6.6	0.0
144	1.1	22.0	12.1	0.0	0.0
145	6.6	93.6	14.3	15.4	11.0
146	1.1	6.6	54.0	13.2	4.4
147	1.1	26.4	20.9	0.0	0.0
148	9.9	43.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
149	0.0	0.0	9.3	0.0	0.0
150	0.0	0.0	0.0	0.0	2.1
151	0.0	0.0	18.6	0.0	0.0
152	7.2	0.0	0.0	0.0	25.8
153	0.0	0.0	0.0	2.1	0.0
154	0.0	0.0	1.0	58.9	0.0
155	5.2	0.0	14.5	25.8	0.0
156	0.0	0.0	4.1	5.2	0.0
157	16.5	0.0	14.5	0.0	0.0
158	4.1	0.0	0.0	0.0	0.0
159	6.2	0.0	0.0	0.0	0.0
160	8.3	0.0	0.0	2.1	0.0
161	79.6	1.0	0.0	24.8	0.0
162	4.1	0.0	0.0	6.2	0.0
163	0.0	16.5	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.1
165	0.0	0.0	0.0	0.0	0.0
166	4.1	26.9	0.0	7.2	1.0
167	1.0	4.1	0.0	0.0	0.0
168	0.0	0.0	26.9	1.0	0.0
169	1.0	0.0	26.9	18.6	0.0
170	0.0	0.0	18.6	0.0	0.0
171	0.0	0.0	14.5	0.0	0.0
172	6.2	0.0	1.0	19.6	0.0
173	0.0	0.0	0.0	1.0	0.0
174	0.0	6.2	0.0	0.0	3.1
175	0.0	2.1	0.0	22.7	7.2
176	2.1	9.3	0.0	2.1	14.5
177	1.0	0.0	8.3	0.0	1.0
178	68.2	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1	0.0
180	0.0	0.0	0.0	0.0	0.0
181	25.8	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	17.6	0.0	0.0	23.8	0.0
184	10.3	0.0	0.0	0.0	1.0
185	0.0	0.0	0.0	0.0	0.0
186	5.2	0.0	0.0	0.0	0.0
187	6.2	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.0	0.0
190	1.0	0.0	0.0	0.0	0.0
191	4.1	0.0	0.0	0.0	0.0
192	48.6	0.0	0.0	0.0	0.0
193	14.5	0.0	0.0	0.0	0.0
194	1.0	0.0	0.0	0.0	0.0
195	21.7	0.0	0.0	0.0	22.7
196	0.0	0.0	20.7	0.0	2.1
197	0.0	0.0	0.0	0.0	1.0
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.0	0.0	0.0	0.0
200	0.0	10.3	0.0	0.0	1.0
201	1.0	0.0	0.0	0.0	0.0
202	0.0	0.0	12.4	0.0	0.0
203	0.0	0.0	0.0	0.0	13.4
204	0.0	4.1	0.0	0.0	1.0
205	0.0	0.0	1.0	0.0	3.1
206	0.0	0.0	0.0	31.0	0.0
207	0.0	0.0	0.0	1.0	0.0
208	1.0	3.1	0.0	0.0	0.0
209	0.0	10.3	3.1	0.0	0.0
210	0.0	6.2	10.3	3.1	0.0
211	2.1	0.0	0.0	0.0	0.0
212	4.1	0.0	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1	0.0
214	8.3	0.0	1.0	0.0	0.0
215	3.1	0.0	49.6	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	106.4	0.0	0.0	2.1	0.0
219	1.0	0.0	3.1	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.1	0.0	0.0	0.0	0.0
222	30.0	0.0	3.1	2.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
149	0.0	0.0	9.9	0.0	0.0
150	0.0	0.0	0.0	0.0	2.2
151	0.0	0.0	19.8	0.0	0.0
152	7.7	0.0	0.0	0.0	27.5
153	0.0	0.0	0.0	2.2	0.0
154	0.0	0.0	1.1	62.8	0.0
155	5.5	0.0	15.4	27.5	0.0
156	0.0	0.0	4.4	5.5	0.0
157	17.6	0.0	15.4	0.0	0.0
158	4.4	0.0	0.0	0.0	0.0
159	6.6	0.0	0.0	0.0	0.0
160	8.8	0.0	0.0	2.2	0.0
161	84.8	1.1	0.0	26.4	0.0
162	4.4	0.0	0.0	6.6	0.0
163	0.0	17.6	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.2
165	0.0	0.0	0.0	0.0	0.0
166	4.4	28.6	0.0	7.7	1.1
167	1.1	4.4	0.0	0.0	0.0
168	0.0	0.0	28.6	1.1	0.0
169	1.1	0.0	28.6	19.8	0.0
170	0.0	0.0	19.8	0.0	0.0
171	0.0	0.0	15.4	0.0	0.0
172	6.6	0.0	1.1	20.9	0.0
173	0.0	0.0	0.0	1.1	0.0
174	0.0	6.6	0.0	0.0	3.3
175	0.0	2.2	0.0	24.2	7.7
176	2.2	9.9	0.0	2.2	15.4
177	1.1	0.0	8.8	0.0	1.1
178	72.7	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.2	0.0
180	0.0	0.0	0.0	0.0	0.0
181	27.5	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	18.7	0.0	0.0	25.3	0.0
184	11.0	0.0	0.0	0.0	1.1
185	0.0	0.0	0.0	0.0	0.0
186	5.5	0.0	0.0	0.0	0.0
187	6.6	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1	0.0
190	1.1	0.0	0.0	0.0	0.0
191	4.4	0.0	0.0	0.0	0.0
192	51.8	0.0	0.0	0.0	0.0
193	15.4	0.0	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0	0.0
195	23.1	0.0	0.0	0.0	24.2
196	0.0	0.0	22.0	0.0	2.2
197	0.0	0.0	0.0	0.0	1.1
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0	0.0
200	0.0	11.0	0.0	0.0	1.1
201	1.1	0.0	0.0	0.0	0.0
202	0.0	0.0	13.2	0.0	0.0
203	0.0	0.0	0.0	0.0	14.3
204	0.0	4.4	0.0	0.0	1.1
205	0.0	0.0	1.1	0.0	3.3
206	0.0	0.0	0.0	33.0	0.0
207	0.0	0.0	0.0	1.1	0.0
208	1.1	3.3	0.0	0.0	0.0
209	0.0	11.0	3.3	0.0	0.0
210	0.0	6.6	11.0	3.3	0.0
211	2.2	0.0	0.0	0.0	0.0
212	4.4	0.0	0.0	0.0	0.0
213	0.0	2.2	0.0	2.2	0.0
214	8.8	0.0	1.1	0.0	0.0
215	3.3	0.0	52.9	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	113.4	0.0	0.0	2.2	0.0
219	1.1	0.0	3.3	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.3	0.0	0.0	0.0	0.0
222	31.9	0.0	3.3	2.2	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
223	48.6	71.3	5.2	0.0	0.0
224	0.0	3.1	0.0	0.0	0.0
225	12.4	2.1	0.0	0.0	0.0
226	0.0	0.0	0.0	1.0	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.1	31.0	0.0	0.0
229	0.0	1.0	0.0	1.0	0.0
230	0.0	3.1	0.0	0.0	16.5
231	0.0	0.0	1.0	0.0	33.1
232	1.0	0.0	3.1	0.0	53.7
233	0.0	0.0	6.2	11.4	19.6
234	14.5	0.0	1.0	0.0	12.4
235	0.0	0.0	0.0	0.0	3.1
236	9.3	11.4	0.0	0.0	16.5
237	6.2	0.0	18.6	0.0	0.0
238	0.0	0.0	0.0	1.0	23.8
239	2.1	0.0	12.4	8.3	0.0
240	0.0	0.0	50.6	0.0	0.0
241	72.3	0.0	0.0	0.0	0.0
242	0.0	0.0	6.2	14.5	3.1
243	0.0	0.0	1.0	24.8	21.7
244	0.0	0.0	2.1	10.3	14.5
245	0.0	0.0	2.1	0.0	22.7
246	0.0	0.0	0.0	5.2	0.0
247	0.0	0.0	0.0	1.0	0.0
248	0.0	0.0	0.0	0.0	4.1
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.1	0.0	0.0	47.5
251	0.0	28.9	2.1	0.0	16.5
252	0.0	0.0	13.4	0.0	9.3
253	2.1	0.0	27.9	0.0	1.0
254	0.0	0.0	11.4	0.0	36.2
255	0.0	0.0	0.0	0.0	14.5
256	0.0	0.0	0.0	15.5	0.0
257	0.0	0.0	0.0	6.2	0.0
258	0.0	0.0	9.3	6.2	4.1
259	0.0	4.1	0.0	20.7	3.1
260	70.3	2.1	0.0	2.1	0.0
261	0.0	2.1	0.0	33.1	0.0
262	0.0	15.5	0.0	1.0	0.0
263	34.1	1.0	4.1	0.0	0.0
264	11.4	14.5	18.6	0.0	53.7
265	34.1	0.0	55.8	0.0	74.4
266	30.0	0.0	71.3	0.0	3.1
267	0.0	0.0	0.0	0.0	0.0
268	3.1	0.0	18.6	0.0	0.0
269	0.0	0.0	3.1	19.6	0.0
270	0.0	26.9	0.0	4.1	0.0
271	0.0	62.0	0.0	0.0	0.0
272	3.1	44.4	0.0	0.0	23.8
273	9.3	0.0	0.0	12.4	1.0
274	16.5	0.0	0.0	1.0	0.0
275	11.4	11.4	0.0	0.0	0.0
276	0.0	0.0	56.8	2.1	0.0
277	0.0	0.0	0.0	4.1	0.0
278	0.0	0.0	1.0	0.0	0.0
279	0.0	0.0	37.2	0.0	0.0
280	0.0	0.0	8.3	0.0	0.0
281	0.0	0.0	19.6	0.0	0.0
282	0.0	0.0	15.5	0.0	38.2
283	0.0	0.0	0.0	0.0	5.2
284	28.9	0.0	0.0	1.0	66.1
285	0.0	0.0	0.0	26.9	7.2
286	0.0	0.0	0.0	45.5	1.0
287	13.4	1.0	0.0	51.7	13.4
288	11.4	0.0	2.1	5.2	0.0
289	12.4	0.0	6.2	2.1	0.0
290	90.9	0.0	0.0	24.8	0.0
291	0.0	0.0	0.0	20.7	0.0
292	12.4	0.0	7.2	78.5	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.0	0.0	0.0	0.0	5.2
295	5.2	0.0	0.0	53.7	7.2
296	0.0	0.0	0.0	3.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
223	51.8	76.0	5.5	0.0	0.0
224	0.0	3.3	0.0	0.0	0.0
225	13.2	2.2	0.0	0.0	0.0
226	0.0	0.0	0.0	1.1	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.4	33.0	0.0	0.0
229	0.0	1.1	0.0	1.1	0.0
230	0.0	3.3	0.0	0.0	17.6
231	0.0	0.0	1.1	0.0	35.2
232	1.1	0.0	3.3	0.0	57.3
233	0.0	0.0	6.6	12.1	20.9
234	15.4	0.0	1.1	0.0	13.2
235	0.0	0.0	0.0	0.0	3.3
236	9.9	12.1	0.0	0.0	17.6
237	6.6	0.0	19.8	0.0	0.0
238	0.0	0.0	0.0	1.1	25.3
239	2.2	0.0	13.2	8.8	0.0
240	0.0	0.0	54.0	0.0	0.0
241	77.1	0.0	0.0	0.0	0.0
242	0.0	0.0	6.6	15.4	3.3
243	0.0	0.0	1.1	26.4	23.1
244	0.0	0.0	2.2	11.0	15.4
245	0.0	0.0	2.2	0.0	24.2
246	0.0	0.0	0.0	5.5	0.0
247	0.0	0.0	0.0	1.1	0.0
248	0.0	0.0	0.0	0.0	4.4
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.4	0.0	0.0	50.7
251	0.0	30.8	2.2	0.0	17.6
252	0.0	0.0	14.3	0.0	9.9
253	2.2	0.0	29.7	0.0	1.1
254	0.0	0.0	12.1	0.0	38.6
255	0.0	0.0	0.0	0.0	15.4
256	0.0	0.0	0.0	16.5	0.0
257	0.0	0.0	0.0	6.6	0.0
258	0.0	0.0	9.9	6.6	4.4
259	0.0	4.4	0.0	22.0	3.3
260	74.9	2.2	0.0	2.2	0.0
261	0.0	2.2	0.0	35.2	0.0
262	0.0	16.5	0.0	1.1	0.0
263	36.3	1.1	4.4	0.0	0.0
264	12.1	15.4	19.8	0.0	57.3
265	36.3	0.0	59.5	0.0	79.3
266	31.9	0.0	76.0	0.0	3.3
267	0.0	0.0	0.0	0.0	0.0
268	3.3	0.0	19.8	0.0	0.0
269	0.0	0.0	3.3	20.9	0.0
270	0.0	28.6	0.0	4.4	0.0
271	0.0	66.1	0.0	0.0	0.0
272	3.3	47.4	0.0	0.0	25.3
273	9.9	0.0	0.0	13.2	1.1
274	17.6	0.0	0.0	1.1	0.0
275	12.1	12.1	0.0	0.0	0.0
276	0.0	0.0	60.6	2.2	0.0
277	0.0	0.0	0.0	4.4	0.0
278	0.0	0.0	1.1	0.0	0.0
279	0.0	0.0	39.7	0.0	0.0
280	0.0	0.0	8.8	0.0	0.0
281	0.0	0.0	20.9	0.0	0.0
282	0.0	0.0	16.5	0.0	40.8
283	0.0	0.0	0.0	0.0	5.5
284	30.8	0.0	0.0	1.1	70.5
285	0.0	0.0	0.0	28.6	7.7
286	0.0	0.0	0.0	48.5	1.1
287	14.3	1.1	0.0	55.1	14.3
288	12.1	0.0	2.2	5.5	0.0
289	13.2	0.0	6.6	2.2	0.0
290	96.9	0.0	0.0	26.4	0.0
291	0.0	0.0	0.0	22.0	0.0
292	13.2	0.0	7.7	83.7	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0	5.5
295	5.5	0.0	0.0	57.3	7.7
296	0.0	0.0	0.0	3.3	0.0

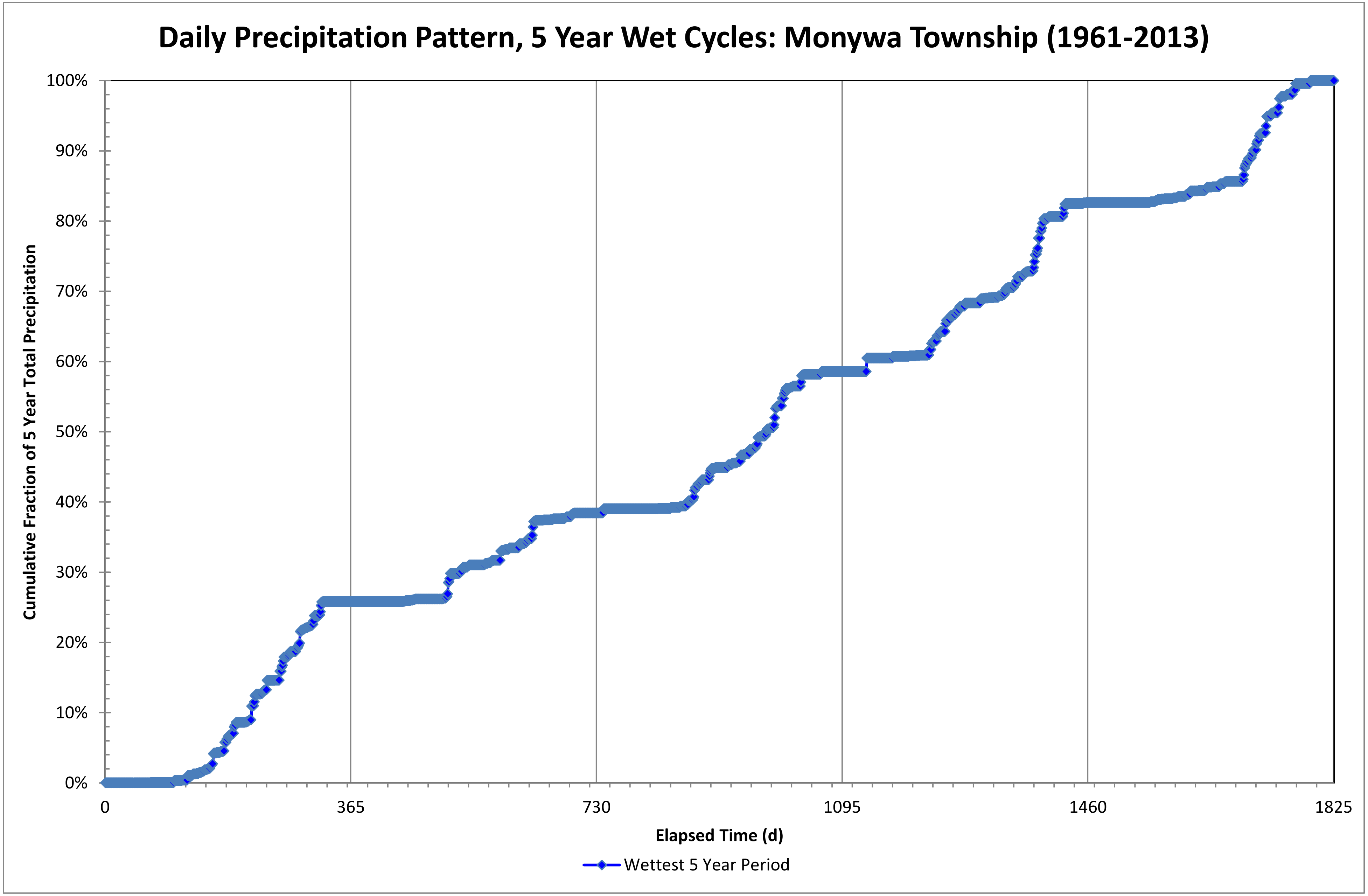
Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
297	7.2	2.1	0.0	21.7	2.1
298	2.1	0.0	0.0	37.2	0.0
299	1.0	0.0	0.0	6.2	0.0
300	1.0	0.0	0.0	31.0	0.0
301	2.1	6.2	0.0	0.0	0.0
302	2.1	0.0	0.0	0.0	0.0
303	7.2	0.0	0.0	0.0	0.0
304	0.0	1.0	32.0	0.0	33.1
305	0.0	0.0	48.6	0.0	0.0
306	2.1	0.0	6.2	2.1	0.0
307	1.0	0.0	1.0	12.4	0.0
308	10.3	0.0	0.0	0.0	50.6
309	0.0	0.0	4.1	3.1	0.0
310	28.9	0.0	0.0	0.0	0.0
311	39.3	0.0	0.0	0.0	0.0
312	1.0	0.0	0.0	0.0	0.0
313	0.0	1.0	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.1	6.2	0.0	0.0	0.0
320	24.8	5.2	0.0	0.0	0.0
321	49.6	3.1	0.0	0.0	0.0
322	26.9	0.0	0.0	0.0	0.0
323	1.0	0.0	0.0	0.0	0.0
324	3.1	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	16.5	0.0	0.0	0.0
329	0.0	0.0	0.0	23.8	0.0
330	0.0	4.1	0.0	41.3	22.7
331	0.0	6.2	0.0	30.0	0.0
332	0.0	2.1	0.0	6.2	0.0
333	0.0	1.0	0.0	0.0	0.0
334	0.0	0.0	18.6	0.0	0.0
335	0.0	0.0	3.1	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.0	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.1	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.0	0.0
363	0.0	0.0	0.0	1.0	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
297	7.7	2.2	0.0	23.1	2.2
298	2.2	0.0	0.0	39.7	0.0
299	1.1	0.0	0.0	6.6	0.0
300	1.1	0.0	0.0	33.0	0.0
301	2.2	6.6	0.0	0.0	0.0
302	2.2	0.0	0.0	0.0	0.0
303	7.7	0.0	0.0	0.0	0.0
304	0.0	1.1	34.1	0.0	35.2
305	0.0	0.0	51.8	0.0	0.0
306	2.2	0.0	6.6	2.2	0.0
307	1.1	0.0	1.1	13.2	0.0
308	11.0	0.0	0.0	0.0	54.0
309	0.0	0.0	4.4	3.3	0.0
310	30.8	0.0	0.0	0.0	0.0
311	41.9	0.0	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.4	6.6	0.0	0.0	0.0
320	26.4	5.5	0.0	0.0	0.0
321	52.9	3.3	0.0	0.0	0.0
322	28.6	0.0	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0	0.0
324	3.3	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	17.6	0.0	0.0	0.0
329	0.0	0.0	0.0	25.3	0.0
330	0.0	4.4	0.0	44.1	24.2
331	0.0	6.6	0.0	31.9	0.0
332	0.0	2.2	0.0	6.6	0.0
333	0.0	1.1	0.0	0.0	0.0
334	0.0	0.0	19.8	0.0	0.0
335	0.0	0.0	3.3	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.4	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1	0.0
363	0.0	0.0	0.0	1.1	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	


Daily Precipitation Pattern, 5 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 5 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
1460
1825
Elapsed Time (d)
Wettest 5 Year Period

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.2	0.0
11	0.0	0.0	29.6	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	107.8
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.5	0.0
11	0.0	0.0	32.5	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	118.4
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.3	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.7
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0
82	0.0	3.2	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0
93	0.0	4.2	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.2	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.2
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	16.9	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.2
111	0.0	0.0	8.5	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.2	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	34.9	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1
125	0.0	0.0	11.6	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.1
129	1.1	0.0	0.0	0.0
130	6.3	0.0	0.0	43.3
131	8.5	1.1	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	48.6
134	0.0	0.0	11.6	0.0
135	0.0	0.0	0.0	15.9
136	2.1	0.0	0.0	0.0
137	0.0	0.0	28.5	3.2
138	1.1	7.4	0.0	0.0
139	0.0	0.0	0.0	0.0
140	6.3	0.0	0.0	0.0
141	0.0	0.0	8.5	41.2
142	0.0	12.7	0.0	0.0
143	2.1	0.0	0.0	6.3
144	1.1	21.1	11.6	0.0
145	6.3	89.9	13.7	14.8
146	1.1	6.3	51.8	12.7
147	1.1	25.4	20.1	0.0
148	9.5	41.2	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	15.1
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.2	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.3	0.0	0.0
82	0.0	3.5	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.2	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.3	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.3	0.0
93	0.0	4.6	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.6	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.5
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	18.6	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.6
111	0.0	0.0	9.3	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.5	0.0	0.0	0.0
116	0.0	0.0	0.0	1.2
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	38.3	0.0	0.0	0.0
124	0.0	0.0	0.0	1.2
125	0.0	0.0	12.8	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.2
129	1.2	0.0	0.0	0.0
130	7.0	0.0	0.0	47.6
131	9.3	1.2	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	53.4
134	0.0	0.0	12.8	0.0
135	0.0	0.0	0.0	17.4
136	2.3	0.0	0.0	0.0
137	0.0	0.0	31.3	3.5
138	1.2	8.1	0.0	0.0
139	0.0	0.0	0.0	0.0
140	7.0	0.0	0.0	0.0
141	0.0	0.0	9.3	45.3
142	0.0	13.9	0.0	0.0
143	2.3	0.0	0.0	7.0
144	1.2	23.2	12.8	0.0
145	7.0	98.6	15.1	16.2
146	1.2	7.0	56.9	13.9
147	1.2	27.8	22.0	0.0
148	10.4	45.3	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
149	0.0	0.0	9.5	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	19.0	0.0
152	7.4	0.0	0.0	0.0
153	0.0	0.0	0.0	2.1
154	0.0	0.0	1.1	60.3
155	5.3	0.0	14.8	26.4
156	0.0	0.0	4.2	5.3
157	16.9	0.0	14.8	0.0
158	4.2	0.0	0.0	0.0
159	6.3	0.0	0.0	0.0
160	8.5	0.0	0.0	2.1
161	81.4	1.1	0.0	25.4
162	4.2	0.0	0.0	6.3
163	0.0	16.9	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.2	27.5	0.0	7.4
167	1.1	4.2	0.0	0.0
168	0.0	0.0	27.5	1.1
169	1.1	0.0	27.5	19.0
170	0.0	0.0	19.0	0.0
171	0.0	0.0	14.8	0.0
172	6.3	0.0	1.1	20.1
173	0.0	0.0	0.0	1.1
174	0.0	6.3	0.0	0.0
175	0.0	2.1	0.0	23.3
176	2.1	9.5	0.0	2.1
177	1.1	0.0	8.5	0.0
178	69.8	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1
180	0.0	0.0	0.0	0.0
181	26.4	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	18.0	0.0	0.0	24.3
184	10.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.3	0.0	0.0	0.0
187	6.3	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1
190	1.1	0.0	0.0	0.0
191	4.2	0.0	0.0	0.0
192	49.7	0.0	0.0	0.0
193	14.8	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0
195	22.2	0.0	0.0	0.0
196	0.0	0.0	21.1	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0
200	0.0	10.6	0.0	0.0
201	1.1	0.0	0.0	0.0
202	0.0	0.0	12.7	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.2	0.0	0.0
205	0.0	0.0	1.1	0.0
206	0.0	0.0	0.0	31.7
207	0.0	0.0	0.0	1.1
208	1.1	3.2	0.0	0.0
209	0.0	10.6	3.2	0.0
210	0.0	6.3	10.6	3.2
211	2.1	0.0	0.0	0.0
212	4.2	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1
214	8.5	0.0	1.1	0.0
215	3.2	0.0	50.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	108.9	0.0	0.0	2.1
219	1.1	0.0	3.2	0.0
220	0.0	0.0	0.0	0.0
221	3.2	0.0	0.0	0.0
222	30.7	0.0	3.2	2.1

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
149	0.0	0.0	10.4	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	20.9	0.0
152	8.1	0.0	0.0	0.0
153	0.0	0.0	0.0	2.3
154	0.0	0.0	1.2	66.1
155	5.8	0.0	16.2	29.0
156	0.0	0.0	4.6	5.8
157	18.6	0.0	16.2	0.0
158	4.6	0.0	0.0	0.0
159	7.0	0.0	0.0	0.0
160	9.3	0.0	0.0	2.3
161	89.4	1.2	0.0	27.8
162	4.6	0.0	0.0	7.0
163	0.0	18.6	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.6	30.2	0.0	8.1
167	1.2	4.6	0.0	0.0
168	0.0	0.0	30.2	1.2
169	1.2	0.0	30.2	20.9
170	0.0	0.0	20.9	0.0
171	0.0	0.0	16.2	0.0
172	7.0	0.0	1.2	22.0
173	0.0	0.0	0.0	1.2
174	0.0	7.0	0.0	0.0
175	0.0	2.3	0.0	25.5
176	2.3	10.4	0.0	2.3
177	1.2	0.0	9.3	0.0
178	76.6	0.0	0.0	0.0
179	0.0	0.0	0.0	2.3
180	0.0	0.0	0.0	0.0
181	29.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	19.7	0.0	0.0	26.7
184	11.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.8	0.0	0.0	0.0
187	7.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.2
190	1.2	0.0	0.0	0.0
191	4.6	0.0	0.0	0.0
192	54.5	0.0	0.0	0.0
193	16.2	0.0	0.0	0.0
194	1.2	0.0	0.0	0.0
195	24.4	0.0	0.0	0.0
196	0.0	0.0	23.2	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.2	0.0	0.0
200	0.0	11.6	0.0	0.0
201	1.2	0.0	0.0	0.0
202	0.0	0.0	13.9	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.6	0.0	0.0
205	0.0	0.0	1.2	0.0
206	0.0	0.0	0.0	34.8
207	0.0	0.0	0.0	1.2
208	1.2	3.5	0.0	0.0
209	0.0	11.6	3.5	0.0
210	0.0	7.0	11.6	3.5
211	2.3	0.0	0.0	0.0
212	4.6	0.0	0.0	0.0
213	0.0	2.3	0.0	2.3
214	9.3	0.0	1.2	0.0
215	3.5	0.0	55.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	119.5	0.0	0.0	2.3
219	1.2	0.0	3.5	0.0
220	0.0	0.0	0.0	0.0
221	3.5	0.0	0.0	0.0
222	33.7	0.0	3.5	2.3

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
223	49.7	72.9	5.3	0.0
224	0.0	3.2	0.0	0.0
225	12.7	2.1	0.0	0.0
226	0.0	0.0	0.0	1.1
227	0.0	0.0	0.0	0.0
228	0.0	4.2	31.7	0.0
229	0.0	1.1	0.0	1.1
230	0.0	3.2	0.0	0.0
231	0.0	0.0	1.1	0.0
232	1.1	0.0	3.2	0.0
233	0.0	0.0	6.3	11.6
234	14.8	0.0	1.1	0.0
235	0.0	0.0	0.0	0.0
236	9.5	11.6	0.0	0.0
237	6.3	0.0	19.0	0.0
238	0.0	0.0	0.0	1.1
239	2.1	0.0	12.7	8.5
240	0.0	0.0	51.8	0.0
241	74.0	0.0	0.0	0.0
242	0.0	0.0	6.3	14.8
243	0.0	0.0	1.1	25.4
244	0.0	0.0	2.1	10.6
245	0.0	0.0	2.1	0.0
246	0.0	0.0	0.0	5.3
247	0.0	0.0	0.0	1.1
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.2	0.0	0.0
251	0.0	29.6	2.1	0.0
252	0.0	0.0	13.7	0.0
253	2.1	0.0	28.5	0.0
254	0.0	0.0	11.6	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	15.9
257	0.0	0.0	0.0	6.3
258	0.0	0.0	9.5	6.3
259	0.0	4.2	0.0	21.1
260	71.9	2.1	0.0	2.1
261	0.0	2.1	0.0	33.8
262	0.0	15.9	0.0	1.1
263	34.9	1.1	4.2	0.0
264	11.6	14.8	19.0	0.0
265	34.9	0.0	57.1	0.0
266	30.7	0.0	72.9	0.0
267	0.0	0.0	0.0	0.0
268	3.2	0.0	19.0	0.0
269	0.0	0.0	3.2	20.1
270	0.0	27.5	0.0	4.2
271	0.0	63.4	0.0	0.0
272	3.2	45.5	0.0	0.0
273	9.5	0.0	0.0	12.7
274	16.9	0.0	0.0	1.1
275	11.6	11.6	0.0	0.0
276	0.0	0.0	58.1	2.1
277	0.0	0.0	0.0	4.2
278	0.0	0.0	1.1	0.0
279	0.0	0.0	38.1	0.0
280	0.0	0.0	8.5	0.0
281	0.0	0.0	20.1	0.0
282	0.0	0.0	15.9	0.0
283	0.0	0.0	0.0	0.0
284	29.6	0.0	0.0	1.1
285	0.0	0.0	0.0	27.5
286	0.0	0.0	0.0	46.5
287	13.7	1.1	0.0	52.9
288	11.6	0.0	2.1	5.3
289	12.7	0.0	6.3	2.1
290	93.0	0.0	0.0	25.4
291	0.0	0.0	0.0	21.1
292	12.7	0.0	7.4	80.3
293	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0
295	5.3	0.0	0.0	55.0
296	0.0	0.0	0.0	3.2

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
223	54.5	80.1	5.8	0.0
224	0.0	3.5	0.0	0.0
225	13.9	2.3	0.0	0.0
226	0.0	0.0	0.0	1.2
227	0.0	0.0	0.0	0.0
228	0.0	4.6	34.8	0.0
229	0.0	1.2	0.0	1.2
230	0.0	3.5	0.0	0.0
231	0.0	0.0	1.2	0.0
232	1.2	0.0	3.5	0.0
233	0.0	0.0	7.0	12.8
234	16.2	0.0	1.2	0.0
235	0.0	0.0	0.0	0.0
236	10.4	12.8	0.0	0.0
237	7.0	0.0	20.9	0.0
238	0.0	0.0	0.0	1.2
239	2.3	0.0	13.9	9.3
240	0.0	0.0	56.9	0.0
241	81.2	0.0	0.0	0.0
242	0.0	0.0	7.0	16.2
243	0.0	0.0	1.2	27.8
244	0.0	0.0	2.3	11.6
245	0.0	0.0	2.3	0.0
246	0.0	0.0	0.0	5.8
247	0.0	0.0	0.0	1.2
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.6	0.0	0.0
251	0.0	32.5	2.3	0.0
252	0.0	0.0	15.1	0.0
253	2.3	0.0	31.3	0.0
254	0.0	0.0	12.8	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	17.4
257	0.0	0.0	0.0	7.0
258	0.0	0.0	10.4	7.0
259	0.0	4.6	0.0	23.2
260	78.9	2.3	0.0	2.3
261	0.0	2.3	0.0	37.1
262	0.0	17.4	0.0	1.2
263	38.3	1.2	4.6	0.0
264	12.8	16.2	20.9	0.0
265	38.3	0.0	62.7	0.0
266	33.7	0.0	80.1	0.0
267	0.0	0.0	0.0	0.0
268	3.5	0.0	20.9	0.0
269	0.0	0.0	3.5	22.0
270	0.0	30.2	0.0	4.6
271	0.0	69.6	0.0	0.0
272	3.5	49.9	0.0	0.0
273	10.4	0.0	0.0	13.9
274	18.6	0.0	0.0	1.2
275	12.8	12.8	0.0	0.0
276	0.0	0.0	63.8	2.3
277	0.0	0.0	0.0	4.6
278	0.0	0.0	1.2	0.0
279	0.0	0.0	41.8	0.0
280	0.0	0.0	9.3	0.0
281	0.0	0.0	22.0	0.0
282	0.0	0.0	17.4	0.0
283	0.0	0.0	0.0	0.0
284	32.5	0.0	0.0	1.2
285	0.0	0.0	0.0	30.2
286	0.0	0.0	0.0	51.1
287	15.1	1.2	0.0	58.0
288	12.8	0.0	2.3	5.8
289	13.9	0.0	7.0	2.3
290	102.1	0.0	0.0	27.8
291	0.0	0.0	0.0	23.2
292	13.9	0.0	8.1	88.2
293	0.0	0.0	0.0	0.0
294	1.2	0.0	0.0	0.0
295	5.8	0.0	0.0	60.3
296	0.0	0.0	0.0	3.5

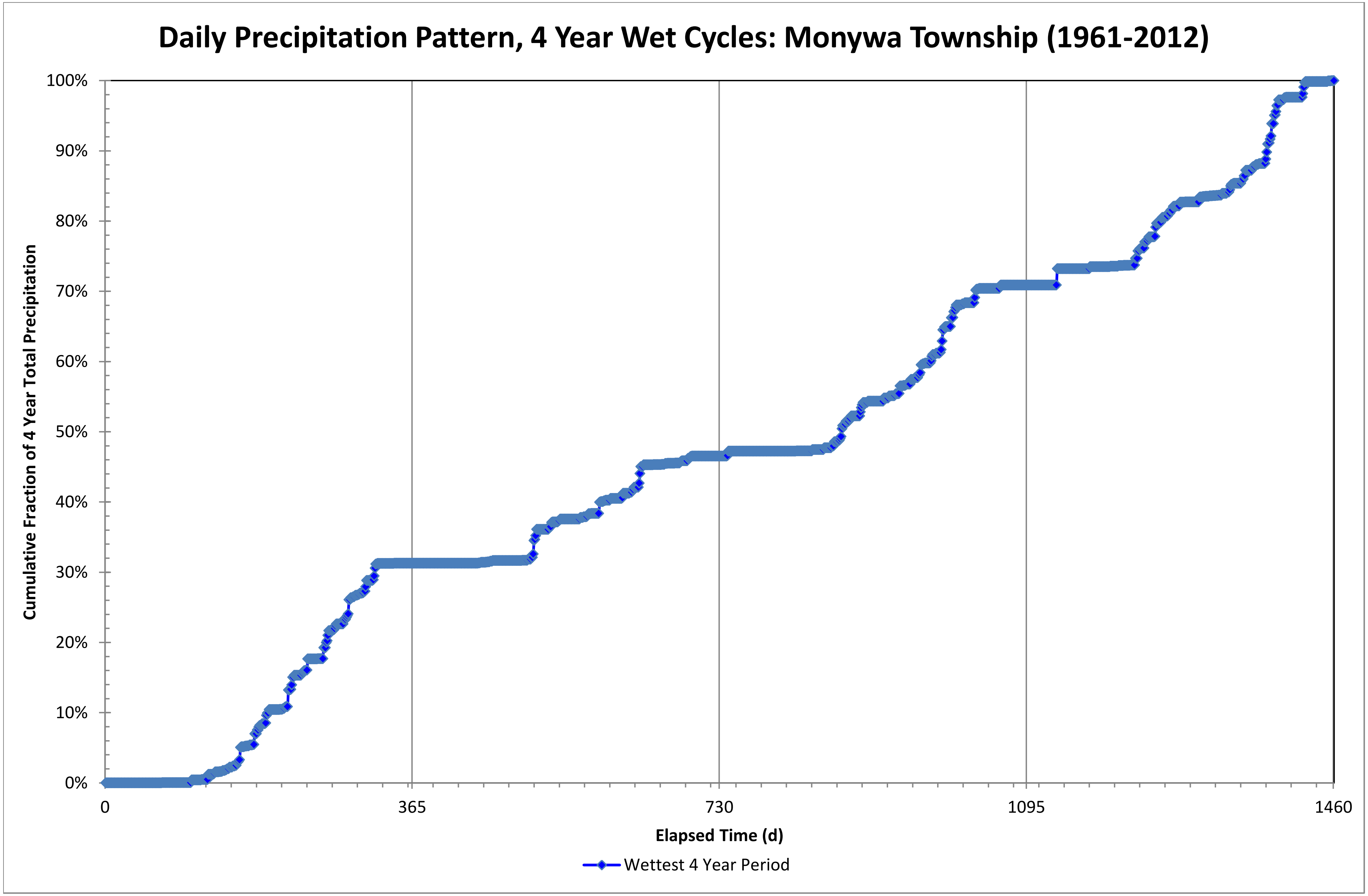
Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
297	7.4	2.1	0.0	22.2
298	2.1	0.0	0.0	38.1
299	1.1	0.0	0.0	6.3
300	1.1	0.0	0.0	31.7
301	2.1	6.3	0.0	0.0
302	2.1	0.0	0.0	0.0
303	7.4	0.0	0.0	0.0
304	0.0	1.1	32.8	0.0
305	0.0	0.0	49.7	0.0
306	2.1	0.0	6.3	2.1
307	1.1	0.0	1.1	12.7
308	10.6	0.0	0.0	0.0
309	0.0	0.0	4.2	3.2
310	29.6	0.0	0.0	0.0
311	40.2	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.2	6.3	0.0	0.0
320	25.4	5.3	0.0	0.0
321	50.7	3.2	0.0	0.0
322	27.5	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0
324	3.2	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	16.9	0.0	0.0
329	0.0	0.0	0.0	24.3
330	0.0	4.2	0.0	42.3
331	0.0	6.3	0.0	30.7
332	0.0	2.1	0.0	6.3
333	0.0	1.1	0.0	0.0
334	0.0	0.0	19.0	0.0
335	0.0	0.0	3.2	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.2
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1
363	0.0	0.0	0.0	1.1
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	**Year 1**	**Year 2**	**Year 3**	**Year 4**
297	8.1	2.3	0.0	24.4
298	2.3	0.0	0.0	41.8
299	1.2	0.0	0.0	7.0
300	1.2	0.0	0.0	34.8
301	2.3	7.0	0.0	0.0
302	2.3	0.0	0.0	0.0
303	8.1	0.0	0.0	0.0
304	0.0	1.2	36.0	0.0
305	0.0	0.0	54.5	0.0
306	2.3	0.0	7.0	2.3
307	1.2	0.0	1.2	13.9
308	11.6	0.0	0.0	0.0
309	0.0	0.0	4.6	3.5
310	32.5	0.0	0.0	0.0
311	44.1	0.0	0.0	0.0
312	1.2	0.0	0.0	0.0
313	0.0	1.2	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.6	7.0	0.0	0.0
320	27.8	5.8	0.0	0.0
321	55.7	3.5	0.0	0.0
322	30.2	0.0	0.0	0.0
323	1.2	0.0	0.0	0.0
324	3.5	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	18.6	0.0	0.0
329	0.0	0.0	0.0	26.7
330	0.0	4.6	0.0	46.4
331	0.0	7.0	0.0	33.7
332	0.0	2.3	0.0	7.0
333	0.0	1.2	0.0	0.0
334	0.0	0.0	20.9	0.0
335	0.0	0.0	3.5	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.2	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.6
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.2
363	0.0	0.0	0.0	1.2
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0



Daily Precipitation Pattern, 4 Year Wet Cycles: Monywa Township (1961-2012)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 4 Year Total Precipitation
0
365
730
1095
1460
Elapsed Time (d)
Wettest 4 Year Period

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	3.2
10	3.4	0.0	29.6
11	31.3	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	113.9	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	3.8	0.0	0.0
11	35.0	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	127.6	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
75	0.0	0.0	0.0
76	0.0	14.5	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	2.1
92	2.2	0.0	0.0
93	0.0	0.0	0.0
94	0.0	0.0	0.0
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.4	0.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	0.0
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	0.0
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	0.0
110	0.0	4.5	8.5
111	8.9	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	0.0
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.1	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.1	11.6
125	12.3	0.0	0.0
126	0.0	0.0	0.0
127	0.0	0.0	0.0
128	0.0	1.1	0.0
129	0.0	0.0	0.0
130	0.0	45.8	0.0
131	0.0	0.0	0.0
132	0.0	0.0	0.0
133	0.0	51.4	11.6
134	12.3	0.0	0.0
135	0.0	16.8	0.0
136	0.0	0.0	28.5
137	30.2	3.4	0.0
138	0.0	0.0	0.0
139	0.0	0.0	0.0
140	0.0	0.0	8.5
141	8.9	43.6	0.0
142	0.0	0.0	0.0
143	0.0	6.7	11.6
144	12.3	0.0	13.7
145	14.5	15.6	51.8
146	54.7	13.4	20.1
147	21.2	0.0	0.0
148	0.0	0.0	9.5

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
75	0.0	0.0	0.0
76	0.0	16.3	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	0.0
92	2.5	0.0	5.0
93	0.0	0.0	3.8
94	0.0	0.0	1.3
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.8	10.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	7.5
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	1.3
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	6.3
110	0.0	5.0	0.0
111	10.0	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	1.3
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.3	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.3	0.0
125	13.8	0.0	0.0
126	0.0	0.0	6.3
127	0.0	0.0	2.5
128	0.0	1.3	0.0
129	0.0	0.0	0.0
130	0.0	51.3	0.0
131	0.0	0.0	0.0
132	0.0	0.0	3.8
133	0.0	57.6	7.5
134	13.8	0.0	2.5
135	0.0	18.8	0.0
136	0.0	0.0	0.0
137	33.8	3.8	0.0
138	0.0	0.0	0.0
139	0.0	0.0	1.3
140	0.0	0.0	0.0
141	10.0	48.8	0.0
142	0.0	0.0	0.0
143	0.0	7.5	0.0
144	13.8	0.0	0.0
145	16.3	17.5	12.5
146	61.3	15.0	5.0
147	23.8	0.0	0.0
148	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
149	10.1	0.0	0.0
150	0.0	0.0	19.0
151	20.1	0.0	0.0
152	0.0	0.0	0.0
153	0.0	2.2	1.1
154	1.1	63.7	14.8
155	15.6	27.9	4.2
156	4.5	5.6	14.8
157	15.6	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.2	0.0
161	0.0	26.8	0.0
162	0.0	6.7	0.0
163	0.0	0.0	0.0
164	0.0	0.0	0.0
165	0.0	0.0	0.0
166	0.0	7.8	0.0
167	0.0	0.0	27.5
168	29.0	1.1	27.5
169	29.0	20.1	19.0
170	20.1	0.0	14.8
171	15.6	0.0	1.1
172	1.1	21.2	0.0
173	0.0	1.1	0.0
174	0.0	0.0	0.0
175	0.0	24.6	0.0
176	0.0	2.2	8.5
177	8.9	0.0	0.0
178	0.0	0.0	0.0
179	0.0	2.2	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	25.7	0.0
184	0.0	0.0	0.0
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.1	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	21.1
196	22.3	0.0	0.0
197	0.0	0.0	0.0
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	0.0
201	0.0	0.0	12.7
202	13.4	0.0	0.0
203	0.0	0.0	0.0
204	0.0	0.0	1.1
205	1.1	0.0	0.0
206	0.0	33.5	0.0
207	0.0	1.1	0.0
208	0.0	0.0	3.2
209	3.4	0.0	10.6
210	11.2	3.4	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.2	1.1
214	1.1	0.0	50.7
215	53.6	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.2	3.2
219	3.4	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	3.2
222	3.4	2.2	5.3

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
149	11.3	0.0	0.0
150	0.0	0.0	2.5
151	22.5	0.0	0.0
152	0.0	0.0	31.3
153	0.0	2.5	0.0
154	1.3	71.3	0.0
155	17.5	31.3	0.0
156	5.0	6.3	0.0
157	17.5	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.5	0.0
161	0.0	30.0	0.0
162	0.0	7.5	0.0
163	0.0	0.0	0.0
164	0.0	0.0	2.5
165	0.0	0.0	0.0
166	0.0	8.8	1.3
167	0.0	0.0	0.0
168	32.5	1.3	0.0
169	32.5	22.5	0.0
170	22.5	0.0	0.0
171	17.5	0.0	0.0
172	1.3	23.8	0.0
173	0.0	1.3	0.0
174	0.0	0.0	3.8
175	0.0	27.5	8.8
176	0.0	2.5	17.5
177	10.0	0.0	1.3
178	0.0	0.0	0.0
179	0.0	2.5	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	28.8	0.0
184	0.0	0.0	1.3
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.3	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	27.5
196	25.0	0.0	2.5
197	0.0	0.0	1.3
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	1.3
201	0.0	0.0	0.0
202	15.0	0.0	0.0
203	0.0	0.0	16.3
204	0.0	0.0	1.3
205	1.3	0.0	3.8
206	0.0	37.5	0.0
207	0.0	1.3	0.0
208	0.0	0.0	0.0
209	3.8	0.0	0.0
210	12.5	3.8	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.5	0.0
214	1.3	0.0	0.0
215	60.1	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.5	0.0
219	3.8	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	0.0
222	3.8	2.5	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
223	5.6	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.1	0.0
227	0.0	0.0	31.7
228	33.5	0.0	0.0
229	0.0	1.1	0.0
230	0.0	0.0	1.1
231	1.1	0.0	3.2
232	3.4	0.0	6.3
233	6.7	12.3	1.1
234	1.1	0.0	0.0
235	0.0	0.0	0.0
236	0.0	0.0	19.0
237	20.1	0.0	0.0
238	0.0	1.1	12.7
239	13.4	8.9	51.8
240	54.7	0.0	0.0
241	0.0	0.0	6.3
242	6.7	15.6	1.1
243	1.1	26.8	2.1
244	2.2	11.2	2.1
245	2.2	0.0	0.0
246	0.0	5.6	0.0
247	0.0	1.1	0.0
248	0.0	0.0	0.0
249	0.0	0.0	0.0
250	0.0	0.0	2.1
251	2.2	0.0	13.7
252	14.5	0.0	28.5
253	30.2	0.0	11.6
254	12.3	0.0	0.0
255	0.0	0.0	0.0
256	0.0	16.8	0.0
257	0.0	6.7	9.5
258	10.1	6.7	0.0
259	0.0	22.3	0.0
260	0.0	2.2	0.0
261	0.0	35.7	0.0
262	0.0	1.1	4.2
263	4.5	0.0	19.0
264	20.1	0.0	57.1
265	60.3	0.0	72.9
266	77.1	0.0	0.0
267	0.0	0.0	19.0
268	20.1	0.0	3.2
269	3.4	21.2	0.0
270	0.0	4.5	0.0
271	0.0	0.0	0.0
272	0.0	0.0	0.0
273	0.0	13.4	0.0
274	0.0	1.1	0.0
275	0.0	0.0	58.1
276	61.4	2.2	0.0
277	0.0	4.5	1.1
278	1.1	0.0	38.1
279	40.2	0.0	8.5
280	8.9	0.0	20.1
281	21.2	0.0	15.9
282	16.8	0.0	0.0
283	0.0	0.0	0.0
284	0.0	1.1	0.0
285	0.0	29.0	0.0
286	0.0	49.1	0.0
287	0.0	55.8	2.1
288	2.2	5.6	6.3
289	6.7	2.2	0.0
290	0.0	26.8	0.0
291	0.0	22.3	7.4
292	7.8	84.9	0.0
293	0.0	0.0	0.0
294	0.0	0.0	0.0
295	0.0	58.1	0.0
296	0.0	3.4	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
223	6.3	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.3	0.0
227	0.0	0.0	0.0
228	37.5	0.0	0.0
229	0.0	1.3	0.0
230	0.0	0.0	20.0
231	1.3	0.0	40.0
232	3.8	0.0	65.1
233	7.5	13.8	23.8
234	1.3	0.0	15.0
235	0.0	0.0	3.8
236	0.0	0.0	20.0
237	22.5	0.0	0.0
238	0.0	1.3	28.8
239	15.0	10.0	0.0
240	61.3	0.0	0.0
241	0.0	0.0	0.0
242	7.5	17.5	3.8
243	1.3	30.0	26.3
244	2.5	12.5	17.5
245	2.5	0.0	27.5
246	0.0	6.3	0.0
247	0.0	1.3	0.0
248	0.0	0.0	5.0
249	0.0	0.0	0.0
250	0.0	0.0	57.6
251	2.5	0.0	20.0
252	16.3	0.0	11.3
253	33.8	0.0	1.3
254	13.8	0.0	43.8
255	0.0	0.0	17.5
256	0.0	18.8	0.0
257	0.0	7.5	0.0
258	11.3	7.5	5.0
259	0.0	25.0	3.8
260	0.0	2.5	0.0
261	0.0	40.0	0.0
262	0.0	1.3	0.0
263	5.0	0.0	0.0
264	22.5	0.0	65.1
265	67.6	0.0	90.1
266	86.3	0.0	3.8
267	0.0	0.0	0.0
268	22.5	0.0	0.0
269	3.8	23.8	0.0
270	0.0	5.0	0.0
271	0.0	0.0	0.0
272	0.0	0.0	28.8
273	0.0	15.0	1.3
274	0.0	1.3	0.0
275	0.0	0.0	0.0
276	68.8	2.5	0.0
277	0.0	5.0	0.0
278	1.3	0.0	0.0
279	45.0	0.0	0.0
280	10.0	0.0	0.0
281	23.8	0.0	0.0
282	18.8	0.0	46.3
283	0.0	0.0	6.3
284	0.0	1.3	80.1
285	0.0	32.5	8.8
286	0.0	55.1	1.3
287	0.0	62.6	16.3
288	2.5	6.3	0.0
289	7.5	2.5	0.0
290	0.0	30.0	0.0
291	0.0	25.0	0.0
292	8.8	95.1	0.0
293	0.0	0.0	0.0
294	0.0	0.0	6.3
295	0.0	65.1	8.8
296	0.0	3.8	0.0

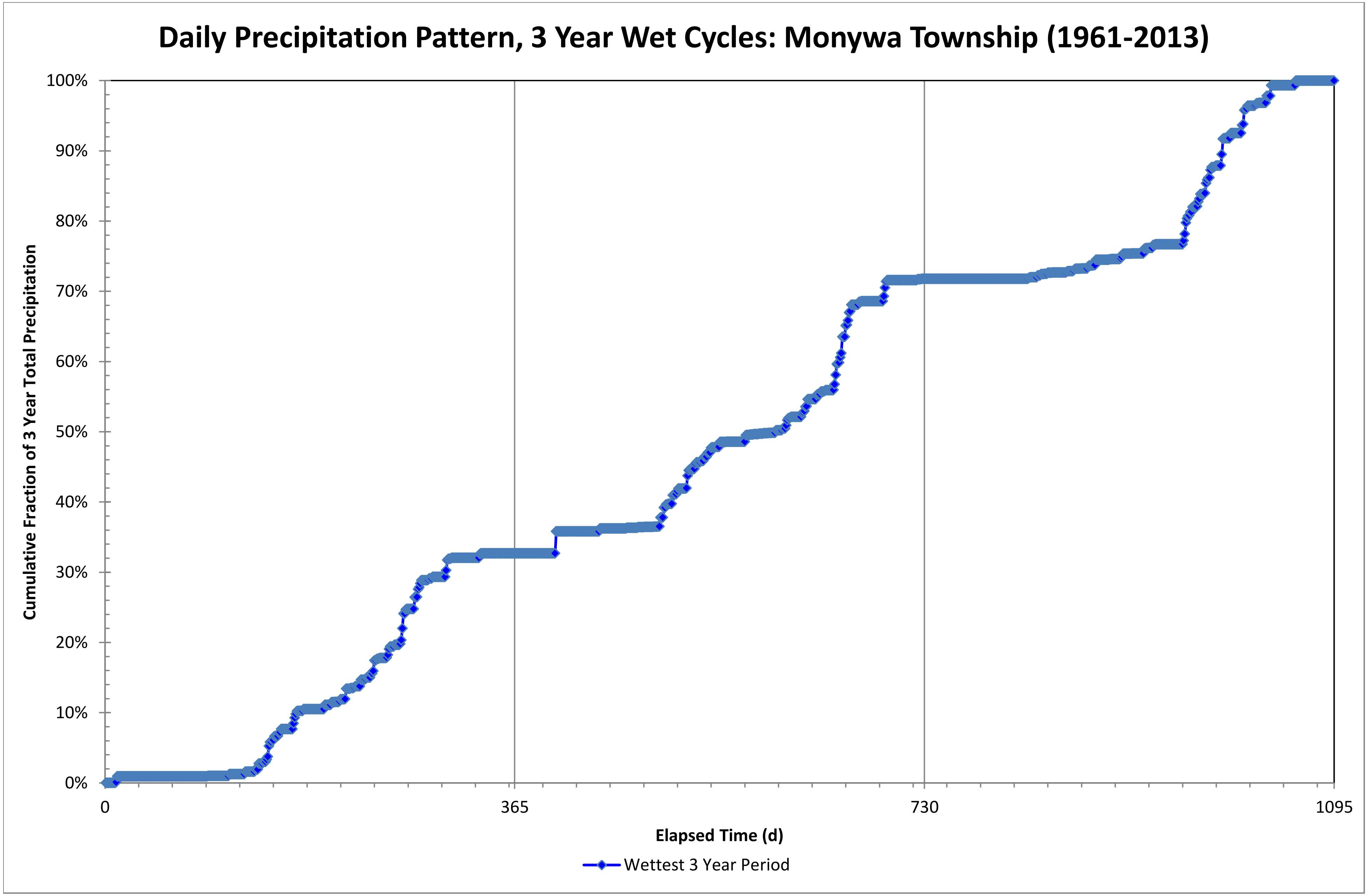
Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	**Year 1**	**Year 2**	**Year 3**
297	0.0	23.5	0.0
298	0.0	40.2	0.0
299	0.0	6.7	0.0
300	0.0	33.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	32.8
304	34.6	0.0	49.7
305	52.5	0.0	6.3
306	6.7	2.2	1.1
307	1.1	13.4	0.0
308	0.0	0.0	4.2
309	4.5	3.4	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	25.7	0.0
330	0.0	44.7	0.0
331	0.0	32.4	0.0
332	0.0	6.7	0.0
333	0.0	0.0	19.0
334	20.1	0.0	3.2
335	3.4	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	4.5	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.1	0.0
363	0.0	1.1	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	**Year 1**	**Year 2**	**Year 3**
297	0.0	26.3	2.5
298	0.0	45.0	0.0
299	0.0	7.5	0.0
300	0.0	37.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	0.0
304	38.8	0.0	40.0
305	58.8	0.0	0.0
306	7.5	2.5	0.0
307	1.3	15.0	0.0
308	0.0	0.0	61.3
309	5.0	3.8	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	28.8	0.0
330	0.0	50.1	27.5
331	0.0	36.3	0.0
332	0.0	7.5	0.0
333	0.0	0.0	0.0
334	22.5	0.0	0.0
335	3.8	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	5.0	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.3	0.0
363	0.0	1.3	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	


Daily Precipitation Pattern, 3 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 3 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
Elapsed Time (d)
Wettest 3 Year Period

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	3.7
87	0.0	0.0
88	3.2	1.6
89	0.0	0.5
90	6.3	0.0
91	0.0	0.0
92	0.0	1.6
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	10.6	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	15.9
114	0.0	1.1
115	4.2	0.0
116	0.0	0.0
117	0.0	8.5
118	4.2	73.0
119	0.0	2.1
120	0.0	3.2
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	7.9
125	0.0	0.0
126	8.5	5.9
127	0.0	0.0
128	0.0	0.5
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	21.7	5.3
137	0.0	12.2
138	0.0	1.1
139	0.0	0.0
140	1.1	0.0
141	44.4	9.0
142	0.0	0.0
143	0.0	7.9
144	12.2	12.2
145	0.0	0.0
146	0.0	0.0
147	0.0	11.0
148	0.0	5.8

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	4.1
87	0.0	0.0
88	3.5	1.8
89	0.0	0.6
90	7.1	0.0
91	0.0	0.0
92	0.0	1.8
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	11.8	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	17.7
114	0.0	1.2
115	4.7	0.0
116	0.0	0.0
117	0.0	9.5
118	4.7	81.6
119	0.0	2.4
120	0.0	3.5
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	8.9
125	0.0	0.0
126	9.5	6.6
127	0.0	0.0
128	0.0	0.6
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	24.2	5.9
137	0.0	13.6
138	0.0	1.2
139	0.0	0.0
140	1.2	0.0
141	49.7	10.1
142	0.0	0.0
143	0.0	8.9
144	13.6	13.6
145	0.0	0.0
146	0.0	0.0
147	0.0	12.3
148	0.0	6.5

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
149	0.0	14.8
150	0.0	0.0
151	0.0	0.0
152	0.0	48.6
153	0.0	0.0
154	0.0	3.2
155	4.2	0.0
156	0.0	0.0
157	0.0	105.8
158	0.0	25.4
159	0.0	11.6
160	0.0	4.2
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	9.0
166	41.2	0.0
167	3.2	0.5
168	20.1	2.1
169	12.2	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	7.4	0.0
175	28.6	69.7
176	1.6	0.5
177	0.0	0.0
178	0.0	0.0
179	4.2	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	29.3	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.6
192	0.0	0.0
193	0.0	0.7
194	0.0	0.0
195	0.0	0.0
196	0.0	29.1
197	5.9	0.0
198	20.6	0.0
199	9.8	0.0
200	2.6	0.0
201	8.5	3.9
202	34.9	0.0
203	0.0	0.0
204	0.0	1.1
205	0.0	4.2
206	0.0	0.5
207	5.3	0.5
208	0.0	0.0
209	0.0	46.5
210	5.8	0.0
211	1.1	0.0
212	15.3	2.1
213	0.0	20.6
214	0.0	0.0
215	0.0	0.0
216	13.2	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	8.1
220	0.0	4.8
221	0.0	41.2
222	0.0	2.6

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
149	0.0	16.6
150	0.0	0.0
151	0.0	0.0
152	0.0	54.4
153	0.0	0.0
154	0.0	3.5
155	4.7	0.0
156	0.0	0.0
157	0.0	118.3
158	0.0	28.4
159	0.0	13.0
160	0.0	4.7
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	10.1
166	46.1	0.0
167	3.5	0.6
168	22.5	2.4
169	13.6	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	8.3	0.0
175	31.9	77.9
176	1.8	0.6
177	0.0	0.0
178	0.0	0.0
179	4.7	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	32.8	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.8
192	0.0	0.0
193	0.0	0.8
194	0.0	0.0
195	0.0	0.0
196	0.0	32.5
197	6.6	0.0
198	23.1	0.0
199	11.0	0.0
200	3.0	0.0
201	9.5	4.4
202	39.0	0.0
203	0.0	0.0
204	0.0	1.2
205	0.0	4.7
206	0.0	0.6
207	5.9	0.6
208	0.0	0.0
209	0.0	52.0
210	6.5	0.0
211	1.2	0.0
212	17.1	2.4
213	0.0	23.1
214	0.0	0.0
215	0.0	0.0
216	14.8	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	9.1
220	0.0	5.3
221	0.0	46.1
222	0.0	3.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
223	4.2	36.0
224	2.6	9.0
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	25.4
229	47.6	2.6
230	18.5	0.0
231	0.0	3.7
232	0.0	0.5
233	0.0	0.0
234	89.9	0.0
235	0.0	0.0
236	7.4	27.5
237	10.0	1.1
238	0.0	42.8
239	0.0	13.2
240	0.0	9.5
241	2.1	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	9.0	0.0
247	9.3	3.7
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	4.8
253	0.0	0.0
254	20.1	0.0
255	0.0	0.0
256	1.6	15.9
257	68.2	4.2
258	0.0	0.0
259	0.0	0.0
260	2.1	0.0
261	0.0	0.0
262	0.0	0.0
263	9.0	14.8
264	0.0	1.1
265	35.4	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	21.7
272	6.9	3.9
273	0.0	30.7
274	0.0	14.8
275	0.0	10.6
276	0.0	14.3
277	0.0	6.9
278	0.0	3.7
279	83.6	0.0
280	89.9	0.0
281	55.0	0.0
282	0.0	0.0
283	1.6	0.0
284	2.1	0.0
285	6.3	0.0
286	5.3	0.0
287	37.0	0.0
288	0.0	2.1
289	20.6	0.0
290	0.0	38.1
291	0.0	22.7
292	0.0	174.5
293	55.5	0.0
294	0.0	0.0
295	54.5	0.0
296	114.7	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
223	4.7	40.2
224	3.0	10.1
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	28.4
229	53.2	3.0
230	20.7	0.0
231	0.0	4.1
232	0.0	0.6
233	0.0	0.0
234	100.5	0.0
235	0.0	0.0
236	8.3	30.7
237	11.2	1.2
238	0.0	47.9
239	0.0	14.8
240	0.0	10.6
241	2.4	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	10.1	0.0
247	10.4	4.1
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	5.3
253	0.0	0.0
254	22.5	0.0
255	0.0	0.0
256	1.8	17.7
257	76.3	4.7
258	0.0	0.0
259	0.0	0.0
260	2.4	0.0
261	0.0	0.0
262	0.0	0.0
263	10.1	16.6
264	0.0	1.2
265	39.6	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	24.2
272	7.7	4.4
273	0.0	34.3
274	0.0	16.6
275	0.0	11.8
276	0.0	16.0
277	0.0	7.7
278	0.0	4.1
279	93.4	0.0
280	100.5	0.0
281	61.5	0.0
282	0.0	0.0
283	1.8	0.0
284	2.4	0.0
285	7.1	0.0
286	5.9	0.0
287	41.4	0.0
288	0.0	2.4
289	23.1	0.0
290	0.0	42.6
291	0.0	25.4
292	0.0	195.1
293	62.1	0.0
294	0.0	0.0
295	60.9	0.0
296	128.3	0.0

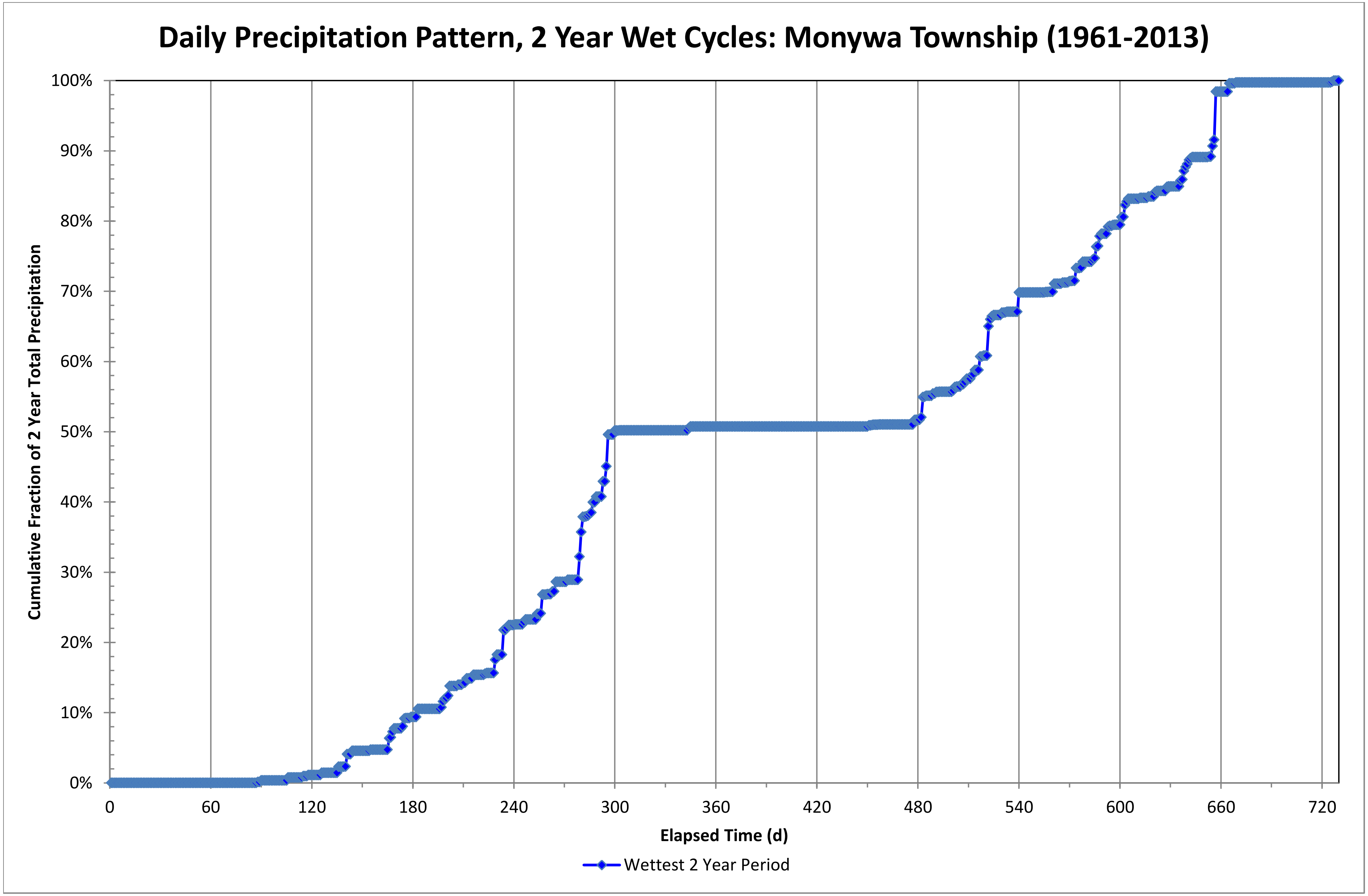
Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	**Year 1**	**Year 2**
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	14.8	29.6
301	0.0	0.0
302	0.0	0.0
303	1.1	0.0
304	0.0	3.2
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	8.5	0.0
345	5.3	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	2.6
362	0.0	4.2
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	**Year 1**	**Year 2**
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	16.6	33.1
301	0.0	0.0
302	0.0	0.0
303	1.2	0.0
304	0.0	3.5
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	9.5	0.0
345	5.9	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	3.0
362	0.0	4.7
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0



Daily Precipitation Pattern, 2 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 2 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
60
120
180
240
300
360
420
480
540
600
660
720
Elapsed Time (d)
Wettest 2 Year Period

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)		Wet, 500 year ARI (mm)		Dry, 100 year ARI (mm)		Dry, 500 year ARI (mm)	
Total	1554.9	**Total**	1901.8	**Total**	424.0	**Total**	382.6
Day	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**
1	0.0	1	0.0	1	0.0	1	0.0
2	0.0	2	0.0	2	0.0	2	0.0
3	0.0	3	0.0	3	0.0	3	0.0
4	0.0	4	0.0	4	0.0	4	0.0
5	0.0	5	0.0	5	0.0	5	0.0
6	0.0	6	0.0	6	0.0	6	0.0
7	0.0	7	0.0	7	0.0	7	0.0
8	0.0	8	0.0	8	0.0	8	0.0
9	0.0	9	0.0	9	0.0	9	0.0
10	0.0	10	0.0	10	0.0	10	0.0
11	0.0	11	0.0	11	0.0	11	0.0
12	0.0	12	0.0	12	0.0	12	0.0
13	0.0	13	0.0	13	0.0	13	0.0
14	0.0	14	0.0	14	0.0	14	0.0
15	0.0	15	0.0	15	0.0	15	0.0
16	0.0	16	0.0	16	0.0	16	0.0
17	0.0	17	0.0	17	0.0	17	0.0
18	0.0	18	0.0	18	0.0	18	0.0
19	0.0	19	0.0	19	0.0	19	0.0
20	0.0	20	0.0	20	0.0	20	0.0
21	0.0	21	0.0	21	0.0	21	0.0
22	0.0	22	0.0	22	0.0	22	0.0
23	0.0	23	0.0	23	0.0	23	0.0
24	0.0	24	0.0	24	0.0	24	0.0
25	0.0	25	0.0	25	0.0	25	0.0
26	0.0	26	0.0	26	0.0	26	0.0
27	0.0	27	0.0	27	0.0	27	0.0
28	0.0	28	0.0	28	0.0	28	0.0
29	0.0	29	0.0	29	0.0	29	0.0
30	0.0	30	0.0	30	0.0	30	0.0
31	0.0	31	0.0	31	0.0	31	0.0
32	0.0	32	0.0	32	0.0	32	0.0
33	0.0	33	0.0	33	0.0	33	0.0
34	0.0	34	0.0	34	0.0	34	0.0
35	0.0	35	0.0	35	0.0	35	0.0
36	0.0	36	0.0	36	0.0	36	0.0
37	0.0	37	0.0	37	0.0	37	0.0
38	0.0	38	0.0	38	0.0	38	0.0
39	0.0	39	0.0	39	0.0	39	0.0
40	0.0	40	0.0	40	0.0	40	0.0
41	0.0	41	0.0	41	0.0	41	0.0
42	0.0	42	0.0	42	0.0	42	0.0
43	0.0	43	0.0	43	0.0	43	0.0
44	0.0	44	0.0	44	0.0	44	0.0
45	0.0	45	0.0	45	0.0	45	0.0
46	0.0	46	0.0	46	0.0	46	0.0
47	0.0	47	0.0	47	0.0	47	0.0
48	0.0	48	0.0	48	0.0	48	0.0
49	0.0	49	0.0	49	0.0	49	0.0
50	0.0	50	0.0	50	0.0	50	0.0
51	0.0	51	0.0	51	0.0	51	0.0
52	0.0	52	0.0	52	0.0	52	0.0
53	0.0	53	0.0	53	0.0	53	0.0
54	0.0	54	0.0	54	0.0	54	0.0
55	0.0	55	0.0	55	0.0	55	0.0
56	0.0	56	0.0	56	0.0	56	0.0
57	0.0	57	0.0	57	0.0	57	0.0
58	0.0	58	0.0	58	0.0	58	0.0
59	0.0	59	0.0	59	0.0	59	0.0
60	0.0	60	0.0	60	0.0	60	0.0
61	0.0	61	0.0	61	0.0	61	0.0
62	0.0	62	0.0	62	0.0	62	0.0
63	0.0	63	0.0	63	0.0	63	0.0
64	0.0	64	0.0	64	0.0	64	0.0
65	0.0	65	0.0	65	0.0	65	0.0
66	0.0	66	0.0	66	0.0	66	0.0
67	0.0	67	0.0	67	0.0	67	0.0
68	2.3	68	2.8	68	0.0	68	0.0
69	0.0	69	0.0	69	0.0	69	0.0
70	0.0	70	0.0	70	0.0	70	0.0
71	0.0	71	0.0	71	0.0	71	0.0
72	0.0	72	0.0	72	0.0	72	0.0
73	0.0	73	0.0	73	0.0	73	0.0
74	0.0	74	0.0	74	0.0	74	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)		Wet, 500 year ARI (mm)		Dry, 100 year ARI (mm)		Dry, 500 year ARI (mm)	
Total	1554.9	**Total**	1901.8	**Total**	424.0	**Total**	382.6
Day	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**
75	0.0	75	0.0	75	0.0	75	0.0
76	0.0	76	0.0	76	0.0	76	0.0
77	0.0	77	0.0	77	0.0	77	0.0
78	0.0	78	0.0	78	0.0	78	0.0
79	0.0	79	0.0	79	0.0	79	0.0
80	0.0	80	0.0	80	0.0	80	0.0
81	0.0	81	0.0	81	0.0	81	0.0
82	0.0	82	0.0	82	0.0	82	0.0
83	0.0	83	0.0	83	0.0	83	0.0
84	0.0	84	0.0	84	0.0	84	0.0
85	0.0	85	0.0	85	0.0	85	0.0
86	0.0	86	0.0	86	0.0	86	0.0
87	0.0	87	0.0	87	0.0	87	0.0
88	0.0	88	0.0	88	0.0	88	0.0
89	0.0	89	0.0	89	0.0	89	0.0
90	0.0	90	0.0	90	0.0	90	0.0
91	0.0	91	0.0	91	0.0	91	0.0
92	0.0	92	0.0	92	0.0	92	0.0
93	0.0	93	0.0	93	0.0	93	0.0
94	0.0	94	0.0	94	0.0	94	0.0
95	0.0	95	0.0	95	0.0	95	0.0
96	0.0	96	0.0	96	0.0	96	0.0
97	0.0	97	0.0	97	0.0	97	0.0
98	0.0	98	0.0	98	0.0	98	0.0
99	0.0	99	0.0	99	0.0	99	0.0
100	0.0	100	0.0	100	0.0	100	0.0
101	0.0	101	0.0	101	0.0	101	0.0
102	0.0	102	0.0	102	0.0	102	0.0
103	18.2	103	22.2	103	0.0	103	0.0
104	0.0	104	0.0	104	0.0	104	0.0
105	0.0	105	0.0	105	0.0	105	0.0
106	0.0	106	0.0	106	0.0	106	0.0
107	0.0	107	0.0	107	0.0	107	0.0
108	0.0	108	0.0	108	0.0	108	0.0
109	0.0	109	0.0	109	2.1	109	1.9
110	0.0	110	0.0	110	0.0	110	0.0
111	0.0	111	0.0	111	0.0	111	0.0
112	0.0	112	0.0	112	0.0	112	0.0
113	0.0	113	0.0	113	0.0	113	0.0
114	0.0	114	0.0	114	0.0	114	0.0
115	3.4	115	4.2	115	0.0	115	0.0
116	0.0	116	0.0	116	0.0	116	0.0
117	0.0	117	0.0	117	0.0	117	0.0
118	0.0	118	0.0	118	0.0	118	0.0
119	0.0	119	0.0	119	0.0	119	0.0
120	0.0	120	0.0	120	0.0	120	0.0
121	0.0	121	0.0	121	0.0	121	0.0
122	0.0	122	0.0	122	0.0	122	0.0
123	37.5	123	45.8	123	4.1	123	3.7
124	0.0	124	0.0	124	0.0	124	0.0
125	0.0	125	0.0	125	17.5	125	15.8
126	0.0	126	0.0	126	0.0	126	0.0
127	0.0	127	0.0	127	0.0	127	0.0
128	0.0	128	0.0	128	0.0	128	0.0
129	1.1	129	1.4	129	0.0	129	0.0
130	6.8	130	8.3	130	0.0	130	0.0
131	9.1	131	11.1	131	0.0	131	0.0
132	0.0	132	0.0	132	3.1	132	2.8
133	0.0	133	0.0	133	0.0	133	0.0
134	0.0	134	0.0	134	0.0	134	0.0
135	0.0	135	0.0	135	37.1	135	33.5
136	2.3	136	2.8	136	1.0	136	0.9
137	0.0	137	0.0	137	0.0	137	0.0
138	1.1	138	1.4	138	0.0	138	0.0
139	0.0	139	0.0	139	0.0	139	0.0
140	6.8	140	8.3	140	0.0	140	0.0
141	0.0	141	0.0	141	7.2	141	6.5
142	0.0	142	0.0	142	0.0	142	0.0
143	2.3	143	2.8	143	12.4	143	11.2
144	1.1	144	1.4	144	1.0	144	0.9
145	6.8	145	8.3	145	25.8	145	23.3
146	1.1	146	1.4	146	0.0	146	0.0
147	1.1	147	1.4	147	0.0	147	0.0
148	10.2	148	12.5	148	0.0	148	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)		Wet, 500 year ARI (mm)		Dry, 100 year ARI (mm)		Dry, 500 year ARI (mm)	
Total	1554.9	**Total**	1901.8	**Total**	424.0	**Total**	382.6
Day	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**	**Day**	**Year 1**
149	0.0	149	0.0	149	0.0	149	0.0
150	0.0	150	0.0	150	0.0	150	0.0
151	0.0	151	0.0	151	0.0	151	0.0
152	7.9	152	9.7	152	0.0	152	0.0
153	0.0	153	0.0	153	27.9	153	25.1
154	0.0	154	0.0	154	11.3	154	10.2
155	5.7	155	6.9	155	1.0	155	0.9
156	0.0	156	0.0	156	0.0	156	0.0
157	18.2	157	22.2	157	0.0	157	0.0
158	4.5	158	5.6	158	16.5	158	14.9
159	6.8	159	8.3	159	0.0	159	0.0
160	9.1	160	11.1	160	0.0	160	0.0
161	87.4	161	106.9	161	0.0	161	0.0
162	4.5	162	5.6	162	0.0	162	0.0
163	0.0	163	0.0	163	0.0	163	0.0
164	0.0	164	0.0	164	5.2	164	4.7
165	0.0	165	0.0	165	11.3	165	10.2
166	4.5	166	5.6	166	0.0	166	0.0
167	1.1	167	1.4	167	0.0	167	0.0
168	0.0	168	0.0	168	0.0	168	0.0
169	1.1	169	1.4	169	1.0	169	0.9
170	0.0	170	0.0	170	0.0	170	0.0
171	0.0	171	0.0	171	5.2	171	4.7
172	6.8	172	8.3	172	1.0	172	0.9
173	0.0	173	0.0	173	0.0	173	0.0
174	0.0	174	0.0	174	0.0	174	0.0
175	0.0	175	0.0	175	0.0	175	0.0
176	2.3	176	2.8	176	0.0	176	0.0
177	1.1	177	1.4	177	0.0	177	0.0
178	74.9	178	91.6	178	0.0	178	0.0
179	0.0	179	0.0	179	0.0	179	0.0
180	0.0	180	0.0	180	3.1	180	2.8
181	28.4	181	34.7	181	0.0	181	0.0
182	0.0	182	0.0	182	0.0	182	0.0
183	19.3	183	23.6	183	0.0	183	0.0
184	11.3	184	13.9	184	0.0	184	0.0
185	0.0	185	0.0	185	0.0	185	0.0
186	5.7	186	6.9	186	0.0	186	0.0
187	6.8	187	8.3	187	0.0	187	0.0
188	0.0	188	0.0	188	0.0	188	0.0
189	0.0	189	0.0	189	0.0	189	0.0
190	1.1	190	1.4	190	0.0	190	0.0
191	4.5	191	5.6	191	0.0	191	0.0
192	53.3	192	65.2	192	4.1	192	3.7
193	15.9	193	19.4	193	1.0	193	0.9
194	1.1	194	1.4	194	0.0	194	0.0
195	23.8	195	29.2	195	0.0	195	0.0
196	0.0	196	0.0	196	0.0	196	0.0
197	0.0	197	0.0	197	0.0	197	0.0
198	0.0	198	0.0	198	0.0	198	0.0
199	0.0	199	0.0	199	0.0	199	0.0
200	0.0	200	0.0	200	0.0	200	0.0
201	1.1	201	1.4	201	0.0	201	0.0
202	0.0	202	0.0	202	0.0	202	0.0
203	0.0	203	0.0	203	0.0	203	0.0
204	0.0	204	0.0	204	0.0	204	0.0
205	0.0	205	0.0	205	0.0	205	0.0
206	0.0	206	0.0	206	0.0	206	0.0
207	0.0	207	0.0	207	0.0	207	0.0
208	1.1	208	1.4	208	0.0	208	0.0
209	0.0	209	0.0	209	0.0	209	0.0
210	0.0	210	0.0	210	0.0	210	0.0
211	2.3	211	2.8	211	0.0	211	0.0
212	4.5	212	5.6	212	6.2	212	5.6
213	0.0	213	0.0	213	19.6	213	17.7
214	9.1	214	11.1	214	4.1	214	3.7
215	3.4	215	4.2	215	0.0	215	0.0
216	0.0	216	0.0	216	0.0	216	0.0
217	0.0	217	0.0	217	0.0	217	0.0
218	116.9	218	143.0	218	0.0	218	0.0
219	1.1	219	1.4	219	36.1	219	32.6
220	0.0	220	0.0	220	0.0	220	0.0
221	3.4	221	4.2	221	0.0	221	0.0
222	32.9	222	40.3	222	0.0	222	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Day	Wet, 100 year ARI (mm) Year 1	Day	Wet, 500 year ARI (mm) Year 1	Day	Dry, 100 year ARI (mm) Year 1	Day	Dry, 500 year ARI (mm) Year 1
Total	1554.9	Total	1901.8	Total	424.0	Total	382.6
223	53.3	223	65.2	223	13.4	223	12.1
224	0.0	224	0.0	224	7.2	224	6.5
225	13.6	225	16.7	225	35.1	225	31.6
226	0.0	226	0.0	226	1.0	226	0.9
227	0.0	227	0.0	227	0.0	227	0.0
228	0.0	228	0.0	228	0.0	228	0.0
229	0.0	229	0.0	229	2.1	229	1.9
230	0.0	230	0.0	230	2.1	230	1.9
231	0.0	231	0.0	231	0.0	231	0.0
232	1.1	232	1.4	232	0.0	232	0.0
233	0.0	233	0.0	233	0.0	233	0.0
234	15.9	234	19.4	234	0.0	234	0.0
235	0.0	235	0.0	235	0.0	235	0.0
236	10.2	236	12.5	236	0.0	236	0.0
237	6.8	237	8.3	237	0.0	237	0.0
238	0.0	238	0.0	238	0.0	238	0.0
239	2.3	239	2.8	239	0.0	239	0.0
240	0.0	240	0.0	240	0.0	240	0.0
241	79.4	241	97.2	241	0.0	241	0.0
242	0.0	242	0.0	242	0.0	242	0.0
243	0.0	243	0.0	243	0.0	243	0.0
244	0.0	244	0.0	244	10.3	244	9.3
245	0.0	245	0.0	245	0.0	245	0.0
246	0.0	246	0.0	246	0.0	246	0.0
247	0.0	247	0.0	247	7.2	247	6.5
248	0.0	248	0.0	248	2.1	248	1.9
249	0.0	249	0.0	249	29.9	249	27.0
250	0.0	250	0.0	250	0.0	250	0.0
251	0.0	251	0.0	251	0.0	251	0.0
252	0.0	252	0.0	252	4.1	252	3.7
253	2.3	253	2.8	253	8.3	253	7.4
254	0.0	254	0.0	254	0.0	254	0.0
255	0.0	255	0.0	255	0.0	255	0.0
256	0.0	256	0.0	256	0.0	256	0.0
257	0.0	257	0.0	257	0.0	257	0.0
258	0.0	258	0.0	258	0.0	258	0.0
259	0.0	259	0.0	259	0.0	259	0.0
260	77.2	260	94.4	260	0.0	260	0.0
261	0.0	261	0.0	261	0.0	261	0.0
262	0.0	262	0.0	262	0.0	262	0.0
263	37.5	263	45.8	263	0.0	263	0.0
264	12.5	264	15.3	264	0.0	264	0.0
265	37.5	265	45.8	265	0.0	265	0.0
266	32.9	266	40.3	266	0.0	266	0.0
267	0.0	267	0.0	267	0.0	267	0.0
268	3.4	268	4.2	268	0.0	268	0.0
269	0.0	269	0.0	269	0.0	269	0.0
270	0.0	270	0.0	270	0.0	270	0.0
271	0.0	271	0.0	271	0.0	271	0.0
272	3.4	272	4.2	272	0.0	272	0.0
273	10.2	273	12.5	273	0.0	273	0.0
274	18.2	274	22.2	274	0.0	274	0.0
275	12.5	275	15.3	275	2.1	275	1.9
276	0.0	276	0.0	276	19.6	276	17.7
277	0.0	277	0.0	277	10.3	277	9.3
278	0.0	278	0.0	278	0.0	278	0.0
279	0.0	279	0.0	279	0.0	279	0.0
280	0.0	280	0.0	280	0.0	280	0.0
281	0.0	281	0.0	281	1.0	281	0.9
282	0.0	282	0.0	282	0.0	282	0.0
283	0.0	283	0.0	283	0.0	283	0.0
284	31.8	284	38.9	284	0.0	284	0.0
285	0.0	285	0.0	285	0.0	285	0.0
286	0.0	286	0.0	286	0.0	286	0.0
287	14.8	287	18.0	287	1.0	287	0.9
288	12.5	288	15.3	288	0.0	288	0.0
289	13.6	289	16.7	289	0.0	289	0.0
290	99.9	290	122.2	290	0.0	290	0.0
291	0.0	291	0.0	291	0.0	291	0.0
292	13.6	292	16.7	292	0.0	292	0.0
293	0.0	293	0.0	293	0.0	293	0.0
294	1.1	294	1.4	294	0.0	294	0.0
295	5.7	295	6.9	295	0.0	295	0.0
296	0.0	296	0.0	296	0.0	296	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	**Year 1**
297	7.9
298	2.3
299	1.1
300	1.1
301	2.3
302	2.3
303	7.9
304	0.0
305	0.0
306	2.3
307	1.1
308	11.3
309	0.0
310	31.8
311	43.1
312	1.1
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	4.5
320	27.2
321	54.5
322	29.5
323	1.1
324	3.4
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.1
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Wet, 500 year ARI (mm)

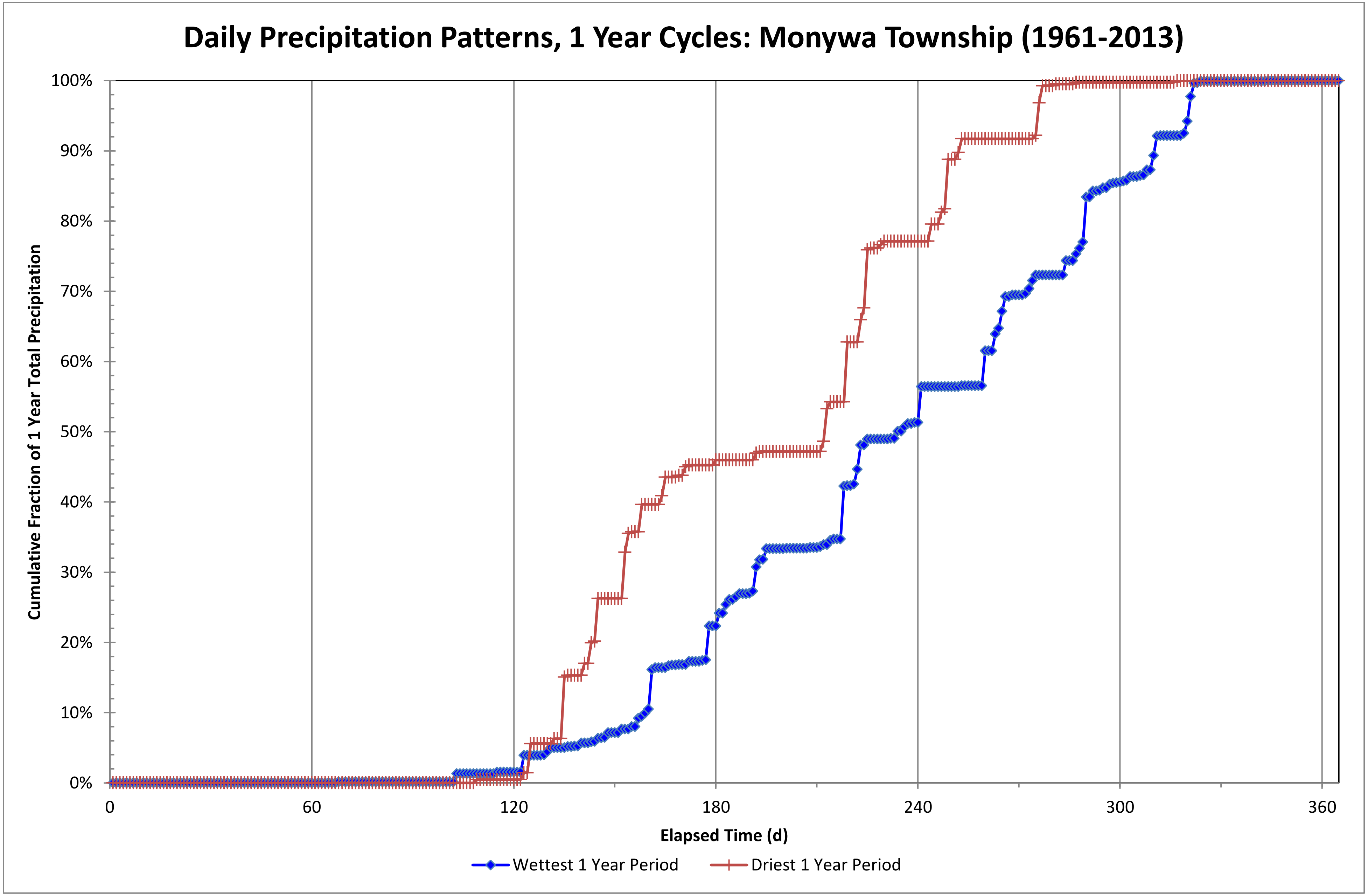
Total	1901.8
Day	**Year 1**
297	9.7
298	2.8
299	1.4
300	1.4
301	2.8
302	2.8
303	9.7
304	0.0
305	0.0
306	2.8
307	1.4
308	13.9
309	0.0
310	38.9
311	52.8
312	1.4
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	5.6
320	33.3
321	66.6
322	36.1
323	1.4
324	4.2
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.4
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	**Year 1**
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	1.0
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	**Year 1**
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	0.9
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0



Daily Precipitation Patterns, 1 Year Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 1 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
60
120
180
240
300
360
Elapsed Time (d)
Wettest 1 Year Period
Driest 1 Year Period

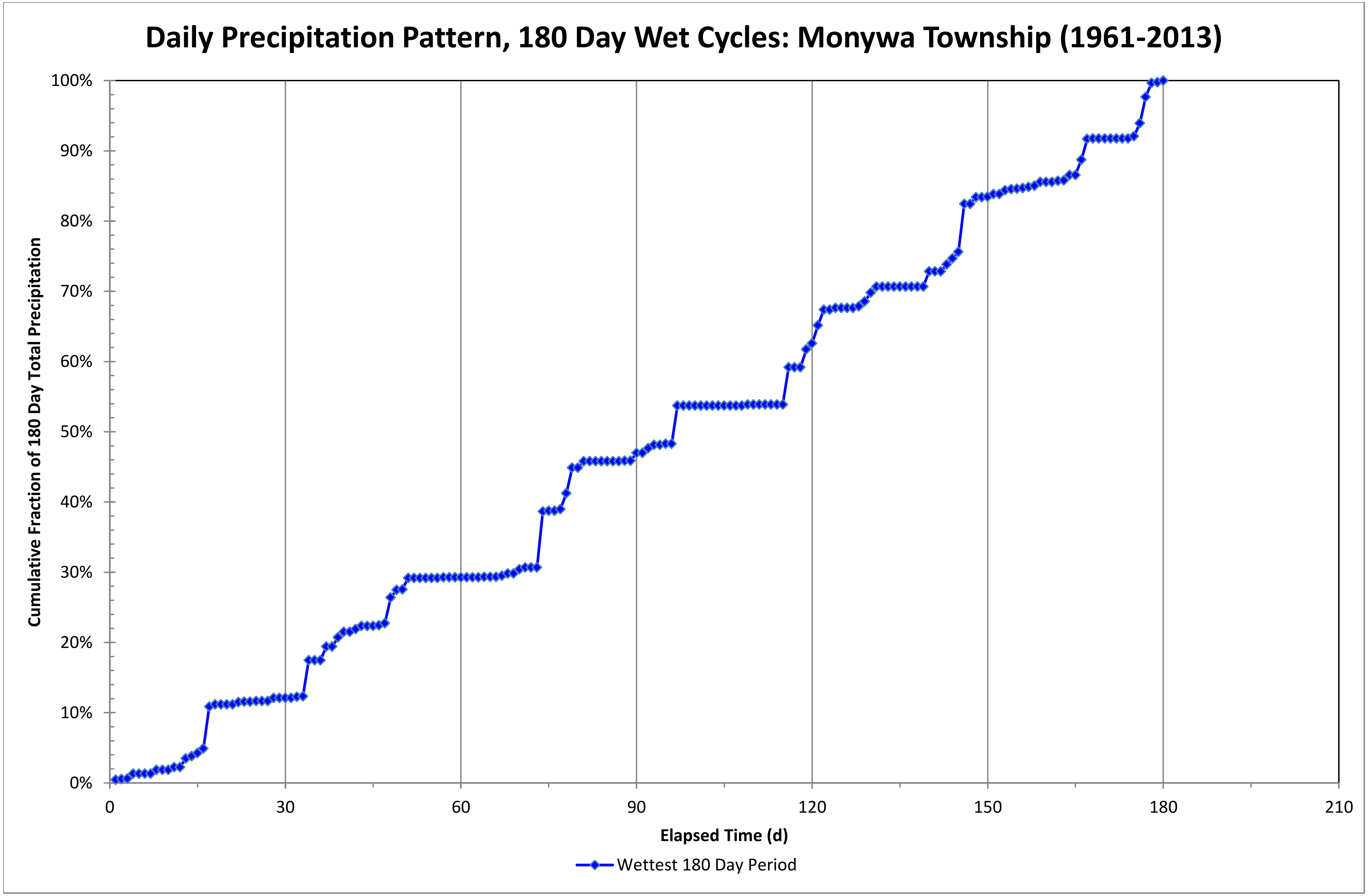
Precipitation, 180 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	174.1	254.4	300.1
Day	**Day +0**	**Day +60**	**Day +120**
1	6.7	0.0	36.8
2	1.1	0.0	32.4
3	1.1	0.0	0.0
4	10.0	1.1	3.3
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.2	0.0
8	7.8	4.5	3.3
9	0.0	0.0	10.0
10	0.0	8.9	17.9
11	5.6	3.3	12.3
12	0.0	0.0	0.0
13	17.9	0.0	0.0
14	4.5	114.9	0.0
15	6.7	1.1	0.0
16	8.9	0.0	0.0
17	85.9	3.3	0.0
18	4.5	32.4	0.0
19	0.0	52.4	0.0
20	0.0	0.0	31.2
21	0.0	13.4	0.0
22	4.5	0.0	0.0
23	1.1	0.0	14.5
24	0.0	0.0	12.3
25	1.1	0.0	13.4
26	0.0	0.0	98.2
27	0.0	0.0	0.0
28	6.7	1.1	13.4
29	0.0	0.0	0.0
30	0.0	15.6	1.1
31	0.0	0.0	5.6
32	2.2	10.0	0.0
33	1.1	6.7	7.8
34	73.6	0.0	2.2
35	0.0	2.2	1.1
36	0.0	0.0	1.1
37	27.9	78.1	2.2
38	0.0	0.0	2.2
39	19.0	0.0	7.8
40	11.2	0.0	0.0
41	0.0	0.0	0.0
42	5.6	0.0	2.2
43	6.7	0.0	1.1
44	0.0	0.0	11.2
45	0.0	0.0	0.0
46	1.1	0.0	31.2
47	4.5	0.0	42.4
48	52.4	0.0	1.1
49	15.6	2.2	0.0
50	1.1	0.0	0.0
51	23.4	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	4.5
56	0.0	75.9	26.8
57	1.1	0.0	53.6
58	0.0	0.0	29.0
59	0.0	36.8	1.1
60	0.0	12.3	3.3

500 year ARI (mm)

Total	214.0	312.7	368.9
Day	**Day +0**	**Day +60**	**Day +120**
1	8.2	0.0	45.3
2	1.4	0.0	39.8
3	1.4	0.0	0.0
4	12.3	1.4	4.1
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.7	0.0
8	9.6	5.5	4.1
9	0.0	0.0	12.3
10	0.0	11.0	21.9
11	6.9	4.1	15.1
12	0.0	0.0	0.0
13	21.9	0.0	0.0
14	5.5	141.3	0.0
15	8.2	1.4	0.0
16	11.0	0.0	0.0
17	105.6	4.1	0.0
18	5.5	39.8	0.0
19	0.0	64.5	0.0
20	0.0	0.0	38.4
21	0.0	16.5	0.0
22	5.5	0.0	0.0
23	1.4	0.0	17.8
24	0.0	0.0	15.1
25	1.4	0.0	16.5
26	0.0	0.0	120.7
27	0.0	0.0	0.0
28	8.2	1.4	16.5
29	0.0	0.0	0.0
30	0.0	19.2	1.4
31	0.0	0.0	6.9
32	2.7	12.3	0.0
33	1.4	8.2	9.6
34	90.5	0.0	2.7
35	0.0	2.7	1.4
36	0.0	0.0	1.4
37	34.3	96.0	2.7
38	0.0	0.0	2.7
39	23.3	0.0	9.6
40	13.7	0.0	0.0
41	0.0	0.0	0.0
42	6.9	0.0	2.7
43	8.2	0.0	1.4
44	0.0	0.0	13.7
45	0.0	0.0	0.0
46	1.4	0.0	38.4
47	5.5	0.0	52.1
48	64.5	0.0	1.4
49	19.2	2.7	0.0
50	1.4	0.0	0.0
51	28.8	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	5.5
56	0.0	93.3	32.9
57	1.4	0.0	65.8
58	0.0	0.0	35.7
59	0.0	45.3	1.4
60	0.0	15.1	4.1



Daily Precipitation Pattern, 180 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 180 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
30
60
90
120
150
180
210
Elapsed Time (d)
Wettest 180 Day Period

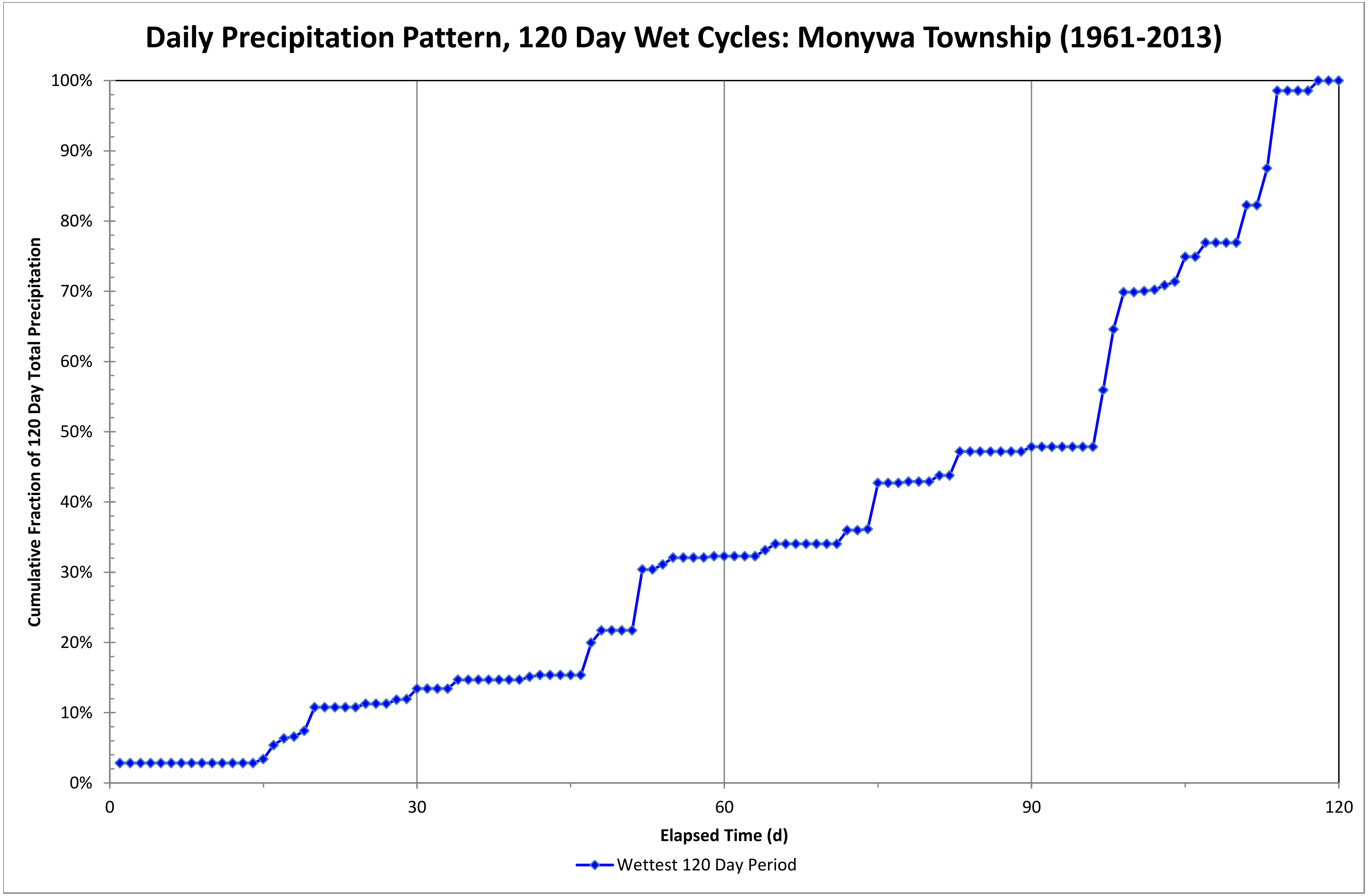
Precipitation, 120 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	143.7	166.9
Day	**Day +0**	**Day +60**
1	30.3	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	9.3
5	0.0	9.6
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	20.8
13	0.0	0.0
14	0.0	1.6
15	6.1	70.4
16	21.3	0.0
17	10.2	0.0
18	2.7	2.2
19	8.7	0.0
20	36.0	0.0
21	0.0	9.3
22	0.0	0.0
23	0.0	36.6
24	0.0	0.0
25	5.5	0.0
26	0.0	0.0
27	0.0	0.0
28	6.0	0.0
29	1.1	0.0
30	15.8	7.1
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	13.7	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	86.3
38	0.0	92.8
39	0.0	56.8
40	0.0	0.0
41	4.4	1.6
42	2.7	2.2
43	0.0	6.6
44	0.0	5.5
45	0.0	38.2
46	0.0	0.0
47	49.1	21.3
48	19.1	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	57.3
52	92.8	0.0
53	0.0	56.2
54	7.6	118.5
55	10.4	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	15.3
59	2.2	0.0
60	0.0	0.0

500 year ARI (mm)

Total	170.7	198.2
Day	**Day +0**	**Day +60**
1	35.9	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	11.0
5	0.0	11.4
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	24.6
13	0.0	0.0
14	0.0	1.9
15	7.3	83.6
16	25.3	0.0
17	12.1	0.0
18	3.2	2.6
19	10.4	0.0
20	42.8	0.0
21	0.0	11.0
22	0.0	0.0
23	0.0	43.4
24	0.0	0.0
25	6.5	0.0
26	0.0	0.0
27	0.0	0.0
28	7.1	0.0
29	1.3	0.0
30	18.8	8.4
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	16.2	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	102.4
38	0.0	110.2
39	0.0	67.4
40	0.0	0.0
41	5.2	1.9
42	3.2	2.6
43	0.0	7.8
44	0.0	6.5
45	0.0	45.4
46	0.0	0.0
47	58.4	25.3
48	22.7	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	68.1
52	110.2	0.0
53	0.0	66.8
54	9.1	140.7
55	12.3	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	18.2
59	2.6	0.0
60	0.0	0.0



Daily Precipitation Pattern, 120 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 120 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
30
60
90
120
Elapsed Time (d)
Wettest 120 Day Period

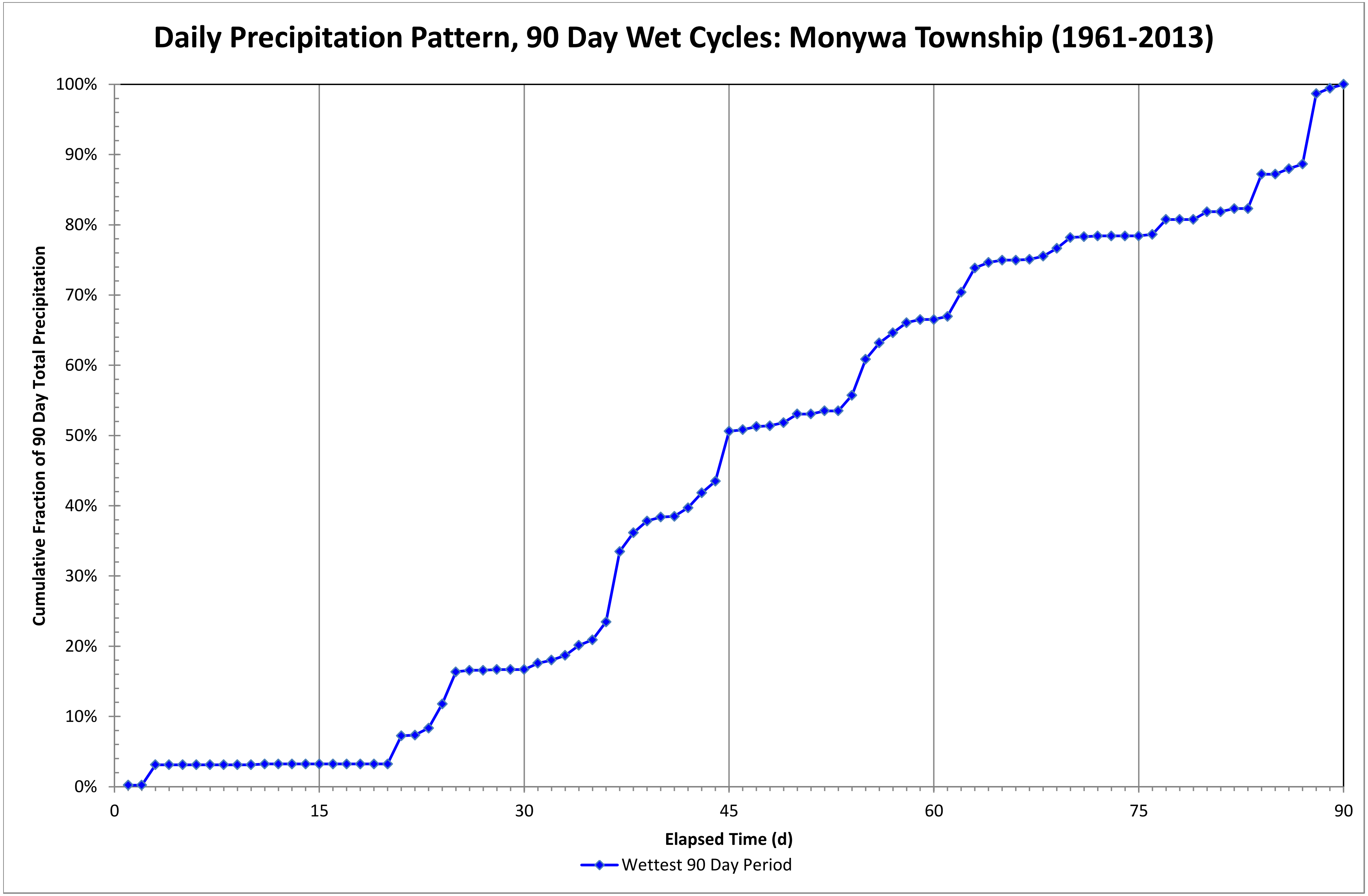
Precipitation, 90 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	153.6	458.8	308.3
Day	**Day +0**	**Day +30**	**Day +60**
1	2.0	8.2	4.1
2	0.0	4.1	31.7
3	26.6	6.1	31.7
4	0.0	13.3	7.2
5	0.0	7.2	3.1
6	0.0	23.6	0.0
7	0.0	92.2	1.0
8	0.0	24.6	4.1
9	0.0	15.4	10.2
10	0.0	5.1	14.3
11	1.0	1.0	1.0
12	0.0	11.3	1.0
13	0.0	19.5	0.0
14	0.0	15.4	0.0
15	0.0	65.5	0.0
16	0.0	2.0	2.0
17	0.0	4.1	19.5
18	0.0	1.0	0.0
19	0.0	4.1	0.0
20	0.0	11.3	10.2
21	36.9	0.0	0.0
22	1.0	4.1	4.1
23	9.2	0.0	0.0
24	31.7	20.5	45.1
25	42.0	47.1	0.0
26	2.0	21.5	7.2
27	0.0	13.3	6.1
28	1.0	13.3	92.2
29	0.0	4.1	7.2
30	0.0	0.0	5.1

500 year ARI (mm)

Total	183.8	548.9	368.8
Day	**Day +0**	**Day +30**	**Day +60**
1	2.5	9.8	4.9
2	0.0	4.9	38.0
3	31.9	7.4	38.0
4	0.0	15.9	8.6
5	0.0	8.6	3.7
6	0.0	28.2	0.0
7	0.0	110.3	1.2
8	0.0	29.4	4.9
9	0.0	18.4	12.3
10	0.0	6.1	17.2
11	1.2	1.2	1.2
12	0.0	13.5	1.2
13	0.0	23.3	0.0
14	0.0	18.4	0.0
15	0.0	78.4	0.0
16	0.0	2.5	2.5
17	0.0	4.9	23.3
18	0.0	1.2	0.0
19	0.0	4.9	0.0
20	0.0	13.5	12.3
21	44.1	0.0	0.0
22	1.2	4.9	4.9
23	11.0	0.0	0.0
24	38.0	24.5	53.9
25	50.2	56.4	0.0
26	2.5	25.7	8.6
27	0.0	15.9	7.4
28	1.2	15.9	110.3
29	0.0	4.9	8.6
30	0.0	0.0	6.1


Daily Precipitation Pattern, 90 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 90 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
45
60
75
90
Elapsed Time (d)
Wettest 90 Day Period

Precipitation, 60 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	442.5	297.3
Day	**Day +0**	**Day +30**
1	7.9	4.0
2	4.0	30.6
3	5.9	30.6
4	12.8	6.9
5	6.9	3.0
6	22.7	0.0
7	88.9	1.0
8	23.7	4.0
9	14.8	9.9
10	4.9	13.8
11	1.0	1.0
12	10.9	1.0
13	18.8	0.0
14	14.8	0.0
15	63.2	0.0
16	2.0	2.0
17	4.0	18.8
18	1.0	0.0
19	4.0	0.0
20	10.9	9.9
21	0.0	0.0
22	4.0	4.0
23	0.0	0.0
24	19.8	43.5
25	45.4	0.0
26	20.7	6.9
27	12.8	5.9
28	12.8	88.9
29	4.0	6.9
30	0.0	4.9

500 year ARI (mm)

Total	517.4	347.7
Day	**Day +0**	**Day +30**
1	9.2	4.6
2	4.6	35.8
3	6.9	35.8
4	15.0	8.1
5	8.1	3.5
6	26.6	0.0
7	104.0	1.2
8	27.7	4.6
9	17.3	11.6
10	5.8	16.2
11	1.2	1.2
12	12.7	1.2
13	21.9	0.0
14	17.3	0.0
15	73.9	0.0
16	2.3	2.3
17	4.6	21.9
18	1.2	0.0
19	4.6	0.0
20	12.7	11.6
21	0.0	0.0
22	4.6	4.6
23	0.0	0.0
24	23.1	50.8
25	53.1	0.0
26	24.3	8.1
27	15.0	6.9
28	15.0	104.0
29	4.6	8.1
30	0.0	5.8

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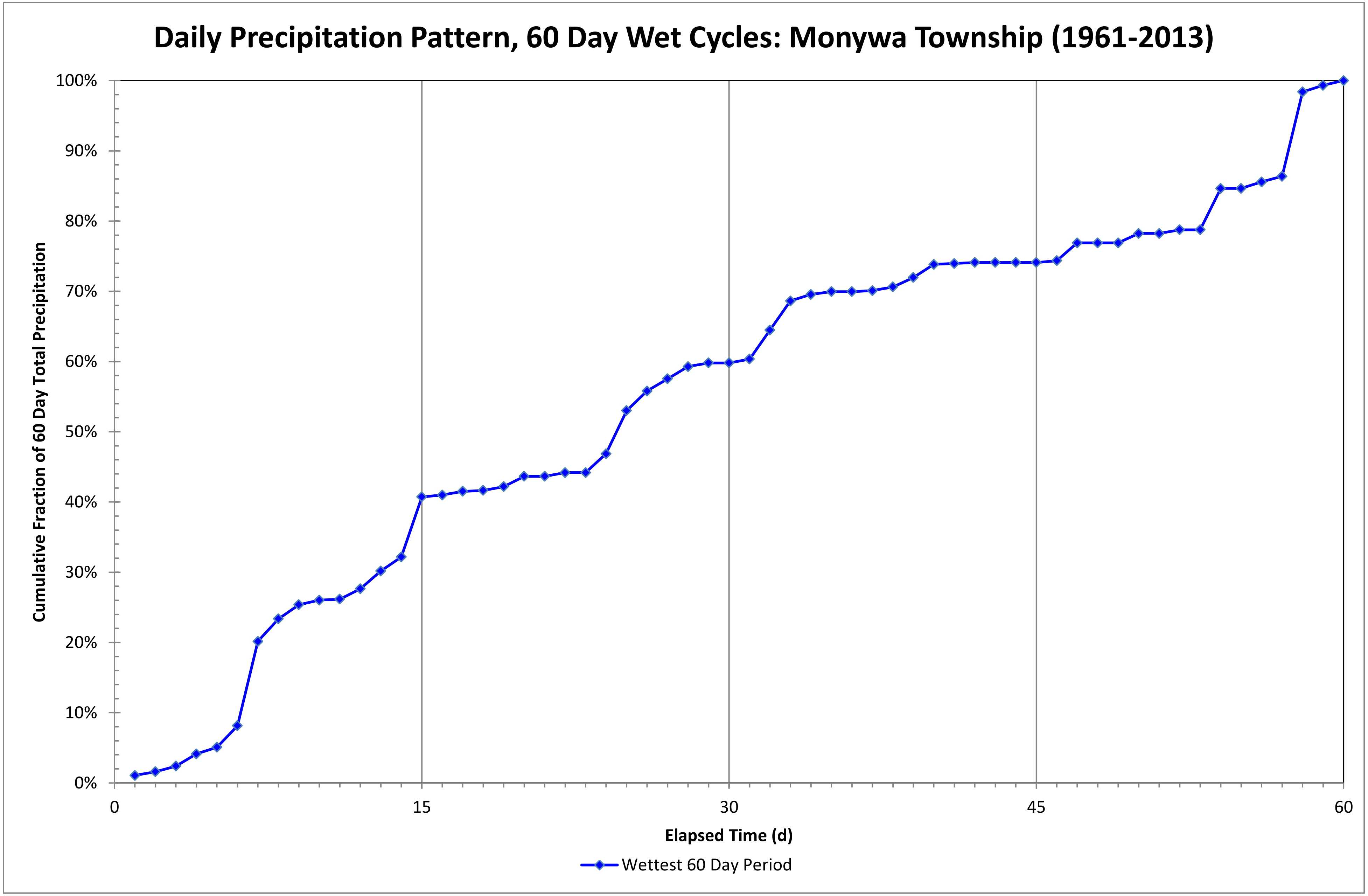

Daily Precipitation Pattern, 60 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 60 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
45
60
Elapsed Time (d)
Wettest 60 Day Period

Precipitation, 30 Day Wet Cycles: Monywa Township (1961-2013)

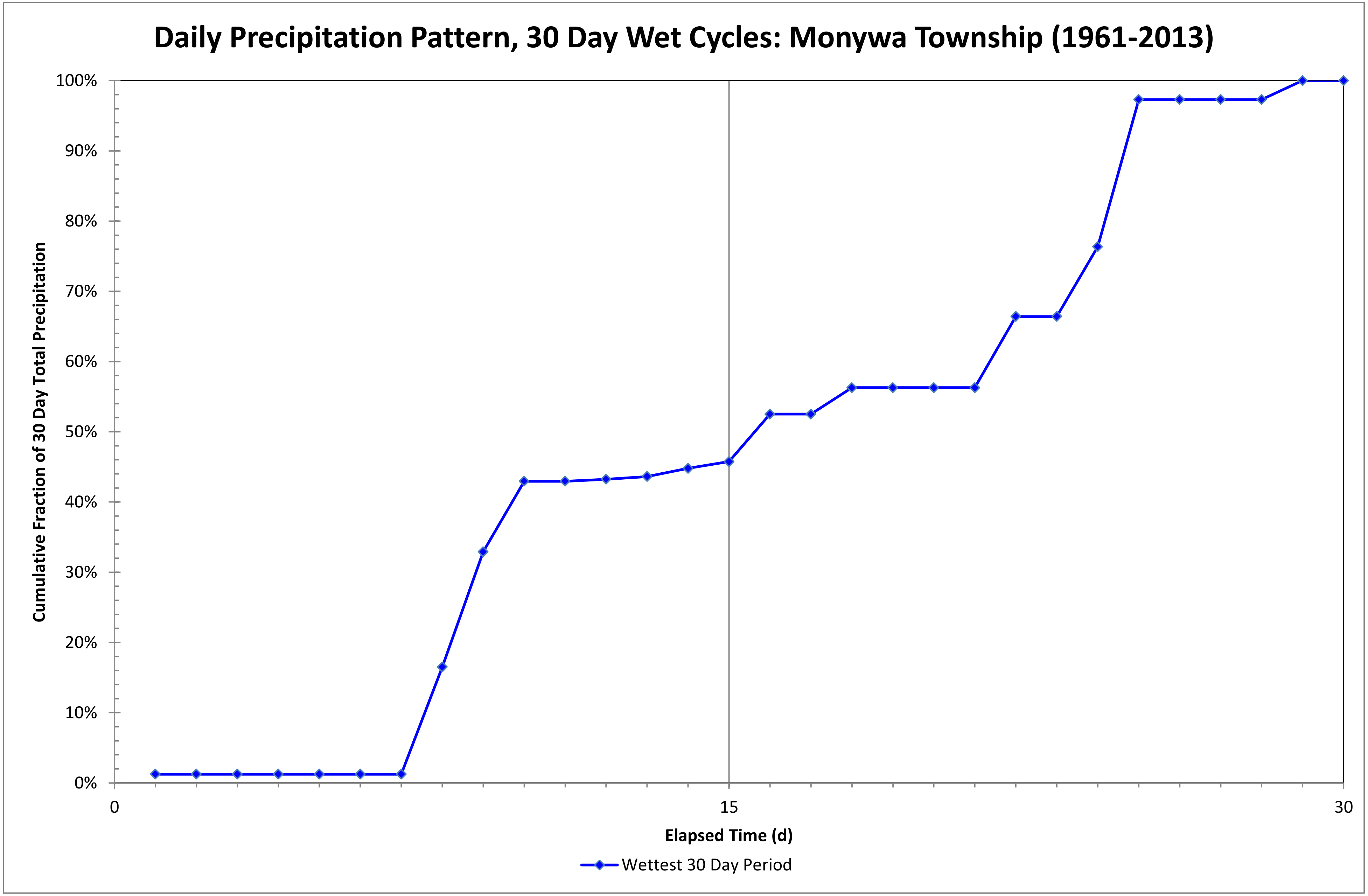
100 year ARI (mm)

Total	519.6
Day	**Day +0**
1	6.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	79.2
9	85.3
10	52.2
11	0.0
12	1.5
13	2.0
14	6.0
15	5.0
16	35.1
17	0.0
18	19.6
19	0.0
20	0.0
21	0.0
22	52.7
23	0.0
24	51.7
25	108.8
26	0.0
27	0.0
28	0.0
29	14.0
30	0.0

500 year ARI (mm)

Total	596.4
Day	**Day +0**
1	7.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	91.0
9	97.9
10	59.9
11	0.0
12	1.7
13	2.3
14	6.9
15	5.8
16	40.3
17	0.0
18	22.5
19	0.0
20	0.0
21	0.0
22	60.4
23	0.0
24	59.3
25	124.9
26	0.0
27	0.0
28	0.0
29	16.1
30	0.0

`


Daily Precipitation Pattern, 30 Day Wet Cycles: Monywa Township (1961-2013)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Fraction of 30 Day Total Precipitation
0
15
30
Elapsed Time (d)
Wettest 30 Day Period

Precipitation, < 30 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	439.8
Day	**Day +0**
1	17.2
2	5.8
3	14.8
4	110.9
5	126.8
6	80.8
7	27.6
8	0.0
9	0.0
10	17.4
11	19.8
12	10.2
13	3.0
14	5.4

500 year ARI (mm)

Total	562.6
Day	**Day +0**
1	22.0
2	7.4
3	18.9
4	141.9
5	162.2
6	103.3
7	35.4
8	0.0
9	0.0
10	22.3
11	25.4
12	13.1
13	3.8
14	6.9

100 year ARI (mm)

Total	342.6
Day	**Day +0**
1	15.3
2	5.1
3	13.2
4	99.0
5	113.2
6	72.1
7	24.7

500 year ARI (mm)

Total	447.3
Day	**Day +0**
1	20.0
2	6.7
3	17.2
4	129.3
5	147.8
6	94.1
7	32.2

100 year ARI (mm)

Total	307.9
Day	**Day +0**
1	78.5
2	72.3
3	141.4
4	15.7

500 year ARI (mm)

Total	410.1
Day	**Day +0**
1	104.6
2	96.3
3	188.3
4	20.9

100 year ARI (mm)

Total	297.7
Day	**Day +0**
1	80.0
2	73.6
3	144.1

500 year ARI (mm)

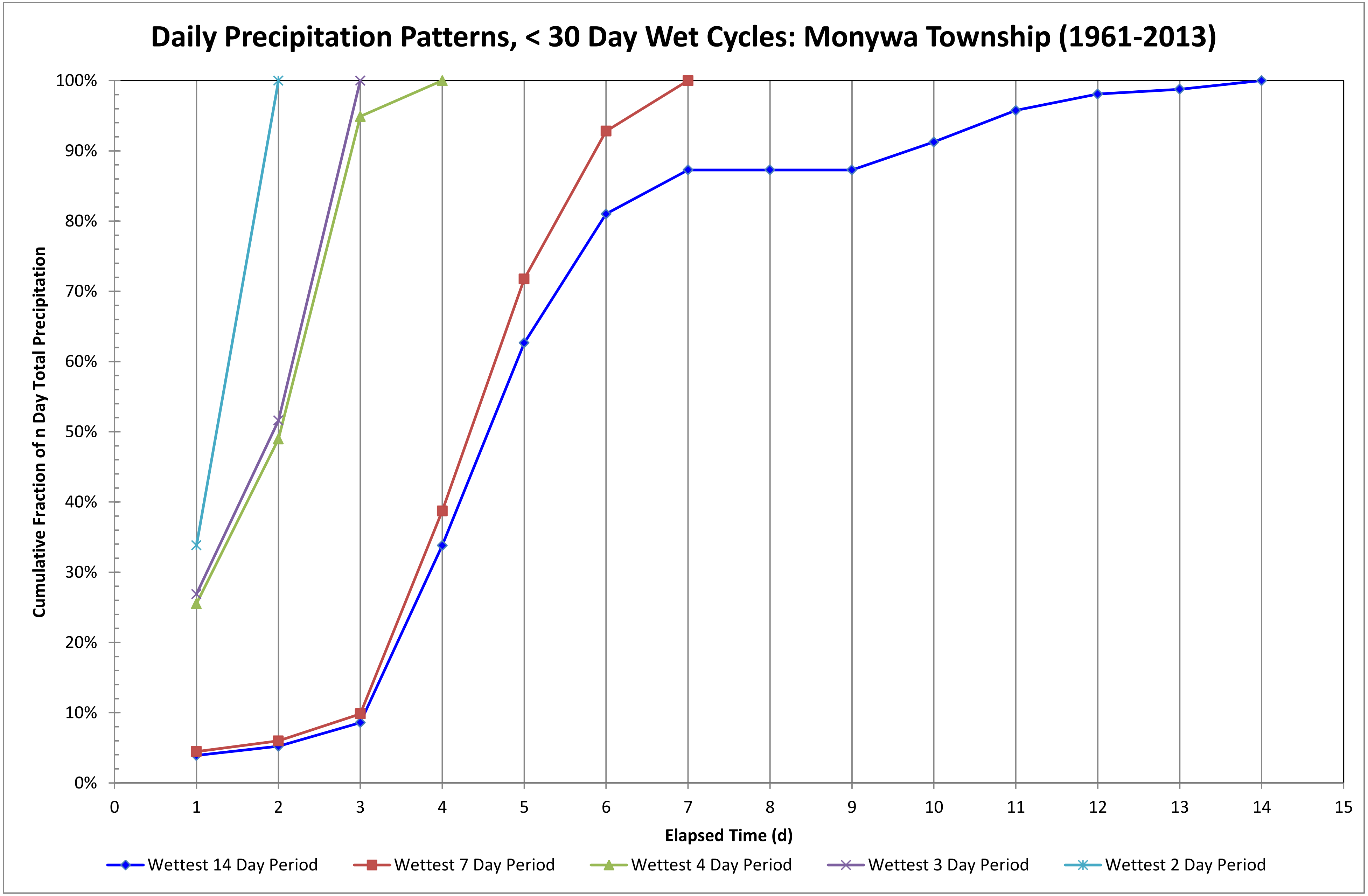
Total	400.7
Day	**Day +0**
1	107.7
2	99.1
3	193.9

100 year ARI (mm)

Total	214.1
Day	**Day +0**
1	72.4
2	141.7

500 year ARI (mm)

Total	248.7
Day	**Day +0**
1	84.1
2	164.6


Daily Precipitation Patterns, < 30 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of n Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Elapsed Time (d)
Wettest 14 Day Period
Wettest 7 Day Period
Wettest 4 Day Period
Wettest 3 Day Period
Wettest 2 Day Period

ATTACHMENT 3.1

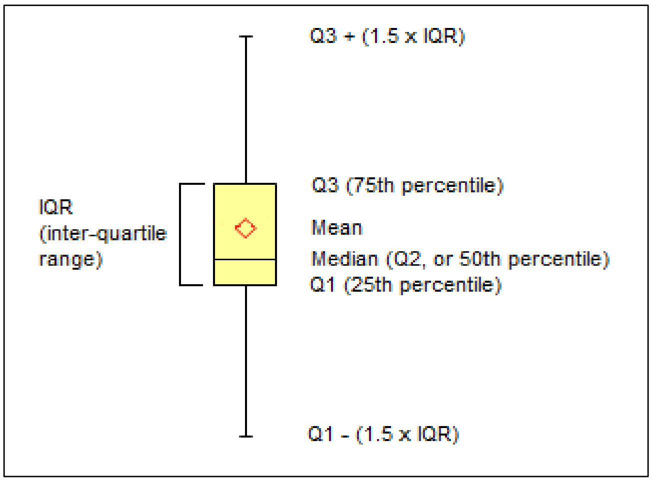
Annual Pan Evaporation Analysis

Pan Evaporation Data, Annual Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

Year	Evap. (mm)
2000	2,078.3
2001	1,921.7
2002	1,925.4
2003	1,975.8
2004	2,108.6
2005	2,051.4
2006	2,055.8
2007	Exclude
2008	Exclude
2009	Exclude
2010	Exclude
2011	Exclude
2012	Exclude
2013	Exclude

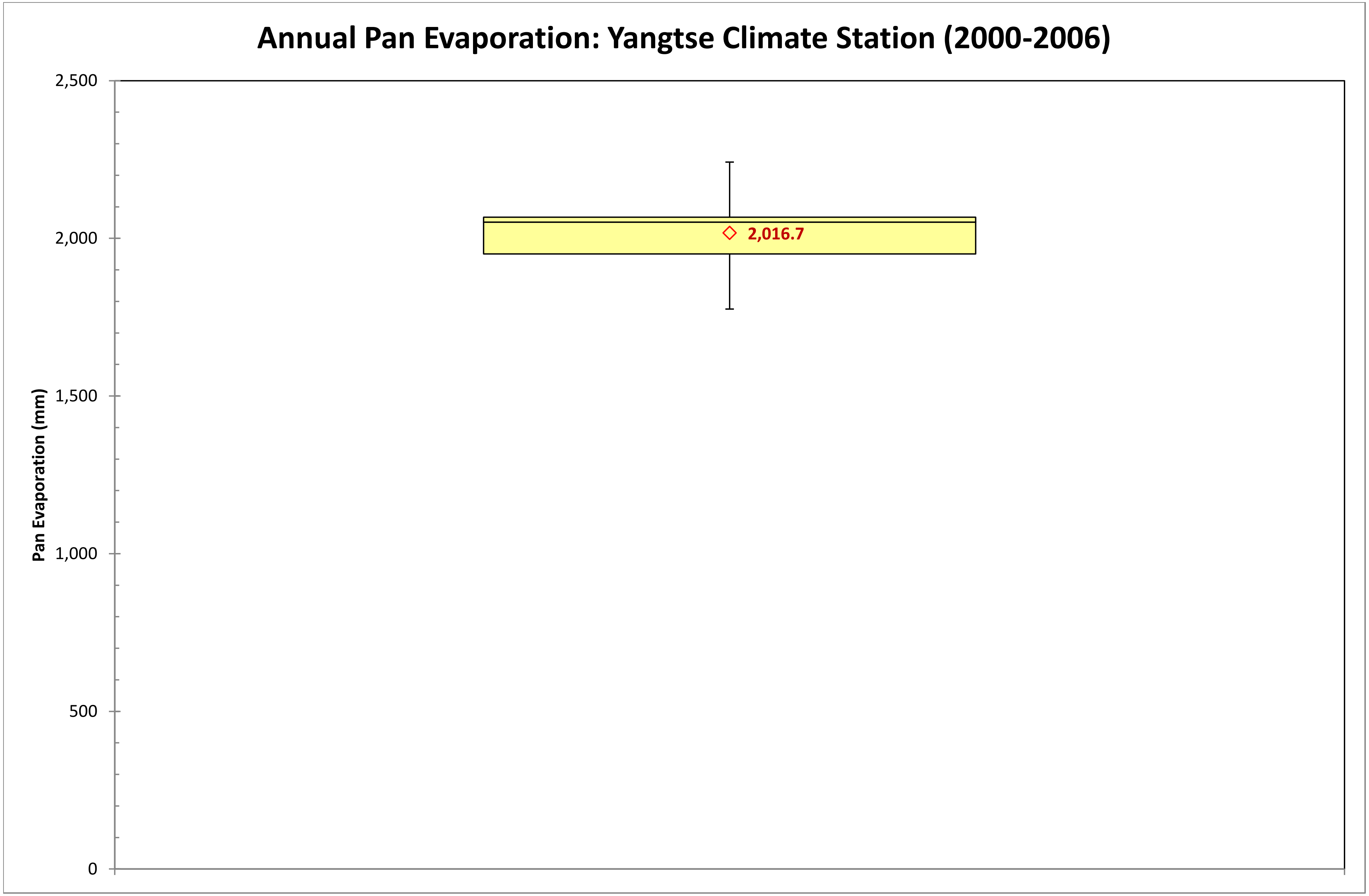
Stat	Evap. (mm)
Mean	2,016.7
SD	75.3
Median	2,051.4
Q1	1,950.6
Q3	2,067.0
Minimum	1,921.7
Maximum	2,108.6
Count	7
Ext Max	2,241.7
Ext Min	1,775.9
25^{th} Pct	1,950.6
50^{th} Pct	100.8
75^{th} Pct	15.7
1.5 * IQR	174.7

Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation. For more discussion on this issue, refer to the climate trend analysis worksheet.



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
2,500
2,000
1,500
1,000
500
0
2,016.7

ATTACHMENT 3.2

Monthly Pan Evaporation Analysis

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

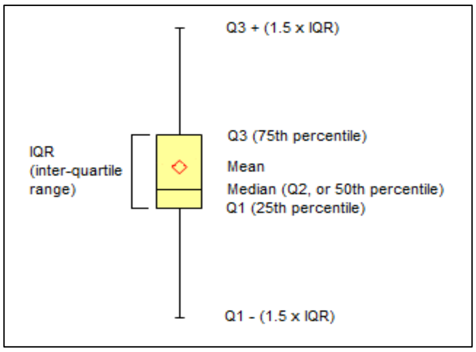
Pan Evaporation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	133.7	154.2	218.7	240.0	117.6	211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1	248.2	149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006	119.2	142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
SD	4.9	12.7	14.4	21.1	43.1	35.9	12.0	37.6	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	205.0	186.9	174.1	175.0	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
Q3	122.0	158.0	220.0	241.8	223.0	218.7	180.1	197.8	173.0	157.3	136.9	126.7
Minimum	119.2	129.6	187.5	191.2	117.6	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	133.7	165.6	224.4	247.8	255.5	269.8	187.3	248.2	208.2	183.9	145.5	131.2
Count	7	7	7	7	7	7	7	7	7	7	7	7
Ext Max	123.7	182.8	248.6	277.2	262.8	274.7	201.8	244.4	215.6	195.3	175.9	151.3
Ext Min	119.2	116.5	172.4	182.9	156.6	125.4	144.1	120.1	102.1	94.0	71.7	85.7
25th Pct	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
50th Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	8.3	5.1	15.9	19.1	1.5
75th Pct	1.1	6.9	7.1	6.3	18.0	31.8	6.0	22.8	23.3	9.5	7.0	14.9
1.5 * IQR	1.7	24.9	28.5	35.4	39.8	56.0	21.6	46.6	42.6	38.0	39.1	24.6

Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 20/06/2013
	Basic Climatology	Approved	Version No. 2.1

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013)
(Analysis Format | Outliers Removed)

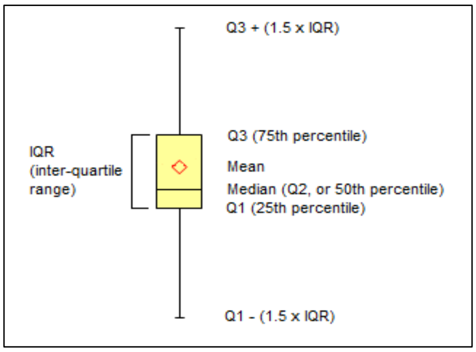
Pan Evaporation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000		154.2	218.7	240.0		211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1		149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006		142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	121.3	149.3	209.5	227.8	216.6	203.1	172.2	172.7	160.2	144.6	124.7	116.5
SD	0.9	12.7	14.4	21.1	23.4	35.9	12.0	26.9	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	209.2	186.9	174.1	172.5	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
Q3	121.0	158.0	220.0	241.8	227.8	218.7	180.1	178.5	173.0	157.3	136.9	126.7
Minimum	120.9	129.6	187.5	191.2	193.7	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	123.0	165.6	224.4	247.8	255.5	269.8	187.3	215.9	208.2	183.9	145.5	131.2
Count	5	7	7	7	6	7	7	6	7	7	7	7
Ext Max	121.2	182.8	248.6	277.2	268.6	274.7	201.8	198.6	215.6	195.3	175.9	151.3
Ext Min	120.8	116.5	172.4	182.9	159.9	125.4	144.1	145.0	102.1	94.0	71.7	85.7
25^{th} Pct	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
50^{th} Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	7.3	5.1	15.9	19.1	1.5
75^{th} Pct	0.1	6.9	7.1	6.3	18.6	31.8	6.0	6.1	23.3	9.5	7.0	14.9
1.5 * IQR	0.1	24.9	28.5	35.4	40.7	56.0	21.6	20.1	42.6	38.0	39.1	24.6

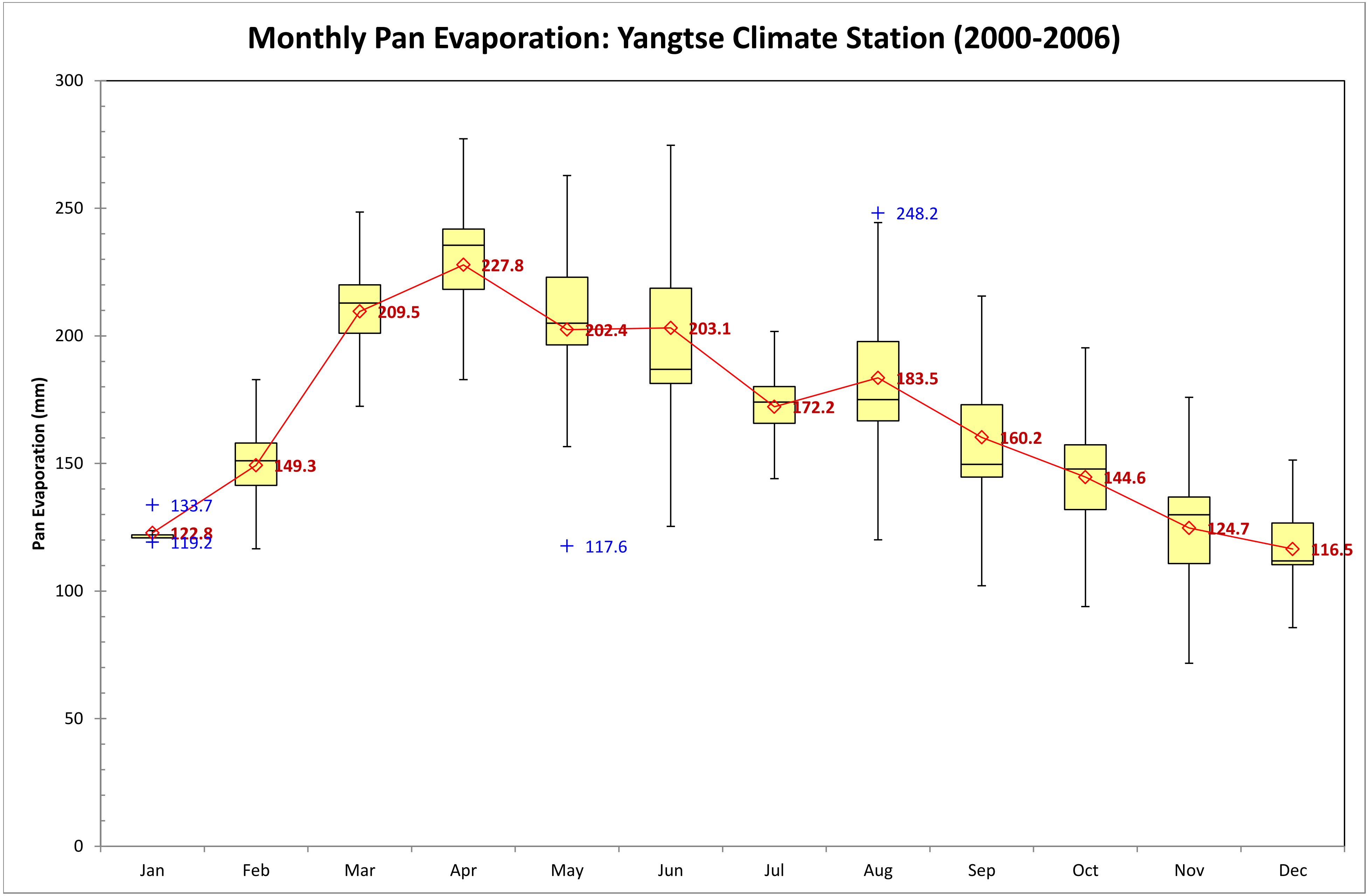
Note: N/D = No Data Available, N/A = Not Applicable.

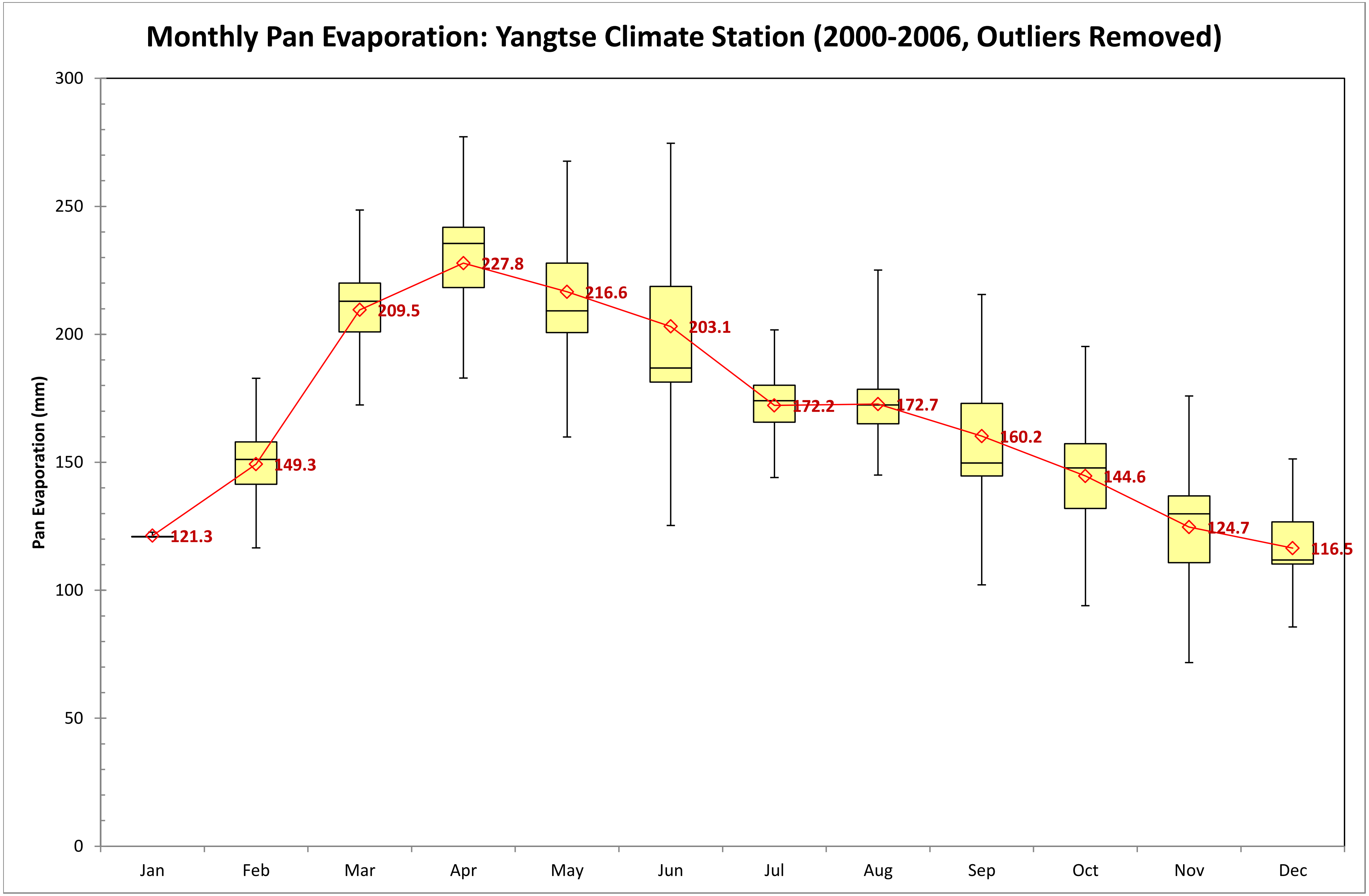
Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25^{th} Pct	Plotting value of the first quartile = Q1
50^{th} Pct	Lower box height = Median - Q1
75^{th} Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.


Monthly Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
133.7
122.8
119.2
149.3
209.5
227.8
202.4
117.6
203.1
172.2
248.2
183.5
160.2
144.6
124.7
116.5


Monthly Pan Evaporation: Yangtse Climate Station (2000-2006, Outliers Removed)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
121.3
149.3
209.5
227.8
216.6
203.1
172.2
172.7
160.2
144.6
124.7
116.5

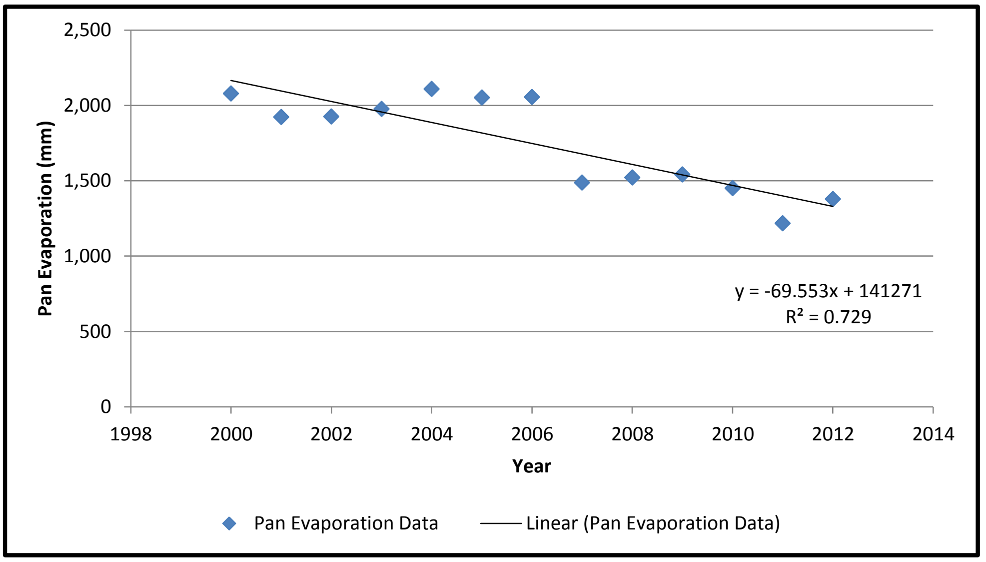
ATTACHMENT 3.3

Pan Evaporation Trend Analysis

Climatic Trend Analysis: Monywa Township Pan Evaporation (2000-2013)

Year	Evap (mm)
2000	2,078
2001	1,922
2002	1,925
2003	1,976
2004	2,109
2005	2,051
2006	2,056
2007	1,488
2008	1,521
2009	1,542
2010	1,451
2011	1,217
2012	1,379
2013	Exclude

Period	Ave. Pan Evap. (mm)
2000-2006	2,017
2007-2012	1,433
2000-2012	1,747



Even though a statistically significant negative trend is shown on the above graph, KP questions its validity. From the dramatic shift in annual pan evaporation occurring from 2007 and onwards (~ 600 mm/yr less), the only conclusion we can draw is that either there was a problem with the instrumentation or that the data was from another site. At this time, there is no satisfactory answer to this question and as a result, pan evaporation data from 2007 and onwards is to be excluded from climate analysis.

ATTACHMENT 3.4

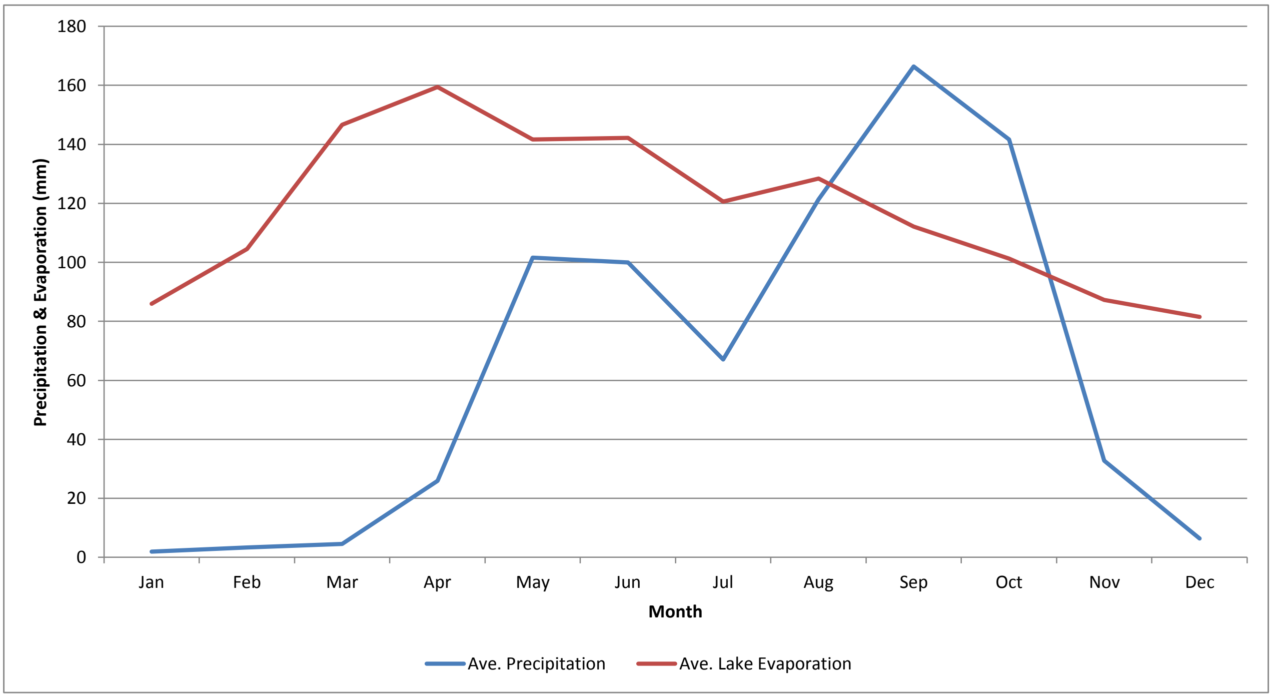
Comparison of Monthly Average
Precipitation & Evaporation

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 4/07/2013
	Basic Climatology	Approved	

Comparison of Average Monthly Precipitation and Lake Evaporation

Comparison Data (mm)												
Variable	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Ave. Precipitation	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
Ave. Pan Evaporation	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
Ave. Lake Evaporation	86.0	104.5	146.7	159.5	141.7	142.2	120.5	128.5	112.1	101.2	87.3	81.6
Precipitation minus Lake Evaporation	-84.1	-101.2	-142.1	-133.5	-40.1	-42.2	-53.5	-7.2	54.2	40.4	-54.6	-75.1

Pan Coefficient = 0.7 **Net Annual Precipiation minus Lake Evaporation =** -638.9 **mm**



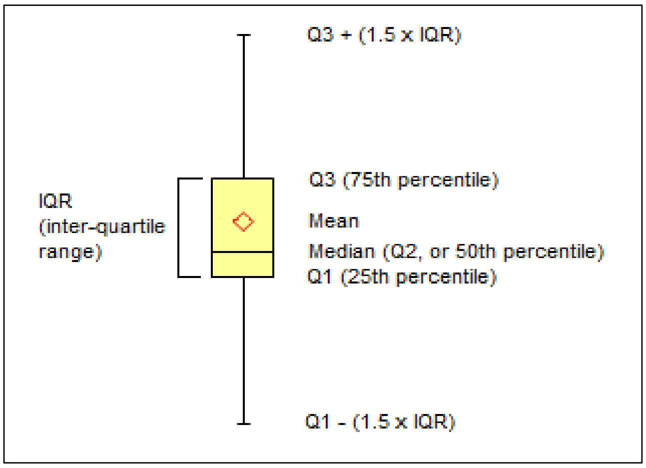
ATTACHMENT 4.1

Annual Average Temperature Analysis

Temperature Data, Annual Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

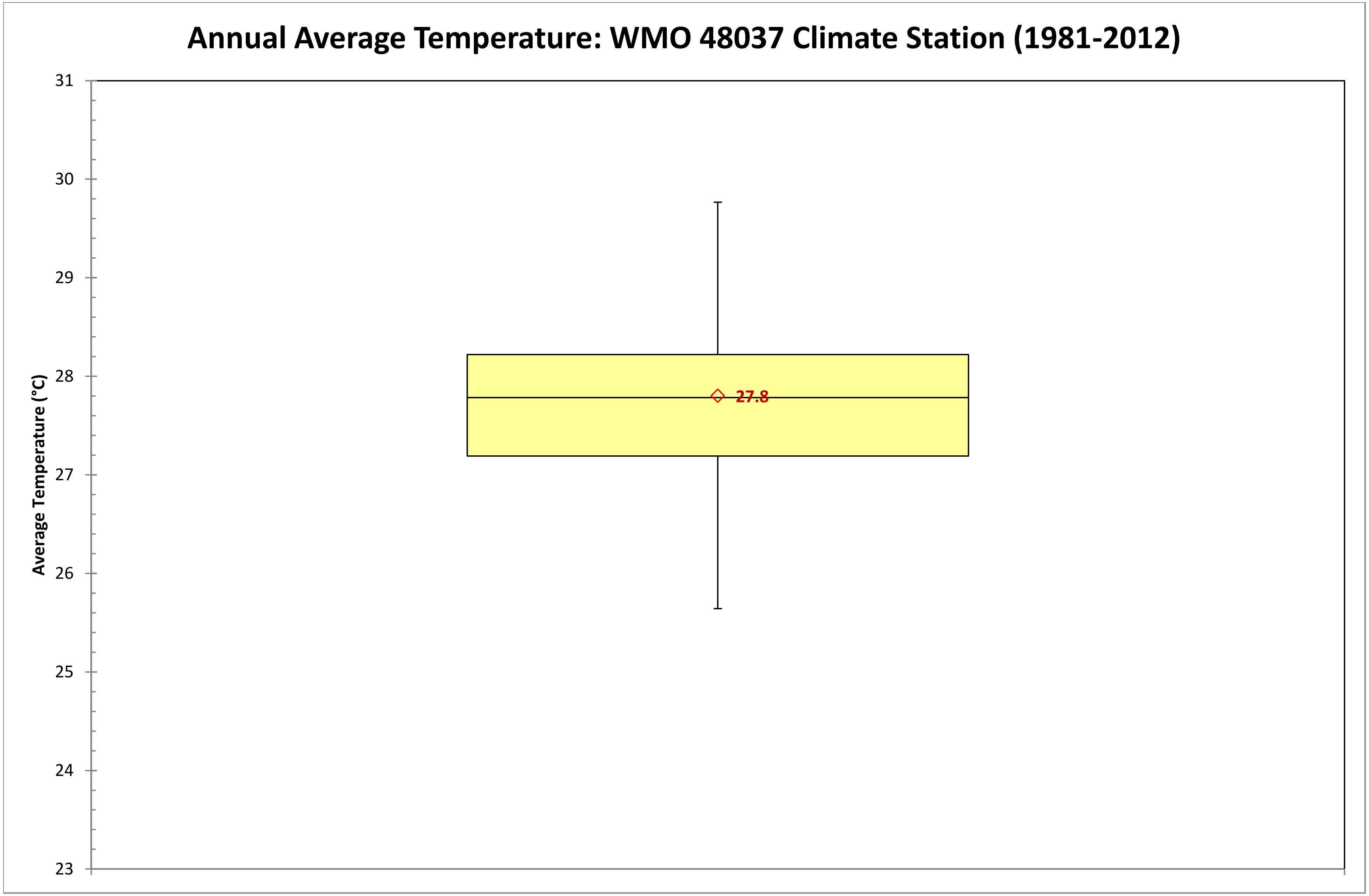
Year	Ave. Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude

Stat	Ave. Temp (°C)
Mean	27.8
SD	0.8
Median	27.8
Q1	27.2
Q3	28.2
Minimum	26.1
Maximum	29.7
Count	25
Ext Max	29.8
Ext Min	25.6
25th Pct	27.2
50th Pct	0.6
75th Pct	0.4
1.5 * IQR	1.5



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers



Annual Average Temperature: WMO 48037 Climate Station (1981-2012)
Average Temperature (°C)
31
30
29
28
27
26
25
24
23
27.8

ATTACHMENT 4.2

Monthly Average Temperature Analysis

Knight Piésold CONSULTING	Subject: Myanmar Wanbao Mining Copper Ltd. | Letpadaung Copper Project Basic Climatology	Made by: AB	Job No.: PE701-00022/04
		Checked: TML	Date: 20/06/2013
		Approved:	Version No. 2.1

Temperature Data, Monthly Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

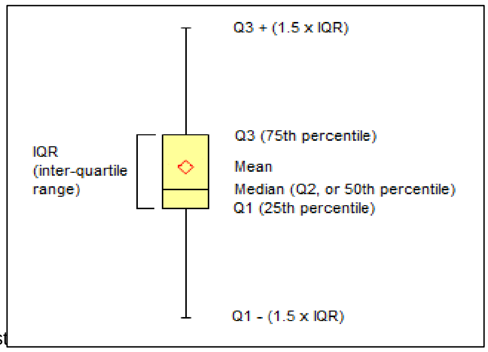
Average Temperature Data (°C)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	23.0	21.5
1982	21.4	23.4	26.3	30.5	31.4	29.9	31.4	29.9	30.3	28.2	25.8	21.3
1983	18.4	21.5	27.2	31.3	32.7	31.2	31.4	29.6	30.1	28.0	23.7	21.1
1984	20.2	23.0	26.9	30.6	30.6	29.4	29.5	29.3	28.0	26.5	23.4	22.0
1985	22.5	22.3	28.7	31.1	30.6	30.1	26.8	29.2	30.4	26.7	23.8	21.9
1986	21.1	23.2	27.6	31.6	32.3	31.1	30.1	28.9	28.8	26.8	N/D	N/D
1987	N/D	21.9	23.1	30.9	28.1	N/D	N/D	29.0	28.9	28.1	24.8	22.7
1988	21.2	N/D	N/D	N/D	30.4	27.8	28.7	28.4	N/D	N/D	N/D	N/D
1989	N/D	N/D	24.8	N/D	31.0	29.3	27.9	28.6	28.2	27.0	23.7	19.9
1990	21.6	21.1	25.8	25.9	28.3	29.0	29.0	30.1	27.8	28.4	25.4	21.2
1991	20.4	23.8	29.5	30.1	30.4	30.6	30.0	29.4	29.3	27.7	23.4	20.1
1992	18.5	21.3	25.9	30.7	31.7	N/D	N/D	29.3	29.8	27.0	23.9	18.4
1993	19.0	22.2	27.8	29.5	30.5	30.7	30.7	29.8	29.1	27.9	25.0	23.1
1994	23.4	23.1	27.2	31.8	32.5	31.9	31.2	32.1	29.7	27.6	25.6	21.4
1995	21.9	25.0	27.4	30.9	31.4	31.9	30.4	29.9	28.8	28.6	25.3	20.7
1996	21.6	23.9	27.4	30.3	31.4	29.3	30.1	28.6	28.6	27.5	25.7	26.8
1997	20.7	23.2	26.6	29.3	33.4	30.5	30.8	29.2	28.4	28.1	26.0	23.8
1998	24.3	24.2	35.5	30.3	31.3	32.9	31.4	31.4	29.7	29.8	27.6	28.0
1999	28.0	32.9	32.9	33.1	29.5	31.8	31.3	30.0	30.3	28.3	24.8	20.4
2000	22.5	22.8	26.5	30.2	29.2	29.9	30.1	31.0	28.6	27.6	24.4	21.3
2001	21.3	24.8	28.0	32.1	29.9	30.1	30.6	29.5	30.4	28.2	25.3	23.3
2002	23.0	25.9	28.9	31.8	30.6	31.2	29.8	28.7	29.2	28.0	24.6	22.6
2003	21.9	24.5	28.0	32.8	29.9	30.3	31.7	30.9	29.7	29.0	26.3	23.8
2004	22.5	24.5	29.5	30.8	33.8	29.9	30.3	31.4	28.9	28.4	27.2	22.9
2005	23.2	27.1	30.4	28.8	32.9	32.0	31.4	30.9	28.9	29.1	25.8	23.1
2006	23.5	25.6	29.3	31.6	31.1	31.2	31.1	30.0	29.0	28.5	26.5	22.0
2007	22.4	23.3	28.8	31.6	30.5	31.4	31.0	30.3	29.5	28.1	25.5	22.9
2008	22.1	23.4	29.5	32.3	30.1	30.5	30.8	30.8	30.3	28.1	24.9	22.9
2009	23.5	26.1	28.1	31.5	31.6	30.2	31.3	30.2	29.4	27.8	25.4	21.3
2010	21.8	24.5	30.9	32.4	33.1	31.9	32.5	30.8	29.8	28.6	26.3	21.8
2011	22.4	23.6	28.1	30.6	31.1	30.2	31.4	29.2	29.8	27.9	25.4	22.5
2012	22.3	25.3	27.9	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D

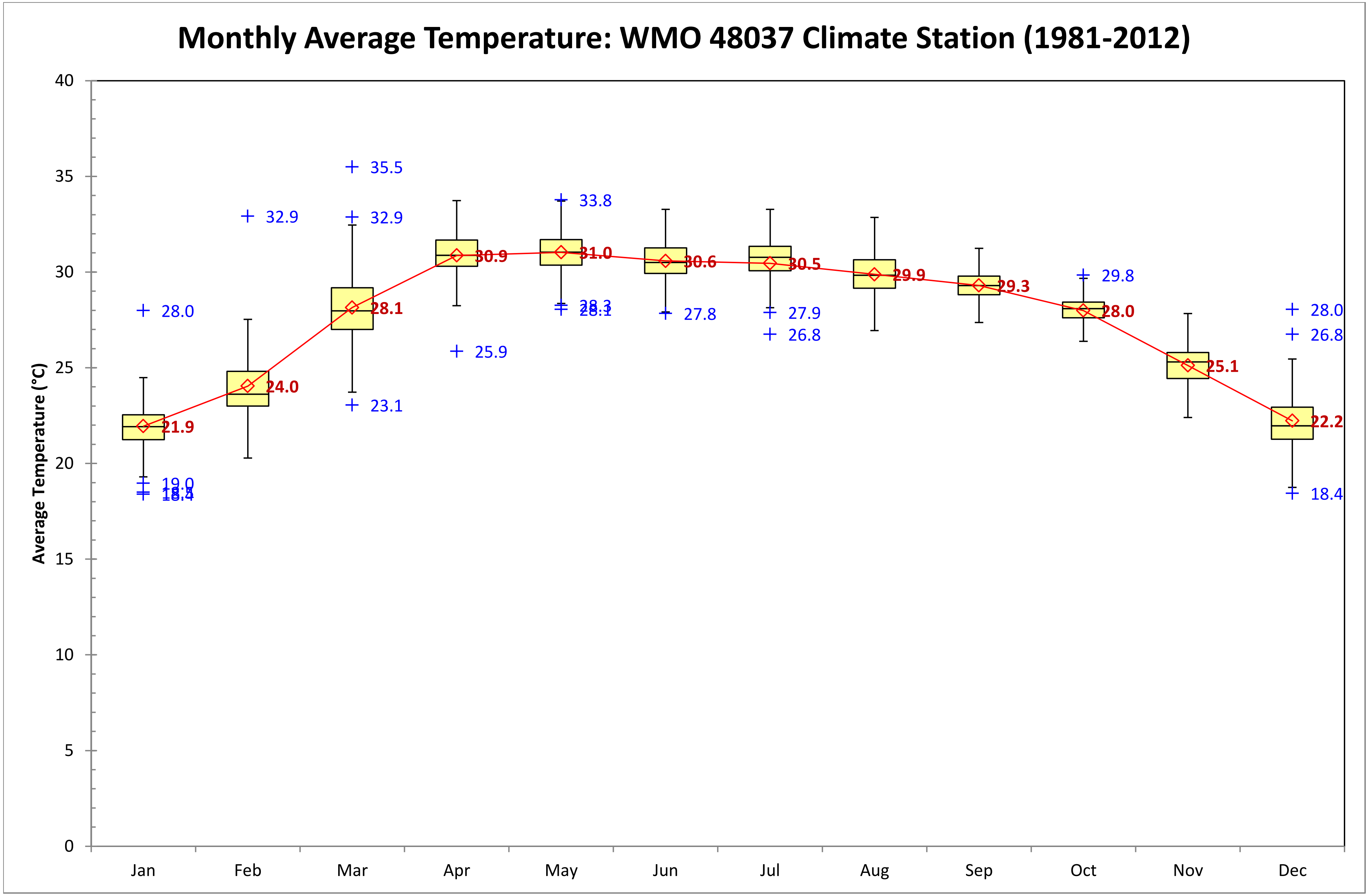
Average Temperature Data Summary Statistics (°C)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
SD	1.9	2.3	2.3	1.4	1.4	1.1	1.2	1.0	0.7	0.7	1.1	1.9
Median	21.9	23.6	28.0	30.9	31.0	30.5	30.8	29.8	29.3	28.1	25.3	22.0
Q1	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
Q3	22.5	24.8	29.2	31.7	31.7	31.3	31.3	30.6	29.8	28.4	25.8	22.9
Minimum	18.4	21.1	23.1	25.9	28.1	27.8	26.8	28.4	27.8	26.5	23.0	18.4
Maximum	28.0	32.9	35.5	33.1	33.8	32.9	32.5	32.1	30.4	29.8	27.6	28.0
Count	29	29	30	28	30	28	28	30	29	29	29	29
Ext Max	24.5	27.5	32.5	33.7	33.7	33.3	33.3	32.9	31.2	29.7	27.8	25.5
Ext Min	19.3	20.3	23.7	28.2	28.4	27.9	28.1	26.9	27.4	26.4	22.4	18.7
25th Pct	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
50th Pct	0.7	0.6	1.0	0.6	0.7	0.6	0.7	0.7	0.5	0.5	0.9	0.7
75th Pct	0.6	1.2	1.2	0.8	0.7	0.8	0.6	0.8	0.5	0.3	0.5	1.0
1.5 * IQR	1.9	2.7	3.3	2.1	2.0	2.0	1.9	2.2	1.5	1.2	2.0	2.5

Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statist





Monthly Average Temperature: WMO 48037 Climate Station (1981-2012)
Average Temperature (°C)
0
5
10
15
20
25
30
35
40
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
28.0
19.0
18.4
32.9
35.5
32.9
23.1
25.9
33.8
28.3
28.1
27.8
27.9
26.8
29.8
28.0
26.8
18.4

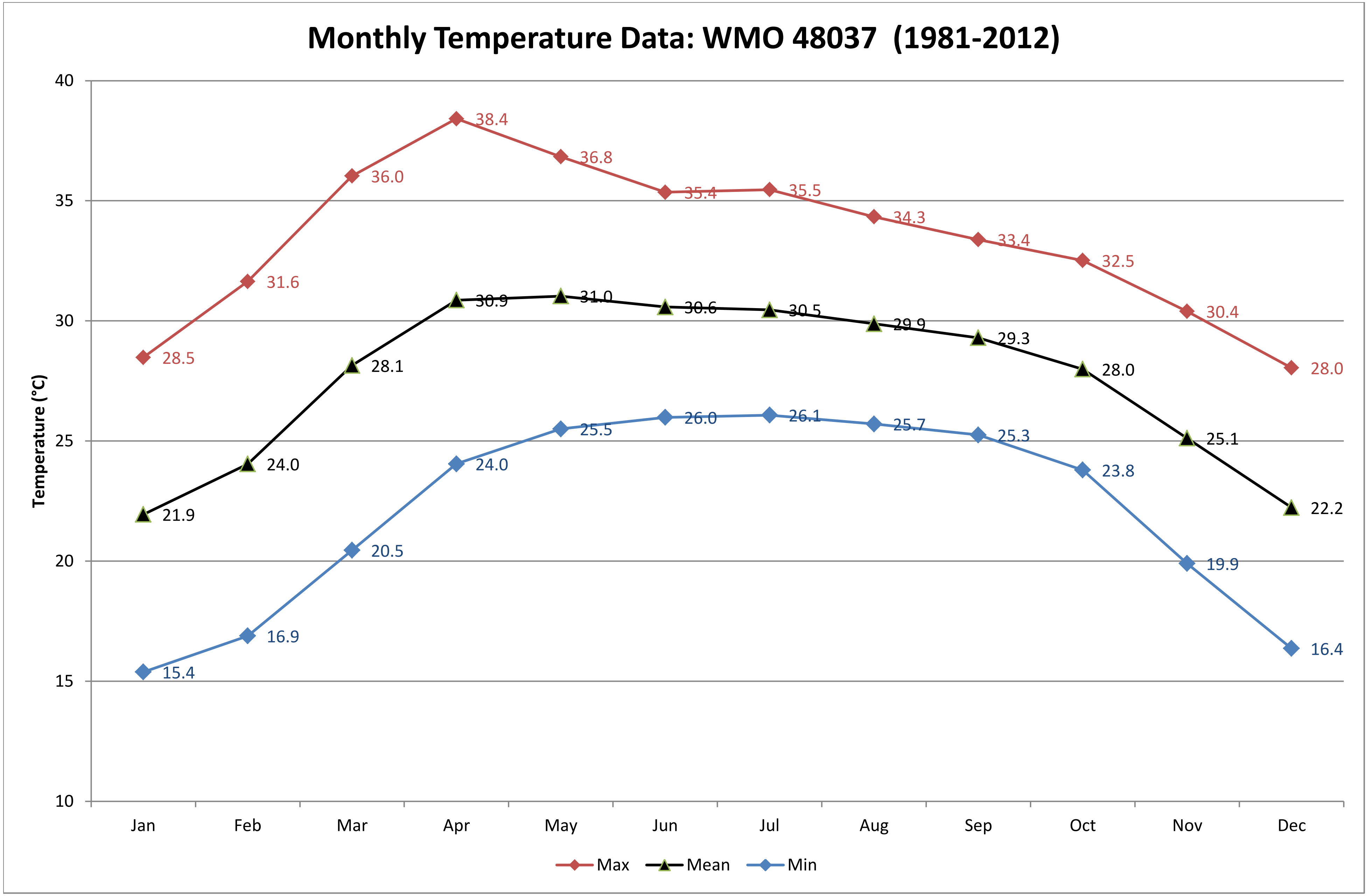
ATTACHMENT 4.3

Monthly Temperature Range Analysis

Knight Piésold CONSULTING	Subject Myanmar Wanbao Mining	Made by AB	Job No. PE701-00022/04
	Copper Ltd. | Letpadaung Copper Project	Checked TML	Date 21/06/2013
	Basic Climatology	Approved	Sheet No.

Monthly Temperature Analysis: WMO 48037 (1981-2012)

Temperature Summary Statistics (°C)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Max	28.5	31.6	36.0	38.4	36.8	35.4	35.5	34.3	33.4	32.5	30.4	28.0
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
Min	15.4	16.9	20.5	24.0	25.5	26.0	26.1	25.7	25.3	23.8	19.9	16.4

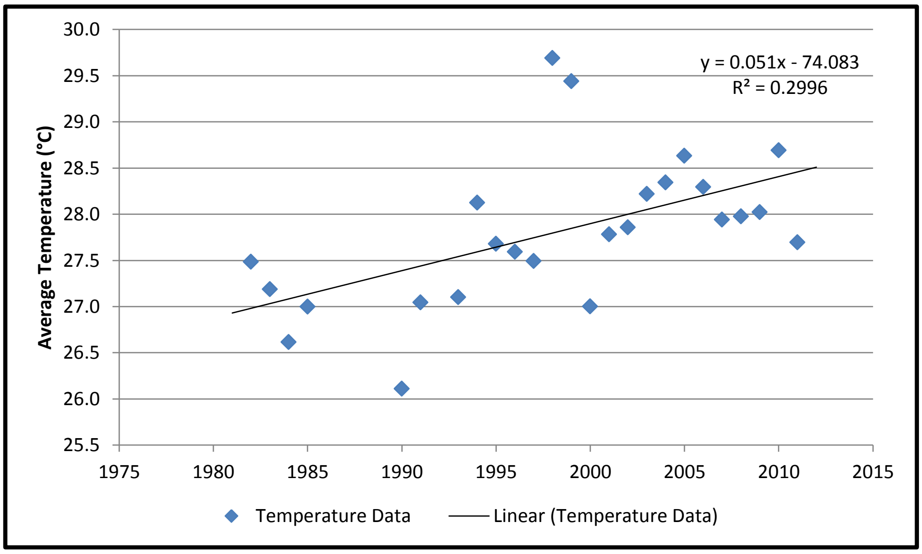

Monthly Temperature Data: WMO 48037 (1981-2012)
Temperature (°C)
40
35
30
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
28.5
31.6
36.0
38.4
36.8
35.4
35.5
34.3
33.4
32.5
30.4
28.0
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
15.4
16.9
20.5
24.0
25.5
26.0
26.1
25.7
25.3
23.8
19.9
16.4
Max
Mean
Min

ATTACHMENT 4.4

Temperature Trend Analysis

Climatic Trend Analysis: WMO 48037 Average Temperature (1981-2012)

Year	Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual average temperature values at this site.

ATTACHMENT 5.1

Wind Rose Analysis

Wind Rose Analysis Results (All Values): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 26,304 **Number of Valid Points:** 26,304 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.90	2.40	3.70	5.10	9.20

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	17.29	0.000	3.015	9.200
22.5	8.76	0.000	2.481	7.400
45.0	4.16	0.000	1.660	7.400
67.5	2.98	0.000	1.047	6.700
90.0	3.87	0.000	1.045	7.300
112.5	4.40	0.000	1.612	6.300
135.0	7.52	0.000	2.141	6.200
157.5	9.18	0.000	2.656	7.600
180.0	7.98	0.000	3.185	8.500
202.5	4.70	0.000	2.997	8.300
225.0	2.71	0.000	2.333	9.000
247.5	2.26	0.000	1.601	7.100
270.0	2.39	0.000	1.354	7.000
292.5	3.09	0.000	1.370	6.700
315.0	4.66	0.000	1.550	6.800
337.5	14.05	0.000	2.961	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	11,172	42.473	0	26,304	100
2 - 4	9,826	37.356	2	15,132	57.527
4 - 6	4,884	18.568	4	5,306	20.172
6 - 8	400	1.521	6	422	1.604
8 - 50	22	0.084	8	22	0.084
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 00:00 to 03:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.20	1.30	2.90	3.90	4.60	7.60

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	17.97	0.000	3.294	5.400
22.5	7.88	0.000	2.608	5.600
45.0	4.05	0.000	2.386	5.300
67.5	2.34	0.000	1.700	4.900
90.0	2.86	0.100	1.723	5.400
112.5	2.74	0.000	2.263	6.000
135.0	3.92	0.100	2.332	6.200
157.5	5.32	0.000	2.825	6.600
180.0	8.00	0.000	3.275	5.600
202.5	5.54	0.000	3.082	5.000
225.0	3.83	0.000	2.329	4.800
247.5	2.52	0.000	1.440	4.500
270.0	3.68	0.000	1.347	4.400
292.5	4.53	0.000	1.602	5.500
315.0	7.21	0.000	1.708	5.000
337.5	17.61	0.000	3.075	7.600
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	1,111	33.79	0	3,288	100
2 - 4	1,452	44.161	2	2,177	66.21
4 - 6	714	21.715	4	725	22.05
6 - 8	11	0.335	6	11	0.335
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 03:00 to 06:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.40	2.30	3.40	4.00	4.90	7.60

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	24.18	0.000	3.381	6.600
22.5	10.58	0.100	2.971	5.500
45.0	4.59	0.100	2.530	6.400
67.5	2.34	0.000	2.174	4.900
90.0	1.98	0.000	1.908	3.800
112.5	2.22	0.000	2.156	3.800
135.0	3.44	0.000	2.471	4.900
157.5	4.71	0.000	3.098	7.600
180.0	5.81	0.100	3.228	7.600
202.5	3.47	0.000	2.687	4.500
225.0	1.76	0.000	1.817	3.900
247.5	1.37	0.000	1.540	4.500
270.0	1.34	0.000	1.809	4.100
292.5	2.19	0.000	2.089	5.500
315.0	3.98	0.000	2.198	5.100
337.5	26.03	0.000	3.815	7.100
Sum:	100.00			

Wind speed bin statistics					
Bin	Counts	Frequency	Exceeding		
(m/s)		(%)	Values > (m/s)	Counts	Frequency (%)
>0 - 2	692	21.046	0	3,288	100
2 - 4	1,675	50.943	2	2,596	78.954
4 - 6	896	27.251	4	921	28.011
6 - 8	25	0.76	6	25	0.76
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 06:00 to 09:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.40	2.30	3.50	4.60	6.10	9.20

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	30.17	0.000	4.112	9.200
22.5	16.09	0.000	3.674	7.400
45.0	5.05	0.000	2.655	5.500
67.5	1.40	0.000	2.022	4.900
90.0	1.31	0.000	1.460	7.300
112.5	1.46	0.000	2.354	6.300
135.0	2.37	0.000	2.205	4.700
157.5	4.56	0.000	2.319	5.700
180.0	5.93	0.000	2.973	6.700
202.5	4.17	0.100	2.889	6.800
225.0	1.55	0.000	1.863	4.000
247.5	1.06	0.100	1.426	3.800
270.0	1.03	0.100	1.229	4.600
292.5	1.40	0.000	1.861	4.400
315.0	2.59	0.000	2.042	4.900
337.5	19.86	0.000	3.887	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	679	20.651	0	3,288	100
2 - 4	1,319	40.116	2	2,609	79.349
4 - 6	1,099	33.425	4	1,290	39.234
6 - 8	178	5.414	6	191	5.809
8 - 50	13	0.395	8	13	0.395
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 09:00 to 12:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.70	2.10	3.40	5.20	8.60

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	31.27	0.000	2.813	8.600
22.5	14.14	0.000	2.300	6.500
45.0	4.05	0.000	1.077	5.800
67.5	2.62	0.000	0.765	6.700
90.0	2.31	0.000	0.736	7.100
112.5	2.71	0.000	1.281	5.600
135.0	4.26	0.000	1.354	5.700
157.5	7.18	0.000	2.002	7.400
180.0	7.57	0.000	2.861	7.800
202.5	3.50	0.000	2.720	7.700
225.0	1.34	0.000	1.161	5.100
247.5	1.00	0.000	1.012	3.800
270.0	1.22	0.000	0.893	5.200
292.5	1.64	0.000	0.661	4.600
315.0	2.59	0.000	1.408	5.200
337.5	12.62	0.000	2.273	8.000
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	**Counts**	**Frequency (%)**	**Exceeding**		
			Values > (m/s)	**Counts**	**Frequency (%)**
>0 - 2	1,559	47.415	0	3,288	100
2 - 4	1,185	36.04	2	1,729	52.585
4 - 6	472	14.355	4	544	16.545
6 - 8	70	2.129	6	72	2.19
8 - 50	2	0.061	8	2	0.061
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 12:00 to 15:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.00	0.20	1.20	2.60	5.00	8.50

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	15.33	0.000	1.768	6.000
22.5	7.48	0.000	1.181	4.700
45.0	4.26	0.000	0.425	3.300
67.5	4.68	0.000	0.203	2.400
90.0	5.93	0.000	0.411	4.500
112.5	5.51	0.000	0.728	5.500
135.0	10.22	0.000	1.469	5.500
157.5	15.82	0.000	2.317	6.700
180.0	10.01	0.000	3.297	8.500
202.5	2.71	0.000	2.581	8.300
225.0	1.49	0.000	2.418	6.500
247.5	1.43	0.000	1.638	6.200
270.0	1.19	0.000	1.249	5.600
292.5	1.83	0.000	1.565	6.400
315.0	2.52	0.000	1.083	5.600
337.5	9.61	0.000	1.577	6.700
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	2,130	64.781	0	3,288	100
2 - 4	792	24.088	2	1,158	35.219
4 - 6	293	8.911	4	366	11.131
6 - 8	67	2.038	6	73	2.22
8 - 50	6	0.182	8	6	0.182
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 15:00 to 18:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.70	1.80	3.10	4.70	7.00

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	7.00	0.000	1.830	5.300
22.5	4.53	0.000	1.410	5.000
45.0	3.44	0.000	0.867	3.400
67.5	4.23	0.000	0.630	4.000
90.0	7.76	0.000	0.808	4.100
112.5	8.70	0.100	1.522	5.800
135.0	20.26	0.000	2.281	5.500
157.5	15.66	0.100	2.797	6.600
180.0	6.75	0.000	3.191	7.000
202.5	3.59	0.000	2.914	7.000
225.0	2.43	0.000	3.099	6.900
247.5	2.01	0.000	2.464	6.900
270.0	1.76	0.000	1.995	6.400
292.5	2.31	0.000	1.403	6.700
315.0	2.59	0.000	1.351	5.300
337.5	7.00	0.000	1.837	5.700
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	**Counts**	**Frequency (%)**	**Exceeding**		
			Values > (m/s)	**Counts**	**Frequency (%)**
>0 - 2	1,778	54.075	0	3,288	100
2 - 4	1,110	33.759	2	1,510	45.925
4 - 6	373	11.344	4	400	12.165
6 - 8	27	0.821	6	27	0.821
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 18:00 to 21:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.00	0.50	2.00	3.60	4.80	7.00

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	5.99	0.000	1.550	4.600
22.5	4.99	0.000	1.399	6.800
45.0	3.95	0.000	1.217	5.000
67.5	3.86	0.000	1.030	4.800
90.0	5.23	0.000	1.226	5.600
112.5	8.39	0.000	1.866	5.200
135.0	10.86	0.000	2.585	5.800
157.5	12.41	0.000	3.027	6.200
180.0	10.65	0.000	3.359	6.300
202.5	5.93	0.000	3.003	6.300
225.0	4.81	0.000	2.452	6.700
247.5	3.98	0.000	1.595	6.600
270.0	2.80	0.000	1.386	7.000
292.5	3.04	0.000	1.055	5.500
315.0	4.96	0.000	1.013	6.800
337.5	8.15	0.000	2.057	6.200
Sum:	100.00			

Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
			Values >	**Counts**	**Frequency**
(m/s)		**(%)**	**(m/s)**		**(%)**
>0 - 2	1,619	49.24	0	3,288	100
2 - 4	1,131	34.398	2	1,669	50.76
4 - 6	522	15.876	4	538	16.363
6 - 8	16	0.487	6	16	0.487
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 21:00 to 00:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	**5th Pct. (m/s)**	**25th Pct. (m/s)**	**50th Pct. (m/s)**	**75th Pct. (m/s)**	**95th Pct. (m/s)**	**Max. (m/s)**
0.00	0.10	0.70	2.00	3.50	4.60	9.00

Directional wind speed sampling statistics				
Wind Direction		**Wind Speed**		
Direction (°)	**Frequency (%)**	**Min. (m/s)**	**Ave. (m/s)**	**Max. (m/s)**
0.0	6.39	0.000	2.322	5.000
22.5	4.41	0.000	1.839	4.800
45.0	3.89	0.000	1.698	7.400
67.5	2.37	0.000	1.468	6.500
90.0	3.56	0.000	1.377	5.100
112.5	3.50	0.000	1.707	5.200
135.0	4.87	0.000	2.244	5.700
157.5	7.76	0.000	2.892	5.100
180.0	9.16	0.000	3.157	5.400
202.5	8.73	0.000	3.389	6.500
225.0	4.44	0.000	2.483	9.000
247.5	4.71	0.000	1.496	7.100
270.0	6.11	0.000	1.192	5.500
292.5	7.76	0.000	1.160	4.500
315.0	10.86	0.000	1.526	4.900
337.5	11.50	0.000	2.493	5.700
Sum:	100.00			

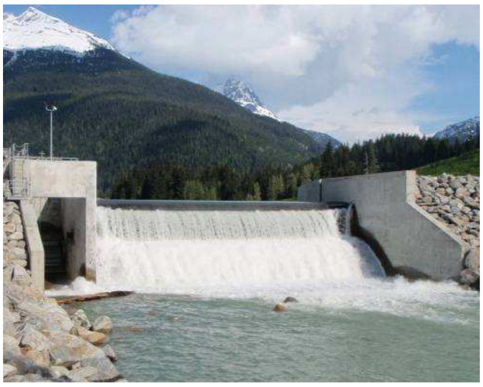
Wind speed bin statistics					
Bin	**Counts**	**Frequency**	**Exceeding**		
(m/s)		**(%)**	**Values > (m/s)**	**Counts**	**Frequency (%)**
>0 - 2	1,604	48.783	0	3,288	100
2 - 4	1,162	35.341	2	1,684	51.217
4 - 6	515	15.663	4	522	15.876
6 - 8	6	0.182	6	7	0.213
8 - 50	1	0.03	8	1	0.03
50 - 89	0	0.000	50	0	0.000

APPENDIX B

Waste Rock Geochemical Assessment (KP Report PE701-00022/16)

Knight Piésold
CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT



WASTE ROCK GEOCHEMICAL ASSESSMENT

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited
(MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

PE701-00022/16
Rev 0
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www.knightpiesold.com

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MYANMAR WANBAO MINING COPPER LTD

LETPADAUNG COPPER PROJECT

WASTE ROCK GEOCHEMICAL ASSESSMENT

KP Job No. PE701-00022/04

CONTRACT

DOCUMENT INFORMATION

REV	DESCRIPTION	PREPARED	REVIEW	KNIGHT PIESOLD APPROVAL	DATE
A	Issued as Draft	TDR	BL	DJTM	01/07/2013
B	Issued for Client Review	TDR/EJT	TDR	DJTM	15/07/2013
0	Issued as Final	TDR/EJT	TDR	DJTM	26/08/2013

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EXECUTIVE SUMMARY

Knight Piésold was requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The project will comprise a high throughput heap leach copper project which will generate approximately 1 billion tonnes of waste rock over the 33 year mine life.

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for this study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

The waste rock, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble,

especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas.
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps.
- Full encapsulation of all waste with a suitable compacted soil liner.
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material.
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height.
- Installation of interim covers, the frequency of which is still to be determined.

Instrumentation and monitoring of the quality of the construction and the performance of the encapsulation system will be required to confirm that the design intent is being achieved and sulfide oxidation has been reduced to acceptable levels.

1. INTRODUCTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The Letpadaung Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

Knight Piésold has conducted an initial geochemical assessment, with samples of waste rock selected and sent to an accredited laboratory for analysis. This report presents the results of the geochemical analysis, with interpretation of the acid generation and metal leaching risk and the implications for the mine waste management at the site. This report follows an interim report which was issued by Knight Piésold prior to receipt of all the test work results (Ref. 1).

It should be noted that this geochemical assessment only relates to the waste rock to be produced by the Letpadaung project. Geochemical studies into the heap leach pad are also required to allow for the design of seepage control measures and closure capping.

1.1 PROJECT DESCRIPTION

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

1.2 GEOLOGICAL SETTING

The following overview of the geological setting comprises excerpts from the Feasibility Study by Mineral Resources Development (Ref. 2).

The Monywa copper district is located along north-south trending Inner Volcanic Arc, which lies within the Central Burma Tectonic Belt. The project is a high sulfidation mineral system with andesite porphyry the most common rock type hosting the copper

mineralisation. Pyroclastics are the second most abundant rock type at Letpadaung, including tuffs and breccias and reworked volcaniclastic siltstones and sandstones.

Typical alteration zones common to most high sulfidation systems are observed at the Letpadaung Project, including residual silica zones, silica-alunite zones, argillic zones and chlorite zones. Copper mineralisation at Letpadaung is dominated by hypogene chalcocite / digenite, covellite and supergene chalcocite. The copper sulfide mineralisation is overlain by a 10 to 200 m thick strongly weathered leach cap. The leach cap can be considered waste material as it contains very limited economic copper mineralisation.

1.3 PREVIOUS GEOCHEMICAL WORK

Two high level geochemical studies have been conducted at the Letpadaung Project and the neighbouring S&K project. These studies have been reviewed and are summarised in the following sections.

Overall there is a very limited amount of geochemical data (twenty one relevant samples) considering the size of the deposit and the clear risk of acid rock drainage that exists from high sulfidation systems. Furthermore, the methods employed in the two studies have not been tailored to suit the mineralogy of the deposit. Therefore, the results and subsequent conclusions are considered questionable.

1.3.1 Feasibility Study Report

An assessment into the acid rock drainage potential of the Letpadaung Project was conducted by Coffey Partners International Pty Ltd in 1997 (Ref. 3) as part of the feasibility study. This study included geochemical testing of ten waste rock samples collected from both the S&K Deposit and the Letpadaung deposit, with material taken from both the leach cap and the internal waste.

The analysis included determination of total sulfur, pyritic sulfur, sulfate sulfur and “unidentified sulfur”. The total sulfur content in nine out of ten sample was high to extremely high (0.68 to 9.12%) with only a single sample of leach cap lapilli tuff exhibiting a low total sulfur content (<0.01%).

The total sulfur was used to calculate the maximum potential acidity which resulted in nine of the ten samples being classified as potentially acid generating. This approach appears to be overly conservative as the majority of the sulfur in leach cap sample was unidentified sulfur and a large proportion of the sulfur in the internal waste was also present as unidentified sulfur. The leach cap samples were essential devoid of pyritic sulfur.

The acid neutralising capacity (ANC) of the samples was highly variable ranging from material which was essential devoid of ANC (<0.01 kg $CaCO_3$/t) up to a sample with a very high ANC (141 kg $CaCO_3$/t). However, the majority of samples exhibited very low to moderate ANC (0.2 to 10 kg $CaCO_3$/t).

The assessment conducted by Coffey concluded that six out of ten samples were Acid Producing (i.e. had positive net acid producing potentials) with a further three samples classified as Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) with only a single sample was classified as Non Acid Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of less than 2). However, as noted earlier, the presence of unidentified sulfur in the samples could have significantly impacted the acid producing classifications.

The unidentified sulfur could be present in mineral forms which may not be acid generating, such as barite or alunite, but as no mineralogical analysis was conducted on the samples it is not possible to definitively determine the nature of the unidentified sulfur. However, previous geological assessments of the deposit do list alunite as being present (Ref. 2, 4 and 5) and, therefore, it is reasonable to assume that some of the unidentified sulfur is present as alunite. If the results of the assessment are recalculated using just the pyritic sulfur to calculate the maximum potential acidity, only 50% of the samples would be classified as potentially acid forming, rather than the 90% reported by Coffey.

1.3.2 ARD Investigation for S&K

An investigation into acid rock drainage and hydrogeological conditions at the S&K project was conducted by Westec Inc. in 1997 (Ref. 6). As part of the investigation, six grab samples and seven core samples were tested using basic static testing methods. It is worth noting that total sulfur values were used to generate the estimates of maximum potential acidity, as was conducted in the Coffey study and, therefore, the acid generating potential of the samples is likely to have been overestimated if non-acid forming sulfur containing minerals were also present in these samples.

Two of the samples tested were limestone / soil samples assessing potential sources of ARD mitigation material. These samples are not relevant to an assessment of the acid formation potential of the deposit itself and, therefore, have been excluded from the discussion of results below.

The results of this assessment indicate that six of the eleven relevant samples were found to be Acid Producing (i.e. had positive net acid producing potentials), two were found to be Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) and three samples were found to be Non Acid

Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of greater than 2).

2. SAMPLE SELECTION

A site visit was undertaken by Bruce Zhang and Tim Rowles of Knight Piésold from the 25th April through to the 28th April 2013 to gather background data on the project and to select and collect samples of waste rock for geochemical testing.

It was originally intended to select samples of waste rock for geochemical analyses from eleven boreholes recently drilled by Wanbao Myanmar. However, ten of these boreholes were found to be located around the periphery of the pit, with one borehole well outside of the pit limits. Therefore, samples were instead selected from ten of the recently drilled boreholes (i.e. those located around the edge of the pit) plus three boreholes which were drilled within the centre of the pit by Ivanhoe. The core was examined prior to selecting samples and was found to be in good condition with no visible signs of significant oxidation.

A total of one hundred and fifty samples were selected from the boreholes within waste zones. These samples represent the range of waste rock lithologies recorded on the geological logs and also an appropriate range of copper and sulfur grades based on the existing assay results which accompanied the logs. Samples were taken from 5 m below ground level to the current pit design base of 450 m depth. The selected samples are summarised in Table 2.1, with a detailed listing provided in Table 2.2.

Table 2.1: Summary Selected Samples

Lithology	Number of Samples
Andesite Porphyry	95
Breccia	14
Diorite Porphyry	12
Pyroclastic	7
Fault Breccia	5
Hydrothermal Breccia	5
Porphyry	5
Dyke	3
Tuff	2
Hornblend Porphyry	1
Feldspar Porphyry	1

Samples were taken from the core trays by manually breaking the core and taking part of the core, leaving the remainder of the core within the trays. Approximately 500 g to 1 kg of core was collected for each sample from the drill intervals indicated in Table 2.2. The samples were placed in cloth bags, labelled and collated into a single crate before being shipped to Genalysis Intertek in Perth for testing.

Table 2.2: Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-001	LS001	25	Andesite Porphyry
701-22-002	LS001	59	Andesite Porphyry
701-22-003	LS001	65.5	Andesite Porphyry
701-22-004	LS001	89.25	Andesite Porphyry
701-22-005	LS001	122	Andesite Porphyry
701-22-006	LS001	136.75	Dyke
701-22-007	LS001	185	Dyke
701-22-008	LS001	221.65	Dyke
701-22-009	LS001	249.15	Andesite Porphyry
701-22-010	LS001	290.75	Andesite Porphyry
701-22-011	LS001	304.05	Andesite Porphyry
701-22-012	LS001	368.85	Andesite Porphyry
701-22-013	LS001	395	Andesite Porphyry
701-22-014	LS001	411.1	Andesite Porphyry
701-22-015	LS001	423.5	Andesite Porphyry
701-22-016	LS002	94.3	Andesite Porphyry
701-22-017	LS002	104.13	Breccia
701-22-018	LS002	128.6	Andesite Porphyry
701-22-019	LS002	148.4	Andesite Porphyry
701-22-020	LS002	355.8	Diorite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-021	LS002	373	Andesite Porphyry
701-22-022	LS002	422.5	Andesite Porphyry
701-22-023	LS002	435.3	Andesite Porphyry
701-22-024	LS002	448.85	Andesite Porphyry
701-22-025	LS002	472.85	Andesite Porphyry
701-22-026	LS003	21.3	Andesite Porphyry
701-22-027	LS003	70	Andesite Porphyry
701-22-028	LS003	74.3	Andesite Porphyry
701-22-029	LS003	97	Andesite Porphyry
701-22-030	LS003	115.5	Andesite Porphyry
701-22-031	LS003	131.7	Andesite Porphyry
701-22-032	LS003	146.75	Breccia
701-22-033	LS003	170.02	Diorite Porphyry
701-22-034	LS003	182.4	Diorite Porphyry
701-22-035	LS003	274.25	Diorite Porphyry
701-22-036	LS003	298.3	Diorite Porphyry
701-22-037	LS003	305	Diorite Porphyry
701-22-038	LS003	324.8	Breccia
701-22-039	LS003	330.2	Andesite Porphyry
701-22-040	LS003	342.8	Diorite Porphyry

ID	Borehole	Depth	Lithology
701-22-041	LS003	353.35	Feldspar Porphyry
701-22-042	LS003	377.5	Andesite Porphyry
701-22-043	LS003	394.75	Porphyry
701-22-044	LS003	410.9	Porphyry
701-22-045	LS003	440.8	Breccia
701-22-046	LS004	30.21	Andesite Porphyry
701-22-047	LS004	50.21	Andesite Porphyry
701-22-048	LS004	69.25	Andesite Porphyry
701-22-049	LS004	110.45	Andesite Porphyry
701-22-050	LS004	134.45	Andesite Porphyry
701-22-051	LS005	28.4	Diorite Porphyry
701-22-052	LS005	50.1	Diorite Porphyry
701-22-053	LS005	72.5	Breccia
701-22-054	LS005	133.9	Breccia
701-22-055	LS005	141.4	Diorite Porphyry
701-22-056	LS006	34.3	Andesite Porphyry
701-22-057	LS006	52.3	Andesite Porphyry
701-22-058	LS006	70.3	Andesite Porphyry
701-22-059	LS006	127.6	Andesite Porphyry
701-22-060	LS006	140.4	Breccia

ID	Borehole	Depth	Lithology
701-22-061	LK002	16.05	Porphyry
701-22-062	LK002	36.3	Andesite Porphyry
701-22-063	LK002	113.6	Breccia
701-22-064	LK002	133.3	Porphyry
701-22-065	LK002	167.3	Porphyry
701-22-066	LK003	40.3	Andesite Porphyry
701-22-067	LK003	54.9	Breccia
701-22-068	LK003	108.6	Breccia
701-22-069	LK003	128.7	Pyroclastic
701-22-070	LK003	145.6	Tuff
701-22-071	LK004	51.23	Hornblende Porphyry
701-22-072	LK004	71.63	Breccia
701-22-073	LK004	81.52	Breccia
701-22-074	LK004	104.71	Andesite Porphyry
701-22-075	LK004	137.51	Diorite Porphyry
701-22-076	LK006	45.2	Breccia
701-22-077	LK006	51.8	Andesite Porphyry
701-22-078	LK006	129.7	Andesite Porphyry
701-22-079	LK006	145.7	Breccia
701-22-080	LK006	165.86	Diorite Porphyry

Table 2.2 (Continued): Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-081	LK006	191.35	Tuff
701-22-082	LK006	214.6	Pyroclastic
701-22-083	L013	5	Andesite Porphyry
701-22-084	L013	11	Andesite Porphyry
701-22-085	L013	17.7	Andesite Porphyry
701-22-086	L013	23.4	Andesite Porphyry
701-22-087	L013	28.9	Andesite Porphyry
701-22-088	L013	34.9	Andesite Porphyry
701-22-089	L013	41.25	Andesite Porphyry
701-22-090	L013	47.7	Andesite Porphyry
701-22-091	L013	52.9	Andesite Porphyry
701-22-092	L013	58.8	Andesite Porphyry
701-22-093	L013	69	Andesite Porphyry
701-22-094	L013	75	Hydrotherm al Breccia
701-22-095	L013	81.9	Hydrotherm al Breccia
701-22-096	L013	86.55	Hydrotherm al Breccia
701-22-097	L013	93.25	Fault Breccia
701-22-098	L013	100.4	Hydrotherm al Breccia
701-22-099	L013	127.55	Andesite Porphyry
701-22-100	L013	177.05	Andesite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-101	L013	199.75	Andesite Porphyry
701-22-102	L223	121.75	Fault Breccia
701-22-103	L223	131	Andesite Porphyry
701-22-104	L223	137	Andesite Porphyry
701-22-105	L223	142.1	Andesite Porphyry
701-22-106	L223	150	Andesite Porphyry
701-22-107	L223	156	Andesite Porphyry
701-22-108	L223	164.55	Andesite Porphyry
701-22-109	L223	170	Andesite Porphyry
701-22-110	L223	178.05	Andesite Porphyry
701-22-111	L223	184	Andesite Porphyry
701-22-112	L223	191.95	Andesite Porphyry
701-22-113	L223	198	Andesite Porphyry
701-22-114	L223	206.5	Andesite Porphyry
701-22-115	L223	212	Andesite Porphyry
701-22-116	L223	220.05	Andesite Porphyry
701-22-117	L223	231.2	Andesite Porphyry
701-22-118	L223	240.4	Andesite Porphyry
701-22-119	L223	244	Fault Breccia
701-22-120	L223	319.3	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-121	L223	325.4	Andesite Porphyry
701-22-122	L223	340.3	Fault Breccia
701-22-123	L087	6	Pyroclastic
701-22-124	L087	16	Pyroclastic
701-22-125	L087	26	Pyroclastic
701-22-126	L087	36	Pyroclastic
701-22-127	L087	46	Pyroclastic
701-22-128	L087	56	Andesite Porphyry
701-22-129	L087	66	Fault Breccia
701-22-130	L087	76	Andesite Porphyry
701-22-131	L087	86	Andesite Porphyry
701-22-132	L087	96	Andesite Porphyry
701-22-133	L087	106	Andesite Porphyry
701-22-134	L087	116	Andesite Porphyry
701-22-135	L087	126	Andesite Porphyry
701-22-136	L087	134	Andesite Porphyry
701-22-137	L087	144	Andesite Porphyry
701-22-138	L087	158	Andesite Porphyry
701-22-139	L087	170	Andesite Porphyry
701-22-140	L087	184	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-141	L087	200	Andesite Porphyry
701-22-142	L087	210	Andesite Porphyry
701-22-143	L087	216	Andesite Porphyry
701-22-144	L087	252	Andesite Porphyry
701-22-145	L087	262	Andesite Porphyry
701-22-146	L087	272	Andesite Porphyry
701-22-147	L087	292	Andesite Porphyry
701-22-148	L087	330	Hydrotherm al Breccia
701-22-149	L087	349.7	Andesite Porphyry
701-22-150	L087	340	Andesite Porphyry

3. TESTWORK METHODS

3.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses a sample's potential to form acid from the oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

Total sulfur and total carbon were determined by LECO induction furnace, with infrared detection. Acid soluble sulfur (HCL S), which includes readily soluble sulfate minerals such as melanterite, epsomite, gypsum and anhydrite as well as a portion of the less soluble iron hydroxyl sulfates such as jarosite, was determined using a hydrochloric acid digest on the solid sample followed by ICP determination of the sulfur content of the digest solution.

Due the presence of alunite and natroalunite in the deposit which would not be identified using the hydrochloric acid digest method, the Chromium Reducible Sulfur (CRS) test was also conducted on the samples to determine the sulfide sulfur content.

The various sulfur species present were then calculated as follows:

Sulfide sulfur (%) = CRS (%)

Acid soluble sulfate (%) = HCL S (%)

Non-acid soluble sulfate (%) = Total sulfur (%) – CRS (%) – HCL S (%)

The test work methods used are based on the ABA methodology defined in the MEND Prediction Manual for Drainage Chemistry from Sulfidic Geological Material (Ref. 7), MEND Acid Rock Drainage Prediction Manual (Ref. 8), and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 9).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used is based on Sobek et al (Ref. 10), however, a siderite correction step has been added to the method, after Stewart et al (Ref. 11).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA), which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfides are present as pyrite.

The Net Acid Producing Potential (NAPP) is the balance between the Maximum Potential Acidity and the Acid Neutralising Capacity. A negative NAPP indicates that there is an excess neutralising capacity and a positive NAPP indicates there is excess potential acidity.

3.2 STATIC NET ACID GENERATION

Static Net Acid Generation (NAG) test work is a direct measure of a sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

The NAG test procedure used is based upon the Static NAG Test (Ref. 12 and 13). The static NAG test involves the addition of 250 mL of 15 per cent hydrogen peroxide to 2.5g of pulverised sample. The sample is allowed to react overnight prior to heating for a period of three hours. Once the sample has cooled, the pH of the solution is measured prior to titration back to pH 4.5 and 7 to determine the acidity produced by the oxidisation reactions.

3.3 ACID FORMING POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (ANC).

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes, and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA, as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG test results to classify the acid formation potential of materials. Knight Piésold's classification system, as summarised in Table 3.1, is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Table 3.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5

3.4 MULTI-ELEMENT ANALYSIS OF SOLIDS

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. A four acid digestion method was employed for the majority of the analyses, with element specific methods used for selenium, mercury and boron.

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:

C_n = measured concentration of element in sample

B_n = average crustal abundance (Bowen, Ref. 17)

The GAI is expressed on a scale of 0 to 6, with 0 indicating that the element concentration is less than or similar to the average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

3.5 X-RAY DIFFRACTION ANALAYSIS

Fifteen of the samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. For each sample a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content. On a limited number of samples a grab of sample was prepared by adding an internal standard, TiO_2, and micronising the mixture to 4 µm. The spiked samples were each prepared as an un-oriented powder mount. A duplicate sample was analysed for every fifteen samples submitted.

The XRD patterns were produced on a PANalytical Cubix[3] XRD fitted with copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3° to 65°2 θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database. Quantitative phase analysis was performed using SIROQUANTTM Version 3 software.

3.6 DISTILLED WATER EXTRACT TESTING

Distilled water extraction tests were conducted on fifty samples to assess the potential for leaching of environmentally significant elements from the waste rock, which could have a detrimental effect on the quality of surface water or near surface groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements, whereas the multi-element tests give the total elemental enrichment of the waste.

The test procedure is based upon the Shake Flask Method as described in the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Ref. 9).

The samples were crushed to minus 2 mm particle size, with 50 grams of each sample then mixed with 150 mL of deionized water in suitably sized vessels. The mixtures were then bottle rolled for 24 hours. The pH and the conductivity of the solutions were then measured and the bottles left to stand for a minimum of 3 hours. The solution was then siphoned off and filtered through a 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) or Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) depending on the element being analysed and the detection limits required.

The distilled water extract test results were compared to a set of reference water quality standards which are discussed in Section 3.7.

3.7 REFERENCE WATER QUALITY STANDARDS

To allow assessment of the results of the distilled water extract analysis, a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 18 & 19) and the ANZECC water quality guideline for livestock drinking water (Ref. 20)).

The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in various guidelines, the lowest concentration has been adopted. These reference values for release from mining operations are presented in Table 3.2.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by the production of the reference water quality values that the Letpadaung Project will be required to meet these reference levels, or that these reference levels should be used as the regulatory framework. The regulatory requirements for the project will be determined by the relevant regulatory authorities during the environmental design phase of the project.

These reference levels are to be used for a preliminary assessment of water quality only. More detailed assessment of the impact of any release from the mine site may be required in later design stages to assess the impact on receiving environments, such as aquatic systems, where different water quality requirements may be applicable.

Table 3.2: Reference Water Quality Guidelines – Release from Mining Operations

Parameter	ANZECC Livestock (mg/L)	IFC 2004 (mg/L)	IFC 2007 (mg/L)	Adopted Reference Level (mg/L)
pH		6 to 9	6 to 9	6 to 9
TDS	2000			2000
Aluminum	5			5
Antimony				N/G
Arsenic	0.5	0.1	0.1	0.1
Barium				N/G
Boron	5			5
Cadmium	0.01	0.1	0.05	0.01
Calcium	1000			1000
Chloride				N/G
Chromium	1			1
Chromium (Cr^{+6})		0.1	0.1	0.1
Cobalt	1			1
Copper	0.4	0.5	0.3	0.3
Cyanide-Total			1	1
Cyanide-Free			0.1	0.1
Cyanide-WAD		0.5	0.5	0.5
Fluoride	2	20		2
Iron		3.5	2	2
Lead	0.1	0.1	0.2	0.1
Magnesium	2000			2000
Manganese				N/G
Mercury	0.002	0.01	0.002	0.002
Molybdenum	0.15			0.15
Nickel	1	0.5	0.5	0.5
Phosphorus				N/G
Selenium	0.02	0.1		0.02
Silver		0.5		0.5
Sodium				N/G
Sulfate	1000			1000
Tin				N/G
Uranium	0.2			0.2
Vanadium				N/G
Zinc	20	2	0.5	0.5

N/G = No guideline value

4. GEOCHEMICAL RESULTS

4.1 XRAY DIFFRACTION

Fifteen samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. The summarised results for the XRD analysis are presented in Table 4.1 with the full results provided in Appendix A. The interpreted results are summarised as follows:

- The most common mineral found in the samples was quartz, comprising between 23% and 63% of the overall sample, averaging 39%.
- Clay minerals including illite, smectite, kaolin and chlorite were found to comprise between 4% and 38% of the samples, averaging 20.5%.
- The amorphous content of the samples ranged from 3% to 35%, averaging 16%.
- Natroalunite and alunite were present in 11 of the 15 samples. These are important minerals in the assessment of acid rock drainage as they commonly lead to overestimation of the sulfide content. The natroalunite and alunite were present at between 0% and 28% but were highly variable and showed no correlation with depth or lithology.
- The carbonate content of the samples varied from 0% to 16%, averaging 3.8%. However, the most common carbonate found in the deposit was siderite (from 0% to 11% and averaging 0.9%). Siderite does not provide any neutralising capacity when the full neutralisation and hydrolysis of aqueous iron is accounted for.
- Two sulfide minerals were identified in the analysis. Pyrite the most common sulfide mineral from 0% to 16% and averaging 4.5%, with chalcopyrite identified in a single sample at 1%.

Table 4.1: Summarised XRD Results

Mineral	Group	Average	Max	Min
Quartz	Silicate	39.3	63.0	23.0
Amorphous content	N/A	15.9	35.0	3.0
Natroalunite	Sulfate	7.5	28.0	0.0
Interlayered illite/ smectite	Clay	8.4	22.0	0.0
Pyrophyllite	Clay	4.3	22.0	0.0
Kaolin	Clay	5.5	22.0	0.0
Chlorite	Clay	1.6	13.0	0.0
Hematite	Oxide	1.1	15.0	0.0
Sodium calcium plagioclase	Feldspar	2.1	12.0	0.0
Pyrite	Sulfide	4.5	16.0	0.0
Siderite	Carbonate	0.9	11.0	0.0
Palygorskite	Clay	0.5	7.0	0.0
Illite/Muscovite	Mica	5.1	16.0	0.0
Potassium feldspar	Feldspar	1.4	8.0	0.0
Ankerite	Carbonate	0.3	4.0	0.0
Dolomite	Carbonate	1.5	8.0	0.0
Calcite	Carbonate	0.7	7.0	0.0
Magnesite	Carbonate	0.4	4.0	0.0
Expanding clay	Clay	0.1	2.0	0.0
Chloritoid	Clay	0.1	2.0	0.0
Diaspore	Hydroxide	0.1	2.0	0.0
Alunite	Sulfate	0.3	3.0	0.0
Jarosite	Hydroxide	0.2	1.0	0.0
Anhydrite	Sulfate	0.1	1.0	0.0
Anatase	Oxide	0.1	1.0	0.0
Chalcopyrite	Sulfide	0.1	1.0	0.0

4.2 SULFUR ANALYSES

The total sulfur content of the waste rock was determined by LECO combustion. In addition, the samples were analysed for sulfide (as Chromium Reducible Sulfur) and sulfate (by acid digest). The results of the analyses are summarised in the following sections, with complete results provided in Appendix B.

4.2.1 Total Sulfur

The total sulfur contents were found to be highly variable across the samples, ranging from 0.03% to 26.6% with an average of 3.49%. The total sulfur contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.1. The total sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.2. The results indicate that 90% of the samples would be classified as having a high to extremely high total sulfur content.

Table 4.2: Total Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 -5%	Extremely High >5%
All	-	4%	3%	3%	35%	35%	20%
Andesite Porphyry	-	5%	4%	4%	45%	26%	15%
Breccia	-	-	-	-	14%	43%	43%
Diorite Porphyry	-	-	-	-	25%	58%	17%
Dyke	-	-	-	-	-	33%	67%
Fault Breccia	-	-	-	-	60%	20%	20%
Feldspar Porphyry	-	-	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	-	80%	20%
Porphyry	-	-	-	-	20%	40%	40%
Pyroclastic	-	-	14%	-	14%	71%	-
Tuff	-	-	-	-	-	50%	50%

4.2.1 Acid Soluble Sulfate

The acid soluble sulfate was found to be highly variable across the samples, ranging from 0.01% to 1.59% with an average of 0.36%. The acid soluble sulfate contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.2. The acid soluble sulfate results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.3. The results indicate that all samples have between 0.01% and 2% acid soluble sulfate, with the highest proportion of samples having between 0.1% and 0.3% sulfate. This indicates that there is a low proportion of readily soluble sulfate within the deposit.

Table 4.3: Acid Soluble Sulfate by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 - 5%	Extremely High >5%
All	-	23%	33%	20%	24%	-	-
Andesite Porphyry	-	27%	36%	20%	17%	-	-
Breccia	-	29%	36%	29%	7%	-	-
Diorite Porphyry	-	25%	33%	33%	8%	-	-
Dyke	-	33%	-	-	67%	-	-
Fault Breccia	-	-	40%	20%	40%	-	-
Feldspar Porphyry	-	-	-	100%	-	-	-
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	100%	-	-
Porphyry	-	-	-	-	100%	-	-
Pyroclastic	-	-	43%	-	57%	-	-
Tuff	-	-	50%	50%	-	-	-

4.2.1 Sulfide Sulfur

Analysis for chromium reducible sulfur was only conducted on those samples which had a total sulfur content of greater than 0.1%. For samples where the chromium reducible sulfur was measured, this was assumed to represent the total sulfide content. For samples with less than 0.1% total sulfur, the sulfide content was assumed to be equal to:

Sulfide Sulfur (%S) = Total Sulfur (%S) – Acid Soluble Sulfate (%S)

The sulfide sulfur contents were found to be highly variable across the samples, ranging from 0.00% to 18.95% with an average of 2.12%. The sulfide sulfur contents showed a slight degree of correlation with depth, as there were more samples with low or insignificant sulfide sulfur contents shallower in the deposit (i.e. up to around 200 m depth). Below 200 m depth there were no samples with less than 0.25% sulfide sulfur. The sulfide contents also showed some correlation to copper grade, with slightly higher copper contents in samples with greater than 5% sulfide sulfur. The distribution of sulfide sulfur, copper grade and depth is presented in Figure 4.3. Although neither of these relationships was suitably well defined or consistent enough to allow either depth

or copper grade to be used as an indicator of likely sulfide sulfur contents, it does indicate that low grade ore which may be stockpiled on site during operations may have higher sulfide contents than general waste rock.

The sulfide sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping presented in Table 4.4. The results indicate that about 25% of the samples had a sulfide content of less than 0.3% (i.e. in the extremely low to low range), 32% of samples had moderate to high sulfide sulfur and 38% of the samples had very high to extremely high sulfide sulfur.

Table 4.4: Sulfide Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 – 2%	Very High 2 – 5%	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
Andesite Porphyry	8%	20%	5%	7%	31%	21%	7%
Breccia	-	-	-	-	21%	43%	36%
Diorite Porphyry	-	-	-	17%	17%	50%	17%
Dyke	-	-	-	-	-	67%	33%
Fault Breccia	-	40%	-	-	40%	20%	-
Feldspar Porphyry	-	-	-	-	-	100%	-
Hornblend Porphyry	100%	-	-	-	-	-	-
Hydrothermal Breccia	-	80%	-	-	-	-	20%
Porphyry	-	20%	20%	20%	-	20%	20%
Pyroclastic	-	71%	-	-	14%	14%	-
Tuff	-	-	-	-	-	50%	50%

The sulfide sulfur results have also been summarised by depth, as this may be useful in mine planning. The results of this classification are provided in Table 4.5.

Table 4.5: Sulfide Sulfur by Depth

Depth (m)	Extremely Low <0.01%	Very low 0.01 - 0.1	Low 0.1 - 0.3	Moderate 0.3 - 0.5	High 0.5 - 2	Very High 2 - 5	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
0 to 50	-	68%	-	5%	18%	5%	5%
50 to 100	3%	37%	7%	10%	23%	20%	-
100 to 150	-	14%	3%	3%	31%	37%	11%
150 to 200	-	32%	-	-	26%	26%	16%
200 to 250	-	18%	9%	18%	36%	18%	-
250 to 300	-	-	-	-	-	43%	57%
300 to 350	-	-	9%	9%	18%	36%	27%
350 to 400	-	-	14%	14%	14%	57%	-
400 to 472	-	-	-	13%	38%	13%	38%

4.3 ACID NEUTRALISING CAPACITY AND CARBONATE CONTENT

The acid neutralising capacity (ANC) of the samples was determined along with the carbon content which, based on the geology of the deposit, was assumed to be representative of the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non-carbonate minerals.

The average acid neutralising capacity of all the samples was moderate to high at 15.4 kg H_2SO_4/t, however, there was a high degree of variability within the samples with the ANC varying from -23 to 155 kg H_2SO_4/t. The negative acid neutralising capacity values are a result of more alkali being required to back titrate the sample solutions to the end point of the test compared to the volume of acid which was added during the test. This indicates that there is residual acidity in the samples. This is discussed further in Section 4.4.

The samples with very high to extremely high acid neutralising capacities were located within discreet zones (i.e. borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m) rather than being evenly distributed throughout the deposit. The carbonate contents of these samples were also significantly higher compared to the other samples, indicating that the carbonates were resulting in the high acid neutralising capacities, as would be expected. The XRD analysis shows that the carbonate minerals in the samples with the high acid neutralising capacity are a mix of ankerite, calcite, dolomite and magnesite.

The calcium and magnesium carbonates will provide significant acid neutralising capacity, however, the ankerite will only provide limited neutralising capacity.

The very high to extremely high acid neutralising capacities were not restricted to a single lithology, suggesting broad scale carbonate alteration within discreet zones.

Outside of these high acid neutralising zones, the acid neutralising capacity was generally very low averaging just 2.9 kg H_2SO_4/t, with approximately 20% of the samples having negative acid neutralising capacities.

The distribution of the acid neutralising capacity with depth and the relationship between acid neutralising capacity and carbonate are shown in Figure 4.4. The distribution of acid neutralising capacity with lithology and depth are provided in Tables 4.6 and 4.7 respectively.

Table 4.6: Acid Neutralising Capacity by Lithology

Lithology	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
Andesite Porphyry	23%	14%	41%	3%	5%	13%	1%
Breccia	21%	21%	36%	-	7%	14%	-
Diorite Porphyry	8%	17%	33%	8%	17%	17%	-
Dyke	100%	-	-	-	-	-	-
Fault Breccia	20%	20%	60%	-	-	-	-
Feldspar Porphyry	-	100%	-	-	-	-	-
Hornblend Porphyry	-	-	-	-	-	100%	-
Hydrothermal Breccia	100%	-	-	-	-	-	-
Porphyry	40%	60%	-	-	-	-	-
Pyroclastic	-	29%	57%	14%	-	-	-
Tuff	50%	-	50%	-	-	-	-

Table 4.7: Acid Neutralising Capacity by Depth

Depth (m)	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
0 to 50	9%	14%	64%	5%	5%	5%	-
50 to 100	20%	20%	33%	-	10%	17%	-
100 to 150	26%	14%	46%	9%	3%	3%	-
150 to 200	16%	16%	32%	-	-	32%	5%
200 to 250	27%	-	27%	-	9%	36%	-
250 to 300	71%	29%	-	-	-	-	-
300 to 350	36%	27%	27%	-	9%	-	-
350 to 400	43%	29%	-	14%	14%	-	-
400 to 472	38%	13%	50%	-	-	-	-

4.4 PASTE pH

The paste pH of the samples was measured at a 1:3 (soil:water) ratio. The pH results ranged from 2.7 to 9.7, with almost a third of samples recording a paste pH of less than 4.5, indicating that a significant proportion of samples contain residual acidity which is readily released when placed in contact with water. In addition, 64 samples recorded a paste pH of between 4.5 and 7, with the remaining 38 samples recording paste pH values greater than 7.

There was no apparent relationship between paste pH and lithology, as shown in Table 4.8. However, reviewing the paste pH results versus sample depths indicates that the vast majority of samples from below 250 m in the deposit recorded paste pH of less than 7, as shown in Table 4.9. The results of the paste pH testing are also provided in Figure 4.5.

Table 4.8: Paste pH by Lithology

Lithology	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
Andesite Porphyry	29%	44%	26%
Breccia	36%	43%	21%
Diorite Porphyry	17%	83%	-
Dyke	100%	-	-
Fault Breccia	40%	40%	20%
Feldspar Porphyry	-	100%	-
Hornblend Porphyry	-	-	100%
Hydrothermal Breccia	20%	80%	-
Porphyry	60%	40%	-
Pyroclastic	29%	29%	43%
Tuff	100%	-	-

Table 4.9: Paste pH by Depth

Depth (m)	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
0 to 50	18%	55%	27%
50 to 100	27%	33%	40%
100 to 150	40%	43%	17%
150 to 200	37%	26%	37%
200 to 250	27%	27%	45%
250 to 300	71%	29%	0%
300 to 350	55%	36%	9%
350 to 400	0%	86%	14%
400 to 472	13%	88%	0%

4.5 NET ACID GENERATION

The NAG test involves the addition of hydrogen peroxide (15% H_2O_2 at a pH of 4.5) to the samples, which oxidises the contained sulfide minerals to release sulfuric acid, which is then neutralised by any available acid consuming minerals within the sample. The pH of the solution is measured and then titrated back to pH 4.5 and then pH 7.0 to give an indication of the net acid generation potential of the sample. As such, a NAG pH of below 4.5 indicates that excess acidity is produced and a pH of greater than 4.5 indicates that excess alkalinity is present.

The NAG test resulted in 96 samples producing NAG pH values of less than pH 4.5, indicating that these samples produce excess acidity under the extreme oxidising conditions imposed by the NAG test. The remaining 54 samples produced pH values greater than 4.5.

The NAG pH shows a strong correlation with depth, with a much greater number of samples recording NAG pH values above 4.5 in the upper 250 m of deposit. Below 250 m depth, all samples were found to have NAG pH values below 4.5 (with the exception of a single sample), as shown in Figure 4.6.

The NAG test has been demonstrated to accurately assess the acid formation potential for samples with less than 1% sulfide sulfur. However, for samples with greater than 1% sulfide sulfur, it is possible that the volume of hydrogen peroxide added during the test may be insufficient to fully oxidise all the sulfide sulfur, resulting in the acid production potential being underestimated. In addition, if these samples with high sulfide sulfur contents also have high ANC values, the final NAG pH may be neutral to alkaline, which would be misleading. Therefore, given that approximately 50% of the samples had sulfide sulfur contents greater than 1%, this limitation of the NAG test has been considered during interpretation of the acid formation potential, as discussed in Section 4.6.

4.6 ACID FORMATION POTENTIAL

To estimate the Acid Formation Potential (AFP) of the samples, the Maximum Potential Acidity (MPA) was calculated based on the sulfide sulfur results using the following formula:

Maximum Potential Acidity (kg H_2SO_4/t) = Sulfide Sulfur (%) x 30.6

This calculation assumes that all the sulfide sulfur is present as pyrite. The mineralogical analysis of the Letpadaung samples indicates that the most common sulfide mineral is pyrite and, therefore, the MPA values calculated from the sulfide contents of the Letpadaung samples is likely to be reasonably accurate.

The Net Acid Producing Potential (NAPP) was then calculated from the Maximum Potential Acidity (MPA) and the measured Acid Neutralising Capacity (ANC) using the following formula:

Net Acid Producing Potential* = Maximum Potential Acidity* – Acid Neutralising Capacity*
**All units kg H_2SO_4/t*

As discussed in Section 3.3 of this report, Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system (as presented in Table 3.1) is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Overall almost a third (30%) of the samples tested were found to be either non-acid forming (25%) or acid consuming (5%), with a further 4% classified as having an uncertain acid formation potential. The remaining 67% of the samples were classified as either Potentially Acid Forming – Low Capacity (9%) or Potentially Acid Forming (58%).

The six samples which were classified as 'uncertain' recorded conflicting acid base accounting results. Five of these samples had low sulfide sulfur contents (0.04% to 0.05%) and very low ANC values (-3 to 3 kg H_2SO_4/t). As such, the samples had marginal NAPP values (-1.8 to 4.2 kg H_2SO_4/t) and NAG pH values around the acid forming cut-off of 4.5. Therefore, these samples should be assumed to be Potentially Acid Forming – Low Capacity.

The other sample which was classified as 'uncertain' produced a NAG pH of 4.8 and a positive NAPP of 16.5 kg H_2SO_4/t. However, review of the acid base accounting results indicates that the sample also had a high sulfide content of 1.26% and a high ANC of 23 kg H_2SO_4/t. Therefore, it is likely that the hydrogen peroxide added in the NAG test was insufficient to oxidise all of the sulfide minerals and, as such, the sample should be considered as potentially acid forming.

<u>Overall 29% of the waste samples can considered as Non Acid Forming with the remaining 71% considered Potentially Acid Forming.</u>

There was no apparent correlation between acid formation potential and lithology, as is shown in Table 4.10 and Figure 4.7.

The distribution of the PAF samples showed a reasonable correlation with depth, with 60% of the samples classified as non-acid forming located within the upper 50 m of the

deposit. The proportion of non-acid forming material decreases with depth and below 250 m, the vast majority of the waste can be considered potentially acid forming. The distribution of acid forming potential by depth is provided in Table 4.11 and Figure 4.8.

Table 4.10: Acid Formation Potential by Lithology

Lithology	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
Andesite Porphyry	5%	29%	3%	7%	55%
Breccia	7%	7%	-	-	86%
Diorite Porphyry	8%	17%	-	-	75%
Dyke	-	-	-	-	100%
Fault Breccia	-	20%	20%	-	60%
Feldspar Porphyry	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-
Hydrothermal Breccia	-	-	40%	40%	20%
Porphyry	-	-	-	60%	40%
Pyroclastic	-	57%	-	14%	29%
Tuff	-	-	-	-	100%

Table 4.11: Acid Formation Potential by Depth

Depth (m)	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
0 to 50	0%	59%	5%	14%	23%
50 to 100	7%	33%	10%	17%	33%
100 to 150	0%	17%	3%	3%	77%
150 to 200	16%	21%	0%	0%	63%
200 to 250	18%	27%	9%	0%	45%
250 to 300	0%	0%	0%	0%	100%
300 to 350	0%	0%	0%	18%	82%
350 to 400	0%	14%	0%	14%	71%
400 to 472	0%	0%	0%	13%	88%

In addition to the acid formation potential classification presented above, another measure of the AFP is the ratio between the ANC and the MPA, as samples which have excess ANC over the MPA have an ANC/MPA ratio greater than 1 and those with excess acidity (i.e. PAF) have an ANC/MPA ratio of less than 1.

There is a broad consensus across the industry that samples which have an ANC/MPA ratio of greater than 2 have a high factor of safety against generation of acid, providing that the acid neutralising capacity is available from highly reactive carbonate (i.e. calcite). Where the neutralising capacity is available from other minerals, such as the iron and magnesium rich carbonates present at Letpadaung, then an ANC/MPA ratio of greater than 3 is required to have a high factor of safety.

The ANC/MPA ratios of the samples indicate that approximately 46% of the non-acid forming and acid consuming samples have low factor of safety (ANC/MPA ratio <2), with 19% of the non-acid forming and acid consuming samples having a moderate factor of safety (ANC/MPA ratio 2 to 3) and the remaining 35% of samples having a high factor of safety (ANC/MPA ratio greater than 3).

The samples with a high factor of safety are predominantly those with high ANC (>80 kg H_2SO_4/t) and are generally restricted to the zones within the deposit which have carbonate alteration (borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m).

For the non-acid forming samples with a low factor of safety, care needs to be taken as there is the potential that the rate of sulfide oxidation may exceed the rate of acid neutralisation available from the neutralising minerals. **Additional testing of the material which has been classified as non-acid forming but has a low ANC/MPA ratio is recommended to confirm that these samples will not generate acid.**

The acid formation potential classifications and associated factors of safety according to the ANC and MPA (calculated from sulfide sulfur) are presented in figures 4.9 and 4.10.

4.7 MULTI-ELEMENT ANALYSIS

Multi-element analysis of the samples was conducted to assess element enrichments. The multi-element analysis results were compared to the average crustal abundance to calculate the geochemical abundance indices. The geochemical abundance index quantifies an assay result for a particular element in terms of average crustal abundance.

The multi-element assay results are presented in Appendix C, with the average crustal abundances (ACA) and corresponding geochemical abundance indices (GAI) presented in Appendix D. The results are also summarised below.

The results of the analyses show that the samples have a high level of elemental enrichment. Fourteen elements were found to be highly enriched in at least one sample, namely sulfur, tellurium, selenium, bismuth, rhenium, arsenic, silver, lead,

copper, indium, antimony, cadmium, molybdenum and zinc. A further four elements were found to be significantly enriched in at least one sample, namely tungsten, tantalum, manganese and mercury, with at least one sample found to be slightly enriched in uranium, tin, caesium, iron, strontium and lithium (all elements listed in decreasing levels of enrichment). However, it should be noted that the laboratory detection limits for tellurium and selenium were equivalent to a significantly enriched classification. Therefore, samples which recorded concentrations of tellurium and selenium below the limits of detection have conservatively been assigned a significantly enriched classification.

There was no apparent correlation between overall enrichment and lithology or depth, however, a weak correlation between total sulfur grades and enrichment was observed, whereby samples with higher total sulfur grades typically recorded higher overall levels of enrichment. In addition, a correlation was observed between acid formation potential and overall enrichments, with PAF and UC samples recording higher levels of enrichment compared to NAF and AC samples.

4.8 DISTILLED WATER EXTRACT

Distilled water extract tests were undertaken to assess whether metals are likely to leach from the waste rock at environmentally significant concentrations. A total of 50 samples were analysed for distilled water extract, samples selected such that all key waste lithologies were represented across a range of copper enrichment levels.

The extract results have been compared to reference guidelines for release from mining operations and livestock drinking water. The extract solutions were generally found to be of a poor quality, with only twelve samples (24%) meeting all the water quality guidelines. In addition, the average concentrations (of all samples) for aluminium, cadmium, copper, iron and zinc were found to exceed the water quality criteria. In addition, there were exceedances for cobalt (3 samples), molybdenum (3 samples), nickel (4 samples), sulfate (1 sample) and uranium (1 sample), although the average concentrations of these elements from all samples were within the water quality criteria.

The majority of the extract solutions also recorded pH values below the lower bound acceptance criteria of pH 6. The results of the distilled water extract testing compared to the reference water quality guidelines are presented in Appendix E.

The distilled water extract results have also been compared to the acid forming potential of the samples. Overall, 40% of the AC samples and 70% of the NAF samples met all the water quality criteria, with only 9% of the PAF, PAF-LC and UC

samples meeting all guidelines. This is also reflected in the average concentrations of dissolved metals from each acid forming classification group, as shown in Table 4.12, which indicates that the PAF material is most likely to leach metals at unacceptable concentrations. This is likely partly due to the fact that the pH of the PAF extract solutions typically recorded lower pH values compared to the NAF and AC samples. However, on the basis of these results, **all waste material has the potential to leach metals at environmentally significant concentrations, especially when acidic conditions are imposed.**

Table 4.12: Average Distilled Water Extract Results by AFP

Acid Formation Potential	Al	Cd	Cu	Fe	Mo	Zn	pH*
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	-
AC	1.96	0.00003	0.03	0.46	**0.52**	0.01	8.5
NAF	1.41	0.00011	**2.88**	0.759	0.024	0.08	8.4
PAF	**10.04**	**0.02**	**17.36**	**26.7**	0.001	**2.84**	**3.8**
PAF-LC	0.73	0.006	**0.49**	0.11	0.002	0.31	**3.4**
UC	0.72	0.001	**1.59**	0.10	0.0001	0.24	**5.2**
All Samples	**6.01**	**0.012**	**10.1**	**14.61**	0.06	**1.60**	**4.0**
Water Quality Reference Level	5.0	0.01	0.3	2.0	0.15	0.5	6.0 – 9.0

**Note: pH is based on a logarithmic scale, which has been accounted for when calculating the average pH values. These values are for indicative purposes only.*

5. IMPLICATIONS FOR WASTE ROCK MANAGEMENT

Based on the results of this geochemical assessment, the implications for waste rock management are presented in the following sections.

5.1 ACID GENERATION

The results of the test work indicate that the potential for acid generation at the Letpadaung project is very high to extreme with material at all depths and from all lithologies within the deposit capable of generating acid.

The geochemistry indicates that for the majority of material, i.e. that which has a low acid neutralising capacity, the onset of acid generation is likely to be rapid with limited lag times (although this needs to be confirmed, as detailed in Section 5.3.1). There is also the potential for large quantities of acid to be generated, with the average net acid producing potential of the PAF material calculated at 87 kg H_2SO_4/t. This equates to tens of millions of tonnes of acid which could be potentially be generated by the waste if it is allowed to freely oxidise. It is therefore apparent that allowing the waste to oxidise and lime treating the acid after formation would have an extremely high cost both in terms of the supply of lime and the management and disposal of the neutralisation sludge. For this reason, active management of the mine waste at the project will be required during operations to minimise the likelihood of the waste acidifying, as discussed in Sections 5.3 to 5.5.

5.2 ENRICHMENT AND METAL LEACHING

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. The PAF material was found to have the highest metal leaching potential, although a portion of the AC and NAF samples were also found to leach certain metals above the reference water quality criteria. Further, the pH of the extract solutions from the AC and NAF remained circum neutral during the test, compared to the PAF solutions which became acidic. Therefore, it is likely that the NAF and AC material would also leach metals, and perhaps to the same extent as the PAF material, should acidic conditions develop within the waste dumps. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from the waste dumps at Letpadaung.

5.3 ONGOING WASTE ROCK CHARACTERISATION

Very limited geochemical characterisation of the deposit has been conducted, especially considering the scale of the project and the high risk profile of high sulfur porphyry systems. As such, additional geochemical work will be required pre-mining

and throughout the life of the project. The scale of the work which will be required will be large and will probably warrant establishing an onsite geochemical laboratory to handle the large number of samples and to ensure a rapid turnaround of results.

5.3.1 Pre-Mining Geochemical Characterisation

The results of this test work give an indication of the extent and severity of the likely acid generation of the material contained within the Letpadaung deposit and provides an indication of the drainage water chemistry from the material when it is mined. The results, however, do not provide information on the likely lag time to acidification or the drainage chemistry which is likely to result after oxidation and acidification of the waste. These factors need to be established prior to bulk mining to allow a detailed mine waste management plan to be produced, which will need to be appropriately tailored to the material at Letpadaung.

As such, it is recommended that an additional testing programme be conducted prior to bulk mining at the project. This test work should comprise additional acid base accounting of the material to be mined in the first year(s) of operations to establish more accurate estimates of the proportion of the PAF / NAF material which will generated in these early stages and allow for design and planning of the initial waste dumps.

The scope of this investigation would likely be similar to that presented herewith. However, as this geochemical assessment has shown a good correlation between the NAG test and the other acid base accounting analysis, it may be possible to limit the testing of the majority of the samples to NAG testing only, with detailed geochemistry only conducted on a limited number of samples. **It is therefore recommended that:**

- **Several hundred samples are collected from the waste zones to be mined in Years 1 and 2 of operations.**
- **All samples are submitted for NAG testing, and approximately 20% of the samples have full acid base accounting test work.**

This investigation is critical to defining operational controls for the project and verifying the proposed operational testing procedures and classification criteria.

In addition to this testing, **kinetic testing is required to establish sulfide oxidation rates, the availability of acid neutralising capacity, the lag times to acidification and the drainage water chemistry for a range of materials.** These tests involve accelerated leaching of material by optimising the conditions for acid formation through repeated wetting and drying cycles and free availability of oxygen. The tests should be conducted on materials from all acid formation potential classifications, i.e. acid

consuming, non-acid forming, uncertain and potentially acid forming. Further, it is recommended that around 20 samples are prepared for kinetic testing, with the selected samples biased towards material which will be mined over the next 2 to 5 years.

5.3.2 Operational Geochemical Classification

To allow for active management of potentially acid generating material during operations, there will be a requirement to conduct geochemical testing throughout the life of the project. The scale of the project and the mining rate (~30 Mtpa of waste) is such that a dedicated on site laboratory will be required to manage this test work. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

Test work will be required on grade control samples or blast hole samples ahead of mining to allow waste blocks to be classified and allow potentially acid generating material to be identified for selective handling. Based on the geochemistry of the Letpadaung deposit, conventional operational testing using total sulfur grades and acid neutralising capacity to determine the acid formation potential of the material will not be appropriate, as the alunite and natroalunite will lead to the incorrect classification of a significant proportion of the waste. The alternate tests which are available to the project are chromium reducible sulfur with acid neutralising capacity or the net acid generation test (NAG) test.

A chromium reducible sulfur and acid neutralising capacity testing programme would be slow to conduct and expensive. Therefore, it is considered unsuitable for such a large scale operation, and the NAG test is recommended for ongoing classification of the acid formation potential of the material.

The NAG test should be conducted on bench height composite samples sourced from closely spaced grade control or blast hole chips (i.e. no more than 15m for each mining bench). The NAG test produces three results when conducted in its entirety; the NAG pH, $NAG_{4.5}$ and $NAG_{7.0}$.

The NAG pH provides a quick reference of the likely acid formation potential of the samples but is hard to model in conventional mining planning software as it is a logarithmic scale. Therefore, the NAG pH is not considered suitable for short term mine planning.

The $NAG_{7.0}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 7.0. For many mining operations, this measure is used to determine the acid formation potential of the waste and can be readily modelled.

However, at Letpadaung the waste has an inherently low in situ pH (generally below pH 7.0) and the use of the $NAG_{7.0}$ results would cause almost all material to be classified as potentially acid forming, which would be overly conservative.

It is therefore recommended that the $NAG_{4.5}$ is used to classify the acid formation potential of the waste material at Letpadaung. The $NAG_{4.5}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 4.5 and the result is expressed in kg H_2SO_4/t which, being a non-logarithmic scale, can be modelled in mine planning software.

Given that the distilled water extract testing has indicated that the vast majority of the waste contains leachable metals, there unlikely to be any benefit of conducting additional testing to characterise the leaching potential of the waste, as significant testing would be required to likely identify only a small proportion of suitable NAF waste rock which could be placed on the outer faces of the waste dumps, where it would be subject to rainfall percolation and will higher leachate rates. Instead, it is recommended that all waste be considered leachable and managed appropriately. This is discussed further in Sections 5.5.4 and 5.5.5.

5.4 RATIONAL FOR ACTIVE WASTE MANAGEMENT

The issue of acid rock drainage has been recognised as a significant issue since the 1970's. Initially, management of acid rock drainage focused on treatment of effluent to reduce the downstream environmental impacts. However, it was soon established that the costs associated with long term treatment (lasting decades or longer) was a significant burden and, in some cases, the cost of treatment exceeded the initial profits generated by the mining activities. In the 1990's, research and development started to focus on the reduction of acid rock drainage from mine waste through the application of cover systems post mining. This approach, however, has proven to only be partially effective and in some cases has added little overall benefit, as covers installed post mining do not prevent the oxidation products (which have been generated during mining operations) from continuing to the be released post closure.

A schematic of the generation of oxidation products over time and measurement of acid load in a system where capping was conducted at the end of operations is provided in Figure 5.1. It shows that installation of the cover system had little impact on the acid load and, in fact, the highest acid loads requiring treatment occurred after capping the waste.

Current research into the generation of acid rock drainage has found that the most effective method of control is to minimise the oxidation of waste both during operations

and on closure to prevent a build-up of oxidation products which would otherwise require treatment during operations and post closure. To achieve this aim, an understanding of the mechanisms of oxidation in waste dumps is required.

The oxidation of sulfide minerals requires the presence of both oxygen and water. The amount of water required to allow the sulfide minerals to oxidise is small, and there is generally enough moisture either naturally contained in the waste rock or from atmospheric humidity that the supply of water is not a limiting factor in the initial oxidation of sulfide minerals. There are some exceptions to this, such as hyper arid regions (e.g. the Atacama Desert) but for Letpadaung it is considered that supply of water will not be a limiting factor for initiating sulfide oxidation.

In a geological setting where acid generating material is located above the water table, the rates of oxygen flux into the material is normally sufficiently slow to limit the rate of oxidation to a level where the acid generated can be naturally buffered. However, when sulfidic material is disturbed through mining operations, the amount of oxygen available for sulfide oxidation increases, allowing higher rates of sulfide oxidation to occur. When the rate of sulfide oxidation exceeds the rate at which the naturally occurring neutralising capacity can buffer the acidity, the material acidifies leading to acid rock drainage.

There are two primary mechanisms for sulfide oxidation; the first, which is discussed above, involves atmospheric oxygen and water (equation 5.1). This reaction generally prevails in circum-neutral pH conditions and is a relatively slow reaction. However, as the pH of the material drops through sulfide oxidation, the iron in the system is oxidised to ferric iron (equation 5.2) and this ferric iron then starts to act as the oxidising agent for the sulfide minerals (equation 5.3). This ferric iron reaction is orders of magnitude faster and results in a rapidly increasing rate of sulfide oxidation and consequent acid generation.

$$FeS_2 + 7/2O_2 + H_2O \longrightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad (5.1)$$

$$Fe^{2+} + 1/4O_2 + H^+ \longrightarrow Fe^{3+} + 1/2H_2O \quad (5.2)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O \longrightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+ \quad (5.3)$$

Waste rock in a conventional waste dump design is dumped from a tip head which may vary in height from 10 m to over 100 m. The action of dumping the waste from a high tip head acts to segregate the waste with the coarser material rilling to base of the tip head and the finer material being retained at the top of the dump. This forms a coarse rubble zone at the base of the tip head and alternating sloping layers of finer and coarse waste through the dump.

The coarse rubble zone and coarse sloping layers allows oxygen to freely flow into and penetrate deep into the waste dump which leads to the initiation of sulfide oxidation within the coarse layers and within the adjacent finer grained material. This initial sulfide oxidation generates heat (as reactions 5.1 & 5.3 are exothermic) which then causes the warm, oxygen depleted air to rise through the sloping layer and vent at the top of the waste dump. This in turn pulls in fresh air through the basal rubble zone supplying oxygen into the system at a faster rate than natural diffusion would allow. As oxidation progresses and the pH drops, the rate of sulfide oxidation increases generating more heat and allowing more oxygen to be pulled into the dump which initiates further sulfide oxidation. This mechanism is shown schematically in Figure 5.2, along with a section through an end tipped waste dump showing the preferred oxidation within the coarse sloping zones. Elimination of this advective system will reduce the rate at which sulfide oxidation occurs and will, therefore, limit the amount of oxidation products in the dump prior to final capping and closure. This is key to the effective management of acid rock drainage in waste dumps.

5.5 MANAGEMENT OF POTENTIALLY ACID GENERATING WASTE

5.5.1 Waste Zone Identification

As discussed in Section 5.3.2, testing will need to be conducted on grade control or blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify those waste blocks which are PAF and those which are NAF. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types. A common convention is to use green tape to indicate NAF waste, red tape to indicate PAF waste and white tape to indicate ore.

5.5.2 Selective Handing

Material will need to be selectively handled to allow separation of PAF and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated (red for PAF waste / green for NAF waste and white for ore). As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit

and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

5.5.3 Waste Placement Methods for PAF Material

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

This should be achieved through the placement of waste in lifts of no greater than 3 m to 5m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement.

5.5.4 NAF Waste Placement

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated. This is discussed in Section 5.5.5 below.

5.5.5 Encapsulation of Waste

All waste rock will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have a high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. As shown in Figure 5.3, material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

5.5.6 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been

placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis
- Atterberg Limits
- Laboratory proctor compaction
- Field density and moisture content
- Particle SG

Based on the scale of the operation and the requirement to encapsulate such a large quantity of material, it is recommended that an on-site geotechnical laboratory be established. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

5.5.7 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

5.5.8 Water Management

Runoff from the PAF waste zones is likely to be slightly to highly acidic and runoff from both the NAF and PAF zones will likely contain elevated concentrations of dissolved metals. Therefore, measures will need to be designed and implemented to capture and store this water. Surface water drains will need to be installed around the periphery

of all active waste dumps to divert clean water around the dumps and also intersect runoff from the dumps. This water can then be directed to the water storage facility. The water storage facility will need to be designed with seepage control measures if the natural in-situ materials are found to be of too high permeability to contain the water without leading to excessive seepage.

The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement. Internal drainage will also need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

5.6 IMPLICATIONS FOR CLOSURE

5.6.1 Waste Dumps

Provided that the waste dumps are managed appropriately during operations, the procedures required for closure should be relatively straightforward to implement. The final surface of the waste will need to be compacted, encapsulated and the store and release cover system constructed, as outlined in Section 5.5.5. A growth medium should then be placed over the cover system and seeded to promoted revegetation. The majority of these work should have been conducted during operations.

Ongoing monitoring of the oxygen concentrations and temperatures within the PAF zones will be required post closure to assess to effectiveness of the encapsulation and determine whether sulfide oxidation is occurring. In addition, the runoff and seepage water will need to be collected and tested to determine whether it is suitable for release. If the water is not of an appropriate quality, it will either need to be treated prior to release or contained. It may be possible to direct seepage waters to the open pits on closure, however, this is discussed further in Section 5.6.2 below.

5.6.2 Pits

A detailed geochemical assessment will be required to determine the final void water quality post closure. This involves hydrological and hydrogeological studies to determine the pit filling water balance and storage volumes when steady state conditions are reached. This pit water balance model is then used in the geochemical modelling, whereby element concentrations are applied to the pit inflows (groundwater, surface water, pit wall run-off and direct precipitation on the pit lake), outflows (evaporation and possibly groundwater or over-topping) and wall rock to simulate

reaction processes within the pit lake, such as water-rock interaction, fluid mixing, dissolution, precipitation, association and sorption. Appropriate mitigation controls will be required if the pit lake water quality is predicted to be poor, and the water balance model indicates that outflows to off-site groundwater or surface water resources will likely occur.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the geochemical characterisation of the waste rock from the Letpadaung project, the following conclusions can be made:

- Knight Piésold selected 150 waste rock samples from 13 boreholes located within the pit extents. Samples were collected from all logged lithologies within these boreholes and from depths ranging from 5 m to 472 m, which is similar to the planned maximum depth of the pit.
- The samples were sent to Genalysis Intertek in Perth who conducted the testing according to the schedule provided by Knight Piésold. The test work conducted was based on internationally accepted methods.
- The waste rock samples were primary composed of quartz, clay minerals (including illite, smectite, kaolin and chlorite) and alunite and natroalunite, with a relatively high amorphous content. The main sulfide mineral in the waste samples was pyrite with trace chalcopyrite. Carbonate was present in the samples, most commonly as siderite, but some calcium and magnesium carbonates were also present in discreet areas.
- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents.
- The sulfide sulfur contents of the samples ranged from extremely low to extremely high, however, the average sulfide content for all samples was 2.1% which is considered very high. There were more samples with extremely low sulfide sulfur in the upper 200 m of the deposit. Below around 250 m depth all samples had sulfur contents greater than 0.1%, with most samples below this depth having high to extremely high sulfide sulfur contents.
- The acid neutralising capacity of the samples was highly variable with a small number of samples from discreet zones in the deposit having high ANC values, correlating with increased carbonate contents. Outside of these carbonate rich zones, the ANC of the deposit was very low averaging less than 3 kg H2SO4/tonne.
- The Net Acid Generation test resulted in 96 samples producing acidic conditions, with the number of samples producing acid increasing with depth.
- Overall, 29% of the waste samples can considered as Non-Acid Forming, with the remaining 71% considered Potentially Acid Forming. According to each sampling and testing result about ARD in blasting area in future mining operation, MWMCL will identify ARD content in whole waste rock.

- The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metalliferous drainage from both the PAF and NAF material.
- Based on the results of the testing, active management of the potentially acid generating materials will be required, with the recommended methods discussed in the following recommendations.

Based on the results of the geochemical testing, the following recommendations can be made:

- It is recommended that additional geochemical assessment be conducted prior to bulk mining to better quantify the amount of potentially acid generating material which will be encountered during the first year(s) of operations to allow detailed waste management planning.
- It is recommended that kinetic testing of approximately 20 waste rock samples commences prior to bulk of each flitch to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.
- It is recommended that an onsite geochemical laboratory be established to conduct routine geochemical testing during operations.
- It is recommended that grade control or blast hole bench height composite samples are tested at a spacing of no more than 15 m. It is further recommended that the NAG test is used to classify the acid formation potential of the material ahead of mining.
- It is recommended that mining practices are established which allow definition of the PAF and NAF waste in the field and allow for selective mining and placement of the material.
- It is recommended that all PAF waste is placed in lifts of no greater than 3 m to 5m in height to eliminate segregation of the waste which could lead to accelerated acid generation.
- It is recommended that all waste be encapsulated during operations with an engineered cover comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The encapsulation material will need to be covered by benign waste or borrow

material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the cover.

- It is recommended that borrow areas for the encapsulation material be identified and samples of the proposed cover material be collected for geotechnical testing to allow detailed design of the cover system.
- It is recommended that geotechnical testing be conducted during construction of the cover system to ensure that the cover system is constructed to the design specification.
- It is recommended that geochemical monitoring of the cover system, comprising oxygen sampling points and thermistors, be conducted to allow the performance of the cover system to be verified during operations.
- It is recommended that a water management system be designed and constructed to prevent clean water from entering the waste dump area and to collect potentially contaminated water and direct this to a suitably designed water storage facility.
- Ongoing monitoring of the waste dump, encapsulation layer, cover system and drainage water will be required post closure.
- Should the drainage waters be found to be of an unacceptable quality, they will either need to be treated prior to release or contained.
- It may be possible to direct seepage waters to the open pits on closure, however, this would require detailed hydrological, hydrogeological and geochemical modelling to determine whether off-site downstream groundwater or surface water resources would be impacted.

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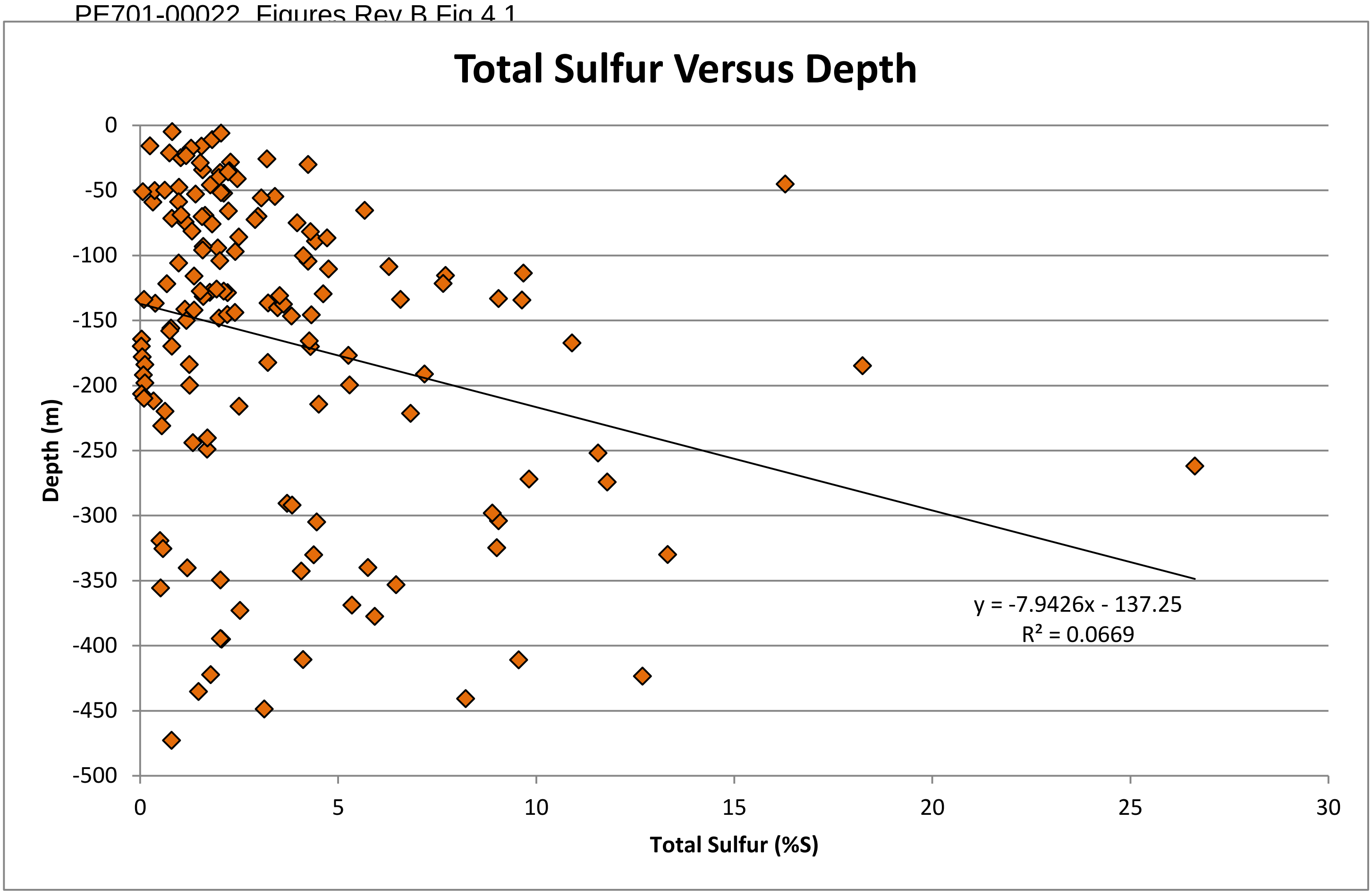
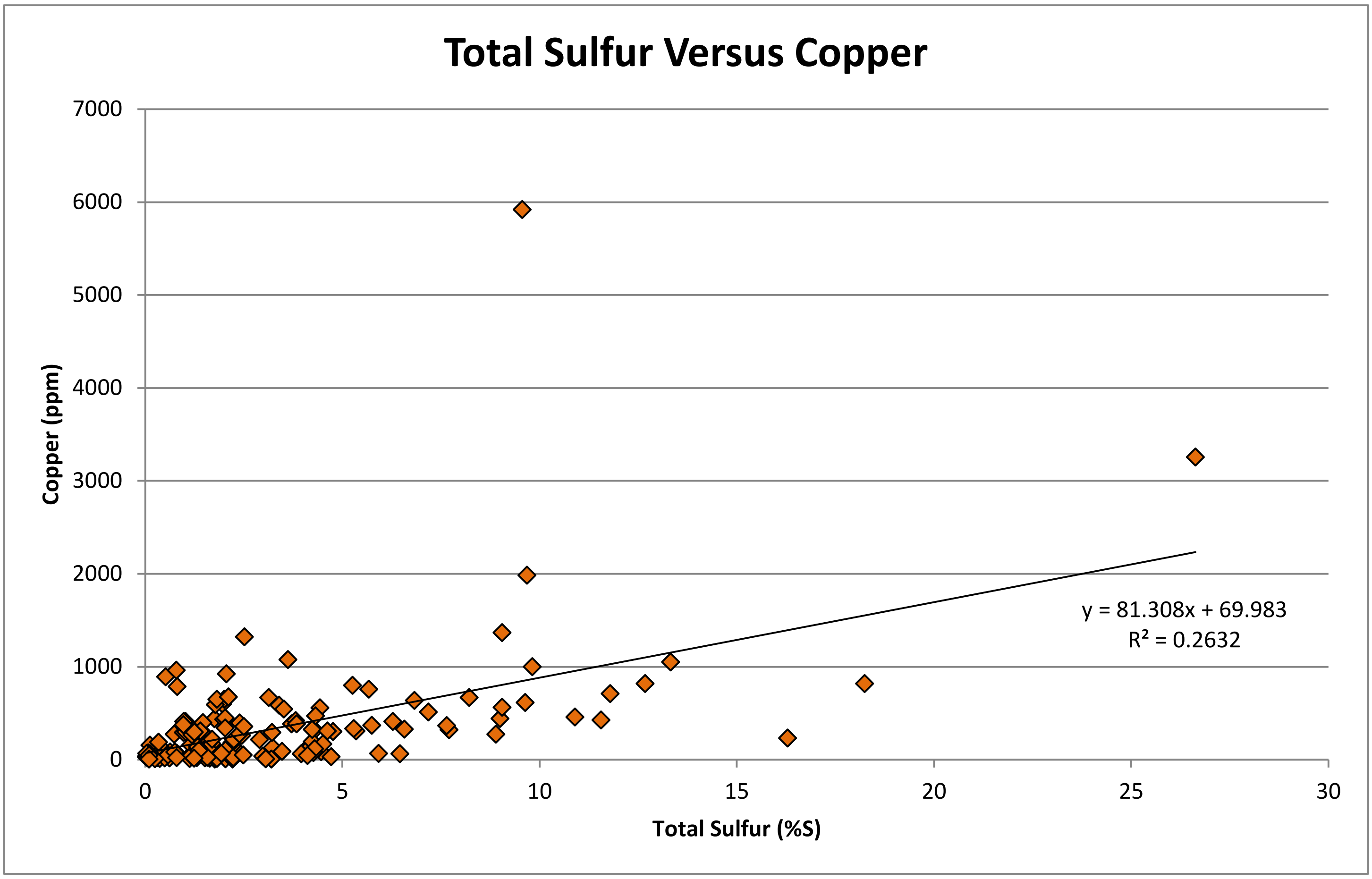
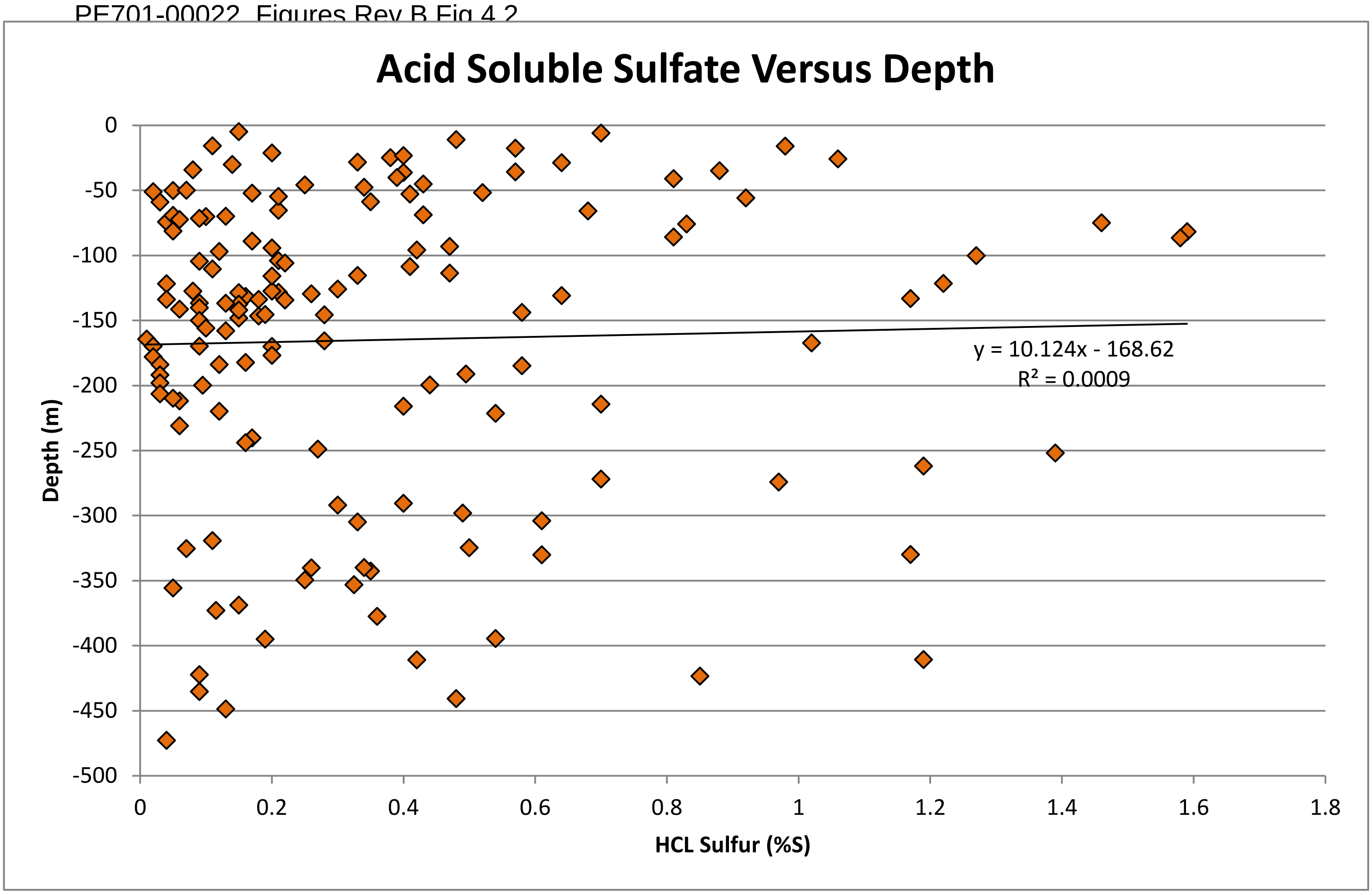
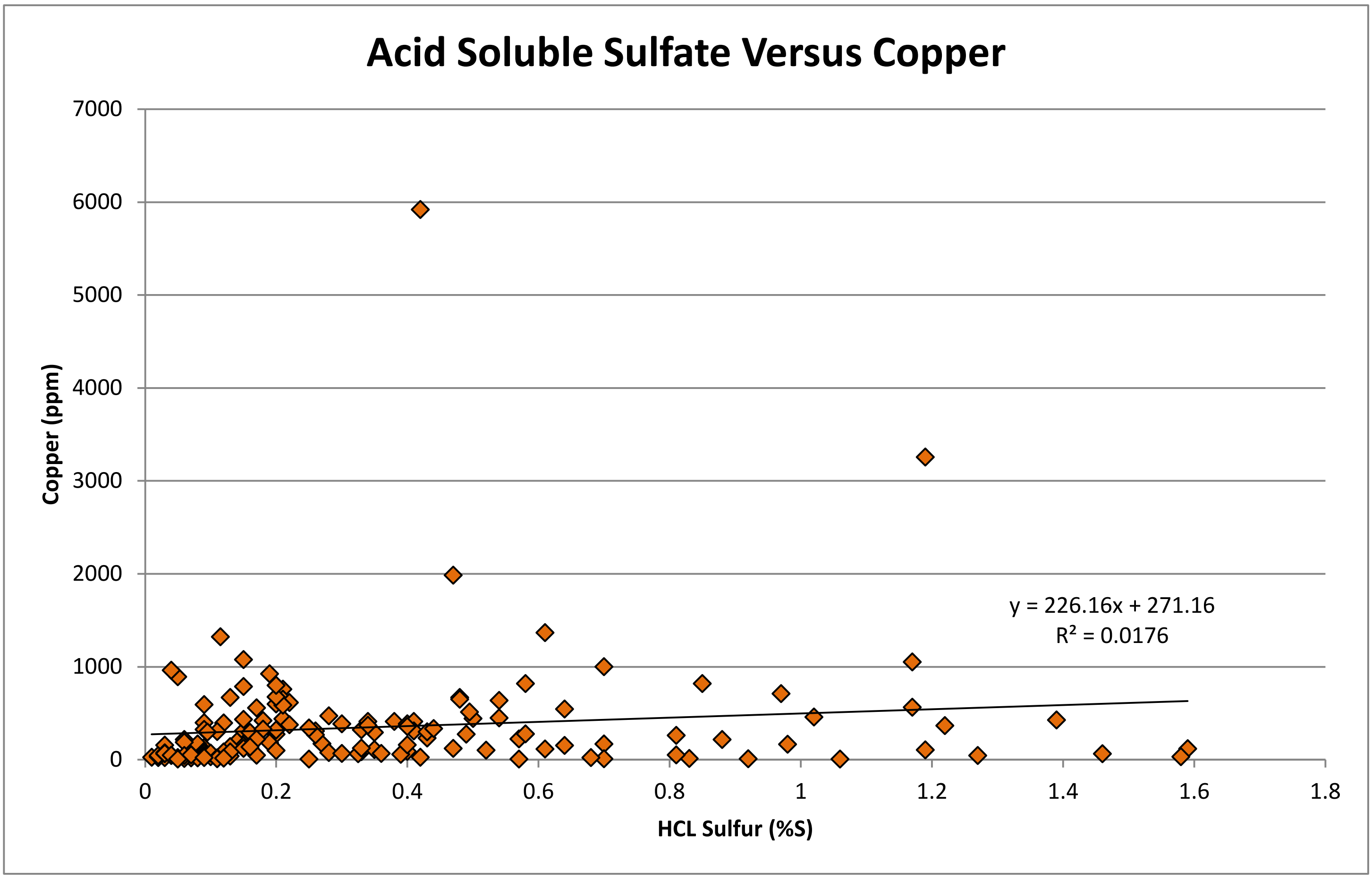
FIGURES

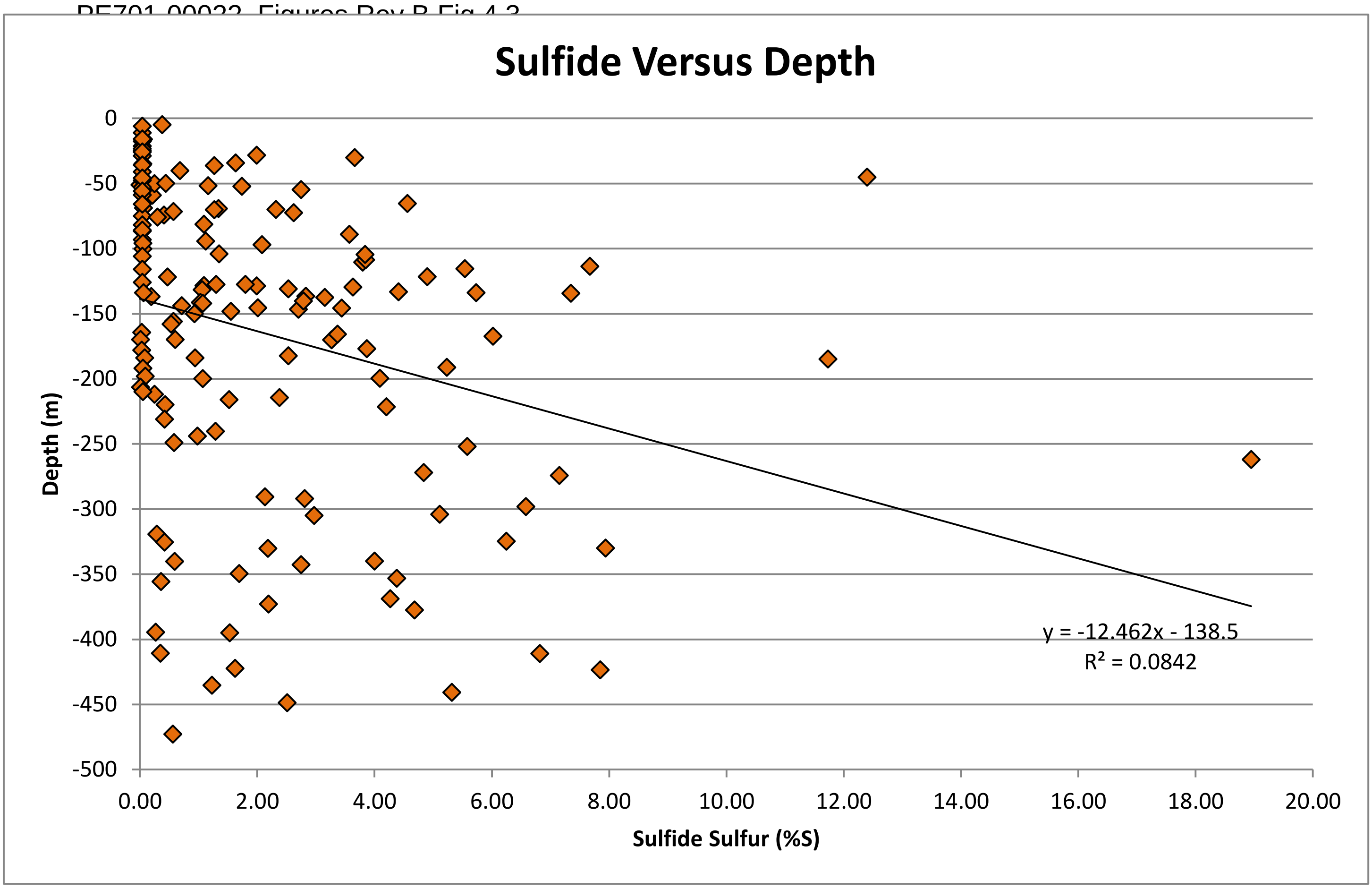
Knight Piésold
CONSULTING

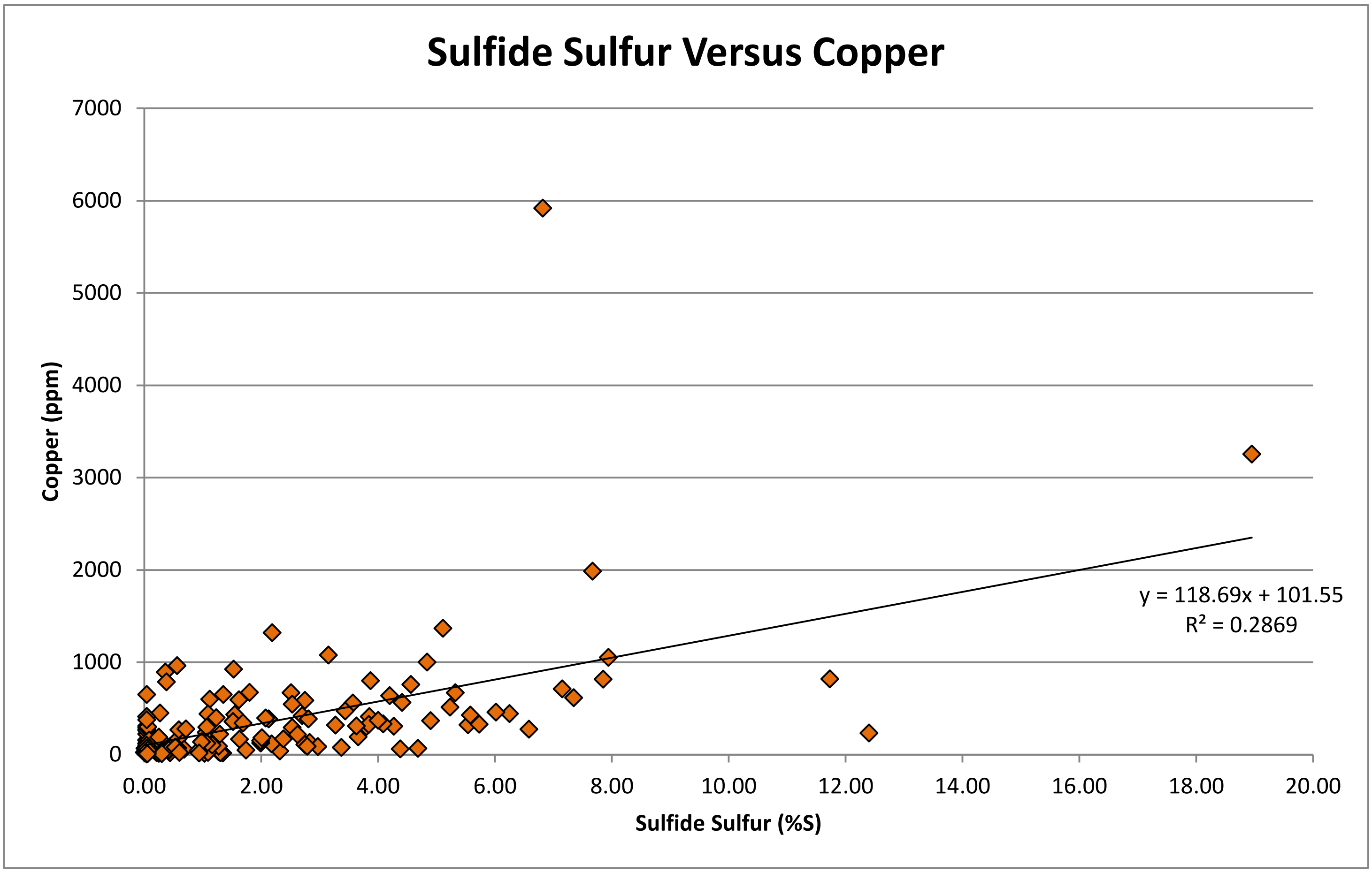

Total Sulfur Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
5
10
15
20
25
30
Total Sulfur (%S)
y = -7.9426x - 137.25
R² = 0.0669

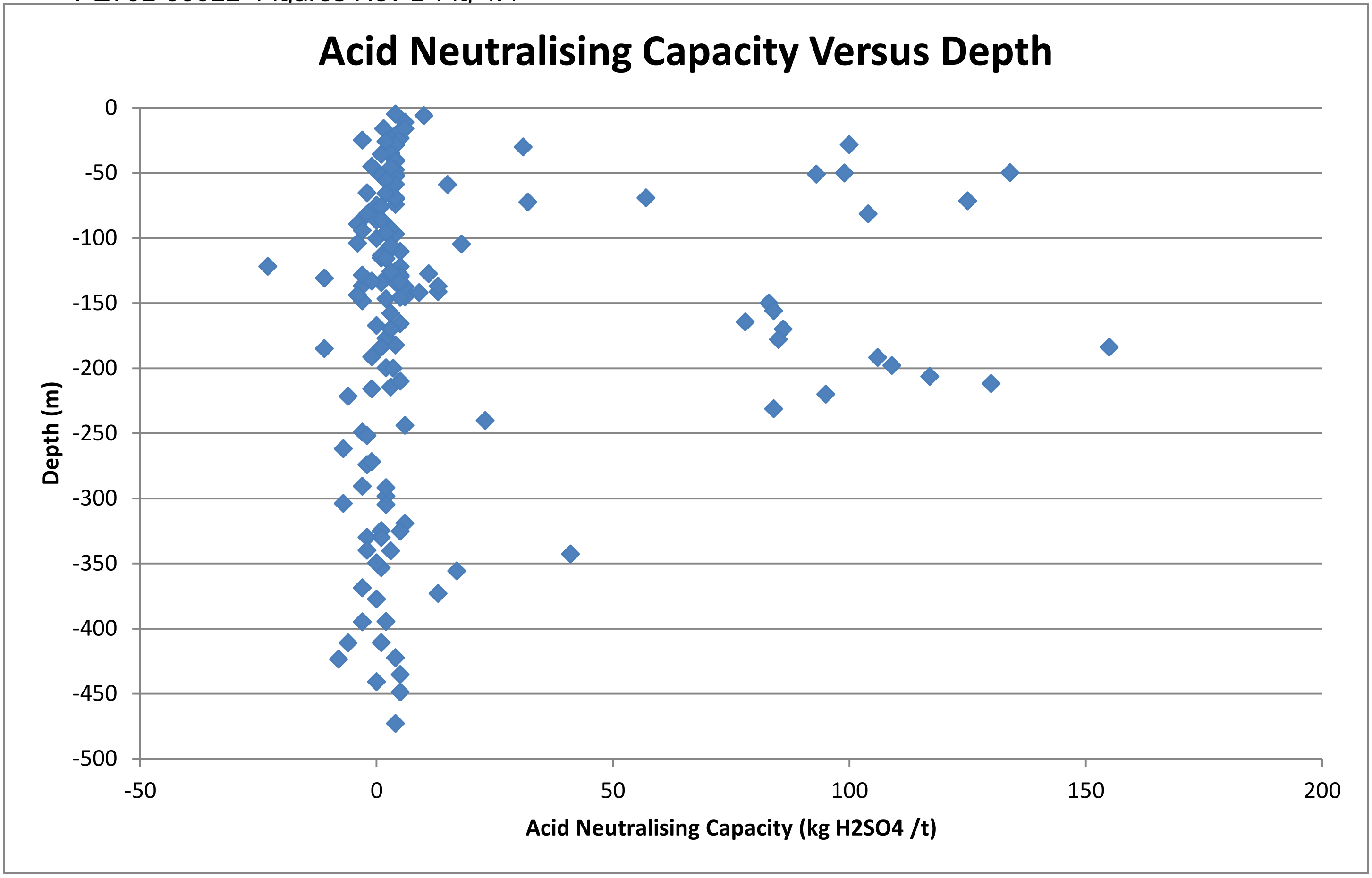

Total Sulfur Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
Total Sulfur (%S)
y = 81.308x + 69.983
R² = 0.2632

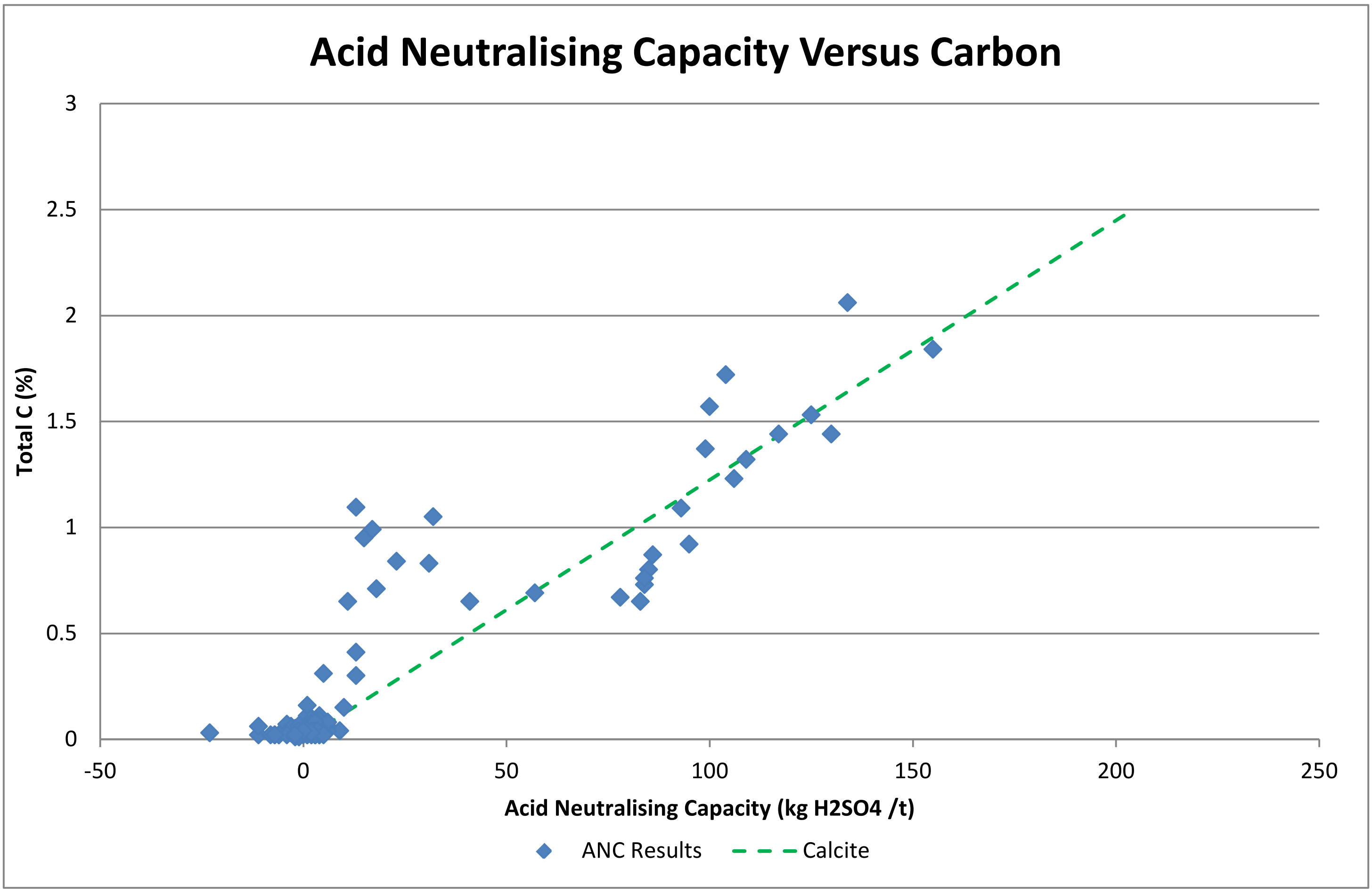

Acid Soluble Sulfate Versus Depth
Depth (m)
HCL Sulfur (%S)
y = 10.124x - 168.62
R² = 0.0009
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

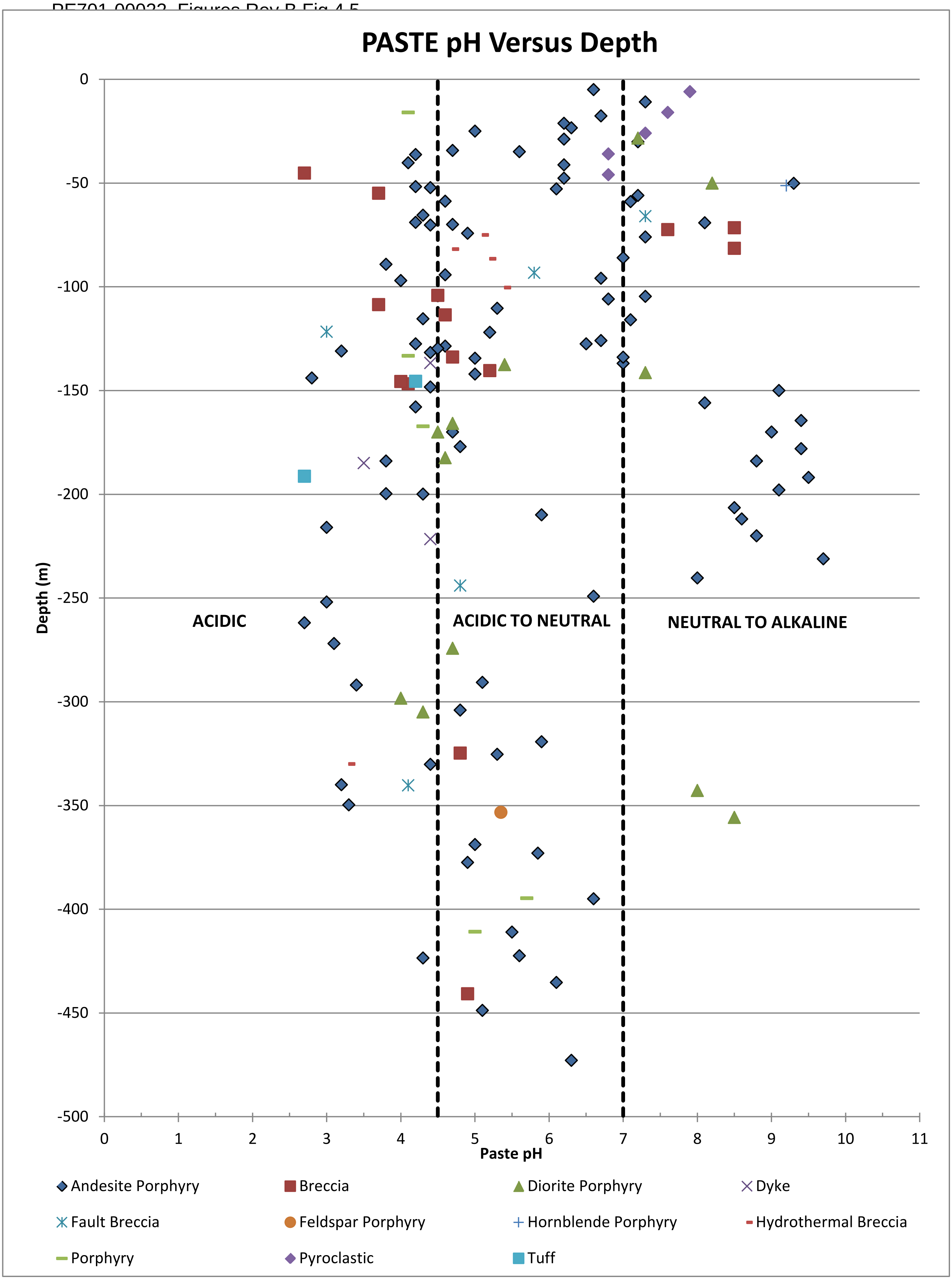

Acid Soluble Sulfate Versus Copper
Copper (ppm)
HCL Sulfur (%S)
y = 226.16x + 271.16
R² = 0.0176
7000
6000
5000
4000
3000
2000
1000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

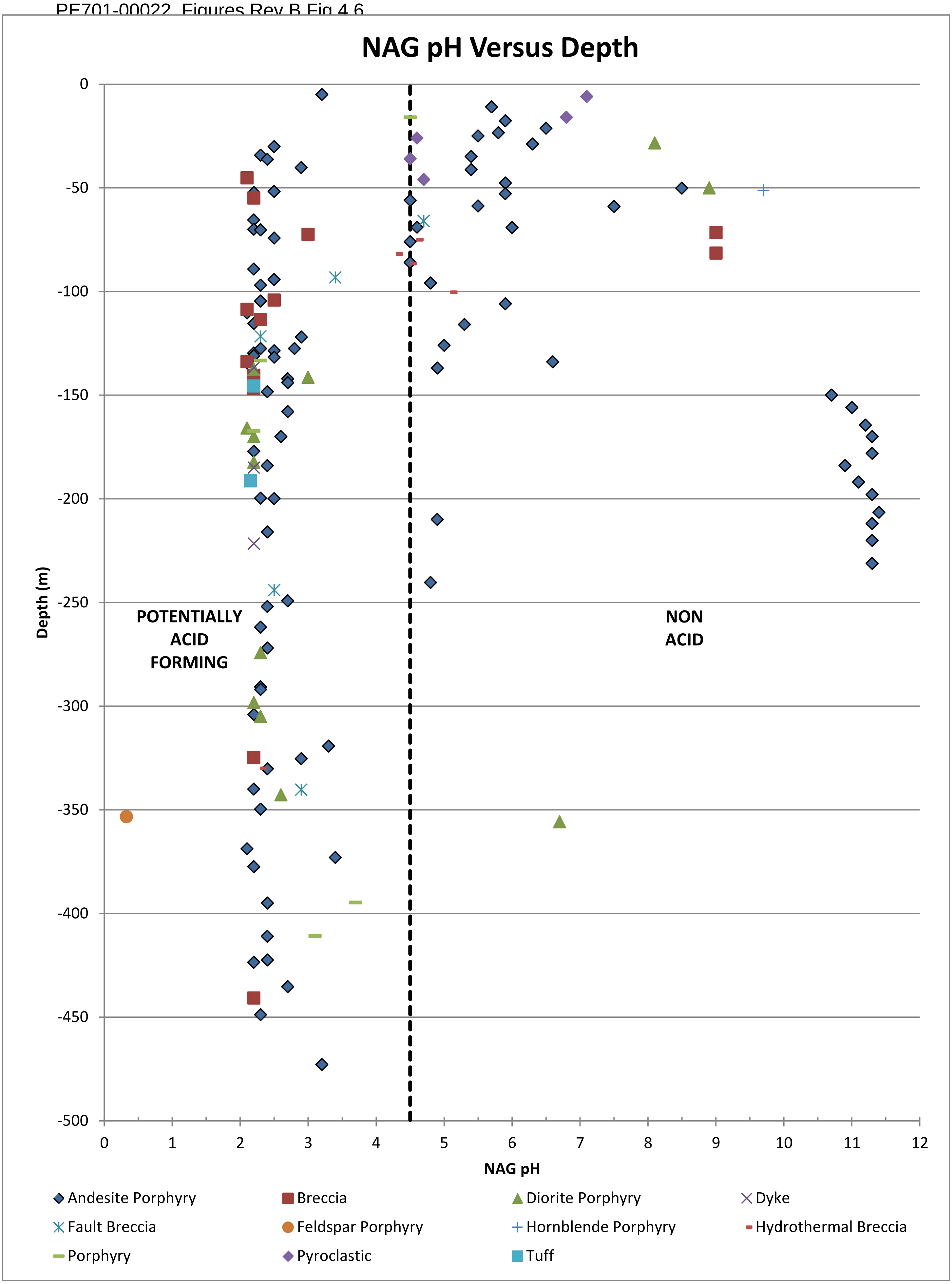

Sulfide Versus Depth
Depth (m)
Sulfide Sulfur (%S)
y = -12.462x - 138.5
R² = 0.0842
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00


Sulfide Sulfur Versus Copper
Copper (ppm)
Sulfide Sulfur (%S)
y = 118.69x + 101.55
R² = 0.2869
7000
6000
5000
4000
3000
2000
1000
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00

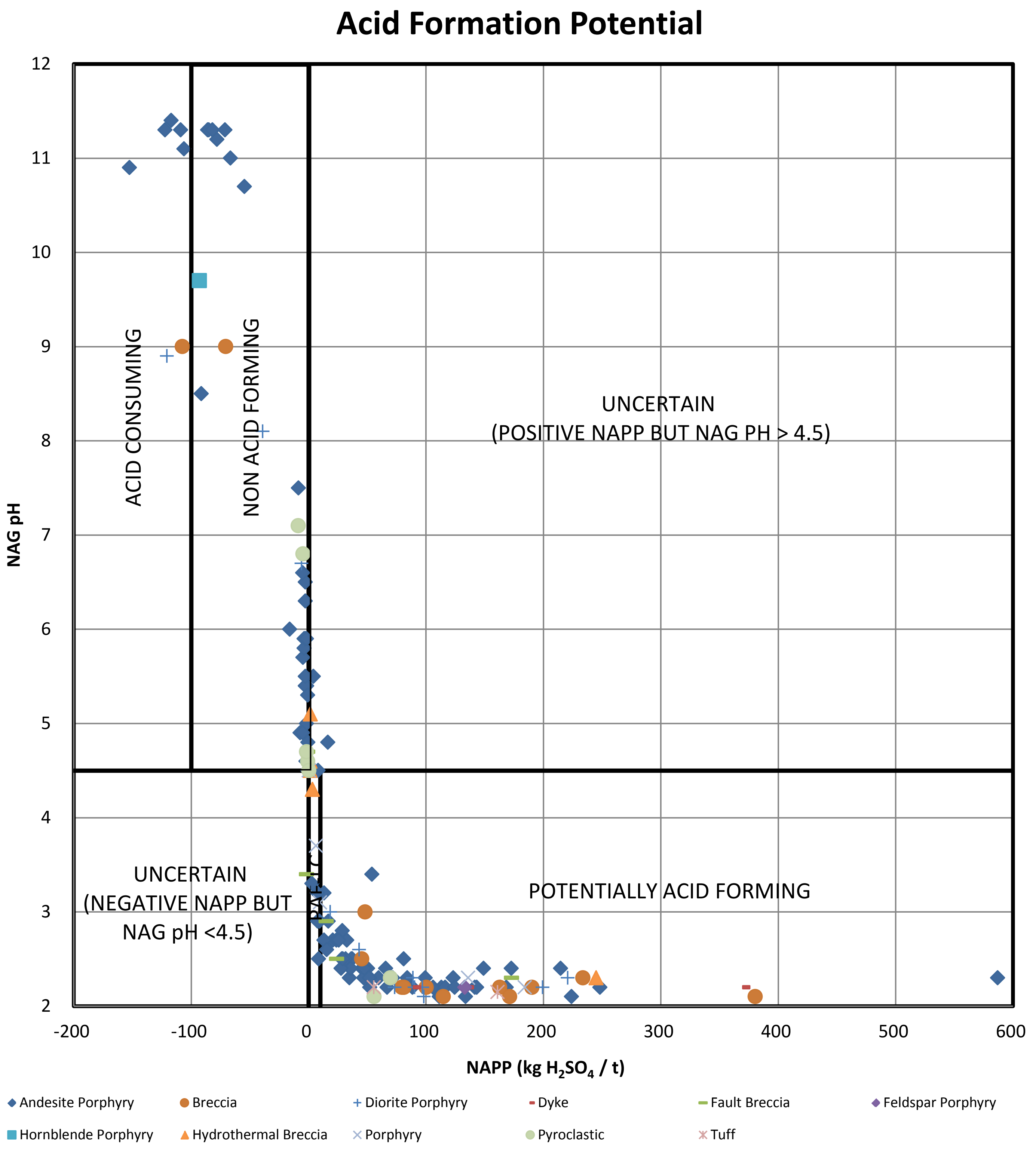

Acid Neutralising Capacity Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
-50
0
50
100
150
200
Acid Neutralising Capacity (kg H2SO4 /t)


Acid Neutralising Capacity Versus Carbon
Total C (%)
3
2.5
2
1.5
1
0.5
0
-50
0
50
100
150
200
250
Acid Neutralising Capacity (kg H2SO4 /t)
ANC Results
Calcite


PASTE pH Versus Depth
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
Depth (m)
ACIDIC
ACIDIC TO NEUTRAL
NEUTRAL TO ALKALINE
0
1
2
3
4
5
6
7
8
9
10
11
Paste pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

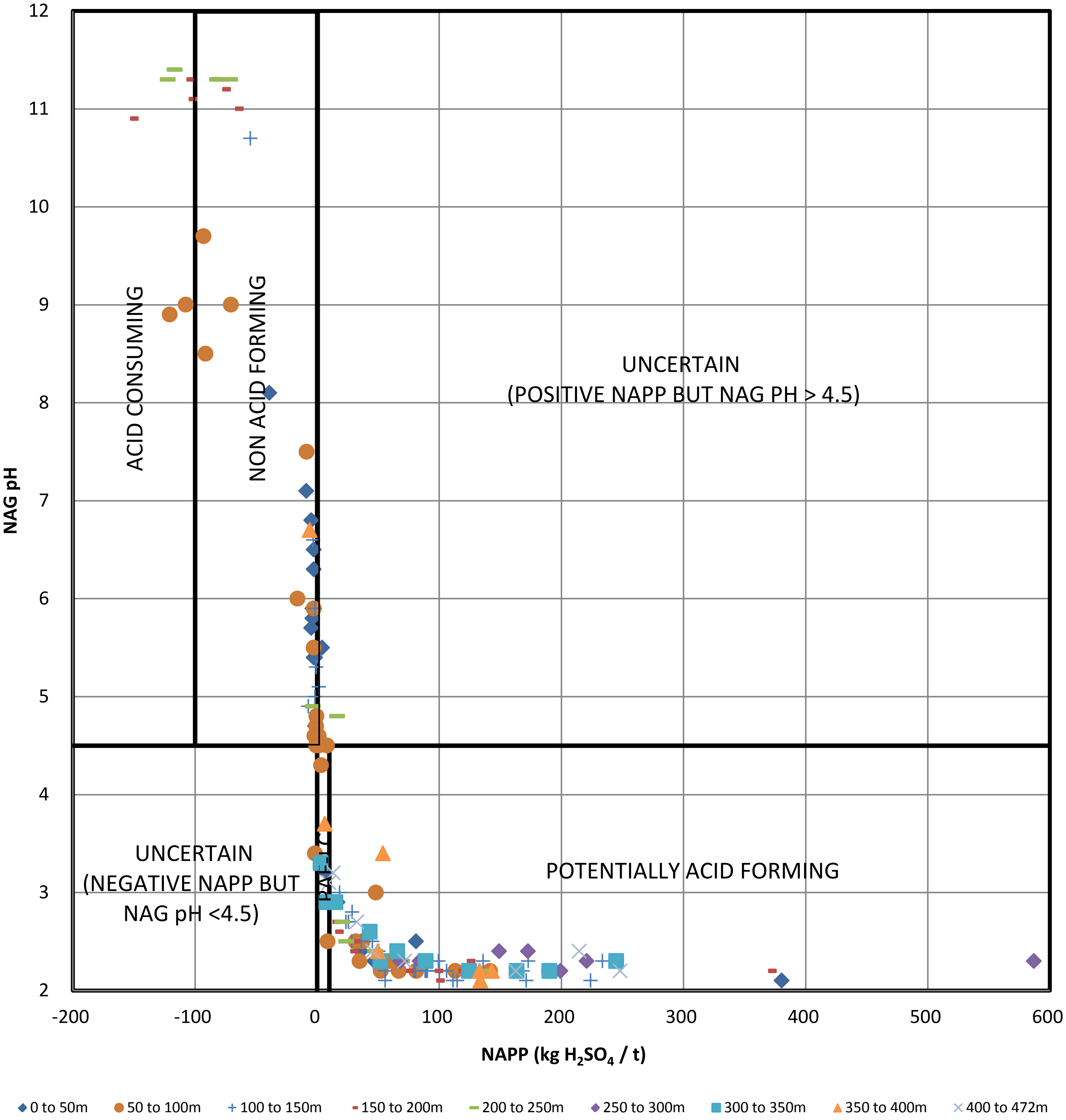


NAG pH Versus Depth
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
Depth (m)
POTENTIALLY ACID FORMING
NON ACID
0
1
2
3
4
5
6
7
8
9
10
11
12
NAG pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

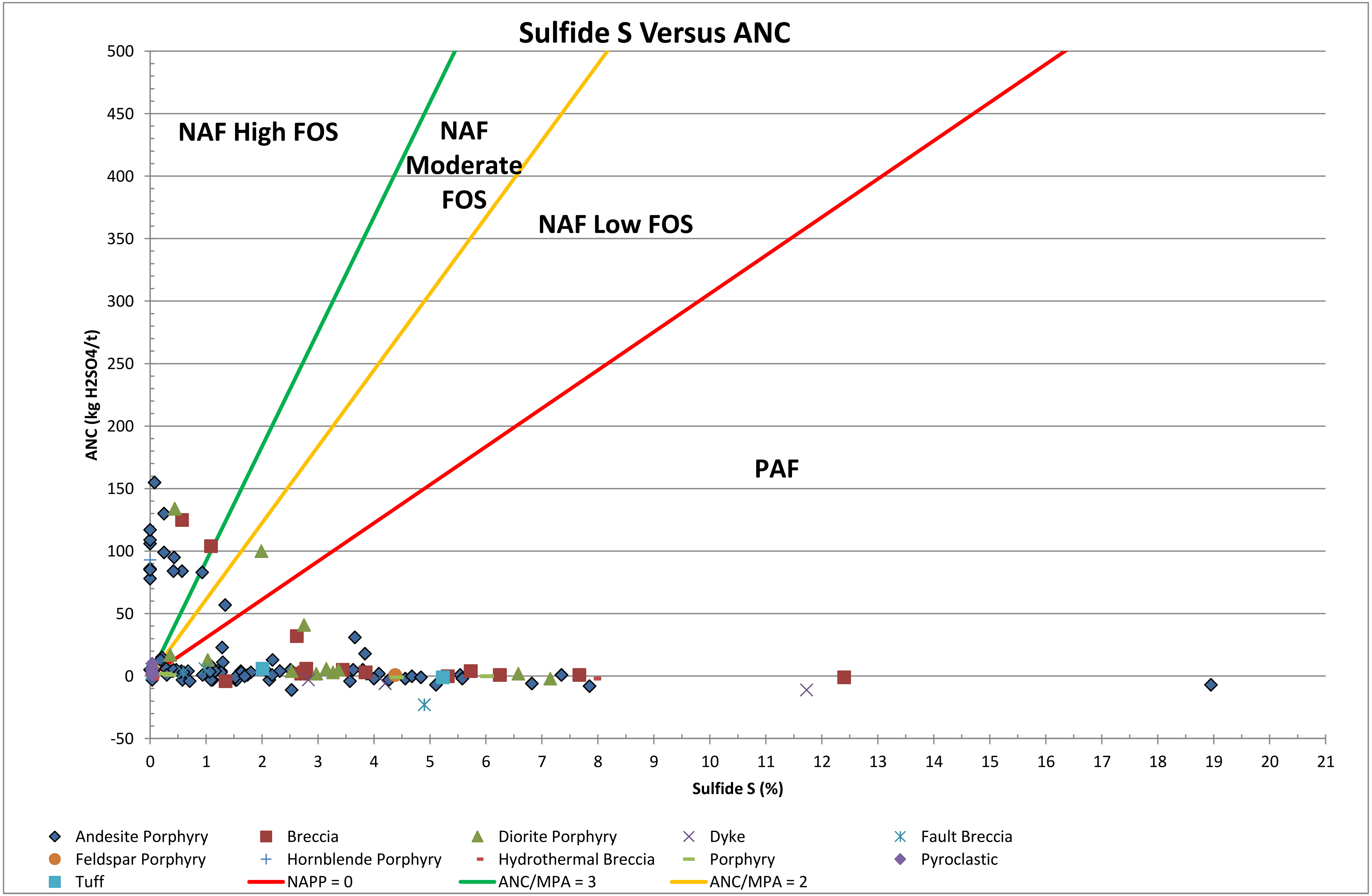


Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

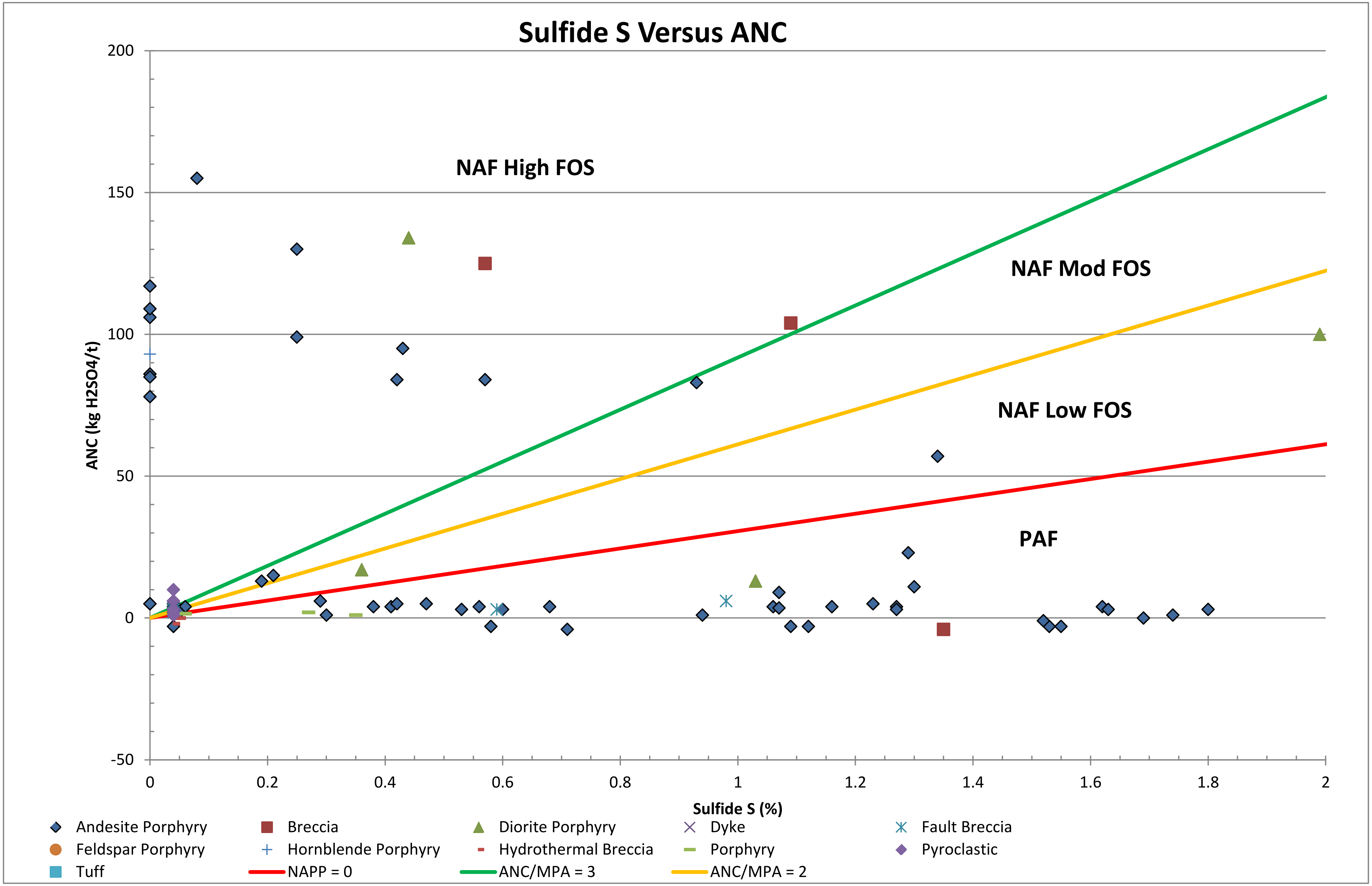
Acid Formation Potential



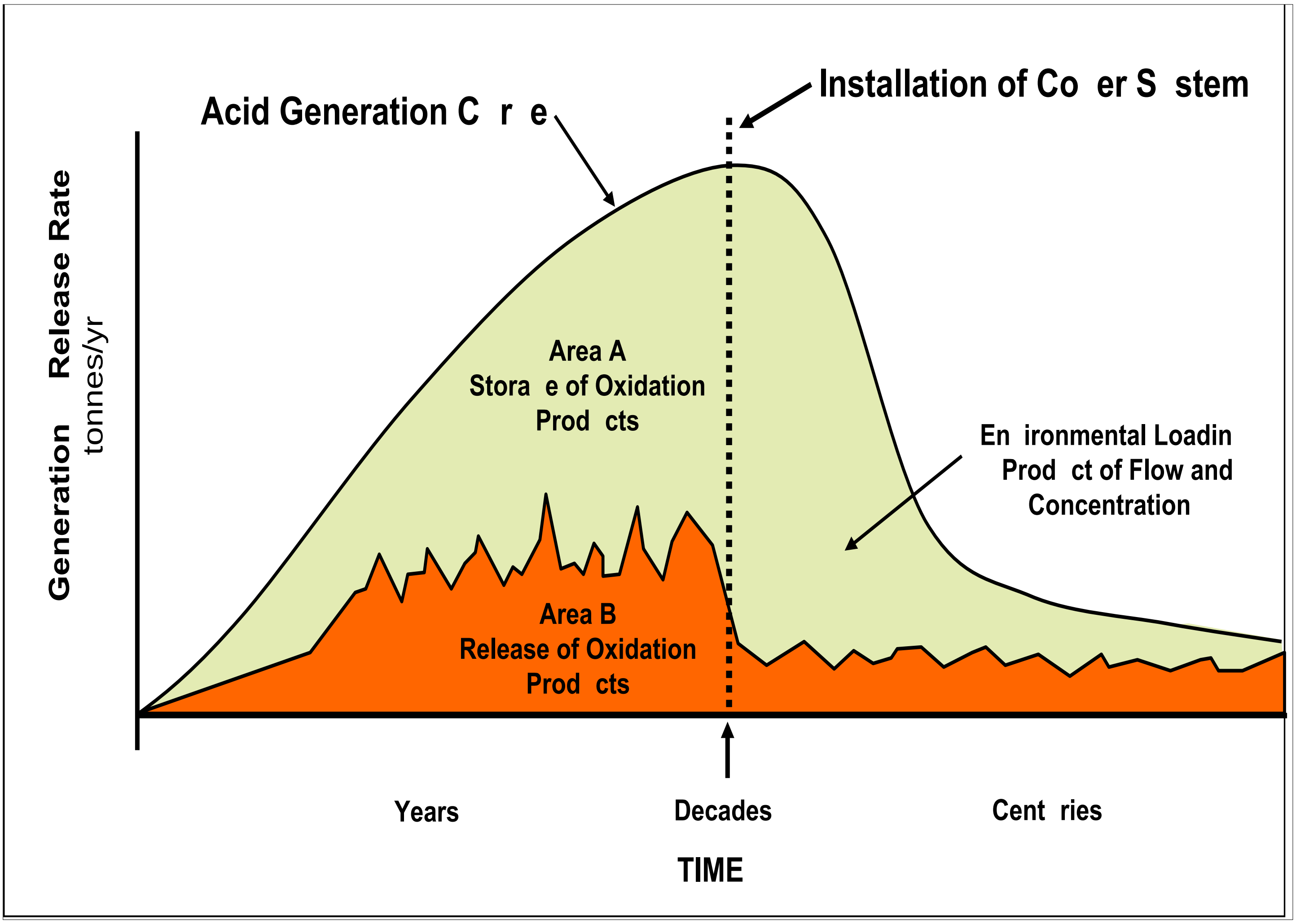
Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

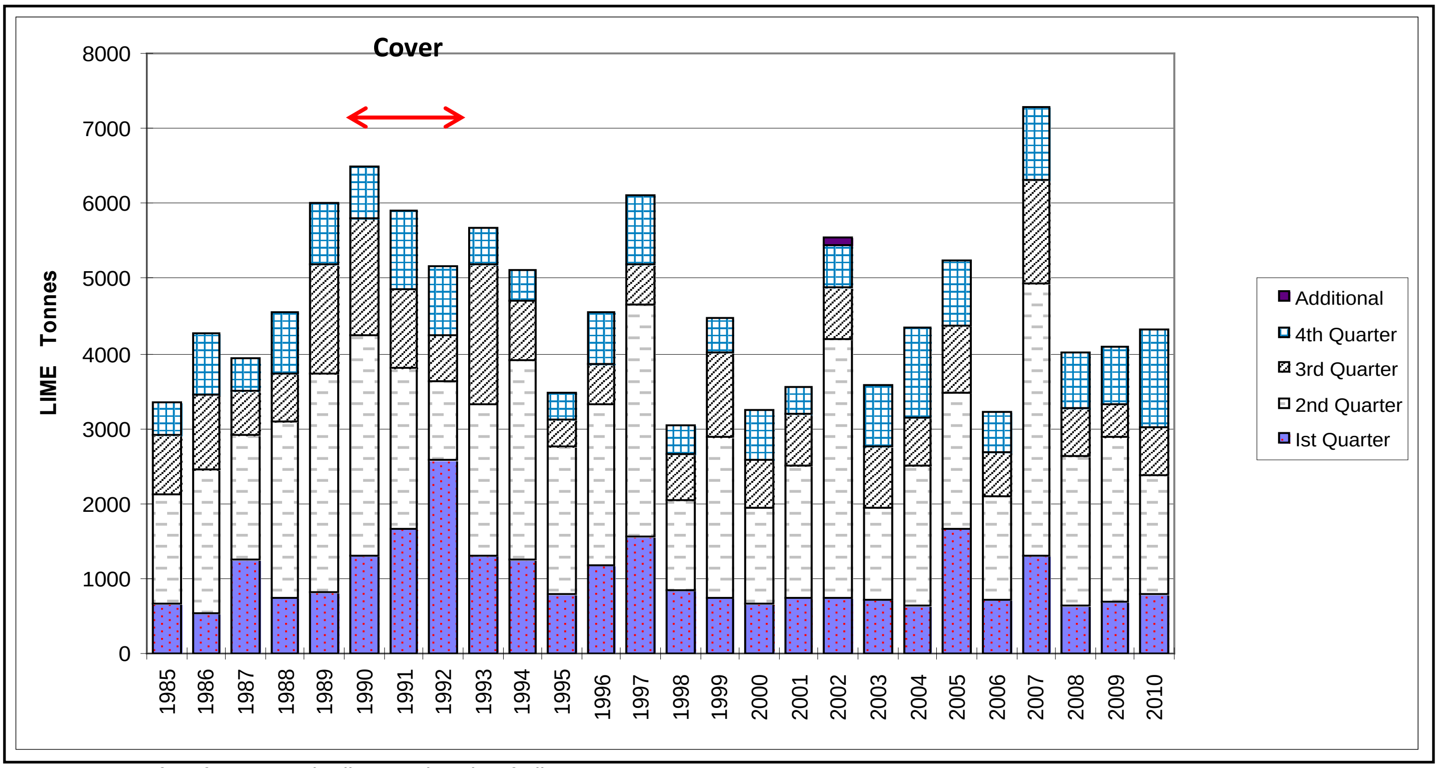


Sulfide S Versus ANC
NAF High FOS
NAF Moderate FOS
NAF Low FOS
PAF
ANC (kg H2SO4/t)
Sulfide S (%)
500
450
400
350
300
250
200
150
100
50
0
-50
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff
NAPP = 0
ANC/MPA = 3
ANC/MPA = 2

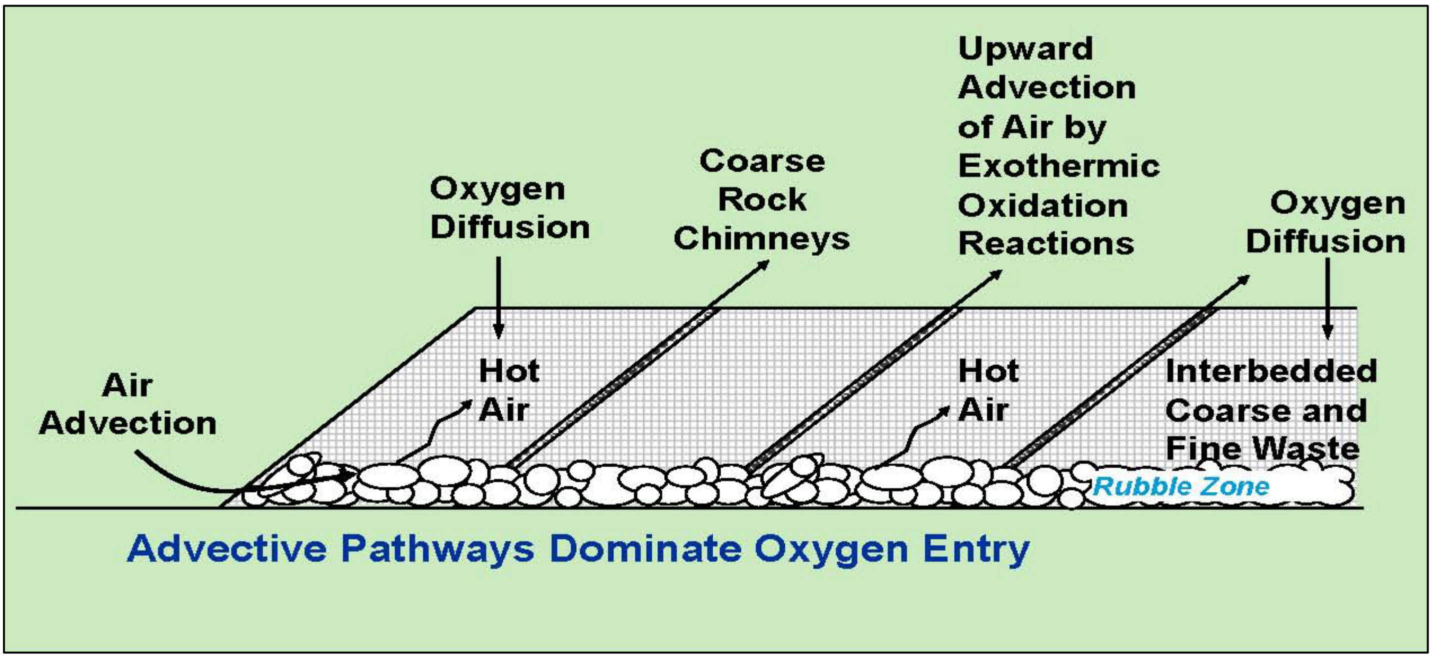


Sulfide S Versus ANC
200
150
100
50
0
-50
ANC (kg H2SO4/t)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Sulfide S (%)
NAF High FOS
NAF Mod FOS
NAF Low FOS
PAF
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff
NAPP = 0
ANC/MPA = 3
ANC/MPA = 2

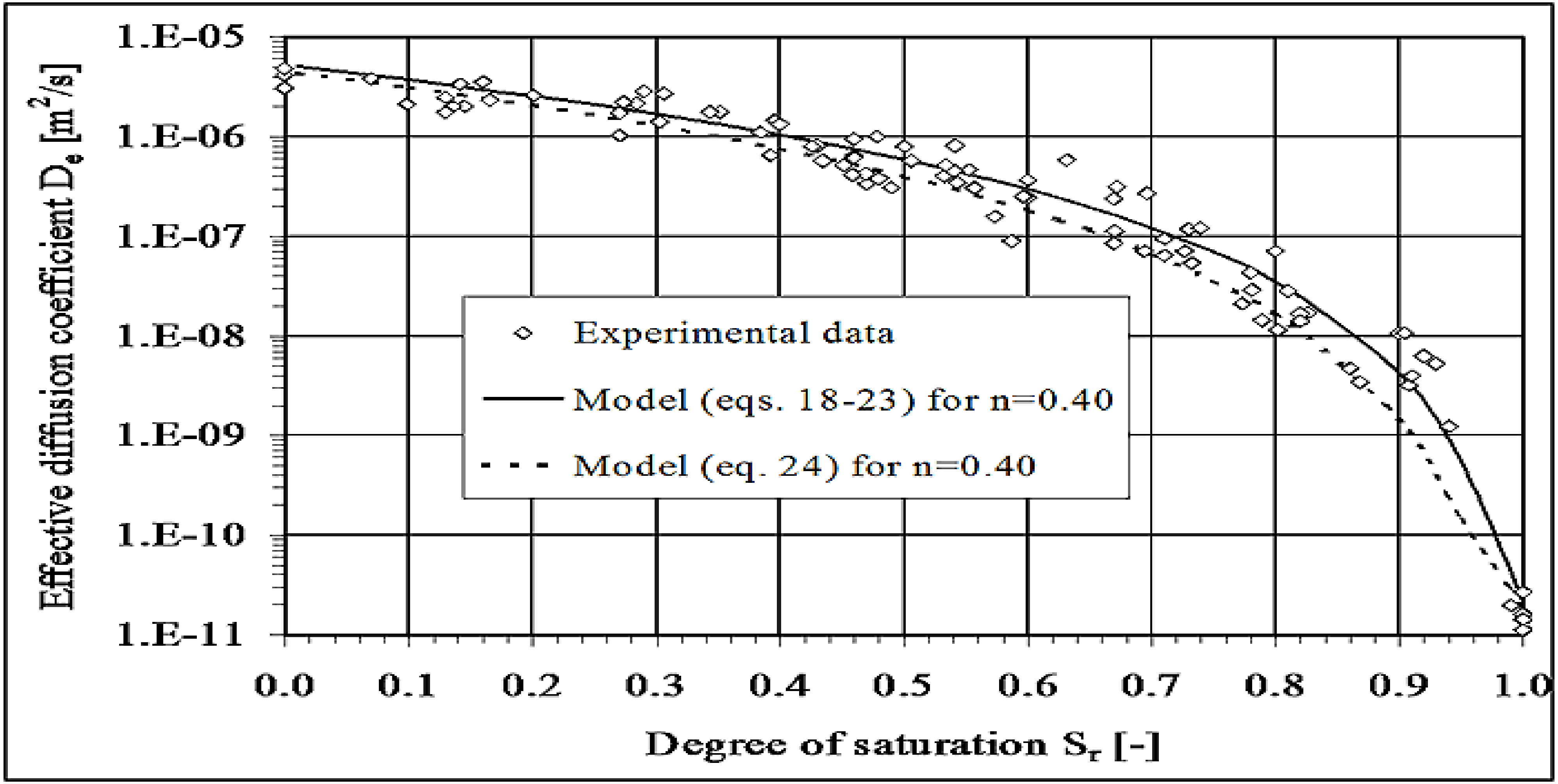




Figures courtesy of Professor Ward Wilson, University of Alberta



Figures courtesy of Professor Ward Wilson, University of Alberta


1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
Effective diffusion coefficient D_e [m^2/s]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Degree of saturation S_r [-]
Experimental data
Model (eqs. 18-23) for n=0.40
Model (eq. 24) for n=0.40

APPENDIX A

X-RAY Diffraction Results

APPENDIX A - QUANTATIVE XRD RESULTS

Mineral & Class	Sample ID	701-22-001	701-22-008	701-22-020	701-22-023	701-22-032	701-22-041	701-22-044	701-22-052	701-22-071	701-22-072	701-22-081	701-22-097	701-22-115	701-22-126	701-22-148	Average	Max	Min
	Borehole	LS001	LS001	LS002	LS002	LS003	LS003	LS003	LS005	LK004	LK004	LK006	L013	L223	L087	L087			
	Depth	25	221.65	355.8	435.3	146.75	353.35	410.9	50.1	51.23	71.63	191.35	93.25	212	36	330			
	Lithology	Andesite Porphyry	Dyke	Diorite Porphyry	Andesite Porphyry	Breccia	Feldspar Porphyry	Porphyry	Diorite Porphyry	Hornblende Porphyry	Breccia	Tuff	Fault Breccia	Andesite Porphyry	Pyroclastic	Hydrothermal Breccia			
Quartz	Silicate	39.00	38.00	31.00	45.00	45.00	34.00	41.00	40.00	24.00	29.00	43.00	47.00	23.00	63.00	47.00	39.27	63.00	23.00
Amorphous content		12.00	10.00	17.00	13.00	17.00	13.00	7.00	13.00	33.00	29.00	11.00	11.00	35.00	14.00	3.00	15.87	35.00	3.00
Natroalunite	Sulfate	6.00	10.00	-	-	<1	<1	26.00	-	-	-	3.00	9.00	-	15.00	28.00	7.46	28.00	-
Interlayered illite/smectite	Clay	21.00	-	14.00	5.00	18.00	8.00	1.00	15.00	9.00	22.00	13.00	-	-	-	-	8.40	22.00	-
Pyrophyllite	Clay	-	13.00	-	-	-	22.00	-	-	-	-	8.00	13.00	-	5.00	4.00	4.33	22.00	-
Kaolin	Clay	5.00	16.00	5.00	17.00	-	8.00	22.00	5.00	2.00	-	2.00	-	-	-	-	5.47	22.00	-
Chlorite	Clay	-	-	6.00	-	-	-	-	-	-	5.00	-	-	13.00	-	-	1.60	13.00	-
Hematite	Oxide	-	-	-	-	-	-	-	-	-	-	-	15.00	-	1.00	-	1.07	15.00	-
Sodium calcium plagioclase	Feldspar	-	-	9.00	-	-	-	-	-	12.00	1.00	-	-	9.00	-	-	2.07	12.00	-
Pyrite	Sulfide	-	10.00	1.00	2.00	6.00	10.00	1.00	-	<1	2.00	15.00	-	-	-	16.00	4.50	16.00	-
Siderite	Carbonate	-	-	11.00	3.00	-	-	-	-	-	-	-	-	-	-	-	0.93	11.00	-
Palygorskite	Clay	-	-	-	-	-	-	-	-	-	-	-	-	7.00	-	-	0.47	7.00	-
Illite/Muscovite	Mica	16.00	-	1.00	13.00	12.00	2.00	1.00	11.00	7.00	4.00	5.00	-	4.00	-	-	5.07	16.00	-
Potassium feldspar	Feldspar	-	2.00	5.00	-	-	<1	-	-	8.00	-	-	4.00	-	1.00	-	1.43	8.00	-
Ankerite	Carbonate	-	-	-	-	-	-	-	4.00	-	-	-	-	-	-	-	0.27	4.00	-
Dolomite	Carbonate	-	1.00	-	-	-	-	2.00	8.00	3.00	7.00	-	1.00	-	-	-	1.47	8.00	-
Calcite	Carbonate	-	-	-	-	<1	-	-	-	2.00	1.00	-	-	7.00	-	-	0.71	7.00	-
Magnesite	Carbonate	-	-	-	-	-	-	-	4.00	-	2.00	-	-	-	-	-	0.40	4.00	-
Expanding clay	Clay	-	-	-	-	-	-	-	-	2.00	-	-	-	-	-	-	0.13	2.00	-
Chloritoid	Clay	-	-	-	-	-	-	-	-	-	-	-	-	2.00	-	-	0.13	2.00	-
Diaspore	Hydroxide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	0.13	2.00	-
Alunite	Sulfate	-	-	1.00	1.00	-	3.00	-	-	-	-	-	-	-	-	-	0.33	3.00	-
Jarosite	Hydroxide	1.00	-	-	1.00	1.00	-	-	-	-	-	-	-	-	-	-	0.20	1.00	-
Anhydrite	Sulfate	-	-	-	<1	1.00	-	-	-	-	-	-	-	-	-	-	0.07	1.00	-
Anatase	Oxide	-	-	-	-	-	-	-	-	-	-	1.00	-	-	-	-	0.07	1.00	-
Chalcopyrite	Sulfide	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX B

Acid Base Accounting Results

Knight Piésold CONSULTING

Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m) (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unitless	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Formation Potential Classification
701-22-001	Andesite Porphyry	LS001	25	-3	0.055	1.025	0.38	0.04	0.04	0.605	5	5.5	0	3	1.2	-2.45	4.22	Uncertain
701-22-002	Andesite Porphyry	LS001	59	15	0.95	0.32	0.03	0.21	0.21	0.08	7.1	7.5	0	0	6.4	2.33	-8.57	Non Acid Forming
701-22-003	Andesite Porphyry	LS001	65.5	-2	0.05	5.67	0.21	4.56	4.56	0.9	4.3	2.2	127	142	139.5	-0.01	141.54	Potentially Acid Forming
701-22-004	Andesite Porphyry	LS001	89.25	-4	0.04	4.43	0.17	3.57	3.57	0.69	3.8	2.2	98	110	109.2	-0.04	113.24	Potentially Acid Forming
701-22-005	Andesite Porphyry	LS001	122	5	0.04	0.67	0.04	0.47	0.47	0.16	5.2	2.9	6	11	14.4	0.35	9.38	Potentially Acid Forming - Low Capacity
701-22-006	Dyke	LS001	136.75	-3	0.04	3.23	0.09	2.83	2.83	0.31	4.4	2.2	79	89	86.6	-0.03	89.60	Potentially Acid Forming
701-22-007	Dyke	LS001	185	-11	0.02	18.24	0.58	11.73	11.73	5.93	3.5	2.2	424	455	358.9	-0.03	369.94	Potentially Acid Forming
701-22-008	Dyke	LS001	221.65	-6	0.02	6.83	0.54	4.2	4.20	2.09	4.4	2.2	133	147	128.5	-0.05	134.52	Potentially Acid Forming
701-22-009	Andesite Porphyry	LS001	249.15	-3	0.03	1.69	0.27	0.58	0.58	0.84	6.6	2.7	12	17	17.7	-0.17	20.75	Potentially Acid Forming
701-22-010	Andesite Porphyry	LS001	290.75	-3	0.04	3.71	0.4	2.13	2.13	1.18	5.1	2.3	67	77	65.2	-0.05	68.18	Potentially Acid Forming
701-22-011	Andesite Porphyry	LS001	304.05	-7	0.02	9.05	0.61	5.11	5.11	3.33	4.8	2.2	180	201	156.4	-0.04	163.37	Potentially Acid Forming
701-22-012	Andesite Porphyry	LS001	368.85	-3	0.03	5.35	0.15	4.27	4.27	0.93	5	2.1	133	144	130.7	-0.02	133.66	Potentially Acid Forming
701-22-013	Andesite Porphyry	LS001	395	-3	0.03	2.06	0.19	1.53	1.53	0.34	6.6	2.4	31	41	46.8	-0.06	49.82	Potentially Acid Forming
701-22-014	Andesite Porphyry	LS001	411.1	-6	0.02	9.56	0.42	6.82	6.82	2.32	5.5	2.4	136	163	208.7	-0.03	214.69	Potentially Acid Forming
701-22-015	Andesite Porphyry	LS001	423.5	-8	0.02	12.68	0.85	7.85	7.85	3.98	4.3	2.2	261	281	240.2	-0.03	248.21	Potentially Acid Forming
701-22-016	Andesite Porphyry	LS002	94.3	-3	0.06	1.96	0.2	1.12	1.12	0.64	4.6	2.5	21	30	34.3	-0.09	37.27	Potentially Acid Forming
701-22-017	Breccia	LS002	104.13	-4	0.07	2.01	0.21	1.35	1.35	0.45	4.5	2.5	27	37	41.3	-0.10	45.31	Potentially Acid Forming
701-22-018	Andesite Porphyry	LS002	128.6	-3	0.05	1.76	0.21	1.09	1.09	0.46	4.6	2.5	20	28	33.4	-0.09	36.35	Potentially Acid Forming
701-22-019	Andesite Porphyry	LS002	148.4	-3	0.05	1.99	0.15	1.55	1.55	0.29	4.4	2.4	33	43	47.4	-0.06	50.43	Potentially Acid Forming
701-22-020	Diorite Porphyry	LS002	355.8	17	0.99	0.52	0.05	0.36	0.36	0.11	8.5	6.7	0	0	11.0	1.54	-5.98	Non Acid Forming
701-22-021	Andesite Porphyry	LS002	373	13	1.095	2.52	0.115	2.19	2.19	0.215	5.85	3.4	7	35.5	67.0	0.19	54.01	Potentially Acid Forming
701-22-022	Andesite Porphyry	LS002	422.5	4	0.05	1.78	0.09	1.62	1.62	0.07	5.6	2.4	29	38	49.6	0.08	45.57	Potentially Acid Forming
701-22-023	Andesite Porphyry	LS002	435.3	5	0.31	1.47	0.09	1.23	1.23	0.15	6.1	2.7	11	24	37.6	0.13	32.64	Potentially Acid Forming
701-22-024	Andesite Porphyry	LS002	448.85	5	0.03	3.13	0.13	2.51	2.51	0.49	5.1	2.3	63	72	76.8	0.07	71.81	Potentially Acid Forming
701-22-025	Andesite Porphyry	LS002	472.85	4	0.02	0.79	0.04	0.56	0.56	0.19	6.3	3.2	3	7	17.1	0.23	13.14	Potentially Acid Forming
701-22-026	Andesite Porphyry	LS003	21.3	4	0.1	0.74	0.2	0.04	0.04	0.5	6.2	6.5	0	0	1.2	3.27	-2.78	Non Acid Forming
701-22-027	Andesite Porphyry	LS003	70	4	0.04	2.98	0.13	2.32	2.32	0.53	4.7	2.2	68	79	71.0	0.06	66.99	Potentially Acid Forming
701-22-028	Andesite Porphyry	LS003	74.3	4	0.06	1.14	0.04	0.41	0.41	0.69	4.9	2.5	17	25	12.5	0.32	8.55	Potentially Acid Forming - Low Capacity
701-22-029	Andesite Porphyry	LS003	97	4	0.05	2.4	0.12	2.08	2.08	0.2	4	2.3	49	61	63.6	0.06	59.65	Potentially Acid Forming
701-22-030	Andesite Porphyry	LS003	115.5	1	0.06	7.71	0.33	5.54	5.54	1.84	4.3	2.2	190	205	169.5	0.01	168.52	Potentially Acid Forming
701-22-031	Andesite Porphyry	LS003	131.7	4	0.07	1.59	0.16	1.06	1.06	0.37	4.4	2.5	21	29	32.4	0.12	28.44	Potentially Acid Forming
701-22-032	Breccia	LS003	146.75	2	0.1	3.82	0.18	2.7	2.70	0.94	4.1	2.2	82	92	82.6	0.02	80.62	Potentially Acid Forming
701-22-033	Diorite Porphyry	LS003	170.02	3	0.05	4.3	0.2	3.27	3.27	0.83	4.5	2.2	93	104	100.1	0.03	97.06	Potentially Acid Forming
701-22-034	Diorite Porphyry	LS003	182.4	4	0.04	3.22	0.16	2.53	2.53	0.53	4.6	2.2	70	82	77.4	0.05	73.42	Potentially Acid Forming
701-22-035	Diorite Porphyry	LS003	274.25	-2	0.03	11.79	0.97	7.15	7.15	3.67	4.7	2.3	223	242	218.8	-0.01	220.79	Potentially Acid Forming
701-22-036	Diorite Porphyry	LS003	298.3	2	0.04	8.89	0.49	6.58	6.58	1.82	4	2.2	208	224	201.3	0.01	199.35	Potentially Acid Forming
701-22-037	Diorite Porphyry	LS003	305	2	0.06	4.46	0.33	2.97	2.97	1.16	4.3	2.3	90	101	90.9	0.02	88.88	Potentially Acid Forming
701-22-038	Breccia	LS003	324.8	1	0.11	9	0.5	6.25	6.25	2.25	4.8	2.2	200	217	191.3	0.01	190.25	Potentially Acid Forming
701-22-039	Andesite Porphyry	LS003	330.2	1	0.07	4.38	0.61	2.18	2.18	1.59	4.4	2.4	60	72	66.7	0.01	65.71	Potentially Acid Forming
701-22-040	Diorite Porphyry	LS003	342.8	41	0.65	4.07	0.35	2.75	2.75	0.97	8	2.6	38	46	84.2	0.49	43.15	Potentially Acid Forming
701-22-041	Feldspar Porphyry	LS003	353.35	1	0.03	6.46	0.325	4.38	4.38	1.755	5.35	2.2	154.5	166.5	134.0	0.01	133.03	Potentially Acid Forming
701-22-042	Andesite Porphyry	LS003	377.5	0	0.03	5.92	0.36	4.68	4.68	0.88	4.9	2.2	133	145	143.2	0.00	143.21	Potentially Acid Forming
701-22-043	Porphyry	LS003	394.75	2	0.04	2.03	0.54	0.27	0.27	1.22	5.7	3.7	1	7	8.3	0.24	6.26	Potentially Acid Forming - Low Capacity
701-22-044	Porphyry	LS003	410.9	1	0.06	4.11	1.19	0.35	0.35	2.57	5	3.1	10	17	10.7	0.09	9.71	Potentially Acid Forming - Low Capacity
701-22-045	Breccia	LS003	440.8	0	0.04	8.22	0.48	5.32	5.32	2.42	4.9	2.2	176	193	162.8	0.00	162.79	Potentially Acid Forming
701-22-046	Andesite Porphyry	LS004	30.21	31	0.83	4.24	0.14	3.66	3.66	0.44	7.2	2.5	53	68	112.0	0.28	81.00	Potentially Acid Forming
701-22-047	Andesite Porphyry	LS004	50.21	99	1.37	0.37	0.05	0.25	0.25	0.07	9.3	8.5	0	0	7.7	12.94	-91.35	Non Acid Forming
701-22-048	Andesite Porphyry	LS004	69.25	57	0.69	1.64	0.05	1.34	1.34	0.25	8.1	6	0	2	41.0	1.39	-16.00	Non Acid Forming
701-22-049	Andesite Porphyry	LS004	110.45	5	0.05	4.76	0.11	3.8	3.80	0.85	5.3	2.1	110	128	116.3	0.04	111.28	Potentially Acid Forming
701-22-050	Andesite Porphyry	LS004	134.45	1	0.16	9.64	0.22	7.35	7.35	2.07	5	2.1	222	244	224.9	0.00	223.91	Potentially Acid Forming
701-22-051	Diorite Porphyry	LS005	28.4	100	1.57	2.28	0.33	1.99	1.99	0	7.2	8.1	0	0	60.9	1.64	-39.11	Non Acid Forming
701-22-052	Diorite Porphyry	LS005	50.1	134	2.06	0.62	0.07	0.44	0.44	0.11	8.2	8.9	0	0	13.5	9.95	-120.54	Acid Consuming
701-22-053	Breccia	LS005	72.5	32	1.05	2.9	0.06	2.62	2.62	0.22	7.6	3	12	26	80.2	0.40	48.17	Potentially Acid Forming
701-22-054	Breccia	LS005	133.9	4	0.04	6.57	0.18	5.73	5.73	0.66	4.7	2.1	160	181	175.3	0.02	171.34	Potentially Acid Forming
701-22-055	Diorite Porphyry	LS005	141.4	13	0.41	1.13	0.06	1.03	1.03	0.04	7.3	3	5	14	31.5	0.41	18.52	Potentially Acid Forming
701-22-056	Andesite Porphyry	LS006	34.3	3	0.03	1.58	0.08	1.63	1.63	0	4.7	2.3	30	40	49.9	0.06	46.88	Potentially Acid Forming
701-22-057	Andesite Porphyry	LS006	52.3	1	0.03	2.11	0.17	1.74	1.74	0.2	4.4	2.2	43	53	53.2	0.02	52.24	Potentially Acid Forming
701-22-058	Andesite Porphyry	LS006	70.3	4	0.04	1.56	0.1	1.27	1.27	0.19	4.4	2.3	28	36	38.9	0.10	34.86	Potentially Acid Forming
701-22-059	Andesite Porphyry	LS006	127.6	11	0.65	1.52	0.08	1.3	1.30	0.14	6.5	2.8	8	27	39.8	0.28	28.78	Potentially Acid Forming
701-22-060	Breccia	LS006	140.4	6	0.05	3.47	0.09	2.79	2.79	0.59	5.2	2.2	81	94	85.4	0.07	79.37	Potentially Acid Forming
701-22-061	Porphyry	LK002	16.05	1.5	0.035	1.55	0.98	0.06	0.06	0.51	4.1	4.5	0	1.5	1.8	0.82	0.34	Potentially Acid Forming - Low Capacity
701-22-062	Andesite Porphyry	LK002	36.3	3	0.04	2.02	0.4	1.27	1.27	0.35	4.2	2.4	23	34	38.9	0.08	35.86	Potentially Acid Forming
701-22-063	Breccia	LK002	113.6	1	0.03	9.68	0.47	7.67	7.67	1.54	4.6	2.3	181	207	234.7	0.00	233.70	Potentially Acid Forming
701-22-064	Porphyry	LK002	133.3	-1	0.02	9.05	1.17	4.41	4.41	3.47	4.1	2.3	126	144	134.9	-0.01	135.95	Potentially Acid Forming
701-22-065	Porphyry	LK002	167.3	0	0.02	10.9	1.02	6.02	6.02	3.86	4.3	2.2	196	215	184.2	0.00	184.21	Potentially Acid Forming
701-22-066	Andesite Porphyry	LK003	40.3	4	0.02	1.98	0.39	0.68	0.68	0.91	4.1	2.9	9	19	20.8	0.19	16.81	Potentially Acid Forming
701-22-067	Breccia	LK003	54.9	3	0.04	3.4	0.21	2.75	2.75	0.44	3.7	2.2	66	81	84.2	0.04	81.15	Potentially Acid Forming
701-22-068	Breccia	LK003	108.6	3	0.05	6.28	0.41	3.85	3.85	2.02	3.7	2.1	137	157	117.8	0.03	114.81	Potentially Acid Forming
701-22-069	Pyroclastic	LK003	128.7	5	0.08	2.21	0.15	1.99	1.99	0.07	3.8	2.1	51	62	60.9	0.08	55.89	Potentially Acid Forming
701-22-070	Tuff	LK003	145.6	6	0.05	2.2	0.19	2.01	2.01	4.44089E-16	4.2	2.2	49	63	61.5	0.10	55.51	Potentially Acid Forming
701-22-071	Hornblende Porphyry	LK004	51.23	93	1.09	0.07	0.02	0	0.00	0.05	9.2	9.7	0	0	0.0	0.00	-93.00	Non Acid Forming
701-22-072	Breccia	LK004	71.63	125	1.53	0.8	0.09	0.57	0.57	0.14	8.5	9	0	0	17.4	7.17	-107.56	Acid Consuming
701-22-073	Breccia	LK004	81.52	104	1.72	1.31	0.05	1.09	1.09	0.17	8.5	9	0	0	33.4	3.12	-70.65	Non Acid Forming
701-22-074	Andesite Porphyry	LK004	104.71	18	0.71	4.24	0.09	3.84	3.84	0.31	7.3	2.3	61	80	117.5	0.15	99.50	Potentially Acid Forming
701-22-075	Diorite Porphyry	LK004	137.51	6	0.05	3.62	0.15	3.15	3.15	0.32	5.4	2.2	67	79	96.4	0.06	90.39	Potentially Acid Forming
701-22-076	Breccia	LK006	45.2	-1	0.05	16.29	0.43	12.4	12.40	3.46	2.7	2.1	409	440	379.4	0.00	380.44	Potentially Acid Forming
701-22-077	Andesite Porphyry	LK006	51.8	4	0.04	2.04	0.52	1.16	1.16	0.36	4.2	2.5	23	32	35.5	0.11	31.50	Potentially Acid Forming
701-22-078	Andesite Porphyry	LK006	129.7	5	0.03	4.62	0.26	3.63	3.63	0.73	4.5	2.2	100	113	111.1	0.05	106.08	Potentially Acid Forming
701-22-079	Breccia	LK006	145.7	5	0.04	4.32	0.28	3.44	3.44	0.6	4	2.2	88	101	105.3	0.05	100.26	Potentially Acid Forming
701-22-080	Diorite Porphyry	LK006	165.86	5	0.04	4.27	0.28	3.37	3.37	0.62	4.7	2.1	95	106	103.1	0.05	98.12	Potentially Acid Forming
701-22-081	Tuff	LK006	191.35	-1	0.065	7.18	0.495	5.23	5.23	1.455	2.7	2.15	166.5	181.5	160.0	-0.01	161.04	Potentially Acid Forming
701-22-082	Pyroclastic	LK006	214.6	3	0.02	4.51	0.7	2.38	2.38	1.43	3.9	2.3	74	84	72.8	0.04	69.83	Potentially Acid Forming
701-22-083	Andesite Porphyry	L013	5	4	0.05	0.81	0.15	0.38	0.38	0.28	6.6	3.2	3	8	11.6	0.34	7.63	Potentially Acid Forming - Low Capacity
701-22-084	Andesite Porphyry	L013	11	6	0.06	1.82	0.48	0.04	0.04	1.3	7.3	5.7	0	4	1.2	4.90	-4.78	Non Acid Forming

Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m) (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unit Less	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Fromation Potential Classification
701-22-085	Andesite Porphyry	L013	17.7	5	0.04	1.29	0.57	0.04	0.04	0.68	6.7	5.9	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-086	Andesite Porphyry	L013	23.4	5	0.06	1.16	0.4	0.04	0.04	0.72	6.3	5.8	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-087	Andesite Porphyry	L013	28.9	4	0.05	1.52	0.64	0.04	0.04	0.84	6.2	6.3	0	4	1.2	3.27	-2.78	Non Acid Forming
701-22-088	Andesite Porphyry	L013	34.9	3	0.04	2.25	0.88	0.05	0.05	1.32	5.6	5.4	0	6	1.5	1.96	-1.47	Non Acid Forming
701-22-089	Andesite Porphyry	L013	41.25	4	0.06	2.45	0.81	0.04	0.04	1.6	6.2	5.4	0	7	1.2	3.27	-2.78	Non Acid Forming
701-22-090	Andesite Porphyry	L013	47.7	4	0.05	0.98	0.34	0.04	0.04	0.6	6.2	5.9	0	1	1.2	3.27	-2.78	Non Acid Forming
701-22-091	Andesite Porphyry	L013	52.9	4	0.05	1.4	0.41	0.04	0.04	0.95	6.1	5.9	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-092	Andesite Porphyry	L013	58.8	4	0.11	0.97	0.35	0.04	0.04	0.58	4.6	5.5	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-093	Andesite Porphyry	L013	69	4	0.09	1.03	0.43	0.06	0.06	0.54	4.2	4.6	0	1	1.8	2.18	-2.16	Non Acid Forming
701-22-094	Hydrothermal Breccia	L013	75	0	0.04	3.96	1.46	0.04	0.04	2.46	5.1	4.6	0	13	1.2	0.00	1.22	Uncertain
701-22-095	Hydrothermal Breccia	L013	81.9	-2	0.03	4.3	1.59	0.04	0.04	2.67	4.7	4.3	0	9	1.2	-1.63	3.22	Potentially Acid Forming - Low Capacity
701-22-096	Hydrothermal Breccia	L013	86.55	0	0.04	4.72	1.58	0.04	0.04	3.1	5.2	4.5	0	13	1.2	0.00	1.22	Potentially Acid Forming - Low Capacity
701-22-097	Fault Breccia	L013	93.25	3	0.09	1.59	0.47	0.04	0.04	1.08	5.8	3.4	8	12	1.2	2.45	-1.78	Uncertain
701-22-098	Hydrothermal Breccia	L013	100.4	0	0.03	4.12	1.27	0.05	0.05	2.8	5.4	5.1	0	13	1.5	0.00	1.53	Uncertain
701-22-099	Andesite Porphyry	L013	127.55	3	0.08	2.11	0.2	1.8	1.80	0.11	4.2	2.3	34	43	55.1	0.05	52.08	Potentially Acid Forming
701-22-100	Andesite Porphyry	L013	177.05	2	0.03	5.26	0.2	3.87	3.87	1.19	4.8	2.2	109	121	118.4	0.02	116.42	Potentially Acid Forming
701-22-101	Andesite Porphyry	L013	199.75	2	0.055	5.285	0.44	4.09	4.09	0.755	3.8	2.3	109	120.5	125.2	0.02	123.15	Potentially Acid Forming
701-22-102	Fault Breccia	L223	121.75	-23	0.03	7.65	1.22	4.9	4.90	1.53	3	2.3	145	165	149.9	-0.15	172.94	Potentially Acid Forming
701-22-103	Andesite Porphyry	L223	131	-11	0.06	3.52	0.64	2.53	2.53	0.35	3.2	2.2	70	84	77.4	-0.14	88.42	Potentially Acid Forming
701-22-104	Andesite Porphyry	L223	137	13	0.3	0.38	0.13	0.19	0.19	0.06	7	4.9	0	8	5.8	2.24	-7.19	Non Acid Forming
701-22-105	Andesite Porphyry	L223	142.1	9	0.04	1.36	0.15	1.07	1.07	0.14	5	2.7	11	23	32.7	0.27	23.74	Potentially Acid Forming
701-22-106	Andesite Porphyry	L223	150	83	0.65	1.17	0.09	0.93	0.93	0.15	9.1	10.7	0	0	28.5	2.92	-54.54	Non Acid Forming
701-22-107	Andesite Porphyry	L223	156	84	0.73	0.78	0.1	0.57	0.57	0.11	8.1	11	0	0	17.4	4.82	-66.56	Non Acid Forming
701-22-108	Andesite Porphyry	L223	164.55	78	0.67	0.04	0.01		0.03	0	9.4	11.2	0	0	0.9	0.00	-77.08	Non Acid Forming
701-22-109	Andesite Porphyry	L223	170	86	0.87	0.03	0.02		0.01	0	9	11.3	0	0	0.3	0.00	-85.69	Non Acid Forming
701-22-110	Andesite Porphyry	L223	178.05	85	0.8	0.05	0.02		0.03	0	9.4	11.3	0	0	0.9	0.00	-84.08	Non Acid Forming
701-22-111	Andesite Porphyry	L223	184	155	1.84	0.12	0.03	0.08	0.08	0.01	8.8	10.9	0	0	2.4	63.32	-152.55	Acid Consuming
701-22-112	Andesite Porphyry	L223	191.95	106	1.23	0.08	0.03		0.05	0	9.5	11.1	0	0	1.5	0.00	-104.47	Acid Consuming
701-22-113	Andesite Porphyry	L223	198	109	1.32	0.12	0.03		0.09	0	9.1	11.3	0	0	2.8	0.00	-106.25	Acid Consuming
701-22-114	Andesite Porphyry	L223	206.5	117	1.44	0.04	0.03		0.01	0	8.5	11.4	0	0	0.3	0.00	-116.69	Acid Consuming
701-22-115	Andesite Porphyry	L223	212	130	1.44	0.34	0.06	0.25	0.25	0.03	8.6	11.3	0	0	7.7	16.99	-122.35	Acid Consuming
701-22-116	Andesite Porphyry	L223	220.05	95	0.92	0.63	0.12	0.43	0.43	0.08	8.8	11.3	0	0	13.2	7.22	-81.84	Non Acid Forming
701-22-117	Andesite Porphyry	L223	231.2	84	0.76	0.55	0.06	0.42	0.42	0.07	9.7	11.3	0	0	12.9	6.54	-71.15	Non Acid Forming
701-22-118	Andesite Porphyry	L223	240.4	23	0.84	1.7	0.17	1.29	1.29	0.24	8	4.8	0	12	39.5	0.58	16.47	Uncertain
701-22-119	Fault Breccia	L223	244	6	0.08	1.33	0.16	0.98	0.98	0.19	4.8	2.5	17	23	30.0	0.20	23.99	Potentially Acid Forming
701-22-120	Andesite Porphyry	L223	319.3	6	0.04	0.5	0.11	0.29	0.29	0.1	5.9	3.3	3	5	8.9	0.68	2.87	Potentially Acid Forming - Low Capacity
701-22-121	Andesite Porphyry	L223	325.4	5	0.03	0.58	0.07	0.42	0.42	0.09	5.3	2.9	7	11.5	12.9	0.39	7.85	Potentially Acid Forming - Low Capacity
701-22-122	Fault Breccia	L223	340.3	3	0.05	1.19	0.26	0.59	0.59	0.34	4.1	2.9	7	12	18.1	0.17	15.05	Potentially Acid Forming
701-22-123	Pyroclastic	L087	6	10	0.15	2.04	0.7	0.04	0.04	1.3	7.9	7.1	0	0	1.2	8.17	-8.78	Non Acid Forming
701-22-124	Pyroclastic	L087	16	6	0.08	0.25	0.11	0.04	0.04	0.1	7.6	6.8	0	1	1.2	4.90	-4.78	Non Acid Forming
701-22-125	Pyroclastic	L087	26	2	0.04	3.2	1.06	0.04	0.04	2.1	7.3	4.6	0	13	1.2	1.63	-0.78	Non Acid Forming
701-22-126	Pyroclastic	L087	36	1	0.02	2.22	0.57	0.04	0.04	1.61	6.8	4.5	0	9	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-127	Pyroclastic	L087	46	3	0.02	1.77	0.25	0.04	0.04	1.48	6.8	4.7	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-128	Andesite Porphyry	L087	56	2	0.02	3.06	0.92	0.04	0.04	2.1	7.2	4.5	0	11	1.2	1.63	-0.78	Uncertain
701-22-129	Fault Breccia	L087	66	2	0.03	2.23	0.68	0.04	0.04	1.51	7.3	4.7	0	5	1.2	1.63	-0.78	Non Acid Forming
701-22-130	Andesite Porphyry	L087	76	1	0.02	1.82	0.83	0.3	0.30	0.69	7.3	4.5	0	6	9.2	0.11	8.18	Potentially Acid Forming - Low Capacity
701-22-131	Andesite Porphyry	L087	86	1	0.03	2.49	0.81	0.04	0.04	1.64	7	4.5	0	6	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-132	Andesite Porphyry	L087	96	2	0.02	1.58	0.42	0.05	0.05	1.11	6.7	4.8	0	5	1.5	1.31	-0.47	Non Acid Forming
701-22-133	Andesite Porphyry	L087	106	3	0.08	0.97	0.22	0.04	0.04	0.71	6.8	5.9	0	0	1.2	2.45	-1.78	Non Acid Forming
701-22-134	Andesite Porphyry	L087	116	2	0.04	1.36	0.2	0.04	0.04	1.12	7.1	5.3	0	4	1.2	1.63	-0.78	Non Acid Forming
701-22-135	Andesite Porphyry	L087	126	3	0.02	1.93	0.3	0.04	0.04	1.59	6.7	5	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-136	Andesite Porphyry	L087	134	5	0.03	0.1	0.04		0.06	0	7	6.6	0	1	1.8	0.00	-3.16	Non Acid Forming
701-22-137	Andesite Porphyry	L087	144	-4	0.02	2.39	0.58	0.71	0.71	1.1	2.8	2.7	16	22	21.7	-0.18	25.73	Potentially Acid Forming
701-22-138	Andesite Porphyry	L087	158	3	0.02	0.75	0.13	0.53	0.53	0.09	4.2	2.7	11	15	16.2	0.18	13.22	Potentially Acid Forming
701-22-139	Andesite Porphyry	L087	170	3	0.04	0.8	0.09	0.6	0.60	0.11	4.7	2.6	12	17	18.4	0.16	15.36	Potentially Acid Forming
701-22-140	Andesite Porphyry	L087	184	1	0.04	1.24	0.12	0.94	0.94	0.18	3.8	2.4	24	30	28.8	0.03	27.76	Potentially Acid Forming
701-22-141	Andesite Porphyry	L087	200	3.5	0.04	1.25	0.095	1.07	1.07	0.085	4.3	2.5	19.5	24.5	32.7	0.11	29.24	Potentially Acid Forming
701-22-142	Andesite Porphyry	L087	210	5	0.02	0.1	0.05		0.05	0	5.9	4.9	0	4	1.5	0.00	-3.47	Non Acid Forming
701-22-143	Andesite Porphyry	L087	216	-1	0.04	2.5	0.4	1.52	1.52	0.58	3	2.4	38	45	46.5	-0.02	47.51	Potentially Acid Forming
701-22-144	Andesite Porphyry	L087	252	-2	0.02	11.56	1.39	5.58	5.58	4.59	3	2.4	178	193	170.7	-0.01	172.75	Potentially Acid Forming
701-22-145	Andesite Porphyry	L087	262	-7	0.02	26.63	1.19	18.95	18.95	6.49	2.7	2.3	493	533	579.9	-0.01	586.87	Potentially Acid Forming
701-22-146	Andesite Porphyry	L087	272	-1	0.01	9.82	0.7	4.84	4.84	4.28	3.1	2.4	149	162	148.1	-0.01	149.10	Potentially Acid Forming
701-22-147	Andesite Porphyry	L087	292	2	0.03	3.84	0.3	2.81	2.81	0.73	3.4	2.3	74	81	86.0	0.02	83.99	Potentially Acid Forming
701-22-148	Hydrothermal Breccia	L087	330	-2	0.01	13.32	1.17	7.94	7.94	4.21	3.3	2.3	216	236	243.0	-0.01	244.96	Potentially Acid Forming
701-22-149	Andesite Porphyry	L087	349.7	0	0.04	2.03	0.25	1.69	1.69	0.09	3.3	2.3	35	42	51.7	0.00	51.71	Potentially Acid Forming
701-22-150	Andesite Porphyry	L087	340	-2	0.02	5.75	0.34	4	4.00	1.41	3.2	2.2	133	143	122.4	-0.02	124.40	Potentially Acid Forming

APPENDIX C

Multi-Element Analysis Results

Knight Piésold
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Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	Geochemical Abundance Index			0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950
Andesite Porphyry	LS001	25	701-22-001	0.685	103517	4.1	10	255.25	2.015	0.155	966.5	0.2	65.425	1.3	12.5	2.59	409.05	2.41	1.12	1.02	1.09	15.865	3.23	1.03	1.785	0.01	0.435	0.5825	38446.5	37.265	5.3	0.169	3914	163.5
Andesite Porphyry	LS001	59	701-22-002	0.11	77727	1.6	13	426.1	1.96	0.33	2481	0.75	65.36	12.6	10	3.68	20.6	2.51	1.53	1.02	5.11	16.56	2.94	1.05	1.56	0.01	0.52	0.105	30829	37.9	12.7	0.243	6818	9922
Andesite Porphyry	LS001	65.5	701-22-003	0.86	81128	10.7	10	381.5	2.5	6.78	1432	0.68	46.42	17.3	23	5.8	756.1	4.4	2.85	1.04	5.77	32.57	4.02	0.9	1.17	0.01	0.94	1.456	37121	27.29	2.2	0.406	2838	291
Andesite Porphyry	LS001	89.25	701-22-004	1.16	79579	12.4	10	542.1	1.16	7.05	1079	0.24	69.4	11.8	12	3.18	555.8	5.02	2.86	1.52	4.51	26.34	5.13	1	1.46	0.03	1.05	1.132	35174	37.25	4.9	0.368	3051	133
Andesite Porphyry	LS001	122	701-22-005	0.54	90610	3.7	10	339.8	1.9	0.74	383	0.12	71.18	4.3	12	3.18	45.6	2.68	1.5	1.01	1.58	19.58	3.19	1.18	1.55	0.01	0.65	0.676	35318	38.73	13.6	0.212	7822	1142
Dyke	LS001	136.75	701-22-006	0.65	87705	7.1	10	448.9	0.68	6.94	819	0.04	54.06	11.1	14	1.9	127.9	4.07	2.23	1.2	3.57	28.31	4.15	0.88	1.63	0.02	0.78	0.663	39963	27.27	2.5	0.264	2892	82
Dyke	LS001	185	701-22-007	1.12	58688	789.6	10	584	0.28	10.93	645	0.13	47.41	22.8	20	0.12	817.9	1.9	0.69	1.48	15.86	18.92	3.73	1.83	0.95	0.18	0.26	0.405	2307	21.06	35.3	0.106	136	41
Dyke	LS001	221.65	701-22-008	0.22	80964	37.3	10	452.1	0.16	6.33	967	0.37	29.96	15.6	26	0.1	634.9	0.95	0.3	0.69	4.85	30.12	2.02	0.89	1.06	0.02	0.13	0.092	7904	16.11	4.9	0.058	122	27
Andesite Porphyry	LS001	249.15	701-22-009	0.13	91995	33.9	10	572.7	0.6	0.99	817	0.13	55.84	5.2	13	1.42	170.1	1.2	0.49	0.94	1.31	24.4	2.52	1.26	1.15	0.02	0.18	0.156	37872	30.23	2.9	0.073	2139	54
Andesite Porphyry	LS001	290.75	701-22-010	0.15	86896	9.4	10	393	0.5	3.17	578	0.12	37.29	10.9	19	0.93	383.7	0.79	0.4	0.67	2.93	24.97	1.65	0.86	0.88	0.01	0.13	0.33	31259	20.77	4.3	0.076	1507	72
Andesite Porphyry	LS001	304.05	701-22-011	1	80277	12.5	10	384.8	0.4	16.79	653	0.1	43.59	19.3	26	0.19	1365.5	0.94	0.43	0.77	7.28	35.11	2.01	1.33	1.44	0.04	0.16	0.21	7861	24.18	25.1	0.093	176	42
Andesite Porphyry	LS001	368.85	701-22-012	0.82	86945	4.9	10	607.5	1.27	5.16	618	0.8	76.58	14.7	19	2.36	306	7.7	3.86	2.36	5.16	26.73	7.7	1.07	1.69	0.03	1.49	0.426	32394	42.52	6.5	0.371	2952	51
Andesite Porphyry	LS001	395	701-22-013	0.14	94738	8.4	10	344.8	1.39	2.21	556	0.05	73.5	9.6	17	1.53	922.7	5.67	2.9	1.59	2.24	19.82	5.6	1.42	2.04	0.01	1.1	0.729	28083	41.01	30.6	0.316	2593	93
Andesite Porphyry	LS001	411.1	701-22-014	0.41	67660	90.4	10	351.1	0.16	2.93	531	0.62	71.86	21	18	0.12	5916	0.8	0.26	0.97	7.8	16.91	1.95	2.49	0.21	0.02	0.1	0.205	4843	44.8	7.2	0.037	120	30
Andesite Porphyry	LS001	423.5	701-22-015	0.09	61701	42.4	10	449.4	0.17	1.13	593	0.08	46.46	21.3	17	0.11	815.9	0.24	0.09	0.63	9.39	4.4	0.98	1.23	0.12	0.02	0.03	0.024	12052	26.4	4.7	0.014	106	30
Andesite Porphyry	LS002	94.3	701-22-016	0.17	90445	2.9	10	1084.9	0.78	0.19	456	0.03	44.35	13.1	14	1.69	597.7	1.26	0.68	0.53	1.83	16.27	1.61	1.62	0.51	0.02	0.25	0.034	27655	28.24	3	0.081	2688	45
Breccia	LS002	104.13	701-22-017	0.25	89815	16.5	10	917.2	0.88	0.43	388	0.03	45.24	16.6	12	2.32	647.2	1.37	0.74	0.55	2.18	16.66	1.69	1.58	0.3	0.02	0.26	0.104	28772	29.07	3.1	0.09	3079	61
Andesite Porphyry	LS002	128.6	701-22-018	0.12	87842	8.2	10	986.7	0.57	0.39	356	0.19	53.64	11.7	18	1.84	437	1.99	0.95	0.93	2.06	16.66	2.59	1.52	0.33	0.02	0.36	0.035	30097	30.18	3.3	0.114	2684	33
Andesite Porphyry	LS002	148.4	701-22-019	0.16	86844	20.3	10	750	0.98	0.3	283	0.05	61.46	11.4	15	2.13	431.5	2.26	1.2	0.97	2.62	16.33	2.73	1.37	0.53	0.01	0.42	0.068	34562	35.94	2.7	0.145	2937	44
Diorite Porphyry	LS002	355.8	701-22-020	0.17	69759	1.3	10	1144.9	1.1	0.06	3774	0.2	50.47	12.6	18	7.93	890.5	1.78	0.9	0.88	6.69	15.03	2.48	0.79	0.12	0.01	0.33	0.029	22713	26.97	3.7	0.104	7768	2062
Andesite Porphyry	LS002	373	701-22-021	1.51	86132	14.9	10	301.2	1.46	1.41	924.5	1.375	68.265	20.6	16.5	12.77	1318.95	3.29	1.795	1.335	7.23	19.12	4.125	1.285	0.15	0.025	0.625	0.4145	21548	37.94	15.85	0.1955	4472.5	4588
Andesite Porphyry	LS002	422.5	701-22-022	0.31	89437	5.5	10	461.3	0.91	0.45	386	0.58	66.88	15.7	11	3.58	592.4	2.67	1.39	1.12	2.48	20.64	3.52	1.73	0.31	0.03	0.52	0.159	26166	35.68	29.8	0.177	3004	145
Andesite Porphyry	LS002	435.3	701-22-023	0.21	90678	3.9	10	536.6	1.12	0.43	502	0.78	68.05	16.1	15	3.51	396.8	2.63	1.36	1.3	2.98	18.9	3.49	1.51	0.71	0.02	0.49	0.066	26125	36.93	16.7	0.167	2823	1297
Andesite Porphyry	LS002	448.85	701-22-024	1.81	85770	47.9	10	646.5	1.25	0.44	563	1.81	65.33	22.2	11	5.66	668	3.57	2.01	1.18	3.62	19.45	3.72	1.21	0.3	0.07	0.69	0.701	35515	36.44	6.3	0.224	3955	65
Andesite Porphyry	LS002	472.85	701-22-025	0.24	91866	6.1	10	1129.3	0.93	0.11	540	1.84	86.89	13.5	20	2.43	961.2	5.66	3.4	1.7	1.18	17.29	5.4	1.88	0.47	0.01	1.16	0.062	20377	47.58	15.8	0.453	2374	41
Andesite Porphyry	LS003	21.3	701-22-026	0.46	78451	15.5	10	403.7	0.81	2.46	1160	0.03	42.38	0.6	18	1.17	273.8	0.98	0.52	0.8	3.74	20.09	2.05	0.95	1.6	0.01	0.19	1.252	32775	22.55	0.5	0.103	2199	490
Andesite Porphyry	LS003	70	701-22-027	0.18	85064	1.6	10	721.9	0.94	1.37	757	0.76	55.69	14	20	1.49	36.4	1.96	1.15	0.87	3.1	17.82	6.71	1.12	1.64	0.02	0.39	0.345	38759	31.12	2.7	0.193	3307	119
Andesite Porphyry	LS003	74.3	701-22-028	0.17	63156	2.7	10	345.7	1.24	1.23	307	2.05	33.21	4.9	16	0.89	44.3	2.06	0.84	0.66	1.04	12.34	1.99	0.96	1.33	0.04	0.28	0.392	21720	16.37	2.8	0.117	1687	93
Andesite Porphyry	LS003	97	701-22-029	0.49	91262	20.3	10	452.5	1.14	2.64	582	0.13	27.5	12.3	13	3.63	393.5	7.4	1.01	0.61	2.94	18.68	1.55	1.13	1.79	0.04	0.33	0.993	34180	13.74	1.8	0.162	2469	142
Andesite Porphyry	LS003	115.5	701-22-030	0.59	71142	16	10	235.1	0.66	5.33	729	0.04	20.58	16.1	16	1.12	319.6	1.2	0.66	0.51	7.07	24.06	1.63	0.54	1.11	0.04	0.22	0.748	16239	11.08	0.7	0.129	798	74
Andesite Porphyry	LS003	131.7	701-22-031	0.22	88979	5.9	10	197.1	1.68	1.28	403	0.15	24.61	11.3	19	1.72	238.1	2.05	1.1	0.81	1.65	18.02	2.77	1.57	1.96	0.01	0.36	4.726	26502	12.65	3.2	0.178	1935	150
Breccia	LS003	146.75	701-22-032	0.68	80243	31.1	10	342.5	0.96	1.55	761	0.58	41.1	15.9	39	3.19	419.4	1.63	0.96	0.67	3.78	18.74	2.04	1.04	1.73	0.03	0.32	0.915	37060	21.45	0.5	0.186	2432	205
Diorite Porphyry	LS003	170.02	701-22-033	0.58	81158	15.5	10	566.2	0.85	2.09	920	0.48	39.13	11.2	13	3.45	317	1.56	0.91	0.7	3.91	23.93	2	0.8	1.44	0.01	0.29	0.459	35907	22.01	0.5	0.154	2004	135
Diorite Porphyry	LS003	182.4	701-22-034	0.46	90464	13.5	10	637.5	1.58	1.98	595	0.03	49.8	10.8	11	2.77	291.6	3.02	1.1	1.12	3.32	18.82	4.23	1.21	1.7	0.01	0.45	0.791	29319	25.29	2.7	0.173	1985	200
Diorite Porphyry	LS003	274.25	701-22-035	0.3	70308	31.6	10	351	0.21	3.32	614	0.81	41.33	16.4	67	0.42	709.3	1.14	0.59	1.03	8.2	7.4	2.52	0.68	1.17	0.02	0.19	0.083	17222	22.69	1.5	0.123	191	54
Diorite Porphyry	LS003	298.3	701-22-036	0.57	80956	14.3	10	478.4	0.64	9.53	1025	0.06	30.91	18.5	18	1.49	271.3	1.67	0.88	0.8	7.71	38.25	2.67	0.64	1.54	0.03	0.31	0.515	31247	16.61	0.7	0.151	1338	53
Diorite Porphyry	LS003	305	701-22-037	0.23	86129	7.2	10	509.5	0.54	4.72	1083	0.02	29.54	14.7	17	1.56	83.1	1.62	1.04	0.74	3.74	31.02	2.2	0.9	1.54	0.01	0.32	0.638	35109	14.86	0.6	0.169	1493	53
Breccia	LS003	324.8	701-22-038	0.39	74621	6.4	10	319	0.52	5.35	360	0.08	30.19	21.3	22	1.29	440.4	1.6	0.87	0.71	7.42	24.56	1.84	0.67	0.94	0.01	0.31	0.311	33090	18.65	1.1	0.134	1143	127
Andesite Porphyry	LS003	330.2	701-22-039	0.3	89832	4.7	10	374.2	0.68	0.88	548	0.09	46.5	20.4	26	1.28	114.3	2.77	1.42	0.76	2.82	18.94	2.73	1.02	2.23	0.02	0.5	0.623	34248	27.25	2.1	0.208	1806	78
Diorite Porphyry	LS003	342.8	701-22-040	0.11	78361	6.3	10	527.3	0.53	1.32	17724	0.07	30.53	17.3	14	1.12	105.8	1.26	0.63	0.8	3.53	25.87	2.21	0.81	1.39	0.01	0.23	0.164	31426	16.28	0.9	0.126	1843	70
Feldspar Porphyry	LS003	353.35	701-22-041	0.165	81866	8	10	311.7	0.32	1.68	814.5	0.14	45.965	12.85	13.5	0.39	60.55	0.965	0.42	0.785	5.405	12.135	2.285	0.755	1.08	0.01	0.15	0.0625	10531	24.835	1.15	0.09	517	47
Andesite Porphyry	LS003	377.5	701-22-042	0.13	70220	18.3	10	287.8	0.21	1.02	552	0.48	45.29	14	10	0.34	65.8	0.69	0.23	0.69	4.83	8.91	1.59	0.59	0.47	0.02	0.09	0.03	13445	26.46	1.4	0.036	139	38
Porphyry	LS003	394.75	701-22-043	0.06	94987	2.5	10	591.7	0.89	0.47	300	0.05	23.35	3.7	21	0.79	448	1.3	0.84	0.41	0.75	17.1	1.37	1.07	1.83	0.01	0.27	0.129	28652	13.93	3.4	0.167	977	56
Porphyry	LS003	410.9	701-22-044	0.07	99172	1.9	10	441.8	0.61	0.91	396	0.24	22.11	19.4	23	0.29	102.9	1.52	0.92	0.35	0.71	17.18	1.28	0.97	1.38	0.01	0.31	0.186	26211	15.1	6.1	0.151	384	42
Breccia	LS003	440.8	701-22-045	0.58	56485	21.3	10	192.8	0.25	2.97	339	0.05	36.22	13	27	0.19	666.2	0.88	0.42	0.58	6.73	8.08	1.77	0.87	0.32	0.02	0.15	0.422	5616	19.48	4.1	0.061	117	40
Andesite Porphyry	LS004	30.21	701-22-046	1.64	74128	36.3	13	584.9	2.12	0.75	2409	7.73	51.06	23.1	11	3	191.3	1.67	1.23	0.83	5.57	19.07	2.4	0.84	1.14	0.01	0.36	3.274	35612	28.6	2.7	0.18	6077	22548
Andesite Porphyry	LS004	50.21	701-22-047	0.12	77670	4.5	12	245.6	1.48	0.06	23035	0.29	52.53	9.7	11	3.16	10.9	2.03	1.22	0.83	2.75	16.55	2.35	0.83	1.33	0.01	0.39	0.035	36106	29.69	3.7	0.19	18699	5202
Andesite Porphyry	LS004	69.25	701-22-048	0.26	81970	12.2	17	112.3	2.07	0.05	2139	4.94	53.42	10.4	19	5.4	15	1.47	0.99	0.77	3.84	20.51	2.1	1.02	1.51	0.01	0.32	0.697	32629	29.57	5	0.168	22825	23584
Andesite Porphyry	LS004	110.45	701-22-049	1.11	88013	24.8	10	226.4	1.79	1.44	1118	0.16	36.48	11.6	16	5.49	300.6	2.79	1.68	0.97	4.86	21.73	3.24	0.79	1.91	0.02	0.6	1.992	39809	19.67	1.3	0.234	3257	398
Andesite Porphyry	LS004	134.45	701-22-050	2.33	81532	46.6	10	275.3	0.25	2.45	727	0.16	40.53	18.3	56	0.27	612.9	1.3	0.74	0.97	9.07	19.12	2.76	1.22	1.7	0.03	0.25	0.548	795	21.79	91.4	0.156	276	1372
Diorite Porphyry	LS005	28.4	701-22-051	0.53	74758	12.1	12	1024.8	1.28	1.24	27866	1.94	55.18	11.6	8	1.94	121.7	2.05	1.23	0.92	3.87	16.16	2.68	0.54	1.5	0.01	0.41	1.021	32133	32.13	7	0.186	13348	3669
Diorite Porphyry	LS005	50.1	701-22-052	0.12	75404	3.8	10	856.6	1.14	0.11	29505	0.17	71	9.4	12	1.83	18.8	2.49	1.43	1.12	2.85	15.41	3.02	0.89	1.6	0.01	0.49	0.056	32950	40.09	8.7	0.234	17656	1747
Breccia	LS005	72.5	701-22-053	1.19	79419	5.8	11	378.5	1.25	2.19	2929	4.32	68.75	12.4	9	1.78	215.1	2.45	1.41	1.3	5.2	19.45	3.24	0.97	1.92	0.06	0.49	0.224	32405	37.22	9.7	0.196	10517	20786
Breccia	LS005	133.9	701-22-054	1.45	77268	44.6	10	363.2	2.51	1.95	1131	1.58	66.32	17	26	4.84	325.5	3.64	2.47	1.1	6.41	16.84	3.43	0.77	1.47	0.04	0.82	0.259	34556	36.34	3	0.318	4717	401
Diorite Porphyry	LS005	141.4	701-22-055	0.18	84906	6.2	10	581.1	1.81	0.2	2575	0.07	71.61	9.8	11	2.04	11	2.75	1.6	1.15	3.4	18.09	3.38	0.97	1.89	0.01	0.55	0.043	34304	40.77	6.3	0.251	7312	4184
Andesite Porphyry	LS006	34.3	701-22-056	0.17	82449	4	10	540.3	0.78	0.7	205	0.04	58.01	8.6	8	2.6	165.8	1.32	0.84	0.52	1.99	16.95	1.51	1.12	1.87	0.01	0.39	0.123	37994	34.51	2.1	0.156	3843	129
Andesite Porphyry	LS006	52.3	701-22-057	0.21	102918	39.7	10	1364.1	0.9	0.42	287	1.04	86.79	61.4	12	2.85	45.3	3.8	2.6	1.35	3.04	17.11	4.15	0.91	1.7	0.01	0.84	0.096	26329	49.58	1.6	0.486	2726	50
Andesite Porphyry	LS006	70.3	701-22-058	0.15	109627	4.8	10	1041.3	1.36	0.42	338	0.32	90.64	24.1	19	2.58	31.7	3.15	1.96	1.72	1.67	16.63	4.38	0.98	1.92	0.01	0.65	0.049	24399	49.66	1.6	0.335	2527	46
Andesite Porphyry	LS006	127.6	701-22-059	0.36	86504	5.7	10	282.2	1.54	0.13	1201	5.53	70.24	10	10	7.26	17.4	2.08	1.36	0.98	3.82	18.57	2.76	1.14	1.7	0.05	0.45	0.938	35570	40.71	3.6	0.21	4326	5554
Breccia	LS006	140.4	701-22-060	0.7	87385	15.9	10	652.6	1.7	1.55	919	2.75	81.64	12.8	12	11.86	87.9	2.99	1.94	1.34	3.4	20.54	4.08	0.93	1.86	0.08	2.05	1.017	38085	45.89	2.6	0.269	3721	160
Porphyry	LK002	16.05	701-22-061	0.535	76271	6.8	10	397.85	0.765	3.435	843.5	0.04	52.005	0.6	10	0.855	163.15	1.05	0.54	0.725	3.345	18.5	1.875	1.005	1.54	0.01	0.18	0.415	37111.5	28.925	0.15	0.1055	2028	122.5
Andesite Porphyry	LK002	36.3	701-22-062	0.06	88566	10.2	10	252.3	0.84	1.62	674	0.02	55.75	3.5	13	1.05	87.4	1.16	0.52	0.9	2.38	17.77	2.32	1.14	1.55	0.01	0.18	0.552	37380	31.58	0.4	0.098	1882	118
Breccia	LK002	113.6	701-22-063	0.82	69550	86.5	10	204.5	0.3	3.07	803	0.05	44.72	15.2	40	0.18	1982.7	1.07	0.52	0.78	7.6	13.68	2.18	1.7	1.11	0.06	0.18	0.172	5571	24.22	2.1	0.111	173	44
Porphyry	LK002	133.3	701-22-064	0.46	80467	21.9	10	249.2	0.2	2.21	900	0.05	42.44	9.7	30	0.08	562.5	0.78	0.4	0.76	4.43	14.23	1.97	1.3	0.86	0.01	0.11	0.185	23261	22.83	0.3	0.068	113	41
Porphyry	LK002	167.3	701-22-065	0.38	73634	14.3	10	418.2	0.09	1.86	819	0.04	26.44	12.3	18	0.06	456.4	0.48	0.19	0.55	6.53	9.79	1.47	0.85	0.65	0.01	0.07	0.193	19430	13.91	0.7	0.038	107	42
Andesite Porphyry	LK003	40.3	701-22-066	0.1	116699	4.7	10	367.7	2.05	0.13	317	10.19	54.15	9.2	28	3.11	55	1.77	1.04	0.8	1.15	19.79	2.31	1.44	1.52	0.03	0.35	0.713	34470	31.68	4.4	0.163	2308	188
Breccia	LK003	54.9	701-22-067	1.29	72160	24.6	10	213	0.99	2.28	182	3.21	69.5	11.5	41	6.08	584.7	1.68	1.01	0.76	3.27	16.06	2.49	1.59	1.43	0.08	0.31	1.104	28001	42.14	2.5	0.173	2433	175
Breccia	LK003	108.6	701-22-068	2.37	81507	29.7	10	421.5	1.06	4.24	397	1.36	55.01	17.9	45	5.74	410.8	1.64	0.93	0.77	5.22	19.2	2.35	1.09	1.35	0.28	0.29	0.588	29777	30.72	1.8	0.152	1980	128
Pyroclastic	LK003	128.7	701-22-069	0.79	79365	18.7	10	382.4	1.31	1.68	440	6.07	58.11	16	83	10.97	147.7	1.84	0.98	0.85	2.68	17.61	2.83	1.44	1.36	0.48	0.35	0.791	32554	30.62	1.8	0.171	3026	219
Tuff	LK003	145.6	701-22-070	0.93	79481	13.4	10	367.1	1.28	1.04	262	1.87	47.78	12.4	49	7.08	181.2	1.38	1.05	0.62	2.64	17.03	2.02	1.23	1.7	0.4	0.3	0.309	32478	25.81	2.7	0.17	2891	188
Hornblende Porphyry	LK004	51.23	701-22-071	0.06	81758	2.2	14	588.2	1.22	0.13	36192	0.16	65.85	8.8	9	1.69	19.9	2.31	1.39	1.05	2.76	16	2.98	1.12	1.97	0.01	0.48	0.026	25548	36.78	8.6	0.221	10769	817
Breccia	LK004	71.63	701-22-072	0.17	78189	4.6	17	1384.9	1.21	0.28	37025	0.36	71.01	10.7	12	2.26	67	2.32	1.36	1.07	2.98	15.82	3.06	1.03	1.61	0.01	0.46	0.12	25453	40.22	6.8	0.209	17165	2436
Breccia	LK004	81.52	701-22-073	0.17	78084	14.8	15	176.6	1.38	0.11	25684	0.65	53.61	9	12	3.11	21.2	2.15	1.26	0.97	3.06	16.47	2.48	0.82	1.32	0.01	0.42	0.092	31413	30.17	8.1	0.211	20189	10476
Andesite Porphyry	LK004	104.71	701-22-074	1.94	77045	108	10	246.5	2.45	1.79	4535	9.84	59.5	13.1	13	8.62	322.1	1.7	1.02	0.92	5.43	18.97	2.64	0.97	1.42	0.06	0.37	3.2	33243	32.91	4.6	0.162	6675	13361
Diorite Porphyry	LK004	137.51	701-22-075	2.72	65841	78.6	10	380.9	1.32	2.03	1492	0.39	58.9	4.6	19	5.72	1075.6	3.45	2.23	1.05	3.56	14.42	3.34	0.66	1.57	0.06	0.74	0.861	28869	34	1.7	0.322	2792	659
Breccia	LK006	45.2	701-22-076	1.25	80115	249.6	10	220.3	2.15	0.55	780	0.2	66.08	56.9	267	7.17	230.3	4.59	1.84	1.61	13.94	15.29	5.48	0.75	1.82	0.01	0.76	1.014	25941	33.94	4.4	0.211	2624	227
Andesite Porphyry	LK006	51.8	701-22-077	0.22	104651	7.7	10	115	1.73	0.18	586	4.65	51.71	8.4	39	2.15	101.4	2.8	1.49	1.01	1.71	17.78	3.26	1.54	2.16	0.05	0.52	1.008	29624	28.66	8.4	0.229	3505	282
Andesite Porphyry	LK006	129.7	701-22-078	1.03	83124	132.5	10	427.9	0.86	2.78	1070	0.14	62.18	14.1	35	3.36	307.1	2.68	1.42	1.18	4.07	21.78	4.13	1.2	2.1	0.53	0.49	0.354	33556	31.94	2	0.232	2369	173
Breccia	LK006	145.7	701-22-079	1.42	77515	40.1	10	316	0.64	5.67	664	0.37	57.02	16.4	85	4.54	471	2.31	1.35	1.07	3.69	36.4	3.44	1.18	1.98	0.23	0.42	0.437	28330	30.56	6.6	0.238	2353	77
Diorite Porphyry	LK006	165.86	701-22-080	0.52	85717	16.5	10	432.8	0.3	0.96	713	0.15	20.95	11.5	16	1.19	76.2	0.87	0.44	0.59	3.67	22.67	1.87	0.79	0.97	0.02	0.14	0.194	24680	11.09	1.5	0.078	1120	74

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Tuff	LK006	191.35	701-22-081	0.755	74508.5	48.55	10	300.9	0.755	3.81	344	0.03	53.315	22.85	92	8.42	511.9	1.26	0.79	0.735	6.17	19.205	2.635	1.14	1.475	0.165	0.245	0.189	23433.5	27.82	2.7	0.143	1960.5	43.5
Pyroclastic	LK006	214.6	701-22-082	0.34	74022	37.7	10	302.9	0.51	1.15	682	0.08	52.45	6.6	22	0.88	166.3	1.07	0.61	0.77	3.21	15.3	2.15	1.04	1.51	0.01	0.19	0.076	20608	29.1	2.6	0.152	683	98
Andesite Porphyry	L013	5	701-22-083	0.45	103191	5	10	356.1	1.15	0.54	500	0.02	60.51	1.3	10	3.48	786.3	0.92	0.48	0.49	1.07	17.42	1.74	1.08	0.93	0.02	0.17	0.135	19976	40.68	2.3	0.079	2226	29
Andesite Porphyry	L013	11	701-22-084	0.3	103902	8.3	10	1591.3	1	0.09	606	0.03	45.83	0.7	17	1.62	647.2	1.31	0.66	0.67	6.6	17.59	2.13	1.06	0.47	0.03	0.24	0.3	24954	29.29	1.8	0.075	1651	46
Andesite Porphyry	L013	17.7	701-22-085	0.23	92568	13.5	10	559.9	0.76	0.18	335	0.02	44.75	0.3	11	1.84	222.8	0.77	0.37	0.63	2.37	17.14	1.15	1.54	0.9	0.01	0.14	0.091	31004	32.92	2.9	0.057	2788	42
Andesite Porphyry	L013	23.4	701-22-086	0.22	89426	3.6	10	555.7	0.95	0.25	362	0.02	83.58	1.2	14	1.84	157.1	0.82	0.34	0.68	2.71	17.02	1.71	1.61	0.45	0.01	0.14	0.137	29273	63.17	2.4	0.051	2974	60
Andesite Porphyry	L013	28.9	701-22-087	0.26	97282	2.3	10	417.9	0.8	0.31	298	0.03	62.22	0.8	16	1.89	151.2	0.85	0.39	0.52	0.82	16.28	1.41	1.45	0.3	0.01	0.15	0.134	30891	35.17	2.9	0.055	2725	49
Andesite Porphyry	L013	34.9	701-22-088	0.21	92565	7.1	10	884.6	0.71	0.23	433	0.03	51.47	0.5	16	1.82	214.5	1.55	0.81	0.5	1.84	18.58	1.72	1.58	0.36	0.01	0.3	0.406	33222	36.9	4.8	0.088	1733	63
Andesite Porphyry	L013	41.25	701-22-089	0.15	100724	5.4	10	901.4	0.66	0.43	471	0.02	38.26	0.6	20	1.62	260.6	1.6	0.88	0.5	1.3	17.83	1.7	1.57	0.37	0.01	0.3	0.359	37270	25.96	3.5	0.095	2239	53
Andesite Porphyry	L013	47.7	701-22-090	0.52	90853	33.4	10	278.4	0.69	1.45	395	0.02	39.74	0.6	28	2.04	409.3	1.29	0.63	0.5	2.86	19.33	1.6	1.97	0.55	0.01	0.23	0.422	28578	23.82	4.3	0.074	2700	57
Andesite Porphyry	L013	52.9	701-22-091	0.17	94139	5.2	10	741.2	0.6	0.29	363	0.02	41.61	0.8	16	1.51	306.4	1.22	0.6	0.6	1.25	16.79	1.76	1.49	0.33	0.01	0.22	0.241	24390	26.07	3	0.101	2005	47
Andesite Porphyry	L013	58.8	701-22-092	1.24	84187	12.8	10	414.7	0.89	1.57	367	0.02	47.01	0.6	18	2.74	291.3	1.17	0.65	0.54	3.7	18.6	1.58	1.78	1.02	0.01	0.22	0.295	33588	29.22	2.5	0.094	3482	60
Andesite Porphyry	L013	69	701-22-093	0.27	76378	8.6	10	920	0.84	0.22	283	0.02	43.76	0.8	14	2.1	299.1	1.7	0.93	0.58	3.77	16.54	1.81	1.77	0.37	0.01	0.33	0.212	33802	27.76	2	0.092	3481	94
Hydrothermal Breccia	L013	75	701-22-094	2.59	67415	14.8	10	993.4	0.3	1.12	986	0.02	88.89	0.3	22	0.08	62.6	1.6	0.61	1.64	3.7	8.65	3.86	1.16	1.03	0.04	0.26	0.031	19072	50.74	0.7	0.103	226	56
Hydrothermal Breccia	L013	81.9	701-22-095	6.22	63052	27.1	10	891.5	0.2	0.95	1046	0.02	82.64	0.6	28	0.09	117.4	1.31	0.43	1.2	7.25	16.47	2.78	1.51	0.36	0.08	0.19	0.117	20356	44.79	1.3	0.047	99	47
Hydrothermal Breccia	L013	86.55	701-22-096	4.05	76280	14.9	10	668.4	0.09	1.44	1108	0.03	94.96	1.3	37	0.13	30.9	1.1	0.41	1.04	2.79	12.96	2.23	1.35	0.61	0.01	0.17	0.055	21447	52.41	0.9	0.058	109	61
Fault Breccia	L013	93.25	701-22-097	0.31	63817	53.3	10	708.2	0.29	5.12	972	0.02	89.91	0.4	18	0.22	120.1	2.01	0.45	2.21	8.87	35.91	5.23	2.19	0.61	0.02	0.22	0.262	10461	48.17	1.8	0.051	250	43
Hydrothermal Breccia	L013	100.4	701-22-098	8.94	71032	234.9	10	996.5	0.12	2.17	780	0.02	108.5	0.4	30	0.07	41.4	2.99	0.7	1.84	11.02	24.61	5.16	3.69	0.35	0.6	0.41	0.105	21136	65.97	0.7	0.05	108	35
Andesite Porphyry	L013	127.55	701-22-099	0.13	92005	4	10	608.4	1.26	0.33	664	0.06	60.72	15.3	14	1.37	672.2	2.51	1.14	1.2	2.59	16.54	3.62	1.57	0.77	0.01	0.43	0.18	27989	35.13	2.4	0.151	2656	42
Andesite Porphyry	L013	177.05	701-22-100	0.13	77104	9.6	10	299.5	0.31	0.46	569	0.03	62.95	9.7	33	0.23	798.8	0.59	0.25	0.63	4.72	7.95	1.32	1.6	0.55	0.01	0.1	0.027	12100	37.92	2.4	0.044	427	35
Andesite Porphyry	L013	199.75	701-22-101	0.37	84181.5	70.2	10	476.55	0.875	3.2	832.5	0.19	54.25	14.9	8.5	1.21	331.35	1.985	1.245	0.76	4.555	17.2	2.43	1.31	1.115	0.01	0.415	0.385	34854	32.72	0.9	0.188	2658.5	37.5
Fault Breccia	L223	121.75	701-22-102	1.15	73986	13.6	10	254.4	0.64	3.78	565	0.13	38.1	15.9	20	2.78	365.4	1.3	0.73	0.78	5.53	25.96	1.9	1.14	1.26	0.01	0.24	0.291	16673	20.45	5.3	0.14	624	29
Andesite Porphyry	L223	131	701-22-103	0.88	90218	25.2	10	509.6	1.59	2.78	702	1.59	63	12.5	49	2.69	542.7	2.14	1	1.01	3.75	17.83	2.82	1.32	1.55	0.01	0.37	0.25	23250	35.59	7.9	0.158	2617	111
Andesite Porphyry	L223	137	701-22-104	0.11	92445	3.4	10	2336.4	1.32	0.33	2656	0.36	66.28	12	17	6.05	139.4	4.27	2.44	1.56	5.53	18.56	5.34	0.96	2.69	0.01	0.89	0.067	28107	35.11	16.1	0.356	6848	3212
Andesite Porphyry	L223	142.1	701-22-105	0.3	90010	10.8	10	366.1	1.87	0.47	2526	0.04	62.36	12.5	15	9.42	120.5	2.77	1.64	1.05	1.95	18.2	3.31	1.09	2.48	0.01	0.56	0.076	28004	34.57	7.1	0.241	5546	151
Andesite Porphyry	L223	150	701-22-106	0.06	83668	2.9	13	673.8	1.26	0.19	30074	0.15	59.29	11.3	14	5.91	44	2.54	1.49	1.09	3.09	16.32	3.2	1	2.09	0.01	0.53	0.017	28266	33.2	10.2	0.217	15884	648
Andesite Porphyry	L223	156	701-22-107	0.07	82823	4.7	14	550	1.18	0.1	31360	0.08	58.54	11.2	10	4.63	69.5	2.49	1.43	1.03	3.03	16.57	3.15	0.97	1.91	0.01	0.5	0.033	24193	32.64	11.8	0.214	16589	760
Andesite Porphyry	L223	164.55	701-22-108	0.05	78650	1.6	14	771.1	1.05	0.04	28364	0.03	53.73	10.5	12	2.67	25.2	2.44	1.37	0.99	2.9	15.99	2.86	0.98	1.97	0.01	0.47	0.019	25123	29.68	10.2	0.199	15034	597
Andesite Porphyry	L223	170	701-22-109	0.05	83545	1.5	16	807.5	1.04	0.08	33866	0.04	65.42	9.4	8	2.59	31.2	2.51	1.41	1.14	2.63	15.8	3.19	0.82	1.56	0.01	0.49	0.013	26237	36.77	8.3	0.208	12438	526
Andesite Porphyry	L223	178.05	701-22-110	0.05	83748	0.9	14	824.9	1.48	0.18	32675	0.04	61.29	10	8	2.88	41.5	2.33	1.3	1.02	2.41	16.58	2.94	0.92	1.66	0.01	0.45	0.013	28304	34.25	10.2	0.199	13872	435
Andesite Porphyry	L223	184	701-22-111	0.1	71817	4.5	24	586.1	0.98	0.17	60694	0.71	73.87	8.9	8	5.76	154.1	2.74	1.46	1.25	3.12	13.93	3.35	0.9	1.26	0.01	0.53	0.041	25014	43.26	9.9	0.216	12201	1154
Andesite Porphyry	L223	191.95	701-22-112	0.05	80740	2.5	23	636.7	1.08	0.07	41901	0.17	56.91	10.8	11	7.84	71.1	2.49	1.43	1.07	3.35	16.26	3.11	0.91	1.56	0.01	0.49	0.041	27898	31.27	11.1	0.218	13776	1023
Andesite Porphyry	L223	198	701-22-113	0.05	81245	2.2	21	507.8	1.2	0.06	45287	0.31	60.57	11.3	12	6.75	61.8	2.3	1.35	0.99	2.91	16.41	2.98	0.99	1.66	0.01	0.47	0.027	28264	33.53	10.2	0.219	10280	759
Andesite Porphyry	L223	206.5	701-22-114	0.05	75323	1.1	17	347.6	1.08	0.11	49237	0.39	54.75	8.4	11	5.59	65.1	2.22	1.24	0.9	2.6	16.03	2.7	0.76	1.23	0.01	0.43	0.03	23675	30.6	8	0.187	9481	677
Andesite Porphyry	L223	212	701-22-115	0.16	68794	6.1	23	282.4	1.13	0.19	42055	0.24	57.94	13.8	17	5.78	185.1	2.44	1.42	0.95	3.09	16.27	3.04	0.64	1.3	0.01	0.49	0.064	19691	32.88	13.5	0.203	11685	670
Andesite Porphyry	L223	220.05	701-22-116	0.21	74328	3.9	19	479.7	1.18	0.25	30275	0.1	64.71	13.1	12	4.49	80.9	2.8	1.61	1.29	2.91	17.19	3.56	0.82	2.04	0.01	0.56	0.023	21700	35.49	14.2	0.241	12043	528
Andesite Porphyry	L223	231.2	701-22-117	0.05	65118	2.7	19	667.6	0.9	0.45	27343	0.04	47.57	13.2	9	10.2	42.8	2.3	1.33	0.94	2.78	16.21	2.66	0.8	2	0.01	0.46	0.034	21691	26.09	15.3	0.2	13673	508
Andesite Porphyry	L223	240.4	701-22-118	0.1	66653	8.6	10	2144.2	1.01	0.26	6170	0.29	56.7	22	11	4.4	218.4	2.26	1.25	1.01	7.14	14.69	2.87	0.71	1.91	0.01	0.44	0.091	21586	31.07	8.3	0.183	10615	2952
Fault Breccia	L223	244	701-22-119	0.06	91667	10.1	10	950.2	1.84	0.29	979	0.07	74.59	7.4	7	2.81	134.9	6.37	3.73	1.95	1.65	18.66	6.2	1.04	2.53	0.01	1.28	0.059	10260	41.13	19.8	0.464	2006	44
Andesite Porphyry	L223	319.3	701-22-120	0.05	89302	1.9	10	1539.6	1.49	0.36	614	0.02	81.83	2.6	4	2.27	18.9	2.82	1.83	1.08	1.08	18.56	3.2	1.15	2.2	0.01	0.6	0.032	11398	44.06	3.9	0.299	2413	40
Andesite Porphyry	L223	325.4	701-22-121	0.19	90018	6.15	10	97.65	1.295	0.455	228	0.02	63.59	1.9	3.5	1.39	48.45	2.175	1.22	1.06	0.96	17.1	2.77	0.765	1.785	0.01	0.41	0.0855	11185.5	35.555	8.9	0.184	1416.5	32.5
Fault Breccia	L223	340.3	701-22-122	0.12	80384	6.7	10	270.5	1.28	0.82	470	0.05	68.37	6.5	4	1.41	267.4	4.6	3.49	1.09	1.08	18.17	3.31	1.08	2.36	0.01	1.1	0.153	11425	36.31	10	0.487	1183	34
Pyroclastic	L087	6	701-22-123	0.44	28106	13.3	10	443.2	0.14	0.63	3117	0.02	44.42	0.5	13	0.09	8.6	0.85	0.44	0.53	1.77	3.25	1.39	0.99	1.07	0.01	0.14	0.005	10074	24.28	0.5	0.094	952	34
Pyroclastic	L087	16	701-22-124	0.94	5217	9.4	10	1500.7	0.21	1.85	1360	0.02	27.48	0.3	11	0.11	9.2	0.65	0.41	0.26	0.79	1.22	0.86	1.16	0.97	0.05	0.12	0.005	1079	15.71	1.2	0.088	229	45
Pyroclastic	L087	26	701-22-125	0.61	47574	25.1	10	500.1	0.11	1.26	799	0.02	50.78	0.2	20	0.07	5.9	0.8	0.37	0.9	3.57	8.23	1.87	0.79	0.97	0.04	0.13	0.009	14691	28.1	0.2	0.077	206	31
Pyroclastic	L087	36	701-22-126	0.19	52739	20.6	10	711.6	0.21	1.36	789	0.02	50.63	0.4	19	0.07	3.7	0.87	0.48	0.85	1.9	8.98	2.08	0.78	1.85	0.03	0.16	0.005	11898	27.44	0.3	0.123	97	36
Pyroclastic	L087	46	701-22-127	0.25	59191	11.7	10	469.4	0.05	1.45	779	0.02	46.09	0.1	18	0.07	3.3	0.97	0.48	0.7	1.49	13.59	2.23	0.93	1.13	0.02	0.15	0.005	7169	22.5	0.3	0.111	119	29
Andesite Porphyry	L087	56	701-22-128	0.33	48233	17	10	412.2	0.13	1.54	801	0.03	65.76	0.3	22	0.07	8.8	1.15	0.63	1.06	2.73	6.8	2.58	1	1.44	0.01	0.19	0.008	15787	35.72	0.4	0.134	130	33
Fault Breccia	L087	66	701-22-129	0.55	30118	18.5	10	531	0.14	2.49	549	0.03	53.81	0.2	17	0.07	22	1.07	0.56	0.93	2.07	4.31	2.28	1.13	1.24	0.01	0.17	0.005	10276	31.39	0.2	0.125	123	40
Andesite Porphyry	L087	76	701-22-130	0.68	40052	23.6	10	416.9	0.13	1.75	634	0.02	35.18	0.2	17	0.08	9.6	0.83	0.5	0.7	1.74	6.76	1.69	1.18	1.12	0.01	0.16	0.009	13256	19.02	0.4	0.107	124	35
Andesite Porphyry	L087	86	701-22-131	0.49	33322	68.4	10	657	0.09	1.65	441	0.02	43.72	0.5	25	0.06	50.5	0.41	0.28	0.55	10.32	11.88	1.19	1.95	0.71	0.02	0.08	0.101	12564	24.22	0.3	0.073	149	28
Andesite Porphyry	L087	96	701-22-132	0.29	60424	101.5	10	560.9	0.19	3.63	666	0.02	44.38	0.2	9	0.08	22.7	0.81	0.4	0.76	1.74	14.62	1.87	0.69	1.21	0.01	0.13	0.023	9907	25.62	0.5	0.12	115	18
Andesite Porphyry	L087	106	701-22-133	0.57	59684	9	10	472.4	0.27	2.25	680	0.02	57.82	0.5	8	0.26	373.2	1.29	0.64	0.86	2.21	14.5	2.4	0.43	1.12	0.01	0.22	0.042	7249	30.95	0.5	0.138	459	37
Andesite Porphyry	L087	116	701-22-134	0.37	44946	16.9	10	794.9	0.06	4.42	640	0.02	70.03	0.2	12	0.09	98.1	0.89	0.34	0.92	4.27	17.56	2.08	0.55	0.61	0.01	0.13	0.053	5455	43.05	0.7	0.065	104	76
Andesite Porphyry	L087	126	701-22-135	0.59	52352	10.1	10	669.5	0.18	1.42	814	0.02	59.48	0.2	14	0.17	65.6	0.65	0.34	0.82	4.78	9.52	1.76	0.64	0.93	0.01	0.11	0.063	7254	32.65	0.5	0.073	102	107
Andesite Porphyry	L087	134	701-22-136	0.46	67255	4.5	10	335.6	0.96	3.15	512	0.03	56.73	1	9	1.14	46.3	1.84	1.12	0.76	3.47	26.79	2.39	1.06	1.91	0.02	0.39	0.285	28050	32.43	0.8	0.203	1621	246
Andesite Porphyry	L087	144	701-22-137	0.22	95143	14.5	10	654.6	1.06	0.28	503	3.37	28.86	48.5	8	2.04	276.6	1.89	1.14	0.53	1.51	15.39	1.8	1.22	1.46	0.04	0.38	0.224	41916	17.95	3.6	0.185	2952	43
Andesite Porphyry	L087	158	701-22-138	0.23	96617	4	10	495	1.82	0.75	568	0.74	76.3	9.2	10	5.34	79.7	2.8	1.6	1.17	1.26	17.24	3.31	1.31	1.71	0.02	0.55	0.108	35059	44.42	13.9	0.231	3446	57
Andesite Porphyry	L087	170	701-22-139	0.07	111852	3.2	10	1325.7	1.43	0.07	421	0.04	109.8	5.1	11	4.13	19.8	4.09	2.17	1.87	1.3	21.2	5.32	1.35	2.19	0.01	0.77	0.037	22166	62.28	11.3	0.329	2179	45
Andesite Porphyry	L087	184	701-22-140	0.09	110558	3.1	10	310.5	1.18	0.1	343	0.07	90.87	27.7	8	3.45	15.4	2.42	1.17	1.35	1.61	19.66	3.57	1	1.97	0.02	0.42	0.039	29580	52.44	3.6	0.188	3028	38
Andesite Porphyry	L087	200	701-22-141	0.125	101364.5	4.9	10	556.35	1.155	0.095	485	0.25	84.315	7	9	2.48	295.95	1.37	0.75	1	1.435	18.56	2.355	1.235	1.775	0.01	0.255	0.0855	26519.5	45.91	5.55	0.1435	2745	50
Andesite Porphyry	L087	210	701-22-142	0.05	116648	3.2	10	1125.2	1.53	0.06	702	0.02	103.8	1.4	7	1.6	4.2	2.38	1.22	1.79	0.8	18.87	4.4	1.42	1.67	0.01	0.43	0.037	19819	54.69	6.7	0.22	1621	29
Andesite Porphyry	L087	216	701-22-143	0.44	98109	34.1	10	623.1	0.65	0.86	357	0.32	39.07	11.9	10	1.8	354.9	1.2	0.81	0.36	2.18	18.34	1.11	1.11	1.58	0.02	0.26	0.451	36433	26.77	3.1	0.15	2980	46
Andesite Porphyry	L087	252	701-22-144	0.07	67645	14.5	10	165.7	0.11	1.28	591	0.02	33.14	4.9	23	0.07	425.6	0.75	0.32	0.66	6.58	7.91	1.73	0.64	0.71	0.01	0.13	0.022	26027	17.96	0.4	0.054	134	20
Andesite Porphyry	L087	262	701-22-145	0.73	41737	54.9	10	56	0.05	8.1	447	0.04	25.31	6	17	0.05	3253.6	0.45	0.21	0.47	19.02	2.4	1.05	0.52	0.53	0.05	0.07	0.051	11699	12.34	0.2	0.048	55	61
Andesite Porphyry	L087	272	701-22-146	0.13	63754	25.7	10	275.4	0.15	1.04	451	0.06	38.76	9.4	21	0.08	998.9	0.63	0.31	0.61	5.58	8.56	1.41	0.79	0.95	0.01	0.1	0.087	13393	21.18	0.4	0.082	68	16
Andesite Porphyry	L087	292	701-22-147	0.23	86290	6.1	10	306.3	0.39	2.23	776	0.08	32.25	10.4	13	0.74	383.3	1.24	0.65	0.64	3.24	11.49	1.83	0.56	1.35	0.01	0.21	0.19	15714	19.17	0.9	0.122	754	38
Hydrothermal Breccia	L087	330	701-22-148	0.11	63098	44.2	10	115.6	0.05	0.29	544	0.03	40.1	18.5	30	0.05	1049.8	0.26	0.12	0.39	8.33	2.8	0.68	0.98	0.24	0.01	0.04	0.023	21676	22.22	0.3	0.024	70	19
Andesite Porphyry	L087	349.7	701-22-149	0.29	97095	13.1	10	597.4	0.86	2.39	526	0.04	58.4	10.9	14	1.67	339	1.3	0.81	0.61	2.26	17.4	1.73	1.16	1.94	0.02	0.26	0.332	32803	36.01	3.5	0.152	2423	81
Andesite Porphyry	L087	340	701-22-150	0.2	88653	9.4	10	120	0.18	2.02	744	0.21	55.7	13	16	0.41	368.3	1.42	0.64	1.03	5.14	13.63	2.83	1.33	1.51	0.01	0.23	0.081	2437	31.12	1.6	0.143	164	31

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	**190**
Andesite Porphyry	LS001	25	701-22-001	1.25	1476.5	4.29	22.895	24.5	702	325.9	6.543	161.14	0.002	10301	0.37	9.4	0.9	3.79	0.7	76.335	0.365	0.4495	0.065	21.115	2255	1.845	0.16	3.625	84	2.1	9.31	1.095	64.5	54.05
Andesite Porphyry	LS001	59	701-22-002	2.3	303	3.55	23.19	11.4	608	51.9	6.65	135.1	0.002	2913	0.37	7.5	0.5	3.79	0.5	13.09	0.36	0.421	0.05	23.46	1619	1.6	0.24	4.58	81	1.8	14.15	1.54	542	48.3
Andesite Porphyry	LS001	65.5	701-22-003	2.7	295	2.64	19.96	12.4	668	30.9	4.971	140.1	0.007	57011	0.69	17	2.5	3.93	3.4	49.34	0.22	0.671	0.74	13.37	1927	1.73	0.43	6.56	124	1.6	25.17	2.94	425	38.2
Andesite Porphyry	LS001	89.25	701-22-004	1.4	346	3.25	28.11	6	869	167.9	7.626	138.6	0.002	42187	0.52	11	2.2	5.48	3.2	278.89	0.3	0.797	1.92	17.36	1558	1.78	0.4	5.48	107	2.3	25.63	2.58	50	44.4
Andesite Porphyry	LS001	122	701-22-005	1.4	365	4.08	26.68	3.9	130	9.9	7.392	151.77	0.002	5889	0.29	8	0.5	4.42	0.7	16.33	0.4	0.436	0.34	19.27	2020	1.93	0.2	4.34	87	2.6	14.5	1.42	158	48.4
Dyke	LS001	136.75	701-22-006	1.3	380	3.32	20.77	7	620	82.5	5.487	158.52	0.002	32511	0.32	11.8	1.9	4.09	0.9	175.07	0.3	0.633	1.08	18.07	1733	2.22	0.31	5.16	105	2.6	20.27	1.88	39	52.7
Dyke	LS001	185	701-22-007	1.5	589	1.92	24.15	31.4	922	415.5	5.695	2.99	0.003	169611	3.98	9.9	4.5	5.66	4.5	1065.68	0.17	0.439	1.63	12.23	1101	9.44	0.1	7.02	90	5.3	4.89	0.69	19	33.1
Dyke	LS001	221.65	701-22-008	2.5	1685	1.65	12.05	16	703	205.7	3.209	3.14	0.008	66532	1.1	13.6	2.1	2.5	2	352.6	0.14	0.23	1.09	11.13	1455	0.14	0.04	3.52	135	2.5	2.63	0.32	11	19
Andesite Porphyry	LS001	249.15	701-22-009	3.9	1196	1.98	21.48	3.8	533	124.5	5.763	125.49	0.022	17061	0.6	15.5	0.8	3.7	1.6	203.56	0.17	0.273	0.42	15.23	1959	1.61	0.09	3.5	134	2.5	3.7	0.5	17	33.6
Andesite Porphyry	LS001	290.75	701-22-010	2.2	822	1.69	13.61	7.3	374	103.3	3.69	90.37	0.002	37126	0.47	12.9	1.6	2.52	0.6	94.52	0.14	0.187	0.74	14.03	1082	1.12	0.06	3.27	96	1.8	3.15	0.49	13	26.1
Andesite Porphyry	LS001	304.05	701-22-011	2.2	819	2.21	16.51	21.7	537	106.8	4.5	8.25	0.002	86321	0.81	12.8	4.2	2.94	2.2	313.24	0.19	0.219	2.71	14.72	1512	0.15	0.07	5.89	114	5.5	3.51	0.54	8	42.4
Andesite Porphyry	LS001	368.85	701-22-012	2.2	1437	4.29	31.86	9.5	676	59.3	8.209	113.56	0.002	51858	0.68	14.4	6.6	7.39	1.9	414.61	0.36	1.228	3.35	24.11	2512	1.21	0.53	6.68	91	2.5	37.37	2.85	162	50.5
Andesite Porphyry	LS001	395	701-22-013	2.3	1072	4.37	28.72	3.9	466	10.4	7.722	114.42	0.002	22324	0.42	14.7	1.2	5.53	0.7	23.98	0.35	0.918	0.57	22.73	2970	1.54	0.41	4.9	104	2.5	27.21	2.28	24	64.7
Andesite Porphyry	LS001	411.1	701-22-014	181.9	1129	0.8	20.7	10.5	518	54.1	7.096	3.08	0.055	90545	2.03	8.2	6	3.18	6.5	421.95	0.07	0.213	1.21	11.2	546	0.7	0.03	3.25	88	5.7	2.14	0.23	23	6
Andesite Porphyry	LS001	423.5	701-22-015	48.8	1377	0.68	16.8	10.7	531	51.4	4.877	3.25	0.079	117410	1.75	4.6	6	2.62	13.3	553.05	0.07	0.078	0.35	10.71	457	0.08	0.01	0.65	88	5.1	0.8	0.08	9	3.6
Andesite Porphyry	LS002	94.3	701-22-016	13.2	710	1.58	13.49	7.2	589	15.8	4.047	79.18	0.107	20485	0.6	12.8	2.4	2.27	0.9	155.7	0.14	0.218	0.05	16.56	1369	0.84	0.09	2.01	119	1.4	6.55	0.69	19	18.9
Breccia	LS002	104.13	701-22-017	8.3	575	1.49	13.7	6.4	421	35	4.173	95.57	0.07	21817	0.47	11.6	3.2	2.29	0.8	91.6	0.14	0.226	0.06	15.08	1347	1.2	0.12	1.92	99	1.5	7.25	0.67	31	10.9
Andesite Porphyry	LS002	128.6	701-22-018	5.4	1093	1.29	20.22	8.1	427	18.4	5.561	91.47	0.049	18517	0.4	13.6	1.4	3.57	1.2	95.69	0.11	0.353	0.07	14.73	1143	1.12	0.13	3.27	104	1.9	9.06	0.79	46	9.4
Andesite Porphyry	LS002	148.4	701-22-019	3.8	1139	1.61	21.37	6.6	376	25.2	6.217	105.6	0.03	22178	0.56	11.4	1.7	3.57	1.7	87.22	0.13	0.387	0.06	16.01	1071	1.22	0.16	3.57	101	2.7	11.91	1.09	27	9.6
Diorite Porphyry	LS002	355.8	701-22-020	2.8	12422	2.89	19.67	11.2	502	14.2	5.319	83.44	0.01	4699	0.05	10.7	0.8	3.48	0.6	178.14	0.21	0.326	0.08	15.06	1931	0.74	0.12	1.29	95	0.5	8.38	0.77	1071	7.8
Andesite Porphyry	LS002	373	701-22-021	1.25	1196.5	2.955	28.09	11.75	808	157.25	7.401	94.665	0.009	26436.5	0.575	16.65	0.95	5.19	0.75	284.9	0.2	0.561	0.75	14	2806	1.215	0.23	1.67	144.5	0.75	17.575	1.47	631.5	7.55
Andesite Porphyry	LS002	422.5	701-22-022	2.6	1472	2.46	26.12	7.2	191	86	7.14	102.63	0.01	18431	0.26	11.9	1.4	4.65	1.5	62.43	0.2	0.455	0.16	19.33	2055	1.11	0.19	2.88	115	2.4	13	1.24	95	16.6
Andesite Porphyry	LS002	435.3	701-22-023	2.2	1551	3.82	26.6	6.5	284	54.3	7.285	99	0.016	14162	0.25	13	1.4	4.77	0.8	128.74	0.31	0.455	0.24	20.86	2824	1.2	0.2	2.96	121	2.1	13.2	1.1	298	27.2
Andesite Porphyry	LS002	448.85	701-22-024	2.4	1859	2.74	24.76	14.2	416	418	6.736	135.89	0.022	31865	0.62	11.9	1.7	4.46	0.9	176.09	0.22	0.543	0.35	19.53	2323	1.75	0.28	3.08	117	1.6	20.37	1.55	519	14.5
Andesite Porphyry	LS002	472.85	701-22-025	7.6	1255	3.57	34.32	6.6	880	17	9.189	70.98	0.037	6956	0.39	11.8	0.9	6.46	0.7	343.12	0.33	0.861	0.07	23.19	2539	0.78	0.48	2.91	116	2.3	31.06	3.69	185	23.9
Andesite Porphyry	LS003	21.3	701-22-026	1.6	624	1.65	15.83	1.1	624	68.7	4.422	114.14	0.002	6448	1.46	10.1	1.9	3.14	0.8	64.55	0.16	0.207	0.96	12.82	1068	1.44	0.09	3.16	93	0.6	4.47	1.18	34	48.5
Andesite Porphyry	LS003	70	701-22-027	1.4	655	2.99	20.53	9.5	441	126.9	5.807	149.69	0.007	29576	0.44	12.3	1	3.48	1.1	84.11	0.25	0.338	0.42	18.66	1893	1.86	0.17	4.17	106	1.1	10.21	1.41	243	53.6
Andesite Porphyry	LS003	74.3	701-22-028	1.4	205	2.41	11.41	7.3	143	16.4	3.21	88.98	0.002	6858	0.46	6.7	0.5	2.2	0.6	31.38	0.2	0.311	0.24	13.79	1585	1.13	0.11	3.09	71	0.6	6.32	0.79	448	39.3
Andesite Porphyry	LS003	97	701-22-029	0.5	449	1.55	10.73	7.7	379	65.7	2.917	132.8	0.002	26827	0.58	10.3	0.5	2.13	0.8	112.54	0.13	0.312	0.72	11.79	929	1.59	0.16	3.3	85	1.6	8.81	1	42	57
Andesite Porphyry	LS003	115.5	701-22-030	2	382	1.18	8.12	12.5	480	176.9	2.141	51.65	0.002	72205	0.67	8.7	1.8	1.84	1.7	110.9	0.1	0.23	0.6	11.91	664	0.7	0.11	3.82	76	1.1	5.57	0.8	19	35.9
Andesite Porphyry	LS003	131.7	701-22-031	1.2	310	3.2	10.43	13.4	323	15.4	2.718	98.69	0.002	16302	0.71	10.6	0.5	2.52	0.6	115.73	0.27	0.377	0.15	14.4	2070	1.27	0.17	4.2	90	1.1	8.68	1.14	36	64.4
Breccia	LS003	146.75	701-22-032	2	439	2.79	15.01	17.9	477	51.9	3.994	148.26	0.004	37881	1.76	11.8	0.9	2.67	1.1	149.7	0.21	0.275	0.51	14.09	1307	2.16	0.16	4.66	89	1.1	11.61	1.12	219	55.4
Diorite Porphyry	LS003	170.02	701-22-033	1.1	638	2.22	14.34	6.7	651	77	3.857	131.58	0.002	40301	0.56	11	0.9	2.4	1.1	93.73	0.19	0.274	0.64	13.13	1204	1.79	0.14	4.71	84	1.1	7.74	1.23	251	50.7
Diorite Porphyry	LS003	182.4	701-22-034	2.7	545	2.3	19.1	7.8	733	20	5.221	113.43	0.002	32716	0.49	8.7	0.9	3.7	0.7	287.25	0.19	0.621	0.69	14.62	1238	1.58	0.15	3.54	80	0.8	9.39	1.05	25	52.8
Diorite Porphyry	LS003	274.25	701-22-035	3	1580	1.59	17.59	31.1	454	90.6	4.524	11.44	0.006	107002	2.49	9.6	2.4	3.7	10.1	452.33	0.12	0.249	0.33	16.01	664	0.21	0.11	4.19	84	1.4	4.89	0.83	59	38.4
Diorite Porphyry	LS003	298.3	701-22-036	1.8	741	3.33	12.85	10.2	708	100.2	3.335	95.48	0.002	83613	0.85	13.8	2.4	2.99	4.6	230.14	0.24	0.336	0.81	12.13	1669	1.24	0.14	6.44	94	2.4	7.78	1.02	21	46.5
Diorite Porphyry	LS003	305	701-22-037	0.9	902	2.61	11.65	7.6	671	63	3.088	113.03	0.002	40639	0.63	14.3	0.7	3.31	1.3	130.84	0.18	0.301	1.32	11.99	1330	1.34	0.16	5.19	104	1.8	8.16	1.04	16	51
Breccia	LS003	324.8	701-22-038	3.9	969	1.47	10.84	13.1	394	33	3.067	98.89	0.005	84643	0.45	14.8	2.5	2.01	3	194.63	0.12	0.266	0.29	8.68	826	1.05	0.13	3.52	97	1.4	7.6	0.88	30	28.4
Andesite Porphyry	LS003	330.2	701-22-039	1.3	561	3.97	15.93	11.3	466	64.4	4.708	85.31	0.002	43426	0.46	20.7	0.8	2.96	0.6	214.29	0.32	0.45	0.66	20.14	2866	1.14	0.21	6.27	128	1.4	12.6	1.47	32	67.7
Diorite Porphyry	LS003	342.8	701-22-040	3.2	894	1.97	13.41	12.3	619	96.2	3.311	97.98	0.002	38595	0.39	11.4	1.3	2.74	1.2	240.09	0.2	0.276	0.82	11.97	919	1.25	0.1	5.33	84	2	5.11	0.76	141	45.7
Feldspar Porphyry	LS003	353.35	701-22-041	1.25	764	1.185	17.79	9	741	105.85	4.917	27.45	0.002	60052	0.46	9.05	2.45	3.155	1.15	444.495	0.085	0.2465	0.84	10.64	752.5	0.365	0.07	3.955	83	1.15	3.475	0.495	39.5	35.4
Andesite Porphyry	LS003	377.5	701-22-042	4.2	735	0.61	16.24	10.2	611	72.8	4.538	14.92	0.007	54322	0.61	8.3	1.8	2.72	2	595.91	0.04	0.17	0.27	8.82	340	0.17	0.03	3.43	75	3.2	1.99	0.24	168	20.4
Porphyry	LS003	394.75	701-22-043	2.1	1096	3.4	8.34	3.5	101	9.1	2.409	63.65	0.002	21159	0.51	14.8	0.5	1.54	0.9	25.26	0.29	0.201	0.2	16.59	2463	0.63	0.14	3.8	101	12.3	7.04	0.87	14	59.1
Porphyry	LS003	410.9	701-22-044	1.7	1087	3.25	7.54	10.7	146	11.3	2.235	29.44	0.002	38815	0.3	15.3	0.5	1.39	0.7	41.2	0.26	0.219	0.26	15.77	1990	0.28	0.14	4.44	93	1.8	7.57	0.99	14	50.3
Breccia	LS003	440.8	701-22-045	2.5	808	0.96	14.59	24.6	476	47.8	3.851	6.19	0.006	75010	2.74	5.8	2.2	2.67	11.6	667.21	0.07	0.189	0.55	15.01	241	0.2	0.06	1.76	60	1.8	3.59	0.36	17	14.1
Andesite Porphyry	LS004	30.21	701-22-046	1.7	612	3.91	18.72	17.4	580	232.3	5.174	146.99	0.003	42999	1.08	8.7	0.6	3.14	2	36.73	0.29	0.369	0.18	13.4	1859	1.69	0.16	3.1	75	8.3	8.83	1.11	2799	34.9
Andesite Porphyry	LS004	50.21	701-22-047	0.6	684	3.9	18.17	8.3	581	43.7	5.255	158.07	0.002	3389	0.42	8.6	0.5	2.97	0.7	31.32	0.3	0.334	0.05	13.83	2000	1.75	0.19	4.62	69	0.9	11.21	1.19	276	43.6
Andesite Porphyry	LS004	69.25	701-22-048	1.2	639	3.95	19.61	8.9	614	162.5	5.485	141.19	0.002	16643	0.79	9.9	0.5	3.31	0.6	18.71	0.29	0.264	0.05	13.52	2234	1.65	0.15	3.4	84	1	8	1.08	1703	49.5
Andesite Porphyry	LS004	110.45	701-22-049	1.3	670	3.32	15.13	8.6	667	96.1	3.954	163.07	0.002	45173	1.72	11.5	1.2	3.44	0.7	154.71	0.25	0.477	0.76	12.63	2084	2.11	0.25	3.53	95	2.4	15.16	1.66	150	64
Andesite Porphyry	LS004	134.45	701-22-050	2.4	530	4.33	16.18	33.2	849	219.8	4.376	3.55	0.002	87035	2.5	11.5	1.8	3.43	2.3	1186.83	0.29	0.301	1.51	14.02	2332	0.19	0.12	4.11	89	1.8	5.99	0.86	258	58.3
Diorite Porphyry	LS005	28.4	701-22-051	2.8	612	3.47	19.75	8.6	523	133.4	5.607	122.53	0.002	25389	0.65	10	1	3.47	0.6	228.61	0.27	0.38	0.33	19.34	2159	1.29	0.19	3.47	92	1.9	10.95	1.23	671	55.9
Diorite Porphyry	LS005	50.1	701-22-052	1.8	577	3.83	25.28	6.2	616	18	7.153	143.59	0.002	5441	0.4	9.2	0.5	4.13	0.5	63.7	0.35	0.423	0.16	22.48	1925	1.65	0.21	5.38	77	1.4	13.19	1.52	100	46.9
Breccia	LS005	72.5	701-22-053	1.6	738	3.93	26.63	7.6	725	607.6	7.336	138.75	0.002	27848	0.62	11.2	1.9	4.77	1	48.93	0.32	0.403	0.56	19.5	2592	1.72	0.19	4.12	118	1.1	11.62	2.36	1510	66.8
Breccia	LS005	133.9	701-22-054	6.7	1141	2.81	26.01	18.1	593	130.2	7.186	155.85	0.017	62521	1.45	11	2.7	4.79	2.3	82.79	0.22	0.516	1.43	14.08	1817	2.32	0.35	3.34	90	2.4	23.48	2.28	549	50.3
Diorite Porphyry	LS005	141.4	701-22-055	1.6	1197	4.08	26.17	6.4	752	21.2	7.331	135.82	0.002	10685	0.41	9.1	0.5	4.47	0.6	28.16	0.34	0.46	0.15	23.1	2286	1.47	0.23	4.88	88	1.1	14.49	1.63	78	61.6
Andesite Porphyry	LS006	34.3	701-22-056	1	707	4.24	18.42	4.1	71	25.1	5.599	154.37	0.005	15433	0.28	7.2	0.7	2.55	0.7	15.06	0.35	0.204	0.36	21.8	2255	1.74	0.13	4.37	64	1.3	7.17	0.98	32	56.8
Andesite Porphyry	LS006	52.3	701-22-057	2.9	879	3.74	33.06	15.5	346	95.4	9.099	102.53	0.002	20818	0.59	10.8	1.3	5.63	0.7	145.71	0.29	0.599	0.85	24.94	2055	1.16	0.42	6.05	106	1.1	25.23	2.95	55	53.9
Andesite Porphyry	LS006	70.3	701-22-058	1.8	630	4	38.47	9.5	383	35.6	9.782	95.69	0.002	15230	0.21	11.6	0.7	6.82	0.7	91.12	0.33	0.555	0.55	27.01	2293	0.97	0.31	6.36	96	1.5	17.71	2.14	38	58.6
Andesite Porphyry	LS006	127.6	701-22-059	1.2	747	3.78	25.28	9.2	567	332.9	7.198	135.76	0.002	14879	0.37	9.5	0.5	4.16	0.5	73.6	0.3	0.362	0.17	25.29	2133	1.56	0.19	8.01	89	1.6	11.08	1.41	1683	52
Breccia	LS006	140.4	701-22-060	1.2	881	3.3	31.48	11.4	1303	488.9	8.508	145.87	0.002	34099	0.48	11.8	0.8	5.68	0.6	877.78	0.27	0.511	0.65	24.97	2089	1.75	0.29	6.71	107	1.9	16.2	1.81	773	57
Porphyry	LK002	16.05	701-22-061	1	709.5	2.595	17.68	2.45	557	23.6	5.1365	132.01	0.002	17529.5	0.78	7.3	1.05	2.88	0.8	49.48	0.23	0.214	0.72	17.205	931	1.34	0.08	3.48	65	1.6	4.66	0.6	36.5	50.4
Andesite Porphyry	LK002	36.3	701-22-062	0.6	333	3.13	19.67	4	563	64.4	5.678	164.18	0.002	22547	0.69	7	0.5	3.34	0.7	48.24	0.29	0.256	0.29	17.01	1213	1.41	0.08	3.41	55	1.5	4.62	0.58	23	46.9
Breccia	LK002	113.6	701-22-063	2	531	2.36	18.03	30.4	662	111.6	5.1	4.5	0.005	91181	5.25	8.8	2.4	3.29	5	449.33	0.16	0.239	0.74	12.35	1206	0.44	0.09	2.94	91	2.6	4.38	0.63	23	34.7
Porphyry	LK002	133.3	701-22-064	2.4	1700	1.61	16.66	11	745	185.2	4.712	3.89	0.036	83916	1.75	8.6	1.6	2.83	3.4	182.67	0.13	0.208	0.36	9.9	919	0.06	0.11	2.81	88	1.6	2.52	0.4	8	43.2
Porphyry	LK002	167.3	701-22-065	2.7	1361	0.88	11.54	11.7	545	137.8	2.786	3.48	0.037	102161	1.26	8.2	2.7	2	2.5	222.33	0.07	0.133	0.33	8.4	552	0.07	0.03	1.75	80	1.6	1.62	0.2	9	15.9
Andesite Porphyry	LK003	40.3	701-22-066	0.6	391	3.42	18.8	26	486	89.3	5.331	117.48	0.006	23024	0.6	14.1	0.6	3.22	0.7	168.25	0.24	0.32	0.1	11.93	2655	1.82	0.15	2.45	129	4	8.22	0.94	2375	56.2
Breccia	LK003	54.9	701-22-067	1.5	365	5.78	21.89	28.6	142	52.8	6.579	129.11	0.002	35677	1.36	7	0.9	3.66	1.4	10.85	0.45	0.301	0.62	16.82	1925	1.89	0.16	3.49	56	1.6	8.37	1.13	1409	49.3
Breccia	LK003	108.6	701-22-068	1.8	699	3.73	17.21	30.6	350	70	5.231	109.43	0.003	58733	1.61	12.5	1.7	2.99	2.1	139.02	0.29	0.294	1.6	14.21	1723	1.65	0.15	4.15	84	2.1	7.88	0.95	450	40.9
Pyroclastic	LK003	128.7	701-22-069	1.9	621	5.34	22.8	50.8	394	53.4	6.147	164.51	0.002	25574	1.81	9.9	0.5	4.08	1.8	116.67	0.4	0.361	0.73	14.29	1891	2.37	0.15	2.97	75	2	8.43	1.17	1915	43.1
Tuff	LK003	145.6	701-22-070	1	539	5.34	16.85	30.6	254	32.2	4.789	155.31	0.002	24978	2.08	8.2	0.7	3.03	1.5	45.57	0.42	0.243	0.56	16.98	1757	1.9	0.15	3.7	61	1.9	7.42	1.06	644	52.8
Hornblende Porphyry	LK004	51.23	701-22-071	2.6	16162	4.58	23.6	5.7	648	10	6.663	92.3	0.002	974	0.15	8.1	0.5	4.01	0.5	271.54	0.36	0.42	0.05	18.17	2105	0.39	0.21	3.77	71	1.3	12.66	1.49	66	62.4
Breccia	LK004	71.63	701-22-072	1.3	3933	3.81	25.98	8.7	726	24	7.299	104.31	0.002	7516	0.33	10.1	0.5	4.5	0.7	107.46	0.31	0.394	0.08	19.2	2239	0.91	0.19	4.95	86	1.5	12.1	1.38	186	50.5
Breccia	LK004	81.52	701-22-073	1.3	1324	3.64	19.36	15.5	663	49.6	5.434	146.48	0.002	14544	0.53	8.9	0.5	3.32	0.5	42.15	0.27	0.368	0.11	12.88	1855	1.57	0.18	3.24	74	1.3	12.08	1.22	329	44.6
Andesite Porphyry	LK004	104.71	701-22-074	1.9	943	3.58	21.6	13.2	837	426.7	6.079	161.45	0.002	42389	2.64	9.6	1.4	3.62	1.1	37.67	0.26	0.316	0.99	13.9	1974	2.97	0.15	3.65	81	2.3	9	1.04	3221	44.1
Diorite Porphyry	LK004	137.51	701-22-075	2.6	686	5.54	20.15	8.4	677	137.8	6.229	144.53	0.002	36784	5.54	4.1	2	3.91	0.7	195.29	0.42	0.682	1.1	22.29	1232	4.49	0.3	4.54	32	3	20.54	2.21	184	39.5
Breccia	LK006	45.2	701-22-076	0.6	243	4.13	29.21	242.5	1282	71.7	7.54	158.97	0.002	150590	9.17	23	1.4	5.85	0.9	35.03	0.25	0.839	0.42	9.87	3194	3.38	0.25	2.27	118	2.2	16.95	1.58	83	71.5
Andesite Porphyry	LK006	51.8	701-22-077	1.6	289	4.02	18.35	17.1	463	39	5.169	139.72	0.002	22594	1.6	15.9	0.5	3.39	0.6	60.85	0.3	0.818	0.05	14.91	3276	1.86	0.23	4.06	118	1.3	12.15	1.61	1218	74.1
Andesite Porphyry	LK006	129.7	701-22-078	1.2	366	7.11	25.52	32.7	1001	135.8	6.759	167.61	0.002	45232	9.53	11.5	1.2	5.08	2	426.93	0.42	0.511	0.48	15.69	2723	2.88	0.22	5.53	97	4.5	12.74	1.59	175	74
Breccia	LK006	145.7	701-22-079	1.9	418	5.74	22.2	47.4	713	194.4	6.533	138.62	0.003	45316	3.54	13.1	1	4.35	4.3	438.73	0.36	0.443	0.74	17.78	2166	1.82	0.2	5.54	95	2.4	10.7	1.46	408	73.5
Diorite Porphyry	LK006	165.86	701-22-080	1.4	691	2.02	8.58	11.2	637	127.2	2.237	84.51	0.002	42387	1.27	10.7	1.9	1.9	3.2	386.94	0.15	0.221	0.5	8.61	1257	0.94	0.08	4.3	91	1.2	3.24	0.45	65	31.8

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	**190**
Tuff	LK006	191.35	701-22-081	1.2	882.5	8.555	22.37	96.1	352	143.35	5.875	120.07	0.002	69346.5	2.73	12.2	1.1	4.025	5.2	282.99	0.605	0.28	1.46	15.57	3167.5	1.27	0.13	3.35	94	3	5.92	0.975	17	47.9
Pyroclastic	LK006	214.6	701-22-082	1.8	785	6.87	19.4	9	623	330.3	5.527	56.03	0.002	46295	2.9	6.9	1.1	3.47	3.8	311.82	0.51	0.241	0.41	26.84	1332	0.62	0.11	7.69	52	3.3	4.97	0.92	12	44.3
Andesite Porphyry	L013	5	701-22-083	4.6	494	4.3	18.21	9.7	195	35.3	5.494	75.03	0.019	8179	0.17	14.4	0.5	2.58	0.9	83.32	0.36	0.195	0.1	16.47	2431	0.89	0.06	2.59	89	1.9	4.66	0.52	42	30.7
Andesite Porphyry	L013	11	701-22-084	10.3	799	2.74	15.86	6.5	880	65.3	4.423	60.67	0.018	19101	0.14	17	1.3	2.97	0.8	158.93	0.27	0.249	0.28	18.02	1819	0.7	0.08	2.58	230	1.5	7.11	0.49	52	24.5
Andesite Porphyry	L013	17.7	701-22-085	7.9	708	3.43	12.41	3.1	278	205.8	3.845	96.6	0.014	12568	0.2	11.8	4.3	1.78	1.5	68.63	0.3	0.142	0.34	10.46	2015	1.15	0.06	3.96	120	1.4	3.11	0.38	25	24.4
Andesite Porphyry	L013	23.4	701-22-086	7.2	679	2.91	23.02	5.3	304	40.7	7.33	98.33	0.007	11426	0.19	10.5	2.1	3.13	1.3	64.67	0.26	0.172	0.16	21.19	1913	1.13	0.05	3.3	112	1.4	3.15	0.32	28	13.8
Andesite Porphyry	L013	28.9	701-22-087	6	851	3.47	18.58	7.8	202	39	5.998	90.05	0.03	16433	0.16	16.4	0.6	2.48	1.1	52.02	0.3	0.164	0.08	19.59	2066	0.98	0.05	1.97	100	2.4	3.82	0.35	24	13.1
Andesite Porphyry	L013	34.9	701-22-088	13.2	1007	2.57	12.06	2.3	580	25.3	4.157	79.31	0.005	26759	0.32	14.1	2.2	1.86	1	148.11	0.25	0.254	0.38	22.15	1792	0.94	0.12	1.56	86	4.8	7.86	0.66	27	16.4
Andesite Porphyry	L013	41.25	701-22-089	7.7	1219	2.72	10.91	2.5	527	18.6	3.384	100.99	0.003	28568	0.26	20.6	1.9	1.88	1.1	144.14	0.23	0.26	0.3	12.08	1806	1.15	0.11	1.35	128	2.4	8.29	0.78	27	11.9
Andesite Porphyry	L013	47.7	701-22-090	7.4	784	2.83	13.18	2.4	186	68.6	3.855	96.16	0.003	10001	0.35	11	2.4	2.04	2.2	57.61	0.22	0.221	0.87	17.16	2077	1.32	0.08	2.3	105	2.6	6.02	1.08	15	10.8
Andesite Porphyry	L013	52.9	701-22-091	9.6	834	3.16	14.22	4.4	527	38.1	4.038	82.68	0.007	13146	0.15	10.8	4	2.42	1.6	148.85	0.26	0.234	0.12	12.72	2190	1.02	0.07	1.55	87	1.9	5.18	0.47	28	9.2
Andesite Porphyry	L013	58.8	701-22-092	4.2	764	3.2	15.1	2.1	266	151.6	4.453	117.82	0.002	10053	0.29	8.1	1.1	2.35	1.1	113.25	0.26	0.214	0.93	21.82	1897	1.67	0.1	2.69	87	2.1	6.05	0.97	15	38
Andesite Porphyry	L013	69	701-22-093	18.9	718	2.65	14.07	1.7	439	19.6	4.104	117.92	0.007	10229	0.15	8.6	1.4	2.21	1.3	60.26	0.24	0.377	1.57	17.38	1638	1.63	0.11	1.89	93	1.7	8.29	0.65	18	9.5
Hydrothermal Breccia	L013	75	701-22-094	2.7	4187	3.44	32.76	1.8	1297	157.9	9.213	3.95	0.004	42213	2.26	6.6	7.8	6.06	7.2	1017.44	0.27	0.386	0.34	26.72	2505	0.05	0.08	4.05	91	4.1	5	0.5	5	29.6
Hydrothermal Breccia	L013	81.9	701-22-095	9.7	4484	1.07	29.19	1.5	1297	189.1	8.441	4.46	0.004	46556	0.82	6.2	18.8	4.97	2	792.98	0.09	0.299	0.87	24.41	671	0.04	0.06	3.55	85	2.1	3.83	0.59	7	16.2
Hydrothermal Breccia	L013	86.55	701-22-096	4.7	5133	2.88	30.4	1.5	1169	240.6	9.372	3.81	0.004	47839	1.06	6.7	12.4	4.26	2.7	731.77	0.23	0.237	0.52	26.36	1712	0.04	0.05	3.15	84	2.8	3.53	0.31	5	17.6
Fault Breccia	L013	93.25	701-22-097	10.1	774	0.97	41.69	3	1685	209.4	10.231	5.4	0.004	17410	1.74	6.3	10	9.13	1.5	1704.67	0.07	0.517	1.88	27.31	659	0.08	0.05	8.58	109	2.9	4.17	0.31	15	19.9
Hydrothermal Breccia	L013	100.4	701-22-098	6	3701	1.1	34.42	0.8	1426	247.5	9.949	2.72	0.004	45201	2.66	7.6	29.8	6.57	3.3	1009.31	0.09	0.656	3.73	26.59	560	0.02	0.06	5.38	90	1.5	5.67	0.32	16	7.6
Andesite Porphyry	L013	127.55	701-22-099	12.5	2010	0.96	22.52	8.8	392	10.6	6.215	91.48	0.087	25032	0.17	10.6	2.3	4.19	1.3	209.43	0.09	0.482	0.22	19.59	901	1.48	0.16	3.42	88	1.5	11.31	1.01	25	37.2
Andesite Porphyry	L013	177.05	701-22-100	6.9	1161	0.98	19.76	13.3	786	26.5	6.103	37.88	0.085	46826	0.27	4.9	6.9	2.69	3.2	465.23	0.1	0.14	0.31	21.17	650	0.56	0.04	2.3	77	4.2	2.41	0.26	10	18.4
Andesite Porphyry	L013	199.75	701-22-101	4.5	1543.5	1.415	17.79	9.75	627.5	47.65	5.3305	106.865	0.041	52430	0.38	8.15	4.9	2.96	1.6	196.805	0.13	0.2305	0.735	22.52	834.5	1.83	0.195	3.755	63	1.2	6.225	1.38	20	38.1
Fault Breccia	L223	121.75	701-22-102	1.7	569	2.2	15.15	11.4	708	53.2	4.079	39.82	0.01	63045	0.84	8.7	2.5	2.84	2.1	482.74	0.18	0.246	1.47	11.44	1589	0.53	0.11	4.29	78	2.3	7.83	0.82	17	44.3
Andesite Porphyry	L223	131	701-22-103	1.2	708	2.55	22.5	26.3	480	17	6.325	91.46	0.007	38605	0.61	9.7	1.8	3.84	2.6	318.02	0.25	0.394	0.46	14.69	1494	1.1	0.15	4.8	87	1.2	7.7	1.01	94	43.8
Andesite Porphyry	L223	137	701-22-104	1.9	1460	4.25	28.32	11.7	651	15.5	7.295	105.51	0.003	4294	0.31	13.9	0.6	5.92	1.1	58.04	0.35	0.743	0.4	18.33	2922	1.09	0.35	4.42	117	1.5	22.58	2.29	452	91
Andesite Porphyry	L223	142.1	701-22-105	1.6	1262	4.2	23.92	8.2	733	16.5	6.562	111.81	0.003	13244	0.51	10.7	0.5	4.34	1.5	23.89	0.35	0.458	0.84	18.47	2702	0.81	0.23	5.4	103	1.7	14.33	1.6	74	86.2
Andesite Porphyry	L223	150	701-22-106	4.1	21636	3.99	22.7	6.5	619	9.4	6.171	86.41	0.002	11382	0.13	11.7	0.7	3.99	0.6	342.38	0.31	0.433	0.05	16.36	2651	0.49	0.21	3.62	103	1.3	13.46	1.4	42	70.5
Andesite Porphyry	L223	156	701-22-107	5.1	19585	4	22.47	5.6	645	9.2	6.135	71.47	0.002	7493	0.26	11.6	0.5	3.99	0.6	303.81	0.31	0.425	0.25	16.19	2590	0.44	0.21	3.45	102	1.7	13.06	1.33	33	71
Andesite Porphyry	L223	164.55	701-22-108	3.9	23723	3.91	20.6	6.2	595	7.3	5.698	63.44	0.003	391	0.13	10.7	0.5	3.73	0.4	401.43	0.32	0.42	0.05	15.55	2457	0.36	0.2	3.3	97	1.8	11.81	1.33	24	56.9
Andesite Porphyry	L223	170	701-22-109	3.8	23048	4.2	24.16	6.1	630	5.1	6.763	71.21	0.003	213	0.24	10.9	0.6	4.18	0.5	371.97	0.32	0.438	0.05	16.49	2525	0.37	0.21	3.38	88	2.2	12.87	1.4	22	55
Andesite Porphyry	L223	178.05	701-22-110	2.1	22177	4.1	23.14	5.7	681	4.9	6.265	79.73	0.003	421	0.2	11.4	0.5	3.98	0.5	354.98	0.32	0.399	0.05	16.7	2526	0.36	0.2	3.86	93	2.5	11.96	1.31	23	63.1
Andesite Porphyry	L223	184	701-22-111	8.1	8201	3.29	26.3	6	613	16.8	7.388	68.04	0.003	966	0.18	9.8	0.8	4.43	1.1	167.06	0.26	0.477	0.1	14.45	2112	0.45	0.21	3.29	84	2.6	13.76	1.41	73	40.8
Andesite Porphyry	L223	191.95	701-22-112	4.1	10930	3.86	21.97	7.2	627	10.6	5.917	89.2	0.004	655	0.14	13.2	0.5	3.95	1	227.9	0.29	0.423	0.05	15	2836	0.59	0.2	3.1	111	1.9	12.59	1.31	56	51.5
Andesite Porphyry	L223	198	701-22-113	2.8	2831	4.12	22.85	6	675	6.7	6.264	95.27	0.002	965	0.19	10.5	0.5	3.89	0.5	79.63	0.32	0.397	0.05	17.14	2490	0.69	0.2	2.71	92	1.1	11.86	1.41	56	54.2
Andesite Porphyry	L223	206.5	701-22-114	5.3	14640	4.09	20.3	6.1	615	8	5.66	59.35	0.005	316	0.14	9.9	0.5	3.63	0.5	152.79	0.33	0.391	0.05	14.6	2431	0.41	0.18	2.94	92	1.6	10.7	1.3	44	38.8
Andesite Porphyry	L223	212	701-22-115	48.7	10375	3.89	21.94	9.6	583	29.3	6.034	65.77	0.016	2737	0.33	11.6	0.5	3.98	1	159.5	0.3	0.441	0.05	15.3	2117	0.42	0.22	3.52	81	2.3	12.85	1.37	74	39.2
Andesite Porphyry	L223	220.05	701-22-116	6	17734	3.94	24.96	5.3	568	19	6.748	77.81	0.002	4697	0.23	13.6	0.5	4.6	0.8	313.55	0.31	0.479	0.35	16.25	2436	0.44	0.23	3.61	97	2.7	14.94	1.49	41	68.1
Andesite Porphyry	L223	231.2	701-22-117	4.5	17118	3.88	18.27	5.3	505	4.7	5.027	75.64	0.003	4154	0.25	11.4	0.5	3.52	0.6	341.74	0.3	0.406	0.19	12.77	2290	0.49	0.2	3.26	95	1.5	11.61	1.42	30	66.1
Andesite Porphyry	L223	240.4	701-22-118	2.5	9704	3.38	21.98	12.3	543	14.1	5.892	86.41	0.004	14538	0.39	11.1	0.9	3.92	1.5	176.44	0.3	0.415	0.32	15.01	2035	0.61	0.19	3.51	90	1.4	10.92	1.28	601	74
Fault Breccia	L223	244	701-22-119	1.4	961	4.11	32.63	3.1	975	51.1	8.261	49.82	0.003	10730	0.64	16.1	0.7	6.56	1.6	628.18	0.34	0.96	0.31	19.32	2320	0.46	0.52	4.55	117	2.5	34.07	3.27	62	95.6
Andesite Porphyry	L223	319.3	701-22-120	1.5	1485	5.18	31.27	0.7	547	15.4	8.549	51.13	0.002	3754	0.36	9.2	0.5	5.09	0.6	194.12	0.41	0.464	0.2	21.91	1856	0.27	0.33	5.48	84	1	16.57	2.06	34	68.5
Andesite Porphyry	L223	325.4	701-22-121	1.1	712.5	5.05	22.585	1	153	19.15	6.391	55.545	0.002	5225	0.51	5.8	0.5	3.98	0.8	40.21	0.41	0.3875	0.14	22.235	1924	0.325	0.175	3.67	44.5	1.05	11.1	1.22	20	50.4
Fault Breccia	L223	340.3	701-22-122	1.5	663	4.75	27.49	3.1	530	50.5	7.444	52.21	0.002	9578	1.05	8.4	0.5	4.44	1	369.97	0.39	0.596	0.06	20.6	2039	0.37	0.49	16.98	55	1.5	38.62	3.07	27	78.5
Pyroclastic	L087	6	701-22-123	4.3	1071	1.43	16.05	1.6	405	71.1	4.573	1.97	0.002	19034	3.63	3.7	3.9	2.43	10.6	249.34	0.13	0.169	0.26	11.64	626	0.02	0.07	2.62	34	5.1	3.78	0.5	4	32.5
Pyroclastic	L087	16	701-22-124	2.3	417	1.34	9.76	0.7	192	101.5	2.826	2.06	0.002	1955	3.35	1.8	5.7	1.42	5.9	123.17	0.1	0.107	0.09	9.26	690	0.02	0.07	2.12	8	5.6	3.11	0.51	5	33.2
Pyroclastic	L087	26	701-22-125	4.3	1815	1.2	19.91	1.4	552	146.7	5.343	1.84	0.002	29384	1.53	5.2	1.8	3.21	7.6	338.37	0.11	0.186	0.14	13.13	551	0.02	0.07	3.02	54	2.4	3.09	0.52	4	29.4
Pyroclastic	L087	36	701-22-126	4.4	1468	2.78	18.85	0.5	582	137.7	5.278	1.56	0.002	22510	4.34	8	0.8	3.1	4.3	185.87	0.23	0.224	0.16	13.89	1390	0.02	0.09	3.65	53	3.8	3.66	0.71	2	53.7
Pyroclastic	L087	46	701-22-127	5.3	1233	2.37	18.04	0.5	620	300.2	4.817	1.29	0.002	14386	2.9	8.1	1	3.31	3.8	237.45	0.19	0.236	0.19	16.07	1023	0.02	0.08	4.26	71	1.9	3.79	0.62	3	36.3
Andesite Porphyry	L087	56	701-22-128	3.9	1965	2.69	25.8	0.5	598	149.3	7.126	1.98	0.002	30423	2.72	6.2	5.5	4.33	8.6	394.6	0.24	0.257	0.31	16.07	1409	0.02	0.11	4.2	89	6.2	4.88	0.92	4	46.1
Fault Breccia	L087	66	701-22-129	4.9	1141	1.69	20.6	1.5	517	100.8	6.013	1.71	0.002	19794	2.92	3.7	3.2	3.62	8.5	520.91	0.16	0.253	0.36	13.92	785	0.02	0.1	3.92	43	6.7	4.6	0.85	5	43
Andesite Porphyry	L087	76	701-22-130	5.4	1718	1.6	15.02	0.5	517	116	4.221	1.85	0.002	25873	7.63	4.9	5.1	2.53	13.1	560.48	0.15	0.182	0.33	13.24	816	0.03	0.08	3.32	57	6.2	3.96	0.65	3	37.6
Andesite Porphyry	L087	86	701-22-131	3.1	1456	0.92	15.54	0.8	470	121.8	4.424	2	0.002	24534	3.13	3.8	5.3	2.31	4.8	380.29	0.08	0.11	0.78	12.78	318	0.02	0.05	2.58	76	2.8	2.1	0.35	4	23.4
Andesite Porphyry	L087	96	701-22-132	7.9	993	2.34	15.81	0.5	589	143.3	4.439	2.5	0.002	18329	5.15	6.2	1.4	2.82	2.2	189.88	0.23	0.199	8.89	19.49	795	0.04	0.07	3.94	72	1.6	3.08	0.73	2	42.6
Andesite Porphyry	L087	106	701-22-133	2.4	632	1.74	20.36	1.3	584	76.4	5.807	15.41	0.002	8216	0.72	6.8	3.9	3.51	1.7	173.53	0.15	0.279	0.41	18.51	696	0.18	0.11	4.08	61	0.9	6.14	0.84	18	36.5
Andesite Porphyry	L087	116	701-22-134	2.5	937	0.99	22.42	0.5	784	160.9	6.625	1.75	0.003	11383	3.55	4.6	3.5	3.53	4.8	527.27	0.1	0.213	0.68	24.88	508	0.04	0.05	3.96	58	1.4	2.91	0.41	6	21.9
Andesite Porphyry	L087	126	701-22-135	1.7	2035	0.83	21.97	0.5	792	124.4	6.059	2.64	0.002	17192	1.19	6.3	4.2	3.3	1.8	576.39	0.09	0.161	0.37	19.68	301	0.04	0.06	2.85	65	0.9	2.86	0.46	7	30
Andesite Porphyry	L087	134	701-22-136	1.5	391	3.25	19.27	0.7	515	37.4	5.505	110.84	0.002	1126	0.62	10.6	0.5	3.33	1.4	709.9	0.29	0.41	0.52	25.25	1496	1.01	0.19	5.78	93	1.6	9.79	1.67	17	60.4
Andesite Porphyry	L087	144	701-22-137	1.4	478	2.9	9.58	11.9	627	252.2	2.785	123.21	0.006	26473	0.31	13.7	0.5	1.79	0.5	129.28	0.25	0.301	0.22	19.99	1576	1.44	0.21	6.78	103	1.8	10	1.24	368	48.3
Andesite Porphyry	L087	158	701-22-138	1.4	460	4.08	27.11	3.9	480	56.9	7.61	140.88	0.002	7422	0.26	9.9	0.5	4.43	0.8	89.43	0.32	0.492	0.19	25.26	2334	1.38	0.24	4.98	88	1.3	13.94	1.57	194	50.7
Andesite Porphyry	L087	170	701-22-139	1.4	454	4.92	40.86	1.8	408	18.6	11.334	87.11	0.002	7696	0.29	14.3	0.5	7	0.8	120.71	0.4	0.744	0.05	32.63	3217	0.69	0.31	5.36	125	2.4	18.33	2.25	35	71.3
Andesite Porphyry	L087	184	701-22-140	1.2	435	4.38	32.23	6	287	25.1	9.102	117.2	0.002	12440	0.22	10.3	0.5	5.24	0.6	81.29	0.35	0.461	0.2	28.69	2475	0.86	0.17	5.4	90	1.4	9.69	1.22	29	59.9
Andesite Porphyry	L087	200	701-22-141	1.6	477	3.67	31.44	4.95	515.5	64.05	8.877	99.85	0.002	12217	0.51	8.45	0.5	4.625	0.55	123.605	0.305	0.2625	0.125	28.59	2060	0.995	0.12	5.315	79	1.35	5.93	0.89	39.5	51
Andesite Porphyry	L087	210	701-22-142	0.6	383	3.6	43.44	4	1214	9.3	11.54	69.96	0.002	903	0.21	9.3	0.5	7.68	0.5	131.86	0.32	0.49	0.05	27.88	1991	0.69	0.18	3.54	89	1	9.99	1.31	37	48.8
Andesite Porphyry	L087	216	701-22-143	1.8	762	3.54	11.18	7	287	181.7	3.527	111.76	0.003	29401	0.62	11.7	1.3	1.52	0.8	67.83	0.3	0.181	0.6	23.4	2074	1.18	0.13	4.61	94	1.6	6.85	0.95	87	46.4
Andesite Porphyry	L087	252	701-22-144	1.4	2620	2	13.82	1.8	654	173.7	3.807	2.73	0.003	114418	0.87	6.3	1	2.42	1.4	548.88	0.16	0.195	0.2	8.05	1396	0.04	0.04	2.64	74	4.1	2.85	0.37	5	23.7
Andesite Porphyry	L087	262	701-22-145	1.3	1705	1.51	9.08	4.5	363	82.2	2.489	2	0.002	220491	2.22	2.2	2.7	1.63	5.2	209.14	0.13	0.104	0.77	6.95	600	0.1	0.04	1.56	37	4.3	1.77	0.31	6	17.5
Andesite Porphyry	L087	272	701-22-146	1.4	2150	2.25	14.35	8.3	506	51.2	4.059	1.68	0.002	85164	2.54	6.2	1.5	2.24	3.9	562.61	0.21	0.15	0.7	12.25	958	0.06	0.05	3.07	68	2.1	2.68	0.46	3	30.7
Andesite Porphyry	L087	292	701-22-147	2	845	2.91	11.52	8.2	705	54.7	3.233	38.16	0.002	39914	0.75	8.2	3	2.16	1.3	329.72	0.25	0.226	1.3	22.25	1674	0.48	0.1	4.94	98	1.6	5.47	0.74	18	40
Hydrothermal Breccia	L087	330	701-22-148	46.8	2568	0.65	14.07	14.6	574	70	4.072	2.22	0.044	124586	1.55	7.6	2.4	1.63	5.5	451.39	0.05	0.06	0.48	11.55	405	0.07	0.02	0.88	73	2.7	1.11	0.16	3	7
Andesite Porphyry	L087	349.7	701-22-149	1.9	550	4.3	17.29	10.6	290	68.4	5.368	115.42	0.003	22144	1.16	9.5	1.2	2.54	0.8	109.22	0.54	0.226	1.08	25.83	2569	1.38	0.13	5.02	80	2.2	6.84	0.93	33	58.1
Andesite Porphyry	L087	340	701-22-150	1.4	626	4.08	22.32	13	727	22.2	5.82	3.17	0.002	53792	1.35	10.2	2.3	4.06	2.2	367.62	0.35	0.316	0.9	23.72	2301	0.3	0.1	6.99	104	6.8	5.22	0.73	13	49.3

APPENDIX D

Geochemical Abundance Index Results

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Andesite Porphyry	LS001	25.00	701-22-001	3	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0
Andesite Porphyry	LS001	65.50	701-22-003	3	0	2	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	89.25	701-22-004	3	0	2	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	136.75	701-22-006	3	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	185.00	701-22-007	3	0	6	0	0	0	6	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
Dyke	LS001	221.65	701-22-008	1	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS001	290.75	701-22-010	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	3	0	2	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	3	0	1	0	0	0	6	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	2	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	2	0	5	0	0	0	5	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	4	0	0	0	4	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	LS002	94.30	701-22-016	1	0	0	0	1	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Breccia	LS002	104.13	701-22-017	1	0	3	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	2	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	148.40	701-22-019	1	0	3	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS002	355.80	701-22-020	1	0	0	0	1	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	LS002	373.00	701-22-021	4	0	3	0	0	0	4	0	3	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0
Andesite Porphyry	LS002	422.50	701-22-022	2	0	1	0	0	0	3	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	1	0	1	0	0	0	3	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	448.85	701-22-024	4	0	4	0	0	0	3	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	472.85	701-22-025	1	0	1	0	1	0	1	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	21.30	701-22-026	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	1	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	74.30	701-22-028	1	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	97.00	701-22-029	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	1	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	3	0	4	0	0	0	4	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	170.02	701-22-033	2	0	3	0	0	0	5	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	182.40	701-22-034	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	2	0	4	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	1	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	2	0	2	0	0	0	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	330.20	701-22-039	2	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Feldspar Porphyry	LS003	353.35	701-22-041	1	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	3	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	4	0	4	0	0	0	3	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS004	69.25	701-22-048	1	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	110.45	701-22-049	3	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	4	0	4	0	0	0	5	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0
Diorite Porphyry	LS005	28.40	701-22-051	2	0	2	0	0	0	4	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	4	0	1	0	0	0	5	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0
Breccia	LS005	133.90	701-22-054	4	0	4	0	0	0	5	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS006	34.30	701-22-056	1	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	1	0	4	0	1	0	3	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	1	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	2	0	1	0	0	0	1	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0
Breccia	LS006	140.40	701-22-060	3	0	3	0	0	0	4	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Porphyry	LK002	16.05	701-22-061	2	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	3	0	5	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	133.30	701-22-064	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	1	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK003	54.90	701-22-067	4	0	3	0	0	0	5	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK003	108.60	701-22-068	4	0	4	0	0	0	6	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Pyroclastic	LK003	128.70	701-22-069	3	0	3	0	0	0	5	0	5	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Tuff	LK003	145.60	701-22-070	3	0	3	0	0	0	4	0	4	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	1	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Breccia	LK004	81.52	701-22-073	1	0	3	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Andesite Porphyry	LK004	104.71	701-22-074	4	0	6	0	0	0	5	0	6	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0
Diorite Porphyry	LK004	137.51	701-22-075	5	0	5	0	0	0	5	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK006	45.20	701-22-076	4	0	6	0	0	0	3	0	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	1	0	2	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	129.70	701-22-078	3	0	6	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0
Breccia	LK006	145.70	701-22-079	4	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LK006	165.86	701-22-080	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	3	0	4	0	0	0	6	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	2	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	2	0	1	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	11.00	701-22-084	2	0	2	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	17.70	701-22-085	1	0	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	23.40	701-22-086	1	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	28.90	701-22-087	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	34.90	701-22-088	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0
Andesite Porphyry	L013	41.25	701-22-089	1	0	1	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	47.70	701-22-090	2	0	4	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	52.90	701-22-091	1	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	58.80	701-22-092	4	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	69.00	701-22-093	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Hydrothermal Breccia	L013	75.00	701-22-094	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	6	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	86.55	701-22-096	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L013	93.25	701-22-097	2	0	5	0	0	0	6	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	100.40	701-22-098	6	0	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	1	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	2	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	199.75	701-22-101	2	0	5	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Fault Breccia	L223	121.75	701-22-102	3	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	3	0	3	0	0	0	5	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	1	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	L223	142.10	701-22-105	2	0	2	0	0	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	1	1	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	212.00	701-22-115	1	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L223	220.05	701-22-116	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	2	0	2	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Fault Breccia	L223	244.00	701-22-119	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	1	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	2	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	2	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	16.00	701-22-124	3	0	2	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	3	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	36.00	701-22-126	1	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	46.00	701-22-127	1	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	56.00	701-22-128	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L087	66.00	701-22-129	2	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	76.00	701-22-130	3	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	86.00	701-22-131	2	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	1	0	5	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	106.00	701-22-133	2	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	2	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	2	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	2	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	1	0	3	0	0	0	2	0	4	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	158.00	701-22-138	1	0	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	2	0	4	0	0	0	4	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	3	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	3	0	5	0	0	0	6	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	4	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	1	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	4	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L087	349.70	701-22-149	1	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Andesite Porphyry	LS001	25.00	701-22-001	0	0	0	0	4	0	0	2	5	0	0	4	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS001	65.50	701-22-003	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	LS001	89.25	701-22-004	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Dyke	LS001	136.75	701-22-006	0	0	0	0	2	0	0	2	6	0	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Dyke	LS001	185.00	701-22-007	0	0	0	0	4	0	0	2	6	4	0	6	0	0	1	0	0	6	0	0	3	0	1	0	2	0	0	0	0
Dyke	LS001	221.65	701-22-008	0	0	0	0	3	0	0	4	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	0	0	3	0	0	5	5	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	290.75	701-22-010	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	0	0	0	0	2	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	0	0	0	0	1	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	1	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	0	0	0	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	0	0	0	0	1	0	0	6	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	0	0	1	0	0	6	6	3	0	6	0	2	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS002	94.30	701-22-016	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS002	104.13	701-22-017	0	0	0	0	1	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	0	0	0	0	0	6	6	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	148.40	701-22-019	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Diorite Porphyry	LS002	355.80	701-22-020	0	0	0	0	0	0	0	4	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0
Andesite Porphyry	LS002	373.00	701-22-021	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	422.50	701-22-022	0	0	0	0	2	0	0	4	6	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	0	0	0	0	1	0	0	5	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	448.85	701-22-024	0	0	0	0	4	0	0	5	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	472.85	701-22-025	0	0	0	0	0	0	0	6	4	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	1	0
Andesite Porphyry	LS003	21.30	701-22-026	0	0	0	0	2	0	0	2	4	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	74.30	701-22-028	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	97.00	701-22-029	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	0	0	0	0	1	0	0	3	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	170.02	701-22-033	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	182.40	701-22-034	0	0	0	0	0	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	0	0	0	0	2	0	0	3	6	3	0	5	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	0	0	0	0	1	0	0	3	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	330.20	701-22-039	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	0	0	2	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Feldspar Porphyry	LS003	353.35	701-22-041	0	0	0	0	2	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	0	0	2	0	0	4	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	0	2	6	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	0	0	0	0	1	0	0	3	6	3	0	5	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	0	0	0	0	3	0	0	2	6	2	0	3	0	0	0	0	0	5	0	0	1	0	0	0	2	0	0	5	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS004	69.25	701-22-048	0	0	0	0	3	0	0	2	5	1	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	4	0
Andesite Porphyry	LS004	110.45	701-22-049	0	0	0	0	2	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	0	0	0	0	3	0	0	2	6	3	0	5	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS005	28.40	701-22-051	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	3	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	4	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	0	0	0	0	5	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LS005	133.90	701-22-054	0	0	0	0	3	0	0	5	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	34.30	701-22-056	0	0	0	0	0	0	0	3	5	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	0	0	0	0	1	0	0	2	5	0	0	3	0	0	0	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	0	0	0	0	4	0	0	2	5	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	4	0
Breccia	LS006	140.40	701-22-060	0	0	0	0	5	0	0	2	6	1	0	3	0	0	1	0	0	6	0	0	1	0	1	0	0	0	0	3	0
Porphyry	LK002	16.05	701-22-061	0	0	0	0	0	0	0	2	5	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	0	0	0	0	2	0	0	3	6	4	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Porphyry	LK002	133.30	701-22-064	0	0	0	0	3	0	0	6	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	0	0	0	0	3	0	0	6	6	2	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	0	0	2	0	0	3	6	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	1	0	0	4	0
Breccia	LK003	54.90	701-22-067	0	0	0	0	1	0	0	2	6	2	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LK003	108.60	701-22-068	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Pyroclastic	LK003	128.70	701-22-069	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Tuff	LK003	145.60	701-22-070	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	3	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0
Breccia	LK004	81.52	701-22-073	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LK004	104.71	701-22-074	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	5	0
Diorite Porphyry	LK004	137.51	701-22-075	0	0	0	0	3	0	0	2	6	4	0	5	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	1	0
Breccia	LK006	45.20	701-22-076	0	0	1	0	2	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	0	0	0	0	1	0	0	2	6	2	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	3	0
Andesite Porphyry	LK006	129.70	701-22-078	0	0	0	0	3	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	1	0	2	0	0	1	0
Breccia	LK006	145.70	701-22-079	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	2	0
Diorite Porphyry	LK006	165.86	701-22-080	0	0	0	0	3	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	0	0	0	0	3	0	0	2	6	3	0	4	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	0	0	0	0	1	0	0	5	4	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	11.00	701-22-084	0	0	0	0	2	0	0	5	6	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	17.70	701-22-085	0	0	0	0	3	0	0	5	5	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	23.40	701-22-086	0	0	0	0	1	0	0	4	5	0	0	5	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	28.90	701-22-087	0	0	0	0	1	0	0	6	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	34.90	701-22-088	0	0	0	0	0	0	0	3	6	0	0	5	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L013	41.25	701-22-089	0	0	0	0	0	0	0	2	6	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	47.70	701-22-090	0	0	0	0	2	0	0	2	5	0	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	52.90	701-22-091	0	0	0	0	1	0	0	4	5	0	0	6	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	58.80	701-22-092	0	0	0	0	3	0	0	2	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	69.00	701-22-093	0	0	0	0	0	0	0	4	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
	Geochemical Abundance Index			20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Hydrothermal Breccia	L013	75.00	701-22-094	0	0	0	0	3	0	0	3	6	3	0	6	0	1	1	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	0	0	0	0	3	0	0	3	6	1	0	6	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	86.55	701-22-096	0	0	0	0	4	0	0	3	6	2	0	6	0	0	0	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Fault Breccia	L013	93.25	701-22-097	0	0	0	0	3	0	0	3	5	3	0	6	0	0	2	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Hydrothermal Breccia	L013	100.40	701-22-098	0	0	0	0	4	0	0	3	6	3	0	6	0	0	1	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	0	0	0	0	0	6	6	0	0	5	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	0	0	0	0	0	6	6	0	0	6	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	199.75	701-22-101	0	0	0	0	1	0	0	6	6	0	0	6	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Fault Breccia	L223	121.75	701-22-102	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	0	0	0	0	0	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	142.10	701-22-105	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	0	0	0	0	3	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	212.00	701-22-115	0	0	0	0	0	0	0	5	3	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	220.05	701-22-116	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	0	0	0	0	0	3	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Fault Breccia	L223	244.00	701-22-119	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	0	0	1	0	0	2	5	2	0	3	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	0	0	0	0	2	0	0	2	6	4	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	16.00	701-22-124	0	0	0	0	2	0	0	2	2	3	0	6	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	0	0	0	0	3	0	0	2	6	2	0	5	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	36.00	701-22-126	0	0	0	0	3	0	0	2	6	4	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	46.00	701-22-127	0	0	0	0	4	0	0	2	5	3	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	56.00	701-22-128	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Fault Breccia	L087	66.00	701-22-129	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	76.00	701-22-130	0	0	0	0	2	0	0	2	6	5	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	86.00	701-22-131	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	106.00	701-22-133	0	0	0	0	2	0	0	2	4	1	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	0	0	0	0	3	0	0	2	5	4	0	6	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	0	0	0	0	3	0	0	2	5	2	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	0	0	0	0	1	0	0	2	2	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	0	0	0	0	4	0	0	3	6	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	L087	158.00	701-22-138	0	0	0	0	1	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	5	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	0	0	2	0	0	2	5	1	0	3	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	0	0	3	0	0	2	6	2	0	4	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	0	0	1	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	0	0	0	0	1	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	0	0	2	0	0	6	6	2	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	349.70	701-22-149	0	0	0	0	2	0	0	2	6	2	0	4	0	0	0	0	0	6	1	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	0	0	0	0	0	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0

APPENDIX E

Distilled Water Extract Results

Appendix E

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl	Co	Cr	Cu	EC	F	Fe-Sol	Hg	K	Mg
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
Andesite Porphyry	LS001	25	701-22-001	0.00003	0.69	0.0001	0.02	0.01	0.0001	0.000005	7.8	0.003	8	0.01	0.01	**1.7**	257	0.1	0.08	0.0001	16.9	6.4
Andesite Porphyry	LS001	122	701-22-005	0.00006	0.55	0.0003	0.02	0.01	0.0026	0.000213	8.73	0.001	6	0.03	0.01	0.05	511	0.1	0.19	0.0001	22.9	18.6
Dyke	LS001	221.65	701-22-008	0.00001	3.18	0.006	0.02	0.03	0.0006	0.001998	14	**0.062**	17	0.55	0.01	**17.91**	438	0.2	1.94	0.0001	2.5	13.9
Andesite Porphyry	LS001	249.15	701-22-009	0.00001	0.49	0.0024	0.03	0.01	0.0001	0.000065	1.52	0.0005	84	0.01	0.01	0.15	560	0.6	0.07	0.0001	18.7	6.3
Andesite Porphyry	LS001	368.85	701-22-012	0.00021	0.4	0.0002	0.02	0.02	0.001	0.000088	7.1	0.009	191	0.16	0.01	**4.4**	1242	0.2	0.11	0.0001	29.4	23.2
Andesite Porphyry	LS001	423.5	701-22-015	0.00001	2.04	0.0004	0.01	0.02	0.0005	0.000005	11.94	0.003	47	0.35	0.01	**15.46**	466	0.2	**2.6**	0.0001	3.4	10.4
Andesite Porphyry	LS002	128.6	701-22-018	0.00001	0.23	0.0011	0.02	0.03	0.0001	0.000007	7.45	0.009	25	0.10	0.01	**2.07**	449	0.1	0.1	0.0001	22.4	14.2
Andesite Porphyry	LS002	148.4	701-22-019	0.00001	0.5	0.0039	0.02	0.03	0.0002	0.000005	9.36	0.002	32	0.15	0.01	**9.94**	549	0.1	0.19	0.0001	23.9	17.2
Diorite Porphyry	LS002	355.8	701-22-020	0.00007	3.5	0.0074	0.04	1.18	0.0008	0.000097	4.03	0.0004	74	0.002	0.01	0.3	672	1.5	**4.52**	0.0001	4.2	6.6
Andesite Porphyry	LS002	435.3	701-22-023	0.00005	0.06	0.0037	0.10	0.02	0.0002	0.000014	10.74	0.009	278	0.10	0.01	**4.58**	1370	0.2	0.12	0.0001	34.5	25.9
Andesite Porphyry	LS003	70	701-22-027	0.00001	1.81	0.0026	0.01	0.03	0.0005	0.000058	22.86	0.008	4	0.24	0.01	**0.36**	433	0.5	0.78	0.0001	26.4	15.4
Andesite Porphyry	LS003	131.7	701-22-031	0.00001	1.28	0.0029	0.01	0.01	0.0009	0.000025	17.8	0.008	22	0.30	0.01	**1.9**	548	0.2	0.83	0.0001	19.6	27.2
Breccia	LS003	146.75	701-22-032	0.00004	1.07	0.0035	0.18	0.01	0.0008	0.000028	17.09	0.010	26	0.46	0.01	**3.33**	644	0.2	1.23	0.0001	24.8	28.7
Diorite Porphyry	LS003	170.02	701-22-033	0.00001	0.52	0.002	0.17	0.02	0.0003	0.000036	11.4	0.003	12	0.12	0.01	**0.62**	509	0.1	0.64	0.0001	26.8	20.9
Andesite Porphyry	LS003	330.2	701-22-039	0.00003	0.9	0.0021	0.17	0.01	0.0006	0.000005	18.19	0.004	61	0.73	0.01	**2.93**	832	0.2	0.4	0.0001	26.8	32.0
Feldspar Porphyry	LS003	353.35	701-22-041	0.00002	0.08	0.0017	0.10	0.004	0.0001	0.000005	19.39	0.004	55	0.28	0.01	0.045	496	0.1	0.05	0.0001	9.0	16.5
Porphyry	LS003	410.9	701-22-044	0.00005	0.34	0.0027	0.12	0.01	0.0002	0.000005	25.48	**0.029**	286	**1.44**	0.01	**1.11**	1179	0.2	0.09	0.0001	14.2	33.9
Andesite Porphyry	LS004	30.21	701-22-046	0.00001	0.08	0.0016	0.28	0.02	0.0001	0.000005	25.78	**0.043**	73	0.02	0.03	0.05	1000	0.4	0.01	0.0001	50.1	24.7
Andesite Porphyry	LS004	110.45	701-22-049	0.00003	0.13	0.0024	0.25	0.01	0.0029	0.000016	10.46	0.001	99	0.03	0.01	**2.38**	905	0.1	0.05	0.0001	41.7	13.2
Diorite Porphyry	LS005	50.1	701-22-052	0.00007	0.45	0.0039	0.04	0.06	0.0001	0.000005	6.85	0.00002	23	0.001	0.01	0.01	344	0.6	0.02	0.0001	15.8	7.9
Diorite Porphyry	LS005	141.4	701-22-055	0.00009	0.11	0.0019	0.04	0.03	0.0001	0.000005	9.18	0.00003	236	0.002	0.01	0.01	1169	0.4	0.03	0.0001	24.8	17.9
Andesite Porphyry	LS006	127.6	701-22-059	0.00001	0.21	0.0014	0.07	0.01	0.0001	0.000005	9.39	0.006	97	0.03	0.01	0.01	874	0.3	0.05	0.0001	37.4	21.6
Breccia	LS006	140.4	701-22-060	0.00012	0.39	0.0022	0.05	0.01	0.0017	0.000013	8.99	0.006	175	0.09	0.01	**0.83**	1022	0.2	0.07	0.0001	37.9	19.7
Porphyry	LK002	133.3	701-22-064	0.00001	2.81	0.001	0.03	0.0005	0.0002	0.000005	10.44	0.005	33	0.12	0.01	**9.6**	335	0.1	**3.04**	0.0001	4.8	7.6
Breccia	LK003	54.9	701-22-067	0.00003	**17.83**	0.0077	0.04	0.02	0.002	0.00002	11.02	**0.269**	17	0.70	0.01	**14.94**	598	0.1	**7.34**	0.0001	20.2	10.9
Hornblende Porphyry	LK004	51.23	701-22-071	0.00003	3.24	0.0056	0.04	0.23	0.0008	0.000057	8.83	0.0001	27	0.001	0.01	0.02	499	0.1	1.98	0.0001	5.5	7.6
Breccia	LK004	71.63	701-22-072	0.00008	1.38	0.0049	0.02	0.07	0.0002	0.000007	8.4	0.00002	115	0.002	0.01	0.01	925	0.4	0.44	0.0001	17.5	5.3
Tuff	LK006	191.35	701-22-081	0.00007	**68.74**	0.0213	0.01	0.003	0.0016	0.000409	23.80	0.001	31	**3.39**	0.10	**13.87**	2302	0.1	**249.7**	0.0001	21.3	40.5
Andesite Porphyry	L013	11	701-22-084	0.00001	0.02	0.001	0.03	0.02	0.0001	0.000005	12.95	0.00002	30	0.001	0.01	0.11	328	0.3	0.03	0.0001	18.4	14.0
Andesite Porphyry	L013	34.9	701-22-088	0.00003	0.99	0.0011	0.01	0.01	0.0001	0.000005	4.91	0.0001	13	0.003	0.01	**3.06**	245	0.1	0.13	0.0001	23.1	4.4
Andesite Porphyry	L013	69	701-22-093	0.00002	3.12	0.0016	0.01	0.03	0.0002	0.000016	9.56	0.0004	5	0.04	0.01	**25.25**	437	0.1	0.18	0.0001	30.1	6.6
Hydrothermal Breccia	L013	75	701-22-094	0.00002	1.02	0.001	0.01	0.03	0.0001	0.000005	18.3	0.001	15	0.02	0.01	**1.91**	324	0.1	0.19	0.0001	9.6	7.7
Fault Breccia	L013	93.25	701-22-097	0.00002	0.45	0.001	0.01	0.01	0.0001	0.000005	12.73	0.001	56	0.01	0.01	**1.15**	523	0.1	0.03	0.0001	6.1	15.3
Andesite Porphyry	L013	127.55	701-22-099	0.00018	**7.37**	0.0023	0.01	0.06	0.0013	0.000005	29.14	0.004	7	0.27	0.01	**61.14**	956	0.2	**2.16**	0.0001	22.0	46.6
Andesite Porphyry	L223	156	701-22-107	0.00002	0.08	0.002	0.02	0.01	0.0001	0.000005	27.63	0.0001	12	0.002	0.01	0.02	869	0.3	0.01	0.0001	9.4	12.8
Andesite Porphyry	L223	170	701-22-109	0.00004	2.84	0.0022	0.02	0.10	0.0003	0.000011	6.54	0.00002	28	0.002	0.01	0.01	396	0.3	0.7	0.0001	5.0	2.7
Andesite Porphyry	L223	184	701-22-111	0.00001	2.92	0.0071	0.06	0.17	0.0005	0.000166	11.6	0.00006	27	0.001	0.01	0.08	546	0.9	0.86	0.0001	8.1	5.5
Andesite Porphyry	L223	206.5	701-22-114	0.00001	2.32	0.0015	0.04	0.10	0.0002	0.000034	7.85	0.00002	99	0.001	0.01	0.02	617	0.3	0.44	0.0001	11.9	2.9
Andesite Porphyry	L223	212	701-22-115	0.00004	2.74	0.0029	0.04	0.02	0.0002	0.000033	6.29	0.00002	74	0.002	0.01	0.03	590	0.4	0.56	0.0001	6.9	2.2
Andesite Porphyry	L223	325.4	701-22-121	0.00001	0.795	0.0012	0.03	0.01	0.0010	0.000005	9.2	0.0003	78	0.05	0.01	**1.22**	888	0.2	0.06	0.0001	19.7	20.4
Fault Breccia	L223	340.3	701-22-122	0.00007	**18.5**	0.0012	0.06	0.01	0.0071	0.000005	36.42	0.005	54	0.60	0.01	**51.26**	1496	0.9	1.39	0.0001	30.9	96.2
Pyroclastic	L087	6	701-22-123	0.00002	0.15	0.0026	0.01	0.03	0.0001	0.000005	28.66	0.00002	18	0.001	0.01	0.03	320	0.7	0.01	0.0001	6.1	8.8
Pyroclastic	L087	36	701-22-126	0.00002	0.09	0.0007	0.01	0.07	0.0001	0.000005	19.63	0.00004	35	0.01	0.01	0.01	339	0.4	0.01	0.0001	8.4	6.7
Andesite Porphyry	L087	76	701-22-130	0.00007	1.85	0.0012	0.01	0.05	0.0001	0.000005	23.05	0.00005	59	0.001	0.01	0.06	509	0.3	0.18	0.0001	11.9	13.6
Andesite Porphyry	L087	96	701-22-132	0.00001	0.12	0.001	0.01	0.03	0.0001	0.000005	6.71	0.00002	27	0.003	0.01	0.01	240	0.1	0.02	0.0001	5.7	6.1
Andesite Porphyry	L087	126	701-22-135	0.00003	0.04	0.001	0.01	0.01	0.0001	0.000011	7.44	0.00003	18	0.004	0.01	0.02	194	0.1	0.01	0.0001	8.8	4.2
Andesite Porphyry	L087	184	701-22-140	0.00002	**18.93**	0.0047	0.01	0.01	0.0092	0.000005	49.34	**0.012**	10	**5.49**	0.01	**0.35**	1034	0.5	**3.02**	0.0001	16.1	73.6
Andesite Porphyry	L087	272	701-22-146	0.00001	**47.16**	0.0037	0.01	0.0001	0.0008	0.000005	14.37	**0.028**	3	0.36	0.33	**130.44**	1344	0.1	**167.5**	0.0001	1.1	7.4
Andesite Porphyry	L087	292	701-22-147	0.00003	**33.36**	0.0027	0.01	0.003	0.0019	0.000005	39.62	**0.024**	7	0.92	0.02	**86.26**	1321	0.1	**35.2**	0.0001	10.6	46.1
Hydrothermal Breccia	L087	330	701-22-148	0.00001	**42.85**	0.0044	0.01	0.0004	0.0005	0.000005	10.55	0.004	2	0.14	0.18	**33.88**	1176	0.1	**241.2**	0.0001	1.3	3.9
			Average	0.0000376	**6.01**	0.003	0.05	0.05	0.0009	0.00007	14.81	**0.01**	56.60	0.35	0.02	**10.10**	716.38	0.28	**14.61**	0.00	17.49	18.03
Adopted Reference Level				0.5	5	0.1	5	N/G	N/G	N/G	1000	0.01	N/G	1	1	0.3	N/G	2	2	0.002	N/G	2000

Appendix E

Lithology	Borehole	Depth (m)	ID	Mn	Mo	Na	Ni	P	Pb	pH	S	SO4	Sb	Se	Sn	Sr	TDSEva	Th	U	V	Zn	AFP
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NONE	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l	-
Andesite Porphyry	LS001	25	701-22-001	1.3	0.00010	14.4	0.01	0.1	0.0017	**5**	26.2	78	0.00001	0.0011	0.0001	0.01	178	0.00005	0.0001	0.01	0.3	UC
Andesite Porphyry	LS001	122	701-22-005	1.26	0.00015	49.9	0.02	0.1	0.0018	**5.2**	61.2	183	0.00004	0.0112	0.0001	0.02	401	0.00021	0.0022	0.01	**0.68**	PAF-LC
Dyke	LS001	221.65	701-22-008	0.5	0.00029	30.3	0.14	0.3	0.0031	**4.4**	56.1	168	0.0007	0.0026	0.0057	0.07	362	0.00041	0.0220	0.01	**0.89**	PAF
Andesite Porphyry	LS001	249.15	701-22-009	0.04	0.01145	92.7	0.01	0.1	0.0006	6.6	34.2	102	0.00479	0.0015	0.0001	0.01	389	0.00025	0.0011	0.01	0.02	PAF
Andesite Porphyry	LS001	368.85	701-22-012	0.09	0.00007	239.6	0.07	0.1	0.0012	**5**	116.6	349	0.00024	**0.022**	0.0001	0.02	947	0.00007	0.0133	0.01	**0.8**	PAF
Andesite Porphyry	LS001	423.5	701-22-015	0.37	0.00008	43.6	0.13	0.3	0.0005	**4.3**	45.6	137	0.00032	0.0015	0.0001	0.15	420	0.00007	0.0146	0.01	0.45	PAF
Andesite Porphyry	LS002	128.6	701-22-018	0.25	0.00005	39.5	0.06	0.1	0.0005	**4.6**	48.9	146	0.00011	0.0069	0.0001	0.02	382	0.00004	0.0341	0.01	**1.82**	PAF
Andesite Porphyry	LS002	148.4	701-22-019	0.32	0.00005	42.9	0.11	0.2	0.0006	**4.4**	58.5	175	0.00054	0.005	0.0001	0.02	350	0.00014	0.0535	0.01	**1.78**	PAF
Diorite Porphyry	LS002	355.8	701-22-020	0.12	0.00799	132.4	0.01	0.4	0.0042	8.5	28.4	85	0.00021	0.003	0.0001	0.01	488	0.00121	0.0005	0.08	**0.66**	NAF
Andesite Porphyry	LS002	435.3	701-22-023	2	0.00006	243.8	0.05	0.1	0.0005	6.1	91	273	0.00004	0.0035	0.0001	0.02	1016	0.00034	0.0003	0.01	**2.76**	PAF
Andesite Porphyry	LS003	70	701-22-027	0.68	0.00012	12.9	0.16	0.1	0.0009	**4.7**	57.5	172	0.00058	0.0036	0.0001	0.07	265	0.00014	0.0052	0.01	**1.63**	PAF
Andesite Porphyry	LS003	131.7	701-22-031	2.1	0.00005	31.5	0.13	0.1	0.0006	**4.4**	71.7	215	0.00014	0.0016	0.0001	0.01	440	0.00025	0.0245	0.01	**1.99**	PAF
Breccia	LS003	146.75	701-22-032	2.1	0.00005	37.3	0.2	0.1	0.0017	**4.1**	83.8	251	0.00019	0.0021	0.0001	0.01	439	0.00019	0.0597	0.01	**2.84**	PAF
Diorite Porphyry	LS003	170.02	701-22-033	0.9	0.00005	36	0.04	0.1	0.001	**4.5**	65.1	195	0.00012	0.0014	0.0001	0.01	340	0.00029	0.0392	0.01	**0.93**	PAF
Andesite Porphyry	LS003	330.2	701-22-039	1.15	0.00006	85.6	0.22	0.1	0.0005	**4.4**	99.5	298	0.00019	0.0052	0.0001	0.01	625	0.00015	0.0264	0.01	**0.61**	PAF
Feldspar Porphyry	LS003	353.35	701-22-041	0.68	0.00016	46.65	0.07	0.1	0.0006	**5.35**	47.05	141	0.00033	0.0028	0.0001	0.04	350	0.00002	0.0053	0.01	**0.695**	PAF
Porphyry	LS003	410.9	701-22-044	0.57	0.0002	161.8	**0.56**	0.1	0.0005	**5**	51	153	0.00054	0.0046	0.0001	0.02	720	0.00004	0.0068	0.01	**0.84**	PAF-LC
Andesite Porphyry	LS004	30.21	701-22-046	19.09	0.00358	117.1	0.01	0.1	0.0066	7.2	117.6	352	0.00034	0.0013	0.0001	0.94	680	0.00001	0.0001	0.01	**0.59**	PAF
Andesite Porphyry	LS004	110.45	701-22-049	1.57	0.00008	140.4	0.02	0.1	0.0013	**5.3**	90.5	271	0.00145	0.0021	0.0001	0.35	580	0.00002	0.0021	0.01	**0.98**	PAF
Diorite Porphyry	LS005	50.1	701-22-052	0.01	0.01026	47.3	0.01	0.1	0.0012	8.2	29.7	89	0.00047	0.0009	0.0001	0.03	210	0.00001	0.0062	0.01	0.01	AC
Diorite Porphyry	LS005	141.4	701-22-055	1.12	0.00228	203.8	0.01	0.1	0.0007	7.3	55.1	165	0.00018	0.0025	0.0001	0.14	657	0.00001	0.0003	0.01	0.01	PAF
Andesite Porphyry	LS006	127.6	701-22-059	5.83	0.00007	122	0.02	0.1	0.0007	6.5	82.1	246	0.00002	0.0063	0.0001	0.01	443	0.00006	0.0007	0.01	**0.87**	PAF
Breccia	LS006	140.4	701-22-060	0.22	0.00012	163.7	0.1	0.1	0.0017	**5.2**	75.5	226	0.00029	0.0078	0.0001	0.02	700	0.00008	0.0036	0.01	**0.95**	PAF
Porphyry	LK002	133.3	701-22-064	0.4	0.00006	22.9	0.09	0.2	0.0006	**4.1**	34.5	103	0.00049	0.0015	0.0001	0.01	203	0.00004	0.0133	0.01	0.19	PAF
Breccia	LK003	54.9	701-22-067	1.88	0.00008	6.3	**0.51**	0.4	0.013	**3.7**	91.4	274	0.00021	0.0047	0.0001	0.01	391	0.00096	0.0315	0.01	**45.3**	PAF
Hornblende Porphyry	LK004	51.23	701-22-071	0.13	0.00851	124.5	0.01	0.1	0.0025	9.2	17.4	52	0.00018	0.0012	0.0001	0.05	246	0.00075	0.0023	0.06	0.01	NAF
Breccia	LK004	71.63	701-22-072	0.02	0.03562	208.2	0.01	0.1	0.0015	8.5	60.7	182	0.00038	0.0015	0.0001	0.06	620	0.00012	0.0042	0.02	0.01	AC
Tuff	LK006	191.35	701-22-081	0.41	0.00062	65.6	**1.905**	0.5	0.0100	**2.7**	419.5	**1257**	0.00047	0.00325	0.0001	0.03	1481	0.01840	0.0914	0.07	**1.02**	PAF
Andesite Porphyry	L013	11	701-22-084	0.02	0.00555	23.3	0.01	0.1	0.0006	7.3	20.3	61	0.00004	0.0023	0.0001	0.63	180	0.00008	0.0002	0.01	0.01	NAF
Andesite Porphyry	L013	34.9	701-22-088	0.05	0.00012	18.6	0.01	0.1	0.0005	**5.6**	23.5	70	0.00003	0.0043	0.0001	0.03	155	0.00014	0.0001	0.01	0.01	NAF
Andesite Porphyry	L013	69	701-22-093	0.19	0.00008	26.6	0.02	0.5	0.0005	**4.2**	55.7	167	0.00001	0.0121	0.0001	0.03	265	0.00050	0.0007	0.01	0.07	NAF
Hydrothermal Breccia	L013	75	701-22-094	0.34	0.00018	25	0.01	0.1	0.0005	**5.1**	36.6	110	0.00011	0.0037	0.0001	0.25	195	0.00066	0.0003	0.01	0.14	UC
Fault Breccia	L013	93.25	701-22-097	0.73	0.00005	71.5	0.01	0.1	0.0005	**5.8**	49.4	148	0.00003	0.0193	0.0001	0.08	331	0.00009	0.0002	0.01	0.27	UC
Andesite Porphyry	L013	127.55	701-22-099	1.49	0.00033	63.7	0.1	1.2	0.0009	**4.2**	164.2	492	0.00022	**0.0229**	0.0001	0.09	682	0.00652	0.0077	0.01	**3.16**	PAF
Andesite Porphyry	L223	156	701-22-107	0.02	0.06095	157.8	0.01	0.1	0.0006	8.1	134.8	404	0.00028	0.0019	0.0001	0.30	631	0.00007	0.0037	0.01	0.01	NAF
Andesite Porphyry	L223	170	701-22-109	0.05	0.14508	86.2	0.01	0.1	0.0014	9	12.2	37	0.00012	0.0017	0.0001	0.08	386	0.00062	0.0026	0.03	0.01	NAF
Andesite Porphyry	L223	184	701-22-111	0.09	**0.96708**	124.7	0.01	0.1	0.0054	8.8	26.8	80	0.00016	**0.0596**	0.0001	0.09	306	0.00043	0.0030	0.02	0.01	AC
Andesite Porphyry	L223	206.5	701-22-114	0.02	**0.53322**	126.5	0.01	0.1	0.0016	8.5	19.3	58	0.00011	0.0015	0.0001	0.10	352	0.00048	0.0008	0.02	0.01	AC
Andesite Porphyry	L223	212	701-22-115	0.02	**1.049**	123.9	0.01	0.1	0.0034	8.6	37.1	111	0.00052	0.0012	0.0001	0.07	400	0.00049	0.0017	0.01	0.01	AC
Andesite Porphyry	L223	325.4	701-22-121	0.115	0.00072	144.65	0.01	0.1	0.0006	**5.3**	97.75	293	0.00005	0.0027	0.0001	0.01	615	0.00004	0.0014	0.01	0.02	PAF-LC
Fault Breccia	L223	340.3	701-22-122	0.73	0.00054	164.3	0.18	0.9	0.0005	**4.1**	294.5	882	0.00004	0.0059	0.0001	0.08	1355	0.00022	**0.9309**	0.01	0.44	PAF
Pyroclastic	L087	6	701-22-123	0.01	0.01194	23.8	0.01	0.1	0.0005	7.9	25.8	77	0.00127	0.0017	0.0001	0.26	183	0.00001	0.0035	0.01	0.01	NAF
Pyroclastic	L087	36	701-22-126	0.08	0.00245	32.1	0.01	0.1	0.0018	6.8	27.6	83	0.00035	0.0012	0.0001	0.23	205	0.00003	0.0002	0.01	0.01	PAF-LC
Andesite Porphyry	L087	76	701-22-130	0.18	0.00821	57	0.01	0.1	0.0032	7.3	44.8	134	0.00188	0.0014	0.0001	0.18	403	0.00020	0.0003	0.01	0.01	PAF-LC
Andesite Porphyry	L087	96	701-22-132	0.04	0.00155	27.3	0.01	0.1	0.001	6.7	18.8	56	0.00034	0.0011	0.0001	0.16	149	0.00003	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	126	701-22-135	0.08	0.00163	18.3	0.01	0.1	0.0008	6.7	16.5	49	0.00054	0.001	0.0001	0.09	126	0.00001	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	184	701-22-140	2.11	0.00106	40.2	**1.18**	0.1	0.0005	**3.8**	198	593	0.00002	0.0027	0.0001	0.03	966	0.00058	0.0449	0.01	**1.56**	PAF
Andesite Porphyry	L087	272	701-22-146	0.74	0.00263	6.5	0.19	2.6	0.0006	**3.1**	261.9	785	0.00014	0.0028	0.0001	0.03	879	0.03736	0.0252	0.01	**0.55**	PAF
Andesite Porphyry	L087	292	701-22-147	2.71	0.00096	51.5	0.29	1.7	0.0005	**3.4**	247.9	743	0.00014	0.0079	0.0001	0.07	961	0.01012	0.0433	0.01	**3.56**	PAF
Hydrothermal Breccia	L087	330	701-22-148	0.58	0.00143	4.6	0.12	0.9	0.0005	**3.3**	242.3	726	0.00027	0.0104	0.0001	0.04	810	0.00303	0.0077	0.01	0.32	PAF
			Average	1.11	0.06	79.61	0.14	0.28	0.002	**5.8**	83.44	249.98	0.0004	0.01	0.0002	0.10	497	0.002	0.03	0.01	**1.60**	
Adopted Reference Level				N/G	0.15	N/G	0.5	N/G	0.1	6	N/G	1000	N/G	0.02	N/G	N/G	2000	N/G	0.2	N/G	0.5	

APPENDIX F

Laboratory Testing Certificates

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

Quantitative X-Ray Diffraction Analysis

Report Prepared for:	Tim Rowles Knight Piesold Pty. Ltd. trowles@knightpiesold.com
Samples Received:	22-May-2013
Samples Analysed:	29-May-2013 -12-June-2013
Written by:	Dr Sharon Ness
Date:	12-June-2013
Intertek Genalysis Job No:	752.0/1307181 (Rev 1)

15 Davison Street, Maddington
Western Australia 6109

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Facsimile: +61 8 9251 8110
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Introduction

Fifteen (15) samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents.

Sampling and Preparation

The samples were crushed and milled to < 60 µm

For each sample (except 701-22-097), a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content.

A grab of sample 701-22-097 was prepared by adding an internal standard, TiO2, and micronising the mixture to 4µm.

The spiked samples were each prepared as an un-oriented powder mount.

A second grab was taken of 701-22-001 and prepared as a duplicate analysis.

Instrumentation

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with Copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3^o to 65^{o}2θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database.

Quantitative phase analysis was performed using SIROQUANT™ Version 3 software.

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Results

The quantitative analysis of the crystalline and amorphous content of each sample is as follows:

Sample ID **701-22-001**

Phase	Formula	original wt%	duplicate wt%	Notes
Amorphous content		13	12	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	17	15	
Interlayered illite/smectite		21	21	see Note 1
Jarosite	(K,Na)Fe3(SO4)2(OH)6	<1	1	
Kaolin	Al2Si2O5(OH)4	5	6	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	5	6	
Quartz	SiO2	39	39	

Sample ID **701-22-008**

Phase	Formula	wt%	Notes
Amorphous content		10	
Dolomite	CaMg(CO3)2	1	
Kaolin	Al2Si2O5(OH)4	16	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	10	
Potassium feldspar	KAlSi3O8	2	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	38	

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Sample ID **701-22-020**

Phase	Formula	wt%	Notes
Amorphous content		17	
Alunite	KAl3(SO4)2(OH)6	1	
Chalcopyrite	CuFeS2	<1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	6	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		14	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Potassium feldspar	KAlSi3O8	5	
Pyrite	FeS2	1	
Quartz	SiO2	31	
Siderite	FeCO3	11	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-023**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	1	
Anhydrite	CaSO4	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	13	
Interlayered illite/smectite		5	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Kaolin	Al2Si2O5(OH)4	17	
Pyrite	FeS2	2	
Quartz	SiO2	45	
Siderite	FeCO3	3	

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Sample ID **701-22-032**

Phase	Formula	wt%	Notes
Amorphous content		17	
Anhydrite	$CaSO_4$	1	
Calcite	$CaCO_3$	<1	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	12	
Interlayered illite/smectite		18	see Note 1
Jarosite	$KFe_3(SO_4)_2(OH)_6$	1	
Natroalunite	$(K,Na)Al_3(SO_4)_2(OH)_6$	<1	
Pyrite	FeS_2	6	
Quartz	SiO_2	45	

Sample ID **701-22-041**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	$KAl_3(SO_4)_2(OH)_6$	3	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	2	
Interlayered illite/smectite		8	see Note 1
Kaolin	$Al_2Si_2O_5(OH)_4$	8	
Natroalunite	$(K,Na)Al_3(SO_4)_2(OH)_6$	<1	
Potassium feldspar	$KAlSi_3O_8$	<1	
Pyrite	FeS_2	10	
Pyrophyllite	$Al_2Si_4O_{10}(OH)_2$	22	
Quartz	SiO_2	34	

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Sample ID **701-22-044**

Phase	Formula	wt%	Notes
Amorphous content		7	
Dolomite	CaMg(CO3)2	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		1	see Note 1
Kaolin	Al2Si2O5(OH)4	22	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	26	
Pyrite	FeS2	1	
Quartz	SiO2	41	

Sample ID **701-22-052**

Phase	Formula	wt%	Notes
Amorphous content		13	
Ankerite	Ca(Fe,Mg)(CO3)2	4	
Dolomite	CaMg(CO3)2	8	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	11	
Interlayered illite/smectite		15	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Magnesite	MgCO3	4	see Note 2
Quartz	SiO2	40	

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Sample ID **701-22-071**

Phase	Formula	wt%	Notes
Amorphous content		33	
Calcite	$CaCO_3$	2	
Dolomite	$CaMg(CO_3)_2$	3	
Expanding clay		2	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	7	
Interlayered illite/smectite		9	see Note 1
Kaolin	$Al_2Si_2O_5(OH)_4$	2	
Potassium feldspar	$KAlSi_3O_8$	8	
Pyrite	FeS_2	<1	
Quartz	SiO_2	24	
Sodium calcium plagioclase	$(Na,Ca)(Al,Si)_2Si_2O_8$	12	

Sample ID **701-22-072**

Phase	Formula	wt%	Notes
Amorphous content		29	
Calcite	$CaCO_3$	1	
Chlorite	$(Fe,Al,Mg)_6(Si,Al)_4O_{10}(OH)_8$	5	
Dolomite	$(Ca,Fe,Mg)_2(CO_3)_2$	7	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	4	
Interlayered illite/smectite		22	see Note 1
Magnesite	$MgCO_3$	2	see Note 2
Pyrite	FeS_2	2	
Quartz	SiO_2	29	
Sodium calcium plagioclase	$(Na,Ca)(Al,Si)_2Si_2O_8$	1	

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Sample ID **701-22-081**

Phase	Formula	wt%	Notes
Amorphous content		11	
Anatase	TiO2	1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	5	
Interlayered illite/smectite		13	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	3	
Pyrite	FeS2	15	
Pyrophyllite	Al2Si4O10(OH)2	8	
Quartz	SiO2	43	

Sample ID **701-22-097**

Phase	Formula	wt%	Notes
Amorphous content		11	see Note 3
Dolomite	CaMg(CO3)2	1	
Hematite	Fe2O3	15	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	9	
Potassium feldspar	KAlSi3O8	4	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	47	

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Sample ID **701-22-115**

Phase	Formula	wt%	Notes
Amorphous content		35	
Calcite	CaCO3	7	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	13	
Chloritoid	(Fe,Mg)2Al4Si2O10(OH)4	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Palygorskite	Mg5(Si4O10)2(OH)2(H2O)8	7	see Note 1
Quartz	SiO2	23	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-126**

Phase	Formula	wt%	Notes
Amorphous content		14	
Hematite	Fe2O3	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	15	
Potassium feldspar	KAlSi3O8	1	
Pyrophyllite	Al2Si4O10(OH)2	5	
Quartz	SiO2	63	

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Sample ID **701-22-148**

Phase	Formula	wt%	Notes
Amorphous content		3	
Diaspore	AlO(OH)	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	28	
Pyrite	FeS2	16	
Pyrophyllite	Al2Si4O10(OH)2	4	
Quartz	SiO2	47	

Calculation of the phase abundances have been based on the Brindley contrast corrections using a particle diameter of 10 µm.

Uncertainty in the SIROQUANT^{TM} analyses should reflect errors (absolute) of no greater than: +/- 10% for phases 50-95%, +/- 5% for phases 10-50% and +/- 2% for phases 3-10%. Phases of < 3% are approaching detection limit and normally no refinements are made on these.

Quality Control

NIST Standard Reference Material 656

The powder consists of sub-micrometer, equi-axial, non-aggregated grains that do not display the effects of absorption contrast, extinction or preferred orientation.

An aliquot of this CRM, spiked with 10% Al_2O_3 for the amorphous content determination, was prepared as un-oriented powder mount of the total sample and the scan analysed with SIROQUANT™.

The results are as follows

Sample ID **β 656 (High β Phase Powder)**

		result	std dev	SRM certified	SRM uncert
Phase	**Formula**	**wt%**	**wt%**	**wt%**	**wt%**
Amorphous content		8.8	0.1	8.6	0.81
Si3N4, alpha	SiN4	16.3	0.6	16.3	2.54
Si3N4, beta	SiN4	74.9	0.4	75.1	0.60

Each interval defined by the certified value and its uncertainty is a 95% confidence interval for the true value of the mean in the absence of systematic error.

Discussion

Notes

1. For confirmation of the clay mineral identification, clay separation and oriented clay mounts (glycol and heat treated) would be required.
2. The magnesite phase possibly has some substitution of the magnesium by calcium.
3. Calculation of the phase abundances has been based on the Brindley contrast corrections using a particle diameter of 4 µm, this being the median particle size determined for this sample after miconising.

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
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Discussion

General

Quantification of the crystalline mineral phases was performed with the SIROQUANT™ software package. This software uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases.

Corrections are incorporated the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

1. There is a limit of detection of 1-2% on most crystalline phases.
2. The detection of a phase may be dependent on its crystallinity.
3. Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
4. Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

1. The limitations for qualitative XRD analysis apply
2. The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.
3. Particle size is important with respect to the absorption of the X-rays by the sample. Milling to < 60 µm will usually produce a median particle size of approximately10 µm which is, in most cases, sufficient to minimize absorption contrast effects. However, this particle size may not be sufficient to minimize the absorption contrast effect if the samples contain a significant amount of iron-bearing phases. This is because the absorption contrast between them and other lower absorber phases is the most severe when analysed with Copper radiation. Micronising reduces the particle size to that more suitable for analysis with this radiation.

The accuracy of the analysis is dependent on sampling and sample preparation in addition to the calculated profiles being exactly representative of the chemistry of the component phases and their crystallinity. Some preferred orientation effects and reflection overlaps may occur which cannot be adequately resolved.

Amorphous content

The amorphous content was determined from the addition of a known spike of a well-crystalline internal standard (ZnO or TiO2) to each sample.

When amorphous material is present, the weight percentage of the spike found by SIROQUANT™ is larger than actually weighed out. SIROQUANT™ then calculates the amount of amorphous material that causes the difference in the spike weight percentages and normalises all weight percentages to include the amorphous content.

Dr. Sharon Ness
Intertek Genalysis
Email: sharon.ness@intertek.com
Mob: 0408 746 062

ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1307060
No. of SAMPLES	:	150
No. of ELEMENTS	:	80
CLIENT O/N	:	PE701-00022 SS13001(REVB) (Job 1
SAMPLE SUBMISSION No.	:	PE701-00022 SS13001(REVB)
PROJECT	:	LETPADAUNG
STATE	:	Rock Chip
DATE RECEIVED	:	20/05/2013
DATE COMPLETED	:	19/06/2013
DATE PRINTED	:	19/06/2013
PRIMARY LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

MAIN OFFICE AND LABORATORY

15 Davison Street, Maddington 6109, Western Australia
PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100 Fax: +61 8 9251 8110
Email: genalysis@intertek.com
Web Page: www.genalysis.com.au

KALGOORLIE SAMPLE PREPARATION DIVISION

12 Keogh Way, Kalgoorlie 6430, Western Australia
Tel: +61 8 9021 6057 Fax: +61 8 9021 3476

ADELAIDE LABORATORY

11 Senna Road, Wingfield, 5013, South Australia
Tel: +61 8 8162 9714 Fax: +61 8 8349 7444

JOHANNESBURG LABORATORY

43 Malcolm Moodie Crescent,
Jet Park, Gauteng, South Africa 1459
Tel: +27 11 552 8149 Fax: +27 11 552 8248

TOWNSVILLE LABORATORY

9-23 Kelli Street, Mt St John, Bohle, Queensland, Australia 4818

Tel: +61 7 4774 3655 Fax: +61 7 4774 4692

SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

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This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Note: Detection Limit only apply when TDS <100mg/l for MS and TDS<5000mg/l for OES except when indicated in spreadsheet

   NB pH Ws/MTR and EC/MTR both measured on 1:3 [soil:water] extract
   All anions and metals read on the same extract, solution values are reported

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0001 701-22-001	0.72	0.02	9.97%	0.76	-3	4.2
0002 701-22-002	0.11		7.77%		15	1.6
0003 701-22-003	0.86		8.11%		-2	10.7
0004 701-22-004	1.16		7.96%		-4	12.4
0005 701-22-005	0.54	0.06	9.06%	0.55	5	3.7
0006 701-22-006	0.65		8.77%		-3	7.1
0007 701-22-007	1.12		5.87%		-11	789.6*
0008 701-22-008	0.22	X	8.10%	3.18	-6	37.3
0009 701-22-009	0.13	X	9.20%	0.49	-3	33.9
0010 701-22-010	0.15		8.69%		-3	9.4
0011 701-22-011	1.00		8.03%		-7	12.5
0012 701-22-012	0.82	0.21	8.69%	0.40	-3	4.9
0013 701-22-013	0.14		9.47%		-3	8.4
0014 701-22-014	0.41		6.77%		-6	90.4
0015 701-22-015	0.09	X	6.17%	2.04	-8	42.4
0016 701-22-016	0.17		9.04%		-3	2.9
0017 701-22-017	0.25		8.98%		-4	16.5
0018 701-22-018	0.12	X	8.78%	0.23	-3	8.2
0019 701-22-019	0.16	0.01	8.68%	0.50	-3	20.3
0020 701-22-020	0.17	0.07	6.98%	3.50	17	1.3
0021 701-22-021	1.47		8.26%		13	15.2
0022 701-22-022	0.31		8.94%		4	5.5
0023 701-22-023	0.21	0.05	9.07%	0.06	5	3.9
0024 701-22-024	1.81		8.58%		5	47.9
0025 701-22-025	0.24		9.19%		4	6.1
0026 701-22-026	0.46		7.85%		4	15.5
0027 701-22-027	0.18	X	8.51%	1.81	4	1.6
0028 701-22-028	0.17		6.32%		4	2.7
0029 701-22-029	0.49		9.13%		4	20.3
0030 701-22-030	0.59		7.11%		1	16.0
0031 701-22-031	0.22	X	8.90%	1.28	4	5.9
0032 701-22-032	0.68	0.04	8.02%	1.07	2	31.1
0033 701-22-033	0.58	0.01	8.12%	0.52	3	15.5
0034 701-22-034	0.46		9.05%		4	13.5
0035 701-22-035	0.30		7.03%		-2	31.6
0036 701-22-036	0.57		8.10%		2	14.3
0037 701-22-037	0.23		8.61%		2	7.2
0038 701-22-038	0.39		7.46%		1	6.4

ANALYSIS

0039 701-22-039	0.30	0.03	8.98%	0.90	1	4.7
0040 701-22-040	0.11		7.84%		41	6.3

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.1	X	0.02	252.9	9.66	1.85
0002 701-22-002		13		426.1		1.96
0003 701-22-003		X		381.5		2.50
0004 701-22-004		X		542.1		1.16
0005 701-22-005	0.3	X	0.02	339.8	12.37	1.90
0006 701-22-006		X		448.9		0.68
0007 701-22-007		10		584.0		0.28
0008 701-22-008	6.0	X	0.02	452.1	25.24	0.16
0009 701-22-009	2.4	X	0.03	572.7	10.55	0.60
0010 701-22-010		X		393.0		0.50
0011 701-22-011		X		384.8		0.40
0012 701-22-012	0.2	X	0.02	607.5	17.18	1.27
0013 701-22-013		X		344.8		1.39
0014 701-22-014		X		351.1		0.16
0015 701-22-015	0.4	X	0.01	449.4	19.89	0.17
0016 701-22-016		X		1084.9		0.78
0017 701-22-017		X		917.2		0.88
0018 701-22-018	1.1	X	0.02	986.7	29.61	0.57
0019 701-22-019	3.9	X	0.02	750.0	34.94	0.98
0020 701-22-020	7.4	X	0.04	1144.9	1184.79	1.10
0021 701-22-021		X		298.3		1.44
0022 701-22-022		X		461.3		0.91
0023 701-22-023	3.7	X	0.10	536.6	22.41	1.12
0024 701-22-024		X		646.5		1.25
0025 701-22-025		X		1129.3		0.93
0026 701-22-026		X		403.7		0.81
0027 701-22-027	2.6	X	0.01	721.9	31.63	0.94
0028 701-22-028		X		345.7		1.24
0029 701-22-029		X		452.5		1.14
0030 701-22-030		X		235.1		0.66
0031 701-22-031	2.9	X	0.01	197.1	10.41	1.68
0032 701-22-032	3.5	X	0.18	342.5	14.54	0.96
0033 701-22-033	2.0	X	0.17	566.2	17.91	0.85
0034 701-22-034		X		637.5		1.58
0035 701-22-035		X		351.0		0.21
0036 701-22-036		X		478.4		0.64
0037 701-22-037		X		509.5		0.54
0038 701-22-038		X		319.0		0.52

ANALYSIS

0039 701-22-039	2.1	X	0.17	374.2	5.99	0.68
0040 701-22-040		X		527.3		0.53

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	0.1	0.16	X	0.06	946	8.08
0002 701-22-002		0.33		0.95	2481	
0003 701-22-003		6.78		0.05	1432	
0004 701-22-004		7.05		0.04	1079	
0005 701-22-005	2.6	0.74	0.213	0.04	383	8.73
0006 701-22-006		6.94		0.04	819	
0007 701-22-007		10.93		0.02	645	
0008 701-22-008	0.6	6.33	1.998	0.02	967	14.00
0009 701-22-009	X	0.99	0.065	0.03	817	1.52
0010 701-22-010		3.17		0.04	578	
0011 701-22-011		16.79*		0.02	653	
0012 701-22-012	1.0	5.16	0.088	0.03	618	7.10
0013 701-22-013		2.21		0.03	556	
0014 701-22-014		2.93		0.02	531	
0015 701-22-015	0.5	1.13	X	0.02	593	11.94
0016 701-22-016		0.19		0.06	456	
0017 701-22-017		0.43		0.07	388	
0018 701-22-018	X	0.39	0.007	0.05	356	7.45
0019 701-22-019	0.2	0.30	X	0.05	283	9.36
0020 701-22-020	0.8	0.06	0.097	0.99	3774	4.03
0021 701-22-021		1.37		1.09	907	
0022 701-22-022		0.45		0.05	386	
0023 701-22-023	0.2	0.43	0.014	0.31	502	10.74
0024 701-22-024		0.44		0.03	563	
0025 701-22-025		0.11		0.02	540	
0026 701-22-026		2.46		0.10	1160	
0027 701-22-027	0.5	1.37	0.058	0.04	757	22.86
0028 701-22-028		1.23		0.06	307	
0029 701-22-029		2.64		0.05	582	
0030 701-22-030		5.33		0.06	729	
0031 701-22-031	0.9	1.28	0.025	0.07	403	17.80
0032 701-22-032	0.8	1.55	0.028	0.10	761	17.09
0033 701-22-033	0.3	2.09	0.036	0.05	920	11.40
0034 701-22-034		1.98		0.04	595	
0035 701-22-035		3.32		0.03	614	
0036 701-22-036		9.53		0.04	1025	
0037 701-22-037		4.72		0.06	1083	
0038 701-22-038		5.35		0.11	360	

ANALYSIS

0039 701-22-039	0.6	0.88	X	0.07	548	18.19
0040 701-22-040		1.32		0.65	1.77%	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0001 701-22-001	0.20	3.07	66.93	7	1.3	11.8
0002 701-22-002	0.75		65.36		12.6	
0003 701-22-003	0.68		46.42		17.3	
0004 701-22-004	0.24		69.40		11.8	
0005 701-22-005	0.12	0.79	71.18	6	4.3	26.5
0006 701-22-006	0.04		54.06		11.1	
0007 701-22-007	0.13		47.41		22.8	
0008 701-22-008	0.37	62.04	29.96	17	15.6	549.3
0009 701-22-009	0.13	0.46	55.84	84	5.2	9.1
0010 701-22-010	0.12		37.29		10.9	
0011 701-22-011	0.10		43.59		19.3	
0012 701-22-012	0.80	9.14	76.58	191	14.7	158.6
0013 701-22-013	0.05		73.50		9.6	
0014 701-22-014	0.62		71.86		21.0	
0015 701-22-015	0.08	3.29	46.46	47	21.3	350.5
0016 701-22-016	0.03		44.35		13.1	
0017 701-22-017	0.03		45.24		16.6	
0018 701-22-018	0.19	9.09	53.64	25	11.7	99.8
0019 701-22-019	0.05	1.73	61.46	32	11.4	149.3
0020 701-22-020	0.20	0.35	50.47	74	12.6	2.2
0021 701-22-021	1.37		69.35		20.7	
0022 701-22-022	0.58		66.88		15.7	
0023 701-22-023	0.78	9.15	68.05	278	16.1	97.9
0024 701-22-024	1.81		65.33		22.2	
0025 701-22-025	1.84		86.89		13.5	
0026 701-22-026	0.03		42.38		0.6	
0027 701-22-027	0.76	8.42	55.69	4	14.0	241.1
0028 701-22-028	2.05		33.21		4.9	
0029 701-22-029	0.13		27.50		12.3	
0030 701-22-030	0.04		20.58		16.1	
0031 701-22-031	0.15	7.88	24.61	22	11.3	297.5
0032 701-22-032	0.58	9.87	41.10	26	15.9	459.0
0033 701-22-033	0.48	2.88	39.13	12	11.2	119.8
0034 701-22-034	0.03		49.80		10.8	
0035 701-22-035	0.81		41.33		16.4	
0036 701-22-036	0.06		30.91		18.5	
0037 701-22-037	0.02		29.54		14.7	
0038 701-22-038	0.08		30.19		21.3	

ANALYSIS

0039 701-22-039	0.09	3.95	46.50	61	20.4	732.0
0040 701-22-040	0.07		30.53		17.3	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	No	14	X	2.55	407.4	1.77
0002 701-22-002	Yes	10		3.68	20.6	
0003 701-22-003	No	23		5.80	756.1	
0004 701-22-004	No	12		3.18	555.8	
0005 701-22-005	No	12	X	3.18	45.6	0.05
0006 701-22-006	No	14		1.90	127.9	
0007 701-22-007	No	20		0.12	817.9	
0008 701-22-008	No	26	X	0.10	634.9	17.91
0009 701-22-009	No	13	X	1.42	170.1	0.15
0010 701-22-010	No	19		0.93	383.7	
0011 701-22-011	No	26		0.19	1365.5	
0012 701-22-012	No	19	X	2.36	306.0	4.40
0013 701-22-013	No	17		1.53	922.7	
0014 701-22-014	No	18		0.12	5916.0*	
0015 701-22-015	No	17	X	0.11	815.9	15.46
0016 701-22-016	No	14		1.69	597.7	
0017 701-22-017	No	12		2.32	647.2	
0018 701-22-018	No	18	X	1.84	437.0	2.07
0019 701-22-019	No	15	X	2.13	431.5	9.94
0020 701-22-020	Yes	18	X	7.93	890.5	0.30
0021 701-22-021	Yes	17		12.62	1301.8	
0022 701-22-022	No	11		3.58	592.4	
0023 701-22-023	Yes	15	X	3.51	396.8	4.58
0024 701-22-024	No	11		5.66	668.0	
0025 701-22-025	No	20		2.43	961.2	
0026 701-22-026	No	18		1.17	273.8	
0027 701-22-027	No	20	X	1.49	36.4	0.36
0028 701-22-028	No	16		0.89	44.3	
0029 701-22-029	No	13		3.63	393.5	
0030 701-22-030	No	16		1.12	319.6	
0031 701-22-031	No	19	X	1.72	238.1	1.90
0032 701-22-032	No	39	X	3.19	419.4	3.33
0033 701-22-033	No	13	X	3.45	317.0	0.62
0034 701-22-034	No	11		2.77	291.6	
0035 701-22-035	No	67		0.42	709.3	
0036 701-22-036	No	18		1.49	271.3	
0037 701-22-037	No	17		1.56	83.1	
0038 701-22-038	No	22		1.29	440.4	

ANALYSIS

0039 701-22-039	No	26	X	1.28	114.3	2.93
0040 701-22-040	No	14		1.12	105.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0001 701-22-001	2.46	258	1.11	1.05	X	1.09
0002 701-22-002	2.51		1.53	1.02		5.11
0003 701-22-003	4.40		2.85	1.04		5.77
0004 701-22-004	5.02		2.86	1.52		4.51
0005 701-22-005	2.68	511	1.50	1.01	0.1	1.58
0006 701-22-006	4.07		2.23	1.20		3.57
0007 701-22-007	1.90		0.69	1.48		15.86
0008 701-22-008	0.95	438	0.30	0.69	0.2	4.85
0009 701-22-009	1.20	560	0.49	0.94	0.6	1.31
0010 701-22-010	0.79		0.40	0.67		2.93
0011 701-22-011	0.94		0.43	0.77		7.28
0012 701-22-012	7.70	1242	3.86	2.36	0.2	5.16
0013 701-22-013	5.67		2.90	1.59		2.24
0014 701-22-014	0.80		0.26	0.97		7.80
0015 701-22-015	0.24	466	0.09	0.63	0.2	9.39
0016 701-22-016	1.26		0.68	0.53		1.83
0017 701-22-017	1.37		0.74	0.55		2.18
0018 701-22-018	1.99	449	0.95	0.93	X	2.06
0019 701-22-019	2.26	549	1.20	0.97	X	2.62
0020 701-22-020	1.78	672	0.90	0.88	1.5	6.69
0021 701-22-021	3.11		1.77	1.32		7.17
0022 701-22-022	2.67		1.39	1.12		2.48
0023 701-22-023	2.63	1370	1.36	1.30	0.2	2.98
0024 701-22-024	3.57		2.01	1.18		3.62
0025 701-22-025	5.66		3.40	1.70		1.18
0026 701-22-026	0.98		0.52	0.80		3.74
0027 701-22-027	1.96	433	1.15	0.87	0.5	3.10
0028 701-22-028	2.06		0.84	0.66		1.04
0029 701-22-029	7.40		1.01	0.61		2.94
0030 701-22-030	1.20		0.66	0.51		7.07
0031 701-22-031	2.05	548	1.10	0.81	0.2	1.65
0032 701-22-032	1.63	644	0.96	0.67	0.2	3.78
0033 701-22-033	1.56	509	0.91	0.70	0.1	3.91
0034 701-22-034	3.02		1.10	1.12		3.32
0035 701-22-035	1.14		0.59	1.03		8.20
0036 701-22-036	1.67		0.88	0.80		7.71
0037 701-22-037	1.62		1.04	0.74		3.74
0038 701-22-038	1.60		0.87	0.71		7.42

ANALYSIS

0039 701-22-039	2.77	832	1.42	0.76	0.2	2.82
0040 701-22-040	1.26		0.63	0.80		3.53

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.05	1.4	0	15.97	3.27	1.07
0002 701-22-002		1.2	0	16.56	2.94	1.05
0003 701-22-003		1.4	0	32.57	4.02	0.90
0004 701-22-004		1.4	0	26.34	5.13	1.00
0005 701-22-005	0.19	1.5	0	19.58	3.19	1.18
0006 701-22-006		1.4	0	28.31	4.15	0.88
0007 701-22-007		1.4	0	18.92	3.73	1.83
0008 701-22-008	1.94	1.3	0	30.12	2.02	0.89
0009 701-22-009	0.07	1.3	0	24.40	2.52	1.26
0010 701-22-010		1.4	0	24.97	1.65	0.86
0011 701-22-011		1.4	0	35.11	2.01	1.33
0012 701-22-012	0.11	1.3	0	26.73	7.70	1.07
0013 701-22-013		1.4	0	19.82	5.60	1.42
0014 701-22-014		1.3	0	16.91	1.95	2.49
0015 701-22-015	2.60	1.4	0	4.40	0.98	1.23
0016 701-22-016		1.4	0	16.27	1.61	1.62
0017 701-22-017		1.4	0	16.66	1.69	1.58
0018 701-22-018	0.10	1.4	0	16.66	2.59	1.52
0019 701-22-019	0.19	1.4	0	16.33	2.73	1.37
0020 701-22-020	4.52	1.2	0	15.03	2.48	0.79
0021 701-22-021		1.2	0	19.12	4.04	1.33
0022 701-22-022		1.5	0	20.64	3.52	1.73
0023 701-22-023	0.12	1.6	0	18.90	3.49	1.51
0024 701-22-024		1.5	0	19.45	3.72	1.21
0025 701-22-025		1.5	0	17.29	5.40	1.88
0026 701-22-026		1.5	0	20.09	2.05	0.95
0027 701-22-027	0.78	1.5	0	17.82	6.71	1.12
0028 701-22-028		1.5	0	12.34	1.99	0.96
0029 701-22-029		1.5	0	18.68	1.55	1.13
0030 701-22-030		1.5	0	24.06	1.63	0.54
0031 701-22-031	0.83	1.5	0	18.02	2.77	1.57
0032 701-22-032	1.23	1.5	0	18.74	2.04	1.04
0033 701-22-033	0.64	1.4	0	23.93	2.00	0.80
0034 701-22-034		1.4	0	18.82	4.23	1.21
0035 701-22-035		1.4	0	7.40	2.52	0.68
0036 701-22-036		1.5	0	38.25	2.67	0.64
0037 701-22-037		1.5	0	31.02	2.20	0.90
0038 701-22-038		1.4	0	24.56	1.84	0.67

ANALYSIS

0039 701-22-039	0.40	1.5	0	18.94	2.73	1.02
0040 701-22-040		1.7	0	25.87	2.21	0.81

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0001 701-22-001	1.84	X	X	0.43	0.593	3.81%
0002 701-22-002	1.56	0.01		0.52	0.105	3.08%
0003 701-22-003	1.17	0.01		0.94	1.456	3.71%
0004 701-22-004	1.46	0.03		1.05	1.132	3.52%
0005 701-22-005	1.55	0.01	X	0.65	0.676	3.53%
0006 701-22-006	1.63	0.02		0.78	0.663	4.00%
0007 701-22-007	0.95	0.18		0.26	0.405	2307
0008 701-22-008	1.06	0.02	X	0.13	0.092	7904
0009 701-22-009	1.15	0.02	X	0.18	0.156	3.79%
0010 701-22-010	0.88	X		0.13	0.330	3.13%
0011 701-22-011	1.44	0.04		0.16	0.210	7861
0012 701-22-012	1.69	0.03	X	1.49	0.426	3.24%
0013 701-22-013	2.04	X		1.10	0.729	2.81%
0014 701-22-014	0.21	0.02		0.10	0.205	4843
0015 701-22-015	0.12	0.02	X	0.03	0.024	1.21%
0016 701-22-016	0.51	0.02		0.25	0.034	2.77%
0017 701-22-017	0.30	0.02		0.26	0.104	2.88%
0018 701-22-018	0.33	0.02	X	0.36	0.035	3.01%
0019 701-22-019	0.53	X	X	0.42	0.068	3.46%
0020 701-22-020	0.12	0.01	X	0.33	0.029	2.27%
0021 701-22-021	0.14	0.03		0.62	0.410	2.13%
0022 701-22-022	0.31	0.03		0.52	0.159	2.62%
0023 701-22-023	0.71	0.02	X	0.49	0.066	2.61%
0024 701-22-024	0.30	0.07		0.69	0.701	3.55%
0025 701-22-025	0.47	X		1.16	0.062	2.04%
0026 701-22-026	1.60	X		0.19	1.252	3.28%
0027 701-22-027	1.64	0.02	X	0.39	0.345	3.88%
0028 701-22-028	1.33	0.04		0.28	0.392	2.17%
0029 701-22-029	1.79	0.04		0.33	0.993	3.42%
0030 701-22-030	1.11	0.04		0.22	0.748	1.62%
0031 701-22-031	1.96	X	X	0.36	4.726	2.65%
0032 701-22-032	1.73	0.03	X	0.32	0.915	3.71%
0033 701-22-033	1.44	0.01	X	0.29	0.459	3.59%
0034 701-22-034	1.70	X		0.45	0.791	2.93%
0035 701-22-035	1.17	0.02		0.19	0.083	1.72%
0036 701-22-036	1.54	0.03		0.31	0.515	3.12%
0037 701-22-037	1.54	X		0.32	0.638	3.51%
0038 701-22-038	0.94	X		0.31	0.311	3.31%

ANALYSIS

0039 701-22-039	2.23	0.02	X	0.50	0.623	3.42%
0040 701-22-040	1.39	X		0.23	0.164	3.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	16.7	38.34	5.5	0.164	3760	6.52
0002 701-22-002		37.90	12.7	0.243	6818	
0003 701-22-003		27.29	2.2	0.406	2838	
0004 701-22-004		37.25	4.9	0.368	3051	
0005 701-22-005	22.9	38.73	13.6	0.212	7822	18.57
0006 701-22-006		27.27	2.5	0.264	2892	
0007 701-22-007		21.06	35.3	0.106	136	
0008 701-22-008	2.5	16.11	4.9	0.058	122	13.85
0009 701-22-009	18.7	30.23	2.9	0.073	2139	6.30
0010 701-22-010		20.77	4.3	0.076	1507	
0011 701-22-011		24.18	25.1	0.093	176	
0012 701-22-012	29.4	42.52	6.5	0.371	2952	23.23
0013 701-22-013		41.01	30.6	0.316	2593	
0014 701-22-014		44.80	7.2	0.037	120	
0015 701-22-015	3.4	26.40	4.7	0.014	106	10.35
0016 701-22-016		28.24	3.0	0.081	2688	
0017 701-22-017		29.07	3.1	0.090	3079	
0018 701-22-018	22.4	30.18	3.3	0.114	2684	14.24
0019 701-22-019	23.9	35.94	2.7	0.145	2937	17.24
0020 701-22-020	4.2	26.97	3.7	0.104	7768	6.55
0021 701-22-021		38.44	15.9	0.188	4270	
0022 701-22-022		35.68	29.8	0.177	3004	
0023 701-22-023	34.5	36.93	16.7	0.167	2823	25.94
0024 701-22-024		36.44	6.3	0.224	3955	
0025 701-22-025		47.58	15.8	0.453	2374	
0026 701-22-026		22.55	0.5	0.103	2199	
0027 701-22-027	26.4	31.12	2.7	0.193	3307	15.40
0028 701-22-028		16.37	2.8	0.117	1687	
0029 701-22-029		13.74	1.8	0.162	2469	
0030 701-22-030		11.08	0.7	0.129	798	
0031 701-22-031	19.6	12.65	3.2	0.178	1935	27.21
0032 701-22-032	24.8	21.45	0.5	0.186	2432	28.73
0033 701-22-033	26.8	22.01	0.5	0.154	2004	20.94
0034 701-22-034		25.29	2.7	0.173	1985	
0035 701-22-035		22.69	1.5	0.123	191	
0036 701-22-036		16.61	0.7	0.151	1338	
0037 701-22-037		14.86	0.6	0.169	1493	
0038 701-22-038		18.65	1.1	0.134	1143	

ANALYSIS

0039 701-22-039	26.8	27.25	2.1	0.208	1806	31.97
0040 701-22-040		16.28	0.9	0.126	1843	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0001 701-22-001	163	1.33		1.4	0.12	32
0002 701-22-002	9922			2.3		10
0003 701-22-003	291			2.7		174
0004 701-22-004	133			1.4		136
0005 701-22-005	1142	1.26		1.4	0.15	21
0006 701-22-006	82			1.3		99
0007 701-22-007	41			1.5		558
0008 701-22-008	27	0.50		2.5	0.29	209
0009 701-22-009	54	0.04		3.9	11.45	52
0010 701-22-010	72			2.2		114
0011 701-22-011	42			2.2		277
0012 701-22-012	51	0.09		2.2	0.07	164
0013 701-22-013	93			2.3		63
0014 701-22-014	30			181.9*		293
0015 701-22-015	30	0.37		48.8	0.08	388
0016 701-22-016	45			13.2		60
0017 701-22-017	61			8.3		62
0018 701-22-018	33	0.25		5.4	X	54
0019 701-22-019	44	0.32		3.8	X	61
0020 701-22-020	2062	0.12		2.8	7.99	16
0021 701-22-021	4514			1.3		80
0022 701-22-022	145			2.6		54
0023 701-22-023	1297	2.00		2.2	0.06	45
0024 701-22-024	65			2.4		96
0025 701-22-025	41			7.6		24
0026 701-22-026	490			1.6		23
0027 701-22-027	119	0.68		1.4	0.12	91
0028 701-22-028	93			1.4		35
0029 701-22-029	142			0.5		73
0030 701-22-030	74			2.0		236
0031 701-22-031	150	2.10		1.2	X	49
0032 701-22-032	205	2.10		2.0	X	117
0033 701-22-033	135	0.90		1.1	X	132
0034 701-22-034	200			2.7		99
0035 701-22-035	54			3.0		361
0036 701-22-036	53			1.8		272
0037 701-22-037	53			0.9		136
0038 701-22-038	127			3.9		275

ANALYSIS

0039 701-22-039	78	1.15	1.3	0.06	134
0040 701-22-040	70		3.2		125

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0001 701-22-001	1473	14.2	2	5.6	0	35
0002 701-22-002	303		0	7.5	0	-5
0003 701-22-003	295		142	2.2	127	175
0004 701-22-004	346		110	2.2	98	140
0005 701-22-005	365	49.9	11	2.9	6	15
0006 701-22-006	380		89	2.2	79	102
0007 701-22-007	589		455	2.2	424	569
0008 701-22-008	1685	30.3	147	2.2	133	215
0009 701-22-009	1196	92.7	17	2.7	12	55
0010 701-22-010	822		77	2.3	67	116
0011 701-22-011	819		201	2.2	180	284
0012 701-22-012	1437	239.6	144	2.1	133	167
0013 701-22-013	1072		41	2.4	31	66
0014 701-22-014	1129		163	2.4	136	298
0015 701-22-015	1377	43.6	281	2.2	261	396
0016 701-22-016	710		30	2.5	21	63
0017 701-22-017	575		37	2.5	27	65
0018 701-22-018	1093	39.5	28	2.5	20	57
0019 701-22-019	1139	42.9	43	2.4	33	64
0020 701-22-020	1.24%	132.4	0	6.7	0	-1
0021 701-22-021	1196		36	3.2	7	67
0022 701-22-022	1472		38	2.4	29	50
0023 701-22-023	1551	243.8	24	2.7	11	40
0024 701-22-024	1859		72	2.3	63	91
0025 701-22-025	1255		7	3.2	3	20
0026 701-22-026	624		0	6.5	0	19
0027 701-22-027	655	12.9	79	2.2	68	87
0028 701-22-028	205		25	2.5	17	31
0029 701-22-029	449		61	2.3	49	69
0030 701-22-030	382		205	2.2	190	235
0031 701-22-031	310	31.5	29	2.5	21	45
0032 701-22-032	439	37.3	92	2.2	82	115
0033 701-22-033	638	36.0	104	2.2	93	129
0034 701-22-034	545		82	2.2	70	94
0035 701-22-035	1580		242	2.3	223	363
0036 701-22-036	741		224	2.2	208	270
0037 701-22-037	902		101	2.3	90	134
0038 701-22-038	969		217	2.2	200	274

ANALYSIS

0039 701-22-039	561	85.6	72	2.4	60	133
0040 701-22-040	894		46	2.6	38	84

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	4.32	23.55	22.9	X	651	X
0002 701-22-002	3.55	23.19	11.4		608	
0003 701-22-003	2.64	19.96	12.4		668	
0004 701-22-004	3.25	28.11	6.0		869	
0005 701-22-005	4.08	26.68	3.9	0.02	130	X
0006 701-22-006	3.32	20.77	7.0		620	
0007 701-22-007	1.92	24.15	31.4		922	
0008 701-22-008	1.65	12.05	16.0	0.14	703	0.3
0009 701-22-009	1.98	21.48	3.8	X	533	X
0010 701-22-010	1.69	13.61	7.3		374	
0011 701-22-011	2.21	16.51	21.7		537	
0012 701-22-012	4.29	31.86	9.5	0.07	676	X
0013 701-22-013	4.37	28.72	3.9		466	
0014 701-22-014	0.80	20.70	10.5		518	
0015 701-22-015	0.68	16.80	10.7	0.13	531	0.3
0016 701-22-016	1.58	13.49	7.2		589	
0017 701-22-017	1.49	13.70	6.4		421	
0018 701-22-018	1.29	20.22	8.1	0.06	427	X
0019 701-22-019	1.61	21.37	6.6	0.11	376	0.2
0020 701-22-020	2.89	19.67	11.2	X	502	0.4
0021 701-22-021	2.64	28.43	11.0		753	
0022 701-22-022	2.46	26.12	7.2		191	
0023 701-22-023	3.82	26.60	6.5	0.05	284	X
0024 701-22-024	2.74	24.76	14.2		416	
0025 701-22-025	3.57	34.32	6.6		880	
0026 701-22-026	1.65	15.83	1.1		624	
0027 701-22-027	2.99	20.53	9.5	0.16	441	X
0028 701-22-028	2.41	11.41	7.3		143	
0029 701-22-029	1.55	10.73	7.7		379	
0030 701-22-030	1.18	8.12	12.5		480	
0031 701-22-031	3.20	10.43	13.4	0.13	323	X
0032 701-22-032	2.79	15.01	17.9	0.20	477	X
0033 701-22-033	2.22	14.34	6.7	0.04	651	X
0034 701-22-034	2.30	19.10	7.8		733	
0035 701-22-035	1.59	17.59	31.1		454	
0036 701-22-036	3.33	12.85	10.2		708	
0037 701-22-037	2.61	11.65	7.6		671	
0038 701-22-038	1.47	10.84	13.1		394	

ANALYSIS

0039 701-22-039	3.97	15.93	11.3	0.22	466	X
0040 701-22-040	1.97	13.41	12.3		619	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	324.0	1.8	4.9		6.654	162.63
0002 701-22-002	51.9		7.1	2.9	6.650	135.10
0003 701-22-003	30.9		4.3		4.971	140.10
0004 701-22-004	167.9		3.8		7.626	138.60
0005 701-22-005	9.9	1.8	5.2		7.392	151.77
0006 701-22-006	82.5		4.4		5.487	158.52
0007 701-22-007	415.5		3.5		5.695	2.99
0008 701-22-008	205.7	3.1	4.4		3.209	3.14
0009 701-22-009	124.5	0.6	6.6		5.763	125.49
0010 701-22-010	103.3		5.1		3.690	90.37
0011 701-22-011	106.8		4.8		4.500	8.25
0012 701-22-012	59.3	1.2	5.0		8.209	113.56
0013 701-22-013	10.4		6.6		7.722	114.42
0014 701-22-014	54.1		5.5		7.096	3.08
0015 701-22-015	51.4	X	4.3		4.877	3.25
0016 701-22-016	15.8		4.6		4.047	79.18
0017 701-22-017	35.0		4.5		4.173	95.57
0018 701-22-018	18.4	0.5	4.6		5.561	91.47
0019 701-22-019	25.2	0.6	4.4		6.217	105.60
0020 701-22-020	14.2	4.2	8.5	2.8	5.319	83.44
0021 701-22-021	157.3		5.9	2.8	7.478	95.49
0022 701-22-022	86.0		5.6		7.140	102.63
0023 701-22-023	54.3	0.5	6.1	3.2	7.285	99.00
0024 701-22-024	418.0		5.1		6.736	135.89
0025 701-22-025	17.0		6.3		9.189	70.98
0026 701-22-026	68.7		6.2		4.422	114.14
0027 701-22-027	126.9	0.9	4.7		5.807	149.69
0028 701-22-028	16.4		4.9		3.210	88.98
0029 701-22-029	65.7		4.0		2.917	132.80
0030 701-22-030	176.9		4.3		2.141	51.65
0031 701-22-031	15.4	0.6	4.4		2.718	98.69
0032 701-22-032	51.9	1.7	4.1		3.994	148.26
0033 701-22-033	77.0	1.0	4.5		3.857	131.58
0034 701-22-034	20.0		4.6		5.221	113.43
0035 701-22-035	90.6		4.7		4.524	11.44
0036 701-22-036	100.2		4.0		3.335	95.48
0037 701-22-037	63.0		4.3		3.088	113.03
0038 701-22-038	33.0		4.8		3.067	98.89

ANALYSIS

0039 701-22-039	64.4	X	4.4	4.708	85.31
0040 701-22-040	96.2		8.0	3.311	97.98

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0001 701-22-001	X	1.04	9974	25.1	X	0.37
0002 701-22-002	X	0.32	2913		0.21	0.03
0003 701-22-003	0.007	5.67	5.70%		4.56	0.21
0004 701-22-004	X	4.43	4.22%		3.57	0.17
0005 701-22-005	X	0.67	5889	61.2	0.47	0.04
0006 701-22-006	X	3.23	3.25%		2.83	0.09
0007 701-22-007	0.003	18.24	16.96%		11.73	0.58
0008 701-22-008	0.008	6.83	6.65%	56.1	4.20	0.54
0009 701-22-009	0.022	1.69	1.71%	34.2	0.58	0.27
0010 701-22-010	0.002	3.71	3.71%		2.13	0.40
0011 701-22-011	X	9.05	8.63%		5.11	0.61
0012 701-22-012	X	5.35	5.19%	116.6	4.27	0.15
0013 701-22-013	X	2.06	2.23%		1.53	0.19
0014 701-22-014	0.055	9.56	9.05%		6.82	0.42
0015 701-22-015	0.079	12.68	11.74%	45.6	7.85	0.85
0016 701-22-016	0.107	1.96	2.05%		1.12	0.20
0017 701-22-017	0.070	2.01	2.18%		1.35	0.21
0018 701-22-018	0.049	1.76	1.85%	48.9	1.09	0.21
0019 701-22-019	0.030	1.99	2.22%	58.5	1.55	0.15
0020 701-22-020	0.010	0.52	4699	28.4	0.36	0.05
0021 701-22-021	0.009	2.62	2.54%		2.19	0.12
0022 701-22-022	0.010	1.78	1.84%		1.62	0.09
0023 701-22-023	0.016	1.47	1.42%	91.0	1.23	0.09
0024 701-22-024	0.022	3.13	3.19%		2.51	0.13
0025 701-22-025	0.037	0.79	6956		0.56	0.04
0026 701-22-026	X	0.74	6448		X	0.20
0027 701-22-027	0.007	2.98	2.96%	57.5	2.32	0.13
0028 701-22-028	X	1.14	6858		0.41	0.04
0029 701-22-029	X	2.40	2.68%		2.08	0.12
0030 701-22-030	0.002	7.71	7.22%		5.54	0.33
0031 701-22-031	X	1.59	1.63%	71.7	1.06	0.16
0032 701-22-032	0.004	3.82	3.79%	83.8	2.70	0.18
0033 701-22-033	X	4.30	4.03%	65.1	3.27	0.20
0034 701-22-034	X	3.22	3.27%		2.53	0.16
0035 701-22-035	0.006	11.79	10.70%		7.15	0.97
0036 701-22-036	X	8.89	8.36%		6.58	0.49
0037 701-22-037	X	4.46	4.06%		2.97	0.33
0038 701-22-038	0.005	9.00	8.46%		6.25	0.50

ANALYSIS

0039 701-22-039	X	4.38	4.34%	99.5	2.18	0.61
0040 701-22-040	X	4.07	3.86%		2.75	0.35

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.36	X	9.6	0.9	0.8	0.47
0002 701-22-002	0.37		7.5	X		0.02
0003 701-22-003	0.69		17.0	2.5		1.78
0004 701-22-004	0.52		11.0	2.2		1.85
0005 701-22-005	0.29	0.04	8.0	0.5	11.2	0.21
0006 701-22-006	0.32		11.8	1.9		1.60
0007 701-22-007	3.98		9.9	4.5		4.07
0008 701-22-008	1.10	0.70	13.6	2.1	2.6	1.43
0009 701-22-009	0.60	4.79	15.5	0.8	1.5	0.64
0010 701-22-010	0.47		12.9	1.6		1.15
0011 701-22-011	0.81		12.8	4.2		4.15
0012 701-22-012	0.68	0.24	14.4	6.6	22.0	5.99
0013 701-22-013	0.42		14.7	1.2		0.57
0014 701-22-014	2.03		8.2	6.0		5.43
0015 701-22-015	1.75	0.32	4.6	6.0	1.5	4.95
0016 701-22-016	0.60		12.8	2.4		1.87
0017 701-22-017	0.47		11.6	3.2		2.00
0018 701-22-018	0.40	0.11	13.6	1.4	6.9	1.00
0019 701-22-019	0.56	0.54	11.4	1.7	5.0	1.38
0020 701-22-020	0.05	0.21	10.7	0.8	3.0	0.54
0021 701-22-021	0.56		16.5	1.0		0.91
0022 701-22-022	0.26		11.9	1.4		0.94
0023 701-22-023	0.25	0.04	13.0	1.4	3.5	1.15
0024 701-22-024	0.62		11.9	1.7		1.66
0025 701-22-025	0.39		11.8	0.9		0.89
0026 701-22-026	1.46		10.1	1.9		1.73
0027 701-22-027	0.44	0.58	12.3	1.0	3.6	0.76
0028 701-22-028	0.46		6.7	X		0.22
0029 701-22-029	0.58		10.3	X		0.38
0030 701-22-030	0.67		8.7	1.8		1.65
0031 701-22-031	0.71	0.14	10.6	X	1.6	0.10
0032 701-22-032	1.76	0.19	11.8	0.9	2.1	X
0033 701-22-033	0.56	0.12	11.0	0.9	1.4	X
0034 701-22-034	0.49		8.7	0.9		0.64
0035 701-22-035	2.49		9.6	2.4		1.55
0036 701-22-036	0.85		13.8	2.4		1.96
0037 701-22-037	0.63		14.3	0.7		0.60
0038 701-22-038	0.45		14.8	2.5		1.99

ANALYSIS

0039 701-22-039	0.46	0.19	20.7	0.8	5.2	0.51
0040 701-22-040	0.39		11.4	1.3		1.12

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	3.93	0.7	X	76.31	10.72	0.39
0002 701-22-002	3.79	0.5		13.09		0.36
0003 701-22-003	3.93	3.4		49.34		0.22
0004 701-22-004	5.48	3.2		278.89		0.30
0005 701-22-005	4.42	0.7	X	16.33	15.41	0.40
0006 701-22-006	4.09	0.9		175.07		0.30
0007 701-22-007	5.66	4.5		1065.68		0.17
0008 701-22-008	2.50	2.0	5.7	352.60	72.26	0.14
0009 701-22-009	3.70	1.6	X	203.56	6.20	0.17
0010 701-22-010	2.52	0.6		94.52		0.14
0011 701-22-011	2.94	2.2		313.24		0.19
0012 701-22-012	7.39	1.9	X	414.61	20.44	0.36
0013 701-22-013	5.53	0.7		23.98		0.35
0014 701-22-014	3.18	6.5		421.95		0.07
0015 701-22-015	2.62	13.3	X	553.05	147.55	0.07
0016 701-22-016	2.27	0.9		155.70		0.14
0017 701-22-017	2.29	0.8		91.60		0.14
0018 701-22-018	3.57	1.2	X	95.69	17.73	0.11
0019 701-22-019	3.57	1.7	X	87.22	17.13	0.13
0020 701-22-020	3.48	0.6	X	178.14	10.48	0.21
0021 701-22-021	5.30	0.7		285.42		0.19
0022 701-22-022	4.65	1.5		62.43		0.20
0023 701-22-023	4.77	0.8	X	128.74	20.83	0.31
0024 701-22-024	4.46	0.9		176.09		0.22
0025 701-22-025	6.46	0.7		343.12		0.33
0026 701-22-026	3.14	0.8		64.55		0.16
0027 701-22-027	3.48	1.1	X	84.11	68.58	0.25
0028 701-22-028	2.20	0.6		31.38		0.20
0029 701-22-029	2.13	0.8		112.54		0.13
0030 701-22-030	1.84	1.7		110.90		0.10
0031 701-22-031	2.52	0.6	X	115.73	11.21	0.27
0032 701-22-032	2.67	1.1	X	149.70	12.15	0.21
0033 701-22-033	2.40	1.1	X	93.73	9.51	0.19
0034 701-22-034	3.70	0.7		287.25		0.19
0035 701-22-035	3.70	10.1		452.33		0.12
0036 701-22-036	2.99	4.6		230.14		0.24
0037 701-22-037	3.31	1.3		130.84		0.18
0038 701-22-038	2.01	3.0		194.63		0.12

ANALYSIS

0039 701-22-039	2.96	0.6	X	214.29	13.06	0.32
0040 701-22-040	2.74	1.2		240.09		0.20

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0001 701-22-001	0.459	160	0.07	20.90	0.081	2244
0002 701-22-002	0.421		X	23.46		1619
0003 701-22-003	0.671		0.74	13.37		1927
0004 701-22-004	0.797		1.92	17.36		1558
0005 701-22-005	0.436	401	0.34	19.27	0.212	2020
0006 701-22-006	0.633		1.08	18.07		1733
0007 701-22-007	0.439		1.63	12.23		1101
0008 701-22-008	0.230	362	1.09	11.13	0.410	1455
0009 701-22-009	0.273	389	0.42	15.23	0.248	1959
0010 701-22-010	0.187		0.74	14.03		1082
0011 701-22-011	0.219		2.71	14.72		1512
0012 701-22-012	1.228	947	3.35	24.11	0.065	2512
0013 701-22-013	0.918		0.57	22.73		2970
0014 701-22-014	0.213		1.21	11.20		546
0015 701-22-015	0.078	420	0.35	10.71	0.068	457
0016 701-22-016	0.218		X	16.56		1369
0017 701-22-017	0.226		0.06	15.08		1347
0018 701-22-018	0.353	382	0.07	14.73	0.041	1143
0019 701-22-019	0.387	350	0.06	16.01	0.143	1071
0020 701-22-020	0.326	488	0.08	15.06	1.213	1931
0021 701-22-021	0.563		0.72	13.58		2525
0022 701-22-022	0.455		0.16	19.33		2055
0023 701-22-023	0.455	1016	0.24	20.86	0.337	2824
0024 701-22-024	0.543		0.35	19.53		2323
0025 701-22-025	0.861		0.07	23.19		2539
0026 701-22-026	0.207		0.96	12.82		1068
0027 701-22-027	0.338	265	0.42	18.66	0.136	1893
0028 701-22-028	0.311		0.24	13.79		1585
0029 701-22-029	0.312		0.72	11.79		929
0030 701-22-030	0.230		0.60	11.91		664
0031 701-22-031	0.377	440	0.15	14.40	0.248	2070
0032 701-22-032	0.275	439	0.51	14.09	0.188	1307
0033 701-22-033	0.274	340	0.64	13.13	0.294	1204
0034 701-22-034	0.621		0.69	14.62		1238
0035 701-22-035	0.249		0.33	16.01		664
0036 701-22-036	0.336		0.81	12.13		1669
0037 701-22-037	0.301		1.32	11.99		1330
0038 701-22-038	0.266		0.29	8.68		826

ANALYSIS

0039 701-22-039	0.450	625	0.66	20.14	0.152	2866
0040 701-22-040	0.276		0.82	11.97		919

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	1.85	0.16	3.61	0.184	84	X
0002 701-22-002	1.60	0.24	4.58		81	
0003 701-22-003	1.73	0.43	6.56		124	
0004 701-22-004	1.78	0.40	5.48		107	
0005 701-22-005	1.93	0.20	4.34	2.174	87	X
0006 701-22-006	2.22	0.31	5.16		105	
0007 701-22-007	9.44	0.10	7.02		90	
0008 701-22-008	0.14	0.04	3.52	22.026	135	X
0009 701-22-009	1.61	0.09	3.50	1.131	134	X
0010 701-22-010	1.12	0.06	3.27		96	
0011 701-22-011	0.15	0.07	5.89		114	
0012 701-22-012	1.21	0.53	6.68	13.273	91	X
0013 701-22-013	1.54	0.41	4.90		104	
0014 701-22-014	0.70	0.03	3.25		88	
0015 701-22-015	0.08	0.01	0.65	14.649	88	X
0016 701-22-016	0.84	0.09	2.01		119	
0017 701-22-017	1.20	0.12	1.92		99	
0018 701-22-018	1.12	0.13	3.27	34.096	104	X
0019 701-22-019	1.22	0.16	3.57	53.465	101	X
0020 701-22-020	0.74	0.12	1.29	0.521	95	0.08
0021 701-22-021	1.20	0.23	1.59		143	
0022 701-22-022	1.11	0.19	2.88		115	
0023 701-22-023	1.20	0.20	2.96	0.260	121	X
0024 701-22-024	1.75	0.28	3.08		117	
0025 701-22-025	0.78	0.48	2.91		116	
0026 701-22-026	1.44	0.09	3.16		93	
0027 701-22-027	1.86	0.17	4.17	5.165	106	X
0028 701-22-028	1.13	0.11	3.09		71	
0029 701-22-029	1.59	0.16	3.30		85	
0030 701-22-030	0.70	0.11	3.82		76	
0031 701-22-031	1.27	0.17	4.20	24.531	90	X
0032 701-22-032	2.16	0.16	4.66	59.662	89	X
0033 701-22-033	1.79	0.14	4.71	39.155	84	X
0034 701-22-034	1.58	0.15	3.54		80	
0035 701-22-035	0.21	0.11	4.19		84	
0036 701-22-036	1.24	0.14	6.44		94	
0037 701-22-037	1.34	0.16	5.19		104	
0038 701-22-038	1.05	0.13	3.52		97	

ANALYSIS

0039 701-22-039	1.14	0.21	6.27	26.375	128	X
0040 701-22-040	1.25	0.10	5.33		84	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0001 701-22-001	2.6	9.31	1.12	62	0.31	54.3
0002 701-22-002	1.8	14.15	1.54	542		48.3
0003 701-22-003	1.6	25.17	2.94	425		38.2
0004 701-22-004	2.3	25.63	2.58	50		44.4
0005 701-22-005	2.6	14.50	1.42	158	0.68	48.4
0006 701-22-006	2.6	20.27	1.88	39		52.7
0007 701-22-007	5.3	4.89	0.69	19		33.1
0008 701-22-008	2.5	2.63	0.32	11	0.89	19.0
0009 701-22-009	2.5	3.70	0.50	17	0.02	33.6
0010 701-22-010	1.8	3.15	0.49	13		26.1
0011 701-22-011	5.5	3.51	0.54	8		42.4
0012 701-22-012	2.5	37.37	2.85	162	0.80	50.5
0013 701-22-013	2.5	27.21	2.28	24		64.7
0014 701-22-014	5.7	2.14	0.23	23		6.0
0015 701-22-015	5.1	0.80	0.08	9	0.45	3.6
0016 701-22-016	1.4	6.55	0.69	19		18.9
0017 701-22-017	1.5	7.25	0.67	31		10.9
0018 701-22-018	1.9	9.06	0.79	46	1.82	9.4
0019 701-22-019	2.7	11.91	1.09	27	1.78	9.6
0020 701-22-020	0.5	8.38	0.77	1071	0.66	7.8
0021 701-22-021	0.8	16.91	1.44	592		4.6
0022 701-22-022	2.4	13.00	1.24	95		16.6
0023 701-22-023	2.1	13.20	1.10	298	2.76	27.2
0024 701-22-024	1.6	20.37	1.55	519		14.5
0025 701-22-025	2.3	31.06	3.69	185		23.9
0026 701-22-026	0.6	4.47	1.18	34		48.5
0027 701-22-027	1.1	10.21	1.41	243	1.63	53.6
0028 701-22-028	0.6	6.32	0.79	448		39.3
0029 701-22-029	1.6	8.81	1.00	42		57.0
0030 701-22-030	1.1	5.57	0.80	19		35.9
0031 701-22-031	1.1	8.68	1.14	36	1.99	64.4
0032 701-22-032	1.1	11.61	1.12	219	2.84	55.4
0033 701-22-033	1.1	7.74	1.23	251	0.93	50.7
0034 701-22-034	0.8	9.39	1.05	25		52.8
0035 701-22-035	1.4	4.89	0.83	59		38.4
0036 701-22-036	2.4	7.78	1.02	21		46.5
0037 701-22-037	1.8	8.16	1.04	16		51.0
0038 701-22-038	1.4	7.60	0.88	30		28.4

ANALYSIS

0039 701-22-039	1.4	12.60	1.47	32	0.61	67.7
0040 701-22-040	2.0	5.11	0.76	141		45.7

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0041 701-22-041	0.16	0.02	8.14%	0.08	1	7.8
0042 701-22-042	0.13		7.02%		0	18.3
0043 701-22-043	0.06		9.50%		2	2.5
0044 701-22-044	0.07	0.05	9.92%	0.34	1	1.9
0045 701-22-045	0.58		5.65%		0	21.3
0046 701-22-046	1.64	0.01	7.41%	0.08	31	36.3
0047 701-22-047	0.12		7.77%		99	4.5
0048 701-22-048	0.26		8.20%		57	12.2
0049 701-22-049	1.11	0.03	8.80%	0.13	5	24.8
0050 701-22-050	2.33		8.15%		1	46.6
0051 701-22-051	0.53		7.48%		100	12.1
0052 701-22-052	0.12	0.07	7.54%	0.45	134	3.8
0053 701-22-053	1.19		7.94%		32	5.8
0054 701-22-054	1.45		7.73%		4	44.6
0055 701-22-055	0.18	0.09	8.49%	0.11	13	6.2
0056 701-22-056	0.17		8.24%		3	4.0
0057 701-22-057	0.21		10.29%		1	39.7
0058 701-22-058	0.15		10.96%		4	4.8
0059 701-22-059	0.36	X	8.65%	0.21	11	5.7
0060 701-22-060	0.70	0.12	8.74%	0.39	6	15.9
0061 701-22-061	0.58		7.57%		2	6.7
0062 701-22-062	0.06		8.86%		3	10.2
0063 701-22-063	0.82		6.95%		1	86.5
0064 701-22-064	0.46	0.01	8.05%	2.81	-1	21.9
0065 701-22-065	0.38		7.36%		0	14.3
0066 701-22-066	0.10		11.67%*		4	4.7
0067 701-22-067	1.29	0.03	7.22%	17.83	3	24.6
0068 701-22-068	2.37		8.15%		3	29.7
0069 701-22-069	0.79		7.94%		5	18.7
0070 701-22-070	0.93		7.95%		6	13.4
0071 701-22-071	0.06	0.03	8.18%	3.24	93	2.2
0072 701-22-072	0.17	0.08	7.82%	1.38	125	4.6
0073 701-22-073	0.17		7.81%		104	14.8
0074 701-22-074	1.94		7.70%		18	108.0
0075 701-22-075	2.72		6.58%		6	78.6
0076 701-22-076	1.25		8.01%		-1	249.6
0077 701-22-077	0.22		10.47%		4	7.7
0078 701-22-078	1.03		8.31%		5	132.5

ANALYSIS

0079 701-22-079	1.42	7.75%	5	40.1
0080 701-22-080	0.52	8.57%	5	16.5

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	X	0.18	326.8	4.51	0.28
0042 701-22-042		X		287.8		0.21
0043 701-22-043		X		591.7		0.89
0044 701-22-044	2.7	X	0.12	441.8	5.99	0.61
0045 701-22-045		X		192.8		0.25
0046 701-22-046	1.6	13	0.28	584.9	18.96	2.12
0047 701-22-047		12		245.6		1.48
0048 701-22-048		17		112.3		2.07
0049 701-22-049	2.4	X	0.25	226.4	14.50	1.79
0050 701-22-050		X		275.3		0.25
0051 701-22-051		12		1024.8		1.28
0052 701-22-052	3.9	X	0.04	856.6	60.96	1.14
0053 701-22-053		11		378.5		1.25
0054 701-22-054		X		363.2		2.51
0055 701-22-055	1.9	X	0.04	581.1	30.01	1.81
0056 701-22-056		X		540.3		0.78
0057 701-22-057		X		1364.1		0.90
0058 701-22-058		X		1041.3		1.36
0059 701-22-059	1.4	X	0.07	282.2	7.50	1.54
0060 701-22-060	2.2	X	0.05	652.6	14.78	1.70
0061 701-22-061		X		398.8		0.74
0062 701-22-062		X		252.3		0.84
0063 701-22-063		X		204.5		0.30
0064 701-22-064	1.0	X	0.03	249.2	0.46	0.20
0065 701-22-065		X		418.2		0.09
0066 701-22-066		X		367.7		2.05
0067 701-22-067	7.7	X	0.04	213.0	20.46	0.99
0068 701-22-068		X		421.5		1.06
0069 701-22-069		X		382.4		1.31
0070 701-22-070		X		367.1		1.28
0071 701-22-071	5.6	14	0.04	588.2	227.06	1.22
0072 701-22-072	4.9	17	0.02	1384.9	71.60	1.21
0073 701-22-073		15		176.6		1.38
0074 701-22-074		X		246.5		2.45
0075 701-22-075		X		380.9		1.32
0076 701-22-076		X		220.3		2.15
0077 701-22-077		X		115.0		1.73
0078 701-22-078		X		427.9		0.86

ANALYSIS

0079 701-22-079	X	316.0	0.64
0080 701-22-080	X	432.8	0.30

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	X	1.60	X	0.03	803	19.38
0042 701-22-042		1.02		0.03	552	
0043 701-22-043		0.47		0.04	300	
0044 701-22-044	0.2	0.91	X	0.06	396	25.48
0045 701-22-045		2.97		0.04	339	
0046 701-22-046	X	0.75	X	0.83	2409	25.78
0047 701-22-047		0.06		1.37	2.30%	
0048 701-22-048		0.05		0.69	2139	
0049 701-22-049	2.9	1.44	0.016	0.05	1118	10.46
0050 701-22-050		2.45		0.16	727	
0051 701-22-051		1.24		1.57	2.79%	
0052 701-22-052	X	0.11	X	2.06	2.95%	6.85
0053 701-22-053		2.19		1.05	2929	
0054 701-22-054		1.95		0.04	1131	
0055 701-22-055	X	0.20	X	0.41	2575	9.18
0056 701-22-056		0.70		0.03	205	
0057 701-22-057		0.42		0.03	287	
0058 701-22-058		0.42		0.04	338	
0059 701-22-059	0.1	0.13	X	0.65	1201	9.39
0060 701-22-060	1.7	1.55	0.013	0.05	919	8.99
0061 701-22-061		3.45		0.04	778	
0062 701-22-062		1.62		0.04	674	
0063 701-22-063		3.07		0.03	803	
0064 701-22-064	0.2	2.21	0.005	0.02	900	10.44
0065 701-22-065		1.86		0.02	819	
0066 701-22-066		0.13		0.02	317	
0067 701-22-067	2.0	2.28	0.020	0.04	182	11.02
0068 701-22-068		4.24		0.05	397	
0069 701-22-069		1.68		0.08	440	
0070 701-22-070		1.04		0.05	262	
0071 701-22-071	0.8	0.13	0.057	1.09	3.62%	8.83
0072 701-22-072	0.2	0.28	0.007	1.53	3.70%	8.40
0073 701-22-073		0.11		1.72	2.57%	
0074 701-22-074		1.79		0.71	4535	
0075 701-22-075		2.03		0.05	1492	
0076 701-22-076		0.55		0.05	780	
0077 701-22-077		0.18		0.04	586	
0078 701-22-078		2.78		0.03	1070	

ANALYSIS

0079 701-22-079	5.67	0.04	664
0080 701-22-080	0.96	0.04	713

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0041 701-22-041	0.15	3.98	45.92	56	13.1	285.9
0042 701-22-042	0.48		45.29		14.0	
0043 701-22-043	0.05		23.35		3.7	
0044 701-22-044	0.24	29.01	22.11	286	19.4	1438.7
0045 701-22-045	0.05		36.22		13.0	
0046 701-22-046	7.73	43.13	51.06	73	23.1	22.6
0047 701-22-047	0.29		52.53		9.7	
0048 701-22-048	4.94		53.42		10.4	
0049 701-22-049	0.16	1.39	36.48	99	11.6	33.0
0050 701-22-050	0.16		40.53		18.3	
0051 701-22-051	1.94		55.18		11.6	
0052 701-22-052	0.17	X	71.00	23	9.4	0.6
0053 701-22-053	4.32		68.75		12.4	
0054 701-22-054	1.58		66.32		17.0	
0055 701-22-055	0.07	0.03	71.61	236	9.8	2.0
0056 701-22-056	0.04		58.01		8.6	
0057 701-22-057	1.04		86.79		61.4*	
0058 701-22-058	0.32		90.64		24.1	
0059 701-22-059	5.53	5.84	70.24	97	10.0	28.9
0060 701-22-060	2.75	5.99	81.64	175	12.8	89.2
0061 701-22-061	0.04		49.15		0.6	
0062 701-22-062	0.02		55.75		3.5	
0063 701-22-063	0.05		44.72		15.2	
0064 701-22-064	0.05	5.37	42.44	33	9.7	115.2
0065 701-22-065	0.04		26.44		12.3	
0066 701-22-066	10.19*		54.15		9.2	
0067 701-22-067	3.21	268.89	69.50	17	11.5	696.4
0068 701-22-068	1.36		55.01		17.9	
0069 701-22-069	6.07		58.11		16.0	
0070 701-22-070	1.87		47.78		12.4	
0071 701-22-071	0.16	0.10	65.85	27	8.8	1.0
0072 701-22-072	0.36	X	71.01	115	10.7	1.6
0073 701-22-073	0.65		53.61		9.0	
0074 701-22-074	9.84		59.50		13.1	
0075 701-22-075	0.39		58.90		4.6	
0076 701-22-076	0.20		66.08		56.9	
0077 701-22-077	4.65		51.71		8.4	
0078 701-22-078	0.14		62.18		14.1	

ANALYSIS

0079 701-22-079	0.37	57.02	16.4
0080 701-22-080	0.15	20.95	11.5

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	No	16	X	0.38	59.2	0.05
0042 701-22-042	No	10		0.34	65.8	
0043 701-22-043	No	21		0.79	448.0	
0044 701-22-044	No	23	X	0.29	102.9	1.11
0045 701-22-045	No	27		0.19	666.2	
0046 701-22-046	Yes	11	0.03	3.00	191.3	0.05
0047 701-22-047	No	11		3.16	10.9	
0048 701-22-048	Yes	19		5.40	15.0	
0049 701-22-049	No	16	X	5.49	300.6	2.38
0050 701-22-050	No	56		0.27	612.9	
0051 701-22-051	No	8		1.94	121.7	
0052 701-22-052	No	12	X	1.83	18.8	X
0053 701-22-053	No	9		1.78	215.1	
0054 701-22-054	No	26		4.84	325.5	
0055 701-22-055	Yes	11	X	2.04	11.0	X
0056 701-22-056	No	8		2.60	165.8	
0057 701-22-057	No	12		2.85	45.3	
0058 701-22-058	No	19		2.58	31.7	
0059 701-22-059	No	10	X	7.26	17.4	0.01
0060 701-22-060	No	12	X	11.86	87.9	0.83
0061 701-22-061	No	13		0.84	160.8	
0062 701-22-062	No	13		1.05	87.4	
0063 701-22-063	No	40		0.18	1982.7	
0064 701-22-064	No	30	X	0.08	562.5	9.60
0065 701-22-065	No	18		0.06	456.4	
0066 701-22-066	No	28		3.11	55.0	
0067 701-22-067	No	41	X	6.08	584.7	14.94
0068 701-22-068	No	45		5.74	410.8	
0069 701-22-069	No	83		10.97	147.7	
0070 701-22-070	No	49		7.08	181.2	
0071 701-22-071	No	9	X	1.69	19.9	0.02
0072 701-22-072	No	12	X	2.26	67.0	0.01
0073 701-22-073	Yes	12		3.11	21.2	
0074 701-22-074	No	13		8.62	322.1	
0075 701-22-075	No	19		5.72	1075.6	
0076 701-22-076	No	267*		7.17	230.3	
0077 701-22-077	No	39		2.15	101.4	
0078 701-22-078	No	35		3.36	307.1	

ANALYSIS

0079 701-22-079	No	85	4.54	471.0
0080 701-22-080	No	16	1.19	76.2

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0041 701-22-041	0.97	497	0.40	0.78	X	5.38
0042 701-22-042	0.69		0.23	0.69		4.83
0043 701-22-043	1.30		0.84	0.41		0.75
0044 701-22-044	1.52	1179	0.92	0.35	0.2	0.71
0045 701-22-045	0.88		0.42	0.58		6.73
0046 701-22-046	1.67	1000	1.23	0.83	0.4	5.57
0047 701-22-047	2.03		1.22	0.83		2.75
0048 701-22-048	1.47		0.99	0.77		3.84
0049 701-22-049	2.79	905	1.68	0.97	0.1	4.86
0050 701-22-050	1.30		0.74	0.97		9.07
0051 701-22-051	2.05		1.23	0.92		3.87
0052 701-22-052	2.49	344	1.43	1.12	0.6	2.85
0053 701-22-053	2.45		1.41	1.30		5.20
0054 701-22-054	3.64		2.47	1.10		6.41
0055 701-22-055	2.75	1169	1.60	1.15	0.4	3.40
0056 701-22-056	1.32		0.84	0.52		1.99
0057 701-22-057	3.80		2.60	1.35		3.04
0058 701-22-058	3.15		1.96	1.72		1.67
0059 701-22-059	2.08	874	1.36	0.98	0.3	3.82
0060 701-22-060	2.99	1022	1.94	1.34	0.2	3.40
0061 701-22-061	0.96		0.54	0.69		3.26
0062 701-22-062	1.16		0.52	0.90		2.38
0063 701-22-063	1.07		0.52	0.78		7.60
0064 701-22-064	0.78	335	0.40	0.76	X	4.43
0065 701-22-065	0.48		0.19	0.55		6.53
0066 701-22-066	1.77		1.04	0.80		1.15
0067 701-22-067	1.68	598	1.01	0.76	X	3.27
0068 701-22-068	1.64		0.93	0.77		5.22
0069 701-22-069	1.84		0.98	0.85		2.68
0070 701-22-070	1.38		1.05	0.62		2.64
0071 701-22-071	2.31	499	1.39	1.05	0.1	2.76
0072 701-22-072	2.32	925	1.36	1.07	0.4	2.98
0073 701-22-073	2.15		1.26	0.97		3.06
0074 701-22-074	1.70		1.02	0.92		5.43
0075 701-22-075	3.45		2.23	1.05		3.56
0076 701-22-076	4.59		1.84	1.61		13.94
0077 701-22-077	2.80		1.49	1.01		1.71
0078 701-22-078	2.68		1.42	1.18		4.07

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0079 701-22-079	2.31	1.35	1.07	3.69
0080 701-22-080	0.87	0.44	0.59	3.67

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.06	1.4	0	12.29	2.27	0.78
0042 701-22-042		1.5	0	8.91	1.59	0.59
0043 701-22-043		1.5	0	17.10	1.37	1.07
0044 701-22-044	0.09	1.4	0	17.18	1.28	0.97
0045 701-22-045		1.5	0	8.08	1.77	0.87
0046 701-22-046	X	1.1	0	19.07	2.40	0.84
0047 701-22-047		1.4	1	16.55	2.35	0.83
0048 701-22-048		1.4	0	20.51	2.10	1.02
0049 701-22-049	0.05	1.5	0	21.73	3.24	0.79
0050 701-22-050		1.5	0	19.12	2.76	1.22
0051 701-22-051		1.4	1	16.16	2.68	0.54
0052 701-22-052	0.02	1.3	1	15.41	3.02	0.89
0053 701-22-053		1.4	0	19.45	3.24	0.97
0054 701-22-054		1.5	0	16.84	3.43	0.77
0055 701-22-055	0.03	1.7	0	18.09	3.38	0.97
0056 701-22-056		1.4	0	16.95	1.51	1.12
0057 701-22-057		1.5	0	17.11	4.15	0.91
0058 701-22-058		1.5	0	16.63	4.38	0.98
0059 701-22-059	0.05	1.8	0	18.57	2.76	1.14
0060 701-22-060	0.07	1.5	0	20.54	4.08	0.93
0061 701-22-061		1.4	0	18.63	1.85	1.08
0062 701-22-062		1.5	0	17.77	2.32	1.14
0063 701-22-063		1.5	0	13.68	2.18	1.70
0064 701-22-064	3.04	1.5	0	14.23	1.97	1.30
0065 701-22-065		1.4	0	9.79	1.47	0.85
0066 701-22-066		1.4	0	19.79	2.31	1.44
0067 701-22-067	7.34	1.5	0	16.06	2.49	1.59
0068 701-22-068		1.5	0	19.20	2.35	1.09
0069 701-22-069		1.6	0	17.61	2.83	1.44
0070 701-22-070		1.5	0	17.03	2.02	1.23
0071 701-22-071	1.98	1.3	2	16.00	2.98	1.12
0072 701-22-072	0.44	1.5	2	15.82	3.06	1.03
0073 701-22-073		1.4	1	16.47	2.48	0.82
0074 701-22-074		1.1	0	18.97	2.64	0.97
0075 701-22-075		1.6	0	14.42	3.34	0.66
0076 701-22-076		1.5	0	15.29	5.48	0.75
0077 701-22-077		1.5	0	17.78	3.26	1.54
0078 701-22-078		1.5	0	21.78	4.13	1.20

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0079 701-22-079	1.5	0	36.40	3.44	1.18
0080 701-22-080	1.5	0	22.67	1.87	0.79

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.98	X	X	0.15	0.060	1.05%
0042 701-22-042	0.47	0.02		0.09	0.030	1.34%
0043 701-22-043	1.83	X		0.27	0.129	2.87%
0044 701-22-044	1.38	X	X	0.31	0.186	2.62%
0045 701-22-045	0.32	0.02		0.15	0.422	5616
0046 701-22-046	1.14	X	X	0.36	3.274	3.56%
0047 701-22-047	1.33	X		0.39	0.035	3.61%
0048 701-22-048	1.51	X		0.32	0.697	3.26%
0049 701-22-049	1.91	0.02	X	0.60	1.992	3.98%
0050 701-22-050	1.70	0.03		0.25	0.548	795
0051 701-22-051	1.50	X		0.41	1.021	3.21%
0052 701-22-052	1.60	X	X	0.49	0.056	3.29%
0053 701-22-053	1.92	0.06		0.49	0.224	3.24%
0054 701-22-054	1.47	0.04		0.82	0.259	3.46%
0055 701-22-055	1.89	X	X	0.55	0.043	3.43%
0056 701-22-056	1.87	X		0.39	0.123	3.80%
0057 701-22-057	1.70	X		0.84	0.096	2.63%
0058 701-22-058	1.92	X		0.65	0.049	2.44%
0059 701-22-059	1.70	0.05	X	0.45	0.938	3.56%
0060 701-22-060	1.86	0.08	X	2.05	1.017	3.81%
0061 701-22-061	1.54	X		0.18	0.421	3.69%
0062 701-22-062	1.55	X		0.18	0.552	3.74%
0063 701-22-063	1.11	0.06		0.18	0.172	5571
0064 701-22-064	0.86	0.01	X	0.11	0.185	2.33%
0065 701-22-065	0.65	0.01		0.07	0.193	1.94%
0066 701-22-066	1.52	0.03		0.35	0.713	3.45%
0067 701-22-067	1.43	0.08	X	0.31	1.104	2.80%
0068 701-22-068	1.35	0.28		0.29	0.588	2.98%
0069 701-22-069	1.36	0.48		0.35	0.791	3.26%
0070 701-22-070	1.70	0.40		0.30	0.309	3.25%
0071 701-22-071	1.97	X	X	0.48	0.026	2.55%
0072 701-22-072	1.61	X	X	0.46	0.120	2.55%
0073 701-22-073	1.32	X		0.42	0.092	3.14%
0074 701-22-074	1.42	0.06		0.37	3.200	3.32%
0075 701-22-075	1.57	0.06		0.74	0.861	2.89%
0076 701-22-076	1.82	0.01		0.76	1.014	2.59%
0077 701-22-077	2.16	0.05		0.52	1.008	2.96%
0078 701-22-078	2.10	0.53		0.49	0.354	3.36%

ANALYSIS

0079 701-22-079	1.98	0.23	0.42	0.437	2.83%
0080 701-22-080	0.97	0.02	0.14	0.194	2.47%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	9.0	24.91	1.1	0.088	495	16.65
0042 701-22-042		26.46	1.4	0.036	139	
0043 701-22-043		13.93	3.4	0.167	977	
0044 701-22-044	14.2	15.10	6.1	0.151	384	33.88
0045 701-22-045		19.48	4.1	0.061	117	
0046 701-22-046	50.1	28.60	2.7	0.180	6077	24.72
0047 701-22-047		29.69	3.7	0.190	1.87%	
0048 701-22-048		29.57	5.0	0.168	2.28%	
0049 701-22-049	41.7	19.67	1.3	0.234	3257	13.16
0050 701-22-050		21.79	91.4	0.156	276	
0051 701-22-051		32.13	7.0	0.186	1.33%	
0052 701-22-052	15.8	40.09	8.7	0.234	1.77%	7.87
0053 701-22-053		37.22	9.7	0.196	1.05%	
0054 701-22-054		36.34	3.0	0.318	4717	
0055 701-22-055	24.8	40.77	6.3	0.251	7312	17.85
0056 701-22-056		34.51	2.1	0.156	3843	
0057 701-22-057		49.58	1.6	0.486	2726	
0058 701-22-058		49.66	1.6	0.335	2527	
0059 701-22-059	37.4	40.71	3.6	0.210	4326	21.64
0060 701-22-060	37.9	45.89	2.6	0.269	3721	19.71
0061 701-22-061		27.83	0.1	0.096	1998	
0062 701-22-062		31.58	0.4	0.098	1882	
0063 701-22-063		24.22	2.1	0.111	173	
0064 701-22-064	4.8	22.83	0.3	0.068	113	7.58
0065 701-22-065		13.91	0.7	0.038	107	
0066 701-22-066		31.68	4.4	0.163	2308	
0067 701-22-067	20.2	42.14	2.5	0.173	2433	10.89
0068 701-22-068		30.72	1.8	0.152	1980	
0069 701-22-069		30.62	1.8	0.171	3026	
0070 701-22-070		25.81	2.7	0.170	2891	
0071 701-22-071	5.5	36.78	8.6	0.221	1.08%	7.63
0072 701-22-072	17.5	40.22	6.8	0.209	1.72%	5.29
0073 701-22-073		30.17	8.1	0.211	2.02%	
0074 701-22-074		32.91	4.6	0.162	6675	
0075 701-22-075		34.00	1.7	0.322	2792	
0076 701-22-076		33.94	4.4	0.211	2624	
0077 701-22-077		28.66	8.4	0.229	3505	
0078 701-22-078		31.94	2.0	0.232	2369	

ANALYSIS

0079 701-22-079	30.56	6.6	0.238	2353
0080 701-22-080	11.09	1.5	0.078	1120

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0041 701-22-041	50	0.69		1.3	0.19	198
0042 701-22-042	38			4.2		181
0043 701-22-043	56			2.1		62
0044 701-22-044	42	0.57		1.7	0.20	126
0045 701-22-045	40			2.5		252
0046 701-22-046	>2.00%	19.09	2.25%	1.7	3.58	130
0047 701-22-047	5202			0.6		11
0048 701-22-048	>2.00%		2.36%	1.2		50
0049 701-22-049	398	1.57		1.3	0.08	146
0050 701-22-050	1372			2.4		295
0051 701-22-051	3669			2.8		70
0052 701-22-052	1747	0.01		1.8	10.26	19
0053 701-22-053	>2.00%		2.08%	1.6		89
0054 701-22-054	401			6.7		201
0055 701-22-055	4184	1.12		1.6	2.28	35
0056 701-22-056	129			1.0		48
0057 701-22-057	50			2.9		65
0058 701-22-058	46			1.8		48
0059 701-22-059	5554	5.83		1.2	0.07	47
0060 701-22-060	160	0.22		1.2	0.12	106
0061 701-22-061	146			1.1		51
0062 701-22-062	118			0.6		62
0063 701-22-063	44			2.0		296
0064 701-22-064	41	0.40		2.4	0.06	277
0065 701-22-065	42			2.7		334
0066 701-22-066	188			0.6		61
0067 701-22-067	175	1.88		1.5	0.08	104
0068 701-22-068	128			1.8		192
0069 701-22-069	219			1.9		68
0070 701-22-070	188			1.0		67
0071 701-22-071	817	0.13		2.6	8.51	2
0072 701-22-072	2436	0.02		1.3	35.62	24
0073 701-22-073	1.05%			1.3		40
0074 701-22-074	1.34%			1.9		130
0075 701-22-075	659			2.6		111
0076 701-22-076	227			0.6		498
0077 701-22-077	282			1.6		62
0078 701-22-078	173			1.2		141

ANALYSIS

0079 701-22-079	77	1.9	132
0080 701-22-080	74	1.4	131

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0041 701-22-041	749	47.2	167	2.2	156	197
0042 701-22-042	735		145	2.2	133	181
0043 701-22-043	1096		7	3.7	1	60
0044 701-22-044	1087	161.8	17	3.1	10	125
0045 701-22-045	808		193	2.2	176	251
0046 701-22-046	612	117.1	68	2.5	53	99
0047 701-22-047	684		0	8.5	0	-88
0048 701-22-048	639		2	6.0	0	-7
0049 701-22-049	670	140.4	128	2.1	110	141
0050 701-22-050	530		244	2.1	222	294
0051 701-22-051	612		0	8.1	0	-30
0052 701-22-052	577	47.3	0	8.9	0	-115
0053 701-22-053	738		26	3.0	12	57
0054 701-22-054	1141		181	2.1	160	197
0055 701-22-055	1197	203.8	14	3.0	5	22
0056 701-22-056	707		40	2.3	30	45
0057 701-22-057	879		53	2.2	43	64
0058 701-22-058	630		36	2.3	28	44
0059 701-22-059	747	122.0	27	2.8	8	35
0060 701-22-060	881	163.7	94	2.2	81	100
0061 701-22-061	703		2	4.6	0	49
0062 701-22-062	333		34	2.4	23	59
0063 701-22-063	531		207	2.3	181	295
0064 701-22-064	1700	22.9	144	2.3	126	278
0065 701-22-065	1361		215	2.2	196	333
0066 701-22-066	391		19	2.9	9	57
0067 701-22-067	365	6.3	81	2.2	66	101
0068 701-22-068	699		157	2.1	137	189
0069 701-22-069	621		62	2.1	51	63
0070 701-22-070	539		63	2.2	49	61
0071 701-22-071	1.62%	124.5	0	9.7	0	-91
0072 701-22-072	3933	208.2	0	9.0	0	-101
0073 701-22-073	1324		0	9.0	0	-64
0074 701-22-074	943		80	2.3	61	112
0075 701-22-075	686		79	2.2	67	105
0076 701-22-076	243		440	2.1	409	499
0077 701-22-077	289		32	2.5	23	58
0078 701-22-078	366		113	2.2	100	136

ANALYSIS

0079 701-22-079	418	101	2.2	88	127
0080 701-22-080	691	106	2.1	95	126

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	1.15	17.91	8.9	0.07	675	X
0042 701-22-042	0.61	16.24	10.2		611	
0043 701-22-043	3.40	8.34	3.5		101	
0044 701-22-044	3.25	7.54	10.7	0.56	146	X
0045 701-22-045	0.96	14.59	24.6		476	
0046 701-22-046	3.91	18.72	17.4	X	580	X
0047 701-22-047	3.90	18.17	8.3		581	
0048 701-22-048	3.95	19.61	8.9		614	
0049 701-22-049	3.32	15.13	8.6	0.02	667	X
0050 701-22-050	4.33	16.18	33.2		849	
0051 701-22-051	3.47	19.75	8.6		523	
0052 701-22-052	3.83	25.28	6.2	X	616	X
0053 701-22-053	3.93	26.63	7.6		725	
0054 701-22-054	2.81	26.01	18.1		593	
0055 701-22-055	4.08	26.17	6.4	X	752	X
0056 701-22-056	4.24	18.42	4.1		71	
0057 701-22-057	3.74	33.06	15.5		346	
0058 701-22-058	4.00	38.47	9.5		383	
0059 701-22-059	3.78	25.28	9.2	0.02	567	X
0060 701-22-060	3.30	31.48	11.4	0.10	1303	X
0061 701-22-061	2.60	16.89	3.0		559	
0062 701-22-062	3.13	19.67	4.0		563	
0063 701-22-063	2.36	18.03	30.4		662	
0064 701-22-064	1.61	16.66	11.0	0.09	745	0.2
0065 701-22-065	0.88	11.54	11.7		545	
0066 701-22-066	3.42	18.80	26.0		486	
0067 701-22-067	5.78	21.89	28.6	0.51	142	0.4
0068 701-22-068	3.73	17.21	30.6		350	
0069 701-22-069	5.34	22.80	50.8		394	
0070 701-22-070	5.34	16.85	30.6		254	
0071 701-22-071	4.58	23.60	5.7	X	648	X
0072 701-22-072	3.81	25.98	8.7	X	726	X
0073 701-22-073	3.64	19.36	15.5		663	
0074 701-22-074	3.58	21.60	13.2		837	
0075 701-22-075	5.54	20.15	8.4		677	
0076 701-22-076	4.13	29.21	242.5*		1282	
0077 701-22-077	4.02	18.35	17.1		463	
0078 701-22-078	7.11	25.52	32.7		1001	

ANALYSIS

0079 701-22-079	5.74	22.20	47.4	713
0080 701-22-080	2.02	8.58	11.2	637

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	104.1	0.6	5.3		4.916	28.10
0042 701-22-042	72.8		4.9		4.538	14.92
0043 701-22-043	9.1		5.7		2.409	63.65
0044 701-22-044	11.3	X	5.0		2.235	29.44
0045 701-22-045	47.8		4.9		3.851	6.19
0046 701-22-046	232.3	6.6	7.2	3.4	5.174	146.99
0047 701-22-047	43.7		9.3	3.4	5.255	158.07
0048 701-22-048	162.5		8.1		5.485	141.19
0049 701-22-049	96.1	1.3	5.3		3.954	163.07
0050 701-22-050	219.8		5.0		4.376	3.55
0051 701-22-051	133.4		7.2	3.4	5.607	122.53
0052 701-22-052	18.0	1.2	8.2	3.5	7.153	143.59
0053 701-22-053	607.6*		7.6	3.1	7.336	138.75
0054 701-22-054	130.2		4.7		7.186	155.85
0055 701-22-055	21.2	0.7	7.3	3.0	7.331	135.82
0056 701-22-056	25.1		4.7		5.599	154.37
0057 701-22-057	95.4		4.4		9.099	102.53
0058 701-22-058	35.6		4.4		9.782	95.69
0059 701-22-059	332.9	0.7	6.5	2.9	7.198	135.76
0060 701-22-060	488.9	1.7	5.2		8.508	145.87
0061 701-22-061	23.8		4.1		4.971	133.02
0062 701-22-062	64.4		4.2		5.678	164.18
0063 701-22-063	111.6		4.6		5.100	4.50
0064 701-22-064	185.2	0.6	4.1		4.712	3.89
0065 701-22-065	137.8		4.3		2.786	3.48
0066 701-22-066	89.3		4.1		5.331	117.48
0067 701-22-067	52.8	13.0	3.7		6.579	129.11
0068 701-22-068	70.0		3.7		5.231	109.43
0069 701-22-069	53.4		3.8		6.147	164.51
0070 701-22-070	32.2		4.2		4.789	155.31
0071 701-22-071	10.0	2.5	9.2	3.7	6.663	92.30
0072 701-22-072	24.0	1.5	8.5	3.5	7.299	104.31
0073 701-22-073	49.6		8.5	3.4	5.434	146.48
0074 701-22-074	426.7		7.3	3.3	6.079	161.45
0075 701-22-075	137.8		5.4		6.229	144.53
0076 701-22-076	71.7		2.7		7.540	158.97
0077 701-22-077	39.0		4.2		5.169	139.72
0078 701-22-078	135.8		4.5		6.759	167.61

ANALYSIS

0079 701-22-079	194.4	4.0	6.533	138.62
0080 701-22-080	127.2	4.7	2.237	84.51

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0041 701-22-041	X	6.48	5.82%	46.7	4.38	0.34
0042 701-22-042	0.007	5.92	5.43%		4.68	0.36
0043 701-22-043	X	2.03	2.12%		0.27	0.54
0044 701-22-044	X	4.11	3.88%	51.0	0.35	1.19
0045 701-22-045	0.006	8.22	7.50%		5.32	0.48
0046 701-22-046	0.003	4.24	4.30%	117.6	3.66	0.14
0047 701-22-047	X	0.37	3389		0.25	0.05
0048 701-22-048	0.002	1.64	1.66%		1.34	0.05
0049 701-22-049	X	4.76	4.52%	90.5	3.80	0.11
0050 701-22-050	X	9.64	8.70%		7.35	0.22
0051 701-22-051	X	2.28	2.54%		1.99	0.33
0052 701-22-052	X	0.62	5441	29.7	0.44	0.07
0053 701-22-053	X	2.90	2.78%		2.62	0.06
0054 701-22-054	0.017	6.57	6.25%		5.73	0.18
0055 701-22-055	X	1.13	1.07%	55.1	1.03	0.06
0056 701-22-056	0.005	1.58	1.54%		1.63	0.08
0057 701-22-057	X	2.11	2.08%		1.74	0.17
0058 701-22-058	X	1.56	1.52%		1.27	0.10
0059 701-22-059	X	1.52	1.49%	82.1	1.30	0.08
0060 701-22-060	X	3.47	3.41%	75.5	2.79	0.09
0061 701-22-061	X	1.66	1.77%		0.06	0.90
0062 701-22-062	X	2.02	2.25%		1.27	0.40
0063 701-22-063	0.005	9.68	9.12%		7.67	0.47
0064 701-22-064	0.036	9.05	8.39%	34.5	4.41	1.17
0065 701-22-065	0.037	10.90	10.22%		6.02	1.02
0066 701-22-066	0.006	1.98	2.30%		0.68	0.39
0067 701-22-067	X	3.40	3.57%	91.4	2.75	0.21
0068 701-22-068	0.003	6.28	5.87%		3.85	0.41
0069 701-22-069	X	2.21	2.56%		1.99	0.15
0070 701-22-070	0.002	2.20	2.50%		2.01	0.19
0071 701-22-071	0.002	0.07	974	17.4		0.02
0072 701-22-072	X	0.80	7516	60.7	0.57	0.09
0073 701-22-073	X	1.31	1.45%		1.09	0.05
0074 701-22-074	X	4.24	4.24%		3.84	0.09
0075 701-22-075	X	3.62	3.68%		3.15	0.15
0076 701-22-076	0.002	16.29	15.06%		12.40	0.43
0077 701-22-077	X	2.04	2.26%		1.16	0.52
0078 701-22-078	0.002	4.62	4.52%		3.63	0.26

ANALYSIS

0079 701-22-079	0.003	4.32	4.53%	3.44	0.28
0080 701-22-080	X	4.27	4.24%	3.37	0.28

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.46	0.32	9.0	2.2	2.8	2.06
0042 701-22-042	0.61		8.3	1.8		1.75
0043 701-22-043	0.51		14.8	X		0.10
0044 701-22-044	0.30	0.54	15.3	X	4.6	0.56
0045 701-22-045	2.74		5.8	2.2		1.73
0046 701-22-046	1.08	0.34	8.7	0.6	1.3	0.32
0047 701-22-047	0.42		8.6	X		0.02
0048 701-22-048	0.79		9.9	X		0.04
0049 701-22-049	1.72	1.45	11.5	1.2	2.1	0.67
0050 701-22-050	2.50		11.5	1.8		2.11
0051 701-22-051	0.65		10.0	1.0		0.33
0052 701-22-052	0.40	0.47	9.2	X	0.9	0.03
0053 701-22-053	0.62		11.2	1.9		1.54
0054 701-22-054	1.45		11.0	2.7		2.16
0055 701-22-055	0.41	0.18	9.1	X	2.5	0.15
0056 701-22-056	0.28		7.2	0.7		0.42
0057 701-22-057	0.59		10.8	1.3		0.92
0058 701-22-058	0.21		11.6	0.7		0.49
0059 701-22-059	0.37	0.02	9.5	X	6.3	0.16
0060 701-22-060	0.48	0.29	11.8	0.8	7.8	0.80
0061 701-22-061	0.87		7.1	1.1		0.83
0062 701-22-062	0.69		7.0	X		0.16
0063 701-22-063	5.25		8.8	2.4		2.14
0064 701-22-064	1.75	0.49	8.6	1.6	1.5	1.56
0065 701-22-065	1.26		8.2	2.7		2.00
0066 701-22-066	0.60		14.1	0.6		0.10
0067 701-22-067	1.36	0.21	7.0	0.9	4.7	0.84
0068 701-22-068	1.61		12.5	1.7		1.73
0069 701-22-069	1.81		9.9	0.5		0.53
0070 701-22-070	2.08		8.2	0.7		0.58
0071 701-22-071	0.15	0.18	8.1	X	1.2	X
0072 701-22-072	0.33	0.38	10.1	X	1.5	0.13
0073 701-22-073	0.53		8.9	X		0.10
0074 701-22-074	2.64		9.6	1.4		1.08
0075 701-22-075	5.54		4.1	2.0		1.83
0076 701-22-076	9.17		23.0	1.4		1.14
0077 701-22-077	1.60		15.9	0.5		0.04
0078 701-22-078	9.53*		11.5	1.2		0.70

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0079 701-22-079	3.54	13.1	1.0	0.97
0080 701-22-080	1.27	10.7	1.9	1.55

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ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	3.18	1.1	X	437.76	43.48	0.08
0042 701-22-042	2.72	2.0		595.91		0.04
0043 701-22-043	1.54	0.9		25.26		0.29
0044 701-22-044	1.39	0.7	X	41.20	18.33	0.26
0045 701-22-045	2.67	11.6		667.21		0.07
0046 701-22-046	3.14	2.0	X	36.73	936.43	0.29
0047 701-22-047	2.97	0.7		31.32		0.30
0048 701-22-048	3.31	0.6		18.71		0.29
0049 701-22-049	3.44	0.7	X	154.71	348.10	0.25
0050 701-22-050	3.43	2.3		1186.83		0.29
0051 701-22-051	3.47	0.6		228.61		0.27
0052 701-22-052	4.13	0.5	0.1	63.70	29.47	0.35
0053 701-22-053	4.77	1.0		48.93		0.32
0054 701-22-054	4.79	2.3		82.79		0.22
0055 701-22-055	4.47	0.6	X	28.16	136.79	0.34
0056 701-22-056	2.55	0.7		15.06		0.35
0057 701-22-057	5.63	0.7		145.71		0.29
0058 701-22-058	6.82	0.7		91.12		0.33
0059 701-22-059	4.16	0.5	X	73.60	5.48	0.30
0060 701-22-060	5.68	0.6	X	877.78	19.48	0.27
0061 701-22-061	2.79	0.8		49.73		0.23
0062 701-22-062	3.34	0.7		48.24		0.29
0063 701-22-063	3.29	5.0		449.33		0.16
0064 701-22-064	2.83	3.4	X	182.67	12.76	0.13
0065 701-22-065	2.00	2.5		222.33		0.07
0066 701-22-066	3.22	0.7		168.25		0.24
0067 701-22-067	3.66	1.4	X	10.85	8.75	0.45
0068 701-22-068	2.99	2.1		139.02		0.29
0069 701-22-069	4.08	1.8		116.67		0.40
0070 701-22-070	3.03	1.5		45.57		0.42
0071 701-22-071	4.01	0.5	X	271.54	53.77	0.36
0072 701-22-072	4.50	0.7	0.1	107.46	58.08	0.31
0073 701-22-073	3.32	0.5		42.15		0.27
0074 701-22-074	3.62	1.1		37.67		0.26
0075 701-22-075	3.91	0.7		195.29		0.42
0076 701-22-076	5.85	0.9		35.03		0.25
0077 701-22-077	3.39	0.6		60.85		0.30
0078 701-22-078	5.08	2.0		426.93		0.42

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0079 701-22-079	4.35	4.3	438.73	0.36
0080 701-22-080	1.90	3.2	386.94	0.15

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ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.244	352	0.81	10.10	0.016	705
0042 701-22-042	0.170		0.27	8.82		340
0043 701-22-043	0.201		0.20	16.59		2463
0044 701-22-044	0.219	720	0.26	15.77	0.040	1990
0045 701-22-045	0.189		0.55	15.01		241
0046 701-22-046	0.369	680	0.18	13.40	0.012	1859
0047 701-22-047	0.334		X	13.83		2000
0048 701-22-048	0.264		X	13.52		2234
0049 701-22-049	0.477	580	0.76	12.63	0.021	2084
0050 701-22-050	0.301		1.51	14.02		2332
0051 701-22-051	0.380		0.33	19.34		2159
0052 701-22-052	0.423	210	0.16	22.48	0.010	1925
0053 701-22-053	0.403		0.56	19.50		2592
0054 701-22-054	0.516		1.43	14.08		1817
0055 701-22-055	0.460	657	0.15	23.10	0.013	2286
0056 701-22-056	0.204		0.36	21.80		2255
0057 701-22-057	0.599		0.85	24.94		2055
0058 701-22-058	0.555		0.55	27.01		2293
0059 701-22-059	0.362	443	0.17	25.29	0.060	2133
0060 701-22-060	0.511	700	0.65	24.97	0.075	2089
0061 701-22-061	0.209		0.78	16.60		933
0062 701-22-062	0.256		0.29	17.01		1213
0063 701-22-063	0.239		0.74	12.35		1206
0064 701-22-064	0.208	203	0.36	9.90	0.040	919
0065 701-22-065	0.133		0.33	8.40		552
0066 701-22-066	0.320		0.10	11.93		2655
0067 701-22-067	0.301	391	0.62	16.82	0.956	1925
0068 701-22-068	0.294		1.60	14.21		1723
0069 701-22-069	0.361		0.73	14.29		1891
0070 701-22-070	0.243		0.56	16.98		1757
0071 701-22-071	0.420	246	X	18.17	0.748	2105
0072 701-22-072	0.394	620	0.08	19.20	0.115	2239
0073 701-22-073	0.368		0.11	12.88		1855
0074 701-22-074	0.316		0.99	13.90		1974
0075 701-22-075	0.682		1.10	22.29		1232
0076 701-22-076	0.839		0.42	9.87		3194
0077 701-22-077	0.818		X	14.91		3276
0078 701-22-078	0.511		0.48	15.69		2723

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0079 701-22-079	0.443	0.74	17.78	2166
0080 701-22-080	0.221	0.50	8.61	1257

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ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	0.37	0.08	3.84	5.967	82	X
0042 701-22-042	0.17	0.03	3.43		75	
0043 701-22-043	0.63	0.14	3.80		101	
0044 701-22-044	0.28	0.14	4.44	6.777	93	X
0045 701-22-045	0.20	0.06	1.76		60	
0046 701-22-046	1.69	0.16	3.10	0.078	75	X
0047 701-22-047	1.75	0.19	4.62		69	
0048 701-22-048	1.65	0.15	3.40		84	
0049 701-22-049	2.11	0.25	3.53	2.098	95	X
0050 701-22-050	0.19	0.12	4.11		89	
0051 701-22-051	1.29	0.19	3.47		92	
0052 701-22-052	1.65	0.21	5.38	6.165	77	0.01
0053 701-22-053	1.72	0.19	4.12		118	
0054 701-22-054	2.32	0.35	3.34		90	
0055 701-22-055	1.47	0.23	4.88	0.291	88	X
0056 701-22-056	1.74	0.13	4.37		64	
0057 701-22-057	1.16	0.42	6.05		106	
0058 701-22-058	0.97	0.31	6.36		96	
0059 701-22-059	1.56	0.19	8.01	0.727	89	X
0060 701-22-060	1.75	0.29	6.71	3.615	107	X
0061 701-22-061	1.36	0.08	3.43		66	
0062 701-22-062	1.41	0.08	3.41		55	
0063 701-22-063	0.44	0.09	2.94		91	
0064 701-22-064	0.06	0.11	2.81	13.348	88	X
0065 701-22-065	0.07	0.03	1.75		80	
0066 701-22-066	1.82	0.15	2.45		129	
0067 701-22-067	1.89	0.16	3.49	31.470	56	X
0068 701-22-068	1.65	0.15	4.15		84	
0069 701-22-069	2.37	0.15	2.97		75	
0070 701-22-070	1.90	0.15	3.70		61	
0071 701-22-071	0.39	0.21	3.77	2.346	71	0.06
0072 701-22-072	0.91	0.19	4.95	4.166	86	0.02
0073 701-22-073	1.57	0.18	3.24		74	
0074 701-22-074	2.97	0.15	3.65		81	
0075 701-22-075	4.49	0.30	4.54		32	
0076 701-22-076	3.38	0.25	2.27		118	
0077 701-22-077	1.86	0.23	4.06		118	
0078 701-22-078	2.88	0.22	5.53		97	

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0079 701-22-079	1.82	0.20	5.54	95
0080 701-22-080	0.94	0.08	4.30	91

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ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	3.43	0.48	40	0.70	32.6
0042 701-22-042	3.2	1.99	0.24	168		20.4
0043 701-22-043	12.3	7.04	0.87	14		59.1
0044 701-22-044	1.8	7.57	0.99	14	0.84	50.3
0045 701-22-045	1.8	3.59	0.36	17		14.1
0046 701-22-046	8.3	8.83	1.11	2799	0.59	34.9
0047 701-22-047	0.9	11.21	1.19	276		43.6
0048 701-22-048	1.0	8.00	1.08	1703		49.5
0049 701-22-049	2.4	15.16	1.66	150	0.98	64.0
0050 701-22-050	1.8	5.99	0.86	258		58.3
0051 701-22-051	1.9	10.95	1.23	671		55.9
0052 701-22-052	1.4	13.19	1.52	100	X	46.9
0053 701-22-053	1.1	11.62	2.36	1510		66.8
0054 701-22-054	2.4	23.48	2.28	549		50.3
0055 701-22-055	1.1	14.49	1.63	78	X	61.6
0056 701-22-056	1.3	7.17	0.98	32		56.8
0057 701-22-057	1.1	25.23	2.95	55		53.9
0058 701-22-058	1.5	17.71	2.14	38		58.6
0059 701-22-059	1.6	11.08	1.41	1683	0.87	52.0
0060 701-22-060	1.9	16.20	1.81	773	0.95	57.0
0061 701-22-061	1.7	4.27	0.57	42		52.2
0062 701-22-062	1.5	4.62	0.58	23		46.9
0063 701-22-063	2.6	4.38	0.63	23		34.7
0064 701-22-064	1.6	2.52	0.40	8	0.19	43.2
0065 701-22-065	1.6	1.62	0.20	9		15.9
0066 701-22-066	4.0	8.22	0.94	2375		56.2
0067 701-22-067	1.6	8.37	1.13	1409	45.30	49.3
0068 701-22-068	2.1	7.88	0.95	450		40.9
0069 701-22-069	2.0	8.43	1.17	1915		43.1
0070 701-22-070	1.9	7.42	1.06	644		52.8
0071 701-22-071	1.3	12.66	1.49	66	X	62.4
0072 701-22-072	1.5	12.10	1.38	186	X	50.5
0073 701-22-073	1.3	12.08	1.22	329		44.6
0074 701-22-074	2.3	9.00	1.04	3221*		44.1
0075 701-22-075	3.0	20.54	2.21	184		39.5
0076 701-22-076	2.2	16.95	1.58	83		71.5
0077 701-22-077	1.3	12.15	1.61	1218		74.1
0078 701-22-078	4.5	12.74	1.59	175		74.0

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0079 701-22-079	2.4	10.70	1.46	408	73.5
0080 701-22-080	1.2	3.24	0.45	65	31.8

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ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0081 701-22-081	0.74	0.07	7.42%	69.57	0	49.0
0082 701-22-082	0.34		7.40%		3	37.7
0083 701-22-083	0.45		10.32%		4	5.0
0084 701-22-084	0.30	X	10.39%	0.02	6	8.3
0085 701-22-085	0.23		9.26%		5	13.5
0086 701-22-086	0.22		8.94%		5	3.6
0087 701-22-087	0.26		9.73%		4	2.3
0088 701-22-088	0.21	0.03	9.26%	0.99	3	7.1
0089 701-22-089	0.15		10.07%		4	5.4
0090 701-22-090	0.52		9.09%		4	33.4
0091 701-22-091	0.17		9.41%		4	5.2
0092 701-22-092	1.24		8.42%		4	12.8
0093 701-22-093	0.27	0.02	7.64%	3.12	4	8.6
0094 701-22-094	2.59	0.02	6.74%	1.02	0	14.8
0095 701-22-095	6.22		6.31%		-2	27.1
0096 701-22-096	4.05		7.63%		0	14.9
0097 701-22-097	0.31	0.02	6.38%	0.45	3	53.3
0098 701-22-098	8.94*		7.10%		0	234.9
0099 701-22-099	0.13	0.18	9.20%	7.37	3	4.0
0100 701-22-100	0.13		7.71%		2	9.6
0101 701-22-101	0.40		8.30%		2	70.7
0102 701-22-102	1.15		7.40%		-23	13.6
0103 701-22-103	0.88		9.02%		-11	25.2
0104 701-22-104	0.11		9.24%		13	3.4
0105 701-22-105	0.30		9.00%		9	10.8
0106 701-22-106	0.06		8.37%		83	2.9
0107 701-22-107	0.07	0.02	8.28%	0.08	84	4.7
0108 701-22-108	X		7.86%		78	1.6
0109 701-22-109	X	0.04	8.35%	2.84	86	1.5
0110 701-22-110	X		8.37%		85	0.9
0111 701-22-111	0.10	0.01	7.18%	2.92	155	4.5
0112 701-22-112	X		8.07%		106	2.5
0113 701-22-113	X		8.12%		109	2.2
0114 701-22-114	X	X	7.53%	2.32	117	1.1
0115 701-22-115	0.16	0.04	6.88%	2.74	130	6.1
0116 701-22-116	0.21		7.43%		95	3.9
0117 701-22-117	X		6.51%		84	2.7
0118 701-22-118	0.10		6.67%		23	8.6

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0119 701-22-119	0.06	9.17%	6	10.1
0120 701-22-120	0.05	8.93%	6	1.9

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ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	21.3	X	X	311.5	3.92	0.65
0082 701-22-082		X		302.9		0.51
0083 701-22-083		X		356.1		1.15
0084 701-22-084	1.0	X	0.03	1591.3	19.82	1.00
0085 701-22-085		X		559.9		0.76
0086 701-22-086		X		555.7		0.95
0087 701-22-087		X		417.9		0.80
0088 701-22-088	1.1	X	X	884.6	5.25	0.71
0089 701-22-089		X		901.4		0.66
0090 701-22-090		X		278.4		0.69
0091 701-22-091		X		741.2		0.60
0092 701-22-092		X		414.7		0.89
0093 701-22-093	1.6	X	X	920.0	29.64	0.84
0094 701-22-094	1.0	X	X	993.4	29.49	0.30
0095 701-22-095		X		891.5		0.20
0096 701-22-096		X		668.4		0.09
0097 701-22-097	1.0	X	0.01	708.2	6.59	0.29
0098 701-22-098		X		996.5		0.12
0099 701-22-099	2.3	X	X	608.4	55.05	1.26
0100 701-22-100		X		299.5		0.31
0101 701-22-101		X		633.8		0.83
0102 701-22-102		X		254.4		0.64
0103 701-22-103		X		509.6		1.59
0104 701-22-104		X		2336.4*		1.32
0105 701-22-105		X		366.1		1.87
0106 701-22-106		13		673.8		1.26
0107 701-22-107	2.0	14	0.02	550.0	6.25	1.18
0108 701-22-108		14		771.1		1.05
0109 701-22-109	2.2	16	0.02	807.5	101.68	1.04
0110 701-22-110		14		824.9		1.48
0111 701-22-111	7.1	24	0.06	586.1	173.44	0.98
0112 701-22-112		23		636.7		1.08
0113 701-22-113		21		507.8		1.20
0114 701-22-114	1.5	17	0.04	347.6	101.98	1.08
0115 701-22-115	2.9	23	0.04	282.4	20.86	1.13
0116 701-22-116		19		479.7		1.18
0117 701-22-117		19		667.6		0.90
0118 701-22-118		X		2144.2		1.01

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0119 701-22-119	X	950.2	1.84
0120 701-22-120	X	1539.6	1.49

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ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.7	3.86	0.410	0.07	359	26.39
0082 701-22-082		1.15		0.02	682	
0083 701-22-083		0.54		0.05	500	
0084 701-22-084	X	0.09	X	0.06	606	12.95
0085 701-22-085		0.18		0.04	335	
0086 701-22-086		0.25		0.06	362	
0087 701-22-087		0.31		0.05	298	
0088 701-22-088	X	0.23	X	0.04	433	4.91
0089 701-22-089		0.43		0.06	471	
0090 701-22-090		1.45		0.05	395	
0091 701-22-091		0.29		0.05	363	
0092 701-22-092		1.57		0.11	367	
0093 701-22-093	0.2	0.22	0.016	0.09	283	9.56
0094 701-22-094	X	1.12	X	0.04	986	18.30
0095 701-22-095		0.95		0.03	1046	
0096 701-22-096		1.44		0.04	1108	
0097 701-22-097	X	5.12	X	0.09	972	12.73
0098 701-22-098		2.17		0.03	780	
0099 701-22-099	1.3	0.33	X	0.08	664	29.14
0100 701-22-100		0.46		0.03	569	
0101 701-22-101		3.21		0.06	884	
0102 701-22-102		3.78		0.03	565	
0103 701-22-103		2.78		0.06	702	
0104 701-22-104		0.33		0.30	2656	
0105 701-22-105		0.47		0.04	2526	
0106 701-22-106		0.19		0.65	3.01%	
0107 701-22-107	X	0.10	X	0.73	3.14%	27.63
0108 701-22-108		0.04		0.67	2.84%	
0109 701-22-109	0.3	0.08	0.011	0.87	3.39%	6.54
0110 701-22-110		0.18		0.80	3.27%	
0111 701-22-111	0.5	0.17	0.166	1.84	6.07%*	11.60
0112 701-22-112		0.07		1.23	4.19%	
0113 701-22-113		0.06		1.32	4.53%	
0114 701-22-114	0.2	0.11	0.034	1.44	4.92%	7.85
0115 701-22-115	0.2	0.19	0.033	1.44	4.21%	6.29
0116 701-22-116		0.25		0.92	3.03%	
0117 701-22-117		0.45		0.76	2.73%	
0118 701-22-118		0.26		0.84	6170	

ANALYSIS

0119 701-22-119	0.29	0.08	979
0120 701-22-120	0.36	0.04	614

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0081 701-22-081	0.03	1.28	59.10	31	23.4	3571.9
0082 701-22-082	0.08		52.45		6.6	
0083 701-22-083	X		60.51		1.3	
0084 701-22-084	0.03	X	45.83	30	0.7	0.9
0085 701-22-085	X		44.75		0.3	
0086 701-22-086	X		83.58		1.2	
0087 701-22-087	0.03		62.22		0.8	
0088 701-22-088	0.03	0.07	51.47	13	0.5	2.8
0089 701-22-089	X		38.26		0.6	
0090 701-22-090	X		39.74		0.6	
0091 701-22-091	X		41.61		0.8	
0092 701-22-092	X		47.01		0.6	
0093 701-22-093	X	0.41	43.76	5	0.8	36.5
0094 701-22-094	X	0.74	88.89	15	0.3	22.9
0095 701-22-095	X		82.64		0.6	
0096 701-22-096	0.03		94.96		1.3	
0097 701-22-097	X	0.57	89.91	56	0.4	9.9
0098 701-22-098	X		108.50		0.4	
0099 701-22-099	0.06	3.64	60.72	7	15.3	270.0
0100 701-22-100	0.03		62.95		9.7	
0101 701-22-101	0.20		57.76		15.3	
0102 701-22-102	0.13		38.10		15.9	
0103 701-22-103	1.59		63.00		12.5	
0104 701-22-104	0.36		66.28		12.0	
0105 701-22-105	0.04		62.36		12.5	
0106 701-22-106	0.15		59.29		11.3	
0107 701-22-107	0.08	0.06	58.54	12	11.2	1.7
0108 701-22-108	0.03		53.73		10.5	
0109 701-22-109	0.04	0.02	65.42	28	9.4	2.3
0110 701-22-110	0.04		61.29		10.0	
0111 701-22-111	0.71	0.06	73.87	27	8.9	1.0
0112 701-22-112	0.17		56.91		10.8	
0113 701-22-113	0.31		60.57		11.3	
0114 701-22-114	0.39	X	54.75	99	8.4	1.4
0115 701-22-115	0.24	X	57.94	74	13.8	1.5
0116 701-22-116	0.10		64.71		13.1	
0117 701-22-117	0.04		47.57		13.2	
0118 701-22-118	0.29		56.70		22.0	

ANALYSIS

0119 701-22-119	0.07	74.59	7.4
0120 701-22-120	X	81.83	2.6

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	No	99	0.10	8.39	510.0	14.08
0082 701-22-082	No	22		0.88	166.3	
0083 701-22-083	No	10		3.48	786.3	
0084 701-22-084	No	17	X	1.62	647.2	0.11
0085 701-22-085	No	11		1.84	222.8	
0086 701-22-086	No	14		1.84	157.1	
0087 701-22-087	No	16		1.89	151.2	
0088 701-22-088	No	16	X	1.82	214.5	3.06
0089 701-22-089	No	20		1.62	260.6	
0090 701-22-090	No	28		2.04	409.3	
0091 701-22-091	No	16		1.51	306.4	
0092 701-22-092	No	18		2.74	291.3	
0093 701-22-093	No	14	X	2.10	299.1	25.25
0094 701-22-094	No	22	X	0.08	62.6	1.91
0095 701-22-095	No	28		0.09	117.4	
0096 701-22-096	No	37		0.13	30.9	
0097 701-22-097	No	18	X	0.22	120.1	1.15
0098 701-22-098	No	30		0.07	41.4	
0099 701-22-099	No	14	X	1.37	672.2	61.14
0100 701-22-100	No	33		0.23	798.8	
0101 701-22-101	No	10		1.22	335.0	
0102 701-22-102	No	20		2.78	365.4	
0103 701-22-103	No	49		2.69	542.7	
0104 701-22-104	No	17		6.05	139.4	
0105 701-22-105	No	15		9.42	120.5	
0106 701-22-106	No	14		5.91	44.0	
0107 701-22-107	No	10	X	4.63	69.5	0.02
0108 701-22-108	No	12		2.67	25.2	
0109 701-22-109	No	8	X	2.59	31.2	0.01
0110 701-22-110	No	8		2.88	41.5	
0111 701-22-111	No	8	X	5.76	154.1	0.08
0112 701-22-112	No	11		7.84	71.1	
0113 701-22-113	No	12		6.75	61.8	
0114 701-22-114	No	11	X	5.59	65.1	0.02
0115 701-22-115	No	17	X	5.78	185.1	0.03
0116 701-22-116	No	12		4.49	80.9	
0117 701-22-117	No	9		10.20	42.8	
0118 701-22-118	Yes	11		4.40	218.4	

ANALYSIS

0119 701-22-119	No	7	2.81	134.9
0120 701-22-120	No	4	2.27	18.9

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0081 701-22-081	1.31	2264	0.89	0.80	X	6.01
0082 701-22-082	1.07		0.61	0.77		3.21
0083 701-22-083	0.92		0.48	0.49		1.07
0084 701-22-084	1.31	328	0.66	0.67	0.3	6.60
0085 701-22-085	0.77		0.37	0.63		2.37
0086 701-22-086	0.82		0.34	0.68		2.71
0087 701-22-087	0.85		0.39	0.52		0.82
0088 701-22-088	1.55	245	0.81	0.50	X	1.84
0089 701-22-089	1.60		0.88	0.50		1.30
0090 701-22-090	1.29		0.63	0.50		2.86
0091 701-22-091	1.22		0.60	0.60		1.25
0092 701-22-092	1.17		0.65	0.54		3.70
0093 701-22-093	1.70	437	0.93	0.58	X	3.77
0094 701-22-094	1.60	324	0.61	1.64	X	3.70
0095 701-22-095	1.31		0.43	1.20		7.25
0096 701-22-096	1.10		0.41	1.04		2.79
0097 701-22-097	2.01	523	0.45	2.21	0.1	8.87
0098 701-22-098	2.99		0.70	1.84		11.02
0099 701-22-099	2.51	956	1.14	1.20	0.2	2.59
0100 701-22-100	0.59		0.25	0.63		4.72
0101 701-22-101	1.21		0.70	0.76		4.49
0102 701-22-102	1.30		0.73	0.78		5.53
0103 701-22-103	2.14		1.00	1.01		3.75
0104 701-22-104	4.27		2.44	1.56		5.53
0105 701-22-105	2.77		1.64	1.05		1.95
0106 701-22-106	2.54		1.49	1.09		3.09
0107 701-22-107	2.49	869	1.43	1.03	0.3	3.03
0108 701-22-108	2.44		1.37	0.99		2.90
0109 701-22-109	2.51	396	1.41	1.14	0.3	2.63
0110 701-22-110	2.33		1.30	1.02		2.41
0111 701-22-111	2.74	546	1.46	1.25	0.9	3.12
0112 701-22-112	2.49		1.43	1.07		3.35
0113 701-22-113	2.30		1.35	0.99		2.91
0114 701-22-114	2.22	617	1.24	0.90	0.3	2.60
0115 701-22-115	2.44	590	1.42	0.95	0.4	3.09
0116 701-22-116	2.80		1.61	1.29		2.91
0117 701-22-117	2.30		1.33	0.94		2.78
0118 701-22-118	2.26		1.25	1.01		7.14

ANALYSIS

0119 701-22-119	6.37	3.73	1.95	1.65
0120 701-22-120	2.82	1.83	1.08	1.08

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	249.62	1.5	0	19.59	2.84	1.13
0082 701-22-082		1.5	0	15.30	2.15	1.04
0083 701-22-083		1.5	0	17.42	1.74	1.08
0084 701-22-084	0.03	1.5	0	17.59	2.13	1.06
0085 701-22-085		1.5	0	17.14	1.15	1.54
0086 701-22-086		1.5	0	17.02	1.71	1.61
0087 701-22-087		1.5	0	16.28	1.41	1.45
0088 701-22-088	0.13	1.5	0	18.58	1.72	1.58
0089 701-22-089		1.5	0	17.83	1.70	1.57
0090 701-22-090		1.5	0	19.33	1.60	1.97
0091 701-22-091		1.5	0	16.79	1.76	1.49
0092 701-22-092		1.5	0	18.60	1.58	1.78
0093 701-22-093	0.18	1.4	0	16.54	1.81	1.77
0094 701-22-094	0.19	1.4	0	8.65	3.86	1.16
0095 701-22-095		1.5	0	16.47	2.78	1.51
0096 701-22-096		1.5	0	12.96	2.23	1.35
0097 701-22-097	0.03	1.5	0	35.91	5.23	2.19
0098 701-22-098		1.5	0	24.61	5.16	3.69
0099 701-22-099	2.16	1.5	0	16.54	3.62	1.57
0100 701-22-100		1.5	0	7.95	1.32	1.60
0101 701-22-101		1.5	0	17.86	2.18	1.45
0102 701-22-102		1.5	0	25.96	1.90	1.14
0103 701-22-103		1.5	0	17.83	2.82	1.32
0104 701-22-104		1.5	0	18.56	5.34	0.96
0105 701-22-105		1.8	0	18.20	3.31	1.09
0106 701-22-106		1.3	1	16.32	3.20	1.00
0107 701-22-107	0.01	1.3	2	16.57	3.15	0.97
0108 701-22-108		1.3	2	15.99	2.86	0.98
0109 701-22-109	0.70	1.3	2	15.80	3.19	0.82
0110 701-22-110		1.3	2	16.58	2.94	0.92
0111 701-22-111	0.86	1.5	2	13.93	3.35	0.90
0112 701-22-112		1.4	2	16.26	3.11	0.91
0113 701-22-113		1.3	2	16.41	2.98	0.99
0114 701-22-114	0.44	1.3	2	16.03	2.70	0.76
0115 701-22-115	0.56	1.5	2	16.27	3.04	0.64
0116 701-22-116		1.3	2	17.19	3.56	0.82
0117 701-22-117		1.3	2	16.21	2.66	0.80
0118 701-22-118		1.2	0	14.69	2.87	0.71

ANALYSIS

0119 701-22-119	1.5	0	18.66	6.20	1.04
0120 701-22-120	1.6	0	18.56	3.20	1.15

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0081 701-22-081	1.87	0.17	X	0.28	0.196	2.32%
0082 701-22-082	1.51	0.01		0.19	0.076	2.06%
0083 701-22-083	0.93	0.02		0.17	0.135	2.00%
0084 701-22-084	0.47	0.03	X	0.24	0.300	2.50%
0085 701-22-085	0.90	X		0.14	0.091	3.10%
0086 701-22-086	0.45	X		0.14	0.137	2.93%
0087 701-22-087	0.30	X		0.15	0.134	3.09%
0088 701-22-088	0.36	X	X	0.30	0.406	3.32%
0089 701-22-089	0.37	X		0.30	0.359	3.73%
0090 701-22-090	0.55	0.01		0.23	0.422	2.86%
0091 701-22-091	0.33	X		0.22	0.241	2.44%
0092 701-22-092	1.02	X		0.22	0.295	3.36%
0093 701-22-093	0.37	0.01	X	0.33	0.212	3.38%
0094 701-22-094	1.03	0.04	X	0.26	0.031	1.91%
0095 701-22-095	0.36	0.08		0.19	0.117	2.04%
0096 701-22-096	0.61	X		0.17	0.055	2.14%
0097 701-22-097	0.61	0.02	X	0.22	0.262	1.05%
0098 701-22-098	0.35	0.60		0.41	0.105	2.11%
0099 701-22-099	0.77	X	X	0.43	0.180	2.80%
0100 701-22-100	0.55	X		0.10	0.027	1.21%
0101 701-22-101	1.26	X		0.25	0.391	3.48%
0102 701-22-102	1.26	X		0.24	0.291	1.67%
0103 701-22-103	1.55	0.01		0.37	0.250	2.33%
0104 701-22-104	2.69	X		0.89	0.067	2.81%
0105 701-22-105	2.48	X		0.56	0.076	2.80%
0106 701-22-106	2.09	X		0.53	0.017	2.83%
0107 701-22-107	1.91	X	X	0.50	0.033	2.42%
0108 701-22-108	1.97	X		0.47	0.019	2.51%
0109 701-22-109	1.56	X	X	0.49	0.013	2.62%
0110 701-22-110	1.66	X		0.45	0.013	2.83%
0111 701-22-111	1.26	X	X	0.53	0.041	2.50%
0112 701-22-112	1.56	X		0.49	0.041	2.79%
0113 701-22-113	1.66	X		0.47	0.027	2.83%
0114 701-22-114	1.23	X	X	0.43	0.030	2.37%
0115 701-22-115	1.30	X	X	0.49	0.064	1.97%
0116 701-22-116	2.04	X		0.56	0.023	2.17%
0117 701-22-117	2.00	X		0.46	0.034	2.17%
0118 701-22-118	1.91	X		0.44	0.091	2.16%

ANALYSIS

0119 701-22-119	2.53	X	1.28	0.059	1.03%
0120 701-22-120	2.20	X	0.60	0.032	1.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	21.0	30.95	2.6	0.162	1910	41.00
0082 701-22-082		29.10	2.6	0.152	683	
0083 701-22-083		40.68	2.3	0.079	2226	
0084 701-22-084	18.4	29.29	1.8	0.075	1651	13.99
0085 701-22-085		32.92	2.9	0.057	2788	
0086 701-22-086		63.17	2.4	0.051	2974	
0087 701-22-087		35.17	2.9	0.055	2725	
0088 701-22-088	23.1	36.90	4.8	0.088	1733	4.37
0089 701-22-089		25.96	3.5	0.095	2239	
0090 701-22-090		23.82	4.3	0.074	2700	
0091 701-22-091		26.07	3.0	0.101	2005	
0092 701-22-092		29.22	2.5	0.094	3482	
0093 701-22-093	30.1	27.76	2.0	0.092	3481	6.57
0094 701-22-094	9.6	50.74	0.7	0.103	226	7.65
0095 701-22-095		44.79	1.3	0.047	99	
0096 701-22-096		52.41	0.9	0.058	109	
0097 701-22-097	6.1	48.17	1.8	0.051	250	15.29
0098 701-22-098		65.97	0.7	0.050	108	
0099 701-22-099	22.0	35.13	2.4	0.151	2656	46.55
0100 701-22-100		37.92	2.4	0.044	427	
0101 701-22-101		35.00	1.0	0.135	2625	
0102 701-22-102		20.45	5.3	0.140	624	
0103 701-22-103		35.59	7.9	0.158	2617	
0104 701-22-104		35.11	16.1	0.356	6848	
0105 701-22-105		34.57	7.1	0.241	5546	
0106 701-22-106		33.20	10.2	0.217	1.59%	
0107 701-22-107	9.4	32.64	11.8	0.214	1.66%	12.83
0108 701-22-108		29.68	10.2	0.199	1.50%	
0109 701-22-109	5.0	36.77	8.3	0.208	1.24%	2.66
0110 701-22-110		34.25	10.2	0.199	1.39%	
0111 701-22-111	8.1	43.26	9.9	0.216	1.22%	5.52
0112 701-22-112		31.27	11.1	0.218	1.38%	
0113 701-22-113		33.53	10.2	0.219	1.03%	
0114 701-22-114	11.9	30.60	8.0	0.187	9481	2.91
0115 701-22-115	6.9	32.88	13.5	0.203	1.17%	2.18
0116 701-22-116		35.49	14.2	0.241	1.20%	
0117 701-22-117		26.09	15.3	0.200	1.37%	
0118 701-22-118		31.07	8.3	0.183	1.06%	

ANALYSIS

0119 701-22-119	41.13	19.8	0.464	2006
0120 701-22-120	44.06	3.9	0.299	2413

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0081 701-22-081	46	0.51		1.2	0.64	223
0082 701-22-082	98			1.8		138
0083 701-22-083	29			4.6		25
0084 701-22-084	46	0.02		10.3	5.55	56
0085 701-22-085	42			7.9		39
0086 701-22-086	60			7.2		35
0087 701-22-087	49			6.0		47
0088 701-22-088	63	0.05		13.2	0.12	69
0089 701-22-089	53			7.7		75
0090 701-22-090	57			7.4		30
0091 701-22-091	47			9.6		43
0092 701-22-092	60			4.2		30
0093 701-22-093	94	0.19		18.9	0.08	32
0094 701-22-094	56	0.34		2.7	0.18	121
0095 701-22-095	47			9.7		132
0096 701-22-096	61			4.7		144
0097 701-22-097	43	0.73		10.1	0.05	49
0098 701-22-098	35			6.0		126
0099 701-22-099	42	1.49		12.5	0.33	65
0100 701-22-100	35			6.9		161
0101 701-22-101	37			4.3		162
0102 701-22-102	29			1.7		234
0103 701-22-103	111			1.2		108
0104 701-22-104	3212			1.9		12
0105 701-22-105	151			1.6		42
0106 701-22-106	648			4.1		36
0107 701-22-107	760	0.02		5.1	60.95	24
0108 701-22-108	597			3.9		1
0109 701-22-109	526	0.05		3.8	145.08	1
0110 701-22-110	435			2.1		2
0111 701-22-111	1154	0.09		8.1	967.08	4
0112 701-22-112	1023			4.1		2
0113 701-22-113	759			2.8		4
0114 701-22-114	677	0.02		5.3	533.22	1
0115 701-22-115	670	0.02		48.7	1049.00	10
0116 701-22-116	528			6.0		19
0117 701-22-117	508			4.5		17
0118 701-22-118	2952			2.5		52

ANALYSIS

0119 701-22-119	44	1.4	41
0120 701-22-120	40	1.5	15

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0081 701-22-081	875	66.9	182	2.1	167	223
0082 701-22-082	785		84	2.3	74	135
0083 701-22-083	494		8	3.2	3	21
0084 701-22-084	799	23.3	4	5.7	0	50
0085 701-22-085	708		3	5.9	0	34
0086 701-22-086	679		3	5.8	0	30
0087 701-22-087	851		4	6.3	0	42
0088 701-22-088	1007	18.6	6	5.4	0	66
0089 701-22-089	1219		7	5.4	0	71
0090 701-22-090	784		1	5.9	0	26
0091 701-22-091	834		2	5.9	0	39
0092 701-22-092	764		2	5.5	0	26
0093 701-22-093	718	26.6	1	4.6	0	28
0094 701-22-094	4187	25.0	13	4.6	0	121
0095 701-22-095	4484		9	4.3	0	134
0096 701-22-096	5133		13	4.5	0	144
0097 701-22-097	774	71.5	12	3.4	8	46
0098 701-22-098	3701		13	5.1	0	126
0099 701-22-099	2010	63.7	43	2.3	34	62
0100 701-22-100	1161		121	2.2	109	159
0101 701-22-101	1534		114	2.4	104	160
0102 701-22-102	569		165	2.3	145	257
0103 701-22-103	708		84	2.2	70	119
0104 701-22-104	1460		8	4.9	0	-1
0105 701-22-105	1262		23	2.7	11	33
0106 701-22-106	2.16%		0	10.7	0	-47
0107 701-22-107	1.96%	157.8	0	11.0	0	-60
0108 701-22-108	2.37%		0	11.2	0	-77
0109 701-22-109	2.30%	86.2	0	11.3	0	-85
0110 701-22-110	2.22%		0	11.3	0	-83
0111 701-22-111	8201	124.7	0	10.9	0	-151
0112 701-22-112	1.09%		0	11.1	0	-104
0113 701-22-113	2831		0	11.3	0	-105
0114 701-22-114	1.46%	126.5	0	11.4	0	-116
0115 701-22-115	1.04%	123.9	0	11.3	0	-120
0116 701-22-116	1.77%		0	11.3	0	-76
0117 701-22-117	1.71%		0	11.3	0	-67
0118 701-22-118	9704		12	4.8	0	29

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0119 701-22-119	961	23	2.5	17	35
0120 701-22-120	1485	5	3.3	3	9

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ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	9.27	24.59	93.9	1.92	365	0.5
0082 701-22-082	6.87	19.40	9.0		623	
0083 701-22-083	4.30	18.21	9.7		195	
0084 701-22-084	2.74	15.86	6.5	X	880	X
0085 701-22-085	3.43	12.41	3.1		278	
0086 701-22-086	2.91	23.02	5.3		304	
0087 701-22-087	3.47	18.58	7.8		202	
0088 701-22-088	2.57	12.06	2.3	X	580	X
0089 701-22-089	2.72	10.91	2.5		527	
0090 701-22-090	2.83	13.18	2.4		186	
0091 701-22-091	3.16	14.22	4.4		527	
0092 701-22-092	3.20	15.10	2.1		266	
0093 701-22-093	2.65	14.07	1.7	0.02	439	0.5
0094 701-22-094	3.44	32.76	1.8	0.01	1297	X
0095 701-22-095	1.07	29.19	1.5		1297	
0096 701-22-096	2.88	30.40	1.5		1169	
0097 701-22-097	0.97	41.69	3.0	X	1685*	X
0098 701-22-098	1.10	34.42	0.8		1426	
0099 701-22-099	0.96	22.52	8.8	0.10	392	1.2
0100 701-22-100	0.98	19.76	13.3		786	
0101 701-22-101	1.68	18.73	10.1		678	
0102 701-22-102	2.20	15.15	11.4		708	
0103 701-22-103	2.55	22.50	26.3		480	
0104 701-22-104	4.25	28.32	11.7		651	
0105 701-22-105	4.20	23.92	8.2		733	
0106 701-22-106	3.99	22.70	6.5		619	
0107 701-22-107	4.00	22.47	5.6	X	645	X
0108 701-22-108	3.91	20.60	6.2		595	
0109 701-22-109	4.20	24.16	6.1	X	630	X
0110 701-22-110	4.10	23.14	5.7		681	
0111 701-22-111	3.29	26.30	6.0	X	613	X
0112 701-22-112	3.86	21.97	7.2		627	
0113 701-22-113	4.12	22.85	6.0		675	
0114 701-22-114	4.09	20.30	6.1	X	615	X
0115 701-22-115	3.89	21.94	9.6	X	583	X
0116 701-22-116	3.94	24.96	5.3		568	
0117 701-22-117	3.88	18.27	5.3		505	
0118 701-22-118	3.38	21.98	12.3		543	

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0119 701-22-119	4.11	32.63	3.1	975
0120 701-22-120	5.18	31.27	0.7	547

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	151.9	8.9	2.7		6.518	121.20
0082 701-22-082	330.3		3.9		5.527	56.03
0083 701-22-083	35.3		6.6		5.494	75.03
0084 701-22-084	65.3	0.6	7.3		4.423	60.67
0085 701-22-085	205.8		6.7		3.845	96.60
0086 701-22-086	40.7		6.3		7.330	98.33
0087 701-22-087	39.0		6.2		5.998	90.05
0088 701-22-088	25.3	X	5.6		4.157	79.31
0089 701-22-089	18.6		6.2		3.384	100.99
0090 701-22-090	68.6		6.2		3.855	96.16
0091 701-22-091	38.1		6.1		4.038	82.68
0092 701-22-092	151.6		4.6		4.453	117.82
0093 701-22-093	19.6	0.5	4.2		4.104	117.92
0094 701-22-094	157.9	X	5.1		9.213	3.95
0095 701-22-095	189.1		4.7		8.441	4.46
0096 701-22-096	240.6		5.2		9.372	3.81
0097 701-22-097	209.4	X	5.8		10.231	5.40
0098 701-22-098	247.5		5.4		9.949	2.72
0099 701-22-099	10.6	0.9	4.2		6.215	91.48
0100 701-22-100	26.5		4.8		6.103	37.88
0101 701-22-101	50.9		3.8		5.726	107.36
0102 701-22-102	53.2		3.0	4.0	4.079	39.82
0103 701-22-103	17.0		3.2		6.325	91.46
0104 701-22-104	15.5		7.0		7.295	105.51
0105 701-22-105	16.5		5.0		6.562	111.81
0106 701-22-106	9.4		9.1		6.171	86.41
0107 701-22-107	9.2	0.6	8.1		6.135	71.47
0108 701-22-108	7.3		9.4		5.698	63.44
0109 701-22-109	5.1	1.4	9.0		6.763	71.21
0110 701-22-110	4.9		9.4	3.8	6.265	79.73
0111 701-22-111	16.8	5.4	8.8		7.388	68.04
0112 701-22-112	10.6		9.5	3.9	5.917	89.20
0113 701-22-113	6.7		9.1		6.264	95.27
0114 701-22-114	8.0	1.6	8.5		5.660	59.35
0115 701-22-115	29.3	3.4	8.6	3.9	6.034	65.77
0116 701-22-116	19.0		8.8		6.748	77.81
0117 701-22-117	4.7		9.7		5.027	75.64
0118 701-22-118	14.1		8.0	2.8	5.892	86.41

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0119 701-22-119	51.1	4.8	8.261	49.82
0120 701-22-120	15.4	5.9	8.549	51.13

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ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0081 701-22-081	X	7.28	6.81%	422.7	5.23	0.50
0082 701-22-082	X	4.51	4.63%		2.38	0.70
0083 701-22-083	0.019	0.81	8179		0.38	0.15
0084 701-22-084	0.018	1.82	1.91%	20.3	X	0.48
0085 701-22-085	0.014	1.29	1.26%		X	0.57
0086 701-22-086	0.007	1.16	1.14%		X	0.40
0087 701-22-087	0.030	1.52	1.64%		X	0.64
0088 701-22-088	0.005	2.25	2.68%	23.5	0.05	0.88
0089 701-22-089	0.003	2.45	2.86%		X	0.81
0090 701-22-090	0.003	0.98	1.00%		X	0.34
0091 701-22-091	0.007	1.40	1.31%		X	0.41
0092 701-22-092	X	0.97	1.01%		X	0.35
0093 701-22-093	0.007	1.03	1.02%	55.7	0.06	0.43
0094 701-22-094	0.004	3.96	4.22%	36.6	X	1.46
0095 701-22-095	0.004	4.30	4.66%		X	1.59
0096 701-22-096	0.004	4.72	4.78%		X	1.58
0097 701-22-097	0.004	1.59	1.74%	49.4	X	0.47
0098 701-22-098	0.004	4.12	4.52%		0.05	1.27
0099 701-22-099	0.087	2.11	2.50%	164.2	1.80	0.20
0100 701-22-100	0.085	5.26	4.68%		3.87	0.20
0101 701-22-101	0.043	5.29	5.34%		4.09	0.39
0102 701-22-102	0.010	7.65	6.30%		4.90	1.22
0103 701-22-103	0.007	3.52	3.86%		2.53	0.64
0104 701-22-104	0.003	0.38	4294		0.19	0.13
0105 701-22-105	0.003	1.36	1.32%		1.07	0.15
0106 701-22-106	0.002	1.17	1.14%		0.93	0.09
0107 701-22-107	0.002	0.78	7493	134.8	0.57	0.10
0108 701-22-108	0.003	0.04	391			X
0109 701-22-109	0.003	0.03	213	12.2		0.02
0110 701-22-110	0.003	0.05	421			0.02
0111 701-22-111	0.003	0.12	966	26.8	0.08	0.03
0112 701-22-112	0.004	0.08	655			0.03
0113 701-22-113	X	0.12	965			0.03
0114 701-22-114	0.005	0.04	316	19.3		0.03
0115 701-22-115	0.016	0.34	2737	37.1	0.25	0.06
0116 701-22-116	0.002	0.63	4697		0.43	0.12
0117 701-22-117	0.003	0.55	4154		0.42	0.06
0118 701-22-118	0.004	1.70	1.45%		1.29	0.17

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0119 701-22-119	0.003	1.33	1.07%	0.98	0.16
0120 701-22-120	X	0.50	3754	0.29	0.11

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ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	2.88	0.47	12.5	1.4	3.3	0.90
0082 701-22-082	2.90		6.9	1.1		0.65
0083 701-22-083	0.17		14.4	X		0.47
0084 701-22-084	0.14	0.04	17.0	1.3	2.3	1.35
0085 701-22-085	0.20		11.8	4.3		3.69
0086 701-22-086	0.19		10.5	2.1		1.79
0087 701-22-087	0.16		16.4	0.6		0.29
0088 701-22-088	0.32	0.03	14.1	2.2	4.3	1.22
0089 701-22-089	0.26		20.6	1.9		1.24
0090 701-22-090	0.35		11.0	2.4		1.94
0091 701-22-091	0.15		10.8	4.0		3.74
0092 701-22-092	0.29		8.1	1.1		1.18
0093 701-22-093	0.15	X	8.6	1.4	12.1	1.08
0094 701-22-094	2.26	0.11	6.6	7.8	3.7	6.77
0095 701-22-095	0.82		6.2	18.8		17.64
0096 701-22-096	1.06		6.7	12.4		10.84
0097 701-22-097	1.74	0.03	6.3	10.0	19.3	9.43
0098 701-22-098	2.66		7.6	29.8		27.55
0099 701-22-099	0.17	0.22	10.6	2.3	22.9	1.93
0100 701-22-100	0.27		4.9	6.9		6.20
0101 701-22-101	0.40		8.2	5.0		4.85
0102 701-22-102	0.84		8.7	2.5		2.66
0103 701-22-103	0.61		9.7	1.8		1.86
0104 701-22-104	0.31		13.9	0.6		0.18
0105 701-22-105	0.51		10.7	X		0.25
0106 701-22-106	0.13		11.7	0.7		0.25
0107 701-22-107	0.26	0.28	11.6	0.5	1.9	0.14
0108 701-22-108	0.13		10.7	X		X
0109 701-22-109	0.24	0.12	10.9	0.6	1.7	X
0110 701-22-110	0.20		11.4	X		0.03
0111 701-22-111	0.18	0.16	9.8	0.8	59.6	0.26
0112 701-22-112	0.14		13.2	X		X
0113 701-22-113	0.19		10.5	X		X
0114 701-22-114	0.14	0.11	9.9	X	1.5	X
0115 701-22-115	0.33	0.52	11.6	X	1.2	0.03
0116 701-22-116	0.23		13.6	X		0.21
0117 701-22-117	0.25		11.4	X		0.09
0118 701-22-118	0.39		11.1	0.9		0.64

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0119 701-22-119	0.64	16.1	0.7	0.60
0120 701-22-120	0.36	9.2	X	0.14

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ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	4.46	5.2	X	287.53	37.66	0.65
0082 701-22-082	3.47	3.8		311.82		0.51
0083 701-22-083	2.58	0.9		83.32		0.36
0084 701-22-084	2.97	0.8	X	158.93	632.67	0.27
0085 701-22-085	1.78	1.5		68.63		0.30
0086 701-22-086	3.13	1.3		64.67		0.26
0087 701-22-087	2.48	1.1		52.02		0.30
0088 701-22-088	1.86	1.0	X	148.11	33.50	0.25
0089 701-22-089	1.88	1.1		144.14		0.23
0090 701-22-090	2.04	2.2		57.61		0.22
0091 701-22-091	2.42	1.6		148.85		0.26
0092 701-22-092	2.35	1.1		113.25		0.26
0093 701-22-093	2.21	1.3	X	60.26	30.94	0.24
0094 701-22-094	6.06	7.2	X	1017.44	251.43	0.27
0095 701-22-095	4.97	2.0		792.98		0.09
0096 701-22-096	4.26	2.7		731.77		0.23
0097 701-22-097	9.13	1.5	X	1704.67*	80.15	0.07
0098 701-22-098	6.57	3.3		1009.31		0.09
0099 701-22-099	4.19	1.3	X	209.43	93.60	0.09
0100 701-22-100	2.69	3.2		465.23		0.10
0101 701-22-101	2.95	1.7		209.64*		0.16
0102 701-22-102	2.84	2.1		482.74		0.18
0103 701-22-103	3.84	2.6		318.02		0.25
0104 701-22-104	5.92	1.1		58.04		0.35
0105 701-22-105	4.34	1.5		23.89		0.35
0106 701-22-106	3.99	0.6		342.38		0.31
0107 701-22-107	3.99	0.6	X	303.81	299.60	0.31
0108 701-22-108	3.73	0.4		401.43		0.32
0109 701-22-109	4.18	0.5	X	371.97	77.45	0.32
0110 701-22-110	3.98	0.5		354.98		0.32
0111 701-22-111	4.43	1.1	X	167.06	90.62	0.26
0112 701-22-112	3.95	1.0		227.90		0.29
0113 701-22-113	3.89	0.5		79.63		0.32
0114 701-22-114	3.63	0.5	X	152.79	98.20	0.33
0115 701-22-115	3.98	1.0	X	159.50	70.94	0.30
0116 701-22-116	4.60	0.8		313.55		0.31
0117 701-22-117	3.52	0.6		341.74		0.30
0118 701-22-118	3.92	1.5		176.44		0.30

ANALYSIS

0119 701-22-119	6.56	1.6	628.18	0.34
0120 701-22-120	5.09	0.6	194.12	0.41

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0081 701-22-081	0.299	1475	1.56	16.29	18.414	3221
0082 701-22-082	0.241		0.41	26.84		1332
0083 701-22-083	0.195		0.10	16.47		2431
0084 701-22-084	0.249	180	0.28	18.02	0.078	1819
0085 701-22-085	0.142		0.34	10.46		2015
0086 701-22-086	0.172		0.16	21.19		1913
0087 701-22-087	0.164		0.08	19.59		2066
0088 701-22-088	0.254	155	0.38	22.15	0.142	1792
0089 701-22-089	0.260		0.30	12.08		1806
0090 701-22-090	0.221		0.87	17.16		2077
0091 701-22-091	0.234		0.12	12.72		2190
0092 701-22-092	0.214		0.93	21.82		1897
0093 701-22-093	0.377	265	1.57	17.38	0.496	1638
0094 701-22-094	0.386	195	0.34	26.72	0.660	2505
0095 701-22-095	0.299		0.87	24.41		671
0096 701-22-096	0.237		0.52	26.36		1712
0097 701-22-097	0.517	331	1.88	27.31	0.094	659
0098 701-22-098	0.656		3.73	26.59		560
0099 701-22-099	0.482	682	0.22	19.59	6.524	901
0100 701-22-100	0.140		0.31	21.17		650
0101 701-22-101	0.232		0.82	23.40		984
0102 701-22-102	0.246		1.47	11.44		1589
0103 701-22-103	0.394		0.46	14.69		1494
0104 701-22-104	0.743		0.40	18.33		2922
0105 701-22-105	0.458		0.84	18.47		2702
0106 701-22-106	0.433		X	16.36		2651
0107 701-22-107	0.425	631	0.25	16.19	0.074	2590
0108 701-22-108	0.420		X	15.55		2457
0109 701-22-109	0.438	386	X	16.49	0.624	2525
0110 701-22-110	0.399		X	16.70		2526
0111 701-22-111	0.477	306	0.10	14.45	0.426	2112
0112 701-22-112	0.423		X	15.00		2836
0113 701-22-113	0.397		X	17.14		2490
0114 701-22-114	0.391	352	X	14.60	0.478	2431
0115 701-22-115	0.441	400	X	15.30	0.489	2117
0116 701-22-116	0.479		0.35	16.25		2436
0117 701-22-117	0.406		0.19	12.77		2290
0118 701-22-118	0.415		0.32	15.01		2035

ANALYSIS

0119 701-22-119	0.960	0.31	19.32	2320
0120 701-22-120	0.464	0.20	21.91	1856

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.28	0.15	3.74	92.993	89	0.07
0082 701-22-082	0.62	0.11	7.69		52	
0083 701-22-083	0.89	0.06	2.59		89	
0084 701-22-084	0.70	0.08	2.58	0.227	230	X
0085 701-22-085	1.15	0.06	3.96		120	
0086 701-22-086	1.13	0.05	3.30		112	
0087 701-22-087	0.98	0.05	1.97		100	
0088 701-22-088	0.94	0.12	1.56	0.111	86	X
0089 701-22-089	1.15	0.11	1.35		128	
0090 701-22-090	1.32	0.08	2.30		105	
0091 701-22-091	1.02	0.07	1.55		87	
0092 701-22-092	1.67	0.10	2.69		87	
0093 701-22-093	1.63	0.11	1.89	0.706	93	X
0094 701-22-094	0.05	0.08	4.05	0.297	91	X
0095 701-22-095	0.04	0.06	3.55		85	
0096 701-22-096	0.04	0.05	3.15		84	
0097 701-22-097	0.08	0.05	8.58	0.194	109	X
0098 701-22-098	0.02	0.06	5.38		90	
0099 701-22-099	1.48	0.16	3.42	7.744	88	X
0100 701-22-100	0.56	0.04	2.30		77	
0101 701-22-101	1.83	0.12	3.94		64	
0102 701-22-102	0.53	0.11	4.29		78	
0103 701-22-103	1.10	0.15	4.80		87	
0104 701-22-104	1.09	0.35	4.42		117	
0105 701-22-105	0.81	0.23	5.40		103	
0106 701-22-106	0.49	0.21	3.62		103	
0107 701-22-107	0.44	0.21	3.45	3.732	102	X
0108 701-22-108	0.36	0.20	3.30		97	
0109 701-22-109	0.37	0.21	3.38	2.562	88	0.03
0110 701-22-110	0.36	0.20	3.86		93	
0111 701-22-111	0.45	0.21	3.29	2.995	84	0.02
0112 701-22-112	0.59	0.20	3.10		111	
0113 701-22-113	0.69	0.20	2.71		92	
0114 701-22-114	0.41	0.18	2.94	0.803	92	0.02
0115 701-22-115	0.42	0.22	3.52	1.670	81	0.01
0116 701-22-116	0.44	0.23	3.61		97	
0117 701-22-117	0.49	0.20	3.26		95	
0118 701-22-118	0.61	0.19	3.51		90	

ANALYSIS

0119 701-22-119	0.46	0.52	4.55	117
0120 701-22-120	0.27	0.33	5.48	84

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0081 701-22-081	3.4	6.40	1.14	18	1.03	55.5
0082 701-22-082	3.3	4.97	0.92	12		44.3
0083 701-22-083	1.9	4.66	0.52	42		30.7
0084 701-22-084	1.5	7.11	0.49	52	X	24.5
0085 701-22-085	1.4	3.11	0.38	25		24.4
0086 701-22-086	1.4	3.15	0.32	28		13.8
0087 701-22-087	2.4	3.82	0.35	24		13.1
0088 701-22-088	4.8	7.86	0.66	27	X	16.4
0089 701-22-089	2.4	8.29	0.78	27		11.9
0090 701-22-090	2.6	6.02	1.08	15		10.8
0091 701-22-091	1.9	5.18	0.47	28		9.2
0092 701-22-092	2.1	6.05	0.97	15		38.0
0093 701-22-093	1.7	8.29	0.65	18	0.07	9.5
0094 701-22-094	4.1	5.00	0.50	5	0.14	29.6
0095 701-22-095	2.1	3.83	0.59	7		16.2
0096 701-22-096	2.8	3.53	0.31	5		17.6
0097 701-22-097	2.9	4.17	0.31	15	0.27	19.9
0098 701-22-098	1.5	5.67	0.32	16		7.6
0099 701-22-099	1.5	11.31	1.01	25	3.16	37.2
0100 701-22-100	4.2	2.41	0.26	10		18.4
0101 701-22-101	1.3	6.17	1.14	20		43.5
0102 701-22-102	2.3	7.83	0.82	17		44.3
0103 701-22-103	1.2	7.70	1.01	94		43.8
0104 701-22-104	1.5	22.58	2.29	452		91.0
0105 701-22-105	1.7	14.33	1.60	74		86.2
0106 701-22-106	1.3	13.46	1.40	42		70.5
0107 701-22-107	1.7	13.06	1.33	33	X	71.0
0108 701-22-108	1.8	11.81	1.33	24		56.9
0109 701-22-109	2.2	12.87	1.40	22	X	55.0
0110 701-22-110	2.5	11.96	1.31	23		63.1
0111 701-22-111	2.6	13.76	1.41	73	X	40.8
0112 701-22-112	1.9	12.59	1.31	56		51.5
0113 701-22-113	1.1	11.86	1.41	56		54.2
0114 701-22-114	1.6	10.70	1.30	44	X	38.8
0115 701-22-115	2.3	12.85	1.37	74	X	39.2
0116 701-22-116	2.7	14.94	1.49	41		68.1
0117 701-22-117	1.5	11.61	1.42	30		66.1
0118 701-22-118	1.4	10.92	1.28	601		74.0

ANALYSIS

0119 701-22-119	2.5	34.07	3.27	62	95.6
0120 701-22-120	1.0	16.57	2.06	34	68.5

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0121 701-22-121	0.16	0.01	8.71%	0.70	5	6.2
0122 701-22-122	0.12	0.07	8.04%	18.50	3	6.7
0123 701-22-123	0.44	0.02	2.81%	0.15	10	13.3
0124 701-22-124	0.94		5217		6	9.4
0125 701-22-125	0.61		4.76%		2	25.1
0126 701-22-126	0.19	0.02	5.27%	0.09	1	20.6
0127 701-22-127	0.25		5.92%		3	11.7
0128 701-22-128	0.33		4.82%		2	17.0
0129 701-22-129	0.55		3.01%		2	18.5
0130 701-22-130	0.68	0.07	4.01%	1.85	1	23.6
0131 701-22-131	0.49		3.33%		1	68.4
0132 701-22-132	0.29	0.01	6.04%	0.12	2	101.5
0133 701-22-133	0.57		5.97%		3	9.0
0134 701-22-134	0.37		4.49%		2	16.9
0135 701-22-135	0.59	0.03	5.24%	0.04	3	10.1
0136 701-22-136	0.46		6.73%		5	4.5
0137 701-22-137	0.22		9.51%		-4	14.5
0138 701-22-138	0.23		9.66%		3	4.0
0139 701-22-139	0.07		11.19%		3	3.2
0140 701-22-140	0.09	0.02	11.06%	18.93	1	3.1
0141 701-22-141	0.12		10.12%		3	4.8
0142 701-22-142	X		11.66%		5	3.2
0143 701-22-143	0.44		9.81%		-1	34.1
0144 701-22-144	0.07		6.76%		-2	14.5
0145 701-22-145	0.73		4.17%		-7	54.9
0146 701-22-146	0.13	X	6.38%	47.16	-1	25.7
0147 701-22-147	0.23	0.03	8.63%	33.36	2	6.1
0148 701-22-148	0.11	X	6.31%	42.85	-2	44.2
0149 701-22-149	0.29		9.71%		0	13.1
0150 701-22-150	0.20		8.87%		-2	9.4

CHECKS						
0001 701-22-001	0.65	0.04	10.73%	0.62	-3	4.0
0002 701-22-021	1.55		8.97%		13	14.6
0003 701-22-041	0.17	X	8.24%	0.08	1	8.2
0004 701-22-061	0.49		7.69%		1	6.9
0005 701-22-081	0.77	0.06	7.48%	67.91	-2	48.1
0006 701-22-101	0.34		8.54%		2	69.7

ANALYSIS

0007 701-22-121	0.22	X	9.30%	0.89	5	6.1
0008 701-22-141	0.13		10.15%		4	5.0

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.6	X	0.03	98.6	11.75	1.23
0122 701-22-122	1.2	X	0.06	270.5	5.66	1.28
0123 701-22-123	2.6	X	X	443.2	30.15	0.14
0124 701-22-124		X		1500.7		0.21
0125 701-22-125		X		500.1		0.11
0126 701-22-126	0.7	X	X	711.6	65.35	0.21
0127 701-22-127		X		469.4		0.05
0128 701-22-128		X		412.2		0.13
0129 701-22-129		X		531.0		0.14
0130 701-22-130	1.2	X	X	416.9	54.72	0.13
0131 701-22-131		X		657.0		0.09
0132 701-22-132	1.0	X	X	560.9	32.50	0.19
0133 701-22-133		X		472.4		0.27
0134 701-22-134		X		794.9		0.06
0135 701-22-135	1.0	X	X	669.5	13.52	0.18
0136 701-22-136		X		335.6		0.96
0137 701-22-137		X		654.6		1.06
0138 701-22-138		X		495.0		1.82
0139 701-22-139		X		1325.7		1.43
0140 701-22-140	4.7	X	X	310.5	10.27	1.18
0141 701-22-141		X		550.3		1.26
0142 701-22-142		X		1125.2		1.53
0143 701-22-143		X		623.1		0.65
0144 701-22-144		X		165.7		0.11
0145 701-22-145		X		56.0		X
0146 701-22-146	3.7	X	X	275.4	0.09	0.15
0147 701-22-147	2.7	X	X	306.3	3.24	0.39
0148 701-22-148	4.4	X	X	115.6	0.44	X
0149 701-22-149		X		597.4		0.86
0150 701-22-150		X		120.0		0.18

CHECKS

0001 701-22-001	X	X	0.01	257.6	6.09	2.18
0002 701-22-021		X		304.1		1.48
0003 701-22-041	1.5	X	X	296.6	3.73	0.36
0004 701-22-061		X		396.9		0.79
0005 701-22-081	21.3	X	X	290.3	2.79	0.86
0006 701-22-101		X		319.3		0.92

ANALYSIS

0007 701-22-121	1.7	X	0.03	96.7	11.47	1.36
0008 701-22-141		X		562.4		1.05

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.9	0.44	X	0.02	207	9.70
0122 701-22-122	7.1	0.82	X	0.05	470	36.42
0123 701-22-123	X	0.63	X	0.15	3117	28.66
0124 701-22-124		1.85		0.08	1360	
0125 701-22-125		1.26		0.04	799	
0126 701-22-126	X	1.36	X	0.02	789	19.63
0127 701-22-127		1.45		0.02	779	
0128 701-22-128		1.54		0.02	801	
0129 701-22-129		2.49		0.03	549	
0130 701-22-130	X	1.75	X	0.02	634	23.05
0131 701-22-131		1.65		0.03	441	
0132 701-22-132	X	3.63	X	0.02	666	6.71
0133 701-22-133		2.25		0.08	680	
0134 701-22-134		4.42		0.04	640	
0135 701-22-135	X	1.42	0.011	0.02	814	7.44
0136 701-22-136		3.15		0.03	512	
0137 701-22-137		0.28		0.02	503	
0138 701-22-138		0.75		0.02	568	
0139 701-22-139		0.07		0.04	421	
0140 701-22-140	9.2	0.10	X	0.04	343	49.34
0141 701-22-141		0.09		0.04	484	
0142 701-22-142		0.06		0.02	702	
0143 701-22-143		0.86		0.04	357	
0144 701-22-144		1.28		0.02	591	
0145 701-22-145		8.10		0.02	447	
0146 701-22-146	0.8	1.04	X	X	451	14.37
0147 701-22-147	1.9	2.23	X	0.03	776	39.62
0148 701-22-148	0.5	0.29	X	0.01	544	10.55
0149 701-22-149		2.39		0.04	526	
0150 701-22-150		2.02		0.02	744	

CHECKS						
0001 701-22-001	X	0.15	X	0.05	987	7.52
0002 701-22-021		1.45		1.10	942	
0003 701-22-041	X	1.76	X	0.03	826	19.39
0004 701-22-061		3.42		0.03	909	
0005 701-22-081	1.4	3.76	0.408	0.06	329	21.20
0006 701-22-101		3.19		0.05	781	

ANALYSIS

0007 701-22-121	1.0	0.47	X	0.04	249	8.70
0008 701-22-141		0.10		0.04	486	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0121 701-22-121	X	0.24	64.45	76	1.9	47.6
0122 701-22-122	0.05	5.25	68.37	54	6.5	604.4
0123 701-22-123	X	X	44.42	18	0.5	1.4
0124 701-22-124	X		27.48		0.3	
0125 701-22-125	X		50.78		0.2	
0126 701-22-126	X	0.04	50.63	35	0.4	14.5
0127 701-22-127	X		46.09		0.1	
0128 701-22-128	0.03		65.76		0.3	
0129 701-22-129	0.03		53.81		0.2	
0130 701-22-130	X	0.05	35.18	59	0.2	1.2
0131 701-22-131	X		43.72		0.5	
0132 701-22-132	X	X	44.38	27	0.2	3.1
0133 701-22-133	X		57.82		0.5	
0134 701-22-134	X		70.03		0.2	
0135 701-22-135	X	0.03	59.48	18	0.2	4.3
0136 701-22-136	0.03		56.73		1.0	
0137 701-22-137	3.37		28.86		48.5	
0138 701-22-138	0.74		76.30		9.2	
0139 701-22-139	0.04		109.80		5.1	
0140 701-22-140	0.07	11.89	90.87	10	27.7	5491.4
0141 701-22-141	0.26		84.58		7.0	
0142 701-22-142	X		103.80		1.4	
0143 701-22-143	0.32		39.07		11.9	
0144 701-22-144	X		33.14		4.9	
0145 701-22-145	0.04		25.31		6.0	
0146 701-22-146	0.06	28.32	38.76	3	9.4	362.7
0147 701-22-147	0.08	23.88	32.25	7	10.4	922.6
0148 701-22-148	0.03	3.57	40.10	2	18.5	142.3
0149 701-22-149	0.04		58.40		10.9	
0150 701-22-150	0.21		55.70		13.0	

CHECKS

0001 701-22-001	0.20	3.05	63.92	8	1.3	10.7
0002 701-22-021	1.38		67.18		20.5	
0003 701-22-041	0.13	4.00	46.01	54	12.6	277.8
0004 701-22-061	0.04		54.86		0.6	
0005 701-22-081	0.03	1.08	47.53	30	22.3	3216.0
0006 701-22-101	0.18		50.74		14.5	

ANALYSIS

0007 701-22-121	X	0.27	62.73	80	1.9	50.1
0008 701-22-141	0.24		84.05		7.0	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	No	3	X	1.40	43.7	1.20
0122 701-22-122	No	4	X	1.41	267.4	51.26
0123 701-22-123	No	13	X	0.09	8.6	0.03
0124 701-22-124	No	11		0.11	9.2	
0125 701-22-125	No	20		0.07	5.9	
0126 701-22-126	No	19	X	0.07	3.7	0.01
0127 701-22-127	No	18		0.07	3.3	
0128 701-22-128	No	22		0.07	8.8	
0129 701-22-129	No	17		0.07	22.0	
0130 701-22-130	No	17	X	0.08	9.6	0.06
0131 701-22-131	No	25		0.06	50.5	
0132 701-22-132	No	9	X	0.08	22.7	0.01
0133 701-22-133	No	8		0.26	373.2	
0134 701-22-134	No	12		0.09	98.1	
0135 701-22-135	No	14	X	0.17	65.6	0.02
0136 701-22-136	No	9		1.14	46.3	
0137 701-22-137	No	8		2.04	276.6	
0138 701-22-138	No	10		5.34	79.7	
0139 701-22-139	No	11		4.13	19.8	
0140 701-22-140	No	8	X	3.45	15.4	0.35
0141 701-22-141	No	8		2.46	293.8	
0142 701-22-142	No	7		1.60	4.2	
0143 701-22-143	No	10		1.80	354.9	
0144 701-22-144	No	23		0.07	425.6	
0145 701-22-145	No	17		X	3253.6	
0146 701-22-146	No	21	0.33	0.08	998.9	130.44
0147 701-22-147	No	13	0.02	0.74	383.3	86.26
0148 701-22-148	No	30	0.18	0.05	1049.8	33.88
0149 701-22-149	No	14		1.67	339.0	
0150 701-22-150	No	16		0.41	368.3	

CHECKS

0001 701-22-001	No	11	X	2.63	410.7	1.63
0002 701-22-021	Yes	16		12.92	1336.1	
0003 701-22-041	No	11	X	0.40	61.9	0.04
0004 701-22-061	No	7		0.87	165.5	
0005 701-22-081	No	85	0.09	8.45	513.8	13.65
0006 701-22-101	No	7		1.20	327.7	

ANALYSIS

0007 701-22-121	No	4	X	1.38	53.2	1.23
0008 701-22-141	No	10		2.50	298.1	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0121 701-22-121	2.09	895	1.14	1.06	0.2	0.87
0122 701-22-122	4.60	1496	3.49	1.09	0.9	1.08
0123 701-22-123	0.85	320	0.44	0.53	0.7	1.77
0124 701-22-124	0.65		0.41	0.26		0.79
0125 701-22-125	0.80		0.37	0.90		3.57
0126 701-22-126	0.87	339	0.48	0.85	0.4	1.90
0127 701-22-127	0.97		0.48	0.70		1.49
0128 701-22-128	1.15		0.63	1.06		2.73
0129 701-22-129	1.07		0.56	0.93		2.07
0130 701-22-130	0.83	509	0.50	0.70	0.3	1.74
0131 701-22-131	0.41		0.28	0.55		10.32
0132 701-22-132	0.81	240	0.40	0.76	0.1	1.74
0133 701-22-133	1.29		0.64	0.86		2.21
0134 701-22-134	0.89		0.34	0.92		4.27
0135 701-22-135	0.65	194	0.34	0.82	0.1	4.78
0136 701-22-136	1.84		1.12	0.76		3.47
0137 701-22-137	1.89		1.14	0.53		1.51
0138 701-22-138	2.80		1.60	1.17		1.26
0139 701-22-139	4.09		2.17	1.87		1.30
0140 701-22-140	2.42	1034	1.17	1.35	0.5	1.61
0141 701-22-141	1.39		0.74	1.03		1.41
0142 701-22-142	2.38		1.22	1.79		0.80
0143 701-22-143	1.20		0.81	0.36		2.18
0144 701-22-144	0.75		0.32	0.66		6.58
0145 701-22-145	0.45		0.21	0.47		19.02*
0146 701-22-146	0.63	1344	0.31	0.61	X	5.58
0147 701-22-147	1.24	1321	0.65	0.64	X	3.24
0148 701-22-148	0.26	1176	0.12	0.39	X	8.33
0149 701-22-149	1.30		0.81	0.61		2.26
0150 701-22-150	1.42		0.64	1.03		5.14

CHECKS						
0001 701-22-001	2.36	256	1.13	0.99	X	1.09
0002 701-22-021	3.47		1.82	1.35		7.29
0003 701-22-041	0.96	494	0.44	0.79	X	5.43
0004 701-22-061	1.14		0.54	0.76		3.43
0005 701-22-081	1.21	2340	0.69	0.67	X	6.33
0006 701-22-101	2.76		1.79	0.76		4.62

ANALYSIS

0007 701-22-121	2.26	880	1.30	1.06	0.2	1.05
0008 701-22-141	1.35		0.76	0.97		1.46

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.03	1.5	0	17.10	2.75	0.78
0122 701-22-122	1.39	1.5	0	18.17	3.31	1.08
0123 701-22-123	X	1.5	0	3.25	1.39	0.99
0124 701-22-124		1.5	0	1.22	0.86	1.16
0125 701-22-125		1.5	0	8.23	1.87	0.79
0126 701-22-126	X	1.4	0	8.98	2.08	0.78
0127 701-22-127		1.4	0	13.59	2.23	0.93
0128 701-22-128		1.4	0	6.80	2.58	1.00
0129 701-22-129		1.5	0	4.31	2.28	1.13
0130 701-22-130	0.18	1.4	0	6.76	1.69	1.18
0131 701-22-131		1.5	0	11.88	1.19	1.95
0132 701-22-132	0.02	1.5	0	14.62	1.87	0.69
0133 701-22-133		1.8	0	14.50	2.40	0.43
0134 701-22-134		1.6	0	17.56	2.08	0.55
0135 701-22-135	X	1.5	0	9.52	1.76	0.64
0136 701-22-136		1.5	0	26.79	2.39	1.06
0137 701-22-137		1.5	0	15.39	1.80	1.22
0138 701-22-138		1.5	0	17.24	3.31	1.31
0139 701-22-139		1.4	0	21.20	5.32	1.35
0140 701-22-140	3.02	1.5	0	19.66	3.57	1.00
0141 701-22-141		1.5	0	18.31	2.39	1.26
0142 701-22-142		1.5	0	18.87	4.40	1.42
0143 701-22-143		1.5	0	18.34	1.11	1.11
0144 701-22-144		1.4	0	7.91	1.73	0.64
0145 701-22-145		1.4	0	2.40	1.05	0.52
0146 701-22-146	167.49	1.4	0	8.56	1.41	0.79
0147 701-22-147	35.23	1.4	0	11.49	1.83	0.56
0148 701-22-148	241.22	1.4	0	2.80	0.68	0.98
0149 701-22-149		1.5	0	17.40	1.73	1.16
0150 701-22-150		1.5	0	13.63	2.83	1.33

CHECKS						
0001 701-22-001	0.10	1.5	0	15.76	3.19	0.99
0002 701-22-021		1.1	0	19.12	4.21	1.24
0003 701-22-041	0.04	1.4	0	11.98	2.30	0.73
0004 701-22-061		1.5	0	18.37	1.90	0.93
0005 701-22-081	249.69	1.4	0	18.82	2.43	1.15
0006 701-22-101		1.5	0	16.54	2.68	1.17

ANALYSIS

0007 701-22-121	0.09	1.5	0	17.10	2.79	0.75
0008 701-22-141		1.5	0	18.81	2.32	1.21

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0121 701-22-121	1.77	X	X	0.39	0.086	1.02%
0122 701-22-122	2.36	X	X	1.10	0.153	1.14%
0123 701-22-123	1.07	X	X	0.14	X	1.01%
0124 701-22-124	0.97	0.05		0.12	X	1079
0125 701-22-125	0.97	0.04		0.13	0.009	1.47%
0126 701-22-126	1.85	0.03	X	0.16	X	1.19%
0127 701-22-127	1.13	0.02		0.15	0.005	7169
0128 701-22-128	1.44	0.01		0.19	0.008	1.58%
0129 701-22-129	1.24	0.01		0.17	X	1.03%
0130 701-22-130	1.12	X	X	0.16	0.009	1.33%
0131 701-22-131	0.71	0.02		0.08	0.101	1.26%
0132 701-22-132	1.21	X	X	0.13	0.023	9907
0133 701-22-133	1.12	X		0.22	0.042	7249
0134 701-22-134	0.61	X		0.13	0.053	5455
0135 701-22-135	0.93	X	X	0.11	0.063	7254
0136 701-22-136	1.91	0.02		0.39	0.285	2.80%
0137 701-22-137	1.46	0.04		0.38	0.224	4.19%
0138 701-22-138	1.71	0.02		0.55	0.108	3.51%
0139 701-22-139	2.19	X		0.77	0.037	2.22%
0140 701-22-140	1.97	0.02	X	0.42	0.039	2.96%
0141 701-22-141	1.79	X		0.25	0.083	2.64%
0142 701-22-142	1.67	X		0.43	0.037	1.98%
0143 701-22-143	1.58	0.02		0.26	0.451	3.64%
0144 701-22-144	0.71	X		0.13	0.022	2.60%
0145 701-22-145	0.53	0.05		0.07	0.051	1.17%
0146 701-22-146	0.95	0.01	X	0.10	0.087	1.34%
0147 701-22-147	1.35	X	X	0.21	0.190	1.57%
0148 701-22-148	0.24	0.01	X	0.04	0.023	2.17%
0149 701-22-149	1.94	0.02		0.26	0.332	3.28%
0150 701-22-150	1.51	0.01		0.23	0.081	2437

CHECKS

0001 701-22-001	1.73	X	X	0.44	0.572	3.88%
0002 701-22-021	0.16	0.02		0.63	0.419	2.18%
0003 701-22-041	1.18	X	X	0.15	0.065	1.06%
0004 701-22-061	1.54	X		0.18	0.409	3.74%
0005 701-22-081	1.08	0.16	X	0.21	0.182	2.36%
0006 701-22-101	0.97	X		0.58	0.379	3.49%

ANALYSIS

0007 701-22-121	1.80	X	X	0.43	0.085	1.22%
0008 701-22-141	1.76	X		0.26	0.088	2.66%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	19.8	36.18	9.0	0.178	1368	20.21
0122 701-22-122	30.9	36.31	10.0	0.487	1183	96.17
0123 701-22-123	6.1	24.28	0.5	0.094	952	8.82
0124 701-22-124		15.71	1.2	0.088	229	
0125 701-22-125		28.10	0.2	0.077	206	
0126 701-22-126	8.4	27.44	0.3	0.123	97	6.74
0127 701-22-127		22.50	0.3	0.111	119	
0128 701-22-128		35.72	0.4	0.134	130	
0129 701-22-129		31.39	0.2	0.125	123	
0130 701-22-130	11.9	19.02	0.4	0.107	124	13.60
0131 701-22-131		24.22	0.3	0.073	149	
0132 701-22-132	5.7	25.62	0.5	0.120	115	6.12
0133 701-22-133		30.95	0.5	0.138	459	
0134 701-22-134		43.05	0.7	0.065	104	
0135 701-22-135	8.8	32.65	0.5	0.073	102	4.22
0136 701-22-136		32.43	0.8	0.203	1621	
0137 701-22-137		17.95	3.6	0.185	2952	
0138 701-22-138		44.42	13.9	0.231	3446	
0139 701-22-139		62.28	11.3	0.329	2179	
0140 701-22-140	16.1	52.44	3.6	0.188	3028	73.63
0141 701-22-141		45.96	5.4	0.145	2728	
0142 701-22-142		54.69	6.7	0.220	1621	
0143 701-22-143		26.77	3.1	0.150	2980	
0144 701-22-144		17.96	0.4	0.054	134	
0145 701-22-145		12.34	0.2	0.048	55	
0146 701-22-146	1.1	21.18	0.4	0.082	68	7.44
0147 701-22-147	10.6	19.17	0.9	0.122	754	46.10
0148 701-22-148	1.3	22.22	0.3	0.024	70	3.86
0149 701-22-149		36.01	3.5	0.152	2423	
0150 701-22-150		31.12	1.6	0.143	164	

CHECKS						
0001 701-22-001	17.1	36.19	5.1	0.174	4068	6.18
0002 701-22-021		37.44	15.8	0.203	4675	
0003 701-22-041	8.9	24.76	1.2	0.092	539	16.43
0004 701-22-061		30.02	0.2	0.115	2058	
0005 701-22-081	21.5	24.69	2.8	0.124	2011	40.09
0006 701-22-101		30.44	0.8	0.241	2692	

ANALYSIS

0007 701-22-121	19.6	34.93	8.8	0.190	1465	20.49
0008 701-22-141		45.86	5.7	0.142	2762	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0121 701-22-121	27	0.12		1.1	1.25	17
0122 701-22-122	34	0.73		1.5	0.54	36
0123 701-22-123	34	X		4.3	11.94	62
0124 701-22-124	45			2.3		8
0125 701-22-125	31			4.3		98
0126 701-22-126	36	0.08		4.4	2.45	68
0127 701-22-127	29			5.3		54
0128 701-22-128	33			3.9		94
0129 701-22-129	40			4.9		68
0130 701-22-130	35	0.18		5.4	8.21	56
0131 701-22-131	28			3.1		76
0132 701-22-132	18	0.04		7.9	1.55	48
0133 701-22-133	37			2.4		30
0134 701-22-134	76			2.5		42
0135 701-22-135	107	0.08		1.7	1.63	59
0136 701-22-136	246			1.5		3
0137 701-22-137	43			1.4		73
0138 701-22-138	57			1.4		23
0139 701-22-139	45			1.4		24
0140 701-22-140	38	2.11		1.2	1.06	38
0141 701-22-141	51			1.6		38
0142 701-22-142	29			0.6		3
0143 701-22-143	46			1.8		77
0144 701-22-144	20			1.4		354
0145 701-22-145	61			1.3		815
0146 701-22-146	16	0.74		1.4	2.63	300
0147 701-22-147	38	2.71		2.0	0.96	118
0148 701-22-148	19	0.58		46.8	1.43	408
0149 701-22-149	81			1.9		62
0150 701-22-150	31			1.4		176

CHECKS						
0001 701-22-001	164	1.27		1.1	0.07	31
0002 701-22-021	4662			1.2		74
0003 701-22-041	44	0.67		1.2	0.12	197
0004 701-22-061	99			0.9		44
0005 701-22-081	41	0.31		1.2	0.59	217
0006 701-22-101	38			4.7		162

ANALYSIS

0007 701-22-121	38	0.11	1.1	0.18	19
0008 701-22-141	49		1.6		39

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0121 701-22-121	697	145.5	11	2.9	7	12
0122 701-22-122	663	164.3	12	2.9	7	33
0123 701-22-123	1071	23.8	0	7.1	0	52
0124 701-22-124	417		1	6.8	0	2
0125 701-22-125	1815		13	4.6	0	96
0126 701-22-126	1468	32.1	9	4.5	0	67
0127 701-22-127	1233		6	4.7	0	51
0128 701-22-128	1965		11	4.5	0	92
0129 701-22-129	1141		5	4.7	0	66
0130 701-22-130	1718	57.0	6	4.5	0	55
0131 701-22-131	1456		6	4.5	0	75
0132 701-22-132	993	27.3	5	4.8	0	46
0133 701-22-133	632		0	5.9	0	27
0134 701-22-134	937		4	5.3	0	40
0135 701-22-135	2035	18.3	6	5.0	0	56
0136 701-22-136	391		1	6.6	0	-2
0137 701-22-137	478		22	2.7	16	77
0138 701-22-138	460		15	2.7	11	20
0139 701-22-139	454		17	2.6	12	21
0140 701-22-140	435	40.2	30	2.4	24	37
0141 701-22-141	474		24	2.4	19	35
0142 701-22-142	383		4	4.9	0	-2
0143 701-22-143	762		45	2.4	38	77
0144 701-22-144	2620		193	2.4	178	356
0145 701-22-145	1705		533	2.3	493	822
0146 701-22-146	2150	6.5	162	2.4	149	301
0147 701-22-147	845	51.5	81	2.3	74	115
0148 701-22-148	2568	4.6	236	2.3	216	409
0149 701-22-149	550		42	2.3	35	62
0150 701-22-150	626		143	2.2	133	178

CHECKS						
0001 701-22-001	1480	14.6	4	5.4	0	34
0002 701-22-021	1197		35	3.6	7	61
0003 701-22-041	779	46.1	166	2.2	153	196
0004 701-22-061	716		1	4.4	0	43
0005 701-22-081	890	64.3	181	2.2	166	219
0006 701-22-101	1553		127	2.2	114	160

ANALYSIS

0007 701-22-121	728	143.8	12	2.9	7	14
0008 701-22-141	480		25	2.6	20	35

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	5.05	22.86	0.9	X	138	X
0122 701-22-122	4.75	27.49	3.1	0.18	530	0.9
0123 701-22-123	1.43	16.05	1.6	X	405	X
0124 701-22-124	1.34	9.76	0.7		192	
0125 701-22-125	1.20	19.91	1.4		552	
0126 701-22-126	2.78	18.85	X	X	582	X
0127 701-22-127	2.37	18.04	X		620	
0128 701-22-128	2.69	25.80	X		598	
0129 701-22-129	1.69	20.60	1.5		517	
0130 701-22-130	1.60	15.02	X	X	517	X
0131 701-22-131	0.92	15.54	0.8		470	
0132 701-22-132	2.34	15.81	X	X	589	X
0133 701-22-133	1.74	20.36	1.3		584	
0134 701-22-134	0.99	22.42	X		784	
0135 701-22-135	0.83	21.97	X	X	792	X
0136 701-22-136	3.25	19.27	0.7		515	
0137 701-22-137	2.90	9.58	11.9		627	
0138 701-22-138	4.08	27.11	3.9		480	
0139 701-22-139	4.92	40.86	1.8		408	
0140 701-22-140	4.38	32.23	6.0	1.18	287	X
0141 701-22-141	3.63	31.37	4.7		508	
0142 701-22-142	3.60	43.44	4.0		1214	
0143 701-22-143	3.54	11.18	7.0		287	
0144 701-22-144	2.00	13.82	1.8		654	
0145 701-22-145	1.51	9.08	4.5		363	
0146 701-22-146	2.25	14.35	8.3	0.19	506	2.6
0147 701-22-147	2.91	11.52	8.2	0.29	705	1.7
0148 701-22-148	0.65	14.07	14.6	0.12	574	0.9
0149 701-22-149	4.30	17.29	10.6		290	
0150 701-22-150	4.08	22.32	13.0		727	

CHECKS

0001 701-22-001	4.26	22.24	26.1	X	753	X
0002 701-22-021	3.27	27.75	12.5		863	
0003 701-22-041	1.22	17.67	9.1	0.07	807	X
0004 701-22-061	2.59	18.47	1.9		555	
0005 701-22-081	7.84	20.15	98.3	1.89	339	0.5
0006 701-22-101	1.15	16.85	9.4		577	

ANALYSIS

0007 701-22-121	5.05	22.31	1.1	X	168	X
0008 701-22-141	3.71	31.51	5.2		523	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	19.0	X	5.1		6.456	55.88
0122 701-22-122	50.5	X	4.1		7.444	52.21
0123 701-22-123	71.1	X	7.9		4.573	1.97
0124 701-22-124	101.5		7.6	3.8	2.826	2.06
0125 701-22-125	146.7		7.3		5.343	1.84
0126 701-22-126	137.7	1.8	6.8		5.278	1.56
0127 701-22-127	300.2		6.8		4.817	1.29
0128 701-22-128	149.3		7.2		7.126	1.98
0129 701-22-129	100.8		7.3		6.013	1.71
0130 701-22-130	116.0	3.2	7.3		4.221	1.85
0131 701-22-131	121.8		7.0		4.424	2.00
0132 701-22-132	143.3	1.0	6.7		4.439	2.50
0133 701-22-133	76.4		6.8		5.807	15.41
0134 701-22-134	160.9		7.1		6.625	1.75
0135 701-22-135	124.4	0.8	6.7		6.059	2.64
0136 701-22-136	37.4		7.0		5.505	110.84
0137 701-22-137	252.2		2.8		2.785	123.21
0138 701-22-138	56.9		4.2		7.610	140.88
0139 701-22-139	18.6		4.7		11.334	87.11
0140 701-22-140	25.1	X	3.8		9.102	117.20
0141 701-22-141	62.8		4.3		8.901	98.43
0142 701-22-142	9.3		5.9		11.540	69.96
0143 701-22-143	181.7		3.0		3.527	111.76
0144 701-22-144	173.7		3.0		3.807	2.73
0145 701-22-145	82.2		2.7		2.489	2.00
0146 701-22-146	51.2	0.6	3.1		4.059	1.68
0147 701-22-147	54.7	0.5	3.4		3.233	38.16
0148 701-22-148	70.0	0.5	3.3		4.072	2.22
0149 701-22-149	68.4		3.3		5.368	115.42
0150 701-22-150	22.2		3.2		5.820	3.17

CHECKS						
0001 701-22-001	327.8	1.6	5.1		6.432	159.65
0002 701-22-021	157.2		5.8	2.6	7.324	93.84
0003 701-22-041	107.6	X	5.4		4.918	26.80
0004 701-22-061	23.4		4.1		5.302	131.00
0005 701-22-081	134.8	11.0	2.7		5.232	118.94
0006 701-22-101	44.4		3.8		4.935	106.37

ANALYSIS

0007 701-22-121	19.3	0.6	5.5	6.326	55.21
0008 701-22-141	65.3			8.853	101.27

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0121 701-22-121	X	0.55	4757	96.6	0.42	0.07
0122 701-22-122	0.002	1.19	9578	294.5	0.59	0.26
0123 701-22-123	0.002	2.04	1.90%	25.8	X	0.70
0124 701-22-124	X	0.25	1955		X	0.11
0125 701-22-125	X	3.20	2.94%		X	1.06
0126 701-22-126	X	2.22	2.25%	27.6	X	0.57
0127 701-22-127	X	1.77	1.44%		X	0.25
0128 701-22-128	X	3.06	3.04%		X	0.92
0129 701-22-129	X	2.23	1.98%		X	0.68
0130 701-22-130	X	1.82	2.59%	44.8	0.30	0.83
0131 701-22-131	X	2.49	2.45%		X	0.81
0132 701-22-132	X	1.58	1.83%	18.8	0.05	0.42
0133 701-22-133	X	0.97	8216		X	0.22
0134 701-22-134	0.003	1.36	1.14%		X	0.20
0135 701-22-135	X	1.93	1.72%	16.5	X	0.30
0136 701-22-136	X	0.10	1126			0.04
0137 701-22-137	0.006	2.39	2.65%		0.71	0.58
0138 701-22-138	X	0.75	7422		0.53	0.13
0139 701-22-139	X	0.80	7696		0.60	0.09
0140 701-22-140	X	1.24	1.24%	198.0	0.94	0.12
0141 701-22-141	X	1.24	1.21%		1.07	0.09
0142 701-22-142	X	0.10	903			0.05
0143 701-22-143	0.003	2.50	2.94%		1.52	0.40
0144 701-22-144	0.003	11.56	11.44%		5.58	1.39
0145 701-22-145	X	26.63	22.05%		18.95	1.19
0146 701-22-146	X	9.82	8.52%	261.9	4.84	0.70
0147 701-22-147	X	3.84	3.99%	247.9	2.81	0.30
0148 701-22-148	0.044	13.32	12.46%	242.3	7.94	1.17
0149 701-22-149	0.003	2.03	2.21%		1.69	0.25
0150 701-22-150	X	5.75	5.38%		4.00	0.34

CHECKS						
0001 701-22-001	X	1.01	1.06%	27.2	X	0.39
0002 701-22-021	0.009	2.42	2.75%			0.11
0003 701-22-041	0.002	6.44	6.19%	47.4		0.31
0004 701-22-061	X	1.44	1.74%			1.06
0005 701-22-081	X	7.08	7.06%	416.3		0.49
0006 701-22-101	0.039	5.28	5.14%			0.49

ANALYSIS

0007 701-22-121	X	0.61	5693	98.9	0.07
0008 701-22-141	X	1.26	1.24%		0.10

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.51	0.05	5.8	X	2.6	0.09
0122 701-22-122	1.05	0.04	8.4	X	5.9	0.13
0123 701-22-123	3.63	1.27	3.7	3.9	1.7	3.71
0124 701-22-124	3.35		1.8	5.7		6.19
0125 701-22-125	1.53		5.2	1.8		1.28
0126 701-22-126	4.34	0.35	8.0	0.8	1.2	0.78
0127 701-22-127	2.90		8.1	1.0		1.09
0128 701-22-128	2.72		6.2	5.5		4.79
0129 701-22-129	2.92		3.7	3.2		3.08
0130 701-22-130	7.63	1.88	4.9	5.1	1.4	4.73
0131 701-22-131	3.13		3.8	5.3		4.77
0132 701-22-132	5.15	0.34	6.2	1.4	1.1	1.30
0133 701-22-133	0.72		6.8	3.9		3.02
0134 701-22-134	3.55		4.6	3.5		2.94
0135 701-22-135	1.19	0.54	6.3	4.2	1.0	4.04
0136 701-22-136	0.62		10.6	X		0.49
0137 701-22-137	0.31		13.7	X		0.26
0138 701-22-138	0.26		9.9	0.5		0.21
0139 701-22-139	0.29		14.3	X		0.10
0140 701-22-140	0.22	0.02	10.3	X	2.7	0.25
0141 701-22-141	0.54		8.4	X		0.24
0142 701-22-142	0.21		9.3	X		0.02
0143 701-22-143	0.62		11.7	1.3		1.22
0144 701-22-144	0.87		6.3	1.0		0.51
0145 701-22-145	2.22		2.2	2.7		2.88
0146 701-22-146	2.54	0.14	6.2	1.5	2.8	1.01
0147 701-22-147	0.75	0.14	8.2	3.0	7.9	3.12
0148 701-22-148	1.55	0.27	7.6	2.4	10.4	2.61
0149 701-22-149	1.16		9.5	1.2		1.19
0150 701-22-150	1.35		10.2	2.3		1.71

CHECKS						
0001 701-22-001	0.38	X	9.2	0.9	1.3	0.53
0002 701-22-021	0.59		16.8	0.9		1.01
0003 701-22-041	0.46	0.34	9.1	2.7	2.8	2.34
0004 701-22-061	0.69		7.5	1.0		0.91
0005 701-22-081	2.58	0.47	11.9	0.8	3.2	0.97
0006 701-22-101	0.36		8.1	4.8		4.77

ANALYSIS

0007 701-22-121	0.51	0.04	5.8	X	2.8	0.12
0008 701-22-141	0.48		8.5	X		0.26

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	3.95	0.8	X	40.02	13.17	0.41
0122 701-22-122	4.44	1.0	X	369.97	76.16	0.39
0123 701-22-123	2.43	10.6	X	249.34	256.35	0.13
0124 701-22-124	1.42	5.9		123.17		0.10
0125 701-22-125	3.21	7.6		338.37		0.11
0126 701-22-126	3.10	4.3	X	185.87	225.98	0.23
0127 701-22-127	3.31	3.8		237.45		0.19
0128 701-22-128	4.33	8.6		394.60		0.24
0129 701-22-129	3.62	8.5		520.91		0.16
0130 701-22-130	2.53	13.1	0.1	560.48	183.34	0.15
0131 701-22-131	2.31	4.8		380.29		0.08
0132 701-22-132	2.82	2.2	X	189.88	157.63	0.23
0133 701-22-133	3.51	1.7		173.53		0.15
0134 701-22-134	3.53	4.8		527.27		0.10
0135 701-22-135	3.30	1.8	X	576.39	94.23	0.09
0136 701-22-136	3.33	1.4		709.90		0.29
0137 701-22-137	1.79	0.5		129.28		0.25
0138 701-22-138	4.43	0.8		89.43		0.32
0139 701-22-139	7.00	0.8		120.71		0.40
0140 701-22-140	5.24	0.6	X	81.29	31.02	0.35
0141 701-22-141	4.61	0.5		121.60		0.30
0142 701-22-142	7.68	0.5		131.86		0.32
0143 701-22-143	1.52	0.8		67.83		0.30
0144 701-22-144	2.42	1.4		548.88		0.16
0145 701-22-145	1.63	5.2		209.14		0.13
0146 701-22-146	2.24	3.9	X	562.61	26.04	0.21
0147 701-22-147	2.16	1.3	X	329.72	65.53	0.25
0148 701-22-148	1.63	5.5	X	451.39	40.84	0.05
0149 701-22-149	2.54	0.8		109.22		0.54
0150 701-22-150	4.06	2.2		367.62		0.35

CHECKS						
0001 701-22-001	3.65	0.7	X	76.36	10.04	0.34
0002 701-22-021	5.08	0.8		284.38		0.21
0003 701-22-041	3.13	1.2	X	451.23	41.67	0.09
0004 701-22-061	2.97	0.8		49.23		0.23
0005 701-22-081	3.59	5.2	X	278.45	30.25	0.56
0006 701-22-101	2.97	1.5		183.97		0.10

ANALYSIS

0007 701-22-121	4.01	0.8	X	40.40	11.73	0.41
0008 701-22-141	4.64	0.6		125.61		0.31

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0121 701-22-121	0.370	600	0.15	22.14	0.024	1967
0122 701-22-122	0.596	1355	0.06	20.60	0.223	2039
0123 701-22-123	0.169	183	0.26	11.64	0.011	626
0124 701-22-124	0.107		0.09	9.26		690
0125 701-22-125	0.186		0.14	13.13		551
0126 701-22-126	0.224	205	0.16	13.89	0.027	1390
0127 701-22-127	0.236		0.19	16.07		1023
0128 701-22-128	0.257		0.31	16.07		1409
0129 701-22-129	0.253		0.36	13.92		785
0130 701-22-130	0.182	403	0.33	13.24	0.200	816
0131 701-22-131	0.110		0.78	12.78		318
0132 701-22-132	0.199	149	8.89	19.49	0.033	795
0133 701-22-133	0.279		0.41	18.51		696
0134 701-22-134	0.213		0.68	24.88		508
0135 701-22-135	0.161	126	0.37	19.68	0.010	301
0136 701-22-136	0.410		0.52	25.25		1496
0137 701-22-137	0.301		0.22	19.99		1576
0138 701-22-138	0.492		0.19	25.26		2334
0139 701-22-139	0.744		X	32.63		3217
0140 701-22-140	0.461	966	0.20	28.69	0.582	2475
0141 701-22-141	0.262		0.13	28.40		2037
0142 701-22-142	0.490		X	27.88		1991
0143 701-22-143	0.181		0.60	23.40		2074
0144 701-22-144	0.195		0.20	8.05		1396
0145 701-22-145	0.104		0.77	6.95		600
0146 701-22-146	0.150	879	0.70	12.25	37.361	958
0147 701-22-147	0.226	961	1.30	22.25	10.119	1674
0148 701-22-148	0.060	810	0.48	11.55	3.034	405
0149 701-22-149	0.226		1.08	25.83		2569
0150 701-22-150	0.316		0.90	23.72		2301

CHECKS						
0001 701-22-001	0.440	196	0.06	21.33	0.025	2266
0002 701-22-021	0.559		0.78	14.42		3087
0003 701-22-041	0.249	348	0.87	11.18	0.021	800
0004 701-22-061	0.219		0.66	17.81		929
0005 701-22-081	0.261	1486	1.36	14.85	18.376	3114
0006 701-22-101	0.229		0.65	21.64		685

ANALYSIS

0007 701-22-121	0.405	629	0.13	22.33	0.049	1881
0008 701-22-141	0.263		0.12	28.78		2083

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.33	0.17	3.66	1.198	41	X
0122 701-22-122	0.37	0.49	16.98	930.896	55	X
0123 701-22-123	0.02	0.07	2.62	3.510	34	X
0124 701-22-124	0.02	0.07	2.12		8	
0125 701-22-125	X	0.07	3.02		54	
0126 701-22-126	X	0.09	3.65	0.247	53	X
0127 701-22-127	X	0.08	4.26		71	
0128 701-22-128	X	0.11	4.20		89	
0129 701-22-129	0.02	0.10	3.92		43	
0130 701-22-130	0.03	0.08	3.32	0.332	57	X
0131 701-22-131	X	0.05	2.58		76	
0132 701-22-132	0.04	0.07	3.94	0.179	72	X
0133 701-22-133	0.18	0.11	4.08		61	
0134 701-22-134	0.04	0.05	3.96		58	
0135 701-22-135	0.04	0.06	2.85	0.186	65	X
0136 701-22-136	1.01	0.19	5.78		93	
0137 701-22-137	1.44	0.21	6.78		103	
0138 701-22-138	1.38	0.24	4.98		88	
0139 701-22-139	0.69	0.31	5.36		125	
0140 701-22-140	0.86	0.17	5.40	44.866	90	X
0141 701-22-141	0.97	0.12	5.32		80	
0142 701-22-142	0.69	0.18	3.54		89	
0143 701-22-143	1.18	0.13	4.61		94	
0144 701-22-144	0.04	0.04	2.64		74	
0145 701-22-145	0.10	0.04	1.56		37	
0146 701-22-146	0.06	0.05	3.07	25.166	68	X
0147 701-22-147	0.48	0.10	4.94	43.285	98	X
0148 701-22-148	0.07	0.02	0.88	7.741	73	X
0149 701-22-149	1.38	0.13	5.02		80	
0150 701-22-150	0.30	0.10	6.99		104	

CHECKS						
0001 701-22-001	1.84	0.16	3.64	0.111	84	X
0002 701-22-021	1.23	0.23	1.75		146	
0003 701-22-041	0.36	0.06	4.07	4.718	84	X
0004 701-22-061	1.32	0.08	3.53		64	
0005 701-22-081	1.26	0.11	2.96	89.824	99	0.07
0006 701-22-101	1.83	0.27	3.57		62	

ANALYSIS

0007 701-22-121	0.32	0.18	3.68	1.523	48	X
0008 701-22-141	1.02	0.12	5.31		78	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0121 701-22-121	1.0	10.52	1.16	18	0.02	49.4
0122 701-22-122	1.5	38.62	3.07	27	0.44	78.5
0123 701-22-123	5.1	3.78	0.50	4	X	32.5
0124 701-22-124	5.6	3.11	0.51	5		33.2
0125 701-22-125	2.4	3.09	0.52	4		29.4
0126 701-22-126	3.8	3.66	0.71	2	X	53.7
0127 701-22-127	1.9	3.79	0.62	3		36.3
0128 701-22-128	6.2	4.88	0.92	4		46.1
0129 701-22-129	6.7	4.60	0.85	5		43.0
0130 701-22-130	6.2	3.96	0.65	3	X	37.6
0131 701-22-131	2.8	2.10	0.35	4		23.4
0132 701-22-132	1.6	3.08	0.73	2	X	42.6
0133 701-22-133	0.9	6.14	0.84	18		36.5
0134 701-22-134	1.4	2.91	0.41	6		21.9
0135 701-22-135	0.9	2.86	0.46	7	X	30.0
0136 701-22-136	1.6	9.79	1.67	17		60.4
0137 701-22-137	1.8	10.00	1.24	368		48.3
0138 701-22-138	1.3	13.94	1.57	194		50.7
0139 701-22-139	2.4	18.33	2.25	35		71.3
0140 701-22-140	1.4	9.69	1.22	29	1.56	59.9
0141 701-22-141	1.4	5.86	0.86	39		50.7
0142 701-22-142	1.0	9.99	1.31	37		48.8
0143 701-22-143	1.6	6.85	0.95	87		46.4
0144 701-22-144	4.1	2.85	0.37	5		23.7
0145 701-22-145	4.3	1.77	0.31	6		17.5
0146 701-22-146	2.1	2.68	0.46	3	0.55	30.7
0147 701-22-147	1.6	5.47	0.74	18	3.56	40.0
0148 701-22-148	2.7	1.11	0.16	3	0.32	7.0
0149 701-22-149	2.2	6.84	0.93	33		58.1
0150 701-22-150	6.8	5.22	0.73	13		49.3

CHECKS

0001 701-22-001	1.6	9.31	1.07	67	0.29	53.8
0002 701-22-021	0.7	18.24	1.50	671		10.5
0003 701-22-041	0.5	3.52	0.51	39	0.69	38.2
0004 701-22-061	1.5	5.05	0.63	31		48.6
0005 701-22-081	2.6	5.44	0.81	16	1.01	40.3
0006 701-22-101	1.1	6.28	1.62	20		32.7

ANALYSIS

0007 701-22-121	1.1	11.68	1.28	22	0.02	51.4
0008 701-22-141	1.3	6.00	0.92	40		51.3

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.20		7.87%			14.7
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.31		6.47%			16.8
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				0.04		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	X		6.20%			0.8
0022 AMIS0167	0.92		1.39%			158.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.30		6.15%			128.8
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	29.30		3.48%			1060.5
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0001 NGL-27		X				
0002 OREAS 45d				184.6		0.83
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		22				
0009 OREAS 45e				254.8		0.72
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			
0015 Control Blank						
0016 OREAS 45e		24				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				822.0		0.29
0022 AMIS0167				90.5		0.47
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		11				
0029 GTS-2a				183.4		0.85
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		X				
0035 CCU-1c						
0036 MPL-5				607.7		17.58
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2	
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ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		0.34			1873	
0003 OREAS 45e				0.55		
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d				1.05		
0008 OREAS 45d						
0009 OREAS 45e		0.28			637	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96				0.16		
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		0.03			11.52%	
0022 AMIS0167		1.07			1021	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1				12.56		
0028 AE21						
0029 GTS-2a		0.28			3.60%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3				8.68		
0034 Au5						
0035 CCU-1c				0.09		
0036 MPL-5		40.49			4.41%	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.07		36.50		29.6	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.04		24.59		57.5	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank				X		
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.09		18.06		29.3	
0022 AMIS0167	0.42		46.41		37.7	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.43		25.29		22.9	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	3.21		587.02		138.4	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		539		3.83	373.5	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		983		1.24	787.0	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		237		0.45	106.8	
0022 AMIS0167		404		1.10	64.4	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		132		1.65	78.7	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		604		24.33	2028.5	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.18		1.32	0.61		15.45
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.18		1.22	0.58		26.02
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank					X	
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.97		1.59	1.24		4.87
0022 AMIS0167	5.88		2.87	0.74		2.50
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	2.17		1.33	1.12		7.01
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	8.64		2.18	4.97		3.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d				21.84	2.38	1.55
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e				17.14	1.99	0.57
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	X					
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				12.30	3.01	1.80
0022 AMIS0167				3.20	4.77	0.93
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a				21.13	3.43	0.50
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5				32.42	23.30	15.92
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0001 NGL-27		0.01				
0002 OREAS 45d	3.69			0.44	0.097	4391
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		0.04				
0009 OREAS 45e	3.37			0.41	0.096	3457
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e		X				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.99			0.59	0.061	8790
0022 AMIS0167	1.95			1.00	0.006	4681
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		X				
0029 GTS-2a	2.83			0.43	0.119	1.83%
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		0.19				
0035 CCU-1c						
0036 MPL-5	1.28			1.08	21.017	1.21%
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		16.99	18.2	0.196	2206	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		11.46	5.9	0.177	1382	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	0.1					X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		8.43	42.9	0.190	5.38%	
0022 AMIS0167		23.91	4.2	0.288	1427	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		10.33	24.0	0.272	2.05%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		326.54	34.1	0.167	8923	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	503			2.6		
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	548			2.4		
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		X				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1129			0.7		
0022 AMIS0167	217			3.9		
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1332			4.1		
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2342			20.0		
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	1039					
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	629					
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		0.1				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.68%					
0022 AMIS0167	669					
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	5690					
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	5877					
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	12.44	14.56	204.2		376	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	6.69	9.72	399.3		314	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				X		X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	5.92	10.68	74.6		366	
0022 AMIS0167	3.46	19.21	104.6		165	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.28	17.24	67.5		802	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	36.44	239.38	2487.9		739	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	22.5				3.789	43.00
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	18.5				2.628	22.47
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	8.4				2.337	19.98
0022 AMIS0167	247.4				5.068	17.48
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	20.0				3.581	58.43
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2101.3				64.600	367.62
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2

0040 BSL13

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	X		617			
0003 OREAS 45e		0.06				
0004 OREAS 97.01						
0005 PD-1						4.62
0006 PD-1					3.18	
0007 OREAS 45d		0.07				
0008 OREAS 45d						
0009 OREAS 45e	X		526			
0010 OREAS 97.01						
0011 PD-1						4.47
0012 RTS-2					1.41	
0013 Control Blank						
0014 Control Blank				0.1		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96		4.13				
0018 OREAS 97.01						
0019 PD-1						4.47
0020 PD-1					3.70	
0021 WGB-1	X		385			
0022 AMIS0167	X		8375			
0023 OREAS 97.01						
0024 PD-1						4.37
0025 PL-21						
0026 RTS-2					1.23	
0027 STSD-1		0.25				
0028 AE21						
0029 GTS-2a	X		2971			
0030 OREAS 97.01						
0031 PD-1						4.40
0032 PD-1					3.48	
0033 STSD-3		0.19				
0034 Au5						
0035 CCU-1c		32.40				
0036 MPL-5	1.601		1.18%			
0037 OREAS 97.01						
0038 PD-1						4.51

ANALYSIS

0039 RTS-2	1.20
0040 BSL13	

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.77		47.5	2.7		
0003 OREAS 45e						
0004 OREAS 97.01						0.67
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.05		88.2	2.8		
0010 OREAS 97.01						0.70
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						0.65
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.24		42.3	0.5		
0022 AMIS0167	7.59		2.8	0.7		
0023 OREAS 97.01						0.70
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.19		30.6	0.9		
0030 OREAS 97.01						0.72
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	353.34		48.0	126.6		
0037 OREAS 97.01						0.72
0038 PD-1						

ANALYSIS

0039 RTS-2

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ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	3.07	2.7		34.03		0.92
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.37	1.3		16.87		0.53
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.82	3.9		113.82		0.33
0022 AMIS0167	4.84	1.5		22.69		1.36
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	4.65	1.2		93.07		0.08
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	38.21	8.2		428.66		74.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2

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ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.383		0.12	14.40		6554
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.329		0.16	12.71		5079
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.464		X	0.91		5191
0022 AMIS0167	0.890		0.19	50.87		713
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.631		1.31	1.23		1081
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2.191		29.82	93.62		2405
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.29	0.19	2.61		236	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.17	0.19	2.39		320	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.36	0.23	0.62		230	
0022 AMIS0167	0.18	0.39	479.51		64	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.36	0.23	0.35		135	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	6.29	0.24	10.50		205	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2

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ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.2	9.84	1.29	40		133.6
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.0	8.48	1.25	40		104.0
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank					0.04	
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.4	14.28	1.40	36		27.4
0022 AMIS0167	0.9	20.58	2.44	170		64.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	19.5	9.96	1.68	182		97.1
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	28.9	22.52	1.40	1314		39.3
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2

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ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		
0044 Control Blank						
0045 OREAS 24b	X		8.28%			8.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				2.01		
0051 AlcoaHi4-OES				50.68		
0052 SOLN-001				50.01		
0053 Alcoa18-MS		5.23				

BLANKS						
0001 Control Blank	X	X	X	X		X
0002 Control Blank	X		X			0.7
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		67			X

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			
0044 Control Blank						
0045 OREAS 24b				737.0		2.09
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			1.03			
0051 AlcoaHi4-OES			19.22			
0052 SOLN-001			X			
0053 Alcoa18-MS	34.6				5.32	

BLANKS						
0001 Control Blank	X	X	X	0.1	0.06	X
0002 Control Blank				0.7		X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				X		X

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0041 CCU-1d				0.09		
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b		0.59			1.13%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						50.83
0051 AlcoaHi4-OES						984.13
0052 SOLN-001						194.49
0053 Alcoa18-MS	5.1		5.125			
BLANKS						
0001 Control Blank	X	X	X	X	X	0.02
0002 Control Blank		X			X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X			X	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank				X		
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.07		84.62		16.2	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.90				565.6

BLANKS						
0001 Control Blank	X	X	0.08	X	X	X
0002 Control Blank	X		0.08		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		X		X	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			X
0044 Control Blank						
0045 OREAS 24b		105		10.50	40.6	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			0.49			0.54
0051 AlcoaHi4-OES			19.92			2.51
0052 SOLN-001			X			0.05
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank		1	X	X	X	X
0002 Control Blank		1		X	0.7	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X		X	0.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank					X	
0045 OREAS 24b	4.18		2.21	1.35		4.84
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	0.11	X	X	X	X	0.01
0002 Control Blank	X		X	X		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.10		0.05	X		X

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					
0044 Control Blank						
0045 OREAS 24b				20.74	5.80	1.34
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	2.08					
0051 AlcoaHi4-OES	100.93					
0052 SOLN-001	50.19					
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X			X	0.10	X
0002 Control Blank				0.10	X	X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				0.11	0.05	X

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	3.89			0.78	0.071	3.07%
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			4.8			

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X			X	X	X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X			0.02	X	X

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					X
0044 Control Blank						
0045 OREAS 24b		43.55	46.9	0.334	1.66%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	3.9					50.29
0051 AlcoaHi4-OES	484.3					202.55
0052 SOLN-001	101.2					193.81
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	0.09	X	X	X	X
0002 Control Blank		0.02	X	X	X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X	X	X	X	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	484			4.1		
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381			2.40%			
0050 Alcoa12-OES		0.50				
0051 AlcoaHi4-OES		19.88				
0052 SOLN-001		0.01				
0053 Alcoa18-MS					6.40	

BLANKS						
0001 Control Blank	4	X		0.1	X	
0002 Control Blank	X			X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	5			X		

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	8998					
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES		249.0				
0051 AlcoaHi4-OES		2051.3				
0052 SOLN-001		496.6				
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	33	X	3	5.0	0	
0002 Control Blank	X					
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X					

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		X
0044 Control Blank						
0045 OREAS 24b	13.67	38.25	61.6		729	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				0.51		1.1
0051 AlcoaHi4-OES				20.55		49.3
0052 SOLN-001				X		X
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	X	0.5	X	X	X
0002 Control Blank	X	0.05	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.33	0.02	X		X	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	23.0				9.967	168.78
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		6.3				

BLANKS						
0001 Control Blank	X	X	5.8		X	X
0002 Control Blank	0.7				0.012	0.18
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	1.1				0.007	0.07

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0041 CCU-1d		31.55				
0042 Control Blank						
0043 Control Blank				0.3		
0044 Control Blank						
0045 OREAS 24b	X		2234			
0046 OREAS 97.01						
0047 PD-1						4.32
0048 PD-1					3.48	
0049 BCS381						
0050 Alcoa12-OES				21.1		
0051 AlcoaHi4-OES				265.3		
0052 SOLN-001				499.1		
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	0.01	X	X		X
0002 Control Blank	X		X			
0003 Control Blank						
0004 Control Blank						0.63
0005 Control Blank						
0006 Acid Blank	X		X			

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	1.00		15.7	X		
0046 OREAS 97.01						0.69
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.74			31.3	

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X		0.3	X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						X
0006 Acid Blank	X		0.3	X		

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	7.34	4.3		125.44		1.01
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			5.8		529.55	

BLANKS						
0001 Control Blank	0.09	X	X	0.05	0.04	X
0002 Control Blank	X	X		X		0.01
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.02	X		0.15		0.02

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.798		X	16.94		4249
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS					5.692	

BLANKS						
0001 Control Blank	X		X	X	X	X
0002 Control Blank	X		X	0.03		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.011		X	0.01		26

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b	0.84	0.38	3.11		105	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						0.50
0051 AlcoaHi4-OES						20.30
0052 SOLN-001						X
0053 Alcoa18-MS				5.313		

BLANKS						
0001 Control Blank	X	X	X	X	1	X
0002 Control Blank	X	X	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	X	X		X	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank					X	
0044 Control Blank						
0045 OREAS 24b	3.9	19.98	2.11	107		135.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES					0.48	
0051 AlcoaHi4-OES					20.57	
0052 SOLN-001					X	
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	X	X	4	X	X
0002 Control Blank	0.2	0.06	0.01	X		0.3
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	0.57	0.04	2		0.3

METHOD CODE DESCRIPTION

/CALC Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/CSA Intertek Genalysis Perth

Induction Furnace Analysed by Infrared Spectrometry

/GR Intertek Genalysis Perth

Analysed by Gravimetric Technique.

/MS Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

4A/MS Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4A/OE Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

4AH/OE Intertek Genalysis Perth

Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

METHOD CODE DESCRIPTION

AR01/MS Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Mass Spectrometry.

AR01/OE Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

NAGx/MTR Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

S71/OE Intertek Genalysis Perth

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

SCR/VOL Intertek Genalysis Perth

Chromium Reducible Suplhur Analysed by Volumetric Technique.

SE1/MS Intertek Genalysis Perth

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Pl

Ws/MTR Intertek Genalysis Perth

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed with Electronic Meter Measurement

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

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APPENDIX C

WRD Slope Stability (KP Report PE701-00022/22)

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APPENDIX D

Surface Water Management Plan (KP Report PE701-00022/18)

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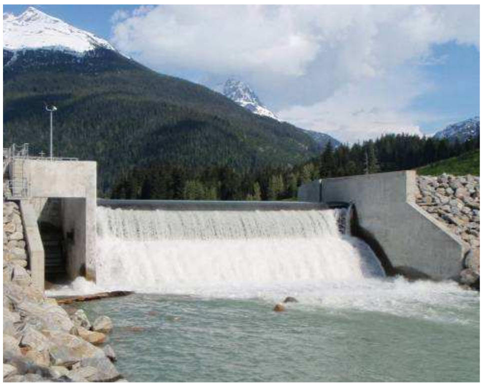
APPENDIX J

Geochemical Study

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT



WASTE ROCK GEOCHEMICAL ASSESSMENT

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited
(MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

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LETPADAUNG COPPER PROJECT

WASTE ROCK GEOCHEMICAL ASSESSMENT

KP Job No. PE701-00022/04

CONTRACT

DOCUMENT INFORMATION

REV	DESCRIPTION	PREPARED	REVIEW	KNIGHT PIESOLD APPROVAL	DATE
A	Issued as Draft	TDR	BL	DJTM	01/07/2013
B	Issued for Client Review	TDR/EJT	TDR	DJTM	15/07/2013
0	Issued as Final	TDR/EJT	TDR	DJTM	26/08/2013

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CONTENTS **PAGE**

EXECUTIVE SUMMARY

Knight Piésold was requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The project will comprise a high throughput heap leach copper project which will generate approximately 1 billion tonnes of waste rock over the 33 year mine life.

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for this study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

The waste rock, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

<u>Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming.</u> There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble,

especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas.
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps.
- Full encapsulation of all waste with a suitable compacted soil liner.
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material.
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height.
- Installation of interim covers, the frequency of which is still to be determined.

Instrumentation and monitoring of the quality of the construction and the performance of the encapsulation system will be required to confirm that the design intent is being achieved and sulfide oxidation has been reduced to acceptable levels.

1. INTRODUCTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The Letpadaung Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

Knight Piésold has conducted an initial geochemical assessment, with samples of waste rock selected and sent to an accredited laboratory for analysis. This report presents the results of the geochemical analysis, with interpretation of the acid generation and metal leaching risk and the implications for the mine waste management at the site. This report follows an interim report which was issued by Knight Piésold prior to receipt of all the test work results (Ref. 1).

It should be noted that this geochemical assessment only relates to the waste rock to be produced by the Letpadaung project. Geochemical studies into the heap leach pad are also required to allow for the design of seepage control measures and closure capping.

1.1 PROJECT DESCRIPTION

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

1.2 GEOLOGICAL SETTING

The following overview of the geological setting comprises excerpts from the Feasibility Study by Mineral Resources Development (Ref. 2).

The Monywa copper district is located along north-south trending Inner Volcanic Arc, which lies within the Central Burma Tectonic Belt. The project is a high sulfidation mineral system with andesite porphyry the most common rock type hosting the copper

mineralisation. Pyroclastics are the second most abundant rock type at Letpadaung, including tuffs and breccias and reworked volcaniclastic siltstones and sandstones.

Typical alteration zones common to most high sulfidation systems are observed at the Letpadaung Project, including residual silica zones, silica-alunite zones, argillic zones and chlorite zones. Copper mineralisation at Letpadaung is dominated by hypogene chalcocite / digenite, covellite and supergene chalcocite. The copper sulfide mineralisation is overlain by a 10 to 200 m thick strongly weathered leach cap. The leach cap can be considered waste material as it contains very limited economic copper mineralisation.

1.3 PREVIOUS GEOCHEMICAL WORK

Two high level geochemical studies have been conducted at the Letpadaung Project and the neighbouring S&K project. These studies have been reviewed and are summarised in the following sections.

Overall there is a very limited amount of geochemical data (twenty one relevant samples) considering the size of the deposit and the clear risk of acid rock drainage that exists from high sulfidation systems. Furthermore, the methods employed in the two studies have not been tailored to suit the mineralogy of the deposit. Therefore, the results and subsequent conclusions are considered questionable.

1.3.1 Feasibility Study Report

An assessment into the acid rock drainage potential of the Letpadaung Project was conducted by Coffey Partners International Pty Ltd in 1997 (Ref. 3) as part of the feasibility study. This study included geochemical testing of ten waste rock samples collected from both the S&K Deposit and the Letpadaung deposit, with material taken from both the leach cap and the internal waste.

The analysis included determination of total sulfur, pyritic sulfur, sulfate sulfur and "unidentified sulfur". The total sulfur content in nine out of ten sample was high to extremely high (0.68 to 9.12%) with only a single sample of leach cap lapilli tuff exhibiting a low total sulfur content (<0.01%).

The total sulfur was used to calculate the maximum potential acidity which resulted in nine of the ten samples being classified as potentially acid generating. This approach appears to be overly conservative as the majority of the sulfur in leach cap sample was unidentified sulfur and a large proportion of the sulfur in the internal waste was also present as unidentified sulfur. The leach cap samples were essential devoid of pyritic sulfur.

The acid neutralising capacity (ANC) of the samples was highly variable ranging from material which was essential devoid of ANC (<0.01 kg $CaCO_3$/t) up to a sample with a very high ANC (141 kg $CaCO_3$/t). However, the majority of samples exhibited very low to moderate ANC (0.2 to 10 kg $CaCO_3$/t).

The assessment conducted by Coffey concluded that six out of ten samples were Acid Producing (i.e. had positive net acid producing potentials) with a further three samples classified as Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) with only a single sample was classified as Non Acid Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of less than 2). However, as noted earlier, the presence of unidentified sulfur in the samples could have significantly impacted the acid producing classifications.

The unidentified sulfur could be present in mineral forms which may not be acid generating, such as barite or alunite, but as no mineralogical analysis was conducted on the samples it is not possible to definitively determine the nature of the unidentified sulfur. However, previous geological assessments of the deposit do list alunite as being present (Ref. 2, 4 and 5) and, therefore, it is reasonable to assume that some of the unidentified sulfur is present as alunite. If the results of the assessment are recalculated using just the pyritic sulfur to calculate the maximum potential acidity, only 50% of the samples would be classified as potentially acid forming, rather than the 90% reported by Coffey.

1.3.2 ARD Investigation for S&K

An investigation into acid rock drainage and hydrogeological conditions at the S&K project was conducted by Westec Inc. in 1997 (Ref. 6). As part of the investigation, six grab samples and seven core samples were tested using basic static testing methods. It is worth noting that total sulfur values were used to generate the estimates of maximum potential acidity, as was conducted in the Coffey study and, therefore, the acid generating potential of the samples is likely to have been overestimated if non-acid forming sulfur containing minerals were also present in these samples.

Two of the samples tested were limestone / soil samples assessing potential sources of ARD mitigation material. These samples are not relevant to an assessment of the acid formation potential of the deposit itself and, therefore, have been excluded from the discussion of results below.

The results of this assessment indicate that six of the eleven relevant samples were found to be Acid Producing (i.e. had positive net acid producing potentials), two were found to be Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) and three samples were found to be Non Acid

Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of greater than 2).

2. SAMPLE SELECTION

A site visit was undertaken by Bruce Zhang and Tim Rowles of Knight Piésold from the 25th April through to the 28th April 2013 to gather background data on the project and to select and collect samples of waste rock for geochemical testing.

It was originally intended to select samples of waste rock for geochemical analyses from eleven boreholes recently drilled by Wanbao Myanmar. However, ten of these boreholes were found to be located around the periphery of the pit, with one borehole well outside of the pit limits. Therefore, samples were instead selected from ten of the recently drilled boreholes (i.e. those located around the edge of the pit) plus three boreholes which were drilled within the centre of the pit by Ivanhoe. The core was examined prior to selecting samples and was found to be in good condition with no visible signs of significant oxidation.

A total of one hundred and fifty samples were selected from the boreholes within waste zones. These samples represent the range of waste rock lithologies recorded on the geological logs and also an appropriate range of copper and sulfur grades based on the existing assay results which accompanied the logs. Samples were taken from 5 m below ground level to the current pit design base of 450 m depth. The selected samples are summarised in Table 2.1, with a detailed listing provided in Table 2.2.

Table 2.1: Summary Selected Samples

Lithology	Number of Samples
Andesite Porphyry	95
Breccia	14
Diorite Porphyry	12
Pyroclastic	7
Fault Breccia	5
Hydrothermal Breccia	5
Porphyry	5
Dyke	3
Tuff	2
Hornblend Porphyry	1
Feldspar Porphyry	1

Samples were taken from the core trays by manually breaking the core and taking part of the core, leaving the remainder of the core within the trays. Approximately 500 g to 1 kg of core was collected for each sample from the drill intervals indicated in Table 2.2. The samples were placed in cloth bags, labelled and collated into a single crate before being shipped to Genalysis Intertek in Perth for testing.

Table 2.2: Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-001	LS001	25	Andesite Porphyry
701-22-002	LS001	59	Andesite Porphyry
701-22-003	LS001	65.5	Andesite Porphyry
701-22-004	LS001	89.25	Andesite Porphyry
701-22-005	LS001	122	Andesite Porphyry
701-22-006	LS001	136.75	Dyke
701-22-007	LS001	185	Dyke
701-22-008	LS001	221.65	Dyke
701-22-009	LS001	249.15	Andesite Porphyry
701-22-010	LS001	290.75	Andesite Porphyry
701-22-011	LS001	304.05	Andesite Porphyry
701-22-012	LS001	368.85	Andesite Porphyry
701-22-013	LS001	395	Andesite Porphyry
701-22-014	LS001	411.1	Andesite Porphyry
701-22-015	LS001	423.5	Andesite Porphyry
701-22-016	LS002	94.3	Andesite Porphyry
701-22-017	LS002	104.13	Breccia
701-22-018	LS002	128.6	Andesite Porphyry
701-22-019	LS002	148.4	Andesite Porphyry
701-22-020	LS002	355.8	Diorite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-021	LS002	373	Andesite Porphyry
701-22-022	LS002	422.5	Andesite Porphyry
701-22-023	LS002	435.3	Andesite Porphyry
701-22-024	LS002	448.85	Andesite Porphyry
701-22-025	LS002	472.85	Andesite Porphyry
701-22-026	LS003	21.3	Andesite Porphyry
701-22-027	LS003	70	Andesite Porphyry
701-22-028	LS003	74.3	Andesite Porphyry
701-22-029	LS003	97	Andesite Porphyry
701-22-030	LS003	115.5	Andesite Porphyry
701-22-031	LS003	131.7	Andesite Porphyry
701-22-032	LS003	146.75	Breccia
701-22-033	LS003	170.02	Diorite Porphyry
701-22-034	LS003	182.4	Diorite Porphyry
701-22-035	LS003	274.25	Diorite Porphyry
701-22-036	LS003	298.3	Diorite Porphyry
701-22-037	LS003	305	Diorite Porphyry
701-22-038	LS003	324.8	Breccia
701-22-039	LS003	330.2	Andesite Porphyry
701-22-040	LS003	342.8	Diorite Porphyry

ID	Borehole	Depth	Lithology
701-22-041	LS003	353.35	Feldspar Porphyry
701-22-042	LS003	377.5	Andesite Porphyry
701-22-043	LS003	394.75	Porphyry
701-22-044	LS003	410.9	Porphyry
701-22-045	LS003	440.8	Breccia
701-22-046	LS004	30.21	Andesite Porphyry
701-22-047	LS004	50.21	Andesite Porphyry
701-22-048	LS004	69.25	Andesite Porphyry
701-22-049	LS004	110.45	Andesite Porphyry
701-22-050	LS004	134.45	Andesite Porphyry
701-22-051	LS005	28.4	Diorite Porphyry
701-22-052	LS005	50.1	Diorite Porphyry
701-22-053	LS005	72.5	Breccia
701-22-054	LS005	133.9	Breccia
701-22-055	LS005	141.4	Diorite Porphyry
701-22-056	LS006	34.3	Andesite Porphyry
701-22-057	LS006	52.3	Andesite Porphyry
701-22-058	LS006	70.3	Andesite Porphyry
701-22-059	LS006	127.6	Andesite Porphyry
701-22-060	LS006	140.4	Breccia

ID	Borehole	Depth	Lithology
701-22-061	LK002	16.05	Porphyry
701-22-062	LK002	36.3	Andesite Porphyry
701-22-063	LK002	113.6	Breccia
701-22-064	LK002	133.3	Porphyry
701-22-065	LK002	167.3	Porphyry
701-22-066	LK003	40.3	Andesite Porphyry
701-22-067	LK003	54.9	Breccia
701-22-068	LK003	108.6	Breccia
701-22-069	LK003	128.7	Pyroclastic
701-22-070	LK003	145.6	Tuff
701-22-071	LK004	51.23	Hornblende Porphyry
701-22-072	LK004	71.63	Breccia
701-22-073	LK004	81.52	Breccia
701-22-074	LK004	104.71	Andesite Porphyry
701-22-075	LK004	137.51	Diorite Porphyry
701-22-076	LK006	45.2	Breccia
701-22-077	LK006	51.8	Andesite Porphyry
701-22-078	LK006	129.7	Andesite Porphyry
701-22-079	LK006	145.7	Breccia
701-22-080	LK006	165.86	Diorite Porphyry

Table 2.2 (Continued): Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-081	LK006	191.35	Tuff
701-22-082	LK006	214.6	Pyroclastic
701-22-083	L013	5	Andesite Porphyry
701-22-084	L013	11	Andesite Porphyry
701-22-085	L013	17.7	Andesite Porphyry
701-22-086	L013	23.4	Andesite Porphyry
701-22-087	L013	28.9	Andesite Porphyry
701-22-088	L013	34.9	Andesite Porphyry
701-22-089	L013	41.25	Andesite Porphyry
701-22-090	L013	47.7	Andesite Porphyry
701-22-091	L013	52.9	Andesite Porphyry
701-22-092	L013	58.8	Andesite Porphyry
701-22-093	L013	69	Andesite Porphyry
701-22-094	L013	75	Hydrotherm al Breccia
701-22-095	L013	81.9	Hydrotherm al Breccia
701-22-096	L013	86.55	Hydrotherm al Breccia
701-22-097	L013	93.25	Fault Breccia
701-22-098	L013	100.4	Hydrotherm al Breccia
701-22-099	L013	127.55	Andesite Porphyry
701-22-100	L013	177.05	Andesite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-101	L013	199.75	Andesite Porphyry
701-22-102	L223	121.75	Fault Breccia
701-22-103	L223	131	Andesite Porphyry
701-22-104	L223	137	Andesite Porphyry
701-22-105	L223	142.1	Andesite Porphyry
701-22-106	L223	150	Andesite Porphyry
701-22-107	L223	156	Andesite Porphyry
701-22-108	L223	164.55	Andesite Porphyry
701-22-109	L223	170	Andesite Porphyry
701-22-110	L223	178.05	Andesite Porphyry
701-22-111	L223	184	Andesite Porphyry
701-22-112	L223	191.95	Andesite Porphyry
701-22-113	L223	198	Andesite Porphyry
701-22-114	L223	206.5	Andesite Porphyry
701-22-115	L223	212	Andesite Porphyry
701-22-116	L223	220.05	Andesite Porphyry
701-22-117	L223	231.2	Andesite Porphyry
701-22-118	L223	240.4	Andesite Porphyry
701-22-119	L223	244	Fault Breccia
701-22-120	L223	319.3	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-121	L223	325.4	Andesite Porphyry
701-22-122	L223	340.3	Fault Breccia
701-22-123	L087	6	Pyroclastic
701-22-124	L087	16	Pyroclastic
701-22-125	L087	26	Pyroclastic
701-22-126	L087	36	Pyroclastic
701-22-127	L087	46	Pyroclastic
701-22-128	L087	56	Andesite Porphyry
701-22-129	L087	66	Fault Breccia
701-22-130	L087	76	Andesite Porphyry
701-22-131	L087	86	Andesite Porphyry
701-22-132	L087	96	Andesite Porphyry
701-22-133	L087	106	Andesite Porphyry
701-22-134	L087	116	Andesite Porphyry
701-22-135	L087	126	Andesite Porphyry
701-22-136	L087	134	Andesite Porphyry
701-22-137	L087	144	Andesite Porphyry
701-22-138	L087	158	Andesite Porphyry
701-22-139	L087	170	Andesite Porphyry
701-22-140	L087	184	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-141	L087	200	Andesite Porphyry
701-22-142	L087	210	Andesite Porphyry
701-22-143	L087	216	Andesite Porphyry
701-22-144	L087	252	Andesite Porphyry
701-22-145	L087	262	Andesite Porphyry
701-22-146	L087	272	Andesite Porphyry
701-22-147	L087	292	Andesite Porphyry
701-22-148	L087	330	Hydrotherm al Breccia
701-22-149	L087	349.7	Andesite Porphyry
701-22-150	L087	340	Andesite Porphyry

3. TESTWORK METHODS

3.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses a sample's potential to form acid from the oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

Total sulfur and total carbon were determined by LECO induction furnace, with infrared detection. Acid soluble sulfur (HCL S), which includes readily soluble sulfate minerals such as melanterite, epsomite, gypsum and anhydrite as well as a portion of the less soluble iron hydroxyl sulfates such as jarosite, was determined using a hydrochloric acid digest on the solid sample followed by ICP determination of the sulfur content of the digest solution.

Due the presence of alunite and natroalunite in the deposit which would not be identified using the hydrochloric acid digest method, the Chromium Reducible Sulfur (CRS) test was also conducted on the samples to determine the sulfide sulfur content.

The various sulfur species present were then calculated as follows:

Sulfide sulfur (%) = CRS (%)

Acid soluble sulfate (%) = HCL S (%)

Non-acid soluble sulfate (%) = Total sulfur (%) – CRS (%) – HCL S (%)

The test work methods used are based on the ABA methodology defined in the MEND Prediction Manual for Drainage Chemistry from Sulfidic Geological Material (Ref. 7), MEND Acid Rock Drainage Prediction Manual (Ref. 8), and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 9).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used is based on Sobek et al (Ref. 10), however, a siderite correction step has been added to the method, after Stewart et al (Ref. 11).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA), which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfides are present as pyrite.

The Net Acid Producing Potential (NAPP) is the balance between the Maximum Potential Acidity and the Acid Neutralising Capacity. A negative NAPP indicates that there is an excess neutralising capacity and a positive NAPP indicates there is excess potential acidity.

3.2 STATIC NET ACID GENERATION

Static Net Acid Generation (NAG) test work is a direct measure of a sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

The NAG test procedure used is based upon the Static NAG Test (Ref. 12 and 13). The static NAG test involves the addition of 250 mL of 15 per cent hydrogen peroxide to 2.5g of pulverised sample. The sample is allowed to react overnight prior to heating for a period of three hours. Once the sample has cooled, the pH of the solution is measured prior to titration back to pH 4.5 and 7 to determine the acidity produced by the oxidisation reactions.

3.3 ACID FORMING POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (ANC).

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes, and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA, as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG test results to classify the acid formation potential of materials. Knight Piésold's classification system, as summarised in Table 3.1, is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Table 3.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP ($kg\ H_2SO_4/t$)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5

3.4 MULTI-ELEMENT ANALYSIS OF SOLIDS

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. A four acid digestion method was employed for the majority of the analyses, with element specific methods used for selenium, mercury and boron.

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:

C_n = measured concentration of element in sample

B_n = average crustal abundance (Bowen, Ref. 17)

The GAI is expressed on a scale of 0 to 6, with 0 indicating that the element concentration is less than or similar to the average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

3.5 X-RAY DIFFRACTION ANALAYSIS

Fifteen of the samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. For each sample a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content. On a limited number of samples a grab of sample was prepared by adding an internal standard, TiO_2, and micronising the mixture to 4 µm. The spiked samples were each prepared as an un-oriented powder mount. A duplicate sample was analysed for every fifteen samples submitted.

The XRD patterns were produced on a PANalytical Cubix[3] XRD fitted with copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3° to 65°2 θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database. Quantitative phase analysis was performed using SIROQUANTTM Version 3 software.

3.6 DISTILLED WATER EXTRACT TESTING

Distilled water extraction tests were conducted on fifty samples to assess the potential for leaching of environmentally significant elements from the waste rock, which could have a detrimental effect on the quality of surface water or near surface groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements, whereas the multi-element tests give the total elemental enrichment of the waste.

The test procedure is based upon the Shake Flask Method as described in the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Ref. 9).

The samples were crushed to minus 2 mm particle size, with 50 grams of each sample then mixed with 150 mL of deionized water in suitably sized vessels. The mixtures were then bottle rolled for 24 hours. The pH and the conductivity of the solutions were then measured and the bottles left to stand for a minimum of 3 hours. The solution was then siphoned off and filtered through a 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) or Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) depending on the element being analysed and the detection limits required.

The distilled water extract test results were compared to a set of reference water quality standards which are discussed in Section 3.7.

3.7 REFERENCE WATER QUALITY STANDARDS

To allow assessment of the results of the distilled water extract analysis, a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 18 & 19) and the ANZECC water quality guideline for livestock drinking water (Ref. 20)).

The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in various guidelines, the lowest concentration has been adopted. These reference values for release from mining operations are presented in Table 3.2.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by the production of the reference water quality values that the Letpadaung Project will be required to meet these reference levels, or that these reference levels should be used as the regulatory framework. The regulatory requirements for the project will be determined by the relevant regulatory authorities during the environmental design phase of the project.

These reference levels are to be used for a preliminary assessment of water quality only. More detailed assessment of the impact of any release from the mine site may be required in later design stages to assess the impact on receiving environments, such as aquatic systems, where different water quality requirements may be applicable.

Table 3.2: Reference Water Quality Guidelines – Release from Mining Operations

Parameter	ANZECC Livestock (mg/L)	IFC 2004 (mg/L)	IFC 2007 (mg/L)	Adopted Reference Level (mg/L)
pH		6 to 9	6 to 9	6 to 9
TDS	2000			2000
Aluminum	5			5
Antimony				N/G
Arsenic	0.5	0.1	0.1	0.1
Barium				N/G
Boron	5			5
Cadmium	0.01	0.1	0.05	0.01
Calcium	1000			1000
Chloride				N/G
Chromium	1			1
Chromium (Cr^{+6})		0.1	0.1	0.1
Cobalt	1			1
Copper	0.4	0.5	0.3	0.3
Cyanide-Total			1	1
Cyanide-Free			0.1	0.1
Cyanide-WAD		0.5	0.5	0.5
Fluoride	2	20		2
Iron		3.5	2	2
Lead	0.1	0.1	0.2	0.1
Magnesium	2000			2000
Manganese				N/G
Mercury	0.002	0.01	0.002	0.002
Molybdenum	0.15			0.15
Nickel	1	0.5	0.5	0.5
Phosphorus				N/G
Selenium	0.02	0.1		0.02
Silver		0.5		0.5
Sodium				N/G
Sulfate	1000			1000
Tin				N/G
Uranium	0.2			0.2
Vanadium				N/G
Zinc	20	2	0.5	0.5

N/G = No guideline value

4. GEOCHEMICAL RESULTS

4.1 XRAY DIFFRACTION

Fifteen samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. The summarised results for the XRD analysis are presented in Table 4.1 with the full results provided in Appendix A. The interpreted results are summarised as follows:

- The most common mineral found in the samples was quartz, comprising between 23% and 63% of the overall sample, averaging 39%.
- Clay minerals including illite, smectite, kaolin and chlorite were found to comprise between 4% and 38% of the samples, averaging 20.5%.
- The amorphous content of the samples ranged from 3% to 35%, averaging 16%.
- Natroalunite and alunite were present in 11 of the 15 samples. These are important minerals in the assessment of acid rock drainage as they commonly lead to overestimation of the sulfide content. The natroalunite and alunite were present at between 0% and 28% but were highly variable and showed no correlation with depth or lithology.
- The carbonate content of the samples varied from 0% to 16%, averaging 3.8%. However, the most common carbonate found in the deposit was siderite (from 0% to 11% and averaging 0.9%). Siderite does not provide any neutralising capacity when the full neutralisation and hydrolysis of aqueous iron is accounted for.
- Two sulfide minerals were identified in the analysis. Pyrite the most common sulfide mineral from 0% to 16% and averaging 4.5%, with chalcopyrite identified in a single sample at 1%.

Table 4.1: Summarised XRD Results

Mineral	Group	Average	Max	Min
Quartz	Silicate	39.3	63.0	23.0
Amorphous content	N/A	15.9	35.0	3.0
Natroalunite	Sulfate	7.5	28.0	0.0
Interlayered illite/ smectite	Clay	8.4	22.0	0.0
Pyrophyllite	Clay	4.3	22.0	0.0
Kaolin	Clay	5.5	22.0	0.0
Chlorite	Clay	1.6	13.0	0.0
Hematite	Oxide	1.1	15.0	0.0
Sodium calcium plagioclase	Feldspar	2.1	12.0	0.0
Pyrite	Sulfide	4.5	16.0	0.0
Siderite	Carbonate	0.9	11.0	0.0
Palygorskite	Clay	0.5	7.0	0.0
Illite/Muscovite	Mica	5.1	16.0	0.0
Potassium feldspar	Feldspar	1.4	8.0	0.0
Ankerite	Carbonate	0.3	4.0	0.0
Dolomite	Carbonate	1.5	8.0	0.0
Calcite	Carbonate	0.7	7.0	0.0
Magnesite	Carbonate	0.4	4.0	0.0
Expanding clay	Clay	0.1	2.0	0.0
Chloritoid	Clay	0.1	2.0	0.0
Diaspore	Hydroxide	0.1	2.0	0.0
Alunite	Sulfate	0.3	3.0	0.0
Jarosite	Hydroxide	0.2	1.0	0.0
Anhydrite	Sulfate	0.1	1.0	0.0
Anatase	Oxide	0.1	1.0	0.0
Chalcopyrite	Sulfide	0.1	1.0	0.0

4.2 SULFUR ANALYSES

The total sulfur content of the waste rock was determined by LECO combustion. In addition, the samples were analysed for sulfide (as Chromium Reducible Sulfur) and sulfate (by acid digest). The results of the analyses are summarised in the following sections, with complete results provided in Appendix B.

4.2.1 Total Sulfur

The total sulfur contents were found to be highly variable across the samples, ranging from 0.03% to 26.6% with an average of 3.49%. The total sulfur contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.1. The total sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.2. The results indicate that 90% of the samples would be classified as having a high to extremely high total sulfur content.

Table 4.2: Total Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 -5%	Extremely High >5%
All	-	4%	3%	3%	35%	35%	20%
Andesite Porphyry	-	5%	4%	4%	45%	26%	15%
Breccia	-	-	-	-	14%	43%	43%
Diorite Porphyry	-	-	-	-	25%	58%	17%
Dyke	-	-	-	-	-	33%	67%
Fault Breccia	-	-	-	-	60%	20%	20%
Feldspar Porphyry	-	-	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	-	80%	20%
Porphyry	-	-	-	-	20%	40%	40%
Pyroclastic	-	-	14%	-	14%	71%	-
Tuff	-	-	-	-	-	50%	50%

4.2.1 Acid Soluble Sulfate

The acid soluble sulfate was found to be highly variable across the samples, ranging from 0.01% to 1.59% with an average of 0.36%. The acid soluble sulfate contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.2. The acid soluble sulfate results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.3. The results indicate that all samples have between 0.01% and 2% acid soluble sulfate, with the highest proportion of samples having between 0.1% and 0.3% sulfate. This indicates that there is a low proportion of readily soluble sulfate within the deposit.

Table 4.3: Acid Soluble Sulfate by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 - 5%	Extremely High >5%
All	-	23%	33%	20%	24%	-	-
Andesite Porphyry	-	27%	36%	20%	17%	-	-
Breccia	-	29%	36%	29%	7%	-	-
Diorite Porphyry	-	25%	33%	33%	8%	-	-
Dyke	-	33%	-	-	67%	-	-
Fault Breccia	-	-	40%	20%	40%	-	-
Feldspar Porphyry	-	-	-	100%	-	-	-
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	100%	-	-
Porphyry	-	-	-	-	100%	-	-
Pyroclastic	-	-	43%	-	57%	-	-
Tuff	-	-	50%	50%	-	-	-

4.2.1 Sulfide Sulfur

Analysis for chromium reducible sulfur was only conducted on those samples which had a total sulfur content of greater than 0.1%. For samples where the chromium reducible sulfur was measured, this was assumed to represent the total sulfide content. For samples with less than 0.1% total sulfur, the sulfide content was assumed to be equal to:

Sulfide Sulfur (%S) = Total Sulfur (%S) – Acid Soluble Sulfate (%S)

The sulfide sulfur contents were found to be highly variable across the samples, ranging from 0.00% to 18.95% with an average of 2.12%. The sulfide sulfur contents showed a slight degree of correlation with depth, as there were more samples with low or insignificant sulfide sulfur contents shallower in the deposit (i.e. up to around 200 m depth). Below 200 m depth there were no samples with less than 0.25% sulfide sulfur. The sulfide contents also showed some correlation to copper grade, with slightly higher copper contents in samples with greater than 5% sulfide sulfur. The distribution of sulfide sulfur, copper grade and depth is presented in Figure 4.3. Although neither of these relationships was suitably well defined or consistent enough to allow either depth

or copper grade to be used as an indicator of likely sulfide sulfur contents, it does indicate that low grade ore which may be stockpiled on site during operations may have higher sulfide contents than general waste rock.

The sulfide sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping presented in Table 4.4. The results indicate that about 25% of the samples had a sulfide content of less than 0.3% (i.e. in the extremely low to low range), 32% of samples had moderate to high sulfide sulfur and 38% of the samples had very high to extremely high sulfide sulfur.

Table 4.4: Sulfide Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 – 2%	Very High 2 – 5%	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
Andesite Porphyry	8%	20%	5%	7%	31%	21%	7%
Breccia	-	-	-	-	21%	43%	36%
Diorite Porphyry	-	-	-	17%	17%	50%	17%
Dyke	-	-	-	-	-	67%	33%
Fault Breccia	-	40%	-	-	40%	20%	-
Feldspar Porphyry	-	-	-	-	-	100%	-
Hornblend Porphyry	100%	-	-	-	-	-	-
Hydrothermal Breccia	-	80%	-	-	-	-	20%
Porphyry	-	20%	20%	20%	-	20%	20%
Pyroclastic	-	71%	-	-	14%	14%	-
Tuff	-	-	-	-	-	50%	50%

The sulfide sulfur results have also been summarised by depth, as this may be useful in mine planning. The results of this classification are provided in Table 4.5.

Table 4.5: Sulfide Sulfur by Depth

Depth (m)	Extremely Low <0.01%	Very low 0.01 - 0.1	Low 0.1 - 0.3	Moderate 0.3 - 0.5	High 0.5 - 2	Very High 2 - 5	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
0 to 50	-	68%	-	5%	18%	5%	5%
50 to 100	3%	37%	7%	10%	23%	20%	-
100 to 150	-	14%	3%	3%	31%	37%	11%
150 to 200	-	32%	-	-	26%	26%	16%
200 to 250	-	18%	9%	18%	36%	18%	-
250 to 300	-	-	-	-	-	43%	57%
300 to 350	-	-	9%	9%	18%	36%	27%
350 to 400	-	-	14%	14%	14%	57%	-
400 to 472	-	-	-	13%	38%	13%	38%

4.3 ACID NEUTRALISING CAPACITY AND CARBONATE CONTENT

The acid neutralising capacity (ANC) of the samples was determined along with the carbon content which, based on the geology of the deposit, was assumed to be representative of the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non-carbonate minerals.

The average acid neutralising capacity of all the samples was moderate to high at 15.4 kg H_2SO_4/t, however, there was a high degree of variability within the samples with the ANC varying from -23 to 155 kg H_2SO_4/t. The negative acid neutralising capacity values are a result of more alkali being required to back titrate the sample solutions to the end point of the test compared to the volume of acid which was added during the test. This indicates that there is residual acidity in the samples. This is discussed further in Section 4.4.

The samples with very high to extremely high acid neutralising capacities were located within discreet zones (i.e. borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m) rather than being evenly distributed throughout the deposit. The carbonate contents of these samples were also significantly higher compared to the other samples, indicating that the carbonates were resulting in the high acid neutralising capacities, as would be expected. The XRD analysis shows that the carbonate minerals in the samples with the high acid neutralising capacity are a mix of ankerite, calcite, dolomite and magnesite.

The calcium and magnesium carbonates will provide significant acid neutralising capacity, however, the ankerite will only provide limited neutralising capacity.

The very high to extremely high acid neutralising capacities were not restricted to a single lithology, suggesting broad scale carbonate alteration within discreet zones.

Outside of these high acid neutralising zones, the acid neutralising capacity was generally very low averaging just 2.9 kg H_2SO_4/t, with approximately 20% of the samples having negative acid neutralising capacities.

The distribution of the acid neutralising capacity with depth and the relationship between acid neutralising capacity and carbonate are shown in Figure 4.4. The distribution of acid neutralising capacity with lithology and depth are provided in Tables 4.6 and 4.7 respectively.

Table 4.6: Acid Neutralising Capacity by Lithology

Lithology	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
Andesite Porphyry	23%	14%	41%	3%	5%	13%	1%
Breccia	21%	21%	36%	-	7%	14%	-
Diorite Porphyry	8%	17%	33%	8%	17%	17%	-
Dyke	100%	-	-	-	-	-	-
Fault Breccia	20%	20%	60%	-	-	-	-
Feldspar Porphyry	-	100%	-	-	-	-	-
Hornblend Porphyry	-	-	-	-	-	100%	-
Hydrothermal Breccia	100%	-	-	-	-	-	-
Porphyry	40%	60%	-	-	-	-	-
Pyroclastic	-	29%	57%	14%	-	-	-
Tuff	50%	-	50%	-	-	-	-

Table 4.7: Acid Neutralising Capacity by Depth

Depth (m)	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
0 to 50	9%	14%	64%	5%	5%	5%	-
50 to 100	20%	20%	33%	-	10%	17%	-
100 to 150	26%	14%	46%	9%	3%	3%	-
150 to 200	16%	16%	32%	-	-	32%	5%
200 to 250	27%	-	27%	-	9%	36%	-
250 to 300	71%	29%	-	-	-	-	-
300 to 350	36%	27%	27%	-	9%	-	-
350 to 400	43%	29%	-	14%	14%	-	-
400 to 472	38%	13%	50%	-	-	-	-

4.4 PASTE pH

The paste pH of the samples was measured at a 1:3 (soil:water) ratio. The pH results ranged from 2.7 to 9.7, with almost a third of samples recording a paste pH of less than 4.5, indicating that a significant proportion of samples contain residual acidity which is readily released when placed in contact with water. In addition, 64 samples recorded a paste pH of between 4.5 and 7, with the remaining 38 samples recording paste pH values greater than 7.

There was no apparent relationship between paste pH and lithology, as shown in Table 4.8. However, reviewing the paste pH results versus sample depths indicates that the vast majority of samples from below 250 m in the deposit recorded paste pH of less than 7, as shown in Table 4.9. The results of the paste pH testing are also provided in Figure 4.5.

Table 4.8: Paste pH by Lithology

Lithology	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
Andesite Porphyry	29%	44%	26%
Breccia	36%	43%	21%
Diorite Porphyry	17%	83%	-
Dyke	100%	-	-
Fault Breccia	40%	40%	20%
Feldspar Porphyry	-	100%	-
Hornblend Porphyry	-	-	100%
Hydrothermal Breccia	20%	80%	-
Porphyry	60%	40%	-
Pyroclastic	29%	29%	43%
Tuff	100%	-	-

Table 4.9: Paste pH by Depth

Depth (m)	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
0 to 50	18%	55%	27%
50 to 100	27%	33%	40%
100 to 150	40%	43%	17%
150 to 200	37%	26%	37%
200 to 250	27%	27%	45%
250 to 300	71%	29%	0%
300 to 350	55%	36%	9%
350 to 400	0%	86%	14%
400 to 472	13%	88%	0%

4.5 NET ACID GENERATION

The NAG test involves the addition of hydrogen peroxide (15% H_2O_2 at a pH of 4.5) to the samples, which oxidises the contained sulfide minerals to release sulfuric acid, which is then neutralised by any available acid consuming minerals within the sample. The pH of the solution is measured and then titrated back to pH 4.5 and then pH 7.0 to give an indication of the net acid generation potential of the sample. As such, a NAG pH of below 4.5 indicates that excess acidity is produced and a pH of greater than 4.5 indicates that excess alkalinity is present.

The NAG test resulted in 96 samples producing NAG pH values of less than pH 4.5, indicating that these samples produce excess acidity under the extreme oxidising conditions imposed by the NAG test. The remaining 54 samples produced pH values greater than 4.5.

The NAG pH shows a strong correlation with depth, with a much greater number of samples recording NAG pH values above 4.5 in the upper 250 m of deposit. Below 250 m depth, all samples were found to have NAG pH values below 4.5 (with the exception of a single sample), as shown in Figure 4.6.

The NAG test has been demonstrated to accurately assess the acid formation potential for samples with less than 1% sulfide sulfur. However, for samples with greater than 1% sulfide sulfur, it is possible that the volume of hydrogen peroxide added during the test may be insufficient to fully oxidise all the sulfide sulfur, resulting in the acid production potential being underestimated. In addition, if these samples with high sulfide sulfur contents also have high ANC values, the final NAG pH may be neutral to alkaline, which would be misleading. Therefore, given that approximately 50% of the samples had sulfide sulfur contents greater than 1%, this limitation of the NAG test has been considered during interpretation of the acid formation potential, as discussed in Section 4.6.

4.6 ACID FORMATION POTENTIAL

To estimate the Acid Formation Potential (AFP) of the samples, the Maximum Potential Acidity (MPA) was calculated based on the sulfide sulfur results using the following formula:

Maximum Potential Acidity (kg H_2SO_4/t) = Sulfide Sulfur (%) x 30.6

This calculation assumes that all the sulfide sulfur is present as pyrite. The mineralogical analysis of the Letpadaung samples indicates that the most common sulfide mineral is pyrite and, therefore, the MPA values calculated from the sulfide contents of the Letpadaung samples is likely to be reasonably accurate.

The Net Acid Producing Potential (NAPP) was then calculated from the Maximum Potential Acidity (MPA) and the measured Acid Neutralising Capacity (ANC) using the following formula:

Net Acid Producing Potential* = Maximum Potential Acidity* – Acid Neutralising Capacity*

**All units kg H_2SO_4/t*

As discussed in Section 3.3 of this report, Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system (as presented in Table 3.1) is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Overall almost a third (30%) of the samples tested were found to be either non-acid forming (25%) or acid consuming (5%), with a further 4% classified as having an uncertain acid formation potential. The remaining 67% of the samples were classified as either Potentially Acid Forming – Low Capacity (9%) or Potentially Acid Forming (58%).

The six samples which were classified as 'uncertain' recorded conflicting acid base accounting results. Five of these samples had low sulfide sulfur contents (0.04% to 0.05%) and very low ANC values (-3 to 3 kg H_2SO_4/t). As such, the samples had marginal NAPP values (-1.8 to 4.2 kg H_2SO_4/t) and NAG pH values around the acid forming cut-off of 4.5. Therefore, these samples should be assumed to be Potentially Acid Forming – Low Capacity.

The other sample which was classified as 'uncertain' produced a NAG pH of 4.8 and a positive NAPP of 16.5 kg H_2SO_4/t. However, review of the acid base accounting results indicates that the sample also had a high sulfide content of 1.26% and a high ANC of 23 kg H_2SO_4/t. Therefore, it is likely that the hydrogen peroxide added in the NAG test was insufficient to oxidise all of the sulfide minerals and, as such, the sample should be considered as potentially acid forming.

<u>Overall 29% of the waste samples can considered as Non Acid Forming with the remaining 71% considered Potentially Acid Forming.</u>

There was no apparent correlation between acid formation potential and lithology, as is shown in Table 4.10 and Figure 4.7.

The distribution of the PAF samples showed a reasonable correlation with depth, with 60% of the samples classified as non-acid forming located within the upper 50 m of the

deposit. The proportion of non-acid forming material decreases with depth and below 250 m, the vast majority of the waste can be considered potentially acid forming. The distribution of acid forming potential by depth is provided in Table 4.11 and Figure 4.8.

Table 4.10: Acid Formation Potential by Lithology

Lithology	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
Andesite Porphyry	5%	29%	3%	7%	55%
Breccia	7%	7%	-	-	86%
Diorite Porphyry	8%	17%	-	-	75%
Dyke	-	-	-	-	100%
Fault Breccia	-	20%	20%	-	60%
Feldspar Porphyry	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-
Hydrothermal Breccia	-	-	40%	40%	20%
Porphyry	-	-	-	60%	40%
Pyroclastic	-	57%	-	14%	29%
Tuff	-	-	-	-	100%

Table 4.11: Acid Formation Potential by Depth

Depth (m)	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
0 to 50	0%	59%	5%	14%	23%
50 to 100	7%	33%	10%	17%	33%
100 to 150	0%	17%	3%	3%	77%
150 to 200	16%	21%	0%	0%	63%
200 to 250	18%	27%	9%	0%	45%
250 to 300	0%	0%	0%	0%	100%
300 to 350	0%	0%	0%	18%	82%
350 to 400	0%	14%	0%	14%	71%
400 to 472	0%	0%	0%	13%	88%

In addition to the acid formation potential classification presented above, another measure of the AFP is the ratio between the ANC and the MPA, as samples which have excess ANC over the MPA have an ANC/MPA ratio greater than 1 and those with excess acidity (i.e. PAF) have an ANC/MPA ratio of less than 1.

There is a broad consensus across the industry that samples which have an ANC/MPA ratio of greater than 2 have a high factor of safety against generation of acid, providing that the acid neutralising capacity is available from highly reactive carbonate (i.e. calcite). Where the neutralising capacity is available from other minerals, such as the iron and magnesium rich carbonates present at Letpadaung, then an ANC/MPA ratio of greater than 3 is required to have a high factor of safety.

The ANC/MPA ratios of the samples indicate that approximately 46% of the non-acid forming and acid consuming samples have low factor of safety (ANC/MPA ratio <2), with 19% of the non-acid forming and acid consuming samples having a moderate factor of safety (ANC/MPA ratio 2 to 3) and the remaining 35% of samples having a high factor of safety (ANC/MPA ratio greater than 3).

The samples with a high factor of safety are predominantly those with high ANC (>80 kg H_2SO_4/t) and are generally restricted to the zones within the deposit which have carbonate alteration (borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m).

For the non-acid forming samples with a low factor of safety, care needs to be taken as there is the potential that the rate of sulfide oxidation may exceed the rate of acid neutralisation available from the neutralising minerals. **Additional testing of the material which has been classified as non-acid forming but has a low ANC/MPA ratio is recommended to confirm that these samples will not generate acid.**

The acid formation potential classifications and associated factors of safety according to the ANC and MPA (calculated from sulfide sulfur) are presented in figures 4.9 and 4.10.

4.7 MULTI-ELEMENT ANALYSIS

Multi-element analysis of the samples was conducted to assess element enrichments. The multi-element analysis results were compared to the average crustal abundance to calculate the geochemical abundance indices. The geochemical abundance index quantifies an assay result for a particular element in terms of average crustal abundance.

The multi-element assay results are presented in Appendix C, with the average crustal abundances (ACA) and corresponding geochemical abundance indices (GAI) presented in Appendix D. The results are also summarised below.

The results of the analyses show that the samples have a high level of elemental enrichment. Fourteen elements were found to be highly enriched in at least one sample, namely sulfur, tellurium, selenium, bismuth, rhenium, arsenic, silver, lead,

copper, indium, antimony, cadmium, molybdenum and zinc. A further four elements were found to be significantly enriched in at least one sample, namely tungsten, tantalum, manganese and mercury, with at least one sample found to be slightly enriched in uranium, tin, caesium, iron, strontium and lithium (all elements listed in decreasing levels of enrichment). However, it should be noted that the laboratory detection limits for tellurium and selenium were equivalent to a significantly enriched classification. Therefore, samples which recorded concentrations of tellurium and selenium below the limits of detection have conservatively been assigned a significantly enriched classification.

There was no apparent correlation between overall enrichment and lithology or depth, however, a weak correlation between total sulfur grades and enrichment was observed, whereby samples with higher total sulfur grades typically recorded higher overall levels of enrichment. In addition, a correlation was observed between acid formation potential and overall enrichments, with PAF and UC samples recording higher levels of enrichment compared to NAF and AC samples.

4.8 DISTILLED WATER EXTRACT

Distilled water extract tests were undertaken to assess whether metals are likely to leach from the waste rock at environmentally significant concentrations. A total of 50 samples were analysed for distilled water extract, samples selected such that all key waste lithologies were represented across a range of copper enrichment levels.

The extract results have been compared to reference guidelines for release from mining operations and livestock drinking water. The extract solutions were generally found to be of a poor quality, with only twelve samples (24%) meeting all the water quality guidelines. In addition, the average concentrations (of all samples) for aluminium, cadmium, copper, iron and zinc were found to exceed the water quality criteria. In addition, there were exceedances for cobalt (3 samples), molybdenum (3 samples), nickel (4 samples), sulfate (1 sample) and uranium (1 sample), although the average concentrations of these elements from all samples were within the water quality criteria.

The majority of the extract solutions also recorded pH values below the lower bound acceptance criteria of pH 6. The results of the distilled water extract testing compared to the reference water quality guidelines are presented in Appendix E.

The distilled water extract results have also been compared to the acid forming potential of the samples. Overall, 40% of the AC samples and 70% of the NAF samples met all the water quality criteria, with only 9% of the PAF, PAF-LC and UC

samples meeting all guidelines. This is also reflected in the average concentrations of dissolved metals from each acid forming classification group, as shown in Table 4.12, which indicates that the PAF material is most likely to leach metals at unacceptable concentrations. This is likely partly due to the fact that the pH of the PAF extract solutions typically recorded lower pH values compared to the NAF and AC samples. However, on the basis of these results, **all waste material has the potential to leach metals at environmentally significant concentrations, especially when acidic conditions are imposed.**

Table 4.12: Average Distilled Water Extract Results by AFP

Acid Formation Potential	Al	Cd	Cu	Fe	Mo	Zn	pH*
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	-
AC	1.96	0.00003	0.03	0.46	**0.52**	0.01	8.5
NAF	1.41	0.00011	**2.88**	0.759	0.024	0.08	8.4
PAF	**10.04**	**0.02**	**17.36**	**26.7**	0.001	**2.84**	**3.8**
PAF-LC	0.73	0.006	**0.49**	0.11	0.002	0.31	**3.4**
UC	0.72	0.001	**1.59**	0.10	0.0001	0.24	**5.2**
All Samples	**6.01**	**0.012**	**10.1**	**14.61**	0.06	**1.60**	**4.0**
Water Quality Reference Level	5.0	0.01	0.3	2.0	0.15	0.5	6.0 – 9.0

**Note: pH is based on a logarithmic scale, which has been accounted for when calculating the average pH values. These values are for indicative purposes only.*

5. IMPLICATIONS FOR WASTE ROCK MANAGEMENT

Based on the results of this geochemical assessment, the implications for waste rock management are presented in the following sections.

5.1 ACID GENERATION

The results of the test work indicate that the potential for acid generation at the Letpadaung project is very high to extreme with material at all depths and from all lithologies within the deposit capable of generating acid.

The geochemistry indicates that for the majority of material, i.e. that which has a low acid neutralising capacity, the onset of acid generation is likely to be rapid with limited lag times (although this needs to be confirmed, as detailed in Section 5.3.1). There is also the potential for large quantities of acid to be generated, with the average net acid producing potential of the PAF material calculated at 87 kg H_2SO_4/t. This equates to tens of millions of tonnes of acid which could be potentially be generated by the waste if it is allowed to freely oxidise. It is therefore apparent that allowing the waste to oxidise and lime treating the acid after formation would have an extremely high cost both in terms of the supply of lime and the management and disposal of the neutralisation sludge. For this reason, active management of the mine waste at the project will be required during operations to minimise the likelihood of the waste acidifying, as discussed in Sections 5.3 to 5.5.

5.2 ENRICHMENT AND METAL LEACHING

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. The PAF material was found to have the highest metal leaching potential, although a portion of the AC and NAF samples were also found to leach certain metals above the reference water quality criteria. Further, the pH of the extract solutions from the AC and NAF remained circum neutral during the test, compared to the PAF solutions which became acidic. Therefore, it is likely that the NAF and AC material would also leach metals, and perhaps to the same extent as the PAF material, should acidic conditions develop within the waste dumps. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from the waste dumps at Letpadaung.

5.3 ONGOING WASTE ROCK CHARACTERISATION

Very limited geochemical characterisation of the deposit has been conducted, especially considering the scale of the project and the high risk profile of high sulfur porphyry systems. As such, additional geochemical work will be required pre-mining

and throughout the life of the project. The scale of the work which will be required will be large and will probably warrant establishing an onsite geochemical laboratory to handle the large number of samples and to ensure a rapid turnaround of results.

5.3.1 Pre-Mining Geochemical Characterisation

The results of this test work give an indication of the extent and severity of the likely acid generation of the material contained within the Letpadaung deposit and provides an indication of the drainage water chemistry from the material when it is mined. The results, however, do not provide information on the likely lag time to acidification or the drainage chemistry which is likely to result after oxidation and acidification of the waste. These factors need to be established prior to bulk mining to allow a detailed mine waste management plan to be produced, which will need to be appropriately tailored to the material at Letpadaung.

As such, it is recommended that an additional testing programme be conducted prior to bulk mining at the project. This test work should comprise additional acid base accounting of the material to be mined in the first year(s) of operations to establish more accurate estimates of the proportion of the PAF / NAF material which will generated in these early stages and allow for design and planning of the initial waste dumps.

The scope of this investigation would likely be similar to that presented herewith. However, as this geochemical assessment has shown a good correlation between the NAG test and the other acid base accounting analysis, it may be possible to limit the testing of the majority of the samples to NAG testing only, with detailed geochemistry only conducted on a limited number of samples. **It is therefore recommended that:**

- **Several hundred samples are collected from the waste zones to be mined in Years 1 and 2 of operations.**
- **All samples are submitted for NAG testing, and approximately 20% of the samples have full acid base accounting test work.**

This investigation is critical to defining operational controls for the project and verifying the proposed operational testing procedures and classification criteria.

In addition to this testing, **kinetic testing is required to establish sulfide oxidation rates, the availability of acid neutralising capacity, the lag times to acidification and the drainage water chemistry for a range of materials.** These tests involve accelerated leaching of material by optimising the conditions for acid formation through repeated wetting and drying cycles and free availability of oxygen. The tests should be conducted on materials from all acid formation potential classifications, i.e. acid

consuming, non-acid forming, uncertain and potentially acid forming. Further, it is recommended that around 20 samples are prepared for kinetic testing, with the selected samples biased towards material which will be mined over the next 2 to 5 years.

5.3.2 Operational Geochemical Classification

To allow for active management of potentially acid generating material during operations, there will be a requirement to conduct geochemical testing throughout the life of the project. The scale of the project and the mining rate (~30 Mtpa of waste) is such that a dedicated on site laboratory will be required to manage this test work. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

Test work will be required on grade control samples or blast hole samples ahead of mining to allow waste blocks to be classified and allow potentially acid generating material to be identified for selective handling. Based on the geochemistry of the Letpadaung deposit, conventional operational testing using total sulfur grades and acid neutralising capacity to determine the acid formation potential of the material will not be appropriate, as the alunite and natroalunite will lead to the incorrect classification of a significant proportion of the waste. The alternate tests which are available to the project are chromium reducible sulfur with acid neutralising capacity or the net acid generation test (NAG) test.

A chromium reducible sulfur and acid neutralising capacity testing programme would be slow to conduct and expensive. Therefore, it is considered unsuitable for such a large scale operation, and the NAG test is recommended for ongoing classification of the acid formation potential of the material.

The NAG test should be conducted on bench height composite samples sourced from closely spaced grade control or blast hole chips (i.e. no more than 15m for each mining bench). The NAG test produces three results when conducted in its entirety; the NAG pH, $NAG_{4.5}$ and $NAG_{7.0}$.

The NAG pH provides a quick reference of the likely acid formation potential of the samples but is hard to model in conventional mining planning software as it is a logarithmic scale. Therefore, the NAG pH is not considered suitable for short term mine planning.

The $NAG_{7.0}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 7.0. For many mining operations, this measure is used to determine the acid formation potential of the waste and can be readily modelled.

However, at Letpadaung the waste has an inherently low in situ pH (generally below pH 7.0) and the use of the $NAG_{7.0}$ results would cause almost all material to be classified as potentially acid forming, which would be overly conservative.

It is therefore recommended that the $NAG_{4.5}$ is used to classify the acid formation potential of the waste material at Letpadaung. The $NAG_{4.5}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 4.5 and the result is expressed in kg H_2SO_4/t which, being a non-logarithmic scale, can be modelled in mine planning software.

Given that the distilled water extract testing has indicated that the vast majority of the waste contains leachable metals, there unlikely to be any benefit of conducting additional testing to characterise the leaching potential of the waste, as significant testing would be required to likely identify only a small proportion of suitable NAF waste rock which could be placed on the outer faces of the waste dumps, where it would be subject to rainfall percolation and will higher leachate rates. Instead, it is recommended that all waste be considered leachable and managed appropriately. This is discussed further in Sections 5.5.4 and 5.5.5.

5.4 RATIONAL FOR ACTIVE WASTE MANAGEMENT

The issue of acid rock drainage has been recognised as a significant issue since the 1970's. Initially, management of acid rock drainage focused on treatment of effluent to reduce the downstream environmental impacts. However, it was soon established that the costs associated with long term treatment (lasting decades or longer) was a significant burden and, in some cases, the cost of treatment exceeded the initial profits generated by the mining activities. In the 1990's, research and development started to focus on the reduction of acid rock drainage from mine waste through the application of cover systems post mining. This approach, however, has proven to only be partially effective and in some cases has added little overall benefit, as covers installed post mining do not prevent the oxidation products (which have been generated during mining operations) from continuing to the be released post closure.

A schematic of the generation of oxidation products over time and measurement of acid load in a system where capping was conducted at the end of operations is provided in Figure 5.1. It shows that installation of the cover system had little impact on the acid load and, in fact, the highest acid loads requiring treatment occurred after capping the waste.

Current research into the generation of acid rock drainage has found that the most effective method of control is to minimise the oxidation of waste both during operations

and on closure to prevent a build-up of oxidation products which would otherwise require treatment during operations and post closure. To achieve this aim, an understanding of the mechanisms of oxidation in waste dumps is required.

The oxidation of sulfide minerals requires the presence of both oxygen and water. The amount of water required to allow the sulfide minerals to oxidise is small, and there is generally enough moisture either naturally contained in the waste rock or from atmospheric humidity that the supply of water is not a limiting factor in the initial oxidation of sulfide minerals. There are some exceptions to this, such as hyper arid regions (e.g. the Atacama Desert) but for Letpadaung it is considered that supply of water will not be a limiting factor for initiating sulfide oxidation.

In a geological setting where acid generating material is located above the water table, the rates of oxygen flux into the material is normally sufficiently slow to limit the rate of oxidation to a level where the acid generated can be naturally buffered. However, when sulfidic material is disturbed through mining operations, the amount of oxygen available for sulfide oxidation increases, allowing higher rates of sulfide oxidation to occur. When the rate of sulfide oxidation exceeds the rate at which the naturally occurring neutralising capacity can buffer the acidity, the material acidifies leading to acid rock drainage.

There are two primary mechanisms for sulfide oxidation; the first, which is discussed above, involves atmospheric oxygen and water (equation 5.1). This reaction generally prevails in circum-neutral pH conditions and is a relatively slow reaction. However, as the pH of the material drops through sulfide oxidation, the iron in the system is oxidised to ferric iron (equation 5.2) and this ferric iron then starts to act as the oxidising agent for the sulfide minerals (equation 5.3). This ferric iron reaction is orders of magnitude faster and results in a rapidly increasing rate of sulfide oxidation and consequent acid generation.

$$FeS_2 + 7/2O_2 + H_2O \longrightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad (5.1)$$

$$Fe^{2+} + 1/4O_2 + H^+ \longrightarrow Fe^{3+} + 1/2H_2O \quad (5.2)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O \longrightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+ \quad (5.3)$$

Waste rock in a conventional waste dump design is dumped from a tip head which may vary in height from 10 m to over 100 m. The action of dumping the waste from a high tip head acts to segregate the waste with the coarser material rilling to base of the tip head and the finer material being retained at the top of the dump. This forms a coarse rubble zone at the base of the tip head and alternating sloping layers of finer and coarse waste through the dump.

The coarse rubble zone and coarse sloping layers allows oxygen to freely flow into and penetrate deep into the waste dump which leads to the initiation of sulfide oxidation within the coarse layers and within the adjacent finer grained material. This initial sulfide oxidation generates heat (as reactions 5.1 & 5.3 are exothermic) which then causes the warm, oxygen depleted air to rise through the sloping layer and vent at the top of the waste dump. This in turn pulls in fresh air through the basal rubble zone supplying oxygen into the system at a faster rate than natural diffusion would allow. As oxidation progresses and the pH drops, the rate of sulfide oxidation increases generating more heat and allowing more oxygen to be pulled into the dump which initiates further sulfide oxidation. This mechanism is shown schematically in Figure 5.2, along with a section through an end tipped waste dump showing the preferred oxidation within the coarse sloping zones. Elimination of this advective system will reduce the rate at which sulfide oxidation occurs and will, therefore, limit the amount of oxidation products in the dump prior to final capping and closure. This is key to the effective management of acid rock drainage in waste dumps.

5.5 MANAGEMENT OF POTENTIALLY ACID GENERATING WASTE

5.5.1 Waste Zone Identification

As discussed in Section 5.3.2, testing will need to be conducted on grade control or blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify those waste blocks which are PAF and those which are NAF. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types. A common convention is to use green tape to indicate NAF waste, red tape to indicate PAF waste and white tape to indicate ore.

5.5.2 Selective Handing

Material will need to be selectively handled to allow separation of PAF and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated (red for PAF waste / green for NAF waste and white for ore). As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit

and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

5.5.3 Waste Placement Methods for PAF Material

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

This should be achieved through the placement of waste in lifts of no greater than 3 m to 5m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement.

5.5.4 NAF Waste Placement

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated. This is discussed in Section 5.5.5 below.

5.5.5 Encapsulation of Waste

All waste rock will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have a high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. As shown in Figure 5.3, material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

5.5.6 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been

placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis
- Atterberg Limits
- Laboratory proctor compaction
- Field density and moisture content
- Particle SG

Based on the scale of the operation and the requirement to encapsulate such a large quantity of material, it is recommended that an on-site geotechnical laboratory be established. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

5.5.7 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

5.5.8 Water Management

Runoff from the PAF waste zones is likely to be slightly to highly acidic and runoff from both the NAF and PAF zones will likely contain elevated concentrations of dissolved metals. Therefore, measures will need to be designed and implemented to capture and store this water. Surface water drains will need to be installed around the periphery

of all active waste dumps to divert clean water around the dumps and also intersect runoff from the dumps. This water can then be directed to the water storage facility. The water storage facility will need to be designed with seepage control measures if the natural in-situ materials are found to be of too high permeability to contain the water without leading to excessive seepage.

The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement. Internal drainage will also need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

5.6 IMPLICATIONS FOR CLOSURE

5.6.1 Waste Dumps

Provided that the waste dumps are managed appropriately during operations, the procedures required for closure should be relatively straightforward to implement. The final surface of the waste will need to be compacted, encapsulated and the store and release cover system constructed, as outlined in Section 5.5.5. A growth medium should then be placed over the cover system and seeded to promoted revegetation. The majority of these work should have been conducted during operations.

Ongoing monitoring of the oxygen concentrations and temperatures within the PAF zones will be required post closure to assess to effectiveness of the encapsulation and determine whether sulfide oxidation is occurring. In addition, the runoff and seepage water will need to be collected and tested to determine whether it is suitable for release. If the water is not of an appropriate quality, it will either need to be treated prior to release or contained. It may be possible to direct seepage waters to the open pits on closure, however, this is discussed further in Section 5.6.2 below.

5.6.2 Pits

A detailed geochemical assessment will be required to determine the final void water quality post closure. This involves hydrological and hydrogeological studies to determine the pit filling water balance and storage volumes when steady state conditions are reached. This pit water balance model is then used in the geochemical modelling, whereby element concentrations are applied to the pit inflows (groundwater, surface water, pit wall run-off and direct precipitation on the pit lake), outflows (evaporation and possibly groundwater or over-topping) and wall rock to simulate

reaction processes within the pit lake, such as water-rock interaction, fluid mixing, dissolution, precipitation, association and sorption. Appropriate mitigation controls will be required if the pit lake water quality is predicted to be poor, and the water balance model indicates that outflows to off-site groundwater or surface water resources will likely occur.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the geochemical characterisation of the waste rock from the Letpadaung project, the following conclusions can be made:

- Knight Piésold selected 150 waste rock samples from 13 boreholes located within the pit extents. Samples were collected from all logged lithologies within these boreholes and from depths ranging from 5 m to 472 m, which is similar to the planned maximum depth of the pit.
- The samples were sent to Genalysis Intertek in Perth who conducted the testing according to the schedule provided by Knight Piésold. The test work conducted was based on internationally accepted methods.
- The waste rock samples were primary composed of quartz, clay minerals (including illite, smectite, kaolin and chlorite) and alunite and natroalunite, with a relatively high amorphous content. The main sulfide mineral in the waste samples was pyrite with trace chalcopyrite. Carbonate was present in the samples, most commonly as siderite, but some calcium and magnesium carbonates were also present in discreet areas.
- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents.
- The sulfide sulfur contents of the samples ranged from extremely low to extremely high, however, the average sulfide content for all samples was 2.1% which is considered very high. There were more samples with extremely low sulfide sulfur in the upper 200 m of the deposit. Below around 250 m depth all samples had sulfur contents greater than 0.1%, with most samples below this depth having high to extremely high sulfide sulfur contents.
- The acid neutralising capacity of the samples was highly variable with a small number of samples from discreet zones in the deposit having high ANC values, correlating with increased carbonate contents. Outside of these carbonate rich zones, the ANC of the deposit was very low averaging less than 3 kg H2SO4/tonne.
- The Net Acid Generation test resulted in 96 samples producing acidic conditions, with the number of samples producing acid increasing with depth.
- Overall, 29% of the waste samples can considered as Non-Acid Forming, with the remaining 71% considered Potentially Acid Forming. According to each sampling and testing result about ARD in blasting area in future mining operation, MWMCL will identify ARD content in whole waste rock.

- The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metalliferous drainage from both the PAF and NAF material.
- Based on the results of the testing, active management of the potentially acid generating materials will be required, with the recommended methods discussed in the following recommendations.

Based on the results of the geochemical testing, the following recommendations can be made:

- It is recommended that additional geochemical assessment be conducted prior to bulk mining to better quantify the amount of potentially acid generating material which will be encountered during the first year(s) of operations to allow detailed waste management planning.
- It is recommended that kinetic testing of approximately 20 waste rock samples commences prior to bulk of each flitch to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.
- It is recommended that an onsite geochemical laboratory be established to conduct routine geochemical testing during operations.
- It is recommended that grade control or blast hole bench height composite samples are tested at a spacing of no more than 15 m. It is further recommended that the NAG test is used to classify the acid formation potential of the material ahead of mining.
- It is recommended that mining practices are established which allow definition of the PAF and NAF waste in the field and allow for selective mining and placement of the material.
- It is recommended that all PAF waste is placed in lifts of no greater than 3 m to 5m in height to eliminate segregation of the waste which could lead to accelerated acid generation.
- It is recommended that all waste be encapsulated during operations with an engineered cover comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The encapsulation material will need to be covered by benign waste or borrow

material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the cover.

- It is recommended that borrow areas for the encapsulation material be identified and samples of the proposed cover material be collected for geotechnical testing to allow detailed design of the cover system.
- It is recommended that geotechnical testing be conducted during construction of the cover system to ensure that the cover system is constructed to the design specification.
- It is recommended that geochemical monitoring of the cover system, comprising oxygen sampling points and thermistors, be conducted to allow the performance of the cover system to be verified during operations.
- It is recommended that a water management system be designed and constructed to prevent clean water from entering the waste dump area and to collect potentially contaminated water and direct this to a suitably designed water storage facility.
- Ongoing monitoring of the waste dump, encapsulation layer, cover system and drainage water will be required post closure.
- Should the drainage waters be found to be of an unacceptable quality, they will either need to be treated prior to release or contained.
- It may be possible to direct seepage waters to the open pits on closure, however, this would require detailed hydrological, hydrogeological and geochemical modelling to determine whether off-site downstream groundwater or surface water resources would be impacted.

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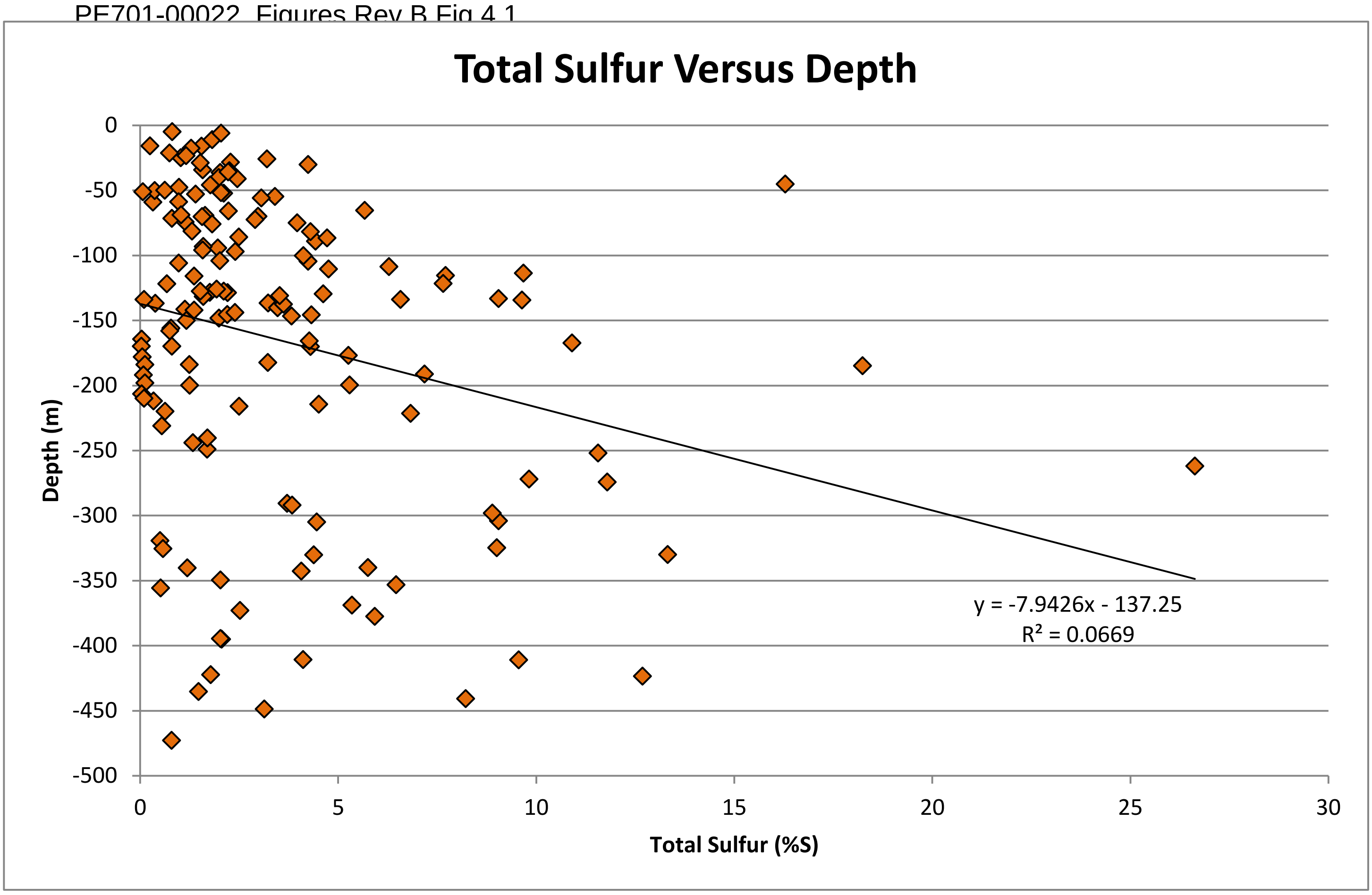
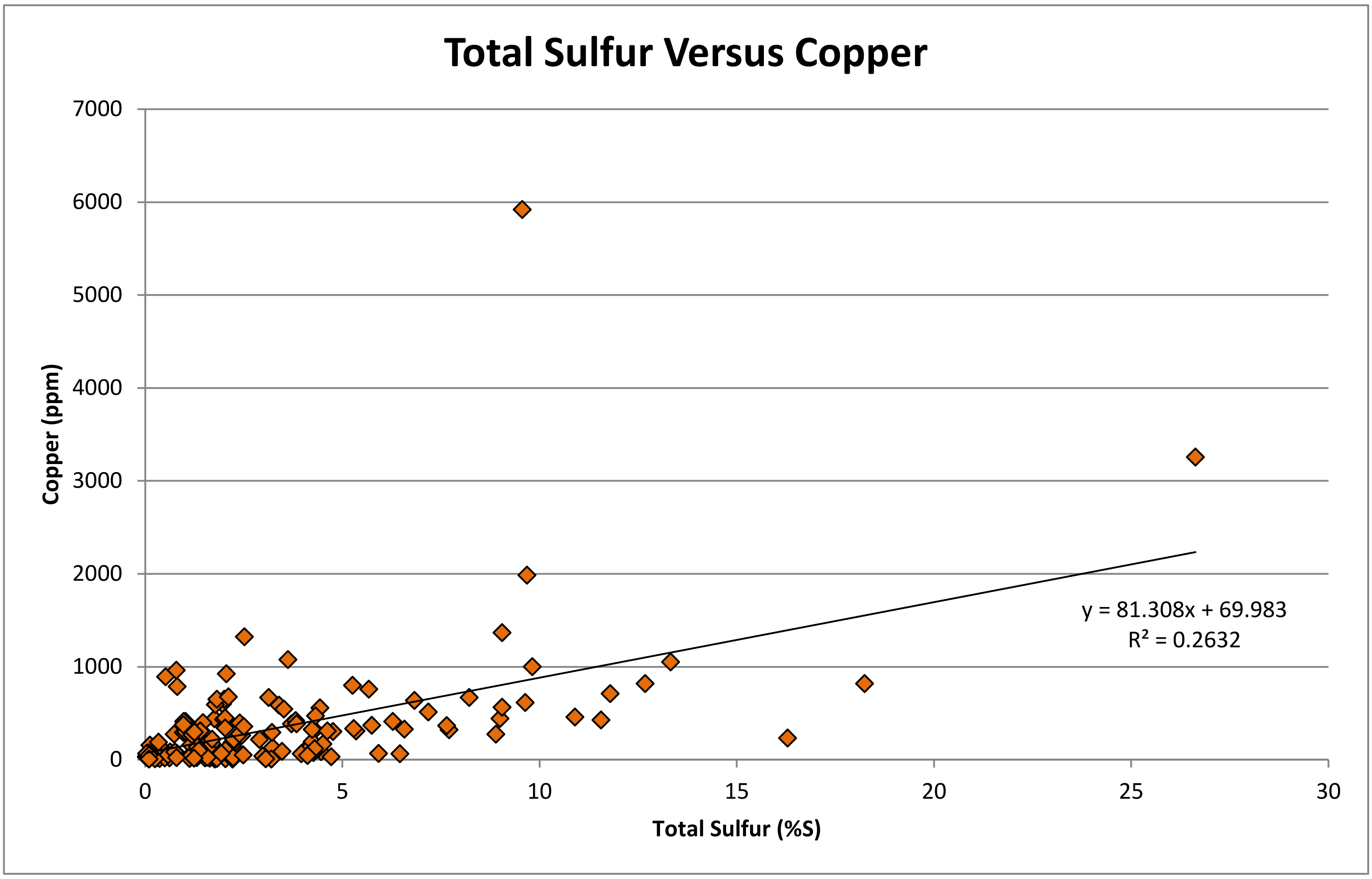
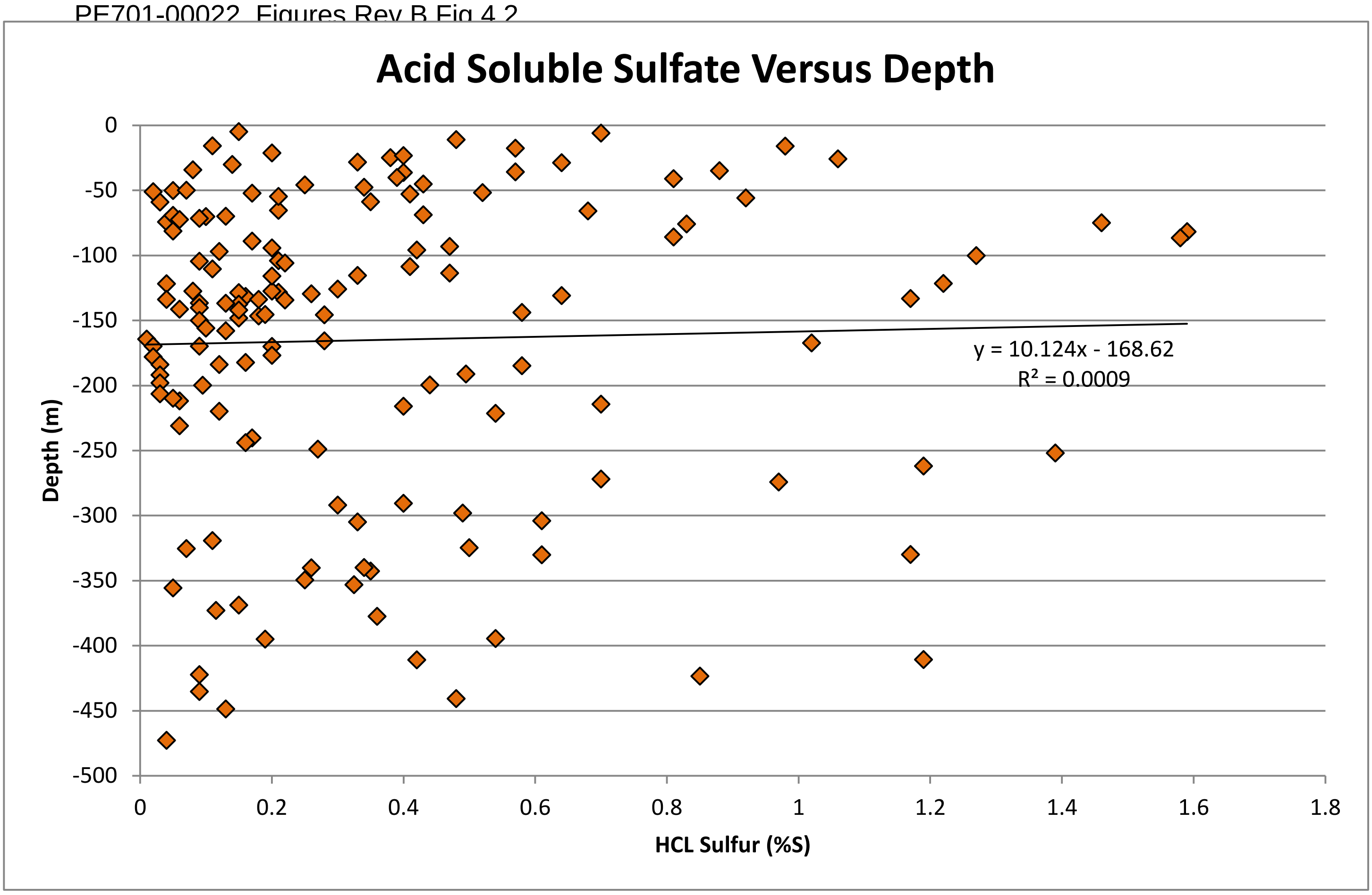
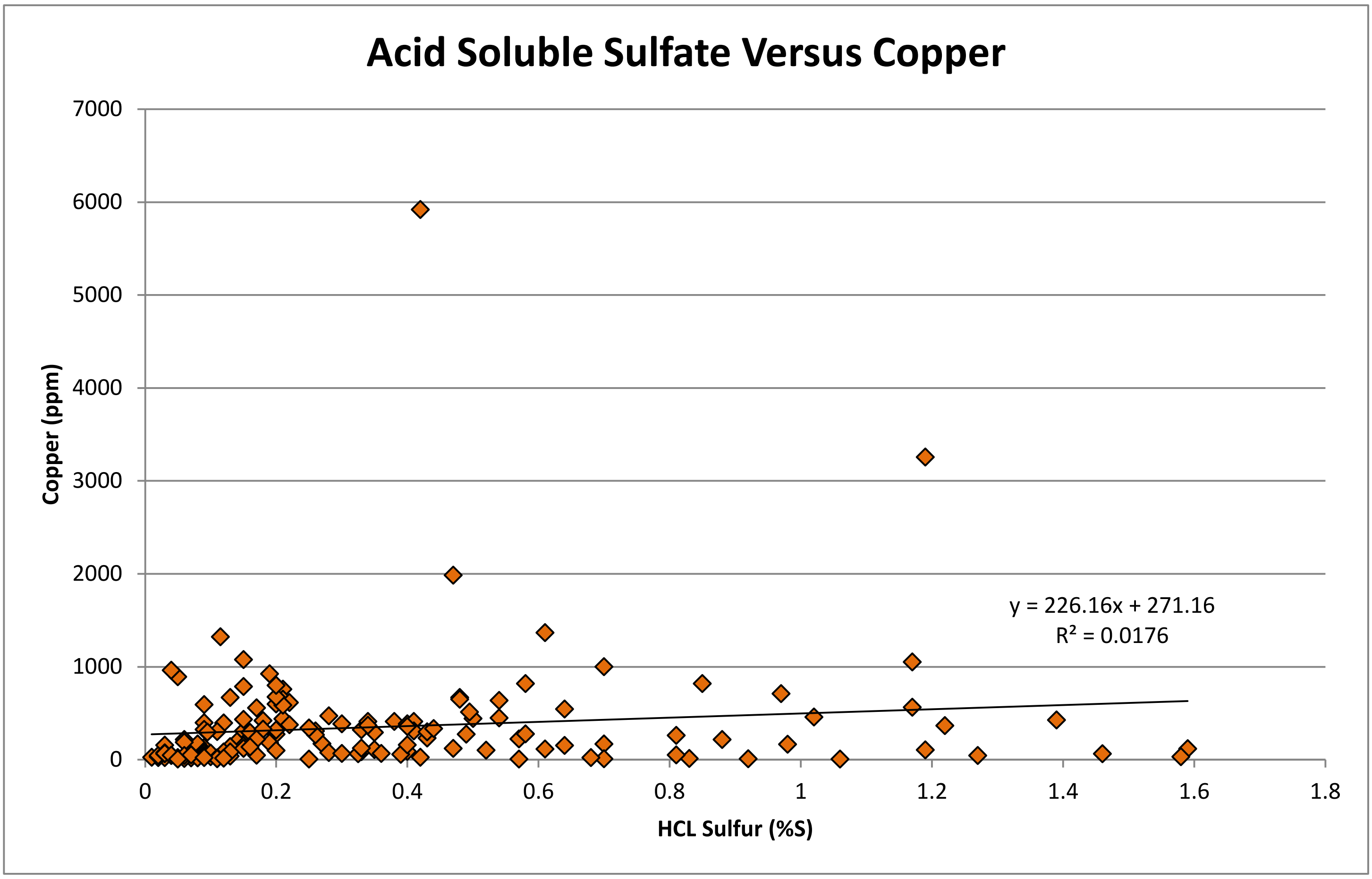
FIGURES

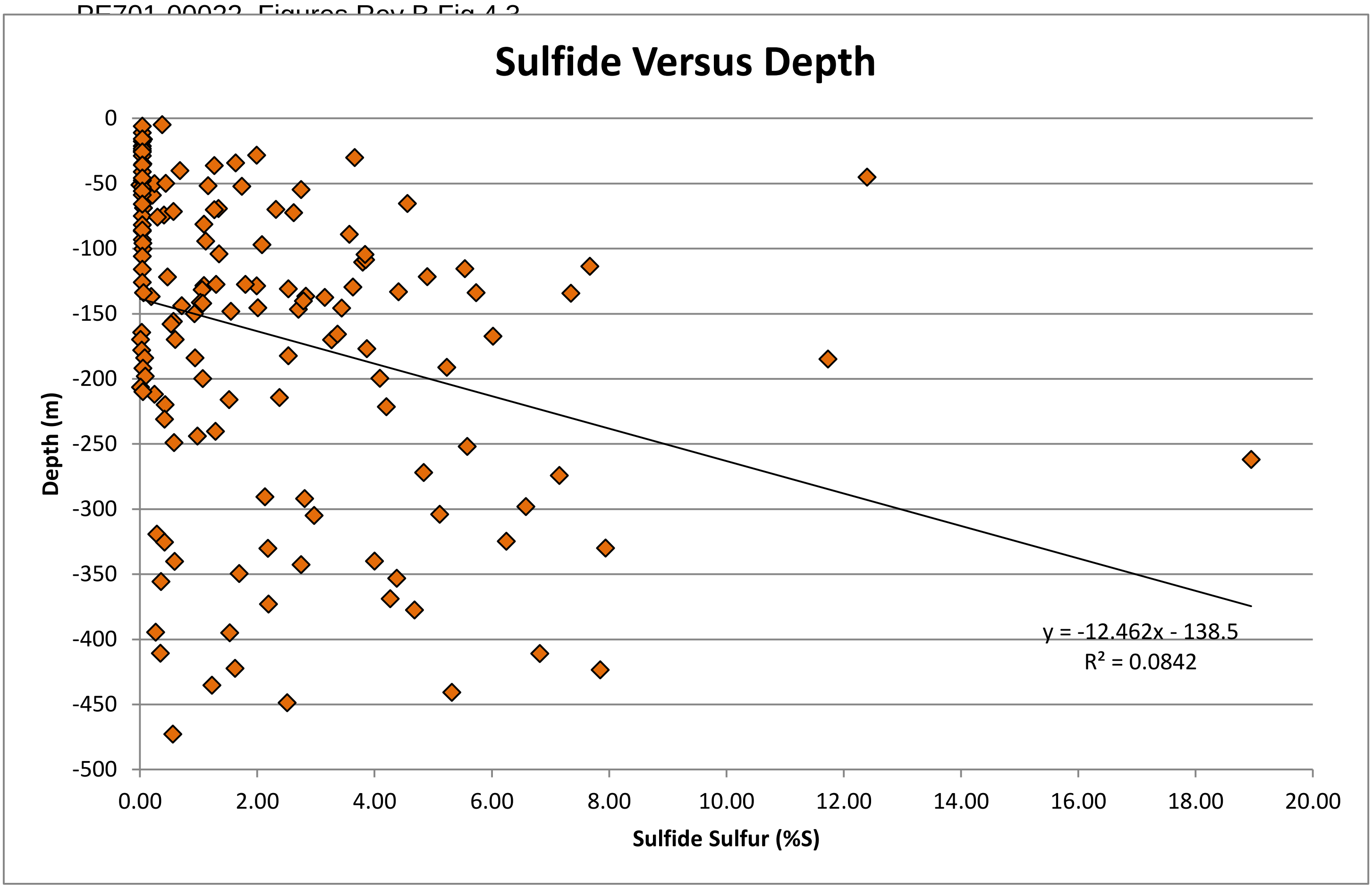
Knight Piésold
CONSULTING


Total Sulfur Versus Depth
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
Depth (m)
0
5
10
15
20
25
30
Total Sulfur (%S)
y = -7.9426x - 137.25
R² = 0.0669

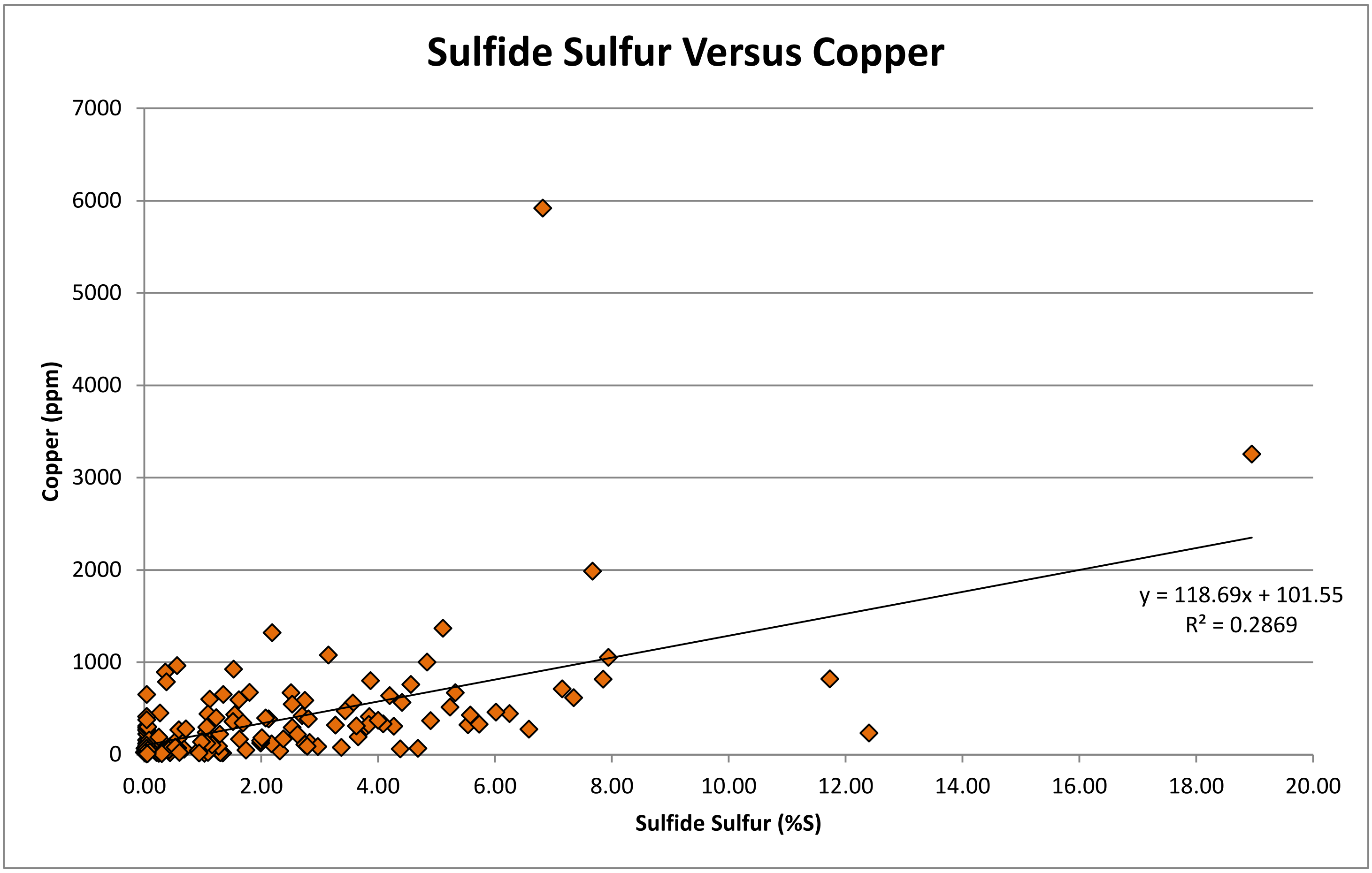

Total Sulfur Versus Copper
7000
6000
5000
4000
3000
2000
1000
0
Copper (ppm)
0
5
10
15
20
25
30
Total Sulfur (%S)
y = 81.308x + 69.983
R² = 0.2632


Acid Soluble Sulfate Versus Depth
Depth (m)
HCL Sulfur (%S)
y = 10.124x - 168.62
R² = 0.0009
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

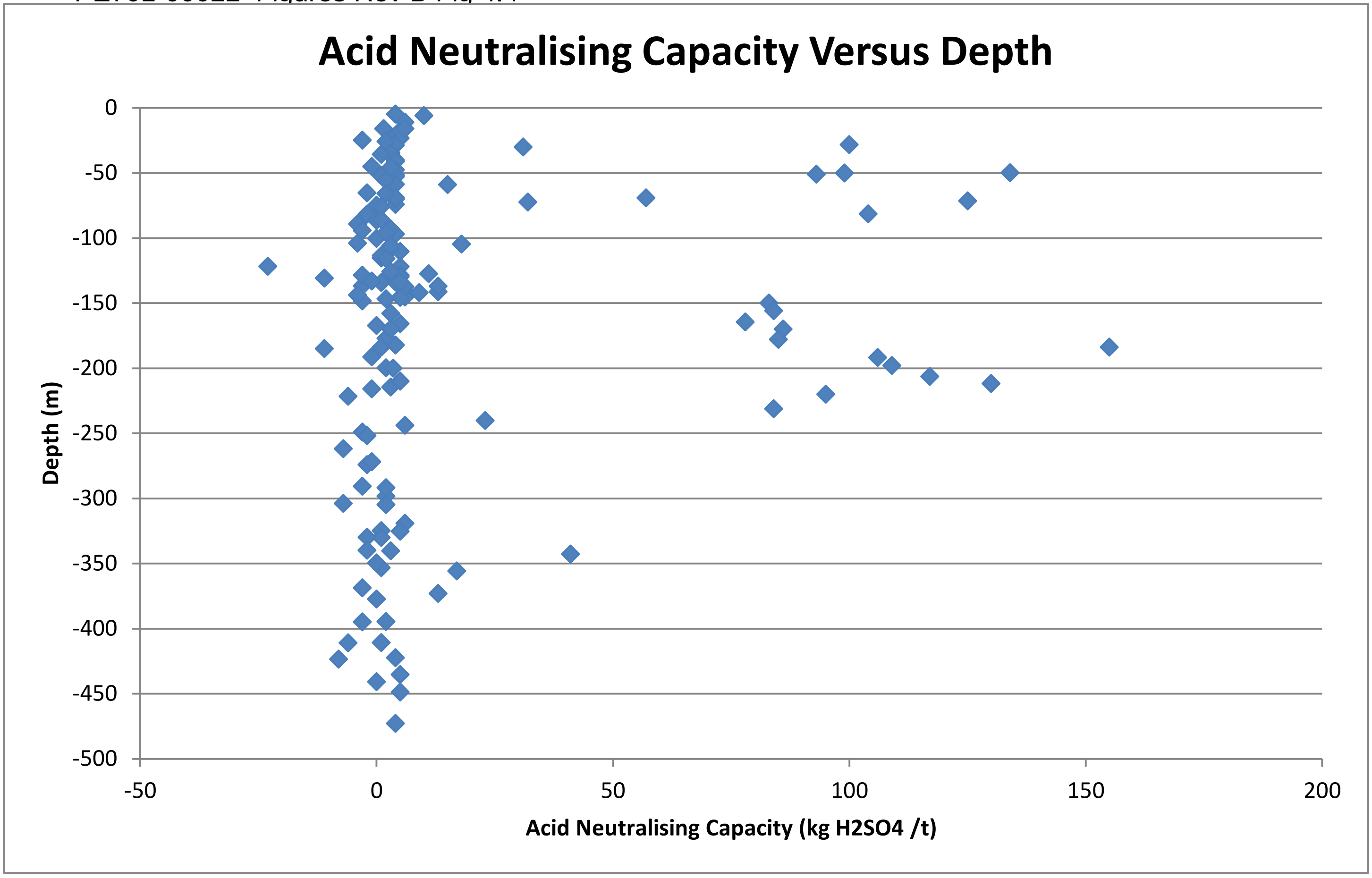

Acid Soluble Sulfate Versus Copper
Copper (ppm)
HCL Sulfur (%S)
y = 226.16x + 271.16
R² = 0.0176
7000
6000
5000
4000
3000
2000
1000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

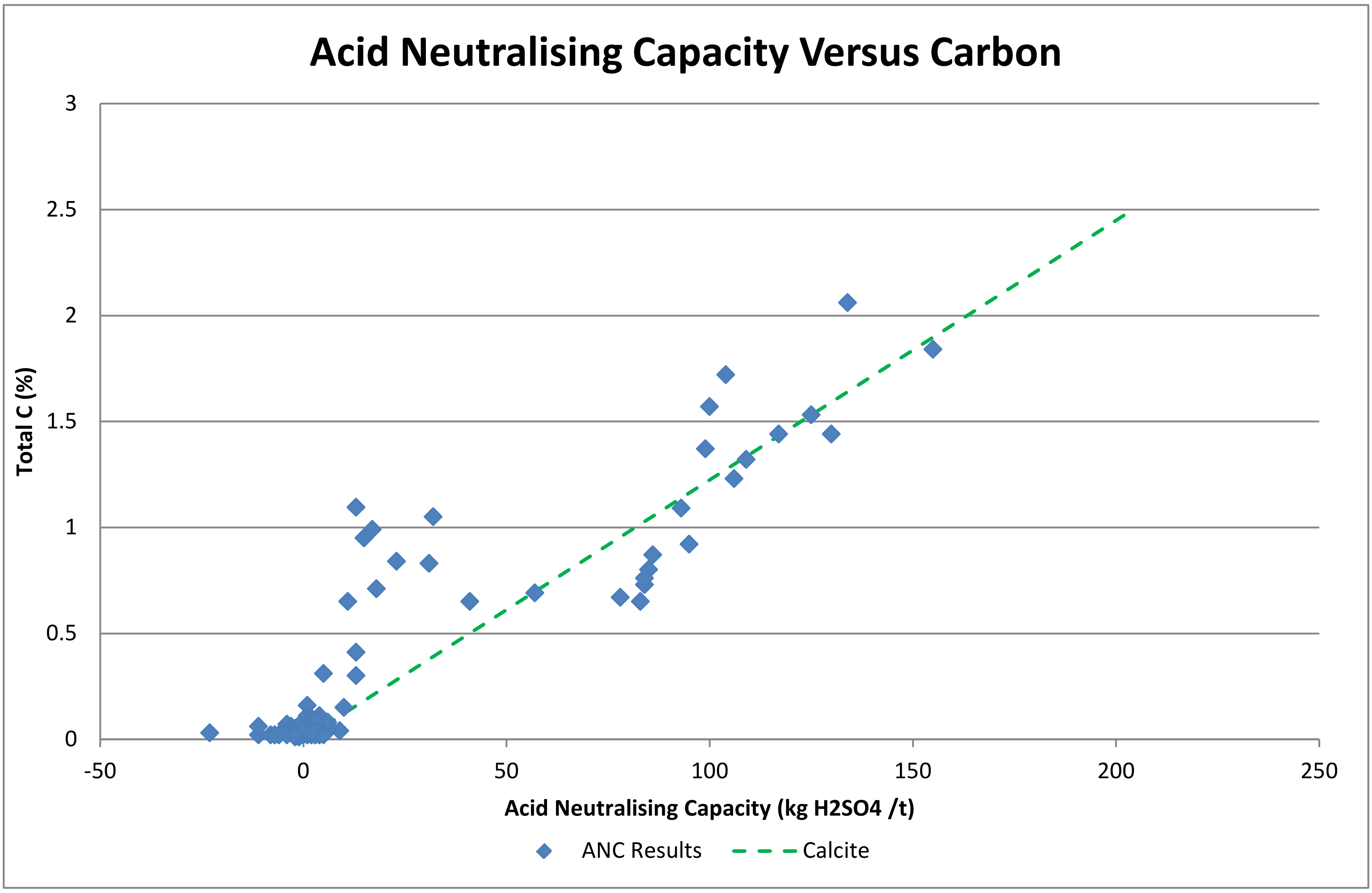


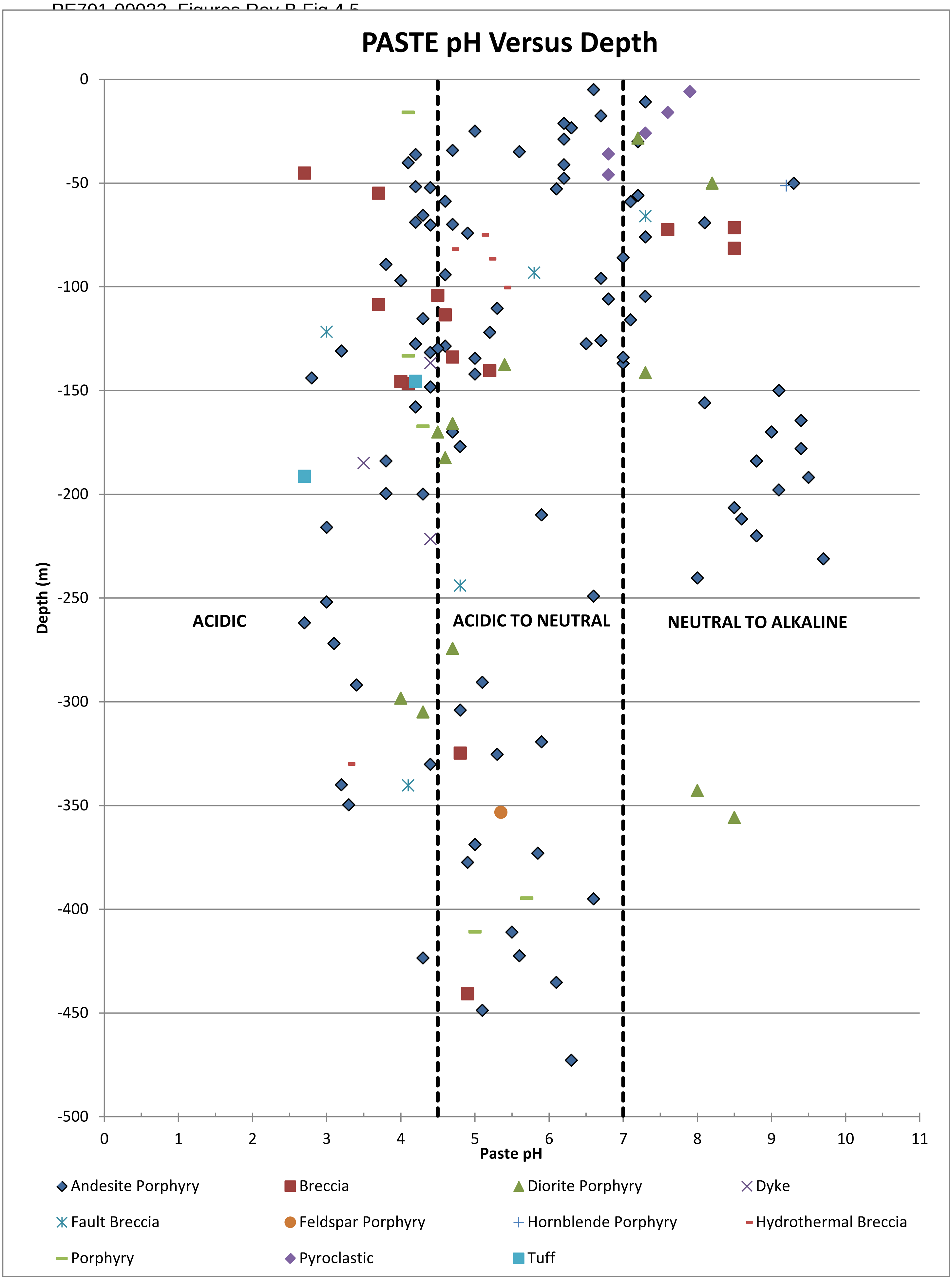
Sulfide Versus Depth
Depth (m)
Sulfide Sulfur (%S)
y = -12.462x - 138.5
R² = 0.0842
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00

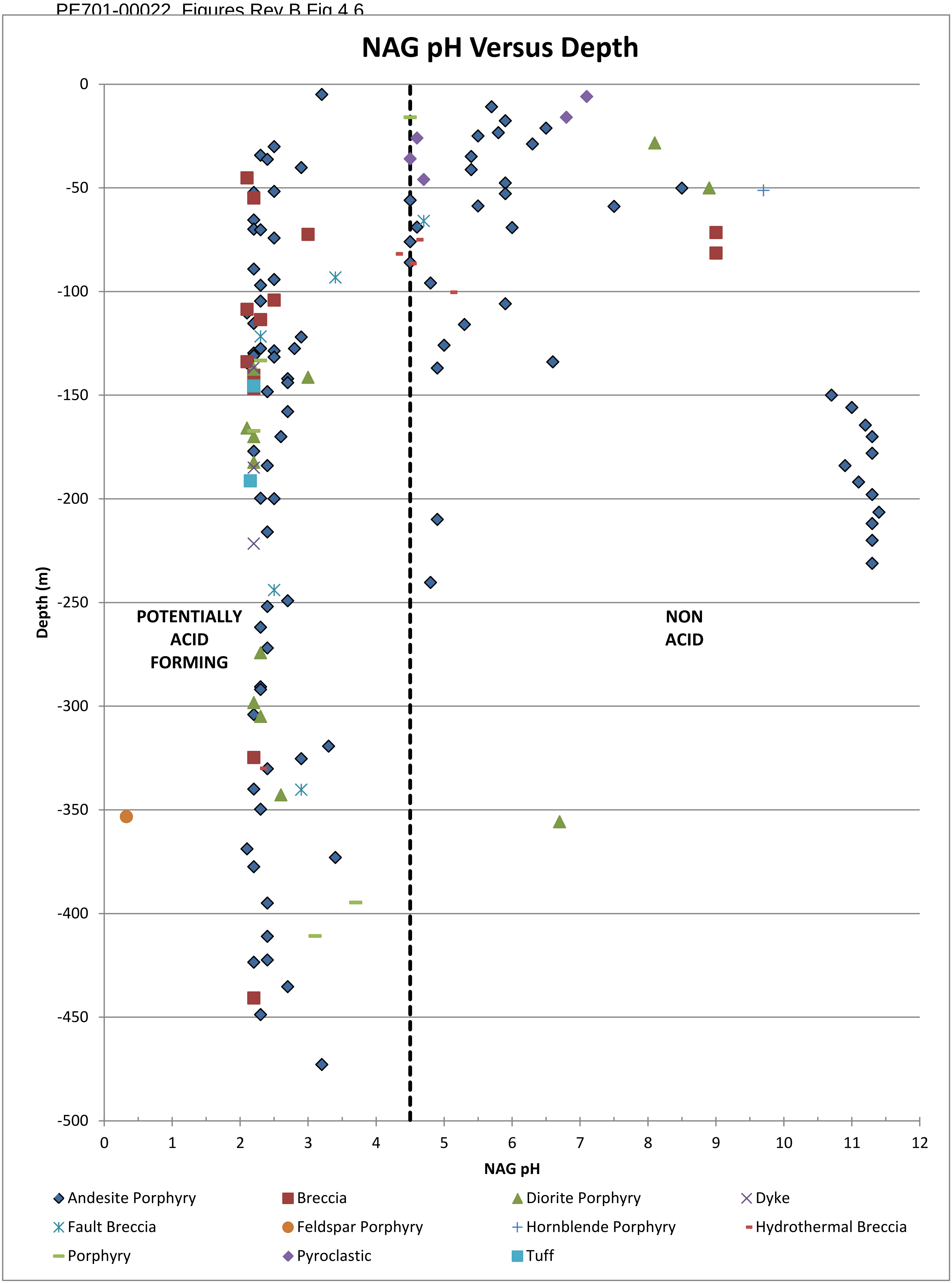


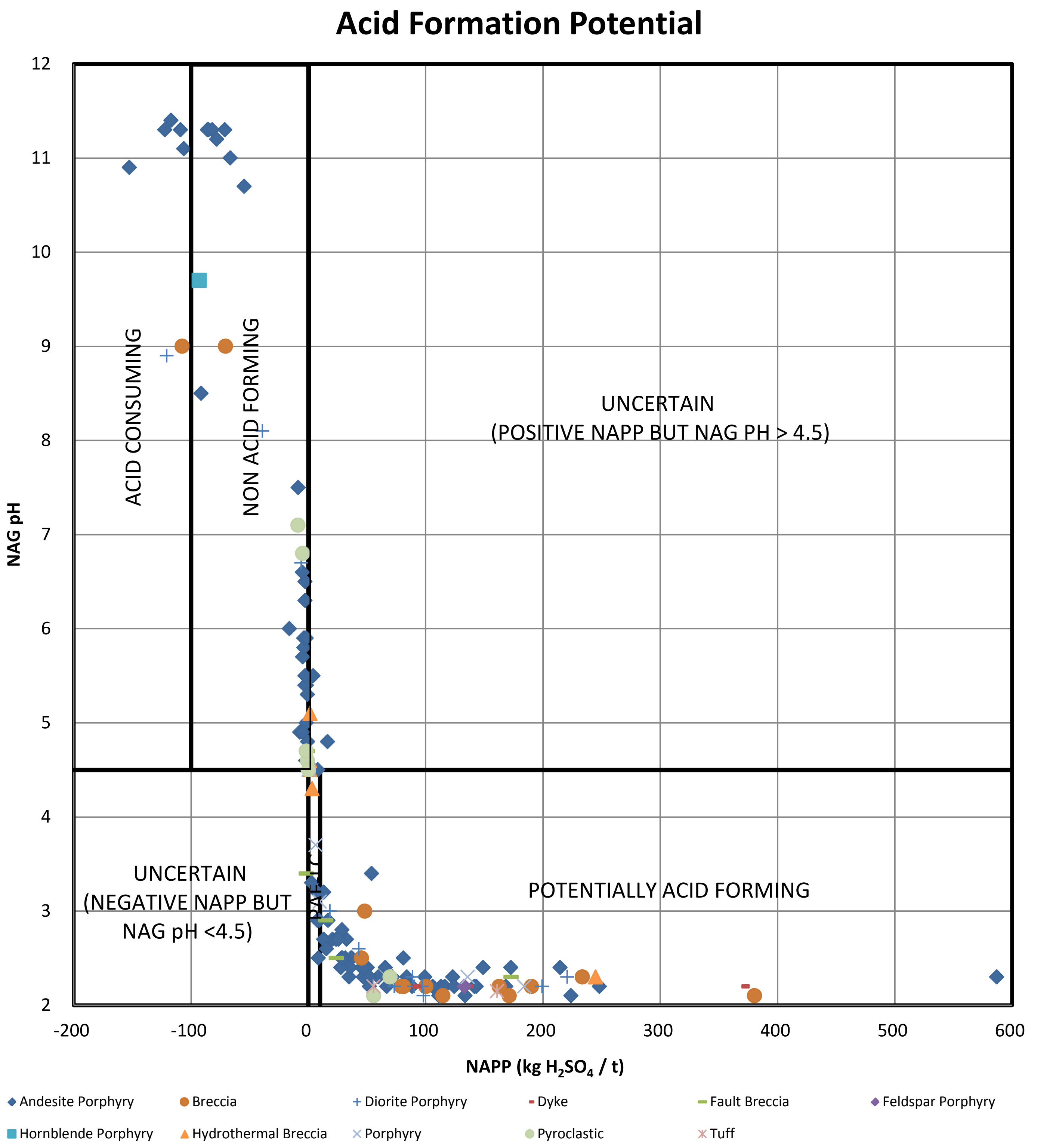
Sulfide Sulfur Versus Copper
Copper (ppm)
Sulfide Sulfur (%S)
y = 118.69x + 101.55
R² = 0.2869
7000
6000
5000
4000
3000
2000
1000
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00


Acid Neutralising Capacity Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
-50
0
50
100
150
200
Acid Neutralising Capacity (kg H2SO4 /t)


Acid Neutralising Capacity Versus Carbon
Total C (%)
3
2.5
2
1.5
1
0.5
0
-50
0
50
100
150
200
250
Acid Neutralising Capacity (kg H2SO4 /t)
ANC Results
Calcite

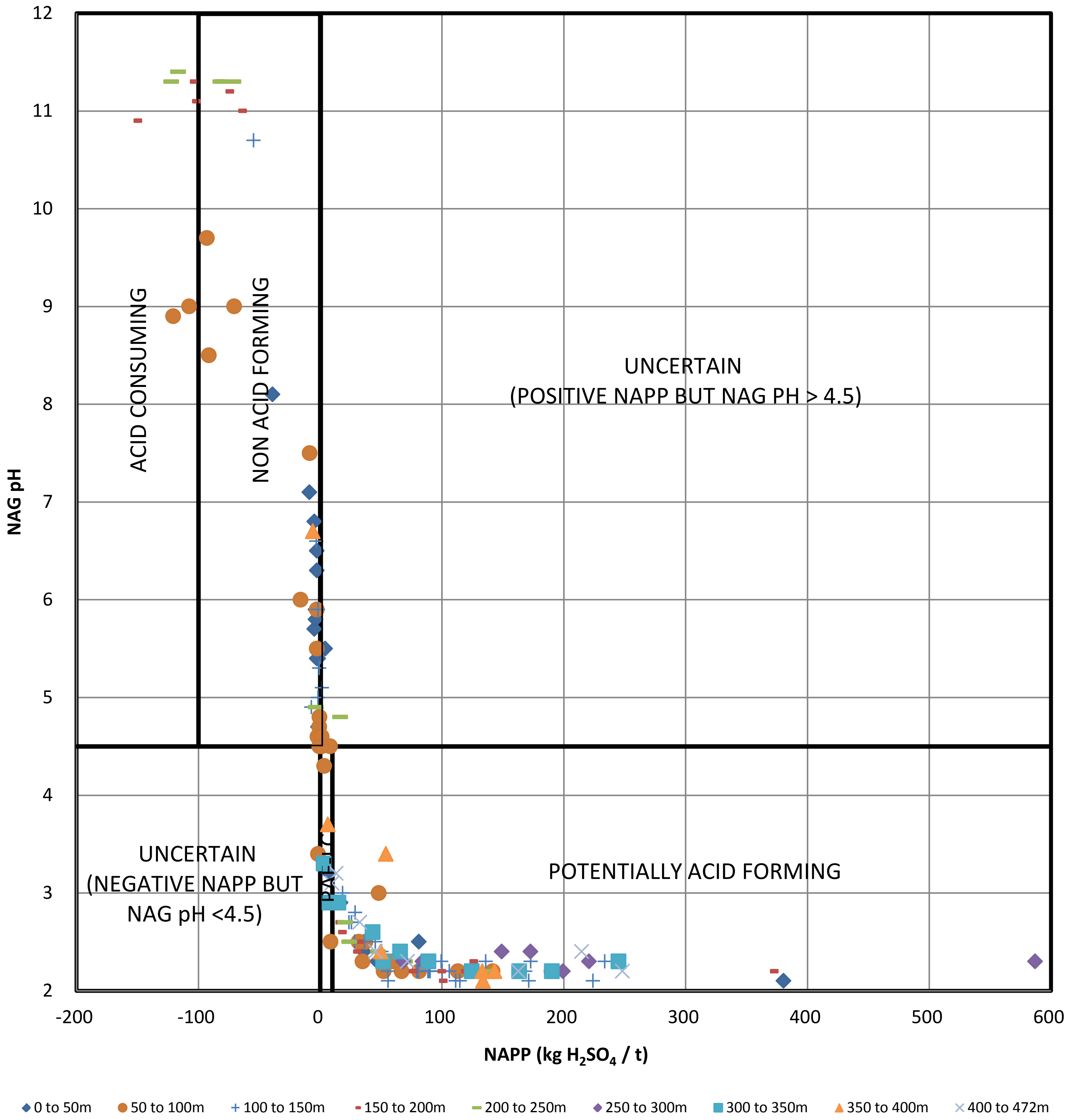

PASTE pH Versus Depth
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
Paste pH
ACIDIC
ACIDIC TO NEUTRAL
NEUTRAL TO ALKALINE
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff


NAG pH Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
1
2
3
4
5
6
7
8
9
10
11
12
NAG pH
POTENTIALLY ACID FORMING
NON ACID
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

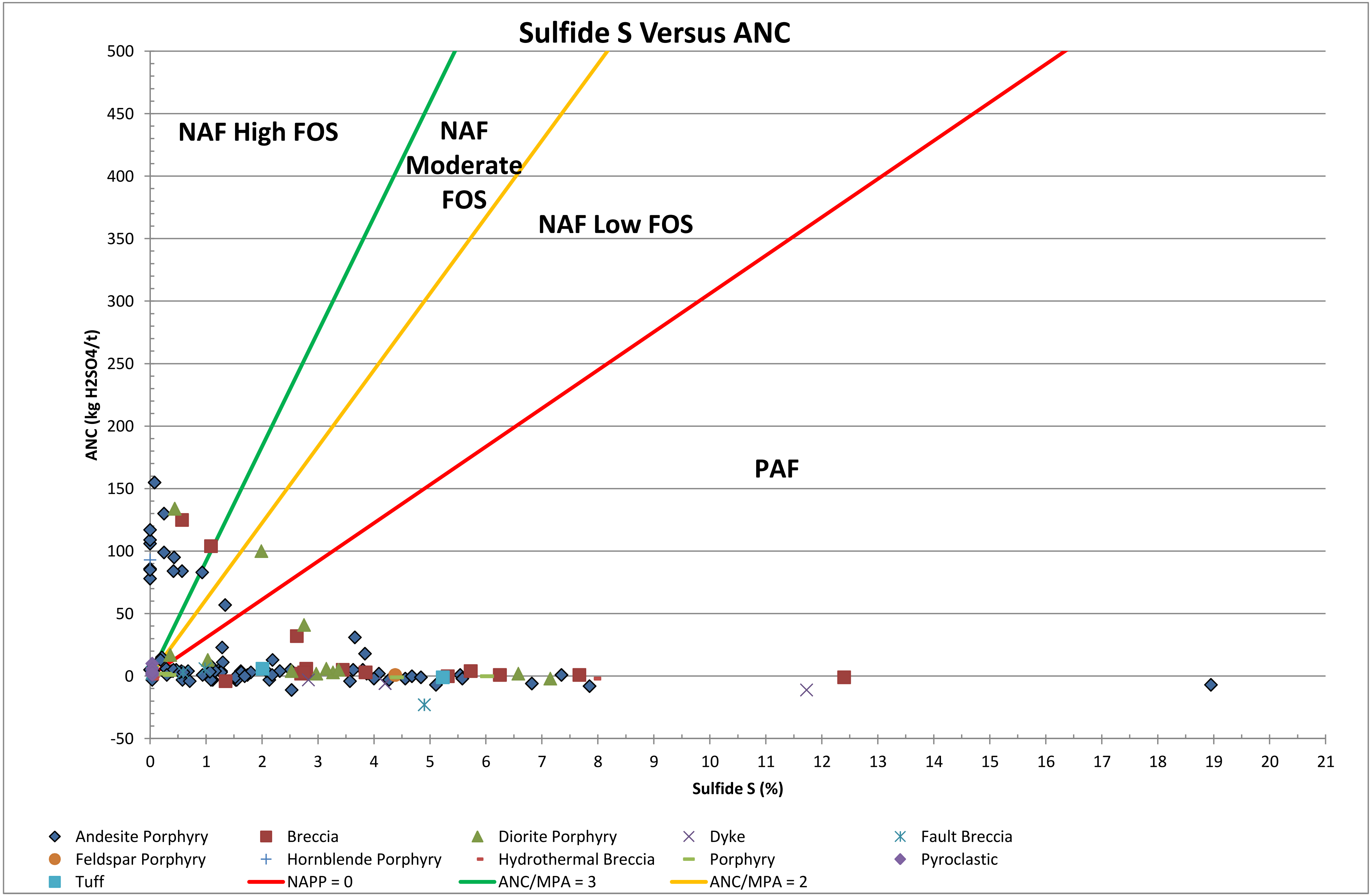


Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

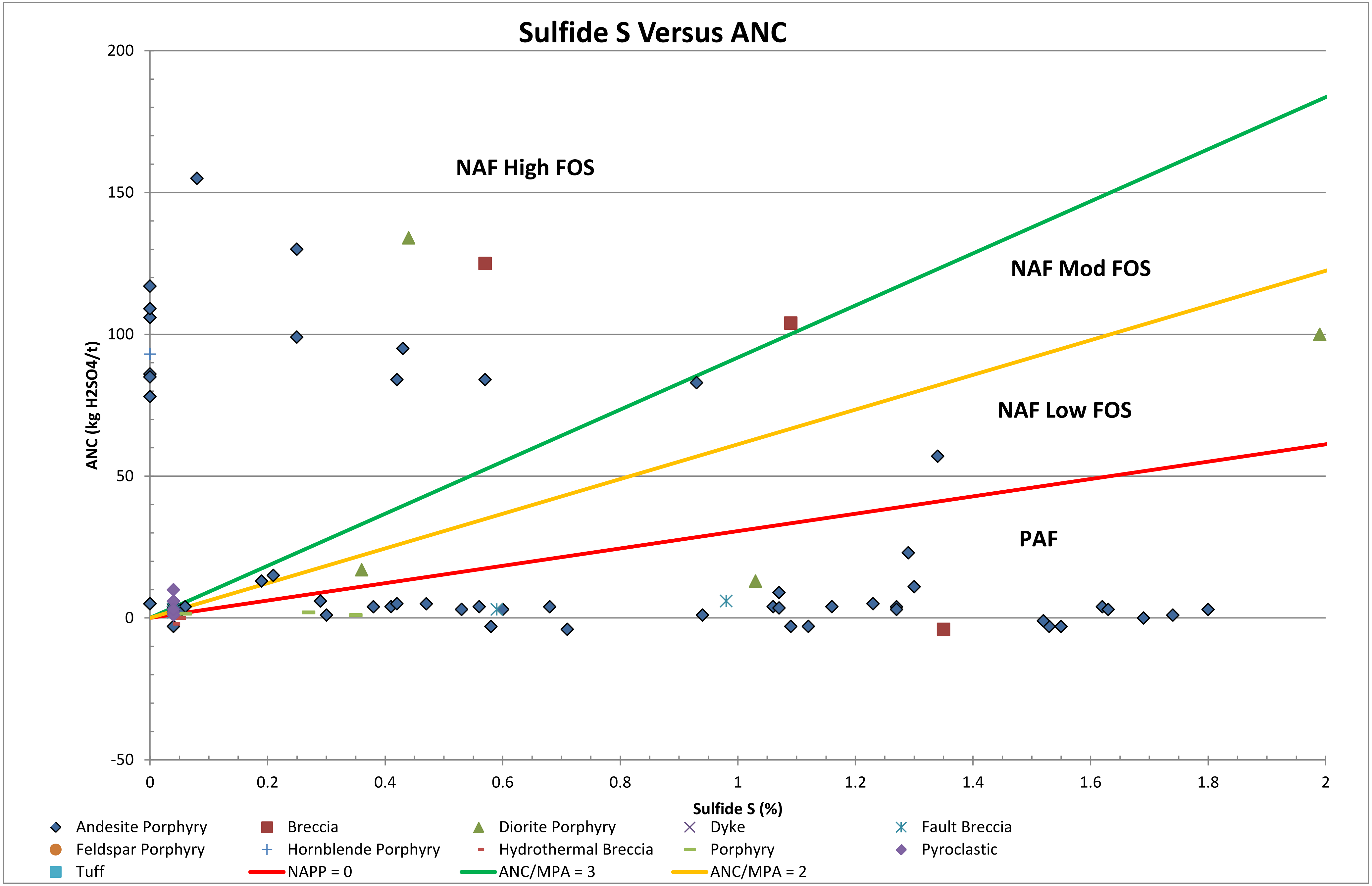
Acid Formation Potential



Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5



Sulfide S Versus ANC
NAF High FOS
NAF Moderate FOS
NAF Low FOS
PAF
ANC (kg H2SO4/t)
500
450
400
350
300
250
200
150
100
50
0
-50
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Sulfide S (%)
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff
NAPP = 0
ANC/MPA = 3
ANC/MPA = 2



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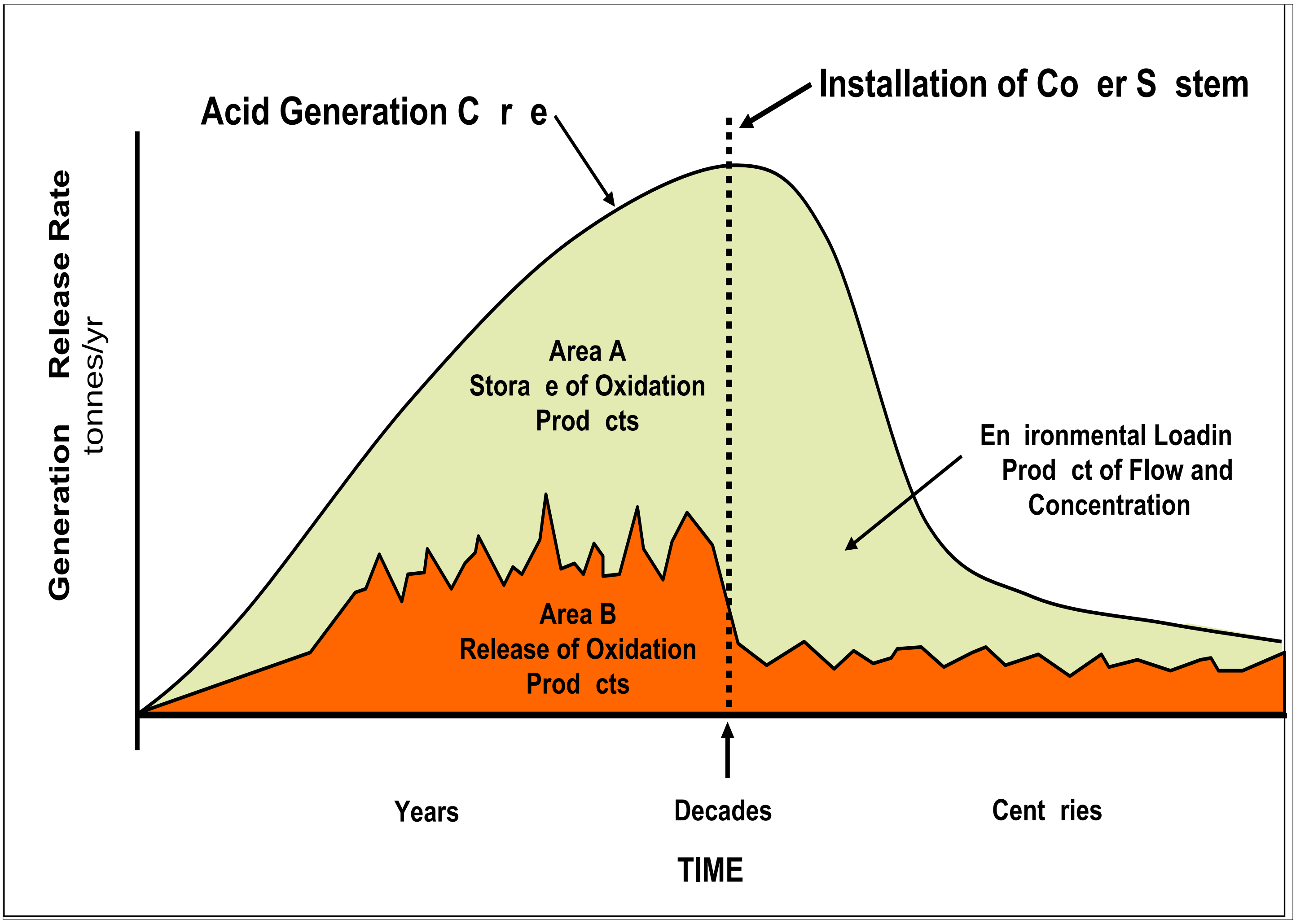
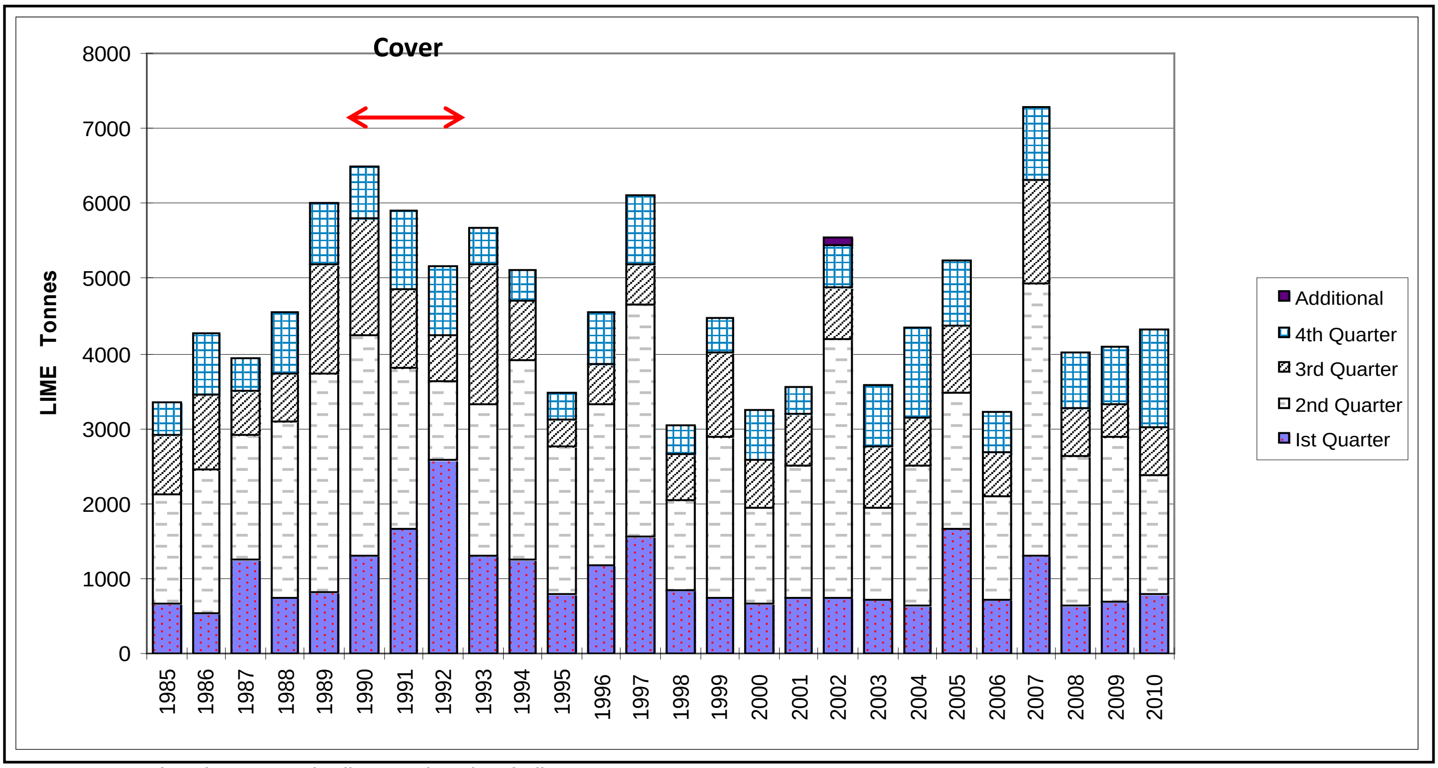
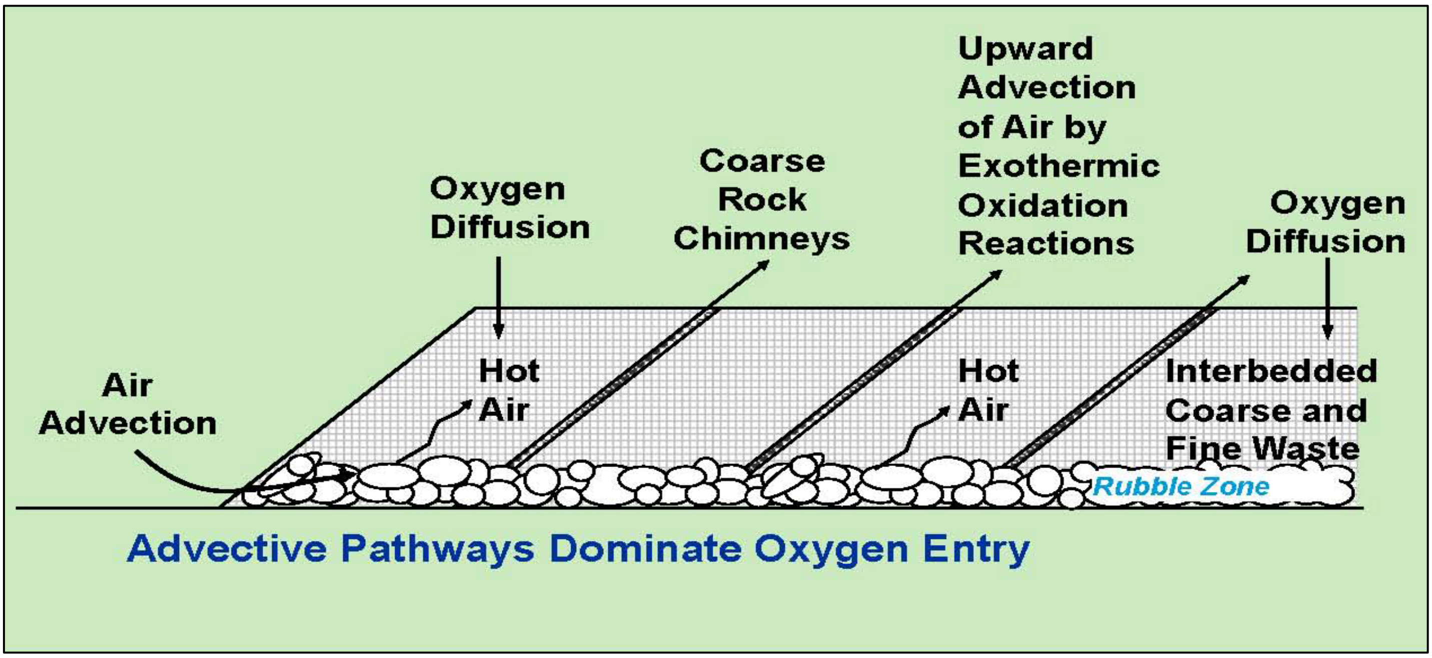
LETPADAUNG COPPER PROJECT
WASTE ROCK GEOCHEMISTRY
ANC & SULFIDE SULFUR (Sulfide less than 2%)

Ref: PE701-00022/16
Figure 4.10

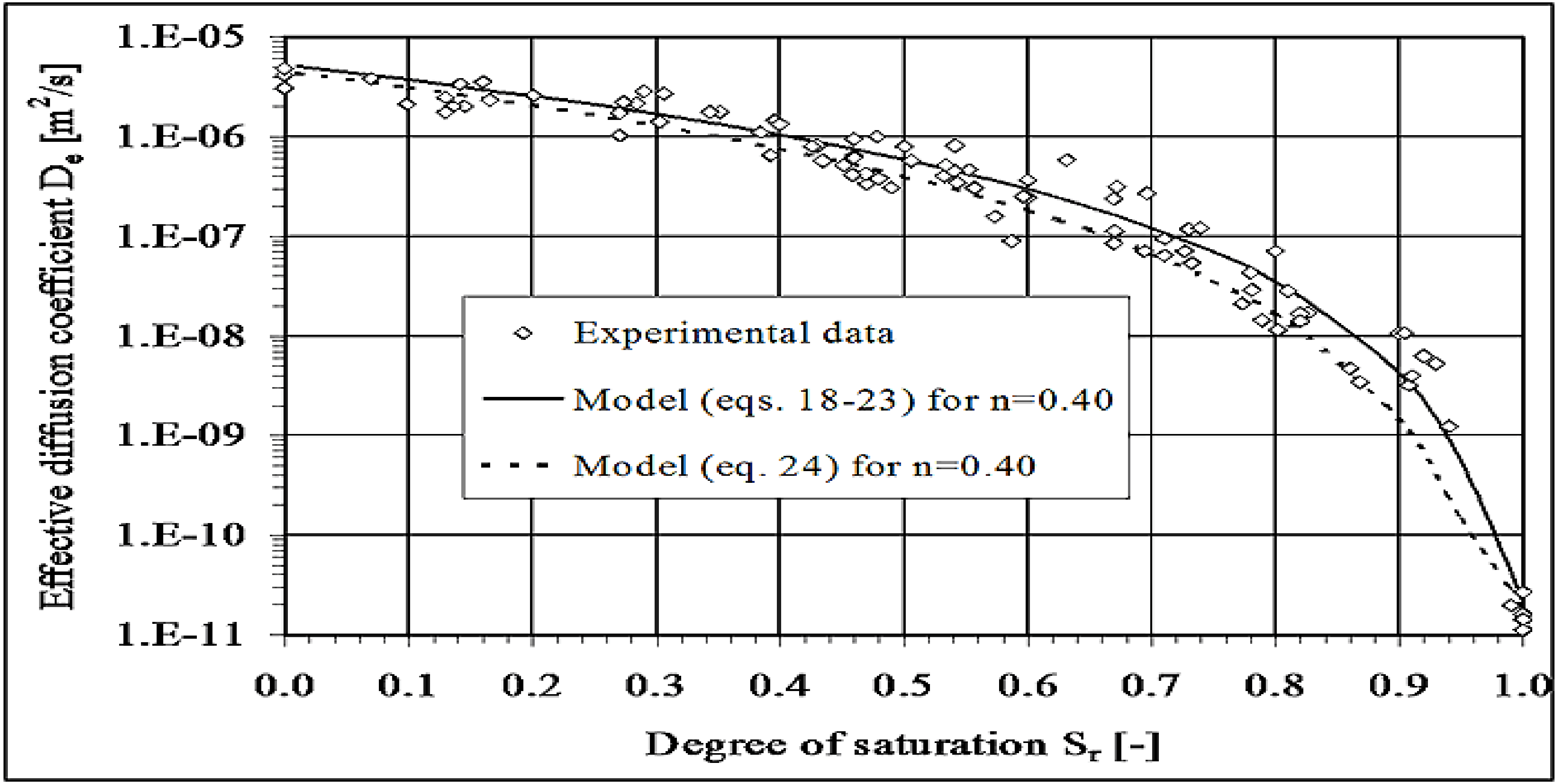




Figures courtesy of Professor Ward Wilson, University of Alberta



Figures courtesy of Professor Ward Wilson, University of Alberta



1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
Effective diffusion coefficient D_e [m^2/s]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Degree of saturation S_r [-]
Experimental data
Model (eqs. 18-23) for n=0.40
Model (eq. 24) for n=0.40

APPENDIX A

X-RAY Diffraction Results

APPENDIX A - QUANTATIVE XRD RESULTS

Mineral & Class	Sample ID	701-22-001	701-22-008	701-22-020	701-22-023	701-22-032	701-22-041	701-22-044	701-22-052	701-22-071	701-22-072	701-22-081	701-22-097	701-22-115	701-22-126	701-22-148	Average	Max	Min
	Borehole	LS001	LS001	LS002	LS002	LS003	LS003	LS003	LS005	LK004	LK004	LK006	L013	L223	L087	L087			
	Depth	25	221.65	355.8	435.3	146.75	353.35	410.9	50.1	51.23	71.63	191.35	93.25	212	36	330			
	Lithology	Andesite Porphyry	Dyke	Diorite Porphyry	Andesite Porphyry	Breccia	Feldspar Porphyry	Porphyry	Diorite Porphyry	Hornblende Porphyry	Breccia	Tuff	Fault Breccia	Andesite Porphyry	Pyroclastic	Hydrothermal Breccia			
Quartz	Silicate	39.00	38.00	31.00	45.00	45.00	34.00	41.00	40.00	24.00	29.00	43.00	47.00	23.00	63.00	47.00	39.27	63.00	23.00
Amorphous content		12.00	10.00	17.00	13.00	17.00	13.00	7.00	13.00	33.00	29.00	11.00	11.00	35.00	14.00	3.00	15.87	35.00	3.00
Natroalunite	Sulfate	6.00	10.00	-	-	<1	<1	26.00	-	-	-	3.00	9.00	-	15.00	28.00	7.46	28.00	-
Interlayered illite/smectite	Clay	21.00	-	14.00	5.00	18.00	8.00	1.00	15.00	9.00	22.00	13.00	-	-	-	-	8.40	22.00	-
Pyrophyllite	Clay	-	13.00	-	-	-	22.00	-	-	-	-	8.00	13.00	-	5.00	4.00	4.33	22.00	-
Kaolin	Clay	5.00	16.00	5.00	17.00	-	8.00	22.00	5.00	2.00	-	2.00	-	-	-	-	5.47	22.00	-
Chlorite	Clay	-	-	6.00	-	-	-	-	-	-	5.00	-	-	13.00	-	-	1.60	13.00	-
Hematite	Oxide	-	-	-	-	-	-	-	-	-	-	-	15.00	-	1.00	-	1.07	15.00	-
Sodium calcium plagioclase	Feldspar	-	-	9.00	-	-	-	-	-	12.00	1.00	-	-	9.00	-	-	2.07	12.00	-
Pyrite	Sulfide	-	10.00	1.00	2.00	6.00	10.00	1.00	-	<1	2.00	15.00	-	-	-	16.00	4.50	16.00	-
Siderite	Carbonate	-	-	11.00	3.00	-	-	-	-	-	-	-	-	-	-	-	0.93	11.00	-
Palygorskite	Clay	-	-	-	-	-	-	-	-	-	-	-	-	7.00	-	-	0.47	7.00	-
Illite/Muscovite	Mica	16.00	-	1.00	13.00	12.00	2.00	1.00	11.00	7.00	4.00	5.00	-	4.00	-	-	5.07	16.00	-
Potassium feldspar	Feldspar	-	2.00	5.00	-	-	<1	-	-	8.00	-	-	4.00	-	1.00	-	1.43	8.00	-
Ankerite	Carbonate	-	-	-	-	-	-	-	4.00	-	-	-	-	-	-	-	0.27	4.00	-
Dolomite	Carbonate	-	1.00	-	-	-	-	2.00	8.00	3.00	7.00	-	1.00	-	-	-	1.47	8.00	-
Calcite	Carbonate	-	-	-	-	<1	-	-	-	2.00	1.00	-	-	7.00	-	-	0.71	7.00	-
Magnesite	Carbonate	-	-	-	-	-	-	-	4.00	-	2.00	-	-	-	-	-	0.40	4.00	-
Expanding clay	Clay	-	-	-	-	-	-	-	-	2.00	-	-	-	-	-	-	0.13	2.00	-
Chloritoid	Clay	-	-	-	-	-	-	-	-	-	-	-	-	2.00	-	-	0.13	2.00	-
Diaspore	Hydroxide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	0.13	2.00	-
Alunite	Sulfate	-	-	1.00	1.00	-	3.00	-	-	-	-	-	-	-	-	-	0.33	3.00	-
Jarosite	Hydroxide	1.00	-	-	1.00	1.00	-	-	-	-	-	-	-	-	-	-	0.20	1.00	-
Anhydrite	Sulfate	-	-	-	<1	1.00	-	-	-	-	-	-	-	-	-	-	0.07	1.00	-
Anatase	Oxide	-	-	-	-	-	-	-	-	-	-	1.00	-	-	-	-	0.07	1.00	-
Chalcopyrite	Sulfide	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX B

Acid Base Accounting Results

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Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m) (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unitless	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Formation Potential Classification
701-22-001	Andesite Porphyry	LS001	25	-3	0.055	1.025	0.38	0.04	0.04	0.605	5	5.5	0	3	1.2	-2.45	4.22	Uncertain
701-22-002	Andesite Porphyry	LS001	59	15	0.95	0.32	0.03	0.21	0.21	0.08	7.1	7.5	0	0	6.4	2.33	-8.57	Non Acid Forming
701-22-003	Andesite Porphyry	LS001	65.5	-2	0.05	5.67	0.21	4.56	4.56	0.9	4.3	2.2	127	142	139.5	-0.01	141.54	Potentially Acid Forming
701-22-004	Andesite Porphyry	LS001	89.25	-4	0.04	4.43	0.17	3.57	3.57	0.69	3.8	2.2	98	110	109.2	-0.04	113.24	Potentially Acid Forming
701-22-005	Andesite Porphyry	LS001	122	5	0.04	0.67	0.04	0.47	0.47	0.16	5.2	2.9	6	11	14.4	0.35	9.38	Potentially Acid Forming - Low Capacity
701-22-006	Dyke	LS001	136.75	-3	0.04	3.23	0.09	2.83	2.83	0.31	4.4	2.2	79	89	86.6	-0.03	89.60	Potentially Acid Forming
701-22-007	Dyke	LS001	185	-11	0.02	18.24	0.58	11.73	11.73	5.93	3.5	2.2	424	455	358.9	-0.03	369.94	Potentially Acid Forming
701-22-008	Dyke	LS001	221.65	-6	0.02	6.83	0.54	4.2	4.20	2.09	4.4	2.2	133	147	128.5	-0.05	134.52	Potentially Acid Forming
701-22-009	Andesite Porphyry	LS001	249.15	-3	0.03	1.69	0.27	0.58	0.58	0.84	6.6	2.7	12	17	17.7	-0.17	20.75	Potentially Acid Forming
701-22-010	Andesite Porphyry	LS001	290.75	-3	0.04	3.71	0.4	2.13	2.13	1.18	5.1	2.3	67	77	65.2	-0.05	68.18	Potentially Acid Forming
701-22-011	Andesite Porphyry	LS001	304.05	-7	0.02	9.05	0.61	5.11	5.11	3.33	4.8	2.2	180	201	156.4	-0.04	163.37	Potentially Acid Forming
701-22-012	Andesite Porphyry	LS001	368.85	-3	0.03	5.35	0.15	4.27	4.27	0.93	5	2.1	133	144	130.7	-0.02	133.66	Potentially Acid Forming
701-22-013	Andesite Porphyry	LS001	395	-3	0.03	2.06	0.19	1.53	1.53	0.34	6.6	2.4	31	41	46.8	-0.06	49.82	Potentially Acid Forming
701-22-014	Andesite Porphyry	LS001	411.1	-6	0.02	9.56	0.42	6.82	6.82	2.32	5.5	2.4	136	163	208.7	-0.03	214.69	Potentially Acid Forming
701-22-015	Andesite Porphyry	LS001	423.5	-8	0.02	12.68	0.85	7.85	7.85	3.98	4.3	2.2	261	281	240.2	-0.03	248.21	Potentially Acid Forming
701-22-016	Andesite Porphyry	LS002	94.3	-3	0.06	1.96	0.2	1.12	1.12	0.64	4.6	2.5	21	30	34.3	-0.09	37.27	Potentially Acid Forming
701-22-017	Breccia	LS002	104.13	-4	0.07	2.01	0.21	1.35	1.35	0.45	4.5	2.5	27	37	41.3	-0.10	45.31	Potentially Acid Forming
701-22-018	Andesite Porphyry	LS002	128.6	-3	0.05	1.76	0.21	1.09	1.09	0.46	4.6	2.5	20	28	33.4	-0.09	36.35	Potentially Acid Forming
701-22-019	Andesite Porphyry	LS002	148.4	-3	0.05	1.99	0.15	1.55	1.55	0.29	4.4	2.4	33	43	47.4	-0.06	50.43	Potentially Acid Forming
701-22-020	Diorite Porphyry	LS002	355.8	17	0.99	0.52	0.05	0.36	0.36	0.11	8.5	6.7	0	0	11.0	1.54	-5.98	Non Acid Forming
701-22-021	Andesite Porphyry	LS002	373	13	1.095	2.52	0.115	2.19	2.19	0.215	5.85	3.4	7	35.5	67.0	0.19	54.01	Potentially Acid Forming
701-22-022	Andesite Porphyry	LS002	422.5	4	0.05	1.78	0.09	1.62	1.62	0.07	5.6	2.4	29	38	49.6	0.08	45.57	Potentially Acid Forming
701-22-023	Andesite Porphyry	LS002	435.3	5	0.31	1.47	0.09	1.23	1.23	0.15	6.1	2.7	11	24	37.6	0.13	32.64	Potentially Acid Forming
701-22-024	Andesite Porphyry	LS002	448.85	5	0.03	3.13	0.13	2.51	2.51	0.49	5.1	2.3	63	72	76.8	0.07	71.81	Potentially Acid Forming
701-22-025	Andesite Porphyry	LS002	472.85	4	0.02	0.79	0.04	0.56	0.56	0.19	6.3	3.2	3	7	17.1	0.23	13.14	Potentially Acid Forming
701-22-026	Andesite Porphyry	LS003	21.3	4	0.1	0.74	0.2	0.04	0.04	0.5	6.2	6.5	0	0	1.2	3.27	-2.78	Non Acid Forming
701-22-027	Andesite Porphyry	LS003	70	4	0.04	2.98	0.13	2.32	2.32	0.53	4.7	2.2	68	79	71.0	0.06	66.99	Potentially Acid Forming
701-22-028	Andesite Porphyry	LS003	74.3	4	0.06	1.14	0.04	0.41	0.41	0.69	4.9	2.5	17	25	12.5	0.32	8.55	Potentially Acid Forming - Low Capacity
701-22-029	Andesite Porphyry	LS003	97	4	0.05	2.4	0.12	2.08	2.08	0.2	4	2.3	49	61	63.6	0.06	59.65	Potentially Acid Forming
701-22-030	Andesite Porphyry	LS003	115.5	1	0.06	7.71	0.33	5.54	5.54	1.84	4.3	2.2	190	205	169.5	0.01	168.52	Potentially Acid Forming
701-22-031	Andesite Porphyry	LS003	131.7	4	0.07	1.59	0.16	1.06	1.06	0.37	4.4	2.5	21	29	32.4	0.12	28.44	Potentially Acid Forming
701-22-032	Breccia	LS003	146.75	2	0.1	3.82	0.18	2.7	2.70	0.94	4.1	2.2	82	92	82.6	0.02	80.62	Potentially Acid Forming
701-22-033	Diorite Porphyry	LS003	170.02	3	0.05	4.3	0.2	3.27	3.27	0.83	4.5	2.2	93	104	100.1	0.03	97.06	Potentially Acid Forming
701-22-034	Diorite Porphyry	LS003	182.4	4	0.04	3.22	0.16	2.53	2.53	0.53	4.6	2.2	70	82	77.4	0.05	73.42	Potentially Acid Forming
701-22-035	Diorite Porphyry	LS003	274.25	-2	0.03	11.79	0.97	7.15	7.15	3.67	4.7	2.3	223	242	218.8	-0.01	220.79	Potentially Acid Forming
701-22-036	Diorite Porphyry	LS003	298.3	2	0.04	8.89	0.49	6.58	6.58	1.82	4	2.2	208	224	201.3	0.01	199.35	Potentially Acid Forming
701-22-037	Diorite Porphyry	LS003	305	2	0.06	4.46	0.33	2.97	2.97	1.16	4.3	2.3	90	101	90.9	0.02	88.88	Potentially Acid Forming
701-22-038	Breccia	LS003	324.8	1	0.11	9	0.5	6.25	6.25	2.25	4.8	2.2	200	217	191.3	0.01	190.25	Potentially Acid Forming
701-22-039	Andesite Porphyry	LS003	330.2	1	0.07	4.38	0.61	2.18	2.18	1.59	4.4	2.4	60	72	66.7	0.01	65.71	Potentially Acid Forming
701-22-040	Diorite Porphyry	LS003	342.8	41	0.65	4.07	0.35	2.75	2.75	0.97	8	2.6	38	46	84.2	0.49	43.15	Potentially Acid Forming
701-22-041	Feldspar Porphyry	LS003	353.35	1	0.03	6.46	0.325	4.38	4.38	1.755	5.35	2.2	154.5	166.5	134.0	0.01	133.03	Potentially Acid Forming
701-22-042	Andesite Porphyry	LS003	377.5	0	0.03	5.92	0.36	4.68	4.68	0.88	4.9	2.2	133	145	143.2	0.00	143.21	Potentially Acid Forming
701-22-043	Porphyry	LS003	394.75	2	0.04	2.03	0.54	0.27	0.27	1.22	5.7	3.7	1	7	8.3	0.24	6.26	Potentially Acid Forming - Low Capacity
701-22-044	Porphyry	LS003	410.9	1	0.06	4.11	1.19	0.35	0.35	2.57	5	3.1	10	17	10.7	0.09	9.71	Potentially Acid Forming - Low Capacity
701-22-045	Breccia	LS003	440.8	0	0.04	8.22	0.48	5.32	5.32	2.42	4.9	2.2	176	193	162.8	0.00	162.79	Potentially Acid Forming
701-22-046	Andesite Porphyry	LS004	30.21	31	0.83	4.24	0.14	3.66	3.66	0.44	7.2	2.5	53	68	112.0	0.28	81.00	Potentially Acid Forming
701-22-047	Andesite Porphyry	LS004	50.21	99	1.37	0.37	0.05	0.25	0.25	0.07	9.3	8.5	0	0	7.7	12.94	-91.35	Non Acid Forming
701-22-048	Andesite Porphyry	LS004	69.25	57	0.69	1.64	0.05	1.34	1.34	0.25	8.1	6	0	2	41.0	1.39	-16.00	Non Acid Forming
701-22-049	Andesite Porphyry	LS004	110.45	5	0.05	4.76	0.11	3.8	3.80	0.85	5.3	2.1	110	128	116.3	0.04	111.28	Potentially Acid Forming
701-22-050	Andesite Porphyry	LS004	134.45	1	0.16	9.64	0.22	7.35	7.35	2.07	5	2.1	222	244	224.9	0.00	223.91	Potentially Acid Forming
701-22-051	Diorite Porphyry	LS005	28.4	100	1.57	2.28	0.33	1.99	1.99	0	7.2	8.1	0	0	60.9	1.64	-39.11	Non Acid Forming
701-22-052	Diorite Porphyry	LS005	50.1	134	2.06	0.62	0.07	0.44	0.44	0.11	8.2	8.9	0	0	13.5	9.95	-120.54	Acid Consuming
701-22-053	Breccia	LS005	72.5	32	1.05	2.9	0.06	2.62	2.62	0.22	7.6	3	12	26	80.2	0.40	48.17	Potentially Acid Forming
701-22-054	Breccia	LS005	133.9	4	0.04	6.57	0.18	5.73	5.73	0.66	4.7	2.1	160	181	175.3	0.02	171.34	Potentially Acid Forming
701-22-055	Diorite Porphyry	LS005	141.4	13	0.41	1.13	0.06	1.03	1.03	0.04	7.3	3	5	14	31.5	0.41	18.52	Potentially Acid Forming
701-22-056	Andesite Porphyry	LS006	34.3	3	0.03	1.58	0.08	1.63	1.63	0	4.7	2.3	30	40	49.9	0.06	46.88	Potentially Acid Forming
701-22-057	Andesite Porphyry	LS006	52.3	1	0.03	2.11	0.17	1.74	1.74	0.2	4.4	2.2	43	53	53.2	0.02	52.24	Potentially Acid Forming
701-22-058	Andesite Porphyry	LS006	70.3	4	0.04	1.56	0.1	1.27	1.27	0.19	4.4	2.3	28	36	38.9	0.10	34.86	Potentially Acid Forming
701-22-059	Andesite Porphyry	LS006	127.6	11	0.65	1.52	0.08	1.3	1.30	0.14	6.5	2.8	8	27	39.8	0.28	28.78	Potentially Acid Forming
701-22-060	Breccia	LS006	140.4	6	0.05	3.47	0.09	2.79	2.79	0.59	5.2	2.2	81	94	85.4	0.07	79.37	Potentially Acid Forming
701-22-061	Porphyry	LK002	16.05	1.5	0.035	1.55	0.98	0.06	0.06	0.51	4.1	4.5	0	1.5	1.8	0.82	0.34	Potentially Acid Forming - Low Capacity
701-22-062	Andesite Porphyry	LK002	36.3	3	0.04	2.02	0.4	1.27	1.27	0.35	4.2	2.4	23	34	38.9	0.08	35.86	Potentially Acid Forming
701-22-063	Breccia	LK002	113.6	1	0.03	9.68	0.47	7.67	7.67	1.54	4.6	2.3	181	207	234.7	0.00	233.70	Potentially Acid Forming
701-22-064	Porphyry	LK002	133.3	-1	0.02	9.05	1.17	4.41	4.41	3.47	4.1	2.3	126	144	134.9	-0.01	135.95	Potentially Acid Forming
701-22-065	Porphyry	LK002	167.3	0	0.02	10.9	1.02	6.02	6.02	3.86	4.3	2.2	196	215	184.2	0.00	184.21	Potentially Acid Forming
701-22-066	Andesite Porphyry	LK003	40.3	4	0.02	1.98	0.39	0.68	0.68	0.91	4.1	2.9	9	19	20.8	0.19	16.81	Potentially Acid Forming
701-22-067	Breccia	LK003	54.9	3	0.04	3.4	0.21	2.75	2.75	0.44	3.7	2.2	66	81	84.2	0.04	81.15	Potentially Acid Forming
701-22-068	Breccia	LK003	108.6	3	0.05	6.28	0.41	3.85	3.85	2.02	3.7	2.1	137	157	117.8	0.03	114.81	Potentially Acid Forming
701-22-069	Pyroclastic	LK003	128.7	5	0.08	2.21	0.15	1.99	1.99	0.07	3.8	2.1	51	62	60.9	0.08	55.89	Potentially Acid Forming
701-22-070	Tuff	LK003	145.6	6	0.05	2.2	0.19	2.01	2.01	4.44089E-16	4.2	2.2	49	63	61.5	0.10	55.51	Potentially Acid Forming
701-22-071	Hornblende Porphyry	LK004	51.23	93	1.09	0.07	0.02	0	0.00	0.05	9.2	9.7	0	0	0.0	0.00	-93.00	Non Acid Forming
701-22-072	Breccia	LK004	71.63	125	1.53	0.8	0.09	0.57	0.57	0.14	8.5	9	0	0	17.4	7.17	-107.56	Acid Consuming
701-22-073	Breccia	LK004	81.52	104	1.72	1.31	0.05	1.09	1.09	0.17	8.5	9	0	0	33.4	3.12	-70.65	Non Acid Forming
701-22-074	Andesite Porphyry	LK004	104.71	18	0.71	4.24	0.09	3.84	3.84	0.31	7.3	2.3	61	80	117.5	0.15	99.50	Potentially Acid Forming
701-22-075	Diorite Porphyry	LK004	137.51	6	0.05	3.62	0.15	3.15	3.15	0.32	5.4	2.2	67	79	96.4	0.06	90.39	Potentially Acid Forming
701-22-076	Breccia	LK006	45.2	-1	0.05	16.29	0.43	12.4	12.40	3.46	2.7	2.1	409	440	379.4	0.00	380.44	Potentially Acid Forming
701-22-077	Andesite Porphyry	LK006	51.8	4	0.04	2.04	0.52	1.16	1.16	0.36	4.2	2.5	23	32	35.5	0.11	31.50	Potentially Acid Forming
701-22-078	Andesite Porphyry	LK006	129.7	5	0.03	4.62	0.26	3.63	3.63	0.73	4.5	2.2	100	113	111.1	0.05	106.08	Potentially Acid Forming
701-22-079	Breccia	LK006	145.7	5	0.04	4.32	0.28	3.44	3.44	0.6	4	2.2	88	101	105.3	0.05	100.26	Potentially Acid Forming
701-22-080	Diorite Porphyry	LK006	165.86	5	0.04	4.27	0.28	3.37	3.37	0.62	4.7	2.1	95	106	103.1	0.05	98.12	Potentially Acid Forming
701-22-081	Tuff	LK006	191.35	-1	0.065	7.18	0.495	5.23	5.23	1.455	2.7	2.15	166.5	181.5	160.0	-0.01	161.04	Potentially Acid Forming
701-22-082	Pyroclastic	LK006	214.6	3	0.02	4.51	0.7	2.38	2.38	1.43	3.9	2.3	74	84	72.8	0.04	69.83	Potentially Acid Forming
701-22-083	Andesite Porphyry	L013	5	4	0.05	0.81	0.15	0.38	0.38	0.28	6.6	3.2	3	8	11.6	0.34	7.63	Potentially Acid Forming - Low Capacity
701-22-084	Andesite Porphyry	L013	11	6	0.06	1.82	0.48	0.04	0.04	1.3	7.3	5.7	0	4	1.2	4.90	-4.78	Non Acid Forming

Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m) (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unit Less	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Fromation Potential Classification
701-22-085	Andesite Porphyry	L013	17.7	5	0.04	1.29	0.57	0.04	0.04	0.68	6.7	5.9	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-086	Andesite Porphyry	L013	23.4	5	0.06	1.16	0.4	0.04	0.04	0.72	6.3	5.8	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-087	Andesite Porphyry	L013	28.9	4	0.05	1.52	0.64	0.04	0.04	0.84	6.2	6.3	0	4	1.2	3.27	-2.78	Non Acid Forming
701-22-088	Andesite Porphyry	L013	34.9	3	0.04	2.25	0.88	0.05	0.05	1.32	5.6	5.4	0	6	1.5	1.96	-1.47	Non Acid Forming
701-22-089	Andesite Porphyry	L013	41.25	4	0.06	2.45	0.81	0.04	0.04	1.6	6.2	5.4	0	7	1.2	3.27	-2.78	Non Acid Forming
701-22-090	Andesite Porphyry	L013	47.7	4	0.05	0.98	0.34	0.04	0.04	0.6	6.2	5.9	0	1	1.2	3.27	-2.78	Non Acid Forming
701-22-091	Andesite Porphyry	L013	52.9	4	0.05	1.4	0.41	0.04	0.04	0.95	6.1	5.9	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-092	Andesite Porphyry	L013	58.8	4	0.11	0.97	0.35	0.04	0.04	0.58	4.6	5.5	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-093	Andesite Porphyry	L013	69	4	0.09	1.03	0.43	0.06	0.06	0.54	4.2	4.6	0	1	1.8	2.18	-2.16	Non Acid Forming
701-22-094	Hydrothermal Breccia	L013	75	0	0.04	3.96	1.46	0.04	0.04	2.46	5.1	4.6	0	13	1.2	0.00	1.22	Uncertain
701-22-095	Hydrothermal Breccia	L013	81.9	-2	0.03	4.3	1.59	0.04	0.04	2.67	4.7	4.3	0	9	1.2	-1.63	3.22	Potentially Acid Forming - Low Capacity
701-22-096	Hydrothermal Breccia	L013	86.55	0	0.04	4.72	1.58	0.04	0.04	3.1	5.2	4.5	0	13	1.2	0.00	1.22	Potentially Acid Forming - Low Capacity
701-22-097	Fault Breccia	L013	93.25	3	0.09	1.59	0.47	0.04	0.04	1.08	5.8	3.4	8	12	1.2	2.45	-1.78	Uncertain
701-22-098	Hydrothermal Breccia	L013	100.4	0	0.03	4.12	1.27	0.05	0.05	2.8	5.4	5.1	0	13	1.5	0.00	1.53	Uncertain
701-22-099	Andesite Porphyry	L013	127.55	3	0.08	2.11	0.2	1.8	1.80	0.11	4.2	2.3	34	43	55.1	0.05	52.08	Potentially Acid Forming
701-22-100	Andesite Porphyry	L013	177.05	2	0.03	5.26	0.2	3.87	3.87	1.19	4.8	2.2	109	121	118.4	0.02	116.42	Potentially Acid Forming
701-22-101	Andesite Porphyry	L013	199.75	2	0.055	5.285	0.44	4.09	4.09	0.755	3.8	2.3	109	120.5	125.2	0.02	123.15	Potentially Acid Forming
701-22-102	Fault Breccia	L223	121.75	-23	0.03	7.65	1.22	4.9	4.90	1.53	3	2.3	145	165	149.9	-0.15	172.94	Potentially Acid Forming
701-22-103	Andesite Porphyry	L223	131	-11	0.06	3.52	0.64	2.53	2.53	0.35	3.2	2.2	70	84	77.4	-0.14	88.42	Potentially Acid Forming
701-22-104	Andesite Porphyry	L223	137	13	0.3	0.38	0.13	0.19	0.19	0.06	7	4.9	0	8	5.8	2.24	-7.19	Non Acid Forming
701-22-105	Andesite Porphyry	L223	142.1	9	0.04	1.36	0.15	1.07	1.07	0.14	5	2.7	11	23	32.7	0.27	23.74	Potentially Acid Forming
701-22-106	Andesite Porphyry	L223	150	83	0.65	1.17	0.09	0.93	0.93	0.15	9.1	10.7	0	0	28.5	2.92	-54.54	Non Acid Forming
701-22-107	Andesite Porphyry	L223	156	84	0.73	0.78	0.1	0.57	0.57	0.11	8.1	11	0	0	17.4	4.82	-66.56	Non Acid Forming
701-22-108	Andesite Porphyry	L223	164.55	78	0.67	0.04	0.01		0.03	0	9.4	11.2	0	0	0.9	0.00	-77.08	Non Acid Forming
701-22-109	Andesite Porphyry	L223	170	86	0.87	0.03	0.02		0.01	0	9	11.3	0	0	0.3	0.00	-85.69	Non Acid Forming
701-22-110	Andesite Porphyry	L223	178.05	85	0.8	0.05	0.02		0.03	0	9.4	11.3	0	0	0.9	0.00	-84.08	Non Acid Forming
701-22-111	Andesite Porphyry	L223	184	155	1.84	0.12	0.03	0.08	0.08	0.01	8.8	10.9	0	0	2.4	63.32	-152.55	Acid Consuming
701-22-112	Andesite Porphyry	L223	191.95	106	1.23	0.08	0.03		0.05	0	9.5	11.1	0	0	1.5	0.00	-104.47	Acid Consuming
701-22-113	Andesite Porphyry	L223	198	109	1.32	0.12	0.03		0.09	0	9.1	11.3	0	0	2.8	0.00	-106.25	Acid Consuming
701-22-114	Andesite Porphyry	L223	206.5	117	1.44	0.04	0.03		0.01	0	8.5	11.4	0	0	0.3	0.00	-116.69	Acid Consuming
701-22-115	Andesite Porphyry	L223	212	130	1.44	0.34	0.06	0.25	0.25	0.03	8.6	11.3	0	0	7.7	16.99	-122.35	Acid Consuming
701-22-116	Andesite Porphyry	L223	220.05	95	0.92	0.63	0.12	0.43	0.43	0.08	8.8	11.3	0	0	13.2	7.22	-81.84	Non Acid Forming
701-22-117	Andesite Porphyry	L223	231.2	84	0.76	0.55	0.06	0.42	0.42	0.07	9.7	11.3	0	0	12.9	6.54	-71.15	Non Acid Forming
701-22-118	Andesite Porphyry	L223	240.4	23	0.84	1.7	0.17	1.29	1.29	0.24	8	4.8	0	12	39.5	0.58	16.47	Uncertain
701-22-119	Fault Breccia	L223	244	6	0.08	1.33	0.16	0.98	0.98	0.19	4.8	2.5	17	23	30.0	0.20	23.99	Potentially Acid Forming
701-22-120	Andesite Porphyry	L223	319.3	6	0.04	0.5	0.11	0.29	0.29	0.1	5.9	3.3	3	5	8.9	0.68	2.87	Potentially Acid Forming - Low Capacity
701-22-121	Andesite Porphyry	L223	325.4	5	0.03	0.58	0.07	0.42	0.42	0.09	5.3	2.9	7	11.5	12.9	0.39	7.85	Potentially Acid Forming - Low Capacity
701-22-122	Fault Breccia	L223	340.3	3	0.05	1.19	0.26	0.59	0.59	0.34	4.1	2.9	7	12	18.1	0.17	15.05	Potentially Acid Forming
701-22-123	Pyroclastic	L087	6	10	0.15	2.04	0.7	0.04	0.04	1.3	7.9	7.1	0	0	1.2	8.17	-8.78	Non Acid Forming
701-22-124	Pyroclastic	L087	16	6	0.08	0.25	0.11	0.04	0.04	0.1	7.6	6.8	0	1	1.2	4.90	-4.78	Non Acid Forming
701-22-125	Pyroclastic	L087	26	2	0.04	3.2	1.06	0.04	0.04	2.1	7.3	4.6	0	13	1.2	1.63	-0.78	Non Acid Forming
701-22-126	Pyroclastic	L087	36	1	0.02	2.22	0.57	0.04	0.04	1.61	6.8	4.5	0	9	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-127	Pyroclastic	L087	46	3	0.02	1.77	0.25	0.04	0.04	1.48	6.8	4.7	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-128	Andesite Porphyry	L087	56	2	0.02	3.06	0.92	0.04	0.04	2.1	7.2	4.5	0	11	1.2	1.63	-0.78	Uncertain
701-22-129	Fault Breccia	L087	66	2	0.03	2.23	0.68	0.04	0.04	1.51	7.3	4.7	0	5	1.2	1.63	-0.78	Non Acid Forming
701-22-130	Andesite Porphyry	L087	76	1	0.02	1.82	0.83	0.3	0.30	0.69	7.3	4.5	0	6	9.2	0.11	8.18	Potentially Acid Forming - Low Capacity
701-22-131	Andesite Porphyry	L087	86	1	0.03	2.49	0.81	0.04	0.04	1.64	7	4.5	0	6	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-132	Andesite Porphyry	L087	96	2	0.02	1.58	0.42	0.05	0.05	1.11	6.7	4.8	0	5	1.5	1.31	-0.47	Non Acid Forming
701-22-133	Andesite Porphyry	L087	106	3	0.08	0.97	0.22	0.04	0.04	0.71	6.8	5.9	0	0	1.2	2.45	-1.78	Non Acid Forming
701-22-134	Andesite Porphyry	L087	116	2	0.04	1.36	0.2	0.04	0.04	1.12	7.1	5.3	0	4	1.2	1.63	-0.78	Non Acid Forming
701-22-135	Andesite Porphyry	L087	126	3	0.02	1.93	0.3	0.04	0.04	1.59	6.7	5	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-136	Andesite Porphyry	L087	134	5	0.03	0.1	0.04		0.06	0	7	6.6	0	1	1.8	0.00	-3.16	Non Acid Forming
701-22-137	Andesite Porphyry	L087	144	-4	0.02	2.39	0.58	0.71	0.71	1.1	2.8	2.7	16	22	21.7	-0.18	25.73	Potentially Acid Forming
701-22-138	Andesite Porphyry	L087	158	3	0.02	0.75	0.13	0.53	0.53	0.09	4.2	2.7	11	15	16.2	0.18	13.22	Potentially Acid Forming
701-22-139	Andesite Porphyry	L087	170	3	0.04	0.8	0.09	0.6	0.60	0.11	4.7	2.6	12	17	18.4	0.16	15.36	Potentially Acid Forming
701-22-140	Andesite Porphyry	L087	184	1	0.04	1.24	0.12	0.94	0.94	0.18	3.8	2.4	24	30	28.8	0.03	27.76	Potentially Acid Forming
701-22-141	Andesite Porphyry	L087	200	3.5	0.04	1.25	0.095	1.07	1.07	0.085	4.3	2.5	19.5	24.5	32.7	0.11	29.24	Potentially Acid Forming
701-22-142	Andesite Porphyry	L087	210	5	0.02	0.1	0.05		0.05	0	5.9	4.9	0	4	1.5	0.00	-3.47	Non Acid Forming
701-22-143	Andesite Porphyry	L087	216	-1	0.04	2.5	0.4	1.52	1.52	0.58	3	2.4	38	45	46.5	-0.02	47.51	Potentially Acid Forming
701-22-144	Andesite Porphyry	L087	252	-2	0.02	11.56	1.39	5.58	5.58	4.59	3	2.4	178	193	170.7	-0.01	172.75	Potentially Acid Forming
701-22-145	Andesite Porphyry	L087	262	-7	0.02	26.63	1.19	18.95	18.95	6.49	2.7	2.3	493	533	579.9	-0.01	586.87	Potentially Acid Forming
701-22-146	Andesite Porphyry	L087	272	-1	0.01	9.82	0.7	4.84	4.84	4.28	3.1	2.4	149	162	148.1	-0.01	149.10	Potentially Acid Forming
701-22-147	Andesite Porphyry	L087	292	2	0.03	3.84	0.3	2.81	2.81	0.73	3.4	2.3	74	81	86.0	0.02	83.99	Potentially Acid Forming
701-22-148	Hydrothermal Breccia	L087	330	-2	0.01	13.32	1.17	7.94	7.94	4.21	3.3	2.3	216	236	243.0	-0.01	244.96	Potentially Acid Forming
701-22-149	Andesite Porphyry	L087	349.7	0	0.04	2.03	0.25	1.69	1.69	0.09	3.3	2.3	35	42	51.7	0.00	51.71	Potentially Acid Forming
701-22-150	Andesite Porphyry	L087	340	-2	0.02	5.75	0.34	4	4.00	1.41	3.2	2.2	133	143	122.4	-0.02	124.40	Potentially Acid Forming

APPENDIX C

Multi-Element Analysis Results

Knight Piésold
CONSULTING

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	Geochemical Abundance Index			0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950
Andesite Porphyry	LS001	25	701-22-001	0.685	103517	4.1	10	255.25	2.015	0.155	966.5	0.2	65.425	1.3	12.5	2.59	409.05	2.41	1.12	1.02	1.09	15.865	3.23	1.03	1.785	0.01	0.435	0.5825	38446.5	37.265	5.3	0.169	3914	163.5
Andesite Porphyry	LS001	59	701-22-002	0.11	77727	1.6	13	426.1	1.96	0.33	2481	0.75	65.36	12.6	10	3.68	20.6	2.51	1.53	1.02	5.11	16.56	2.94	1.05	1.56	0.01	0.52	0.105	30829	37.9	12.7	0.243	6818	9922
Andesite Porphyry	LS001	65.5	701-22-003	0.86	81128	10.7	10	381.5	2.5	6.78	1432	0.68	46.42	17.3	23	5.8	756.1	4.4	2.85	1.04	5.77	32.57	4.02	0.9	1.17	0.01	0.94	1.456	37121	27.29	2.2	0.406	2838	291
Andesite Porphyry	LS001	89.25	701-22-004	1.16	79579	12.4	10	542.1	1.16	7.05	1079	0.24	69.4	11.8	12	3.18	555.8	5.02	2.86	1.52	4.51	26.34	5.13	1	1.46	0.03	1.05	1.132	35174	37.25	4.9	0.368	3051	133
Andesite Porphyry	LS001	122	701-22-005	0.54	90610	3.7	10	339.8	1.9	0.74	383	0.12	71.18	4.3	12	3.18	45.6	2.68	1.5	1.01	1.58	19.58	3.19	1.18	1.55	0.01	0.65	0.676	35318	38.73	13.6	0.212	7822	1142
Dyke	LS001	136.75	701-22-006	0.65	87705	7.1	10	448.9	0.68	6.94	819	0.04	54.06	11.1	14	1.9	127.9	4.07	2.23	1.2	3.57	28.31	4.15	0.88	1.63	0.02	0.78	0.663	39963	27.27	2.5	0.264	2892	82
Dyke	LS001	185	701-22-007	1.12	58688	789.6	10	584	0.28	10.93	645	0.13	47.41	22.8	20	0.12	817.9	1.9	0.69	1.48	15.86	18.92	3.73	1.83	0.95	0.18	0.26	0.405	2307	21.06	35.3	0.106	136	41
Dyke	LS001	221.65	701-22-008	0.22	80964	37.3	10	452.1	0.16	6.33	967	0.37	29.96	15.6	26	0.1	634.9	0.95	0.3	0.69	4.85	30.12	2.02	0.89	1.06	0.02	0.13	0.092	7904	16.11	4.9	0.058	122	27
Andesite Porphyry	LS001	249.15	701-22-009	0.13	91995	33.9	10	572.7	0.6	0.99	817	0.13	55.84	5.2	13	1.42	170.1	1.2	0.49	0.94	1.31	24.4	2.52	1.26	1.15	0.02	0.18	0.156	37872	30.23	2.9	0.073	2139	54
Andesite Porphyry	LS001	290.75	701-22-010	0.15	86896	9.4	10	393	0.5	3.17	578	0.12	37.29	10.9	19	0.93	383.7	0.79	0.4	0.67	2.93	24.97	1.65	0.86	0.88	0.01	0.13	0.33	31259	20.77	4.3	0.076	1507	72
Andesite Porphyry	LS001	304.05	701-22-011	1	80277	12.5	10	384.8	0.4	16.79	653	0.1	43.59	19.3	26	0.19	1365.5	0.94	0.43	0.77	7.28	35.11	2.01	1.33	1.44	0.04	0.16	0.21	7861	24.18	25.1	0.093	176	42
Andesite Porphyry	LS001	368.85	701-22-012	0.82	86945	4.9	10	607.5	1.27	5.16	618	0.8	76.58	14.7	19	2.36	306	7.7	3.86	2.36	5.16	26.73	7.7	1.07	1.69	0.03	1.49	0.426	32394	42.52	6.5	0.371	2952	51
Andesite Porphyry	LS001	395	701-22-013	0.14	94738	8.4	10	344.8	1.39	2.21	556	0.05	73.5	9.6	17	1.53	922.7	5.67	2.9	1.59	2.24	19.82	5.6	1.42	2.04	0.01	1.1	0.729	28083	41.01	30.6	0.316	2593	93
Andesite Porphyry	LS001	411.1	701-22-014	0.41	67660	90.4	10	351.1	0.16	2.93	531	0.62	71.86	21	18	0.12	5916	0.8	0.26	0.97	7.8	16.91	1.95	2.49	0.21	0.02	0.1	0.205	4843	44.8	7.2	0.037	120	30
Andesite Porphyry	LS001	423.5	701-22-015	0.09	61701	42.4	10	449.4	0.17	1.13	593	0.08	46.46	21.3	17	0.11	815.9	0.24	0.09	0.63	9.39	4.4	0.98	1.23	0.12	0.02	0.03	0.024	12052	26.4	4.7	0.014	106	30
Andesite Porphyry	LS002	94.3	701-22-016	0.17	90445	2.9	10	1084.9	0.78	0.19	456	0.03	44.35	13.1	14	1.69	597.7	1.26	0.68	0.53	1.83	16.27	1.61	1.62	0.51	0.02	0.25	0.034	27655	28.24	3	0.081	2688	45
Breccia	LS002	104.13	701-22-017	0.25	89815	16.5	10	917.2	0.88	0.43	388	0.03	45.24	16.6	12	2.32	647.2	1.37	0.74	0.55	2.18	16.66	1.69	1.58	0.3	0.02	0.26	0.104	28772	29.07	3.1	0.09	3079	61
Andesite Porphyry	LS002	128.6	701-22-018	0.12	87842	8.2	10	986.7	0.57	0.39	356	0.19	53.64	11.7	18	1.84	437	1.99	0.95	0.93	2.06	16.66	2.59	1.52	0.33	0.02	0.36	0.035	30097	30.18	3.3	0.114	2684	33
Andesite Porphyry	LS002	148.4	701-22-019	0.16	86844	20.3	10	750	0.98	0.3	283	0.05	61.46	11.4	15	2.13	431.5	2.26	1.2	0.97	2.62	16.33	2.73	1.37	0.53	0.01	0.42	0.068	34562	35.94	2.7	0.145	2937	44
Diorite Porphyry	LS002	355.8	701-22-020	0.17	69759	1.3	10	1144.9	1.1	0.06	3774	0.2	50.47	12.6	18	7.93	890.5	1.78	0.9	0.88	6.69	15.03	2.48	0.79	0.12	0.01	0.33	0.029	22713	26.97	3.7	0.104	7768	2062
Andesite Porphyry	LS002	373	701-22-021	1.51	86132	14.9	10	301.2	1.46	1.41	924.5	1.375	68.265	20.6	16.5	12.77	1318.95	3.29	1.795	1.335	7.23	19.12	4.125	1.285	0.15	0.025	0.625	0.4145	21548	37.94	15.85	0.1955	4472.5	4588
Andesite Porphyry	LS002	422.5	701-22-022	0.31	89437	5.5	10	461.3	0.91	0.45	386	0.58	66.88	15.7	11	3.58	592.4	2.67	1.39	1.12	2.48	20.64	3.52	1.73	0.31	0.03	0.52	0.159	26166	35.68	29.8	0.177	3004	145
Andesite Porphyry	LS002	435.3	701-22-023	0.21	90678	3.9	10	536.6	1.12	0.43	502	0.78	68.05	16.1	15	3.51	396.8	2.63	1.36	1.3	2.98	18.9	3.49	1.51	0.71	0.02	0.49	0.066	26125	36.93	16.7	0.167	2823	1297
Andesite Porphyry	LS002	448.85	701-22-024	1.81	85770	47.9	10	646.5	1.25	0.44	563	1.81	65.33	22.2	11	5.66	668	3.57	2.01	1.18	3.62	19.45	3.72	1.21	0.3	0.07	0.69	0.701	35515	36.44	6.3	0.224	3955	65
Andesite Porphyry	LS002	472.85	701-22-025	0.24	91866	6.1	10	1129.3	0.93	0.11	540	1.84	86.89	13.5	20	2.43	961.2	5.66	3.4	1.7	1.18	17.29	5.4	1.88	0.47	0.01	1.16	0.062	20377	47.58	15.8	0.453	2374	41
Andesite Porphyry	LS003	21.3	701-22-026	0.46	78451	15.5	10	403.7	0.81	2.46	1160	0.03	42.38	0.6	18	1.17	273.8	0.98	0.52	0.8	3.74	20.09	2.05	0.95	1.6	0.01	0.19	1.252	32775	22.55	0.5	0.103	2199	490
Andesite Porphyry	LS003	70	701-22-027	0.18	85064	1.6	10	721.9	0.94	1.37	757	0.76	55.69	14	20	1.49	36.4	1.96	1.15	0.87	3.1	17.82	6.71	1.12	1.64	0.02	0.39	0.345	38759	31.12	2.7	0.193	3307	119
Andesite Porphyry	LS003	74.3	701-22-028	0.17	63156	2.7	10	345.7	1.24	1.23	307	2.05	33.21	4.9	16	0.89	44.3	2.06	0.84	0.66	1.04	12.34	1.99	0.96	1.33	0.04	0.28	0.392	21720	16.37	2.8	0.117	1687	93
Andesite Porphyry	LS003	97	701-22-029	0.49	91262	20.3	10	452.5	1.14	2.64	582	0.13	27.5	12.3	13	3.63	393.5	7.4	1.01	0.61	2.94	18.68	1.55	1.13	1.79	0.04	0.33	0.993	34180	13.74	1.8	0.162	2469	142
Andesite Porphyry	LS003	115.5	701-22-030	0.59	71142	16	10	235.1	0.66	5.33	729	0.04	20.58	16.1	16	1.12	319.6	1.2	0.66	0.51	7.07	24.06	1.63	0.54	1.11	0.04	0.22	0.748	16239	11.08	0.7	0.129	798	74
Andesite Porphyry	LS003	131.7	701-22-031	0.22	88979	5.9	10	197.1	1.68	1.28	403	0.15	24.61	11.3	19	1.72	238.1	2.05	1.1	0.81	1.65	18.02	2.77	1.57	1.96	0.01	0.36	4.726	26502	12.65	3.2	0.178	1935	150
Breccia	LS003	146.75	701-22-032	0.68	80243	31.1	10	342.5	0.96	1.55	761	0.58	41.1	15.9	39	3.19	419.4	1.63	0.96	0.67	3.78	18.74	2.04	1.04	1.73	0.03	0.32	0.915	37060	21.45	0.5	0.186	2432	205
Diorite Porphyry	LS003	170.02	701-22-033	0.58	81158	15.5	10	566.2	0.85	2.09	920	0.48	39.13	11.2	13	3.45	317	1.56	0.91	0.7	3.91	23.93	2	0.8	1.44	0.01	0.29	0.459	35907	22.01	0.5	0.154	2004	135
Diorite Porphyry	LS003	182.4	701-22-034	0.46	90464	13.5	10	637.5	1.58	1.98	595	0.03	49.8	10.8	11	2.77	291.6	3.02	1.1	1.12	3.32	18.82	4.23	1.21	1.7	0.01	0.45	0.791	29319	25.29	2.7	0.173	1985	200
Diorite Porphyry	LS003	274.25	701-22-035	0.3	70308	31.6	10	351	0.21	3.32	614	0.81	41.33	16.4	67	0.42	709.3	1.14	0.59	1.03	8.2	7.4	2.52	0.68	1.17	0.02	0.19	0.083	17222	22.69	1.5	0.123	191	54
Diorite Porphyry	LS003	298.3	701-22-036	0.57	80956	14.3	10	478.4	0.64	9.53	1025	0.06	30.91	18.5	18	1.49	271.3	1.67	0.88	0.8	7.71	38.25	2.67	0.64	1.54	0.03	0.31	0.515	31247	16.61	0.7	0.151	1338	53
Diorite Porphyry	LS003	305	701-22-037	0.23	86129	7.2	10	509.5	0.54	4.72	1083	0.02	29.54	14.7	17	1.56	83.1	1.62	1.04	0.74	3.74	31.02	2.2	0.9	1.54	0.01	0.32	0.638	35109	14.86	0.6	0.169	1493	53
Breccia	LS003	324.8	701-22-038	0.39	74621	6.4	10	319	0.52	5.35	360	0.08	30.19	21.3	22	1.29	440.4	1.6	0.87	0.71	7.42	24.56	1.84	0.67	0.94	0.01	0.31	0.311	33090	18.65	1.1	0.134	1143	127
Andesite Porphyry	LS003	330.2	701-22-039	0.3	89832	4.7	10	374.2	0.68	0.88	548	0.09	46.5	20.4	26	1.28	114.3	2.77	1.42	0.76	2.82	18.94	2.73	1.02	2.23	0.02	0.5	0.623	34248	27.25	2.1	0.208	1806	78
Diorite Porphyry	LS003	342.8	701-22-040	0.11	78361	6.3	10	527.3	0.53	1.32	17724	0.07	30.53	17.3	14	1.12	105.8	1.26	0.63	0.8	3.53	25.87	2.21	0.81	1.39	0.01	0.23	0.164	31426	16.28	0.9	0.126	1843	70
Feldspar Porphyry	LS003	353.35	701-22-041	0.165	81866	8	10	311.7	0.32	1.68	814.5	0.14	45.965	12.85	13.5	0.39	60.55	0.965	0.42	0.785	5.405	12.135	2.285	0.755	1.08	0.01	0.15	0.0625	10531	24.835	1.15	0.09	517	47
Andesite Porphyry	LS003	377.5	701-22-042	0.13	70220	18.3	10	287.8	0.21	1.02	552	0.48	45.29	14	10	0.34	65.8	0.69	0.23	0.69	4.83	8.91	1.59	0.59	0.47	0.02	0.09	0.03	13445	26.46	1.4	0.036	139	38
Porphyry	LS003	394.75	701-22-043	0.06	94987	2.5	10	591.7	0.89	0.47	300	0.05	23.35	3.7	21	0.79	448	1.3	0.84	0.41	0.75	17.1	1.37	1.07	1.83	0.01	0.27	0.129	28652	13.93	3.4	0.167	977	56
Porphyry	LS003	410.9	701-22-044	0.07	99172	1.9	10	441.8	0.61	0.91	396	0.24	22.11	19.4	23	0.29	102.9	1.52	0.92	0.35	0.71	17.18	1.28	0.97	1.38	0.01	0.31	0.186	26211	15.1	6.1	0.151	384	42
Breccia	LS003	440.8	701-22-045	0.58	56485	21.3	10	192.8	0.25	2.97	339	0.05	36.22	13	27	0.19	666.2	0.88	0.42	0.58	6.73	8.08	1.77	0.87	0.32	0.02	0.15	0.422	5616	19.48	4.1	0.061	117	40
Andesite Porphyry	LS004	30.21	701-22-046	1.64	74128	36.3	13	584.9	2.12	0.75	2409	7.73	51.06	23.1	11	3	191.3	1.67	1.23	0.83	5.57	19.07	2.4	0.84	1.14	0.01	0.36	3.274	35612	28.6	2.7	0.18	6077	22548
Andesite Porphyry	LS004	50.21	701-22-047	0.12	77670	4.5	12	245.6	1.48	0.06	23035	0.29	52.53	9.7	11	3.16	10.9	2.03	1.22	0.83	2.75	16.55	2.35	0.83	1.33	0.01	0.39	0.035	36106	29.69	3.7	0.19	18699	5202
Andesite Porphyry	LS004	69.25	701-22-048	0.26	81970	12.2	17	112.3	2.07	0.05	2139	4.94	53.42	10.4	19	5.4	15	1.47	0.99	0.77	3.84	20.51	2.1	1.02	1.51	0.01	0.32	0.697	32629	29.57	5	0.168	22825	23584
Andesite Porphyry	LS004	110.45	701-22-049	1.11	88013	24.8	10	226.4	1.79	1.44	1118	0.16	36.48	11.6	16	5.49	300.6	2.79	1.68	0.97	4.86	21.73	3.24	0.79	1.91	0.02	0.6	1.992	39809	19.67	1.3	0.234	3257	398
Andesite Porphyry	LS004	134.45	701-22-050	2.33	81532	46.6	10	275.3	0.25	2.45	727	0.16	40.53	18.3	56	0.27	612.9	1.3	0.74	0.97	9.07	19.12	2.76	1.22	1.7	0.03	0.25	0.548	795	21.79	91.4	0.156	276	1372
Diorite Porphyry	LS005	28.4	701-22-051	0.53	74758	12.1	12	1024.8	1.28	1.24	27866	1.94	55.18	11.6	8	1.94	121.7	2.05	1.23	0.92	3.87	16.16	2.68	0.54	1.5	0.01	0.41	1.021	32133	32.13	7	0.186	13348	3669
Diorite Porphyry	LS005	50.1	701-22-052	0.12	75404	3.8	10	856.6	1.14	0.11	29505	0.17	71	9.4	12	1.83	18.8	2.49	1.43	1.12	2.85	15.41	3.02	0.89	1.6	0.01	0.49	0.056	32950	40.09	8.7	0.234	17656	1747
Breccia	LS005	72.5	701-22-053	1.19	79419	5.8	11	378.5	1.25	2.19	2929	4.32	68.75	12.4	9	1.78	215.1	2.45	1.41	1.3	5.2	19.45	3.24	0.97	1.92	0.06	0.49	0.224	32405	37.22	9.7	0.196	10517	20786
Breccia	LS005	133.9	701-22-054	1.45	77268	44.6	10	363.2	2.51	1.95	1131	1.58	66.32	17	26	4.84	325.5	3.64	2.47	1.1	6.41	16.84	3.43	0.77	1.47	0.04	0.82	0.259	34556	36.34	3	0.318	4717	401
Diorite Porphyry	LS005	141.4	701-22-055	0.18	84906	6.2	10	581.1	1.81	0.2	2575	0.07	71.61	9.8	11	2.04	11	2.75	1.6	1.15	3.4	18.09	3.38	0.97	1.89	0.01	0.55	0.043	34304	40.77	6.3	0.251	7312	4184
Andesite Porphyry	LS006	34.3	701-22-056	0.17	82449	4	10	540.3	0.78	0.7	205	0.04	58.01	8.6	8	2.6	165.8	1.32	0.84	0.52	1.99	16.95	1.51	1.12	1.87	0.01	0.39	0.123	37994	34.51	2.1	0.156	3843	129
Andesite Porphyry	LS006	52.3	701-22-057	0.21	102918	39.7	10	1364.1	0.9	0.42	287	1.04	86.79	61.4	12	2.85	45.3	3.8	2.6	1.35	3.04	17.11	4.15	0.91	1.7	0.01	0.84	0.096	26329	49.58	1.6	0.486	2726	50
Andesite Porphyry	LS006	70.3	701-22-058	0.15	109627	4.8	10	1041.3	1.36	0.42	338	0.32	90.64	24.1	19	2.58	31.7	3.15	1.96	1.72	1.67	16.63	4.38	0.98	1.92	0.01	0.65	0.049	24399	49.66	1.6	0.335	2527	46
Andesite Porphyry	LS006	127.6	701-22-059	0.36	86504	5.7	10	282.2	1.54	0.13	1201	5.53	70.24	10	10	7.26	17.4	2.08	1.36	0.98	3.82	18.57	2.76	1.14	1.7	0.05	0.45	0.938	35570	40.71	3.6	0.21	4326	5554
Breccia	LS006	140.4	701-22-060	0.7	87385	15.9	10	652.6	1.7	1.55	919	2.75	81.64	12.8	12	11.86	87.9	2.99	1.94	1.34	3.4	20.54	4.08	0.93	1.86	0.08	2.05	1.017	38085	45.89	2.6	0.269	3721	160
Porphyry	LK002	16.05	701-22-061	0.535	76271	6.8	10	397.85	0.765	3.435	843.5	0.04	52.005	0.6	10	0.855	163.15	1.05	0.54	0.725	3.345	18.5	1.875	1.005	1.54	0.01	0.18	0.415	37111.5	28.925	0.15	0.1055	2028	122.5
Andesite Porphyry	LK002	36.3	701-22-062	0.06	88566	10.2	10	252.3	0.84	1.62	674	0.02	55.75	3.5	13	1.05	87.4	1.16	0.52	0.9	2.38	17.77	2.32	1.14	1.55	0.01	0.18	0.552	37380	31.58	0.4	0.098	1882	118
Breccia	LK002	113.6	701-22-063	0.82	69550	86.5	10	204.5	0.3	3.07	803	0.05	44.72	15.2	40	0.18	1982.7	1.07	0.52	0.78	7.6	13.68	2.18	1.7	1.11	0.06	0.18	0.172	5571	24.22	2.1	0.111	173	44
Porphyry	LK002	133.3	701-22-064	0.46	80467	21.9	10	249.2	0.2	2.21	900	0.05	42.44	9.7	30	0.08	562.5	0.78	0.4	0.76	4.43	14.23	1.97	1.3	0.86	0.01	0.11	0.185	23261	22.83	0.3	0.068	113	41
Porphyry	LK002	167.3	701-22-065	0.38	73634	14.3	10	418.2	0.09	1.86	819	0.04	26.44	12.3	18	0.06	456.4	0.48	0.19	0.55	6.53	9.79	1.47	0.85	0.65	0.01	0.07	0.193	19430	13.91	0.7	0.038	107	42
Andesite Porphyry	LK003	40.3	701-22-066	0.1	116699	4.7	10	367.7	2.05	0.13	317	10.19	54.15	9.2	28	3.11	55	1.77	1.04	0.8	1.15	19.79	2.31	1.44	1.52	0.03	0.35	0.713	34470	31.68	4.4	0.163	2308	188
Breccia	LK003	54.9	701-22-067	1.29	72160	24.6	10	213	0.99	2.28	182	3.21	69.5	11.5	41	6.08	584.7	1.68	1.01	0.76	3.27	16.06	2.49	1.59	1.43	0.08	0.31	1.104	28001	42.14	2.5	0.173	2433	175
Breccia	LK003	108.6	701-22-068	2.37	81507	29.7	10	421.5	1.06	4.24	397	1.36	55.01	17.9	45	5.74	410.8	1.64	0.93	0.77	5.22	19.2	2.35	1.09	1.35	0.28	0.29	0.588	29777	30.72	1.8	0.152	1980	128
Pyroclastic	LK003	128.7	701-22-069	0.79	79365	18.7	10	382.4	1.31	1.68	440	6.07	58.11	16	83	10.97	147.7	1.84	0.98	0.85	2.68	17.61	2.83	1.44	1.36	0.48	0.35	0.791	32554	30.62	1.8	0.171	3026	219
Tuff	LK003	145.6	701-22-070	0.93	79481	13.4	10	367.1	1.28	1.04	262	1.87	47.78	12.4	49	7.08	181.2	1.38	1.05	0.62	2.64	17.03	2.02	1.23	1.7	0.4	0.3	0.309	32478	25.81	2.7	0.17	2891	188
Hornblende Porphyry	LK004	51.23	701-22-071	0.06	81758	2.2	14	588.2	1.22	0.13	36192	0.16	65.85	8.8	9	1.69	19.9	2.31	1.39	1.05	2.76	16	2.98	1.12	1.97	0.01	0.48	0.026	25548	36.78	8.6	0.221	10769	817
Breccia	LK004	71.63	701-22-072	0.17	78189	4.6	17	1384.9	1.21	0.28	37025	0.36	71.01	10.7	12	2.26	67	2.32	1.36	1.07	2.98	15.82	3.06	1.03	1.61	0.01	0.46	0.12	25453	40.22	6.8	0.209	17165	2436
Breccia	LK004	81.52	701-22-073	0.17	78084	14.8	15	176.6	1.38	0.11	25684	0.65	53.61	9	12	3.11	21.2	2.15	1.26	0.97	3.06	16.47	2.48	0.82	1.32	0.01	0.42	0.092	31413	30.17	8.1	0.211	20189	10476
Andesite Porphyry	LK004	104.71	701-22-074	1.94	77045	108	10	246.5	2.45	1.79	4535	9.84	59.5	13.1	13	8.62	322.1	1.7	1.02	0.92	5.43	18.97	2.64	0.97	1.42	0.06	0.37	3.2	33243	32.91	4.6	0.162	6675	13361
Diorite Porphyry	LK004	137.51	701-22-075	2.72	65841	78.6	10	380.9	1.32	2.03	1492	0.39	58.9	4.6	19	5.72	1075.6	3.45	2.23	1.05	3.56	14.42	3.34	0.66	1.57	0.06	0.74	0.861	28869	34	1.7	0.322	2792	659
Breccia	LK006	45.2	701-22-076	1.25	80115	249.6	10	220.3	2.15	0.55	780	0.2	66.08	56.9	267	7.17	230.3	4.59	1.84	1.61	13.94	15.29	5.48	0.75	1.82	0.01	0.76	1.014	25941	33.94	4.4	0.211	2624	227
Andesite Porphyry	LK006	51.8	701-22-077	0.22	104651	7.7	10	115	1.73	0.18	586	4.65	51.71	8.4	39	2.15	101.4	2.8	1.49	1.01	1.71	17.78	3.26	1.54	2.16	0.05	0.52	1.008	29624	28.66	8.4	0.229	3505	282
Andesite Porphyry	LK006	129.7	701-22-078	1.03	83124	132.5	10	427.9	0.86	2.78	1070	0.14	62.18	14.1	35	3.36	307.1	2.68	1.42	1.18	4.07	21.78	4.13	1.2	2.1	0.53	0.49	0.354	33556	31.94	2	0.248	2369	173
Breccia	LK006	145.7	701-22-079	1.42	77515	40.1	10	316	0.64	5.67	664	0.37	57.02	16.4	85	4.54	471	2.31	1.35	1.07	3.69	36.4	3.44	1.18	1.98	0.23	0.42	0.437	28330	30.56	6.6	0.238	2353	77
Diorite Porphyry	LK006	165.86	701-22-080	0.52	85717	16.5	10	432.8	0.3	0.96	713	0.15	20.95	11.5	16	1.19	76.2	0.87	0.44	0.59	3.67	22.67	1.87	0.79	0.97	0.02	0.14	0.194	24680	11.09	1.5	0.078	1120	74

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Tuff	LK006	191.35	701-22-081	0.755	74508.5	48.55	10	300.9	0.755	3.81	344	0.03	53.315	22.85	92	8.42	511.9	1.26	0.79	0.735	6.17	19.205	2.635	1.14	1.475	0.165	0.245	0.189	23433.5	27.82	2.7	0.143	1960.5	43.5
Pyroclastic	LK006	214.6	701-22-082	0.34	74022	37.7	10	302.9	0.51	1.15	682	0.08	52.45	6.6	22	0.88	166.3	1.07	0.61	0.77	3.21	15.3	2.15	1.04	1.51	0.01	0.19	0.076	20608	29.1	2.6	0.152	683	98
Andesite Porphyry	L013	5	701-22-083	0.45	103191	5	10	356.1	1.15	0.54	500	0.02	60.51	1.3	10	3.48	786.3	0.92	0.48	0.49	1.07	17.42	1.74	1.08	0.93	0.02	0.17	0.135	19976	40.68	2.3	0.079	2226	29
Andesite Porphyry	L013	11	701-22-084	0.3	103902	8.3	10	1591.3	1	0.09	606	0.03	45.83	0.7	17	1.62	647.2	1.31	0.66	0.67	6.6	17.59	2.13	1.06	0.47	0.03	0.24	0.3	24954	29.29	1.8	0.075	1651	46
Andesite Porphyry	L013	17.7	701-22-085	0.23	92568	13.5	10	559.9	0.76	0.18	335	0.02	44.75	0.3	11	1.84	222.8	0.77	0.37	0.63	2.37	17.14	1.15	1.54	0.9	0.01	0.14	0.091	31004	32.92	2.9	0.057	2788	42
Andesite Porphyry	L013	23.4	701-22-086	0.22	89426	3.6	10	555.7	0.95	0.25	362	0.02	83.58	1.2	14	1.84	157.1	0.82	0.34	0.68	2.71	17.02	1.71	1.61	0.45	0.01	0.14	0.137	29273	63.17	2.4	0.051	2974	60
Andesite Porphyry	L013	28.9	701-22-087	0.26	97282	2.3	10	417.9	0.8	0.31	298	0.03	62.22	0.8	16	1.89	151.2	0.85	0.39	0.52	0.82	16.28	1.41	1.45	0.3	0.01	0.15	0.134	30891	35.17	2.9	0.055	2725	49
Andesite Porphyry	L013	34.9	701-22-088	0.21	92565	7.1	10	884.6	0.71	0.23	433	0.03	51.47	0.5	16	1.82	214.5	1.55	0.81	0.5	1.84	18.58	1.72	1.58	0.36	0.01	0.3	0.406	33222	36.9	4.8	0.088	1733	63
Andesite Porphyry	L013	41.25	701-22-089	0.15	100724	5.4	10	901.4	0.66	0.43	471	0.02	38.26	0.6	20	1.62	260.6	1.6	0.88	0.5	1.3	17.83	1.7	1.57	0.37	0.01	0.3	0.359	37270	25.96	3.5	0.095	2239	53
Andesite Porphyry	L013	47.7	701-22-090	0.52	90853	33.4	10	278.4	0.69	1.45	395	0.02	39.74	0.6	28	2.04	409.3	1.29	0.63	0.5	2.86	19.33	1.6	1.97	0.55	0.01	0.23	0.422	28578	23.82	4.3	0.074	2700	57
Andesite Porphyry	L013	52.9	701-22-091	0.17	94139	5.2	10	741.2	0.6	0.29	363	0.02	41.61	0.8	16	1.51	306.4	1.22	0.6	0.6	1.25	16.79	1.76	1.49	0.33	0.01	0.22	0.241	24390	26.07	3	0.101	2005	47
Andesite Porphyry	L013	58.8	701-22-092	1.24	84187	12.8	10	414.7	0.89	1.57	367	0.02	47.01	0.6	18	2.74	291.3	1.17	0.65	0.54	3.7	18.6	1.58	1.78	1.02	0.01	0.22	0.295	33588	29.22	2.5	0.094	3482	60
Andesite Porphyry	L013	69	701-22-093	0.27	76378	8.6	10	920	0.84	0.22	283	0.02	43.76	0.8	14	2.1	299.1	1.7	0.93	0.58	3.77	16.54	1.81	1.77	0.37	0.01	0.33	0.212	33802	27.76	2	0.092	3481	94
Hydrothermal Breccia	L013	75	701-22-094	2.59	67415	14.8	10	993.4	0.3	1.12	986	0.02	88.89	0.3	22	0.08	62.6	1.6	0.61	1.64	3.7	8.65	3.86	1.16	1.03	0.04	0.26	0.031	19072	50.74	0.7	0.103	226	56
Hydrothermal Breccia	L013	81.9	701-22-095	6.22	63052	27.1	10	891.5	0.2	0.95	1046	0.02	82.64	0.6	28	0.09	117.4	1.31	0.43	1.2	7.25	16.47	2.78	1.51	0.36	0.08	0.19	0.117	20356	44.79	1.3	0.047	99	47
Hydrothermal Breccia	L013	86.55	701-22-096	4.05	76280	14.9	10	668.4	0.09	1.44	1108	0.03	94.96	1.3	37	0.13	30.9	1.1	0.41	1.04	2.79	12.96	2.23	1.35	0.61	0.01	0.17	0.055	21447	52.41	0.9	0.058	109	61
Fault Breccia	L013	93.25	701-22-097	0.31	63817	53.3	10	708.2	0.29	5.12	972	0.02	89.91	0.4	18	0.22	120.1	2.01	0.45	2.21	8.87	35.91	5.23	2.19	0.61	0.02	0.22	0.262	10461	48.17	1.8	0.051	250	43
Hydrothermal Breccia	L013	100.4	701-22-098	8.94	71032	234.9	10	996.5	0.12	2.17	780	0.02	108.5	0.4	30	0.07	41.4	2.99	0.7	1.84	11.02	24.61	5.16	3.69	0.35	0.6	0.41	0.105	21136	65.97	0.7	0.05	108	35
Andesite Porphyry	L013	127.55	701-22-099	0.13	92005	4	10	608.4	1.26	0.33	664	0.06	60.72	15.3	14	1.37	672.2	2.51	1.14	1.2	2.59	16.54	3.62	1.57	0.77	0.01	0.43	0.18	27989	35.13	2.4	0.151	2656	42
Andesite Porphyry	L013	177.05	701-22-100	0.13	77104	9.6	10	299.5	0.31	0.46	569	0.03	62.95	9.7	33	0.23	798.8	0.59	0.25	0.63	4.72	7.95	1.32	1.6	0.55	0.01	0.1	0.027	12100	37.92	2.4	0.044	427	35
Andesite Porphyry	L013	199.75	701-22-101	0.37	84181.5	70.2	10	476.55	0.875	3.2	832.5	0.19	54.25	14.9	8.5	1.21	331.35	1.985	1.245	0.76	4.555	17.2	2.43	1.31	1.115	0.01	0.415	0.385	34854	32.72	0.9	0.188	2658.5	37.5
Fault Breccia	L223	121.75	701-22-102	1.15	73986	13.6	10	254.4	0.64	3.78	565	0.13	38.1	15.9	20	2.78	365.4	1.3	0.73	0.78	5.53	25.96	1.9	1.14	1.26	0.01	0.24	0.291	16673	20.45	5.3	0.14	624	29
Andesite Porphyry	L223	131	701-22-103	0.88	90218	25.2	10	509.6	1.59	2.78	702	1.59	63	12.5	49	2.69	542.7	2.14	1	1.01	3.75	17.83	2.82	1.32	1.55	0.01	0.37	0.25	23250	35.59	7.9	0.158	2617	111
Andesite Porphyry	L223	137	701-22-104	0.11	92445	3.4	10	2336.4	1.32	0.33	2656	0.36	66.28	12	17	6.05	139.4	4.27	2.44	1.56	5.53	18.56	5.34	0.96	2.69	0.01	0.89	0.067	28107	35.11	16.1	0.356	6848	3212
Andesite Porphyry	L223	142.1	701-22-105	0.3	90010	10.8	10	366.1	1.87	0.47	2526	0.04	62.36	12.5	15	9.42	120.5	2.77	1.64	1.05	1.95	18.2	3.31	1.09	2.48	0.01	0.56	0.076	28004	34.57	7.1	0.241	5546	151
Andesite Porphyry	L223	150	701-22-106	0.06	83668	2.9	13	673.8	1.26	0.19	30074	0.15	59.29	11.3	14	5.91	44	2.54	1.49	1.09	3.09	16.32	3.2	1	2.09	0.01	0.53	0.017	28266	33.2	10.2	0.217	15884	648
Andesite Porphyry	L223	156	701-22-107	0.07	82823	4.7	14	550	1.18	0.1	31360	0.08	58.54	11.2	10	4.63	69.5	2.49	1.43	1.03	3.03	16.57	3.15	0.97	1.91	0.01	0.5	0.033	24193	32.64	11.8	0.214	16589	760
Andesite Porphyry	L223	164.55	701-22-108	0.05	78650	1.6	14	771.1	1.05	0.04	28364	0.03	53.73	10.5	12	2.67	25.2	2.44	1.37	0.99	2.9	15.99	2.86	0.98	1.97	0.01	0.47	0.019	25123	29.68	10.2	0.199	15034	597
Andesite Porphyry	L223	170	701-22-109	0.05	83545	1.5	16	807.5	1.04	0.08	33866	0.04	65.42	9.4	8	2.59	31.2	2.51	1.41	1.14	2.63	15.8	3.19	0.82	1.56	0.01	0.49	0.013	26237	36.77	8.3	0.208	12438	526
Andesite Porphyry	L223	178.05	701-22-110	0.05	83748	0.9	14	824.9	1.48	0.18	32675	0.04	61.29	10	8	2.88	41.5	2.33	1.3	1.02	2.41	16.58	2.94	0.92	1.66	0.01	0.45	0.013	28304	34.25	10.2	0.199	13872	435
Andesite Porphyry	L223	184	701-22-111	0.1	71817	4.5	24	586.1	0.98	0.17	60694	0.71	73.87	8.9	8	5.76	154.1	2.74	1.46	1.25	3.12	13.93	3.35	0.9	1.26	0.01	0.53	0.041	25014	43.26	9.9	0.216	12201	1154
Andesite Porphyry	L223	191.95	701-22-112	0.05	80740	2.5	23	636.7	1.08	0.07	41901	0.17	56.91	10.8	11	7.84	71.1	2.49	1.43	1.07	3.35	16.26	3.11	0.91	1.56	0.01	0.49	0.041	27898	31.27	11.1	0.218	13776	1023
Andesite Porphyry	L223	198	701-22-113	0.05	81245	2.2	21	507.8	1.2	0.06	45287	0.31	60.57	11.3	12	6.75	61.8	2.3	1.35	0.99	2.91	16.41	2.98	0.99	1.66	0.01	0.47	0.027	28264	33.53	10.2	0.219	10280	759
Andesite Porphyry	L223	206.5	701-22-114	0.05	75323	1.1	17	347.6	1.08	0.11	49237	0.39	54.75	8.4	11	5.59	65.1	2.22	1.24	0.9	2.6	16.03	2.7	0.76	1.23	0.01	0.43	0.03	23675	30.6	8	0.187	9481	677
Andesite Porphyry	L223	212	701-22-115	0.16	68794	6.1	23	282.4	1.13	0.19	42055	0.24	57.94	13.8	17	5.78	185.1	2.44	1.42	0.95	3.09	16.27	3.04	0.64	1.3	0.01	0.49	0.064	19691	32.88	13.5	0.203	11685	670
Andesite Porphyry	L223	220.05	701-22-116	0.21	74328	3.9	19	479.7	1.18	0.25	30275	0.1	64.71	13.1	12	4.49	80.9	2.8	1.61	1.29	2.91	17.19	3.56	0.82	2.04	0.01	0.56	0.023	21700	35.49	14.2	0.241	12043	528
Andesite Porphyry	L223	231.2	701-22-117	0.05	65118	2.7	19	667.6	0.9	0.45	27343	0.04	47.57	13.2	9	10.2	42.8	2.3	1.33	0.94	2.78	16.21	2.66	0.8	2	0.01	0.46	0.034	21691	26.09	15.3	0.2	13673	508
Andesite Porphyry	L223	240.4	701-22-118	0.1	66653	8.6	10	2144.2	1.01	0.26	6170	0.29	56.7	22	11	4.4	218.4	2.26	1.25	1.01	7.14	14.69	2.87	0.71	1.91	0.01	0.44	0.091	21586	31.07	8.3	0.183	10615	2952
Fault Breccia	L223	244	701-22-119	0.06	91667	10.1	10	950.2	1.84	0.29	979	0.07	74.59	7.4	7	2.81	134.9	6.37	3.73	1.95	1.65	18.66	6.2	1.04	2.53	0.01	1.28	0.059	10260	41.13	19.8	0.464	2006	44
Andesite Porphyry	L223	319.3	701-22-120	0.05	89302	1.9	10	1539.6	1.49	0.36	614	0.02	81.83	2.6	4	2.27	18.9	2.82	1.83	1.08	1.08	18.56	3.2	1.15	2.2	0.01	0.6	0.032	11398	44.06	3.9	0.299	2413	40
Andesite Porphyry	L223	325.4	701-22-121	0.19	90018	6.15	10	97.65	1.295	0.455	228	0.02	63.59	1.9	3.5	1.39	48.45	2.175	1.22	1.06	0.96	17.1	2.77	0.765	1.785	0.01	0.41	0.0855	11185.5	35.555	8.9	0.184	1416.5	32.5
Fault Breccia	L223	340.3	701-22-122	0.12	80384	6.7	10	270.5	1.28	0.82	470	0.05	68.37	6.5	4	1.41	267.4	4.6	3.49	1.09	1.08	18.17	3.31	1.08	2.36	0.01	1.1	0.153	11425	36.31	10	0.487	1183	34
Pyroclastic	L087	6	701-22-123	0.44	28106	13.3	10	443.2	0.14	0.63	3117	0.02	44.42	0.5	13	0.09	8.6	0.85	0.44	0.53	1.77	3.25	1.39	0.99	1.07	0.01	0.14	0.005	10074	24.28	0.5	0.094	952	34
Pyroclastic	L087	16	701-22-124	0.94	5217	9.4	10	1500.7	0.21	1.85	1360	0.02	27.48	0.3	11	0.11	9.2	0.65	0.41	0.26	0.79	1.22	0.86	1.16	0.97	0.05	0.12	0.005	1079	15.71	1.2	0.088	229	45
Pyroclastic	L087	26	701-22-125	0.61	47574	25.1	10	500.1	0.11	1.26	799	0.02	50.78	0.2	20	0.07	5.9	0.8	0.37	0.9	3.57	8.23	1.87	0.79	0.97	0.04	0.13	0.009	14691	28.1	0.2	0.077	206	31
Pyroclastic	L087	36	701-22-126	0.19	52739	20.6	10	711.6	0.21	1.36	789	0.02	50.63	0.4	19	0.07	3.7	0.87	0.48	0.85	1.9	8.98	2.08	0.78	1.85	0.03	0.16	0.005	11898	27.44	0.3	0.123	97	36
Pyroclastic	L087	46	701-22-127	0.25	59191	11.7	10	469.4	0.05	1.45	779	0.02	46.09	0.1	18	0.07	3.3	0.97	0.48	0.7	1.49	13.59	2.23	0.93	1.13	0.02	0.15	0.005	7169	22.5	0.3	0.111	119	29
Andesite Porphyry	L087	56	701-22-128	0.33	48233	17	10	412.2	0.13	1.54	801	0.03	65.76	0.3	22	0.07	8.8	1.15	0.63	1.06	2.73	6.8	2.58	1	1.44	0.01	0.19	0.008	15787	35.72	0.4	0.134	130	33
Fault Breccia	L087	66	701-22-129	0.55	30118	18.5	10	531	0.14	2.49	549	0.03	53.81	0.2	17	0.07	22	1.07	0.56	0.93	2.07	4.31	2.28	1.13	1.24	0.01	0.17	0.005	10276	31.39	0.2	0.125	123	40
Andesite Porphyry	L087	76	701-22-130	0.68	40052	23.6	10	416.9	0.13	1.75	634	0.02	35.18	0.2	17	0.08	9.6	0.83	0.5	0.7	1.74	6.76	1.69	1.18	1.12	0.01	0.16	0.009	13256	19.02	0.4	0.107	124	35
Andesite Porphyry	L087	86	701-22-131	0.49	33322	68.4	10	657	0.09	1.65	441	0.02	43.72	0.5	25	0.06	50.5	0.41	0.28	0.55	10.32	11.88	1.19	1.95	0.71	0.02	0.08	0.101	12564	24.22	0.3	0.073	149	28
Andesite Porphyry	L087	96	701-22-132	0.29	60424	101.5	10	560.9	0.19	3.63	666	0.02	44.38	0.2	9	0.08	22.7	0.81	0.4	0.76	1.74	14.62	1.87	0.69	1.21	0.01	0.13	0.023	9907	25.62	0.5	0.12	115	18
Andesite Porphyry	L087	106	701-22-133	0.57	59684	9	10	472.4	0.27	2.25	680	0.02	57.82	0.5	8	0.26	373.2	1.29	0.64	0.86	2.21	14.5	2.4	0.43	1.12	0.01	0.22	0.042	7249	30.95	0.5	0.138	459	37
Andesite Porphyry	L087	116	701-22-134	0.37	44946	16.9	10	794.9	0.06	4.42	640	0.02	70.03	0.2	12	0.09	98.1	0.89	0.34	0.92	4.27	17.56	2.08	0.55	0.61	0.01	0.13	0.053	5455	43.05	0.7	0.065	104	76
Andesite Porphyry	L087	126	701-22-135	0.59	52352	10.1	10	669.5	0.18	1.42	814	0.02	59.48	0.2	14	0.17	65.6	0.65	0.34	0.82	4.78	9.52	1.76	0.64	0.93	0.01	0.11	0.063	7254	32.65	0.5	0.073	102	107
Andesite Porphyry	L087	134	701-22-136	0.46	67255	4.5	10	335.6	0.96	3.15	512	0.03	56.73	1	9	1.14	46.3	1.84	1.12	0.76	3.47	26.79	2.39	1.06	1.91	0.02	0.39	0.285	28050	32.43	0.8	0.203	1621	246
Andesite Porphyry	L087	144	701-22-137	0.22	95143	14.5	10	654.6	1.06	0.28	503	3.37	28.86	48.5	8	2.04	276.6	1.89	1.14	0.53	1.51	15.39	1.8	1.22	1.46	0.04	0.38	0.224	41916	17.95	3.6	0.185	2952	43
Andesite Porphyry	L087	158	701-22-138	0.23	96617	4	10	495	1.82	0.75	568	0.74	76.3	9.2	10	5.34	79.7	2.8	1.6	1.17	1.26	17.24	3.31	1.31	1.71	0.02	0.55	0.108	35059	44.42	13.9	0.231	3446	57
Andesite Porphyry	L087	170	701-22-139	0.07	111852	3.2	10	1325.7	1.43	0.07	421	0.04	109.8	5.1	11	4.13	19.8	4.09	2.17	1.87	1.3	21.2	5.32	1.35	2.19	0.01	0.77	0.037	22166	62.28	11.3	0.329	2179	45
Andesite Porphyry	L087	184	701-22-140	0.09	110558	3.1	10	310.5	1.18	0.1	343	0.07	90.87	27.7	8	3.45	15.4	2.42	1.17	1.35	1.61	19.66	3.57	1	1.97	0.02	0.42	0.039	29580	52.44	3.6	0.188	3028	38
Andesite Porphyry	L087	200	701-22-141	0.125	101364.5	4.9	10	556.35	1.155	0.095	485	0.25	84.315	7	9	2.48	295.95	1.37	0.75	1	1.435	18.56	2.355	1.235	1.775	0.01	0.255	0.0855	26519.5	45.91	5.55	0.1435	2745	50
Andesite Porphyry	L087	210	701-22-142	0.05	116648	3.2	10	1125.2	1.53	0.06	702	0.02	103.8	1.4	7	1.6	4.2	2.38	1.22	1.79	0.8	18.87	4.4	1.42	1.67	0.01	0.43	0.037	19819	54.69	6.7	0.22	1621	29
Andesite Porphyry	L087	216	701-22-143	0.44	98109	34.1	10	623.1	0.65	0.86	357	0.32	39.07	11.9	10	1.8	354.9	1.2	0.81	0.36	2.18	18.34	1.11	1.11	1.58	0.02	0.26	0.451	36433	26.77	3.1	0.15	2980	46
Andesite Porphyry	L087	252	701-22-144	0.07	67645	14.5	10	165.7	0.11	1.28	591	0.02	33.14	4.9	23	0.07	425.6	0.75	0.32	0.66	6.58	7.91	1.73	0.64	0.71	0.01	0.13	0.022	26027	17.96	0.4	0.054	134	20
Andesite Porphyry	L087	262	701-22-145	0.73	41737	54.9	10	56	0.05	8.1	447	0.04	25.31	6	17	0.05	3253.6	0.45	0.21	0.47	19.02	2.4	1.05	0.52	0.53	0.05	0.07	0.051	11699	12.34	0.2	0.048	55	61
Andesite Porphyry	L087	272	701-22-146	0.13	63754	25.7	10	275.4	0.15	1.04	451	0.06	38.76	9.4	21	0.08	998.9	0.63	0.31	0.61	5.58	8.56	1.41	0.79	0.95	0.01	0.1	0.087	13393	21.18	0.4	0.082	68	16
Andesite Porphyry	L087	292	701-22-147	0.23	86290	6.1	10	306.3	0.39	2.23	776	0.08	32.25	10.4	13	0.74	383.3	1.24	0.65	0.64	3.24	11.49	1.83	0.56	1.35	0.01	0.21	0.19	15714	19.17	0.9	0.122	754	38
Hydrothermal Breccia	L087	330	701-22-148	0.11	63098	44.2	10	115.6	0.05	0.29	544	0.03	40.1	18.5	30	0.05	1049.8	0.26	0.12	0.39	8.33	2.8	0.68	0.98	0.24	0.01	0.04	0.023	21676	22.22	0.3	0.024	70	19
Andesite Porphyry	L087	349.7	701-22-149	0.29	97095	13.1	10	597.4	0.86	2.39	526	0.04	58.4	10.9	14	1.67	339	1.3	0.81	0.61	2.26	17.4	1.73	1.16	1.94	0.02	0.26	0.332	32803	36.01	3.5	0.152	2423	81
Andesite Porphyry	L087	340	701-22-150	0.2	88653	9.4	10	120	0.18	2.02	744	0.21	55.7	13	16	0.41	368.3	1.42	0.64	1.03	5.14	13.63	2.83	1.33	1.51	0.01	0.23	0.081	2437	31.12	1.6	0.143	164	31

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	Geochemical Abundance Index			1.5	23000	20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Andesite Porphyry	LS001	25	701-22-001	1.25	1476.5	4.29	22.895	24.5	702	325.9	6.543	161.14	0.002	10301	0.37	9.4	0.9	3.79	0.7	76.335	0.365	0.4495	0.065	21.115	2255	1.845	0.16	3.625	84	2.1	9.31	1.095	64.5	54.05
Andesite Porphyry	LS001	59	701-22-002	2.3	303	3.55	23.19	11.4	608	51.9	6.65	135.1	0.002	2913	0.37	7.5	0.5	3.79	0.5	13.09	0.36	0.421	0.05	23.46	1619	1.6	0.24	4.58	81	1.8	14.15	1.54	542	48.3
Andesite Porphyry	LS001	65.5	701-22-003	2.7	295	2.64	19.96	12.4	668	30.9	4.971	140.1	0.007	57011	0.69	17	2.5	3.93	3.4	49.34	0.22	0.671	0.74	13.37	1927	1.73	0.43	6.56	124	1.6	25.17	2.94	425	38.2
Andesite Porphyry	LS001	89.25	701-22-004	1.4	346	3.25	28.11	6	869	167.9	7.626	138.6	0.002	42187	0.52	11	2.2	5.48	3.2	278.89	0.3	0.797	1.92	17.36	1558	1.78	0.4	5.48	107	2.3	25.63	2.58	50	44.4
Andesite Porphyry	LS001	122	701-22-005	1.4	365	4.08	26.68	3.9	130	9.9	7.392	151.77	0.002	5889	0.29	8	0.5	4.42	0.7	16.33	0.4	0.436	0.34	19.27	2020	1.93	0.2	4.34	87	2.6	14.5	1.42	158	48.4
Dyke	LS001	136.75	701-22-006	1.3	380	3.32	20.77	7	620	82.5	5.487	158.52	0.002	32511	0.32	11.8	1.9	4.09	0.9	175.07	0.3	0.633	1.08	18.07	1733	2.22	0.31	5.16	105	2.6	20.27	1.88	39	52.7
Dyke	LS001	185	701-22-007	1.5	589	1.92	24.15	31.4	922	415.5	5.695	2.99	0.003	169611	3.98	9.9	4.5	5.66	4.5	1065.68	0.17	0.439	1.63	12.23	1101	9.44	0.1	7.02	90	5.3	4.89	0.69	19	33.1
Dyke	LS001	221.65	701-22-008	2.5	1685	1.65	12.05	16	703	205.7	3.209	3.14	0.008	66532	1.1	13.6	2.1	2.5	2	352.6	0.14	0.23	1.09	11.13	1455	0.14	0.04	3.52	135	2.5	2.63	0.32	11	19
Andesite Porphyry	LS001	249.15	701-22-009	3.9	1196	1.98	21.48	3.8	533	124.5	5.763	125.49	0.022	17061	0.6	15.5	0.8	3.7	1.6	203.56	0.17	0.273	0.42	15.23	1959	1.61	0.09	3.5	134	2.5	3.7	0.5	17	33.6
Andesite Porphyry	LS001	290.75	701-22-010	2.2	822	1.69	13.61	7.3	374	103.3	3.69	90.37	0.002	37126	0.47	12.9	1.6	2.52	0.6	94.52	0.14	0.187	0.74	14.03	1082	1.12	0.06	3.27	96	1.8	3.15	0.49	13	26.1
Andesite Porphyry	LS001	304.05	701-22-011	2.2	819	2.21	16.51	21.7	537	106.8	4.5	8.25	0.002	86321	0.81	12.8	4.2	2.94	2.2	313.24	0.19	0.219	2.71	14.72	1512	0.15	0.07	5.89	114	5.5	3.51	0.54	8	42.4
Andesite Porphyry	LS001	368.85	701-22-012	2.2	1437	4.29	31.86	9.5	676	59.3	8.209	113.56	0.002	51858	0.68	14.4	6.6	7.39	1.9	414.61	0.36	1.228	3.35	24.11	2512	1.21	0.53	6.68	91	2.5	37.37	2.85	162	50.5
Andesite Porphyry	LS001	395	701-22-013	2.3	1072	4.37	28.72	3.9	466	10.4	7.722	114.42	0.002	22324	0.42	14.7	1.2	5.53	0.7	23.98	0.35	0.918	0.57	22.73	2970	1.54	0.41	4.9	104	2.5	27.21	2.28	24	64.7
Andesite Porphyry	LS001	411.1	701-22-014	181.9	1129	0.8	20.7	10.5	518	54.1	7.096	3.08	0.055	90545	2.03	8.2	6	3.18	6.5	421.95	0.07	0.213	1.21	11.2	546	0.7	0.03	3.25	88	5.7	2.14	0.23	23	6
Andesite Porphyry	LS001	423.5	701-22-015	48.8	1377	0.68	16.8	10.7	531	51.4	4.877	3.25	0.079	117410	1.75	4.6	6	2.62	13.3	553.05	0.07	0.078	0.35	10.71	457	0.08	0.01	0.65	88	5.1	0.8	0.08	9	3.6
Andesite Porphyry	LS002	94.3	701-22-016	13.2	710	1.58	13.49	7.2	589	15.8	4.047	79.18	0.107	20485	0.6	12.8	2.4	2.27	0.9	155.7	0.14	0.218	0.05	16.56	1369	0.84	0.09	2.01	119	1.4	6.55	0.69	19	18.9
Breccia	LS002	104.13	701-22-017	8.3	575	1.49	13.7	6.4	421	35	4.173	95.57	0.07	21817	0.47	11.6	3.2	2.29	0.8	91.6	0.14	0.226	0.06	15.08	1347	1.2	0.12	1.92	99	1.5	7.25	0.67	31	10.9
Andesite Porphyry	LS002	128.6	701-22-018	5.4	1093	1.29	20.22	8.1	427	18.4	5.561	91.47	0.049	18517	0.4	13.6	1.4	3.57	1.2	95.69	0.11	0.353	0.07	14.73	1143	1.12	0.13	3.27	104	1.9	9.06	0.79	46	9.4
Andesite Porphyry	LS002	148.4	701-22-019	3.8	1139	1.61	21.37	6.6	376	25.2	6.217	105.6	0.03	22178	0.56	11.4	1.7	3.57	1.7	87.22	0.13	0.387	0.06	16.01	1071	1.22	0.16	3.57	101	2.7	11.91	1.09	27	9.6
Diorite Porphyry	LS002	355.8	701-22-020	2.8	12422	2.89	19.67	11.2	502	14.2	5.319	83.44	0.01	4699	0.05	10.7	0.8	3.48	0.6	178.14	0.21	0.326	0.08	15.06	1931	0.74	0.12	1.29	95	0.5	8.38	0.77	1071	7.8
Andesite Porphyry	LS002	373	701-22-021	1.25	1196.5	2.955	28.09	11.75	808	157.25	7.401	94.665	0.009	26436.5	0.575	16.65	0.95	5.19	0.75	284.9	0.2	0.561	0.75	14	2806	1.215	0.23	1.67	144.5	0.75	17.575	1.47	631.5	7.55
Andesite Porphyry	LS002	422.5	701-22-022	2.6	1472	2.46	26.12	7.2	191	86	7.14	102.63	0.01	18431	0.26	11.9	1.4	4.65	1.5	62.43	0.2	0.455	0.16	19.33	2055	1.11	0.19	2.88	115	2.4	13	1.24	95	16.6
Andesite Porphyry	LS002	435.3	701-22-023	2.2	1551	3.82	26.6	6.5	284	54.3	7.285	99	0.016	14162	0.25	13	1.4	4.77	0.8	128.74	0.31	0.455	0.24	20.86	2824	1.2	0.2	2.96	121	2.1	13.2	1.1	298	27.2
Andesite Porphyry	LS002	448.85	701-22-024	2.4	1859	2.74	24.76	14.2	416	418	6.736	135.89	0.022	31865	0.62	11.9	1.7	4.46	0.9	176.09	0.22	0.543	0.35	19.53	2323	1.75	0.28	3.08	117	1.6	20.37	1.55	519	14.5
Andesite Porphyry	LS002	472.85	701-22-025	7.6	1255	3.57	34.32	6.6	880	17	9.189	70.98	0.037	6956	0.39	11.8	0.9	6.46	0.7	343.12	0.33	0.861	0.07	23.19	2539	0.78	0.48	2.91	116	2.3	31.06	3.69	185	23.9
Andesite Porphyry	LS003	21.3	701-22-026	1.6	624	1.65	15.83	1.1	624	68.7	4.422	114.14	0.002	6448	1.46	10.1	1.9	3.14	0.8	64.55	0.16	0.207	0.96	12.82	1068	1.44	0.09	3.16	93	0.6	4.47	1.18	34	48.5
Andesite Porphyry	LS003	70	701-22-027	1.4	655	2.99	20.53	9.5	441	126.9	5.807	149.69	0.007	29576	0.44	12.3	1	3.48	1.1	84.11	0.25	0.338	0.42	18.66	1893	1.86	0.17	4.17	106	1.1	10.21	1.41	243	53.6
Andesite Porphyry	LS003	74.3	701-22-028	1.4	205	2.41	11.41	7.3	143	16.4	3.21	88.98	0.002	6858	0.46	6.7	0.5	2.2	0.6	31.38	0.2	0.311	0.24	13.79	1585	1.13	0.11	3.09	71	0.6	6.32	0.79	448	39.3
Andesite Porphyry	LS003	97	701-22-029	0.5	449	1.55	10.73	7.7	379	65.7	2.917	132.8	0.002	26827	0.58	10.3	0.5	2.13	0.8	112.54	0.13	0.312	0.72	11.79	929	1.59	0.16	3.3	85	1.6	8.81	1	42	57
Andesite Porphyry	LS003	115.5	701-22-030	2	382	1.18	8.12	12.5	480	176.9	2.141	51.65	0.002	72205	0.67	8.7	1.8	1.84	1.7	110.9	0.1	0.23	0.6	11.91	664	0.7	0.11	3.82	76	1.1	5.57	0.8	19	35.9
Andesite Porphyry	LS003	131.7	701-22-031	1.2	310	3.2	10.43	13.4	323	15.4	2.718	98.69	0.002	16302	0.71	10.6	0.5	2.52	0.6	115.73	0.27	0.377	0.15	14.4	2070	1.27	0.17	4.2	90	1.1	8.68	1.14	36	64.4
Breccia	LS003	146.75	701-22-032	2	439	2.79	15.01	17.9	477	51.9	3.994	148.26	0.004	37881	1.76	11.8	0.9	2.67	1.1	149.7	0.21	0.275	0.51	14.09	1307	2.16	0.16	4.66	89	1.1	11.61	1.12	219	55.4
Diorite Porphyry	LS003	170.02	701-22-033	1.1	638	2.22	14.34	6.7	651	77	3.857	131.58	0.002	40301	0.56	11	0.9	2.4	1.1	93.73	0.19	0.274	0.64	13.13	1204	1.79	0.14	4.71	84	1.1	7.74	1.23	251	50.7
Diorite Porphyry	LS003	182.4	701-22-034	2.7	545	2.3	19.1	7.8	733	20	5.221	113.43	0.002	32716	0.49	8.7	0.9	3.7	0.7	287.25	0.19	0.621	0.69	14.62	1238	1.58	0.15	3.54	80	0.8	9.39	1.05	25	52.8
Diorite Porphyry	LS003	274.25	701-22-035	3	1580	1.59	17.59	31.1	454	90.6	4.524	11.44	0.006	107002	2.49	9.6	2.4	3.7	10.1	452.33	0.12	0.249	0.33	16.01	664	0.21	0.11	4.19	84	1.4	4.89	0.83	59	38.4
Diorite Porphyry	LS003	298.3	701-22-036	1.8	741	3.33	12.85	10.2	708	100.2	3.335	95.48	0.002	83613	0.85	13.8	2.4	2.99	4.6	230.14	0.24	0.336	0.81	12.13	1669	1.24	0.14	6.44	94	2.4	7.78	1.02	21	46.5
Diorite Porphyry	LS003	305	701-22-037	0.9	902	2.61	11.65	7.6	671	63	3.088	113.03	0.002	40639	0.63	14.3	0.7	3.31	1.3	130.84	0.18	0.301	1.32	11.99	1330	1.34	0.16	5.19	104	1.8	8.16	1.04	16	51
Breccia	LS003	324.8	701-22-038	3.9	969	1.47	10.84	13.1	394	33	3.067	98.89	0.005	84643	0.45	14.8	2.5	2.01	3	194.63	0.12	0.266	0.29	8.68	826	1.05	0.13	3.52	97	1.4	7.6	0.88	30	28.4
Andesite Porphyry	LS003	330.2	701-22-039	1.3	561	3.97	15.93	11.3	466	64.4	4.708	85.31	0.002	43426	0.46	20.7	0.8	2.96	0.6	214.29	0.32	0.45	0.66	20.14	2866	1.14	0.21	6.27	128	1.4	12.6	1.47	32	67.7
Diorite Porphyry	LS003	342.8	701-22-040	3.2	894	1.97	13.41	12.3	619	96.2	3.311	97.98	0.002	38595	0.39	11.4	1.3	2.74	1.2	240.09	0.2	0.276	0.82	11.97	919	1.25	0.1	5.33	84	2	5.11	0.76	141	45.7
Feldspar Porphyry	LS003	353.35	701-22-041	1.25	764	1.185	17.79	9	741	105.85	4.917	27.45	0.002	60052	0.46	9.05	2.45	3.155	1.15	444.495	0.085	0.2465	0.84	10.64	752.5	0.365	0.07	3.955	83	1.15	3.475	0.495	39.5	35.4
Andesite Porphyry	LS003	377.5	701-22-042	4.2	735	0.61	16.24	10.2	611	72.8	4.538	14.92	0.007	54322	0.61	8.3	1.8	2.72	2	595.91	0.04	0.17	0.27	8.82	340	0.17	0.03	3.43	75	3.2	1.99	0.24	168	20.4
Porphyry	LS003	394.75	701-22-043	2.1	1096	3.4	8.34	3.5	101	9.1	2.409	63.65	0.002	21159	0.51	14.8	0.5	1.54	0.9	25.26	0.29	0.201	0.2	16.59	2463	0.63	0.14	3.8	101	12.3	7.04	0.87	14	59.1
Porphyry	LS003	410.9	701-22-044	1.7	1087	3.25	7.54	10.7	146	11.3	2.235	29.44	0.002	38815	0.3	15.3	0.5	1.39	0.7	41.2	0.26	0.219	0.26	15.77	1990	0.28	0.14	4.44	93	1.8	7.57	0.99	14	50.3
Breccia	LS003	440.8	701-22-045	2.5	808	0.96	14.59	24.6	476	47.8	3.851	6.19	0.006	75010	2.74	5.8	2.2	2.67	11.6	667.21	0.07	0.189	0.55	15.01	241	0.2	0.06	1.76	60	1.8	3.59	0.36	17	14.1
Andesite Porphyry	LS004	30.21	701-22-046	1.7	612	3.91	18.72	17.4	580	232.3	5.174	146.99	0.003	42999	1.08	8.7	0.6	3.14	2	36.73	0.29	0.369	0.18	13.4	1859	1.69	0.16	3.1	75	8.3	8.83	1.11	2799	34.9
Andesite Porphyry	LS004	50.21	701-22-047	0.6	684	3.9	18.17	8.3	581	43.7	5.255	158.07	0.002	3389	0.42	8.6	0.5	2.97	0.7	31.32	0.3	0.334	0.05	13.83	2000	1.75	0.19	4.62	69	0.9	11.21	1.19	276	43.6
Andesite Porphyry	LS004	69.25	701-22-048	1.2	639	3.95	19.61	8.9	614	162.5	5.485	141.19	0.002	16643	0.79	9.9	0.5	3.31	0.6	18.71	0.29	0.264	0.05	13.52	2234	1.65	0.15	3.4	84	1	8	1.08	1703	49.5
Andesite Porphyry	LS004	110.45	701-22-049	1.3	670	3.32	15.13	8.6	667	96.1	3.954	163.07	0.002	45173	1.72	11.5	1.2	3.44	0.7	154.71	0.25	0.477	0.76	12.63	2084	2.11	0.25	3.53	95	2.4	15.16	1.66	150	64
Andesite Porphyry	LS004	134.45	701-22-050	2.4	530	4.33	16.18	33.2	849	219.8	4.376	3.55	0.002	87035	2.5	11.5	1.8	3.43	2.3	1186.83	0.29	0.301	1.51	14.02	2332	0.19	0.12	4.11	89	1.8	5.99	0.86	258	58.3
Diorite Porphyry	LS005	28.4	701-22-051	2.8	612	3.47	19.75	8.6	523	133.4	5.607	122.53	0.002	25389	0.65	10	1	3.47	0.6	228.61	0.27	0.38	0.33	19.34	2159	1.29	0.19	3.47	92	1.9	10.95	1.23	671	55.9
Diorite Porphyry	LS005	50.1	701-22-052	1.8	577	3.83	25.28	6.2	616	18	7.153	143.59	0.002	5441	0.4	9.2	0.5	4.13	0.5	63.7	0.35	0.423	0.16	22.48	1925	1.65	0.21	5.38	77	1.4	13.19	1.52	100	46.9
Breccia	LS005	72.5	701-22-053	1.6	738	3.93	26.63	7.6	725	607.6	7.336	138.75	0.002	27848	0.62	11.2	1.9	4.77	1	48.93	0.32	0.403	0.56	19.5	2592	1.72	0.19	4.12	118	1.1	11.62	2.36	1510	66.8
Breccia	LS005	133.9	701-22-054	6.7	1141	2.81	26.01	18.1	593	130.2	7.186	155.85	0.017	62521	1.45	11	2.7	4.79	2.3	82.79	0.22	0.516	1.43	14.08	1817	2.32	0.35	3.34	90	2.4	23.48	2.28	549	50.3
Diorite Porphyry	LS005	141.4	701-22-055	1.6	1197	4.08	26.17	6.4	752	21.2	7.331	135.82	0.002	10685	0.41	9.1	0.5	4.47	0.6	28.16	0.34	0.46	0.15	23.1	2286	1.47	0.23	4.88	88	1.1	14.49	1.63	78	61.6
Andesite Porphyry	LS006	34.3	701-22-056	1	707	4.24	18.42	4.1	71	25.1	5.599	154.37	0.005	15433	0.28	7.2	0.7	2.55	0.7	15.06	0.35	0.204	0.36	21.8	2255	1.74	0.13	4.37	64	1.3	7.17	0.98	32	56.8
Andesite Porphyry	LS006	52.3	701-22-057	2.9	879	3.74	33.06	15.5	346	95.4	9.099	102.53	0.002	20818	0.59	10.8	1.3	5.63	0.7	145.71	0.29	0.599	0.85	24.94	2055	1.16	0.42	6.05	106	1.1	25.23	2.95	55	53.9
Andesite Porphyry	LS006	70.3	701-22-058	1.8	630	4	38.47	9.5	383	35.6	9.782	95.69	0.002	15230	0.21	11.6	0.7	6.82	0.7	91.12	0.33	0.555	0.55	27.01	2293	0.97	0.31	6.36	96	1.5	17.71	2.14	38	58.6
Andesite Porphyry	LS006	127.6	701-22-059	1.2	747	3.78	25.28	9.2	567	332.9	7.198	135.76	0.002	14879	0.37	9.5	0.5	4.16	0.5	73.6	0.3	0.362	0.17	25.29	2133	1.56	0.19	8.01	89	1.6	11.08	1.41	1683	52
Breccia	LS006	140.4	701-22-060	1.2	881	3.3	31.48	11.4	1303	488.9	8.508	145.87	0.002	34099	0.48	11.8	0.8	5.68	0.6	877.78	0.27	0.511	0.65	24.97	2089	1.75	0.29	6.71	107	1.9	16.2	1.81	773	57
Porphyry	LK002	16.05	701-22-061	1	709.5	2.595	17.68	2.45	557	23.6	5.1365	132.01	0.002	17529.5	0.78	7.3	1.05	2.88	0.8	49.48	0.23	0.214	0.72	17.205	931	1.34	0.08	3.48	65	1.6	4.66	0.6	36.5	50.4
Andesite Porphyry	LK002	36.3	701-22-062	0.6	333	3.13	19.67	4	563	64.4	5.678	164.18	0.002	22547	0.69	7	0.5	3.34	0.7	48.24	0.29	0.256	0.29	17.01	1213	1.41	0.08	3.41	55	1.5	4.62	0.58	23	46.9
Breccia	LK002	113.6	701-22-063	2	531	2.36	18.03	30.4	662	111.6	5.1	4.5	0.005	91181	5.25	8.8	2.4	3.29	5	449.33	0.16	0.239	0.74	12.35	1206	0.44	0.09	2.94	91	2.6	4.38	0.63	23	34.7
Porphyry	LK002	133.3	701-22-064	2.4	1700	1.61	16.66	11	745	185.2	4.712	3.89	0.036	83916	1.75	8.6	1.6	2.83	3.4	182.67	0.13	0.208	0.36	9.9	919	0.06	0.11	2.81	88	1.6	2.52	0.4	8	43.2
Porphyry	LK002	167.3	701-22-065	2.7	1361	0.88	11.54	11.7	545	137.8	2.786	3.48	0.037	102161	1.26	8.2	2.7	2	2.5	222.33	0.07	0.133	0.33	8.4	552	0.07	0.03	1.75	80	1.6	1.62	0.2	9	15.9
Andesite Porphyry	LK003	40.3	701-22-066	0.6	391	3.42	18.8	26	486	89.3	5.331	117.48	0.006	23024	0.6	14.1	0.6	3.22	0.7	168.25	0.24	0.32	0.1	11.93	2655	1.82	0.15	2.45	129	4	8.22	0.94	2375	56.2
Breccia	LK003	54.9	701-22-067	1.5	365	5.78	21.89	28.6	142	52.8	6.579	129.11	0.002	35677	1.36	7	0.9	3.66	1.4	10.85	0.45	0.301	0.62	16.82	1925	1.89	0.16	3.49	56	1.6	8.37	1.13	1409	49.3
Breccia	LK003	108.6	701-22-068	1.8	699	3.73	17.21	30.6	350	70	5.231	109.43	0.003	58733	1.61	12.5	1.7	2.99	2.1	139.02	0.29	0.294	1.6	14.21	1723	1.65	0.15	4.15	84	2.1	7.88	0.95	450	40.9
Pyroclastic	LK003	128.7	701-22-069	1.9	621	5.34	22.8	50.8	394	53.4	6.147	164.51	0.002	25574	1.81	9.9	0.5	4.08	1.8	116.67	0.4	0.361	0.73	14.29	1891	2.37	0.15	2.97	75	2	8.43	1.17	1915	43.1
Tuff	LK003	145.6	701-22-070	1	539	5.34	16.85	30.6	254	32.2	4.789	155.31	0.002	24978	2.08	8.2	0.7	3.03	1.5	45.57	0.42	0.243	0.56	16.98	1757	1.9	0.15	3.7	61	1.9	7.42	1.06	644	52.8
Hornblende Porphyry	LK004	51.23	701-22-071	2.6	16162	4.58	23.6	5.7	648	10	6.663	92.3	0.002	974	0.15	8.1	0.5	4.01	0.5	271.54	0.36	0.42	0.05	18.17	2105	0.39	0.21	3.77	71	1.3	12.66	1.49	66	62.4
Breccia	LK004	71.63	701-22-072	1.3	3933	3.81	25.98	8.7	726	24	7.299	104.31	0.002	7516	0.33	10.1	0.5	4.5	0.7	107.46	0.31	0.394	0.08	19.2	2239	0.91	0.19	4.95	86	1.5	12.1	1.38	186	50.5
Breccia	LK004	81.52	701-22-073	1.3	1324	3.64	19.36	15.5	663	49.6	5.434	146.48	0.002	14544	0.53	8.9	0.5	3.32	0.5	42.15	0.27	0.368	0.11	12.88	1855	1.57	0.18	3.24	74	1.3	12.08	1.22	329	44.6
Andesite Porphyry	LK004	104.71	701-22-074	1.9	943	3.58	21.6	13.2	837	426.7	6.079	161.45	0.002	42389	2.64	9.6	1.4	3.62	1.1	37.67	0.26	0.316	0.99	13.9	1974	2.97	0.15	3.65	81	2.3	9	1.04	3221	44.1
Diorite Porphyry	LK004	137.51	701-22-075	2.6	686	5.54	20.15	8.4	677	137.8	6.229	144.53	0.002	36784	5.54	4.1	2	3.91	0.7	195.29	0.42	0.682	1.1	22.29	1232	4.49	0.3	4.54	32	3	20.54	2.21	184	39.5
Breccia	LK006	45.2	701-22-076	0.6	243	4.13	29.21	242.5	1282	71.7	7.54	158.97	0.002	150590	9.17	23	1.4	5.85	0.9	35.03	0.25	0.839	0.42	9.87	3194	3.38	0.25	2.27	118	2.2	16.95	1.58	83	71.5
Andesite Porphyry	LK006	51.8	701-22-077	1.6	289	4.02	18.35	17.1	463	39	5.169	139.72	0.002	22594	1.6	15.9	0.5	3.39	0.6	60.85	0.3	0.818	0.05	14.91	3276	1.86	0.23	4.06	118	1.3	12.15	1.61	1218	74.1
Andesite Porphyry	LK006	129.7	701-22-078	1.2	366	7.11	25.52	32.7	1001	135.8	6.759	167.61	0.002	45232	9.53	11.5	1.2	5.08	2	426.93	0.42	0.511	0.48	15.69	2723	2.88	0.22	5.53	97	4.5	12.74	1.59	175	74
Breccia	LK006	145.7	701-22-079	1.9	418	5.74	22.2	47.4	713	194.4	6.533	138.62	0.003	45316	3.54	13.1	1	4.35	4.3	438.73	0.36	0.443	0.74	17.78	2166	1.82	0.2	5.54	95	2.4	10.7	1.46	408	73.5
Diorite Porphyry	LK006	165.86	701-22-080	1.4	691	2.02	8.58	11.2	637	127.2	2.237	84.51	0.002	42387	1.27	10.7	1.9	1.9	3.2	386.94	0.15	0.221	0.5	8.61	1257	0.94	0.08	4.3	91	1.2	3.24	0.45	65	31.8

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	Geochemical Abundance Index			1.5	23000	20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Tuff	LK006	191.35	701-22-081	1.2	882.5	8.555	22.37	96.1	352	143.35	5.875	120.07	0.002	69346.5	2.73	12.2	1.1	4.025	5.2	282.99	0.605	0.28	1.46	15.57	3167.5	1.27	0.13	3.35	94	3	5.92	0.975	17	47.9
Pyroclastic	LK006	214.6	701-22-082	1.8	785	6.87	19.4	9	623	330.3	5.527	56.03	0.002	46295	2.9	6.9	1.1	3.47	3.8	311.82	0.51	0.241	0.41	26.84	1332	0.62	0.11	7.69	52	3.3	4.97	0.92	12	44.3
Andesite Porphyry	L013	5	701-22-083	4.6	494	4.3	18.21	9.7	195	35.3	5.494	75.03	0.019	8179	0.17	14.4	0.5	2.58	0.9	83.32	0.36	0.195	0.1	16.47	2431	0.89	0.06	2.59	89	1.9	4.66	0.52	42	30.7
Andesite Porphyry	L013	11	701-22-084	10.3	799	2.74	15.86	6.5	880	65.3	4.423	60.67	0.018	19101	0.14	17	1.3	2.97	0.8	158.93	0.27	0.249	0.28	18.02	1819	0.7	0.08	2.58	230	1.5	7.11	0.49	52	24.5
Andesite Porphyry	L013	17.7	701-22-085	7.9	708	3.43	12.41	3.1	278	205.8	3.845	96.6	0.014	12568	0.2	11.8	4.3	1.78	1.5	68.63	0.3	0.142	0.34	10.46	2015	1.15	0.06	3.96	120	1.4	3.11	0.38	25	24.4
Andesite Porphyry	L013	23.4	701-22-086	7.2	679	2.91	23.02	5.3	304	40.7	7.33	98.33	0.007	11426	0.19	10.5	2.1	3.13	1.3	64.67	0.26	0.172	0.16	21.19	1913	1.13	0.05	3.3	112	1.4	3.15	0.32	28	13.8
Andesite Porphyry	L013	28.9	701-22-087	6	851	3.47	18.58	7.8	202	39	5.998	90.05	0.03	16433	0.16	16.4	0.6	2.48	1.1	52.02	0.3	0.164	0.08	19.59	2066	0.98	0.05	1.97	100	2.4	3.82	0.35	24	13.1
Andesite Porphyry	L013	34.9	701-22-088	13.2	1007	2.57	12.06	2.3	580	25.3	4.157	79.31	0.005	26759	0.32	14.1	2.2	1.86	1	148.11	0.25	0.254	0.38	22.15	1792	0.94	0.12	1.56	86	4.8	7.86	0.66	27	16.4
Andesite Porphyry	L013	41.25	701-22-089	7.7	1219	2.72	10.91	2.5	527	18.6	3.384	100.99	0.003	28568	0.26	20.6	1.9	1.88	1.1	144.14	0.23	0.26	0.3	12.08	1806	1.15	0.11	1.35	128	2.4	8.29	0.78	27	11.9
Andesite Porphyry	L013	47.7	701-22-090	7.4	784	2.83	13.18	2.4	186	68.6	3.855	96.16	0.003	10001	0.35	11	2.4	2.04	2.2	57.61	0.22	0.221	0.87	17.16	2077	1.32	0.08	2.3	105	2.6	6.02	1.08	15	10.8
Andesite Porphyry	L013	52.9	701-22-091	9.6	834	3.16	14.22	4.4	527	38.1	4.038	82.68	0.007	13146	0.15	10.8	4	2.42	1.6	148.85	0.26	0.234	0.12	12.72	2190	1.02	0.07	1.55	87	1.9	5.18	0.47	28	9.2
Andesite Porphyry	L013	58.8	701-22-092	4.2	764	3.2	15.1	2.1	266	151.6	4.453	117.82	0.002	10053	0.29	8.1	1.1	2.35	1.1	113.25	0.26	0.214	0.93	21.82	1897	1.67	0.1	2.69	87	2.1	6.05	0.97	15	38
Andesite Porphyry	L013	69	701-22-093	18.9	718	2.65	14.07	1.7	439	19.6	4.104	117.92	0.007	10229	0.15	8.6	1.4	2.21	1.3	60.26	0.24	0.377	1.57	17.38	1638	1.63	0.11	1.89	93	1.7	8.29	0.65	18	9.5
Hydrothermal Breccia	L013	75	701-22-094	2.7	4187	3.44	32.76	1.8	1297	157.9	9.213	3.95	0.004	42213	2.26	6.6	7.8	6.06	7.2	1017.44	0.27	0.386	0.34	26.72	2505	0.05	0.08	4.05	91	4.1	5	0.5	5	29.6
Hydrothermal Breccia	L013	81.9	701-22-095	9.7	4484	1.07	29.19	1.5	1297	189.1	8.441	4.46	0.004	46556	0.82	6.2	18.8	4.97	2	792.98	0.09	0.299	0.87	24.41	671	0.04	0.06	3.55	85	2.1	3.83	0.59	7	16.2
Hydrothermal Breccia	L013	86.55	701-22-096	4.7	5133	2.88	30.4	1.5	1169	240.6	9.372	3.81	0.004	47839	1.06	6.7	12.4	4.26	2.7	731.77	0.23	0.237	0.52	26.36	1712	0.04	0.05	3.15	84	2.8	3.53	0.31	5	17.6
Fault Breccia	L013	93.25	701-22-097	10.1	774	0.97	41.69	3	1685	209.4	10.231	5.4	0.004	17410	1.74	6.3	10	9.13	1.5	1704.67	0.07	0.517	1.88	27.31	659	0.08	0.05	8.58	109	2.9	4.17	0.31	15	19.9
Hydrothermal Breccia	L013	100.4	701-22-098	6	3701	1.1	34.42	0.8	1426	247.5	9.949	2.72	0.004	45201	2.66	7.6	29.8	6.57	3.3	1009.31	0.09	0.656	3.73	26.59	560	0.02	0.06	5.38	90	1.5	5.67	0.32	16	7.6
Andesite Porphyry	L013	127.55	701-22-099	12.5	2010	0.96	22.52	8.8	392	10.6	6.215	91.48	0.087	25032	0.17	10.6	2.3	4.19	1.3	209.43	0.09	0.482	0.22	19.59	901	1.48	0.16	3.42	88	1.5	11.31	1.01	25	37.2
Andesite Porphyry	L013	177.05	701-22-100	6.9	1161	0.98	19.76	13.3	786	26.5	6.103	37.88	0.085	46826	0.27	4.9	6.9	2.69	3.2	465.23	0.1	0.14	0.31	21.17	650	0.56	0.04	2.3	77	4.2	2.41	0.26	10	18.4
Andesite Porphyry	L013	199.75	701-22-101	4.5	1543.5	1.415	17.79	9.75	627.5	47.65	5.3305	106.865	0.041	52430	0.38	8.15	4.9	2.96	1.6	196.805	0.13	0.2305	0.735	22.52	834.5	1.83	0.195	3.755	63	1.2	6.225	1.38	20	38.1
Fault Breccia	L223	121.75	701-22-102	1.7	569	2.2	15.15	11.4	708	53.2	4.079	39.82	0.01	63045	0.84	8.7	2.5	2.84	2.1	482.74	0.18	0.246	1.47	11.44	1589	0.53	0.11	4.29	78	2.3	7.83	0.82	17	44.3
Andesite Porphyry	L223	131	701-22-103	1.2	708	2.55	22.5	26.3	480	17	6.325	91.46	0.007	38605	0.61	9.7	1.8	3.84	2.6	318.02	0.25	0.394	0.46	14.69	1494	1.1	0.15	4.8	87	1.2	7.7	1.01	94	43.8
Andesite Porphyry	L223	137	701-22-104	1.9	1460	4.25	28.32	11.7	651	15.5	7.295	105.51	0.003	4294	0.31	13.9	0.6	5.92	1.1	58.04	0.35	0.743	0.4	18.33	2922	1.09	0.35	4.42	117	1.5	22.58	2.29	452	91
Andesite Porphyry	L223	142.1	701-22-105	1.6	1262	4.2	23.92	8.2	733	16.5	6.562	111.81	0.003	13244	0.51	10.7	0.5	4.34	1.5	23.89	0.35	0.458	0.84	18.47	2702	0.81	0.23	5.4	103	1.7	14.33	1.6	74	86.2
Andesite Porphyry	L223	150	701-22-106	4.1	21636	3.99	22.7	6.5	619	9.4	6.171	86.41	0.002	11382	0.13	11.7	0.7	3.99	0.6	342.38	0.31	0.433	0.05	16.36	2651	0.49	0.21	3.62	103	1.3	13.46	1.4	42	70.5
Andesite Porphyry	L223	156	701-22-107	5.1	19585	4	22.47	5.6	645	9.2	6.135	71.47	0.002	7493	0.26	11.6	0.5	3.99	0.6	303.81	0.31	0.425	0.25	16.19	2590	0.44	0.21	3.45	102	1.7	13.06	1.33	33	71
Andesite Porphyry	L223	164.55	701-22-108	3.9	23723	3.91	20.6	6.2	595	7.3	5.698	63.44	0.003	391	0.13	10.7	0.5	3.73	0.4	401.43	0.32	0.42	0.05	15.55	2457	0.36	0.2	3.3	97	1.8	11.81	1.33	24	56.9
Andesite Porphyry	L223	170	701-22-109	3.8	23048	4.2	24.16	6.1	630	5.1	6.763	71.21	0.003	213	0.24	10.9	0.6	4.18	0.5	371.97	0.32	0.438	0.05	16.49	2525	0.37	0.21	3.38	88	2.2	12.87	1.4	22	55
Andesite Porphyry	L223	178.05	701-22-110	2.1	22177	4.1	23.14	5.7	681	4.9	6.265	79.73	0.003	421	0.2	11.4	0.5	3.98	0.5	354.98	0.32	0.399	0.05	16.7	2526	0.36	0.2	3.86	93	2.5	11.96	1.31	23	63.1
Andesite Porphyry	L223	184	701-22-111	8.1	8201	3.29	26.3	6	613	16.8	7.388	68.04	0.003	966	0.18	9.8	0.8	4.43	1.1	167.06	0.26	0.477	0.1	14.45	2112	0.45	0.21	3.29	84	2.6	13.76	1.41	73	40.8
Andesite Porphyry	L223	191.95	701-22-112	4.1	10930	3.86	21.97	7.2	627	10.6	5.917	89.2	0.004	655	0.14	13.2	0.5	3.95	1	227.9	0.29	0.423	0.05	15	2836	0.59	0.2	3.1	111	1.9	12.59	1.31	56	51.5
Andesite Porphyry	L223	198	701-22-113	2.8	2831	4.12	22.85	6	675	6.7	6.264	95.27	0.002	965	0.19	10.5	0.5	3.89	0.5	79.63	0.32	0.397	0.05	17.14	2490	0.69	0.2	2.71	92	1.1	11.86	1.41	56	54.2
Andesite Porphyry	L223	206.5	701-22-114	5.3	14640	4.09	20.3	6.1	615	8	5.66	59.35	0.005	316	0.14	9.9	0.5	3.63	0.5	152.79	0.33	0.391	0.05	14.6	2431	0.41	0.18	2.94	92	1.6	10.7	1.3	44	38.8
Andesite Porphyry	L223	212	701-22-115	48.7	10375	3.89	21.94	9.6	583	29.3	6.034	65.77	0.016	2737	0.33	11.6	0.5	3.98	1	159.5	0.3	0.441	0.05	15.3	2117	0.42	0.22	3.52	81	2.3	12.85	1.37	74	39.2
Andesite Porphyry	L223	220.05	701-22-116	6	17734	3.94	24.96	5.3	568	19	6.748	77.81	0.002	4697	0.23	13.6	0.5	4.6	0.8	313.55	0.31	0.479	0.35	16.25	2436	0.44	0.23	3.61	97	2.7	14.94	1.49	41	68.1
Andesite Porphyry	L223	231.2	701-22-117	4.5	17118	3.88	18.27	5.3	505	4.7	5.027	75.64	0.003	4154	0.25	11.4	0.5	3.52	0.6	341.74	0.3	0.406	0.19	12.77	2290	0.49	0.2	3.26	95	1.5	11.61	1.42	30	66.1
Andesite Porphyry	L223	240.4	701-22-118	2.5	9704	3.38	21.98	12.3	543	14.1	5.892	86.41	0.004	14538	0.39	11.1	0.9	3.92	1.5	176.44	0.3	0.415	0.32	15.01	2035	0.61	0.19	3.51	90	1.4	10.92	1.28	601	74
Fault Breccia	L223	244	701-22-119	1.4	961	4.11	32.63	3.1	975	51.1	8.261	49.82	0.003	10730	0.64	16.1	0.7	6.56	1.6	628.18	0.34	0.96	0.31	19.32	2320	0.46	0.52	4.55	117	2.5	34.07	3.27	62	95.6
Andesite Porphyry	L223	319.3	701-22-120	1.5	1485	5.18	31.27	0.7	547	15.4	8.549	51.13	0.002	3754	0.36	9.2	0.5	5.09	0.6	194.12	0.41	0.464	0.2	21.91	1856	0.27	0.33	5.48	84	1	16.57	2.06	34	68.5
Andesite Porphyry	L223	325.4	701-22-121	1.1	712.5	5.05	22.585	1	153	19.15	6.391	55.545	0.002	5225	0.51	5.8	0.5	3.98	0.8	40.21	0.41	0.3875	0.14	22.235	1924	0.325	0.175	3.67	44.5	1.05	11.1	1.22	20	50.4
Fault Breccia	L223	340.3	701-22-122	1.5	663	4.75	27.49	3.1	530	50.5	7.444	52.21	0.002	9578	1.05	8.4	0.5	4.44	1	369.97	0.39	0.596	0.06	20.6	2039	0.37	0.49	16.98	55	1.5	38.62	3.07	27	78.5
Pyroclastic	L087	6	701-22-123	4.3	1071	1.43	16.05	1.6	405	71.1	4.573	1.97	0.002	19034	3.63	3.7	3.9	2.43	10.6	249.34	0.13	0.169	0.26	11.64	626	0.02	0.07	2.62	34	5.1	3.78	0.5	4	32.5
Pyroclastic	L087	16	701-22-124	2.3	417	1.34	9.76	0.7	192	101.5	2.826	2.06	0.002	1955	3.35	1.8	5.7	1.42	5.9	123.17	0.1	0.107	0.09	9.26	690	0.02	0.07	2.12	8	5.6	3.11	0.51	5	33.2
Pyroclastic	L087	26	701-22-125	4.3	1815	1.2	19.91	1.4	552	146.7	5.343	1.84	0.002	29384	1.53	5.2	1.8	3.21	7.6	338.37	0.11	0.186	0.14	13.13	551	0.02	0.07	3.02	54	2.4	3.09	0.52	4	29.4
Pyroclastic	L087	36	701-22-126	4.4	1468	2.78	18.85	0.5	582	137.7	5.278	1.56	0.002	22510	4.34	8	0.8	3.1	4.3	185.87	0.23	0.224	0.16	13.89	1390	0.02	0.09	3.65	53	3.8	3.66	0.71	2	53.7
Pyroclastic	L087	46	701-22-127	5.3	1233	2.37	18.04	0.5	620	300.2	4.817	1.29	0.002	14386	2.9	8.1	1	3.31	3.8	237.45	0.19	0.236	0.19	16.07	1023	0.02	0.08	4.26	71	1.9	3.79	0.62	3	36.3
Andesite Porphyry	L087	56	701-22-128	3.9	1965	2.69	25.8	0.5	598	149.3	7.126	1.98	0.002	30423	2.72	6.2	5.5	4.33	8.6	394.6	0.24	0.257	0.31	16.07	1409	0.02	0.11	4.2	89	6.2	4.88	0.92	4	46.1
Fault Breccia	L087	66	701-22-129	4.9	1141	1.69	20.6	1.5	517	100.8	6.013	1.71	0.002	19794	2.92	3.7	3.2	3.62	8.5	520.91	0.16	0.253	0.36	13.92	785	0.02	0.1	3.92	43	6.7	4.6	0.85	5	43
Andesite Porphyry	L087	76	701-22-130	5.4	1718	1.6	15.02	0.5	517	116	4.221	1.85	0.002	25873	7.63	4.9	5.1	2.53	13.1	560.48	0.15	0.182	0.33	13.24	816	0.03	0.08	3.32	57	6.2	3.96	0.65	3	37.6
Andesite Porphyry	L087	86	701-22-131	3.1	1456	0.92	15.54	0.8	470	121.8	4.424	2	0.002	24534	3.13	3.8	5.3	2.31	4.8	380.29	0.08	0.11	0.78	12.78	318	0.02	0.05	2.58	76	2.8	2.1	0.35	4	23.4
Andesite Porphyry	L087	96	701-22-132	7.9	993	2.34	15.81	0.5	589	143.3	4.439	2.5	0.002	18329	5.15	6.2	1.4	2.82	2.2	189.88	0.23	0.199	8.89	19.49	795	0.04	0.07	3.94	72	1.6	3.08	0.73	2	42.6
Andesite Porphyry	L087	106	701-22-133	2.4	632	1.74	20.36	1.3	584	76.4	5.807	15.41	0.002	8216	0.72	6.8	3.9	3.51	1.7	173.53	0.15	0.279	0.41	18.51	696	0.18	0.11	4.08	61	0.9	6.14	0.84	18	36.5
Andesite Porphyry	L087	116	701-22-134	2.5	937	0.99	22.42	0.5	784	160.9	6.625	1.75	0.003	11383	3.55	4.6	3.5	3.53	4.8	527.27	0.1	0.213	0.68	24.88	508	0.04	0.05	3.96	58	1.4	2.91	0.41	6	21.9
Andesite Porphyry	L087	126	701-22-135	1.7	2035	0.83	21.97	0.5	792	124.4	6.059	2.64	0.002	17192	1.19	6.3	4.2	3.3	1.8	576.39	0.09	0.161	0.37	19.68	301	0.04	0.06	2.85	65	0.9	2.86	0.46	7	30
Andesite Porphyry	L087	134	701-22-136	1.5	391	3.25	19.27	0.7	515	37.4	5.505	110.84	0.002	1126	0.62	10.6	0.5	3.33	1.4	709.9	0.29	0.41	0.52	25.25	1496	1.01	0.19	5.78	93	1.6	9.79	1.67	17	60.4
Andesite Porphyry	L087	144	701-22-137	1.4	478	2.9	9.58	11.9	627	252.2	2.785	123.21	0.006	26473	0.31	13.7	0.5	1.79	0.5	129.28	0.25	0.301	0.22	19.99	1576	1.44	0.21	6.78	103	1.8	10	1.24	368	48.3
Andesite Porphyry	L087	158	701-22-138	1.4	460	4.08	27.11	3.9	480	56.9	7.61	140.88	0.002	7422	0.26	9.9	0.5	4.43	0.8	89.43	0.32	0.492	0.19	25.26	2334	1.38	0.24	4.98	88	1.3	13.94	1.57	194	50.7
Andesite Porphyry	L087	170	701-22-139	1.4	454	4.92	40.86	1.8	408	18.6	11.334	87.11	0.002	7696	0.29	14.3	0.5	7	0.8	120.71	0.4	0.744	0.05	32.63	3217	0.69	0.31	5.36	125	2.4	18.33	2.25	35	71.3
Andesite Porphyry	L087	184	701-22-140	1.2	435	4.38	32.23	6	287	25.1	9.102	117.2	0.002	12440	0.22	10.3	0.5	5.24	0.6	81.29	0.35	0.461	0.2	28.69	2475	0.86	0.17	5.4	90	1.4	9.69	1.22	29	59.9
Andesite Porphyry	L087	200	701-22-141	1.6	477	3.67	31.44	4.95	515.5	64.05	8.877	99.85	0.002	12217	0.51	8.45	0.5	4.625	0.55	123.605	0.305	0.2625	0.125	28.59	2060	0.995	0.12	5.315	79	1.35	5.93	0.89	39.5	51
Andesite Porphyry	L087	210	701-22-142	0.6	383	3.6	43.44	4	1214	9.3	11.54	69.96	0.002	903	0.21	9.3	0.5	7.68	0.5	131.86	0.32	0.49	0.05	27.88	1991	0.69	0.18	3.54	89	1	9.99	1.31	37	48.8
Andesite Porphyry	L087	216	701-22-143	1.8	762	3.54	11.18	7	287	181.7	3.527	111.76	0.003	29401	0.62	11.7	1.3	1.52	0.8	67.83	0.3	0.181	0.6	23.4	2074	1.18	0.13	4.61	94	1.6	6.85	0.95	87	46.4
Andesite Porphyry	L087	252	701-22-144	1.4	2620	2	13.82	1.8	654	173.7	3.807	2.73	0.003	114418	0.87	6.3	1	2.42	1.4	548.88	0.16	0.195	0.2	8.05	1396	0.04	0.04	2.64	74	4.1	2.85	0.37	5	23.7
Andesite Porphyry	L087	262	701-22-145	1.3	1705	1.51	9.08	4.5	363	82.2	2.489	2	0.002	220491	2.22	2.2	2.7	1.63	5.2	209.14	0.13	0.104	0.77	6.95	600	0.1	0.04	1.56	37	4.3	1.77	0.31	6	17.5
Andesite Porphyry	L087	272	701-22-146	1.4	2150	2.25	14.35	8.3	506	51.2	4.059	1.68	0.002	85164	2.54	6.2	1.5	2.24	3.9	562.61	0.21	0.15	0.7	12.25	958	0.06	0.05	3.07	68	2.1	2.68	0.46	3	30.7
Andesite Porphyry	L087	292	701-22-147	2	845	2.91	11.52	8.2	705	54.7	3.233	38.16	0.002	39914	0.75	8.2	3	2.16	1.3	329.72	0.25	0.226	1.3	22.25	1674	0.48	0.1	4.94	98	1.6	5.47	0.74	18	40
Hydrothermal Breccia	L087	330	701-22-148	46.8	2568	0.65	14.07	14.6	574	70	4.072	2.22	0.044	124586	1.55	7.6	2.4	1.63	5.5	451.39	0.05	0.06	0.48	11.55	405	0.07	0.02	0.88	73	2.7	1.11	0.16	3	7
Andesite Porphyry	L087	349.7	701-22-149	1.9	550	4.3	17.29	10.6	290	68.4	5.368	115.42	0.003	22144	1.16	9.5	1.2	2.54	0.8	109.22	0.54	0.226	1.08	25.83	2569	1.38	0.13	5.02	80	2.2	6.84	0.93	33	58.1
Andesite Porphyry	L087	340	701-22-150	1.4	626	4.08	22.32	13	727	22.2	5.82	3.17	0.002	53792	1.35	10.2	2.3	4.06	2.2	367.62	0.35	0.316	0.9	23.72	2301	0.3	0.1	6.99	104	6.8	5.22	0.73	13	49.3

APPENDIX D

Geochemical Abundance Index Results

Knight Piésold CONSULTING

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Andesite Porphyry	LS001	25.00	701-22-001	3	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0
Andesite Porphyry	LS001	65.50	701-22-003	3	0	2	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	89.25	701-22-004	3	0	2	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	136.75	701-22-006	3	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	185.00	701-22-007	3	0	6	0	0	0	6	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
Dyke	LS001	221.65	701-22-008	1	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS001	290.75	701-22-010	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	3	0	2	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	3	0	1	0	0	0	6	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	2	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	2	0	5	0	0	0	5	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	4	0	0	0	4	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	LS002	94.30	701-22-016	1	0	0	0	1	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Breccia	LS002	104.13	701-22-017	1	0	3	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	2	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	148.40	701-22-019	1	0	3	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS002	355.80	701-22-020	1	0	0	0	1	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	LS002	373.00	701-22-021	4	0	3	0	0	0	4	0	3	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0
Andesite Porphyry	LS002	422.50	701-22-022	2	0	1	0	0	0	3	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	1	0	1	0	0	0	3	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	448.85	701-22-024	4	0	4	0	0	0	3	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	472.85	701-22-025	1	0	1	0	1	0	1	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	21.30	701-22-026	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	1	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	74.30	701-22-028	1	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	97.00	701-22-029	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	1	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	3	0	4	0	0	0	4	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	170.02	701-22-033	2	0	3	0	0	0	5	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	182.40	701-22-034	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	2	0	4	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	1	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	2	0	2	0	0	0	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	330.20	701-22-039	2	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Feldspar Porphyry	LS003	353.35	701-22-041	1	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	3	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	4	0	4	0	0	0	3	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS004	69.25	701-22-048	1	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	110.45	701-22-049	3	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	4	0	4	0	0	0	5	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0
Diorite Porphyry	LS005	28.40	701-22-051	2	0	2	0	0	0	4	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	4	0	1	0	0	0	5	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0
Breccia	LS005	133.90	701-22-054	4	0	4	0	0	0	5	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS006	34.30	701-22-056	1	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	1	0	4	0	1	0	3	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	1	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	2	0	1	0	0	0	1	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0
Breccia	LS006	140.40	701-22-060	3	0	3	0	0	0	4	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Porphyry	LK002	16.05	701-22-061	2	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	3	0	5	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	133.30	701-22-064	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	1	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK003	54.90	701-22-067	4	0	3	0	0	0	5	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK003	108.60	701-22-068	4	0	4	0	0	0	6	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Pyroclastic	LK003	128.70	701-22-069	3	0	3	0	0	0	5	0	5	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Tuff	LK003	145.60	701-22-070	3	0	3	0	0	0	4	0	4	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	1	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Breccia	LK004	81.52	701-22-073	1	0	3	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Andesite Porphyry	LK004	104.71	701-22-074	4	0	6	0	0	0	5	0	6	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0
Diorite Porphyry	LK004	137.51	701-22-075	5	0	5	0	0	0	5	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK006	45.20	701-22-076	4	0	6	0	0	0	3	0	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	1	0	2	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	129.70	701-22-078	3	0	6	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0
Breccia	LK006	145.70	701-22-079	4	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LK006	165.86	701-22-080	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	3	0	4	0	0	0	6	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	2	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	2	0	1	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	11.00	701-22-084	2	0	2	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	17.70	701-22-085	1	0	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	23.40	701-22-086	1	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	28.90	701-22-087	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	34.90	701-22-088	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0
Andesite Porphyry	L013	41.25	701-22-089	1	0	1	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	47.70	701-22-090	2	0	4	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	52.90	701-22-091	1	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	58.80	701-22-092	4	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	69.00	701-22-093	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Hydrothermal Breccia	L013	75.00	701-22-094	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	6	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	86.55	701-22-096	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L013	93.25	701-22-097	2	0	5	0	0	0	6	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	100.40	701-22-098	6	0	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	1	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	2	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	199.75	701-22-101	2	0	5	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Fault Breccia	L223	121.75	701-22-102	3	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	3	0	3	0	0	0	5	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	1	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	L223	142.10	701-22-105	2	0	2	0	0	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	1	1	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	212.00	701-22-115	1	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L223	220.05	701-22-116	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	2	0	2	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Fault Breccia	L223	244.00	701-22-119	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	1	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	2	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	2	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	16.00	701-22-124	3	0	2	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	3	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	36.00	701-22-126	1	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	46.00	701-22-127	1	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	56.00	701-22-128	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L087	66.00	701-22-129	2	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	76.00	701-22-130	3	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	86.00	701-22-131	2	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	1	0	5	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	106.00	701-22-133	2	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	2	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	2	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	2	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	1	0	3	0	0	0	2	0	4	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	158.00	701-22-138	1	0	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	2	0	4	0	0	0	4	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	3	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	3	0	5	0	0	0	6	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	4	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	1	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	4	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L087	349.70	701-22-149	1	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Andesite Porphyry	LS001	25.00	701-22-001	0	0	0	0	4	0	0	2	5	0	0	4	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS001	65.50	701-22-003	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	LS001	89.25	701-22-004	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Dyke	LS001	136.75	701-22-006	0	0	0	0	2	0	0	2	6	0	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Dyke	LS001	185.00	701-22-007	0	0	0	0	4	0	0	2	6	4	0	6	0	0	1	0	0	6	0	0	3	0	1	0	2	0	0	0	0
Dyke	LS001	221.65	701-22-008	0	0	0	0	3	0	0	4	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	0	0	3	0	0	5	5	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	290.75	701-22-010	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	0	0	0	0	2	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	0	0	0	0	1	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	1	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	0	0	0	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	0	0	0	0	1	0	0	6	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	0	0	1	0	0	6	6	3	0	6	0	2	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS002	94.30	701-22-016	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS002	104.13	701-22-017	0	0	0	0	1	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	0	0	0	0	0	6	6	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	148.40	701-22-019	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Diorite Porphyry	LS002	355.80	701-22-020	0	0	0	0	0	0	0	4	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0
Andesite Porphyry	LS002	373.00	701-22-021	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	422.50	701-22-022	0	0	0	0	2	0	0	4	6	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	0	0	0	0	1	0	0	5	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	448.85	701-22-024	0	0	0	0	4	0	0	5	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	472.85	701-22-025	0	0	0	0	0	0	0	6	4	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	1	0
Andesite Porphyry	LS003	21.30	701-22-026	0	0	0	0	2	0	0	2	4	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	74.30	701-22-028	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	97.00	701-22-029	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	0	0	0	0	1	0	0	3	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	170.02	701-22-033	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	182.40	701-22-034	0	0	0	0	0	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	0	0	0	0	2	0	0	3	6	3	0	5	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	0	0	0	0	1	0	0	3	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	330.20	701-22-039	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	0	0	2	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Feldspar Porphyry	LS003	353.35	701-22-041	0	0	0	0	2	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	0	0	2	0	0	4	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	0	2	6	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	0	0	0	0	1	0	0	3	6	3	0	5	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	0	0	0	0	3	0	0	2	6	2	0	3	0	0	0	0	0	5	0	0	1	0	0	0	2	0	0	5	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS004	69.25	701-22-048	0	0	0	0	3	0	0	2	5	1	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	4	0
Andesite Porphyry	LS004	110.45	701-22-049	0	0	0	0	2	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	0	0	0	0	3	0	0	2	6	3	0	5	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS005	28.40	701-22-051	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	3	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	4	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	0	0	0	0	5	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LS005	133.90	701-22-054	0	0	0	0	3	0	0	5	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	34.30	701-22-056	0	0	0	0	0	0	0	3	5	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	0	0	0	0	1	0	0	2	5	0	0	3	0	0	0	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	0	0	0	0	4	0	0	2	5	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	4	0
Breccia	LS006	140.40	701-22-060	0	0	0	0	5	0	0	2	6	1	0	3	0	0	1	0	0	6	0	0	1	0	1	0	0	0	0	3	0
Porphyry	LK002	16.05	701-22-061	0	0	0	0	0	0	0	2	5	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	0	0	0	0	2	0	0	3	6	4	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Porphyry	LK002	133.30	701-22-064	0	0	0	0	3	0	0	6	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	0	0	0	0	3	0	0	6	6	2	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	0	0	2	0	0	3	6	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	1	0	0	4	0
Breccia	LK003	54.90	701-22-067	0	0	0	0	1	0	0	2	6	2	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LK003	108.60	701-22-068	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Pyroclastic	LK003	128.70	701-22-069	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Tuff	LK003	145.60	701-22-070	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	3	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0
Breccia	LK004	81.52	701-22-073	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LK004	104.71	701-22-074	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	5	0
Diorite Porphyry	LK004	137.51	701-22-075	0	0	0	0	3	0	0	2	6	4	0	5	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	1	0
Breccia	LK006	45.20	701-22-076	0	0	1	0	2	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	0	0	0	0	1	0	0	2	6	2	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	3	0
Andesite Porphyry	LK006	129.70	701-22-078	0	0	0	0	3	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	1	0	2	0	0	1	0
Breccia	LK006	145.70	701-22-079	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	2	0
Diorite Porphyry	LK006	165.86	701-22-080	0	0	0	0	3	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	0	0	0	0	3	0	0	2	6	3	0	4	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	0	0	0	0	1	0	0	5	4	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	11.00	701-22-084	0	0	0	0	2	0	0	5	6	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	17.70	701-22-085	0	0	0	0	3	0	0	5	5	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	23.40	701-22-086	0	0	0	0	1	0	0	4	5	0	0	5	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	28.90	701-22-087	0	0	0	0	1	0	0	6	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	34.90	701-22-088	0	0	0	0	0	0	0	3	6	0	0	5	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L013	41.25	701-22-089	0	0	0	0	0	0	0	2	6	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	47.70	701-22-090	0	0	0	0	2	0	0	2	5	0	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	52.90	701-22-091	0	0	0	0	1	0	0	4	5	0	0	6	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	58.80	701-22-092	0	0	0	0	3	0	0	2	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	69.00	701-22-093	0	0	0	0	0	0	0	4	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Hydrothermal Breccia	L013	75.00	701-22-094	0	0	0	0	3	0	0	3	6	3	0	6	0	1	1	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	0	0	0	0	3	0	0	3	6	1	0	6	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	86.55	701-22-096	0	0	0	0	4	0	0	3	6	2	0	6	0	0	0	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Fault Breccia	L013	93.25	701-22-097	0	0	0	0	3	0	0	3	5	3	0	6	0	0	2	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Hydrothermal Breccia	L013	100.40	701-22-098	0	0	0	0	4	0	0	3	6	3	0	6	0	0	1	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	0	0	0	0	0	6	6	0	0	5	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	0	0	0	0	0	6	6	0	0	6	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	199.75	701-22-101	0	0	0	0	1	0	0	6	6	0	0	6	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Fault Breccia	L223	121.75	701-22-102	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	0	0	0	0	0	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	142.10	701-22-105	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	0	0	0	0	3	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	212.00	701-22-115	0	0	0	0	0	0	0	5	3	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	220.05	701-22-116	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	0	0	0	0	0	3	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Fault Breccia	L223	244.00	701-22-119	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	0	0	1	0	0	2	5	2	0	3	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	0	0	0	0	2	0	0	2	6	4	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	16.00	701-22-124	0	0	0	0	2	0	0	2	2	3	0	6	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	0	0	0	0	3	0	0	2	6	2	0	5	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	36.00	701-22-126	0	0	0	0	3	0	0	2	6	4	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	46.00	701-22-127	0	0	0	0	4	0	0	2	5	3	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	56.00	701-22-128	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Fault Breccia	L087	66.00	701-22-129	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	76.00	701-22-130	0	0	0	0	2	0	0	2	6	5	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	86.00	701-22-131	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	106.00	701-22-133	0	0	0	0	2	0	0	2	4	1	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	0	0	0	0	3	0	0	2	5	4	0	6	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	0	0	0	0	3	0	0	2	5	2	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	0	0	0	0	1	0	0	2	2	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	0	0	0	0	4	0	0	3	6	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	L087	158.00	701-22-138	0	0	0	0	1	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	5	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	0	0	2	0	0	2	5	1	0	3	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	0	0	3	0	0	2	6	2	0	4	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	0	0	1	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	0	0	0	0	1	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	0	0	2	0	0	6	6	2	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	349.70	701-22-149	0	0	0	0	2	0	0	2	6	2	0	4	0	0	0	0	0	6	1	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	0	0	0	0	0	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0

APPENDIX E

Distilled Water Extract Results

Appendix E

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl	Co	Cr	Cu	EC	F	Fe-Sol	Hg	K	Mg
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
Andesite Porphyry	LS001	25	701-22-001	0.00003	0.69	0.0001	0.02	0.01	0.0001	0.000005	7.8	0.003	8	0.01	0.01	**1.7**	257	0.1	0.08	0.0001	16.9	6.4
Andesite Porphyry	LS001	122	701-22-005	0.00006	0.55	0.0003	0.02	0.01	0.0026	0.000213	8.73	0.001	6	0.03	0.01	0.05	511	0.1	0.19	0.0001	22.9	18.6
Dyke	LS001	221.65	701-22-008	0.00001	3.18	0.006	0.02	0.03	0.0006	0.001998	14	**0.062**	17	0.55	0.01	**17.91**	438	0.2	1.94	0.0001	2.5	13.9
Andesite Porphyry	LS001	249.15	701-22-009	0.00001	0.49	0.0024	0.03	0.01	0.0001	0.000065	1.52	0.0005	84	0.01	0.01	0.15	560	0.6	0.07	0.0001	18.7	6.3
Andesite Porphyry	LS001	368.85	701-22-012	0.00021	0.4	0.0002	0.02	0.02	0.001	0.000088	7.1	0.009	191	0.16	0.01	**4.4**	1242	0.2	0.11	0.0001	29.4	23.2
Andesite Porphyry	LS001	423.5	701-22-015	0.00001	2.04	0.0004	0.01	0.02	0.0005	0.000005	11.94	0.003	47	0.35	0.01	**15.46**	466	0.2	**2.6**	0.0001	3.4	10.4
Andesite Porphyry	LS002	128.6	701-22-018	0.00001	0.23	0.0011	0.02	0.03	0.0001	0.000007	7.45	0.009	25	0.10	0.01	**2.07**	449	0.1	0.1	0.0001	22.4	14.2
Andesite Porphyry	LS002	148.4	701-22-019	0.00001	0.5	0.0039	0.02	0.03	0.0002	0.000005	9.36	0.002	32	0.15	0.01	**9.94**	549	0.1	0.19	0.0001	23.9	17.2
Diorite Porphyry	LS002	355.8	701-22-020	0.00007	3.5	0.0074	0.04	1.18	0.0008	0.000097	4.03	0.0004	74	0.002	0.01	0.3	672	1.5	**4.52**	0.0001	4.2	6.6
Andesite Porphyry	LS002	435.3	701-22-023	0.00005	0.06	0.0037	0.10	0.02	0.0002	0.000014	10.74	0.009	278	0.10	0.01	**4.58**	1370	0.2	0.12	0.0001	34.5	25.9
Andesite Porphyry	LS003	70	701-22-027	0.00001	1.81	0.0026	0.01	0.03	0.0005	0.000058	22.86	0.008	4	0.24	0.01	**0.36**	433	0.5	0.78	0.0001	26.4	15.4
Andesite Porphyry	LS003	131.7	701-22-031	0.00001	1.28	0.0029	0.01	0.01	0.0009	0.000025	17.8	0.008	22	0.30	0.01	**1.9**	548	0.2	0.83	0.0001	19.6	27.2
Breccia	LS003	146.75	701-22-032	0.00004	1.07	0.0035	0.18	0.01	0.0008	0.000028	17.09	0.010	26	0.46	0.01	**3.33**	644	0.2	1.23	0.0001	24.8	28.7
Diorite Porphyry	LS003	170.02	701-22-033	0.00001	0.52	0.002	0.17	0.02	0.0003	0.000036	11.4	0.003	12	0.12	0.01	**0.62**	509	0.1	0.64	0.0001	26.8	20.9
Andesite Porphyry	LS003	330.2	701-22-039	0.00003	0.9	0.0021	0.17	0.01	0.0006	0.000005	18.19	0.004	61	0.73	0.01	**2.93**	832	0.2	0.4	0.0001	26.8	32.0
Feldspar Porphyry	LS003	353.35	701-22-041	0.00002	0.08	0.0017	0.10	0.004	0.0001	0.000005	19.39	0.004	55	0.28	0.01	0.045	496	0.1	0.05	0.0001	9.0	16.5
Porphyry	LS003	410.9	701-22-044	0.00005	0.34	0.0027	0.12	0.01	0.0002	0.000005	25.48	**0.029**	286	**1.44**	0.01	**1.11**	1179	0.2	0.09	0.0001	14.2	33.9
Andesite Porphyry	LS004	30.21	701-22-046	0.00001	0.08	0.0016	0.28	0.02	0.0001	0.000005	25.78	**0.043**	73	0.02	0.03	0.05	1000	0.4	0.01	0.0001	50.1	24.7
Andesite Porphyry	LS004	110.45	701-22-049	0.00003	0.13	0.0024	0.25	0.01	0.0029	0.000016	10.46	0.001	99	0.03	0.01	**2.38**	905	0.1	0.05	0.0001	41.7	13.2
Diorite Porphyry	LS005	50.1	701-22-052	0.00007	0.45	0.0039	0.04	0.06	0.0001	0.000005	6.85	0.00002	23	0.001	0.01	0.01	344	0.6	0.02	0.0001	15.8	7.9
Diorite Porphyry	LS005	141.4	701-22-055	0.00009	0.11	0.0019	0.04	0.03	0.0001	0.000005	9.18	0.00003	236	0.002	0.01	0.01	1169	0.4	0.03	0.0001	24.8	17.9
Andesite Porphyry	LS006	127.6	701-22-059	0.00001	0.21	0.0014	0.07	0.01	0.0001	0.000005	9.39	0.006	97	0.03	0.01	0.01	874	0.3	0.05	0.0001	37.4	21.6
Breccia	LS006	140.4	701-22-060	0.00012	0.39	0.0022	0.05	0.01	0.0017	0.000013	8.99	0.006	175	0.09	0.01	**0.83**	1022	0.2	0.07	0.0001	37.9	19.7
Porphyry	LK002	133.3	701-22-064	0.00001	2.81	0.001	0.03	0.0005	0.0002	0.000005	10.44	0.005	33	0.12	0.01	**9.6**	335	0.1	**3.04**	0.0001	4.8	7.6
Breccia	LK003	54.9	701-22-067	0.00003	**17.83**	0.0077	0.04	0.02	0.002	0.00002	11.02	**0.269**	17	0.70	0.01	**14.94**	598	0.1	**7.34**	0.0001	20.2	10.9
Hornblende Porphyry	LK004	51.23	701-22-071	0.00003	3.24	0.0056	0.04	0.23	0.0008	0.000057	8.83	0.0001	27	0.001	0.01	0.02	499	0.1	1.98	0.0001	5.5	7.6
Breccia	LK004	71.63	701-22-072	0.00008	1.38	0.0049	0.02	0.07	0.0002	0.000007	8.4	0.00002	115	0.002	0.01	0.01	925	0.4	0.44	0.0001	17.5	5.3
Tuff	LK006	191.35	701-22-081	0.00007	**68.74**	0.0213	0.01	0.003	0.0016	0.000409	23.80	0.001	31	**3.39**	0.10	**13.87**	2302	0.1	**249.7**	0.0001	21.3	40.5
Andesite Porphyry	L013	11	701-22-084	0.00001	0.02	0.001	0.03	0.02	0.0001	0.000005	12.95	0.00002	30	0.001	0.01	0.11	328	0.3	0.03	0.0001	18.4	14.0
Andesite Porphyry	L013	34.9	701-22-088	0.00003	0.99	0.0011	0.01	0.01	0.0001	0.000005	4.91	0.0001	13	0.003	0.01	**3.06**	245	0.1	0.13	0.0001	23.1	4.4
Andesite Porphyry	L013	69	701-22-093	0.00002	3.12	0.0016	0.01	0.03	0.0002	0.000016	9.56	0.0004	5	0.04	0.01	**25.25**	437	0.1	0.18	0.0001	30.1	6.6
Hydrothermal Breccia	L013	75	701-22-094	0.00002	1.02	0.001	0.01	0.03	0.0001	0.000005	18.3	0.001	15	0.02	0.01	**1.91**	324	0.1	0.19	0.0001	9.6	7.7
Fault Breccia	L013	93.25	701-22-097	0.00002	0.45	0.001	0.01	0.01	0.0001	0.000005	12.73	0.001	56	0.01	0.01	**1.15**	523	0.1	0.03	0.0001	6.1	15.3
Andesite Porphyry	L013	127.55	701-22-099	0.00018	**7.37**	0.0023	0.01	0.06	0.0013	0.000005	29.14	0.004	7	0.27	0.01	**61.14**	956	0.2	**2.16**	0.0001	22.0	46.6
Andesite Porphyry	L223	156	701-22-107	0.00002	0.08	0.002	0.02	0.01	0.0001	0.000005	27.63	0.0001	12	0.002	0.01	0.02	869	0.3	0.01	0.0001	9.4	12.8
Andesite Porphyry	L223	170	701-22-109	0.00004	2.84	0.0022	0.02	0.10	0.0003	0.000011	6.54	0.00002	28	0.002	0.01	0.01	396	0.3	0.7	0.0001	5.0	2.7
Andesite Porphyry	L223	184	701-22-111	0.00001	2.92	0.0071	0.06	0.17	0.0005	0.000166	11.6	0.00006	27	0.001	0.01	0.08	546	0.9	0.86	0.0001	8.1	5.5
Andesite Porphyry	L223	206.5	701-22-114	0.00001	2.32	0.0015	0.04	0.10	0.0002	0.000034	7.85	0.00002	99	0.001	0.01	0.02	617	0.3	0.44	0.0001	11.9	2.9
Andesite Porphyry	L223	212	701-22-115	0.00004	2.74	0.0029	0.04	0.02	0.0002	0.000033	6.29	0.00002	74	0.002	0.01	0.03	590	0.4	0.56	0.0001	6.9	2.2
Andesite Porphyry	L223	325.4	701-22-121	0.00001	0.795	0.0012	0.03	0.01	0.0010	0.000005	9.2	0.0003	78	0.05	0.01	**1.22**	888	0.2	0.06	0.0001	19.7	20.4
Fault Breccia	L223	340.3	701-22-122	0.00007	**18.5**	0.0012	0.06	0.01	0.0071	0.000005	36.42	0.005	54	0.60	0.01	**51.26**	1496	0.9	1.39	0.0001	30.9	96.2
Pyroclastic	L087	6	701-22-123	0.00002	0.15	0.0026	0.01	0.03	0.0001	0.000005	28.66	0.00002	18	0.001	0.01	0.03	320	0.7	0.01	0.0001	6.1	8.8
Pyroclastic	L087	36	701-22-126	0.00002	0.09	0.0007	0.01	0.07	0.0001	0.000005	19.63	0.00004	35	0.01	0.01	0.01	339	0.4	0.01	0.0001	8.4	6.7
Andesite Porphyry	L087	76	701-22-130	0.00007	1.85	0.0012	0.01	0.05	0.0001	0.000005	23.05	0.00005	59	0.001	0.01	0.06	509	0.3	0.18	0.0001	11.9	13.6
Andesite Porphyry	L087	96	701-22-132	0.00001	0.12	0.001	0.01	0.03	0.0001	0.000005	6.71	0.00002	27	0.003	0.01	0.01	240	0.1	0.02	0.0001	5.7	6.1
Andesite Porphyry	L087	126	701-22-135	0.00003	0.04	0.001	0.01	0.01	0.0001	0.000011	7.44	0.00003	18	0.004	0.01	0.02	194	0.1	0.01	0.0001	8.8	4.2
Andesite Porphyry	L087	184	701-22-140	0.00002	**18.93**	0.0047	0.01	0.01	0.0092	0.000005	49.34	**0.012**	10	**5.49**	0.01	**0.35**	1034	0.5	**3.02**	0.0001	16.1	73.6
Andesite Porphyry	L087	272	701-22-146	0.00001	**47.16**	0.0037	0.01	0.0001	0.0008	0.000005	14.37	**0.028**	3	0.36	0.33	**130.44**	1344	0.1	**167.5**	0.0001	1.1	7.4
Andesite Porphyry	L087	292	701-22-147	0.00003	**33.36**	0.0027	0.01	0.003	0.0019	0.000005	39.62	**0.024**	7	0.92	0.02	**86.26**	1321	0.1	**35.2**	0.0001	10.6	46.1
Hydrothermal Breccia	L087	330	701-22-148	0.00001	**42.85**	0.0044	0.01	0.0004	0.0005	0.000005	10.55	0.004	2	0.14	0.18	**33.88**	1176	0.1	**241.2**	0.0001	1.3	3.9
			Average	0.0000376	**6.01**	0.003	0.05	0.05	0.0009	0.00007	14.81	**0.01**	56.60	0.35	0.02	**10.10**	716.38	0.28	**14.61**	0.00	17.49	18.03
Adopted Reference Level				0.5	5	0.1	5	N/G	N/G	N/G	1000	0.01	N/G	1	1	0.3	N/G	2	2	0.002	N/G	2000

Appendix E

Lithology	Borehole	Depth (m)	ID	Mn	Mo	Na	Ni	P	Pb	pH	S	SO4	Sb	Se	Sn	Sr	TDSEva	Th	U	V	Zn	AFP
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NONE	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l	-
Andesite Porphyry	LS001	25	701-22-001	1.3	0.00010	14.4	0.01	0.1	0.0017	**5**	26.2	78	0.00001	0.0011	0.0001	0.01	178	0.00005	0.0001	0.01	0.3	UC
Andesite Porphyry	LS001	122	701-22-005	1.26	0.00015	49.9	0.02	0.1	0.0018	**5.2**	61.2	183	0.00004	0.0112	0.0001	0.02	401	0.00021	0.0022	0.01	**0.68**	PAF-LC
Dyke	LS001	221.65	701-22-008	0.5	0.00029	30.3	0.14	0.3	0.0031	**4.4**	56.1	168	0.0007	0.0026	0.0057	0.07	362	0.00041	0.0220	0.01	**0.89**	PAF
Andesite Porphyry	LS001	249.15	701-22-009	0.04	0.01145	92.7	0.01	0.1	0.0006	6.6	34.2	102	0.00479	0.0015	0.0001	0.01	389	0.00025	0.0011	0.01	0.02	PAF
Andesite Porphyry	LS001	368.85	701-22-012	0.09	0.00007	239.6	0.07	0.1	0.0012	**5**	116.6	349	0.00024	**0.022**	0.0001	0.02	947	0.00007	0.0133	0.01	**0.8**	PAF
Andesite Porphyry	LS001	423.5	701-22-015	0.37	0.00008	43.6	0.13	0.3	0.0005	**4.3**	45.6	137	0.00032	0.0015	0.0001	0.15	420	0.00007	0.0146	0.01	0.45	PAF
Andesite Porphyry	LS002	128.6	701-22-018	0.25	0.00005	39.5	0.06	0.1	0.0005	**4.6**	48.9	146	0.00011	0.0069	0.0001	0.02	382	0.00004	0.0341	0.01	**1.82**	PAF
Andesite Porphyry	LS002	148.4	701-22-019	0.32	0.00005	42.9	0.11	0.2	0.0006	**4.4**	58.5	175	0.00054	0.005	0.0001	0.02	350	0.00014	0.0535	0.01	**1.78**	PAF
Diorite Porphyry	LS002	355.8	701-22-020	0.12	0.00799	132.4	0.01	0.4	0.0042	8.5	28.4	85	0.00021	0.003	0.0001	0.01	488	0.00121	0.0005	0.08	**0.66**	NAF
Andesite Porphyry	LS002	435.3	701-22-023	2	0.00006	243.8	0.05	0.1	0.0005	6.1	91	273	0.00004	0.0035	0.0001	0.02	1016	0.00034	0.0003	0.01	**2.76**	PAF
Andesite Porphyry	LS003	70	701-22-027	0.68	0.00012	12.9	0.16	0.1	0.0009	**4.7**	57.5	172	0.00058	0.0036	0.0001	0.07	265	0.00014	0.0052	0.01	**1.63**	PAF
Andesite Porphyry	LS003	131.7	701-22-031	2.1	0.00005	31.5	0.13	0.1	0.0006	**4.4**	71.7	215	0.00014	0.0016	0.0001	0.01	440	0.00025	0.0245	0.01	**1.99**	PAF
Breccia	LS003	146.75	701-22-032	2.1	0.00005	37.3	0.2	0.1	0.0017	**4.1**	83.8	251	0.00019	0.0021	0.0001	0.01	439	0.00019	0.0597	0.01	**2.84**	PAF
Diorite Porphyry	LS003	170.02	701-22-033	0.9	0.00005	36	0.04	0.1	0.001	**4.5**	65.1	195	0.00012	0.0014	0.0001	0.01	340	0.00029	0.0392	0.01	**0.93**	PAF
Andesite Porphyry	LS003	330.2	701-22-039	1.15	0.00006	85.6	0.22	0.1	0.0005	**4.4**	99.5	298	0.00019	0.0052	0.0001	0.01	625	0.00015	0.0264	0.01	**0.61**	PAF
Feldspar Porphyry	LS003	353.35	701-22-041	0.68	0.00016	46.65	0.07	0.1	0.0006	**5.35**	47.05	141	0.00033	0.0028	0.0001	0.04	350	0.00002	0.0053	0.01	**0.695**	PAF
Porphyry	LS003	410.9	701-22-044	0.57	0.0002	161.8	**0.56**	0.1	0.0005	**5**	51	153	0.00054	0.0046	0.0001	0.02	720	0.00004	0.0068	0.01	**0.84**	PAF-LC
Andesite Porphyry	LS004	30.21	701-22-046	19.09	0.00358	117.1	0.01	0.1	0.0066	7.2	117.6	352	0.00034	0.0013	0.0001	0.94	680	0.00001	0.0001	0.01	**0.59**	PAF
Andesite Porphyry	LS004	110.45	701-22-049	1.57	0.00008	140.4	0.02	0.1	0.0013	**5.3**	90.5	271	0.00145	0.0021	0.0001	0.35	580	0.00002	0.0021	0.01	**0.98**	PAF
Diorite Porphyry	LS005	50.1	701-22-052	0.01	0.01026	47.3	0.01	0.1	0.0012	8.2	29.7	89	0.00047	0.0009	0.0001	0.03	210	0.00001	0.0062	0.01	0.01	AC
Diorite Porphyry	LS005	141.4	701-22-055	1.12	0.00228	203.8	0.01	0.1	0.0007	7.3	55.1	165	0.00018	0.0025	0.0001	0.14	657	0.00001	0.0003	0.01	0.01	PAF
Andesite Porphyry	LS006	127.6	701-22-059	5.83	0.00007	122	0.02	0.1	0.0007	6.5	82.1	246	0.00002	0.0063	0.0001	0.01	443	0.00006	0.0007	0.01	**0.87**	PAF
Breccia	LS006	140.4	701-22-060	0.22	0.00012	163.7	0.1	0.1	0.0017	**5.2**	75.5	226	0.00029	0.0078	0.0001	0.02	700	0.00008	0.0036	0.01	**0.95**	PAF
Porphyry	LK002	133.3	701-22-064	0.4	0.00006	22.9	0.09	0.2	0.0006	**4.1**	34.5	103	0.00049	0.0015	0.0001	0.01	203	0.00004	0.0133	0.01	0.19	PAF
Breccia	LK003	54.9	701-22-067	1.88	0.00008	6.3	**0.51**	0.4	0.013	**3.7**	91.4	274	0.00021	0.0047	0.0001	0.01	391	0.00096	0.0315	0.01	**45.3**	PAF
Hornblende Porphyry	LK004	51.23	701-22-071	0.13	0.00851	124.5	0.01	0.1	0.0025	9.2	17.4	52	0.00018	0.0012	0.0001	0.05	246	0.00075	0.0023	0.06	0.01	NAF
Breccia	LK004	71.63	701-22-072	0.02	0.03562	208.2	0.01	0.1	0.0015	8.5	60.7	182	0.00038	0.0015	0.0001	0.06	620	0.00012	0.0042	0.02	0.01	AC
Tuff	LK006	191.35	701-22-081	0.41	0.00062	65.6	**1.905**	0.5	0.0100	**2.7**	419.5	**1257**	0.00047	0.00325	0.0001	0.03	1481	0.01840	0.0914	0.07	**1.02**	PAF
Andesite Porphyry	L013	11	701-22-084	0.02	0.00555	23.3	0.01	0.1	0.0006	7.3	20.3	61	0.00004	0.0023	0.0001	0.63	180	0.00008	0.0002	0.01	0.01	NAF
Andesite Porphyry	L013	34.9	701-22-088	0.05	0.00012	18.6	0.01	0.1	0.0005	**5.6**	23.5	70	0.00003	0.0043	0.0001	0.03	155	0.00014	0.0001	0.01	0.01	NAF
Andesite Porphyry	L013	69	701-22-093	0.19	0.00008	26.6	0.02	0.5	0.0005	**4.2**	55.7	167	0.00001	0.0121	0.0001	0.03	265	0.00050	0.0007	0.01	0.07	NAF
Hydrothermal Breccia	L013	75	701-22-094	0.34	0.00018	25	0.01	0.1	0.0005	**5.1**	36.6	110	0.00011	0.0037	0.0001	0.25	195	0.00066	0.0003	0.01	0.14	UC
Fault Breccia	L013	93.25	701-22-097	0.73	0.00005	71.5	0.01	0.1	0.0005	**5.8**	49.4	148	0.00003	0.0193	0.0001	0.08	331	0.00009	0.0002	0.01	0.27	UC
Andesite Porphyry	L013	127.55	701-22-099	1.49	0.00033	63.7	0.1	1.2	0.0009	**4.2**	164.2	492	0.00022	**0.0229**	0.0001	0.09	682	0.00652	0.0077	0.01	**3.16**	PAF
Andesite Porphyry	L223	156	701-22-107	0.02	0.06095	157.8	0.01	0.1	0.0006	8.1	134.8	404	0.00028	0.0019	0.0001	0.30	631	0.00007	0.0037	0.01	0.01	NAF
Andesite Porphyry	L223	170	701-22-109	0.05	0.14508	86.2	0.01	0.1	0.0014	9	12.2	37	0.00012	0.0017	0.0001	0.08	386	0.00062	0.0026	0.03	0.01	NAF
Andesite Porphyry	L223	184	701-22-111	0.09	**0.96708**	124.7	0.01	0.1	0.0054	8.8	26.8	80	0.00016	**0.0596**	0.0001	0.09	306	0.00043	0.0030	0.02	0.01	AC
Andesite Porphyry	L223	206.5	701-22-114	0.02	**0.53322**	126.5	0.01	0.1	0.0016	8.5	19.3	58	0.00011	0.0015	0.0001	0.10	352	0.00048	0.0008	0.02	0.01	AC
Andesite Porphyry	L223	212	701-22-115	0.02	**1.049**	123.9	0.01	0.1	0.0034	8.6	37.1	111	0.00052	0.0012	0.0001	0.07	400	0.00049	0.0017	0.01	0.01	AC
Andesite Porphyry	L223	325.4	701-22-121	0.115	0.00072	144.65	0.01	0.1	0.0006	**5.3**	97.75	293	0.00005	0.0027	0.0001	0.01	615	0.00004	0.0014	0.01	0.02	PAF-LC
Fault Breccia	L223	340.3	701-22-122	0.73	0.00054	164.3	0.18	0.9	0.0005	**4.1**	294.5	882	0.00004	0.0059	0.0001	0.08	1355	0.00022	**0.9309**	0.01	0.44	PAF
Pyroclastic	L087	6	701-22-123	0.01	0.01194	23.8	0.01	0.1	0.0005	7.9	25.8	77	0.00127	0.0017	0.0001	0.26	183	0.00001	0.0035	0.01	0.01	NAF
Pyroclastic	L087	36	701-22-126	0.08	0.00245	32.1	0.01	0.1	0.0018	6.8	27.6	83	0.00035	0.0012	0.0001	0.23	205	0.00003	0.0002	0.01	0.01	PAF-LC
Andesite Porphyry	L087	76	701-22-130	0.18	0.00821	57	0.01	0.1	0.0032	7.3	44.8	134	0.00188	0.0014	0.0001	0.18	403	0.00020	0.0003	0.01	0.01	PAF-LC
Andesite Porphyry	L087	96	701-22-132	0.04	0.00155	27.3	0.01	0.1	0.001	6.7	18.8	56	0.00034	0.0011	0.0001	0.16	149	0.00003	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	126	701-22-135	0.08	0.00163	18.3	0.01	0.1	0.0008	6.7	16.5	49	0.00054	0.001	0.0001	0.09	126	0.00001	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	184	701-22-140	2.11	0.00106	40.2	**1.18**	0.1	0.0005	**3.8**	198	593	0.00002	0.0027	0.0001	0.03	966	0.00058	0.0449	0.01	**1.56**	PAF
Andesite Porphyry	L087	272	701-22-146	0.74	0.00263	6.5	0.19	2.6	0.0006	**3.1**	261.9	785	0.00014	0.0028	0.0001	0.03	879	0.03736	0.0252	0.01	**0.55**	PAF
Andesite Porphyry	L087	292	701-22-147	2.71	0.00096	51.5	0.29	1.7	0.0005	**3.4**	247.9	743	0.00014	0.0079	0.0001	0.07	961	0.01012	0.0433	0.01	**3.56**	PAF
Hydrothermal Breccia	L087	330	701-22-148	0.58	0.00143	4.6	0.12	0.9	0.0005	**3.3**	242.3	726	0.00027	0.0104	0.0001	0.04	810	0.00303	0.0077	0.01	0.32	PAF
			Average	1.11	0.06	79.61	0.14	0.28	0.002	**5.8**	83.44	249.98	0.0004	0.01	0.0002	0.10	497	0.002	0.03	0.01	**1.60**	
Adopted Reference Level				N/G	0.15	N/G	0.5	N/G	0.1	6	N/G	1000	N/G	0.02	N/G	N/G	2000	N/G	0.2	N/G	0.5	

APPENDIX F

Laboratory Testing Certificates

Knight Piésold
CONSULTING

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

Quantitative X-Ray Diffraction Analysis

Report Prepared for:	Tim Rowles Knight Piesold Pty. Ltd. trowles@knightpiesold.com
Samples Received:	22-May-2013
Samples Analysed:	29-May-2013 -12-June-2013
Written by:	Dr Sharon Ness
Date:	12-June-2013
Intertek Genalysis Job No:	752.0/1307181 (Rev 1)

Intertek trading as Genalysis Laboratory Services Pty Ltd.
15 Davison Street Maddington WA 6109
ABN: 32 008 787 237

Introduction

Fifteen (15) samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents.

Sampling and Preparation

The samples were crushed and milled to < 60 µm

For each sample (except 701-22-097), a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content.

A grab of sample 701-22-097 was prepared by adding an internal standard, TiO2, and micronising the mixture to 4µm.

The spiked samples were each prepared as an un-oriented powder mount.

A second grab was taken of 701-22-001 and prepared as a duplicate analysis.

Instrumentation

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with Copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3^o to 65^{o}2θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database.

Quantitative phase analysis was performed using SIROQUANT™ Version 3 software.

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Western Australia 6109

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Results

The quantitative analysis of the crystalline and amorphous content of each sample is as follows:

Sample ID **701-22-001**

Phase	Formula	original wt%	duplicate wt%	Notes
Amorphous content		13	12	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	17	15	
Interlayered illite/smectite		21	21	see Note 1
Jarosite	(K,Na)Fe3(SO4)2(OH)6	<1	1	
Kaolin	Al2Si2O5(OH)4	5	6	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	5	6	
Quartz	SiO2	39	39	

Sample ID **701-22-008**

Phase	Formula	wt%	Notes
Amorphous content		10	
Dolomite	CaMg(CO3)2	1	
Kaolin	Al2Si2O5(OH)4	16	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	10	
Potassium feldspar	KAlSi3O8	2	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	38	

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Sample ID **701-22-020**

Phase	Formula	wt%	Notes
Amorphous content		17	
Alunite	KAl3(SO4)2(OH)6	1	
Chalcopyrite	CuFeS2	<1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	6	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		14	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Potassium feldspar	KAlSi3O8	5	
Pyrite	FeS2	1	
Quartz	SiO2	31	
Siderite	FeCO3	11	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-023**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	1	
Anhydrite	CaSO4	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	13	
Interlayered illite/smectite		5	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Kaolin	Al2Si2O5(OH)4	17	
Pyrite	FeS2	2	
Quartz	SiO2	45	
Siderite	FeCO3	3	

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Sample ID **701-22-032**

Phase	Formula	wt%	Notes
Amorphous content		17	
Anhydrite	CaSO4	1	
Calcite	CaCO3	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	12	
Interlayered illite/smectite		18	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Pyrite	FeS2	6	
Quartz	SiO2	45	

Sample ID **701-22-041**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	3	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	2	
Interlayered illite/smectite		8	see Note 1
Kaolin	Al2Si2O5(OH)4	8	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Potassium feldspar	KAlSi3O8	<1	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	22	
Quartz	SiO2	34	

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Western Australia 6109

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Sample ID **701-22-044**

Phase	Formula	wt%	Notes
Amorphous content		7	
Dolomite	CaMg(CO3)2	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		1	see Note 1
Kaolin	Al2Si2O5(OH)4	22	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	26	
Pyrite	FeS2	1	
Quartz	SiO2	41	

Sample ID **701-22-052**

Phase	Formula	wt%	Notes
Amorphous content		13	
Ankerite	Ca(Fe,Mg)(CO3)2	4	
Dolomite	CaMg(CO3)2	8	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	11	
Interlayered illite/smectite		15	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Magnesite	MgCO3	4	see Note 2
Quartz	SiO2	40	

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Sample ID **701-22-071**

Phase	Formula	wt%	Notes
Amorphous content		33	
Calcite	$CaCO_3$	2	
Dolomite	$CaMg(CO_3)_2$	3	
Expanding clay		2	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	7	
Interlayered illite/smectite		9	see Note 1
Kaolin	$Al_2Si_2O_5(OH)_4$	2	
Potassium feldspar	$KAlSi_3O_8$	8	
Pyrite	FeS_2	<1	
Quartz	SiO_2	24	
Sodium calcium plagioclase	$(Na,Ca)(Al,Si)_2Si_2O_8$	12	

Sample ID **701-22-072**

Phase	Formula	wt%	Notes
Amorphous content		29	
Calcite	$CaCO_3$	1	
Chlorite	$(Fe,Al,Mg)_6(Si,Al)_4O_{10}(OH)_8$	5	
Dolomite	$(Ca,Fe,Mg)_2(CO_3)_2$	7	
Illite/Muscovite	$(K,Ca,Na)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	4	
Interlayered illite/smectite		22	see Note 1
Magnesite	$MgCO_3$	2	see Note 2
Pyrite	FeS_2	2	
Quartz	SiO_2	29	
Sodium calcium plagioclase	$(Na,Ca)(Al,Si)_2Si_2O_8$	1	

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Western Australia 6109

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Sample ID **701-22-081**

Phase	Formula	wt%	Notes
Amorphous content		11	
Anatase	TiO2	1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	5	
Interlayered illite/smectite		13	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	3	
Pyrite	FeS2	15	
Pyrophyllite	Al2Si4O10(OH)2	8	
Quartz	SiO2	43	

Sample ID **701-22-097**

Phase	Formula	wt%	Notes
Amorphous content		11	see Note 3
Dolomite	CaMg(CO3)2	1	
Hematite	Fe2O3	15	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	9	
Potassium feldspar	KAlSi3O8	4	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	47	

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Western Australia 6109

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Sample ID **701-22-115**

Phase	Formula	wt%	Notes
Amorphous content		35	
Calcite	CaCO3	7	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	13	
Chloritoid	(Fe,Mg)2Al4Si2O10(OH)4	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Palygorskite	Mg5(Si4O10)2(OH)2(H2O)8	7	see Note 1
Quartz	SiO2	23	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-126**

Phase	Formula	wt%	Notes
Amorphous content		14	
Hematite	Fe2O3	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	15	
Potassium feldspar	KAlSi3O8	1	
Pyrophyllite	Al2Si4O10(OH)2	5	
Quartz	SiO2	63	

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

Sample ID **701-22-148**

Phase	Formula	wt%	Notes
Amorphous content		3	
Diaspore	AlO(OH)	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	28	
Pyrite	FeS2	16	
Pyrophyllite	Al2Si4O10(OH)2	4	
Quartz	SiO2	47	

Calculation of the phase abundances have been based on the Brindley contrast corrections using a particle diameter of 10 µm.

Uncertainty in the SIROQUANT™ analyses should reflect errors (absolute) of no greater than: +/- 10% for phases 50-95%, +/- 5% for phases 10-50% and +/- 2% for phases 3-10%. Phases of < 3% are approaching detection limit and normally no refinements are made on these.

15 Davison Street, Maddington
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Quality Control

NIST Standard Reference Material 656

The powder consists of sub-micrometer, equi-axial, non-aggregated grains that do not display the effects of absorption contrast, extinction or preferred orientation.

An aliquot of this CRM, spiked with 10% Al2O3 for the amorphous content determination, was prepared as un-oriented powder mount of the total sample and the scan analysed with SIROQUANT™.

The results are as follows

Sample ID **β 656 (High β Phase Powder)**

		result	std dev	SRM certified	SRM uncert
Phase	**Formula**	**wt%**	**wt%**	**wt%**	**wt%**
Amorphous content		8.8	0.1	8.6	0.81
Si3N4, alpha	SiN4	16.3	0.6	16.3	2.54
Si3N4, beta	SiN4	74.9	0.4	75.1	0.60

Each interval defined by the certified value and its uncertainty is a 95% confidence interval for the true value of the mean in the absence of systematic error.

Discussion

Notes

1. For confirmation of the clay mineral identification, clay separation and oriented clay mounts (glycol and heat treated) would be required.

2. The magnesite phase possibly has some substitution of the magnesium by calcium.

3. Calculation of the phase abundances has been based on the Brindley contrast corrections using a particle diameter of 4 µm, this being the median particle size determined for this sample after miconising.

Intertek GENALYSIS LABORATORY SERVICES

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

Discussion

General

Quantification of the crystalline mineral phases was performed with the SIROQUANT™ software package. This software uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases.

Corrections are incorporated the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

1. There is a limit of detection of 1-2% on most crystalline phases.
2. The detection of a phase may be dependent on its crystallinity.
3. Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
4. Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

1. The limitations for qualitative XRD analysis apply
2. The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.
3. Particle size is important with respect to the absorption of the X-rays by the sample. Milling to < 60 µm will usually produce a median particle size of approximately10 µm which is, in most cases, sufficient to minimize absorption contrast effects. However, this particle size may not be sufficient to minimize the absorption contrast effect if the samples contain a significant amount of iron-bearing phases. This is because the absorption contrast between them and other lower absorber phases is the most severe when analysed with Copper radiation. Micronising reduces the particle size to that more suitable for analysis with this radiation.

The accuracy of the analysis is dependent on sampling and sample preparation in addition to the calculated profiles being exactly representative of the chemistry of the component phases and their crystallinity. Some preferred orientation effects and reflection overlaps may occur which cannot be adequately resolved.

Amorphous content

The amorphous content was determined from the addition of a known spike of a well-crystalline internal standard (ZnO or TiO2) to each sample.

When amorphous material is present, the weight percentage of the spike found by SIROQUANT^{TM} is larger than actually weighed out. SIROQUANT^{TM} then calculates the amount of amorphous material that causes the difference in the spike weight percentages and normalises all weight percentages to include the amorphous content.

Dr. Sharon Ness
Intertek Genalysis
Email: sharon.ness@intertek.com
Mob: 0408 746 062

ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1307060
No. of SAMPLES	:	150
No. of ELEMENTS	:	80
CLIENT O/N	:	PE701-00022 SS13001(REVB) (Job 1
SAMPLE SUBMISSION No.	:	PE701-00022 SS13001(REVB)
PROJECT	:	LETPADAUNG
STATE	:	Rock Chip
DATE RECEIVED	:	20/05/2013
DATE COMPLETED	:	19/06/2013
DATE PRINTED	:	19/06/2013
PRIMARY LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

MAIN OFFICE AND LABORATORY

15 Davison Street, Maddington 6109, Western Australia
PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100 Fax: +61 8 9251 8110
Email: genalysis@intertek.com
Web Page: www.genalysis.com.au

KALGOORLIE SAMPLE PREPARATION DIVISION

12 Keogh Way, Kalgoorlie 6430, Western Australia
Tel: +61 8 9021 6057 Fax: +61 8 9021 3476

ADELAIDE LABORATORY

11 Senna Road, Wingfield, 5013, South Australia
Tel: +61 8 8162 9714 Fax: +61 8 8349 7444

JOHANNESBURG LABORATORY

43 Malcolm Moodie Crescent,
Jet Park, Gauteng, South Africa 1459
Tel: +27 11 552 8149 Fax: +27 11 552 8248

TOWNSVILLE LABORATORY

9-23 Kelli Street, Mt St John, Bohle, Queensland, Australia 4818

Tel: +61 7 4774 3655 Fax: +61 7 4774 4692

SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work http://www.intertek.com/terms/

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Note: Detection Limit only apply when TDS <100mg/l for MS and TDS<5000mg/l for OES except when indicated in spreadsheet

   NB pH Ws/MTR and EC/MTR both measured on 1:3 [soil:water] extract
   All anions and metals read on the same extract, solution values are reported

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0001 701-22-001	0.72	0.02	9.97%	0.76	-3	4.2
0002 701-22-002	0.11		7.77%		15	1.6
0003 701-22-003	0.86		8.11%		-2	10.7
0004 701-22-004	1.16		7.96%		-4	12.4
0005 701-22-005	0.54	0.06	9.06%	0.55	5	3.7
0006 701-22-006	0.65		8.77%		-3	7.1
0007 701-22-007	1.12		5.87%		-11	789.6*
0008 701-22-008	0.22	X	8.10%	3.18	-6	37.3
0009 701-22-009	0.13	X	9.20%	0.49	-3	33.9
0010 701-22-010	0.15		8.69%		-3	9.4
0011 701-22-011	1.00		8.03%		-7	12.5
0012 701-22-012	0.82	0.21	8.69%	0.40	-3	4.9
0013 701-22-013	0.14		9.47%		-3	8.4
0014 701-22-014	0.41		6.77%		-6	90.4
0015 701-22-015	0.09	X	6.17%	2.04	-8	42.4
0016 701-22-016	0.17		9.04%		-3	2.9
0017 701-22-017	0.25		8.98%		-4	16.5
0018 701-22-018	0.12	X	8.78%	0.23	-3	8.2
0019 701-22-019	0.16	0.01	8.68%	0.50	-3	20.3
0020 701-22-020	0.17	0.07	6.98%	3.50	17	1.3
0021 701-22-021	1.47		8.26%		13	15.2
0022 701-22-022	0.31		8.94%		4	5.5
0023 701-22-023	0.21	0.05	9.07%	0.06	5	3.9
0024 701-22-024	1.81		8.58%		5	47.9
0025 701-22-025	0.24		9.19%		4	6.1
0026 701-22-026	0.46		7.85%		4	15.5
0027 701-22-027	0.18	X	8.51%	1.81	4	1.6
0028 701-22-028	0.17		6.32%		4	2.7
0029 701-22-029	0.49		9.13%		4	20.3
0030 701-22-030	0.59		7.11%		1	16.0
0031 701-22-031	0.22	X	8.90%	1.28	4	5.9
0032 701-22-032	0.68	0.04	8.02%	1.07	2	31.1
0033 701-22-033	0.58	0.01	8.12%	0.52	3	15.5
0034 701-22-034	0.46		9.05%		4	13.5
0035 701-22-035	0.30		7.03%		-2	31.6
0036 701-22-036	0.57		8.10%		2	14.3
0037 701-22-037	0.23		8.61%		2	7.2
0038 701-22-038	0.39		7.46%		1	6.4

ANALYSIS

0039 701-22-039	0.30	0.03	8.98%	0.90	1	4.7
0040 701-22-040	0.11		7.84%		41	6.3

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.1	X	0.02	252.9	9.66	1.85
0002 701-22-002		13		426.1		1.96
0003 701-22-003		X		381.5		2.50
0004 701-22-004		X		542.1		1.16
0005 701-22-005	0.3	X	0.02	339.8	12.37	1.90
0006 701-22-006		X		448.9		0.68
0007 701-22-007		10		584.0		0.28
0008 701-22-008	6.0	X	0.02	452.1	25.24	0.16
0009 701-22-009	2.4	X	0.03	572.7	10.55	0.60
0010 701-22-010		X		393.0		0.50
0011 701-22-011		X		384.8		0.40
0012 701-22-012	0.2	X	0.02	607.5	17.18	1.27
0013 701-22-013		X		344.8		1.39
0014 701-22-014		X		351.1		0.16
0015 701-22-015	0.4	X	0.01	449.4	19.89	0.17
0016 701-22-016		X		1084.9		0.78
0017 701-22-017		X		917.2		0.88
0018 701-22-018	1.1	X	0.02	986.7	29.61	0.57
0019 701-22-019	3.9	X	0.02	750.0	34.94	0.98
0020 701-22-020	7.4	X	0.04	1144.9	1184.79	1.10
0021 701-22-021		X		298.3		1.44
0022 701-22-022		X		461.3		0.91
0023 701-22-023	3.7	X	0.10	536.6	22.41	1.12
0024 701-22-024		X		646.5		1.25
0025 701-22-025		X		1129.3		0.93
0026 701-22-026		X		403.7		0.81
0027 701-22-027	2.6	X	0.01	721.9	31.63	0.94
0028 701-22-028		X		345.7		1.24
0029 701-22-029		X		452.5		1.14
0030 701-22-030		X		235.1		0.66
0031 701-22-031	2.9	X	0.01	197.1	10.41	1.68
0032 701-22-032	3.5	X	0.18	342.5	14.54	0.96
0033 701-22-033	2.0	X	0.17	566.2	17.91	0.85
0034 701-22-034		X		637.5		1.58
0035 701-22-035		X		351.0		0.21
0036 701-22-036		X		478.4		0.64
0037 701-22-037		X		509.5		0.54
0038 701-22-038		X		319.0		0.52

ANALYSIS

0039 701-22-039	2.1	X	0.17	374.2	5.99	0.68
0040 701-22-040		X		527.3		0.53

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	0.1	0.16	X	0.06	946	8.08
0002 701-22-002		0.33		0.95	2481	
0003 701-22-003		6.78		0.05	1432	
0004 701-22-004		7.05		0.04	1079	
0005 701-22-005	2.6	0.74	0.213	0.04	383	8.73
0006 701-22-006		6.94		0.04	819	
0007 701-22-007		10.93		0.02	645	
0008 701-22-008	0.6	6.33	1.998	0.02	967	14.00
0009 701-22-009	X	0.99	0.065	0.03	817	1.52
0010 701-22-010		3.17		0.04	578	
0011 701-22-011		16.79*		0.02	653	
0012 701-22-012	1.0	5.16	0.088	0.03	618	7.10
0013 701-22-013		2.21		0.03	556	
0014 701-22-014		2.93		0.02	531	
0015 701-22-015	0.5	1.13	X	0.02	593	11.94
0016 701-22-016		0.19		0.06	456	
0017 701-22-017		0.43		0.07	388	
0018 701-22-018	X	0.39	0.007	0.05	356	7.45
0019 701-22-019	0.2	0.30	X	0.05	283	9.36
0020 701-22-020	0.8	0.06	0.097	0.99	3774	4.03
0021 701-22-021		1.37		1.09	907	
0022 701-22-022		0.45		0.05	386	
0023 701-22-023	0.2	0.43	0.014	0.31	502	10.74
0024 701-22-024		0.44		0.03	563	
0025 701-22-025		0.11		0.02	540	
0026 701-22-026		2.46		0.10	1160	
0027 701-22-027	0.5	1.37	0.058	0.04	757	22.86
0028 701-22-028		1.23		0.06	307	
0029 701-22-029		2.64		0.05	582	
0030 701-22-030		5.33		0.06	729	
0031 701-22-031	0.9	1.28	0.025	0.07	403	17.80
0032 701-22-032	0.8	1.55	0.028	0.10	761	17.09
0033 701-22-033	0.3	2.09	0.036	0.05	920	11.40
0034 701-22-034		1.98		0.04	595	
0035 701-22-035		3.32		0.03	614	
0036 701-22-036		9.53		0.04	1025	
0037 701-22-037		4.72		0.06	1083	
0038 701-22-038		5.35		0.11	360	

ANALYSIS

0039 701-22-039	0.6	0.88	X	0.07	548	18.19
0040 701-22-040		1.32		0.65	1.77%	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0001 701-22-001	0.20	3.07	66.93	7	1.3	11.8
0002 701-22-002	0.75		65.36		12.6	
0003 701-22-003	0.68		46.42		17.3	
0004 701-22-004	0.24		69.40		11.8	
0005 701-22-005	0.12	0.79	71.18	6	4.3	26.5
0006 701-22-006	0.04		54.06		11.1	
0007 701-22-007	0.13		47.41		22.8	
0008 701-22-008	0.37	62.04	29.96	17	15.6	549.3
0009 701-22-009	0.13	0.46	55.84	84	5.2	9.1
0010 701-22-010	0.12		37.29		10.9	
0011 701-22-011	0.10		43.59		19.3	
0012 701-22-012	0.80	9.14	76.58	191	14.7	158.6
0013 701-22-013	0.05		73.50		9.6	
0014 701-22-014	0.62		71.86		21.0	
0015 701-22-015	0.08	3.29	46.46	47	21.3	350.5
0016 701-22-016	0.03		44.35		13.1	
0017 701-22-017	0.03		45.24		16.6	
0018 701-22-018	0.19	9.09	53.64	25	11.7	99.8
0019 701-22-019	0.05	1.73	61.46	32	11.4	149.3
0020 701-22-020	0.20	0.35	50.47	74	12.6	2.2
0021 701-22-021	1.37		69.35		20.7	
0022 701-22-022	0.58		66.88		15.7	
0023 701-22-023	0.78	9.15	68.05	278	16.1	97.9
0024 701-22-024	1.81		65.33		22.2	
0025 701-22-025	1.84		86.89		13.5	
0026 701-22-026	0.03		42.38		0.6	
0027 701-22-027	0.76	8.42	55.69	4	14.0	241.1
0028 701-22-028	2.05		33.21		4.9	
0029 701-22-029	0.13		27.50		12.3	
0030 701-22-030	0.04		20.58		16.1	
0031 701-22-031	0.15	7.88	24.61	22	11.3	297.5
0032 701-22-032	0.58	9.87	41.10	26	15.9	459.0
0033 701-22-033	0.48	2.88	39.13	12	11.2	119.8
0034 701-22-034	0.03		49.80		10.8	
0035 701-22-035	0.81		41.33		16.4	
0036 701-22-036	0.06		30.91		18.5	
0037 701-22-037	0.02		29.54		14.7	
0038 701-22-038	0.08		30.19		21.3	

ANALYSIS

0039 701-22-039	0.09	3.95	46.50	61	20.4	732.0
0040 701-22-040	0.07		30.53		17.3	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	No	14	X	2.55	407.4	1.77
0002 701-22-002	Yes	10		3.68	20.6	
0003 701-22-003	No	23		5.80	756.1	
0004 701-22-004	No	12		3.18	555.8	
0005 701-22-005	No	12	X	3.18	45.6	0.05
0006 701-22-006	No	14		1.90	127.9	
0007 701-22-007	No	20		0.12	817.9	
0008 701-22-008	No	26	X	0.10	634.9	17.91
0009 701-22-009	No	13	X	1.42	170.1	0.15
0010 701-22-010	No	19		0.93	383.7	
0011 701-22-011	No	26		0.19	1365.5	
0012 701-22-012	No	19	X	2.36	306.0	4.40
0013 701-22-013	No	17		1.53	922.7	
0014 701-22-014	No	18		0.12	5916.0*	
0015 701-22-015	No	17	X	0.11	815.9	15.46
0016 701-22-016	No	14		1.69	597.7	
0017 701-22-017	No	12		2.32	647.2	
0018 701-22-018	No	18	X	1.84	437.0	2.07
0019 701-22-019	No	15	X	2.13	431.5	9.94
0020 701-22-020	Yes	18	X	7.93	890.5	0.30
0021 701-22-021	Yes	17		12.62	1301.8	
0022 701-22-022	No	11		3.58	592.4	
0023 701-22-023	Yes	15	X	3.51	396.8	4.58
0024 701-22-024	No	11		5.66	668.0	
0025 701-22-025	No	20		2.43	961.2	
0026 701-22-026	No	18		1.17	273.8	
0027 701-22-027	No	20	X	1.49	36.4	0.36
0028 701-22-028	No	16		0.89	44.3	
0029 701-22-029	No	13		3.63	393.5	
0030 701-22-030	No	16		1.12	319.6	
0031 701-22-031	No	19	X	1.72	238.1	1.90
0032 701-22-032	No	39	X	3.19	419.4	3.33
0033 701-22-033	No	13	X	3.45	317.0	0.62
0034 701-22-034	No	11		2.77	291.6	
0035 701-22-035	No	67		0.42	709.3	
0036 701-22-036	No	18		1.49	271.3	
0037 701-22-037	No	17		1.56	83.1	
0038 701-22-038	No	22		1.29	440.4	

ANALYSIS

0039 701-22-039	No	26	X	1.28	114.3	2.93
0040 701-22-040	No	14		1.12	105.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0001 701-22-001	2.46	258	1.11	1.05	X	1.09
0002 701-22-002	2.51		1.53	1.02		5.11
0003 701-22-003	4.40		2.85	1.04		5.77
0004 701-22-004	5.02		2.86	1.52		4.51
0005 701-22-005	2.68	511	1.50	1.01	0.1	1.58
0006 701-22-006	4.07		2.23	1.20		3.57
0007 701-22-007	1.90		0.69	1.48		15.86
0008 701-22-008	0.95	438	0.30	0.69	0.2	4.85
0009 701-22-009	1.20	560	0.49	0.94	0.6	1.31
0010 701-22-010	0.79		0.40	0.67		2.93
0011 701-22-011	0.94		0.43	0.77		7.28
0012 701-22-012	7.70	1242	3.86	2.36	0.2	5.16
0013 701-22-013	5.67		2.90	1.59		2.24
0014 701-22-014	0.80		0.26	0.97		7.80
0015 701-22-015	0.24	466	0.09	0.63	0.2	9.39
0016 701-22-016	1.26		0.68	0.53		1.83
0017 701-22-017	1.37		0.74	0.55		2.18
0018 701-22-018	1.99	449	0.95	0.93	X	2.06
0019 701-22-019	2.26	549	1.20	0.97	X	2.62
0020 701-22-020	1.78	672	0.90	0.88	1.5	6.69
0021 701-22-021	3.11		1.77	1.32		7.17
0022 701-22-022	2.67		1.39	1.12		2.48
0023 701-22-023	2.63	1370	1.36	1.30	0.2	2.98
0024 701-22-024	3.57		2.01	1.18		3.62
0025 701-22-025	5.66		3.40	1.70		1.18
0026 701-22-026	0.98		0.52	0.80		3.74
0027 701-22-027	1.96	433	1.15	0.87	0.5	3.10
0028 701-22-028	2.06		0.84	0.66		1.04
0029 701-22-029	7.40		1.01	0.61		2.94
0030 701-22-030	1.20		0.66	0.51		7.07
0031 701-22-031	2.05	548	1.10	0.81	0.2	1.65
0032 701-22-032	1.63	644	0.96	0.67	0.2	3.78
0033 701-22-033	1.56	509	0.91	0.70	0.1	3.91
0034 701-22-034	3.02		1.10	1.12		3.32
0035 701-22-035	1.14		0.59	1.03		8.20
0036 701-22-036	1.67		0.88	0.80		7.71
0037 701-22-037	1.62		1.04	0.74		3.74
0038 701-22-038	1.60		0.87	0.71		7.42

ANALYSIS

0039 701-22-039	2.77	832	1.42	0.76	0.2	2.82
0040 701-22-040	1.26		0.63	0.80		3.53

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.05	1.4	0	15.97	3.27	1.07
0002 701-22-002		1.2	0	16.56	2.94	1.05
0003 701-22-003		1.4	0	32.57	4.02	0.90
0004 701-22-004		1.4	0	26.34	5.13	1.00
0005 701-22-005	0.19	1.5	0	19.58	3.19	1.18
0006 701-22-006		1.4	0	28.31	4.15	0.88
0007 701-22-007		1.4	0	18.92	3.73	1.83
0008 701-22-008	1.94	1.3	0	30.12	2.02	0.89
0009 701-22-009	0.07	1.3	0	24.40	2.52	1.26
0010 701-22-010		1.4	0	24.97	1.65	0.86
0011 701-22-011		1.4	0	35.11	2.01	1.33
0012 701-22-012	0.11	1.3	0	26.73	7.70	1.07
0013 701-22-013		1.4	0	19.82	5.60	1.42
0014 701-22-014		1.3	0	16.91	1.95	2.49
0015 701-22-015	2.60	1.4	0	4.40	0.98	1.23
0016 701-22-016		1.4	0	16.27	1.61	1.62
0017 701-22-017		1.4	0	16.66	1.69	1.58
0018 701-22-018	0.10	1.4	0	16.66	2.59	1.52
0019 701-22-019	0.19	1.4	0	16.33	2.73	1.37
0020 701-22-020	4.52	1.2	0	15.03	2.48	0.79
0021 701-22-021		1.2	0	19.12	4.04	1.33
0022 701-22-022		1.5	0	20.64	3.52	1.73
0023 701-22-023	0.12	1.6	0	18.90	3.49	1.51
0024 701-22-024		1.5	0	19.45	3.72	1.21
0025 701-22-025		1.5	0	17.29	5.40	1.88
0026 701-22-026		1.5	0	20.09	2.05	0.95
0027 701-22-027	0.78	1.5	0	17.82	6.71	1.12
0028 701-22-028		1.5	0	12.34	1.99	0.96
0029 701-22-029		1.5	0	18.68	1.55	1.13
0030 701-22-030		1.5	0	24.06	1.63	0.54
0031 701-22-031	0.83	1.5	0	18.02	2.77	1.57
0032 701-22-032	1.23	1.5	0	18.74	2.04	1.04
0033 701-22-033	0.64	1.4	0	23.93	2.00	0.80
0034 701-22-034		1.4	0	18.82	4.23	1.21
0035 701-22-035		1.4	0	7.40	2.52	0.68
0036 701-22-036		1.5	0	38.25	2.67	0.64
0037 701-22-037		1.5	0	31.02	2.20	0.90
0038 701-22-038		1.4	0	24.56	1.84	0.67

ANALYSIS

0039 701-22-039	0.40	1.5	0	18.94	2.73	1.02
0040 701-22-040		1.7	0	25.87	2.21	0.81

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0001 701-22-001	1.84	X	X	0.43	0.593	3.81%
0002 701-22-002	1.56	0.01		0.52	0.105	3.08%
0003 701-22-003	1.17	0.01		0.94	1.456	3.71%
0004 701-22-004	1.46	0.03		1.05	1.132	3.52%
0005 701-22-005	1.55	0.01	X	0.65	0.676	3.53%
0006 701-22-006	1.63	0.02		0.78	0.663	4.00%
0007 701-22-007	0.95	0.18		0.26	0.405	2307
0008 701-22-008	1.06	0.02	X	0.13	0.092	7904
0009 701-22-009	1.15	0.02	X	0.18	0.156	3.79%
0010 701-22-010	0.88	X		0.13	0.330	3.13%
0011 701-22-011	1.44	0.04		0.16	0.210	7861
0012 701-22-012	1.69	0.03	X	1.49	0.426	3.24%
0013 701-22-013	2.04	X		1.10	0.729	2.81%
0014 701-22-014	0.21	0.02		0.10	0.205	4843
0015 701-22-015	0.12	0.02	X	0.03	0.024	1.21%
0016 701-22-016	0.51	0.02		0.25	0.034	2.77%
0017 701-22-017	0.30	0.02		0.26	0.104	2.88%
0018 701-22-018	0.33	0.02	X	0.36	0.035	3.01%
0019 701-22-019	0.53	X	X	0.42	0.068	3.46%
0020 701-22-020	0.12	0.01	X	0.33	0.029	2.27%
0021 701-22-021	0.14	0.03		0.62	0.410	2.13%
0022 701-22-022	0.31	0.03		0.52	0.159	2.62%
0023 701-22-023	0.71	0.02	X	0.49	0.066	2.61%
0024 701-22-024	0.30	0.07		0.69	0.701	3.55%
0025 701-22-025	0.47	X		1.16	0.062	2.04%
0026 701-22-026	1.60	X		0.19	1.252	3.28%
0027 701-22-027	1.64	0.02	X	0.39	0.345	3.88%
0028 701-22-028	1.33	0.04		0.28	0.392	2.17%
0029 701-22-029	1.79	0.04		0.33	0.993	3.42%
0030 701-22-030	1.11	0.04		0.22	0.748	1.62%
0031 701-22-031	1.96	X	X	0.36	4.726	2.65%
0032 701-22-032	1.73	0.03	X	0.32	0.915	3.71%
0033 701-22-033	1.44	0.01	X	0.29	0.459	3.59%
0034 701-22-034	1.70	X		0.45	0.791	2.93%
0035 701-22-035	1.17	0.02		0.19	0.083	1.72%
0036 701-22-036	1.54	0.03		0.31	0.515	3.12%
0037 701-22-037	1.54	X		0.32	0.638	3.51%
0038 701-22-038	0.94	X		0.31	0.311	3.31%

ANALYSIS

0039 701-22-039	2.23	0.02	X	0.50	0.623	3.42%
0040 701-22-040	1.39	X		0.23	0.164	3.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	16.7	38.34	5.5	0.164	3760	6.52
0002 701-22-002		37.90	12.7	0.243	6818	
0003 701-22-003		27.29	2.2	0.406	2838	
0004 701-22-004		37.25	4.9	0.368	3051	
0005 701-22-005	22.9	38.73	13.6	0.212	7822	18.57
0006 701-22-006		27.27	2.5	0.264	2892	
0007 701-22-007		21.06	35.3	0.106	136	
0008 701-22-008	2.5	16.11	4.9	0.058	122	13.85
0009 701-22-009	18.7	30.23	2.9	0.073	2139	6.30
0010 701-22-010		20.77	4.3	0.076	1507	
0011 701-22-011		24.18	25.1	0.093	176	
0012 701-22-012	29.4	42.52	6.5	0.371	2952	23.23
0013 701-22-013		41.01	30.6	0.316	2593	
0014 701-22-014		44.80	7.2	0.037	120	
0015 701-22-015	3.4	26.40	4.7	0.014	106	10.35
0016 701-22-016		28.24	3.0	0.081	2688	
0017 701-22-017		29.07	3.1	0.090	3079	
0018 701-22-018	22.4	30.18	3.3	0.114	2684	14.24
0019 701-22-019	23.9	35.94	2.7	0.145	2937	17.24
0020 701-22-020	4.2	26.97	3.7	0.104	7768	6.55
0021 701-22-021		38.44	15.9	0.188	4270	
0022 701-22-022		35.68	29.8	0.177	3004	
0023 701-22-023	34.5	36.93	16.7	0.167	2823	25.94
0024 701-22-024		36.44	6.3	0.224	3955	
0025 701-22-025		47.58	15.8	0.453	2374	
0026 701-22-026		22.55	0.5	0.103	2199	
0027 701-22-027	26.4	31.12	2.7	0.193	3307	15.40
0028 701-22-028		16.37	2.8	0.117	1687	
0029 701-22-029		13.74	1.8	0.162	2469	
0030 701-22-030		11.08	0.7	0.129	798	
0031 701-22-031	19.6	12.65	3.2	0.178	1935	27.21
0032 701-22-032	24.8	21.45	0.5	0.186	2432	28.73
0033 701-22-033	26.8	22.01	0.5	0.154	2004	20.94
0034 701-22-034		25.29	2.7	0.173	1985	
0035 701-22-035		22.69	1.5	0.123	191	
0036 701-22-036		16.61	0.7	0.151	1338	
0037 701-22-037		14.86	0.6	0.169	1493	
0038 701-22-038		18.65	1.1	0.134	1143	

ANALYSIS

0039 701-22-039	26.8	27.25	2.1	0.208	1806	31.97
0040 701-22-040		16.28	0.9	0.126	1843	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0001 701-22-001	163	1.33		1.4	0.12	32
0002 701-22-002	9922			2.3		10
0003 701-22-003	291			2.7		174
0004 701-22-004	133			1.4		136
0005 701-22-005	1142	1.26		1.4	0.15	21
0006 701-22-006	82			1.3		99
0007 701-22-007	41			1.5		558
0008 701-22-008	27	0.50		2.5	0.29	209
0009 701-22-009	54	0.04		3.9	11.45	52
0010 701-22-010	72			2.2		114
0011 701-22-011	42			2.2		277
0012 701-22-012	51	0.09		2.2	0.07	164
0013 701-22-013	93			2.3		63
0014 701-22-014	30			181.9*		293
0015 701-22-015	30	0.37		48.8	0.08	388
0016 701-22-016	45			13.2		60
0017 701-22-017	61			8.3		62
0018 701-22-018	33	0.25		5.4	X	54
0019 701-22-019	44	0.32		3.8	X	61
0020 701-22-020	2062	0.12		2.8	7.99	16
0021 701-22-021	4514			1.3		80
0022 701-22-022	145			2.6		54
0023 701-22-023	1297	2.00		2.2	0.06	45
0024 701-22-024	65			2.4		96
0025 701-22-025	41			7.6		24
0026 701-22-026	490			1.6		23
0027 701-22-027	119	0.68		1.4	0.12	91
0028 701-22-028	93			1.4		35
0029 701-22-029	142			0.5		73
0030 701-22-030	74			2.0		236
0031 701-22-031	150	2.10		1.2	X	49
0032 701-22-032	205	2.10		2.0	X	117
0033 701-22-033	135	0.90		1.1	X	132
0034 701-22-034	200			2.7		99
0035 701-22-035	54			3.0		361
0036 701-22-036	53			1.8		272
0037 701-22-037	53			0.9		136
0038 701-22-038	127			3.9		275

ANALYSIS

0039 701-22-039	78	1.15	1.3	0.06	134
0040 701-22-040	70		3.2		125

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0001 701-22-001	1473	14.2	2	5.6	0	35
0002 701-22-002	303		0	7.5	0	-5
0003 701-22-003	295		142	2.2	127	175
0004 701-22-004	346		110	2.2	98	140
0005 701-22-005	365	49.9	11	2.9	6	15
0006 701-22-006	380		89	2.2	79	102
0007 701-22-007	589		455	2.2	424	569
0008 701-22-008	1685	30.3	147	2.2	133	215
0009 701-22-009	1196	92.7	17	2.7	12	55
0010 701-22-010	822		77	2.3	67	116
0011 701-22-011	819		201	2.2	180	284
0012 701-22-012	1437	239.6	144	2.1	133	167
0013 701-22-013	1072		41	2.4	31	66
0014 701-22-014	1129		163	2.4	136	298
0015 701-22-015	1377	43.6	281	2.2	261	396
0016 701-22-016	710		30	2.5	21	63
0017 701-22-017	575		37	2.5	27	65
0018 701-22-018	1093	39.5	28	2.5	20	57
0019 701-22-019	1139	42.9	43	2.4	33	64
0020 701-22-020	1.24%	132.4	0	6.7	0	-1
0021 701-22-021	1196		36	3.2	7	67
0022 701-22-022	1472		38	2.4	29	50
0023 701-22-023	1551	243.8	24	2.7	11	40
0024 701-22-024	1859		72	2.3	63	91
0025 701-22-025	1255		7	3.2	3	20
0026 701-22-026	624		0	6.5	0	19
0027 701-22-027	655	12.9	79	2.2	68	87
0028 701-22-028	205		25	2.5	17	31
0029 701-22-029	449		61	2.3	49	69
0030 701-22-030	382		205	2.2	190	235
0031 701-22-031	310	31.5	29	2.5	21	45
0032 701-22-032	439	37.3	92	2.2	82	115
0033 701-22-033	638	36.0	104	2.2	93	129
0034 701-22-034	545		82	2.2	70	94
0035 701-22-035	1580		242	2.3	223	363
0036 701-22-036	741		224	2.2	208	270
0037 701-22-037	902		101	2.3	90	134
0038 701-22-038	969		217	2.2	200	274

ANALYSIS

0039 701-22-039	561	85.6	72	2.4	60	133
0040 701-22-040	894		46	2.6	38	84

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	4.32	23.55	22.9	X	651	X
0002 701-22-002	3.55	23.19	11.4		608	
0003 701-22-003	2.64	19.96	12.4		668	
0004 701-22-004	3.25	28.11	6.0		869	
0005 701-22-005	4.08	26.68	3.9	0.02	130	X
0006 701-22-006	3.32	20.77	7.0		620	
0007 701-22-007	1.92	24.15	31.4		922	
0008 701-22-008	1.65	12.05	16.0	0.14	703	0.3
0009 701-22-009	1.98	21.48	3.8	X	533	X
0010 701-22-010	1.69	13.61	7.3		374	
0011 701-22-011	2.21	16.51	21.7		537	
0012 701-22-012	4.29	31.86	9.5	0.07	676	X
0013 701-22-013	4.37	28.72	3.9		466	
0014 701-22-014	0.80	20.70	10.5		518	
0015 701-22-015	0.68	16.80	10.7	0.13	531	0.3
0016 701-22-016	1.58	13.49	7.2		589	
0017 701-22-017	1.49	13.70	6.4		421	
0018 701-22-018	1.29	20.22	8.1	0.06	427	X
0019 701-22-019	1.61	21.37	6.6	0.11	376	0.2
0020 701-22-020	2.89	19.67	11.2	X	502	0.4
0021 701-22-021	2.64	28.43	11.0		753	
0022 701-22-022	2.46	26.12	7.2		191	
0023 701-22-023	3.82	26.60	6.5	0.05	284	X
0024 701-22-024	2.74	24.76	14.2		416	
0025 701-22-025	3.57	34.32	6.6		880	
0026 701-22-026	1.65	15.83	1.1		624	
0027 701-22-027	2.99	20.53	9.5	0.16	441	X
0028 701-22-028	2.41	11.41	7.3		143	
0029 701-22-029	1.55	10.73	7.7		379	
0030 701-22-030	1.18	8.12	12.5		480	
0031 701-22-031	3.20	10.43	13.4	0.13	323	X
0032 701-22-032	2.79	15.01	17.9	0.20	477	X
0033 701-22-033	2.22	14.34	6.7	0.04	651	X
0034 701-22-034	2.30	19.10	7.8		733	
0035 701-22-035	1.59	17.59	31.1		454	
0036 701-22-036	3.33	12.85	10.2		708	
0037 701-22-037	2.61	11.65	7.6		671	
0038 701-22-038	1.47	10.84	13.1		394	

ANALYSIS

0039 701-22-039	3.97	15.93	11.3	0.22	466	X
0040 701-22-040	1.97	13.41	12.3		619	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	324.0	1.8	4.9		6.654	162.63
0002 701-22-002	51.9		7.1	2.9	6.650	135.10
0003 701-22-003	30.9		4.3		4.971	140.10
0004 701-22-004	167.9		3.8		7.626	138.60
0005 701-22-005	9.9	1.8	5.2		7.392	151.77
0006 701-22-006	82.5		4.4		5.487	158.52
0007 701-22-007	415.5		3.5		5.695	2.99
0008 701-22-008	205.7	3.1	4.4		3.209	3.14
0009 701-22-009	124.5	0.6	6.6		5.763	125.49
0010 701-22-010	103.3		5.1		3.690	90.37
0011 701-22-011	106.8		4.8		4.500	8.25
0012 701-22-012	59.3	1.2	5.0		8.209	113.56
0013 701-22-013	10.4		6.6		7.722	114.42
0014 701-22-014	54.1		5.5		7.096	3.08
0015 701-22-015	51.4	X	4.3		4.877	3.25
0016 701-22-016	15.8		4.6		4.047	79.18
0017 701-22-017	35.0		4.5		4.173	95.57
0018 701-22-018	18.4	0.5	4.6		5.561	91.47
0019 701-22-019	25.2	0.6	4.4		6.217	105.60
0020 701-22-020	14.2	4.2	8.5	2.8	5.319	83.44
0021 701-22-021	157.3		5.9	2.8	7.478	95.49
0022 701-22-022	86.0		5.6		7.140	102.63
0023 701-22-023	54.3	0.5	6.1	3.2	7.285	99.00
0024 701-22-024	418.0		5.1		6.736	135.89
0025 701-22-025	17.0		6.3		9.189	70.98
0026 701-22-026	68.7		6.2		4.422	114.14
0027 701-22-027	126.9	0.9	4.7		5.807	149.69
0028 701-22-028	16.4		4.9		3.210	88.98
0029 701-22-029	65.7		4.0		2.917	132.80
0030 701-22-030	176.9		4.3		2.141	51.65
0031 701-22-031	15.4	0.6	4.4		2.718	98.69
0032 701-22-032	51.9	1.7	4.1		3.994	148.26
0033 701-22-033	77.0	1.0	4.5		3.857	131.58
0034 701-22-034	20.0		4.6		5.221	113.43
0035 701-22-035	90.6		4.7		4.524	11.44
0036 701-22-036	100.2		4.0		3.335	95.48
0037 701-22-037	63.0		4.3		3.088	113.03
0038 701-22-038	33.0		4.8		3.067	98.89

ANALYSIS

0039 701-22-039	64.4	X	4.4	4.708	85.31
0040 701-22-040	96.2		8.0	3.311	97.98

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0001 701-22-001	X	1.04	9974	25.1	X	0.37
0002 701-22-002	X	0.32	2913		0.21	0.03
0003 701-22-003	0.007	5.67	5.70%		4.56	0.21
0004 701-22-004	X	4.43	4.22%		3.57	0.17
0005 701-22-005	X	0.67	5889	61.2	0.47	0.04
0006 701-22-006	X	3.23	3.25%		2.83	0.09
0007 701-22-007	0.003	18.24	16.96%		11.73	0.58
0008 701-22-008	0.008	6.83	6.65%	56.1	4.20	0.54
0009 701-22-009	0.022	1.69	1.71%	34.2	0.58	0.27
0010 701-22-010	0.002	3.71	3.71%		2.13	0.40
0011 701-22-011	X	9.05	8.63%		5.11	0.61
0012 701-22-012	X	5.35	5.19%	116.6	4.27	0.15
0013 701-22-013	X	2.06	2.23%		1.53	0.19
0014 701-22-014	0.055	9.56	9.05%		6.82	0.42
0015 701-22-015	0.079	12.68	11.74%	45.6	7.85	0.85
0016 701-22-016	0.107	1.96	2.05%		1.12	0.20
0017 701-22-017	0.070	2.01	2.18%		1.35	0.21
0018 701-22-018	0.049	1.76	1.85%	48.9	1.09	0.21
0019 701-22-019	0.030	1.99	2.22%	58.5	1.55	0.15
0020 701-22-020	0.010	0.52	4699	28.4	0.36	0.05
0021 701-22-021	0.009	2.62	2.54%		2.19	0.12
0022 701-22-022	0.010	1.78	1.84%		1.62	0.09
0023 701-22-023	0.016	1.47	1.42%	91.0	1.23	0.09
0024 701-22-024	0.022	3.13	3.19%		2.51	0.13
0025 701-22-025	0.037	0.79	6956		0.56	0.04
0026 701-22-026	X	0.74	6448		X	0.20
0027 701-22-027	0.007	2.98	2.96%	57.5	2.32	0.13
0028 701-22-028	X	1.14	6858		0.41	0.04
0029 701-22-029	X	2.40	2.68%		2.08	0.12
0030 701-22-030	0.002	7.71	7.22%		5.54	0.33
0031 701-22-031	X	1.59	1.63%	71.7	1.06	0.16
0032 701-22-032	0.004	3.82	3.79%	83.8	2.70	0.18
0033 701-22-033	X	4.30	4.03%	65.1	3.27	0.20
0034 701-22-034	X	3.22	3.27%		2.53	0.16
0035 701-22-035	0.006	11.79	10.70%		7.15	0.97
0036 701-22-036	X	8.89	8.36%		6.58	0.49
0037 701-22-037	X	4.46	4.06%		2.97	0.33
0038 701-22-038	0.005	9.00	8.46%		6.25	0.50

ANALYSIS

0039 701-22-039	X	4.38	4.34%	99.5	2.18	0.61
0040 701-22-040	X	4.07	3.86%		2.75	0.35

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.36	X	9.6	0.9	0.8	0.47
0002 701-22-002	0.37		7.5	X		0.02
0003 701-22-003	0.69		17.0	2.5		1.78
0004 701-22-004	0.52		11.0	2.2		1.85
0005 701-22-005	0.29	0.04	8.0	0.5	11.2	0.21
0006 701-22-006	0.32		11.8	1.9		1.60
0007 701-22-007	3.98		9.9	4.5		4.07
0008 701-22-008	1.10	0.70	13.6	2.1	2.6	1.43
0009 701-22-009	0.60	4.79	15.5	0.8	1.5	0.64
0010 701-22-010	0.47		12.9	1.6		1.15
0011 701-22-011	0.81		12.8	4.2		4.15
0012 701-22-012	0.68	0.24	14.4	6.6	22.0	5.99
0013 701-22-013	0.42		14.7	1.2		0.57
0014 701-22-014	2.03		8.2	6.0		5.43
0015 701-22-015	1.75	0.32	4.6	6.0	1.5	4.95
0016 701-22-016	0.60		12.8	2.4		1.87
0017 701-22-017	0.47		11.6	3.2		2.00
0018 701-22-018	0.40	0.11	13.6	1.4	6.9	1.00
0019 701-22-019	0.56	0.54	11.4	1.7	5.0	1.38
0020 701-22-020	0.05	0.21	10.7	0.8	3.0	0.54
0021 701-22-021	0.56		16.5	1.0		0.91
0022 701-22-022	0.26		11.9	1.4		0.94
0023 701-22-023	0.25	0.04	13.0	1.4	3.5	1.15
0024 701-22-024	0.62		11.9	1.7		1.66
0025 701-22-025	0.39		11.8	0.9		0.89
0026 701-22-026	1.46		10.1	1.9		1.73
0027 701-22-027	0.44	0.58	12.3	1.0	3.6	0.76
0028 701-22-028	0.46		6.7	X		0.22
0029 701-22-029	0.58		10.3	X		0.38
0030 701-22-030	0.67		8.7	1.8		1.65
0031 701-22-031	0.71	0.14	10.6	X	1.6	0.10
0032 701-22-032	1.76	0.19	11.8	0.9	2.1	X
0033 701-22-033	0.56	0.12	11.0	0.9	1.4	X
0034 701-22-034	0.49		8.7	0.9		0.64
0035 701-22-035	2.49		9.6	2.4		1.55
0036 701-22-036	0.85		13.8	2.4		1.96
0037 701-22-037	0.63		14.3	0.7		0.60
0038 701-22-038	0.45		14.8	2.5		1.99

ANALYSIS

0039 701-22-039	0.46	0.19	20.7	0.8	5.2	0.51
0040 701-22-040	0.39		11.4	1.3		1.12

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	3.93	0.7	X	76.31	10.72	0.39
0002 701-22-002	3.79	0.5		13.09		0.36
0003 701-22-003	3.93	3.4		49.34		0.22
0004 701-22-004	5.48	3.2		278.89		0.30
0005 701-22-005	4.42	0.7	X	16.33	15.41	0.40
0006 701-22-006	4.09	0.9		175.07		0.30
0007 701-22-007	5.66	4.5		1065.68		0.17
0008 701-22-008	2.50	2.0	5.7	352.60	72.26	0.14
0009 701-22-009	3.70	1.6	X	203.56	6.20	0.17
0010 701-22-010	2.52	0.6		94.52		0.14
0011 701-22-011	2.94	2.2		313.24		0.19
0012 701-22-012	7.39	1.9	X	414.61	20.44	0.36
0013 701-22-013	5.53	0.7		23.98		0.35
0014 701-22-014	3.18	6.5		421.95		0.07
0015 701-22-015	2.62	13.3	X	553.05	147.55	0.07
0016 701-22-016	2.27	0.9		155.70		0.14
0017 701-22-017	2.29	0.8		91.60		0.14
0018 701-22-018	3.57	1.2	X	95.69	17.73	0.11
0019 701-22-019	3.57	1.7	X	87.22	17.13	0.13
0020 701-22-020	3.48	0.6	X	178.14	10.48	0.21
0021 701-22-021	5.30	0.7		285.42		0.19
0022 701-22-022	4.65	1.5		62.43		0.20
0023 701-22-023	4.77	0.8	X	128.74	20.83	0.31
0024 701-22-024	4.46	0.9		176.09		0.22
0025 701-22-025	6.46	0.7		343.12		0.33
0026 701-22-026	3.14	0.8		64.55		0.16
0027 701-22-027	3.48	1.1	X	84.11	68.58	0.25
0028 701-22-028	2.20	0.6		31.38		0.20
0029 701-22-029	2.13	0.8		112.54		0.13
0030 701-22-030	1.84	1.7		110.90		0.10
0031 701-22-031	2.52	0.6	X	115.73	11.21	0.27
0032 701-22-032	2.67	1.1	X	149.70	12.15	0.21
0033 701-22-033	2.40	1.1	X	93.73	9.51	0.19
0034 701-22-034	3.70	0.7		287.25		0.19
0035 701-22-035	3.70	10.1		452.33		0.12
0036 701-22-036	2.99	4.6		230.14		0.24
0037 701-22-037	3.31	1.3		130.84		0.18
0038 701-22-038	2.01	3.0		194.63		0.12

ANALYSIS

0039 701-22-039	2.96	0.6	X	214.29	13.06	0.32
0040 701-22-040	2.74	1.2		240.09		0.20

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0001 701-22-001	0.459	160	0.07	20.90	0.081	2244
0002 701-22-002	0.421		X	23.46		1619
0003 701-22-003	0.671		0.74	13.37		1927
0004 701-22-004	0.797		1.92	17.36		1558
0005 701-22-005	0.436	401	0.34	19.27	0.212	2020
0006 701-22-006	0.633		1.08	18.07		1733
0007 701-22-007	0.439		1.63	12.23		1101
0008 701-22-008	0.230	362	1.09	11.13	0.410	1455
0009 701-22-009	0.273	389	0.42	15.23	0.248	1959
0010 701-22-010	0.187		0.74	14.03		1082
0011 701-22-011	0.219		2.71	14.72		1512
0012 701-22-012	1.228	947	3.35	24.11	0.065	2512
0013 701-22-013	0.918		0.57	22.73		2970
0014 701-22-014	0.213		1.21	11.20		546
0015 701-22-015	0.078	420	0.35	10.71	0.068	457
0016 701-22-016	0.218		X	16.56		1369
0017 701-22-017	0.226		0.06	15.08		1347
0018 701-22-018	0.353	382	0.07	14.73	0.041	1143
0019 701-22-019	0.387	350	0.06	16.01	0.143	1071
0020 701-22-020	0.326	488	0.08	15.06	1.213	1931
0021 701-22-021	0.563		0.72	13.58		2525
0022 701-22-022	0.455		0.16	19.33		2055
0023 701-22-023	0.455	1016	0.24	20.86	0.337	2824
0024 701-22-024	0.543		0.35	19.53		2323
0025 701-22-025	0.861		0.07	23.19		2539
0026 701-22-026	0.207		0.96	12.82		1068
0027 701-22-027	0.338	265	0.42	18.66	0.136	1893
0028 701-22-028	0.311		0.24	13.79		1585
0029 701-22-029	0.312		0.72	11.79		929
0030 701-22-030	0.230		0.60	11.91		664
0031 701-22-031	0.377	440	0.15	14.40	0.248	2070
0032 701-22-032	0.275	439	0.51	14.09	0.188	1307
0033 701-22-033	0.274	340	0.64	13.13	0.294	1204
0034 701-22-034	0.621		0.69	14.62		1238
0035 701-22-035	0.249		0.33	16.01		664
0036 701-22-036	0.336		0.81	12.13		1669
0037 701-22-037	0.301		1.32	11.99		1330
0038 701-22-038	0.266		0.29	8.68		826

ANALYSIS

0039 701-22-039	0.450	625	0.66	20.14	0.152	2866
0040 701-22-040	0.276		0.82	11.97		919

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	1.85	0.16	3.61	0.184	84	X
0002 701-22-002	1.60	0.24	4.58		81	
0003 701-22-003	1.73	0.43	6.56		124	
0004 701-22-004	1.78	0.40	5.48		107	
0005 701-22-005	1.93	0.20	4.34	2.174	87	X
0006 701-22-006	2.22	0.31	5.16		105	
0007 701-22-007	9.44	0.10	7.02		90	
0008 701-22-008	0.14	0.04	3.52	22.026	135	X
0009 701-22-009	1.61	0.09	3.50	1.131	134	X
0010 701-22-010	1.12	0.06	3.27		96	
0011 701-22-011	0.15	0.07	5.89		114	
0012 701-22-012	1.21	0.53	6.68	13.273	91	X
0013 701-22-013	1.54	0.41	4.90		104	
0014 701-22-014	0.70	0.03	3.25		88	
0015 701-22-015	0.08	0.01	0.65	14.649	88	X
0016 701-22-016	0.84	0.09	2.01		119	
0017 701-22-017	1.20	0.12	1.92		99	
0018 701-22-018	1.12	0.13	3.27	34.096	104	X
0019 701-22-019	1.22	0.16	3.57	53.465	101	X
0020 701-22-020	0.74	0.12	1.29	0.521	95	0.08
0021 701-22-021	1.20	0.23	1.59		143	
0022 701-22-022	1.11	0.19	2.88		115	
0023 701-22-023	1.20	0.20	2.96	0.260	121	X
0024 701-22-024	1.75	0.28	3.08		117	
0025 701-22-025	0.78	0.48	2.91		116	
0026 701-22-026	1.44	0.09	3.16		93	
0027 701-22-027	1.86	0.17	4.17	5.165	106	X
0028 701-22-028	1.13	0.11	3.09		71	
0029 701-22-029	1.59	0.16	3.30		85	
0030 701-22-030	0.70	0.11	3.82		76	
0031 701-22-031	1.27	0.17	4.20	24.531	90	X
0032 701-22-032	2.16	0.16	4.66	59.662	89	X
0033 701-22-033	1.79	0.14	4.71	39.155	84	X
0034 701-22-034	1.58	0.15	3.54		80	
0035 701-22-035	0.21	0.11	4.19		84	
0036 701-22-036	1.24	0.14	6.44		94	
0037 701-22-037	1.34	0.16	5.19		104	
0038 701-22-038	1.05	0.13	3.52		97	

ANALYSIS

0039 701-22-039	1.14	0.21	6.27	26.375	128	X
0040 701-22-040	1.25	0.10	5.33		84	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0001 701-22-001	2.6	9.31	1.12	62	0.31	54.3
0002 701-22-002	1.8	14.15	1.54	542		48.3
0003 701-22-003	1.6	25.17	2.94	425		38.2
0004 701-22-004	2.3	25.63	2.58	50		44.4
0005 701-22-005	2.6	14.50	1.42	158	0.68	48.4
0006 701-22-006	2.6	20.27	1.88	39		52.7
0007 701-22-007	5.3	4.89	0.69	19		33.1
0008 701-22-008	2.5	2.63	0.32	11	0.89	19.0
0009 701-22-009	2.5	3.70	0.50	17	0.02	33.6
0010 701-22-010	1.8	3.15	0.49	13		26.1
0011 701-22-011	5.5	3.51	0.54	8		42.4
0012 701-22-012	2.5	37.37	2.85	162	0.80	50.5
0013 701-22-013	2.5	27.21	2.28	24		64.7
0014 701-22-014	5.7	2.14	0.23	23		6.0
0015 701-22-015	5.1	0.80	0.08	9	0.45	3.6
0016 701-22-016	1.4	6.55	0.69	19		18.9
0017 701-22-017	1.5	7.25	0.67	31		10.9
0018 701-22-018	1.9	9.06	0.79	46	1.82	9.4
0019 701-22-019	2.7	11.91	1.09	27	1.78	9.6
0020 701-22-020	0.5	8.38	0.77	1071	0.66	7.8
0021 701-22-021	0.8	16.91	1.44	592		4.6
0022 701-22-022	2.4	13.00	1.24	95		16.6
0023 701-22-023	2.1	13.20	1.10	298	2.76	27.2
0024 701-22-024	1.6	20.37	1.55	519		14.5
0025 701-22-025	2.3	31.06	3.69	185		23.9
0026 701-22-026	0.6	4.47	1.18	34		48.5
0027 701-22-027	1.1	10.21	1.41	243	1.63	53.6
0028 701-22-028	0.6	6.32	0.79	448		39.3
0029 701-22-029	1.6	8.81	1.00	42		57.0
0030 701-22-030	1.1	5.57	0.80	19		35.9
0031 701-22-031	1.1	8.68	1.14	36	1.99	64.4
0032 701-22-032	1.1	11.61	1.12	219	2.84	55.4
0033 701-22-033	1.1	7.74	1.23	251	0.93	50.7
0034 701-22-034	0.8	9.39	1.05	25		52.8
0035 701-22-035	1.4	4.89	0.83	59		38.4
0036 701-22-036	2.4	7.78	1.02	21		46.5
0037 701-22-037	1.8	8.16	1.04	16		51.0
0038 701-22-038	1.4	7.60	0.88	30		28.4

ANALYSIS

0039 701-22-039	1.4	12.60	1.47	32	0.61	67.7
0040 701-22-040	2.0	5.11	0.76	141		45.7

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0041 701-22-041	0.16	0.02	8.14%	0.08	1	7.8
0042 701-22-042	0.13		7.02%		0	18.3
0043 701-22-043	0.06		9.50%		2	2.5
0044 701-22-044	0.07	0.05	9.92%	0.34	1	1.9
0045 701-22-045	0.58		5.65%		0	21.3
0046 701-22-046	1.64	0.01	7.41%	0.08	31	36.3
0047 701-22-047	0.12		7.77%		99	4.5
0048 701-22-048	0.26		8.20%		57	12.2
0049 701-22-049	1.11	0.03	8.80%	0.13	5	24.8
0050 701-22-050	2.33		8.15%		1	46.6
0051 701-22-051	0.53		7.48%		100	12.1
0052 701-22-052	0.12	0.07	7.54%	0.45	134	3.8
0053 701-22-053	1.19		7.94%		32	5.8
0054 701-22-054	1.45		7.73%		4	44.6
0055 701-22-055	0.18	0.09	8.49%	0.11	13	6.2
0056 701-22-056	0.17		8.24%		3	4.0
0057 701-22-057	0.21		10.29%		1	39.7
0058 701-22-058	0.15		10.96%		4	4.8
0059 701-22-059	0.36	X	8.65%	0.21	11	5.7
0060 701-22-060	0.70	0.12	8.74%	0.39	6	15.9
0061 701-22-061	0.58		7.57%		2	6.7
0062 701-22-062	0.06		8.86%		3	10.2
0063 701-22-063	0.82		6.95%		1	86.5
0064 701-22-064	0.46	0.01	8.05%	2.81	-1	21.9
0065 701-22-065	0.38		7.36%		0	14.3
0066 701-22-066	0.10		11.67%*		4	4.7
0067 701-22-067	1.29	0.03	7.22%	17.83	3	24.6
0068 701-22-068	2.37		8.15%		3	29.7
0069 701-22-069	0.79		7.94%		5	18.7
0070 701-22-070	0.93		7.95%		6	13.4
0071 701-22-071	0.06	0.03	8.18%	3.24	93	2.2
0072 701-22-072	0.17	0.08	7.82%	1.38	125	4.6
0073 701-22-073	0.17		7.81%		104	14.8
0074 701-22-074	1.94		7.70%		18	108.0
0075 701-22-075	2.72		6.58%		6	78.6
0076 701-22-076	1.25		8.01%		-1	249.6
0077 701-22-077	0.22		10.47%		4	7.7
0078 701-22-078	1.03		8.31%		5	132.5

ANALYSIS

0079 701-22-079	1.42	7.75%	5	40.1
0080 701-22-080	0.52	8.57%	5	16.5

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	X	0.18	326.8	4.51	0.28
0042 701-22-042		X		287.8		0.21
0043 701-22-043		X		591.7		0.89
0044 701-22-044	2.7	X	0.12	441.8	5.99	0.61
0045 701-22-045		X		192.8		0.25
0046 701-22-046	1.6	13	0.28	584.9	18.96	2.12
0047 701-22-047		12		245.6		1.48
0048 701-22-048		17		112.3		2.07
0049 701-22-049	2.4	X	0.25	226.4	14.50	1.79
0050 701-22-050		X		275.3		0.25
0051 701-22-051		12		1024.8		1.28
0052 701-22-052	3.9	X	0.04	856.6	60.96	1.14
0053 701-22-053		11		378.5		1.25
0054 701-22-054		X		363.2		2.51
0055 701-22-055	1.9	X	0.04	581.1	30.01	1.81
0056 701-22-056		X		540.3		0.78
0057 701-22-057		X		1364.1		0.90
0058 701-22-058		X		1041.3		1.36
0059 701-22-059	1.4	X	0.07	282.2	7.50	1.54
0060 701-22-060	2.2	X	0.05	652.6	14.78	1.70
0061 701-22-061		X		398.8		0.74
0062 701-22-062		X		252.3		0.84
0063 701-22-063		X		204.5		0.30
0064 701-22-064	1.0	X	0.03	249.2	0.46	0.20
0065 701-22-065		X		418.2		0.09
0066 701-22-066		X		367.7		2.05
0067 701-22-067	7.7	X	0.04	213.0	20.46	0.99
0068 701-22-068		X		421.5		1.06
0069 701-22-069		X		382.4		1.31
0070 701-22-070		X		367.1		1.28
0071 701-22-071	5.6	14	0.04	588.2	227.06	1.22
0072 701-22-072	4.9	17	0.02	1384.9	71.60	1.21
0073 701-22-073		15		176.6		1.38
0074 701-22-074		X		246.5		2.45
0075 701-22-075		X		380.9		1.32
0076 701-22-076		X		220.3		2.15
0077 701-22-077		X		115.0		1.73
0078 701-22-078		X		427.9		0.86

ANALYSIS

0079 701-22-079	X	316.0	0.64
0080 701-22-080	X	432.8	0.30

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	X	1.60	X	0.03	803	19.38
0042 701-22-042		1.02		0.03	552	
0043 701-22-043		0.47		0.04	300	
0044 701-22-044	0.2	0.91	X	0.06	396	25.48
0045 701-22-045		2.97		0.04	339	
0046 701-22-046	X	0.75	X	0.83	2409	25.78
0047 701-22-047		0.06		1.37	2.30%	
0048 701-22-048		0.05		0.69	2139	
0049 701-22-049	2.9	1.44	0.016	0.05	1118	10.46
0050 701-22-050		2.45		0.16	727	
0051 701-22-051		1.24		1.57	2.79%	
0052 701-22-052	X	0.11	X	2.06	2.95%	6.85
0053 701-22-053		2.19		1.05	2929	
0054 701-22-054		1.95		0.04	1131	
0055 701-22-055	X	0.20	X	0.41	2575	9.18
0056 701-22-056		0.70		0.03	205	
0057 701-22-057		0.42		0.03	287	
0058 701-22-058		0.42		0.04	338	
0059 701-22-059	0.1	0.13	X	0.65	1201	9.39
0060 701-22-060	1.7	1.55	0.013	0.05	919	8.99
0061 701-22-061		3.45		0.04	778	
0062 701-22-062		1.62		0.04	674	
0063 701-22-063		3.07		0.03	803	
0064 701-22-064	0.2	2.21	0.005	0.02	900	10.44
0065 701-22-065		1.86		0.02	819	
0066 701-22-066		0.13		0.02	317	
0067 701-22-067	2.0	2.28	0.020	0.04	182	11.02
0068 701-22-068		4.24		0.05	397	
0069 701-22-069		1.68		0.08	440	
0070 701-22-070		1.04		0.05	262	
0071 701-22-071	0.8	0.13	0.057	1.09	3.62%	8.83
0072 701-22-072	0.2	0.28	0.007	1.53	3.70%	8.40
0073 701-22-073		0.11		1.72	2.57%	
0074 701-22-074		1.79		0.71	4535	
0075 701-22-075		2.03		0.05	1492	
0076 701-22-076		0.55		0.05	780	
0077 701-22-077		0.18		0.04	586	
0078 701-22-078		2.78		0.03	1070	

ANALYSIS

0079 701-22-079	5.67	0.04	664
0080 701-22-080	0.96	0.04	713

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0041 701-22-041	0.15	3.98	45.92	56	13.1	285.9
0042 701-22-042	0.48		45.29		14.0	
0043 701-22-043	0.05		23.35		3.7	
0044 701-22-044	0.24	29.01	22.11	286	19.4	1438.7
0045 701-22-045	0.05		36.22		13.0	
0046 701-22-046	7.73	43.13	51.06	73	23.1	22.6
0047 701-22-047	0.29		52.53		9.7	
0048 701-22-048	4.94		53.42		10.4	
0049 701-22-049	0.16	1.39	36.48	99	11.6	33.0
0050 701-22-050	0.16		40.53		18.3	
0051 701-22-051	1.94		55.18		11.6	
0052 701-22-052	0.17	X	71.00	23	9.4	0.6
0053 701-22-053	4.32		68.75		12.4	
0054 701-22-054	1.58		66.32		17.0	
0055 701-22-055	0.07	0.03	71.61	236	9.8	2.0
0056 701-22-056	0.04		58.01		8.6	
0057 701-22-057	1.04		86.79		61.4*	
0058 701-22-058	0.32		90.64		24.1	
0059 701-22-059	5.53	5.84	70.24	97	10.0	28.9
0060 701-22-060	2.75	5.99	81.64	175	12.8	89.2
0061 701-22-061	0.04		49.15		0.6	
0062 701-22-062	0.02		55.75		3.5	
0063 701-22-063	0.05		44.72		15.2	
0064 701-22-064	0.05	5.37	42.44	33	9.7	115.2
0065 701-22-065	0.04		26.44		12.3	
0066 701-22-066	10.19*		54.15		9.2	
0067 701-22-067	3.21	268.89	69.50	17	11.5	696.4
0068 701-22-068	1.36		55.01		17.9	
0069 701-22-069	6.07		58.11		16.0	
0070 701-22-070	1.87		47.78		12.4	
0071 701-22-071	0.16	0.10	65.85	27	8.8	1.0
0072 701-22-072	0.36	X	71.01	115	10.7	1.6
0073 701-22-073	0.65		53.61		9.0	
0074 701-22-074	9.84		59.50		13.1	
0075 701-22-075	0.39		58.90		4.6	
0076 701-22-076	0.20		66.08		56.9	
0077 701-22-077	4.65		51.71		8.4	
0078 701-22-078	0.14		62.18		14.1	

ANALYSIS

0079 701-22-079	0.37	57.02	16.4
0080 701-22-080	0.15	20.95	11.5

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	No	16	X	0.38	59.2	0.05
0042 701-22-042	No	10		0.34	65.8	
0043 701-22-043	No	21		0.79	448.0	
0044 701-22-044	No	23	X	0.29	102.9	1.11
0045 701-22-045	No	27		0.19	666.2	
0046 701-22-046	Yes	11	0.03	3.00	191.3	0.05
0047 701-22-047	No	11		3.16	10.9	
0048 701-22-048	Yes	19		5.40	15.0	
0049 701-22-049	No	16	X	5.49	300.6	2.38
0050 701-22-050	No	56		0.27	612.9	
0051 701-22-051	No	8		1.94	121.7	
0052 701-22-052	No	12	X	1.83	18.8	X
0053 701-22-053	No	9		1.78	215.1	
0054 701-22-054	No	26		4.84	325.5	
0055 701-22-055	Yes	11	X	2.04	11.0	X
0056 701-22-056	No	8		2.60	165.8	
0057 701-22-057	No	12		2.85	45.3	
0058 701-22-058	No	19		2.58	31.7	
0059 701-22-059	No	10	X	7.26	17.4	0.01
0060 701-22-060	No	12	X	11.86	87.9	0.83
0061 701-22-061	No	13		0.84	160.8	
0062 701-22-062	No	13		1.05	87.4	
0063 701-22-063	No	40		0.18	1982.7	
0064 701-22-064	No	30	X	0.08	562.5	9.60
0065 701-22-065	No	18		0.06	456.4	
0066 701-22-066	No	28		3.11	55.0	
0067 701-22-067	No	41	X	6.08	584.7	14.94
0068 701-22-068	No	45		5.74	410.8	
0069 701-22-069	No	83		10.97	147.7	
0070 701-22-070	No	49		7.08	181.2	
0071 701-22-071	No	9	X	1.69	19.9	0.02
0072 701-22-072	No	12	X	2.26	67.0	0.01
0073 701-22-073	Yes	12		3.11	21.2	
0074 701-22-074	No	13		8.62	322.1	
0075 701-22-075	No	19		5.72	1075.6	
0076 701-22-076	No	267*		7.17	230.3	
0077 701-22-077	No	39		2.15	101.4	
0078 701-22-078	No	35		3.36	307.1	

ANALYSIS

0079 701-22-079	No	85	4.54	471.0
0080 701-22-080	No	16	1.19	76.2

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0041 701-22-041	0.97	497	0.40	0.78	X	5.38
0042 701-22-042	0.69		0.23	0.69		4.83
0043 701-22-043	1.30		0.84	0.41		0.75
0044 701-22-044	1.52	1179	0.92	0.35	0.2	0.71
0045 701-22-045	0.88		0.42	0.58		6.73
0046 701-22-046	1.67	1000	1.23	0.83	0.4	5.57
0047 701-22-047	2.03		1.22	0.83		2.75
0048 701-22-048	1.47		0.99	0.77		3.84
0049 701-22-049	2.79	905	1.68	0.97	0.1	4.86
0050 701-22-050	1.30		0.74	0.97		9.07
0051 701-22-051	2.05		1.23	0.92		3.87
0052 701-22-052	2.49	344	1.43	1.12	0.6	2.85
0053 701-22-053	2.45		1.41	1.30		5.20
0054 701-22-054	3.64		2.47	1.10		6.41
0055 701-22-055	2.75	1169	1.60	1.15	0.4	3.40
0056 701-22-056	1.32		0.84	0.52		1.99
0057 701-22-057	3.80		2.60	1.35		3.04
0058 701-22-058	3.15		1.96	1.72		1.67
0059 701-22-059	2.08	874	1.36	0.98	0.3	3.82
0060 701-22-060	2.99	1022	1.94	1.34	0.2	3.40
0061 701-22-061	0.96		0.54	0.69		3.26
0062 701-22-062	1.16		0.52	0.90		2.38
0063 701-22-063	1.07		0.52	0.78		7.60
0064 701-22-064	0.78	335	0.40	0.76	X	4.43
0065 701-22-065	0.48		0.19	0.55		6.53
0066 701-22-066	1.77		1.04	0.80		1.15
0067 701-22-067	1.68	598	1.01	0.76	X	3.27
0068 701-22-068	1.64		0.93	0.77		5.22
0069 701-22-069	1.84		0.98	0.85		2.68
0070 701-22-070	1.38		1.05	0.62		2.64
0071 701-22-071	2.31	499	1.39	1.05	0.1	2.76
0072 701-22-072	2.32	925	1.36	1.07	0.4	2.98
0073 701-22-073	2.15		1.26	0.97		3.06
0074 701-22-074	1.70		1.02	0.92		5.43
0075 701-22-075	3.45		2.23	1.05		3.56
0076 701-22-076	4.59		1.84	1.61		13.94
0077 701-22-077	2.80		1.49	1.01		1.71
0078 701-22-078	2.68		1.42	1.18		4.07

ANALYSIS

0079 701-22-079	2.31	1.35	1.07	3.69
0080 701-22-080	0.87	0.44	0.59	3.67

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.06	1.4	0	12.29	2.27	0.78
0042 701-22-042		1.5	0	8.91	1.59	0.59
0043 701-22-043		1.5	0	17.10	1.37	1.07
0044 701-22-044	0.09	1.4	0	17.18	1.28	0.97
0045 701-22-045		1.5	0	8.08	1.77	0.87
0046 701-22-046	X	1.1	0	19.07	2.40	0.84
0047 701-22-047		1.4	1	16.55	2.35	0.83
0048 701-22-048		1.4	0	20.51	2.10	1.02
0049 701-22-049	0.05	1.5	0	21.73	3.24	0.79
0050 701-22-050		1.5	0	19.12	2.76	1.22
0051 701-22-051		1.4	1	16.16	2.68	0.54
0052 701-22-052	0.02	1.3	1	15.41	3.02	0.89
0053 701-22-053		1.4	0	19.45	3.24	0.97
0054 701-22-054		1.5	0	16.84	3.43	0.77
0055 701-22-055	0.03	1.7	0	18.09	3.38	0.97
0056 701-22-056		1.4	0	16.95	1.51	1.12
0057 701-22-057		1.5	0	17.11	4.15	0.91
0058 701-22-058		1.5	0	16.63	4.38	0.98
0059 701-22-059	0.05	1.8	0	18.57	2.76	1.14
0060 701-22-060	0.07	1.5	0	20.54	4.08	0.93
0061 701-22-061		1.4	0	18.63	1.85	1.08
0062 701-22-062		1.5	0	17.77	2.32	1.14
0063 701-22-063		1.5	0	13.68	2.18	1.70
0064 701-22-064	3.04	1.5	0	14.23	1.97	1.30
0065 701-22-065		1.4	0	9.79	1.47	0.85
0066 701-22-066		1.4	0	19.79	2.31	1.44
0067 701-22-067	7.34	1.5	0	16.06	2.49	1.59
0068 701-22-068		1.5	0	19.20	2.35	1.09
0069 701-22-069		1.6	0	17.61	2.83	1.44
0070 701-22-070		1.5	0	17.03	2.02	1.23
0071 701-22-071	1.98	1.3	2	16.00	2.98	1.12
0072 701-22-072	0.44	1.5	2	15.82	3.06	1.03
0073 701-22-073		1.4	1	16.47	2.48	0.82
0074 701-22-074		1.1	0	18.97	2.64	0.97
0075 701-22-075		1.6	0	14.42	3.34	0.66
0076 701-22-076		1.5	0	15.29	5.48	0.75
0077 701-22-077		1.5	0	17.78	3.26	1.54
0078 701-22-078		1.5	0	21.78	4.13	1.20

ANALYSIS

0079 701-22-079	1.5	0	36.40	3.44	1.18
0080 701-22-080	1.5	0	22.67	1.87	0.79

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.98	X	X	0.15	0.060	1.05%
0042 701-22-042	0.47	0.02		0.09	0.030	1.34%
0043 701-22-043	1.83	X		0.27	0.129	2.87%
0044 701-22-044	1.38	X	X	0.31	0.186	2.62%
0045 701-22-045	0.32	0.02		0.15	0.422	5616
0046 701-22-046	1.14	X	X	0.36	3.274	3.56%
0047 701-22-047	1.33	X		0.39	0.035	3.61%
0048 701-22-048	1.51	X		0.32	0.697	3.26%
0049 701-22-049	1.91	0.02	X	0.60	1.992	3.98%
0050 701-22-050	1.70	0.03		0.25	0.548	795
0051 701-22-051	1.50	X		0.41	1.021	3.21%
0052 701-22-052	1.60	X	X	0.49	0.056	3.29%
0053 701-22-053	1.92	0.06		0.49	0.224	3.24%
0054 701-22-054	1.47	0.04		0.82	0.259	3.46%
0055 701-22-055	1.89	X	X	0.55	0.043	3.43%
0056 701-22-056	1.87	X		0.39	0.123	3.80%
0057 701-22-057	1.70	X		0.84	0.096	2.63%
0058 701-22-058	1.92	X		0.65	0.049	2.44%
0059 701-22-059	1.70	0.05	X	0.45	0.938	3.56%
0060 701-22-060	1.86	0.08	X	2.05	1.017	3.81%
0061 701-22-061	1.54	X		0.18	0.421	3.69%
0062 701-22-062	1.55	X		0.18	0.552	3.74%
0063 701-22-063	1.11	0.06		0.18	0.172	5571
0064 701-22-064	0.86	0.01	X	0.11	0.185	2.33%
0065 701-22-065	0.65	0.01		0.07	0.193	1.94%
0066 701-22-066	1.52	0.03		0.35	0.713	3.45%
0067 701-22-067	1.43	0.08	X	0.31	1.104	2.80%
0068 701-22-068	1.35	0.28		0.29	0.588	2.98%
0069 701-22-069	1.36	0.48		0.35	0.791	3.26%
0070 701-22-070	1.70	0.40		0.30	0.309	3.25%
0071 701-22-071	1.97	X	X	0.48	0.026	2.55%
0072 701-22-072	1.61	X	X	0.46	0.120	2.55%
0073 701-22-073	1.32	X		0.42	0.092	3.14%
0074 701-22-074	1.42	0.06		0.37	3.200	3.32%
0075 701-22-075	1.57	0.06		0.74	0.861	2.89%
0076 701-22-076	1.82	0.01		0.76	1.014	2.59%
0077 701-22-077	2.16	0.05		0.52	1.008	2.96%
0078 701-22-078	2.10	0.53		0.49	0.354	3.36%

ANALYSIS

0079 701-22-079	1.98	0.23	0.42	0.437	2.83%
0080 701-22-080	0.97	0.02	0.14	0.194	2.47%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	9.0	24.91	1.1	0.088	495	16.65
0042 701-22-042		26.46	1.4	0.036	139	
0043 701-22-043		13.93	3.4	0.167	977	
0044 701-22-044	14.2	15.10	6.1	0.151	384	33.88
0045 701-22-045		19.48	4.1	0.061	117	
0046 701-22-046	50.1	28.60	2.7	0.180	6077	24.72
0047 701-22-047		29.69	3.7	0.190	1.87%	
0048 701-22-048		29.57	5.0	0.168	2.28%	
0049 701-22-049	41.7	19.67	1.3	0.234	3257	13.16
0050 701-22-050		21.79	91.4	0.156	276	
0051 701-22-051		32.13	7.0	0.186	1.33%	
0052 701-22-052	15.8	40.09	8.7	0.234	1.77%	7.87
0053 701-22-053		37.22	9.7	0.196	1.05%	
0054 701-22-054		36.34	3.0	0.318	4717	
0055 701-22-055	24.8	40.77	6.3	0.251	7312	17.85
0056 701-22-056		34.51	2.1	0.156	3843	
0057 701-22-057		49.58	1.6	0.486	2726	
0058 701-22-058		49.66	1.6	0.335	2527	
0059 701-22-059	37.4	40.71	3.6	0.210	4326	21.64
0060 701-22-060	37.9	45.89	2.6	0.269	3721	19.71
0061 701-22-061		27.83	0.1	0.096	1998	
0062 701-22-062		31.58	0.4	0.098	1882	
0063 701-22-063		24.22	2.1	0.111	173	
0064 701-22-064	4.8	22.83	0.3	0.068	113	7.58
0065 701-22-065		13.91	0.7	0.038	107	
0066 701-22-066		31.68	4.4	0.163	2308	
0067 701-22-067	20.2	42.14	2.5	0.173	2433	10.89
0068 701-22-068		30.72	1.8	0.152	1980	
0069 701-22-069		30.62	1.8	0.171	3026	
0070 701-22-070		25.81	2.7	0.170	2891	
0071 701-22-071	5.5	36.78	8.6	0.221	1.08%	7.63
0072 701-22-072	17.5	40.22	6.8	0.209	1.72%	5.29
0073 701-22-073		30.17	8.1	0.211	2.02%	
0074 701-22-074		32.91	4.6	0.162	6675	
0075 701-22-075		34.00	1.7	0.322	2792	
0076 701-22-076		33.94	4.4	0.211	2624	
0077 701-22-077		28.66	8.4	0.229	3505	
0078 701-22-078		31.94	2.0	0.232	2369	

ANALYSIS

0079 701-22-079	30.56	6.6	0.238	2353
0080 701-22-080	11.09	1.5	0.078	1120

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0041 701-22-041	50	0.69		1.3	0.19	198
0042 701-22-042	38			4.2		181
0043 701-22-043	56			2.1		62
0044 701-22-044	42	0.57		1.7	0.20	126
0045 701-22-045	40			2.5		252
0046 701-22-046	>2.00%	19.09	2.25%	1.7	3.58	130
0047 701-22-047	5202			0.6		11
0048 701-22-048	>2.00%		2.36%	1.2		50
0049 701-22-049	398	1.57		1.3	0.08	146
0050 701-22-050	1372			2.4		295
0051 701-22-051	3669			2.8		70
0052 701-22-052	1747	0.01		1.8	10.26	19
0053 701-22-053	>2.00%		2.08%	1.6		89
0054 701-22-054	401			6.7		201
0055 701-22-055	4184	1.12		1.6	2.28	35
0056 701-22-056	129			1.0		48
0057 701-22-057	50			2.9		65
0058 701-22-058	46			1.8		48
0059 701-22-059	5554	5.83		1.2	0.07	47
0060 701-22-060	160	0.22		1.2	0.12	106
0061 701-22-061	146			1.1		51
0062 701-22-062	118			0.6		62
0063 701-22-063	44			2.0		296
0064 701-22-064	41	0.40		2.4	0.06	277
0065 701-22-065	42			2.7		334
0066 701-22-066	188			0.6		61
0067 701-22-067	175	1.88		1.5	0.08	104
0068 701-22-068	128			1.8		192
0069 701-22-069	219			1.9		68
0070 701-22-070	188			1.0		67
0071 701-22-071	817	0.13		2.6	8.51	2
0072 701-22-072	2436	0.02		1.3	35.62	24
0073 701-22-073	1.05%			1.3		40
0074 701-22-074	1.34%			1.9		130
0075 701-22-075	659			2.6		111
0076 701-22-076	227			0.6		498
0077 701-22-077	282			1.6		62
0078 701-22-078	173			1.2		141

ANALYSIS

0079 701-22-079	77	1.9	132
0080 701-22-080	74	1.4	131

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0041 701-22-041	749	47.2	167	2.2	156	197
0042 701-22-042	735		145	2.2	133	181
0043 701-22-043	1096		7	3.7	1	60
0044 701-22-044	1087	161.8	17	3.1	10	125
0045 701-22-045	808		193	2.2	176	251
0046 701-22-046	612	117.1	68	2.5	53	99
0047 701-22-047	684		0	8.5	0	-88
0048 701-22-048	639		2	6.0	0	-7
0049 701-22-049	670	140.4	128	2.1	110	141
0050 701-22-050	530		244	2.1	222	294
0051 701-22-051	612		0	8.1	0	-30
0052 701-22-052	577	47.3	0	8.9	0	-115
0053 701-22-053	738		26	3.0	12	57
0054 701-22-054	1141		181	2.1	160	197
0055 701-22-055	1197	203.8	14	3.0	5	22
0056 701-22-056	707		40	2.3	30	45
0057 701-22-057	879		53	2.2	43	64
0058 701-22-058	630		36	2.3	28	44
0059 701-22-059	747	122.0	27	2.8	8	35
0060 701-22-060	881	163.7	94	2.2	81	100
0061 701-22-061	703		2	4.6	0	49
0062 701-22-062	333		34	2.4	23	59
0063 701-22-063	531		207	2.3	181	295
0064 701-22-064	1700	22.9	144	2.3	126	278
0065 701-22-065	1361		215	2.2	196	333
0066 701-22-066	391		19	2.9	9	57
0067 701-22-067	365	6.3	81	2.2	66	101
0068 701-22-068	699		157	2.1	137	189
0069 701-22-069	621		62	2.1	51	63
0070 701-22-070	539		63	2.2	49	61
0071 701-22-071	1.62%	124.5	0	9.7	0	-91
0072 701-22-072	3933	208.2	0	9.0	0	-101
0073 701-22-073	1324		0	9.0	0	-64
0074 701-22-074	943		80	2.3	61	112
0075 701-22-075	686		79	2.2	67	105
0076 701-22-076	243		440	2.1	409	499
0077 701-22-077	289		32	2.5	23	58
0078 701-22-078	366		113	2.2	100	136

ANALYSIS

0079 701-22-079	418	101	2.2	88	127
0080 701-22-080	691	106	2.1	95	126

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	1.15	17.91	8.9	0.07	675	X
0042 701-22-042	0.61	16.24	10.2		611	
0043 701-22-043	3.40	8.34	3.5		101	
0044 701-22-044	3.25	7.54	10.7	0.56	146	X
0045 701-22-045	0.96	14.59	24.6		476	
0046 701-22-046	3.91	18.72	17.4	X	580	X
0047 701-22-047	3.90	18.17	8.3		581	
0048 701-22-048	3.95	19.61	8.9		614	
0049 701-22-049	3.32	15.13	8.6	0.02	667	X
0050 701-22-050	4.33	16.18	33.2		849	
0051 701-22-051	3.47	19.75	8.6		523	
0052 701-22-052	3.83	25.28	6.2	X	616	X
0053 701-22-053	3.93	26.63	7.6		725	
0054 701-22-054	2.81	26.01	18.1		593	
0055 701-22-055	4.08	26.17	6.4	X	752	X
0056 701-22-056	4.24	18.42	4.1		71	
0057 701-22-057	3.74	33.06	15.5		346	
0058 701-22-058	4.00	38.47	9.5		383	
0059 701-22-059	3.78	25.28	9.2	0.02	567	X
0060 701-22-060	3.30	31.48	11.4	0.10	1303	X
0061 701-22-061	2.60	16.89	3.0		559	
0062 701-22-062	3.13	19.67	4.0		563	
0063 701-22-063	2.36	18.03	30.4		662	
0064 701-22-064	1.61	16.66	11.0	0.09	745	0.2
0065 701-22-065	0.88	11.54	11.7		545	
0066 701-22-066	3.42	18.80	26.0		486	
0067 701-22-067	5.78	21.89	28.6	0.51	142	0.4
0068 701-22-068	3.73	17.21	30.6		350	
0069 701-22-069	5.34	22.80	50.8		394	
0070 701-22-070	5.34	16.85	30.6		254	
0071 701-22-071	4.58	23.60	5.7	X	648	X
0072 701-22-072	3.81	25.98	8.7	X	726	X
0073 701-22-073	3.64	19.36	15.5		663	
0074 701-22-074	3.58	21.60	13.2		837	
0075 701-22-075	5.54	20.15	8.4		677	
0076 701-22-076	4.13	29.21	242.5*		1282	
0077 701-22-077	4.02	18.35	17.1		463	
0078 701-22-078	7.11	25.52	32.7		1001	

ANALYSIS

0079 701-22-079	5.74	22.20	47.4	713
0080 701-22-080	2.02	8.58	11.2	637

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	104.1	0.6	5.3		4.916	28.10
0042 701-22-042	72.8		4.9		4.538	14.92
0043 701-22-043	9.1		5.7		2.409	63.65
0044 701-22-044	11.3	X	5.0		2.235	29.44
0045 701-22-045	47.8		4.9		3.851	6.19
0046 701-22-046	232.3	6.6	7.2	3.4	5.174	146.99
0047 701-22-047	43.7		9.3	3.4	5.255	158.07
0048 701-22-048	162.5		8.1		5.485	141.19
0049 701-22-049	96.1	1.3	5.3		3.954	163.07
0050 701-22-050	219.8		5.0		4.376	3.55
0051 701-22-051	133.4		7.2	3.4	5.607	122.53
0052 701-22-052	18.0	1.2	8.2	3.5	7.153	143.59
0053 701-22-053	607.6*		7.6	3.1	7.336	138.75
0054 701-22-054	130.2		4.7		7.186	155.85
0055 701-22-055	21.2	0.7	7.3	3.0	7.331	135.82
0056 701-22-056	25.1		4.7		5.599	154.37
0057 701-22-057	95.4		4.4		9.099	102.53
0058 701-22-058	35.6		4.4		9.782	95.69
0059 701-22-059	332.9	0.7	6.5	2.9	7.198	135.76
0060 701-22-060	488.9	1.7	5.2		8.508	145.87
0061 701-22-061	23.8		4.1		4.971	133.02
0062 701-22-062	64.4		4.2		5.678	164.18
0063 701-22-063	111.6		4.6		5.100	4.50
0064 701-22-064	185.2	0.6	4.1		4.712	3.89
0065 701-22-065	137.8		4.3		2.786	3.48
0066 701-22-066	89.3		4.1		5.331	117.48
0067 701-22-067	52.8	13.0	3.7		6.579	129.11
0068 701-22-068	70.0		3.7		5.231	109.43
0069 701-22-069	53.4		3.8		6.147	164.51
0070 701-22-070	32.2		4.2		4.789	155.31
0071 701-22-071	10.0	2.5	9.2	3.7	6.663	92.30
0072 701-22-072	24.0	1.5	8.5	3.5	7.299	104.31
0073 701-22-073	49.6		8.5	3.4	5.434	146.48
0074 701-22-074	426.7		7.3	3.3	6.079	161.45
0075 701-22-075	137.8		5.4		6.229	144.53
0076 701-22-076	71.7		2.7		7.540	158.97
0077 701-22-077	39.0		4.2		5.169	139.72
0078 701-22-078	135.8		4.5		6.759	167.61

ANALYSIS

0079 701-22-079	194.4	4.0	6.533	138.62
0080 701-22-080	127.2	4.7	2.237	84.51

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0041 701-22-041	X	6.48	5.82%	46.7	4.38	0.34
0042 701-22-042	0.007	5.92	5.43%		4.68	0.36
0043 701-22-043	X	2.03	2.12%		0.27	0.54
0044 701-22-044	X	4.11	3.88%	51.0	0.35	1.19
0045 701-22-045	0.006	8.22	7.50%		5.32	0.48
0046 701-22-046	0.003	4.24	4.30%	117.6	3.66	0.14
0047 701-22-047	X	0.37	3389		0.25	0.05
0048 701-22-048	0.002	1.64	1.66%		1.34	0.05
0049 701-22-049	X	4.76	4.52%	90.5	3.80	0.11
0050 701-22-050	X	9.64	8.70%		7.35	0.22
0051 701-22-051	X	2.28	2.54%		1.99	0.33
0052 701-22-052	X	0.62	5441	29.7	0.44	0.07
0053 701-22-053	X	2.90	2.78%		2.62	0.06
0054 701-22-054	0.017	6.57	6.25%		5.73	0.18
0055 701-22-055	X	1.13	1.07%	55.1	1.03	0.06
0056 701-22-056	0.005	1.58	1.54%		1.63	0.08
0057 701-22-057	X	2.11	2.08%		1.74	0.17
0058 701-22-058	X	1.56	1.52%		1.27	0.10
0059 701-22-059	X	1.52	1.49%	82.1	1.30	0.08
0060 701-22-060	X	3.47	3.41%	75.5	2.79	0.09
0061 701-22-061	X	1.66	1.77%		0.06	0.90
0062 701-22-062	X	2.02	2.25%		1.27	0.40
0063 701-22-063	0.005	9.68	9.12%		7.67	0.47
0064 701-22-064	0.036	9.05	8.39%	34.5	4.41	1.17
0065 701-22-065	0.037	10.90	10.22%		6.02	1.02
0066 701-22-066	0.006	1.98	2.30%		0.68	0.39
0067 701-22-067	X	3.40	3.57%	91.4	2.75	0.21
0068 701-22-068	0.003	6.28	5.87%		3.85	0.41
0069 701-22-069	X	2.21	2.56%		1.99	0.15
0070 701-22-070	0.002	2.20	2.50%		2.01	0.19
0071 701-22-071	0.002	0.07	974	17.4		0.02
0072 701-22-072	X	0.80	7516	60.7	0.57	0.09
0073 701-22-073	X	1.31	1.45%		1.09	0.05
0074 701-22-074	X	4.24	4.24%		3.84	0.09
0075 701-22-075	X	3.62	3.68%		3.15	0.15
0076 701-22-076	0.002	16.29	15.06%		12.40	0.43
0077 701-22-077	X	2.04	2.26%		1.16	0.52
0078 701-22-078	0.002	4.62	4.52%		3.63	0.26

ANALYSIS

0079 701-22-079	0.003	4.32	4.53%	3.44	0.28
0080 701-22-080	X	4.27	4.24%	3.37	0.28

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.46	0.32	9.0	2.2	2.8	2.06
0042 701-22-042	0.61		8.3	1.8		1.75
0043 701-22-043	0.51		14.8	X		0.10
0044 701-22-044	0.30	0.54	15.3	X	4.6	0.56
0045 701-22-045	2.74		5.8	2.2		1.73
0046 701-22-046	1.08	0.34	8.7	0.6	1.3	0.32
0047 701-22-047	0.42		8.6	X		0.02
0048 701-22-048	0.79		9.9	X		0.04
0049 701-22-049	1.72	1.45	11.5	1.2	2.1	0.67
0050 701-22-050	2.50		11.5	1.8		2.11
0051 701-22-051	0.65		10.0	1.0		0.33
0052 701-22-052	0.40	0.47	9.2	X	0.9	0.03
0053 701-22-053	0.62		11.2	1.9		1.54
0054 701-22-054	1.45		11.0	2.7		2.16
0055 701-22-055	0.41	0.18	9.1	X	2.5	0.15
0056 701-22-056	0.28		7.2	0.7		0.42
0057 701-22-057	0.59		10.8	1.3		0.92
0058 701-22-058	0.21		11.6	0.7		0.49
0059 701-22-059	0.37	0.02	9.5	X	6.3	0.16
0060 701-22-060	0.48	0.29	11.8	0.8	7.8	0.80
0061 701-22-061	0.87		7.1	1.1		0.83
0062 701-22-062	0.69		7.0	X		0.16
0063 701-22-063	5.25		8.8	2.4		2.14
0064 701-22-064	1.75	0.49	8.6	1.6	1.5	1.56
0065 701-22-065	1.26		8.2	2.7		2.00
0066 701-22-066	0.60		14.1	0.6		0.10
0067 701-22-067	1.36	0.21	7.0	0.9	4.7	0.84
0068 701-22-068	1.61		12.5	1.7		1.73
0069 701-22-069	1.81		9.9	0.5		0.53
0070 701-22-070	2.08		8.2	0.7		0.58
0071 701-22-071	0.15	0.18	8.1	X	1.2	X
0072 701-22-072	0.33	0.38	10.1	X	1.5	0.13
0073 701-22-073	0.53		8.9	X		0.10
0074 701-22-074	2.64		9.6	1.4		1.08
0075 701-22-075	5.54		4.1	2.0		1.83
0076 701-22-076	9.17		23.0	1.4		1.14
0077 701-22-077	1.60		15.9	0.5		0.04
0078 701-22-078	9.53*		11.5	1.2		0.70

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0079 701-22-079	3.54	13.1	1.0	0.97
0080 701-22-080	1.27	10.7	1.9	1.55

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	3.18	1.1	X	437.76	43.48	0.08
0042 701-22-042	2.72	2.0		595.91		0.04
0043 701-22-043	1.54	0.9		25.26		0.29
0044 701-22-044	1.39	0.7	X	41.20	18.33	0.26
0045 701-22-045	2.67	11.6		667.21		0.07
0046 701-22-046	3.14	2.0	X	36.73	936.43	0.29
0047 701-22-047	2.97	0.7		31.32		0.30
0048 701-22-048	3.31	0.6		18.71		0.29
0049 701-22-049	3.44	0.7	X	154.71	348.10	0.25
0050 701-22-050	3.43	2.3		1186.83		0.29
0051 701-22-051	3.47	0.6		228.61		0.27
0052 701-22-052	4.13	0.5	0.1	63.70	29.47	0.35
0053 701-22-053	4.77	1.0		48.93		0.32
0054 701-22-054	4.79	2.3		82.79		0.22
0055 701-22-055	4.47	0.6	X	28.16	136.79	0.34
0056 701-22-056	2.55	0.7		15.06		0.35
0057 701-22-057	5.63	0.7		145.71		0.29
0058 701-22-058	6.82	0.7		91.12		0.33
0059 701-22-059	4.16	0.5	X	73.60	5.48	0.30
0060 701-22-060	5.68	0.6	X	877.78	19.48	0.27
0061 701-22-061	2.79	0.8		49.73		0.23
0062 701-22-062	3.34	0.7		48.24		0.29
0063 701-22-063	3.29	5.0		449.33		0.16
0064 701-22-064	2.83	3.4	X	182.67	12.76	0.13
0065 701-22-065	2.00	2.5		222.33		0.07
0066 701-22-066	3.22	0.7		168.25		0.24
0067 701-22-067	3.66	1.4	X	10.85	8.75	0.45
0068 701-22-068	2.99	2.1		139.02		0.29
0069 701-22-069	4.08	1.8		116.67		0.40
0070 701-22-070	3.03	1.5		45.57		0.42
0071 701-22-071	4.01	0.5	X	271.54	53.77	0.36
0072 701-22-072	4.50	0.7	0.1	107.46	58.08	0.31
0073 701-22-073	3.32	0.5		42.15		0.27
0074 701-22-074	3.62	1.1		37.67		0.26
0075 701-22-075	3.91	0.7		195.29		0.42
0076 701-22-076	5.85	0.9		35.03		0.25
0077 701-22-077	3.39	0.6		60.85		0.30
0078 701-22-078	5.08	2.0		426.93		0.42

ANALYSIS

0079 701-22-079	4.35	4.3	438.73	0.36
0080 701-22-080	1.90	3.2	386.94	0.15

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.244	352	0.81	10.10	0.016	705
0042 701-22-042	0.170		0.27	8.82		340
0043 701-22-043	0.201		0.20	16.59		2463
0044 701-22-044	0.219	720	0.26	15.77	0.040	1990
0045 701-22-045	0.189		0.55	15.01		241
0046 701-22-046	0.369	680	0.18	13.40	0.012	1859
0047 701-22-047	0.334		X	13.83		2000
0048 701-22-048	0.264		X	13.52		2234
0049 701-22-049	0.477	580	0.76	12.63	0.021	2084
0050 701-22-050	0.301		1.51	14.02		2332
0051 701-22-051	0.380		0.33	19.34		2159
0052 701-22-052	0.423	210	0.16	22.48	0.010	1925
0053 701-22-053	0.403		0.56	19.50		2592
0054 701-22-054	0.516		1.43	14.08		1817
0055 701-22-055	0.460	657	0.15	23.10	0.013	2286
0056 701-22-056	0.204		0.36	21.80		2255
0057 701-22-057	0.599		0.85	24.94		2055
0058 701-22-058	0.555		0.55	27.01		2293
0059 701-22-059	0.362	443	0.17	25.29	0.060	2133
0060 701-22-060	0.511	700	0.65	24.97	0.075	2089
0061 701-22-061	0.209		0.78	16.60		933
0062 701-22-062	0.256		0.29	17.01		1213
0063 701-22-063	0.239		0.74	12.35		1206
0064 701-22-064	0.208	203	0.36	9.90	0.040	919
0065 701-22-065	0.133		0.33	8.40		552
0066 701-22-066	0.320		0.10	11.93		2655
0067 701-22-067	0.301	391	0.62	16.82	0.956	1925
0068 701-22-068	0.294		1.60	14.21		1723
0069 701-22-069	0.361		0.73	14.29		1891
0070 701-22-070	0.243		0.56	16.98		1757
0071 701-22-071	0.420	246	X	18.17	0.748	2105
0072 701-22-072	0.394	620	0.08	19.20	0.115	2239
0073 701-22-073	0.368		0.11	12.88		1855
0074 701-22-074	0.316		0.99	13.90		1974
0075 701-22-075	0.682		1.10	22.29		1232
0076 701-22-076	0.839		0.42	9.87		3194
0077 701-22-077	0.818		X	14.91		3276
0078 701-22-078	0.511		0.48	15.69		2723

ANALYSIS

0079 701-22-079	0.443	0.74	17.78	2166
0080 701-22-080	0.221	0.50	8.61	1257

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	0.37	0.08	3.84	5.967	82	X
0042 701-22-042	0.17	0.03	3.43		75	
0043 701-22-043	0.63	0.14	3.80		101	
0044 701-22-044	0.28	0.14	4.44	6.777	93	X
0045 701-22-045	0.20	0.06	1.76		60	
0046 701-22-046	1.69	0.16	3.10	0.078	75	X
0047 701-22-047	1.75	0.19	4.62		69	
0048 701-22-048	1.65	0.15	3.40		84	
0049 701-22-049	2.11	0.25	3.53	2.098	95	X
0050 701-22-050	0.19	0.12	4.11		89	
0051 701-22-051	1.29	0.19	3.47		92	
0052 701-22-052	1.65	0.21	5.38	6.165	77	0.01
0053 701-22-053	1.72	0.19	4.12		118	
0054 701-22-054	2.32	0.35	3.34		90	
0055 701-22-055	1.47	0.23	4.88	0.291	88	X
0056 701-22-056	1.74	0.13	4.37		64	
0057 701-22-057	1.16	0.42	6.05		106	
0058 701-22-058	0.97	0.31	6.36		96	
0059 701-22-059	1.56	0.19	8.01	0.727	89	X
0060 701-22-060	1.75	0.29	6.71	3.615	107	X
0061 701-22-061	1.36	0.08	3.43		66	
0062 701-22-062	1.41	0.08	3.41		55	
0063 701-22-063	0.44	0.09	2.94		91	
0064 701-22-064	0.06	0.11	2.81	13.348	88	X
0065 701-22-065	0.07	0.03	1.75		80	
0066 701-22-066	1.82	0.15	2.45		129	
0067 701-22-067	1.89	0.16	3.49	31.470	56	X
0068 701-22-068	1.65	0.15	4.15		84	
0069 701-22-069	2.37	0.15	2.97		75	
0070 701-22-070	1.90	0.15	3.70		61	
0071 701-22-071	0.39	0.21	3.77	2.346	71	0.06
0072 701-22-072	0.91	0.19	4.95	4.166	86	0.02
0073 701-22-073	1.57	0.18	3.24		74	
0074 701-22-074	2.97	0.15	3.65		81	
0075 701-22-075	4.49	0.30	4.54		32	
0076 701-22-076	3.38	0.25	2.27		118	
0077 701-22-077	1.86	0.23	4.06		118	
0078 701-22-078	2.88	0.22	5.53		97	

ANALYSIS

0079 701-22-079	1.82	0.20	5.54	95
0080 701-22-080	0.94	0.08	4.30	91

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	3.43	0.48	40	0.70	32.6
0042 701-22-042	3.2	1.99	0.24	168		20.4
0043 701-22-043	12.3	7.04	0.87	14		59.1
0044 701-22-044	1.8	7.57	0.99	14	0.84	50.3
0045 701-22-045	1.8	3.59	0.36	17		14.1
0046 701-22-046	8.3	8.83	1.11	2799	0.59	34.9
0047 701-22-047	0.9	11.21	1.19	276		43.6
0048 701-22-048	1.0	8.00	1.08	1703		49.5
0049 701-22-049	2.4	15.16	1.66	150	0.98	64.0
0050 701-22-050	1.8	5.99	0.86	258		58.3
0051 701-22-051	1.9	10.95	1.23	671		55.9
0052 701-22-052	1.4	13.19	1.52	100	X	46.9
0053 701-22-053	1.1	11.62	2.36	1510		66.8
0054 701-22-054	2.4	23.48	2.28	549		50.3
0055 701-22-055	1.1	14.49	1.63	78	X	61.6
0056 701-22-056	1.3	7.17	0.98	32		56.8
0057 701-22-057	1.1	25.23	2.95	55		53.9
0058 701-22-058	1.5	17.71	2.14	38		58.6
0059 701-22-059	1.6	11.08	1.41	1683	0.87	52.0
0060 701-22-060	1.9	16.20	1.81	773	0.95	57.0
0061 701-22-061	1.7	4.27	0.57	42		52.2
0062 701-22-062	1.5	4.62	0.58	23		46.9
0063 701-22-063	2.6	4.38	0.63	23		34.7
0064 701-22-064	1.6	2.52	0.40	8	0.19	43.2
0065 701-22-065	1.6	1.62	0.20	9		15.9
0066 701-22-066	4.0	8.22	0.94	2375		56.2
0067 701-22-067	1.6	8.37	1.13	1409	45.30	49.3
0068 701-22-068	2.1	7.88	0.95	450		40.9
0069 701-22-069	2.0	8.43	1.17	1915		43.1
0070 701-22-070	1.9	7.42	1.06	644		52.8
0071 701-22-071	1.3	12.66	1.49	66	X	62.4
0072 701-22-072	1.5	12.10	1.38	186	X	50.5
0073 701-22-073	1.3	12.08	1.22	329		44.6
0074 701-22-074	2.3	9.00	1.04	3221*		44.1
0075 701-22-075	3.0	20.54	2.21	184		39.5
0076 701-22-076	2.2	16.95	1.58	83		71.5
0077 701-22-077	1.3	12.15	1.61	1218		74.1
0078 701-22-078	4.5	12.74	1.59	175		74.0

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0079 701-22-079	2.4	10.70	1.46	408	73.5
0080 701-22-080	1.2	3.24	0.45	65	31.8

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0081 701-22-081	0.74	0.07	7.42%	69.57	0	49.0
0082 701-22-082	0.34		7.40%		3	37.7
0083 701-22-083	0.45		10.32%		4	5.0
0084 701-22-084	0.30	X	10.39%	0.02	6	8.3
0085 701-22-085	0.23		9.26%		5	13.5
0086 701-22-086	0.22		8.94%		5	3.6
0087 701-22-087	0.26		9.73%		4	2.3
0088 701-22-088	0.21	0.03	9.26%	0.99	3	7.1
0089 701-22-089	0.15		10.07%		4	5.4
0090 701-22-090	0.52		9.09%		4	33.4
0091 701-22-091	0.17		9.41%		4	5.2
0092 701-22-092	1.24		8.42%		4	12.8
0093 701-22-093	0.27	0.02	7.64%	3.12	4	8.6
0094 701-22-094	2.59	0.02	6.74%	1.02	0	14.8
0095 701-22-095	6.22		6.31%		-2	27.1
0096 701-22-096	4.05		7.63%		0	14.9
0097 701-22-097	0.31	0.02	6.38%	0.45	3	53.3
0098 701-22-098	8.94*		7.10%		0	234.9
0099 701-22-099	0.13	0.18	9.20%	7.37	3	4.0
0100 701-22-100	0.13		7.71%		2	9.6
0101 701-22-101	0.40		8.30%		2	70.7
0102 701-22-102	1.15		7.40%		-23	13.6
0103 701-22-103	0.88		9.02%		-11	25.2
0104 701-22-104	0.11		9.24%		13	3.4
0105 701-22-105	0.30		9.00%		9	10.8
0106 701-22-106	0.06		8.37%		83	2.9
0107 701-22-107	0.07	0.02	8.28%	0.08	84	4.7
0108 701-22-108	X		7.86%		78	1.6
0109 701-22-109	X	0.04	8.35%	2.84	86	1.5
0110 701-22-110	X		8.37%		85	0.9
0111 701-22-111	0.10	0.01	7.18%	2.92	155	4.5
0112 701-22-112	X		8.07%		106	2.5
0113 701-22-113	X		8.12%		109	2.2
0114 701-22-114	X	X	7.53%	2.32	117	1.1
0115 701-22-115	0.16	0.04	6.88%	2.74	130	6.1
0116 701-22-116	0.21		7.43%		95	3.9
0117 701-22-117	X		6.51%		84	2.7
0118 701-22-118	0.10		6.67%		23	8.6

ANALYSIS

0119 701-22-119	0.06	9.17%	6	10.1
0120 701-22-120	0.05	8.93%	6	1.9

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	21.3	X	X	311.5	3.92	0.65
0082 701-22-082		X		302.9		0.51
0083 701-22-083		X		356.1		1.15
0084 701-22-084	1.0	X	0.03	1591.3	19.82	1.00
0085 701-22-085		X		559.9		0.76
0086 701-22-086		X		555.7		0.95
0087 701-22-087		X		417.9		0.80
0088 701-22-088	1.1	X	X	884.6	5.25	0.71
0089 701-22-089		X		901.4		0.66
0090 701-22-090		X		278.4		0.69
0091 701-22-091		X		741.2		0.60
0092 701-22-092		X		414.7		0.89
0093 701-22-093	1.6	X	X	920.0	29.64	0.84
0094 701-22-094	1.0	X	X	993.4	29.49	0.30
0095 701-22-095		X		891.5		0.20
0096 701-22-096		X		668.4		0.09
0097 701-22-097	1.0	X	0.01	708.2	6.59	0.29
0098 701-22-098		X		996.5		0.12
0099 701-22-099	2.3	X	X	608.4	55.05	1.26
0100 701-22-100		X		299.5		0.31
0101 701-22-101		X		633.8		0.83
0102 701-22-102		X		254.4		0.64
0103 701-22-103		X		509.6		1.59
0104 701-22-104		X		2336.4*		1.32
0105 701-22-105		X		366.1		1.87
0106 701-22-106		13		673.8		1.26
0107 701-22-107	2.0	14	0.02	550.0	6.25	1.18
0108 701-22-108		14		771.1		1.05
0109 701-22-109	2.2	16	0.02	807.5	101.68	1.04
0110 701-22-110		14		824.9		1.48
0111 701-22-111	7.1	24	0.06	586.1	173.44	0.98
0112 701-22-112		23		636.7		1.08
0113 701-22-113		21		507.8		1.20
0114 701-22-114	1.5	17	0.04	347.6	101.98	1.08
0115 701-22-115	2.9	23	0.04	282.4	20.86	1.13
0116 701-22-116		19		479.7		1.18
0117 701-22-117		19		667.6		0.90
0118 701-22-118		X		2144.2		1.01

ANALYSIS

0119 701-22-119	X	950.2	1.84
0120 701-22-120	X	1539.6	1.49

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.7	3.86	0.410	0.07	359	26.39
0082 701-22-082		1.15		0.02	682	
0083 701-22-083		0.54		0.05	500	
0084 701-22-084	X	0.09	X	0.06	606	12.95
0085 701-22-085		0.18		0.04	335	
0086 701-22-086		0.25		0.06	362	
0087 701-22-087		0.31		0.05	298	
0088 701-22-088	X	0.23	X	0.04	433	4.91
0089 701-22-089		0.43		0.06	471	
0090 701-22-090		1.45		0.05	395	
0091 701-22-091		0.29		0.05	363	
0092 701-22-092		1.57		0.11	367	
0093 701-22-093	0.2	0.22	0.016	0.09	283	9.56
0094 701-22-094	X	1.12	X	0.04	986	18.30
0095 701-22-095		0.95		0.03	1046	
0096 701-22-096		1.44		0.04	1108	
0097 701-22-097	X	5.12	X	0.09	972	12.73
0098 701-22-098		2.17		0.03	780	
0099 701-22-099	1.3	0.33	X	0.08	664	29.14
0100 701-22-100		0.46		0.03	569	
0101 701-22-101		3.21		0.06	884	
0102 701-22-102		3.78		0.03	565	
0103 701-22-103		2.78		0.06	702	
0104 701-22-104		0.33		0.30	2656	
0105 701-22-105		0.47		0.04	2526	
0106 701-22-106		0.19		0.65	3.01%	
0107 701-22-107	X	0.10	X	0.73	3.14%	27.63
0108 701-22-108		0.04		0.67	2.84%	
0109 701-22-109	0.3	0.08	0.011	0.87	3.39%	6.54
0110 701-22-110		0.18		0.80	3.27%	
0111 701-22-111	0.5	0.17	0.166	1.84	6.07%*	11.60
0112 701-22-112		0.07		1.23	4.19%	
0113 701-22-113		0.06		1.32	4.53%	
0114 701-22-114	0.2	0.11	0.034	1.44	4.92%	7.85
0115 701-22-115	0.2	0.19	0.033	1.44	4.21%	6.29
0116 701-22-116		0.25		0.92	3.03%	
0117 701-22-117		0.45		0.76	2.73%	
0118 701-22-118		0.26		0.84	6170	

ANALYSIS

0119 701-22-119	0.29	0.08	979
0120 701-22-120	0.36	0.04	614

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0081 701-22-081	0.03	1.28	59.10	31	23.4	3571.9
0082 701-22-082	0.08		52.45		6.6	
0083 701-22-083	X		60.51		1.3	
0084 701-22-084	0.03	X	45.83	30	0.7	0.9
0085 701-22-085	X		44.75		0.3	
0086 701-22-086	X		83.58		1.2	
0087 701-22-087	0.03		62.22		0.8	
0088 701-22-088	0.03	0.07	51.47	13	0.5	2.8
0089 701-22-089	X		38.26		0.6	
0090 701-22-090	X		39.74		0.6	
0091 701-22-091	X		41.61		0.8	
0092 701-22-092	X		47.01		0.6	
0093 701-22-093	X	0.41	43.76	5	0.8	36.5
0094 701-22-094	X	0.74	88.89	15	0.3	22.9
0095 701-22-095	X		82.64		0.6	
0096 701-22-096	0.03		94.96		1.3	
0097 701-22-097	X	0.57	89.91	56	0.4	9.9
0098 701-22-098	X		108.50		0.4	
0099 701-22-099	0.06	3.64	60.72	7	15.3	270.0
0100 701-22-100	0.03		62.95		9.7	
0101 701-22-101	0.20		57.76		15.3	
0102 701-22-102	0.13		38.10		15.9	
0103 701-22-103	1.59		63.00		12.5	
0104 701-22-104	0.36		66.28		12.0	
0105 701-22-105	0.04		62.36		12.5	
0106 701-22-106	0.15		59.29		11.3	
0107 701-22-107	0.08	0.06	58.54	12	11.2	1.7
0108 701-22-108	0.03		53.73		10.5	
0109 701-22-109	0.04	0.02	65.42	28	9.4	2.3
0110 701-22-110	0.04		61.29		10.0	
0111 701-22-111	0.71	0.06	73.87	27	8.9	1.0
0112 701-22-112	0.17		56.91		10.8	
0113 701-22-113	0.31		60.57		11.3	
0114 701-22-114	0.39	X	54.75	99	8.4	1.4
0115 701-22-115	0.24	X	57.94	74	13.8	1.5
0116 701-22-116	0.10		64.71		13.1	
0117 701-22-117	0.04		47.57		13.2	
0118 701-22-118	0.29		56.70		22.0	

ANALYSIS

0119 701-22-119	0.07	74.59	7.4
0120 701-22-120	X	81.83	2.6

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	No	99	0.10	8.39	510.0	14.08
0082 701-22-082	No	22		0.88	166.3	
0083 701-22-083	No	10		3.48	786.3	
0084 701-22-084	No	17	X	1.62	647.2	0.11
0085 701-22-085	No	11		1.84	222.8	
0086 701-22-086	No	14		1.84	157.1	
0087 701-22-087	No	16		1.89	151.2	
0088 701-22-088	No	16	X	1.82	214.5	3.06
0089 701-22-089	No	20		1.62	260.6	
0090 701-22-090	No	28		2.04	409.3	
0091 701-22-091	No	16		1.51	306.4	
0092 701-22-092	No	18		2.74	291.3	
0093 701-22-093	No	14	X	2.10	299.1	25.25
0094 701-22-094	No	22	X	0.08	62.6	1.91
0095 701-22-095	No	28		0.09	117.4	
0096 701-22-096	No	37		0.13	30.9	
0097 701-22-097	No	18	X	0.22	120.1	1.15
0098 701-22-098	No	30		0.07	41.4	
0099 701-22-099	No	14	X	1.37	672.2	61.14
0100 701-22-100	No	33		0.23	798.8	
0101 701-22-101	No	10		1.22	335.0	
0102 701-22-102	No	20		2.78	365.4	
0103 701-22-103	No	49		2.69	542.7	
0104 701-22-104	No	17		6.05	139.4	
0105 701-22-105	No	15		9.42	120.5	
0106 701-22-106	No	14		5.91	44.0	
0107 701-22-107	No	10	X	4.63	69.5	0.02
0108 701-22-108	No	12		2.67	25.2	
0109 701-22-109	No	8	X	2.59	31.2	0.01
0110 701-22-110	No	8		2.88	41.5	
0111 701-22-111	No	8	X	5.76	154.1	0.08
0112 701-22-112	No	11		7.84	71.1	
0113 701-22-113	No	12		6.75	61.8	
0114 701-22-114	No	11	X	5.59	65.1	0.02
0115 701-22-115	No	17	X	5.78	185.1	0.03
0116 701-22-116	No	12		4.49	80.9	
0117 701-22-117	No	9		10.20	42.8	
0118 701-22-118	Yes	11		4.40	218.4	

ANALYSIS

0119 701-22-119	No	7	2.81	134.9
0120 701-22-120	No	4	2.27	18.9

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0081 701-22-081	1.31	2264	0.89	0.80	X	6.01
0082 701-22-082	1.07		0.61	0.77		3.21
0083 701-22-083	0.92		0.48	0.49		1.07
0084 701-22-084	1.31	328	0.66	0.67	0.3	6.60
0085 701-22-085	0.77		0.37	0.63		2.37
0086 701-22-086	0.82		0.34	0.68		2.71
0087 701-22-087	0.85		0.39	0.52		0.82
0088 701-22-088	1.55	245	0.81	0.50	X	1.84
0089 701-22-089	1.60		0.88	0.50		1.30
0090 701-22-090	1.29		0.63	0.50		2.86
0091 701-22-091	1.22		0.60	0.60		1.25
0092 701-22-092	1.17		0.65	0.54		3.70
0093 701-22-093	1.70	437	0.93	0.58	X	3.77
0094 701-22-094	1.60	324	0.61	1.64	X	3.70
0095 701-22-095	1.31		0.43	1.20		7.25
0096 701-22-096	1.10		0.41	1.04		2.79
0097 701-22-097	2.01	523	0.45	2.21	0.1	8.87
0098 701-22-098	2.99		0.70	1.84		11.02
0099 701-22-099	2.51	956	1.14	1.20	0.2	2.59
0100 701-22-100	0.59		0.25	0.63		4.72
0101 701-22-101	1.21		0.70	0.76		4.49
0102 701-22-102	1.30		0.73	0.78		5.53
0103 701-22-103	2.14		1.00	1.01		3.75
0104 701-22-104	4.27		2.44	1.56		5.53
0105 701-22-105	2.77		1.64	1.05		1.95
0106 701-22-106	2.54		1.49	1.09		3.09
0107 701-22-107	2.49	869	1.43	1.03	0.3	3.03
0108 701-22-108	2.44		1.37	0.99		2.90
0109 701-22-109	2.51	396	1.41	1.14	0.3	2.63
0110 701-22-110	2.33		1.30	1.02		2.41
0111 701-22-111	2.74	546	1.46	1.25	0.9	3.12
0112 701-22-112	2.49		1.43	1.07		3.35
0113 701-22-113	2.30		1.35	0.99		2.91
0114 701-22-114	2.22	617	1.24	0.90	0.3	2.60
0115 701-22-115	2.44	590	1.42	0.95	0.4	3.09
0116 701-22-116	2.80		1.61	1.29		2.91
0117 701-22-117	2.30		1.33	0.94		2.78
0118 701-22-118	2.26		1.25	1.01		7.14

ANALYSIS

0119 701-22-119	6.37	3.73	1.95	1.65
0120 701-22-120	2.82	1.83	1.08	1.08

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	249.62	1.5	0	19.59	2.84	1.13
0082 701-22-082		1.5	0	15.30	2.15	1.04
0083 701-22-083		1.5	0	17.42	1.74	1.08
0084 701-22-084	0.03	1.5	0	17.59	2.13	1.06
0085 701-22-085		1.5	0	17.14	1.15	1.54
0086 701-22-086		1.5	0	17.02	1.71	1.61
0087 701-22-087		1.5	0	16.28	1.41	1.45
0088 701-22-088	0.13	1.5	0	18.58	1.72	1.58
0089 701-22-089		1.5	0	17.83	1.70	1.57
0090 701-22-090		1.5	0	19.33	1.60	1.97
0091 701-22-091		1.5	0	16.79	1.76	1.49
0092 701-22-092		1.5	0	18.60	1.58	1.78
0093 701-22-093	0.18	1.4	0	16.54	1.81	1.77
0094 701-22-094	0.19	1.4	0	8.65	3.86	1.16
0095 701-22-095		1.5	0	16.47	2.78	1.51
0096 701-22-096		1.5	0	12.96	2.23	1.35
0097 701-22-097	0.03	1.5	0	35.91	5.23	2.19
0098 701-22-098		1.5	0	24.61	5.16	3.69
0099 701-22-099	2.16	1.5	0	16.54	3.62	1.57
0100 701-22-100		1.5	0	7.95	1.32	1.60
0101 701-22-101		1.5	0	17.86	2.18	1.45
0102 701-22-102		1.5	0	25.96	1.90	1.14
0103 701-22-103		1.5	0	17.83	2.82	1.32
0104 701-22-104		1.5	0	18.56	5.34	0.96
0105 701-22-105		1.8	0	18.20	3.31	1.09
0106 701-22-106		1.3	1	16.32	3.20	1.00
0107 701-22-107	0.01	1.3	2	16.57	3.15	0.97
0108 701-22-108		1.3	2	15.99	2.86	0.98
0109 701-22-109	0.70	1.3	2	15.80	3.19	0.82
0110 701-22-110		1.3	2	16.58	2.94	0.92
0111 701-22-111	0.86	1.5	2	13.93	3.35	0.90
0112 701-22-112		1.4	2	16.26	3.11	0.91
0113 701-22-113		1.3	2	16.41	2.98	0.99
0114 701-22-114	0.44	1.3	2	16.03	2.70	0.76
0115 701-22-115	0.56	1.5	2	16.27	3.04	0.64
0116 701-22-116		1.3	2	17.19	3.56	0.82
0117 701-22-117		1.3	2	16.21	2.66	0.80
0118 701-22-118		1.2	0	14.69	2.87	0.71

ANALYSIS

0119 701-22-119	1.5	0	18.66	6.20	1.04
0120 701-22-120	1.6	0	18.56	3.20	1.15

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0081 701-22-081	1.87	0.17	X	0.28	0.196	2.32%
0082 701-22-082	1.51	0.01		0.19	0.076	2.06%
0083 701-22-083	0.93	0.02		0.17	0.135	2.00%
0084 701-22-084	0.47	0.03	X	0.24	0.300	2.50%
0085 701-22-085	0.90	X		0.14	0.091	3.10%
0086 701-22-086	0.45	X		0.14	0.137	2.93%
0087 701-22-087	0.30	X		0.15	0.134	3.09%
0088 701-22-088	0.36	X	X	0.30	0.406	3.32%
0089 701-22-089	0.37	X		0.30	0.359	3.73%
0090 701-22-090	0.55	0.01		0.23	0.422	2.86%
0091 701-22-091	0.33	X		0.22	0.241	2.44%
0092 701-22-092	1.02	X		0.22	0.295	3.36%
0093 701-22-093	0.37	0.01	X	0.33	0.212	3.38%
0094 701-22-094	1.03	0.04	X	0.26	0.031	1.91%
0095 701-22-095	0.36	0.08		0.19	0.117	2.04%
0096 701-22-096	0.61	X		0.17	0.055	2.14%
0097 701-22-097	0.61	0.02	X	0.22	0.262	1.05%
0098 701-22-098	0.35	0.60		0.41	0.105	2.11%
0099 701-22-099	0.77	X	X	0.43	0.180	2.80%
0100 701-22-100	0.55	X		0.10	0.027	1.21%
0101 701-22-101	1.26	X		0.25	0.391	3.48%
0102 701-22-102	1.26	X		0.24	0.291	1.67%
0103 701-22-103	1.55	0.01		0.37	0.250	2.33%
0104 701-22-104	2.69	X		0.89	0.067	2.81%
0105 701-22-105	2.48	X		0.56	0.076	2.80%
0106 701-22-106	2.09	X		0.53	0.017	2.83%
0107 701-22-107	1.91	X	X	0.50	0.033	2.42%
0108 701-22-108	1.97	X		0.47	0.019	2.51%
0109 701-22-109	1.56	X	X	0.49	0.013	2.62%
0110 701-22-110	1.66	X		0.45	0.013	2.83%
0111 701-22-111	1.26	X	X	0.53	0.041	2.50%
0112 701-22-112	1.56	X		0.49	0.041	2.79%
0113 701-22-113	1.66	X		0.47	0.027	2.83%
0114 701-22-114	1.23	X	X	0.43	0.030	2.37%
0115 701-22-115	1.30	X	X	0.49	0.064	1.97%
0116 701-22-116	2.04	X		0.56	0.023	2.17%
0117 701-22-117	2.00	X		0.46	0.034	2.17%
0118 701-22-118	1.91	X		0.44	0.091	2.16%

ANALYSIS

0119 701-22-119	2.53	X	1.28	0.059	1.03%
0120 701-22-120	2.20	X	0.60	0.032	1.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	21.0	30.95	2.6	0.162	1910	41.00
0082 701-22-082		29.10	2.6	0.152	683	
0083 701-22-083		40.68	2.3	0.079	2226	
0084 701-22-084	18.4	29.29	1.8	0.075	1651	13.99
0085 701-22-085		32.92	2.9	0.057	2788	
0086 701-22-086		63.17	2.4	0.051	2974	
0087 701-22-087		35.17	2.9	0.055	2725	
0088 701-22-088	23.1	36.90	4.8	0.088	1733	4.37
0089 701-22-089		25.96	3.5	0.095	2239	
0090 701-22-090		23.82	4.3	0.074	2700	
0091 701-22-091		26.07	3.0	0.101	2005	
0092 701-22-092		29.22	2.5	0.094	3482	
0093 701-22-093	30.1	27.76	2.0	0.092	3481	6.57
0094 701-22-094	9.6	50.74	0.7	0.103	226	7.65
0095 701-22-095		44.79	1.3	0.047	99	
0096 701-22-096		52.41	0.9	0.058	109	
0097 701-22-097	6.1	48.17	1.8	0.051	250	15.29
0098 701-22-098		65.97	0.7	0.050	108	
0099 701-22-099	22.0	35.13	2.4	0.151	2656	46.55
0100 701-22-100		37.92	2.4	0.044	427	
0101 701-22-101		35.00	1.0	0.135	2625	
0102 701-22-102		20.45	5.3	0.140	624	
0103 701-22-103		35.59	7.9	0.158	2617	
0104 701-22-104		35.11	16.1	0.356	6848	
0105 701-22-105		34.57	7.1	0.241	5546	
0106 701-22-106		33.20	10.2	0.217	1.59%	
0107 701-22-107	9.4	32.64	11.8	0.214	1.66%	12.83
0108 701-22-108		29.68	10.2	0.199	1.50%	
0109 701-22-109	5.0	36.77	8.3	0.208	1.24%	2.66
0110 701-22-110		34.25	10.2	0.199	1.39%	
0111 701-22-111	8.1	43.26	9.9	0.216	1.22%	5.52
0112 701-22-112		31.27	11.1	0.218	1.38%	
0113 701-22-113		33.53	10.2	0.219	1.03%	
0114 701-22-114	11.9	30.60	8.0	0.187	9481	2.91
0115 701-22-115	6.9	32.88	13.5	0.203	1.17%	2.18
0116 701-22-116		35.49	14.2	0.241	1.20%	
0117 701-22-117		26.09	15.3	0.200	1.37%	
0118 701-22-118		31.07	8.3	0.183	1.06%	

ANALYSIS

0119 701-22-119	41.13	19.8	0.464	2006
0120 701-22-120	44.06	3.9	0.299	2413

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0081 701-22-081	46	0.51		1.2	0.64	223
0082 701-22-082	98			1.8		138
0083 701-22-083	29			4.6		25
0084 701-22-084	46	0.02		10.3	5.55	56
0085 701-22-085	42			7.9		39
0086 701-22-086	60			7.2		35
0087 701-22-087	49			6.0		47
0088 701-22-088	63	0.05		13.2	0.12	69
0089 701-22-089	53			7.7		75
0090 701-22-090	57			7.4		30
0091 701-22-091	47			9.6		43
0092 701-22-092	60			4.2		30
0093 701-22-093	94	0.19		18.9	0.08	32
0094 701-22-094	56	0.34		2.7	0.18	121
0095 701-22-095	47			9.7		132
0096 701-22-096	61			4.7		144
0097 701-22-097	43	0.73		10.1	0.05	49
0098 701-22-098	35			6.0		126
0099 701-22-099	42	1.49		12.5	0.33	65
0100 701-22-100	35			6.9		161
0101 701-22-101	37			4.3		162
0102 701-22-102	29			1.7		234
0103 701-22-103	111			1.2		108
0104 701-22-104	3212			1.9		12
0105 701-22-105	151			1.6		42
0106 701-22-106	648			4.1		36
0107 701-22-107	760	0.02		5.1	60.95	24
0108 701-22-108	597			3.9		1
0109 701-22-109	526	0.05		3.8	145.08	1
0110 701-22-110	435			2.1		2
0111 701-22-111	1154	0.09		8.1	967.08	4
0112 701-22-112	1023			4.1		2
0113 701-22-113	759			2.8		4
0114 701-22-114	677	0.02		5.3	533.22	1
0115 701-22-115	670	0.02		48.7	1049.00	10
0116 701-22-116	528			6.0		19
0117 701-22-117	508			4.5		17
0118 701-22-118	2952			2.5		52

ANALYSIS

0119 701-22-119	44	1.4	41
0120 701-22-120	40	1.5	15

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0081 701-22-081	875	66.9	182	2.1	167	223
0082 701-22-082	785		84	2.3	74	135
0083 701-22-083	494		8	3.2	3	21
0084 701-22-084	799	23.3	4	5.7	0	50
0085 701-22-085	708		3	5.9	0	34
0086 701-22-086	679		3	5.8	0	30
0087 701-22-087	851		4	6.3	0	42
0088 701-22-088	1007	18.6	6	5.4	0	66
0089 701-22-089	1219		7	5.4	0	71
0090 701-22-090	784		1	5.9	0	26
0091 701-22-091	834		2	5.9	0	39
0092 701-22-092	764		2	5.5	0	26
0093 701-22-093	718	26.6	1	4.6	0	28
0094 701-22-094	4187	25.0	13	4.6	0	121
0095 701-22-095	4484		9	4.3	0	134
0096 701-22-096	5133		13	4.5	0	144
0097 701-22-097	774	71.5	12	3.4	8	46
0098 701-22-098	3701		13	5.1	0	126
0099 701-22-099	2010	63.7	43	2.3	34	62
0100 701-22-100	1161		121	2.2	109	159
0101 701-22-101	1534		114	2.4	104	160
0102 701-22-102	569		165	2.3	145	257
0103 701-22-103	708		84	2.2	70	119
0104 701-22-104	1460		8	4.9	0	-1
0105 701-22-105	1262		23	2.7	11	33
0106 701-22-106	2.16%		0	10.7	0	-47
0107 701-22-107	1.96%	157.8	0	11.0	0	-60
0108 701-22-108	2.37%		0	11.2	0	-77
0109 701-22-109	2.30%	86.2	0	11.3	0	-85
0110 701-22-110	2.22%		0	11.3	0	-83
0111 701-22-111	8201	124.7	0	10.9	0	-151
0112 701-22-112	1.09%		0	11.1	0	-104
0113 701-22-113	2831		0	11.3	0	-105
0114 701-22-114	1.46%	126.5	0	11.4	0	-116
0115 701-22-115	1.04%	123.9	0	11.3	0	-120
0116 701-22-116	1.77%		0	11.3	0	-76
0117 701-22-117	1.71%		0	11.3	0	-67
0118 701-22-118	9704		12	4.8	0	29

ANALYSIS

0119 701-22-119	961	23	2.5	17	35
0120 701-22-120	1485	5	3.3	3	9

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	9.27	24.59	93.9	1.92	365	0.5
0082 701-22-082	6.87	19.40	9.0		623	
0083 701-22-083	4.30	18.21	9.7		195	
0084 701-22-084	2.74	15.86	6.5	X	880	X
0085 701-22-085	3.43	12.41	3.1		278	
0086 701-22-086	2.91	23.02	5.3		304	
0087 701-22-087	3.47	18.58	7.8		202	
0088 701-22-088	2.57	12.06	2.3	X	580	X
0089 701-22-089	2.72	10.91	2.5		527	
0090 701-22-090	2.83	13.18	2.4		186	
0091 701-22-091	3.16	14.22	4.4		527	
0092 701-22-092	3.20	15.10	2.1		266	
0093 701-22-093	2.65	14.07	1.7	0.02	439	0.5
0094 701-22-094	3.44	32.76	1.8	0.01	1297	X
0095 701-22-095	1.07	29.19	1.5		1297	
0096 701-22-096	2.88	30.40	1.5		1169	
0097 701-22-097	0.97	41.69	3.0	X	1685*	X
0098 701-22-098	1.10	34.42	0.8		1426	
0099 701-22-099	0.96	22.52	8.8	0.10	392	1.2
0100 701-22-100	0.98	19.76	13.3		786	
0101 701-22-101	1.68	18.73	10.1		678	
0102 701-22-102	2.20	15.15	11.4		708	
0103 701-22-103	2.55	22.50	26.3		480	
0104 701-22-104	4.25	28.32	11.7		651	
0105 701-22-105	4.20	23.92	8.2		733	
0106 701-22-106	3.99	22.70	6.5		619	
0107 701-22-107	4.00	22.47	5.6	X	645	X
0108 701-22-108	3.91	20.60	6.2		595	
0109 701-22-109	4.20	24.16	6.1	X	630	X
0110 701-22-110	4.10	23.14	5.7		681	
0111 701-22-111	3.29	26.30	6.0	X	613	X
0112 701-22-112	3.86	21.97	7.2		627	
0113 701-22-113	4.12	22.85	6.0		675	
0114 701-22-114	4.09	20.30	6.1	X	615	X
0115 701-22-115	3.89	21.94	9.6	X	583	X
0116 701-22-116	3.94	24.96	5.3		568	
0117 701-22-117	3.88	18.27	5.3		505	
0118 701-22-118	3.38	21.98	12.3		543	

ANALYSIS

0119 701-22-119	4.11	32.63	3.1	975
0120 701-22-120	5.18	31.27	0.7	547

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	151.9	8.9	2.7		6.518	121.20
0082 701-22-082	330.3		3.9		5.527	56.03
0083 701-22-083	35.3		6.6		5.494	75.03
0084 701-22-084	65.3	0.6	7.3		4.423	60.67
0085 701-22-085	205.8		6.7		3.845	96.60
0086 701-22-086	40.7		6.3		7.330	98.33
0087 701-22-087	39.0		6.2		5.998	90.05
0088 701-22-088	25.3	X	5.6		4.157	79.31
0089 701-22-089	18.6		6.2		3.384	100.99
0090 701-22-090	68.6		6.2		3.855	96.16
0091 701-22-091	38.1		6.1		4.038	82.68
0092 701-22-092	151.6		4.6		4.453	117.82
0093 701-22-093	19.6	0.5	4.2		4.104	117.92
0094 701-22-094	157.9	X	5.1		9.213	3.95
0095 701-22-095	189.1		4.7		8.441	4.46
0096 701-22-096	240.6		5.2		9.372	3.81
0097 701-22-097	209.4	X	5.8		10.231	5.40
0098 701-22-098	247.5		5.4		9.949	2.72
0099 701-22-099	10.6	0.9	4.2		6.215	91.48
0100 701-22-100	26.5		4.8		6.103	37.88
0101 701-22-101	50.9		3.8		5.726	107.36
0102 701-22-102	53.2		3.0	4.0	4.079	39.82
0103 701-22-103	17.0		3.2		6.325	91.46
0104 701-22-104	15.5		7.0		7.295	105.51
0105 701-22-105	16.5		5.0		6.562	111.81
0106 701-22-106	9.4		9.1		6.171	86.41
0107 701-22-107	9.2	0.6	8.1		6.135	71.47
0108 701-22-108	7.3		9.4		5.698	63.44
0109 701-22-109	5.1	1.4	9.0		6.763	71.21
0110 701-22-110	4.9		9.4	3.8	6.265	79.73
0111 701-22-111	16.8	5.4	8.8		7.388	68.04
0112 701-22-112	10.6		9.5	3.9	5.917	89.20
0113 701-22-113	6.7		9.1		6.264	95.27
0114 701-22-114	8.0	1.6	8.5		5.660	59.35
0115 701-22-115	29.3	3.4	8.6	3.9	6.034	65.77
0116 701-22-116	19.0		8.8		6.748	77.81
0117 701-22-117	4.7		9.7		5.027	75.64
0118 701-22-118	14.1		8.0	2.8	5.892	86.41

ANALYSIS

0119 701-22-119	51.1	4.8	8.261	49.82
0120 701-22-120	15.4	5.9	8.549	51.13

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0081 701-22-081	X	7.28	6.81%	422.7	5.23	0.50
0082 701-22-082	X	4.51	4.63%		2.38	0.70
0083 701-22-083	0.019	0.81	8179		0.38	0.15
0084 701-22-084	0.018	1.82	1.91%	20.3	X	0.48
0085 701-22-085	0.014	1.29	1.26%		X	0.57
0086 701-22-086	0.007	1.16	1.14%		X	0.40
0087 701-22-087	0.030	1.52	1.64%		X	0.64
0088 701-22-088	0.005	2.25	2.68%	23.5	0.05	0.88
0089 701-22-089	0.003	2.45	2.86%		X	0.81
0090 701-22-090	0.003	0.98	1.00%		X	0.34
0091 701-22-091	0.007	1.40	1.31%		X	0.41
0092 701-22-092	X	0.97	1.01%		X	0.35
0093 701-22-093	0.007	1.03	1.02%	55.7	0.06	0.43
0094 701-22-094	0.004	3.96	4.22%	36.6	X	1.46
0095 701-22-095	0.004	4.30	4.66%		X	1.59
0096 701-22-096	0.004	4.72	4.78%		X	1.58
0097 701-22-097	0.004	1.59	1.74%	49.4	X	0.47
0098 701-22-098	0.004	4.12	4.52%		0.05	1.27
0099 701-22-099	0.087	2.11	2.50%	164.2	1.80	0.20
0100 701-22-100	0.085	5.26	4.68%		3.87	0.20
0101 701-22-101	0.043	5.29	5.34%		4.09	0.39
0102 701-22-102	0.010	7.65	6.30%		4.90	1.22
0103 701-22-103	0.007	3.52	3.86%		2.53	0.64
0104 701-22-104	0.003	0.38	4294		0.19	0.13
0105 701-22-105	0.003	1.36	1.32%		1.07	0.15
0106 701-22-106	0.002	1.17	1.14%		0.93	0.09
0107 701-22-107	0.002	0.78	7493	134.8	0.57	0.10
0108 701-22-108	0.003	0.04	391			X
0109 701-22-109	0.003	0.03	213	12.2		0.02
0110 701-22-110	0.003	0.05	421			0.02
0111 701-22-111	0.003	0.12	966	26.8	0.08	0.03
0112 701-22-112	0.004	0.08	655			0.03
0113 701-22-113	X	0.12	965			0.03
0114 701-22-114	0.005	0.04	316	19.3		0.03
0115 701-22-115	0.016	0.34	2737	37.1	0.25	0.06
0116 701-22-116	0.002	0.63	4697		0.43	0.12
0117 701-22-117	0.003	0.55	4154		0.42	0.06
0118 701-22-118	0.004	1.70	1.45%		1.29	0.17

ANALYSIS

0119 701-22-119	0.003	1.33	1.07%	0.98	0.16
0120 701-22-120	X	0.50	3754	0.29	0.11

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	2.88	0.47	12.5	1.4	3.3	0.90
0082 701-22-082	2.90		6.9	1.1		0.65
0083 701-22-083	0.17		14.4	X		0.47
0084 701-22-084	0.14	0.04	17.0	1.3	2.3	1.35
0085 701-22-085	0.20		11.8	4.3		3.69
0086 701-22-086	0.19		10.5	2.1		1.79
0087 701-22-087	0.16		16.4	0.6		0.29
0088 701-22-088	0.32	0.03	14.1	2.2	4.3	1.22
0089 701-22-089	0.26		20.6	1.9		1.24
0090 701-22-090	0.35		11.0	2.4		1.94
0091 701-22-091	0.15		10.8	4.0		3.74
0092 701-22-092	0.29		8.1	1.1		1.18
0093 701-22-093	0.15	X	8.6	1.4	12.1	1.08
0094 701-22-094	2.26	0.11	6.6	7.8	3.7	6.77
0095 701-22-095	0.82		6.2	18.8		17.64
0096 701-22-096	1.06		6.7	12.4		10.84
0097 701-22-097	1.74	0.03	6.3	10.0	19.3	9.43
0098 701-22-098	2.66		7.6	29.8		27.55
0099 701-22-099	0.17	0.22	10.6	2.3	22.9	1.93
0100 701-22-100	0.27		4.9	6.9		6.20
0101 701-22-101	0.40		8.2	5.0		4.85
0102 701-22-102	0.84		8.7	2.5		2.66
0103 701-22-103	0.61		9.7	1.8		1.86
0104 701-22-104	0.31		13.9	0.6		0.18
0105 701-22-105	0.51		10.7	X		0.25
0106 701-22-106	0.13		11.7	0.7		0.25
0107 701-22-107	0.26	0.28	11.6	0.5	1.9	0.14
0108 701-22-108	0.13		10.7	X		X
0109 701-22-109	0.24	0.12	10.9	0.6	1.7	X
0110 701-22-110	0.20		11.4	X		0.03
0111 701-22-111	0.18	0.16	9.8	0.8	59.6	0.26
0112 701-22-112	0.14		13.2	X		X
0113 701-22-113	0.19		10.5	X		X
0114 701-22-114	0.14	0.11	9.9	X	1.5	X
0115 701-22-115	0.33	0.52	11.6	X	1.2	0.03
0116 701-22-116	0.23		13.6	X		0.21
0117 701-22-117	0.25		11.4	X		0.09
0118 701-22-118	0.39		11.1	0.9		0.64

ANALYSIS

0119 701-22-119	0.64	16.1	0.7	0.60
0120 701-22-120	0.36	9.2	X	0.14

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	4.46	5.2	X	287.53	37.66	0.65
0082 701-22-082	3.47	3.8		311.82		0.51
0083 701-22-083	2.58	0.9		83.32		0.36
0084 701-22-084	2.97	0.8	X	158.93	632.67	0.27
0085 701-22-085	1.78	1.5		68.63		0.30
0086 701-22-086	3.13	1.3		64.67		0.26
0087 701-22-087	2.48	1.1		52.02		0.30
0088 701-22-088	1.86	1.0	X	148.11	33.50	0.25
0089 701-22-089	1.88	1.1		144.14		0.23
0090 701-22-090	2.04	2.2		57.61		0.22
0091 701-22-091	2.42	1.6		148.85		0.26
0092 701-22-092	2.35	1.1		113.25		0.26
0093 701-22-093	2.21	1.3	X	60.26	30.94	0.24
0094 701-22-094	6.06	7.2	X	1017.44	251.43	0.27
0095 701-22-095	4.97	2.0		792.98		0.09
0096 701-22-096	4.26	2.7		731.77		0.23
0097 701-22-097	9.13	1.5	X	1704.67*	80.15	0.07
0098 701-22-098	6.57	3.3		1009.31		0.09
0099 701-22-099	4.19	1.3	X	209.43	93.60	0.09
0100 701-22-100	2.69	3.2		465.23		0.10
0101 701-22-101	2.95	1.7		209.64*		0.16
0102 701-22-102	2.84	2.1		482.74		0.18
0103 701-22-103	3.84	2.6		318.02		0.25
0104 701-22-104	5.92	1.1		58.04		0.35
0105 701-22-105	4.34	1.5		23.89		0.35
0106 701-22-106	3.99	0.6		342.38		0.31
0107 701-22-107	3.99	0.6	X	303.81	299.60	0.31
0108 701-22-108	3.73	0.4		401.43		0.32
0109 701-22-109	4.18	0.5	X	371.97	77.45	0.32
0110 701-22-110	3.98	0.5		354.98		0.32
0111 701-22-111	4.43	1.1	X	167.06	90.62	0.26
0112 701-22-112	3.95	1.0		227.90		0.29
0113 701-22-113	3.89	0.5		79.63		0.32
0114 701-22-114	3.63	0.5	X	152.79	98.20	0.33
0115 701-22-115	3.98	1.0	X	159.50	70.94	0.30
0116 701-22-116	4.60	0.8		313.55		0.31
0117 701-22-117	3.52	0.6		341.74		0.30
0118 701-22-118	3.92	1.5		176.44		0.30

ANALYSIS

0119 701-22-119	6.56	1.6	628.18	0.34
0120 701-22-120	5.09	0.6	194.12	0.41

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0081 701-22-081	0.299	1475	1.56	16.29	18.414	3221
0082 701-22-082	0.241		0.41	26.84		1332
0083 701-22-083	0.195		0.10	16.47		2431
0084 701-22-084	0.249	180	0.28	18.02	0.078	1819
0085 701-22-085	0.142		0.34	10.46		2015
0086 701-22-086	0.172		0.16	21.19		1913
0087 701-22-087	0.164		0.08	19.59		2066
0088 701-22-088	0.254	155	0.38	22.15	0.142	1792
0089 701-22-089	0.260		0.30	12.08		1806
0090 701-22-090	0.221		0.87	17.16		2077
0091 701-22-091	0.234		0.12	12.72		2190
0092 701-22-092	0.214		0.93	21.82		1897
0093 701-22-093	0.377	265	1.57	17.38	0.496	1638
0094 701-22-094	0.386	195	0.34	26.72	0.660	2505
0095 701-22-095	0.299		0.87	24.41		671
0096 701-22-096	0.237		0.52	26.36		1712
0097 701-22-097	0.517	331	1.88	27.31	0.094	659
0098 701-22-098	0.656		3.73	26.59		560
0099 701-22-099	0.482	682	0.22	19.59	6.524	901
0100 701-22-100	0.140		0.31	21.17		650
0101 701-22-101	0.232		0.82	23.40		984
0102 701-22-102	0.246		1.47	11.44		1589
0103 701-22-103	0.394		0.46	14.69		1494
0104 701-22-104	0.743		0.40	18.33		2922
0105 701-22-105	0.458		0.84	18.47		2702
0106 701-22-106	0.433		X	16.36		2651
0107 701-22-107	0.425	631	0.25	16.19	0.074	2590
0108 701-22-108	0.420		X	15.55		2457
0109 701-22-109	0.438	386	X	16.49	0.624	2525
0110 701-22-110	0.399		X	16.70		2526
0111 701-22-111	0.477	306	0.10	14.45	0.426	2112
0112 701-22-112	0.423		X	15.00		2836
0113 701-22-113	0.397		X	17.14		2490
0114 701-22-114	0.391	352	X	14.60	0.478	2431
0115 701-22-115	0.441	400	X	15.30	0.489	2117
0116 701-22-116	0.479		0.35	16.25		2436
0117 701-22-117	0.406		0.19	12.77		2290
0118 701-22-118	0.415		0.32	15.01		2035

ANALYSIS

0119 701-22-119	0.960	0.31	19.32	2320
0120 701-22-120	0.464	0.20	21.91	1856

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.28	0.15	3.74	92.993	89	0.07
0082 701-22-082	0.62	0.11	7.69		52	
0083 701-22-083	0.89	0.06	2.59		89	
0084 701-22-084	0.70	0.08	2.58	0.227	230	X
0085 701-22-085	1.15	0.06	3.96		120	
0086 701-22-086	1.13	0.05	3.30		112	
0087 701-22-087	0.98	0.05	1.97		100	
0088 701-22-088	0.94	0.12	1.56	0.111	86	X
0089 701-22-089	1.15	0.11	1.35		128	
0090 701-22-090	1.32	0.08	2.30		105	
0091 701-22-091	1.02	0.07	1.55		87	
0092 701-22-092	1.67	0.10	2.69		87	
0093 701-22-093	1.63	0.11	1.89	0.706	93	X
0094 701-22-094	0.05	0.08	4.05	0.297	91	X
0095 701-22-095	0.04	0.06	3.55		85	
0096 701-22-096	0.04	0.05	3.15		84	
0097 701-22-097	0.08	0.05	8.58	0.194	109	X
0098 701-22-098	0.02	0.06	5.38		90	
0099 701-22-099	1.48	0.16	3.42	7.744	88	X
0100 701-22-100	0.56	0.04	2.30		77	
0101 701-22-101	1.83	0.12	3.94		64	
0102 701-22-102	0.53	0.11	4.29		78	
0103 701-22-103	1.10	0.15	4.80		87	
0104 701-22-104	1.09	0.35	4.42		117	
0105 701-22-105	0.81	0.23	5.40		103	
0106 701-22-106	0.49	0.21	3.62		103	
0107 701-22-107	0.44	0.21	3.45	3.732	102	X
0108 701-22-108	0.36	0.20	3.30		97	
0109 701-22-109	0.37	0.21	3.38	2.562	88	0.03
0110 701-22-110	0.36	0.20	3.86		93	
0111 701-22-111	0.45	0.21	3.29	2.995	84	0.02
0112 701-22-112	0.59	0.20	3.10		111	
0113 701-22-113	0.69	0.20	2.71		92	
0114 701-22-114	0.41	0.18	2.94	0.803	92	0.02
0115 701-22-115	0.42	0.22	3.52	1.670	81	0.01
0116 701-22-116	0.44	0.23	3.61		97	
0117 701-22-117	0.49	0.20	3.26		95	
0118 701-22-118	0.61	0.19	3.51		90	

ANALYSIS

0119 701-22-119	0.46	0.52	4.55	117
0120 701-22-120	0.27	0.33	5.48	84

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0081 701-22-081	3.4	6.40	1.14	18	1.03	55.5
0082 701-22-082	3.3	4.97	0.92	12		44.3
0083 701-22-083	1.9	4.66	0.52	42		30.7
0084 701-22-084	1.5	7.11	0.49	52	X	24.5
0085 701-22-085	1.4	3.11	0.38	25		24.4
0086 701-22-086	1.4	3.15	0.32	28		13.8
0087 701-22-087	2.4	3.82	0.35	24		13.1
0088 701-22-088	4.8	7.86	0.66	27	X	16.4
0089 701-22-089	2.4	8.29	0.78	27		11.9
0090 701-22-090	2.6	6.02	1.08	15		10.8
0091 701-22-091	1.9	5.18	0.47	28		9.2
0092 701-22-092	2.1	6.05	0.97	15		38.0
0093 701-22-093	1.7	8.29	0.65	18	0.07	9.5
0094 701-22-094	4.1	5.00	0.50	5	0.14	29.6
0095 701-22-095	2.1	3.83	0.59	7		16.2
0096 701-22-096	2.8	3.53	0.31	5		17.6
0097 701-22-097	2.9	4.17	0.31	15	0.27	19.9
0098 701-22-098	1.5	5.67	0.32	16		7.6
0099 701-22-099	1.5	11.31	1.01	25	3.16	37.2
0100 701-22-100	4.2	2.41	0.26	10		18.4
0101 701-22-101	1.3	6.17	1.14	20		43.5
0102 701-22-102	2.3	7.83	0.82	17		44.3
0103 701-22-103	1.2	7.70	1.01	94		43.8
0104 701-22-104	1.5	22.58	2.29	452		91.0
0105 701-22-105	1.7	14.33	1.60	74		86.2
0106 701-22-106	1.3	13.46	1.40	42		70.5
0107 701-22-107	1.7	13.06	1.33	33	X	71.0
0108 701-22-108	1.8	11.81	1.33	24		56.9
0109 701-22-109	2.2	12.87	1.40	22	X	55.0
0110 701-22-110	2.5	11.96	1.31	23		63.1
0111 701-22-111	2.6	13.76	1.41	73	X	40.8
0112 701-22-112	1.9	12.59	1.31	56		51.5
0113 701-22-113	1.1	11.86	1.41	56		54.2
0114 701-22-114	1.6	10.70	1.30	44	X	38.8
0115 701-22-115	2.3	12.85	1.37	74	X	39.2
0116 701-22-116	2.7	14.94	1.49	41		68.1
0117 701-22-117	1.5	11.61	1.42	30		66.1
0118 701-22-118	1.4	10.92	1.28	601		74.0

ANALYSIS

0119 701-22-119	2.5	34.07	3.27	62	95.6
0120 701-22-120	1.0	16.57	2.06	34	68.5

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0121 701-22-121	0.16	0.01	8.71%	0.70	5	6.2
0122 701-22-122	0.12	0.07	8.04%	18.50	3	6.7
0123 701-22-123	0.44	0.02	2.81%	0.15	10	13.3
0124 701-22-124	0.94		5217		6	9.4
0125 701-22-125	0.61		4.76%		2	25.1
0126 701-22-126	0.19	0.02	5.27%	0.09	1	20.6
0127 701-22-127	0.25		5.92%		3	11.7
0128 701-22-128	0.33		4.82%		2	17.0
0129 701-22-129	0.55		3.01%		2	18.5
0130 701-22-130	0.68	0.07	4.01%	1.85	1	23.6
0131 701-22-131	0.49		3.33%		1	68.4
0132 701-22-132	0.29	0.01	6.04%	0.12	2	101.5
0133 701-22-133	0.57		5.97%		3	9.0
0134 701-22-134	0.37		4.49%		2	16.9
0135 701-22-135	0.59	0.03	5.24%	0.04	3	10.1
0136 701-22-136	0.46		6.73%		5	4.5
0137 701-22-137	0.22		9.51%		-4	14.5
0138 701-22-138	0.23		9.66%		3	4.0
0139 701-22-139	0.07		11.19%		3	3.2
0140 701-22-140	0.09	0.02	11.06%	18.93	1	3.1
0141 701-22-141	0.12		10.12%		3	4.8
0142 701-22-142	X		11.66%		5	3.2
0143 701-22-143	0.44		9.81%		-1	34.1
0144 701-22-144	0.07		6.76%		-2	14.5
0145 701-22-145	0.73		4.17%		-7	54.9
0146 701-22-146	0.13	X	6.38%	47.16	-1	25.7
0147 701-22-147	0.23	0.03	8.63%	33.36	2	6.1
0148 701-22-148	0.11	X	6.31%	42.85	-2	44.2
0149 701-22-149	0.29		9.71%		0	13.1
0150 701-22-150	0.20		8.87%		-2	9.4

CHECKS

0001 701-22-001	0.65	0.04	10.73%	0.62	-3	4.0
0002 701-22-021	1.55		8.97%		13	14.6
0003 701-22-041	0.17	X	8.24%	0.08	1	8.2
0004 701-22-061	0.49		7.69%		1	6.9
0005 701-22-081	0.77	0.06	7.48%	67.91	-2	48.1
0006 701-22-101	0.34		8.54%		2	69.7

ANALYSIS

0007 701-22-121	0.22	X	9.30%	0.89	5	6.1
0008 701-22-141	0.13		10.15%		4	5.0

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.6	X	0.03	98.6	11.75	1.23
0122 701-22-122	1.2	X	0.06	270.5	5.66	1.28
0123 701-22-123	2.6	X	X	443.2	30.15	0.14
0124 701-22-124		X		1500.7		0.21
0125 701-22-125		X		500.1		0.11
0126 701-22-126	0.7	X	X	711.6	65.35	0.21
0127 701-22-127		X		469.4		0.05
0128 701-22-128		X		412.2		0.13
0129 701-22-129		X		531.0		0.14
0130 701-22-130	1.2	X	X	416.9	54.72	0.13
0131 701-22-131		X		657.0		0.09
0132 701-22-132	1.0	X	X	560.9	32.50	0.19
0133 701-22-133		X		472.4		0.27
0134 701-22-134		X		794.9		0.06
0135 701-22-135	1.0	X	X	669.5	13.52	0.18
0136 701-22-136		X		335.6		0.96
0137 701-22-137		X		654.6		1.06
0138 701-22-138		X		495.0		1.82
0139 701-22-139		X		1325.7		1.43
0140 701-22-140	4.7	X	X	310.5	10.27	1.18
0141 701-22-141		X		550.3		1.26
0142 701-22-142		X		1125.2		1.53
0143 701-22-143		X		623.1		0.65
0144 701-22-144		X		165.7		0.11
0145 701-22-145		X		56.0		X
0146 701-22-146	3.7	X	X	275.4	0.09	0.15
0147 701-22-147	2.7	X	X	306.3	3.24	0.39
0148 701-22-148	4.4	X	X	115.6	0.44	X
0149 701-22-149		X		597.4		0.86
0150 701-22-150		X		120.0		0.18

CHECKS

0001 701-22-001	X	X	0.01	257.6	6.09	2.18
0002 701-22-021		X		304.1		1.48
0003 701-22-041	1.5	X	X	296.6	3.73	0.36
0004 701-22-061		X		396.9		0.79
0005 701-22-081	21.3	X	X	290.3	2.79	0.86
0006 701-22-101		X		319.3		0.92

ANALYSIS

0007 701-22-121	1.7	X	0.03	96.7	11.47	1.36
0008 701-22-141		X		562.4		1.05

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.9	0.44	X	0.02	207	9.70
0122 701-22-122	7.1	0.82	X	0.05	470	36.42
0123 701-22-123	X	0.63	X	0.15	3117	28.66
0124 701-22-124		1.85		0.08	1360	
0125 701-22-125		1.26		0.04	799	
0126 701-22-126	X	1.36	X	0.02	789	19.63
0127 701-22-127		1.45		0.02	779	
0128 701-22-128		1.54		0.02	801	
0129 701-22-129		2.49		0.03	549	
0130 701-22-130	X	1.75	X	0.02	634	23.05
0131 701-22-131		1.65		0.03	441	
0132 701-22-132	X	3.63	X	0.02	666	6.71
0133 701-22-133		2.25		0.08	680	
0134 701-22-134		4.42		0.04	640	
0135 701-22-135	X	1.42	0.011	0.02	814	7.44
0136 701-22-136		3.15		0.03	512	
0137 701-22-137		0.28		0.02	503	
0138 701-22-138		0.75		0.02	568	
0139 701-22-139		0.07		0.04	421	
0140 701-22-140	9.2	0.10	X	0.04	343	49.34
0141 701-22-141		0.09		0.04	484	
0142 701-22-142		0.06		0.02	702	
0143 701-22-143		0.86		0.04	357	
0144 701-22-144		1.28		0.02	591	
0145 701-22-145		8.10		0.02	447	
0146 701-22-146	0.8	1.04	X	X	451	14.37
0147 701-22-147	1.9	2.23	X	0.03	776	39.62
0148 701-22-148	0.5	0.29	X	0.01	544	10.55
0149 701-22-149		2.39		0.04	526	
0150 701-22-150		2.02		0.02	744	

CHECKS						
0001 701-22-001	X	0.15	X	0.05	987	7.52
0002 701-22-021		1.45		1.10	942	
0003 701-22-041	X	1.76	X	0.03	826	19.39
0004 701-22-061		3.42		0.03	909	
0005 701-22-081	1.4	3.76	0.408	0.06	329	21.20
0006 701-22-101		3.19		0.05	781	

ANALYSIS

0007 701-22-121	1.0	0.47	X	0.04	249	8.70
0008 701-22-141		0.10		0.04	486	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0121 701-22-121	X	0.24	64.45	76	1.9	47.6
0122 701-22-122	0.05	5.25	68.37	54	6.5	604.4
0123 701-22-123	X	X	44.42	18	0.5	1.4
0124 701-22-124	X		27.48		0.3	
0125 701-22-125	X		50.78		0.2	
0126 701-22-126	X	0.04	50.63	35	0.4	14.5
0127 701-22-127	X		46.09		0.1	
0128 701-22-128	0.03		65.76		0.3	
0129 701-22-129	0.03		53.81		0.2	
0130 701-22-130	X	0.05	35.18	59	0.2	1.2
0131 701-22-131	X		43.72		0.5	
0132 701-22-132	X	X	44.38	27	0.2	3.1
0133 701-22-133	X		57.82		0.5	
0134 701-22-134	X		70.03		0.2	
0135 701-22-135	X	0.03	59.48	18	0.2	4.3
0136 701-22-136	0.03		56.73		1.0	
0137 701-22-137	3.37		28.86		48.5	
0138 701-22-138	0.74		76.30		9.2	
0139 701-22-139	0.04		109.80		5.1	
0140 701-22-140	0.07	11.89	90.87	10	27.7	5491.4
0141 701-22-141	0.26		84.58		7.0	
0142 701-22-142	X		103.80		1.4	
0143 701-22-143	0.32		39.07		11.9	
0144 701-22-144	X		33.14		4.9	
0145 701-22-145	0.04		25.31		6.0	
0146 701-22-146	0.06	28.32	38.76	3	9.4	362.7
0147 701-22-147	0.08	23.88	32.25	7	10.4	922.6
0148 701-22-148	0.03	3.57	40.10	2	18.5	142.3
0149 701-22-149	0.04		58.40		10.9	
0150 701-22-150	0.21		55.70		13.0	

CHECKS

CHECKS	Cd	Cd	Ce	Cl	Co	Co
0001 701-22-001	0.20	3.05	63.92	8	1.3	10.7
0002 701-22-021	1.38		67.18		20.5	
0003 701-22-041	0.13	4.00	46.01	54	12.6	277.8
0004 701-22-061	0.04		54.86		0.6	
0005 701-22-081	0.03	1.08	47.53	30	22.3	3216.0
0006 701-22-101	0.18		50.74		14.5	

ANALYSIS

0007 701-22-121	X	0.27	62.73	80	1.9	50.1
0008 701-22-141	0.24		84.05		7.0	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	No	3	X	1.40	43.7	1.20
0122 701-22-122	No	4	X	1.41	267.4	51.26
0123 701-22-123	No	13	X	0.09	8.6	0.03
0124 701-22-124	No	11		0.11	9.2	
0125 701-22-125	No	20		0.07	5.9	
0126 701-22-126	No	19	X	0.07	3.7	0.01
0127 701-22-127	No	18		0.07	3.3	
0128 701-22-128	No	22		0.07	8.8	
0129 701-22-129	No	17		0.07	22.0	
0130 701-22-130	No	17	X	0.08	9.6	0.06
0131 701-22-131	No	25		0.06	50.5	
0132 701-22-132	No	9	X	0.08	22.7	0.01
0133 701-22-133	No	8		0.26	373.2	
0134 701-22-134	No	12		0.09	98.1	
0135 701-22-135	No	14	X	0.17	65.6	0.02
0136 701-22-136	No	9		1.14	46.3	
0137 701-22-137	No	8		2.04	276.6	
0138 701-22-138	No	10		5.34	79.7	
0139 701-22-139	No	11		4.13	19.8	
0140 701-22-140	No	8	X	3.45	15.4	0.35
0141 701-22-141	No	8		2.46	293.8	
0142 701-22-142	No	7		1.60	4.2	
0143 701-22-143	No	10		1.80	354.9	
0144 701-22-144	No	23		0.07	425.6	
0145 701-22-145	No	17		X	3253.6	
0146 701-22-146	No	21	0.33	0.08	998.9	130.44
0147 701-22-147	No	13	0.02	0.74	383.3	86.26
0148 701-22-148	No	30	0.18	0.05	1049.8	33.88
0149 701-22-149	No	14		1.67	339.0	
0150 701-22-150	No	16		0.41	368.3	

CHECKS

0001 701-22-001	No	11	X	2.63	410.7	1.63
0002 701-22-021	Yes	16		12.92	1336.1	
0003 701-22-041	No	11	X	0.40	61.9	0.04
0004 701-22-061	No	7		0.87	165.5	
0005 701-22-081	No	85	0.09	8.45	513.8	13.65
0006 701-22-101	No	7		1.20	327.7	

ANALYSIS

0007 701-22-121	No	4	X	1.38	53.2	1.23
0008 701-22-141	No	10		2.50	298.1	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0121 701-22-121	2.09	895	1.14	1.06	0.2	0.87
0122 701-22-122	4.60	1496	3.49	1.09	0.9	1.08
0123 701-22-123	0.85	320	0.44	0.53	0.7	1.77
0124 701-22-124	0.65		0.41	0.26		0.79
0125 701-22-125	0.80		0.37	0.90		3.57
0126 701-22-126	0.87	339	0.48	0.85	0.4	1.90
0127 701-22-127	0.97		0.48	0.70		1.49
0128 701-22-128	1.15		0.63	1.06		2.73
0129 701-22-129	1.07		0.56	0.93		2.07
0130 701-22-130	0.83	509	0.50	0.70	0.3	1.74
0131 701-22-131	0.41		0.28	0.55		10.32
0132 701-22-132	0.81	240	0.40	0.76	0.1	1.74
0133 701-22-133	1.29		0.64	0.86		2.21
0134 701-22-134	0.89		0.34	0.92		4.27
0135 701-22-135	0.65	194	0.34	0.82	0.1	4.78
0136 701-22-136	1.84		1.12	0.76		3.47
0137 701-22-137	1.89		1.14	0.53		1.51
0138 701-22-138	2.80		1.60	1.17		1.26
0139 701-22-139	4.09		2.17	1.87		1.30
0140 701-22-140	2.42	1034	1.17	1.35	0.5	1.61
0141 701-22-141	1.39		0.74	1.03		1.41
0142 701-22-142	2.38		1.22	1.79		0.80
0143 701-22-143	1.20		0.81	0.36		2.18
0144 701-22-144	0.75		0.32	0.66		6.58
0145 701-22-145	0.45		0.21	0.47		19.02*
0146 701-22-146	0.63	1344	0.31	0.61	X	5.58
0147 701-22-147	1.24	1321	0.65	0.64	X	3.24
0148 701-22-148	0.26	1176	0.12	0.39	X	8.33
0149 701-22-149	1.30		0.81	0.61		2.26
0150 701-22-150	1.42		0.64	1.03		5.14

CHECKS						
0001 701-22-001	2.36	256	1.13	0.99	X	1.09
0002 701-22-021	3.47		1.82	1.35		7.29
0003 701-22-041	0.96	494	0.44	0.79	X	5.43
0004 701-22-061	1.14		0.54	0.76		3.43
0005 701-22-081	1.21	2340	0.69	0.67	X	6.33
0006 701-22-101	2.76		1.79	0.76		4.62

ANALYSIS

0007 701-22-121	2.26	880	1.30	1.06	0.2	1.05
0008 701-22-141	1.35		0.76	0.97		1.46

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.03	1.5	0	17.10	2.75	0.78
0122 701-22-122	1.39	1.5	0	18.17	3.31	1.08
0123 701-22-123	X	1.5	0	3.25	1.39	0.99
0124 701-22-124		1.5	0	1.22	0.86	1.16
0125 701-22-125		1.5	0	8.23	1.87	0.79
0126 701-22-126	X	1.4	0	8.98	2.08	0.78
0127 701-22-127		1.4	0	13.59	2.23	0.93
0128 701-22-128		1.4	0	6.80	2.58	1.00
0129 701-22-129		1.5	0	4.31	2.28	1.13
0130 701-22-130	0.18	1.4	0	6.76	1.69	1.18
0131 701-22-131		1.5	0	11.88	1.19	1.95
0132 701-22-132	0.02	1.5	0	14.62	1.87	0.69
0133 701-22-133		1.8	0	14.50	2.40	0.43
0134 701-22-134		1.6	0	17.56	2.08	0.55
0135 701-22-135	X	1.5	0	9.52	1.76	0.64
0136 701-22-136		1.5	0	26.79	2.39	1.06
0137 701-22-137		1.5	0	15.39	1.80	1.22
0138 701-22-138		1.5	0	17.24	3.31	1.31
0139 701-22-139		1.4	0	21.20	5.32	1.35
0140 701-22-140	3.02	1.5	0	19.66	3.57	1.00
0141 701-22-141		1.5	0	18.31	2.39	1.26
0142 701-22-142		1.5	0	18.87	4.40	1.42
0143 701-22-143		1.5	0	18.34	1.11	1.11
0144 701-22-144		1.4	0	7.91	1.73	0.64
0145 701-22-145		1.4	0	2.40	1.05	0.52
0146 701-22-146	167.49	1.4	0	8.56	1.41	0.79
0147 701-22-147	35.23	1.4	0	11.49	1.83	0.56
0148 701-22-148	241.22	1.4	0	2.80	0.68	0.98
0149 701-22-149		1.5	0	17.40	1.73	1.16
0150 701-22-150		1.5	0	13.63	2.83	1.33

CHECKS						
0001 701-22-001	0.10	1.5	0	15.76	3.19	0.99
0002 701-22-021		1.1	0	19.12	4.21	1.24
0003 701-22-041	0.04	1.4	0	11.98	2.30	0.73
0004 701-22-061		1.5	0	18.37	1.90	0.93
0005 701-22-081	249.69	1.4	0	18.82	2.43	1.15
0006 701-22-101		1.5	0	16.54	2.68	1.17

ANALYSIS

0007 701-22-121	0.09	1.5	0	17.10	2.79	0.75
0008 701-22-141		1.5	0	18.81	2.32	1.21

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0121 701-22-121	1.77	X	X	0.39	0.086	1.02%
0122 701-22-122	2.36	X	X	1.10	0.153	1.14%
0123 701-22-123	1.07	X	X	0.14	X	1.01%
0124 701-22-124	0.97	0.05		0.12	X	1079
0125 701-22-125	0.97	0.04		0.13	0.009	1.47%
0126 701-22-126	1.85	0.03	X	0.16	X	1.19%
0127 701-22-127	1.13	0.02		0.15	0.005	7169
0128 701-22-128	1.44	0.01		0.19	0.008	1.58%
0129 701-22-129	1.24	0.01		0.17	X	1.03%
0130 701-22-130	1.12	X	X	0.16	0.009	1.33%
0131 701-22-131	0.71	0.02		0.08	0.101	1.26%
0132 701-22-132	1.21	X	X	0.13	0.023	9907
0133 701-22-133	1.12	X		0.22	0.042	7249
0134 701-22-134	0.61	X		0.13	0.053	5455
0135 701-22-135	0.93	X	X	0.11	0.063	7254
0136 701-22-136	1.91	0.02		0.39	0.285	2.80%
0137 701-22-137	1.46	0.04		0.38	0.224	4.19%
0138 701-22-138	1.71	0.02		0.55	0.108	3.51%
0139 701-22-139	2.19	X		0.77	0.037	2.22%
0140 701-22-140	1.97	0.02	X	0.42	0.039	2.96%
0141 701-22-141	1.79	X		0.25	0.083	2.64%
0142 701-22-142	1.67	X		0.43	0.037	1.98%
0143 701-22-143	1.58	0.02		0.26	0.451	3.64%
0144 701-22-144	0.71	X		0.13	0.022	2.60%
0145 701-22-145	0.53	0.05		0.07	0.051	1.17%
0146 701-22-146	0.95	0.01	X	0.10	0.087	1.34%
0147 701-22-147	1.35	X	X	0.21	0.190	1.57%
0148 701-22-148	0.24	0.01	X	0.04	0.023	2.17%
0149 701-22-149	1.94	0.02		0.26	0.332	3.28%
0150 701-22-150	1.51	0.01		0.23	0.081	2437

CHECKS

0001 701-22-001	1.73	X	X	0.44	0.572	3.88%
0002 701-22-021	0.16	0.02		0.63	0.419	2.18%
0003 701-22-041	1.18	X	X	0.15	0.065	1.06%
0004 701-22-061	1.54	X		0.18	0.409	3.74%
0005 701-22-081	1.08	0.16	X	0.21	0.182	2.36%
0006 701-22-101	0.97	X		0.58	0.379	3.49%

ANALYSIS

0007 701-22-121	1.80	X	X	0.43	0.085	1.22%
0008 701-22-141	1.76	X		0.26	0.088	2.66%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	19.8	36.18	9.0	0.178	1368	20.21
0122 701-22-122	30.9	36.31	10.0	0.487	1183	96.17
0123 701-22-123	6.1	24.28	0.5	0.094	952	8.82
0124 701-22-124		15.71	1.2	0.088	229	
0125 701-22-125		28.10	0.2	0.077	206	
0126 701-22-126	8.4	27.44	0.3	0.123	97	6.74
0127 701-22-127		22.50	0.3	0.111	119	
0128 701-22-128		35.72	0.4	0.134	130	
0129 701-22-129		31.39	0.2	0.125	123	
0130 701-22-130	11.9	19.02	0.4	0.107	124	13.60
0131 701-22-131		24.22	0.3	0.073	149	
0132 701-22-132	5.7	25.62	0.5	0.120	115	6.12
0133 701-22-133		30.95	0.5	0.138	459	
0134 701-22-134		43.05	0.7	0.065	104	
0135 701-22-135	8.8	32.65	0.5	0.073	102	4.22
0136 701-22-136		32.43	0.8	0.203	1621	
0137 701-22-137		17.95	3.6	0.185	2952	
0138 701-22-138		44.42	13.9	0.231	3446	
0139 701-22-139		62.28	11.3	0.329	2179	
0140 701-22-140	16.1	52.44	3.6	0.188	3028	73.63
0141 701-22-141		45.96	5.4	0.145	2728	
0142 701-22-142		54.69	6.7	0.220	1621	
0143 701-22-143		26.77	3.1	0.150	2980	
0144 701-22-144		17.96	0.4	0.054	134	
0145 701-22-145		12.34	0.2	0.048	55	
0146 701-22-146	1.1	21.18	0.4	0.082	68	7.44
0147 701-22-147	10.6	19.17	0.9	0.122	754	46.10
0148 701-22-148	1.3	22.22	0.3	0.024	70	3.86
0149 701-22-149		36.01	3.5	0.152	2423	
0150 701-22-150		31.12	1.6	0.143	164	

CHECKS

CHECKS	K	La	Li	Lu	Mg	Mg
0001 701-22-001	17.1	36.19	5.1	0.174	4068	6.18
0002 701-22-021		37.44	15.8	0.203	4675	
0003 701-22-041	8.9	24.76	1.2	0.092	539	16.43
0004 701-22-061		30.02	0.2	0.115	2058	
0005 701-22-081	21.5	24.69	2.8	0.124	2011	40.09
0006 701-22-101		30.44	0.8	0.241	2692	

ANALYSIS

0007 701-22-121	19.6	34.93	8.8	0.190	1465	20.49
0008 701-22-141		45.86	5.7	0.142	2762	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0121 701-22-121	27	0.12		1.1	1.25	17
0122 701-22-122	34	0.73		1.5	0.54	36
0123 701-22-123	34	X		4.3	11.94	62
0124 701-22-124	45			2.3		8
0125 701-22-125	31			4.3		98
0126 701-22-126	36	0.08		4.4	2.45	68
0127 701-22-127	29			5.3		54
0128 701-22-128	33			3.9		94
0129 701-22-129	40			4.9		68
0130 701-22-130	35	0.18		5.4	8.21	56
0131 701-22-131	28			3.1		76
0132 701-22-132	18	0.04		7.9	1.55	48
0133 701-22-133	37			2.4		30
0134 701-22-134	76			2.5		42
0135 701-22-135	107	0.08		1.7	1.63	59
0136 701-22-136	246			1.5		3
0137 701-22-137	43			1.4		73
0138 701-22-138	57			1.4		23
0139 701-22-139	45			1.4		24
0140 701-22-140	38	2.11		1.2	1.06	38
0141 701-22-141	51			1.6		38
0142 701-22-142	29			0.6		3
0143 701-22-143	46			1.8		77
0144 701-22-144	20			1.4		354
0145 701-22-145	61			1.3		815
0146 701-22-146	16	0.74		1.4	2.63	300
0147 701-22-147	38	2.71		2.0	0.96	118
0148 701-22-148	19	0.58		46.8	1.43	408
0149 701-22-149	81			1.9		62
0150 701-22-150	31			1.4		176

CHECKS						
0001 701-22-001	164	1.27		1.1	0.07	31
0002 701-22-021	4662			1.2		74
0003 701-22-041	44	0.67		1.2	0.12	197
0004 701-22-061	99			0.9		44
0005 701-22-081	41	0.31		1.2	0.59	217
0006 701-22-101	38			4.7		162

ANALYSIS

0007 701-22-121	38	0.11	1.1	0.18	19
0008 701-22-141	49		1.6		39

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0121 701-22-121	697	145.5	11	2.9	7	12
0122 701-22-122	663	164.3	12	2.9	7	33
0123 701-22-123	1071	23.8	0	7.1	0	52
0124 701-22-124	417		1	6.8	0	2
0125 701-22-125	1815		13	4.6	0	96
0126 701-22-126	1468	32.1	9	4.5	0	67
0127 701-22-127	1233		6	4.7	0	51
0128 701-22-128	1965		11	4.5	0	92
0129 701-22-129	1141		5	4.7	0	66
0130 701-22-130	1718	57.0	6	4.5	0	55
0131 701-22-131	1456		6	4.5	0	75
0132 701-22-132	993	27.3	5	4.8	0	46
0133 701-22-133	632		0	5.9	0	27
0134 701-22-134	937		4	5.3	0	40
0135 701-22-135	2035	18.3	6	5.0	0	56
0136 701-22-136	391		1	6.6	0	-2
0137 701-22-137	478		22	2.7	16	77
0138 701-22-138	460		15	2.7	11	20
0139 701-22-139	454		17	2.6	12	21
0140 701-22-140	435	40.2	30	2.4	24	37
0141 701-22-141	474		24	2.4	19	35
0142 701-22-142	383		4	4.9	0	-2
0143 701-22-143	762		45	2.4	38	77
0144 701-22-144	2620		193	2.4	178	356
0145 701-22-145	1705		533	2.3	493	822
0146 701-22-146	2150	6.5	162	2.4	149	301
0147 701-22-147	845	51.5	81	2.3	74	115
0148 701-22-148	2568	4.6	236	2.3	216	409
0149 701-22-149	550		42	2.3	35	62
0150 701-22-150	626		143	2.2	133	178

CHECKS						
0001 701-22-001	1480	14.6	4	5.4	0	34
0002 701-22-021	1197		35	3.6	7	61
0003 701-22-041	779	46.1	166	2.2	153	196
0004 701-22-061	716		1	4.4	0	43
0005 701-22-081	890	64.3	181	2.2	166	219
0006 701-22-101	1553		127	2.2	114	160

ANALYSIS

0007 701-22-121	728	143.8	12	2.9	7	14
0008 701-22-141	480		25	2.6	20	35

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	5.05	22.86	0.9	X	138	X
0122 701-22-122	4.75	27.49	3.1	0.18	530	0.9
0123 701-22-123	1.43	16.05	1.6	X	405	X
0124 701-22-124	1.34	9.76	0.7		192	
0125 701-22-125	1.20	19.91	1.4		552	
0126 701-22-126	2.78	18.85	X	X	582	X
0127 701-22-127	2.37	18.04	X		620	
0128 701-22-128	2.69	25.80	X		598	
0129 701-22-129	1.69	20.60	1.5		517	
0130 701-22-130	1.60	15.02	X	X	517	X
0131 701-22-131	0.92	15.54	0.8		470	
0132 701-22-132	2.34	15.81	X	X	589	X
0133 701-22-133	1.74	20.36	1.3		584	
0134 701-22-134	0.99	22.42	X		784	
0135 701-22-135	0.83	21.97	X	X	792	X
0136 701-22-136	3.25	19.27	0.7		515	
0137 701-22-137	2.90	9.58	11.9		627	
0138 701-22-138	4.08	27.11	3.9		480	
0139 701-22-139	4.92	40.86	1.8		408	
0140 701-22-140	4.38	32.23	6.0	1.18	287	X
0141 701-22-141	3.63	31.37	4.7		508	
0142 701-22-142	3.60	43.44	4.0		1214	
0143 701-22-143	3.54	11.18	7.0		287	
0144 701-22-144	2.00	13.82	1.8		654	
0145 701-22-145	1.51	9.08	4.5		363	
0146 701-22-146	2.25	14.35	8.3	0.19	506	2.6
0147 701-22-147	2.91	11.52	8.2	0.29	705	1.7
0148 701-22-148	0.65	14.07	14.6	0.12	574	0.9
0149 701-22-149	4.30	17.29	10.6		290	
0150 701-22-150	4.08	22.32	13.0		727	

CHECKS

0001 701-22-001	4.26	22.24	26.1	X	753	X
0002 701-22-021	3.27	27.75	12.5		863	
0003 701-22-041	1.22	17.67	9.1	0.07	807	X
0004 701-22-061	2.59	18.47	1.9		555	
0005 701-22-081	7.84	20.15	98.3	1.89	339	0.5
0006 701-22-101	1.15	16.85	9.4		577	

ANALYSIS

0007 701-22-121	5.05	22.31	1.1	X	168	X
0008 701-22-141	3.71	31.51	5.2		523	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	19.0	X	5.1		6.456	55.88
0122 701-22-122	50.5	X	4.1		7.444	52.21
0123 701-22-123	71.1	X	7.9		4.573	1.97
0124 701-22-124	101.5		7.6	3.8	2.826	2.06
0125 701-22-125	146.7		7.3		5.343	1.84
0126 701-22-126	137.7	1.8	6.8		5.278	1.56
0127 701-22-127	300.2		6.8		4.817	1.29
0128 701-22-128	149.3		7.2		7.126	1.98
0129 701-22-129	100.8		7.3		6.013	1.71
0130 701-22-130	116.0	3.2	7.3		4.221	1.85
0131 701-22-131	121.8		7.0		4.424	2.00
0132 701-22-132	143.3	1.0	6.7		4.439	2.50
0133 701-22-133	76.4		6.8		5.807	15.41
0134 701-22-134	160.9		7.1		6.625	1.75
0135 701-22-135	124.4	0.8	6.7		6.059	2.64
0136 701-22-136	37.4		7.0		5.505	110.84
0137 701-22-137	252.2		2.8		2.785	123.21
0138 701-22-138	56.9		4.2		7.610	140.88
0139 701-22-139	18.6		4.7		11.334	87.11
0140 701-22-140	25.1	X	3.8		9.102	117.20
0141 701-22-141	62.8		4.3		8.901	98.43
0142 701-22-142	9.3		5.9		11.540	69.96
0143 701-22-143	181.7		3.0		3.527	111.76
0144 701-22-144	173.7		3.0		3.807	2.73
0145 701-22-145	82.2		2.7		2.489	2.00
0146 701-22-146	51.2	0.6	3.1		4.059	1.68
0147 701-22-147	54.7	0.5	3.4		3.233	38.16
0148 701-22-148	70.0	0.5	3.3		4.072	2.22
0149 701-22-149	68.4		3.3		5.368	115.42
0150 701-22-150	22.2		3.2		5.820	3.17

CHECKS						
0001 701-22-001	327.8	1.6	5.1		6.432	159.65
0002 701-22-021	157.2		5.8	2.6	7.324	93.84
0003 701-22-041	107.6	X	5.4		4.918	26.80
0004 701-22-061	23.4		4.1		5.302	131.00
0005 701-22-081	134.8	11.0	2.7		5.232	118.94
0006 701-22-101	44.4		3.8		4.935	106.37

ANALYSIS

0007 701-22-121	19.3	0.6	5.5	6.326	55.21
0008 701-22-141	65.3			8.853	101.27

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0121 701-22-121	X	0.55	4757	96.6	0.42	0.07
0122 701-22-122	0.002	1.19	9578	294.5	0.59	0.26
0123 701-22-123	0.002	2.04	1.90%	25.8	X	0.70
0124 701-22-124	X	0.25	1955		X	0.11
0125 701-22-125	X	3.20	2.94%		X	1.06
0126 701-22-126	X	2.22	2.25%	27.6	X	0.57
0127 701-22-127	X	1.77	1.44%		X	0.25
0128 701-22-128	X	3.06	3.04%		X	0.92
0129 701-22-129	X	2.23	1.98%		X	0.68
0130 701-22-130	X	1.82	2.59%	44.8	0.30	0.83
0131 701-22-131	X	2.49	2.45%		X	0.81
0132 701-22-132	X	1.58	1.83%	18.8	0.05	0.42
0133 701-22-133	X	0.97	8216		X	0.22
0134 701-22-134	0.003	1.36	1.14%		X	0.20
0135 701-22-135	X	1.93	1.72%	16.5	X	0.30
0136 701-22-136	X	0.10	1126			0.04
0137 701-22-137	0.006	2.39	2.65%		0.71	0.58
0138 701-22-138	X	0.75	7422		0.53	0.13
0139 701-22-139	X	0.80	7696		0.60	0.09
0140 701-22-140	X	1.24	1.24%	198.0	0.94	0.12
0141 701-22-141	X	1.24	1.21%		1.07	0.09
0142 701-22-142	X	0.10	903			0.05
0143 701-22-143	0.003	2.50	2.94%		1.52	0.40
0144 701-22-144	0.003	11.56	11.44%		5.58	1.39
0145 701-22-145	X	26.63	22.05%		18.95	1.19
0146 701-22-146	X	9.82	8.52%	261.9	4.84	0.70
0147 701-22-147	X	3.84	3.99%	247.9	2.81	0.30
0148 701-22-148	0.044	13.32	12.46%	242.3	7.94	1.17
0149 701-22-149	0.003	2.03	2.21%		1.69	0.25
0150 701-22-150	X	5.75	5.38%		4.00	0.34

CHECKS						
0001 701-22-001	X	1.01	1.06%	27.2	X	0.39
0002 701-22-021	0.009	2.42	2.75%			0.11
0003 701-22-041	0.002	6.44	6.19%	47.4		0.31
0004 701-22-061	X	1.44	1.74%			1.06
0005 701-22-081	X	7.08	7.06%	416.3		0.49
0006 701-22-101	0.039	5.28	5.14%			0.49

ANALYSIS

0007 701-22-121	X	0.61	5693	98.9	0.07
0008 701-22-141	X	1.26	1.24%		0.10

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.51	0.05	5.8	X	2.6	0.09
0122 701-22-122	1.05	0.04	8.4	X	5.9	0.13
0123 701-22-123	3.63	1.27	3.7	3.9	1.7	3.71
0124 701-22-124	3.35		1.8	5.7		6.19
0125 701-22-125	1.53		5.2	1.8		1.28
0126 701-22-126	4.34	0.35	8.0	0.8	1.2	0.78
0127 701-22-127	2.90		8.1	1.0		1.09
0128 701-22-128	2.72		6.2	5.5		4.79
0129 701-22-129	2.92		3.7	3.2		3.08
0130 701-22-130	7.63	1.88	4.9	5.1	1.4	4.73
0131 701-22-131	3.13		3.8	5.3		4.77
0132 701-22-132	5.15	0.34	6.2	1.4	1.1	1.30
0133 701-22-133	0.72		6.8	3.9		3.02
0134 701-22-134	3.55		4.6	3.5		2.94
0135 701-22-135	1.19	0.54	6.3	4.2	1.0	4.04
0136 701-22-136	0.62		10.6	X		0.49
0137 701-22-137	0.31		13.7	X		0.26
0138 701-22-138	0.26		9.9	0.5		0.21
0139 701-22-139	0.29		14.3	X		0.10
0140 701-22-140	0.22	0.02	10.3	X	2.7	0.25
0141 701-22-141	0.54		8.4	X		0.24
0142 701-22-142	0.21		9.3	X		0.02
0143 701-22-143	0.62		11.7	1.3		1.22
0144 701-22-144	0.87		6.3	1.0		0.51
0145 701-22-145	2.22		2.2	2.7		2.88
0146 701-22-146	2.54	0.14	6.2	1.5	2.8	1.01
0147 701-22-147	0.75	0.14	8.2	3.0	7.9	3.12
0148 701-22-148	1.55	0.27	7.6	2.4	10.4	2.61
0149 701-22-149	1.16		9.5	1.2		1.19
0150 701-22-150	1.35		10.2	2.3		1.71

CHECKS						
0001 701-22-001	0.38	X	9.2	0.9	1.3	0.53
0002 701-22-021	0.59		16.8	0.9		1.01
0003 701-22-041	0.46	0.34	9.1	2.7	2.8	2.34
0004 701-22-061	0.69		7.5	1.0		0.91
0005 701-22-081	2.58	0.47	11.9	0.8	3.2	0.97
0006 701-22-101	0.36		8.1	4.8		4.77

ANALYSIS

0007 701-22-121	0.51	0.04	5.8	X	2.8	0.12
0008 701-22-141	0.48		8.5	X		0.26

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	3.95	0.8	X	40.02	13.17	0.41
0122 701-22-122	4.44	1.0	X	369.97	76.16	0.39
0123 701-22-123	2.43	10.6	X	249.34	256.35	0.13
0124 701-22-124	1.42	5.9		123.17		0.10
0125 701-22-125	3.21	7.6		338.37		0.11
0126 701-22-126	3.10	4.3	X	185.87	225.98	0.23
0127 701-22-127	3.31	3.8		237.45		0.19
0128 701-22-128	4.33	8.6		394.60		0.24
0129 701-22-129	3.62	8.5		520.91		0.16
0130 701-22-130	2.53	13.1	0.1	560.48	183.34	0.15
0131 701-22-131	2.31	4.8		380.29		0.08
0132 701-22-132	2.82	2.2	X	189.88	157.63	0.23
0133 701-22-133	3.51	1.7		173.53		0.15
0134 701-22-134	3.53	4.8		527.27		0.10
0135 701-22-135	3.30	1.8	X	576.39	94.23	0.09
0136 701-22-136	3.33	1.4		709.90		0.29
0137 701-22-137	1.79	0.5		129.28		0.25
0138 701-22-138	4.43	0.8		89.43		0.32
0139 701-22-139	7.00	0.8		120.71		0.40
0140 701-22-140	5.24	0.6	X	81.29	31.02	0.35
0141 701-22-141	4.61	0.5		121.60		0.30
0142 701-22-142	7.68	0.5		131.86		0.32
0143 701-22-143	1.52	0.8		67.83		0.30
0144 701-22-144	2.42	1.4		548.88		0.16
0145 701-22-145	1.63	5.2		209.14		0.13
0146 701-22-146	2.24	3.9	X	562.61	26.04	0.21
0147 701-22-147	2.16	1.3	X	329.72	65.53	0.25
0148 701-22-148	1.63	5.5	X	451.39	40.84	0.05
0149 701-22-149	2.54	0.8		109.22		0.54
0150 701-22-150	4.06	2.2		367.62		0.35

CHECKS

0001 701-22-001	3.65	0.7	X	76.36	10.04	0.34
0002 701-22-021	5.08	0.8		284.38		0.21
0003 701-22-041	3.13	1.2	X	451.23	41.67	0.09
0004 701-22-061	2.97	0.8		49.23		0.23
0005 701-22-081	3.59	5.2	X	278.45	30.25	0.56
0006 701-22-101	2.97	1.5		183.97		0.10

ANALYSIS

0007 701-22-121	4.01	0.8	X	40.40	11.73	0.41
0008 701-22-141	4.64	0.6		125.61		0.31

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0121 701-22-121	0.370	600	0.15	22.14	0.024	1967
0122 701-22-122	0.596	1355	0.06	20.60	0.223	2039
0123 701-22-123	0.169	183	0.26	11.64	0.011	626
0124 701-22-124	0.107		0.09	9.26		690
0125 701-22-125	0.186		0.14	13.13		551
0126 701-22-126	0.224	205	0.16	13.89	0.027	1390
0127 701-22-127	0.236		0.19	16.07		1023
0128 701-22-128	0.257		0.31	16.07		1409
0129 701-22-129	0.253		0.36	13.92		785
0130 701-22-130	0.182	403	0.33	13.24	0.200	816
0131 701-22-131	0.110		0.78	12.78		318
0132 701-22-132	0.199	149	8.89	19.49	0.033	795
0133 701-22-133	0.279		0.41	18.51		696
0134 701-22-134	0.213		0.68	24.88		508
0135 701-22-135	0.161	126	0.37	19.68	0.010	301
0136 701-22-136	0.410		0.52	25.25		1496
0137 701-22-137	0.301		0.22	19.99		1576
0138 701-22-138	0.492		0.19	25.26		2334
0139 701-22-139	0.744		X	32.63		3217
0140 701-22-140	0.461	966	0.20	28.69	0.582	2475
0141 701-22-141	0.262		0.13	28.40		2037
0142 701-22-142	0.490		X	27.88		1991
0143 701-22-143	0.181		0.60	23.40		2074
0144 701-22-144	0.195		0.20	8.05		1396
0145 701-22-145	0.104		0.77	6.95		600
0146 701-22-146	0.150	879	0.70	12.25	37.361	958
0147 701-22-147	0.226	961	1.30	22.25	10.119	1674
0148 701-22-148	0.060	810	0.48	11.55	3.034	405
0149 701-22-149	0.226		1.08	25.83		2569
0150 701-22-150	0.316		0.90	23.72		2301

CHECKS						
0001 701-22-001	0.440	196	0.06	21.33	0.025	2266
0002 701-22-021	0.559		0.78	14.42		3087
0003 701-22-041	0.249	348	0.87	11.18	0.021	800
0004 701-22-061	0.219		0.66	17.81		929
0005 701-22-081	0.261	1486	1.36	14.85	18.376	3114
0006 701-22-101	0.229		0.65	21.64		685

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0007 701-22-121	0.405	629	0.13	22.33	0.049	1881
0008 701-22-141	0.263		0.12	28.78		2083

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ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.33	0.17	3.66	1.198	41	X
0122 701-22-122	0.37	0.49	16.98	930.896	55	X
0123 701-22-123	0.02	0.07	2.62	3.510	34	X
0124 701-22-124	0.02	0.07	2.12		8	
0125 701-22-125	X	0.07	3.02		54	
0126 701-22-126	X	0.09	3.65	0.247	53	X
0127 701-22-127	X	0.08	4.26		71	
0128 701-22-128	X	0.11	4.20		89	
0129 701-22-129	0.02	0.10	3.92		43	
0130 701-22-130	0.03	0.08	3.32	0.332	57	X
0131 701-22-131	X	0.05	2.58		76	
0132 701-22-132	0.04	0.07	3.94	0.179	72	X
0133 701-22-133	0.18	0.11	4.08		61	
0134 701-22-134	0.04	0.05	3.96		58	
0135 701-22-135	0.04	0.06	2.85	0.186	65	X
0136 701-22-136	1.01	0.19	5.78		93	
0137 701-22-137	1.44	0.21	6.78		103	
0138 701-22-138	1.38	0.24	4.98		88	
0139 701-22-139	0.69	0.31	5.36		125	
0140 701-22-140	0.86	0.17	5.40	44.866	90	X
0141 701-22-141	0.97	0.12	5.32		80	
0142 701-22-142	0.69	0.18	3.54		89	
0143 701-22-143	1.18	0.13	4.61		94	
0144 701-22-144	0.04	0.04	2.64		74	
0145 701-22-145	0.10	0.04	1.56		37	
0146 701-22-146	0.06	0.05	3.07	25.166	68	X
0147 701-22-147	0.48	0.10	4.94	43.285	98	X
0148 701-22-148	0.07	0.02	0.88	7.741	73	X
0149 701-22-149	1.38	0.13	5.02		80	
0150 701-22-150	0.30	0.10	6.99		104	

CHECKS

0001 701-22-001	1.84	0.16	3.64	0.111	84	X
0002 701-22-021	1.23	0.23	1.75		146	
0003 701-22-041	0.36	0.06	4.07	4.718	84	X
0004 701-22-061	1.32	0.08	3.53		64	
0005 701-22-081	1.26	0.11	2.96	89.824	99	0.07
0006 701-22-101	1.83	0.27	3.57		62	

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0007 701-22-121	0.32	0.18	3.68	1.523	48	X
0008 701-22-141	1.02	0.12	5.31		78	

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ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0121 701-22-121	1.0	10.52	1.16	18	0.02	49.4
0122 701-22-122	1.5	38.62	3.07	27	0.44	78.5
0123 701-22-123	5.1	3.78	0.50	4	X	32.5
0124 701-22-124	5.6	3.11	0.51	5		33.2
0125 701-22-125	2.4	3.09	0.52	4		29.4
0126 701-22-126	3.8	3.66	0.71	2	X	53.7
0127 701-22-127	1.9	3.79	0.62	3		36.3
0128 701-22-128	6.2	4.88	0.92	4		46.1
0129 701-22-129	6.7	4.60	0.85	5		43.0
0130 701-22-130	6.2	3.96	0.65	3	X	37.6
0131 701-22-131	2.8	2.10	0.35	4		23.4
0132 701-22-132	1.6	3.08	0.73	2	X	42.6
0133 701-22-133	0.9	6.14	0.84	18		36.5
0134 701-22-134	1.4	2.91	0.41	6		21.9
0135 701-22-135	0.9	2.86	0.46	7	X	30.0
0136 701-22-136	1.6	9.79	1.67	17		60.4
0137 701-22-137	1.8	10.00	1.24	368		48.3
0138 701-22-138	1.3	13.94	1.57	194		50.7
0139 701-22-139	2.4	18.33	2.25	35		71.3
0140 701-22-140	1.4	9.69	1.22	29	1.56	59.9
0141 701-22-141	1.4	5.86	0.86	39		50.7
0142 701-22-142	1.0	9.99	1.31	37		48.8
0143 701-22-143	1.6	6.85	0.95	87		46.4
0144 701-22-144	4.1	2.85	0.37	5		23.7
0145 701-22-145	4.3	1.77	0.31	6		17.5
0146 701-22-146	2.1	2.68	0.46	3	0.55	30.7
0147 701-22-147	1.6	5.47	0.74	18	3.56	40.0
0148 701-22-148	2.7	1.11	0.16	3	0.32	7.0
0149 701-22-149	2.2	6.84	0.93	33		58.1
0150 701-22-150	6.8	5.22	0.73	13		49.3

CHECKS

0001 701-22-001	1.6	9.31	1.07	67	0.29	53.8
0002 701-22-021	0.7	18.24	1.50	671		10.5
0003 701-22-041	0.5	3.52	0.51	39	0.69	38.2
0004 701-22-061	1.5	5.05	0.63	31		48.6
0005 701-22-081	2.6	5.44	0.81	16	1.01	40.3
0006 701-22-101	1.1	6.28	1.62	20		32.7

ANALYSIS

0007 701-22-121	1.1	11.68	1.28	22	0.02	51.4
0008 701-22-141	1.3	6.00	0.92	40		51.3

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.20		7.87%			14.7
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.31		6.47%			16.8
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				0.04		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	X		6.20%			0.8
0022 AMIS0167	0.92		1.39%			158.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.30		6.15%			128.8
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	29.30		3.48%			1060.5
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0001 NGL-27		X				
0002 OREAS 45d				184.6		0.83
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		22				
0009 OREAS 45e				254.8		0.72
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			
0015 Control Blank						
0016 OREAS 45e		24				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				822.0		0.29
0022 AMIS0167				90.5		0.47
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		11				
0029 GTS-2a				183.4		0.85
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		X				
0035 CCU-1c						
0036 MPL-5				607.7		17.58
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		0.34			1873	
0003 OREAS 45e				0.55		
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d				1.05		
0008 OREAS 45d						
0009 OREAS 45e		0.28			637	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96				0.16		
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		0.03			11.52%	
0022 AMIS0167		1.07			1021	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1				12.56		
0028 AE21						
0029 GTS-2a		0.28			3.60%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3				8.68		
0034 Au5						
0035 CCU-1c				0.09		
0036 MPL-5		40.49			4.41%	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.07		36.50		29.6	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.04		24.59		57.5	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank				X		
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.09		18.06		29.3	
0022 AMIS0167	0.42		46.41		37.7	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.43		25.29		22.9	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	3.21		587.02		138.4	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		539		3.83	373.5	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		983		1.24	787.0	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		237		0.45	106.8	
0022 AMIS0167		404		1.10	64.4	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		132		1.65	78.7	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		604		24.33	2028.5	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.18		1.32	0.61		15.45
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.18		1.22	0.58		26.02
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank					X	
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.97		1.59	1.24		4.87
0022 AMIS0167	5.88		2.87	0.74		2.50
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	2.17		1.33	1.12		7.01
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	8.64		2.18	4.97		3.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d				21.84	2.38	1.55
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e				17.14	1.99	0.57
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	X					
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				12.30	3.01	1.80
0022 AMIS0167				3.20	4.77	0.93
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a				21.13	3.43	0.50
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5				32.42	23.30	15.92
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0001 NGL-27		0.01				
0002 OREAS 45d	3.69			0.44	0.097	4391
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		0.04				
0009 OREAS 45e	3.37			0.41	0.096	3457
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e		X				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.99			0.59	0.061	8790
0022 AMIS0167	1.95			1.00	0.006	4681
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		X				
0029 GTS-2a	2.83			0.43	0.119	1.83%
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		0.19				
0035 CCU-1c						
0036 MPL-5	1.28			1.08	21.017	1.21%
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		16.99	18.2	0.196	2206	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		11.46	5.9	0.177	1382	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	0.1					X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		8.43	42.9	0.190	5.38%	
0022 AMIS0167		23.91	4.2	0.288	1427	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		10.33	24.0	0.272	2.05%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		326.54	34.1	0.167	8923	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	503			2.6		
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	548			2.4		
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		X				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1129			0.7		
0022 AMIS0167	217			3.9		
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1332			4.1		
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2342			20.0		
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	1039					
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	629					
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		0.1				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.68%					
0022 AMIS0167	669					
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	5690					
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	5877					
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	12.44	14.56	204.2		376	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	6.69	9.72	399.3		314	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				X		X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	5.92	10.68	74.6		366	
0022 AMIS0167	3.46	19.21	104.6		165	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.28	17.24	67.5		802	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	36.44	239.38	2487.9		739	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	22.5				3.789	43.00
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	18.5				2.628	22.47
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	8.4				2.337	19.98
0022 AMIS0167	247.4				5.068	17.48
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	20.0				3.581	58.43
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2101.3				64.600	367.62
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	X		617			
0003 OREAS 45e		0.06				
0004 OREAS 97.01						
0005 PD-1						4.62
0006 PD-1					3.18	
0007 OREAS 45d		0.07				
0008 OREAS 45d						
0009 OREAS 45e	X		526			
0010 OREAS 97.01						
0011 PD-1						4.47
0012 RTS-2					1.41	
0013 Control Blank						
0014 Control Blank				0.1		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96		4.13				
0018 OREAS 97.01						
0019 PD-1						4.47
0020 PD-1					3.70	
0021 WGB-1	X		385			
0022 AMIS0167	X		8375			
0023 OREAS 97.01						
0024 PD-1						4.37
0025 PL-21						
0026 RTS-2					1.23	
0027 STSD-1		0.25				
0028 AE21						
0029 GTS-2a	X		2971			
0030 OREAS 97.01						
0031 PD-1						4.40
0032 PD-1					3.48	
0033 STSD-3		0.19				
0034 Au5						
0035 CCU-1c		32.40				
0036 MPL-5	1.601		1.18%			
0037 OREAS 97.01						
0038 PD-1						4.51

ANALYSIS

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ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.77		47.5	2.7		
0003 OREAS 45e						
0004 OREAS 97.01						0.67
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.05		88.2	2.8		
0010 OREAS 97.01						0.70
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						0.65
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.24		42.3	0.5		
0022 AMIS0167	7.59		2.8	0.7		
0023 OREAS 97.01						0.70
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.19		30.6	0.9		
0030 OREAS 97.01						0.72
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	353.34		48.0	126.6		
0037 OREAS 97.01						0.72
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	3.07	2.7		34.03		0.92
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.37	1.3		16.87		0.53
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.82	3.9		113.82		0.33
0022 AMIS0167	4.84	1.5		22.69		1.36
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	4.65	1.2		93.07		0.08
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	38.21	8.2		428.66		74.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.383		0.12	14.40		6554
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.329		0.16	12.71		5079
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.464		X	0.91		5191
0022 AMIS0167	0.890		0.19	50.87		713
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.631		1.31	1.23		1081
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2.191		29.82	93.62		2405
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.29	0.19	2.61		236	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.17	0.19	2.39		320	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.36	0.23	0.62		230	
0022 AMIS0167	0.18	0.39	479.51		64	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.36	0.23	0.35		135	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	6.29	0.24	10.50		205	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.2	9.84	1.29	40		133.6
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.0	8.48	1.25	40		104.0
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank					0.04	
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.4	14.28	1.40	36		27.4
0022 AMIS0167	0.9	20.58	2.44	170		64.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	19.5	9.96	1.68	182		97.1
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	28.9	22.52	1.40	1314		39.3
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		
0044 Control Blank						
0045 OREAS 24b	X		8.28%			8.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				2.01		
0051 AlcoaHi4-OES				50.68		
0052 SOLN-001				50.01		
0053 Alcoa18-MS		5.23				

BLANKS						
0001 Control Blank	X	X	X	X		X
0002 Control Blank	X		X			0.7
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		67			X

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			
0044 Control Blank						
0045 OREAS 24b				737.0		2.09
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			1.03			
0051 AlcoaHi4-OES			19.22			
0052 SOLN-001			X			
0053 Alcoa18-MS	34.6				5.32	

BLANKS						
0001 Control Blank	X	X	X	0.1	0.06	X
0002 Control Blank				0.7		X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				X		X

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0041 CCU-1d				0.09		
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b		0.59			1.13%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						50.83
0051 AlcoaHi4-OES						984.13
0052 SOLN-001						194.49
0053 Alcoa18-MS	5.1		5.125			
BLANKS						
0001 Control Blank	X	X	X	X	X	0.02
0002 Control Blank		X			X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X			X	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank				X		
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.07		84.62		16.2	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.90				565.6

BLANKS						
0001 Control Blank	X	X	0.08	X	X	X
0002 Control Blank	X		0.08		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		X		X	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			X
0044 Control Blank						
0045 OREAS 24b		105		10.50	40.6	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			0.49			0.54
0051 AlcoaHi4-OES			19.92			2.51
0052 SOLN-001			X			0.05
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank		1	X	X	X	X
0002 Control Blank		1		X	0.7	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X		X	0.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank					X	
0045 OREAS 24b	4.18		2.21	1.35		4.84
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	0.11	X	X	X	X	0.01
0002 Control Blank	X		X	X		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.10		0.05	X		X

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					
0044 Control Blank						
0045 OREAS 24b				20.74	5.80	1.34
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	2.08					
0051 AlcoaHi4-OES	100.93					
0052 SOLN-001	50.19					
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X			X	0.10	X
0002 Control Blank				0.10	X	X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				0.11	0.05	X

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	3.89			0.78	0.071	3.07%
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			4.8			

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X			X	X	X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X			0.02	X	X

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					X
0044 Control Blank						
0045 OREAS 24b		43.55	46.9	0.334	1.66%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	3.9					50.29
0051 AlcoaHi4-OES	484.3					202.55
0052 SOLN-001	101.2					193.81
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	0.09	X	X	X	X
0002 Control Blank		0.02	X	X	X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X	X	X	X	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	484			4.1		
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381			2.40%			
0050 Alcoa12-OES		0.50				
0051 AlcoaHi4-OES		19.88				
0052 SOLN-001		0.01				
0053 Alcoa18-MS					6.40	

BLANKS						
0001 Control Blank	4	X		0.1	X	
0002 Control Blank	X			X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	5			X		

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	8998					
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES		249.0				
0051 AlcoaHi4-OES		2051.3				
0052 SOLN-001		496.6				
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	33	X	3	5.0	0	
0002 Control Blank	X					
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X					

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		X
0044 Control Blank						
0045 OREAS 24b	13.67	38.25	61.6		729	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				0.51		1.1
0051 AlcoaHi4-OES				20.55		49.3
0052 SOLN-001				X		X
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	X	0.5	X	X	X
0002 Control Blank	X	0.05	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.33	0.02	X		X	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	23.0				9.967	168.78
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		6.3				

BLANKS						
0001 Control Blank	X	X	5.8		X	X
0002 Control Blank	0.7				0.012	0.18
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	1.1				0.007	0.07

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0041 CCU-1d		31.55				
0042 Control Blank						
0043 Control Blank				0.3		
0044 Control Blank						
0045 OREAS 24b	X		2234			
0046 OREAS 97.01						
0047 PD-1						4.32
0048 PD-1					3.48	
0049 BCS381						
0050 Alcoa12-OES				21.1		
0051 AlcoaHi4-OES				265.3		
0052 SOLN-001				499.1		
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	0.01	X	X		X
0002 Control Blank	X		X			
0003 Control Blank						
0004 Control Blank						0.63
0005 Control Blank						
0006 Acid Blank	X		X			

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	1.00		15.7	X		
0046 OREAS 97.01						0.69
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.74			31.3	

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X		0.3	X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						X
0006 Acid Blank	X		0.3	X		

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	7.34	4.3		125.44		1.01
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			5.8		529.55	

BLANKS						
0001 Control Blank	0.09	X	X	0.05	0.04	X
0002 Control Blank	X	X		X		0.01
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.02	X		0.15		0.02

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.798		X	16.94		4249
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS					5.692	

BLANKS						
0001 Control Blank	X		X	X	X	X
0002 Control Blank	X		X	0.03		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.011		X	0.01		26

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b	0.84	0.38	3.11		105	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						0.50
0051 AlcoaHi4-OES						20.30
0052 SOLN-001						X
0053 Alcoa18-MS				5.313		

BLANKS						
0001 Control Blank	X	X	X	X	1	X
0002 Control Blank	X	X	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	X	X		X	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank					X	
0044 Control Blank						
0045 OREAS 24b	3.9	19.98	2.11	107		135.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES					0.48	
0051 AlcoaHi4-OES					20.57	
0052 SOLN-001					X	
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	X	X	4	X	X
0002 Control Blank	0.2	0.06	0.01	X		0.3
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	0.57	0.04	2		0.3

METHOD CODE DESCRIPTION

/CALC Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/CSA Intertek Genalysis Perth

Induction Furnace Analysed by Infrared Spectrometry

/GR Intertek Genalysis Perth

Analysed by Gravimetric Technique.

/MS Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

4A/MS Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4A/OE Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

4AH/OE Intertek Genalysis Perth

Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

METHOD CODE DESCRIPTION

AR01/MS Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Mass Spectrometry.

AR01/OE Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

NAGx/MTR Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

S71/OE Intertek Genalysis Perth

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

SCR/VOL Intertek Genalysis Perth

Chromium Reducible Suplhur Analysed by Volumetric Technique.

SE1/MS Intertek Genalysis Perth

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Pl

Ws/MTR Intertek Genalysis Perth

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed with Electronic Meter Measurement

15 Davison Street, Maddington
Western Australia 6109

Telephone: +61 8 9251 8100
Facsimile: +61 8 9251 8110
www.intertek.com

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APPENDIX K

Air Quality, Noise and Vibration Modeling

Knight Piésold
CONSULTING

MYANMAR WANBAO COPPER MINING LIMITED
LETPADAUNG PROJECT

AIR QUALITY, NOISE AND VIBRATION MODELING
LETPADAUNG PROJECT

PREPARED FOR:

Knight Piésold Pty. Ltd
Level 1/ 184 Adelaide Terrace, East Perth
Perth, Western Australia, Australia, 6004

PREPARED BY:

Knight Piésold Consultores S.A.
Calle Aricota 106, Piso 5,
Santiago de Surco, Lima 33, Peru

Knight Piésold
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LETPADAUNG COPPER PROJECT

AIR QUALITY, NOISE AND VIBRATION MODELING

DRAFT REPORT

KP Job No. LI201-00239/05

CONTRACT
PROPOSAL APPROVED PEL-0225-2013

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1. INTRODUCTION

The Letpadaung Copper Project is located at Letpadaung in the Sagaing Division and is part of a larger project known as the Monywa Copper Project, which is developing the Sabetaung & Kyisintaung (S&K) deposits within the Monywa Copper Geological Complex. Myanmar Wanbao Mining Copper Limited (MWMCL), which will be responsible for the complete development of the Letpadaung deposit, has adopted the Environmental and Social assessments reviewed by AATA International Inc. in 1996.

As part of the Environmental Impact Assessment (EIA) of the Letpadaung Project, particulate matter dispersion as well as noise and vibration propagation have been modelled, which has allowed quantifying impacts caused by the project within the environmental baseline area. This area has been delimited in coordination with Knight Piésold Pty. Ltd and comprises the sites of the noise, vibration and air quality sampling stations.

The input information used for estimating particulate matter, noise and vibration emissions, and specific for this project was provided by the company Myanmar Wanbao Mining Copper Limited in coordination with Knight Piésold Pty. Ltd (Knight Piésold Australia). In terms of methodology, the computer programs used for modelling air quality dispersion (particulate matter) as well as noise and vibration propagation were AERMOD View, version 8.2, and SoundPLAN, version 7.2; which allowed a quantification of impacts produced by project activities during the construction and operation phases.

2. OBJECTIVES

The specific objectives of this study are presented below:

- To prepare an inventory of particulate matter, noise and vibration emissions produced by the project's construction and operation phases.
- To quantify impacts on air quality caused by the project's construction and operation phases; this is to be achieved by modelling particulate matter dispersion (PM_{10}).
- To quantify impacts on noise and vibration quality induced by activities to be executed during the project's construction and operation phases; this is to be accomplished by modelling noise and vibrations.

3. LETPADAUNG PROJECT DESCRIPTION

The Letpadaung Project is located 5.3 km from the city of Monywa, on the western bank of the Chindwin River and south of the Yama Stream, a Chindwin tributary. The company Myanmar Wanbao Mining Copper Limited (MWMCL) is responsible for developing the project. This project is part of the Monywa Copper Project, which is developing the Sabetaung and Kyisintaung copper deposits, located 6 km northwest from the Letpadaung deposit.

The project's construction phase will include the execution of all activities required for the operation, as well as the construction and operation of complementary facilities. Construction activities will take place during the day; these activities consist of earthworks, land grading, facility construction, facility assembly, drilling and blasting, excavations, materials transportation, consumables transportation, and road improvement.

The project's operation phase is the one during which copper ore exploitation, processing and dressing take place. Figure 1 shows the location of the project and the facilities considered during year 5 of the mining plan, which include the execution of an open pit, waste rock dumps, crushing facilities, pump station, conveyor belt, and heap leach piles. During this phase, typical operation activities and improvements are considered, which will ensure their normal execution through implementation of mitigation measures for dust and noise control, in order to comply with MWMCL's environmental standards. According to information provided by the company Knight Piésold Pty. Ltd in coordination with MWMCL, Table 1 presents the project-related production of copper ore concentrate and waste rock throughout the first 10 years.

Table 1: Letpadaung Project Mining Plan

Mining plan	Material handling (1)		
	Ore	Waste rock	Total
Year 1	27,600	41,400	69,000
Year 2	27,000	42,000	69,000
Year 3	28,000	41,000	69,000
Year 4	33,000	36,000	69,000
Year 5	30,000	39,000	69,000
Year 6	32,000	37,000	69,000
Year 7	30,000	39,000	69,000
Year 8	30,100	39,200	69,300
Year 9	30,700	38,700	69,400
Year 10	30,200	38,800	69,000

Source: MWMCL
Note :(1) Units in kt (kiloton)

4. METHODOLOGY

4.1 NOISE AND AIR QUALITY BACKGROUND

This section provides a brief summary of results obtained through air and noise quality samplings, which were executed as part of the Environmental Baseline section of the Letpadaung Copper Project's Environmental and Social Impact Assessment (ESIA), performed by the company Knight Piésold Pty.

4.1.1 Air Quality Baseline

In order to characterize environmental baseline conditions for Letpadaung Project's EIA, 8 air quality stations were sampled during the dry and wet season of 2013. The samplings comprised measurements of particulate matter (PM_{10} and $PM_{2.5}$) and gases (SO_2, NO_2 and CO), which were determined with an Environmental Perimeter Air Monitoring Station (EPAS – Haz-Scanner) equipment.

Based on results shown in Table 2, it was determined that background concentrations for PM_{10} vary between 7.1 and 20 µg/m^3, depending on each air quality station's location.

The measurement lasted 24 hours; this period presents continuous hourly records measured at a height of 3 m above ground level, a height that was chosen in order to obtain values that represent the human exposure level. Figure 1 shows the location of air quality sampling stations.

Table 2: Summary of pollutant concentration - Air quality baseline

Pollutant ($\mu g/m^3$)		Season (2013)	Sampling period	Points of air quality sampling								AQS according to WHO ($\mu g/m^3$)			
				Station 1	**Station 2**	**Station 3**	**Station 4**	**Station 5**	**Station 6**	**Station 7**	**Station 8**	**IT-1**	**IT-2**	**IT-3**	**AQG**
Particulate matter	Small particles less than 10 micrometers - PM_{10}	Dry	24 hour average	14.3	12.7	11.4	17.6	22.3	9.5	19.2	10.4	150	100	75	50
		Wet	24 hour average	8.3	2.7	4.2	11.0	17.7	4.7	10.8	4.4	150	100	75	50
		Average	**24 hour average**	**11.3**	**7.7**	**7.8**	**14.3**	**20.0**	**7.1**	**15.0**	**7.4**	150	100	75	50
	Fine particles less than 2,5 micrometers - $PM_{2,5}$	Dry	24 hour average	11.0	8.5	8.2	11.1	14.2	8.5	11.3	7.8	75	50	37,5	25
		Wet	24 hour average	6.0	1.7	2.4	5.6	8.8	2.6	5.2	2.6	75	50	37,5	25
		Average	**24 hour average**	**8.5**	**5.1**	**5.3**	**8.4**	**11.5**	**5.5**	**8.3**	**5.2**	75	50	37,5	25
	Inhalable coarse particles - $PM_{10-2.5}$	Dry	24 hour average	3.3	4.15	3.2	6.5	8.1	1	7.9	2.6	-	-	-	-
		Wet	24 hour average	2.3	1.0	1.8	5.3	8.9	2.1	5.6	1.8	-	-	-	-
		Average	**24 hour average**	**2.8**	**2.6**	**2.5**	**5.9**	**8.5**	**1.6**	**6.8**	**2.2**	-	-	-	-
Gases	Carbone monoxide - CO	Dry	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.4	-	-	-	10 000
		Wet	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	10 000
		Average	**Maximum 8 hour mean**	**0.3**	**0.3**	**0.4**	**0.4**	**0.5**	**0.4**	**0.4**	**0.4**	-	-	-	10 000
	Nitrogen dioxide - NO_2	Dry	1 hour average	28.1	25.2	32.7	28.7	23.1	20.7	9.7	14.6	-	-	-	200
		Wet	1 hour average	26.0	24.1	34.8	29.3	22.0	19.7	9.5	13.2	-	-	-	200
		Average	**1 hour average**	**27.1**	**24.7**	**33.7**	**29.0**	**22.6**	**20.2**	**9.6**	**13.9**	-	-	-	200
	Sulphur dioxide - SO_2	Dry	24 hour average	2.6	2.3	2.5	2.4	3.0	2.5	2.5	2.5	125	50	-	20
		Wet	24 hour average	2.5	2.4	2.5	2.4	2.5	2.5	2.5	2.5	125	50	-	20
		Average	**24 hour average**	**2.6**	**2.4**	**2.5**	**2.4**	**2.8**	**2.5**	**2.5**	**2.5**	125	50	-	20

Elaborated by Knight Piésold.

Source: MWMCL

Notes:

"AQS": Air Quality Standards.

"WHO": World Health Organization.

"AQG": Air Quality Guideline.

"IT": Interim Target. According to Vahlsing, C., & Smith, K. R. (2011) developing countries, with higher levels of air pollution, could select an interim target level achievable based on their own air quality management infrastructure, and progress towards the AQG value.

Pollutant concentrations greater than Air quality Standards:

IT-1

IT-2

IT-3

AQG

According to information provided by the company Knight Piésold Pty. Ltd, results obtained during measurements at the 8 air quality stations (Table 2) present particulate matter (PM_{10} and $PM_{2.5}$) and gas (CO, NO_2 and SO_2) concentrations that do not exceed air quality standards established by World Health Organization (WHO). Furthermore, measurement results for meteorological parameters were also obtained during air quality samplings, which are shown in Table 3.

Table 3: Meteorological conditions during air quality sampling

Parameters	Season (2013)	
	Dry	Wet
Temperature	31ºC	26ºC
Relative humidity	56%	86%
Wind speed	10 km/hr	10 km/hr
Wind direction	104º (ESE)	106º (ESE)

Source: MWMCL

4.1.2 Noise Quality Baseline

For the purpose of characterizing the environmental baseline conditions of the Letpadaung Project's EIA, 10 noise stations were sampled during the dry and wet seasons of 2013, whose locations are shown in Figure 1. Based on information provided and shown in Table 4, noise equivalent values have been determined per period (daytime and night-time); consequently, during the dry season, noise levels for the daytime period varied between 41.3 and 46.6 dB(A), while they varied between 41.5 and 46.3 dB(A) for the night-time period. It is important to point out that, except for the value determined for Station 3 during the night-time period, the remaining recorded values do not exceed international noise standards established by the IFC (2007).

On the other hand, values exceeding IFC standards were recorded during the wet season. These values range from 59.9 to 85.5 dB (A) during the daytime period, and from 66.7 to 74.6 dB(A) during the night-time period.

The criterion considered for assessing the results obtained at sampling stations close to vehicle traffic and built-up areas was the one established by the OECD (Organisation for Economic Cooperation and Development). This standard considers a value below 65 dB(A) to be an acceptable noise level for the daytime period, and a value below 55 dB(A) to be acceptable for the night-time period.

Table 4: Noise quality baseline around area of Letpadaung Project

Period	Time	Noise level measured in $L_{Aeq(1h)}$ dB(A)																			
		Dry season										Wet season									
		Nº Stations										Nº Stations									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Daytime	07:00-08:00	45.7	47.7	43.7	45.7	43.7	44.5	46.5	41.2	39.4	40.3	65.0	73.0	61.0	49.1	82.0	65.0	97.0	74.0	61.0	55.0
	08:00-09:00	41.5	44.3	44.3	44.7	41.3	46.6	46.6	41.6	40.7	41.7	67.0	76.0	56.0	49.1	74.0	69.0	78.0	75.0	56.0	55.0
	09:00-10:00	43.2	43.5	45.1	50.5	42.4	42.4	48.4	45.4	47.8	43.8	74.0	79.0	61.0	73.0	71.0	61.0	70.0	72.0	58.0	50.0
	10:00-11:00	45.1	40.1	43.1	48.1	48.1	46.1	47.1	42.1	45.3	45.3	67.0	78.0	62.0	62.0	63.0	64.0	53.0	68.0	56.0	44.1
	11:00-12:00	45.1	42.9	42.9	45.9	44.7	44.7	44.7	44.7	44.7	41.3	71.0	73.0	62.0	61.0	68.0	65.0	67.0	61.0	78.0	46.1
	12:00-13:00	38.7	41.8	44.8	45.8	45.8	45.8	45.8	44.8	42.8	42.8	67.0	71.0	55.0	53.0	84.0	67.0	61.0	62.0	71.0	37.6
	13:00-14:00	40.1	40.6	45.6	46.6	46.6	46.5	46.5	41.5	41.5	42.1	67.0	69.0	55.0	54.0	75.0	68.0	73.0	65.0	67.0	54.0
	14:00-15:00	41.2	43.5	42.5	42.5	42.5	42.5	42.5	42.5	39.5	39.5	69.0	71.0	52.0	50.1	64.0	61.0	74.0	66.0	62.0	53.0
	15:00-16:00	45.6	44.2	47.2	45.2	45.2	40.3	40.3	40.3	40.3	39.4	65.0	70.0	44.0	74.0	74.0	67.0	62.0	61.0	60.0	68.0
	16:00-17:00	39.5	39.2	44.0	47.5	43.8	43.8	43.8	39.8	39.8	40.6	64.0	74.0	47.0	69.4	60.0	56.0	54.0	64.0	58.0	59.0
	17:00-18:00	39.0	41.7	45.7	47.7	42.3	42.3	47.3	42.3	39.0	39.0	66.0	65.0	46.0	66.2	53.1	47.5	81.0	53.0	63.0	60.0
	18:00-19:00	40.5	39.8	43.8	43.8	40.8	41.8	41.8	41.8	41.8	41.8	56.2	55.1	54.0	61.0	60.0	44.4	54.0	43.6	51.0	64.0
	19:00-20:00	38.0	40.9	43.9	47.9	39.3	37.8	38.7	38.7	38.7	38.7	66.0	47.4	56.0	62.4	58.0	45.9	51.1	42.6	58.0	61.0
	20:00-21:00	39.4	42.5	47.5	43.5	36.5	41.2	41.2	41.2	41.2	38.1	51.6	46.8	68.0	61.8	50.2	43.4	43.2	49.1	39.2	59.0
	21:00-22:00	37.5	41.3	43.1	47.1	42.1	42.1	38.1	38.1	38.1	36.8	58.1	61.0	59.0	62.1	58.0	45.8	48.3	41.4	38.4	60.0
	LAeq-Daytime	**42.2**	**42.8**	**44.7**	**46.6**	**43.9**	**43.8**	**45.0**	**42.2**	**42.3**	**41.3**	**67.5**	**72.9**	**59.9**	**66.5**	**75.4**	**63.8**	**85.5**	**67.9**	**67.8**	**60.0**
	Noise Level Guidelines (1)	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**
Night-time	22:00-23:00	38.5	41.5	42.5	43.6	47.5	47.5	44.5	41.5	41.5	39.4	64.0	70.0	76.0	59.0	47.6	63.0	42.7	42.8	38.7	76.0
	23:00-24:00	40.3	39.8	45.8	45.8	45.8	45.8	45.8	38.8	38.8	38.8	64.9	67.0	56.0	68.0	63.0	66.0	44.9	45.4	60.0	56.0
	24:00-01:00	40.5	43.9	43.9	43.9	43.9	43.9	43.9	43.1	43.1	40.5	69.0	68.0	58.0	66.0	69.0	62.0	56.0	63.0	61.0	63.0
	01:00-02:00	41.2	42.9	42.9	42.9	42.9	41.7	47.7	41.7	41.7	37.9	75.0	69.0	63.0	74.0	61.0	64.0	58.0	60.0	68.0	51.0
	02:00-03:00	46.7	43.3	43.3	43.3	43.3	43.3	43.3	43.3	44.3	44.3	69.0	70.0	67.0	74.0	60.0	81.0	58.0	65.0	71.0	67.0
	03:00-04:00	39.8	41.6	39.6	45.6	42.6	42.6	42.6	42.6	42.6	42.6	73.0	70.0	57.0	82.0	69.0	72.0	77.0	62.0	72.0	56.0
	04:00-05:00	42.7	41.1	45.1	42.7	45.1	43.5	43.5	43.5	43.5	43.5	74.0	46.8	56.0	75.0	62.0	74.0	76.0	63.0	49.1	58.0
	05:00-06:00	43.7	43.2	49.2	45.2	45.2	45.2	38.2	38.2	38.2	38.2	72.0	70.0	63.0	69.0	73.0	73.2	77.0	75.0	53.1	62.0
	06:00-07:00	41.7	42.5	51.5	41.5	42.5	42.8	42.8	42.8	42.8	42.8	67.0	70.0	67.0	63.0	42.8	74.1	73.0	74.0	69.0	62.0
	LAeq-Night time	**42.4**	**42.4**	**46.3**	**44.0**	**44.6**	**44.4**	**44.2**	**42.0**	**42.2**	**41.5**	**71.2**	**68.9**	**67.9**	**74.6**	**66.7**	**74.0**	**72.5**	**68.7**	**67.0**	**67.6**
	Noise Level Guidelines (1)	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**

Prepared by Knight Piésold.

Source: MWMCL

Notes:

(1) Noise Level Guidelines according to IFC (2007). Noise impacts should not exceed the levels or result in a maximum increase in background levels of 3 dB at the nearest location off-site.

Noise level guidelines according to WHO (1999):

Receptor	Daytime / Night-time	Noise exceedance
Residential (IFC criteria)	55 / 45	(light shading)
Residential close to highway (OECD criteria)	65 / 55	(orange shading)

Furthermore, the samplings also provided measurement results for meteorological parameters, which are shown in Table 5.

Table 5: Meteorological conditions during noise quality sampling

Season (2013)	Station	Parameters			
		Temperature ºC	Relative humidity (%)	Wind speed (m/s)	Wind direction
Dry	1	29-31	41-63	2.5-3.3	167 (S)
	2	29-31	40-64	2.6-3.5	178 (S)
	3	26-42	41-63	2.5-3.4	158 (S)
	4	25-42	41-63	2.4-3.8	169 (S)
	5	26-45	41-60	2.8-3.9	175 (S)
	6	23-40	40-61	2.3-3.5	164 (S)
	7	23-38	40-65	2.3-3.5	165 (S)
	8	23-37	40-68	2.3-3.5	172 (S)
	9	23-41	40-66	2.5-3.6	164 (S)
	10	24-41	41-67	2.6-3.8	172 (S)
Wet	1	29.9-30.4	36-93	0.5-3.3	177 (S)
	2	30.4-31.1	40-91	0.6-3.5	174 (S)
	3	34.8-41.7	41-83	0.5-3.4	168 (S)
	4	34.8-41.9	41-83	0.4-3.8	175 (S)
	5	34.8-42.4	41-90	0.8-3.9	176 (S)
	6	35.8-44.6	40-81	0.3-3.5	168 (S)
	7	37.6-39.4	40-85	0.3-3.5	167 (S)
	8	35.3-37.8	40-90	0.3-3.5	173 (S)
	9	35.1-36.9	40-96	0.5-3.6	166 (S)
	10	37.4-41	41-87	0.6-3.8	177 (S)

Source: MWMCL

4.1.3 Vibration Quality Baseline

Vibration measurements conducted within the project's environmental baseline area were recorded in mm/s and are given in Table 6.

Table 6: Vibration levels around Letpadaung Project area

Location	Vibration levels (mm/s)						Safe level according to DIN 4150-3 (mm/s)[1]		
	Hot dry season			Wet season			MSB	RB	IB
	Mean	Max	Min	Mean	Max	Min			
Station 1	0.371	1.400	0.000	0.360	1.500	0.000	3	5	20
Station 2	0.510	3.000	0.100	0.515	3.000	0.100	3	5	20
Station 3	1.383	4.800	0.400	1.410	5.900	0.400	3	5	20
Station 4	0.298	0.800	0.100	0.294	0.700	0.100	3	5	20
Station 5	0.229	1.200	0.100	0.225	1.200	0.100	3	5	20
Station 6	0.958	4.500	0.200	0.990	4.500	0.200	3	5	20
Station 7	0.360	1.500	0.000	0.373	1.500	0.000	3	5	20
Station 8	0.329	1.400	0.100	0.338	1.500	0.100	3	5	20
Station 9	0.279	1.300	0.100	0.271	1.200	0.100	3	5	20
Station 10	0.233	1.100	0.100	0.223	1.200	0.100	3	5	20

Prepared by Knight Piésold.
Source: MWMCL
Notes:
[1] Safe level for frequency less than 10 Hz
[2] MSB = More sensitive buildings
[3] RB = Residential buildings
[4] IB = Industrial buildings. Commercial, Industrial or Similar
Legend:

x	Values greater than MSB standard
x	Values greater than RB standard
x	Values greater than IB standard

In order to assess the mean records obtained at stations close to roads (stations 1, 2, 3 and 5), it has been considered to compare them to standards established by the Federal Transit Administration (FTA) of the U.S. Department of Transit. Based on mean vibration level records, expressed in mm/s, the velocity level was determined in $Lv_{ref\ 1\ \mu inches}$ (VdB) units. The velocity level (L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref\,1:\frac{micro\ in.}{sec}} = 20 \times \log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is the RMS (Root Mean Square) of velocity amplitude, and v_{ref} is the reference velocity amplitude.

Table 7: General assessment of vibration levels recorded close to roads

Location	Vibration levels in VdB ref 1 micro inch/sec		General assessment according to FTA[(1)]		
	Season		Category		
	Hot dry	Wet	C1[(2)]	C2[(3)]	C3[(4)]
Station 1	**83.3**	**83.0**	65	72	75
Station 2	**86.1**	**86.1**	65	72	75
Station 3	**94.7**	**94.9**	65	72	75
Station 5	**79.1**	**78.9**	65	72	75

Prepared by Knight Piésold.

Notes:

(1) Standard values for frequent events are defined as more than 70 vibration events of the same source per day (FTA, 2006). Most rapid transit projects fall into this category.

(2) C1 = Category 1. Buildings where vibration would interfere with interior operations

(3) C2 = Category 2. Residences and buildings where people normally sleep

(4) C3 = Category 3. Institutional land use, mainly during daytime

Legend:

x	Values greater than C1 standard
x	Values greater than C2 standard
x	Values greater than C3 standard

According to results shown in Table 7, vibrations are clearly felt by inhabitants who are close to the referred stations. According to FTA criteria (2006), the area close to these stations is suitable for dwellings that present resistant structures rather than for sensitive buildings.

4.2 METEOROLOGICAL INFORMATION

In order to model air quality dispersion (AERMOD View v. 8.2) and noise propagation (Sound PLAN v. 7.2), weather data generated by the MM5 model[1] has been used. This model contains hourly ground-level and vertical data. This data comprises the period from January 2010 to December 2012 and is representative for an area of 144 km^2 (MM5 model grid area), which is where the Letpadaung Project lies. The information generated by the MM5 model is based on global reanalysis climate data provided by the National Center for Environmental Protection (NCEP). This information has a resolution of 2.5 degrees for the entire planet, with records for every 6 hours. Table 8 shows the characteristics of information generated by the MM5 model.

[1]Developed by Pennsylvania State University (PSU) and National Center for Atmospheric Research (NCAR). MM5 meteorological model is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation.

Table 8: Surface & Upper air met data pre-processed from MM5 meteorological model

Met data information	
Met data type: Star-End date: Latitude: Longitude: Datum: Site time zone Place:	AERMET-Ready (Surface &Upper air data) Jan 01, 2010 – Dec 31, 2012 22.084864 N 95.090047 E WGS84 UTC/GMT UTC + 6 hour(s) Letpadaung Project
Calculated pseudo met station parameters	
Anemometer height: Station base elevation: Upper air adjustment:	14 m 98 m -6 hour(s)
MM5-Processed grid cell	
Grid cell center (Lat, Lon): Grid cell dimension: Information of MM5 model:	22.084864 N, 9.090047 E 12 km x 12 km http://www.mmm.ucar.edu/mm5/mm5-home.html
Hourly surface met data (*.sam)	
Format: Output interval: File format description:	SAMSON (surface met data for preprocessing by AERMET) Hourly http://www.webmet.com/MetGuide/Samson.html
Upper air data (*.ua)	
Format: Data reported: Output interval: File format description:	TD-6201 – Fixed Length (upper air met data for pre-processing by AERMET). UTC/GMT 00Z and 12Z http://www.webmet.com/MetGuide/TD6200.html

Prepared by Knight Piésold
Source: Lakes Environmental Software

The hourly surface parameters that have been pre-processed by AERMET are:

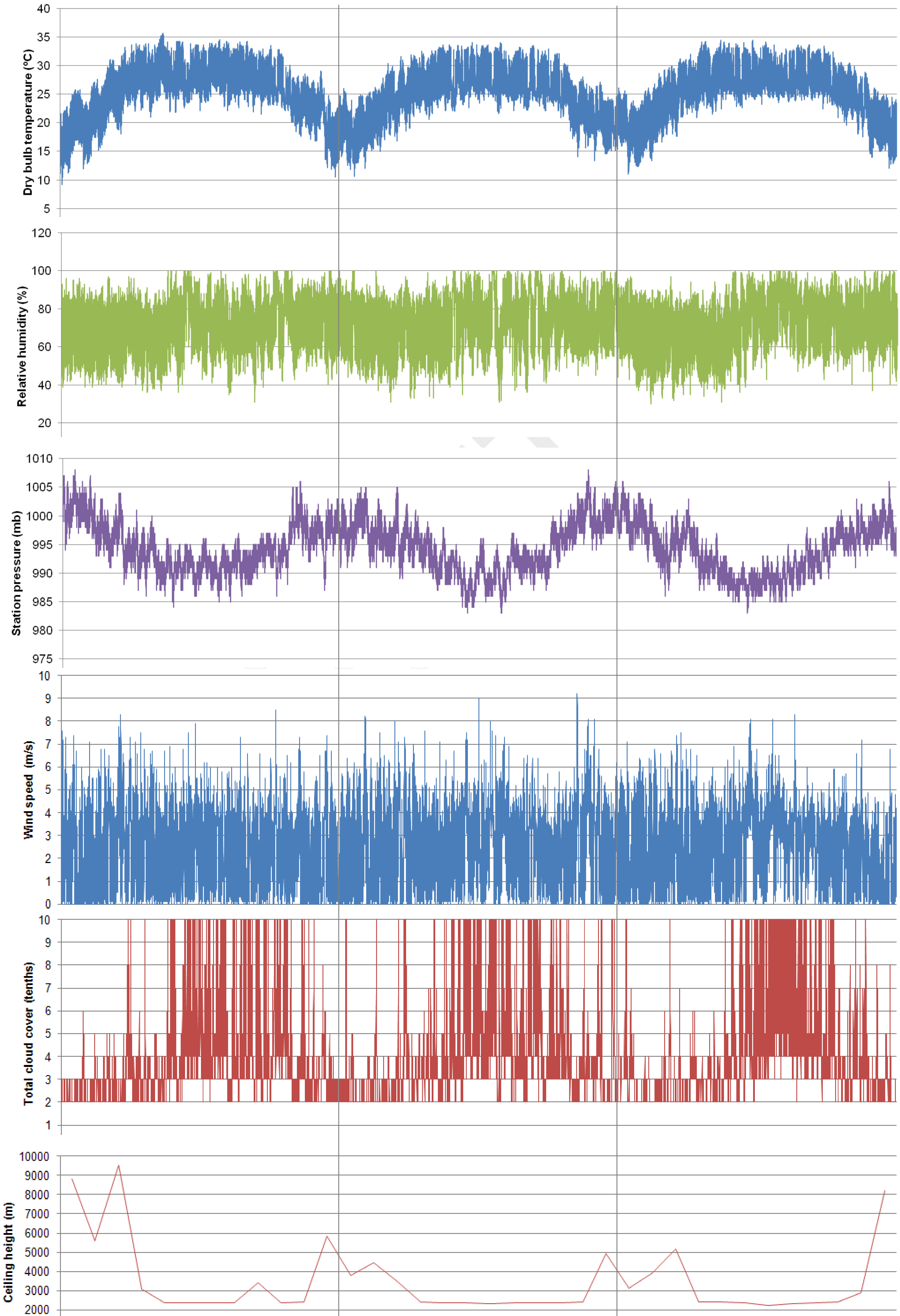
- Total cloud cover (tenths)
- Dry bulb temperature (ºC)
- Dew point temperature (ºC)
- Relative humidity (%)
- Station pressure (mb)
- Wind direction (deg)
- Wind speed (meter/second)
- Ceiling height (m): 77777 = unlimited ceiling height
- Hourly precipitation quantity (hundreds of inches)

Graph 1 shows the variations of each meteorological parameter throughout the period 2010-2012, where one can see each parameter's variation. It also allows distinguishing the dry[2] (November to April) and wet season (May to October). Considering the information period 2010-2012, one can observe that temperatures vary between 10 and 35 °C; relative humidity, between 40 and 100%; atmospheric pressure, between 985 and 1005 mbar; wind speed, between calms (0 m/s) and 9 m/s; cloud cover, between partly clear sky (2-5 tenths) and cloudy sky (6-10 tenths); and cloud altitude is higher during the dry season (3,000-9,000 m) and lower during the wet season (2,500 m approximately).

Regarding wind speed (Graph 2), one can see that 2 directions predominate: the northern winds (September to May) and the southern ones (June to September); this behaviour seems to be influenced by monsoons, due to transportation of moist air masses that come from the south and dry air masses from the north. With respect to precipitation, Graph 3 shows the variation of this parameter throughout the months between 2010 and 2012; one can make out that monthly cumulative precipitation is higher during July, reaching a maximum of 384.81 mm in 2012. Table 9 shows daily precipitation values throughout the assessment period (2010-2012).

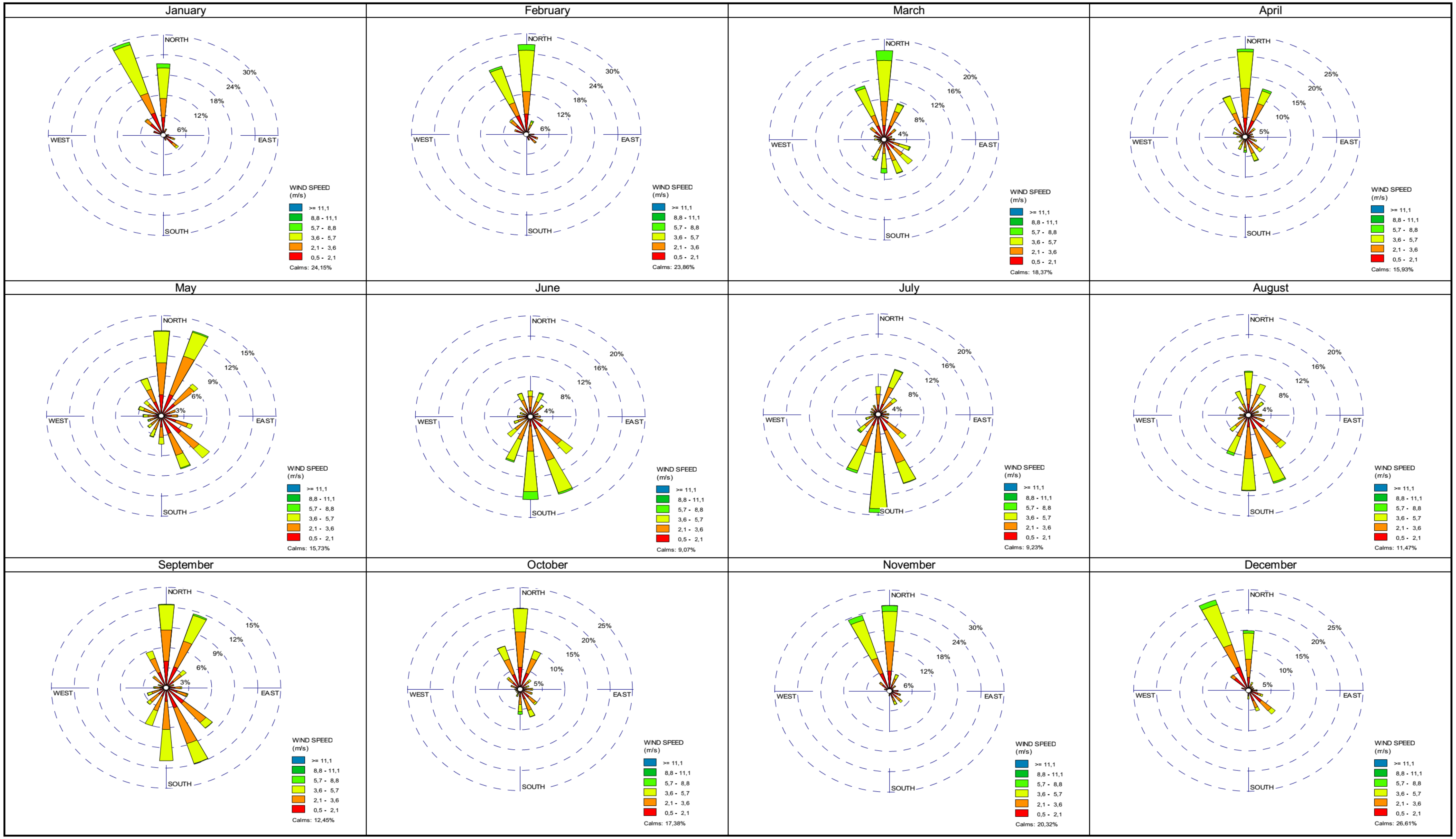
[2] The dry season is divided into a cold-dry period (November to February) and a warm-dry one (March to April).

Graph 1: Hourly surface met data from January 2010 to December 2012


Dry bulb temperature (°C)
40
35
30
25
20
15
10
5
Relative humidity (%)
120
100
80
60
40
20
Station pressure (mb)
1010
1005
1000
995
990
985
980
975
Wind speed (m/s)
10
9
8
7
6
5
4
3
2
1
0
Total cloud cover (tenths)
10
9
8
7
6
5
4
3
2
1
Ceiling height (m)
10000
9000
8000
7000
6000
5000
4000
3000
2000

Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

Graph 2: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

Table 9: Daily precipitation amount (mm) by year (2010 - 2012) - Letpadaung Project

Day	2010											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	2.79	0	0	13.46	1.524	0	0	0	0
2	0	0	0	0	0	0	12.45	2.794	4.826	0	0	0
3	0	0	0	0	3.302	0	3.556	28.45	61.47	2.032	0	0
4	0	0	0	0	0	0	0	57.66	2.286	3.048	0	0
5	0	0	0	0	0	0.254	3.81	1.27	1.016	0	0	0
6	0	0	0	0	0	2.794	0	1.524	0	12.45	0	0
7	0	0	0	0	0	0	0	5.588	0	7.874	0	0
8	0	0	0	0	0	0	0.508	0	0.762	13.72	0	0
9	0	0	0	0	0	40.13	0	0	7.62	25.4	0	0
10	0	0	0	0	0	2.286	0	0	0.508	6.35	0	0
11	0	0	0	0	0.254	44.96	9.398	0	0	19.3	0	0
12	0	0	0	0	0.254	27.94	0.254	0	0	0	0	0
13	0	0	0	0	0	7.366	5.08	0	7.874	0	0	0
14	0	0	0	0	0	5.842	1.27	1.524	1.778	2.54	0	0
15	0	0	0	0	0	23.62	2.54	0.254	0	11.68	0	0
16	0	0	0	0	2.032	11.43	0	1.016	4.318	0.762	0	0
17	0	0	0	0	0	22.1	0.254	0	0	1.27	0	0
18	0	0	0	0	0	2.794	0	0	1.27	0	0	0
19	0	0	0	0	8.636	35.31	0	6.858	26.16	2.54	0	0
20	0	0	0	0	36.07	1.27	5.334	2.54	0	6.858	0	0
21	0	0	0	7.62	11.68	2.54	0	0	0	0.762	0	0
22	0	0	0	0	1.016	0	0	0	0	22.61	0	0
23	0	0	0	0	3.556	5.334	3.048	0	0.508	24.13	0	0
24	0	0	0	0	39.37	25.91	0	1.778	7.62	4.572	0	0
25	0	0	0	1.02	29.97	38.35	0	10.16	0	0	0	0
26	0	0	0	0	4.318	0.508	0	2.032	8.89	0.254	0	0
27	0	0	3.3	0	12.95	10.41	2.286	0.508	0	0	0	0
28	0	0	23.6	0	5.08	7.62	13.46	4.318	0.254	0	0	0
29	0		19.8	0	3.302	0	88.9	3.556	0	0.508	0	0
30	0		8.13	0	22.86	0	22.1	5.08	0	26.42	0	0
31	0		9.91		2.794		6.096	1.27		0		0
Total	**0**	**0**	**64.8**	**11.4**	**187.5**	**318.8**	**193.8**	**139.7**	**137.2**	**195.1**	**0**	**0**

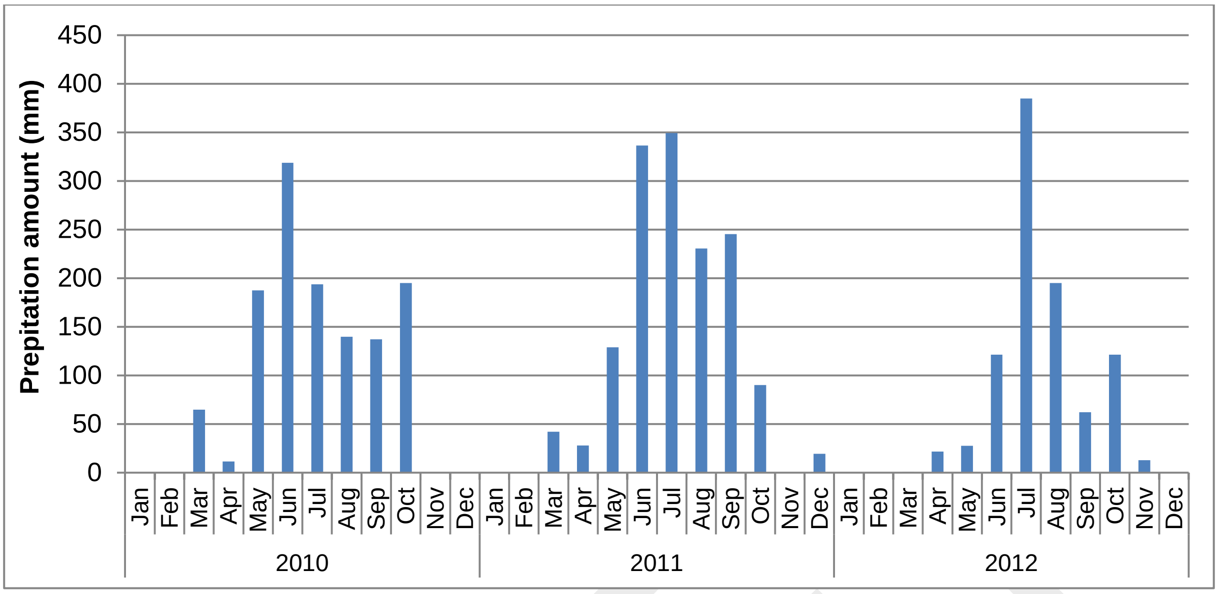
Day	2011											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0	32.5	5.08	1.02	0	0	0	0
2	0	0	0	0	0	0	3.05	5.84	0	0	0	0
3	0	0	0	0	0	0	1.02	0	0	3.81	0	0
4	0	0	0	0	0	0	3.3	7.11	0	1.02	0	0
5	0	0	0	0	0	0	7.11	5.84	12.7	0	0	0
6	0	0	0	0	2.29	4.57	2.54	2.29	14	16.5	0	0
7	0	0	0	0	0	2.79	0	16.8	20.6	7.62	0	0
8	0	0	0	0	0.25	24.6	0	37.1	14.2	6.6	0	0
9	0	0	0	0	0	24.9	0	20.6	0	0	0	0
10	0	0	0	0	0	0	0	32	20.3	0	0	0
11	0	0	0	0	0	0	0	2.29	0	0	0	0.76
12	0	0	0	0	0	0	4.57	8.64	0	0	0	0.76
13	0	0	0	0	0	0	0	13.7	10.7	0	0	0
14	0	0	0	0	0	5.59	0	1.52	6.6	0	0	0
15	0	0	0	0	0	24.9	0	0	12.7	0	0	0
16	0	0	0.76	0	0.25	9.14	15.5	1.02	22.1	4.83	0	0
17	0	0	0	0	0	13.2	2.29	0	42.7	14.2	0	0
18	0	0	0	0	4.32	64	2.29	0	5.33	25.7	0	0
19	0	0	0	0	0	3.3	24.1	3.81	2.03	0	0	0
20	0	0	0	0	1.27	41.7	102	0	0	6.86	0	0
21	0	0	0	14.2	0	0.25	87.1	0.76	56.4	0.25	0	0
22	0	0	0	0	0	1.27	19.1	10.2	5.08	0	0	0
23	0	0	0	0.25	0	0	0.51	0	0	0	0	0
24	0	0	0	0.76	0	0	33.8	0	0	0	0	0
25	0	0	0	9.91	0	3.05	26.4	0	0	0	0	0
26	0	0	3.81	1.02	0.51	30.7	9.4	1.78	0	0	0	0
27	0	0	2.03	0	5.84	9.65	0.25	27.4	0	0	0	9.4
28	0	0	19.6	1.78	4.57	16	0	1.78	0	2.79	0	8.38
29	0		4.06	0	21.3	20.1	0	5.59	0	0	0	0
30	0		11.7	0	34	4.06	0	8.38	0	0	0	0
31	0		0		54.1		0	15		0		0
Total	**0**	**0**	**41.9**	**27.9**	**129**	**336**	**349**	**230**	**245**	**90.2**	**0**	**19.3**

Day	2012											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	9.65	13.7	2.54	7.37	0	0.76	1.27	0
2	0	0	0	0.51	0	7.11	2.29	7.87	0	0.25	0	0
3	0	0	0.51	0	0	8.38	2.29	0	0	0	0	0
4	0	0	0	0	0	1.02	3.56	31.8	27.7	0	0	0
5	0	0	0	3.56	0	0	1.78	0.51	2.03	3.3	0	0
6	0	0	0	0	0	0	2.79	10.7	1.52	0	0	0
7	0	0	0	0.51	0	0	5.33	12.2	14	28.7	0.25	0
8	0	0	0	2.54	0	0	4.83	1.27	5.59	4.06	4.32	0
9	0	0	0	7.62	0	5.33	8.13	4.32	3.56	3.56	2.29	0
10	0	0	0	0.51	0	3.56	2.54	8.64	0	22.6	0	0
11	0	0	0	2.54	0	0	2.03	15.5	0	52.8	0	0
12	0	0	0	1.02	0.51	1.52	3.05	15	0	0.76	0	0
13	0	0	0	0	0	0	2.54	7.37	0	0	0	0
14	0	0	0	0	0.51	0.25	4.83	2.54	0	0	0	0
15	0	0	0	0	0.25	0	26.2	4.83	0	0	0	0
16	0	0	0	0	0	1.52	0	0	0	0	0	0
17	0	0	0	0	0	1.52	2.29	0.76	0	4.57	0	0
18	0	0	0	0	0	6.35	4.83	0	0	0	3.3	0
19	0	0	0	0	0	0	6.86	5.84	0	0	0	0
20	0	0	0	0	0	30.5	0	24.9	0	0	0.51	0
21	0	0	0	0	0	0.76	0	9.14	0	0	0.76	0
22	0	0	0	0	0	2.03	0	1.52	0	0	0	0
23	0	0	0	0	0	9.65	3.81	1.27	0	0	0	0
24	0	0	0	0	0	7.87	4.06	0	0.25	0	0	0
25	0	0	0	0	0.25	4.32	9.4	7.11	0	0	0	0
26	0	0	0	0	0	4.32	13	0	4.57	0	0	0
27	0	0	0	0	0	4.83	62.2	0	0	0	0	0
28	0	0	0	2.79	0.76	0.25	29.5	2.29	1.02	0	0	0
29	0	0	0	0	0	0	106	5.84	0	0	0	0
30	0		0	0	13.7	6.6	57.4	6.6	1.78	0	0	0
31	0		0		1.78		10.9	0		0		0
Total	**0**	**0**	**0.51**	**21.6**	**27.4**	**121**	**385**	**195**	**62**	**121**	**12.7**	**0**

Prepared by Knight Piésold.

Source: Lakes Environmental Software.

Graph 3: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold
Source: MWMCL

As part of complementary information to estimate the inventory of emissions due to wind erosion, weather data shown in Table 10 was used. This weather data was recorded between July 1995 and April 2007 by the weather station located in the project area.

Table 10: Maximum wind speed (July 1995 to April 18, 2007)

Month	Year/ maximum wind speed(1)									Maximum
	1995	1996	1997	2001	2003	2004	2005	2006	2007	
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6

Prepared by Knight Piésold
Source: MWMCL
Notes:
(1) Weather station collapsed and broke into pieces due to strong wind (April 18, 2007, 16:35 hr).

4.3 AIR QUALITY DISPERSION MODELING

Air quality dispersion modelling took place for the project's construction and operation phases, taking into account the influence of changes caused by the dry and wet season (mainly wind speed variations due to monsoon influence).

Considering the project's extractive characteristics, dust emissions (PM_{10} and $PM_{2.5}$) have been inventoried; of these emissions, it was considered modelling PM_{10} emission dispersion, given that it is seen as an air quality impact indicator for extractive open pit mining activities (Vallero, 2008).

4.3.1 Particulate Matter Emission Inventory

Estimation of emission factors[3] (*EF*) for particulate matter ($PM_{10}$and $PM_{2.5}$), based on each assessed activity, was performed by applying standardized methods approved by the United States Environmental Protection Agency (USEPA), which are published in the AP-42 Guide, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (USEPA, 1995-2011). Moreover, the parameters used for estimating the *EF* were based on the specific project characteristics for the construction and operation phases. These parameters were provided by MWMCL, while meteorological parameters were based on weather data generated by the MM5 model and weather station records about maximum wind speed:

- Total blast area (m^2)
- Relative humidity content of material (%)
- Material drop height from excavators (m)
- Fine particle content of material (%)
- Mean vehicle weight (Mg)
- Fines load on paved road surface (g/m^2)
- Mean wind speed in project area (m/s)
- Number of days and hours with precipitation above 0.254 mm

[3]According to USEPA, an emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity linked with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of material handled).

- Sulphur content in diesel fuel[4]
- Vehicle fleet power in kW units

After estimating *EF* per activity, PM_{10} and $PM_{2.5}$ (units: kg/year and g/s) were estimated by applying the general emission estimation equation (USEPA, 1995-2011):

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where *E* is emission, *A* is activity rate, *EF* is emission factor, and *ER* is overall emission reduction efficiency in percent. Estimation of activity levels (A) was based on available project-related information for the construction and operation phases:

- Area of each component
- Number of drilling and blasting events per month
- Material volume obtained per blast
- Number of front loaders (loader and dozer), trucks (light and heavy) and vehicles (pickup trucks)
- Load capacity of loaders and trucks, in tons
- Tons of topsoil removed (tons/month)
- Machinery operation time per day (hours)
- Kilometres covered by machinery per day
- Monthly excavated material volume
- Material hauling by trucks (tons/month)
- Material unloading by trucks (tons/month)
- Length of paved and unpaved roads (km)
- Mean annual evaporation level in inches
- Frequency of hours watering unpaved roads
- Watering intensity on unpaved roads (gallons per square yard)
- Maximum monthly wind speed (m/s)
- Soil texture characteristics and fines content at surface (%)
- Waste rock dump sizes (m^2)

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[4]A sulfur content value of 2,000 ppm has been assumed, based on information from the United Nations Environment Programme (UNEP) – Diesel Fuel Sulphur Levels: Global Status December 2012, available at: www.unep.org/transport/pcfv

The construction phase includes activities that will be performed within the area comprising the mine, access roads, and the road close to the project site. Table 11 shows a list of activities that will be carried out during the construction phase.

Table 11: Activities during construction phase

Component	Activity
Mining area	Drilling Blasting Bulldozing (removing topsoil) Bulldozing (travel mode) Crawler dozer and grading Digging Loading trucks Unloading trucks in waste rock dumps Fuel consumption (diesel)
Unpaved roads	Travel of mining dump truck from digging area to waste rock dumps Travel of light trucks Fuel consumption (diesel)
Paved roads (highway near to mining area)	Travel of light vehicles Fuel consumption (diesel)

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The operation phase includes activities that will take place within the area comprising the pit, material haul roads, waste rock dumps, crushers and road close to project area. Table 12 shows a list of activities that will be performed during this phase.

Table 12: Activities during operation phase

Component	Activity
Open pit	Drilling Blasting Earthmoving in blast area (loader, crawler dozer and ballgrader) Loading of dump trucks delivering ore and waste rock Loader travel in blast area Fuel consumption by equipment (trucks, dozer, and others) Haul truck travel in blast area to crushers (dust from wheeled) Haul truck travel in blast area to crushers (dust from exhaust)
Road from open pit to waste rock areas	Haul truck travel to waste rock storage area (dust from wheeled) Haul truck travel to waste rock storage area (dust from exhaust)
Waste rock storage areas (WRD1 and WRD2)	Haul truck unloading at waste rock areas Dozer activity in waste rock areas Wind erosion in WRDs, applied to maximum wind speed
Crushers semi-mobile	Unloading to each semi-mobile crusher Primary crushing (High-moisture ore) Material handling and transfer for each point (High-moisture ore)
Highway near to mining area	Light duty vehicles (dust from wheeled) Light duty vehicles (dust from exhaust)

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<u>Construction Phase</u>

During the construction phase, activities related to drilling and blasting, earthworks (topsoil removal, excavations and land grading), loading and unloading of materials by trucks, and light and heavy vehicle traffic on paved and unpaved roads will take place.

Table 13 shows the assessed activities and their emission factors, for which equations including a scaling factor representing a particle-size dependent emission magnitude have been used. Based on an activity-level assignment, emissions have been determined according to their source. Table 14 shows emissions according to source type.

Table 13: Emission factors during construction phase

Activity	Description	Scaling Factors (k)		Emission factor equations by activity (1, 2, 3)		Emission factor (EF)			Reference (1)
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Drilling for blasting	-	0.52	0.03	EF = k*0.59	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
Blasting	-	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	0.10349	0.00597	kg/blast	AP-42 Blasting - Section 11.9
Earthmoving (overburden, removing topsoil)	Bulldozing (removing top soil)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	1.67006	1.83253	kg/hr	AP-42 Dozer equation - Section 11.9
	Bulldozing travel mode	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	3.00776	0.30078	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Crawler dozer and grading	0.25	0.025	EF = k*0.029	EF	0.00725	0.00073	kg/Mg	AP-42 Dozer equation - Section 11.9
	Excavator	0.75	0.017	$k*0.0029\ (d)^{0.7}/(M)^{0.3}$	$k*0.0046\ (d)^{1.1}/(M)^{0.3}$	0.00547	0.00012	kg/m^3	NERDDC (1988) & SPCC (1983), cited by NPI (2012)
	Fuel consumption - earthmoving	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
Trucks loading	Digging area	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Loading equation - Section 13.2.4
Trucks unloading	Waste dump	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Unloading equation - Section 13.2.4
Material transport - roads	Unpaved roads - Mining dump truck	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.28337	0.12834	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Unpaved roads - Light trucks	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.65094	0.06509	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Paved roads	0.62	0.15	$EF = [k\ (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.1
	Fuel consumption - light truck and light duty vehicles	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
	Fuel consumption - Mining dump truck	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*0.473\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor (2)

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(1) Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

(2) Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

(3) Symbols for equations:	Value	Description
A: Area per blast (m^2)	93.5	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	10	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	21.1	Moisture content of overburden, material handling by excavator and bulldozers.
M: Material moisture content (%)	17	Moisture content of overburden, material handling by loading and unloading.
d: drop height (m)	13.8	Excavator.
s: Material silt content (%)	10	Silt content of material on unpaved roads.
s: Material silt content (%)	50	Silt content of material overburden.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer
W: Mean vehicle weight (Mg)	113	Dump Truck (TR100, TEREX). Average weight between net weight and net load.
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Representative value, source: Table 13.2.1-3, Section 13.2.1 Paved Roads.
P: Precipitation with at least 0,254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0,254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 14: Construction phase – Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Mining area	116,354.3	3.6896	67,658.0	2.1454
Line	Paved roads – Highway	30,212.9	0.9580	11,170.1	0.3542
	Unpaved roads - Mining Dump truck	105,052.2	3.3312	40,190.2	1.2744
	Unpaved Roads - Light trucks	16,392.3	0.5198	4,637.8	0.1471
Total		268,011.6	8.4986	123,656.0	3.9211

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Below, calculation of PM_{10} and $PM_{2.5}$ emissions is detailed for each activity.

Drilling and Blasting

Drilling and blasting activities are considered for extracting construction materials, rock removal and preparing the land for setting up facilities and/or building infrastructure. Calculation of particulate matter emissions due to drilling considers the number of drilling events to be performed, while the calculation corresponding to blasting events considers the number of blasting events to be conducted and the horizontal area removed by each blast. It is worth highlighting that no particulate matter emission reduction control measures have been considered for these activities. Table 15 shows emission estimation results for drilling and blasting activities. Equations considered for emission estimation are the following:

$$E = EF \times N$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor, and *N* is the number of drilling events performed per year.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is a scaling factor based on size of emitted particles, *N* is the number of blasting events per year, and *A* is the horizontal area removed by blasting (m^2). Total blasting area considered was 24,693.08 m^2 per year, while 22 blasting events equivalent to a volume of 180,000 m^3 were considered per month. Based on this information, a value of *A* = 93.5 m^2 per blast was determined.

Table 15: Construction phase - Drilling, blasting, earthmoving and handling

Activity	Installation/Sub activity	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	**Units**	**PM_{10}**	**$PM_{2,5}$**	**Units**	**kg/year**	**g/s**	**kg/year**	**g/s**
Drilling	Mining area	10,800	hole/yr	0.30680	0.01770	kg/hole	3 313.4	0.105	191.2	0.006
Blasting	Mining area	264	blast/yr	0.10349	0.00597	kg/blast	27.3	0.001	1.6	0.000
Bulldozing (removing top soil)	Mining area	29,200	hr/yr	1.67006	1.83253	kg/hr	48,765.9	1.546	53 509.8	1.697
Bulldozing travel mode	Mining area	3,650	VKT/yr	3.00776	0.30078	kg/VKT	10,978.3	0.348	1 097.8	0.035
Crawler dozer and grading	Mining area	3 600,000	Mg/yr	0.00725	0.00073	kg/Mg	26,100.0	0.828	2 610.0	0.083
Digging by excavator	Mining area	3 000,000	m^3/yr	0.00547	0.00012	kg/m^3	16,413.9	0.520	372.0	0.012
Loading trucks	Mining area	12 000,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	378.1	0.012	57.3	0.002
Unloading trucks	Waste Dump	9 600,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	302.5	0.010	45.8	0.001
Fuel consumption (diesel)	Drilling and blasting	16 060,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,916.4	0.092	2 828.9	0.090
	Bulldozing (loader, dozer, crawler and grader)	26 280,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	4,772.2	0.151	4 629.1	0.147
	Excavator in mining area	13 140,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,386.1	0.076	2 314.5	0.073
Total							**116,354**	**3.690**	**67,658**	**2.145**

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Data input used to estimate activity rates:

Description	Value	Notes	Source
Number of hole by month	900	Depth of 10,350 m	Myanmar Wanbao Mining Copper Limited
Number of blast by month	22	Quantity = 180,000 m^3	Myanmar Wanbao Mining Copper Limited
Number of loader and dozer for bulldozing	10	Models: LW800K, ZL50G, MD32	Myanmar Wanbao Mining Copper Limited
Removing topsoil (tonnes/month)	300,000	2 Grader and 6 crawler dozer.	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Kilometer travelled per loader	1	km/day from 8:00 a.m. - 6:00 p.m.	Value estimated by extension area of the project.
Material handling	250,000	Volume of material in m^3/month for digging.	Myanmar Wanbao Mining Copper Limited
Material handling	1000,000	Material loading tonnes/month.	Myanmar Wanbao Mining Copper Limited
Material handling	800,000	Material unloading tonnes/month.	Myanmar Wanbao Mining Copper Limited

Earthmoving

Estimation of particulate matter emission due to earthmoving activities comprises piling up and arranging materials, stripping, filling, machinery traffic, grading and excavation. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 15 shows emission results for the mentioned activities.

Equations considered for estimating emissions based on each activity are detailed below.

<u>Bulldozing (Removing Topsoil)</u>

Equations from USEPA's Guide AP-42, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation that determines PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation to calculate $PM_{2.5}$ emissions is the one below:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is the scaling factor based on size of emitted particles, *s* is fine particle content (%), *M* is the material's moisture content (%) and *T* is machinery operation time (hours). Values assigned are *s* = 50%, *M* = 21.1% and *T*= 29,200 h/year.

<u>Bulldozing Travel Mode</u>

Particulate matter emissions caused by earthmoving machinery travel were estimated through the following equations (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor in kg/VKT units, *VKT* is total kilometres covered by machinery per year (km/year), *k* is a scaling factor constant based on size of emitted particles in lb/VMT units, *s* is fine particle content (%), *W* is mean weight of all machinery (tons), and *P* is number of days with

precipitation above 0.254 mm per year. Values assigned are *VKT* = 3,650 km/year, *s* = 50%, *M* = 21.1% and P= 110 days/year (Lakes Environmental, 2013).

<u>Crawler Dozer and Grading</u>

Particulate matter emissions generated by using machinery for grading and moving topsoil were estimated through the following equation (USEPA, 1995-2011):

$$E = A \times k \times EF$$

Where *E* is PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/Mg units, and *k* is scaling factor based on size of emitted particles. Values assigned are *EF* = 0.029 kg/Mg (Table 11.9-4, Section 11.9, AP-42, USEPA) and *A* = 3600,000 Mg/year equivalent to 300,000 tons/month.

<u>Excavating</u>

PM_{10} emissions generated by excavator use were estimated through the following equation:

$$E = k \times 0.0029 \times \frac{d^{0.7}}{M^{0.3}} \times V$$

While the equation that determines $PM_{2.5}$ emissions is as follows:

$$E = k \times 0.0046 \times \frac{d^{1.1}}{M^{0.3}} \times V$$

Where E are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *d* is material drop height (m), *M* is the material's moisture content (%), and *V* is material volume to be removed. Values assigned are *d* = 13.8 m, *M* = 21.1% and *V* = 3,000,000 m^3/year, equivalent to 250,000 m^3/month.

Loading and Unloading of Material

Activities related to loading and unloading of material take place in different project execution areas. Haul trucks are loaded with power shovels, while the material is directly unloaded at the work fronts and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 15 shows emission estimation results for the mentioned activities.

Emissions due to loading and unloading of material were based on USEPA's Guide *AP-42*. It is worth pointing out that the same equation is used for estimating both activities' emissions:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *U* is mean wind speed (m/s), *M* is the material's moisture content (%), and *Q* is quantity of material that will be loaded or unloaded per year. Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 17% and *Q* = 12,000,000 Mg/yr (loading) and 9,600,000 Mg/yr (unloading).

Vehicle Traffic on Paved and Unpaved Roads

Considerations are that particulate matter emissions produced by vehicle traffic will have its origin in unpaved haul roads, as well as in light vehicle traffic on paved roads close to the project area. Table 16 shows particulate matter emission results.

Below, criteria considered for estimating emissions are detailed.

Table 16: Construction phase - Material transporting

Activity	Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
Travel of mining dump truck on unpaved roads	Digging area to waste dump	105,495	Vehicles/yr	1 265,934	VKT/yr	1.28337	0.12834	kg/VKT	96	70 932	2.249	7,093	0.225
Travel of light trucks on unpaved roads	Mining area	37,960	Vehicles/yr	455,520	VKT/yr	0.65094	0.06509	kg/VKT	96	12 946	0.411	1,295	0.041
Travel of light duty vehicles on paved roads	Highway near to mining area	58,400	Vehicles/yr	876,000	VKT/yr	0.02844	0.00688	kg/VKT	-	24 910	0.790	6,027	0.191
Fuel consumption (diesel)	Digging area to waste dump	105,495	hr/yr	110 769,231	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	34 121	1.082	33,097	1.049
	Mining area	37,960	hr/yr	18 980,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	3 447	0.109	3,343	0.106
	Highway near to mining area	58,400	hr/yr	29 200,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	5 302	0.168	5,143	0.163
Total										**142 908**	**4.532**	**47 511**	**1.507**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	35	Route from digging area to waste dump. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Number of other trucks	13	Refuelling truck, light truck, truck with crane, and maintenance truck.	Myanmar Wanbao Mining Copper Limited
Number of light duty vehicle by hour	20	Weight vehicle between1.8 to 20 tonnes.	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	91	91 tonnes per dump truck. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Length of unpaved roads (km)	6	Digging area (open pit) to waste dumps, averaged value.	Value estimated by extension area of the project.
Length of paved roads (km)	15	Paved roads near to mining area.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	36	Vehicles per hour for dump truck	Value calculated.
Time between water application in hours (T)	3	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.2	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

Dust Entrainment from Unpaved Roads

Different routes are considered for hauling material between work fronts and WRDs. Particulate matter emissions caused by hauling material on considered routes were based on Section 13.2.2, Unpaved Roads of USEPA's AP-42 Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by trucks per year (km/year), *k* is scaling factor constant based on size of emitted particles lb/VMT units, *s* is fine particle content (%), *W* is mean weight (tons) of heavy trucks or light vehicles, and *P* is number of days with precipitation above 0.254 mm per year. Values assigned were *VKT* = 1,265,934 km/year for heavy trucks and 455,520 km/year for light vehicles, *s* = 10%, *W* =113 Mg (heavy trucks) and 25 Mg (light vehicles) and P= 110 days/year (Lakes Environmental, 2013). Length of assigned road route was 6 km and includes the area between the excavation area and WRDs. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (TEREX T100).

On the other hand, as a mitigation measure on dirt roads that will be used for hauling material, road watering by tank trucks is considered. Efficiency percentage of emission reduction, *ER*, has been determined by applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Where *ER* is dust reduction efficiency of watering roads with tank trucks, *A* is annual evaporation level (inches), *D* is mean vehicle traffic per hour, *T* is time between two road watering events (hours), and *I* is watering intensity (gal/yd^2). Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 36 trucks/hour, *T* = 3 hours, *I* = 2.2 gal/yd^2. Using these values in the above dust emission reduction equation yields an *ER* value of 96%.

Dust Entrainment from Paved Roads

Paved roads closest to the study area have been considered as possible routes for construction material transportation and light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1000}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by vehicles per year (km/year), *k* is scaling factor constant based on size of emitted particles in g/VKT units, *sL* is road surface fines load (g/m^2), *W* is mean vehicle weight (tons), and *P* is number of hours with precipitation over 0.254 mm per year. Values assigned are *VKT* = 876,000 km/year, *sL* = 2 g/m^2 (conservative value), *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons.

Fuel Consumption by Equipment and Vehicles

Emissions due to fuel consumption have been assumed to depend on percentage of sulfur in fuel, fuel type, machinery and vehicle power, load factor, and mean machinery and vehicle lifespan. Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to the following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Where $EF_{adj(PM)}$ is a sulfur content-adjusted emission factor, *AR* is the activity level (hp-hr/yr), EF_{ss} is zero-hour steady-state emission factor (g/hp-hr), *TAF* is transient adjustment factor (unitless), *DF* is deterioration factor (unitless), and S_{PMadj} is the emission factor's adjustment factor, which depends on fuel sulfur content (g/hp-hr).

Values assigned for determining emission factor are EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery) and 2.37 (heavy trucks), *DF* = 1.116, S_{PMadj} = 0.03438 (vehicles and machinery) and 0.040167 (heavy trucks).

<u>Operation Phase</u>

During the operation phase, activities related to drilling and blasting, earthmoving, material loading and unloading, heavy vehicle traffic on paved roads between the pit and the WRDs (haul roads), wind erosion of stockpiles at WRDs, unloading at semi-mobile crushers, materials crushing, ore handling, ore transfer to heap leach piles (HLPs), and vehicle traffic along paved roads will take place.

Table 17 shows assessed activities and their emission factors, for which equations that include a scaling factor representing emission magnitude based on particle size, have been used. According to activity level assignment, emissions were determined based on their source. Table 18 shows emissions based on source type.

Table 17: Emission factors for mine operations

	Activity	Scaling factors (k)		Equations of emission factor by activity [1, 2, 3]		Emission factor (EF)			Reference [1]
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	$EF\text{-}PM_{10}$	$EF\text{-}PM_{2,5}$	Units	
Open pit									
1	Drilling	0.52	0.03	EF = k*0.59	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
2	Blasting	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	3.61765	0.20871	kg/blast	AP-42 Blasting - Section 11.9
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	1.16153	kg/hr	AP-42 Dozer equation - Section 11.9
4	Loading of dump trucks delivering ore and waste rock	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Loading equation - Section 13.2.4
5	Loader travel in blast area	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.70659	0.07066	kg/VKT	AP-42 Travel on unpaved roads - Section 13
6	Fuel consumption by equipment (trucks, dozer, and others)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
7	Haul truck travel in blast area to crushers (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
8	Haul truck travel in blast area to crushers (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor [2]
Road from open pit to waste rock areas (waste road)									
9	Haul truck travel to waste rock storage area (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
10	Haul truck travel to waste rock storage area (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
Waste rock storage areas (WRD1 and WRD2)									
11	Haul truck unloading at waste rock areas	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Unloading equation - Section 13.2.4
12	Dozer activity in waste rock areas	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	2.31756	kg/hr	AP-42 Dozer equation - Section 11.9
13	Wind erosion in WRDs, applied to maximum wind speed.	0.5	0.075	$EF = k \sum_{1}^{N} P_i$ $P = 58 (u^*-u_t^*)^2 + 25(u^*-u_t^*)$; P = 0 if $u^* \le u_t^*$	EF	0.014	0.0011	$g/m^2.hr$	AP-42 Industrial wind erosion - Section 13.2.
Crushers semi-mobile									
14	Unloading to each crusher semi-movil	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.0004	0.0001	kg/Mg	AP-42 Unloading equation - Section 13.2.4
15	Primary crushing (High-moisture ore)	-	0.2	EF = 0.004	k*EF	0.004	0.0008	kg/Mg	AP-42 Primary crushing - Section 11.24
16	Material handling and transfer for each point (High-moisture ore)	-	0.3	EF = 0.002	k*EF	0.002	0.0006	kg/Mg	AP-42 Material handling and transfer - Sectio
Highway near to mining area									
17	Light duty vehicles (dust from wheeled)	0.62	0.15	$EF = [k (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.
18	Light duty vehicles (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]

Prepared by Knight Piésold.
[1]Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).
[2] Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

[2] Symbols for equations:	Value	Description
A: Area per blast (m^2)	1,000	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	2.75	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	2.75	Moisture content of overburden, material handling by loading and unloading.
s: Material silt content (%)	10	Silt content in % by weight.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer and loader.
W: Mean vehicle weight (Mg)	153.1	Dump Truck TEREX (TR100, NTE260). Average weight (net weight and net load).
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Assumed as conservative value (AP-42, Table 13.2.1-3, Section 13.2.1 Paved Roads).
P: Precipitation with at least 0.254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0.254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv.
Horsepower by equipment	500	Representative value for earthmoving equipment and light vehicles (load factor = 0,59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 18: Operation phase - Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Open pit	157,889	5.0066	56,488	1,7912
Line	Open pit	202,039	6.4066	57,178	1,8131
Line	Open pit to WRD#1	46,949	1.4887	4,746	0,1505
Line	Open pit to WRD#2	4,107	0.1302	436	0,0138
Area	WRD#1	28,884	0.9159	15,118	0,4794
Area	WRD#2	2,512	0.0796	1,315	0,0417
Area	WRD#1 - wind erosion	22,241	0.7053	1,668	0,0529
Area	WRD#2 - wind erosion	1,820	0.0577	136	0,0043
Area	Crushed ore #1	14,862	0.4713	2,906	0,0922
Area	Crushed ore #2	14,862	0.4713	2,906	0,0922
Area	Transfer #1	13,500	0.4281	4,050	0,1284
Area	Transfer #2	13,500	0.4281	4,050	0,1284
Line	Highway 1	25,069	0.7949	6,181	0,1960
Line	Highway 2	35,097	1.1129	8,653	0,2744
Total		583,333	18.4974	165,832	5.2585

Prepared by Knight Piésold.

Open Pit

In the pit area, considerations are that activities related to drilling, blasting, earthmoving, material loading, truck and machinery travel along roads, and fuel consumption will take place. Tables 19 and 20 show calculation results for particulate matter emissions from the pit.

Table 19: Emission sources in open pit - Drilling, blasting, earthmoving and loading

Activity		Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
1	Drilling	13,416	hole/yr	0.30680	0.01770	kg/hole	4 116.0	0.131	237.5	0.008
2	Blasting	604	blast/yr	3.61765	0.20871	kg/blast	2 185.1	0.069	126.1	0.004
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	43,800	hr/yr	2.58945	1.16153	kg/hr	113 418.0	3.596	50 875.0	1.613
4	Loading of dump trucks delivering ore and waste rock	69 000,000	Mg/yr	0.00040	0.00006	kg/Mg	27 853.9	0.883	4 217.9	0.134
5	Loader travel in blast area	14,600	VKT/yr	0.70659	0.07066	kg/VKT	10 316.3	0.327	1 031.6	0.033
6	Fuel consumption by equipment (trucks, dozer, and others)	21 900,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	3 976.9	0.126	3 857.6	0.122
Total							**157,889**	**5.007**	**56,488**	**1.791**

Prepared by Knight Piésold.
Source: Myanmar Wanbao Mining Copper Limited.
Parameters used:

Description	Value	Notes
Number of hole by month	1,118	Total depth of 19 000 m (17 m per hole)
Number of blast by year	604	Quantity = 3.5 million tonne/month
Number of loader	5	Model: LW800K, ZL50G (XCMG).
Number of dozer	5	Model: MD32 (Inner Mongolia)
Number of crawler dozer	3	Model: CAT D9R and D475A-EO (KOMATSU).
Number of ballgrader.	2	Model: 14M (CAT).
Kilometre travelled per loader in blast area	1	km/day from 8:00 a.m. - 6:00 p.m.
Material handling in kt (kilo tonne by year)	69,000	Mining plan for year 5 (ore and waste rock).
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.

Table 20: Emission sources in open pit - Haul truck travel in open pit

Activity		Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
7	Haul truck travel in blast area to crushers (dust from wheeled)	Blast area	559,964	Vehicles/yr	1 119,928	VKT/yr	1.47112	0.14711	kg/VKT	90	159.540	5.059	15,954	0.506
8	Haul truck travel in blast area to crushers (dust from exhaust)	Blast area	8	worked hrs/Veh-day	137 970,000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	42.499	1.348	41,224	1.307
Total											**202,039**	**6.407**	**57,178**	**1.813**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Haulage routes average per truck (km)	1	Material transport on unpaved roads in open pit.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	128	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

Drilling and Blasting

During the operation phase, drilling and blasting activities are considered necessary for ore extraction. Calculation of particulate matter emissions due to drilling considers the number of drilling events, which was estimated based on information provided by MWMCL related to drilling depth for each blasting event (17 m per hole) and total drilling distance per month (19,000 m). Furthermore, for the calculation corresponding to blasting events, MWMCL information has been taken into account, which considers a total blasting area of 603,900 m^2 per year, equivalent to a quantity of 3.5 million tons per month. It is worth noting that no particulate matter emission reduction control measures have been considered for these activities. Table 19 shows emission results for the mentioned activities.

Equations considered for estimating emissions were the following:

$$E = EF \times N$$

Value assigned for emission calculation was for *N* = 13,412 holes/yr.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

According to information provided by MWMCL, total blasting area amounts to 603,900 m^2 per year and generates 3.5 million tons per month. Based on this information, the following values were determined: *A* = 1,000 m^2 per blast and *N* = 604 blasting events per year.

Earthmoving

Estimation of particulate matter emissions due to earthmoving activities comprises material stockpiling and arrangement, stripping, filling, machinery traffic, and grading. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 19 shows emission results for the mentioned activities.

Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation for calculating PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation used for calculating $PM_{2.5}$ emissions is as follows:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are *s* = 10%, *M* = 2.75% and *T*= 43,800 h/year.

Loading of Dump Trucks Delivering Ore and Waste Rock

Trucks are loaded with material at the pit. These materials are then transported to crusher or WRDs. Truck loading is performed by power shovels, while unloading takes place directly at semi-mobile crushers and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 19 shows emission results for material loading activities.

Material loading emissions were based on USEPA's *AP-42* Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 69,000 kt/yr (load).

Loader Travel in Blast Area

Equation considered for estimating front loader emissions within blasting area is the following:

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned are *VKT* = 14,600 km/year, *s* = 10%, *M* = 2.75% and P= 110 days/year (Lakes Environmental, 2013). Table 19 shows emission results for activities related to machinery traffic.

Fuel Consumption by Equipment

Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010), according to the following equations:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{SS} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining the emission factor are *NA* = 21,900,000 hp-hr/yr, EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), *DF* = 1.116, S_{PMadj}= 0.03438 (vehicles and machinery).

Haul Truck Travel in Blasting Area to Crushers

Particulate matter emissions caused by hauling material between blasting area and crushers were based on Section 13.2.2, Unpaved Roads, of USEPA's *AP-42* Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned were *VKT* = 1 119,928 km/year, *s* = 10%, *W* =153.1 Mg and P = 110 days/year (Lakes Environmental, 2013). Assigned road route length was 1 km. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (123 tons).

Emission estimation was also considered, due to the trucks' fuel consumption. This estimation was made by applying the equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

On the other hand, as a mitigation measure for dirt roads that will be used for hauling materials, road watering using tank trucks is considered. The efficiency percentage of emission reduction, *ER*, has been determined applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 128 trucks/hour, *T* = 2 hours, and *I* = 2.34 gal/yd^2. Applying these values in the above dust emission reduction equation one obtains *ER* = 90%. Emission estimation results are shown in Table 20.

Road from Open Pit to Waste Rock Areas

Roads that go from the pit boundary to waste rock dumps 1 and 2 (WRDs) generate emissions due to re-suspension of particulate matter from unpaved road surface, as well as particulate matter emissions due to the trucks' fuel combustion. These emission sources have been estimated using the following equations:

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

As control measure, it has been considered to water the roads using tank trucks. Emission reduction efficiency has been determined through the equation below:

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 72 trucks/hour, *T* = 2 hours (8:00-10:00 a.m., 3:00-5:00 p.m.), and *I* = 2.34 gal/yd^2. Inserting these values in the above dust emission reduction equation yields *ER* = 95%.

Table 21 shows calculation results for particulate matter emissions generated along the route between pit boundary and waste rock dumps (WRDs).

Table 21: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Line sources	Length	Data (conservative value)		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			km	Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
9	Haul truck travel to waste rock storage area (dust from wheeled)	Open pit to WRD #1	1	291 181	Veh/yr	582 362	VKT/yr	1.47112	0.14711	kg/VKT	95	46 891	1.487	4 689	0.149
		Open pit to WRD #2	1	25 320	Veh/yr	50 640	VKT/yr	1.47112	0.14711	kg/VKT	95	4 077	0.129	408	0.013
10	Haul truck travel to waste rock storage area (dust from exhaust)	Open pit to WRD #1	1	4	worked hrs/Veh-day	189 000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	58	0.002	56	0.002
		Open pit to WRD #2	1	2	worked hrs/Veh-day	94 500	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	29	0.001	28	0.001
Total												**51 056**	**1.619**	**5 182**	**0.164**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0.59)	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	39,000	Mining plan for year 5 (WRD 1 & 2).	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	72	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

Waste Rock Storage Areas (WRD1 and WRD2)

At the waste rock dumps, activities related to material unloading, earthmoving, and wind erosion exposure will take place.

Below, details of the calculation conducted for estimating emissions are provided (Table 22).

Haul Truck Unloading at Waste Rock Areas

Material unloading activities consist of directly unloading trucks at areas where waste rock dumps are located (WRDs). Table 22 shows emission results for material unloading activities. Calculation for estimating emissions generated by material unloading is based on USEPA's AP-42 Guide, applying the following mathematical expression:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 35,880 kt/yr (WRD1) and 3,120 kt/yr (WRD2).

Table 22: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

	Activity	Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
11	Haul truck unloading at waste rock areas	WRD #1	35 880,000	Mg/yr	0.00040	0.00006	kg/Mg	14,484.0	0.4593	2,193.3	0.0695
		WRD #2	3 120,000	Mg/yr	0.00040	0.00006	kg/Mg	1,259.5	0.0399	190.7	0.0060
12	Dozer activity in waste rock areas	WRD #1	5,373	hr/yr	2.58945	2.31756	kg/hr	13,912.6	0.4412	12,451.8	0.3948
		WRD #2	467	hr/yr	2.58945	2.31756	kg/hr	1,209.8	0.0384	1,082.8	0.0343
	Dozer activity in waste rock areas (dust from exhaust)	WRD #1	2 686,400	hp-hr/yr	0.18159	0.17614	g/hp-hr	487.8	0.0155	473.2	0.0150
		WRD #2	233,600	hp-hr/yr	0.18159	0.17614	g/hp-hr	42.4	0.0013	41.1	0.0013
Total								**31 396**	**0,9956**	**16 433**	**0.5211**

Prepared by Knight Piésold.
Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Number of dozer	4	Model: MD32 (Inner Mongolia)	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	4	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

Dozer Activity in Waste Rock Areas

Machinery linked to this type of activity for earthmoving is caterpillar tractors and graders. Table 22 shows emission results for the mentioned activities. Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) have been considered.

Calculation of PM_{10} emissions is based on the following expression:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the expression below has been used for calculating $PM_{2.5}$ emissions:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are s = 10%, *M* = 2.75% and *T*= 5,373 hr/year (WRD1) and 467 hr/year (WRD2).

Moreover, emissions generated by fuel consumption have been estimated through the following equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining emission factor are *NA* = 2 686,400 hp-hr/yr (WRD1) and 233,600 hp-hr/yr (WRD2), EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), and *DF* = 1.116, and S_{PMadj}= 0.03438 (vehicles and machinery).

Wind Erosion in WRDs

Estimation of emissions caused by wind erosion has been determined based on monthly weather data recorded by the weather station located in the study area between July 1995 and April 2007. Based on this information, friction velocity values have been determined, which are influenced by roughness height of the surface to be eroded. The procedure for calculating particulate matter emissions was based on USEPA's AP-42 Guide, Section 13.2.5, Industrial Wind Erosion.

Friction velocity has been estimated using the following equation (USEPA, 1995-2011):

$$u(z) = \frac{u^*}{0,4} \ln \frac{z}{z_o} (z > z_o)$$

Where *u* is wind speed, *u** is friction velocity, *z* is height above test surface, and z_o is roughness length. Upon calculating friction velocity, erosion potential was determined based on exposed surface (fine material) by applying the following expression (USEPA, 1995-2011):

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 0 \ \text{for}\ u^* \leq u_t^*$$

Where *P* is erosion potential in g/m^2, and u_t^* is threshold friction velocity, which depends on the type of exposed material. A value of 0.58 m/s was considered for u_t^*, which represents fine material for *s* = 10%. Furthermore, based on a frequency distribution analysis of weather data generated by the MM5 model, it was determined that wind speeds above 5.7 m/s present a frequency of 2.4% (Lakes Environmental, 2013). Table 23 shows calculation results for monthly erosion potential based on wind speed frequency.

Subsequently, emissions were estimated by applying the following equation:

$$E = k \times \sum_{i=1}^{N} P_i \times A$$

Where *N* is number of perturbations, P_i is potential erosion corresponding to maximum speed for period *i* between perturbations, and *A* is surface area that presents wind-erodible material. It should be pointed out that according to hourly weather data generated by MM5 model, maximum mean wind speeds correspond to 8.8 m/s; hence, it is estimated that wind speed perturbations above 11 m/s occur for time periods of less than 1 hour. Table 24 shows calculation results for emissions due to wind erosion events at waste rock dumps.

Table 23: Erosion potential emission factors

Month	Maximum wind speed (January 1995 to 18-Apr-2007) [(1)]									Max - u (m/s)	Friction velocity u* (m/s)	Erosion potential - P (g/m²)	Emission factor g/(m².hr)	
	1995	1996	1997	2001	2003	2004	2005	2006	2007			PM	EF - PM_{10}	EF - $PM_{2,5}$
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6	0.29	0.00	0.00	0.00
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8	0.36	0.00	0.00	0.00
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1	0.43	0.00	0.00	0.00
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3	0.54	0.00	0.00	0.00
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6	0.61	0.82	0.01	0.00
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2	0.54	0.00	0.00	0.00
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1	0.48	0.00	0.00	0.00
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6	0.40	0.00	0.00	0.00
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8	0.62	1.17	0.01	0.00
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0	0.32	0.00	0.00	0.00
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2	0.33	0.00	0.00	0.00
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6	0.35	0.00	0.00	0.00

Prepared by Knight Piésold.

Notes:

[(1)] Weather station was fall down and damaged into pieces by strong wind (18 April 2007, 16:35 hr).

Parameters	Value	Units	Source
Threshold friction velocity - u_t* (m/s)	0.58	m/s	AP-42, Table 13.2.5-1 (Tyler sieve No. 32)
Roughness height for open terrain (m)	0.005	m	AP-42, Industrial wind erosion.
Scaling factor k ≤ 10 µm	0.5	-	AP-42, Table 13.2.5-2
Scaling factor k ≤ 2,5 µm	0.075	-	AP-42, Table 13.2.5-3
Hourly wind class frequency distribution > 5,7 m/s	2.4	%	Lakes environmental (2013).

Table 24: Wind erosion emissions in Waste Rock Dumps (WRDs)

Month	Emission factor g/(m^2.hr)		Emissions (g/s)				Scaling factor
			WRD #1		WRD #2		
	EF - PM_{10}	EF - $PM_{2,5}$	PM_{10}	$PM_{2,5}$	PM_{10}	$PM_{2,5}$	
Jan	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0
May	0.0098	0.0007	0.290	0.022	0.024	0.002	0.4
Jun	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0
Sep	0.0140	0.0011	0.416	0.031	0.034	0.003	0.6
Oct	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0
Total			**0.705**	**0.053**	**0.058**	**0.004**	**1**

Prepared by Knight Piésold.

Assumptions:

Control efficiency for water spray assumed to be 50% (NPI, 2012).

2.4% of time that wind speed is greater than 5.7 m/s (Lakes Environmental, 2013).

Disturbed area for WRDs assumed to be 10% of silt content, due to soil texture analysis (Gravel Clay Silty Sandy) according to Knight Piésold (2000).

Parameters	Value	Disturbed area	Units
Total area of WRD #1 - 92.44%	2 132,700	213,270	m^2
Total area of WRD #2 - 17.45%	174,500	17,450	m^2
Total area - 100%	2 307,200	230,720	m^2

Semi-Mobile Crushers

Considerations are that activities related to material unloading, material crushing and transfer from conveyor belt to heap leach piles will take place at crusher area. Table 25 shows calculation results for particulate matter emissions resulting from the mentioned activities.

Table 25: Emission sources at semi-mobile crushers - Unloading, Crushing and Material Handling

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
14	Unloading to each crusher semi-movil	Crushed ore #1	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
		Crushed ore #2	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
15	Crushing ore and wet suppression systems (spray nozzles)	Crushed ore #1	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
		Crushed ore #2	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
16	Material handling and transfer for each point	Transfer #1	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
		Transfer #2	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
Total								**56,725**	**1.7987**	**13,913**	**0.4412**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	30,000	Mining plan for ore (year 5).	Myanmar Wanbao Mining Copper Limited
Controlled emissions by wet suppression systems (spray nozzles)	77.5	Percentage (controlled EF by wet suppression/uncontrolled EF)	AP-42, Section 11.19.2, Table 11.19.2-1.

Unloading of Material

Materials will be directly unloaded from trucks at areas where crushers are located. Emissions generated by unloading material were based on USEPA's AP-42 Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 30,000 kt/yr. Moreover, application of water-spraying systems (spray nozzles) has been considered as emission reduction measure. These systems achieve emission reduction (*ER*) efficiency close to 77.5% (USEPA AP-42, Section 11.19.2, Table 11.19.2-1).

Primary Crushing

Estimation of emissions caused by crushing material was based on the following equation:

$$E = k \times 0.004 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned for calculating emissions are *Q* = 30,000 kt/yr and *ER* = 77.5%.

Material Handling and Transfer (Conveyors)

Estimation of emissions due to ore transfer to conveyor belt was based on following equation:

$$E = N \times k \times 0.002 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Where *N* is number of transfer points. Values assigned to each parameter were *N* = 2, *Q* = 30,000 kt/yr and *ER* = 77.5%.

Highway near to Mining Area

Paved roads closest to the study area have been considered as possible routes for light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1{,}000}$$

Values assigned are *VKT* = 2,102,400 km/year, *sL* = 2 g/m^2, *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons. Furthermore, emissions due to fuel consumption have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Table 26 shows calculation results for particulate matter emissions produced by the mentioned activities.

Table 26: Emission sources on road close to mining area

Activity		Line sources	No. of vehicle passes/year	Length (1)	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
				km	Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
17	Light duty vehicles (dust from wheeled)	Highway 1	58,400	15	876,000	VKT/yr	0.02844	0.00688	kg/VKT	24,910	0.790	6,027	0.191
		Highway 2	58,400	21	1 226,400	VKT/yr	0.02844	0.00688	kg/VKT	34,875	1.106	8,437	0.268
18	Light duty vehicles (dust from exhaust)	Highway 1	58,400	15	876,000	VKT/yr	0.18159	0.17614	g/hp-hr	159	0.005	154	0,005
		Highway 2	58,400	21	1 226,400	VKT/yr	0.18159	0.17614	g/hp-hr	223	0.007	216	0,007
Total										**60,167**	**1.908**	**14,834**	**0.470**

Prepared by Knight Piésold.

(1) Length of paved roads until boundary environmental baseline area.

Parameters used:

Description	Value	Notes	Source
Nº of light duty vehicle by hour	20	Representative value.	Myanmar Wanbao Mining Copper Limited
Average daily traffic (ADT)	160	Assumed equivalent to 34 vehicles.	-
Horsepower of equipment	187.7	Value for light duty vehicle (load factor = 0.59).	Myanmar Wanbao Mining Copper Limited

4.3.2 AERMOD Model Configuration

Assessment of emission sources corresponding to different activities during the construction and operation phases has been performed using the AERMOD model, which can simulate atmospheric dispersion of particle and gas emissions from one or several sources on flat and complex terrain. To this effect, hourly weather data is used (surface and altitude data), as well as the ground's geophysical characteristics, together determining parameters that characterize the atmospheric stability of the area of interest and are included in the equations governing the model (Cimorelli *et al.*, 2005). Parameters included in dispersion calculations have been determined by AERMOD pre-processors (AERMET for meteorological and ground parameters, and AERMAP for parameters related to terrain relief).

Surface and altitude weather data obtained as results from MM5 meteorological model (Lakes Environmental, 2013) has been entered in AERMET meteorological pre-processor. Regarding topographic information, it corresponds to the end of the construction phase and year 5 of the operation phase (Stage I).

<u>Sectors and Surface Parameters for Letpadaung Project Area</u>

Among the setup options represented by ground characteristics, the AERMET processor requires surface parameters such as Albedo, Bowen ratio[5] (H/λE), and roughness length (m). These parameters are considered in AERMET's processing since they influence atmospheric turbulence characterization and, hence, pollutant dispersion (Cimorelli *et al.*, 2005).

With regard to the Letpadaung Project, surface parameter information entered in AERMET's pre-processor comes from NASA reanalysis satellite data generated by the Giovanni[6] Interactive Visualization and Analysis project - GES DISC (Goddard Earth Sciences, Data and Information Services Center). Downloaded information corresponds to the period between January 2010 and December 2012; the selected area comprises southeast (SE) and northwest coordinates (NW): latitude (22.06379, 22.10488) and longitude (95.0636, 95.112749). Table 27 shows mean values throughout the months entered in AERMET's pre-processor, which were determined

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[5] The Bowen ratio is used to describe the type of heat transfer. It is calculated by the equation $B = H/\lambda E$; where H is sensible hating and λE is latent heating.
[6] Retrieved in http://disc.sci.gsfc.nasa.gov/giovanni

based on information downloaded from the Giovanni project – GES DISC (Appendix A and Table 28).

Table 27: Mean surface parameters for Letpadaung Project area

Month	Albedo	Bowen ratio	Roughness length (m)
January	0.175	0.646	0.618
February	0.178	1.383	0.525
March	0.175	3.254	0.391
April	0.169	1.434	0.316
May	0.166	0.649	0.342
June	0.165	0.099	0.422
July	0.164	0.065	0.497
August	0.163	0.051	0.540
September	0.159	0.043	0.569
October	0.160	0.079	0.609
November	0.166	0.189	0.641
December	0.167	0.307	0.646

Prepared by Knight Piésold
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center.

Table 28: Surface parameters for Letpadaung Project

Year	Month	Roughness length (m)		Latent heat flux (λE) from land (W/m^2)	Sensible heat flux (H) from land (W/m^2)	Bowen ratio (H/λE)	Surface albedo (fraction)
		Sensible heat	Momentum				
2010	January	0.6	0.635	50.5	45.2	0.89	0.175
	February	0.482	0.567	35.9	69.6	1.94	0.178
	March	0.322	0.46	14.9	90.7	6.10	0.175
	April	0.237	0.394	30.5	84.2	2.76	0.168
	May	0.267	0.418	83.9	52.0	0.62	0.165
	June	0.357	0.486	131.6	12.5	0.09	0.165
	July	0.447	0.546	130.3	8.4	0.06	0.164
	August	0.501	0.579	129.2	6.2	0.05	0.164
	September	0.537	0.601	107.6	5.4	0.05	0.16
	October	0.587	0.63	95.5	4.0	0.04	0.157
	November	0.629	0.652	98.5	20.0	0.20	0.167
	December	0.636	0.656	69.8	21.5	0.31	0.167
2011	January	0.6	0.635	66.7	32.7	0.49	0.176
	February	0.482	0.567	56.4	58.1	1.03	0.178
	March	0.323	0.46	59.4	58.1	0.98	0.174
	April	0.238	0.394	88.7	37.1	0.42	0.169
	May	0.267	0.418	125.2	22.6	0.18	0.167
	June	0.357	0.486	135.6	11.5	0.08	0.165
	July	0.448	0.546	134.7	7.2	0.05	0.165
	August	0.501	0.579	130.3	7.0	0.05	0.163
	September	0.537	0.601	117.2	6.0	0.05	0.16
	October	0.587	0.63	105.4	9.8	0.09	0.161
	November	0.629	0.652	95.2	21.0	0.22	0.168
	December	0.636	0.656	72.6	20.3	0.28	0.166
2012	January	0.6	0.636	64.1	35.4	0.55	0.175
	February	0.482	0.567	49.6	58.6	1.18	0.179
	March	0.322	0.46	31.4	84.3	2.68	0.175
	April	0.238	0.394	56.3	63.2	1.12	0.169
	May	0.266	0.418	62.1	71.2	1.15	0.166
	June	0.357	0.486	130.3	15.3	0.12	0.166
	July	0.447	0.546	141.7	10.9	0.08	0.164
	August	0.501	0.579	130.3	6.6	0.05	0.163
	September	0.537	0.601	98.1	2.5	0.03	0.158
	October	0.587	0.63	108.1	11.1	0.10	0.163
	November	0.629	0.652	89.6	12.7	0.14	0.163
	December	0.637	0.656	69.9	23.4	0.34	0.169

Prepared by Knight Piésold.
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences. Data and Information Services Center.

Notes:
The MERRA is a NASA reanalysis for the satellite era using a major new version (V5) of the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS). The MERRA focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales. This MERRA Instance of Giovanni focuses on visualizing and analysing the MERRA hourly 2D data from the MERRA HISTORY COLLECTIONS. All data used here are at GEOS-5 native resolution of 2/3 longitude by 1/2 latitude degrees.
Selected time period: Jan 2010 - Dec 2012
Selected area for averaging: Lat (22.06379. 22.10488). Lon (95.0636. 95.112749).

Receptor Locations

Points for which the model calculates concentration level contributions resulting from emissions generated by the different assessed activities are called receptors.

PM_{10} dispersion modeling used a total of 9 discrete receptors located within the study area; of which 8 correspond to air quality sampling sites, while 1 is located in the city of Monywa (Table 29).

Table 29: Discrete Cartesian receptors of air quality modeling

Location	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	715,252.18	2,442,082.56	127
Station 2	719,251.74	2,438,468.46	80
Station 3	713,421.56	2,444,860.13	90
Station 4	715,622.86	2,448,138.15	78
Station 5	709,895.01	2,450,963.14	83
Station 6	711,883.05	2,440,896.18	120
Station 7	707,251.93	2,438,634.96	149
Station 8	705,617.76	2,442,419.11	175
Monywa	720,911.88	2,446,350.66	81

Prepared by Knight Piésold.

Moreover, a Cartesian receptor grid was set up, comprising an area of 216 km^2 (Table 30), which considers the final range of PM_{10} dispersion generated by construction activities. Figure 2 shows the receptor grid entered in the model corresponding to the project's construction phase.

Table 30: Uniform Cartesian grid receptor network – Construction phase

Description	X Axis	Y Axis	Units
Origin (SW corner) (X, Y)	705,529.84	2,437,860.72	UTM WGS84 (m)
No. of points	65	55	-
Spacing (Dx, Dy)	250	250	m
Length	16	13.5	km
Number of receptors	3,575		-

Prepared by Knight Piésold.

In relation to the operation phase, a nested receptor grid comprising an area of 506.25 km^2 (22.5 km x 22.5 km) has been set up, shown in Table 31. Figure 3 shows the receptor grid considered for the project's operation phase.

Table 31: Nested receptor grids – Operation phase

Bounding box		
Origin (SW corner) (X, Y)	714,759.58 m	2,441,933.91 m
Size (Width, Height)	2,500 m	2,500 m
Receptor spacing	150 m	
Number of receptors	1,804	
Nested grids		
Number of nested grid	**Distance from Bounding Box**	**Receptor spacing**
1	2,500 m	300 m
2	5,000 m	500 m
3	20,000 m	2,000 m

Prepared by Knight Piésold.

4.4 NOISE AND VIBRATION MODELLING

Noise level propagation during construction and operation activities was determined with the computer simulation program SoundPLAN, version 7.2, which includes physical variables and acoustic characteristics of sound sources. Regarding the determination of projections of vibrations caused by activities (blasting, machinery and vehicle traffic) towards the location of sensitive receptors, mathematical formulations proposed by Devine (1962; quoted by López Jimeno *et al.*, 2003) and the Federal Transit Administration (FTA) of the U.S. Department of Transit (2006) have been used.

4.4.1 Noise Modelling Input

Modelling methodology is based on ISO 9613 standard, which uses divergent attenuation principles along with extra attenuation caused by obstacles and air attenuation. The model's input variables are the sound powers of noise sources for each considered phase. The exclusive contribution generated by assessed project sources was modelled; this contribution was based on information related to the sources' spatial geometry.

Temperature was set at 25°C and relative humidity at 80%, which are considered meteorological values that are representative for the study area. Also, wind speed has been assumed to vary between 1 and 5 m/s, according to what is established in ISO 9613, Part 2, and the noise propagation direction is towards the receptors.

During the construction and operation phases (Stage 1), activities will take place that are categorized into stationary, linear, and impulsive (blasting), depending on the noise sources.

Noise Emission Inventory

Stationary and Linear Sources in Mining Area

The noise emission characteristics in L_{AeqT} dB(A) of each piece of machinery are based on values published by the British Standard (BS 5228) "Update of Noise database for prediction of noise on construction and open sites" (contained in Annex C) (DEFRA; 2005, 2008). Table 32 shows global acoustic powers assigned to each piece of machinery that will be used, determined through the equation that relates a stationary noise emission source to a specific distance [L_{AeqT} in dB(A)] and acoustic power (Lw), which applies for an obstacle-free ground-level propagation direction:

$$Lw = Lp + 20\log(r) + 8$$

Where Lw is projected acoustic power, Lp is sound pressure level in L_{Aeq} dB(A), and r is the distance between receptor and source.

Upon assigning powers to each piece of machinery, the global acoustic power level representing a noise emission area was determined, for which the following mathematical expression was used:

$$L_T = 10\log\sum_{i}^{n} 10^{\frac{L_i}{10}}$$

Where L_T is the sum of all sound radiation sources, n is the number of sources, and L_i are each source's noise levels, expressed in dB(A).

Table 32: Acoustic power (Lw) in dB(A) of equipment used during construction and operation phases - Stationary sources

Scenario	Operating Route	Designation[(1)]	Model[(1)]	Amount[(1)]	Engine power (kW)	Operation weight (tons)	Octave band sound pressure levels @ 10 m (Hz)[(2)]								A-weighted sound pressure level, LAeq, dB @ 10 m[(2)]	Acoustic power level
							63	125	250	500	1k	2k	4k	8k		
Construction & Operation (Stage I)	Blasting Zone	Hole Pumping Truck	PP-150	1	199	17	77	83	82	84	85	85	84	79	91	119
		Hole Stemming Machine	ZL50F-II	2	162	17	77	83	82	84	85	85	84	79	91	119
	Drilling Area	Drilling Rig	T35	1	142	15.1	83	84	79	85	82	79	75	71	87	115
		Drilling Rig	ROC L6 (25)	2	287	21.7	94	95	90	91	87	85	80	73	92	120
		Drilling Rig	HCR1500-20 II	1	261	17.3	77	83	82	84	85	85	84	79	91	119
	Digging Area	Excavator	EX1900-6BH	1	810	383	82	78	82	81	81	78	72	64	85	113
		Excavator	EX1200-6LD	2	567	223	82	78	82	81	81	78	72	64	86	114
		Excavator	PC2000-8	5	728	204.1	89	92	83	81	82	78	73	65	86	114
	Mining Area	Excavator	XE370C	1	184	36.6	81	80	80	83	82	79	76	73	86	114
		Loader	LW800K	2	250	28.5	91	81	73	71	71	72	62	59	77	105
		Loader	ZL50G	3	162	16	86	82	77	74	70	66	62	55	76	104
		Dozer	MD32	5	235	45	89	90	81	73	74	70	68	64	80	108
		Roller	W2601	2	174	18	80	75	77	72	67	62	54	46	73	101
		Crawler Dozer	CAT D9R	6	350	48	80	84	76	77	79	81	69	59	85	113
		Ballgrader	14M	2	221	25	88	87	83	79	84	78	74	65	86	114
		Refuelling Truck	ND5318GJYZ(20T)	2	235	20	91	81	76	77	73	72	70	62	79	107
		Light Truck	BJ1138VJPHG	2	140	13.2	84	81	74	73	72	68	61	53	76	104
		Truck with Crane	ND1250A50J	2	235	13.6	85	73	67	71	72	69	63	56	76	104
		Fire-Fighting Truck	ND1310D35J	2	235	20	85	80	77	72	74	70	65	58	78	106
		Maintenance Truck	ND1160A45J	2	235	10	85	73	67	71	72	69	63	56	76	104
		Sprinkler Truck	TR50W	3	392	45	92	91	86	85	84	85	77	77	90	118
		AN Mixing-Loading Truck	NCHA-15	2	247	15	85	73	67	71	72	69	63	56	76	104
		Heavy ANFO Mixing-Loading Truck	NCHZ-15	2	447	15	88	93	84	84	83	81	79	69	88	116
	Digging area to WRD	Mining Dump Truck	TR100	35	783	113	89	94	89	85	83	81	76	71	89	117
Operation (Stage I)	Digging Area	Excavator (front shovel)	PC4000	2	1,400	391	91	86	80	81	80	78	77	70	85	113
	Drilling Area	Rotary Rig	DML	5	460	27.2	86	92	85	88	84	83	78	77	90	118
	Mining Area	Crawler Dozer	D475A-EO	1	728	108.4	80	84	76	77	79	81	69	59	85	113
	Digging area to WRD and Leaching Pad	Mining Dump Truck	NTE260	10	1,865	236	97	95	91	91	86	84	79	75	92	120
	Crushing area	Tracked Semi-Mobile Crusher	--	2	310	90	91	91	88	87	85	83	78	68	90	118

Prepared by Knight Piésold
(1) Source: Mining Plan according to Myanmar Wanbao Mining Copper Limited
(2) Sound levels according to DEFRA (2005, 2008)

Linear Sources on Paved Roads

During construction and operation phases, noise generation due to vehicle traffic on roads close to project has been considered. For this reason, in a conservative approach a flow of 20 light vehicles and 14 heavy vehicles has been considered per hour, equivalent to 816 vehicles per day during 24 hours. For this linear source, it has been considered to set up the model by applying the noise propagation method based on the German RLS 90 standard[7], which considers that noise emission on a road corresponds to a point located 25 m from the centerline (called LM25) and 4 m above ground level. Thus, the speeds considered are a maximum vehicle speed of 48 km/h and a speed of 40 km/h when vehicles pass built-up areas.

Subsequently, the RLS 90 method calculates sound propagation from the emission line using the LM25 value.

Blasting

Modelling methodology is based on sound field propagation standard ISO 9613, Part I & II, “Attenuation of sound during propagation outdoors”, which uses divergent attenuation principles along with extra attenuation caused by obstacles and attenuation due to air effects. The used software is SoundPLAN, version 7.2, which includes all physical variables related to the noise sources’ geomorphology and sound power.

Table 33 shows the octave frequency band spectrum (Hz) that corresponds to noise emission for a surface blasting event. This information is representative for blasting activities in mining projects and has been used as part of the environmental impact assessments conducted by Knight Piésold for open pit mining projects (Knight Piésold; 2010, 2011).

Table 33: Acoustic power (Lw) in dB(C) for blasting events

Source	Central Frequency in Octave Bands (Hz)								Lw in dB(C)
	63	125	250	500	1k	2k	4k	8k	
Surface blast	144.0	137.0	133.0	129.0	124.0	116.0	110.0	107.0	145.0

Prepared by Knight Piésold
Source: Data measured by Control Acústico Ltda for blasting events in northern Chile during 2003

[7]German Noise Classification System

Acoustic power shown in Table 33 is related to SEL (Sound Exposure Level), a parameter that represents the total energy produced by a single noise event with a duration of 1 second, a time period considered representative for blasting events (Afeni & Osasan, 2009).

Receptor Locations

The SoundPLAN v. 7.2 model receptors were set up considering a calculation area that comprises the noise sampling stations, whose locations are shown in Table 34.

Table 34: Discrete Cartesian receptors of noise quality modeling

Description	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	713,421.56	2,444,860.13	91
Station 2	716,226.37	2,444,500.06	81
Station 3	719,184.44	2,443,299.27	79
Station 4	719,251.74	2,438,468.46	78
Station 5	717,231.75	2,445,136.04	81
Station 6	715,622.86	2,448,138.15	82
Station 7	709,895.01	2,450,963.14	89
Station 8	711,883.05	2,440,896.18	120
Station 9	707,251.93	2,438,634.96	148
Station 10	705,617.76	2,442,419.11	81

Prepared by Knight Piésold

4.4.2 Vibration Modeling Input

The main activities of interest capable of generating major impact due to vibrations during the construction and operation phases are blasting events, truck and construction machinery traffic (drills, vibratory roller, grader, bulldozer). Such activities have been assessed in this study by applying mathematical models that project vibration at a given point, for which available formulations related to each activity were revised.

Blasting

In order to forecast vibrations produced by blasting, the mathematical formulation proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) for representing vibration behaviour in open pit mining operations was proposed.

$$PPV = K \times \left(\frac{d}{W^{1/2}}\right)^{-\alpha}$$

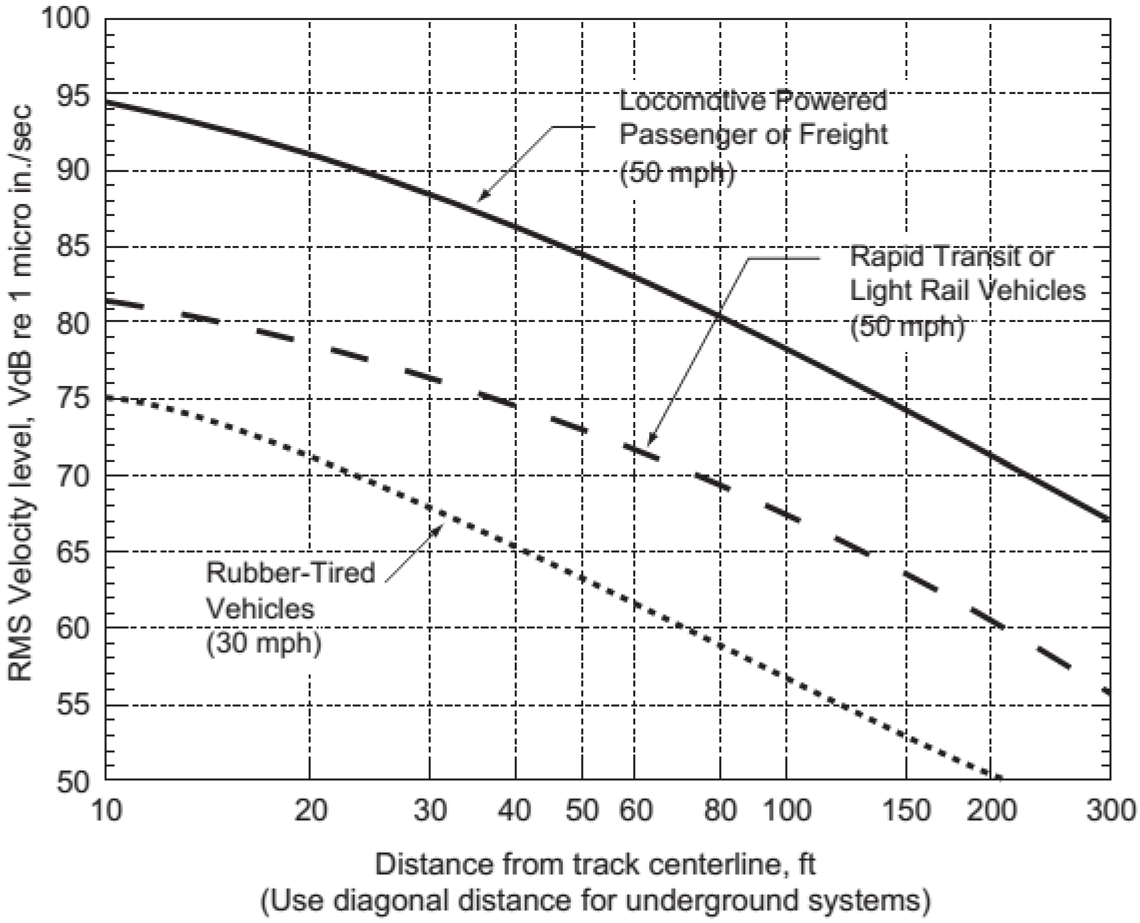
Where *PPV* is particle peak velocity (mm/s), *W* is explosive charge weight (kg), *d* is the distance between detonation area and receptor of interest (m), *K* is velocity factor, and α is attenuation factor. It is worth mentioning that the values *K* and α are variables that have been statistically determined and depend on the soil's geological conditions. Thus, the mean factors considered were the theory-based *K* = 357 and α = 2.07, which had been proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) and determined from field measurements and theoretical calculations based on studied soil type.

Regarding this study, it has been considered to use between 600 and 1,200 kg of explosive charge for each blasting event during the project's construction and operation phases. It should be pointed out that when an explosive charge is detonated, a pressure wave that displaces particles surrounding the detonation area is generated. The elasticity of the transmitted wave is directly proportional to the particle's velocity. The same amount of explosive charge detonated and measured at a fixed distance does not necessarily produce the same vibration magnitude if performed at different sites. In general, blast-induced vibrations take very short time according to the short duration of typical production blast at less than 2 seconds (Kuzu, 2008; Afeni & Osasan, 2009). Human reactions to blast-induced vibration start at particle velocities of generally about 10 mm/s (Siskind *et al.*, 1980 as cited in Kuzu, 2008).

Truck Traffic

Vibrations generated by truck traffic within the study area have been estimated by using criteria proposed by the Federal Transit Administration (FTA) of the U.S. Department of Transit in 2006, which are based on maximum vibration levels for one-time events. According to Graph 4, maximum vibration level values expected at each receptor are estimated, based on the distance between the track's centerline and the receptor. In this case, it corresponds to the graph's lower dotted curve (rubber-tired vehicles).

Graph 4: Generalized ground surface vibration curves



Source: FTA (2006)

The velocity level (RMS L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref\,1\frac{micro\ in.}{sec}} = 20\log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is RMS (Root Mean Square) of velocity amplitude, and v_{ref} is reference velocity amplitude. Projections of vibration levels Lv at a distance (D) have been estimated through the following mathematical expression (FTA, 2006):

$$L_v(D) = L_v(25\ ft) - 30\log\left(\frac{D}{25}\right)$$

According to the FTA (2006), background vibrations in residential areas are usually 50 VdB or less, far below the human perception threshold, which is around 65 VdB. Larger vibrations that exceed 70 VdB generate significant responses, such as a reaction of discomfort.

According to the abovementioned, it has been considered to assess vibrations generated by truck traffic based on the FTA criterion shown in Table 35.

Table 35: Ground-borne vibration (GBV) impact criteria for general assessment

Land Use Category	GBV Impact levels (VdB ref. 1 micro-inch/sec)	
	Frequent events(1)	Infrequent events(2)
Category 1:Buildings where vibration would interfere with interior operations	65 VdB	65 VdB
Category 2: Dwellings and buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land primarily with daytime use	75 VdB	83 VdB

Source FTA (2006)
Notes:
(1) “Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
(2) "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

In this case, receptors located within the project area correspond mainly to dwellings, which is why the criterion for Category 2 will be applied.

Construction Machinery

For the case of construction machinery, the FTA criterion establishes a maximum of 100 VdB for fragile buildings, or 95 VdB for fragile historical buildings.

Vibration level sources[8] corresponding to equipment used during the construction phase vary between 86 L_v (front loader) and 94 L_v (vibratory roller), for which from a conservative point of view a value of 94 L_v was chosen. Furthermore, for modelling the vibrations of vehicles travelling close to the roads, a maximum speed of 48 km/h has been considered (30 mph).

[8] RMS velocity in decibels (VdB) ref 1 micro-inch/second at 25 ft

5. MODELING RESULTS

The results produced by the AERMOD View v. 8.2 and SoundPLAN v. 7.2 modelling systems allowed quantifying the impact produced by project activities. Moreover, these results have been added to the information provided by baseline sampling related to air and noise quality.

5.1 PARTICULATE MATTER CONCENTRATIONS - PM_{10}

5.1.1 Construction Phase

In Figures 4 and 5 one can see the impact of dispersion of PM_{10} emissions generated by construction activities. Table 36 shows the results generated by the model (PM_{10} impacts) at each receptor depending on sampling station location. These results were added to the background concentrations obtained during baseline sampling. Hence, total PM_{10} concentration results that do not exceed international standards established by the WHO were obtained.

Table 36: Impact analysis of PM_{10} concentration – Construction phase

Receptor	Impacts of PM_{10} (µg/m^3)		Background concentration of PM_{10} (µg/m^3)(1)		Total PM_{10} (µg/m^3)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	1.5	13.3	11.3	14.3	12.8	27.6
Station 2	0.3	11.4	7.7	12.65	8	24.05
Station 3	2.2	21.4	7.8	11.4	10	32.8
Station 4	0.4	12.8	14.3	17.6	14.7	30.4
Station 5	0.2	3.7	20.0	22.3	20.2	26
Station 6	0.2	5.1	7.1	9.5	7.3	14.6
Station 7	0.1	1.8	15.0	19.2	15.1	21
Station 8	0.1	1.9	7.4	10.4	7.5	12.3
Monywa	0.2	11.9	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.1.2 Operation Phase

In Figures 6 and 7 one can see the impact of dispersion of PM_{10} emissions generated by mine operation activities. Table 37 shows the results provided by the model (PM_{10} impacts) for each receptor depending on sampling station location. These results have been added to the background concentrations obtained during

baseline sampling. Thus, total PM_{10} concentration results that do not exceed international standards established by the WHO have been obtained.

Table 37: Impact analysis of PM_{10} concentration – Operation phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)(1)		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	2.3	33.3	11.3	14.3	13.6	47.6
Station 2	1.2	15.6	7.7	12.65	8.9	28.3
Station 3	2.7	29.3	7.8	11.4	10.5	40.7
Station 4	1.0	14.4	14.3	17.6	15.3	32.0
Station 5	0.8	19.2	20.0	22.3	20.8	41.5
Station 6	0.4	10.3	7.1	9.5	7.5	19.8
Station 7	0.1	6.6	15.0	19.2	15.1	25.8
Station 8	0.2	6.1	7.4	10.4	7.6	16.5
Monywa	0.3	6.1	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.2 NOISE AND VIBRATIONS

5.2.1 Noise

This section shows results provided by SoundPLAN v. 7.2 noise modelling system related to noise propagation in the study area and noise levels at receptors. It is worth mentioning that the shown noise levels represent an exclusive contribution generated by noise sources considered by the project.

<u>Construction Phase</u>

Figure 8 shows propagation of noise generated by noise sources considered during the construction phase. Tables 38 and 39 show projected noise levels at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC. Subsequently, the total noise of the evaluated stations was determined by the energetic sum of noise generated by the project and the background noise, applying the following mathematical expression:

$$L_T = 10 \log \sum_{i}^{n} 10^{\frac{L_i}{10}}$$

According to the results of total noise, for all sampling stations the noise background increment is lower than 10.2 dB (A). The largest increases of noise were observed for station 1 and 2, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 38: Assessment of noise modelling results for construction phase – Daytime

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.2	67.5	52.4	67.6	65 (4)
Station 2	49	42.8	72.9	49.9	73.0	65 (4)
Station 3	29.2	44.7	59.9	44.9	59.9	55 (5)
Station 4	16	46.6	66.5	46.6	66.5	55 (5)
Station 5	31.6	43.9	75.4	44.1	75.4	65 (4)
Station 6	20.7	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	35.5	42.2	67.9	43.0	67.9	55 (5)
Station 9	0	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Prepared by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 65 dB(A) according to OECD.
(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 39: Assessment of noise modelling results for construction phase – Night-time

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	23.7	46.3	67.9	46.4	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	27.7	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	0	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 55 dB(A) according to OECD.
(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 40 shows noise levels projected at receptors due to blasting events within the mine area, which do not exceed reference values according to the North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901"., which in Section 901.109 establishes a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Furthermore, Figure 9 shows the propagation of noise produced by blasting events in the study area in LeqT units in dB(C) for T = 24 hours.

Table 40: Assessment of noise modelling results for construction phase - Blasting events

Location	Sound Exposure level (SEL) for 1 second(1)	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	85.2	107.0	112.0
Station 2	104.8	107.0	112.0
Station 3	99.8	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	103.6	107.0	112.0
Station 6	95.7	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
(1)Values determined based on values in L_{eqT} units in dB(C), where T = 1 hour.

Operation Phase

Figure 10 shows propagation of noise generated by noise sources considered during the operation phase. Tables 41 and 42 show noise levels projected at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC.

According to the results of total noise, for all sampling stations, the noise background increment is lower than 11.3 dB (A). The largest increases of noise were observed for station 1, 2 and 5, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 41: Assessment of noise modeling results for operation phase – Daytime

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	53.2	42.2	67.5	53.5	67.6	65 [4]
Station 2	51.7	42.8	72.9	52.2	73.0	65 [4]
Station 3	48.4	44.7	59.9	50.0	60.2	55 [5]
Station 4	16.5	46.6	66.5	46.6	66.5	55 [5]
Station 5	52.1	43.9	75.4	52.7	75.4	65 [4]
Station 6	16.5	43.8	63.8	43.9	63.8	55 [5]
Station 7	4.4	45.0	85.5	45.0	85.5	55 [5]
Station 8	43.2	42.2	67.9	45.7	67.9	55 [5]
Station 9	Not perceptible	42.3	67.8	42.3	67.8	55 [5]
Station 10	1	41.3	60.0	41.3	60.0	55 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 65 dB(A) according to OECD.
[5] Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 42: Assessment of noise modeling results for operation phase – Night-time

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 [4]
Station 2	49	42.4	68.9	49.9	68.9	55 [4]
Station 3	45	46.3	67.9	48.7	67.9	45 [5]
Station 4	16	44.0	74.6	44.0	74.6	45 [5]
Station 5	28.5	44.6	66.7	44.7	66.7	55 [4]
Station 6	16.5	44.4	74.0	44.4	74.0	45 [5]
Station 7	4.4	44.2	72.5	44.2	72.5	45 [5]
Station 8	35.5	42.0	68.7	42.9	68.7	45 [5]
Station 9	Not perceptible	42.2	67.0	42.2	67.0	45 [5]
Station 10	1	41.5	67.6	41.5	67.6	45 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 55 dB(A) according to OECD.
[5] Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 43 shows noise levels projected at receptors due to blasting events in mine area, which do not exceed reference values according to North American standard “Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901,” which establishes in Section 901.109 a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Moreover, Figure 11 shows the propagation of noise produced by blasting events in the study area in L_{eqT} units in dB(C) for T = 24 hours.

Table 43: Assessment of noise modelling results for operation phase - Blasting events

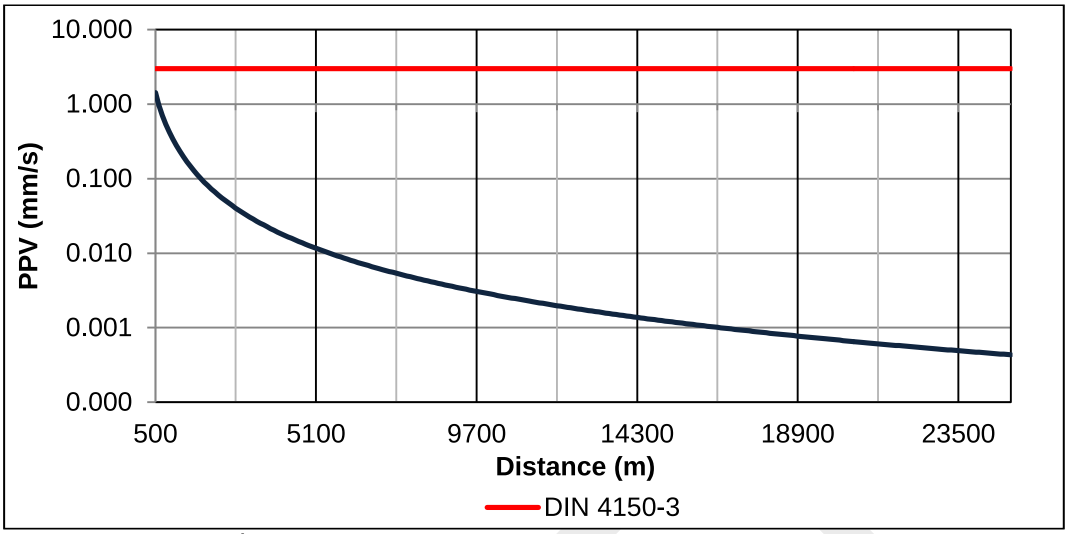
Location	**Sound Exposure level (SEL) for 1 second** [(1)]	**Standard - SEL in dB(C)**	
		Class A	**Class B**
Station 1	93.5	107.0	112.0
Station 2	94.0	107.0	112.0
Station 3	83.5	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	102.4	107.0	112.0
Station 6	95.8	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
[(1)] Values determined based on values in LeqT units in dB(C), where T = 1 hour.

5.2.2 Vibrations

Graph 5 shows PPV values for distances ranging from 0.5 km to 250 km, considering a blasting event. These PPV values were calculated by applying the mathematical expression proposed by Devine (1962; quoted by López Jimeno *et al.*, 1987). Furthermore, it shows a 3 mm/s protection standard corresponding to sensitive buildings based on German DIN standard No. 4150-3 (DIN = Deutsches Institut für Normung). According to Kuzu (2008), human reactions due to vibrations caused by blasting events start at particle peak velocities close to 10 mm/s. For this reason, the 3 mm/s standard proposed by the DIN 4150-3 standard is considered the most demanding one.

Graph 5: Prediction of blast-induced vibration level



Prepared by Knight Piésold

Table 44 shows modelling results for vibrations caused by blasting events at nearby sensitive receptors. These vibrations do not exceed safety limits suggested by German DIN standard No. 4150-3.

Table 44: Modelling results of vibrations caused by blasting at receptor sites

Location	Distance from blasting area to receptor (km)	PPV (mm/s)	Safe level according to DIN 4150-3 (mm/s)
Station 1	2.5	0.0508	3
Station 2	1.13	0.2629	3
Station 3	2.67	0.0443	3
Station 4	5.03	0.0120	3
Station 5	1.96	0.0841	3
Station 6	4.71	0.0137	3
Station 7	9.39	0.0033	3
Station 8	3.67	0.0229	3
Station 9	8.84	0.0037	3
Station 10	9.54	0.0032	3

Prepared by Knight Piésold

Vibrations caused by vehicle traffic along paved roads do not exceed the FTA's allowed limit of 65 VdB. Table 45 shows results for vibration levels projected at the distance where dwellings are located with regard to the vehicle's route.

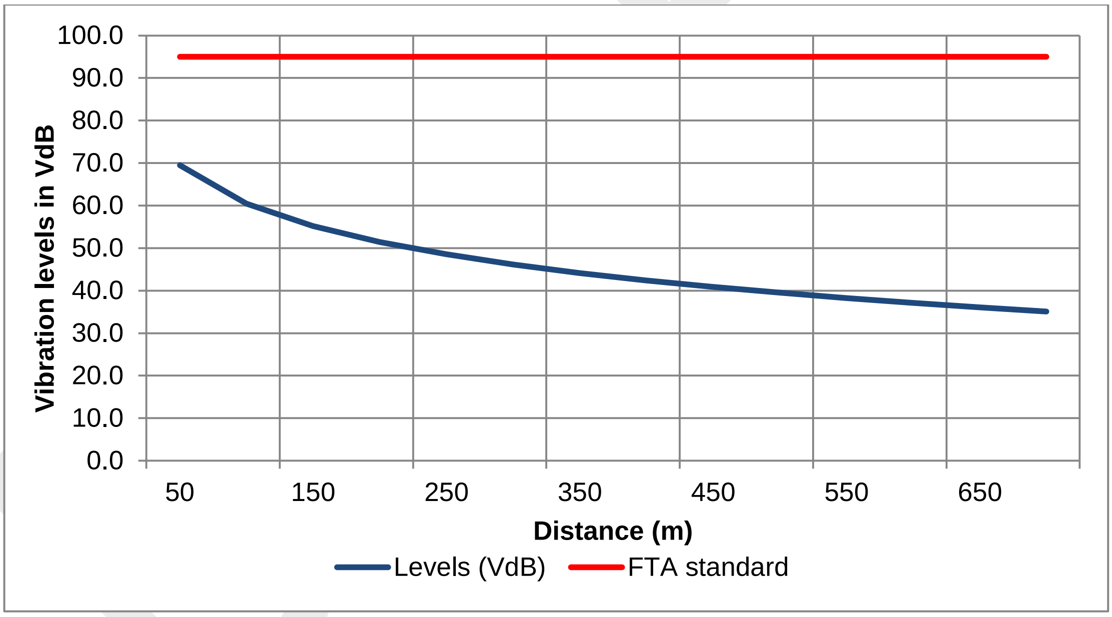
Table 45: Modeling results of vibrations caused by vehicles on road close to receptor sites

Location	Distance from track centerline (m)	Lv (ref 1 micro-inches/s) (VdB)	FTA Standard Category I
1	14	64	65 VdB
2	16	63	
3	199	26	
5	22	59	

Prepared by Knight Piésold

Regarding activities resulting from heavy machinery operation during the construction phase, Graph 6 shows Lv values projected at a specific distance. According to the results, the vibration levels generated by machinery do not exceed the limit of 95 VdB recommended by the FTA for sensitive structures.

Graph 6: Modelling results of vibrations caused by construction equipment at receptor sites



Prepared by Knight Piésold

6. CONCLUSIONS

Inventories of particulate matter (PM_{10} and $PM_{2.5}$), noise and vibrations were developed for construction and operation phases. According to results, it is evident that operation phase generates more dust and noise than construction phase.

According to results provided by computer programs Aermod View 8.2 and SoundPLAN 7.2, the impact caused by emissions of particulate matter, noise and vibrations during the construction and operation phases does not exceed environmental quality standards established by the IFC/WHO and OECD. The sites that present the highest concentrations of particulate matter, as well as the highest noise and vibration levels are within project area facilities, such as the pit and the waste rock dumps.

Regarding the impact on air quality, during the construction phase Station 3 (air quality) is the one receiving the highest contributions of PM_{10} concentration (21.4 $\mu g/m^3$ for mean maximum 24-hour value and 2.2 $\mu g/m^3$ for mean maximum annual value) resulting from dispersion of particulate matter. Furthermore, during the operation phase, stations 1 and 3 receive larger PM_{10} concentration contributions, which range from 29.3 to 33.3 $\mu g/m^3$ (mean maximum 24-hour value) and from 2.3 to 2.7 $\mu g/m^3$ (mean maximum annual value).

With regard to impact on noise quality, one can see that during the construction and operation phases the stations 1, 2, 3, 5 and 8 are the ones receiving the largest noise contributions, due to the proximity of these stations to vehicle traffic on the roads surrounding the project area.

Finally, vibrations caused by project activities during its various phases comply with standards established by DIN standard 4150-3 and by FTA criteria.

7. RECOMMENDATIONS

Regarding the impact on air quality, it is recommended to permanently monitor PM_{10} and $PM_{2.5}$ at stations 1 and 3 during the project's construction and operation phases, as part of the environmental monitoring plan.

Regarding the impact on noise quality due to the proximity of urban areas and roads surrounding the project area, it can be reduce to some extent by adopting mitigation measures such the implementation of noise barriers and suitable traffic management. According to FTA (2006), Section 6.8.1 Noise Mitigation Measures, noise barriers are effective in mitigating noise when they break the line-of-sight between source and receiver. Where the barrier is very close to the transit vehicle or where the vehicles travel between sets of parallel barriers, barrier effectiveness can be increased by as much as 5 decibels by applying sound-absorbing material to the inner surface of the barrier (FTA, 2006). The normal minimum requirement is a surface density of 4 pounds per square foot (FTA, 2006).

Finally, it is recommended to permanently monitor noise and vibration at stations 1, 2, 3, 5 and 8 during the project's construction and operation phases considering a quarterly frequency, as part of the environmental monitoring plan to verify the mitigation actions implemented.

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FIGURES

APPENDIX A

Merra Monthly History Data Collections – Giovanni Project

APPENDIX B

Maximun 24 hour mean concentrations for PM_{10} impacts during dry-cold, dry-hot and wet seasons

APPENDIX L

Conceptual Closure Plan

Knight Piésold
CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT



CONCEPTUAL CLOSURE PLAN

PREPARED FOR:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chien Street
Pyay Road, Hlaing Township
Yangon, Myanmar

PREPARED BY:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

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Knight Piésold
CONSULTING
www.knightpiesold.com

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LETPADAUNG COPPER PROJECT

CONCEPTUAL CLOSURE PLAN

KP Report No. PE701-00022/04

CONTRACT

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A	MWMCL, MONYWA SITE OFFICE, SALINGYI TOWNSHIP SAGAING REGION	0	1

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EXECUTIVE SUMMARY

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a concept closure plan for the site has been developed which addresses closure and rehabilitation of the following areas:

- Open Pit
- Waste Dumps
- Heap Leach Pads
- Plant, Equipment and Infrastructure
- Process and Stormwater Ponds
- Accommodation Camps

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

In developing the concept closure plan reference has been made to Myanmar regulations as well as international standards, guidelines and best practice including IFC Guidelines, Chinese standards, European Commission 'Best Available Techniques' and Western Australian guidelines.

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;
- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;

- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

The Conceptual Closure Plan presented here allows integration with the design concepts and ensures that the design and operation of the site are compatible with the closure plan. After commissioning a Detailed Closure Plan will be developed.

An outline closure land-use plan has been developed for the site. On closure the open pit will remain as a void with a permanent pit lake. The remaining areas will be rehabilitated to one of four land-use categories, namely:

i. Scrub/grazing
ii. Agriculture
iii. Pond or wetland areas
iv. Landfill

Progressive rehabilitation will be undertaken wherever possible. All equipment and infrastructure will be removed from site unless there is a beneficial use to the community such as buildings or roads.

Due to the potential for long-term environmental pollution, both the waste dumps and heap leach pads are to be covered with low or very low permeability capping systems to reduce infiltration.

Surface water run-off and leachate from waste dumps and heap leach pads will be controlled via a surface water management system that separates clean from potentially contaminated

water, provides settling areas to reduce suspended load prior to discharge, and allows treatment of water which doesn't reach the necessary standards before release from the site.

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that two landfills will be constructed on the site so that wastes are contained within the site boundary. One facility will accept inert/non-hazardous waste whilst the other will be a hazardous waste landfill.

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

Closure costs will be developed concurrent with the Closure Plan and financial provision will be made to ensure that adequate funds are available for final closure.

1. INTRODUCTION

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a closure plan for the site needs to be developed.

Closure and rehabilitation of the following areas will be required:

- Open Pit.
- Waste Dumps.
- Heap Leach Pads.
- Plant, Equipment and Infrastructure.
- Process and Stormwater Ponds.
- Accommodation Camps.

This report presents the concept closure plan for the whole site.

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

The Mine Closure Management Plan will cover the full range of closure events which include:

- Unexpected mine closure (either temporary or permanent);
- Progressive rehabilitation through the life of the mine; and
- Permanent closure.

2. MYANMAR REGULATORY REQUIREMENTS

2.1 EXISTING ENVIRONMENTAL LEGISLATION

Though Myanmar does have some legislation related to protecting people and the environment, the country lacks the necessary adequate administrative and legal structures, standards, safeguards and political will to enforce such provisions. In addition, while Myanmar is party to several international treaties such as the Convention on Biological Diversity (CBD), in the past, Myanmar has not incorporated the provisions contained in these agreements into domestic law. For example, national laws did not require specific environmental and social impact assessments (ESIA) or public participation by local communities in the decision-making processes of large-scale development projects. However, to address the environmental expectations of the laws described below, an ESIA would be required to establish the mechanisms for preventing such actions from occurring. There are no specific laws that comprehensively regulate pollution, no standards to adequately protect biodiversity, develop resettlement plans, or provide compensation. There are, however, the 1995 Community Forest Instructions (CFI), the March 2012 Environmental Conservation Law, the November 2012 Foreign Investment Law, Rules and Notification by Myanmar Investment Commission (2013), Rules of the Conservation of Water Resources and Rivers Law (2013) and the Land Acquisition Act that, if systematically enforced, would improve environmental protection and the land-based rights of local populations. Myanmar became a party to the CBD in 1994. Article 14(1)(a) of the Convention requires an EIA and Article 8(j) mandates indigenous participation where there is a significant impact on biodiversity. Section 54 of the 2012 Foreign Investment Law provides that "If any provision of this Law is contrary with any matter of the International Treaty and Agreement adopted by the Republic of the Union of Myanmar, the matters contained in the International Treaty and Agreement shall be abided by.

2.2 THE ENVIRONMENTAL CONSERVATION LAW 2012 (ECL)

2.2.1 Objectives

The ECL, the landmark law specifically dedicated to address environmental conservation, was enacted:

a) to implement the national environmental policy;
b) to lay down basic principles and provide guidance to systematically integrate environmental conservation matters with the sustainable development works;
c) to build a healthy and clean environment and to conserve natural and cultural heritage for the benefit of current and future generations;

d) to restore the deteriorating and disappearing ecosystem to the fullest extent possible;

e) to enable to manage and implement for the decrease and loss of natural resources and for enabling the benefits of sustainable use;

f) to enable promotion of public awareness and cooperation in the matters of environmental conservation;

g) to enable promotion of international, regional, and bilateral cooperation in the matters of environmental conservation; and

h) to co-operate with the government departments and organisations, international organisations, non-governmental organisations and private individuals on environmental conservation matters.[1]

2.2.2 Current Position

Though the ECL paves the way for the use of EIA and/or SIA in evaluation of issuing a prior permission for prescribed businesses, the prior permission scheme itself is discretionary and there is currently no basis in the law for the Ministry to determine whether or not to issue a permit, and whether to impose environmental compliance conditions on the user. Also, some of the Ministry of Environmental Conservation and Forestry's (MOECAF) broad powers granted under the law require the approval of the Union Government and the Environmental Conservation Council (ECC) but without the clear power and basis of the approval.

There are no regulatory guidelines and rules specified to enable the ECL to be operable in practice: such as setting the environmental quality standards, emission standards, and classes of hazardous waste and substances. In addition, there is a need to cover the non-point sources of pollution that is not discussed in the ECL.

The ECL provides for integration with sectoral policies and co-ordination amongst the Ministries and departments.[2] It is expected that the Environmental Conservation Rules (ECR) of the ECL which is underway would provide regulatory guidelines to implement the ECL.

2.2.3 Obligations of Business Owners and Occupiers

The polluter at source has obligations to clean, discharge, dispose, or keep pollutants in accordance with the prescribed standards[3].

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[1] ECL Section 3
[2] ECL Section 18
[3] ECL Section 14

The owner or occupier of business activities, materials or places that are source of the pollution must install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If this is not possible, it must be arranged to dispose the wastes in accordance with environmentally sound methods[4].

The individuals or organisations carrying on the businesses in the industrial zones, or special economic zones or businesses set by the government ministries have responsibilities to contribute either in cash or in kind and carry out the management of pollutants and environmental conservations including the treatment of wastes collectively[5]; must give the fees for the usage and expenses incurred in connection with management of environmental conservation by the relevant industrial zones, special economic zones and business organisations[6]; and must comply with the environmental conservation directives published by the relevant industrial zone, special economic zone or the business organisations[7].

2.3 FOREIGN INVESTMENT LAW 2012 (FIL)

The FIL, in its Basic Principles, states that the investment shall be allowed based upon principles including “protection and conservation of the environment”[8].

The duties of the investor requires the carrying out of business in a manner not to cause environmental pollution or damage in accord with existing laws in respect of investment business[9].

2.4 NOTIFICATION OF MIC 1/2013

The list of Economic Activities under Prohibition includes:

- Installation of Factory in Myanmar utilizing of the imported wastes
- Manufacturing of hazardous material which are not in compliance with the Environmental and Conservation Law, Rules and Procedures promulgated from time to time.
- Activities which may emit hazardous chemicals, minerals, rays, noise, particles etc., and may cause earth/water/air pollution which affect public health.
- Exploitation of minerals including gold in the revering and water way.

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[4] ECL Section15
[5] ECL Section 16(a)
[6] ECL Section 16(b)
[7] ECL Section 16(c)
[8] Fill Clause 8(l)
[9] Fill Clause 17(h)

The list of Economic Activities Permitted with Specific Conditions includes at No (3) includes Economics activities which required Environmental Impact Assessment.

Exploration and production of minerals, manufacturing of iron, steel and minerals and operation in cultural heritage, archaeological and prominent geographical symbolical sites, etc., all require that it will be allowed subject to the need for Environmental Impact and Social Impact, or Environmental Impact, alone being carried out for initial study of environment.

Clause 37 of the Rules of the FIL states "In order to scrutinize accepted proposals sector by sector, a Proposal Review Group, composed of high ranking officers from the Environmental Conservation Department, is to be formed to perform preliminary scrutiny.

Section 47 states that the Commission shall scrutinise investment proposals in the following manners:

- Scrutinising remarks from the Ministry of Environmental Protection and Forestry on the protection measures of social and environmental impact.

Notification No 1/2013 of MIC dated 29th January, 2013 List of Economic Activities requiring environmental impact assessments:

- Exploration and production of minerals – Depending upon the business activity, to avoid environmental and social impacts, or to minimise environmental and social impacts, it will be allowed only after conducting initial study and assessment upon environmental and social impacts.

2.5 MINES LAW (1994) (MML) AND ASSOCIATED MINES RULES

The Mines Law (1994) aims to protect the environment from mining operations that may be detrimental to conservation of environmental quality.

Section (3) of the Mine Law states the objectives as follows:

- To carry out for the development of conservation, utilisation and research works of mineral resources;
- To protect the environmental conservation works that may have detrimental effects due to mining operations.

Under duties of the holder of Permit, it is stated that the holder of permit shall comply with the rules prescribed under this Law in respect of the following matters:

- Making provisions for safety and the prevention of accidents in a mine and their implementation;

- Making and implementation of plans relating to the welfare, health, sanitation and discipline of personnel and workers in a mine;
- Making provisions for the environmental conservation works that may have detrimental effects due to mining operation;
- Reporting of accidents, loss of life and bodily injury received due to such accidents in the mine; and
- Submission to the inspection of the Chief Inspector and inspectors[10].

Rules 69 to 73 govern the rights of utilisation of land and water for mineral production which includes the provisions of the responsibility of the mineral permit holder so that there is no pollution of the environment due to the use of land and water.

The holder of a mineral exploration permit or a mineral production permit must backfill or otherwise make safe bore holes, excavations, surface of land damaged during the course of underground mining operations to the satisfaction of the Ministry or the Department. The holder must also establish forest plantations or pay compensation to the Ministry of Forestry, if trees were cut and cleared for mineral exploration or mineral production within a forest land or in a land area covered with forests.

In disposing of liquids, wastes, tailings and fumes which have resulted from mineral production, the holder of a mineral production permit must undertake laboratory tests as may be necessary for the prevention of pollution of water, air and land in the environment and for the safety of living beings. If toxic materials are found in the waste products, which are harmful to living beings, degradation shall be made by chemical means and systematic disposal shall be made only when it is assured that there is no danger.

The holder of a permit for mineral production within an area under the Ministry's administrative control or which does not lie within the Mineral Reserve Area or Gemstone Tract, shall carry out such production only after co-ordinating and receiving agreement from the individual or organisation having the right of cultivation, right of possession, right of use and occupancy, beneficial enjoyment, right of succession or transfer of the said land[11].

Chapter XXI of the Myanmar Mining Rules (MMR) describes "making provisions to prevent detrimental effects due to mining operations on the environmental conservation works". The requirements include:

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[10] MML Section 13
[11] MML Section 14

- Backfilling or making safe bore holes, excavations or surface of the land damaged during the course of underground mining[12]; and
- Undertaking laboratory tests, as necessary, to prevent pollution of water, air and land[13].

2.6 ENVIRONMENTAL POLICIES

A national environmental policy was drafted by the NCEA in 1994. The National Environment Policy is as follows:

"To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources."

The objective of Myanmar's environmental policy is aimed at achieving harmony and balance between people, the environment, heritage and natural resources through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilise its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations.

The development of the environmental policy was followed by the drafting of 'Myanmar Agenda 21' in 1997, which follows a UN framework for a multi-pronged approach to sustainable development. The Myanmar Agenda 21 recognises the need for Environmental Impact Assessments. Myanmar, in its Agenda 21, calls for integrated management of natural resources and provides a blueprint for achieving sustainable development.

The ECL provides more institutional space to regulate environmental quality and conduct EIA's and SIA's for infrastructure and investment projects funded by the government and private sector.

[12] MML Section 105
[13] MML Section 106

2.7 MYANMAR INVESTMENT COMMISSION (MIC)

The MIC issued a Notification on 30 June 1994 on Protection of Environment stating that:

1. The Myanmar Investment Commission, at its meeting 8/94 held on 17 June 1994 has resolved that all projects established with the permission of the Commission shall be responsible for the preservation of the environment at and around the area of the project site. The enterprises are entirely responsible that they shall be able to control pollution or air, water and land, and other environmental degradation, and that they can keep the project site environmentally friendly.
2. Consequently, it is hereby notified that treatment plant, industrial waste water treatment plant and other pollution control procedures should be promptly implemented and abide with the sanitary and hygienic rules and regulations set by the authorities concerned.
3. In the future proposals that are to be submitted to the Commission, either under the Union of Myanmar Foreign Investment Law or the Myanmar Citizens Investment Law, shall incorporate the provision in their contracts that they shall undertake proper sewage and industrial wastewater treatment systems and other environmental control systems. The system so used shall be in accordance with the rules and regulations specified by the respective development committees and local authorities.

3. INTERNATIONAL GUIDELINES AND STANDARDS

3.1 GENERAL

In addition to adherence with applicable local legal obligations, Letpadaung is committed to conducting project mine closure and reclamation activities in line with international good practices. Relevant standards and guidelines consulted during the development of the Letpadaung Concept Closure Plan are outlined below.

3.2 INTERNATIONAL FINANCE CORPORATION GUIDELINES

3.2.1 General

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines relevant to the Letpadaung project comprise general environmental guidelines as well as mining-specific guidelines.

3.2.2 Environmental

IFC EHS General Environmental Guidelines[14] include a number of sections relevant to closure and rehabilitation of the site. These sections include:

- Waste Water and Ambient Water Quality.
- Waste Management.

Relevant best practice recommendations from these guidelines include:

- Plan and implement the segregation of liquid effluents in order to limit the volume of water requiring specialized treatment.
- Assess compliance of wastewater discharges with the applicable discharge standards.
- Establish waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences.
- Where waste cannot be recovered or reused, it should be treated, destroyed, and disposed of in an environmentally sound manner.
- Where offsite disposal in not possible, facilities should be constructed that will provide for the environmental sound long-term storage of wastes on-site.

[14] Environmental Health & Safety Guidelines: Environmental, International Finance Corporation

3.2.3 Mining

IFC EHS Guidelines for Mining[15] include the following best practice recommendations for mine closure:

- The Mine Reclamation and Closure Plan should incorporate both physical rehabilitation and socio-economic considerations.
- Preparation of a Mine Reclamation and Closure Plan in draft form prior to the start of production with annual updates during the mine life.
- Finalise the plan during the last five years of forecasted operations.
- The Mine Reclamation and Closure Plan will be designed so that:
  - Future public health and safety are not compromised;
  - The after-use of the site is beneficial and sustainable to the affected communities in the long term; and
  - Adverse socio-economic impacts are minimised and socio-economic benefits are maximised.

The Mine Reclamation and Closure Plan will clearly identify allocated and sustainable funding sources to implement closure at any stage in the mine life including the provision for early or temporary closure. Funding should be by either cash accrual or a financial guarantee.

Closure and post closure plans will include appropriate aftercare and continued monitoring of the site, pollutant emissions, and related potential impacts. The duration of post closure monitoring will be defined on a risk basis. However, site conditions typically require a minimum period of five years after closure or longer.

3.3 CHINESE STANDARDS

In preparing this closure plan, reference has been made to the Code for Waste Dump Design of Nonferrous Metal Mines[16]. The standard is assumed to apply to waste dumps and heap leach pads as well as application of general principles to overall site closure. Amongst others, it requires that:

- The reclamation plan for the waste dump be prepared at the same time as the waste disposal plan;

[15] IFC (2007). Environmental Health & Safety Guidelines for Mining, International Finance Corporation, 10 December 2007

[16] Code for Waste Dump Design of Nonferrous Metal Mines (2007). National Standard of the People's Republic of China, GB 504421-2007. Implemented 01 October 2007.

- The final landform be in keeping with the local natural environment with vegetation coverage no less than the original coverage;
- The end land use of arable or agricultural land be the main priority;
- Slopes be slackened appropriately for stability, development and utilisation of the site;
- Reclamation be completed within three years of completion of waste disposal (one year for engineering and two years for habitat/vegetation establishment);
- The design shall include measures to prevent waste residue, dust and water pollution influencing the environment; and
- Waste dumps containing heavy metals, sulfides or other toxic soluble waste shall have waterproof and leakproof measures to prevent release of contaminants to the environment.

3.4 EUROPEAN COMMISSION BEST AVAILABLE TECHNIQUES (BAT)

The European Commission Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities (January 2009) provides details of current good practice relating to waste rock management. Recommendations relevant to the Letpadaung project include:

- The site should be designed for closure. This implies that the closure of the site is taken into account in the feasibility study of a new mine site and is then continuously monitored and updated during the life cycle of the mine.
- Closure costs are included in the assessment of alternatives.
- Facilities are designed to facilitate premature closure if necessary.
- After-care design should minimise the need for active management.
- Life-cycle management: A reduction of the risk of any failures can be assisted by a commitment of the operator to the adequate and rigorous application of appropriate available engineering techniques for the design, operation and closure of tailings and waste rock management facilities over the entire period of their operating life. Some tools elemental to good engineering are the establishment of an environmental baseline, the characterisation of tailings and waste-rock, the use of dam safety manuals and audits, as well as applying planning for closure from the outset.
- Upon closure, ARD generating .waste-rock heaps should be covered with engineered dry covers that aim to prevent ARD generation.

- Progressive restoration/revegetation: Heaps and dams are often restored/revegetated during operation. Amongst other advantages, this allows a shorter closure period.
- Development of a monitoring plan that includes inspections and audits.

3.5 WESTERN AUSTRALIA MINE CLOSURE GUIDELINES

The Guidelines for Preparing Mine Closure Plans, produced by the Government of Western Australia (June 2011) provide further good practice guidance. Recommendations include:

- At all stages, from the project approval stage onwards, the Mine Closure Plan should demonstrate that ecologically sustainable mine closure can be achieved consistent with agreed post-mining outcomes and land uses, and without unacceptable liability.
- Planning for mine closure should be fully integrated in the life of mine planning, and should start as early as possible and continue through to final closure and relinquishment. For new projects, closure planning should start in the project feasibility stage (before project approvals).
- Mine closure plans must be site-specific. Generic “off-the-shelf” closure plans will not be acceptable.
- Closure planning should be risk-based taking into account results of materials characterisation, data on the local environmental and climatic conditions, and consideration of potential impacts through contaminant pathways and environmental receptors.
- Consultation should take place between proponents and stakeholders which should include acknowledging and responding to stakeholder’s concerns. Information from consultation is central to closure planning and risk management.
- Post-mining land uses should be identified and agreed upon through consultation before approval of new projects. This should take into account the operational life span of the project, and should include consideration of opportunities to improve management outcomes of the wider environmental setting and landscape, and possibilities for multiple land uses. For existing mining projects, post-mining land uses should be agreed as soon as practicable.
- Characterisation of materials needs to be carried out prior to project approval to a sufficient level of detail to develop a workable closure plan. This is fundamental to effective closure planning. Characterisation of materials should

include the identification of materials with potential to produce acid, metalliferous or saline drainage, dispersive materials, fibrous and asbestiform materials, and radioactive materials, as well as benign materials intended for use in mine rehabilitation activities.

- Closure planning should be based on adaptive management. Closure plans should identify relevant experience and research, and how lessons learned from these are to be applied.
- Closure plans should demonstrate that appropriate systems for closure performance monitoring and maintenance, and for record keeping and management are in place.

4. CLOSURE CONSIDERATIONS

4.1 DEFINITIONS

For the purposes of this closure plan, the following terminology has been adopted:

CLOSURE – Life of mine process which culminates in tenement relinquishment. It includes decommissioning and rehabilitation.

DECOMMISSIONING – The process that begins near, or at, the cessation of mineral production and ends with the removal of all unwanted infrastructure and services.

REHABILITATION – The return of disturbed land to a stable, productive, and self-sustaining condition.

RELINQUISHMENT – Formal approval by the regulating authority that completion criteria have been achieved.

4.2 CLOSURE PRINCIPLES

Current good mining practice suggests that mine planning should be undertaken with mine closure at the forefront of consideration. Some key principles and elements related to mine closure include:

- Integrate sustainable development considerations within the corporate decision-making process,
- Plan, design, operate and close operations that enhance sustainable development;
- Implement risk management strategies based on valid data and sound science,
- Consult with interested and affected parties in the identification, assessment and management of all social, health, safety, environmental and economic impacts associated with closure activities, and
- Inform potentially affected parties of significant risks from mining, minerals and metals operations and of the measures that will be taken to manage potential closure risks effectively;
- Seek continual improvement in environmental performance,
  - Assess the positive, negative, indirect and cumulative impacts of new projects from exploration through closure,
  - Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses, and
  - Design and plan all operations so that adequate resources are available to meet closure requirements of operations;

- Contribute to the social, economic and institutional development of the communities in which the project operates,
- Contribute to community development from project development through closure in collaboration with host communities and their representatives; and,
- Implement effective and transparent engagement, communications and independently verified reporting arrangements with stakeholders.

4.3 SHORT-TERM OBJECTIVES

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

4.4 LONG-TERM OBJECTIVES

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;

- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;
- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

As part of the closure plans, a set of rehabilitation standards will be developed and agreed with the relevant authorities, which when achieved will demonstrate successful rehabilitation. They will be inclusive of legislative requirement, recognitions of final land use requirement and quantified through consultation with relevant stakeholders.

4.5 SOCIAL CONSIDERATIONS

During development of the closure plan, consideration should be given to the impact that the scheme will have on the local population. Issues to be addressed include (DITR, 2006b):

- Ensuring future public health and safety of the community is not compromised;
- An early and effective communication strategy should be established and the community engaged throughout the life of the operation, including through decommissioning and closure;
- Community development should include strategies for sustaining the socio-economic state of the community without the support of the mine;
- Develop capacity to maintain certain infrastructure services and facilities for future community or local government ownership or as part of arising business development opportunities;

- Provide appropriate skills transfer and employment opportunities through the development of local business enterprises;
- Community development should be driven by the needs of the community with the aim of contributing to the building of the long-term strength of community viability; and
- Develop the formal and informal processes, systems, structures and relationships within the community that actively supports the capacity of current and future generations to create a range of healthy and liveable communities.

It should be noted that consultations have not yet commenced but will be undertaken in later stages of the feasibility design. The concept closure plan presented here provides an engineered solution for land use that has been adopted on similar schemes elsewhere. Refinement of the design will be completed following the consultation process.

4.6 PRE-CLOSURE STUDIES AND CONSULTATIONS

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

4.7 DEVELOPMENT OF THE CLOSURE PLAN

A dynamic rehabilitation plan will be developed which has the flexibility to evolve as results from investigations, research, on-site trials and detailed mine planning become available. The development schedule for the closure plan will consist of the following stages:

1. The Conceptual Closure Plan will be prepared during the design stage (this report). This will allow integration with the design concepts and ensure that the design and operation of the site are compatible with the closure plan.
2. After commissioning the Detailed Closure Plan will be developed which incorporates the following:

a) A closure plan for each specific area / type of facility and structure on site.

b) Rehabilitation completion standards for approval with the regulators.

c) Testing program for assessment of short term and long term physical and chemical stability of waste dump and heap leach materials.

d) Rehabilitation trials to assess the viability of the closure concept plan.

e) Progressive rehabilitation plans for areas of the site which are no longer required for the ongoing operation.

3. During mine operation the closure plan will be updated every five years based on the results of the testwork programme and the changes in the operation and mine planning.

4. A minimum of five years before closure of the mine, a Final Closure Plan will be developed and approved with the regulators.

Key activities that will be undertaken to develop the Plan include:

- **Options workshops**: to identify closure options and develop a strategy to identify and develop the preferred closure option taking into account social, environmental and economic implications;
- **Risk assessment workshops**: to identify risks associated with the preferred closure option(s) and to develop a mitigation programme to manage risks to acceptable levels;
- **Closure cost estimation**: to develop an estimate of mine closure costs, including the construction, demobilisation, demolition, removal and remediation of all plant facilities as well as all other ongoing remediation activities.

An outline of the level of detail to be included in the closure plan in relation to the time before closure works commence is provided in Table 4.1 (Government of WA Guidelines for Closure Plans).

Table 4.1: Anticipated level of closure detail

Life of Mine	Post-mining Land use	Identification and Management of Key Environmental Issues	Closure Outcomes	Closure Costing	Closure Implementation and Monitoring Plans
Long term (25+ years)	Provisional targets unless agreed to by all key stakeholders as being final	High risk components completed	Indicative except for high risk operations	Indicative	Preliminary except for high risk operations
Medium term (10 to 25 years)	Well advanced	Completed	Well advanced	Increased accuracy	Well advanced
Short term (Up to 10 years)	Well advanced to Completed	Completed	Well advanced to Completed	Accurate	Completed
Existing operations	Determined on a case by case basis depending on mine life and risk	Completed	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk

5. CONCEPTUAL CLOSURE DESIGN

5.1 OVERVIEW

The following sections describe the conceptual design for the key physical elements of the mine site. The closure concepts for each component are based on the best engineering interpretation of the data available currently with verification of the assumptions to be part of the ongoing closure plan testing program.

A closure land-use plan is provided as Figure 5.1 which shows the principal mine areas and proposed final land-uses.

5.2 TOPSOIL RECOVERY

As part of the site clearance and preparation prior to construction of the mine, topsoil and other suitable subsoils will be recovered from all areas to be disturbed with sufficient volume recovery to ensure effective rehabilitation of the site on closure. The soils will be stockpiled at various locations around the site and will be protected throughout the mine life. The recovery and storage of the soils will conserve valuable nutrients and enhance the future viability of native seed and micro-organisms. As such efficient recovery and management of the resource is critical to rehabilitation.

Initial assessments of ground conditions suggest that some 7 Mm^3 of topsoil and subsoil can be recovered from the disturbed footprint of the mine with an average thickness of 400 mm. The stockpiles will have a maximum height of 4 m which is a balance between optimising storage volumes whilst trying to maintain low stockpile heights which assists with preserving viability of the soils. Preliminary stockpile locations are shown on Figure 5.1.

5.3 OPEN PIT

5.3.1 General

The key factor in closure of the open pit is the maintenance of the safety of the public and the environment.

The key risks are:

- Steep sloping side walls of the pit;
- Collapse of sides and creation of zones of instability; and
- Accumulation of water in the pit which will generally be of poor water quality due to acid rock drainage and accumulation of metals and salts in the water associated with evaporation and/or changes in water chemistry.

The closure design will ensure that the risk of harm to humans, fauna or domestic animals is reduced as far as reasonably practicable. Measures will also be included to reduce the likelihood of contamination of groundwater or surface water by the mine pit after closure.

5.3.2 Post-Closure Land-Use

The mine pit will be partially backfilled during the later stages of operation as waste rock from one section of the pit is placed in other sections where resources have been fully exploited. It is not practical to completely backfill the pit and a void will be left on completion of mining operations.

Due to the potential for acid generation in the pit walls and waste rock within the pit, it is proposed that the pit be flooded to reduce oxygen exposure to the potentially reactive rock.

The mine pit area will not have a post-closure use other than to act as a sump for potentially contaminated contact surface run-off from the site. Some non-contaminated water from the waste dump areas may also be routed to the pit in order to maintain pit lake levels sufficiently high to reduce acid generation in the base of the pit.

5.3.3 Decommissioning and Reclamation

On closure, all equipment will be removed from the Open Pit and any areas with a high risk of ongoing instability will be backfilled and/or re-profiled. Access to the pit will be blocked at the access ramps.

The dewatering system will be decommissioned and the Open Pit will be allowed to fill with inflows from direct rainfall, runoff from pit walls, groundwater inflows, and surface water inflows from the upslope catchment areas which will include potentially contaminated contact water from the waste dumps.

An abandonment bund wall, constructed of NAF mine waste to a minimum height of 2 m, will be constructed around the full pit perimeter outside of the area of potential future instability in order to restrict access to the pit. Warnings signs will also be installed.

5.3.4 Water Management

The pit lake will be managed through a combination of adjusting surface run-off inflows and evaporation areas to ensure acid-generating materials are continuously below the waterline and not subject to oxidation whilst also maintaining the pit lake water levels below the pit rim baseline groundwater level to reduce seepage to local groundwater.

Surface water discharges from the Open Pit will be prevented in perpetuity unless the water is demonstrated to be consistently of a suitable quality for release.

Pit Lake water quality will be monitored after closure, and any requirements for passive or active water treatment of Pit Lake inflows will be determined according to water use objectives.

5.4 WASTE ROCK DUMPS

5.4.1 General

The waste rock dumps (WRDs) will be constructed during operations to provide structures which are safe and stable whilst also providing landforms that are appropriate for rehabilitation and the final land use. Due to the significant quantities of PAF waste that will be produced from the pit, the dumps will be constructed to encapsulate the PAF waste concurrent with mining and also allow progressive rehabilitation of the dumps.

It is noted that geochemistry evaluations have not yet been fully completed and therefore the concepts presented herewith are based on the available data which suggest a significant potential for acid generation and metals leaching.

5.4.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the WRDs compared to the surrounding topography combined with minimal flat areas and low rainfall experienced in the area are unlikely to make the WRDs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.4.3 Decommissioning and Reclamation

The waste rock dumps will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H. Some reprofiling may be required to reduce slope angles to enable effective rehabilitation and for the slopes to be grazed by animals. This will be confirmed during detailed design. The outer walls will be finished with a cover system (described below).

The top of the waste rock dump will be shaped to shed water to drainage channels located on the final top surface that direct flows to drop drains. The benches of the waste rock dump will be graded to direct water also to the drop drains. The drop drains will be lined with heavy fresh benign NAF rock with drain stop boards constructed every five metres down the slope to control the flow speed of the water down the slope. At

the base of each drop drain an energy dissipater and sediment trap with the capacity to hold runoff from a 1 in 10 year storm of 1 hour duration will be constructed to control flows and contain runoff prior to release to the general site surface water management system.

After all the batter slopes have been covered, they should be seeded/planted with a mixture of local grass seed and the seeds or plants of shrubs and trees local to the area.

The rehabilitation of waste rock dump batters should occur progressively during the mining process, after each berm is established and the outer walls shaped, to enable the success of the rehabilitation techniques to be reviewed and refined. This will allow a fully developed and assured method of revegetation and batter treatment, as well as drainage structures, to be developed and minimise the level of maintenance required after closure works are complete.

5.4.4 Cover System

Cover systems are an integral design component for the successful reclamation and closure of the Project. At the surface of the cover system, direct precipitation will either run off the cover, be removed through evapotranspiration or infiltrate into the active zone. Water that infiltrates is typically stored in the active zone and can exfiltrate to the surface and evaporate. A portion of the water that infiltrates can also percolate into the underlying waste, which is intended to be reduced by the placement of the cover system. The objectives of the cover systems considered for the Project include:

- Physical stabilization to provide dust and erosion control, particularly wind and water erosion of waste materials, and to act as a barrier to prevent direct contact of the waste by flora and fauna
- Chemical stabilization through control of oxygen or water ingress; and contaminant release control through reduced infiltration, and
- Meeting land use objectives and other societal values by providing a growth medium for establishment of sustainable vegetation; and reclaiming the area for post-closure land uses.

A combination of cover system efficiency and saturation conditions can help to reduce oxygen ingress and the subsequent oxidization of waste materials which typically results in ARD production.

The proposed cover system concept aims to maximize use of the climate, cover material characteristics, cover material availability, hydrogeologic setting and waste

material physical properties to minimize potential effects related to the waste material chemical properties.

In consideration of the anticipated chemistry of the waste rock combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses, a low Infiltration cover system (50-90 % reduction of net infiltration) is proposed for the WRDs in order to reduce the risk of acid generation in the waste dumps and the associated release of low-pH leachate to the environment. Release of solubilised heavy metals will also be reduced.

A low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-8} m/s would be required to construct a cover system capable of reducing net infiltration to approximately 50 to 90% of the infiltration rate expected for a bare surface. Considering the characteristics and availability of materials on site, the cover system would be constructed from a minimum 1 m thick compacted low permeability soil layer, overlain by a 2 m thick gravelly store and release layer, and finished with a re-vegetated subsoil/topsoil layer some 400 mm thick comprising 250 mm of subsoil over which 150 mm of topsoil is place. A typical section through the cover system is provided on Figure 5.2.

Additionally, prior to placement of the cover system, some localised grading may be required to promote positive surface drainage thereby minimizing the likelihood of standing water and saturation of the materials in the cover system. Sloped areas must be protected from surface erosion through re-vegetation and development of drainage structures, to reduce infiltration and to prevent breakthrough of flow into the underlying tailings.

It is anticipated that the low permeability materials and the store and release layer will be sourced from overburden strip from the mine pit during operations. Alternatively borrow areas may need to be established if insufficient material is available locally and/or mine scheduling isn't compatible with the waste dump construction.

5.4.5 Water Management

A surface water management system will be progressively established concurrent to waste dump development. Major flowpaths are shown on Figure 5.1. Provision is made in the design for separate systems to manage non-contaminated contact water and potentially contaminated contact water. Non-contaminated contact water will be suitable for release into watercourses downstream of the site following basic settling to reduce suspended sediment loads. Potentially contaminated contact water will be directed initially to the mine pit dewatering system and, once the pit is

decommissioned, the water will flow to the pit lake to prevent release of the potentially-contaminated water to the wider environment.

Runoff and drainage water from the waste dumps will be analysed during the closure phase to determine the water quality characteristics. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated, while seepage from the waste rock may be of poorer quality. If water treatment is found to be necessary, a suitably designed passive water treatment wetland system will be designed to enable improvement of water quality to be undertaken prior to release into the environment.

5.4.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.5 HEAP LEACH PADS

5.5.1 General

The heap leach pads (HLPs) will contain acid-generating material as well as residual acidity from the leaching process. The HLPs must be closed and rehabilitated in such a way that the waste is not exposed to the environment and that infiltration of water is reduced to a level where long-term leachate generation is negligible.

The HLPs should also be reshaped to provide landforms that are stable in the long-term and do not pose a hazard to personnel undertaking rehabilitation or the local population post-closure.

5.5.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the HLPs compared to the surrounding topography combined with the low rainfall experienced in the area are unlikely to make the HLPs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.5.3 Decommissioning and Reclamation

Once all viable resource has been recovered from the HLPs, the pads are to be flushed with fresh water to reduce the amount of free acid in the heaps.

The principal aspects of the outline HLP closure are:

- Perimeter slopes to be reshaped to a grade that ensures long-term stability and that is appropriate for machinery to safely operate during the rehabilitation and future maintenance works.
- Surplus material is to be placed as fill between HLP 1 and 2 to infill the valley and create a single large landform for rehabilitation.
- Final top surface to be reshaped to provide positive drainage to the closure surface water management system.
- Placement of an appropriate cover system to reduce infiltration into the HLPs and provide a growing medium suitable for rehabilitation.
- Revegetation of the closure surface.

The reshaping and filling exercise is illustrated on Figure 5.3.

5.5.4 Cover System

In consideration of the anticipated chemistry of the HLP material on closure, combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses very low infiltration cover systems (>90 % reduction of net infiltration) are proposed for the HLPs. Reducing infiltration into the heaps will reduce further acid generation and quantities of leachate produced.

A very low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-9} m/s would be required to construct a cover system capable of reducing net infiltration to greater than 90% of the infiltration rate to be expected for a bare waste rock surface.

The main elements of the cover will be:

- Low permeability soil (1 m thick) or synthetic liner to prevent ingress of water;
- Protective fill layer (0.6 to 1.5 m thick depending on liner system adopted) which may also act as ‘store and release’ capping;
- Topsoil to allow revegetation (approximately 400 mm).

The cover options are illustrated in Figure 5.2. Studies into the most appropriate cover system shall be undertaken during the operational phase of the mine. Considerations in the studies will include availability of suitable fill materials.

5.5.5 Water Management

The HLPs should be reshaped to positively drain all run-off to perimeter channels that convey the non-contaminated contact water to the site surface water management system with subsequent release in to watercourses downstream of the site.

Any leachate generated from the heaps will be routed into a closed (potentially-contaminated contact water) system for treatment prior to release. During initial drawdown, the leachate will be passed through the process plant to ensure that the water quality is suitable for discharge. Once the drawdown phase is complete and leachate quantity and quality have reduced to manageable levels, leachate will be passed through passive treatment systems to render the water suitable for release.

The passive treatment systems will be developed during operations when leachate chemistry is better understood. Possible options, which may be combined, include sediment control, wetlands, or limestone-filled ‘polishing’ channels.

5.5.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with grasses and small native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.6 PLANT, EQUIPMENT AND INFRASTRUCTURE

5.6.1 General

All plant, equipment and infrastructure on the site shall be recovered, removed and re-used wherever possible. The primary objective is to ensure the site is safe and does not generate hazards for the community.

As a general rule, where facilities are of no use to the community:

- All structures shall be removed;
- All waste shall be buried at least three metres below a finished surface;
- Concrete should be broken up and buried;
- All batters should be flattened to at least a 1V:4H slope for public safety;
- All areas should be ripped, scarified, topsoiled and then seeded to encourage a vegetated cover, unless otherwise agreed with the local community.

5.6.2 Post-Closure Land-Use

Buildings on the site should be made available to the local community, if they have no value and cannot be economically removed and re-used elsewhere. Such opportunities can assist communities to adjust the socio-economic effects of closure and allow the development of new enterprises and provision of alternative local employment.

Where practicable, areas that are rehabilitated will be returned to the pre-mine land use. Discussions may be held with regulatory agencies and stakeholders to determine

the potential to create small water storage structures to improve water availability for post-closure land use in agriculture and livestock rearing.

The future of any water supply bores associated with the project should be discussed with local authorities and the community. The presence of a water supply may provide much needed infrastructure to the community as well as providing commercial and industrial opportunities which are not currently available, due to the cost of establishing such facilities. Transfer of these assets to the community may also offset some of the socio-economic losses that arise due to closure of the mine.

5.6.3 Decommissioning and Reclamation

All process tanks, pipes and water lines should be flushed free of any solids or residual fluids prior to removal. Materials that constituted these facilities should be recovered for reuse or recycling or otherwise buried at least three (3) metres deep within the site. Opportunities for burial may arise in some of the process water ponds to be closed.

All fixed and mobile equipment with marketable value will be removed from site and sold. Equipment that cannot be sold or is deemed to be hazardous will be disposed of in an appropriate manner.

Fuels and lubricants will be required during the closure phase. Additional fuels will only be provided on an as-needed basis to reduce the materials remaining on site. Fuels remaining at the end of the active closure phase will be returned to the original supplier or possibly sold to a third party user. Fuel storage tanks and associated pipework should be recovered for reuse or recycling or otherwise be disposed of as hazardous waste.

Unused explosives and detonation devices stored on site will be checked for condition and either returned to the supplier for credit, shipped to another third party user, or destroyed through appropriate procedures. In all cases the explosives will be handled, transported and disposed of in compliance with the appropriate legislation. The explosives magazines will be returned to the supplier or to a third party.

During the initial closure stage, power generation requirements will be reduced and only those generators required for on-going activities will remain operational. Excess generators will be removed from the power plant and poles and distribution lines will be salvaged or buried in a landfill. At the end of the closure phase when the mine no longer has any power requirements, the remaining generators will be removed from the site and the remaining poles distribution lines will be salvaged or buried in the landfill.

Roads required for access during the rehabilitation phase and for post-closure monitoring and maintenance will be left in place. After these roads are no longer

required for Project use, they will be left in place for use by local communities. Site roads not needed for the closure works will be broken up, resoiled and re-vegetated unless the local communities would prefer that the roads are left in place.

Where buildings and structures are to be removed, they should be demolished with reusable or recyclable waste removed from site. Rubble and other inert waste can be buried in designated locations at least three (3) metres below final ground surface. Any contaminated soils will be treated and disposed of appropriately. Hazardous waste is to be disposed of in an on-site hazardous waste facility.

Reuse of items, such as HDPE pipe, should be considered as part of the closure plan. HDPE pipe, for example, can be used as fence posts for barricading areas with public safety issues or used as posts for fencing associated with local cropping and grazing activities.

5.6.4 Water Management

Following demolition, the disturbed areas will be shaped to prevent ponding of water and to provide positive drainage into the site surface water management system.

5.6.5 Waste Management

Reusable or recyclable waste should be removed from site. Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.6.6 Rehabilitation

Disturbed areas will be reshaped for drainage, topsoil applied and will then be re-vegetated using grass and shrub species native to the region to encourage vegetation to re-establish in the area.

5.7 PROCESS AND WASTE WATER PONDS

5.7.1 General

There are a number of ponds located to the east and south east of the site. These include HLP stormwater ponds, process water ponds and surface water stormwater ponds. It is proposed that these ponds be used on closure for treatment of run-off and storage of wastes.

5.7.2 Post-Closure Land-Use

Uses of the former ponds include:

- Settling ponds for uncontaminated surface run-off water to reduce sediment loads prior to discharge off site.

- Wetlands and/or polishing ponds for the passive treatment of water with low levels of contamination prior to discharge.
- HDPE-lined ponds to be utilised for the construction of a hazardous waste landfill to store decommission wastes.

Any pond areas not required for the above uses should be infilled and returned to agricultural use.

5.7.3 Decommissioning and Reclamation

Process and waste water ponds shall be completely drained until only residual solids/sludge are present.

Once drained, any residual sludge is to be sampled and tested. Sludges which are considered 'hazardous' should be disposed of in the site hazardous waste landfill. Inert or non-hazardous wastes will either be disposed of in an appropriate storage area or, if physical and chemical characteristics are suitable, be used as fill in the reclamation process.

The pond base will then be prepared according to the final end use. Any HDPE liner, or similar, where not required will be removed and disposed of. Clay liners for ponds will be retained unless the area is to be used for agriculture in which case the liner will be ripped prior to backfilling to promote through drainage.

Where ponds are to be retained as ponds or wetlands, hydraulic control structures will be built to control flows in and out as well as retained water levels.

5.7.4 Water Management

The former pond areas will be used to manage run-off water from the site with collection channels routed to the pond areas. Hydraulic control structures will be constructed as necessary to maintain or prevent ponding of water.

5.7.5 Waste Management

Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.7.6 Rehabilitation

Disturbed areas will be reshaped where necessary for drainage, topsoil applied and will then be re-vegetated. Wetland areas will either be re-vegetated with reed beds or, if water chemistry is acceptable, be provided to the local community as rice paddies. Areas designated for agriculture should be handed over to the local community to vegetate.

5.8 SURFACE WATER MANAGEMENT

5.8.1 Routing

At closure, contaminated mine contact water will continue to be allowed to drain to the open pit, and non-contaminated water will be directed to the surrounding natural aquatic environment. Diversion and collection ditches that are no longer required will be decommissioned (backfilled) and re-vegetated. In general, collection ponds accepting non-contact water will be reclaimed through re-vegetation and allowed to collect and store water for use by the local communities. Collection ponds accepting mine contact water will not be decommissioned directly after closure, and will continue to function to direct mine-contact water into the Pit.

The operational surface water management system will be adjusted to convey flows generated by the closure land forms and land uses.

It is envisaged that the majority of run-off generated post closure will be uncontaminated and will only require settlement to reduce suspended loads prior to discharge. It is the intention that as much water as possible is returned to the surrounding environment. However there is provision in the design to direct some of the run-off water to the open pit. A pit lake will need to be maintained to reduce acid generation in the pit walls and buried waste. If the detailed hydrogeological modelling, and/or experience on site, shows that recharge of the pit lake is insufficient to maintain appropriate water levels then run-off from Waste Rock Dump 1 can be directed to the pit.

An outline design for surface water routing is provided on Figure 5.1.

5.8.2 Chemistry

It is envisaged that during initial stages of HLP drawdown, a substantial volume of contaminated leachate will still be produced by the heaps. The process plant, potentially with adaptions, will be used to treat this water until concentrations reach a level where other, less onerous, treatment options can be successfully adopted.

Runoff collected in the collection ponds will be analysed in the closure phase to determine if water quality characteristics meet applicable standards. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated. When water quality meets acceptable standards, the mine contact collection ponds will be backfilled and re-vegetated.

Where surface run-off and/or leachate from areas such as the waste rock dumps and heap leach pads is not suitable for release then treatment systems should be implemented.

The first level of treatment is sedimentation through sedimentation ponds or wetland areas to reduce the suspended load. In many cases this is likely to be sufficient to improve the water to meet the relevant release criteria.

Water treatment methods used to eliminate or reduce acidity and heavy metals precipitation from impacted waters can be grouped into two types: (1) active and (2) passive treatment:

Active treatment involves neutralising acid-polluted waters with alkaline chemicals. However, the chemicals can be expensive and the treatment facility is expensive to construct and operate.

Passive treatment involves the construction of a treatment system that employs naturally occurring chemical and biological reactions that aid acid rock drainage treatment and which require little maintenance. Passive control measures include anoxic drains, limestone rock channels, alkaline recharges of groundwater, and the diversion of drainage through man-made wetlands or other settling structures.

There is also a possibility to combine active and passive treatment techniques (e.g. liming and constructed wetlands)

An evaluation of water chemistry, potential environmental impacts, and whether or not water treatment will be required will be undertaken as part of the ongoing closure planning during the mine life. If necessary the design will be updated to include additional water treatment.

5.9 WASTE MANAGEMENT

5.9.1 Waste Streams

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

Waste generated by the decommissioning and rehabilitation of the site will be one of three different categories of waste:

Inert Waste. This is waste which is neither chemically or biologically reactive and will not decompose. It includes concrete, bricks and uncontaminated sediment/sludge from stormwater ponds.

Non-Hazardous Waste. This is waste which is not inert but does not have properties that pose a substantial threat to public health or the environment (and therefore

classifies as hazardous waste). Types of waste will include plastic liner, plastic pipes, metals, and timber.

Hazardous Waste. This is waste that poses substantial or potential threats to public health or the environment by exhibiting one or four of the following properties:

i. Ignitability

ii. Reactivity

iii. Corrosivity

iv. Toxicity

Hazardous wastes are likely to include fuels, oils, contaminated soils and sludges, and components of equipment and machinery.

5.9.2 Hierarchy of Waste Management

Waste generated from the decommissioning activities will be managed to reduce the environmental impact. MWMCL will seek to treat the wastes in the following order of priorities:

i. Reuse

ii. Recycle

iii. Dispose

If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that landfills will be constructed on the site so that wastes are contained within the site boundary. Disposal options are discussed in more detail below.

5.9.3 Disposal Options

Two landfill facilities will be constructed to handle decommissioning wastes. An inert and non-hazardous facility will be constructed on the western side of Waste Rock Dump No. 3. The facility will be constructed in cells to separate different types of waste

and also to reduce the exposed tip head to a manageable size. The waste will be regularly covered with a soil cover to reduce dust generation. On completion the whole landfill will be capped with a 1 m thick low permeability soil cover, 2 m of store and release fill and finished with topsoil. The cover will be shaped to shed water.

The HDPE-lined base of the HLP stormwater pond will form the basis of the hazardous waste landfill. After draining and de-sludging, the HDPE liner will be inspected and repaired if necessary. Intermediate bund walls will be constructed to provide cells for different waste types, a leachate collection system will be installed and a second HDPE liner placed to provide double containment of the wastes.

As waste is placed, daily cover will be applied to reduce dust and minimise the risk of release of hazardous material to the environment. The landfill cover will comprise a very low permeability (HDPE or similar) cover to reduce infiltration and associated soil and topsoil cover. The landfill area will be revegetated with grass, fenced to restrict access and signage erected to warn the local population of the hazard.

Monitoring of the landfills will form part of the overall site monitoring programme with maintenance undertaken as necessary. It is envisaged that satisfactory closure and handover of the landfills will be one of the closure criteria adopted.

6. SOCIO-ECONOMIC INITIATIVES AT CLOSURE

The Mine Closure Management Plan will set out:

- Initiatives with local communities;
- Broader economic initiatives; and
- Plans to maximise local and regional opportunities at closure.

These initiatives will be developed during the mine life in consultation with the relevant stakeholders and local communities.

7. CLOSURE SCHEDULE

A detailed Closure Schedule will be developed during the mine life to manage the various stages of decommissioning and rehabilitation. The following summary schedule highlights the key areas of work anticipated:

Period	Activity
Yr 1 to 20	Stage 1 Mining Ongoing recovery of topsoil and rehabilitation materials from the disturbed footprint with construction and progressive rehabilitation of WRDs 1 to 3. Heap Leach Pads 1 and 2 in operation.
Yr 21 to 30	Stage 2 Mining Completion of WRD rehabilitation (Yr 23). Mine waste deposited in-pit. HLP 3 in operation.
Yr 31 to 35	Decommissioning and Rehabilitation Decommissioning of pit and ore recovery/processing infrastructure. Flushing of HLPs, installation of cover system and rehabilitation. Removal of copper recovery plant and conversion of waste water ponds to closure land-use.
Yr 36 to 40	Monitoring and Maintenance Ongoing performance monitoring of the site. Relinquishment of lease when closure criteria are achieved.

8. PROGRESSIVE CLOSURE AND REHABILITATION

Progressive restoration/revegetation during operation has the following advantages:

- Costs are spread over a longer period and may be recovered from mining revenues.
- Closure activities can be integrated into the daily operational activities of the mine.
- A shorter closure implementation period will result.
- Monitoring programmes are integrated into routine environmental management
- Techniques can be trialled and refined in localised areas with successful techniques can be incorporated into the final closure plan.
- Potential for better rehabilitation outcomes through the use of recently disturbed topsoil.
- Adverse environmental effects such as dust generation and contamination are minimised.
- The amount of time required for monitoring and maintenance post mine life is reduced.

The closure plan will be developed to enable progressive rehabilitation during the mine life. The principal focus will be rehabilitation of the waste rock dumps as capping and revegetation can be implemented throughout the WRD development. Because of in-pit disposal in Stage 2 of the mining plan, no further waste is to be placed in the dumps after about Year 20 allowing ample time to fully close the dumps during the operational period of the open pit.

9. CARE AND MAINTENANCE PLAN

Whilst design of the closure landforms will seek to reduce care and maintenance requirements, there will be ongoing aftercare liabilities for a number of years. A care and maintenance plan will be developed as part of the Closure Plan to ensure that closure objectives are achieved and so that efficient and relatively rapid rehabilitation can take place.

10. POST-CLOSURE MONITORING

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

The Monitoring Plan will include as a minimum:

- Physical stability monitoring:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps;
  - Heap leach pad;
  - Site security features.
- Chemical stability:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps; and
  - Heap leach pad.
- Water Quality:
  - Pit lake
  - Surface run-off
  - Leachate generation.
- Environmental impacts and anticipated mitigation, management measures and associated monitoring;
- Expected maintenance requirements;
- Monitoring of community initiatives;
- Monitoring of community health and safety;
- Monitoring of socio-economic activities; and
- Land resettlement, use and management.

11. PROVISIONS FOR EARLY OR TEMPORARY CLOSURE

Mining operations may be forced to close prematurely (referred to as *early* closure) or on care and maintenance (referred to as *temporary* closure).

In the event of *early* closure, the closure process should be accelerated. Immediate review of the pre-existing Mine Closure Plan to include a detailed Decommissioning Plan would be undertaken.

If a *temporary* closure is imminent, a detailed Care and Maintenance Plan would be prepared and implemented, based on the pre-existing Mine Closure Plan. The Care and Maintenance Plan would demonstrate that on-going environmental obligations will be met during the period of temporary closure.

12. RISKS AND OPPORTUNITIES

12.1 RISKS

In preparing this concept closure plan a number of risks were identified. As the closure plan is developed over the mine life these risks will be mitigated where possible. Potential risks at the current time include:

i. Insufficient topsoil and subsoil recovered from disturbed areas, and stored appropriately, for adequate rehabilitation of the disturbed areas.

ii. Insufficient low permeability soil sources on site for WRD liner system.

iii. Insufficient NAF waste and/or borrow sources within the site area for adequate cover depth to WRDs and HLPs.

iv. Restricted footprints for WRDs and HLPs resulting in steep slopes that are difficult and expensive to cover and revegetate.

v. Lack of agreement of closure objectives and end land-use between the operator, regulatory authorities and other relevant stakeholders.

vi. Difficult to manage acid and metals generation from WRDs and HLPs and thereby ensure protection of the downstream environment.

vii. Ongoing liabilities for MWMCL in regards to treatment of run-off prior to discharge if chemical concentrations in surface water remain higher than release criteria.

12.2 OPPORTUNITIES

With the development of the closure plan during the mine life, operational designs can be adapted to reduce the work required to close the site thereby saving time and cost on closure. Potential opportunities to be explored include:

i. Optimising HLP design, potentially through use of the valleys between the heaps, to reduce footprint, increase leaching efficient and adopt closure batter angles for operational purposes.

ii. Optimise HLP stacking and leaching to exhaust cells and allow progressive rehabilitation rather than operating all the HLPs simultaneously until closure.

iii. Optimise WRD design to adopt closure batter angles for operational purposes and reduce the volume of earthworks needed to achieve the necessary profiles on closure.

13. CLOSURE COSTS AND FUNDING PROVISION

13.1 GENERAL

Closure costs will be accounted for in line with the corporate accounting practices. Letpadaung will estimate mine closure costs throughout the operational life of the Project and will accrue mine closure cost provisions on an annual basis. This will ensure that the accrued closure provision meets the costs of a planned closure event, whether permanent or otherwise, at such time as it occurs. In the event of temporary and/or unplanned mine closure, Letpadaung will develop and agree with the applicable Myanmar regulatory authorities a care and maintenance regime, the costs for which would be covered by Letpadaung's own cash reserves and cash flows.

The closure cost estimate, as reported in the Project financial statements, will be updated annually during the operational life to reflect known developments, including scope changes, the effect of a further year's inflation, exchange rate differentials and new regulatory requirements. Closure cost estimation procedures will ensure that identified post-closure costs, whether ongoing or one-off, are realistically estimated and incorporated into the estimate.

Progressive rehabilitation will be built into operations plans and budgets and will also be subject to annual planning, budgeting and permitting.

13.2 COST PROVISIONS FOR FINAL MINE CLOSURE

Letpadaung's approach to the estimation and management of costs related to the final closure of the Letpadaung copper mine at the end of the operational mine life comprises the following:

- A provision for mine closure costs on Letpadaung's balance sheet to be determined in accordance with International Financial Reporting Standards including appropriate actuarial assumptions;
- A Letpadaung commitment to review, monitor and update mine closure plans and costs on a yearly basis (Annual Mine Closure Assessment¨). The Annual Mine Closure Assessment will provide (i) an ongoing estimated date of closure (Mine Closure Date) (ii) an update of the estimated cost of mine closure (Mine Closure Cost¨) and (iii) as presented further below an assessment of the date by which Letpadaung will start setting aside cash contributions against the Mine Closure Cost (Closure Contribution Date);
  - The Closure Contribution Date will be the earlier of (i) 7 years before the Mine Closure Date and (ii) the date on which Letpadaung forecasts

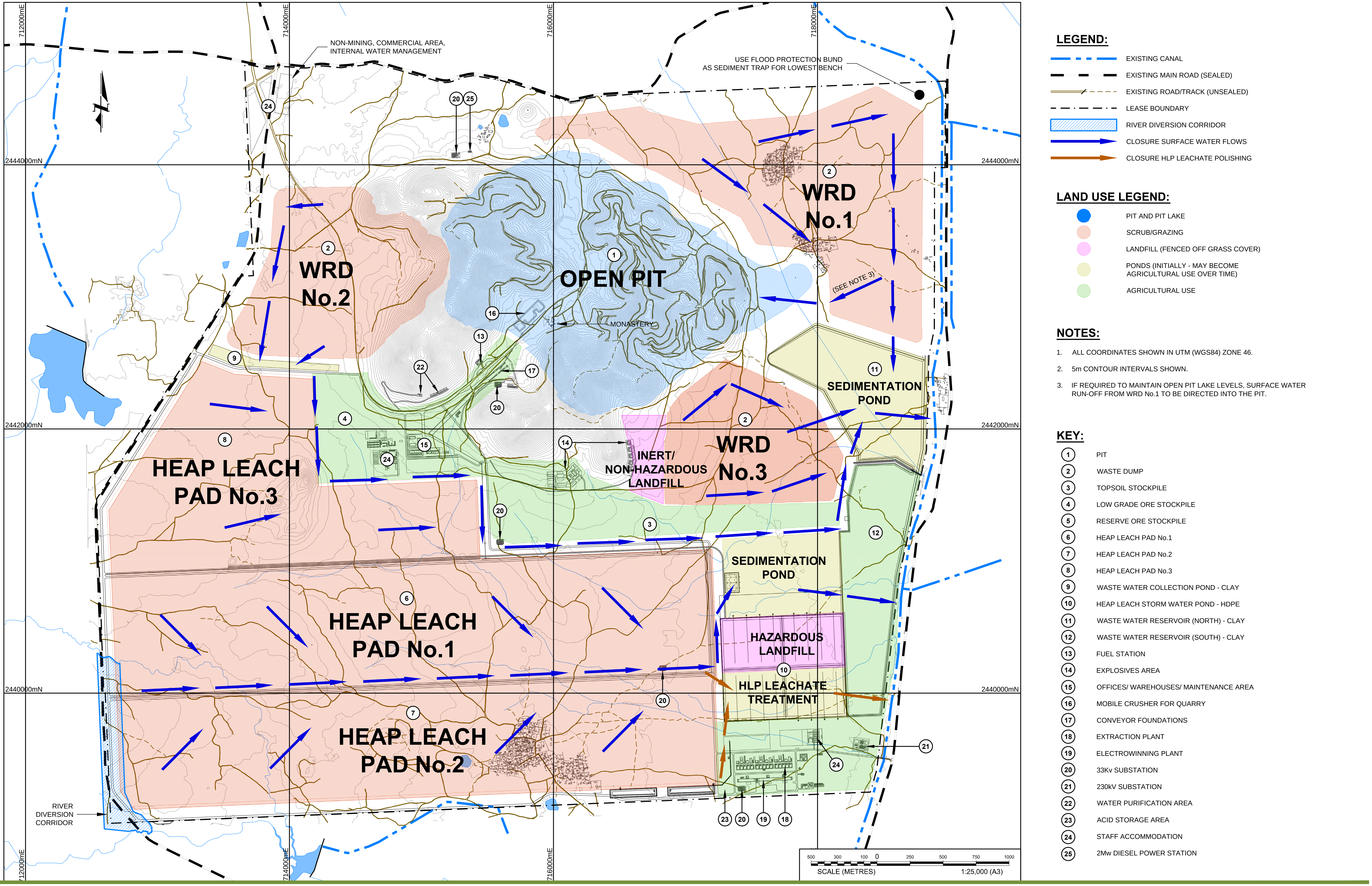
aggregate post finance cash flows from such date to the Mine Closure Date falls below twice the Mine Closure Costs; and

- From the Closure Contribution Date, Letpadaung will commit to making cash contributions in priority to shareholder dividend payments ensuring that a dedicated mine closure reserve account is funded by the Mine Closure Date in an amount equal to the Mine Closure Cost by making equal annual cash contributions (the determination of which will take account of interest on the funds in the mine closure reserve account). To the extent that cash flow in any year is insufficient to meet the required annual contribution, any shortfall shall be made up in the following year. The cash contribution shall also be adjusted to reflect any change to the Mine Closure Cost.

13.3 TEMPORARY/ UNPLANNED MINE CLOSURE

Letpadaung will give a commitment to comply with an agreed care and maintenance regime if there is an unplanned closure of the mine at any time. From a financial perspective, it is expected that there will be sufficient cash within Letpadaung (e.g. from cash balances and payments received on sales made before closure) not only to cover care and maintenance obligations but also, together with proceeds from the sale of Letpadaung's realisable assets, to meet any closure costs. Letpadaung will ensure that any spending on care and maintenance and closure costs is prioritised, ahead of other costs, in the event of an unplanned closure.

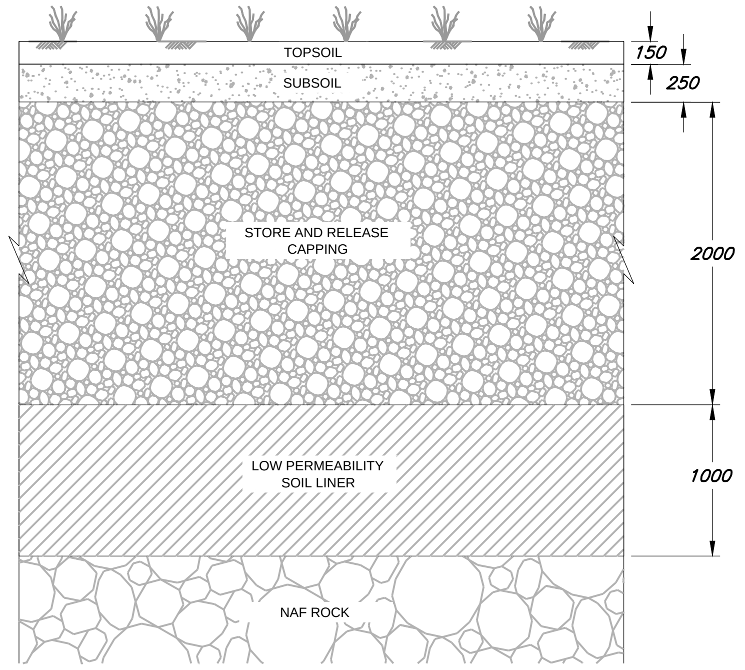
FIGURES



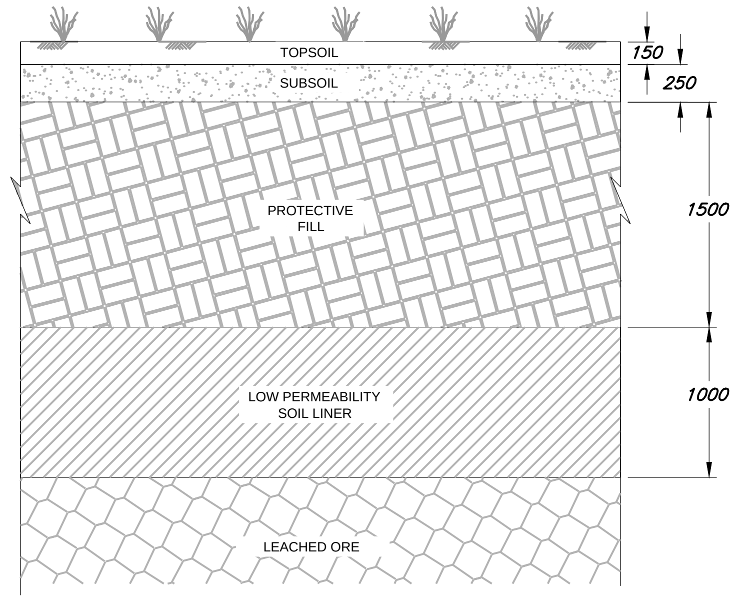
Knight Piésold CONSULTING

LETPADUANG PROJECT
CONCEPT CLOSURE PLAN
LAND-USE AND SURFACE WATER MANAGEMENT

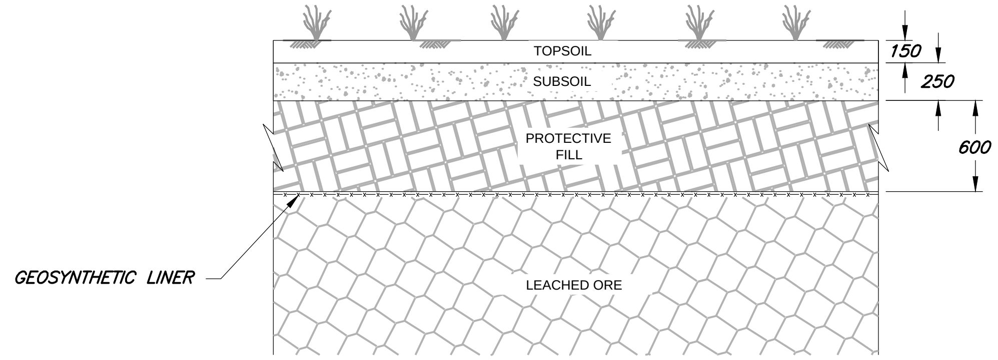
Ref: PE701-00022/20
Figure 5.1



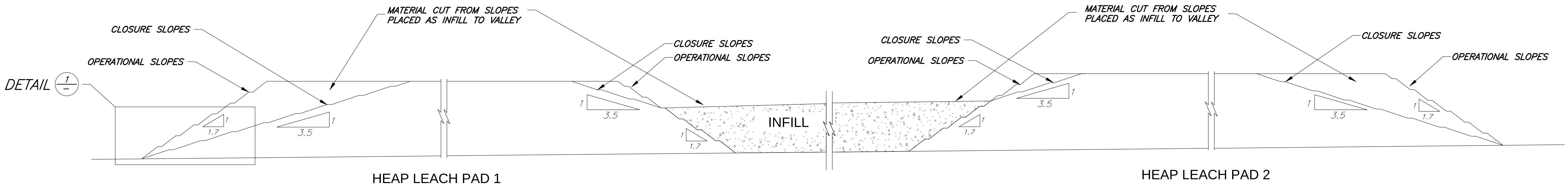
WASTE ROCK DUMPS

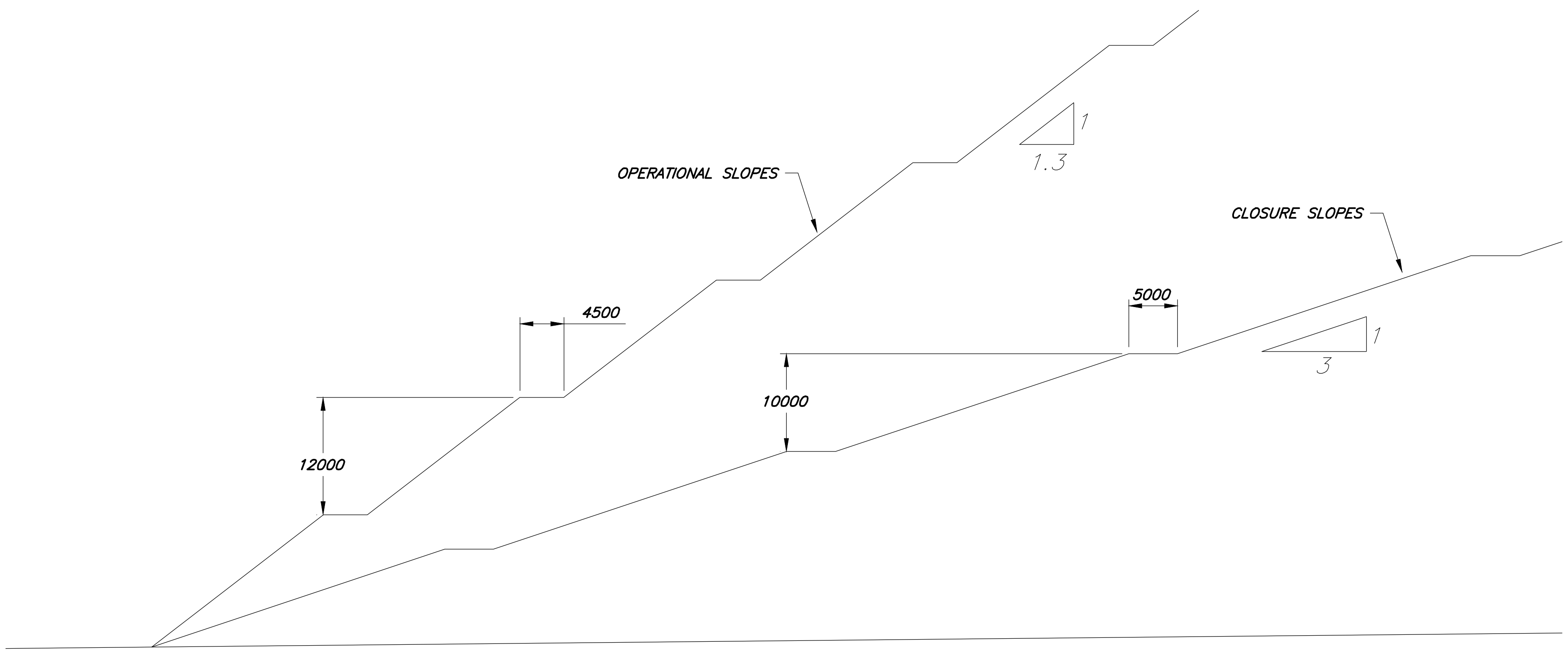


HEAP LEACH PADS
(LOW PERMEABILITY SOIL LINER)



HEAPS LEACH PADS
(GEOSYNTHETIC LINER)





DETAIL 1 BATTER PROFILE
SCALE N.T.S.

Knight Piésold CONSULTING

LETPADAUNG COPPER PROJECT
CONCEPT HEAP LEACH PADS CLOSURE DESIGN
REPROFILING OF BATTERS

Ref: PE401-00022/20
Figure 5.3

APPENDIX M

Resettlement Action Plan

Prepared by Myanmar Wanbao Mining Copper Limited

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LIMITED (MWMCL)
LETPADAUNG COPPER PROJECT



RESETTLEMENT ACTION PLAN

PREPARED FOR:

Knight Piésold Pty Limited
Level 1, 184 Adelaide Terrace
East Perth, WA 6004, AUSTRALIA
p. +61 9223 6300 • f. +61 9223 6399

PREPARED BY:

Myanmar Wanbao Mining Copper Limited (MWMCL)
70(I) Bo Chein Street
Pyay Road, Hlaing Township
Yangon, Myanmar

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1. INTRODUCTION

1.1 BACKGROUND

This Resettlement Action Plan for the Environmental and Social Impact Assessment (ESIA) for the Letpadaung Copper Mine Project (hereafter referred to as "the Project") has been prepared to assist in developing the ESIA, establishing the direct Social Impacts on the 4 villages requiring relocation within the Letpadaung Lease Area.

1.2 PROJECT LOCATION

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic centre of central Myanmar and 722 km north of Yangon.

Travel to Monywa from the project site can be undertaken by road or by river transport. From Monywa, ongoing travel and transport can be undertaken by road, rail and air. The Project location within Myanmar is shown at Figure 1.1.

The Project site is located around the geographic location 22^{o}07' N, 95^{0}02' E and occupies an area of 32.73 km^2. The site location is shown at Figure 1.2 and the project area is shown at Figure 1.3.

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).

1.3 PROJECT OWNERSHIP

Wanbao Mining Ltd. (Wanbao Mining) was established on 16 March 2005 and is a subsidiary company of China North Industries Corporation. Wanbao Mining is a professional mining company approved by the Chinese Government with a registered capital of 1,300 million RMB. The headquarters is in Beijing and overseas subsidiaries are established to run overseas projects.

Myanmar Wanbao Mining Copper Ltd (MWMCL) is registered in Myanmar and wholly owned by Hong Kong Wanbao Mining Copper Ltd. which itself is a wholly owned subsidiary of Wanbao Mining Ltd. With a registered capital of USD 10 million, MWMCL is the operational entity to develop the Letpadaung Project.

The Myanmar partner in the project contributes the mining rights while Wanbao is responsible for project investment development and management. Both parties will share project benefits based on the production sharing contract for Letpadaung Copper Mine. The large scale mineral production permit for Letpadaung is currently held by Myanmar Economics Holding Limited (MEHL).

1.4 PROJECT HISTORY

Copper mining and smelting started in the Monywa copper district several centuries ago. The British discovered the mineral wealth of the Salingyi district in the 1930's and the Myanmar Geological Department visited and investigated this site in the 1950's together with a Yugoslavian geological team. This visit resulted in the implementation of an exploration programme. Myanmar Geological Bureau and relevant institutions of the United Nations (UN), Japan and Yugoslavia carried out a series of exploration programmes after the initial programme.

Mining Enterprise No 1 (ME-1) of Myanmar and Bor Institute of Yugoslavia signed an agreement in 1978 to jointly develop Sabetaung and Kyisintaung deposits and a processing plant with the capacity of 8000 t/d was built in 1984. Production was difficult to maintain and co-operation stopped soon afterwards due to low recovery and poor economic benefits.

ME-1 signed a Feasibility Study agreement with Ivanhoe Myanmar Holdings Limited in 1994 to jointly develop Sabetaung and Kyisintaung deposits. A 1 t/d copper pilot plant was built in 1995 and detailed exploration started. Myanmar Ivanhoe Copper Corporation Limited (MICCL) was formed in 1996. Mining only took place at Sabetaung and Sabetaung South while Kyisintaung and Letpadaung deposits remained untouched. MICCL design capacity was 25 kt/a cathode copper. The plant was put into production in 1998 and the capacity was expanded to 39 kt/a in 2004. The mine essentially ceased operating between April 2008 and August 2010, with only sporadic production continuing. Some production was resumed in September 2010 but only on a small scale.

Wanbao Mining Ltd. organised an expert group to visit the Monywa copper mines and investigate the resources and production there in July 2007. The expert group recommended purchase of the project following the visit.

Wanbao Mining Ltd. organised another expert group to visit the site in December 2008. Data relating to previous exploration programmes, feasibility study reports and mine production conditions were collected. The experts also collected 200 basic assay samples of drill core from the Kyisintaung and Letpadaung deposits and processed them in the MICCL laboratory to 75 micron size. One hundred grams of each sample was sent to The National Geologic Test Centre of China for testing and the test results confirmed the presence of a primary ore body.

Wanbao Mining Ltd. reached a draft co-operative development agreement with the Myanmar Government in March 2010 preliminarily acquiring the mining right of the Letpadaung deposit. The formal co-operative development agreement was signed on 3 June 2010. At present, Myanmar Wanbao Mining Copper Ltd. (MWMCL) is in the process of preparing to develop the Letpadaung deposit.

In May 2010, Myanmar Wanbao Mining Copper Ltd. selected China Nerin Engineering Co., Ltd. (NERIN) to complete the Feasibility Study, Basic Design and Detail Design for this project.

NERIN completed the Feasibility Study Report for the Myanmar Monywa Letpadaung Copper Project (100 kt/a cathode Cu) in September 2010 and completed the Project Application Report in October 2010. The Basic Design was submitted for review in February 2011 and was approved by MWMCL in May 2011.

2. OBJECTIVES

MWMCL's Resettlement Action Plan (RAP) is the outline of responsibilities for resettlement of the Letpadaung Project, specifying the procedures it will follow and the actions it will take to properly resettle and compensate affected people and communities. This RAP is MWMCL's commitment to the Implementation Committee, Government affiliated Agencies and to the affected people that it will meet its obligations arising from voluntary and involuntary resettlement.

This RAP will identify the full range of people affected by the project and justify their displacement. This RAP outlines eligibility criteria for affected parties, establishes rates of compensation for lost assets, and describes levels of assistance for relocation and reconstruction of affected households. This RAP's planning protects MWMCL against unanticipated or exaggerated claims from individuals who have false eligibility for resettlement benefits.

The ultimate goal of this RAP is to enable those displaced by the Letpadaung Mining Project to improve their standard of living—a goal that requires an examination of social, environmental, and economic conditions beyond simple physical inventories.

3. IDENTIFICATION OF PROJECT IMPACTS AND AFFECTED POPULATIONS

The MWMCL RAP will identify all people affected by the project and all adverse impacts on their livelihoods associated with the project's land acquisition. Typical effects include breakup of communities and social support networks; loss of dwellings, farm buildings, and other structures (wells, boreholes, irrigation works, and fencing), agricultural land, trees, and standing crops; impeded or lost access to community resources such as water sources, pasture, forest and woodland, medicinal plants, game animals, or fisheries; loss of business; loss of access to public infrastructure or services; and reduced income resulting from these losses.

Consultation with officials of local government, community leaders, and other representatives of the affected population will be conducted as it is essential to gaining a comprehensive understanding of the types and degrees of adverse project effects.

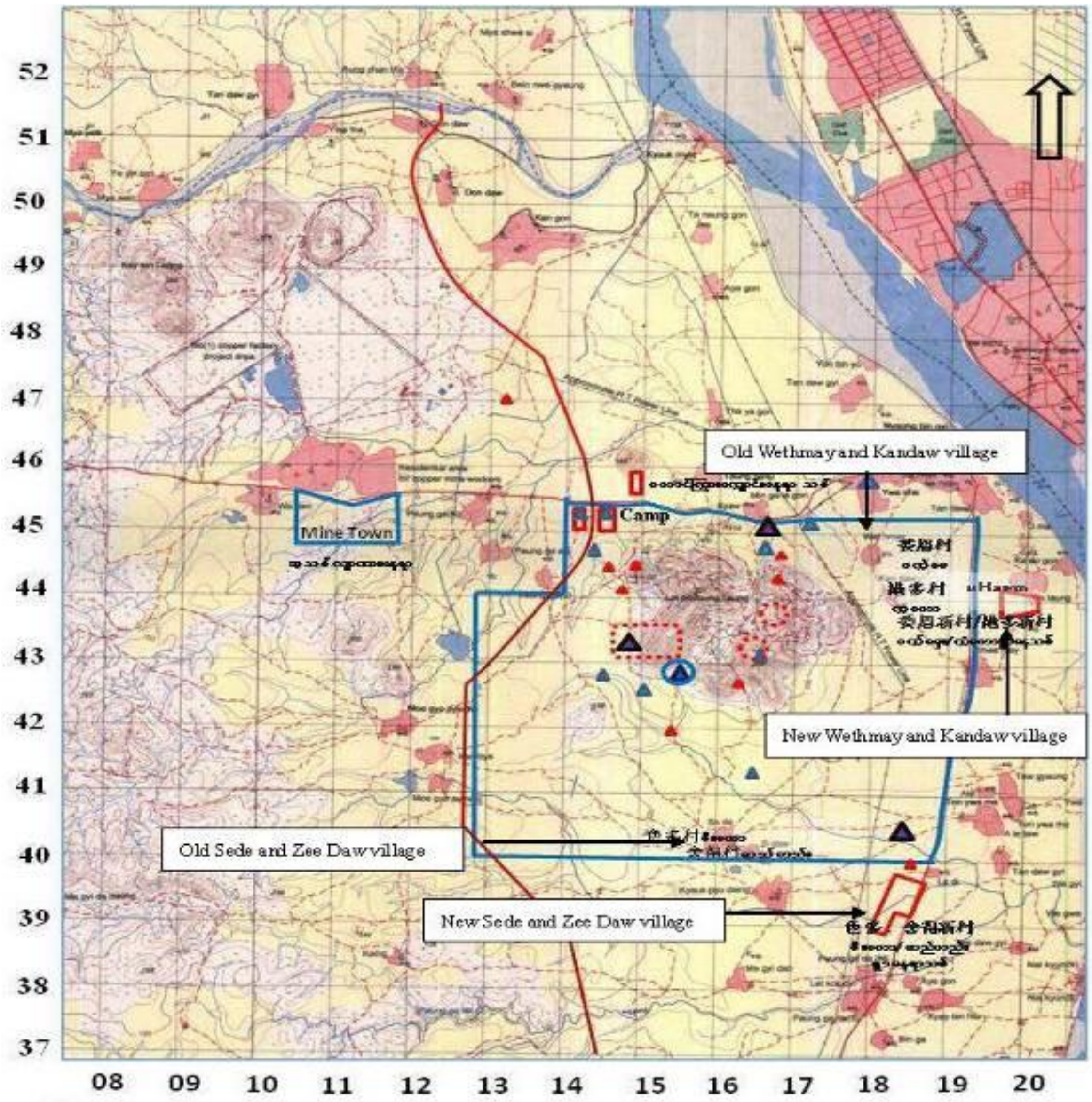
The Regional authorities and MEHL have considered the physical relocation of affected populations to the new 4 village sites and have also conducted an environmental and social assessment of the resettlement site utilizing the local indigenous leaders of the villages.

Affected populations and impacts have been identified through a series of steps:

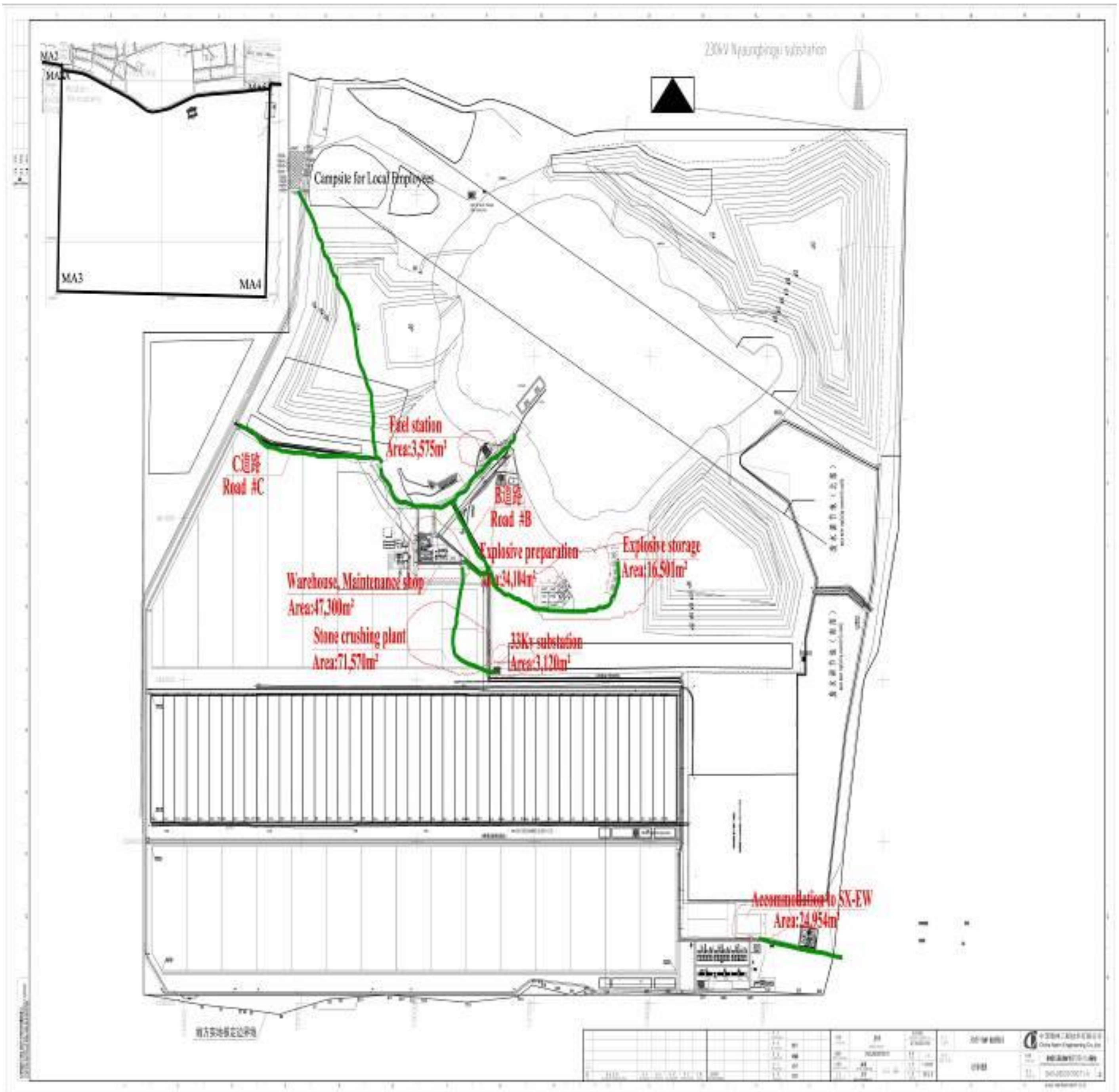
1. Thematic maps that identify such features as population settlements, infrastructure, soil composition, natural vegetation areas, water resources, and land use patterns;
2. A **census** that enumerates the affected people and registers them according to location;
3. An **inventory** of lost and affected assets at the household, enterprise, and community level;
4. Socioeconomic surveys and studies of all affected people (including seasonal, migrant, and host populations), as necessary;
5. Analysis of surveys and studies to establish compensation parameters, to design appropriate income restoration and sustainable development initiatives, and to identify baseline monitoring indicators; and
6. Consultation with affected populations regarding mitigation of effects and development opportunities

3.1 Mapping

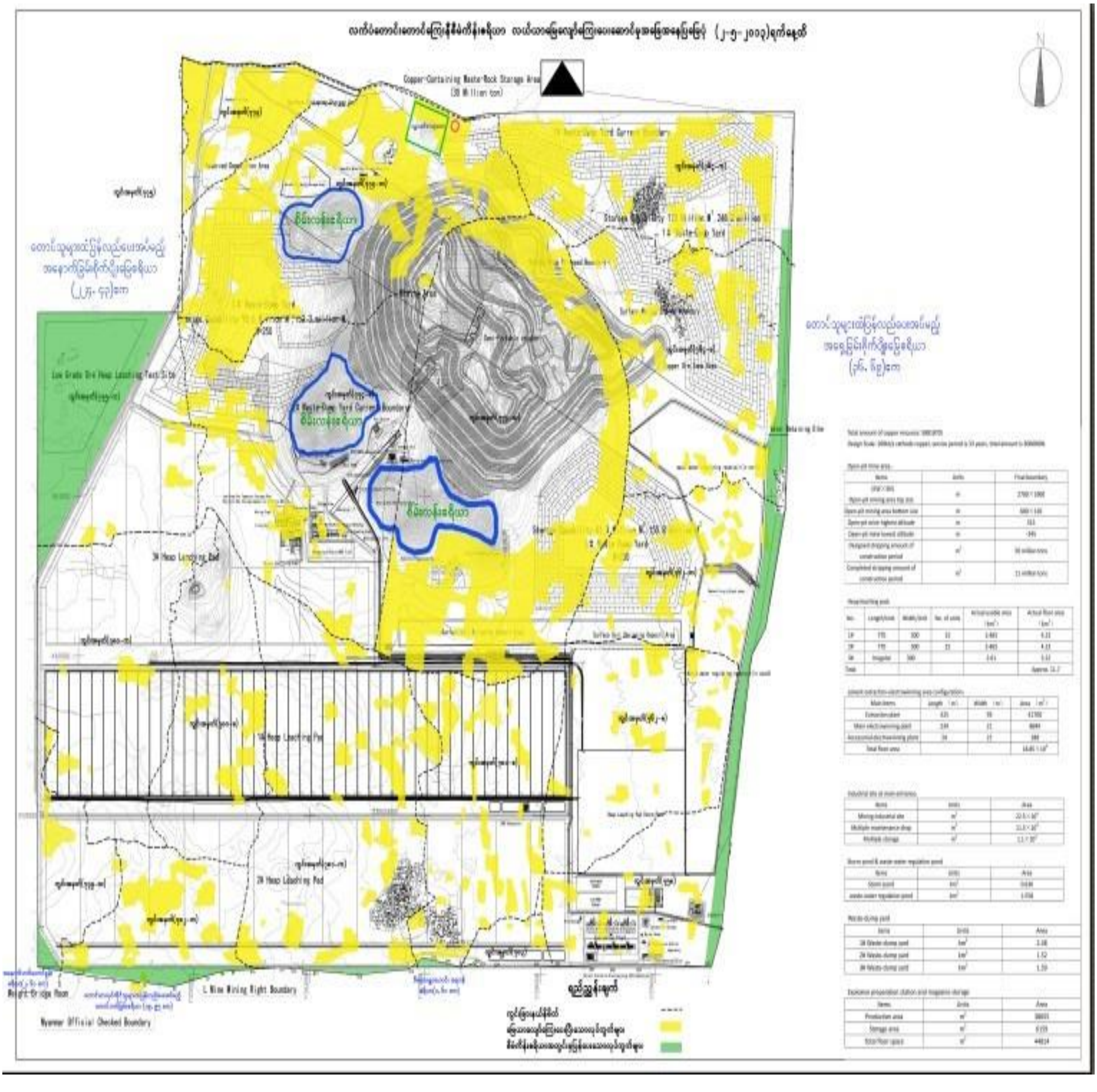
MWMCL's Resettlement Action Plan (RAP) has been mapped to indicate the locations of the 4 old villages of Wethmay, Kandaw, Sede and Zee Daw, as well as their established new locations outside of the perimeter of the Letpadaung Lease area.



3.1.1 Land Access Mapping Early Works Stage 1



3.1.2 Land Compensation Completion Mapping



3.2 Census

The census for MWMCL encompasses all people adversely affected by the project, regardless of their legal status—landowner, holder of land rights, tenant, illegal squatter—or whether they are actually living on an affected site at the time of the census. The lack of legal land title does not disqualify people from resettlement assistance.

The census serves five important and interrelated functions:

■ enumerating and collecting basic information on the affected population;

■ registering the affected population by residence or locality;

■ establishing a list of legitimate beneficiaries **before the project's onset** that counters spurious claims from those moving into the project area solely in anticipation of benefits;

■ laying a framework for subsequent socioeconomic research needed to establish fair compensation rates and to design, monitor, and evaluate sustainable income restoration or development interventions; and

■ providing a baseline for monitoring and evaluation.

Sr	Group of villager	Sr	villager	Quantity of house	Family unit	Population		
						Man	Woman	Total
1	Ton	1	Ton Ywa Ma	171	175	318	403	721
	_	2	A Le Taw	62	63	153	196	349
	_	3	Ton Ywa This	83	84	160	211	371
	_	4	Le Di	59	59	141	169	310
	Total		**(4)village**	**381**	**381**	**772**	**979**	**1751**
2	Let Pa Daung	5	Let Pa Daung	136	143	329	395	724
	_	6	Ma Soe Yein	32	33	68	92	160
	_	7	Shwe Hlay	216	220	563	620	1183
	_	8	Taw Gyung	118	120	254	336	590
	Total		**(4)village**	**502**	**516**	**1214**	**1443**	**2657**
3	Ywa She	9	Ka Do Gon	84	84	247	273	520
	_	10	Pa Laung	145	145	449	507	956
	_	11	Kan Daw	97	97	239	254	493
		12	Wet Hmay	110	110	214	243	457
	Total		**(4)village**	**436**	**436**	**1149**	**1277**	**2426**
4	Nyaung Bin Gyi	13	Aung Chan Si	93	97	312	358	670
	_	14	Min Ga La Gon	29	31	70	84	154

	Total		**(2)village**	**122**	**128**	**382**	**442**	**824**
5	Moe Gyo Bin	15	Moe gyo pyin(N)	172	175	462	489	951
	_	16	Moe gyo pyin(M)	90	93	244	267	511
	_	17	Moe gyo pyin(S)	142	145	353	381	734
	_	18	Poung Ga(N)	211	217	576	648	1224
	_	19	Poung Ga(M)	142	146	371	428	799
	_	20	Poung Ga(S)	65	65	205	216	421
	Total		**(6)village**	**802**	**841**	**2211**	**2429**	**4640**
6	Paung Ga Da	21	Paung Ga Da(s)	165	168	420	533	953
	_	22	Kyuk Pyu Daung	176	221	497	579	1076
	_	23	Zi Daw	60	67	144	168	312
	_	24	Se De	166	168	371	475	846
	Total		**(4)village**	**567**	**624**	**1432**	**1755**	**3187**
7	Taung Ba Lu	25	Taung Ba Lu	145	149	413	451	864
	_	26	Kyaw Ywa	56	63	163	182	645
	Total		**(2)village**	**201**	**212**	**576**	**633**	**1209**
	(7)Group		**(26)village**	**3005**	**3138**	**7736**	**8958**	**16694**

Private landowners and holders of rights to land as well as any person currently occupying lease land for shelter, business purposes, or other sources of livelihood (caretakers, squatters, scavengers) have been included in the census. While landless people or squatters may not be eligible for land compensation, they may be eligible for resettlement assistance, compensation for assets (such as shelters and standing crops, orchards, or woodlots), and, where practicable, the benefits of development interventions, which may include provision of land.

MWMCL has given particular attention to vulnerable groups living in the project area. These groups include households headed by women or children, people with disabilities, the extremely poor, the elderly, and groups that suffer social and economic discrimination, including indigenous peoples and minorities. Members of vulnerable groups may require special or supplementary resettlement assistance because they are less able to cope with the physical and/or economic displacement than the affected population in general. MWMCL will consult World Bank Group Operational Directive OD 4.20, on Indigenous Peoples.

3.3 Inventory of Affected Assets

MWMCL has undertaken a detailed survey of all losses that will result for each household, enterprise, or community affected by the Letpadaung Project. The survey accounts for land acquisition and loss of physical assets as well as loss of income—temporary or permanent—resulting from displacement of household members from employment or income-generating resources. The Village Tract, Name of Village, Quantity of Farmers and the Land Area by Acre is recorded below to be within the Letpadaung Lease Area.

Sr.	Name of Village-tract	Name of Village	Quantity of Farmers	Land Area (Acre)
1	Moe Kyo Pyin	Phaung Kar (Ta)	111	624.52
		Phaung Kar (Ma)	17	108.3
		Phaung Kar (La)	53	112.87
		Moe Kyo Pyin (Ta)	71	372.93
		Moe Kyo Pyin (Ma)	48	188.63
		Moe Kyo Pyin (La)	86	533.59
2	Taung Palu	Taung Palu	23	126.45
		Kyaw Village	72	272.4
3	Tone	Tone	80	336.52
		Taw Kyaung	23	85.38
		Ahlaltaw	10	18.33
		Leti	5	6.62
		Ywarthit	30	95.09
		Ahlalywa	16	52.62
4	Phaung Ka Tar	Sel Tee	252	1783.72
		Zee Taw	74	426.6
		Kyauk Phyu Tai	48	199.16
		Ma Kyee Tan	3	4.73
		Phaung Ka Tar	3	4.44

Sr.	Name of Village-tract	Name of Village	Quantity of Farmers	Land Area (Acre)
5	Ywa Shae	Wet Hmay	75	367.33
		Kantaw	90	404.96
		Htan Taw	9	28.43
		Ywa Shae	5	9.55
		Ku Toe Kone	2	7.49
		Pa Laung	4	12.76
6	Nyaung Pin Gyi	Nyaung Pin Gyi	3	10.54
		Aung Chan Si	13	28.9
		Htan Taw Gyi	6	14.37
7	Letpadaung	Shwe Hlay	140	543.25
		Masoeyein/We Gyi	2	4.26
		Letpandaung	1	1.34
	Total		1375	6786.08

3.4 Socioeconomic Studies

The socioeconomic studies are linked closely with the census and inventory of assets to provide comprehensive information on household economic resources, including common property resources. This information provides MWMCL resettlement planners with an understanding of household income streams and of how these streams can be restored after resettlement is complete. It also provides a baseline for evaluating the success of livelihood restoration and sustainable development measures. This is the community data of Salingyi Township, Monywa District, Sagaing Region concerning with Administration, Security, Law Enforcement, Economy, Social Affair, and Regional Development activities collected from 2012 April to 2012 December.

Administration Sector

1. Location, Area, Boundary and Topography

(a) Location

(1) Longitude from94´ 54' to 95´ 8' E
(2) Latitude from21´ 49' to 22´ 9' N
(3) Attitude 332' (Above Sea level)

(b) Area

(1) As Square Mile 263.017 sq. Miles
(2) As Acre 168331 Acre

(c) Neighbouring Townships

(1) To the North Yin Mar Bin Township
(2) To the East Monywa and Chaung Oo Township
(3) To the South Ye Sagyo and Myaing Township (Magway Region)
(4) To the West Yin Mar Bin and Pale Township

(d) Topography

About 50% of Salingyi Township is hilly. There are some plains along the Chindwin riverside and West, South West and South of the town, Salingyi. The highest Mount is Letpadaung and its attitude is (1057) ft. above Sea Level.

2. Climate

(a) Annual Average Temperature from 42'F to 100' F
(b) Annual Average Rainfall from 10 inch to 30 inch

3. Rainfall

The condition of Rainfall in Salingyi Township is described as follows-

Sr.	Month	Regular		2010		2011		2012	
		Rainy Day	Inch	Rainy Day	Inch	Rainy Day	Inch	Rainy Day	Inch
1	January	-	-	-	-	-	-		
2	February	-	0.02	-	-	-	-		
3	March	-	0.16	-	-	3	1.29		
4	April	2	0.69	2	0.2	5	1.48	4	1.13
5	May	8	4.88	6	2.82	4	3.26		
6	June	5	3.62	9	3.2	5	4.59	2	1.66
7	July	5	2.56	9	3.35	2	1.25	3	0.61
8	August	6	3.97	7	5.7	10	12.17	4	1.58
9	September	10	8.15	6	5.29	4	2.74	7	7.98
10	October	7	5.34	11	21.19	11	11.1	2	2.54
11	November	1	0.76	-	-	-	-		
12	December	-	0.23	-	-	1	0.24		
Annual Rainfall		44	30.38	50	41.75	45	38.12	22	15.5

4. Mineral Resources

In Salingyi Township, Copper is being produced from Sabetaung and Kyisintaung Copper Mine. In 2010-2011, Letpadaung Copper Mine was started operation by Production Sharing Contact (PSC) between Myanma Economic Holdings Limited (MEHL) and Myanmar Wanbao Mining Copper Limited (MWMCL). Land Grant (Long Term 60 years) for the area of (7867.78) acres has already issued to MEHL for the Mining Purposes.

5. Population

Population in Salingyi Township is shown in following table-

Description	No. of Houses	No. of Families	Over (18)year			Under (18)year			Total Population		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban (3)Quarters	939	1027	4439	5599	10038	1964	1998	3962	6403	7597	14000
(39) Villages Tracts and (152)Villages	20543	21550	45643	49852	95495	37121	43384	80505	82764	93236	176000
Total	**21482**	**22577**	**50082**	**55451**	**105533**	**39085**	**45382**	**84467**	**89167**	**100833**	**190000**

6. District, Township, Town, Quarter, Village Tracts and Villages

(a) District - Monywa
(b) Township - Salingyi
(c) Quarter - (3) Quarters
(d) Village Tracts - (39) Tracts
(e) Villages - (152) Villages

Security Sector

7. Territory Security

Security Plans for Salingyi Township are as follows -

(a) Municipal Area Security Plan
(b) Territory Security Plan (Urban/Rural)
(c) Bomb Prevention Plan
(d) Prevention Plan for Natural Disasters
(e) Plan to Arrest the absconders
(f) Security plan for farm lands
(g) Security plan for Tourist
(h) Security plan for Roads and Bridges
(i) Security plan for Inland Water Transport
(j) Security plan for Famous Pagodas

8. Following Important infrastructures are guarded to safe with high level security-

(a) No.(6) Textile Mill, Salingyi
(b) Nyaung Bin Gyi Electrical Power Substation.
(c) Nyaung Bin Gyi Electrical Power River Water Utilization Works
(d) Copper Mine Projects
(e) Moe Gyo Sulphuric Acid Plant.

Activities for Rule of Law

9. Regular Patrolling is being performed by Salingyi Township Police Force.

10. For the prevention and alleviation the crimes in Salingyi Township, Criminal Prevention Talk in public, taking action for law enforcement and distributing pamphlets about criminal prevention are performed in rural and urban.

11. Regular Police Patrolling are performed by out-posted Police Stations two times a week for "Crime Free Week"

12. Taking the Action upon various complaint letters

Sr.	Types of Complaints	2011 1st (9)months			2012 1st (9)months			Remark
		Complaints	Inspected	Remain	Complaints	Inspected	Remain	
1	Administration	5	5	-	10	7	3	
2	Land Use Case	3	3	-	3	2	1	
3	Abuse Case	3	3	-	1	1	-	
4	Social Case	2	2	-	2	2	-	

Registration and Issuing the National Identity cards by Immigration and National Identity Department

13. Salingyi Immigration and National Identity Department issued 1620 identity cards in 2011-2012 financial year and 4077 identity cards in 2012-2013 financial year.

Criminal Condition

14. Criminal condition of Salingyi Township are shown in table

Comparison of Criminal Cases In Salingyi Township (2007-2012)

Sr.	Descriptions	2007	2008	2009	2010	2011	2012
1	Murder	2	1		1	2	
2	Dacoit (Asian Gangs)						
3	Robbery						
4	Kidnapping						
5	Rape		2				6
6	Burglary						
7	Theft (Animal)						
8	High Treason						
9	The Temporary Amendment Act(Arms)						
10	Unlawful Association						
11	Public Properties Protection Act (6-1)	5	3	3	1	2	3
12	Theft(Bicycle)						
13	Theft(Pick-Pocket)						
14	Theft (382)	1					
15	Theft (Ordinary)	2	1			2	7
16	Accident (Ordinary)	3	3	4	4	8	4
17	Accident (Vehicle)	7	12	15	14	17	23
18	Others	43	23	14	18	22	73
19	The Arms Act (1878)	1	1	1			
20	Gambling	4	12	3	1	7	
21	Prostitute						
22	Act (54)	1	1				
23	Unlawful Drugs and Liquor	11	22	21	2	3	23
24	Police Act	224	215	305	321	258	59
25	Police Act (Breaching the Pledge)	4	8	1		4	2
26	Narcotic						
27	Obscene Movies						
28	Emergency Act (5-Nya)						
	Total	**308**	**304**	**367**	**362**	**325**	**200**

Fire Prevention

15. (a) Fire engine and machinery list

Sr.	Location	Type of vehicle	No. of Vehicle	Remark
1	No.2 Quarter (Fire Brigade)	Fire Engine	2	
2	No.6 Textile Mill	Fire Engine	1	

3	Sulphuric Acid Plant	Fire Engine	1	
4	MEHL	Fire Engine	2	
5	Letpadaung Copper Mine	Fire Engine	2	
6	Kan Gone Village	Light Fire Engine	1	
7	Salingyi Fire Brigade	Portable Fire Extinguisher	3	

(b) Preparation

Salingyi Fire brigade always prepare the followings to be ready in case of fire-

(1) Daily test run of fire engines and machine
(2) Weekly maintenance and inspection
(3) Monthly drilling the troops, rehearsal and maintenance of Pipes and Hoses
(4) Training the new volunteer
(5) Checking and filly the water to all receivers.

(c) Fire Prevention Performance

In Salingyi Township, government fire fighter and volunteer fire fighter give the public lecture for fire prevention. Especially they patrol around quarters and villages and arrange the security at the night times.

In summer, the time for fire wage is limited. All combustibles within the villages or housing are removed. All lines and streets in quarter and villages are maintenance to be able to enter the fire engines.

(d) Organization of Volunteer Fire Brigade

Sr.	Quarter		Village		Total	
	Platoon	Crews	Platoon	Crews	Platoon	Crews
1	3	105	42	1480	45	1585

Agricultural Sector

16. Land Utilization

Land utilization in Salingyi Township is as follows-

Sr.	Type of Land	Utilization Area	
		2011-2012	**2012-2013**
1	Cultivable Land Area	11417	111445
	Paddy field	6227	6196
	Farm Land	99631	99680
	Seasonal farm land on the river bank	5520	5530
	Garden	39	39
2	Net cultivable level	111662	111255
	Paddy field	6196	6296
	Farm Land	99418	99570
	Seasonal farm land on the river bank	5409	5450
	Garden	39	39

17. Condition of Agriculture is as follows-

Sr.	Name of Crop	Actual Cultivated (Acre)(2010-2011)	Plan to Cultivate (Acre)(2011-12)	Comparison (Acre)		Cultivated (%)
				Last Year	This Year	
1	**Paddy (Rainy Season)**	**13016**	**14000**	**13016**	**4435**	**31.68**

2	**Various Kinds of Pea**	**35682**	**35285**	**35682**	**33106**	**93.56**
	(a) Pigeon Pea	19473	19000	19473	18890	
	(b) Green Gram	16209	16285	16209	13195	
	-Before Rainy Season	847	885	847	851	
	-After Rainy Season	15362	15400	15362	12344	
	(c) Blue Phascolus	-	-	-	1021	
3	**Oil-Crops**	**29707**	**30172**	**29707**	**32148**	**103.13**
	(a) Ground Nut	447	500	447	286	
	(b) Sesame	25244	25650	25244	22651	
	(c) Sun Flower	3944	3950	3944	3018	
	(d) Long Term Sesame	-	-	-	6121	
	(d) Other oil crops	72	72	72	72	
4	**Spice**	**614**	**658**	**614**	**516**	**78.42**
	(a) Red Chilli	614	658	614	516	
5	**Cotton**	**8427**	**7005**	**8427**	**4211**	**60.77**
	(a)Before Rainy Season	30	35	30	42	91.77
	(b) Rainy Season	1152	1110	1152	418	
	(c) After Rainy Season	7245	5860	7245	3751	
6	**Other Crops and Harvests**	**52331**	**51751**	**52331**	**47487**	
	(a) Millet and Corns	22806	22369	22806	18204	
	-Millet	21459	20959	21459	17260	
	-Corns	1347	1410	1347	944	
	(b) Other Harvests	29525	29382	29525	29283	
	-Vegetables	3552	3550	3552	3288	
	-Food for Oxen and Cows	19844	19700	19844	19866	
	-Others (not edible)	2218	2218	2218	2218	
	-Toddy	1249	1249	1249	1249	
	-Banana	152	155	152	152	
	-Coconut	150	150	150	150	
	-Betel Leaves	142	142	142	142	
	-Fruit Plant	2218	2218	2218	2218	
7	**Castor Oil Plant**	**24080**	**24080**	**24080**	**19264**	**80.00**
	Total	163857	162951	163857	141167	**86.15**

Sufficiency of Provision

18. Sufficiency of Provision in Salingyi Township are indicated in following tables-

(a) Local Rice Sufficiency

Sr.	**Description**	**Unit**	**2010-11**	**2011-12**	**2012-13**
1	**Population**	**Herd**	**190000**	**190000**	**19000**
	-Urban	/	14000	14000	14000
	-Rural	/	176000	176000	176000
2	**Total Paddy Production**	**(Tin) Myanmar Unit)**	**1333189**	**1276887**	**1464072**
	-Rainy Season Paddy	/	1119434	1052887	1193215
	-Summer Paddy	/	223755	214000	270857
3	**Utilization**	/	2890500	2849248	2890000
	-Seed kept for the next year	/	33000	28000	32800
	-Waste	/	49500	46248	48200
	-Requirement for Consuming	/	2808000	2775000	2808000
4	**Remaining for Consuming**	/	1250689	1229945	1382072
5	**Surplus**	/	1557311	1545055	1425928
6	**Sufficiency (%)**	%	46	44	49

(b) Vegetable Oil Sufficiency

Sr.	**Description**	**Unit**	**2010-11**	**2011-12**	**2012-13**

1	Ground Nut Oil Production	Ton	662	673	713
2	Sesame Oil Production	/	3070	3320	3446
3	Sunflower Oil Production	/	2120	2143	2225
4	Other Oil Production	/	50	50	52
5	Total Oil Production	/	5912	6186	6436
6	Total Population	Pax	190000	190000	190000
7	Requirement for Consuming	Ton	1860	1360	1397
	Oil Sufficiency	%	317	455	460

19. Communication Facilities of Salingyi Township are as follows-

Communication Sector of Salingyi Township

Sr.	Description	2011-12	2012-13
1	Main Post Office	2	2
2	Mini Post Office	1	1
3	Mail Box	2	2
4	Telegraph Office	1	1
5	Telephone Exchange(Auto)	1	1
6	GSM Tower	-	2

Electrical Power Sectors

20. Electrical Power Substations and Transmission Lines in Salingyi Township are as follows-

Electrical Power Installation for Industries

Sr.	Department	Installed Capacity	Type of Cable	Length of Cable (miles)
1	S&K Copper Mine (1)	10MVA	ACSR $95mm^2$	3.95
2	S&K Copper Mine (2)	10MVA	ACSR $95mm^3$	3.95
3	No.(6) Textile Mill	10MVA	ACSR $185mm^4$	10
4	Temporary Power line of LPD	3.15MVA	ACSR $95mm^3$	2
4	Sulphuric Acid Plant	1.5 MVA	ACSR $95mm^5$	3.5
5	Nyaung Bin Gyi River water Electrical Pump	7.5 MVA	ACSR $95mm^6$	3
	Total	**39 MVA**		**26.4**

Industrial Sector

21. There is no industrial zone or industrial commercial production.

22. Salingyi Township has annual Tax and Revenue as follows-

(a)Revenue From Township General Administration Department (Kyat in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue from Liquor	60	67.11	111.85	60	67.61	112.68
2	Land Revenue	2.7	2.73	101.11	2.72	31.05	1141.54
3	Revenue for Water and Dam	-	-	-	-	-	-
4	Revenue for Mineral	0.5	2.22	444.00	1.5	1.11	74.00
	Total	63.2	72.06	114.02	64.22	99.77	155.36

(b) Revenue From Internal Revenue Department (Kyats in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%

1	Income Tax	350	305.713	87.35	1000	1003.012	100.30
2	Commercial Tax	450.56	222.79	49.45	350	471.829	134.81
3	Revenue for Stamp	8	9.729	121.61	20	98.882	494.41
4	State Lottery Tax	315.8	232.72	73.69	310	254.424	82.07
	Total	1124.36	770.952	68.57	1680	1828.147	108.82

(c) Revenue From Township Development Committee Under Ministry of Border Affairs(Kyats in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue	77.249	32.93	42.63	47.249	35.59	75.32
2	Tender Tax	1018.558	257.54	25.28	1073.558	980.87	91.37
3	Fine and Others	20.192	4.73	23.43	20.192	50.52	250.20
	Total	1115.999	295.2	26.45	1140.999	1066.98	93.51

(d) Revenue From Forestry Department (Kyats in Lakh)

Sr	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue from Private business	13.33	10.02	23.43	10.73	10.73	23.43
2	Selling Timber	0.94	4.34	23.43	1	3.03	23.43
3	Fine and Others	0.85	0.1	23.43	0.6	2.18	23.43
	Total	15.12	14.46	95.63	12.33	15.94	129.28

(e) Revenue From Post and Telecommunication Department (Kyats in Lakh)

Sr	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Income From Mail	1	2.4	23.43	1	0.77	23.43
2	Income From Telegraph	0.3	0.29	23.43	1	0.77	23.43
3	Income From Telephone Tax	38.52	78.56	23.43	135.96	82.65	23.43
	Total	39.82	81.25	204.04	137.96	84.19	61.02

(f) Comparison of Individual Income in Salingyi Township from 2007 to 2012

Sr.	**Description**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
1	Population (thousands)	117	181	183	185	190
2	Income (Kyats)	533171	593318	652408	724538	802416

Net Gross Products and Services of Salingyi Township in (2012-2013) Financial Year up to (2012 November) based on Local Price in (2011-2012)

Kyats in Million

Sr.		Description	2011-12			2011-12			Development (%)
			Planned	Obtained	%	Planned	Obtained	%	
1		2	3	4	5	6	7	8	9
1		**Gross Products**	**109772.70**	**67591.20**	**61.6**	**113415.90**	**60206.30**	**53.1**	**-10.90**
	1	Agriculture	57511.60	22719.00	**39.5**	60032.70	19652.80	**32.7**	-13.50
	2	Meat and Fish	7745.80	5319.90	**68.7**	8171.90	5443.10	**66.6**	2.30
	3	Forest	36.50	41.50	**113.7**	36.70	36.40	**99.2**	-12.30
	4	Energy							
	5	Minerals	11709.00	30723.00	**262.4**	9023.90	25058.80	**277.7**	-18.40
	6	Industry	30036.40	6551.00	**21.8**	33039.70	7554.60	**22.9**	15.30

	7	Electrical Power	825.00	707.90	**85.8**	850.20	865.60	**101.8**	22.30
	8	Construction	1908.40	1528.90	**80.1**	2260.80	1595.00	**70.6**	4.30
2		**Gross Services**	**6279.00**	**4410.10**	**70.2**	**7087.80**	**5013.70**	**70.7**	**13.70**
	1	Transportation	1707.50	1385.80	**81.2**	1895.40	1496.80	**79.0**	8.00
	2	Communication	86.40	36.10	**41.8**	60.80	42.80	**70.4**	18.60
	3	Finance	18.50	4.10	**22.2**	21.20	7.20	**34.0**	75.60
	4	Social and Management	1732.80	1100.30	**63.5**	1958.00	1296.20	**66.2**	17.80
	5	Rental Fee and Others	2733.80	1883.80	**68.9**	3152.40	2170.7	**68.9**	15.20
3		**Trade**	**28363.8**	**15149.5**	**53.4**	**28701.7**	**14588.2**	**50.8**	**-3.7**
4		**Net Gross Product and Services**	**144415.50**	**87150.80**	**60.3**	**149205.40**	**79808.20**	**53.5**	**-8.40**

Education Sector

23. Education Sector of Salingyi Township is presented as follows-

(a) Number of Teachers (Basic Education)

Sr.	Rank	2011-2012			2012-2013		
		Permitted	Appointed	Vacant	Permitted	Appointed	Vacant
1	High School Head Master	2	2	0	3	3	0
2	Middle School Head Master	7	7	0	7	6	1
3	Primary School Head Master	99	94	5	98	97	1
4	High School Assistant Teacher	65	64	1	86	79	7
5	High School Teacher (Sports)	2	2	0	2	2	0
6	Middle School Assistant Teacher	235	228	7	226	223	3
7	Middle School Teacher (Sports)	7	5	2	7	5	2
8	Middle School Teacher (Grade-II)	175	173	2	170	168	2
9	Primary School Teacher	316	312	4	239	231	8
	Total	**908**	**887**	**21**	**838**	**814**	**24**

(b) Number Of Students
(Basic Education)

Sr.	Standard	(2011-12)			(2011-12)		
		Boys	Girls	Total	Boys	Girls	Total
1	Grade 11	438	482	920	449	515	964
2	Grade 10	563	574	1137	562	911	1473
	Total High School Students	**1001**	**1056**	**2057**	**1011**	**1426**	**2437**
3	Grade 9	658	668	1326	658	744	1402
4	Grade 8	715	798	1513	792	798	1590
5	Grade 7	896	870	1766	889	951	1840
6	Grade 6	988	1030	2018	1011	1041	2052
	Total Middle School Students	**3257**	**3366**	**6623**	**3350**	**3534**	**6884**
7	Grade 5	1121	1185	2306	1152	1195	2347
8	Grade 4	1197	1232	2429	1276	1202	2478
9	Grade 3	1271	1257	2528	1256	1135	2391
10	Grade 2	1315	1158	2473	1204	1180	2384
11	Grade 1	1468	1425	2893	1587	1529	3116
	Total Primary School Students	**6372**	**6257**	**12629**	**6475**	**6241**	**12716**
Total Students		**10630**	**10679**	**21309**	**10836**	**11201**	**22037**

(c) Ratio of Teacher and Student

Standard	2011-12			2011-12		
	Teacher	Student	Ratio	Teacher	Student	Ratio
High School	65	2057	1:32	79	2137	1:27

Middle School	221	6614	1:30	223	6884	1:30
Primary School	588	12617	1:24	571	12716	1:22
Total	**874**	**21288**	**1:24**	**873**	**21737**	**1:24**

(d) Distinction Winners of Matriculation in 2011-12

4 Distinctions Winner	4-Persons
3 Distinctions Winner	4-Persons
2 Distinctions Winner	18-Persons
1 Distinctions Winner	66-Persons
Total	92-Persons

(e) Number of Basic Education Schools

Basic Schools in Salingyi Township										
Year	Main Schools			Sub Schools			Associate School			Extended Primary School
	High	Middle	Primary	High	Middle	Primary	High	Middle	Primary	
2011-2012	2	1	73	5	15	2	1	1	1	10
2012-2013	2	1	73	5	15	3	-	1	-	11

Health Sector

24. Health Sector consists as follows-

(a)Hospitals and Clinics

Sr	**Description of Health Centre**	**Numbers**		**Progress**	**Remark**
		2011-12	**2012-13**		
1	(25) Bedded Township Hospital	1	1	-	
2	(16)Bedded Town Hospital	1	1	-	
3	Rural Health Care Centre	4	4	-	
4	Sub Rural Health Care Centre	21	22	1	
5	Maternal and Child Clinic	1	1	-	
6	Traditional Clinic	2	2	-	
7	Private Clinic	3	3	-	

(b)Medical Officers and Staffs

Sr.	**Description**	**Permitted**	**Appointed**	**Vacant**	**Associate**
1	Township Medical Officer	1	1	0	
2	Assistant Doctor	4	2	2	
3	Dentist	1	1	0	
4	Doctor for Town Hospital	1	1	0	
5	Medical Assistant	1	0	1	
6	Second Medical Assistant	4	4	0	
7	Senior Nurse (Grade-1)	1	1	0	
8	Nurse (Upper Class)	6	5	1	
9	Nurse	11	6	5	
10	Mid-Wife	5	5	0	
11	Paramedic Grade 1	2	2	0	
12	Paramedic Grade 2	9	6	3	
13	Others	73	47	26	
	Total	**119**	**81**	**38**	

(c) Ratio of Medical Employees and Population

Sr.	Description	Medic	Population	Ratio
1	Doctor	5	137196	1:72439
2	Nurse	11	137196	1:22472

(d) Total Patients In Medical Centres

Sr.	Description	2011-12		2012-13	
		In-Patient	Out-Patient	In-Patient	Out-Patient
1	Township Hospital	649	971	1029	1572
2	Town Hospital	479	768	938	1983
3	Rural Health Care Centre		13375		12026

Religious Sector

25. Religious Sector consists as follows-

Condition of Monasteries, Monk, Novices and Nuns

Sr.	Name of Group	Monastery	Monk	Novice	Nun
1	Shwe Kyin	25	45	66	-
2	Sudama	216	489	563	28
Total		**241**	**534**	**629**	**28**

Environmental Sector

26. For the Environmental Sector, Salingyi Local Authorities made public environmental Education lectures to distribute environmental protection aspects to the people as follows-

Public Lecture for Environmental Management

Sr.	Titles of Public Lecture	No. of Ceremony	Attendees	No. of Families
1	Public Lecture for Flora and Fauna	3	669	191
2	Prevention of Air Pollution	2	446	191
3	Fire Prevention	3	669	194
4	Systematically usage of Fertilizer and Insecticide	1	236	191
5	Elimination of Climactic Change	6	1338	191
6	Management of Waste	1	223	191

3.5 Analysis of Surveys and Studies

Analysis of the data collected in the census, assets inventory, and socioeconomic studies serves three ends: 1) it provides information needed to establish an entitlement matrix for household- and community-level compensation; 2) it yields basic economic and social information needed to design appropriate livelihood restoration and development interventions; and 3) it provides quantifiable demographic, economic, educational, occupational, and health indicators for future monitoring and evaluation of RAP implementation.

To date, analysis of surveys and studies are being conducted by the CSD Team and through the Baselines studies completed by EMC and reported by Knight Piésold.

3.6 Consultation with Affected People Concerning

Community Consultation & Social Development (CSD) Program

The CSD Program began on the 28th of March 2013, establishing a team composed of 1 village representative from each of the 35 surrounding villages.(Inclusive of the 4 new villages) Of these 35 villages 29 members volunteered for employment as a CSD Team representative. The water festival in April allowed for a 2 week break in training activities, and on the 21st of April a professional Myanmar National from World Vision Myanmar joined the team as Project Manager. (CSD Team List 6.1.1)

Following an accelerated training program, including on the job training, this team began to engage the villagers in a friendly manner. Considerations were taken to leave the disturbed villages alone for the time being. Community consultation began to take form. The CSD Team entered each village only with written prior consent from the Village Administrator or representative.

It became immediately clear that the information regarding the Letpadaung Project had been misconstrued by outside forces (students), and in truth, the villagers were hungry for jobs, while at the same time having great concern for the status of land compensation and permanent employment to replace farming activities and livelihood. Many villagers have been threatened if they cooperate with MWMCL and have asked for police protection.

Key Issues have been identified through initial engagements. The priorities being: job opportunities, water, electricity, road repair, hospital facilities and assistance for the aged.

Below are some particulars gathered through the CSD Team engagements:

Key Issues:

1) Land compensation from Kangone Village is a serious issue.
2) Job opportunities: priority and transparency
3) Acid Plant is running without permission from the Government (The activist went and met with some representatives from the Acid plant) which against the commission report.
4) The Minister Col. Kyi Naing is going around the villages but met strong opposition by the Old Sae Tae villagers when he visited Zee Taw and Sae Tae villages.
5) The “Farmers Protection” group was formed by the farmers from 14 villages and the group will persuade other villages to be involved in the group. The purpose of this group is:
   a) Not losing any lands b) Cooperative farming in this rainy season.

Village Engagement:

1) Household visiting
2) Consultation with Village Head and villagers
3) Consultation with EIA/SIA activists from Done Taw, Gone Taw, Kan Kone
4) Providing feedback to community’s request

Villages Refusing CSD Engagement:

1) Wethmay (Old)
2) Sede (Old)
3) Zidaw (Old)
4) Tawgyaung
5) Aleywa
6) Ton Ywathit
7) Ton Ywama
8) Moe Gyoe Pyin (Middle)

Villages:

No	Village	Project Area
1	Wethmay	Wanbao Area
2	Kan Taw	Wanbao Area
3	Pa Laung	Wanbao Area
4	Nyaung Pin Gyi	Wanbao Area
5	Ywar Shae	Wanbao Area
6	Kyaut Phyu Tie	Wanbao Area
7	Taung Pa Lu	Wanbao Area
8	Shwe Hlae	Wanbao Area
9	Lae Ti	Wanbao Area
10	Phaung Ka Tar	Wanbao Area
11	Kyaw Ywar	Wanbao Area
12	Zee Taw	Wanbao Area
13	Sae Tae	Wanbao Area
14	Ton/Ywar Thit	Wanbao Area
15	Taw Kyaung / Aleywa	Wanbao Area
16	Done Taw	Yang Tse Area
17	Phoung Kar(N)	Yang Tse Area
18	Shwe Pan Khing	Yang Tse Area
19	Kan Kone	Yang Tse Area
20	The Taw Gyi	Yang Tse Area
21	Yey Kyi Pin	Yang Tse Area
22	War Tann	Yang Tse Area
23	Tel Pin Kan	Yang Tse Area
24	Goan Taw	Yang Tse Area
25	Ywar Thar	Yang Tse Area
26	Phaung Kar (M)	Yang Tse Area
27	Phaung Kar (S)	Yang Tse Area
28	Moe Gyo Pyin(N)	Yang Tse Area
29	Moe Gyo Pyin(S)	Yang Tse Area
30	Moe Gyo Pyin(M)	Yang Tse Area

Note: Yon Pin Yoe is not to be listed in our future plan.

NGOs Identified:

1) Cesvi / Pack Myanmar for micro finance and mother and child health activities in Yin Mar Pin Tsp., villages (Thae Taw Gyi, Shwe Pan Khaing, Tel Pin Kan)

Community Consultation Methodology:

1) Pamphlet distribution
2) Construction plan in next two months
3) Complaint and feedback provision
4) Community's need are listed
5) Job opportunity transparency

Community Engagement and CSD Projected Timeline:

Action Plan	Month					
	May	June	July	Aug	Sep	Oct
Completed questionnaire						
Need Assessment with community						
Collaboration with HR for job opportunity/selection						
Collaboration with PR on how to prioritize the support based on need assessment information						
Classify the donor sources (gov, mehl, mytcl, mwmcl)						
Provide community's urgent need that has to be done before Wet Season.						
Provide community's urgent need that can be done in rainy season						
Assign CSD to facilitate the villagers to participate in implementation and to take ownership						
Assign CSD to do monitoring the implementation						
Assign CSD to listen community's voices						

4. ASSISTANCE BENEFITS AND DEVELOPMENT OPPORTUNITIES

With the information provided by the surveys and studies, resettlement planning has been engaged in informed and constructive consultations with the affected community regarding the RAP strategy for livelihood restoration. A committee of community representatives liaising with the CSD Team serves as a focal point for consultations on the types of assistance proposed by MWMCL resettlement planners as well as for subsequent participation of the community in RAP implementation. Where host communities are affected by resettlement decisions, representatives of these communities have been included in these consultations.

S/N	Village Name	Books & furniture	Medical Service Hospital & Mobile Unit	Electricity Power Lines to the villages	Drinking Water	Road Repairing	Playground	Kinder-gartens	School Repairing	TOTAL
1	Shwe Pann Khine	650,000	16,800 USD/month for medical services . The average expense for medicine is approx. 5,000 USD/month Total Costs of: 21,800 USD/month or 261,600 USD/year	Long distance to install						650,000
2	Ywar Thar	650,000								650,000
3	Goan Taw	650,000								650,000
4	Doan Taw	650,000								650,000
5	War Tann	650,000		111,300,000	20,160,000	14,150,000				146,260,000
6	Tel Pin Kan	650,000		83,670,000	37,670,000	14,810,000				136,800,000
7	Kan Kone	650,000							40,000,000	40,650,000
8	Phaung Kar (North)	650,000								650,000
9	Phaung Kar (Middle)	650,000								650,000
10	Phaung Kar (South)	650,000								650,000
11	Moe Kyo Pyin(North)	650,000			72,840,000	1,930,000				75,420,000
12	Moe Kyo Pyin(Middle)	650,000								650,000
13	Moe Kyo Pyin(South)	650,000								650,000
14	Yey Kyi Pin	650,000		Long distance to install						650,000
15	Thel Taw Kyi	650,000		Long distance to install						650,000
16	Taung Pa Lu	650,000							30,000,000	30,650,000
17	Kyaw Ywar	650,000							8,880,000	9,530,000
18	Nyaung Pin Kyi	650,000							30,000,000	30,650,000
19	Ywar Shay	650,000								650,000

20	Pal Laung	650,000								650,000
21	Wet Mhay (New)	650,000					11,850,000	65,500,000		78,000,000
22	Kan Taw (New)	650,000								650,000
23	Sae Tae (New)	650,000								650,000
24	Zee Taw (New)	650,000						65,500,000		66,150,000
25	Ton/YwarThit	650,000								650,000
26	Taw Kyaung	650,000								650,000
27	A Lel Taw/ Lae Ti	650,000		20,520,000						21,170,000
28	Phaung Ka Tar	650,000								650,000
29	Kyauk Phyu Tai	650,000		61,950,000						62,600,000
30	Shwe Hlay	650,000		60,200,000						60,850,000
	TOTAL Cost (Kyats)	19500000	222,360,000	337640000	130,670,000	30,890,000	11,850,000	131,000,000	108,880,000	992,790,000
	TOTAL Cost (FEC)	22,941	261,600	397,224	153,729	36,341	13,941	154,118	128,094	1,167,988

Community Donations and Opportunities

All Donations of Myanmar Yang Tse and Myanmar Wanbao Mining Copper Limited.

1- Educational donation to Wet Mhay/KanTaw new villages (1.4 million kyats)
2- Primary school building donation to MaGyiTaHtaung village (3.0 Million kyats)
3- Computer set donation to primary school of Phaungkar village (0.3 Million kyats)
4- Bridge donation to Zeetaw-Kyauk Phyu Taing village (0.8 Million kyats)
5- Bridge donation to Taung Pa Lu-Thar Yar Kone Taing village (0.85 Million kyats)
6- Retaining wall construction for Ywar Thar Village (2012-June) 150.0million kyats.
7- Dam Construction at Moe Kyo Pyin Village (2012-June) 14.0 million kyat
8- Dam Construction at Phaung Kar Village (2012-June) 10.0 million kyats.
9- Dam Construction at War Tann Village (2012-April) 10.0 million kyats.
10- Dam Construction at Tae Pin Kan Village (2012-May) 10.0 million kyats.
11- Road Repairing For Aye Kone Village (Cost 4.5 Million kyats)July-2012
12- Construction of Pagoda & Road Repairin For Shwe Pann Khine Village(Cost 22 Million kyats) Sept-2012
13- Road Repairing For Taung Pa Lu Village (Cost 4 Million kyats) Sept-2012
14- Road Repairing For Thar Yar Kone –Taungpalu Village (Cost 8.5 Million kyats) Sept-2012
15- Road Repairing For Hta Naung Kone Village (Cost 8.5 Million kyats) Sept-2012
16- Road Repairing For Kan Kone Village (Cost 5.5 Million kyats) Oct-2012
17- Pond Reconstruction For Sar Linn Gyi Town(Cost 2.5 Million kyats) May-2012
18- Road Repairing For Doan Taw Village (Cost 3.1Million kyats) Dec-2012
19- ShwePannKhine village road Construction Cost(6.5 million kyats) Feb-2013
20- ShwePannKhine-Telpinkan village road Construction Cost(23 million kyats) Feb-2013
21- Telpinkan New village extension Construction Cost(3.1 million kyats) Feb-2013
22- Water Tube well donation to Ma Gyi Ta Htaung Village (Cost 3.8 million kyats)
23- Water Pipe line Construction to Kyauk Myet-Taung Kyar Monastery (Cost 2.5 million kyats)
24- Water Tube well & Purifier Donation to Kan Kone Village (Cost 8.0 million kyats)
25- Donation for Earth quake Victims (30,000,000 kyats) Nov-2012
26- Donation for Fire Victim Moegyopyin Village 4.2 million kyats 16-2-2013
27- Donation DaMarYone Building for Kyauk Myet village Monastery Cost 24 million kyats (Feb-2013)
28- Cash Donation to Taungkyar Monastery for Electrical Installation (480000 Kyats)4-3-2013
29- Construct electricity supply facility for Myaypyinthar monastery cost 37.49 million kyats）
30- Let Pa Taung Pagoda Construction (cost 12.7 Million kyats)
31- Kyartwintaung Monastery Road Construction (cost 1.8 Million kyats)
32- Road Repairing in War Tan Village (1-5-2013 to 6-5-2013) 15.0 Million kyats.
33- Access Road Repairing between Mine town and Moe Kyo Pyin Village (8-5-2013) 20.7 Million kyats.
34- Access Road Repairing between Shwe Pann Khine and The Taw Gyi Village (28-4-2013 to 9-5-2013) 6.0 Million kyats.
35- Country Hospital, near Kankone village Construction cost will be over 200 million kyats
36- Tailing Reclamation from War Tan vIllage Total cost over 45 million kyats.
37- Primary School Repairing in Kyaw Ywar Village (26-4-2013) Cost 8.8 million kyats.
38- Water Line Installation in War Tann Village (26-4-2013) Cost 18.6 million kyats.
39- Books & Furniture Donation to Local 30 villages (7-5-2013) Total cost 19.5 million kyats.
40- Housing construction for fire victim in Moe Kyo Pyin (mid) Village(15-5-2013)Cost 29.7 million kyats

5. LEGAL FRAMEWORK

The public consultations regarding resettlement identified in this document conform to the following legislations and standards:

- Myanmar regulations

- Guidelines established by international financing institutions, specifically the World Bank Group

5.1 INSTITUTIONAL, LEGISLATIVE AND REGULATORY FRAMEWORK

International, regional, and local treaties, laws, regulations, and standards dealing with environmental quality, health and safety, protection of sensitive areas, endangered species, facilities siting, lease/exploration license/concession agreements, and land use control will be identified and evaluated for each of the construction, operation, and decommissioning phases of the project.

IFC guidelines and government legislation relating to transport infrastructure, water resources, mineral resources development, and industrial facilities will be addressed, together with the health and safety requirements specific to the proposed activities. Relevant Myanmar regulations and IFC guidelines dealing with indigenous peoples, wildlife, cultural resources, land tenure, etc. will be addressed for the proposed activities. A general listing of legislative and regulatory considerations is provided in Section 4 - Legal and Policy Framework.

World Bank Group Requirements and Guidelines

The Letpadaung project has voluntarily undertaken the intent to be consistent with the World Bank/International Finance Corporation (WB/IFC) Policies, Procedures, and Guidelines. The World Bank Group's Environmental Assessment Policy (OP 4.01, January 1999) provides that project-affected groups and local non-governmental organizations (NGOs) should be consulted about the project's potential environmental and social impacts during the ESIA process. This consultation's purpose is to consider local views when designing the environmental and social management plans as well as in the project structure.

Emphasis is placed on the engagement of local stakeholders, namely those likely to experience the day-to-day impacts of a proposed project.

Other relevant World Bank Group policies with provisions for public consultation include:

- Operational Policy 4.04: Natural Habitats
- Operational Policy 4.11: Safeguarding Cultural Property
- Operational Policy 4.12 Resettlement
- Revised Draft Operational Policy 4.10 Indigenous People (replaces Operational Directive

4.20 on Indigenous Peoples)

- Operational Policy 14.70: Involving Non-Government Organizations in Bank-Supported Activities

The World Bank Group requirements focus on:

- Early consultation with affected people and NGOs
- Early information disclosure
- Providing information in a way that allows informed consultation with stakeholders

In addition to the requirement for consultation with stakeholders, the World Bank Group has specific requirements for disclosure of documentation resulting from the ESIA process. These include preparation and publication of a Public Consultation Disclosure Plan (PCDP) for consultation, as well as disclosure of the draft ESIA in public places.

6. COMPENSATION FRAMEWORK

The RAP compensation framework specifies all forms of asset ownership or use rights among the population affected by the Letpadaung Project and the project's strategy for compensating them for the partial or complete loss of those assets. The compensation framework includes a description of the following: 1) any compensation guidelines established by the host government; 2) in the absence of established guidelines, the methodology that the Letpadaung Project will use to value losses; 3) the proposed types and levels of compensation to be paid; 4) compensation and assistance eligibility criteria; and 5) how and when compensation will be paid.

Brief on Land Occupation Procedures of Letpadaung Copper Mine

1. Issuing of Farm Land Nationalization Act (39) (La Na -39) for the utilization of farm lands as mining purpose.
2. Preparation for compensation.
    (a) Organization of compensation committee
    (b) Field-work for the confirmation of farm lands and farmers
    (c) Defining the rate of compensation for farm land and trees
    (d) Reporting and waiting for confirmation for the compensation rate from the government.
    (e) Compensation
3. Submission to the Ministry of Home affairs for land grant
4. Receiving the land grant for the mining purpose.

Issuing of La Na (39) for utilization of farms lands for the mining purpose.

1. Ministry of Mines received La Na (39) for utilization of farm lands for the mining purpose (No.1 Mining Enterprise) Oct 18th January 2001 with reference No. 5/41-5(130)/Oo 6 from Sagaing Division Peace and Development Council. No.1 Mining Enterprise handed over La Na (39) to the Myanma Economic Holdings Limited (MEHL) on 5th March 2010. According to La Na (39), the total area (7867.78) acre include the following-

(a)	Registered permanent farm land	4826.70 Acre
(b)	Temporary farm land	230.80 Acre
(c)	Other land (Including mountain area, road and etc.,)	2810.28 Acre
	Total	7867.78 Acre

Preparation for compensation

2. Before carrying out the compensation work, MEHL (Copper Mine) studied the ground condition of the farm land with the help of local authorities and local Settlement and Land Record Department. Then MEHL submitted a letter to the regional authorities to organize a committee for compensation work with the letter of Ref No. 2/3/AhKhYa/Paing (3200/2012), dated on 12.10.2010.

(a) **Organization of Compensation Committee**

Regional authorities organized a committee for compensation of Letpadaung Copper Mine Project and it included two parts. One is Leading Committee and one is Acting Committee. In Leading Committee, the members are Regional Level officials and in Acting Committee, the members are district and township level officials including village heads of respective areas.

(b) **Field-work for the confirmation of farm lands and farmers**

Salingyi Township authority set up (3) teams for the field-work to check, confirm and record the ground situation of farm lands. According to the records of the (3) teams, the farm lands are increased up to (5487.27) Acre within ten years (2001 to 2010).

(c) **Defining the rate of compensation**

For the land compensation, 12 to 20 times of revenue is legal for compensation. But that amount is very little (only 5 to 20 kyats). So, compensation committee considered two ways for land compensation. One is to give the compensation according to the local average current price of land. It was approximately cost about (200,000 Ks to 400,000 Ks). Another way is to give the additional compensation depending on the type and selling price of the crops for (3) times (or) three year profit. It was cost about (525,000 Ks to 550,000 Ks) for one acre.

For the Land Compensation of the new villages' area, the compensation procedures are the same as in mine lease area, but the rate is not the same for two reasons. First reason is that areas are outside of mine lease. Second reason is that areas have better fertility than most areas in mine lease area. But the rates of trees compensation are the same for all areas.

(d**) Reporting and waiting for confirmation for the compensation rate from the government**

After defining the rate of compensation, compensation committee reported to the regional authority to get the confirmation. Regional Authority confirmed the rate of compensation as follows-

Approved rate of farm land compensation in Letpadaung Copper Mine based on (1) Acre

Sr.	Name of crop	Production rate (Myanmar Unit)				Annual Local Current price (Kyats)				Cost for (1) Acre	(3)Time of Cost
		Max	Fair	Poor	Average	Min	Fair	Max	Average		
1	Sesame	11	8	5	8	20000	23000	26000	23000	184000	552000
2	Sunflower	33	25	17	25	5000	7000	9000	7000	175000	525000
3	Pigeon pea	15	10	5	10	13000	18000	23000	18000	180000	540000

Explanation (1) Production Rate is based on the Local average production rate

(2) Current Price is based on the average annual price of local market

Compensation Committee calculated the amount of compensation for each farm depending on the land class and type of crops as mentioned above and total compensation was the sum of land revenue 20 times and 3 times selling prices of the crops as shown in annex-4.

Approved rate of compensation rate of trees in Letpadaung Copper Mine

Toddy Tree	=	5000 Kyat
Mango Tree	=	8000 Kyat

Explanation: Toddy trees are compensated with minimum height (9)ft.
Mango trees are also compensated when they have fruits

Note: Even the compensation rate was defined as above, at actual compensation it is done w rate of 1000 Kyats for Toddy trees and 16,000 Kayts for Mango trees.

(e) **Compensation**

Land and Trees Compensation for new village area

Four Villages were located inside mine lease area and they have to be needed to shift outside. Two place were selected as a new village area and land compensation was also done in (19.2.2011 to18.12.2012) as follows-

(1)	New Taungyar Monastery Area	-	(6.55) Acre	4,387,322.25	Kyats
(2)	Wet Hmay – Kan Daw Village area	-	(54.67) Acre	37,095,410.55	Kyats
(3)	Sete- Ze Daw	-	(58.25) Acre	39,493,045.05	Kyats
	Total	-	(119.97) Acre	80,975,777.85	Kyats

Kan Daw village was already relocated in new village with (97) houses and one monastery. Wet Hmay village shifted (67) houses and one monastery and (43) houses were remained to shift. Ze Daw village shifted (29) houses and (37) and one monastery were remained. Sete Village shifted (28) houses and (140) houses and one monastery are remained.

Tree compensation had already done for the new villages are as follow-

(1) New Taungyar Monastery Area	(10) Toddy trees,	100,000	Kyats
(2) Wet Hmay – Kan Daw village	(2722) toddy trees	13,610,000	Kyats
(3) Sete – Ze Daw village	(1542) toddy trees	7,710,000	Kyats
	(2) Mango trees	16,000	Kyats
Total	(4274) toddy trees and (2) Mango trees	21,436,000	Kyats

Some farmers did not receive the additional compensation for toddy trees (5000ks/tree) yet. Therefore some toddy trees in Wet Hmay- Kandaw village area are compensated in the rate of (5000ks/tree).

Total compensation for the new villages' area is 21,436,000Kyats and it was already done on (18.12.2012).

Land and Trees Compensation for mine lease area

(a) Land Compensation

Compensation farm land Area

Permanent Registered farm land - 4826.70 Acre compensation must be done according to land

Temporary Registered farm land - 230.86 Acre

Unlawful farm	-	1725.37	Acre	compensation was done according to the instruction of Authorities
Total compensation Area	-	6782.93	Acre	
Remaining Other Area	-	1084.85	Acre	Area including Mountains, village, Roads, Canals Monasteries etc.

Notes: Although Farmers cultivated unlawfully within mine lease area over (1700) acre within (2001 to 2010), Chairman of MEHL and Local Authorities instruct to compensate that lands with the same rate of previous compensation.

The first compensation for farmlands in mine lease area had done within (5-4-2011 to19-8-2011) and area is (5487.27) Acres and total compensation is (3,000,153,745) kyats.

After the first compensation, some farmers complained to the government to get the compensation for their un registered farm lands. Then regional government made the regional land record department to investigate the complained land whether they are actually farm lands or not. According to the report of land record department (1298.81) acre are to be compensated.

Therefore, the second compensation had done within (30-1-2012 to 6-11-2012), area is (1298.81) acre and compensation was (707,775,034) kyats. Finally all compensation was done on (6-11-2012) and total compensated area was (6786.08) acre and total compensation became (3,707,928,779) Kyats i.e.; over (3.7) billion kyats. And only (1081.7) acre remained. That means that the project shows its kindness to the native farmers even they were absent to register for their farmlands and even they were absent to give the land revenue to the government, they happily received the compensations, (at that time).

(b) Trees Compensation

Trees compensation for the mine lease area had done as follows-

(1) Toddy Trees	- (35815)No’s	(358,150,000) Kyats
(2) Mango Trees	- (188) No’s	(3,008,000) Kyats
(3) Thanakhar Trees	- (one Garden)	(1,900,000) Kyats
Total		**(363,058,000) Kyats**

(c) Auxiliary Compensation

Before land compensation finished, auxiliary or additional compensation were done for the survey works, drilling works in the beginning of mine developing period and some construction works as follows-

(1)	Compensation for the geological survey works	1,572,125 Kyats
(2)	Compensation for the electrical power line construction	355,142 Kyats
(3)	Compensation for the construction of workshop	2,120,575 Kyats

Total **4,047,842 Kyats**

Total Compensation of the Project

4. Total Compensation of the Letpadaung Copper Project is as follows-

(a) Farm Land Compensation of for mine lease area (6786.80) acre3,707,928,779.00 Kyats

(b) Trees Compensation of mine lease area 363,058,000.00 Kyats

(c) Land Compensation of New Villages area (119.97)Acre 80,975,777.85 Kyats

(d) Trees Compensation of New Village area 21,436,000.00 Kyats

(e) Auxiliaries Compensation for Mine Developing Works 4,047,842.00 Kyats

Total Compensation for the Project 4,177,446,398.85 Kyats

Sample Acknowledgement of compensations are attached with annex (1 to 3)

Submission to Ministry of Home Affairs for the land grant

3. After all compensation was finished, submission procedures we performed to get the long term land grant from the Ministry of Home Affairs.

Receiving the land grant for the Ministry Purpose

4. 60 years Long term land grant for Letpadaung Copper Mine was issued to MEHL by Ministry of Home Affairs on 3rd August 2012.

Annex-1

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the farm land

Date: . .20--

Hereby, I --------------------- sign and acknowledge that I give up my farm land to utilize as copper mine situated in the Letpadaung Taung Copper Mine Project Area at ------------------ group of village, ---------------------village and I receive the compensation as follows-

(a) Field No. --------------------------------
(b) Land Mark No. --------------------------------
(c) Area (Acre) --------------------------------
(d) Type of Land --------------------------------
(e) Additional compensation of crops --------------------------------Ks
Including (20) times of land revenue ( )

(Finger Print)

Payer (signature)		Payee (signature)	
Name	----------------------	Name	-------------------------
Rank	----------------------	Father's name	-------------------------
Dept.	----------------------	NRC No.	-------------------------

In The Presence of

Annex-2

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the Trees

Date: . .20--

Hereby, I -------------------- sign and acknowledge that I give up my trees for copper mine situated in the Letpadaung Taung Copper Mine Project Area at ----------------- group of village, --------------------village and I receive the compensation as follows-

(a) Type of Trees --------------------------------
(b) Number of Trees. --------------------------------
(c) Rate of Compensation --------------------------------
(d) Total Compensation --------------------------------kyats
(---------------------------------------)kyats

(Finger Print)

Payer (signature)		Payee (signature)	
Name	----------------------	Name	-------------------------
Rank	----------------------	Father's name	-------------------------
Dept.	----------------------	NRC No.	-------------------------

In The Presence of

Annex-3

(SAMPLE)

Acknowledgement of receiving the compensation

Date: . .20--

I am --------------------- who is living in ----------------------- group village,----------------------village, Letpadaung Taung Copper Mine Project had done ----------------------------- work on my farm land. For that purposes, Letpadaung Copper Mine project gave and I received ------------------------------- Kyats as compensation.

(Finger Print)

Payer (signature)		Payee (signature)	
Name	----------------------	Name	-------------------------
Rank	----------------------	Father's name	-------------------------
Dept.	----------------------	NRC No.	-------------------------

Date. -------------------------

In The Presence of

7. RESETTLEMENT ASSISTANCE AND LIVELIHOOD

Wherever possible, MWMCL has planned to avoid or minimize the displacement of people by exploring alternative project designs. Where displacement is unavoidable, MWMCL has planning to execute resettlement as a development initiative that provides displaced persons with opportunities to participate in planning and implementing resettlement activities, as well as to restore and improve their livelihood.

Sagaing Region, Monywa District, Sar Lin Gyi Township, Township Level Business Planning of Conveniently Moving 5 Monasteries and 4 Villages that are included in the LetpadaungHill Copper Mining Reject.

Introduction

1. Sar Lin Gyi Township, LetpadaungHill Copper Minning Project is implemented in Copper ration between Union of Myanmar Wan Bao Mining Copper Ltd. The 5 Mouasteries include in the Project and Wet Hmay Village shall be moved in a short time to New Accepted Buildings with the Quality Checked and this Business shall be started. In order that the Reverauds and Family Members of the 4 Villages may conveniently moved and placed to the New Places, this Planning is drawn.

News

2. At present Valley Wai Lu Wun Monastery is completed (100%) and wet Hmay. Kan Taw New Housing Project is completed (100%) and the Qualities have been already checked and when the needed repairs businesses are completed, the moving /placing businesses are known to be completed in levels.

So that the moving /placements Arrangements may be able to be systematically accomplished in business levels, Hse Te-Zee Taw Housing Project (Including Monastery Construction.) has already been completed to (76.76%) and it is constructed up to the 100% completion.

Therefore , as the first level of Moving/placements, and when the facts found out by the quality inspection team of valley Wai Lu Wun New Monastery and Wet Hmay, Kan Taw New Housing are repaired, and when these are handed area to District General Administration Department by Union of Myanmar, Myanmar Economic Holdings Limited, the systematic moving and placements shall be accomplished.

Aim

3. In order to be able to accomplish the moving placements conveniently and systematically in Business Levels.

Rough Planning

4. Is as follows;-

(1.) Fixing the Arrangements of 5 Moving Monasteries concerning Business to be accomplished Before / During / or After it.

(2) For Moving Family Members, Buildings, Materials, Animals, Before/During/After Businesses, Arrangements are fixed.

Detail Planning

5. Concerning the 5 Monasteries to be moved, Business Accomplishment Arrangement fixed in Levels are as follows –

(a) Businesses before Moving

(1) Township Sangha Nayake Reverend, Reverends from Monasteries to be moved must firstly be invited on a suitable date and enquire, negotiate the needs wanted by the reverends.

(2) To record the words of the reverends by the Township Religious Officer.

(3) Taking the Record of Remaining Materials for making the list of material by Union of Myanmar Economic Holding Limited and Township Religious Officer together with the list billeting tem.

(4) In the piling of materials, Pre arrangements are made with the case Management of Township Religious Officer and staff so as to cause least damages.

(5) Offering the supporting Money by Union of Myanmar, Myanmar Economic Holding Limited and negotiate and present the Department of Transportation program of the whole planning to the leading Committee.

(6) According to the preferential arrangement of moving/placement of 5 Monasteries the Recording of the Decision of the Lecturing Reverends.

(7) Report of Township Police Officer to Regional/District Police Officer to keep security Forces in advance.

(8) After Consideration of Project Director in all aspects of Moving 5 Monasteries to present The Leading Committee in concern with supply of vehicles, diesel/petrol and Finance.

(9) To present Ability of Financial Support Receipt of Permission Participation in the Business by Union of Myanmar, Myanmar Economic Holding Limited.

(b) **Business to be accomplished During Moving**

(1) When the vehicles, Machineries, Man Power Finance are at readiness for Moving by Union of Myanmar Myanma Economic Holdings Ltd and the Fixed date is received, the Detailed Arrangement for moving has to be addressed to the monastery reverends, to be moved according to Myanmar Buddhist Traditions by Township Administration Officer, Township Religious Officer, Township Police Officer, Township Sangha Nayaka and record the opinions of the reverend.

(2) To present the moving date through Monywa District General Administration Department to Regional Governmental Body and accept the Directives.

(3) In moving and transporting to the fixed new monastery from the original monastery, so that Man power, vehicles, Machineries may suit with the original place and new Monastery, Union of Myanmar, Myanmar Economic Holdings Limited has to arrange in advance.

(4) In transporting the Materials to be transported for old Monastery to new monastery the representatives who can take responsibility by township Religious office, Township Police Force, Union of Myanmar, Myanmar Economic Holdings Limited to scrutinize the materials.

(5) If difficulties are met on arrival at new monastery, concerning departments and Union of Myanmar, Myanmar Economic Holdings Ltd. has to fulfil it.

(6) Only after the satisfactory accomplishment for the Reverends of the monastery, to stop the business.

(c) **Accomplishment after business completion**

(1) In order to be smoothly solve the problems met during the use of moving transportation news, the business committee member have to go to the new monastery in turns and accomplish the needs of the Reverends.

(2) Each and every assigned responsible persons shall have report the business accomplishment reports to the leading team.

(3) According to the directive of regional governmental body and with the management District General Administration Department, to accomplish it by keeping on the watch.

Business arrangements concerning the moving family members, buildings, materials, animals

6. Fixed facts are as follows:-

(1) As the Union of Myanmar, Myanmar Economic Holdings Limited has already recorded the buildings of each moving family, the committees already formed have to check with the recorded photos whether the differentiated 4 types are in accordance (or) not and to record systematically and draw the detailed arrangement of placements.

(2) After checking according to the 4 types, the formed committee members with the management of Monywa District General Administration Department meet the Head of the families to be moved and village elders of that village and by explaining the moving/ placement arrangements in detail and accomplish the placement at the new building place and transfer according to law and record it.

(3) The arrangements for accomplishment of administration, support matters by the responsible persons assigned for financial support, transportation arrangements in moving the buildings to be moved which was given by Union of Myanmar, Myanmar Economic Holdings Ltd. Must be presented in detail.

(4) The formed committee members shall have to negotiate with the moving village elders, head of family and announce the fixed moving date and if there are needs in moving to solve them by combined negotiation.

(5) Before 10 days from the moving date, to widely distribute the announcement letter of administration's office to make moving arrangements by the families to be moved and to issue each and every house head of family for moving information.

(6) Township Police Officer leading team, Township information team, administration officers, and headmen in cooperation has to announce continuously in mornings, afternoons, nights by warning them.

(7) The Sub Committee that takes Responsibility in for Transportation in moving to the New Buildings, it has to calculate according to Houses and the Need of Vehicle in advance and negotiate in advance with Union of Myanmar, Myanmar Economic Holdings Limited.

(8) According to Houses to be moved and with the Management of Committees formed for the Pre-calculated Financial Supports, Union of Myanmar, Myanmar Economic Holdings Ltd has to give the Financial Support in advance.

(9) On the Proposal put up by the Transportation Committee, in order to systematically transport the Moving Family Member and Buildings, it has to present to the Leading be supported by the Union of Myanmar, Myanmar Economic Holdings Ltd, with Man Power, Vehicle Strength, Retrial/ Diesel Strength.

(10) In order to pile the Original Building and Materials, to form the Material List Collection/ Maintenance/ Transportation team in advance.

(11) Because these are Government Departments it has to request the Directives of the Upper Levels of offices by the Concerning Department Head of Township Level and present the facts wanted to be accomplished to the Planning Heads.

(b) **<u>Business Accomplishments to be made are as follows : -</u>**

(1) So that the Piled Materials may not be remained, to record by the List Collection Maintenance / Transportation Team and accomplish by separately giving duties so that there shall be no loss.

(2) In transporting by Transporting Vessels, it has to be managed by Business it has to be managed by Business Committed so that it may be systematic.

(3) In order not to lost Piled Materials, Township Police officer has to make the Security Planning separately and accomplish systematically.

(4) On the day of Starting to Transport Piled Materials, Economic Holding Ltd has to arrange in advance at the Original Place and the Fixed Housing Place so that the Vehicle, Manpower may be enough.

(5) With the Strength of Township Development Committee, Township Public Works Corporation and Departmental Strength, to mark whether the list of Piled Materials and Materials arrived at the New Housing are the same (or) not and help in the transfer / acceptance.

(6) By systematically accept the moved Family Members and Materials and the Difficulties of the Family Members have to be reported to Fire Brigade Force, Red Cross and Township Veterans Organizations.

(7) If the Moving Families have Difficulties that are met, in order to be able to settle it, the Business Committee Members have to go in turns and settle it at the suitable Convenience.

(c) Business Accomplishments after Moving

(1) Family Members who have moved to New Houses shall be issued as the Special Matter by Township Immigration Department, National Registration Department and issue Citizen Scrutiny Cards and Form (66/6) Household Member Lists.

(2) Moving Family Members, as Arrival at the New Housing, So that there should be no disturbance by Unwanted Elements Security shall be taken by leading Team of Township Police Force.

(3) Only to stop the Accomplishments of Security Arrangements of the Family Members after receiving the Directive of the Leading Committee of the Whole Planning.

(4) All those Assigned Persons have to make reports of Business Accomplishments to the Leading Committee with Facts / Tables as well as to the Own Department Head.

(5) Moving Families and Materials are Moved and Place by the Township, Final Report has to be compiled and put up to Regional Governmental Body through District General Admin Dept.

Forming Respective Committees

7. (a) Committee for moving the monasteries and 4 villages included in Letpadaung Hill Copper Project is formed as the following.

1.	All Township Sangha Nayaka Reverend	Chairman
2	Reverands of monasteries from 4 Villages	Chairman
3	U Khin Maung Hsan District	Chairman
4	U Zaw Min Han, Township Admin	President
5	U Nay Lin Kyaw, Factory Manager (Sar Lin Gyi)	Member

6	Township Police Office	Member
7	Project Incharge	Member
8	Staff Officer (Project)	Member
9	Staff Officer (Immigration)	Member
10	Staff Officer (Co-op)	Member
11	Township Manager (Cotton)	Member
12	Township Manager (Bank)	Member
13	Township Medical Officer	Member
14	Township Education Officer	Member
15	Post Office Sipin (Communication)	Member
16	Township Manager (Agri)	Member
17	Staff Officer (Mechanised Agri)	Member
18	Staff Officer (Land Records)	Member
19	Staff Officer (Infor)	Member
20	Executive Officer (Sipin)	Member
21	Township Engineer (Pa Has Nga)	Member

Business Duties are fixed as follows: -

(1) To cooperate and negotiate so that the moving monks, novices, religious buildings, family members, buildings may conveniently be transferred can be done conveniently, smoothly and with full contentment.

(2) Directed to draw planning for security matters by Township Police Force.

(3) Before/ during/ After moving and placements periods, to cooperate timely with business committees.

(4) If urgent matter happens to cooperate and combine with the above/below forces and planning made by the Township Police Officer.

(5) In order that the whole planning may be succeeded, the financial need must be calculated in advance and negotiate with Union of Myanmar Economic Holdings Ltd. is advances.

The moving and placement committee for monasteries and religious buildings

8. It is formed as the following

1.	Township Religious Officer	President
2	Factory Manager (Cotton and Cloths Factory)	Member
3	Staff Officer (Co-op)	Member
4	Staff Officer (Forest)	Member
5	Staff Officer (Project)	Member
6	Staff Officer (Fire Bridge)	Member
7	Township Electrical Engineer	Member
8	Union of Myanmar Myanmar Economic Holding Ltd.	Member
9	Staff Officer (Greening)	Member
10	Staff Officer (Industrialized Agri)	Member
11	Township Manager (Bank)	Secretary

Fixing business duties

1. To implement according to directives of Township Leading Committee
2. As it is the matter of building religion whenever accomplishments are made, to accept the words of the Township Sangha Nayaka Reverand and make accomplishments.
3. Before/During/After moving, the businesses to be accomplish must be done without any gap and make accomplishments by taking the departmental staff.

4. If there are business and financial difficulties in business accomplishments to present in advance to leading committee.
5. To manage so that there may be no injury lost during transportation with vehicles
6. To accomplish the loading up/down system systematically on arrival at new village.
7. Make aim to the contentment and happiness of the reverends that have to move.

Settlement Committee for the families, buildings, properties and animals to be transferred

9. It is formed and assigned as below -

(1) U THAUNG MYINT: Executive Officer, Development Committee: Chairman

(2) U SOE SHWE: Head of Department, Land Records : Member

(3) DR.KHIN KHIN TUN Head of Township Health Department Member

(4) DAW SAN SAN YEE Audit Officer, Township Accountancy Office Member

(5) DAW MYINT MYINT KYI Township Education Officer Member

(6) DAW KHIN WIN KYI Head of Dept, Information/Public Relation Member

(7) DAW THEIN THEIN MYINT Engineer, Public Work Member

(8) U TINT WAI Head of Post Office Member

(9) U NYI NYI HTWE Tactic Master, Sport/Physical Education Member

(10) U TUN AUNG Telephone Member

(11) Captain AUNG KYAW KYAW(retd.) UMEHL Member

(12) DR. THAUNG SEIN Veterinary/Husbandry Member

(13) All rural clerks Member

(14) All surveyors (Site In-charge) Member

(15) Heads of Village Administration concerned Member
(Ywashae, Phaungkatar)

(16) U AUNG THAN OO Township Manager, Cotton/Sericulture Joint Secretary

(17) Dy. Police Commander TUN OO Head of Township Police Force, Myanmar Police Force Secretary

Assignment

It is assigned as follows –

(1) To implement the instructions of Leading Committee.

(2) To carry out systematically the works to be performed before transfer, while transfer and after transfer without any gap and to help extracting employees from the department concerned.

(3) To present ahead to Leading Committee if found difficulty in work and financial problems.

(4) To schedule the families, buildings, properties and animals to be transferred currently and present to Leading Committee.

(5) To control not to happen any injury and loss while carrying with vehicles.

(6) To coordinate ahead with Holding in order to fulfil requirement of vehicles and labour power and plan to be fair power in the housings to transfer.

(7) To control loading in/off while reaching new village.

(8) To solve the problems of families arrived in new housing and to fulfil what they require.

(9) To carry out for the families to be transferred to be running smooth everything in peace.

(10) To serve the duties assigned separately.

Transport Committee

10. It is formed and assigned as follows -

(1) Sub-Inspector of Police TUN OO — Head of Township Police Force — Chairman

(2) U TIN AUNG MOE — Head of Dept, Township Fire Services Dept. — Member

(3) U HLA WIN — Asst.Factory Manager Thread and Textile Factory (Sarlingyi) — Member

(4) Captain WIN NYUNT OO (retd.) — Thunder Salphurid Acid Factory — Member

(5) U KYAW NYUNT — Chairman (MaHtaTha) — Member

(6) U AUNG MYINT TUN — MaHtaTha — Member

(7) U ZAW WIN — Engineer, Nyaungbingyi Power Station — Member

(8) U THEIN ZAW — In-charge, Water Resources (Nyaungbingyi) — Member

(9) U KYAW THU LAT — HTOO Construction Company — Member

(10) Captain AUNG KYAW KYAW (retd.) — UMEHL — Secretary

Assignment

It is assigned as follows -

(1) To draw a plan and report back for receiving vehicles enough for properties and animals of (5) monasteries and (4) villages to be transferred.

(2) To calculate financial requirement for transport and present to Leading Committee.

(3) To solve the duties assigned separatly by Leading Committee.

Security Committee

11. It is formed and assigned as follows -

(1) Dy.Superintendent of Police TUN OO — Head of Township Police Force — Chairman

(2) DAW WAH WAH SWE — Township Judge — Member

(3) DAW KHIN SWE TUN — Township Law Officer — Member

(4) U TIN AUNG MOE — Head of Dept, Tsp Fire Services — Member

(7) U KYAW SOE OO — Security Officer, UMEHL — Member

(8) U WIN OO TIN — Company Commander, Township Reserved Fire Services — Member

(9) Sub-Inspector of Police THEIN AUNG — Station Officer, Nyaungbingyi Police Station — Member

(10) Heads of Village Administration (Ywashae, Phaungkatar) — Member

(11) Heads of ten/hundred-house concerned — Member

(12) Inspector of Police HLA NGWE — Station Officer, Sarlingyi — Secretary

Assignment

It is assigned as follows -

(1) To take security with enough security power in former places and new housings and religious buildings for transferring (4) villages.

(2) Head of Township Police Force is to preview destruction and harassment to be appeared up in transferring houses paying attention up to use power and act in accord with the laws.

(3) To coordinate ahead with armed forces in accord with police procedure to have power of armed forces, if necessary.

(4) To pay special attention not to appear any unnecessary case absolutely because Letpadaung Hill Copper Project is the work of good-will between Republic of the Union of Myanmar and People's Republic of China.

(5) To serve the duties separately assigned.

Information Committee

12. It is formed and assigned as follows –

(1) DAW KHIN WIN KYI Head of Information/Relation Chairman

(2) Sub-Inspector of Police THEIN AUNG Station Officer, Nyaungbingyi Police Station Member

(3) Telecommunication Officer from UMEHL Member

(4) Heads of Village Administration (Ywashae, Phaungkatar) Member

(5) Heads of Hundred-House from (4) villages Member

(6) U TIN SAUNG Elder of town Member

(7) U NAY WIN AUNG Elder of town Member

(8) U TIN WIN Asst.Education Officer Secretary

Assignment

It is assigned as follows -

(1) To implement the instructions of Leading Committee.

(2) To carry out systematically the works to be performed before transfer, while transfer and after transfer without any gap and to help extracting employees from the department concerned.

(3) To draw information letter (draft) for transferring (4) villages and present to Leading Committee.

(4) To announce in a row day and night as stated in announcement with effect from the instructing date of Leading Committee after confirming Announcement (draft).

(5) To plan head for receiving hand-horns and walking talkies enough.

(6) To demarcate as necessary for information and Holding is to plan for receiving loudspeakers enough.

(7) To present ahead to Leading Committee if found difficulty in work and financial problems.

(8) To serve the duties separately assigned.

Forming office staff

13. Office staff is formed as follows for exactly recording with right schedules and lists and running fast in performing works -

(1) DAW SAN SAN YEE Auditing Officer Head of Office

(2) U SOE THU Dy.Head of Dept.(General/Admin) Dy.Head of Office

(3) Sub-Inspector AUNG NAING MYINT Police Force Office of the Head of Township Member

(4) U WAI PHYO AUNG Township Planning Member

(5) U NGWE AUNG Development Bank Member

(6) U KO KO GYI Land Records Member

(7) 2 staff-members from Holding Member

(8) U KYAW ZIN LAT Township Dy.Asst.Engineer Member

(9) U AUNG KYI SOE Township Engineer Member

(Development Committee)

(10) U SAN NAUNG Education Member

Assignment

(1) To successfully implement the instructions of Township Leading Committee.

(2) Giving necessary advices, preparing chief accounts, making chief accounts for the whole project in each village, preparing in time and presenting to Leading Committee in time.

(3) To present difficulties in work and financial problems to Leading Committee.

(4) To record stores in ledger/cash book.

(5) To prepare account clearance statement

Administration

14. Head of Township Administration shall control and supervise under the instructions of the Cabinet of Region and Monywa District General Administration Department.

Telecommunication

15. Telecommunication shall be done as below -

(1) Head of Township Administration 09-47095456

071-70099

(2) Lt.Col. MYINT AUNG (Retd.) 09-6452262

(3) Deputy Superintendent of Police TUN OO, 09-49232254
Head of Township Police Force

(4) U THAUNG MYINT, Executive Officer, Development Committee 09-47058398

(5) U SWE YEE, Manager, Development Bank 09-6450942

(6) U AUNG THAN OO, Manager, Cotton and Sericulture 09-47058326

(7) U THEIN KYAING, Head of Staff, Forest 09-49216251

(8) U AUNG SOE, Head of Staff, IMPD and National Registration 09-6451423

(9) Captain KYAW HLA MOE (Retd.), Holding 09-47053728

(10) Captain AUNG KYAW KYAW (Retd.), Holding 09-49291189

(11) U SAW WIN CHIT (Holding) 09-47054737

(12) U KYAW THU LAT 09-43041212

(13) Walking talkies (10) Nos.

Project Period

16. Project period is fixed with effect from 27th November 2011 till successful completion.

Conclusion

17. Letpadaung Copper Project is a joint venture business between Myanmar Economic Holding Limited and Myanmar Wanbao Mining Copper Ltd. It is the biggest copper project in Myanmar. It will make good income for the State and more job opportunities for local people. As it is also the work of good-will between Republic of the Union of Myanmar and People's Republic of China, it is reported that all staff-members inclusive in project will serve in balance in each step of project considering as a National Task for the monks, novices and families to be transferred.

8. BUDGET AND IMPLEMENTATION SCHEDULE

MWMCL's budget and implementation schedule for the Resettlement Action Plan of the 4 old villages of Wethmay, Kandaw, Sede and Zee Daw is outlined in this section.

Accomplished Arrangements Condition

In moving to the new villages

1. Depending on the houses resided in the old village compensation support for the damaged building is calculated at 1 sq.ft. Rate of the building.
   (Minimum K 35000/- to maximum K 1000000/- ten lakhs)
2. If there are needs in the houses of the new village, so as to be able to repair on own satisfaction, the support money K 10 lakhs (A-type), K 8 lakhs (B-type), K 6 lakhs (C-type) and K 4 lakhs (D-type) is given depending on the type of houses.
4. Plastic round table (3ft diameter), mesh cover for covering food donated by the project at 1 set each for every family.
5. The electric meter cost fitted at the houses in the new village and the fitting cost K 85500/- was supported to family members who moved into the new village.
6. The dismantling and moving and sale of houses in the old village was accomplished according to the wilful contempt of the villagers.
7. Arrangements were made with motor vehicles for transportation of materials, buildings in the old houses in moving the villages, without any labour charge for loading up/down of materials.

General Expenses List of

Land Compensation, Perennial Crops Compensation, Moving of Villages,

Up to 15.3.2013 for

Letpadaung Hill Copper Mining Project

*	Land and crops compensation of (6786.08) acres of Agriculture land and other land	370, 7928,779.20
*	Compensation for new valley monastery and perennial Crops of 2 new villages	21,436,000.00
*	Land/Crop compensation for new valley monastery and 2 new villages	80,975,777.85
*	Compensation for perennial crops within mine area	363,058,000.00
*	Building compensation for (3) monasteries and (4) New Villages	71,171,800.00
*	Construction Expense of New Monastery and (2) New Villages	5,776,192,852.00
*	Transportation expenses of moving villages	15,391,900.00
*	Support for moving and building renovation expenses	125,200,000.00
*	The giving condition to monasteries and families in New villages (meter costs) and (metre assemblies)	19,579,500.00
*	Expenses for religious and social accomplishments	660,617,860.00 and FEC 9,651.48
*	Compensation for the land included in construct of road from Kye Sin Hill, Sabei Hill Copper Mines to Letpadaung Hill Copper Mine Connection of 16.21 acres of land ----------------------	8,948,065.20
	Total kyats	10,850,500,534.25 and FEC 9,651.48

This is only up to 15.3.2013 and the expenses after Investigation Commission report are not included. The expenses during Implementation Committee period is still on on-going process.

9. ORGANIZATIONAL ROLES & RESPONSIBILITIES

Activity Description	MEHL & Government	MWMCL Corporate Management	Community Relations Manager	Community & Stakeholders
Develop RAP and implement	R	A	I	C
Construct and install new villages and facilities (schools etc.)	R	A	I	C
Construct new monasteries	R	A	I	C
Manage Land Compensation payments	R	A	I	C
Monitor Relocation Process	R	A	A	C
Manage Grievance Process	C	C	R	A
Consultation with Affected people	C	C	R	A
Manage Village Assistance Benefits & Programs	C	R	C	C

R = Responsible / Accountable: The person(s) who is ultimately answerable for the execution and results of the activity.

A = Assisting / Attending: The person(s) who assists in the execution of the task and/or attends a meeting.

C = Consulted: The person(s) to be consulted during the decision making process. A two-way communication.

I = Informed: The person(s) who need to be informed after a decision is made or action taken. A one-way communication.

Overall responsibility for the implementation of this Management Plan shall rest with the Project Environment Manager who shall report on progress to the Project General Manager.

10. CONSULTATION AND PARTICIPATION

Goals and Key Objectives

The primary goal of the Public Consultation and Disclosure Plan (PCDP) for early works and full scale production selection was to engage key stakeholders in the decision-making process for accepting determined sites, and to reach consensus with key stakeholders on the most appropriate sites with respect to environmental, social, and health issues for the Letpadaung Project. The key objectives of the site selection PCDP were to:

- Introduce the Letpadaung Project
- Demonstrate the Letpadaung project's commitment to PCDP
- Lay the foundation for future stakeholder participation
- Identify key issues, concerns, and expectations for future phases of the project
- Manage stakeholder expectations

The site selection PCDP was split into two rounds of consultation. The key objectives of the first round of consultations were to:

- Share Letpadaung Project information
- Discuss location options
- Collect feedback on the site selection process

The key objectives of the second round of consultations were to:

- Explain in clear and sufficient detail the nature of the project
- Confirm or validate the information gathered in the previous consultation rounds and survey work
- Deliver further information on the potential environmental, social, and health impacts of the project
- Explore the key issues and concerns of stakeholders regarding potential project impacts that are relevant for site selection
- Based on the information gathered and studied, discuss the preferred site for the project

10.1 Project Information & Grievance Centre Planning

Project Information Centres are currently in the planning stages to be set up in several locations surrounding the Sabetaung, Kyisintaung and Letpadaung mine areas. Due to the large number of villages, 35 independent collectives, there will be a unification of some of the villages that have current friendly dispositions towards each other.

Ideal planning of these centres would be to locate 2 full capacity Information Centres, individual

for each mine. One will be located at the main gates of MYTCL and the other at the main gates of MWMCL. Open daily from 09:00 to 12:00 and 14:00 to 17:00 five days a week (Sunday to Thursday), the Centres will employ five full-time workers to provide information about the projects to visitors to the centres. Visitors can submit questions in writing, receiving written responses in both Myanmar and English languages.

Information at the Letpadaung Centre is anticipated to experience the most number of visitors, and in particular, grievances. In order to accommodate this Project Information Sheets and News Updates, as well as a Project brochure will be available. There will be a sequential poster displayed on the wall explaining the Project's activities, an exhibit of the Copper Mine's products, and if possible a model of the potential mine. Information in the form of a PowerPoint Presentation or a video documenting the potential social and environmental impacts and benefits of the Project will be developed for viewing at the Wanbao Centre.

A visitor's book will be made available for personal comments on the project, and again it is anticipated that this will be the basis for much of the grievances. Issues based on compensation, employment and environment will most likely be the common denominator for reply.

Village Based Information & Grievance Centre Planning

Due to the distances of many of the villages from these centralized Centres, it would be in our best interest to provide smaller unmanned stations for the collection of grievances or inquiries. Planning for Drop-boxes at safe locations within the villages are a possibility.

All Information Centre Planning is still in the planning stages.

Currently the CSD Team is the open channel of communication to retrieve complaints, requests and even gratitude towards the Projects. All are being documented daily.

10.2 Project Information Sheets

An information pamphlet (10.2.1) was designed to address the immediate issues that were raised on a general basis from the villages surrounding the Letpadaung Mine. It was also distributed to the S&K mine villages to give a universal message.

Available in the local Myanmar language, the pamphlets were distributed by the CSD Team along with a questionnaire (10.2.2) (10.2.3) regarding demographic individual information, job status, income levels, housing, as well as needs for basic necessities such as water, electricity and job opportunities. These pamphlets were distributed village by village upon a personal invitation letter composed by the CSD Team.

The process of distribution was as follows.

1. Letter of invitation sent out with corresponding CSD Team member from each of the 29 existing and cooperating villages.

2. Letter returned, signed by the village administrator or representative.

3. Appointment arranged through the CSD Team member.

4. Visit engagement.

5. Record of grievances and collection of survey questionnaires.

6. Creation of database.

This first pamphlet also provided a brief of the early works stages and overview of the Project, aimed at promoting the Project through detailing potential benefits, and showing commitment to keeping stakeholders informed of the Project's development through the provision of answering frequently asked questions. A list of potential job opportunities also was included to inspire acceptance of the restart to the Letpadaung Project.

10.2.1 CSD Pamphlet 1.

ENGAGE

COMMUNICATE

PARTICIPATE

WORKING TOGETHER

ACHIEVING A COMMON GOAL

BUILDING OUR FUTURE

HELPING EACH OTHER

GROWING FOR A BETTER TOMORROW

THE LETPADAUNG MINING PROJECT
&
OUR COMMUNITY & SOCIAL DEVELOPMENT PLANNING
CSD TEAM

INTRODUCING THE CSD TEAM

It is our pleasure to introduce to you the CSD Team consisting of 40 members that will begin consultations with the villages surrounding the S&K&L Projects.

FIRST CONTACT

One representative from each of the neighboring 30 villages have been hand selected by the communities to create this team who will engage in direct communications with our village friends. We will first come to your villages by invitation, and we are very happy that you will accept us to come and speak to you about the future of your village, our mining company and how we will grow together towards a better tomorrow.

WE WILL COME IN A SMALL GROUP OF 5 OR 6 PERSONS

Our CSD Team wants to make contact with you to hear what you really have to say from your heart, and not from the mouths of those people who do not live in your village. We want to speak to all of you... women, children and men both young and old. We want to open the channels of communication between us so that we understand how we can help each other through the times ahead of us all.

The Letpadaung Project will move forward. There is no question about this truth. As a community we must now understand how it will affect us all, and what we must do to make certain that the environment, the people of all the communities and the businesses in our areas continue to grow after the mine has completed operations years from today.

TODAY WE MUST SPEAK TO EACH OTHER ABOUT TOMORROW

The future ahead of us is very promising in many ways. With the mine will come job opportunities, business opportunities, education, infrastructure, funding to government facilities and community projects so very needed such as water, electricity, medicine and so much more. There is nothing to fear.

How the CSD Team Will Work For You

The CSD Team is part of your community. They are the people from your villages. They are your family, neighbors and trusted friends. They are going to come and speak to you and are there to listen... to take back the information you give to them... to discuss with the company your questions or needs... and they will return to you with answers as quickly as possible. They will then work together with you to accomplish your goals. The CSD Team works for you too.

Construction Will Begin June 15

We want you to know our every move from this point forward, and if, or how it might affect you, and what we are going to do if it does. On June 15th there are 6 areas where we will begin construction works on a small scale. These will mostly be out of sight as they are within the middle of the mountain range. They are just normal construction works as you see all the time. We have completed the intital Environmental Impact Assessment on these areas, and we know that there will be no impact to the Baseline Study that is now being conducted by a third part and the International Environmental Engineering Company of Knight Piesold Australia. **Knight Piesold is creating Environmental Management Plans for these areas of Early Works for us to follow.**

Construction Plans

1. **Fuel Station**
2. **Explosives Bunker Buildings and Safety Area**
3. **Offices/Warehouses/ Maintenance Area**
4. **Mobile Crusher for Quarry**
5. **Access Roads**
6. **Conveyor Foundation Blocks**

We have given a map to the CSD Teams to show you the locations of these areas.

Job Opportunities

With the beginning of the construction works we will have a wide variety of jobs that will become available. Our CSD Team has a questionairre to help us find those people to fit the new job opportunities. There are many construction jobs that everyone can do, and there are some jobs that require higher levels of education. Here is a list of how many jobs and what types will become available once construction period begins June 15th.

After Restarting in the Construction Period

	Q1	Q2	Q3	Q4
Administration	3135	36	37	
Logistic	283	298	332	326
Technicians	48	50	50	51
Operators	679	759	804	837
Repairmen	113	140	152	299
Labour	492	709	766	667
Securities	200	207	217	201
Others	87	103	103	94
Total	1933	2301	2460	2512

Our Future Together

We hope that you have as much hope for the future as we do, and we thank you for taking the time to welcome our CSD Team into your village, into your home and into your life as we begin our work together to making a sustainable future.

Thank You :)

10.2.2 Job Opportunity Questionnaire 1.

NO.

Date: 2013

(Village No: 01-34; Household No. 001-999; Individual No. 1-9)

Job Opportunities Questionnaire

Consent for Job opportunity questionnaire

We are collecting data from the villages in order to know your interests, your current job opportunities and your suggestion that can enhance our project's staff recruitment process, and also any other areas that need to be improved.

This questionnaire usually takes only a few minutes to complete. Any information that you provide will be kept strictly confidential. Your participation is voluntary and you can choose not to answer any or all of the questions if you choose. However, your participation is very much important for the company to do further improvement to give sustainable benefits to the villages.

Note: Only those who are interested in applying for jobs at MYTCL and MWMCL are requested to complete this questionnaire.

Respondent Name……………………..... Gender……………………..

Age………………………......……………………..... Village……………………......

House Type……………………………………… Address……………………….

Telephone ……………………....…………………….

Q1) What are family member's education status?

(A)Primary School …………… (B)Middle School ……………. (C)High School …………….

(D)College, Diploma, Graduate ………………

Q2) Respondent's Marital Status……………………………………………..

(A) Single (B) Married (C) Divorce (D) Widow

Q3) Choose one of your most professional skills?

(A) a plumber; (B) Electrician (C) Mechanic (D)Logistics & Maintenance

(E) Gardener (F) Construction Worker (G) Welder (H)Unskilled Labour

(I) Cleaner; （J） Bricklayer; (K) Machine repairer; (L) Others ……………………

Q4) How long have you been working that professional?

(A) 0 - 1 Years (B)1 - 2 Years (C)2 – 3 Years (D) 3 Years and above

Q5) What are the types of work for income in your family?

(A) Agriculture (B) Daily wages worker (C) Monthly wages worker (unskilled)

(D) Monthly wages worker (professional) (E)Others ……………………………….

Q6) What is your family's total monthly income?

(A）10000 – 50000 (B) 50000 – 100000 (C) 100000 – 150000 (D) 150000 and above

Q7) Are you satisfied with the project's basic salary (FEC 110)? (Note: The basic salary may be varied from rank by rank)

(A) Yes (B) No

Q8) What is your suggestion on project job opportunity? (Use other side to comment)

10.2.3 Village Situation Analysais Questionnaire 1.

NO.

Date: **2013**

(Village No: 01-34; Household No. 001-999; Individual No. 1-9)

Villages Situation Analysis Questionnaire

Consent for Village Situation Analyses Questionnaire

We are conducting survey of the village situation and community's concerns on the mine project that going to be implemented soon. We also would like to ask some questions about your family livelihood situation. The gathered information will be given to the company for further consideration.

This questionnaire usually takes 15 – 20 minutes to complete (adjust as appropriate). Any information that you provide will be kept strictly confidential and will not be shown to other people. Your participation is voluntary and you can choose not to answer any or all of the questions if you want. However, your participation is very much important for the company to do further improvement to give the best benefit to the villages.

………

Respondent Name ……………………………………..

Household head Name ……………………………………..

Relationship of Respondent and HH head …………………………………….

Marital Status …………………………………….

Age (year) …………………………………….

Village Name …………………………………….

Contact Way …………………………………….

Q1) How many members are in your family? …………………………..

Q2) How many children and adults are living in your household?

Age	Male	Female
0-6		
7-18		
19-60		
Above 60		

Q3) Did all school age children attend regularly in the past academic year?

(A) Yes (B) No

Q4) If no, what was the main reason for these children not attending school?

(A) Sickness / Handicap

(B) Can't afford to pay school fees, uniform, textbook

(C) Can't pay transportation / far away

(D) No boarding school available

(E) Children work for the family

Q5) Type of house

(A) Brick wall and zinc roof (B) two story's wooden house with zinc roof

(C) One wooden storey with zinc roof (D) Bamboo sheet house with zinc roof

(E) Bamboo sheet house (F) Toddy Palm house

Q6) –Are you satisfied with the new built houses?
(A) Satisfied
（B） Basically Satisfied
(C) Not Satisfied
(D) Do not care

Q7) What is your average monthly income?

(A)	10000 – 50000
(B)	50000 – 100000
(C)	100000 – 150000
(D)	150000 and above

Q8) What is your main source of income?

(A)	Daily wages
(B)	Vendor
(C)	Monthly wages
(D)	Farming
(E)	Animal Husbandry
(F)	Trading
(G)	Other ………………………………..

Q9) How many family members work at Myanmar Yang Tse and Myanmar Wanbao?

(A) 0 (B) 1 (C) 2 (D) More than 2

Q10) If no one works for the company, what is the reason?

(A) No trust of company (B) Low salary (C) No knowledge to apply (D) Failed Interview

(E) Other …………………………

Q11) What is the land area that was occupied?

Acre____________________

Q12) How much land do you have left?

Acre____________________

Q13) Have you received land compensation?

(A) Yes (B) No

Q14) If not yet received it, what is the reason?

(A) In the process of land ownership evaluation

(B) Less than the market price

(C) Not compensated according to the type of land

(D) Different perceptions among the villagers (pressure not to)

Q15) Please give some suggestions about the project development (environmentally and socially) to improve project surrounding areas;

(A) investment in community aid
(B) investment in living infrastructure
(C) investment in public service
(D) investment in environmental protection

Q16) Do you think the transparency is enough? What is the best way to improve transparency?

(A) linkman to inform regularly
(B) improve public consultation
(C) report to local authorities regularly
(D)

Q17) What is the biggest difficulty in your village?

(A) power
(B) water
(C) medicine
(D) education
(E) hygiene
(F) entertainment
(G) cultural life

(H) other

Q18) What is your acceptance of these mine projects?

(A) Understand and accept
(B) Not Understand but accept
(C) Understand but not accept
(D) Not accept
(E) Other……………………..

Q19) What are your friends and relatives' acceptance on these mine projects?

(A) 100% understand and accept
(B) 50% understand and accept
(C) 30% understand and accept
(D) Not agree
(E) Other…………………………

Q20) How much do you know about these mine projects' environmental and social impact in your villages?

(A) A little
(B) Some
(C) Well enough
(D) Don't know

Q21) Do you have any other suggestions? If yes, please describe.

………

………………..

………

………………..

………

…………………

10.3 Attitudes towards the Project

In the early consultation and fieldwork stages, directly affected people were initially in support of the Project, this was mainly due to a clouded vision that the Letpadaung Mine would ever go into full production. This attitude took a very abrupt turn once activities escalated, and mining progress began to infringe on farmlands without free and prior consent.

Fair compensation for lands became the primary concern, and due to an uprising Myanmar Wanbao Mining Copper Limited chose to halt all activities and to consult with the government authorities to find a solution.

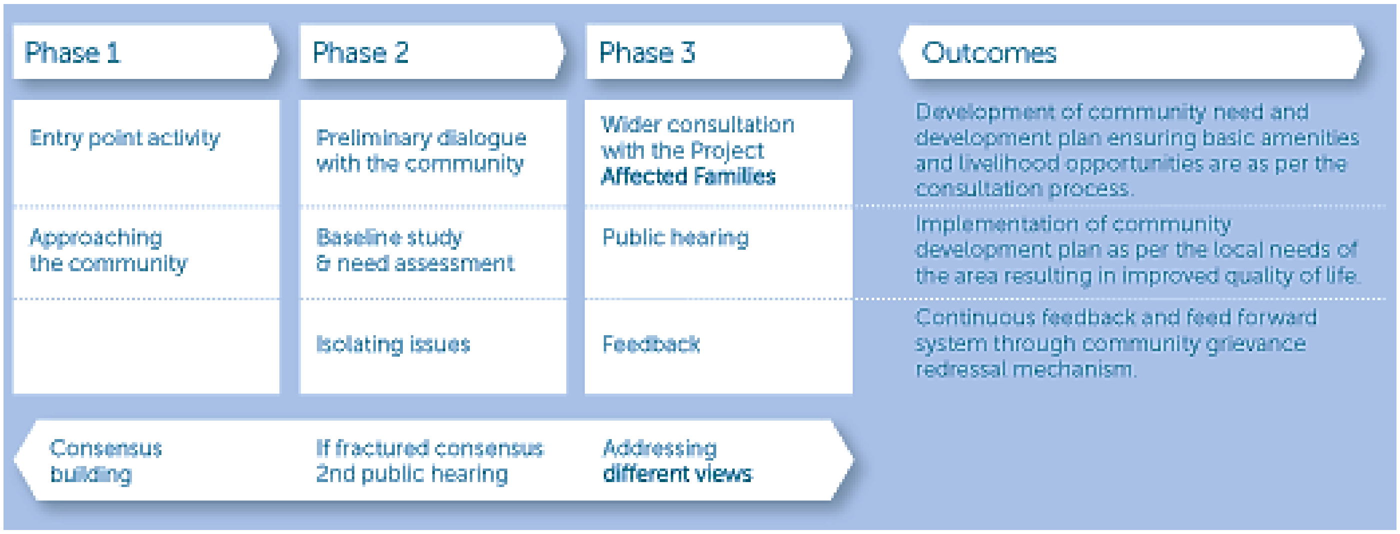
Through interactions with the CSD Team the consensus has been that the Project is a benefit to the locals, providing high paying job opportunities and upgrading their current way of life. Industrialization is an accepted idealism.

More recently some discontent around the Project has become evident amongst a sector of students provoking the halt to the entire project. Organized through undetermined committees, activities have been in disruptive as well as peaceful and legal demonstrations. Distribution of pamphlets, organized public meetings and refusals by households to relocate to newly constructed villages have interfered with the resettlement planning.

Community opposition occurs in any large-scale development, those with substantial resettlement components typically being particularly contentious. In response to the recent display of discontent, MWMCL has increased levels of consultation on all appropriate levels, and particularly with those who seem most concerned about Project developments, including community leaders and government officials of the Implementation Committee (IC).

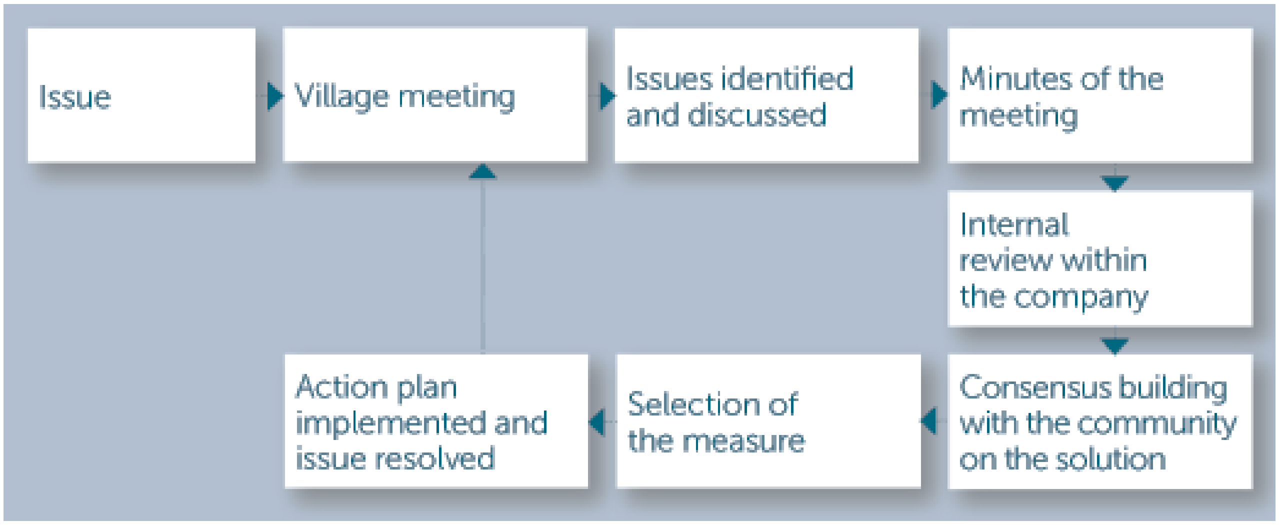
Regular meetings have been set in place to report all progress to the IC, following a detailed timeline to complete an ESIA simultaneously with early works of construction that will not interfere with any Baseline data collection, nor interfere with any environmental aspects.

10.4 Consultation with Host Area Communities



Our consultation approach: building community understanding

Both Myanmar Yang Tse and Myanmar Wanbao Mining operations are very well established, and have a consistent and open dialogue process in place through various platforms, and building and nurturing relationships with communities near our ongoing operations will continue. We continue to work to understand the concerns of our neighbouring communities and endeavour to closely manage them. We also work to ensure that all consultations occur in a culturally sensitive manner, in local languages where possible and in a collaborative and open manner. As shown in the diagram on below, the process is one of continuous consultation, which is ongoing throughout the life of the project, and its closure.



How we resolve issues

10.5 Resettlement

We firmly believe in avoiding forced evictions or involuntary resettlements whenever possible.

While the planning and implementation of mitigation measures for resettlement and rehabilitation cannot guarantee complete success on each occasion, we are committed to minimizing the negative impacts, such as stress generated by the land acquisition and resettlement processes, by adopting such project design and location alternatives that reduce the number of people potentially affected and that minimize the severity of potential impacts.

To guide all future resettlements we have put in place a Land and Resettlement Management Standard, which obliges all our operations to adhere to common processes, including:

- All operations shall undertake project specific social impact assessment studies and, where appropriate, prepare a Resettlement Action Plan aligned with applicable national regulatory and policy framework as well as international standards.
- Where households need to be physically displaced then we will ensure that such households are provided with alternative housing which is culturally appropriate. We aim to find resettlement sites in suitable locations chosen in consultation with the people to be resettled. Our goal is always to make sure the housing and access to infrastructure and amenities will be of an improved standard compared to that prior to displacement. To the extent possible people will be given options for resettlement.
- All the people that are within the area of impact of our operations will be assessed for long-term rehabilitation assistance and programmatic support to help them restore their livelihoods and

overall quality of lives to at least pre-project levels and where possible we hope it will be considerably better.

For our Myanmar projects, we use public consultation to gauge the needs of the communities and address any concerns. By way of example, surrounding our S&K&L operations, we have constructed 4 resettlement villages for displaced families with supporting physical infrastructure, including roads, drainage, electricity and new water supply, and social infrastructure, including schools, childcare centres, temples and playgrounds. We plan to continue throughout the future of our mining enterprise to be a suitable source of assisting the local and regional governments in restructuring the rural communities of our region.

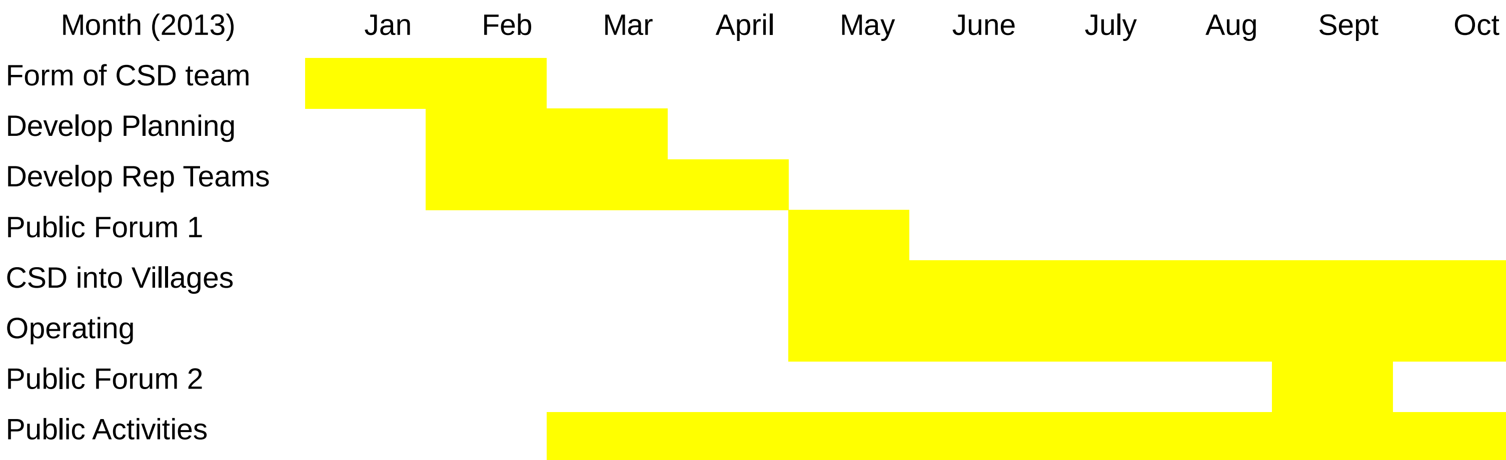
10.6 Plans for Disclosures and Consultation

Consultation for each phase of the project will focus around a specific topic and will utilize different consultation strategies and result in different ESIA related outputs as summarized in Table 1.

Table1: Key Phases of the PCDP Process

Project Phase	Topics for Discussion During Consultation	Consultation Strategy	ESIA Outputs
Site Selection	Details of the early works sites	■ Face-to-face meetings, workshops, and group meetings	Scoping consultation supporting document Announcement of preferred site selected
Preconstruction Studies Land Clearing	Scoping Phase Supporting Document	■ Face-to-face meetings and workshops, group meetings ■ Written comments ■ Appointment of Community Liaison Officer (CLO) ■ Web-site disclosure (www.myanmaryangte.com.mm)	Scoping report and terms of reference for ESIA
Early Works in Non-affected Areas (Baseline Study – ESIA) June –July 2013	Baseline Study, engineering design and impact assessment and management planning	■ Surveys/questionnaires ■ Interviews ■ Working groups ■ Communication centre ■ CLO ■ Web-site disclosure and commenting procedure	Draft ESIA Report
	Draft ESIA Report	■ Open public meetings and hearings ■ Workshops ■ Written comments ■ Communication centre ■ CLO ■ Web-site disclosure and commenting procedure	Final ESIA Report and project approval
Construction and Operation	Project Implementation Plans	■ CLO ■ Communication centre ■ Grievance mechanism ■ Newsletter	Management report

Figure 1: Schedule for Public Consultations utilizing the CSD Team during ESIA Process



Consultations for the basic design, and early works site selection phase of the PCDP commenced on April 2013, and are ongoing. The baseline Study phase of the PCDP was initiated in February 2013 with the socioeconomic household, business, construction, and aquatic, flora and fauna, traffic, noise and air surveys in the Letpadaung area. Scoping Study and the Terms of Reference for the ESIA have been accepted by the governing group of the Implementation Committee, established through the instruction of the President's office to monitor the progress and Environmental and Social implications. The PCDP will continue throughout the ESIA, as well as through the project construction, commissioning, and operation phases.

10.7 Stakeholder Identification and Analysis

Stakeholders are identified to determine all of the organizations and individuals who may be directly or indirectly affected (positively and negatively) by the project and related activity. It also includes anyone who may be able to contribute to the program of work due to their expert knowledge of and/or experience in the region. It is an ongoing process requiring regular review and updating.

The stakeholder identification and analysis process for the Letpadaung Project is in its infancy stages. Recognizing the strategic importance of the project, a diverse range of stakeholders is currently being identified that could be involved in the PCDP process:

- Authorities, including members of national, regional, and local government entities
- International, national, and local non-governmental organizations (NGOs) with a direct interest in the project that may have useful data or insight into the project's national and local challenges
- Other groups including media, academics, institutions, foundations, community, and business groups
- Residents, landowners, and land users in the areas around the potential sites considered for the project, or that could potentially be impacted by the project
- Bilateral and multilateral organizations
- Wanbao Mining project participants
- Businesses and potential employees
- Media

Beginning at early works selection, the Letpadaung Project initiated work with consultants to identify the key stakeholders to consult at various project stages. The stakeholders are broadly categorized into primary and secondary groups:

- Primary stakeholders: Individuals or groups who may be directly affected by the project

- Secondary stakeholders: Individuals or organizations with an influence, interest, or expertise to offer the project, even if the project does not directly involve or affect them

To develop an effective stakeholder involvement program, it is necessary to determine exactly who the stakeholders are. This is partially due to the different methods that may be required to involve various stakeholder groups effectively.

Also, different issues are likely to be vital concerns for each stakeholder group. For example, an international NGO may be concerned with how the proposed project will affect more global issues such as climate change, while a local resident is much more likely to be concerned about the immediate effects upon health, economy, and the environment.

Table 2 presents the list of stakeholder groups identified and categorized according to the primary and secondary stakeholder categories. Appendix A contains a full list of identified stakeholders.

Table 2: Preliminary List of Stakeholder Groups

Primary Stakeholders	Secondary Stakeholders
■ Project participants (management and employees) ■ Community leaders ■ Local community members, including vulnerable subgroups (e.g. disabled peoples, ethnic minorities, women, and children) ■ Actual and potential suppliers and contractors ■ Fuel suppliers ■ Local businesses and co-operatives (e.g. fishing) ■ Local churches/monasteries and civic organizations ■ Local government	■ Myanmar National government ■ Sagaing Divisional government ■ MOECAF ■ Ministry of Mines ■ International and national environmental, social, health, and human rights groups ■ Universities and other academic groups ■ Actual and potential customers ■ Other upstream companies ■ Trade associations, industrial bodies, and other opinion formers ■ Labor unions ■ Political parties ■ International financial community ■ International, national, regional, and local media

The project established a database utilizing the CSD Team to identify the stakeholders and capture their potential interests or concerns. The database serves as a tool to decide what party to consult based on the understanding of:

- Who will be affected by the project and the decisions made
- Who has NOT been involved up to now but should be in the future

10.8 Issue Identification and Analysis

Issue identification and analysis is closely tied to stakeholder analysis. It is important to understand who key stakeholders are and their interest in each issue as well as the risks and opportunities associated with them.

The range of issues identified and analysed includes political, socioeconomic, ethical, and environmental issues associated directly with the project and with the wider strategic context of the project.

This activity places particular attention on any gaps between stakeholder expectations, project commitments, project performance, and stakeholder awareness during the process of identification of potential new issues and assessment of the manageability of issues.

The issue analysis will enable those involved in the project to understand:

- The key issues for each stakeholder group through stakeholder dialogue
- The historical background
- What is important to those who are involved and/or affected
- Stakeholders' priorities
- Stakeholders' concern

A site-selection evaluation tool was developed for the early works study. This tool analysed the socioeconomic and environmental resources and receptors with the potential to influence the future location of the Letpadaung project and/or to be affected by it. The tool was used to identify issues and conduct analyses for the early works phase of the PCDP. Table 3 presents the list of socioeconomic and environmental resources and receptors that were pertinent to the site selection process for the Letpadaung Project.

Table 3: Environmental and Socioeconomic Resources and Receptors

Criteria	Resources and Receptors
Environment	Habitats and species (terrestrial and marine flora and fauna, including fish) Agriculture and processes Water quality
Socioeconomic	Planning and development Land based livelihoods and recreation Settlements and buildings Framing-based livelihood and water-borne transport Cultural sites Community health and safety

Appendix B provides a list of the issues identified to date. This includes issues associated directly with the project, the wider strategic issues referred to as themes, and issues relevant to the Letpadaung Project commitments to community development.

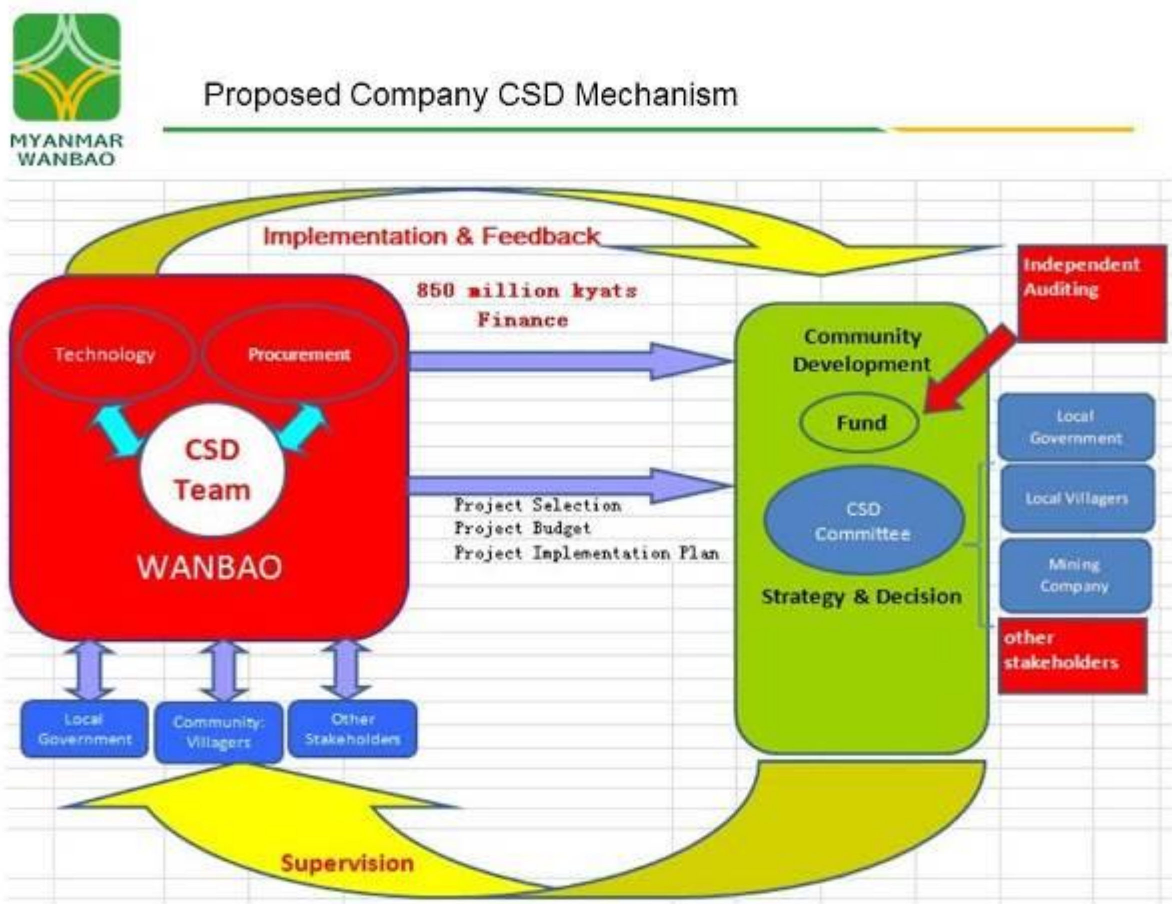
More issues will likely be identified during each phase of the PCDP. The feedback from the PCDP may also require the manageability of some issues to be reassessed; this could add new dimensions to the discussion, and require changes in plans. The list in Appendix B will be regularly updated and the issues will be re-analysed at the end of each phase of the PCDP

10.9 Methodology

Overview

The Letpadaung Project has an established program of stakeholder involvement from work completed during the early works phase. The goal during the next phase, operations, is to build upon the work already undertaken, and to develop a strategy that provides opportunities for all stakeholders to contribute to the development.

Figure 2: Letpadaung Project Public Consultation and Disclosure Plan for ESIA



10.9.1 Review and Analysis of Consultation Prior to Operations Phase

The various methods of stakeholder involvement available to the project during the early works phase were analysed to determine:

- Their suitability for reaching different stakeholder groups
- Positive and negative aspects associated with their implementation based on previous results from the site selection consultations or general experience
- Ways each method could be improved or developed to ensure greater success during the Operations Phase

Consultation during the early works will use the following forms of communication:

- Public awareness meetings and focus groups
- Face-to-face discussions with local people and national and international NGOs
- An environmental, social, and health exhibition featuring posters, brochures (non-technical summary reports), and safety video on site
- Dissemination of the Scoping Study and Terms of Reference Supporting Document and non-technical summary to libraries and other public venues

10.9.2 Action Tracking and Monitoring Of Issues and Stakeholders

The Letpadaung Project will maintain a database for managing issues and stakeholder information. This tool will be used to manage ongoing project issues, and for stakeholder identification and analysis processes. The database stores the items below.

- Stakeholder profiles
- Consultation tracking sheets for each stakeholder (a group, in some cases)
- Issues register
- Issues sheets
- Action register

10.9.3 PCDP Stakeholder Process

The Letpadaung project stakeholder database was used as the reference document for the stakeholder identification process. The stakeholders were classified into two primary categories in the database:

- Primary stakeholders: Individuals or groups who may be directly affected by the project.

- Secondary stakeholders: Individuals or organizations with an influence, interest, or expertise to offer the project, even if the project does not directly involve or affect them

Key stakeholder groups were identified and prioritized on the basis of the specified goal and objectives of this particular phase of the PCDP.

For the first round of consultations, the primary stakeholders were placed into the following three categories:

- Key national decision makers: Individuals with the power to influence decision making, or those who can provide information to support site selection decision making (IC)

- Key regional and local decision makers and representatives: Regional and local administrators, traditional leaders, information holders, and representative groups and committees

- Respected knowledge holders: Trusted and respected organizations that can inform the decision-making process (e.g. academic institutions and some non-governmental organizations)

For the second round of consultations, the primary stakeholders were placed into the following three categories:

- Communities potentially directly affected by any of the three site options under consideration. This included communities that customarily own or use land that would be required for each potential location and local farmers.

- Key regional and local decision makers and representatives, including consultation with the Letpadaung technical staff and the Letpadaung Administrators, and a second meeting with the head of the traditional leaders and his advisors.

- Respected knowledge holders, influencers, and local businesses including Myanmar-based NGOs, businesses, and church leaders.

10.9.4 Stakeholder Dialogue Process

Two rounds of consultations will be conducted during the early works phase of the PCDP :

- The first round, conducted from June 10, 2013
- The second round, conducted from July 10th, 2013

Preparation and Disclosure of Project Information

Information for disclosure and in support of the consultations was prepared before the dialogue began. Table 4 lists the material prepared and used for the site selection PCDP (first round) and Table 5 (second round).

Table 4: Consultation Materials (First Round)

Document	Audience	Description	Languages
Slide Presentation	Decision makers, local representatives, information holders	Introduces the project, the ESIA, and site selection	English, Myanmar
Question and answer sheet	Letpadaung project, appointed local and international consultants	Set responses to key questions	English and Myanmar
List of questions and scripts	Consulters	Lists of questions and scripts for use during consultation meetings	English
Consultation tracking database	appointed local and international consultants	For entering key information from consultation meeting	English
Meeting minute Proforma	appointed local and international consultants	For writing up meeting notes	English

Table 5: Consultation Materials (Second Round)

Tool	Description
Pictorial Presentation	Large A1 format pictorial presentation including photographs and diagrams of the following issues: ■ Reasons for the construction and uses ■ Previous consultation undertaken during initial visit ■ Work completed to date, including social and environmental studies ■ Health and safety
Map & symbols- participative meeting tool	Large A0 format satellite image of the study areas and surrounding land. This includes the map to depict known settlements and cultural sites, and stick-on symbols placed on the map by participants to indicate where particular activities or sites are located. Symbols depict activities such as fishing, agriculture areas, recreation areas, cultural sites, pathways/walkways, etc.
Power Point Presentation	Detailed presentation of project and potential impacts, translated into Myanmar. This provides in-depth information on certain aspects (e.g. visual layouts of project and diagrams of potential water quality impacts), and will be used mainly in meetings where literacy and existing understanding of issues were already high.
Question & Answers (Q & A)	A List of standard Questions and Answers was developed with Letpadaung Project and used as a guide and prompt for all meetings. Questions will range from project and potential impacts to wider development issues. The questions were translated into Myanmar.

The slide presentation will be used to provide a summary of the project and the key environmental and socioeconomic issues, including:

■ A broad overview of the proposed project (e.g. why it is needed, who is involved, what it involves, where it is).

■ A broad overview of the ESIA process (e.g. what it is, who is involved) and proposed timetable for consultation.

■ Detailed description of the site selection process the project was utilizing.

Methods of Consultation

The preferred methods for consultations during early works phase were face-to-face meetings and workshops. For the first round of consultations, each meeting will follow a similar agenda, commencing with a slide presentation followed by a series of questions and a general discussion about the project. The participants were provided with specific information regarding the actual sites under construction.

10.9.5 Recording and Reporting

The PCDP will be updated throughout the ESIA. The update will include a review of the activities and findings and the evaluation of the effectiveness of the previous PCDP phase together with any lessons learned and plans for the next phase.

A written record will be made of each meeting and consultation event. Any concerns will be entered into the issue register and in the stakeholder profiles, and used to amend the issues sheets as required. Any actions agreed will be entered into the consultation tracking sheets and into the action register.
Some issues may require feedback or responses to questions, comments, proposals, concerns, and stakeholder expectations. The format and deadline for the delivery of the feedback/response for each phase of the PCDP will be clearly communicated to the stakeholders at the outset of each meeting. The Meeting Minutes Proforma, as outlined in Appendix C, will be used to capture feedback.

Additionally, feedback can be provided by contacting the Myanmar Wanbao Mining Copper Limited office in Yangon, and through the website. www.myanmarwanbao.com.mm

10.9.6 Evaluation of Effectiveness

The effectiveness of the individual initiatives and the overall PCDP program for each phase will be assessed .
The key measures of the PCDP's effectiveness are:

- Adequate and timely disclosure of information to project-affected stakeholders.
- Adequate provision of opportunities for stakeholders to voice their opinions, expectations, and concerns.
- Demonstrable evidence that stakeholder opinions, expectations, and concerns have been taken into account in the ESHIA and project decision-making processes.

11. GRIEVANCE REDRESS

The Letpadaung Project developed a formal grievance process for the developmental process of the CSD Team. Wanbao Management will manage this process. Its primary objective will be to ensure that people affected by the project can present their grievances to the CSD project team for consideration and correction if appropriate. The local community stakeholders will be informed of the intention to implement the grievance mechanism, and the procedure will be communicated and disclosed accordingly. The grievance process will also ensure all complaints from local communities are addressed in an appropriate and timely manner, with corrective actions being implemented if appropriate and the complainant being informed of the outcome. It will be applicable to all complaints from communities affected by the Letpadaung Project.

11.1 Responsibilities

The CSD Project Manager will be responsible for collating written complaints and coordinating responses to all complaints. These responses to complaints will be in writing.

11.2 Procedure

General Complaints

All complaints received verbally or in writing shall be recorded in a grievances log. It will be kept in a shared drive, and accessible to the CSD Project Manager and the Environmental Systems and Operational Development Manager (ESODM).

Upon receiving a complaint, all employees and contractor personnel shall refer the complaint to the CSD Manager, the Public Relations Manager, or to the ESODM Manager. The form shall then be forwarded to the Deputy General Manager who will assign it a number.

The community liaison officer (PR Officer) shall ensure that appropriate action is taken to respond to a compliant. If the CSD Project Manager is unable to respond to or deal with a complaint directly, he or she will refer the complaint to the appropriate manager, through the Manager of Local Issues and Government Relations and Government Relations. The CSD Project Manager remains responsible for tracking the complaint and ensuring that it is addressed.

Grievance Log

The CSD Project Manager ensures that each complaint has an individual number, and is appropriately tracked and recorded actions are completed. It also contains a record of the person responsible for an individual complaint, and records dates for the following actions:

- Date the complaint was reported
- Information on proposed corrective action sent to complainant (if appropriate)
- The date the complaint was closed out
- Date response sent to complainant

Grievance Action Form

This specifies the information required to ensure the complaint is addressed appropriately. The form consists of these five parts:

1. Information about the complainant, and the complaint number (taken from the Grievance Log)
2. The complaint section where all the details relevant to the complaint are recorded
3. For recording the appropriate immediate action to be implemented and identifies appropriate long-term action
4. Corrective action to be implemented. If a complaint is related to any physical issue, a photo should be taken and attached to the Grievance Action Form.
5. Details how corrective action, if any, shall be verified and signed off

Responding to a Compliant

Response to complaints must be in writing, though a verbal response will be provided if this is more appropriate under the circumstances (e.g. where the complainant cannot read). All complaints must be responded to within two weeks of being received, even if the response is just a summary of what is planned and when it is likely to be implemented. Further correspondence should be given once the complaint is closed (within 28 days).

Monitoring Complaints

The CSD Manager will be responsible for:

- Providing the Project Team with a weekly report detailing the number and status of complaints.
- Any outstanding issues to be addressed.
- Monthly reports, including analysis of the type of complaints, levels of complaints, and actions

12. MONITORING AND EVALUATION

Potential Impacts and Recommendations for MitigatingImpacts

Discussion regarding potential impacts of the Project and recommendations regarding mitigation measures was relatively limited during the first consultation round. A number of stakeholders noted that they require further information regarding the Project to enable them to provide considered input into the identification of potential impacts. It was notable that many potential impacts that were raised by stakeholders were positive rather than negative in nature, in line with the strong overall vision of the Project as being positive for the Letpadaung region.

The main potential issues and areas of recommendation raised by stakeholders were:

- environmental stewardship
- resettlement
- in-migration and development
- potential local benefits

MEHL has also implemented a monitoring system within 2 of the villages.

1 officer and 1 staff member are available for monitoring the MEHL internal complaints systems.

Liaison Officers are placed in Whetmay and Kandaw Villages.

Evaluation of Effectiveness

Following the Early Works consultations, The Letpadaung project will conduct an evaluation using the Proforma in Appendix B. Issues that will be highlighted include:

- status of resolution of commitments from this Phase
- integration of these activities with those of Government and Public Affairs
- recommendations for amendments to system of recording
- stakeholder fatigue
- geographical scope and focus

Appendix A – Stakeholder Listing

Stakeholder Organizations

Amnesty International (AI)	World Wide Fund for Nature (WWF)
Global Witness (GW)	United States Agency for International Development (USAID)
Human Rights Watch (HRW)	United Nations Environment Program (UNEP)
Open Society	United Nations Development Program (UNDP)
International Crisis Group	International Organization on Migration (IOM)
HIV/AIDS Alliance	World Bank Group
Care International	Department for International Development (DfID)
Catholic Fund for Overseas Development (Cafod)	The Halo Trust (demining NGO)
Catholic Relief Services (CRS)	Canadian International Development Agency (DIDA)
Christian Aid	International Development Research Centre (IDRC)
Council on Housing Rights & Evictions (COHRE)	European Union
Global Fund	Swedish International Development Agency (SIDA)
Development Workshop	Norwegian Agency for Development Cooperation (NORAD)
Save the Children	
Open Society Institute (OSI)	Friends of the Earth International (FoEI)Greenpeace
Oxfam	Area Churches
Pact	The World Conservation Union (IUCN)
Population Services International (PSI)	International Republican Institute/African Institute for Corporate Citizenship
Save the Children	International Alert
Survival International	Conservation International (CI)
World Learning	Flora and Fauna International (FFI)
World Vision	International Fund for animal Welfare (IFAW)
World Health Organization (WHO)	Smithsonian Institution, Monitoring and Assessment of Biodiversity (MAB) Unit
International Business Leaders Forum (BLF)	The Nature Conservancy

Appendix B – Meeting Minutes Proforma

Meeting Minutes Proforma - Table

Date of Meeting		
Venue for Meeting		
Consultation Phase		
Meeting Reference		
Goal and Objectives		
Subject		
Materials Used		
Materials Circulated	Format	Circulation
Meeting Organizer(s)	Name	Affiliation and Position
Meeting		
Recorder		
Method(s) of Record		
Technical Expert(s)		
Independent		
Interpreter		
Letpadaung Project Representative(s)		
Agenda		

Questions Raised

Number	Topic	Details of Question	Raised By	Response Provided	By Whom

Comments / Proposals / Recommendations put forward

Number	Topic	Details	Proposed By	Response Provided	By Whom

Information Provided

Number	Topic	Details	Provided By	Response Provided	By Whom

Actions Agreed

Number	Topic	Details of Action	Actionee	Milestone

Summary of Level of Stakeholder Interest / Concern and Stance towards Project by Issue

Stakeholder Organization - Individual or	Topic	Level of Stakeholder Interest - Concern	Comments

Attendees List

Date of Meeting	
Venue for Meeting	
Consultation Phase	
Meeting Reference	

Name of Organization	Name of Individual	Position of Individual in Org	Contact Details: Addre	Contact Details: Tel. Number	Contact Details: Email	Signature	Key Area of Interest of Organization /Individual

Appendix C – PCDP
Effectiveness Evaluation Record

<table>
<tr><th colspan="5">PCDP Effectiveness Evaluation Record</th></tr>
<tr><td colspan="5">EVALUATION CRITERIA AND RESULTS</td></tr>
<tr><td colspan="5">Title:</td></tr>
<tr><td colspan="5">Date:</td></tr>
<tr><td colspan="5">Goal Statements:
■ adequate and timely information is provided to project-affected stakeholders;
■ these stakeholders are given sufficient opportunity to voice their opinions and concerns; and</td></tr>
<tr><td>Activity 1</td><td>Evidence used:</td><td>Progress</td><td>Comments:</td><td>Rating</td></tr>
<tr><td>Output 1</td><td></td><td>Progress</td><td>Comments</td><td>Rating</td></tr>
<tr><td>Activity 2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Output 2.</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Achieving Goals
(As listed above)

Comment:</td></tr>
</table>

Action (if required):	
Lessons Learned: (i) PCDP structure and contents: (ii) Consultation methods/stakeholder: (iii) Integration of consultations with ESIA process and Project activities:	
Staff responsible for review: Names:	Date
Senior Manager approval: Names: Signature:	Date:

Rating key

1 = Completely achieved
2 = Largely achieved
3 = Partially achieved
4 = Achieved to a very limited extent
5 = Not realized
x = Too early to judge extent of achievement