Stormwater Report to Support Rezoning Application

285-305 Pacific Highway, Lake Munmorah

Prepared for EDH Architects

Our Ref: 18158_v1.0

7th February 2019

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1.0	07/02/19	Matthew Brown	MB	Vince Cubis	VC

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1 Executive Summary

Cubo Consulting Pty Ltd has been engaged by EDH Architects to prepare a stormwater report to support the rezoning application for submission to Central Coast Council for the proposed residential subdivision and development at 285-305 Pacific Highway, Lake Munmorah. This report provides information on:

- Stormwater quantity and site discharge management;
- Stormwater quality and treatment options, including assessment of downstream wetlands; and
- Site overland flows and flooding.

This report also includes some preliminary information on stormwater retention and water conservation, which are typically required at the Development Application (DA) stage. Assumptions have been made in the preparation of this report, e.g. proposed development layout, that will need to be addressed before proceeding with detailed design.

The proposed rezoning site is located on RU6 Transitional Land on the northern side of the Pacific Highway to the west of the Lake Munmorah Shopping Centre. The proposal is to rezone the land to R2 Low Density Residential land to facilitate subdivision and residential development.

The report concludes that:

1. On-site detention will be required for the site to ensure post-development flows are maintained with predevelopment levels. A total OSD volume of approx. 7,000 m^3, split into 2,500 m^3 for the western catchment and 4,500 m^3 for the eastern catchment, may ensure that post-development runoff is kept within pre-development levels.
2. it is recommended that smaller upstream OSD's (part of the overall volume) are provided for the rezoning site to maintain base flows in the upper reaches of the creeks, particularly during smaller storm events.
3. Preliminary MUSIC modelling for the rezoning site indicates that Central Coast Council's pollutant reduction targets may be met through:
    a. For the western catchment, bioretention ponds with a total filter area of 340 m^2 and upstream GPT(s). (if constructed wetlands are adopted the water quality area may increase to 3400 m^2.)
    b. For the western catchment, bioretention ponds with a total filter area of 580 m^2 and upstream GPT(s). (if constructed wetlands are adopted the water quality area may increase by 5800 m^2.)
    c. The MUSIC modelling assumes that all proposed lots within the development will have a minimum 2,000 L rainwater tank (as per BASIX requirements) with water reuse of 121 kL/year/lot.
4. The site is located within the upper reaches of the Karignan Creek catchment that drains into Lake Macquarie. Overland flows and flooding through the proposed rezoning site have been simulated in both 1D and 2D HEC-RAS models. Flood waters appear to be constrained to the existing natural channels running through the site. It is expected that:
    a. For the western catchment, proposed development works are expected to be on the edge of the 100-year ARI flood extent and require only minimal filling to flood proof lots.
    b. For the eastern catchment, some earthworks and lot filling may be required for flood proofing within the existing 100-year flood areas. Post-development modelling suggests that only localised increases to flow depth and velocity will occur as a result of the development, with no significant impacts to creek flows expected downstream of the proposed rezoning site.

c. Within the proposed rezoning site, the maximum increase in PMF level compared to the 1% AEP is 360 mm, with an average increase of 76 mm. Therefore, the flood levels throughout the rezoning site should be based on the 1% AEP water levels plus 500 mm freeboard.

d. Due to the steepness of the site, there appears to be limited backwater influence from the downstream wetlands and Lake Macquarie.

5. Detailed sediment and erosion control plans will be required to ensure that sediment is not transported to downstream wetlands during the construction phase. Erosion/scour protection measures, and revegetation, may be required at the discharge locations to the downstream channels within both the eastern and western catchments.

Based on the outcomes provided in this report, it is our view that appropriate stormwater measures can be put into place to adequately manage site stormwater post-development and that stormwater management will not preclude the rezoning of the site to allow residential development.

Supporting information is contained at the appendices to this report.

Yours Faithfully,

Prepared by

Matthew Brown
Drainage Engineer

Reviewed by

Vince Cubis
Director

2 Background Information

This document presents the stormwater plan to support the rezoning application for submission to Central Coast Council for the proposed development at Lot 1 DP626787, Lot 438 DP755266, Lot 437 DP755266, 285-305 Pacific Highway Lake Munmorah NSW 2259.

3 Existing Site

The proposed rezoning site has an area of approximately 23 hectares and is made up of three separate blocks, each with existing dwellings. The land is currently zoned as RU6 Transitional Land. The land is generally clear, with sparse trees and a small forested area to the north-west. A natural drainage channel runs through the eastern half of the site, draining to a larger creek to the east, then north to Karignan Creek and Lake Macquarie. There is also a natural drainage channel that crosses the south-western corner of the site and runs along the western boundary, draining to Lake Macquarie.

The site is bound to the east by residential land; to the north by a reserve for public recreation and an environmental conservation area; to the west by commercial land, a reserve for public recreation and environmental conservation/management area; and to the south by the Pacific Highway.

Topography for the site and surrounding areas was generated using 1m LiDAR information taken from the Geoscience Australia website (ELVIS database). The site is located at the top of the Karignan Creek catchment that flows into Lake Macquarie, with the Pacific Highway being the (approximate) dividing ridgeline between the catchments of Lake Macquarie and Lake Munmorah.

The site is situated on a ridge that extends north from the Pacific Highway. The site generally falls towards Lake Macquarie to the north at moderate grades between 2 and 10%. The land also falls away to the north-east and north-west from the top of the ridge lines toward the natural water courses running through, and adjacent to, the site. Site topography is contained at **Appendix A**.

Based on aerial imagery and topographic information, and using the 'Strahler system', the natural watercourses have been assessed to be first order streams.

Preliminary feedback from NSW Department of Primary Industries (Water) (Algis Sutas), regarding the natural drainage channels through the site, advised:

> *"I wish to confirm our telephone discussion and my advice provided to you this afternoon as follows:*
>
> - *I have reviewed the information provided by you as well as various aerial photo images of the site. I also have prior knowledge of the adjacent site to the west.*
> - *In regard to the eastern blue line, I could not see any evidence of bed or bank along the course of the blue line. There is some dark green areas on the lower (northern most sections) sections, which may indicate some wet areas or flow paths.*
> - *The site photos and air photos do not indicate any defined riparian corridor, aquatic vegetation or geomorphic features.*
> - *I note that there has been an access track constructed for the telecommunications tower located in the south east corner of the property. There does not appear to be any evidence of flow or scour across this access track.*
> - *Whilst there may have been some sort of flow path previously, the site has been highly modified by land clearing, construction of the dams and the altered drainage from the highway.*
> - *Based on the above information, I am satisfied at this stage that it appears that the blue lines in the southern half of the site are probably not rivers as defined under the Water Management Act 2000. However, it is possible that the northern part of the site may contain remnant wetland or undefined flow paths..*
> - *To assist in the rezoning and DA stages I suggest that you compile further evidence via contour survey, vegetation surveys, flood and stormwater investigations, etc.*

- *At this stage a site inspection would not be required.*
- *Further information regarding controlled activity approvals can be found at https://www.industry.nsw.gov.au/water/licensing-trade/approvals/controlled-activities.*

Please contact me again if you wish to discuss any of the above issues,

regards

Algis"

Soils and geological information were taken from the following sources:

- NSW Government Resources & Energy 1:100,000 Soil landscape mapping (Gosford-Lake Macquarie)
- NSW Government Department of Environment eSpade soil mapping (specific to the site)

These sources indicate that the site is located on Munmorah Conglomerate (Conglomerate, pebbly sandstone, grey to green shale) within the Doyalson group. Soils are expected to be clay and clay loams overlain by sand, moderately well drained and with moderate to high runoff.

Central Coast Council mapping indicates that the site is primarily a Class 5 (within 500 m of Class 1-4 soils) acid sulphate soil site, however there is a very small area in the north-eastern corner of the site that is classified Class 3 (works beyond 1 m below ground surface). This is likely to be outside the zone of any proposed development works.

Aerial photography of the existing site is presented in Figure 3-1 below.

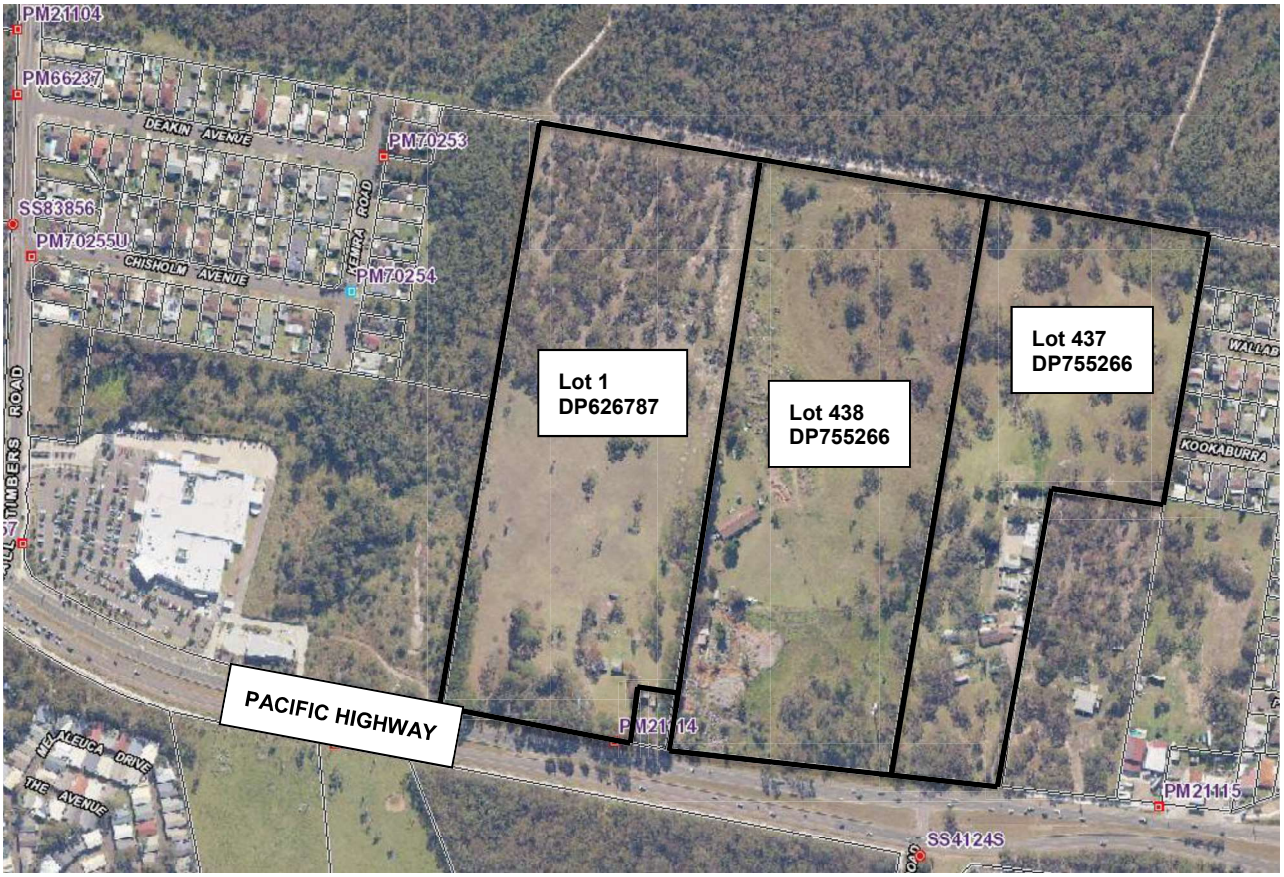

Figure 3-1 Existing Site (Source - Sixmaps)

4 Proposed Rezoning

The site is proposed to be rezoned from RU6 Transition land to R2 Low density residential, to allow for future subdivision and land development.

5 Stormwater Management

Stormwater management for the proposed rezoning is required to comply with Central Coast Council documentation including:

- Wyong Development Control Plan 2013
  - Chapter 3.3 (Floodplain Management)
  - Chapter 3.10 (Wetlands Management)
  - Chapter 4 (Subdivision)
- Central Coast Council – Civil Works Specification Design Guideline 2018

Generally, these stormwater management requirements are to:

- Include water retention and reuse measures to reduce potable water demand within the development.
- Provide concept stormwater design to:
  - Convey runoff from the site to downstream disposal locations, ensuring that there are no significant impacts to adjacent properties and downstream wetlands.
  - Incorporate on-site detention, as required, such that post-development runoff does not exceed pre-development runoff for all storm events from the 1-year ARI to the 100-year ARI.
  - Incorporate water sensitive urban design (WSUD) principles to provide a more integrated approach to urban water cycle management
  - Ensure that stormwater discharge from the site is managed in such a way to reduce pollutant loads to meet Central Coast Council pollutant reduction targets and assist in the protection of sensitive ecosystems and hydrological regimes of downstream environments.
- Assess 100-year flood extent across the site and provide measures to ensure that any developed land is flood free, whilst not significantly altering the hydrological characteristics and flood levels of natural drainage channels.

Erosion and sediment control procedures will need to be put into place during any construction activities on site to limit the risk of soil disturbance and erosion and potential transportation of sediments to downstream wetlands/drainage areas (see Section 5.7).

5.1 Constraints and Opportunities

Site opportunities include:

- Rainwater tanks will be required for the proposed development as part of BASIX requirements. This will assist in potable water reduction and provide on-site detention storage and stormwater treatment through temporary storage and reuse.
- The site slope is generally less than 5% which provides opportunities for a range of stormwater treatment options ranging from proprietary devices to constructed wetlands.

Site constraints include:

- The site is located immediately upstream of a Wetland Management Area as identified in DCP 2013 Section 3.10.

- Natural water courses run through the eastern half of the development and along the western boundary, which may subject the site to overland flows and flooding. Lot filling may be required to fully flood proof each lot.
- Based on Table 1 in the NSW Department of Industry *Guidelines for controlled activities on waterfront land* first order streams are required to have a 10 m vegetated riparian zone from the top of bank.

5.2 Water Conservation Target

In accordance with DCP 2013, Section 6.7.7.1.1 the target for potable water reduction is 40%.

Noting that the proposed development is currently only in the rezoning stage, it is recommended that the installation of the following WELS rated devices would allow for the 40% reduction in potable water to be met:

- 4-star dual-flush toilets
- 3-star showerheads
- 4-star taps (for all taps other than bath outlets and garden taps)
- Water efficient washing machines and dishwashers, wherever possible.

5.3 Water Retention Target

The minimum Stormwater Retention Volume (SRV) is calculated from the following formula.

$SRV = 0.01A(0.02F)^2$ where: SRV = stormwater retention volume (m^3)

A = total site area (m^2) – 232,000 m^2

F = fraction impervious (%)

As per DCP 2013, the developed site imperviousness based on residential lots between 450 m^2 and 700 m^2 is 80%. Due to the riparian zone set back requirements, it is our view that it is reasonable to reduce the impervious percentage to 70%. Thus, the required stormwater retention volume is:

Stormwater Retention Volume (SRV) = 4,547.2 m^3

Further detail will be provided as part of the DA process, but it expected that this volume can be met through rainwater tanks for each lot, on-site detention storage and general allowance for ponding across the site.

5.4 Stormwater Detention

Due to the increase in imperviousness of the site as part of future development, it is expected that on-site detention (OSD) will be required for the site. The site is split broadly into two catchments, west and east, which drain into natural watercourses. This has been further broken down into 6 catchments to more easily fit the required OSD pond sizes within the development and maintain base flows through the upper reaches of the creeks. Stormwater detention has been addressed for each catchment separately with all OSD ponds designed in an offline configuration. DRAINS model results are contained at **Appendix B**.

The western catchment of the proposed development has an area of approximately 77,000 m^2 and drains to the natural drainage channel to the west of the site. The eastern catchment of the proposed development has an area of approximately 132,000 m^2 and drains to the natural drainage channel that crosses through the east of the site.

Approximately 2 hectares of the proposed rezoning site is made up of the existing drainage channels running through the site. Runoff from these areas will not differ pre- and post-development and has not been considered in the modelling.

Flow estimation calculations in the following sections have been determined using a RAFTS model set up in DRAINS software. Rainfall intensity was taken from the BoM website specifically for the site and the catchment areas were estimated based on site contour information.

5.4.1 DRAINS Model Results

A summary of the OSD requirements, based on the DRAINS modelling, is contained in the table below.

Table 5-1 Proposed OSD ponds

	Catchment Area	OSD Area	OSD Volume	Storm	Pre-development	Post-development with OSD
OSD 1	1.2 ha	120 m^2 base 450 m^2 top	400 m^3	1 yr ARI	136 L/s	132 L/s
				10 yr ARI	386 L/s	342 L/s
				100 yr ARI	760 L/s	747 L/s
OSD 2	6.5 ha	950 m^2 base 1,950 m^2 top	2,100 m^3	1 yr ARI	480 L/s	481 L/s
				10 yr ARI	1,540 L/s	1,510 L/s
				100 yr ARI	2,910 L/s	2,830 L/s
OSD 3	1.3 ha	120 m^2 base 450 m^2 top	400 m^3	1 yr ARI	136 L/s	132 L/s
				10 yr ARI	386 L/s	342 L/s
				100 yr ARI	760 L/s	747 L/s
OSD 4	6.5 ha	950 m^2 base 1,950 m^2 top	2,100 m^3	1 yr ARI	480 L/s	481 L/s
				10 yr ARI	1,540 L/s	1,510 L/s
				100 yr ARI	2,910 L/s	2,830 L/s
OSD 5	1.9 ha	200 m^2 base 800 m^2 top	700 m^3	1 yr ARI	185 L/s	167 L/s
				10 yr ARI	544 L/s	491 L/s
				100 yr ARI	1,050 L/s	954 L/s
OSD 6	3.5 ha	480 m^2 base 1,300 m^2 top	1,300 m^3	1 yr ARI	301 L/s	316 L/s
				10 yr ARI	928 L/s	861 L/s
				100 yr ARI	1,690 L/s	1,540 L/s
Total East	7.7 ha	-	2,500 m^3	1 yr ARI	616 L/s	613 L/s
				10 yr ARI	1,926 L/s	1,852 L/s
				100 yr ARI	3,670 L/s	3,577 L/s
Total West	13.2 ha	-	4,500 m^3	1 yr ARI	1,102 L/s	1,096 L/s
				10 yr ARI	3,398 L/s	3,204 L/s
				100 yr ARI	6,410 L/s	6,071 L/s
Total Site	**20.9 ha**		**7,000 m^3**	**1 yr ARI**	**1,718 L/s**	**1,709 L/s**
				10 yr ARI	**5,324 L/s**	**5,056 L/s**
				100 yr ARI	**10,080 L/s**	**9,648 L/s**

The results show that discharge from the site can be effectively managed to within pre-development levels for both the eastern and western catchment. The OSD arrangements above will also result in only a 5% decrease in storm flows from pre-development levels, ensuring that flows to the downstream wetlands are maintained throughout all storm events.

The stormwater quality requirements for the site (refer Section 5.5) are proposed to be integrated within the OSD system.

5.4.2 Upstream Reaches

OSD 1 and OSD 3 are proposed to be located in the upper reaches of the proposed rezoning site to ensure that flows are maintained within the upstream reaches of the creeks. Due to the larger OSD ponds being located at the downstream end of the proposed rezoning site, it is likely that there will still be a reduction in flows in the upstream reaches of the site, however, flows into the downstream wetlands will not be affected.

If maintaining upstream creek flows is a key concern, smaller upstream discharge systems can be provided to better replicate the existing natural flow processes.

5.5 Stormwater Quality

Central Coast Council requires, as a minimum, the following reductions in total pollutant load, compared to untreated runoff from the predeveloped site.

Table 5-2 Minimum pollutant reduction targets

Pollutant	Minimum Reduction
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%
Gross Pollutants	80%

5.5.2 Base Information

In accordance with industry best practice, a MUSIC model (Version 6.3.0) was used for the analysis and design of stormwater quality treatment train for the site. MUSIC modelling parameters were adopted using the Central Coast Council MUSIC-link data. The model was run over a rainfall period of 20 years (1/1/1974 to 31/12/1993) at a time-step of 6 minutes. The MUSIC model is shown in Figure 5-1 below.

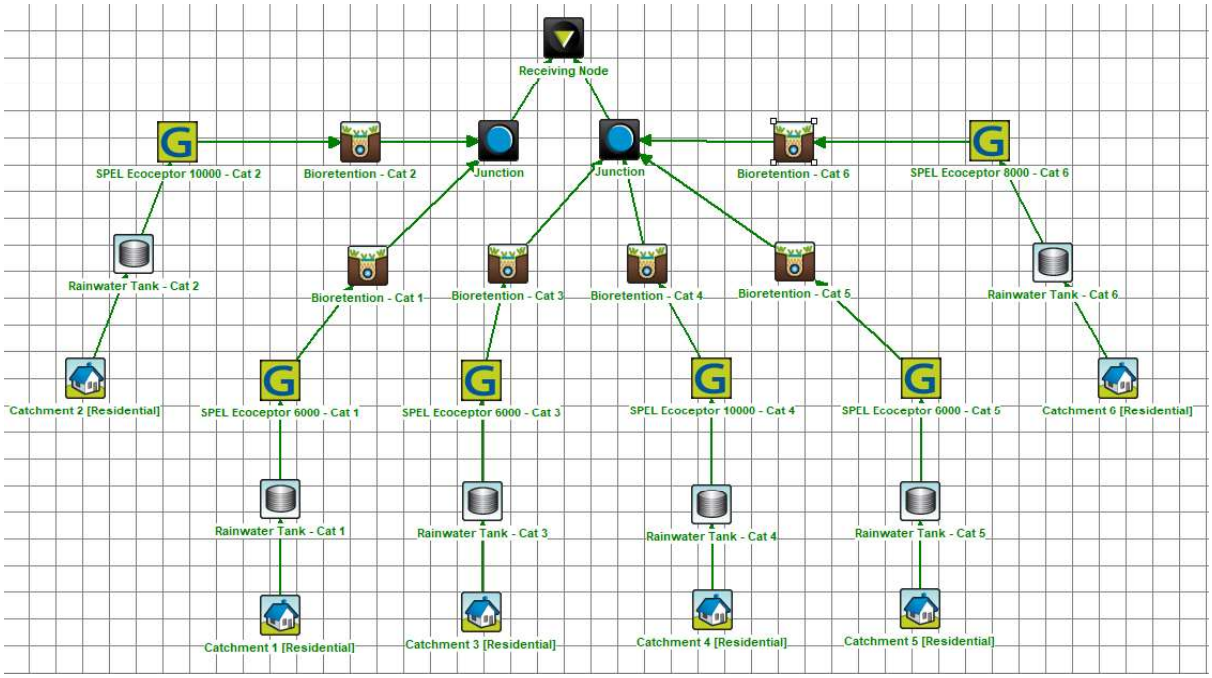

Figure 5-1 MUSIC model arrangement

5.5.3 Proposed Treatment

To meet the Central Coast Council pollutant reduction targets, it is proposed to provide a gross pollutant trap (GPT) and bioretention system at each OSD pond. The bioretention systems may be integrated into the base of the OSD ponds, however if this is undesirable due to potential clogging during large storm events, the bioretention systems may be constructed adjacent to the OSD ponds and connected to the low flow (typically up to 1-year) OSD outlet.

Each bioretention system was assumed to have:

- A saturated hydraulic conductivity of 100 mm/hour;
- TN filter content of 800 mg/kg;
- Orthophosphate filter content of 50 mg/kg;
- Unlined base with underdrain; and
- Effective nutrient vegetation.

The proposed bioretention system sizes are as follows:

Table 5-3 Proposed bioretention systems

	High Flow bypass (L/s)	Extended Detention Depth (m)	Filter Area (m^2)	Filter Depth (m)
Catchment 1	200	0.3	60	0.6
Catchment 2	500	0.3	280	0.6
Catchment 3	200	0.3	60	0.6
Catchment 4	500	0.3	280	0.6
Catchment 5	200	0.3	90	0.6
Catchment 6	400	0.3	150	0.6

In addition, each subdivision lot was modelled to have a 2,000 L rainwater tanks, consistent with BASIX minimum requirements, with water reuse set as 121 kL/year/lot and distributed based on Precipitation-Evapotranspiration patterns.

5.5.4 Results

Results from the preliminary MUSIC model for the proposed subdivision are shown in Table 5-4 and 0 below. The MUSIC-link report is contained at **Appendix C**.

Table 5-4 Catchment MUSIC model outputs

Pollutant	Western Catchment	Target Achieved?	Eastern Catchment	Target Achieved?
Total Suspended Solids (TSS)	81.7 %	Yes	82.0 %	Yes
Total Phosphorous (TP)	51.8 %	Yes	52.6 %	Yes
Total Nitrogen (TN)	45.0 %	Yes	45.5 %	Yes
Gross Pollutants (GP)	100 %	Yes	100 %	Yes

Table 5-5 Overall MUSIC model outputs

Pollutant	Post-development	Post-development with treatment	Pollutant reduction	Target Achieved?
Total Suspended Solids (TSS)	35,100 kg/yr	6,380 kg/yr	81.9 %	Yes
Total Phosphorous (TP)	56.6 kg/yr	27.0 kg/yr	52.3 %	Yes
Total Nitrogen (TN)	417 kg/yr	2228 kg/yr	45.3 %	Yes
Gross Pollutants (GP)	5,050 kg/yr	0 kg/yr	100 %	Yes

The results indicate that Council's pollutant reduction targets can be achieved through appropriately sized proprietary and non-proprietary devices.

5.6 Flooding Assessment

Central Coast Council flood mapping indicates that the site is not located on flood prone land (i.e. not situated within areas subject to flooding in storm events up to and including the Probable Maximum Flood (PMF)).

However, as mentioned above, existing drainage channels run to the east and west of the proposed rezoning site. A flood model has been prepared to assess the potential flood impacts of flows through these watercourses for the 1% AEP and PMF storm events.

We note that the site is within the study area for the Lake Macquarie Catchment Overland Flood Study currently which is being prepared by Central Coast Council and BMT and expected to be completed in 2019.

5.6.1 HEC-RAS

Two HEC-RAS models, 1-D and 2-D were constructed to simulate overland flows through the proposed rezoning site. Geometric data for both models was constructed using 1m LiDAR data from the Geoscience Australia database. For the rezoning process, the use of LiDAR data for flood modelling is considered acceptable, however detailed site survey information may be required for modelling for detailed design.

The 2-D model was set up as the primary model for flood mapping and used precipitation as the input for flows. As the 2-D HEC-RAS model does not have initial and ongoing loss capabilities at the current time, a 1-D model was set up to calibrate flow outputs between models. The 1-D model was also used to compare between pre= and post-development flood scenarios.

5.6.2 1-D Model

The 1-D model was set up and exported from Civil Site Design (a CAD attachment). Manning's roughness values of 0.04 and 0.06 were set for the main channel and overbank flows, respectively. Locations of the transition between the main channel and banks were approximated based on the channel cross sections. The site was separated into three creeks as shown in Figure 5-2 below.

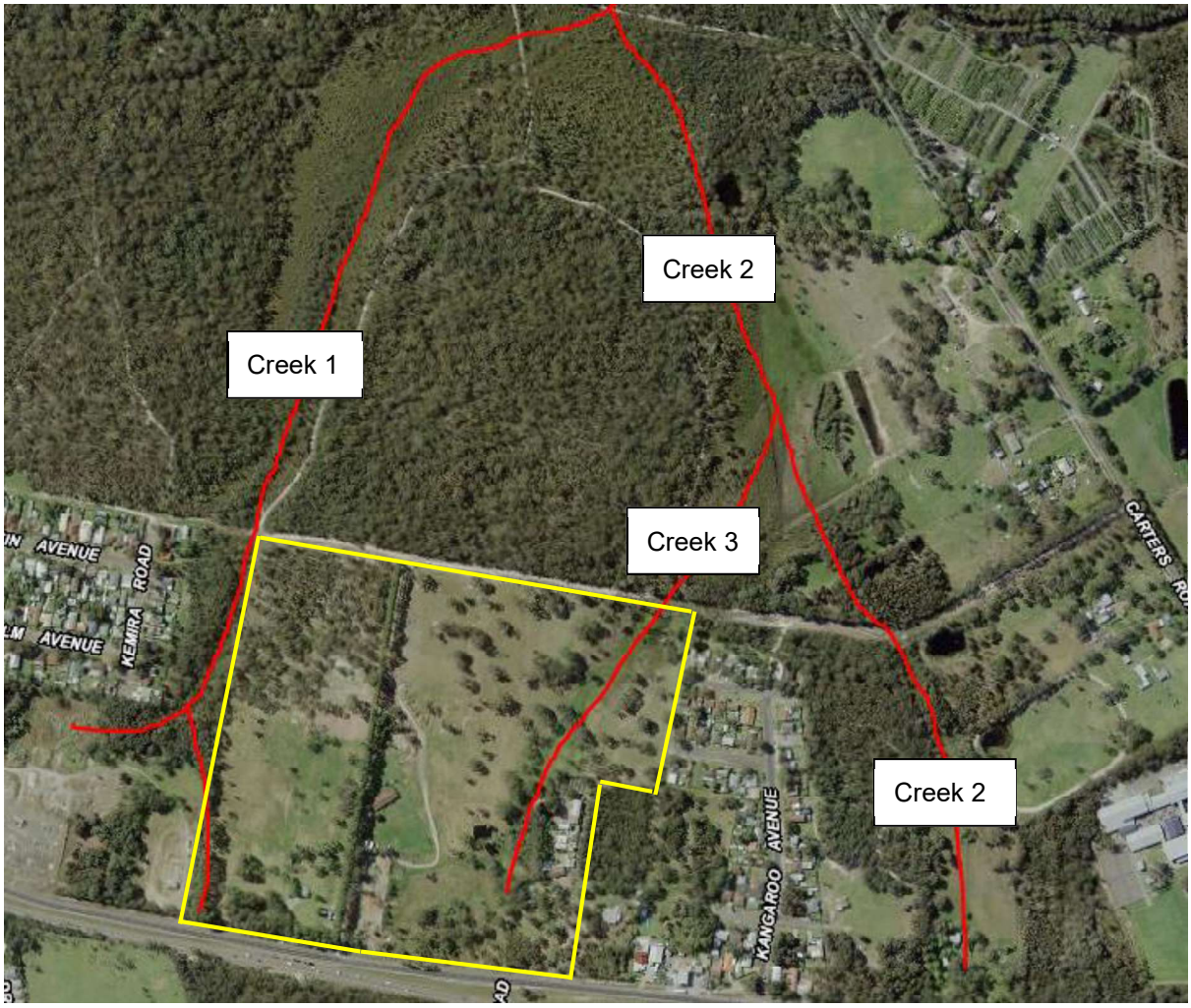

Figure 5-2 1-D HEC-RAS model arrangement

As Creeks 1 and 2 drain into Lake Macquarie, the downstream boundary condition was set to the 1% AEP lake flood level. The Lake Macquarie Waterway Flood Risk Management Study and Plan (2011) prepared by WMA Water on behalf of Lake Macquarie Council indicates a 1% AEP water level of 1.70 m AHD for rainfall dominated events coinciding with a major ocean storm event. This was considered to be a conservative modelling approach, given the significant difference in catchment size and time of concentration between the lake and the proposed rezoning site. However, due to the level difference between the lake and proposed rezoning site, the lake tailwater is not expected to have a significant impact on flood levels for the site.

Flow inputs for the 1D model were calculated using the rational method and the rainfall intensity for the 1% AEP 2-hour storm event (taken from the Bureau of Meteorology website specifically for the site). The runoff coefficient was estimated based on the Gosford City Council Civil Works Specification – Design. Catchment flows were calculated for the total catchment area, and for the catchment areas upstream of the proposed rezoning site. The catchment flows were then apportioned into inputs for the model at 100 m intervals, as shown in the table below.

	Creek Length	Upstream Peak Flow	Total Peak Flow	Peak Flow per Creek Segment
Creek 1	1,240 m	1.61 m^3/s	11.8 m^3/s	0.85 m^3/s/100 m
Creek 2	1,220 m	3.06 m^3/s	11.2 m^3/s	0.68 m^3/s/100 m
Creek 3	785 m	0.15 m^3/s	4.9 m^3/s	0.59 m^3/s/100 m

5.6.2.1 Results

The results show that, upstream of the existing floodplain/wetland (approx. chainage 250 m of Creeks 1 and 2), 1% AEP storm flows are contained within the main creek channels, with the following characteristics. Outputs, including long sections and cross sections, are contained at **Appendix D**.

Table 5-6 HEC-RAS 1D Results 1% AEP Storm - Creek 1

	Minimum	Maximum	Average
Flow Depth	105 mm	1,370 mm**	**444 mm**
Flow Velocity	0.03 m/s	1.27 m/s	**0.58 m/s**
Flow Width	24 m	539 m**	**137 m**

Table 5-7 HEC-RAS 1D Results 1% AEP Storm - Creek 2

	Minimum	Maximum	Average
Flow Depth	105 mm	1,350 mm**	**488 mm**
Flow Velocity	0.04 m/s	1.26 m/s	**0.58 m/s**
Flow Width	31 m	547 m**	**147 m**

Table 5-8 HEC-RAS 1D Results 1% AEP Storm - Creek 3

	Minimum	Maximum	Average
Flow Depth	60 mm	1,920 mm**	**277 mm**
Flow Velocity	0.02 m/s	1.00 m/s	**0.53 m/s**
Flow Width	7.6 m	253 m	**50 m**

**Note that the maximum water level and flow width are at the tailwaters of each creek and influenced by the downstream conditions. The average values are more representative of the flow levels and widths through the development site.

5.6.3 2-D Model

The 2-D HEC-RAS model was set up for the full catchment areas of Creeks 1, 2 and 3. As with the 1-D model, the downstream boundary condition was set to a maximum level of 1.7 m AHD. This was converted to a time series to better simulate water level change over the storm duration. A Mannings roughness of 0.04 was applied across the modelled area.

Rainfall data for the 100-year, 2-hour storm was taken from the Bureau of Meteorology Intensity Frequency Duration (IFD) online calculator specifically for the site. The data was downloaded on a 5-minute time step and converted (using linear interpolation) to 1-second data for use in the model. The rainfall was applied over the entire modelled catchment.

Due to the extent of the model, the grid size was set to 5 m^2 to allow for quicker iterations of model runs. The grid size was improved to 1 m^2 along the centreline of the creeks to provide additional detail of water movement through these areas. The model was run at a 1-second calculation step with outputs on a 30-second timestep. The model was run as an unsteady flow model.

5.6.3.1 Results

Results of the 2-D HEC-RAS matched up well with the 1-D model results for the main creeks. The 2-D model provided additional detail for the smaller channels feeding into the main creeks, however these were outside the boundaries of the proposed rezoning site. The modelled flood extent, including flood contours, is contained at **Appendix A**.

When compared to preliminary subdivision layouts, the modelling indicates that some areas of the proposed development site may need to be raised to provide freeboard to the 1% AEP flood level. Preliminary sketches showing cut and fill across the site are contained at **Appendix A**.

5.6.4 Probable Maximum Flood (PMF)

The Probable Maximum Precipitation (PMP) across the catchment was modelled to assess the likely extent of the PMF event compared to the 1% AEP event. The PMP was estimated using the Generalised Short-Duration Method (GSDM), which is applicable to sites up to 1,000 km^2 and storm durations of 6 hours (applicable to the rezoning site). The catchment is approximately 2 km^2, with the 2-hour storm expected to be most critical.

Based on the GSDM, the following factors were considered appropriate for the proposed rezoning site:

- 'Smooth' catchment, maximum grade of 10%
- Catchment elevation less than 1,500 m, therefore Elevation Adjustment Factor is equal to 1.
- Moisture Adjustment Factor of 0.72
- 2-hour 'smooth' rainfall depth of 628 mm

Based on this, the PMP value for a 2-hour storm event is 450 mm or 225 mm/hr. The spatial distribution of the PMP was assumed to be uniform across the site, due to the relatively small size of the catchment (less than 2.6 km^2).

Results of the 2D HEC-RAS model with the PMP applied, indicate that, throughout the proposed rezoning site, the maximum increase water level from the 1% AEP to the PMP event is 360 mm. Therefore, the critical storm event for determining site flood levels is the 1% AEP plus 500 mm freeboard.

5.6.5 Model Sensitivity

A sensitivity analysis was run for the 2D model to assess the impact of catchment roughness on water levels throughout the proposed development site. A 25% increase and decrease were applied to the roughness in the model. The outputs indicate that a change in roughness would have only minor impacts on water levels, with an average change of 9 mm and maximum change of around 70 mm.

5.6.6 Post-Development

A post-development 1-D model of Creek 3 was prepared to assess the impacts of the development on the creek. Based on current plans, Creeks 1 and 2 were not expected to be significantly impacted by the proposed rezoning and have not been included in this modelling.

Flows in the 1-D model were not changed which was considered to be a conservative modelling approach due to:

- the OSD ponds discharging into the creek further downstream than the natural discharge locations into the creek.
- the OSD ponds (slightly) reducing post-development flow compared to pre-development creek flow.

The results of the modelling are contained in the table below:

Table 5-9 HEC-RAS 1D Results 1% AEP Storm Post-Development - Creek 3

	Minimum		Maximum		Average		Difference
	Pre-	Post-	Pre-	Post-	Pre-	Post-	
Flow Depth	60 mm	60 mm	1.90 m**	1.90 m**	**277 mm**	**278 mm**	**+1 mm**
Flow Velocity	0.02 m/s	0.02 m/s	1.00 m/s	1.00 m/s	**0.53 m/s**	**0.55 m/s**	**+0.02 m/s**
Flow Width	7.6 m	7.89 m/s	253 m	253 m	**50 m**	**47.2 m**	**-2.8 m**

**Note that the maximum water level and flow width are at the tailwaters of each creek and influenced by the downstream conditions. The average values are more representative of the flow levels and widths through the development site.

The results indicate that the proposed rezoning is likely to reduce the flow area of the creek during the 1% AEP storm event, primarily through restricting the flow width of the channel (up to 20 m reduction in some areas). Due to the grade of the creek, this loss of flow area is primarily transferred into a change in velocity, rather than a change in water depth. In the narrowed sections of creek, velocities increase by up to 0.12 m/s (approx. 21%) compared to pre-development whilst the water levels in these areas increase by up to 30 mm (approx. 18%).

On average, the proposed rezoning (and subsequent development) may have localised impacts on the flow within Creek 2, however the overall impact on creek flows, particularly downstream of the site, are not expected to be significant.

5.7 Downstream Wetland Management Area

The wetland area downstream of the proposed rezoning site is classified as a Wetland Management Area and SEPP 14 Coastal Wetland in DCP 2013 Section 3.10. The proposed rezoning and development do not overlap with the wetland area.

The proposed stormwater management for the rezoning site aims to control and treat runoff from the site, to as close as possible mimic existing flows and water quality entering the downstream wetlands. The results of preliminary modelling indicate that this is achievable.

Detailed sediment and erosion control plans will be required to ensure that sediment transport to the wetlands in minimised during the construction phase.

6 References

Bureau of Meteorology. *Online IFD Calculators*

Central Coast Council. *Former Wyong LGA Online Mapping*

Central Coast Council. (2013). *Wyong Development Control Plan (DCP) 2013*

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Gosford City Council. (November 2015). *Gosford City Council Civil Works Specification - Design*

NSW Government Department of Environment. *Online eSpade soil mapping*

NSW Government Department of Finance and Service. *Online SIX Maps and e-Topography*

NSW Government Department of Industry. (May 2018). *Guidelines for controlled activities on waterfront land – Riparian Corridors*.

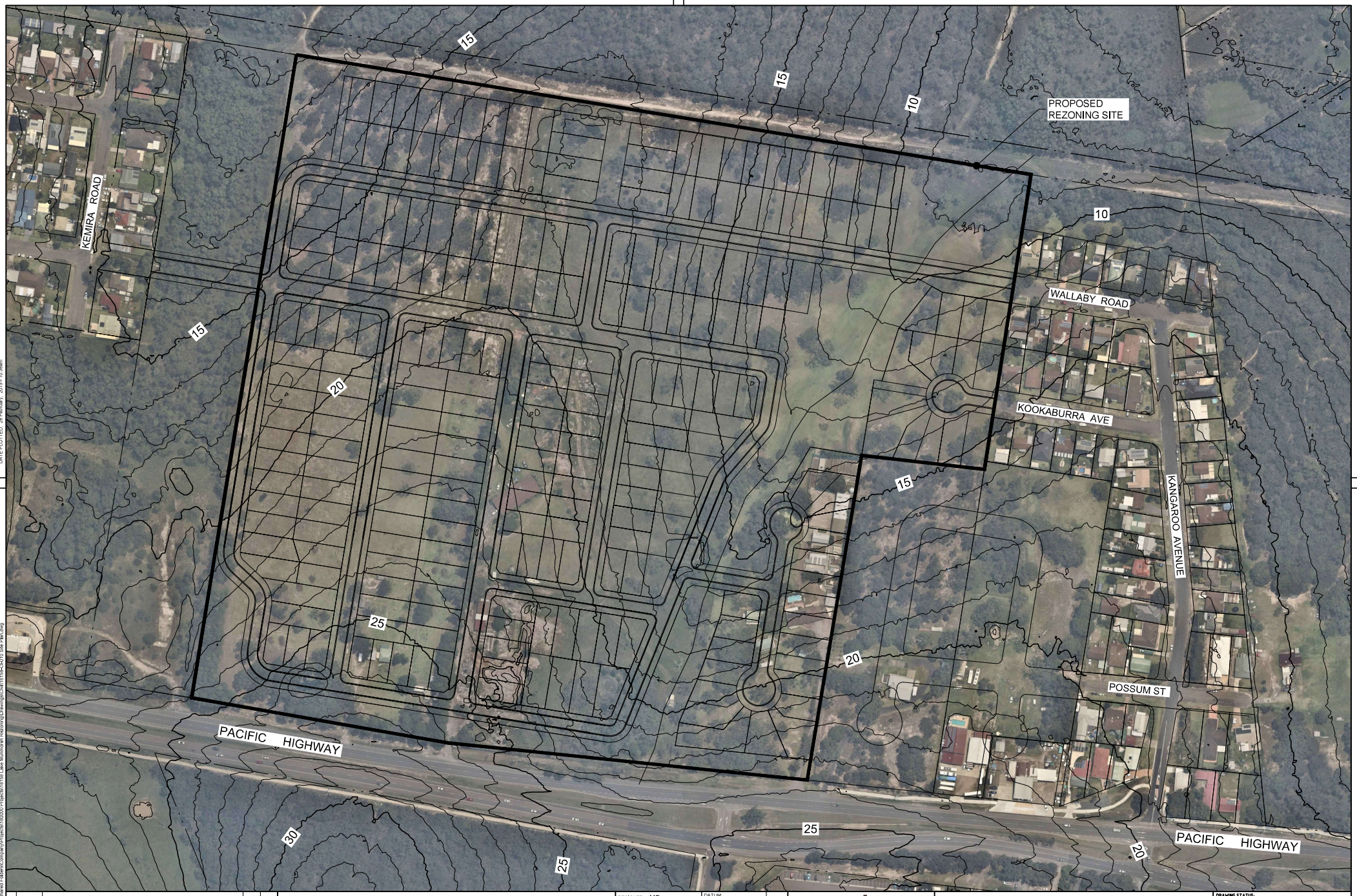
NSW Government Department of Resources & Energy. *Online 1:100,000 Soil landscape mapping*

WMA Water. (2011). *Lake Macquarie Waterway Flood Risk Management Study and Plan*

7 Appendices

APPENDIX A

A. Cubo Drawings 18104-CI



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1	07/02/19	PRELIMINARY	IC	VC

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NORTH

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DRAWN: IC	COORDINATE SYSTEM:	
CHECKED: VC		
RECOMMENDED:	APPROVED:	
PROJECT MANAGER DATE	PROJECT DIRECTOR DATE	

Cubo
CUBO CONSULTING PTY LTD
ABN: 46 610 277 462
Suite 6, 220 The Entrance Road, Erina NSW
Phone: (02) 4326 0990 Email: admin@cubo.net.au

SHOPBOX PTY LTD

PROPOSED DEVELOPMENT
285 PACIFIC HIGHWAY, LAKE MUNMORAH NSW 2259
LOT 438 DP755266, LOT 437 DP755266, LOT 1 DP626787
SITE PLAN

DRAWING STATUS:
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DRAWING NUMBER: 18158-CI-010 REV 2

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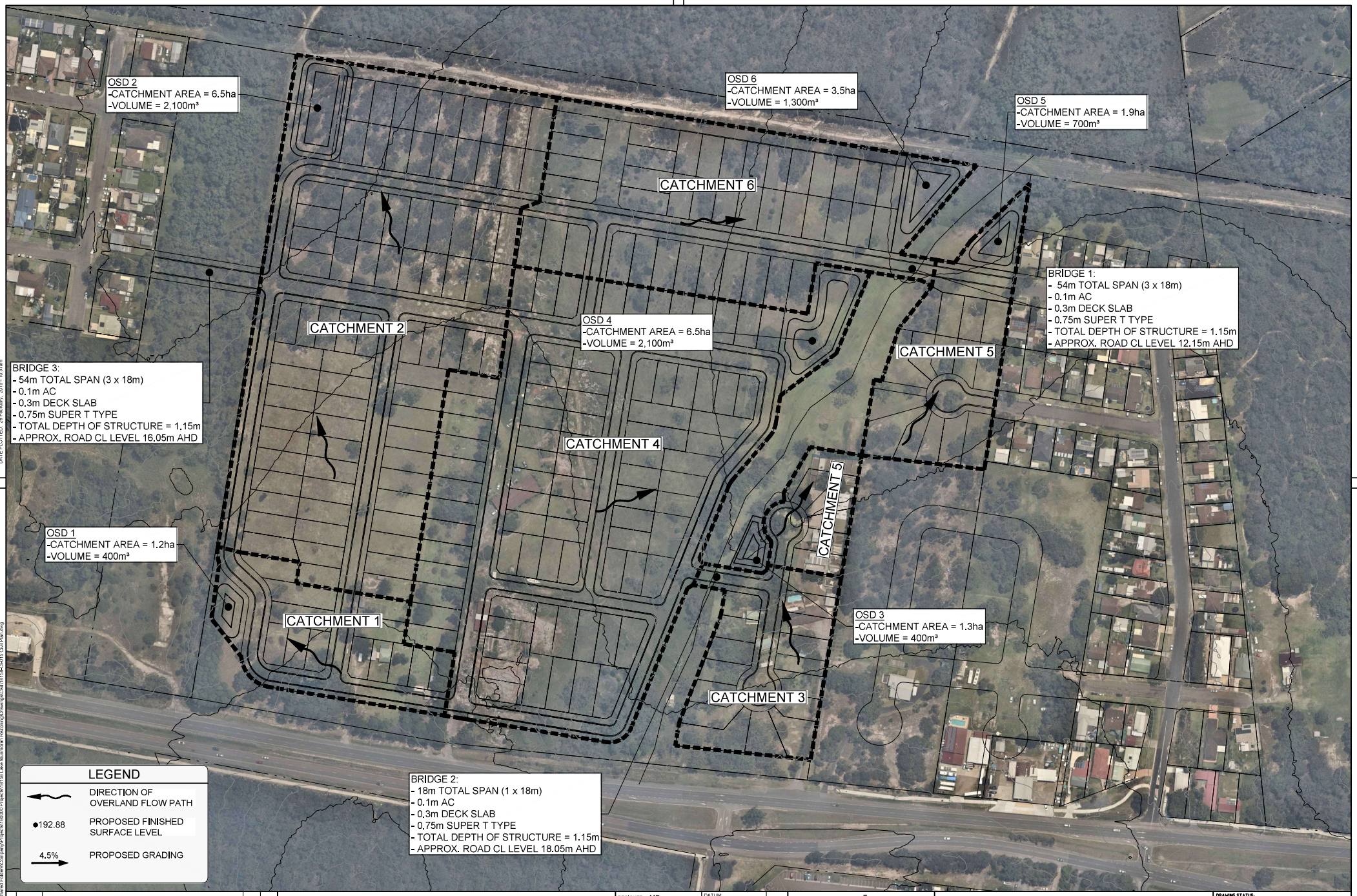

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REV	DATE	REVISIONS	DRN	CHK
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1	07/02/19	PRELIMINARY	IC	VC

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SCALE 1:1250 @A1

NORTH

DESIGNED: MB
DRAWN: IC
CHECKED: VC
RECOMMENDED:
PROJECT MANAGER DATE

DATUM: AHD
A1
COORDINATE SYSTEM:
APPROVED:
PROJECT DIRECTOR DATE

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Suite 6, 220 The Entrance Road, Erina NSW
Phone: (02) 4326 0990 Email: admin@cubo.net.au

SHOPBOX PTY LTD
PROPOSED DEVELOPMENT
285 PACIFIC HIGHWAY, LAKE MUNMORAH NSW 2259
LOT 438 DP755266, LOT 437 DP755266, LOT 1 DP626787
CIVIL PLAN

DRAWING STATUS: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DRAWING NUMBER: 18158-CI-015 REV 2

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1	07/02/19	PRELIMINARY	IC	VC

SCALE 1:1250 @A1

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DESIGNED: MB	DATUM: AHD	A1	
DRAWN: IC	COORDINATE SYSTEM:		
CHECKED: VC			
RECOMMENDED:	APPROVED:	25	
PROJECT MANAGER / DATE	PROJECT DIRECTOR / DATE		

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SHOPBOX PTY LTD

PROPOSED DEVELOPMENT
285 PACIFIC HIGHWAY, LAKE MUNMORAH NSW 2259
LOT 438 DP755266, LOT 437 DP755266, LOT 1 DP626787
1% AEP FLOODING PLAN PRE DEVELOPMENT

DRAWING STATUS: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DRAWING NUMBER: 18158-CI-020 REV 2

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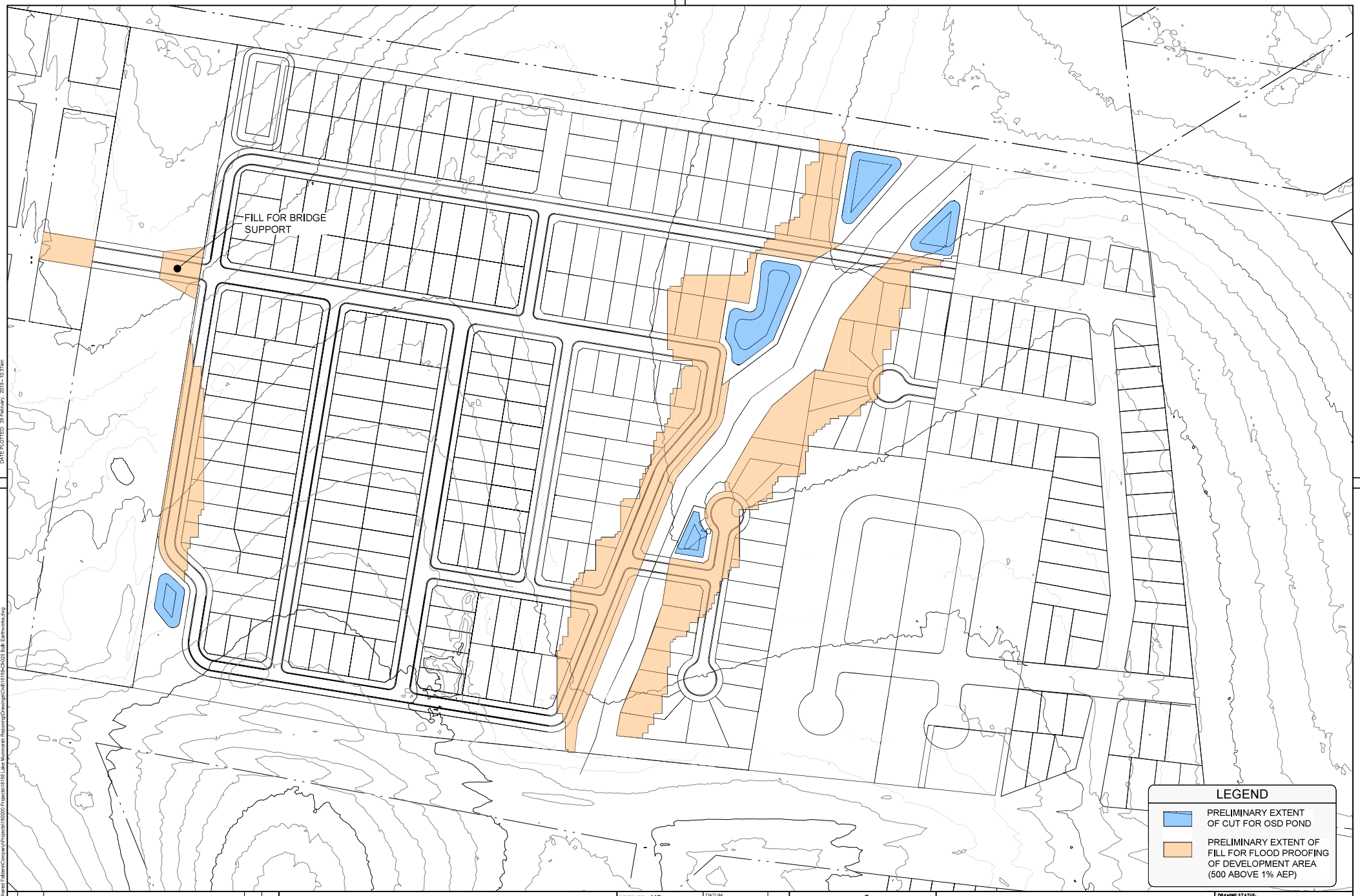

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1	07/02/19	PRELIMINARY	IC	VC

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NORTH

DESIGNED: MB	DATUM: AHD	A1
DRAWN: IC	COORDINATE SYSTEM:	
CHECKED: VC		
RECOMMENDED:	APPROVED:	
PROJECT MANAGER / DATE	PROJECT DIRECTOR / DATE	

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SHOPBOX PTY LTD

PROPOSED DEVELOPMENT
285 PACIFIC HIGHWAY, LAKE MUNMORAH NSW 2259
LOT 438 DP755266, LOT 437 DP755266, LOT 1 DP626787

BULK EARTHWORKS PLAN

DRAWING STATUS: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DRAWING NUMBER: 18158-CI-025 REV 2

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APPENDIX B

B. DRAINS Model Set Up and Outputs

LAKE MUNMORAH REZONING OSD 1 AND 3 MODEL DETAILS

PIT / NODE DETAILS

Name	Type	Family	Version 14 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N83	Node						40		0	965.2	-527.2		171		No					
N85	Node						34		0	1169	-369		173		No					
N6779	Node						39		0	1245.718	-427.431		18349		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin786	37.5	120		None						1385.185	-489.352	No			18352
	39	450													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat5430	N83	1.3	0	5	0.035	0	1	LakeM
Cat54	Basin786	1.3	70	5	0.025	0	1	LakeM

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF6108	Basin786	N6779	0.1	37.5			Pathway 4m wide	0.3	0.3	0.6	2	0	21191	37.5	37.4	5

Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL (m)	D/S IL (m)	
OF15	N6779	N85	120				Large Creek	0.3	0.3	0.6	3.33	0	179	37.4	34	120

This model has no pipes with non-return valves

LAKE MUNMORAH REZONING OSD 2 AND 4 MODEL DETAILS

PIT / NODE DETAILS

Name	Type	Family	Version 14 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N83	Node						40		0	965.2	-527.2		171		No					
N85	Node						34		0	1169	-369		173		No					
N6779	Node						39		0	1245.718	-427.431		18349		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin786	37.5	950		None						1385.185	-489.352	No			18352
	39	1950													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat5430	N83	6.5	0	5	0.035	0	1	LakeM
Cat54	Basin786	6.5	70	5	0.025	0	1	LakeM

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF6108	Basin786	N6779	0.1	37.5			Pathway 4m wide	0.3	0.3	0.6	2	0	21191	37.5	37.4	5

Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL (m)	D/S IL (m)	
OF15	N6779	N85	120				Large Creek	0.3	0.3	0.6	3.33	0	179	37.4	34	120

This model has no pipes with non-return valves

LAKE MUNMORAH REZONING OSD 5 MODEL DETAILS

PIT / NODE DETAILS — Version 14

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N83	Node						40		0	965.2	-527.2		171		No					
N85	Node						34		0	1169	-369		173		No					
N6779	Node						39		0	1245.718	-427.431		18349		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin786	37.5	200		None						1385.185	-489.352	No			18352
	39	800													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat5430	N83	1.9	0	5	0.035	0	1	LakeM
Cat54	Basin786	1.9	70	5	0.025	0	1	LakeM

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF6108	Basin786	N6779	0.1	37.5			Pathway 4m wide	0.3	0.3	0.6	2	0	21191	37.5	37.4	5

Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL (m)	D/S IL (m)
OF15	N6779	N85	120				Large Creek	0.3	0.3	0.6	3.33	0	179	37.4	34	120

This model has no pipes with non-return valves

LAKE MUNMORAH REZONING OSD 6 MODEL DETAILS

PIT / NODE DETAILS — Version 14

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N83	Node						40		0	965.2	-527.2		171		No					
N85	Node						34		0	1169	-369		173		No					
N6779	Node						39		0	1245.718	-427.431		18349		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin786	37.5	480		None						1385.185	-489.352	No			18352
	39	1300													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat5430	N83	3.5	0	5	0.035	0	1	LakeM
Cat54	Basin786	3.5	70	5	0.025	0	1	LakeM

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF6108	Basin786	N6779	0.1	37.5			Pathway 4m wide	0.3	0.3	0.6	2	0	21191	37.5	37.4	5

Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL (m)	D/S IL (m)
OF15	N6779	N85	120				Large Creek	0.3	0.3	0.6	3.33	0	179	37.4	34	120

This model has no pipes with non-return valves

LAKE MUNMORAH REZONING OSD 1 AND 3 - 1 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.46		0.132				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.136	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
Cat54	0.298	AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.91 impervious + 1.69 pervious = 2.60 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 93.3 mm/h, Zone 1	202.15	69.16 (34.2%)	69.16 (97.7%)	0.00 (0.0%)
AR&R 1 year, 10 minutes storm, average 73.7 mm/h, Zone 1	319.37	147.21 (46.1%)	112.17 (100.4%)	35.04 (16.9%)
AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1	459.33	282.92 (61.6%)	160.45 (99.8%)	122.46 (41.0%)
AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1	548.6	366.15 (66.7%)	190.40 (99.2%)	175.75 (49.3%)
AR&R 1 year, 1 hour storm, average 27.6 mm/h, Zone 1	717.6	522.87 (72.9%)	249.17 (99.2%)	273.70 (58.7%)
AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1	920.42	695.60 (75.6%)	318.42 (98.8%)	377.19 (63.0%)
AR&R 1 year, 6 hours storm, average 8.93 mm/h, Zone 1	1393.34	1042.41 (74.8%)	461.28 (94.6%)	581.13 (64.2%)
AR&R 1 year, 9 hours storm, average 6.99 mm/h, Zone 1	1635.66	1195.28 (73.1%)	533.29 (93.2%)	661.99 (62.3%)
AR&R 1 year, 72 hours storm, average 1.79 mm/h, Zone 1	3349.84	1905.77 (56.9%)	935.71 (79.8%)	970.06 (44.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.13	0.13	2.249	0.06	0.04	3.3	0.73	AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1
OF6108	0.132	0.132	1.844	0.079	0.09	3.17	1.1	AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.01	82.2	0.132	0	0.132

CONTINUITY CHECK for AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	295.21	295.21	0	0
N85	400.12	400.12	0	0
N6779	399.75	400.12	0	-0.1
Basin786	400.4	399.75	0.65	0

Run Log for Dev multiple OSD 1 and 3 WORKING run at 09:29:18 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 2 AND 4 - 1 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.53		0.481				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.48	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
Cat54	1.485	AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (4.55 impervious + 8.45 pervious = 13.0 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 93.3 mm/h, Zone 1	1010.75	345.52 (34.2%)	345.52 (97.7%)	0.00 (0.0%)
AR&R 1 year, 10 minutes storm, average 73.7 mm/h, Zone 1	1596.83	716.63 (44.9%)	541.43 (96.9%)	175.19 (16.9%)
AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1	2296.67	1395.10 (60.7%)	782.80 (97.4%)	612.30 (41.0%)
AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1	2743	1811.26 (66.0%)	932.54 (97.1%)	878.72 (49.3%)
AR&R 1 year, 1 hour storm, average 27.6 mm/h, Zone 1	3588	2593.66 (72.3%)	1225.17 (97.6%)	1368.49 (58.7%)
AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1	4602.11	3450.26 (75.0%)	1564.36 (97.1%)	1885.90 (63.0%)
AR&R 1 year, 6 hours storm, average 8.93 mm/h, Zone 1	6966.7	5211.68 (74.8%)	2306.01 (94.6%)	2905.66 (64.2%)
AR&R 1 year, 9 hours storm, average 6.99 mm/h, Zone 1	8178.3	5974.93 (73.1%)	2664.98 (93.1%)	3309.95 (62.3%)
AR&R 1 year, 72 hours storm, average 1.79 mm/h, Zone 1	16749.2	9528.64 (56.9%)	4678.33 (79.8%)	4850.32 (44.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q		Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.48		0.48	2.249	0.129	0.14	3.64	1.14	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
OF6108	0.481		0.481	1.844	0.128	0.2	4	1.63	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total		Max Q Low Level	Max Q High Level
Basin786	38.1		680	0.481	0	0.481

CONTINUITY CHECK for AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)		Difference %
N83	1449.21		1449.21	0	0
N85	1990.25		1990.25	0	0
N6779	1986.69		1990.25	0	-0.2
Basin786	2001.06		1986.69	14.36	0

Run Log for Dev multiple OSD 2 and 4 WORKING run at 09:35:22 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 5 - 1 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.47		0.167				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.185	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
Cat54	0.436	AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.33 impervious + 2.47 pervious = 3.80 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 93.3 mm/h, Zone 1	295.45	101.00 (34.2%)	101.00 (97.7%)	0.00 (0.0%)
AR&R 1 year, 10 minutes storm, average 73.7 mm/h, Zone 1	466.77	214.96 (46.1%)	163.75 (100.2%)	51.21 (16.9%)
AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1	671.33	413.06 (61.5%)	234.08 (99.6%)	178.98 (41.0%)
AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1	801.8	534.53 (66.7%)	277.68 (98.9%)	256.86 (49.3%)
AR&R 1 year, 1 hour storm, average 27.6 mm/h, Zone 1	1048.8	763.78 (72.8%)	363.77 (99.1%)	400.02 (58.7%)
AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1	1345.23	1016.56 (75.6%)	465.30 (98.8%)	551.27 (63.0%)
AR&R 1 year, 6 hours storm, average 8.93 mm/h, Zone 1	2036.42	1524.05 (74.8%)	674.70 (94.7%)	849.35 (64.2%)
AR&R 1 year, 9 hours storm, average 6.99 mm/h, Zone 1	2390.58	1747.80 (73.1%)	780.27 (93.3%)	967.53 (62.3%)
AR&R 1 year, 72 hours storm, average 1.79 mm/h, Zone 1	4895.92	2795.36 (57.1%)	1377.59 (80.4%)	1417.77 (44.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.165	0.165	2.249	0.07	0.05	3.35	0.79	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
OF6108	0.167	0.167	1.844	0.085	0.1	3.42	1.15	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.11	178.1	0.167	0	0.167

CONTINUITY CHECK for AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	431.54	431.54	0	0
N85	584.7	584.7	0	0
N6779	583.68	584.7	0	-0.2
Basin786	585.02	583.68	1.33	0

Run Log for Dev multiple OSD 5 WORKING run at 14:55:01 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 6 - 1 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.5		0.316				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.301	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
Cat54	0.802	AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.45 impervious + 4.55 pervious = 7.00 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 93.3 mm/h, Zone 1	544.25	186.03 (34.2%)	186.03 (97.7%)	0.00 (0.0%)
AR&R 1 year, 10 minutes storm, average 73.7 mm/h, Zone 1	859.83	389.51 (45.3%)	295.18 (98.1%)	94.34 (16.9%)
AR&R 1 year, 20 minutes storm, average 53 mm/h, Zone 1	1236.67	754.13 (61.0%)	424.43 (98.1%)	329.70 (41.0%)
AR&R 1 year, 30 minutes storm, average 42.2 mm/h, Zone 1	1477	977.97 (66.2%)	504.81 (97.7%)	473.16 (49.3%)
AR&R 1 year, 1 hour storm, average 27.6 mm/h, Zone 1	1932	1400.52 (72.5%)	663.64 (98.1%)	736.88 (58.7%)
AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1	2478.06	1865.88 (75.3%)	850.39 (98.0%)	1015.49 (63.0%)
AR&R 1 year, 6 hours storm, average 8.93 mm/h, Zone 1	3751.3	2807.31 (74.8%)	1242.73 (94.7%)	1564.58 (64.2%)
AR&R 1 year, 9 hours storm, average 6.99 mm/h, Zone 1	4403.7	3218.93 (73.1%)	1436.66 (93.2%)	1782.28 (62.3%)
AR&R 1 year, 72 hours storm, average 1.79 mm/h, Zone 1	9018.8	5133.25 (56.9%)	2521.55 (79.9%)	2611.70 (44.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.315	0.315	2.249	0.101	0.1	3.5	0.98	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1
OF6108	0.316	0.316	1.844	0.107	0.15	4	1.43	AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.08	351.4	0.316	0	0.316

CONTINUITY CHECK for AR&R 1 year, 2 hours storm, average 17.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	788.31	788.31	0	0
N85	1075.24	1075.24	0	0
N6779	1072.54	1075.24	0	-0.3
Basin786	1077.58	1072.54	5.04	0

Run Log for Dev multiple OSD 6 WORKING run at 09:42:49 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 1 AND 3 - 10 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.51		0.342				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.386	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
Cat54	0.649	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.91 impervious + 1.69 pervious = 2.60 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 184 mm/h, Zone 1	398.67	222.91 (55.9%)	138.92 (99.6%)	83.99 (32.4%)
AR&R 10 year, 10 minutes storm, average 145 mm/h, Zone 1	628.33	449.89 (71.6%)	218.68 (99.4%)	231.21 (56.6%)
AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1	910	729.75 (80.2%)	317.33 (99.6%)	412.42 (69.7%)
AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1	1088.1	901.15 (82.8%)	378.33 (99.3%)	522.82 (73.9%)
AR&R 10 year, 1 hour storm, average 54.8 mm/h, Zone 1	1424.8	1225.57 (86.0%)	496.10 (99.5%)	729.47 (78.8%)
AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1	1825.16	1593.82 (87.3%)	634.05 (99.3%)	959.77 (80.9%)
AR&R 10 year, 6 hours storm, average 17.4 mm/h, Zone 1	2714.4	2344.36 (86.4%)	923.34 (97.2%)	1421.02 (80.5%)
AR&R 10 year, 9 hours storm, average 13.6 mm/h, Zone 1	3182.4	2701.98 (84.9%)	1074.41 (96.5%)	1627.57 (78.7%)
AR&R 10 year, 72 hours storm, average 3.63 mm/h, Zone 1	6796.4	4980.72 (73.3%)	2108.03 (88.6%)	2872.69 (65.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.342	0.342	2.249	0.106	0.1	3.53	1.01	AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1
OF6108	0.342	0.342	1.844	0.11	0.16	4	1.47	AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.41	181.9	0.342	0	0.342

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	742.5	742.5	0	0
N85	853.71	853.71	0	0
N6779	850.65	853.71	0	-0.4
Basin786	851.29	850.65	0.65	0

Run Log for Dev multiple OSD 1 and 3 WORKING run at 14:49:56 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 2 AND 4 - 10 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.65		1.509				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	1.544	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
Cat54	3.241	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (4.55 impervious + 8.45 pervious = 13.0 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 184 mm/h, Zone 1	1993.33	1093.95 (54.9%)	673.98 (96.6%)	419.96 (32.4%)
AR&R 10 year, 10 minutes storm, average 145 mm/h, Zone 1	3141.67	2229.67 (71.0%)	1073.61 (97.6%)	1156.06 (56.6%)
AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1	4550	3629.31 (79.8%)	1567.20 (98.4%)	2062.11 (69.7%)
AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1	5440.5	4485.98 (82.5%)	1871.87 (98.3%)	2614.10 (73.9%)
AR&R 10 year, 1 hour storm, average 54.8 mm/h, Zone 1	7124	6107.68 (85.7%)	2460.32 (98.7%)	3647.36 (78.8%)
AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1	9125.78	7943.55 (87.0%)	3144.74 (98.5%)	4798.81 (80.9%)
AR&R 10 year, 6 hours storm, average 17.4 mm/h, Zone 1	13572	11719.81 (86.4%)	4614.72 (97.1%)	7105.09 (80.5%)
AR&R 10 year, 9 hours storm, average 13.6 mm/h, Zone 1	15912	13508.25 (84.9%)	5370.37 (96.4%)	8137.88 (78.7%)
AR&R 10 year, 72 hours storm, average 3.63 mm/h, Zone 1	33982	24904.13 (73.3%)	10540.54 (88.6%)	14363.59 (65.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	1.509	1.509	2.249	0.249	0.42	4.24	1.68	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
OF6108	1.509	1.509	1.844	0.248	0.49	4	2.35	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.49	1232.3	1.509	0	1.509

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	3688.02	3688.02	0	0
N85	4249.53	4249.53	0	0
N6779	4240.41	4249.53	0	-0.2
Basin786	4255.56	4240.41	15.21	0

Run Log for Dev multiple OSD 2 and 4 WORKING run at 14:53:00 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 5 - 10 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.53		0.492				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.544	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
Cat54	0.948	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.33 impervious + 2.47 pervious = 3.80 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 184 mm/h, Zone 1	582.67	325.37 (55.8%)	202.61 (99.4%)	122.76 (32.4%)
AR&R 10 year, 10 minutes storm, average 145 mm/h, Zone 1	918.33	657.16 (71.6%)	319.23 (99.3%)	337.92 (56.6%)
AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1	1330	1066.06 (80.2%)	463.29 (99.5%)	602.77 (69.7%)
AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1	1590.3	1316.37 (82.8%)	552.25 (99.2%)	764.12 (73.9%)
AR&R 10 year, 1 hour storm, average 54.8 mm/h, Zone 1	2082.4	1790.81 (86.0%)	724.65 (99.4%)	1066.15 (78.8%)
AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1	2667.54	2329.08 (87.3%)	926.35 (99.2%)	1402.73 (80.9%)
AR&R 10 year, 6 hours storm, average 17.4 mm/h, Zone 1	3967.2	3426.55 (86.4%)	1349.65 (97.2%)	2076.90 (80.5%)
AR&R 10 year, 9 hours storm, average 13.6 mm/h, Zone 1	4651.2	3949.36 (84.9%)	1570.59 (96.5%)	2378.77 (78.7%)
AR&R 10 year, 72 hours storm, average 3.63 mm/h, Zone 1	9933.2	7290.02 (73.4%)	3091.44 (88.9%)	4198.58 (65.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.491	0.491	2.249	0.131	0.15	3.65	1.15	AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1
OF6108	0.492	0.492	1.844	0.13	0.21	4	1.64	AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.41	314.9	0.492	0	0.492

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	1085.09	1085.09	0	0
N85	1246.39	1246.39	0	0
N6779	1242.61	1246.39	0	-0.3
Basin786	1243.99	1242.61	1.38	0

Run Log for Dev multiple OSD 5 WORKING run at 14:55:25 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 6 - 10 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.58		0.861				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.928	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
Cat54	1.746	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.45 impervious + 4.55 pervious = 7.00 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 184 mm/h, Zone 1	1073.33	592.82 (55.2%)	366.69 (97.6%)	226.14 (32.4%)
AR&R 10 year, 10 minutes storm, average 145 mm/h, Zone 1	1691.67	1203.87 (71.2%)	581.38 (98.2%)	622.49 (56.6%)
AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1	2450	1957.16 (79.9%)	846.80 (98.8%)	1110.37 (69.7%)
AR&R 10 year, 30 minutes storm, average 83.7 mm/h, Zone 1	2929.5	2418.36 (82.6%)	1010.77 (98.6%)	1407.59 (73.9%)
AR&R 10 year, 1 hour storm, average 54.8 mm/h, Zone 1	3836	3292.17 (85.8%)	1328.20 (98.9%)	1963.97 (78.8%)
AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1	4913.88	4284.64 (87.2%)	1700.66 (98.9%)	2583.98 (80.9%)
AR&R 10 year, 6 hours storm, average 17.4 mm/h, Zone 1	7308	6312.13 (86.4%)	2486.26 (97.2%)	3825.87 (80.5%)
AR&R 10 year, 9 hours storm, average 13.6 mm/h, Zone 1	8568	7274.80 (84.9%)	2892.88 (96.5%)	4381.92 (78.7%)
AR&R 10 year, 72 hours storm, average 3.63 mm/h, Zone 1	18298	13413.34 (73.3%)	5679.17 (88.7%)	7734.18 (65.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S		Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.86		0.86	2.249	0.18	0.25	3.9	1.39	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1
OF6108	0.861		0.861	1.844	0.18	0.31	4	1.99	AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol		Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.39		613.8	0.861	0	0.861

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 35.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	1993.16	1993.16	0	0
N85	2291.56	2291.56	0	0
N6779	2286.12	2291.56	0	-0.2
Basin786	2291.5	2286.12	5.37	0

Run Log for Dev multiple OSD 6 WORKING run at 14:57:29 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 1 AND 3 - 100 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.57		0.747				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	0.76	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
Cat54	1.141	AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.91 impervious + 1.69 pervious = 2.60 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1	686.83	504.15 (73.4%)	237.38 (98.7%)	266.77 (59.8%)
AR&R 100 year, 10 minutes storm, average 251 mm/h, Zone 1	1087.67	903.74 (83.1%)	377.73 (99.2%)	526.01 (74.4%)
AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	1577.33	1393.05 (88.3%)	549.78 (99.6%)	843.27 (82.2%)
AR&R 100 year, 30 minutes storm, average 145 mm/h, Zone 1	1885	1694.08 (89.9%)	656.17 (99.5%)	1037.91 (84.7%)
AR&R 100 year, 1 hour storm, average 94.8 mm/h, Zone 1	2464.8	2262.66 (91.8%)	859.48 (99.6%)	1403.18 (87.6%)
AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1	3120	2883.36 (92.4%)	1086.68 (99.5%)	1796.68 (88.6%)
AR&R 100 year, 6 hours storm, average 29.3 mm/h, Zone 1	4570.8	4189.45 (91.7%)	1572.39 (98.3%)	2617.06 (88.1%)
AR&R 100 year, 9 hours storm, average 22.8 mm/h, Zone 1	5335.33	4844.07 (90.8%)	1827.30 (97.9%)	3016.77 (87.0%)
AR&R 100 year, 72 hours storm, average 6.14 mm/h, Zone 1	11492	9295.24 (80.9%)	3719.12 (92.5%)	5576.12 (74.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q		Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.741	0.741	2.249	0.166	0.22	3.83	1.32	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	
OF6108	0.747	0.747	1.844	0.166	0.28	4	1.9	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.84	333.2	0.747	0	0.747

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	649.94	649.94	0	0
N85	744.82	744.82	0	0
N6779	742.29	744.82	0	-0.3
Basin786	743.11	742.29	0.82	0

Run Log for Dev multiple OSD 1 and 3 WORKING run at 14:48:21 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 2 AND 4 - 100 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.75		2.831				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	2.907	AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1
Cat54	5.696	AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1

Outflow Volumes for Total Catchment (4.55 impervious + 8.45 pervious = 13.0 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1	3434.17	2500.90 (72.8%)	1167.07 (97.1%)	1333.83 (59.8%)
AR&R 100 year, 10 minutes storm, average 251 mm/h, Zone 1	5438.33	4498.99 (82.7%)	1868.94 (98.2%)	2630.05 (74.4%)
AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	7886.67	6945.74 (88.1%)	2729.41 (98.9%)	4216.33 (82.2%)
AR&R 100 year, 30 minutes storm, average 145 mm/h, Zone 1	9425	8450.17 (89.7%)	3260.63 (98.8%)	5189.54 (84.7%)
AR&R 100 year, 1 hour storm, average 94.8 mm/h, Zone 1	12324	11293.42 (91.6%)	4277.55 (99.2%)	7015.88 (87.6%)
AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1	15600	14391.77 (92.3%)	5408.29 (99.1%)	8983.48 (88.6%)
AR&R 100 year, 6 hours storm, average 29.3 mm/h, Zone 1	22854	20944.82 (91.6%)	7859.58 (98.3%)	13085.24 (88.1%)
AR&R 100 year, 9 hours storm, average 22.8 mm/h, Zone 1	26676.65	24218.83 (90.8%)	9135.07 (97.8%)	15083.76 (87.0%)
AR&R 100 year, 72 hours storm, average 6.14 mm/h, Zone 1	57459.99	46470.58 (80.9%)	18590.02 (92.4%)	27880.56 (74.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	2.829	2.829	2.249	0.355	0.73	4.77	2.06	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
OF6108	2.831	2.831	1.844	0.355	0.85	4	2.78	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.96	2054.1	2.831	0	2.831

CONTINUITY CHECK for AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	6905.91	6905.91	0	0
N85	7481.33	7481.33	0	0
N6779	7469.48	7481.33	0	-0.2
Basin786	7485.79	7469.48	16.4	0

Run Log for Dev multiple OSD 2 and 4 WORKING run at 14:53:43 on 6/2/2019

The maximum flow in these overflow routes is unsafe: OF6108, OF15

LAKE MUNMORAH REZONING OSD 5 - 100 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.59		0.954				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	1.046	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
Cat54	1.668	AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.33 impervious + 2.47 pervious = 3.80 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1	1003.83	736.56 (73.4%)	346.67 (98.7%)	389.89 (59.8%)
AR&R 100 year, 10 minutes storm, average 251 mm/h, Zone 1	1589.67	1320.49 (83.1%)	551.70 (99.2%)	768.78 (74.4%)
AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	2305.33	2035.47 (88.3%)	803.00 (99.5%)	1232.47 (82.2%)
AR&R 100 year, 30 minutes storm, average 145 mm/h, Zone 1	2755	2475.12 (89.8%)	958.18 (99.4%)	1516.95 (84.7%)
AR&R 100 year, 1 hour storm, average 94.8 mm/h, Zone 1	3602.4	3306.50 (91.8%)	1255.69 (99.6%)	2050.80 (87.6%)
AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1	4560	4213.85 (92.4%)	1587.92 (99.5%)	2625.93 (88.6%)
AR&R 100 year, 6 hours storm, average 29.3 mm/h, Zone 1	6680.4	6123.13 (91.7%)	2298.21 (98.3%)	3824.92 (88.1%)
AR&R 100 year, 9 hours storm, average 22.8 mm/h, Zone 1	7797.79	7079.93 (90.8%)	2670.82 (97.9%)	4409.11 (87.0%)
AR&R 100 year, 72 hours storm, average 6.14 mm/h, Zone 1	16796	13595.08 (80.9%)	5445.38 (92.6%)	8149.70 (74.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	0.95	0.95	2.249	0.191	0.27	3.96	1.44	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
OF6108	0.954	0.954	1.844	0.191	0.34	4	2.05	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.83	571.6	0.954	0	0.954

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	949.45	949.45	0	0
N85	1088.09	1088.09	0	0
N6779	1083.91	1088.09	0	-0.4
Basin786	1086.02	1083.91	2.11	0

Run Log for Dev multiple OSD 5 WORKING run at 14:54:31 on 6/2/2019

Flows were safe in all overflow routes.

LAKE MUNMORAH REZONING OSD 6 - 100 YEAR ARI FLOOD EVENT

DRAINS results prepared from Version 2018.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N6779	37.65		1.541				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat5430	1.688	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
Cat54	3.071	AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.45 impervious + 4.55 pervious = 7.00 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 317 mm/h, Zone 1	1849.17	1350.21 (73.0%)	631.99 (97.6%)	718.22 (59.8%)
AR&R 100 year, 10 minutes storm, average 251 mm/h, Zone 1	2928.33	2425.79 (82.8%)	1009.61 (98.5%)	1416.18 (74.4%)
AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1	4246.67	3742.91 (88.1%)	1472.59 (99.1%)	2270.33 (82.2%)
AR&R 100 year, 30 minutes storm, average 145 mm/h, Zone 1	5075	4553.21 (89.7%)	1758.84 (99.0%)	2794.37 (84.7%)
AR&R 100 year, 1 hour storm, average 94.8 mm/h, Zone 1	6636	6084.25 (91.7%)	2306.46 (99.3%)	3777.78 (87.6%)
AR&R 100 year, 2 hours storm, average 60 mm/h, Zone 1	8400	7756.09 (92.3%)	2918.92 (99.3%)	4837.17 (88.6%)
AR&R 100 year, 6 hours storm, average 29.3 mm/h, Zone 1	12306	11279.36 (91.7%)	4233.39 (98.3%)	7045.98 (88.1%)
AR&R 100 year, 9 hours storm, average 22.8 mm/h, Zone 1	14364.35	13041.65 (90.8%)	4919.58 (97.9%)	8122.07 (87.0%)
AR&R 100 year, 72 hours storm, average 6.14 mm/h, Zone 1	30940	25027.40 (80.9%)	10014.73 (92.5%)	15012.67 (74.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF15	1.535	1.535	2.249	0.252	0.42	4.26	1.69	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1
OF6108	1.541	1.541	1.844	0.252	0.5	4	2.36	AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin786	38.86	1111.7	1.541	0	1.541

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 182 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N83	1742.33	1742.33	0	0
N85	1996.03	1996.03	0	0
N6779	1991.7	1996.03	0	-0.2
Basin786	2000.58	1991.7	8.87	0

Run Log for Dev multiple OSD 6 WORKING run at 14:57:39 on 6/2/2019

Flows were safe in all overflow routes.

CATCHMENTS 1 AND 3 ON-SITE DETENTION OUTLET STRUCTURES - LAKE MUNMORAH REZONING

Orifice C = 0.6 Weir C = 1.7 No. Hi = 1 **NOTE THAT LEVELS ARE INDICATIVE ONLY**

Basin IL = 37.5 m AHD No. Low = 1

			LOW LEVEL						HIGH LEVEL						TOTAL				
Orifice IL	37	m AHD	Pit Size	600	mm				Orifice IL	37	m AHD	Pit Size	600	mm				Weir IL	38.7	m AHD	
Orifice Size	250	mm	Pit SL	37.5	m AHD				Orifice Size	375	mm	Pit SL	38	m AHD				Weir Lengt	4	m	
	Q			Q		LOW			Q			Q		HIGH		Pit flow			Q		Level	Total Flow
37.5	0.0922			0		0.0000			0.207557			0		0	0.0000	0.0000			0		37.5	0.0000
37.52	0.0941			0.01154		0.0115			0.211668			0		0	0.0115	0.0115			0		37.52	0.0115
37.54	0.0959			0.03264		0.0326			0.2157			0		0	0.0326	0.0326			0		37.54	0.0326
37.56	0.0976			0.059964		0.0600			0.219658			0		0	0.0600	0.0600			0		37.56	0.0600
37.58	0.0994			0.09232		0.0923			0.223546			0		0	0.0923	0.0923			0		37.58	0.0923
37.6	0.1011			0.129021		0.1011			0.227368			0		0	0.1011	0.1011			0		37.6	0.1011
37.62	0.1027			0.169602		0.1027			0.231126			0		0	0.1027	0.1027			0		37.62	0.1027
37.64	0.1044			0.213723		0.1044			0.234824			0		0	0.1044	0.1044			0		37.64	0.1044
37.66	0.1060			0.26112		0.1060			0.238465			0		0	0.1060	0.1060			0		37.66	0.1060
37.68	0.1076			0.31158		0.1076			0.242051			0		0	0.1076	0.1076			0		37.68	0.1076
37.7	0.1091			0.364926		0.1091			0.245585			0		0	0.1091	0.1091			0		37.7	0.1091
37.72	0.1107			0.421012		0.1107			0.249069			0		0	0.1107	0.1107			0		37.72	0.1107
37.74	0.1122			0.479708		0.1122			0.252504			0		0	0.1122	0.1122			0		37.74	0.1122
37.76	0.1137			0.540904		0.1137			0.255894			0		0	0.1137	0.1137			0		37.76	0.1137
37.78	0.1152			0.604501		0.1152			0.259239			0		0	0.1152	0.1152			0		37.78	0.1152
37.8	0.1167			0.670412		0.1167			0.262542			0		0	0.1167	0.1167			0		37.8	0.1167
37.82	0.1181			0.738559		0.1181			0.265803			0		0	0.1181	0.1181			0		37.82	0.1181
37.84	0.1196			0.80887		0.1196			0.269025			0		0	0.1196	0.1196			0		37.84	0.1196
37.86	0.1210			0.88128		0.1210			0.272209			0		0	0.1210	0.1210			0		37.86	0.1210
37.88	0.1224			0.955731		0.1224			0.275356			0		0	0.1224	0.1224			0		37.88	0.1224
37.9	0.1238			1.032167		0.1238			0.278467			0		0	0.1238	0.1238			0		37.9	0.1238
37.92	0.1251			1.11054		0.1251			0.281545			0		0	0.1251	0.1251			0		37.92	0.1251
37.94	0.1265			1.190801		0.1265			0.284588			0		0	0.1265	0.1265			0		37.94	0.1265
37.96	0.1278			1.272908		0.1278			0.2876			0		0	0.1278	0.1278			0		37.96	0.1278
37.98	0.1291			1.356819		0.1291			0.29058			0		0	0.1291	0.1291			0		37.98	0.1291
38	0.1305			1.442498		0.1305			0.29353			8.92E-20		8.92E-20	0.1305	0.1305			0		38	0.1305
38.02	0.1318			1.529908		0.1318			0.296451			0.01154		0.01154	0.1318	0.1433			0		38.02	0.1433
38.04	0.1330			1.619015		0.1330			0.299344			0.03264		0.03264	0.1330	0.1657			0		38.04	0.1657
38.06	0.1343			1.709788		0.1343			0.302208			0.059964		0.059964	0.1343	0.1943			0		38.06	0.1943
38.08	0.1356			1.802197		0.1356			0.305046			0.09232		0.09232	0.1356	0.2279			0		38.08	0.2279
38.1	0.1368			1.896213		0.1368			0.307857			0.129021		0.129021	0.1368	0.2658			0		38.1	0.2658
38.12	0.1381			1.991809		0.1381			0.310643			0.169602		0.169602	0.1381	0.3077			0		38.12	0.3077
38.14	0.1393			2.08896		0.1393			0.313405			0.213723		0.213723	0.1393	0.3134			0		38.14	0.3134
38.16	0.1405			2.187641		0.1405			0.316142			0.26112		0.26112	0.1405	0.3161			0		38.16	0.3161
38.18	0.1417			2.287829		0.1417			0.318856			0.31158		0.31158	0.1417	0.3189			0		38.18	0.3189
38.2	0.1429			2.389501		0.1429			0.321547			0.364926		0.321547	0.1429	0.3215			0		38.2	0.3215
38.22	0.1441			2.492636		0.1441			0.324215			0.421012		0.324215	0.1441	0.3242			0		38.22	0.3242
38.24	0.1453			2.597214		0.1453			0.326862			0.479708		0.326862	0.1453	0.3269			0		38.24	0.3269
38.26	0.1464			2.703215		0.1464			0.329487			0.540904		0.329487	0.1464	0.3295			0		38.26	0.3295
38.28	0.1476			2.81062		0.1476			0.332092			0.604501		0.332092	0.1476	0.3321			0		38.28	0.3321
38.3	0.1487			2.91941		0.1487			0.334676			0.670412		0.334676	0.1487	0.3347			0		38.3	0.3347
38.32	0.1499			3.02957		0.1499			0.337241			0.738559		0.337241	0.1499	0.3372			0		38.32	0.3372
38.34	0.1510			3.141081		0.1510			0.339786			0.80887		0.339786	0.1510	0.3398			0		38.34	0.3398

38.36	0.1521	3.253927	0.1521	0.342312	0.88128	0.342312	0.1521	0.3423	0	38.36	0.3423
38.38	0.1533	3.368094	0.1533	0.34482	0.955731	0.34482	0.1533	0.3448	0	38.38	0.3448
38.4	0.1544	3.483565	0.1544	0.34731	1.032167	0.34731	0.1544	0.3473	0	38.4	0.3473
38.42	0.1555	3.600327	0.1555	0.349782	1.11054	0.349782	0.1555	0.3498	0	38.42	0.3498
38.44	0.1565	3.718364	0.1565	0.352237	1.190801	0.352237	0.1565	0.3522	0	38.44	0.3522
38.46	0.1576	3.837665	0.1576	0.354674	1.272908	0.354674	0.1576	0.3547	0	38.46	0.3547
38.48	0.1587	3.958214	0.1587	0.357095	1.356819	0.357095	0.1587	0.3571	0	38.48	0.3571
38.5	0.1598	4.08	0.1598	0.3595	1.442498	0.3595	0.1598	0.3595	0	38.5	0.3595
38.52	0.1608	4.20301	0.1608	0.361889	1.529908	0.361889	0.1608	0.3619	0	38.52	0.3619
38.54	0.1619	4.327232	0.1619	0.364262	1.619015	0.364262	0.1619	0.3643	0	38.54	0.3643
38.56	0.1629	4.452654	0.1629	0.366619	1.709788	0.366619	0.1629	0.3666	0	38.56	0.3666
38.58	0.1640	4.579265	0.1640	0.368962	1.802197	0.368962	0.1640	0.3690	0	38.58	0.3690
38.6	0.1650	4.707054	0.1650	0.37129	1.896213	0.37129	0.1650	0.3713	0	38.6	0.3713
38.62	0.1660	4.83601	0.1660	0.373603	1.991809	0.373603	0.1660	0.3736	0	38.62	0.3736
38.64	0.1671	4.966123	0.1671	0.375902	2.08896	0.375902	0.1671	0.3759	0	38.64	0.3759
38.66	0.1681	5.097382	0.1681	0.378188	2.187641	0.378188	0.1681	0.3782	0	38.66	0.3782
38.68	0.1691	5.229777	0.1691	0.380459	2.287829	0.380459	0.1691	0.3805	0	38.68	0.3805
38.7	0.1701	5.363299	0.1701	0.382717	2.389501	0.382717	0.1701	0.3827	5.4E-19	38.7	0.3827
38.72	0.1711	5.497939	0.1711	0.384962	2.492636	0.384962	0.1711	0.3850	0.019233	38.72	0.4042
38.74	0.1721	5.633687	0.1721	0.387193	2.597214	0.387193	0.1721	0.3872	0.0544	38.74	0.4416
38.76	0.1731	5.770534	0.1731	0.389412	2.703215	0.389412	0.1731	0.3894	0.099939	38.76	0.4894
38.78	0.1741	5.908471	0.1741	0.391618	2.81062	0.391618	0.1741	0.3916	0.153866	38.78	0.5455
38.8	0.1750	6.04749	0.1750	0.393812	2.91941	0.393812	0.1750	0.3938	0.215035	38.8	0.6088
38.82	0.1760	6.187583	0.1760	0.395994	3.02957	0.395994	0.1760	0.3960	0.282671	38.82	0.6787
38.84	0.1770	6.328742	0.1770	0.398164	3.141081	0.398164	0.1770	0.3982	0.356206	38.84	0.7544
38.86	0.1779	6.470957	0.1779	0.400322	3.253927	0.400322	0.1779	0.4003	0.4352	38.86	0.8355
38.88	0.1789	6.614222	0.1789	0.402469	3.368094	0.402469	0.1789	0.4025	0.519299	38.88	0.9218
38.9	0.1798	6.75853	0.1798	0.404604	3.483565	0.404604	0.1798	0.4046	0.60821	38.9	1.0128
38.92	0.1808	6.903871	0.1808	0.406728	3.600327	0.406728	0.1808	0.4067	0.701686	38.92	1.1084
38.94	0.1817	7.05024	0.1817	0.408841	3.718364	0.408841	0.1817	0.4088	0.799513	38.94	1.2084
38.96	0.1826	7.197629	0.1826	0.410943	3.837665	0.410943	0.1826	0.4109	0.901507	38.96	1.3124
38.98	0.1836	7.346031	0.1836	0.413034	3.958214	0.413034	0.1836	0.4130	1.007502	38.98	1.4205
39	0.1845	7.495439	0.1845	0.415115	4.08	0.415115	0.1845	0.4151	1.117354	39	1.5325
39.02	0.1854	7.645846	0.1854	0.417185	4.20301	0.417185	0.1854	0.4172	1.230931	39.02	1.6481
39.04	0.1863	7.797246	0.1863	0.419245	4.327232	0.419245	0.1863	0.4192	1.348116	39.04	1.7674
39.06	0.1872	7.949633	0.1872	0.421295	4.452654	0.421295	0.1872	0.4213	1.4688	39.06	1.8901
39.08	0.1881	8.102999	0.1881	0.423336	4.579265	0.423336	0.1881	0.4233	1.592885	39.08	2.0162
39.1	0.1891	8.257339	0.1891	0.425366	4.707054	0.425366	0.1891	0.4254	1.720279	39.1	2.1456
39.12	0.1899	8.412647	0.1899	0.427387	4.83601	0.427387	0.1899	0.4274	1.8509	39.12	2.2783
39.14	0.1908	8.568917	0.1908	0.429398	4.966123	0.429398	0.1908	0.4294	1.984668	39.14	2.4141
39.16	0.1917	8.726142	0.1917	0.4314	5.097382	0.4314	0.1917	0.4314	2.121513	39.16	2.5529
39.18	0.1926	8.884318	0.1926	0.433393	5.229777	0.433393	0.1926	0.4334	2.261366	39.18	2.6948
39.2	0.1935	9.043438	0.1935	0.435376	5.363299	0.435376	0.1935	0.4354	2.404163	39.2	2.8395
39.22	0.1944	9.203496	0.1944	0.437351	5.497939	0.437351	0.1944	0.4374	2.549846	39.22	2.9872
39.24	0.1953	9.364488	0.1953	0.439316	5.633687	0.439316	0.1953	0.4393	2.698358	39.24	3.1377
39.26	0.1961	9.526408	0.1961	0.441273	5.770534	0.441273	0.1961	0.4413	2.849646	39.26	3.2909
39.28	0.1970	9.68925	0.1970	0.443221	5.908471	0.443221	0.1970	0.4432	3.003661	39.28	3.4469
39.3	0.1978	9.85301	0.1978	0.445161	6.04749	0.445161	0.1978	0.4452	3.160354	39.3	3.6055

CATCHMENTS 2 AND 4 ON-SITE DETENTION OUTLET STRUCTURES - LAKE MUNMORAH REZONING

Orifice C = 0.6 Weir C = 1.7 No. Hi = 1 **NOTE THAT LEVELS ARE INDICATIVE ONLY**

Basin IL = 37.5 m AHD No. Low = 2

		LOW LEVEL					HIGH LEVEL					TOTAL							
Orifice IL	37 m AHD	Pit Size	900 mm				Orifice IL	36.7 m AHD	Pit Size	1200 mm						Weir IL	38.65 m AHD		
Orifice Size	300 mm	Pit SL	37.5 m AHD				Orifice Size	750 mm	Pit SL	38.05 m AHD						Weir Lengt	4 m		
	Q		Q	LOW			Q		Q	HIGH			Pit flow				Q	Level	Total Flow
37.5	0.2657		0	0.0000			1.050166		0	0	0.0000	0.0000					0	37.5	0.0000
37.52	0.2709		0.01731	0.0173			1.063213		0	0	0.0173	0.0173					0	37.52	0.0173
37.54	0.2761		0.04896	0.0490			1.0761		0	0	0.0490	0.0490					0	37.54	0.0490
37.56	0.2812		0.089945	0.0899			1.088836		0	0	0.0899	0.0899					0	37.56	0.0899
37.58	0.2861		0.13848	0.1385			1.101424		0	0	0.1385	0.1385					0	37.58	0.1385
37.6	0.2910		0.193531	0.1935			1.11387		0	0	0.1935	0.1935					0	37.6	0.1935
37.62	0.2958		0.254404	0.2544			1.126178		0	0	0.2544	0.2544					0	37.62	0.2544
37.64	0.3006		0.320585	0.3006			1.138353		0	0	0.3006	0.3006					0	37.64	0.3006
37.66	0.3052		0.39168	0.3052			1.1504		0	0	0.3052	0.3052					0	37.66	0.3052
37.68	0.3098		0.467369	0.3098			1.162321		0	0	0.3098	0.3098					0	37.68	0.3098
37.7	0.3143		0.547389	0.3143			1.174122		0	0	0.3143	0.3143					0	37.7	0.3143
37.72	0.3188		0.631518	0.3188			1.185805		0	0	0.3188	0.3188					0	37.72	0.3188
37.74	0.3232		0.719562	0.3232			1.197374		0	0	0.3232	0.3232					0	37.74	0.3232
37.76	0.3275		0.811356	0.3275			1.208832		0	0	0.3275	0.3275					0	37.76	0.3275
37.78	0.3318		0.906752	0.3318			1.220183		0	0	0.3318	0.3318					0	37.78	0.3318
37.8	0.3361		1.005619	0.3361			1.231429		0	0	0.3361	0.3361					0	37.8	0.3361
37.82	0.3402		1.107838	0.3402			1.242574		0	0	0.3402	0.3402					0	37.82	0.3402
37.84	0.3444		1.213304	0.3444			1.253619		0	0	0.3444	0.3444					0	37.84	0.3444
37.86	0.3484		1.32192	0.3484			1.264568		0	0	0.3484	0.3484					0	37.86	0.3484
37.88	0.3525		1.433596	0.3525			1.275423		0	0	0.3525	0.3525					0	37.88	0.3525
37.9	0.3564		1.548251	0.3564			1.286186		0	0	0.3564	0.3564					0	37.9	0.3564
37.92	0.3604		1.66581	0.3604			1.29686		0	0	0.3604	0.3604					0	37.92	0.3604
37.94	0.3643		1.786201	0.3643			1.307447		0	0	0.3643	0.3643					0	37.94	0.3643
37.96	0.3681		1.909362	0.3681			1.317948		0	0	0.3681	0.3681					0	37.96	0.3681
37.98	0.3719		2.035229	0.3719			1.328367		0	0	0.3719	0.3719					0	37.98	0.3719
38	0.3757		2.163747	0.3757			1.338705		0	0	0.3757	0.3757					0	38	0.3757
38.02	0.3795		2.294861	0.3795			1.348963		0	0	0.3795	0.3795					0	38.02	0.3795
38.04	0.3832		2.428522	0.3832			1.359144		0	0	0.3832	0.3832					0	38.04	0.3832
38.06	0.3868		2.564682	0.3868			1.36925		0.00816	0.00816	0.3868	0.3950					0	38.06	0.3950
38.08	0.3905		2.703295	0.3905			1.379281		0.042401	0.042401	0.3905	0.4329					0	38.08	0.4329
38.1	0.3941		2.844319	0.3941			1.38924		0.091232	0.091232	0.3941	0.4853					0	38.1	0.4853
38.12	0.3976		2.987714	0.3976			1.399128		0.151125	0.151125	0.3976	0.5487					0	38.12	0.5487
38.14	0.4012		3.13344	0.4012			1.408946		0.22032	0.22032	0.4012	0.6215					0	38.14	0.6215
38.16	0.4047		3.281462	0.4047			1.418697		0.2977	0.2977	0.4047	0.7024					0	38.16	0.7024
38.18	0.4081		3.431743	0.4081			1.428381		0.382477	0.382477	0.4081	0.7906					0	38.18	0.7906
38.2	0.4116		3.584252	0.4116			1.438		0.474053	0.474053	0.4116	0.8856					0	38.2	0.8856
38.22	0.4150		3.738954	0.4150			1.447555		0.571957	0.571957	0.4150	0.9870					0	38.22	0.9870
38.24	0.4184		3.895821	0.4184			1.457047		0.675804	0.675804	0.4184	1.0942					0	38.24	1.0942
38.26	0.4217		4.054822	0.4217			1.466478		0.78527	0.78527	0.4217	1.2070					0	38.26	1.2070
38.28	0.4251		4.215929	0.4251			1.475848		0.900082	0.900082	0.4251	1.3252					0	38.28	1.3252
38.3	0.4284		4.379116	0.4284			1.48516		1.02	1.02	0.4284	1.4484					0	38.3	1.4484
38.32	0.4317		4.544354	0.4317			1.494413		1.144816	1.144816	0.4317	1.4944					0	38.32	1.4944
38.34	0.4349		4.711621	0.4349			1.50361		1.274345	1.274345	0.4349	1.5036					0	38.34	1.5036

38.36	0.4382	4.880891	0.4382	1.51275	1.408422	1.408422	0.4382	1.5128	0	38.36	1.5128
38.38	0.4414	5.052141	0.4414	1.521836	1.546896	1.521836	0.4414	1.5218	0	38.38	1.5218
38.4	0.4446	5.225348	0.4446	1.530868	1.689632	1.530868	0.4446	1.5309	0	38.4	1.5309
38.42	0.4477	5.40049	0.4477	1.539846	1.836508	1.539846	0.4477	1.5398	0	38.42	1.5398
38.44	0.4509	5.577547	0.4509	1.548773	1.987408	1.548773	0.4509	1.5488	0	38.44	1.5488
38.46	0.4540	5.756497	0.4540	1.557649	2.142229	1.557649	0.4540	1.5576	0	38.46	1.5576
38.48	0.4571	5.937321	0.4571	1.566474	2.300874	1.566474	0.4571	1.5665	0	38.48	1.5665
38.5	0.4602	6.12	0.4602	1.57525	2.463252	1.57525	0.4602	1.5752	0	38.5	1.5752
38.52	0.4632	6.304515	0.4632	1.583977	2.629281	1.583977	0.4632	1.5840	0	38.52	1.5840
38.54	0.4663	6.490848	0.4663	1.592656	2.79888	1.592656	0.4663	1.5927	0	38.54	1.5927
38.56	0.4693	6.678981	0.4693	1.601289	2.971977	1.601289	0.4693	1.6013	0	38.56	1.6013
38.58	0.4723	6.868898	0.4723	1.609875	3.148502	1.609875	0.4723	1.6099	0	38.58	1.6099
38.6	0.4753	7.060581	0.4753	1.618415	3.32839	1.618415	0.4753	1.6184	0	38.6	1.6184
38.62	0.4782	7.254015	0.4782	1.626911	3.511579	1.626911	0.4782	1.6269	0	38.62	1.6269
38.64	0.4812	7.449184	0.4812	1.635362	3.698011	1.635362	0.4812	1.6354	0	38.64	1.6354
38.66	0.4841	7.646072	0.4841	1.643771	3.88763	1.643771	0.4841	1.6438	0.0068	38.66	1.6506
38.68	0.4870	7.844666	0.4870	1.652136	4.080384	1.652136	0.4870	1.6521	0.035334	38.68	1.6875
38.7	0.4899	8.044949	0.4899	1.660459	4.276222	1.660459	0.4899	1.6605	0.076026	38.7	1.7365
38.72	0.4928	8.246908	0.4928	1.668741	4.475096	1.668741	0.4928	1.6687	0.125938	38.72	1.7947
38.74	0.4956	8.45053	0.4956	1.676981	4.676961	1.676981	0.4956	1.6770	0.1836	38.74	1.8606
38.76	0.4984	8.655801	0.4984	1.685182	4.881774	1.685182	0.4984	1.6852	0.248084	38.76	1.9333
38.78	0.5013	8.862707	0.5013	1.693343	5.089492	1.693343	0.5013	1.6933	0.318731	38.78	2.0121
38.8	0.5041	9.071236	0.5041	1.701464	5.300075	1.701464	0.5041	1.7015	0.395044	38.8	2.0965
38.82	0.5069	9.281375	0.5069	1.709547	5.513486	1.709547	0.5069	1.7095	0.476631	38.82	2.1862
38.84	0.5097	9.493112	0.5097	1.717592	5.729686	1.717592	0.5097	1.7176	0.56317	38.84	2.2808
38.86	0.5124	9.706436	0.5124	1.7256	5.94864	1.7256	0.5124	1.7256	0.654392	38.86	2.3800
38.88	0.5152	9.921334	0.5152	1.73357	6.170314	1.73357	0.5152	1.7336	0.750068	38.88	2.4836
38.9	0.5179	10.13779	0.5179	1.741504	6.394676	1.741504	0.5179	1.7415	0.85	38.9	2.5915
38.92	0.5206	10.35581	0.5206	1.749402	6.621693	1.749402	0.5206	1.7494	0.954014	38.92	2.7034
38.94	0.5233	10.57536	0.5233	1.757265	6.851334	1.757265	0.5233	1.7573	1.061954	38.94	2.8192
38.96	0.5260	10.79644	0.5260	1.765092	7.083571	1.765092	0.5260	1.7651	1.173685	38.96	2.9388
38.98	0.5287	11.01905	0.5287	1.772885	7.318374	1.772885	0.5287	1.7729	1.28908	38.98	3.0620
39	0.5313	11.24316	0.5313	1.780644	7.555715	1.780644	0.5313	1.7806	1.408027	39	3.1887
39.02	0.5340	11.46877	0.5340	1.788369	7.795568	1.788369	0.5340	1.7884	1.530423	39.02	3.3188
39.04	0.5366	11.69587	0.5366	1.796061	8.037907	1.796061	0.5366	1.7961	1.656173	39.04	3.4522
39.06	0.5393	11.92445	0.5393	1.80372	8.282705	1.80372	0.5393	1.8037	1.785191	39.06	3.5889
39.08	0.5419	12.1545	0.5419	1.811347	8.52994	1.811347	0.5419	1.8113	1.917395	39.08	3.7287
39.1	0.5445	12.38601	0.5445	1.818942	8.779587	1.818942	0.5445	1.8189	2.05271	39.1	3.8717
39.12	0.5471	12.61897	0.5471	1.826505	9.031624	1.826505	0.5471	1.8265	2.191067	39.12	4.0176
39.14	0.5496	12.85338	0.5496	1.834037	9.286026	1.834037	0.5496	1.8340	2.3324	39.14	4.1664
39.16	0.5522	13.08921	0.5522	1.841538	9.542774	1.841538	0.5522	1.8415	2.476647	39.16	4.3182
39.18	0.5547	13.32648	0.5547	1.849009	9.801845	1.849009	0.5547	1.8490	2.623752	39.18	4.4728
39.2	0.5573	13.56516	0.5573	1.85645	10.06322	1.85645	0.5573	1.8564	2.773658	39.2	4.6301
39.22	0.5598	13.80524	0.5598	1.863861	10.32688	1.863861	0.5598	1.8639	2.926316	39.22	4.7902
39.24	0.5623	14.04673	0.5623	1.871242	10.5928	1.871242	0.5623	1.8712	3.081676	39.24	4.9529
39.26	0.5648	14.28961	0.5648	1.878595	10.86096	1.878595	0.5648	1.8786	3.239692	39.26	5.1183
39.28	0.5673	14.53388	0.5673	1.885919	11.13135	1.885919	0.5673	1.8859	3.40032	39.28	5.2862
39.3	0.5698	14.77951	0.5698	1.893215	11.40395	1.893215	0.5698	1.8932	3.563518	39.3	5.4567

CATCHMENT 5 ON-SITE DETENTION OUTLET STRUCTURES - LAKE MUNMORAH REZONING

Orifice C =	0.6	Weir C =	1.7	No. Hi =	1	**NOTE THAT LEVELS ARE INDICATIVE ONLY**	
Basin IL =	37.5 m AHD			No. Low =	1		

		LOW LEVEL					HIGH LEVEL					TOTAL					
Orifice IL	37 m AHD	Pit Size	600 mm				Orifice IL	37 m AHD	Pit Size	600 mm					Weir IL	38.7 m AHD	
Orifice Size	225 mm	Pit SL	37.5 m AHD				Orifice Size	450 mm	Pit SL	38.05 m AHD					Weir Lengt	5 m	
	Q		Q	LOW			Q		Q	HIGH		Pit flow				Q	Level	Total Flow
37.5	0.0747		0	0.0000			0.298883		0	0		0.0000	0.0000			0	37.5	0.0000
37.52	0.0762		0.01154	0.0115			0.304802		0	0		0.0115	0.0115			0	37.52	0.0115
37.54	0.0777		0.03264	0.0326			0.310608		0	0		0.0326	0.0326			0	37.54	0.0326
37.56	0.0791		0.059964	0.0600			0.316308		0	0		0.0600	0.0600			0	37.56	0.0600
37.58	0.0805		0.09232	0.0805			0.321906		0	0		0.0805	0.0805			0	37.58	0.0805
37.6	0.0819		0.129021	0.0819			0.32741		0	0		0.0819	0.0819			0	37.6	0.0819
37.62	0.0832		0.169602	0.0832			0.332822		0	0		0.0832	0.0832			0	37.62	0.0832
37.64	0.0845		0.213723	0.0845			0.338147		0	0		0.0845	0.0845			0	37.64	0.0845
37.66	0.0858		0.26112	0.0858			0.34339		0	0		0.0858	0.0858			0	37.66	0.0858
37.68	0.0871		0.31158	0.0871			0.348554		0	0		0.0871	0.0871			0	37.68	0.0871
37.7	0.0884		0.364926	0.0884			0.353643		0	0		0.0884	0.0884			0	37.7	0.0884
37.72	0.0897		0.421012	0.0897			0.358659		0	0		0.0897	0.0897			0	37.72	0.0897
37.74	0.0909		0.479708	0.0909			0.363606		0	0		0.0909	0.0909			0	37.74	0.0909
37.76	0.0921		0.540904	0.0921			0.368487		0	0		0.0921	0.0921			0	37.76	0.0921
37.78	0.0933		0.604501	0.0933			0.373304		0	0		0.0933	0.0933			0	37.78	0.0933
37.8	0.0945		0.670412	0.0945			0.37806		0	0		0.0945	0.0945			0	37.8	0.0945
37.82	0.0957		0.738559	0.0957			0.382757		0	0		0.0957	0.0957			0	37.82	0.0957
37.84	0.0968		0.80887	0.0968			0.387396		0	0		0.0968	0.0968			0	37.84	0.0968
37.86	0.0980		0.88128	0.0980			0.391981		0	0		0.0980	0.0980			0	37.86	0.0980
37.88	0.0991		0.955731	0.0991			0.396513		0	0		0.0991	0.0991			0	37.88	0.0991
37.9	0.1002		1.032167	0.1002			0.400993		0	0		0.1002	0.1002			0	37.9	0.1002
37.92	0.1014		1.11054	0.1014			0.405424		0	0		0.1014	0.1014			0	37.92	0.1014
37.94	0.1025		1.190801	0.1025			0.409807		0	0		0.1025	0.1025			0	37.94	0.1025
37.96	0.1035		1.272908	0.1035			0.414144		0	0		0.1035	0.1035			0	37.96	0.1035
37.98	0.1046		1.356819	0.1046			0.418436		0	0		0.1046	0.1046			0	37.98	0.1046
38	0.1057		1.442498	0.1057			0.422684		0	0		0.1057	0.1057			0	38	0.1057
38.02	0.1067		1.529908	0.1067			0.42689		0	0		0.1067	0.1067			0	38.02	0.1067
38.04	0.1078		1.619015	0.1078			0.431055		0	0		0.1078	0.1078			0	38.04	0.1078
38.06	0.1088		1.709788	0.1088			0.43518		0.00408	0.00408		0.1088	0.1129			0	38.06	0.1129
38.08	0.1098		1.802197	0.1098			0.439266		0.0212	0.0212		0.1098	0.1310			0	38.08	0.1310
38.1	0.1108		1.896213	0.1108			0.443315		0.045616	0.045616		0.1108	0.1564			0	38.1	0.1564
38.12	0.1118		1.991809	0.1118			0.447327		0.075563	0.075563		0.1118	0.1874			0	38.12	0.1874
38.14	0.1128		2.08896	0.1128			0.451303		0.11016	0.11016		0.1128	0.2230			0	38.14	0.2230
38.16	0.1138		2.187641	0.1138			0.455244		0.14885	0.14885		0.1138	0.2627			0	38.16	0.2627
38.18	0.1148		2.287829	0.1148			0.459152		0.191238	0.191238		0.1148	0.3060			0	38.18	0.3060
38.2	0.1158		2.389501	0.1158			0.463027		0.237027	0.237027		0.1158	0.3528			0	38.2	0.3528
38.22	0.1167		2.492636	0.1167			0.46687		0.285979	0.285979		0.1167	0.4027			0	38.22	0.4027
38.24	0.1177		2.597214	0.1177			0.470681		0.337902	0.337902		0.1177	0.4556			0	38.24	0.4556
38.26	0.1186		2.703215	0.1186			0.474461		0.392635	0.392635		0.1186	0.4745			0	38.26	0.4745
38.28	0.1196		2.81062	0.1196			0.478212		0.450041	0.450041		0.1196	0.4782			0	38.28	0.4782
38.3	0.1205		2.91941	0.1205			0.481934		0.51	0.481934		0.1205	0.4819			0	38.3	0.4819
38.32	0.1214		3.02957	0.1214			0.485627		0.572408	0.485627		0.1214	0.4856			0	38.32	0.4856
38.34	0.1223		3.141081	0.1223			0.489292		0.637173	0.489292		0.1223	0.4893			0	38.34	0.4893

38.36	0.1232	3.253927	0.1232	0.49293	0.704211	0.49293	0.1232	0.4929	0	38.36	0.4929
38.38	0.1241	3.368094	0.1241	0.496541	0.773448	0.496541	0.1241	0.4965	0	38.38	0.4965
38.4	0.1250	3.483565	0.1250	0.500126	0.844816	0.500126	0.1250	0.5001	0	38.4	0.5001
38.42	0.1259	3.600327	0.1259	0.503686	0.918254	0.503686	0.1259	0.5037	0	38.42	0.5037
38.44	0.1268	3.718364	0.1268	0.507221	0.993704	0.507221	0.1268	0.5072	0	38.44	0.5072
38.46	0.1277	3.837665	0.1277	0.510731	1.071115	0.510731	0.1277	0.5107	0	38.46	0.5107
38.48	0.1286	3.958214	0.1286	0.514217	1.150437	0.514217	0.1286	0.5142	0	38.48	0.5142
38.5	0.1294	4.08	0.1294	0.51768	1.231626	0.51768	0.1294	0.5177	0	38.5	0.5177
38.52	0.1303	4.20301	0.1303	0.52112	1.31464	0.52112	0.1303	0.5211	0	38.52	0.5211
38.54	0.1311	4.327232	0.1311	0.524537	1.39944	0.524537	0.1311	0.5245	0	38.54	0.5245
38.56	0.1320	4.452654	0.1320	0.527932	1.485988	0.527932	0.1320	0.5279	0	38.56	0.5279
38.58	0.1328	4.579265	0.1328	0.531305	1.574251	0.531305	0.1328	0.5313	0	38.58	0.5313
38.6	0.1337	4.707054	0.1337	0.534657	1.664195	0.534657	0.1337	0.5347	0	38.6	0.5347
38.62	0.1345	4.83601	0.1345	0.537989	1.755789	0.537989	0.1345	0.5380	0	38.62	0.5380
38.64	0.1353	4.966123	0.1353	0.541299	1.849005	0.541299	0.1353	0.5413	0	38.64	0.5413
38.66	0.1361	5.097382	0.1361	0.54459	1.943815	0.54459	0.1361	0.5446	0	38.66	0.5446
38.68	0.1370	5.229777	0.1370	0.547861	2.040192	0.547861	0.1370	0.5479	0	38.68	0.5479
38.7	0.1378	5.363299	0.1378	0.551112	2.138111	0.551112	0.1378	0.5511	6.75E-19	38.7	0.5511
38.72	0.1386	5.497939	0.1386	0.554345	2.237548	0.554345	0.1386	0.5543	0.024042	38.72	0.5784
38.74	0.1394	5.633687	0.1394	0.557558	2.338481	0.557558	0.1394	0.5576	0.068	38.74	0.6256
38.76	0.1402	5.770534	0.1402	0.560754	2.440887	0.560754	0.1402	0.5608	0.124924	38.76	0.6857
38.78	0.1410	5.908471	0.1410	0.563931	2.544746	0.563931	0.1410	0.5639	0.192333	38.78	0.7563
38.8	0.1418	6.04749	0.1418	0.56709	2.650038	0.56709	0.1418	0.5671	0.268794	38.8	0.8359
38.82	0.1426	6.187583	0.1426	0.570232	2.756743	0.570232	0.1426	0.5702	0.353338	38.82	0.9236
38.84	0.1433	6.328742	0.1433	0.573356	2.864843	0.573356	0.1433	0.5734	0.445257	38.84	1.0186
38.86	0.1441	6.470957	0.1441	0.576464	2.97432	0.576464	0.1441	0.5765	0.544	38.86	1.1205
38.88	0.1449	6.614222	0.1449	0.579555	3.085157	0.579555	0.1449	0.5796	0.649124	38.88	1.2287
38.9	0.1457	6.75853	0.1457	0.582629	3.197338	0.582629	0.1457	0.5826	0.760263	38.9	1.3429
38.92	0.1464	6.903871	0.1464	0.585688	3.310846	0.585688	0.1464	0.5857	0.877108	38.92	1.4628
38.94	0.1472	7.05024	0.1472	0.58873	3.425667	0.58873	0.1472	0.5887	0.999392	38.94	1.5881
38.96	0.1479	7.197629	0.1479	0.591757	3.541785	0.591757	0.1479	0.5918	1.126883	38.96	1.7186
38.98	0.1487	7.346031	0.1487	0.594769	3.659187	0.594769	0.1487	0.5948	1.259378	38.98	1.8541
39	0.1494	7.495439	0.1494	0.597765	3.777857	0.597765	0.1494	0.5978	1.396693	39	1.9945
39.02	0.1502	7.645846	0.1502	0.600747	3.897784	0.600747	0.1502	0.6007	1.538664	39.02	2.1394
39.04	0.1509	7.797246	0.1509	0.603713	4.018953	0.603713	0.1509	0.6037	1.685145	39.04	2.2889
39.06	0.1517	7.949633	0.1517	0.606665	4.141353	0.606665	0.1517	0.6067	1.836	39.06	2.4427
39.08	0.1524	8.102999	0.1524	0.609603	4.26497	0.609603	0.1524	0.6096	1.991106	39.08	2.6007
39.1	0.1531	8.257339	0.1531	0.612527	4.389794	0.612527	0.1531	0.6125	2.150349	39.1	2.7629
39.12	0.1539	8.412647	0.1539	0.615437	4.515812	0.615437	0.1539	0.6154	2.313624	39.12	2.9291
39.14	0.1546	8.568917	0.1546	0.618333	4.643013	0.618333	0.1546	0.6183	2.480835	39.14	3.0992
39.16	0.1553	8.726142	0.1553	0.621216	4.771387	0.621216	0.1553	0.6212	2.651891	39.16	3.2731
39.18	0.1560	8.884318	0.1560	0.624085	4.900922	0.624085	0.1560	0.6241	2.826707	39.18	3.4508
39.2	0.1567	9.043438	0.1567	0.626941	5.031609	0.626941	0.1567	0.6269	3.005204	39.2	3.6321
39.22	0.1574	9.203496	0.1574	0.629785	5.163438	0.629785	0.1574	0.6298	3.187307	39.22	3.8171
39.24	0.1582	9.364488	0.1582	0.632615	5.296398	0.632615	0.1582	0.6326	3.372947	39.24	4.0056
39.26	0.1589	9.526408	0.1589	0.635433	5.43048	0.635433	0.1589	0.6354	3.562058	39.26	4.1975
39.28	0.1596	9.68925	0.1596	0.638239	5.565675	0.638239	0.1596	0.6382	3.754576	39.28	4.3928
39.3	0.1603	9.85301	0.1603	0.641032	5.701973	0.641032	0.1603	0.6410	3.950443	39.3	4.5915

CATCHMENT 6 ON-SITE DETENTION OUTLET STRUCTURES - LAKE MUNMORAH REZONING

Orifice C =	0.6	Weir C =	1.7	No. Hi =	1	**NOTE THAT LEVELS ARE INDICATIVE ONLY**	
Basin IL =	37.5 m AHD			No. Low =	1		

			LOW LEVEL						HIGH LEVEL					TOTAL			
Orifice IL	37 m AHD	Pit Size	600 mm					Orifice IL	37 m AHD	Pit Size	900 mm				Weir IL	38.7 m AHD	
Orifice Size	300 mm	Pit SL	37.5 m AHD					Orifice Size	600 mm	Pit SL	38 m AHD				Weir Lengt	5 m	
Q		Q		LOW				Q		Q		HIGH		Pit flow		Q	Level	Total Flow
37.5	0.1328	0		0.0000				0.531347		0		0	0.0000	0.0000		0	37.5	0.0000
37.52	0.1355	0.01154		0.0115				0.54187		0		0	0.0115	0.0115		0	37.52	0.0115
37.54	0.1380	0.03264		0.0326				0.552192		0		0	0.0326	0.0326		0	37.54	0.0326
37.56	0.1406	0.059964		0.0600				0.562325		0		0	0.0600	0.0600		0	37.56	0.0600
37.58	0.1431	0.09232		0.0923				0.572278		0		0	0.0923	0.0923		0	37.58	0.0923
37.6	0.1455	0.129021		0.1290				0.582061		0		0	0.1290	0.1290		0	37.6	0.1290
37.62	0.1479	0.169602		0.1479				0.591683		0		0	0.1479	0.1479		0	37.62	0.1479
37.64	0.1503	0.213723		0.1503				0.60115		0		0	0.1503	0.1503		0	37.64	0.1503
37.66	0.1526	0.26112		0.1526				0.610471		0		0	0.1526	0.1526		0	37.66	0.1526
37.68	0.1549	0.31158		0.1549				0.619652		0		0	0.1549	0.1549		0	37.68	0.1549
37.7	0.1572	0.364926		0.1572				0.628698		0		0	0.1572	0.1572		0	37.7	0.1572
37.72	0.1594	0.421012		0.1594				0.637616		0		0	0.1594	0.1594		0	37.72	0.1594
37.74	0.1616	0.479708		0.1616				0.646411		0		0	0.1616	0.1616		0	37.74	0.1616
37.76	0.1638	0.540904		0.1638				0.655088		0		0	0.1638	0.1638		0	37.76	0.1638
37.78	0.1659	0.604501		0.1659				0.663652		0		0	0.1659	0.1659		0	37.78	0.1659
37.8	0.1680	0.670412		0.1680				0.672107		0		0	0.1680	0.1680		0	37.8	0.1680
37.82	0.1701	0.738559		0.1701				0.680456		0		0	0.1701	0.1701		0	37.82	0.1701
37.84	0.1722	0.80887		0.1722				0.688704		0		0	0.1722	0.1722		0	37.84	0.1722
37.86	0.1742	0.88128		0.1742				0.696855		0		0	0.1742	0.1742		0	37.86	0.1742
37.88	0.1762	0.955731		0.1762				0.704911		0		0	0.1762	0.1762		0	37.88	0.1762
37.9	0.1782	1.032167		0.1782				0.712877		0		0	0.1782	0.1782		0	37.9	0.1782
37.92	0.1802	1.11054		0.1802				0.720754		0		0	0.1802	0.1802		0	37.92	0.1802
37.94	0.1821	1.190801		0.1821				0.728546		0		0	0.1821	0.1821		0	37.94	0.1821
37.96	0.1841	1.272908		0.1841				0.736256		0		0	0.1841	0.1841		0	37.96	0.1841
37.98	0.1860	1.356819		0.1860				0.743886		0		0	0.1860	0.1860		0	37.98	0.1860
38	0.1879	1.442498		0.1879				0.751438		1.34E-19		1.34E-19	0.1879	0.1879		0	38	0.1879
38.02	0.1897	1.529908		0.1897				0.758915		0.01731		0.01731	0.1897	0.2070		0	38.02	0.2070
38.04	0.1916	1.619015		0.1916				0.766319		0.04896		0.04896	0.1916	0.2405		0	38.04	0.2405
38.06	0.1934	1.709788		0.1934				0.773653		0.089945		0.089945	0.1934	0.2834		0	38.06	0.2834
38.08	0.1952	1.802197		0.1952				0.780917		0.13848		0.13848	0.1952	0.3337		0	38.08	0.3337
38.1	0.1970	1.896213		0.1970				0.788115		0.193531		0.193531	0.1970	0.3906		0	38.1	0.3906
38.12	0.1988	1.991809		0.1988				0.795247		0.254404		0.254404	0.1988	0.4532		0	38.12	0.4532
38.14	0.2006	2.08896		0.2006				0.802316		0.320585		0.320585	0.2006	0.5212		0	38.14	0.5212
38.16	0.2023	2.187641		0.2023				0.809323		0.39168		0.39168	0.2023	0.5940		0	38.16	0.5940
38.18	0.2041	2.287829		0.2041				0.816271		0.467369		0.467369	0.2041	0.6714		0	38.18	0.6714
38.2	0.2058	2.389501		0.2058				0.823159		0.547389		0.547389	0.2058	0.7532		0	38.2	0.7532
38.22	0.2075	2.492636		0.2075				0.82999		0.631518		0.631518	0.2075	0.8300		0	38.22	0.8300
38.24	0.2092	2.597214		0.2092				0.836766		0.719562		0.719562	0.2092	0.8368		0	38.24	0.8368
38.26	0.2109	2.703215		0.2109				0.843487		0.811356		0.811356	0.2109	0.8435		0	38.26	0.8435
38.28	0.2125	2.81062		0.2125				0.850155		0.906752		0.850155	0.2125	0.8502		0	38.28	0.8502
38.3	0.2142	2.91941		0.2142				0.856771		1.005619		0.856771	0.2142	0.8568		0	38.3	0.8568
38.32	0.2158	3.02957		0.2158				0.863336		1.107838		0.863336	0.2158	0.8633		0	38.32	0.8633
38.34	0.2175	3.141081		0.2175				0.869852		1.213304		0.869852	0.2175	0.8699		0	38.34	0.8699

38.36	0.2191	3.253927	0.2191	0.87632	1.32192	0.87632	0.2191	0.8763	0	38.36	0.8763
38.38	0.2207	3.368094	0.2207	0.88274	1.433596	0.88274	0.2207	0.8827	0	38.38	0.8827
38.4	0.2223	3.483565	0.2223	0.889113	1.548251	0.889113	0.2223	0.8891	0	38.4	0.8891
38.42	0.2239	3.600327	0.2239	0.895442	1.66581	0.895442	0.2239	0.8954	0	38.42	0.8954
38.44	0.2254	3.718364	0.2254	0.901726	1.786201	0.901726	0.2254	0.9017	0	38.44	0.9017
38.46	0.2270	3.837665	0.2270	0.907966	1.909362	0.907966	0.2270	0.9080	0	38.46	0.9080
38.48	0.2285	3.958214	0.2285	0.914164	2.035229	0.914164	0.2285	0.9142	0	38.48	0.9142
38.5	0.2301	4.08	0.2301	0.92032	2.163747	0.92032	0.2301	0.9203	0	38.5	0.9203
38.52	0.2316	4.20301	0.2316	0.926435	2.294861	0.926435	0.2316	0.9264	0	38.52	0.9264
38.54	0.2331	4.327232	0.2331	0.93251	2.428522	0.93251	0.2331	0.9325	0	38.54	0.9325
38.56	0.2346	4.452654	0.2346	0.938546	2.564682	0.938546	0.2346	0.9385	0	38.56	0.9385
38.58	0.2361	4.579265	0.2361	0.944543	2.703295	0.944543	0.2361	0.9445	0	38.58	0.9445
38.6	0.2376	4.707054	0.2376	0.950502	2.844319	0.950502	0.2376	0.9505	0	38.6	0.9505
38.62	0.2391	4.83601	0.2391	0.956424	2.987714	0.956424	0.2391	0.9564	0	38.62	0.9564
38.64	0.2406	4.966123	0.2406	0.96231	3.13344	0.96231	0.2406	0.9623	0	38.64	0.9623
38.66	0.2420	5.097382	0.2420	0.96816	3.281462	0.96816	0.2420	0.9682	0	38.66	0.9682
38.68	0.2435	5.229777	0.2435	0.973975	3.431743	0.973975	0.2435	0.9740	0	38.68	0.9740
38.7	0.2449	5.363299	0.2449	0.979755	3.584252	0.979755	0.2449	0.9798	6.75E-19	38.7	0.9798
38.72	0.2464	5.497939	0.2464	0.985502	3.738954	0.985502	0.2464	0.9855	0.024042	38.72	1.0095
38.74	0.2478	5.633687	0.2478	0.991215	3.895821	0.991215	0.2478	0.9912	0.068	38.74	1.0592
38.76	0.2492	5.770534	0.2492	0.996895	4.054822	0.996895	0.2492	0.9969	0.124924	38.76	1.1218
38.78	0.2506	5.908471	0.2506	1.002543	4.215929	1.002543	0.2506	1.0025	0.192333	38.78	1.1949
38.8	0.2520	6.04749	0.2520	1.00816	4.379116	1.00816	0.2520	1.0082	0.268794	38.8	1.2770
38.82	0.2534	6.187583	0.2534	1.013745	4.544354	1.013745	0.2534	1.0137	0.353338	38.82	1.3671
38.84	0.2548	6.328742	0.2548	1.0193	4.711621	1.0193	0.2548	1.0193	0.445257	38.84	1.4646
38.86	0.2562	6.470957	0.2562	1.024825	4.880891	1.024825	0.2562	1.0248	0.544	38.86	1.5688
38.88	0.2576	6.614222	0.2576	1.03032	5.052141	1.03032	0.2576	1.0303	0.649124	38.88	1.6794
38.9	0.2589	6.75853	0.2589	1.035786	5.225348	1.035786	0.2589	1.0358	0.760263	38.9	1.7960
38.92	0.2603	6.903871	0.2603	1.041223	5.40049	1.041223	0.2603	1.0412	0.877108	38.92	1.9183
38.94	0.2617	7.05024	0.2617	1.046632	5.577547	1.046632	0.2617	1.0466	0.999392	38.94	2.0460
38.96	0.2630	7.197629	0.2630	1.052013	5.756497	1.052013	0.2630	1.0520	1.126883	38.96	2.1789
38.98	0.2643	7.346031	0.2643	1.057367	5.937321	1.057367	0.2643	1.0574	1.259378	38.98	2.3167
39	0.2657	7.495439	0.2657	1.062694	6.12	1.062694	0.2657	1.0627	1.396693	39	2.4594
39.02	0.2670	7.645846	0.2670	1.067994	6.304515	1.067994	0.2670	1.0680	1.538664	39.02	2.6067
39.04	0.2683	7.797246	0.2683	1.073268	6.490848	1.073268	0.2683	1.0733	1.685145	39.04	2.7584
39.06	0.2696	7.949633	0.2696	1.078516	6.678981	1.078516	0.2696	1.0785	1.836	39.06	2.9145
39.08	0.2709	8.102999	0.2709	1.083739	6.868898	1.083739	0.2709	1.0837	1.991106	39.08	3.0748
39.1	0.2722	8.257339	0.2722	1.088937	7.060581	1.088937	0.2722	1.0889	2.150349	39.1	3.2393
39.12	0.2735	8.412647	0.2735	1.09411	7.254015	1.09411	0.2735	1.0941	2.313624	39.12	3.4077
39.14	0.2748	8.568917	0.2748	1.099259	7.449184	1.099259	0.2748	1.0993	2.480835	39.14	3.5801
39.16	0.2761	8.726142	0.2761	1.104384	7.646072	1.104384	0.2761	1.1044	2.651891	39.16	3.7563
39.18	0.2774	8.884318	0.2774	1.109485	7.844666	1.109485	0.2774	1.1095	2.826707	39.18	3.9362
39.2	0.2786	9.043438	0.2786	1.114563	8.044949	1.114563	0.2786	1.1146	3.005204	39.2	4.1198
39.22	0.2799	9.203496	0.2799	1.119617	8.246908	1.119617	0.2799	1.1196	3.187307	39.22	4.3069
39.24	0.2812	9.364488	0.2812	1.124649	8.45053	1.124649	0.2812	1.1246	3.372947	39.24	4.4976
39.26	0.2824	9.526408	0.2824	1.129659	8.655801	1.129659	0.2824	1.1297	3.562058	39.26	4.6917
39.28	0.2837	9.68925	0.2837	1.134646	8.862707	1.134646	0.2837	1.1346	3.754576	39.28	4.8892
39.3	0.2849	9.85301	0.2849	1.139612	9.071236	1.139612	0.2849	1.1396	3.950443	39.3	5.0901

APPENDIX C

C. MUSIC Model Set Up and Outputs

MUSIC-*link* Report

Project Details		Company Details	
Project:	Lake Munmorah Rezoning	**Company:**	Cubo Consulting
Report Export Date:	6/02/2019	**Contact:**	Matthew Brown
Catchment Name:	MUSIC 20190206_new	**Address:**	Suite 6, 220 The Entrance Road, Erina
Catchment Area:	20.9ha	**Phone:**	02 4326 0990
Impervious Area*:	70.35%	**Email:**	Matthew.Brown@cubo.net.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.31		
Study Area:	Upland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	11%	Rain Water Tank Node	6	Urban Source Node	6
TSS	81.9%	Bio Retention Node	6		
TP	52.3%	Generic Node	6		
TN	45.3%				
GP	100%				

Comments

The proposed treatment train achieves Central Coast Council's pollutant reduction targets.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention - Cat 1	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 1	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 1	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 1	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 1	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention - Cat 1	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 1	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Bio	Bioretention - Cat 2	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 2	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 2	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 2	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 2	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention - Cat 2	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 2	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Bio	Bioretention - Cat 3	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 3	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 3	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 3	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 3	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention - Cat 3	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 3	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Bio	Bioretention - Cat 4	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 4	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 4	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 4	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 4	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention - Cat 4	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 4	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Bio	Bioretention - Cat 5	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 5	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 5	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 5	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 5	PET Scaling Factor	2.1	2.1	2.1
Bio	Bioretention - Cat 5	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 5	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Bio	Bioretention - Cat 6	Exfiltration Rate (mm/hr)	0	0	0
Bio	Bioretention - Cat 6	Extended detention depth (m)	0.1	0.3	0.3
Bio	Bioretention - Cat 6	Filter depth (m)	0.5	1	0.6
Bio	Bioretention - Cat 6	Orthophosphate Content in Filter (mg/kg)	40	50	50
Bio	Bioretention - Cat 6	PET Scaling Factor	2.1	2.1	2.1

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention - Cat 6	Saturated Hydraulic Conductivity (mm/hr)	100	180	100
Bio	Bioretention - Cat 6	Total Nitrogen Content in Filter (mg/kg)	750	950	800
Receiving	Receiving Node	% Load Reduction	None	None	11
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TN % Load Reduction	45	None	45.3
Receiving	Receiving Node	TP % Load Reduction	45	None	52.3
Receiving	Receiving Node	TSS % Load Reduction	80	None	81.9
Urban	Catchment 1	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 1	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 1	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catchment 1	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 1	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 1	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catchment 2	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 2	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 2	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catchment 2	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 2	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 2	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catchment 3	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 3	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 3	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catchment 3	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 3	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 3	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catchment 4	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 4	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 4	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catchment 4	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 4	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 4	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catchment 5	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 5	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 5	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catchment 5	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 5	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 5	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catchment 6	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catchment 6	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catchment 6	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Catchment 6	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catchment 6	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catchment 6	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15

Only certain parameters are reported when they pass validation

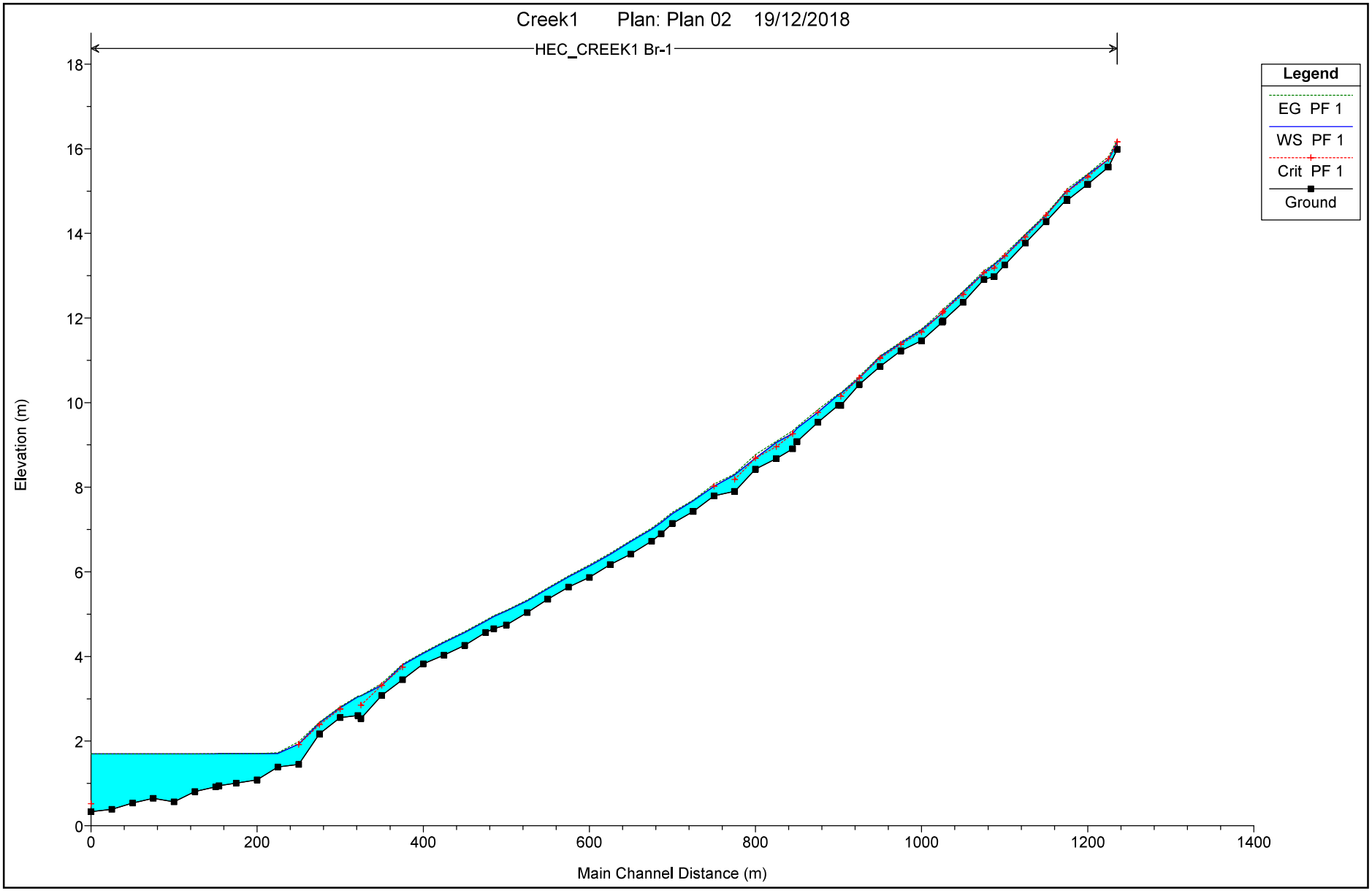
APPENDIX D

D. HEC-RAS 1-D Model Outputs

(Refer drawing CI-020 for chainages through the proposed rezoning site)

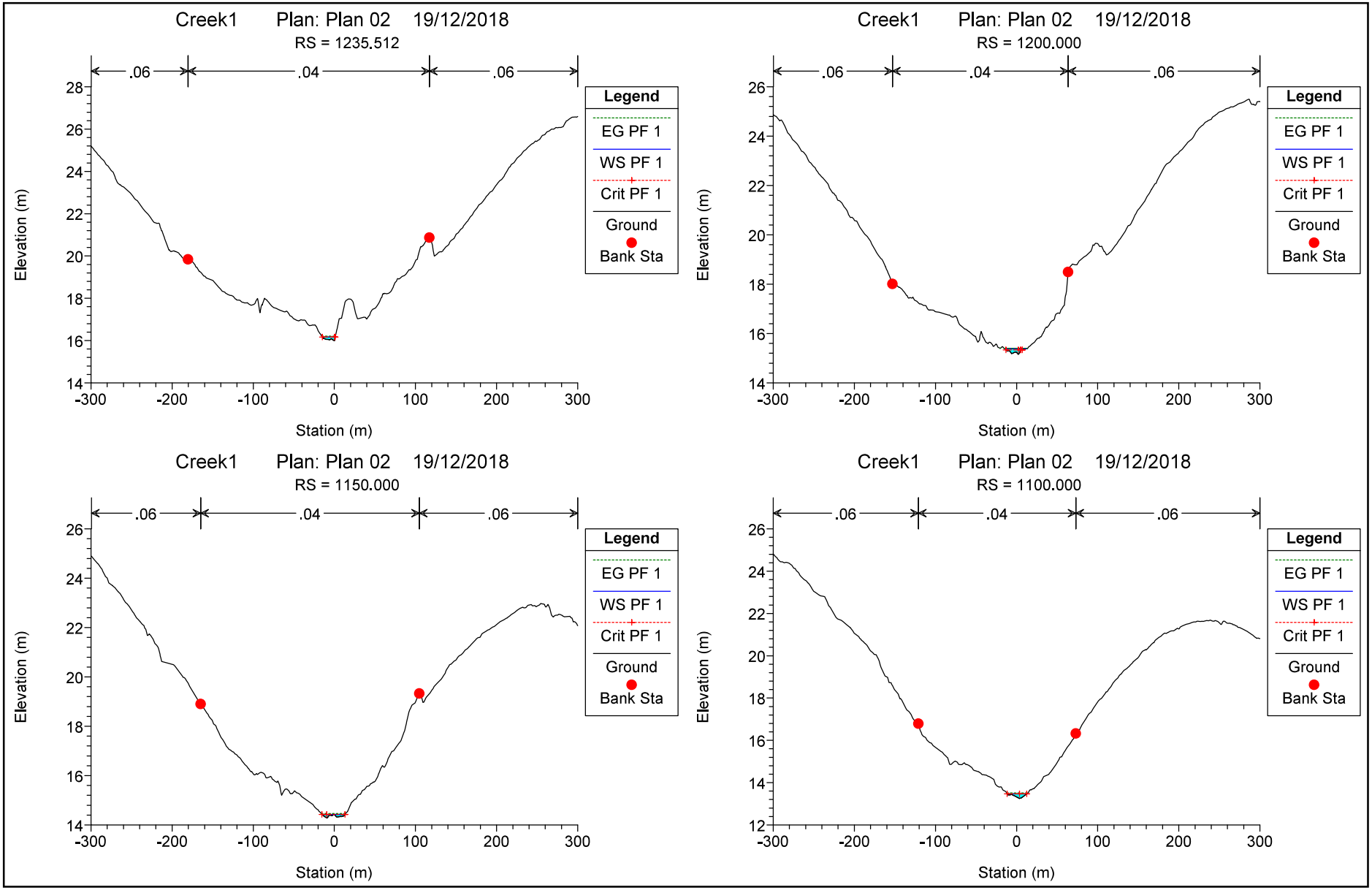
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



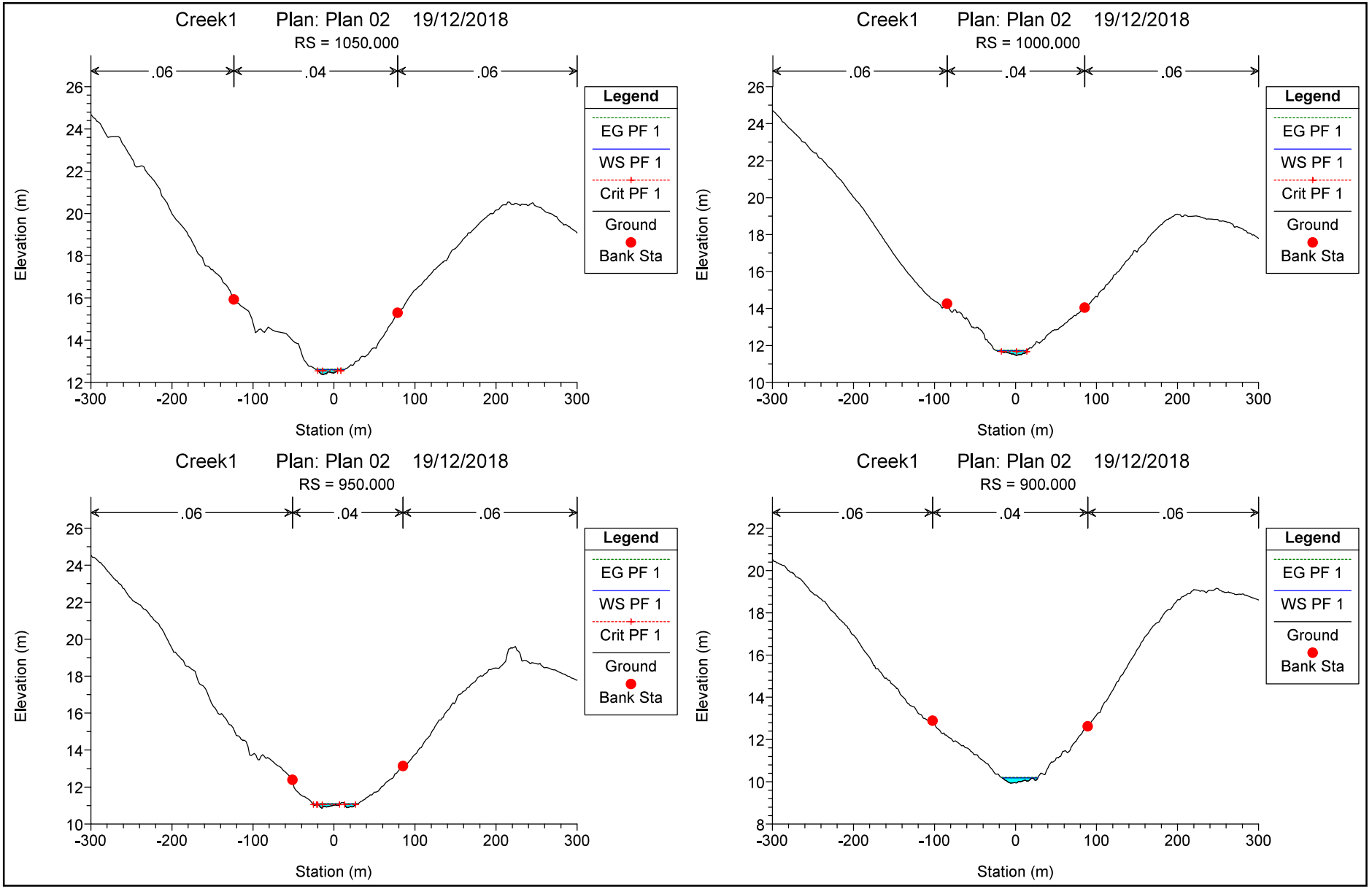
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



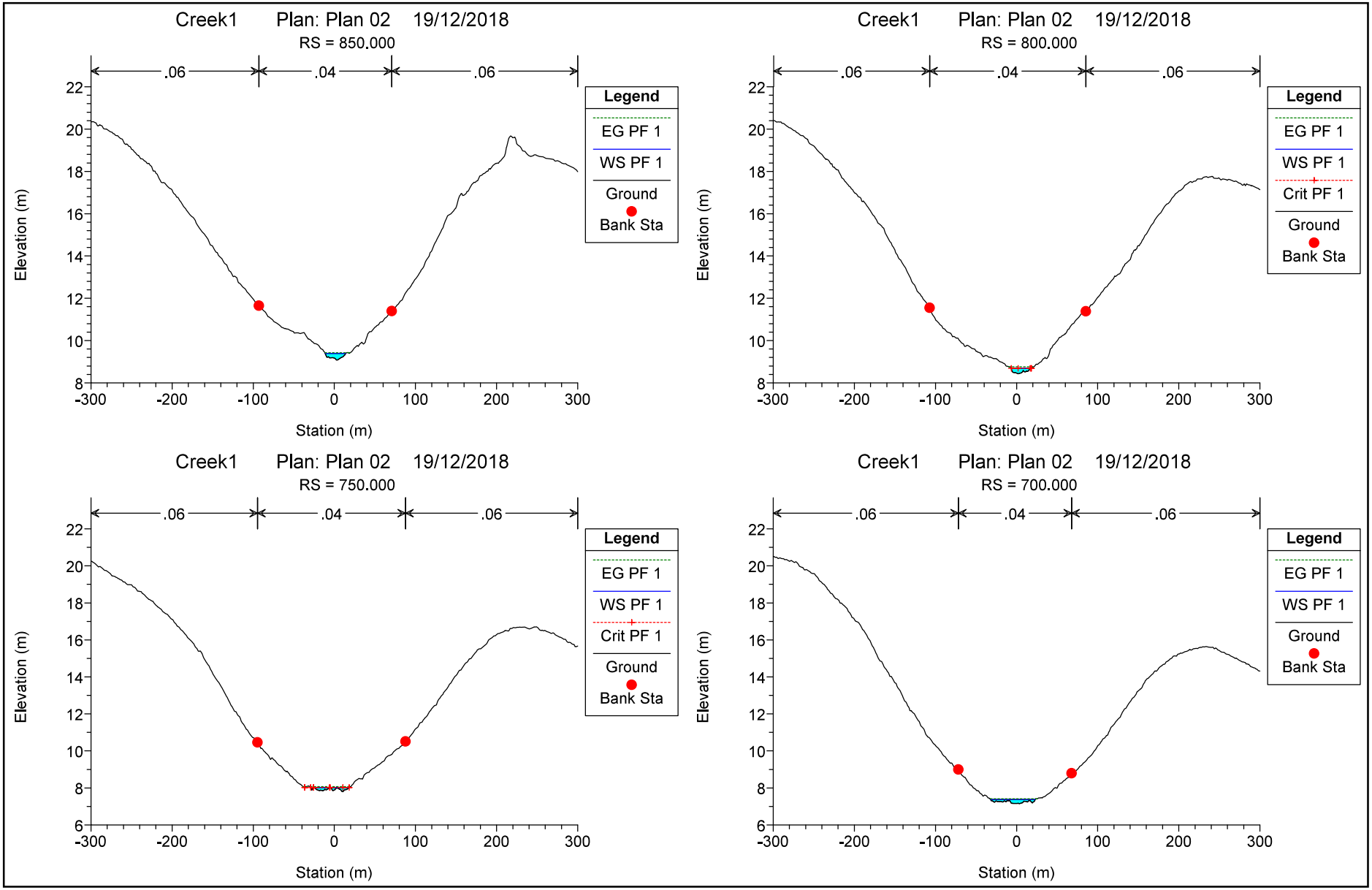
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



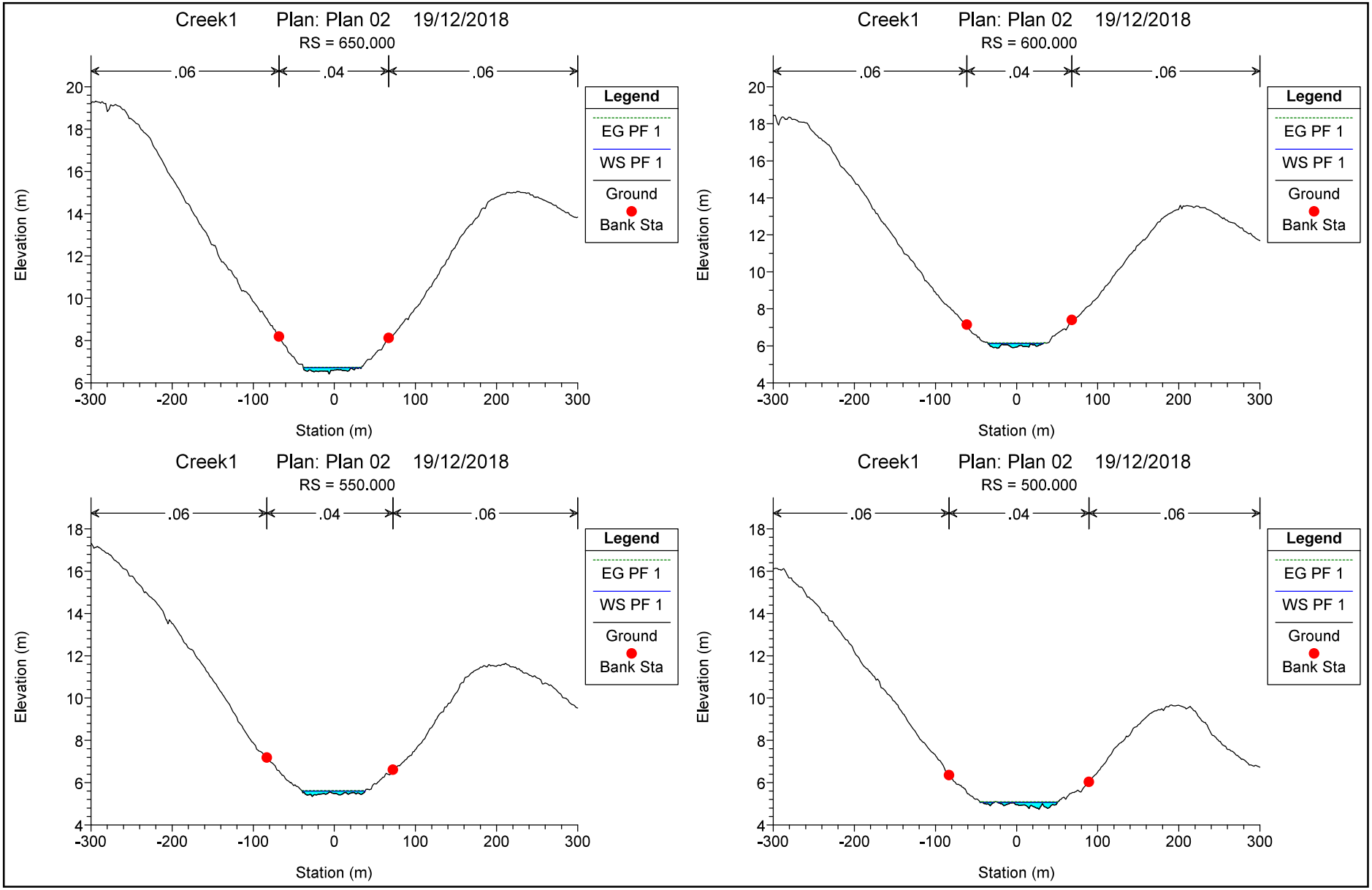
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



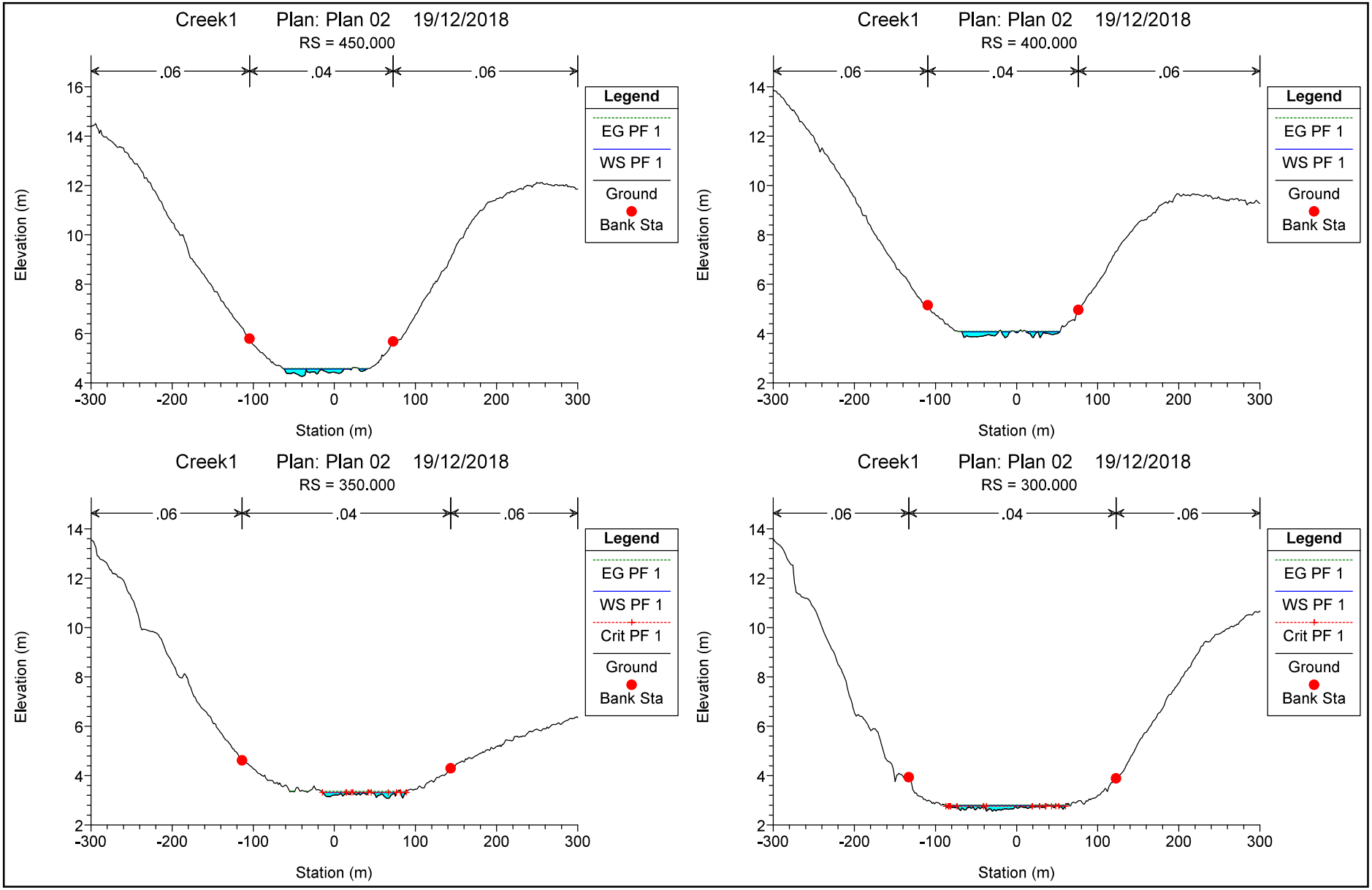
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



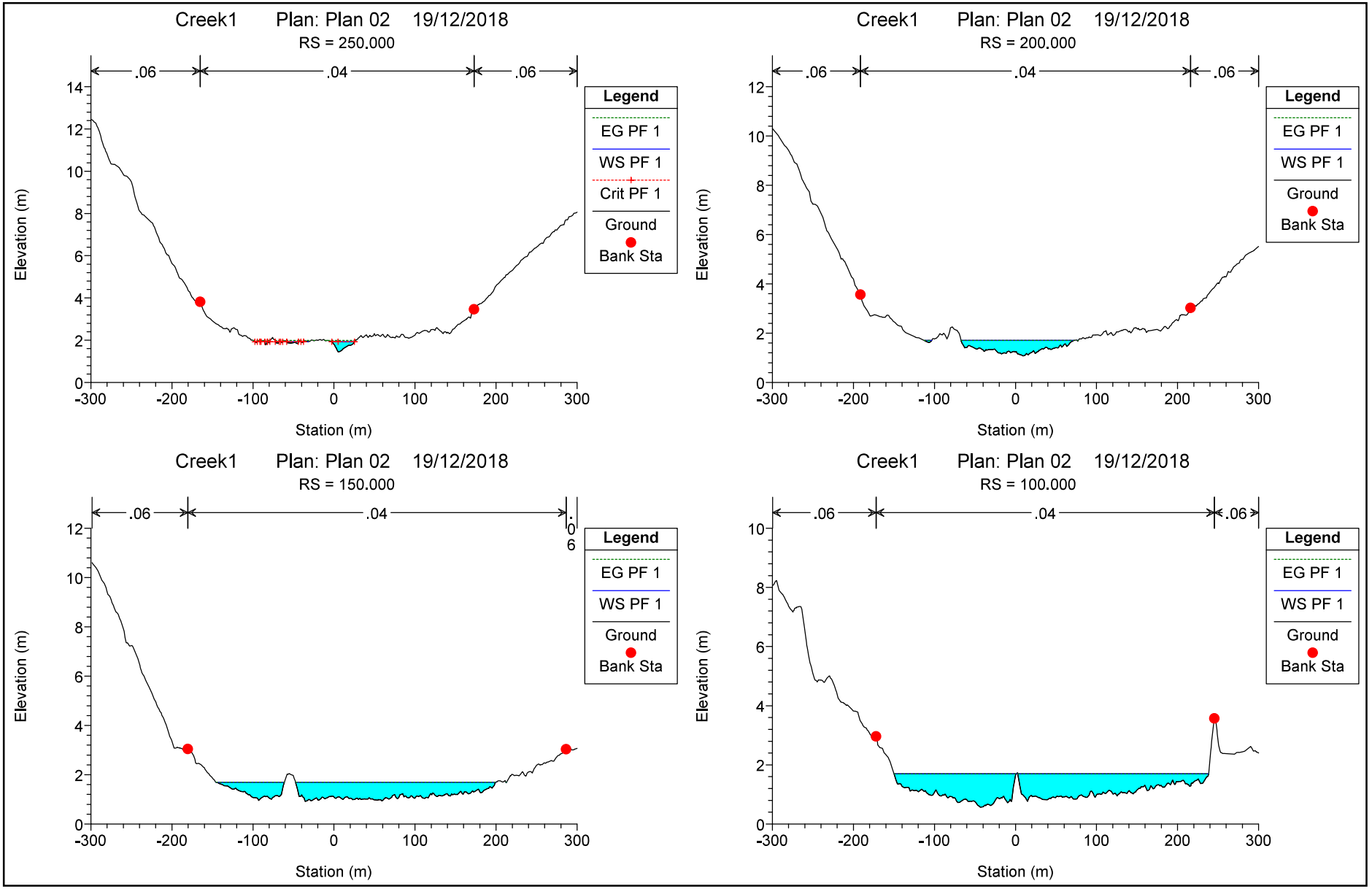
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



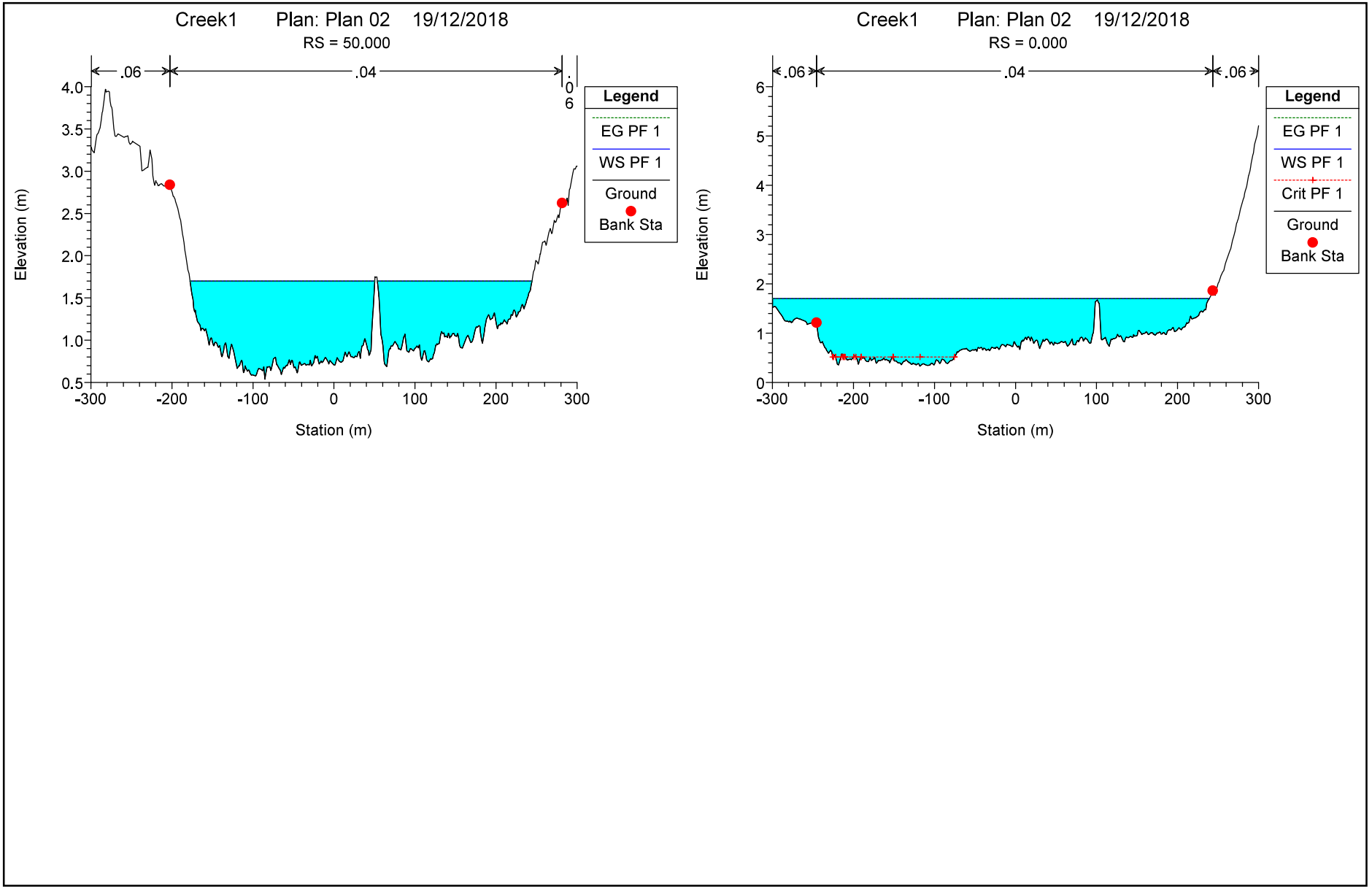
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



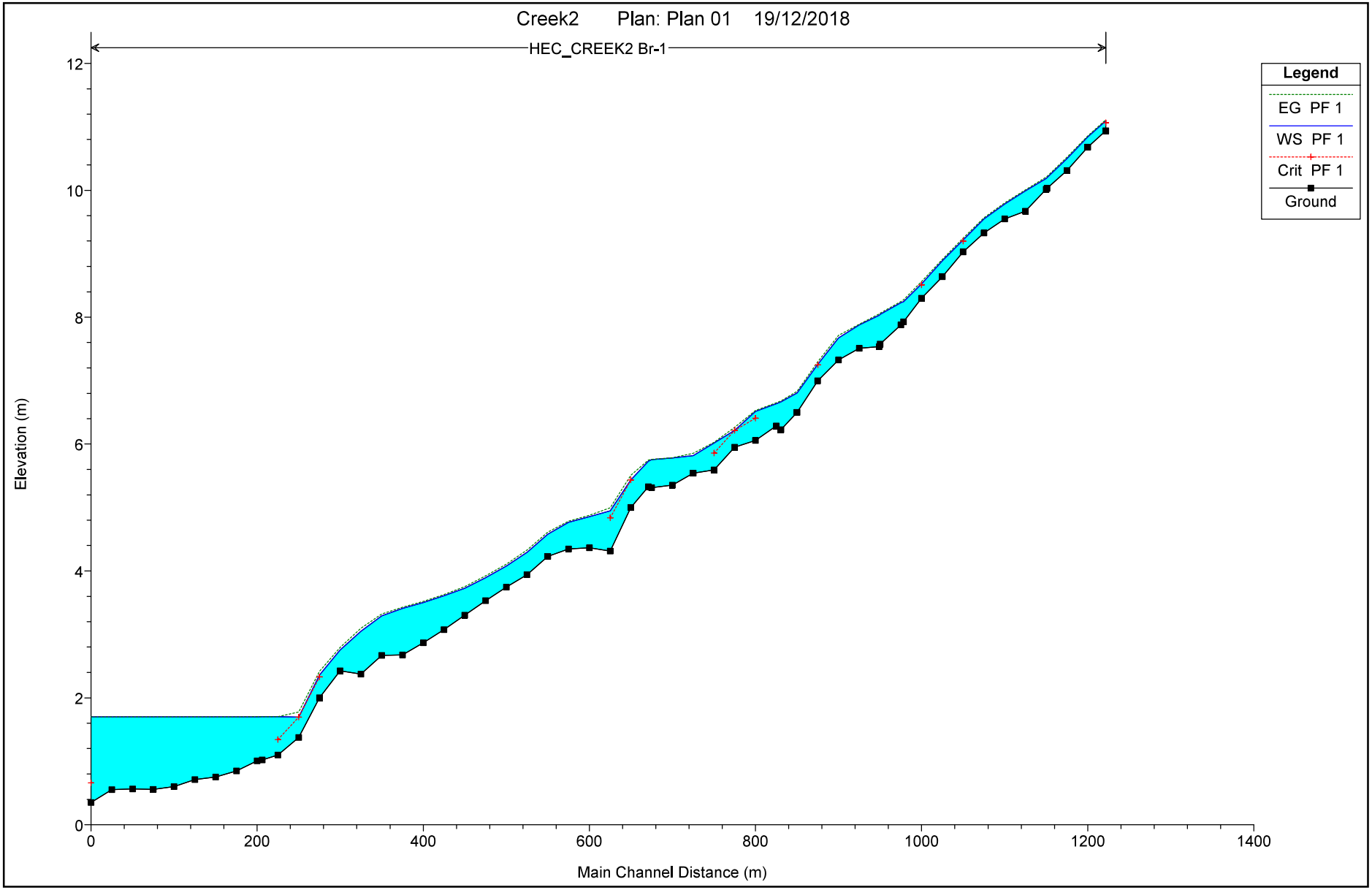
D1. Creek 1 - 1% AEP Results

1% AEP FLOOD



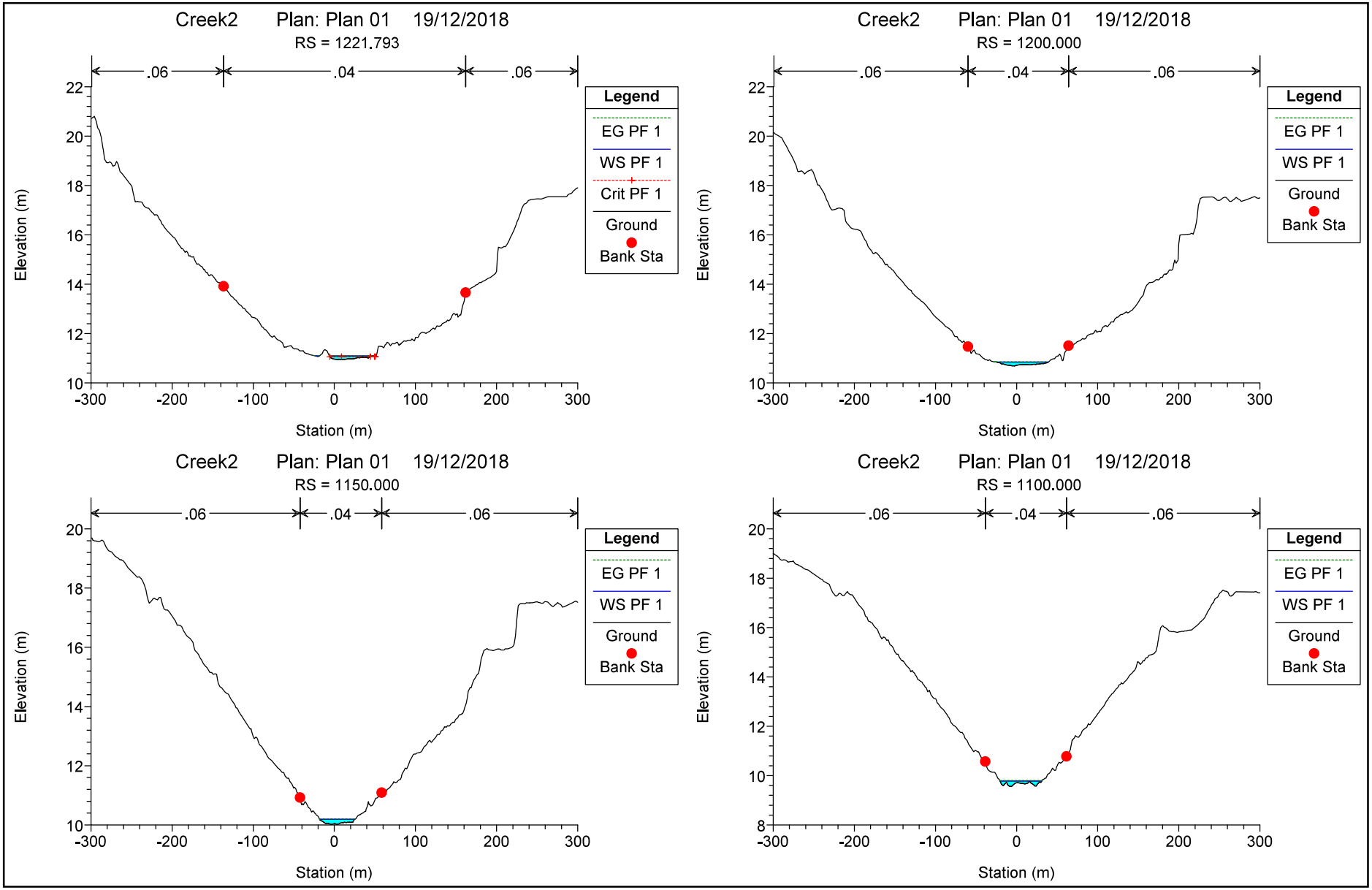
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



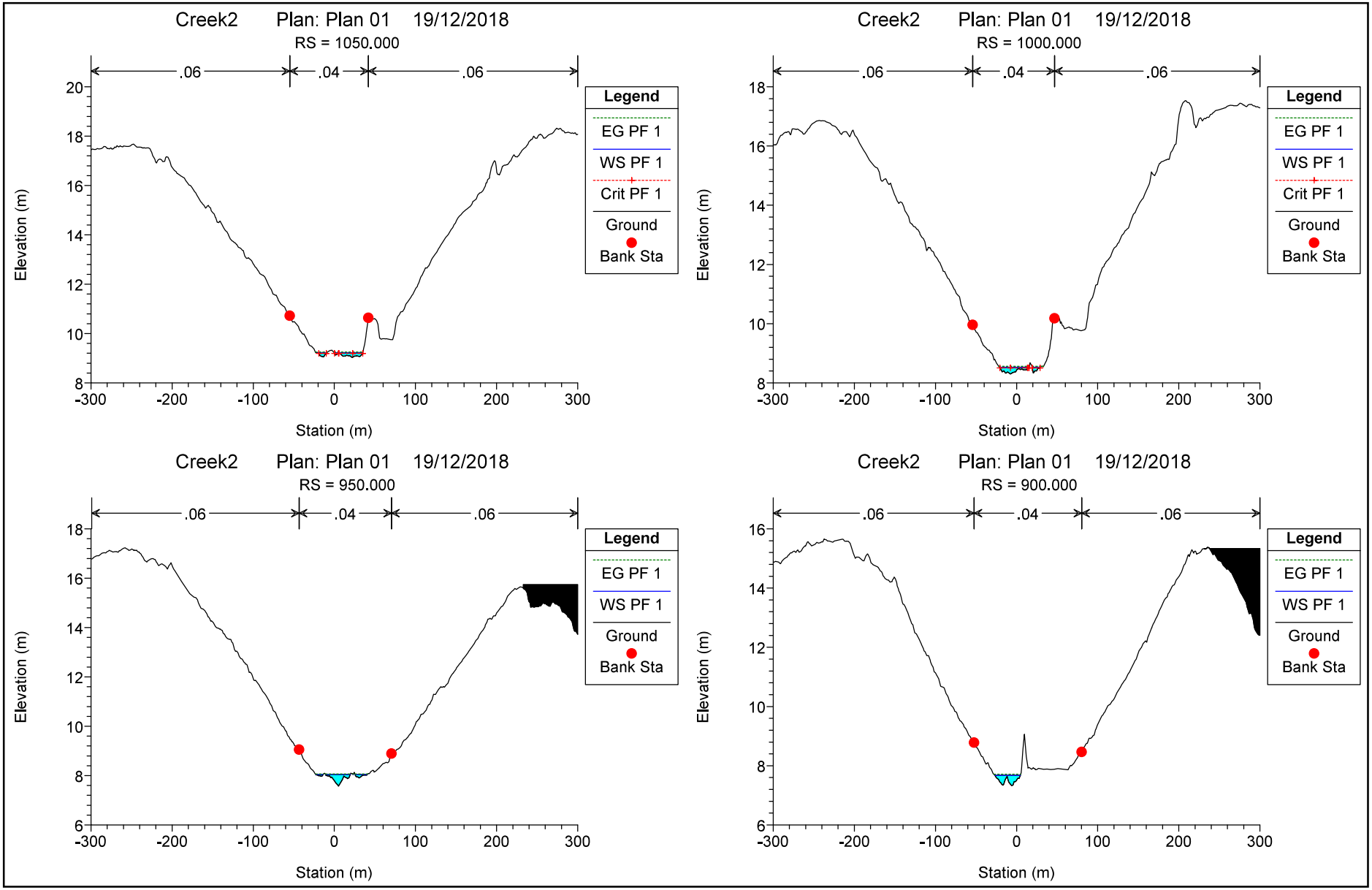
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



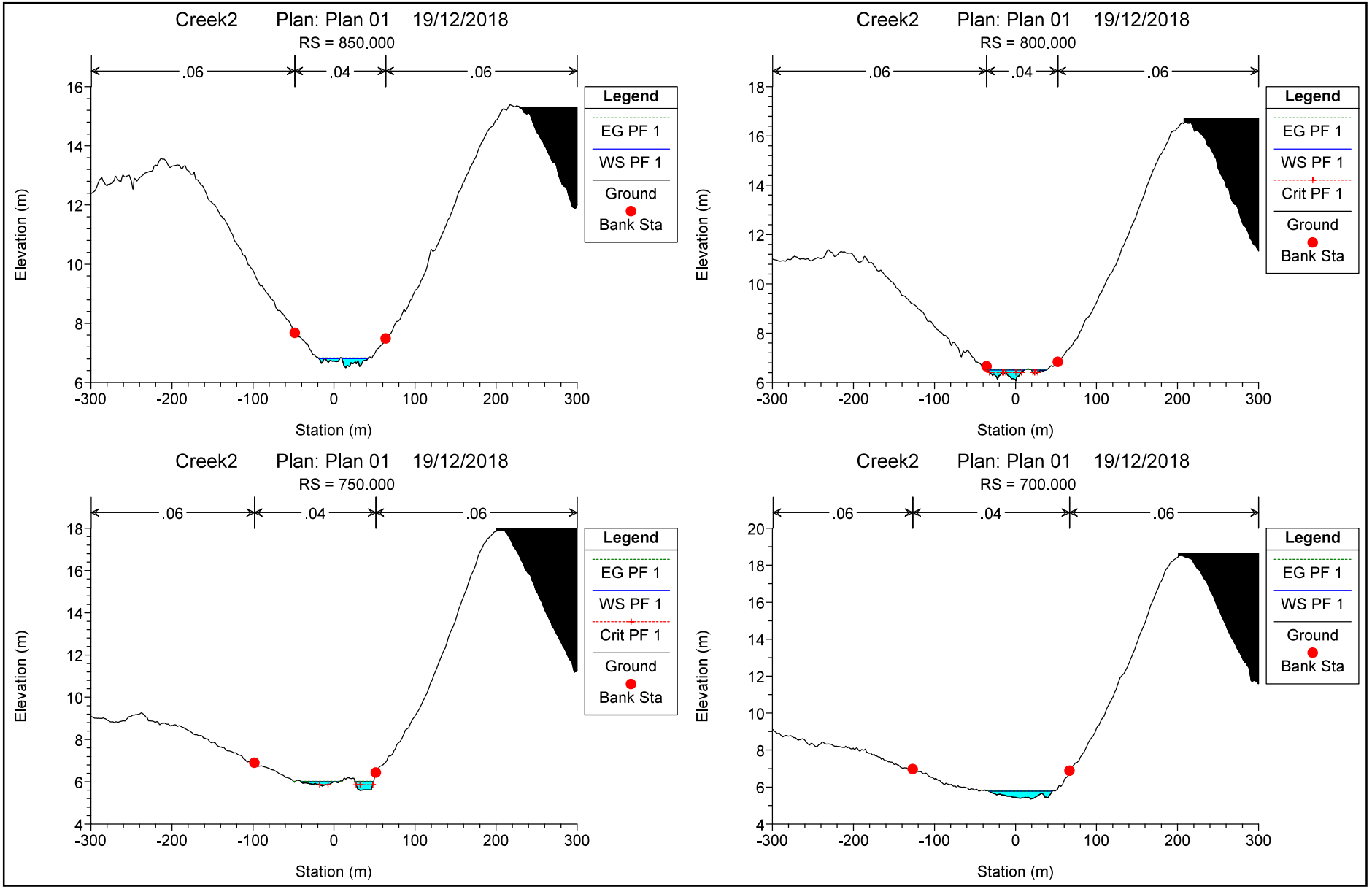
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



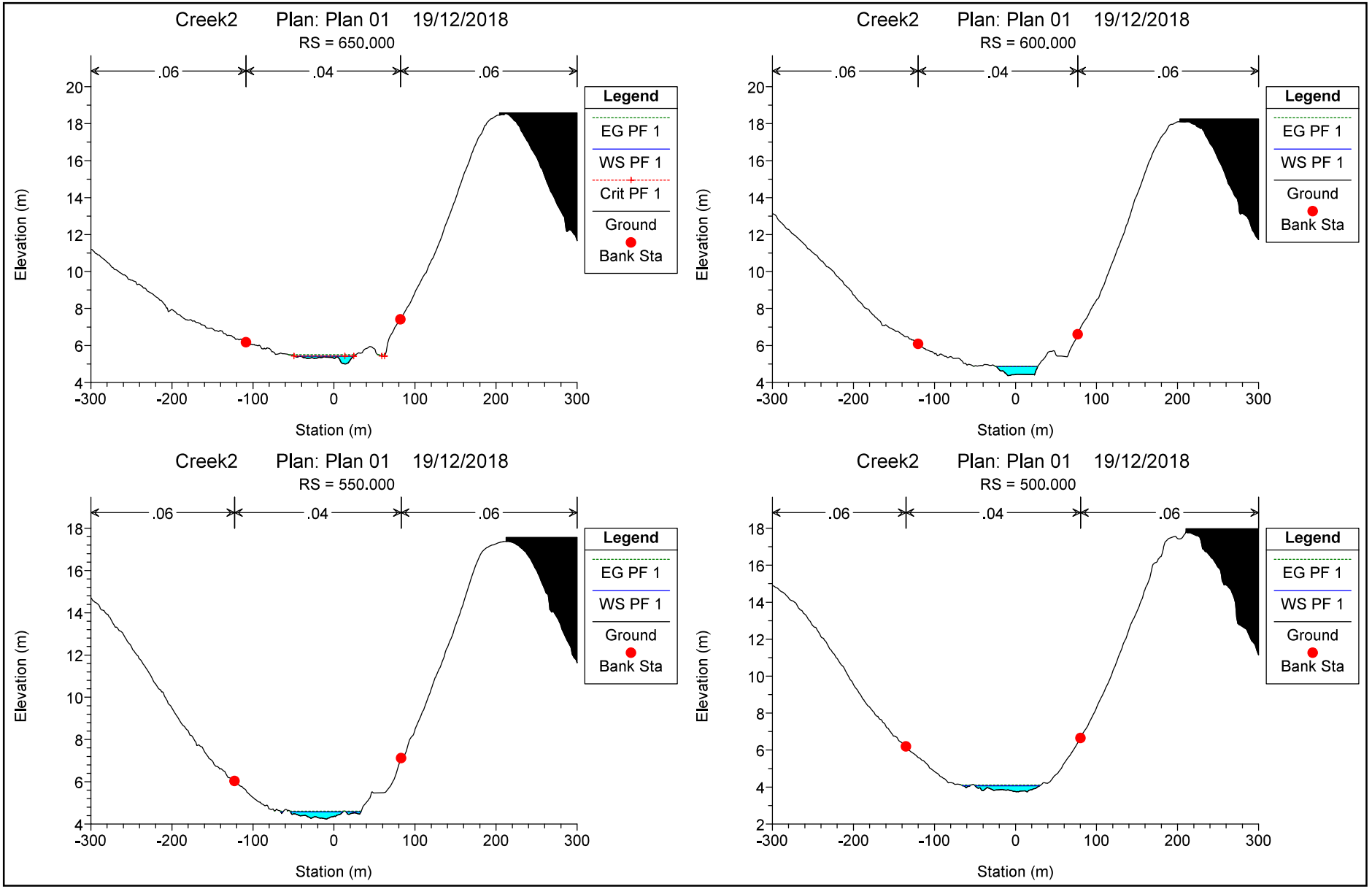
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



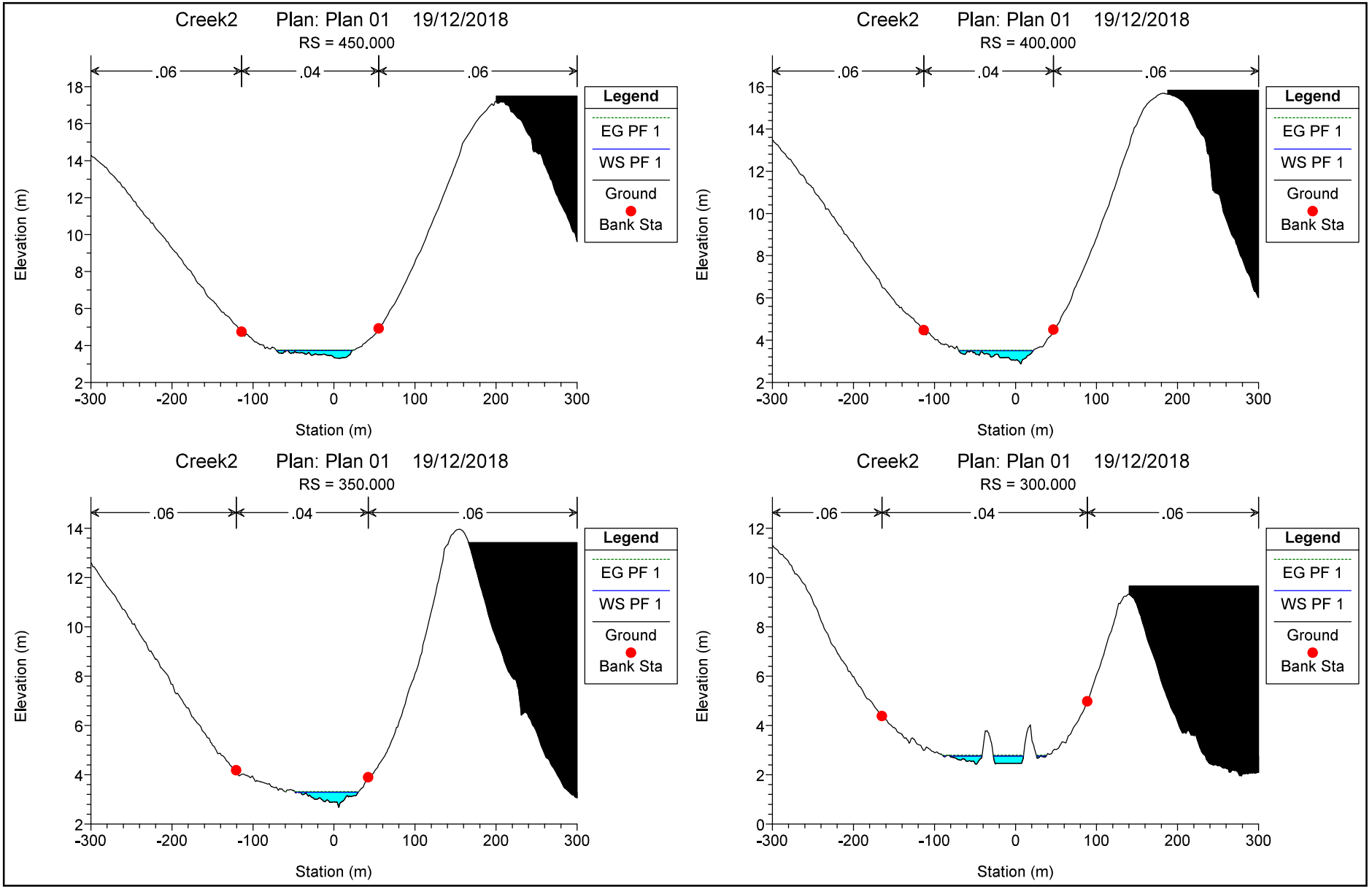
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



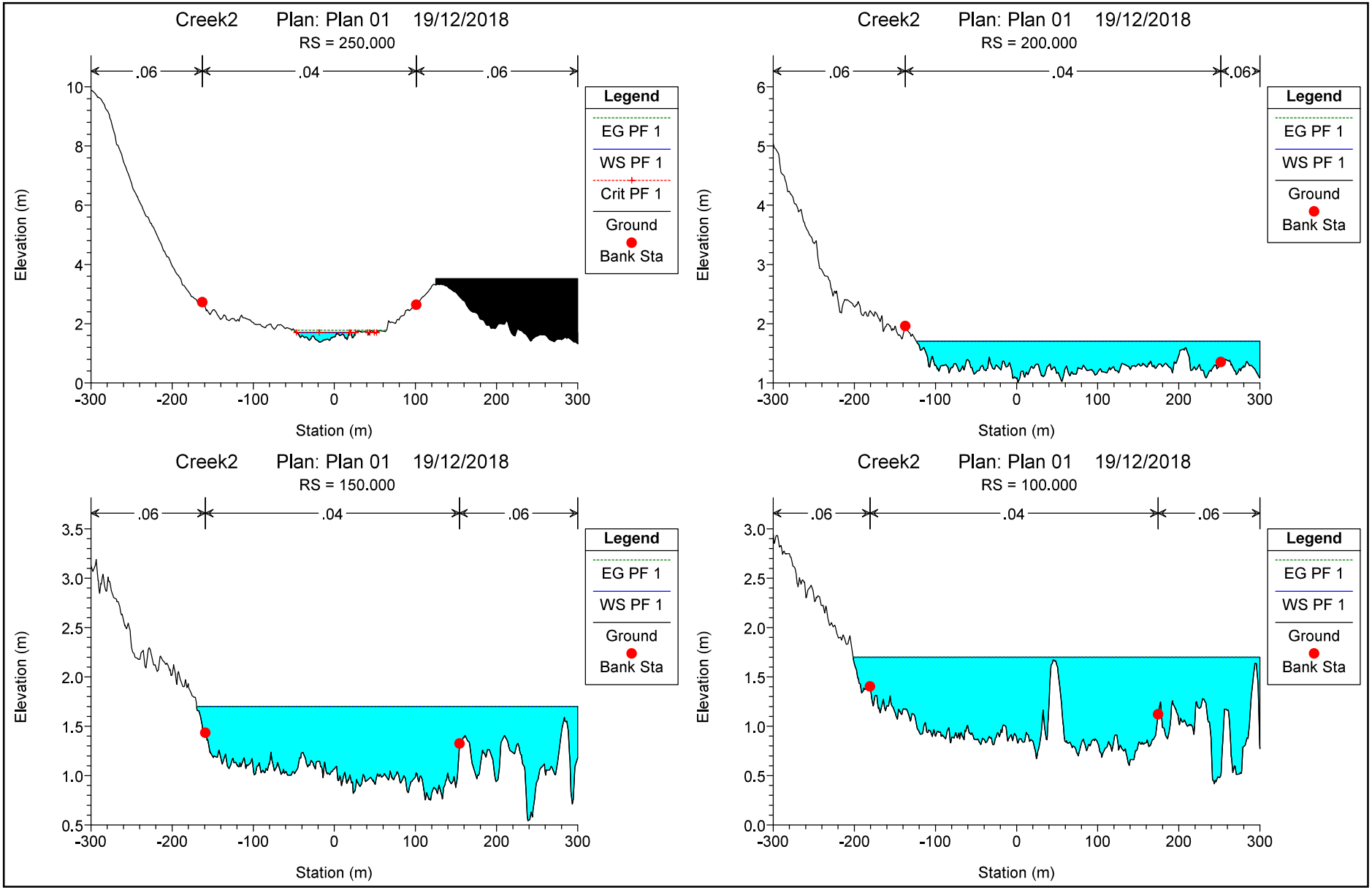
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



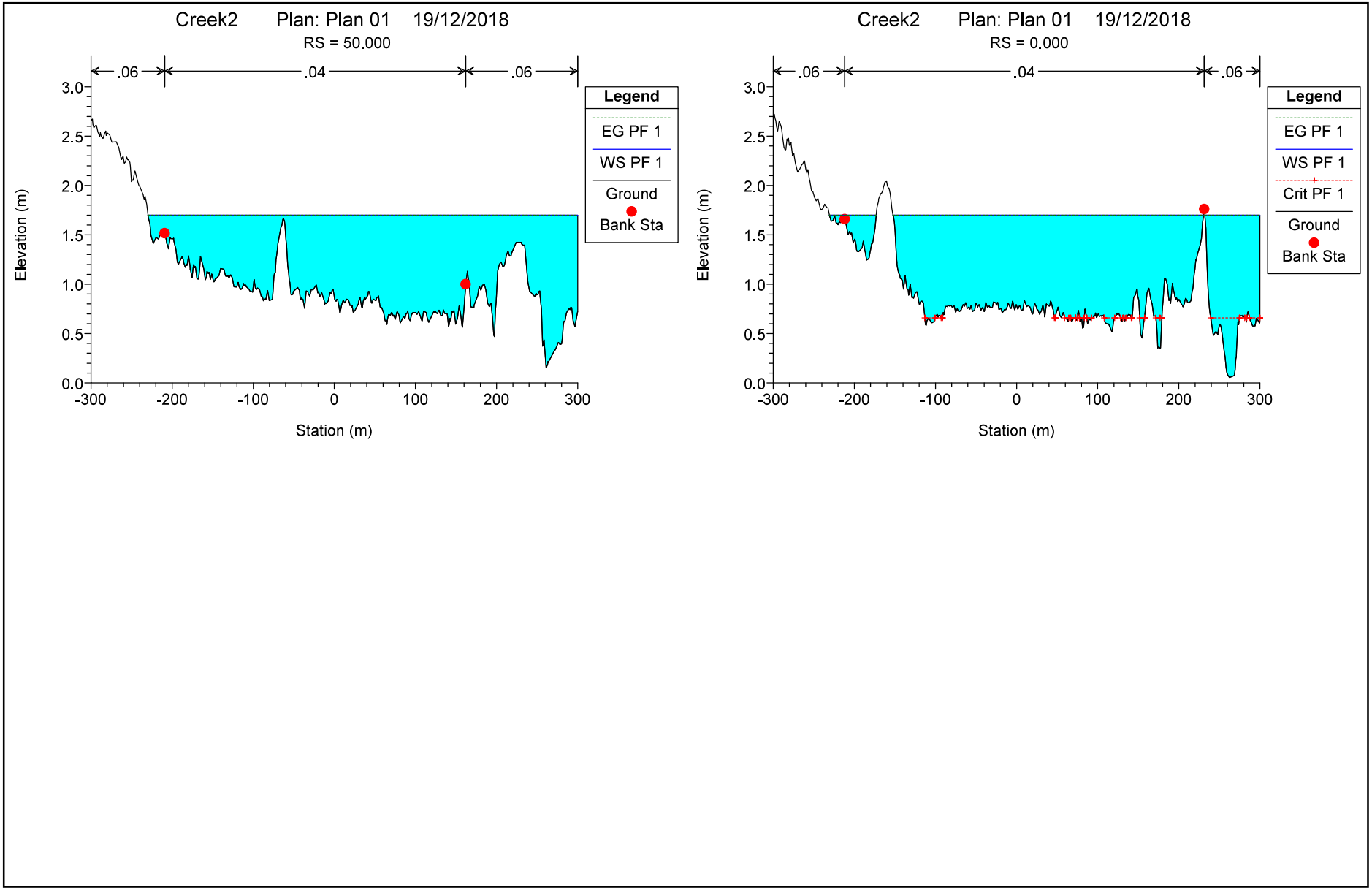
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



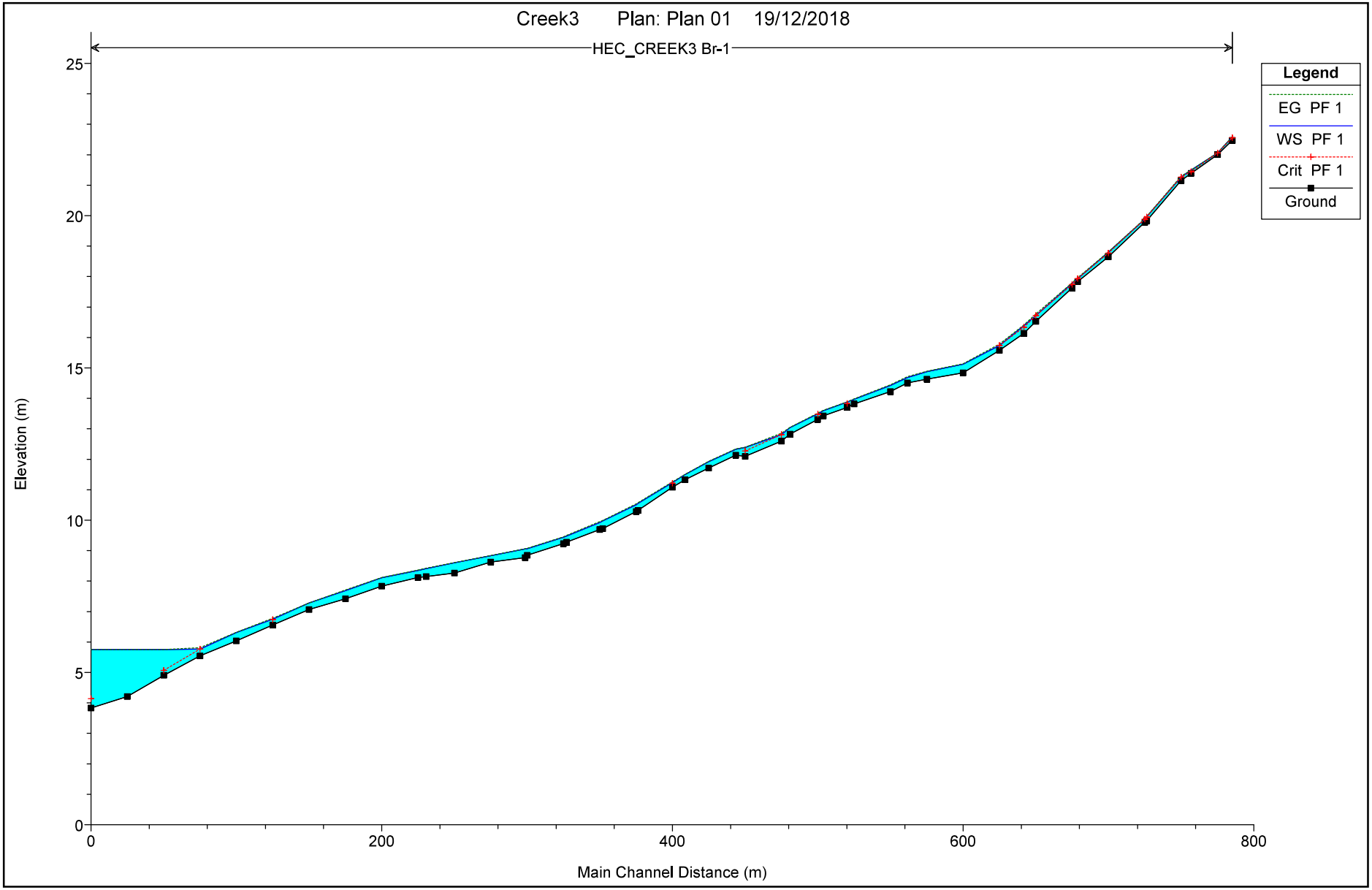
D2. Creek 2 - 1% AEP Results

1% AEP FLOOD



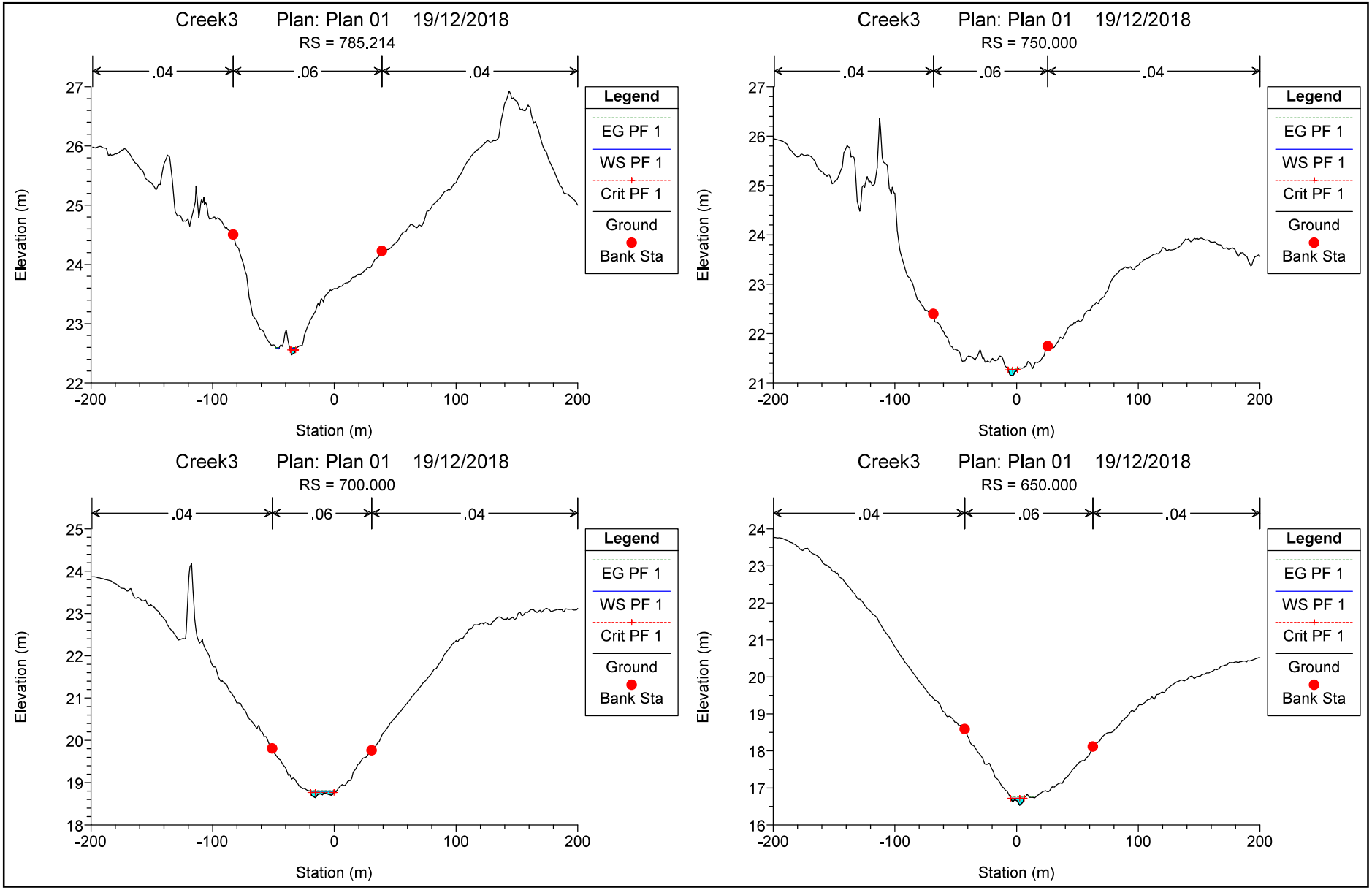
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



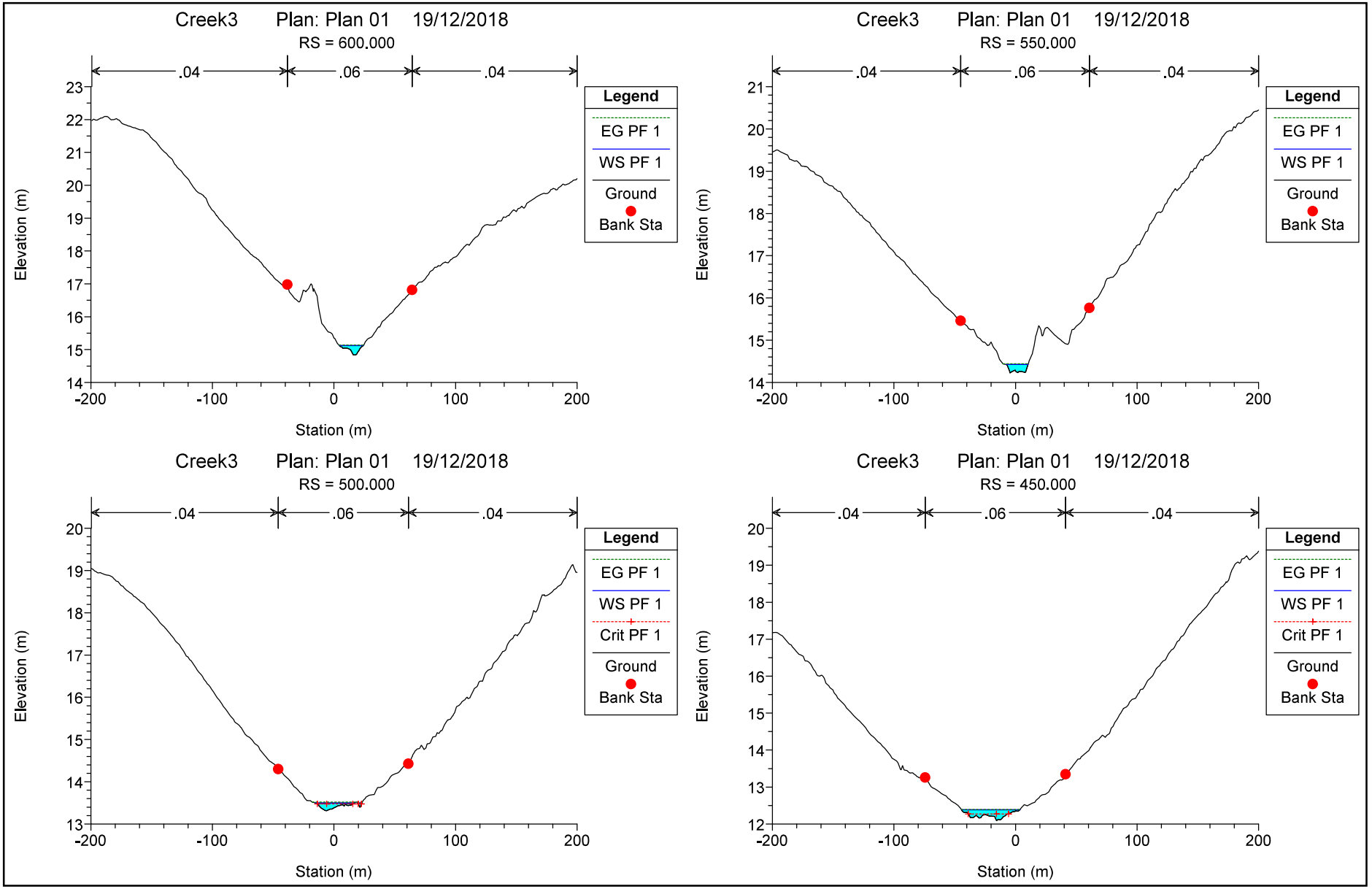
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



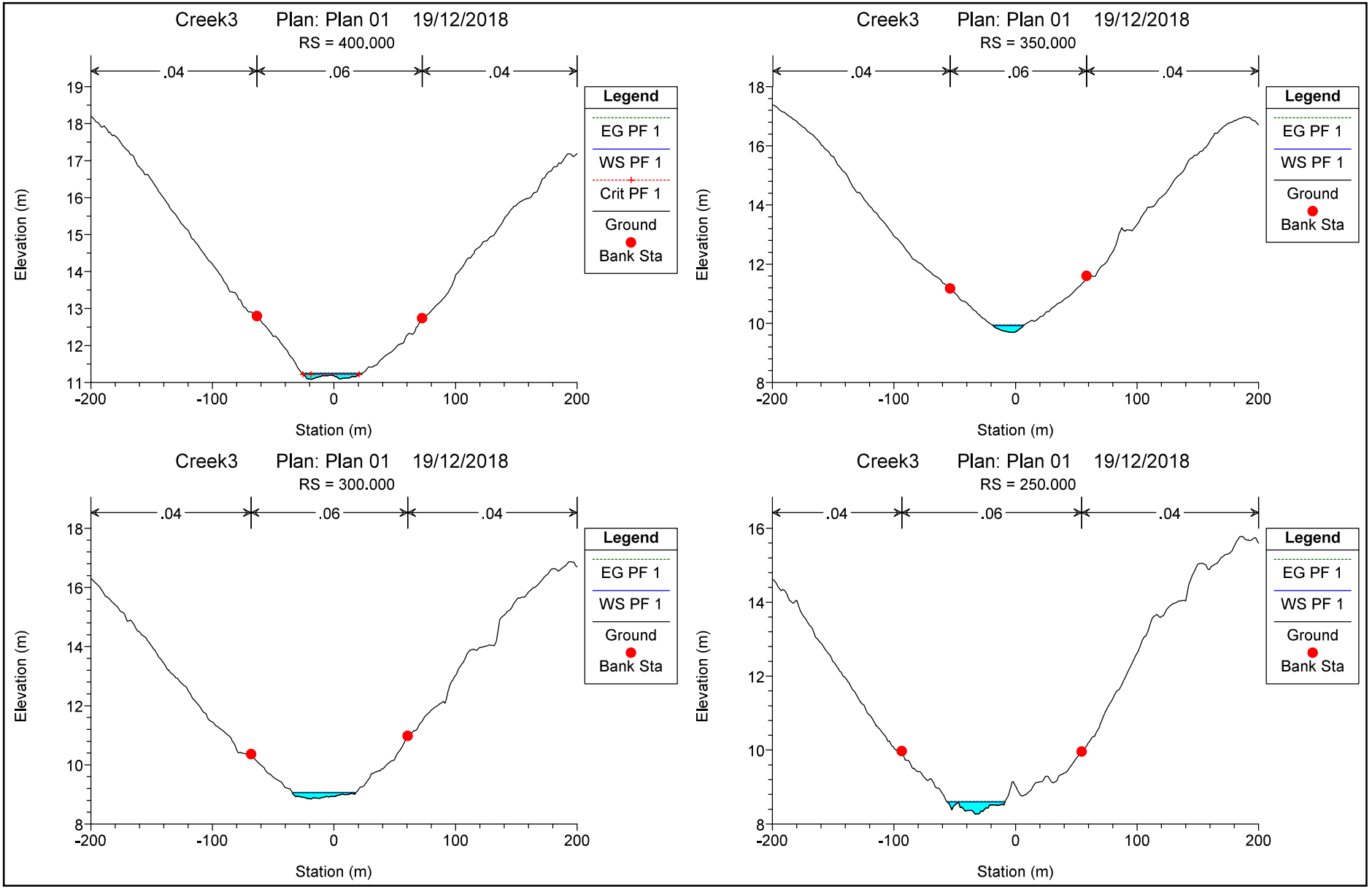
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



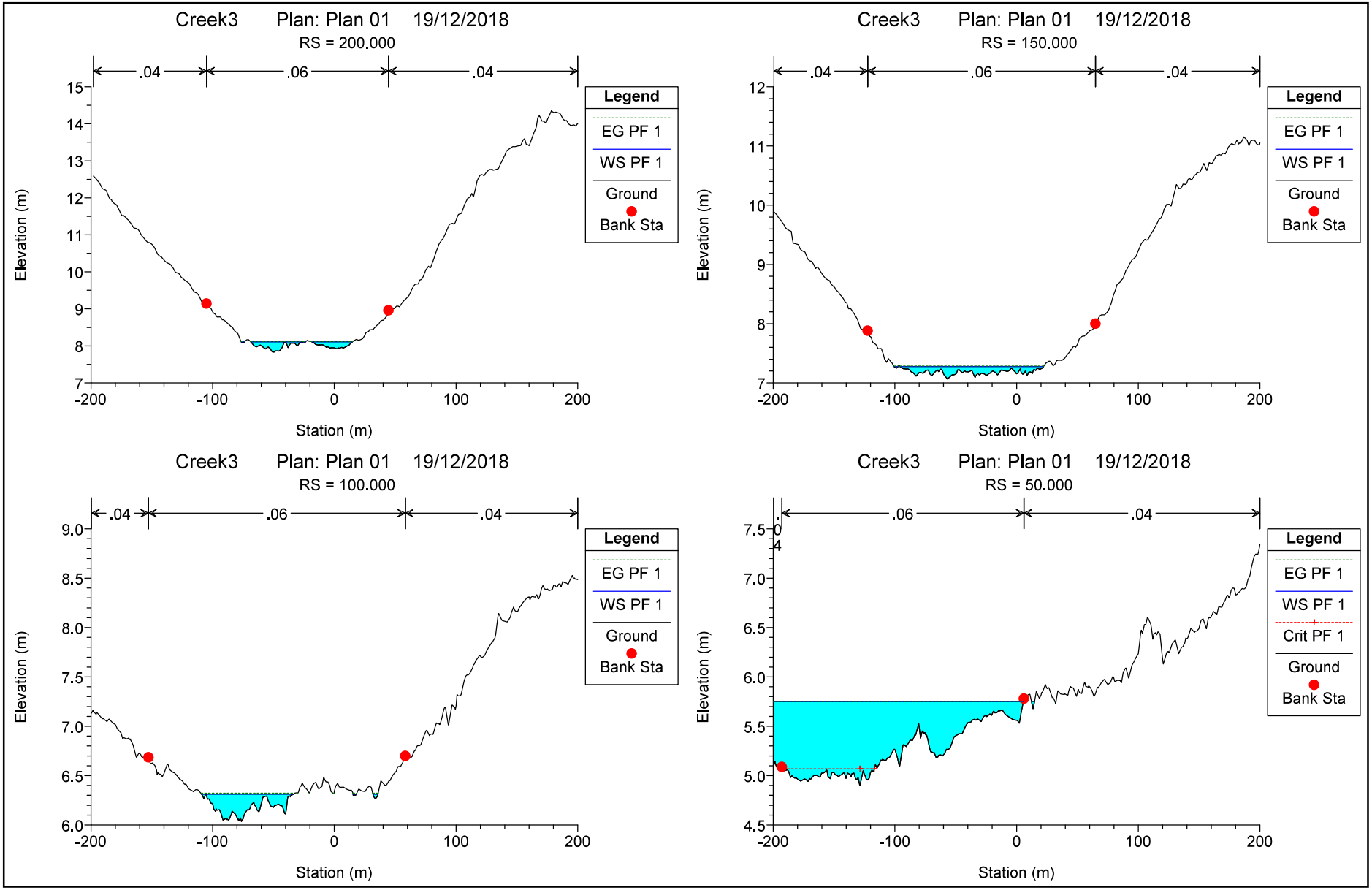
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



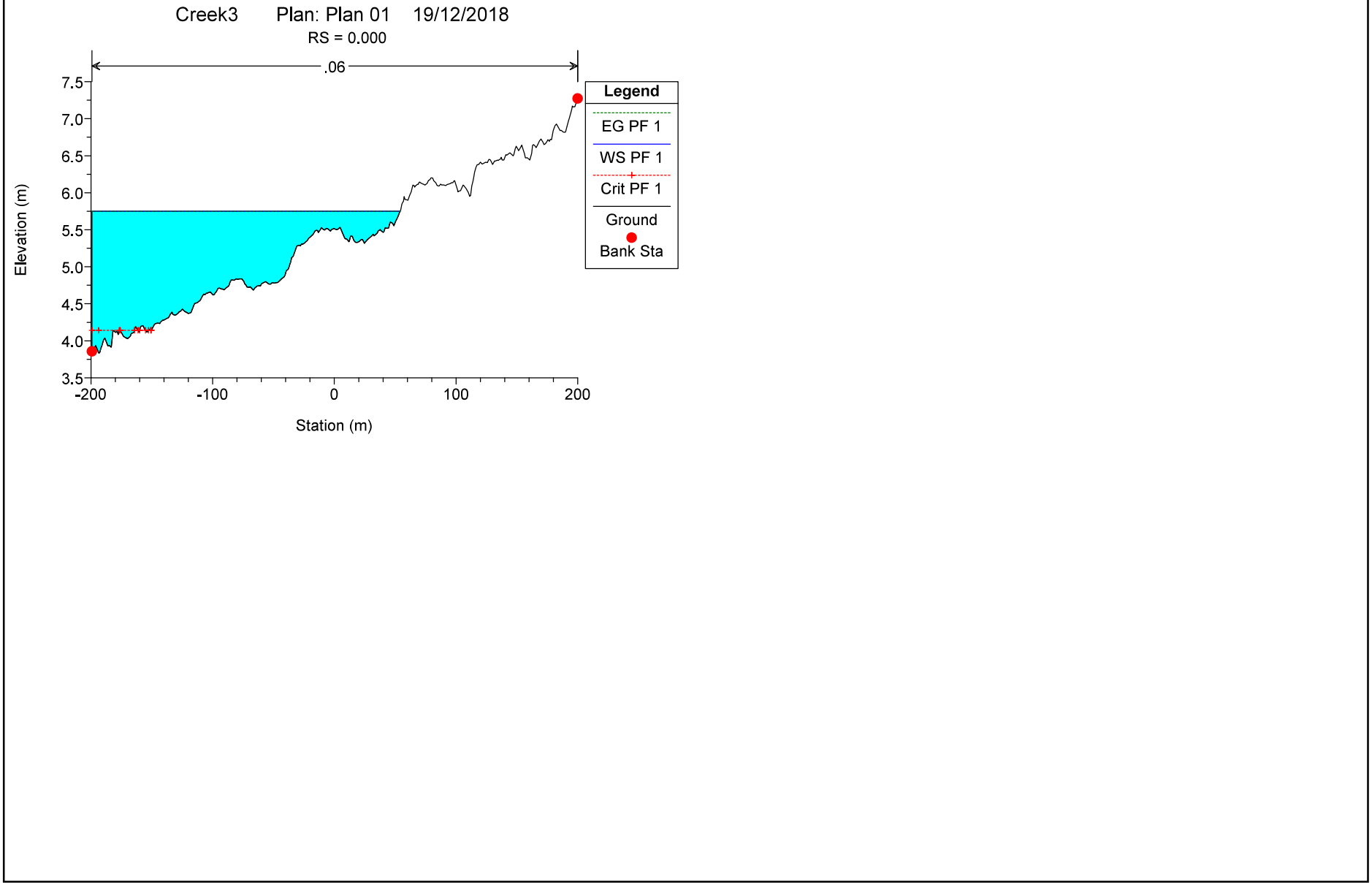
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



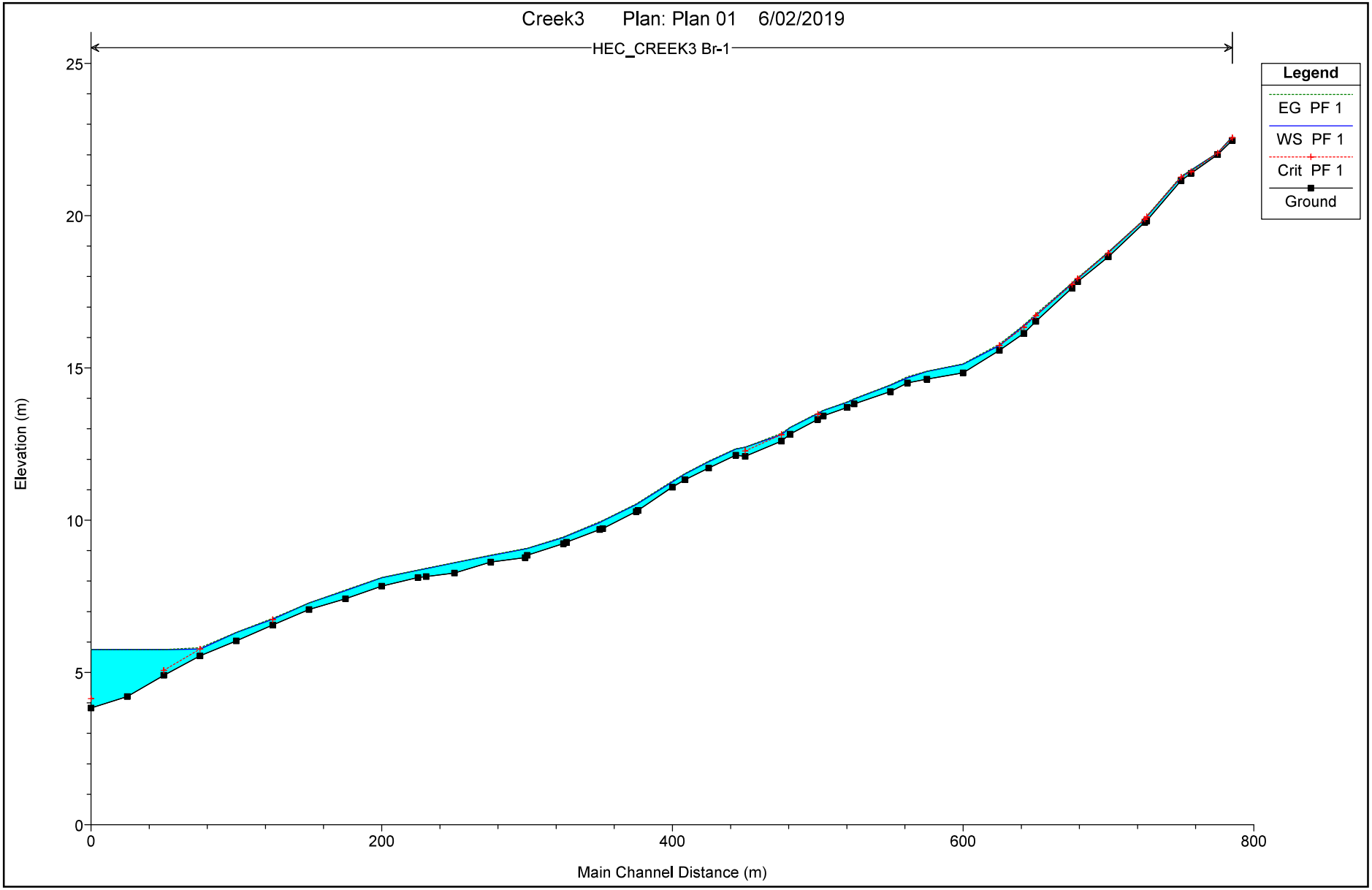
D3. Creek 3 - 1% AEP Results

1% AEP FLOOD



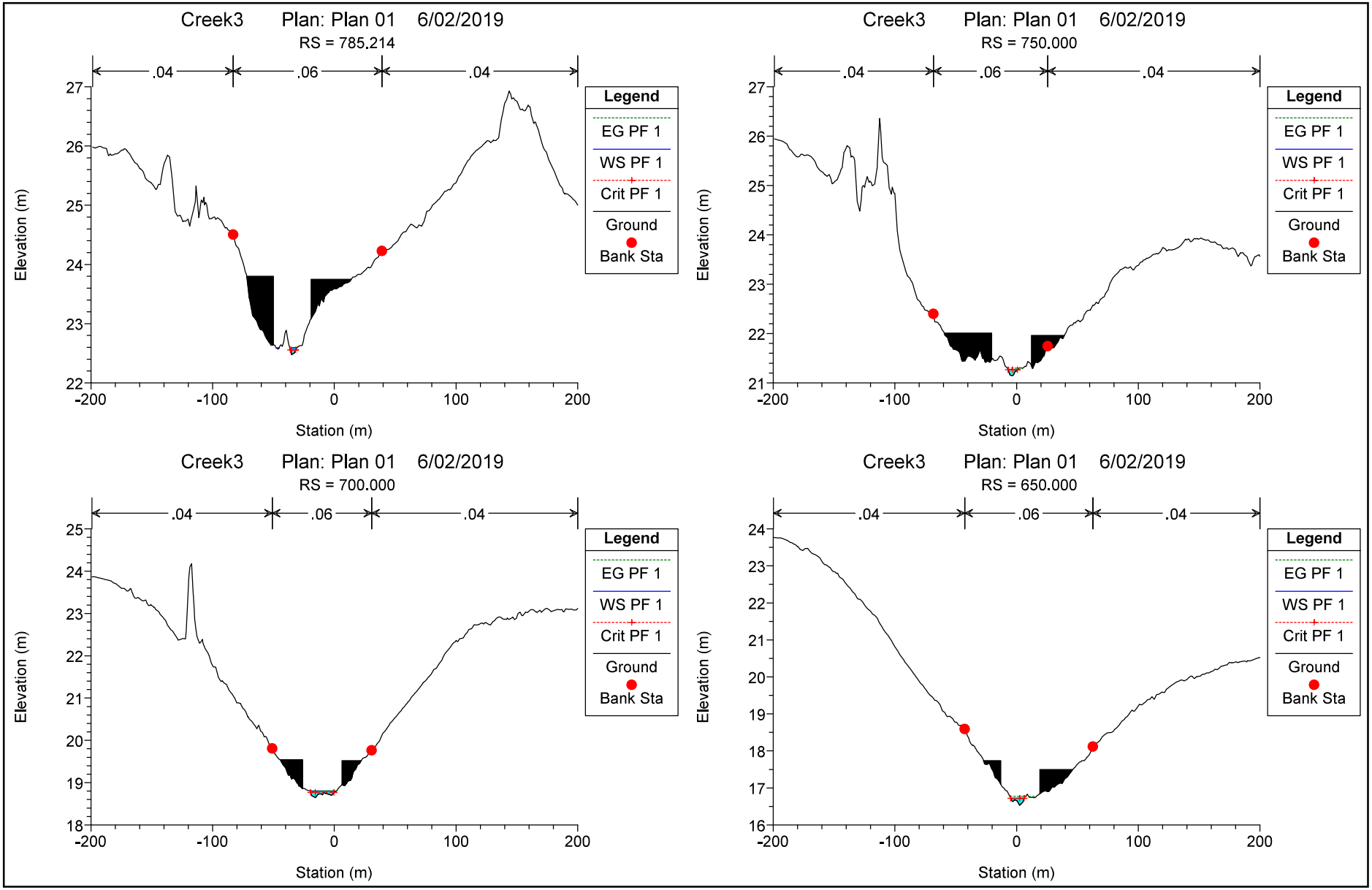
D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD



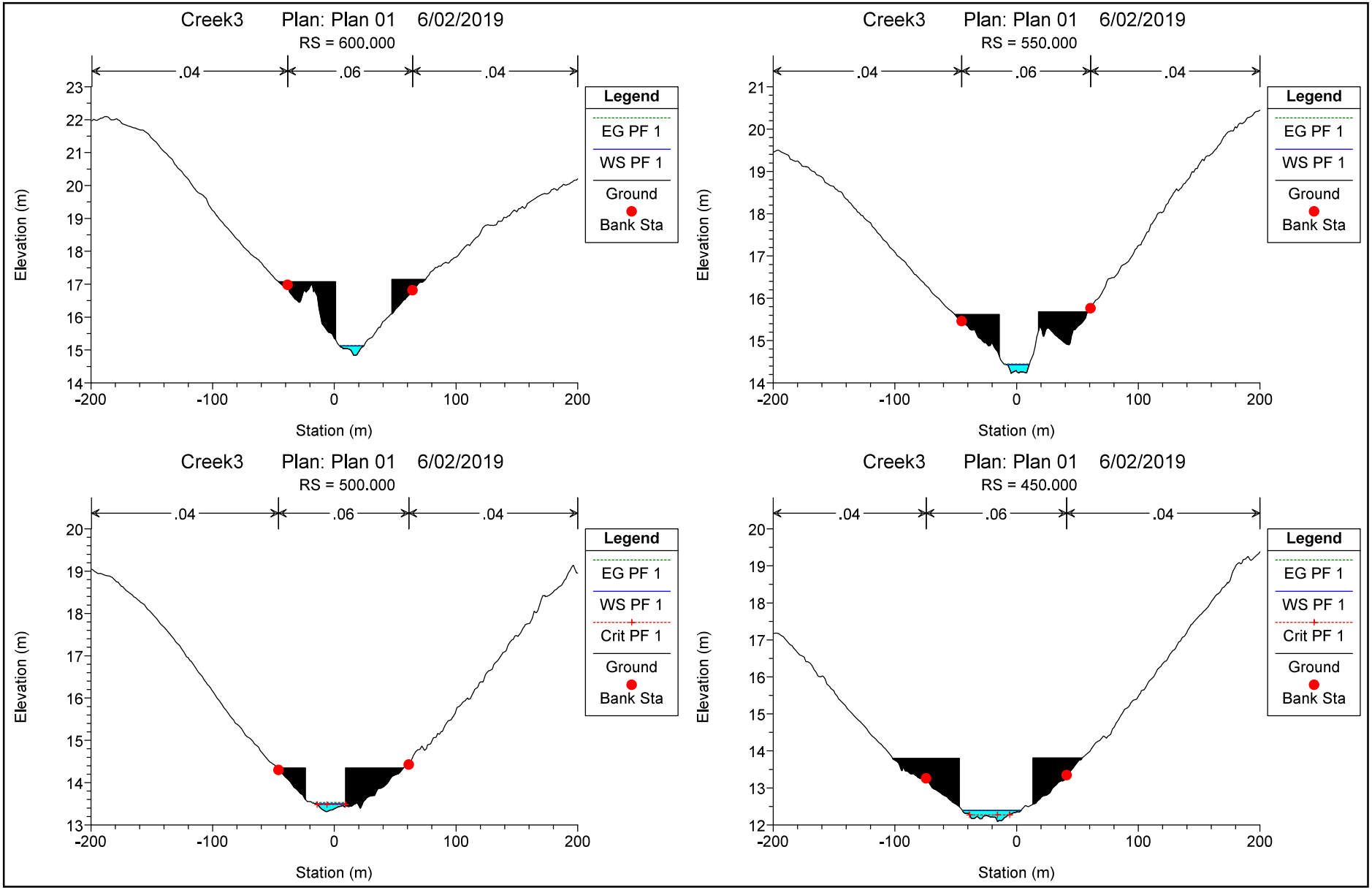
D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD



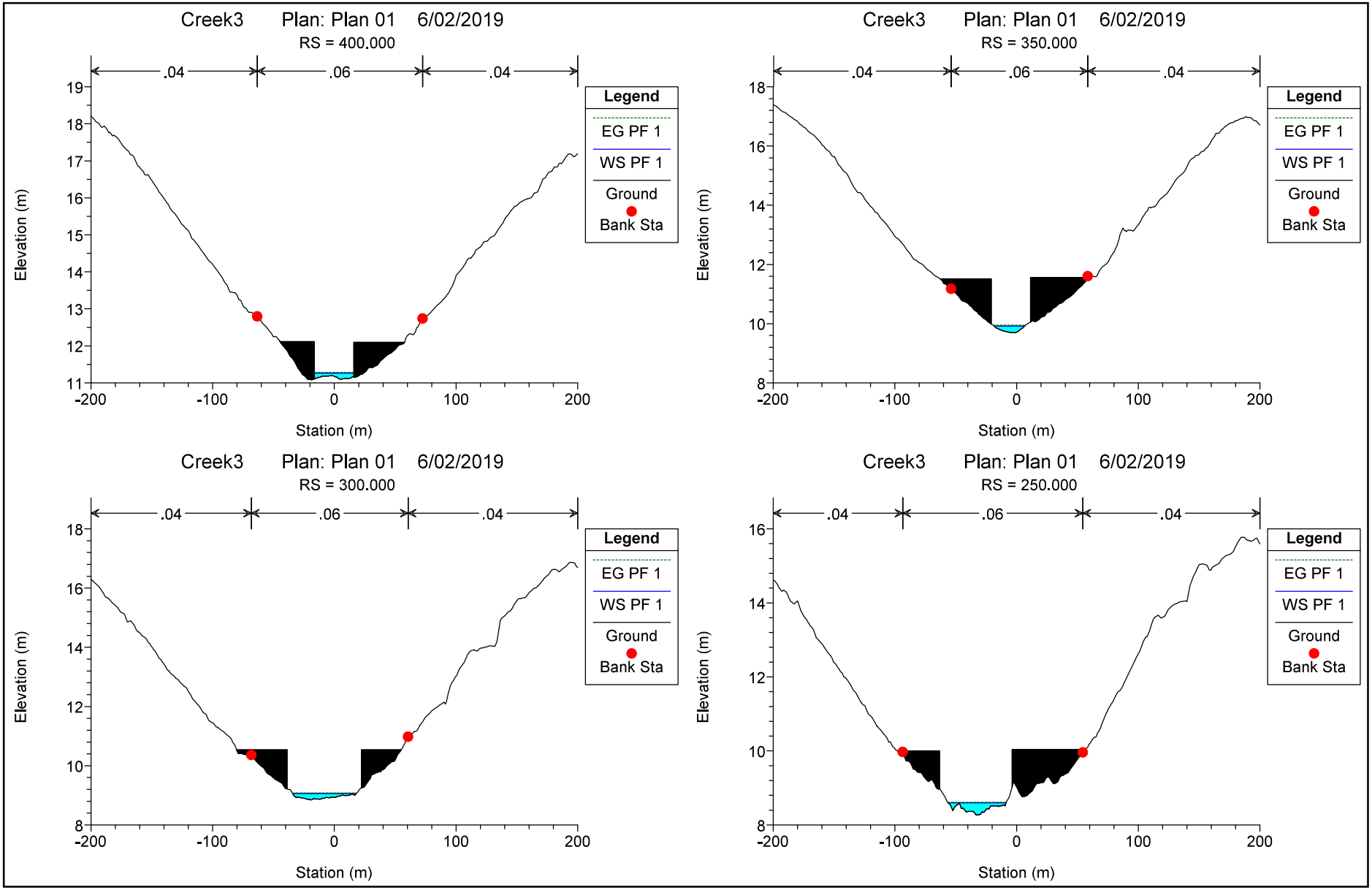
D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD



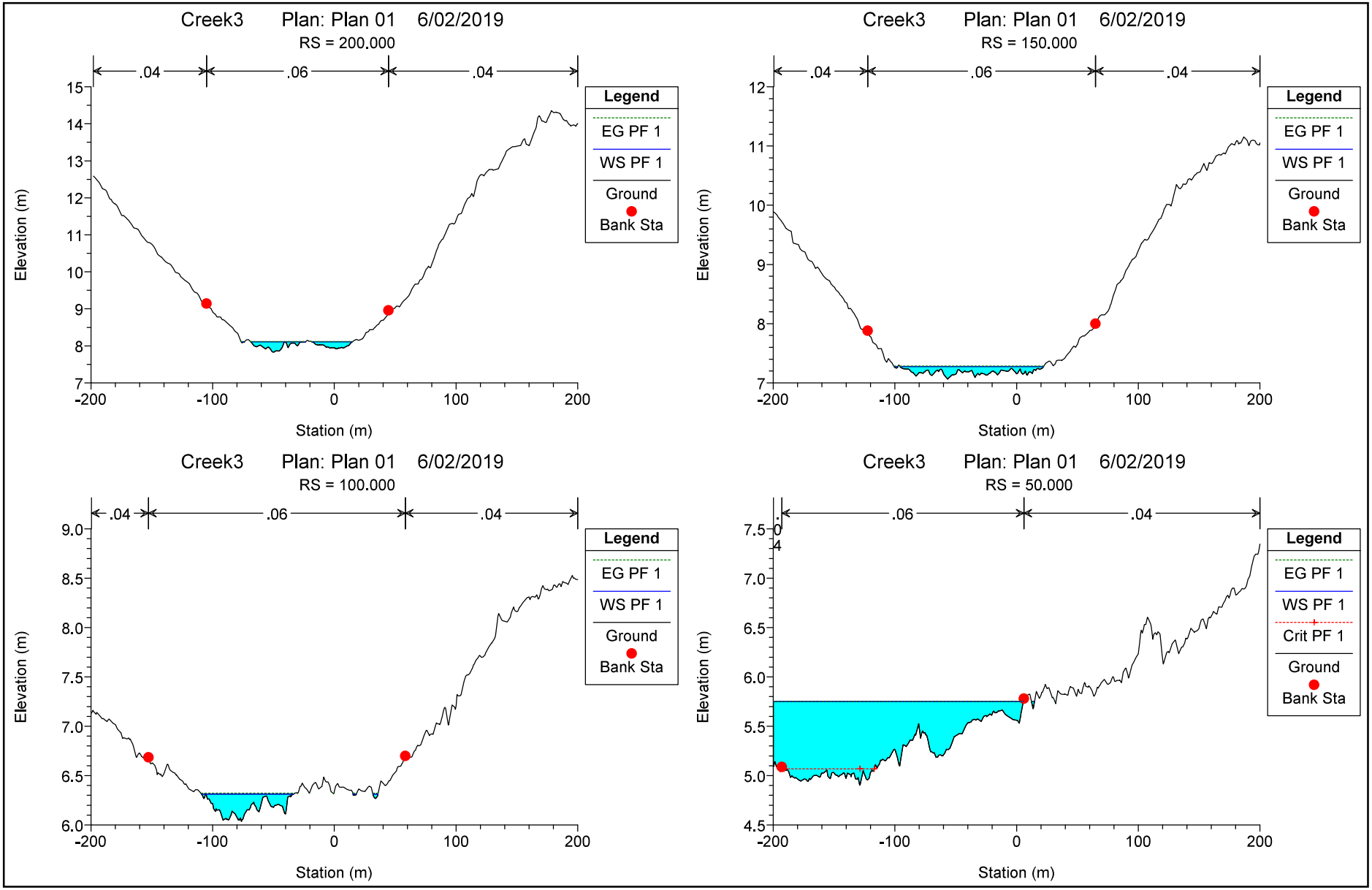
D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD



D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD



D4. Creek 3 - Post Development 1% AEP Results

1% AEP FLOOD