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MOUNT GILEAD PTY LTD AND S & A DZWONNIK

Mount Gilead Rezoning

Stormwater Management and Flooding Assessment

Issue No. 6

4th September 2014

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MOUNT GILEAD PTY LTD AND S & A DZWONNIK

MOUNT GILEAD REZONING
STORMWATER MANAGEMENT AND FLOODING ASSESSMENT

Disclaimer

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Project No: 301015-03252 - MOUNT GILEAD REZONING

REV	DESCRIPTION	ORIGINAL	REVIEW	WORLEY-PARSONS APPROVAL	DATE
3	Issue for Council Review	T Michel	C Thomas		19/03/2014
4	Final Draft	T Michel	C Thomas		18/07/2014
5	Final	TM T Michel	CRT C Thomas	CRT C Thomas	14/08/2014
6	Revised Masterplan	TMichel T Michel	C Thomas	CThomas C Thomas	04/09/2014

CONTENTS

1 INTRODUCTION

Mount Gilead Pty Ltd and S & A Dzwonnik (the Proponents) are seeking to rezone a 210 hectare parcel of land located to the south of Campbelltown (refer to **Figure 1.1**). The Site is located within the Campbelltown City Council (Council) Local Government Area at Mount Gilead and is approximately 5 km to the south of the Campbelltown City Centre.

The Site is bound by Noorumba Reserve to the north, Appin Road to the east, historic “Beulah” to the south and to the west by rural land holdings (refer to **Figure 1.2**). Sydney Water’s Upper Canal is located along part of the north-western boundary.

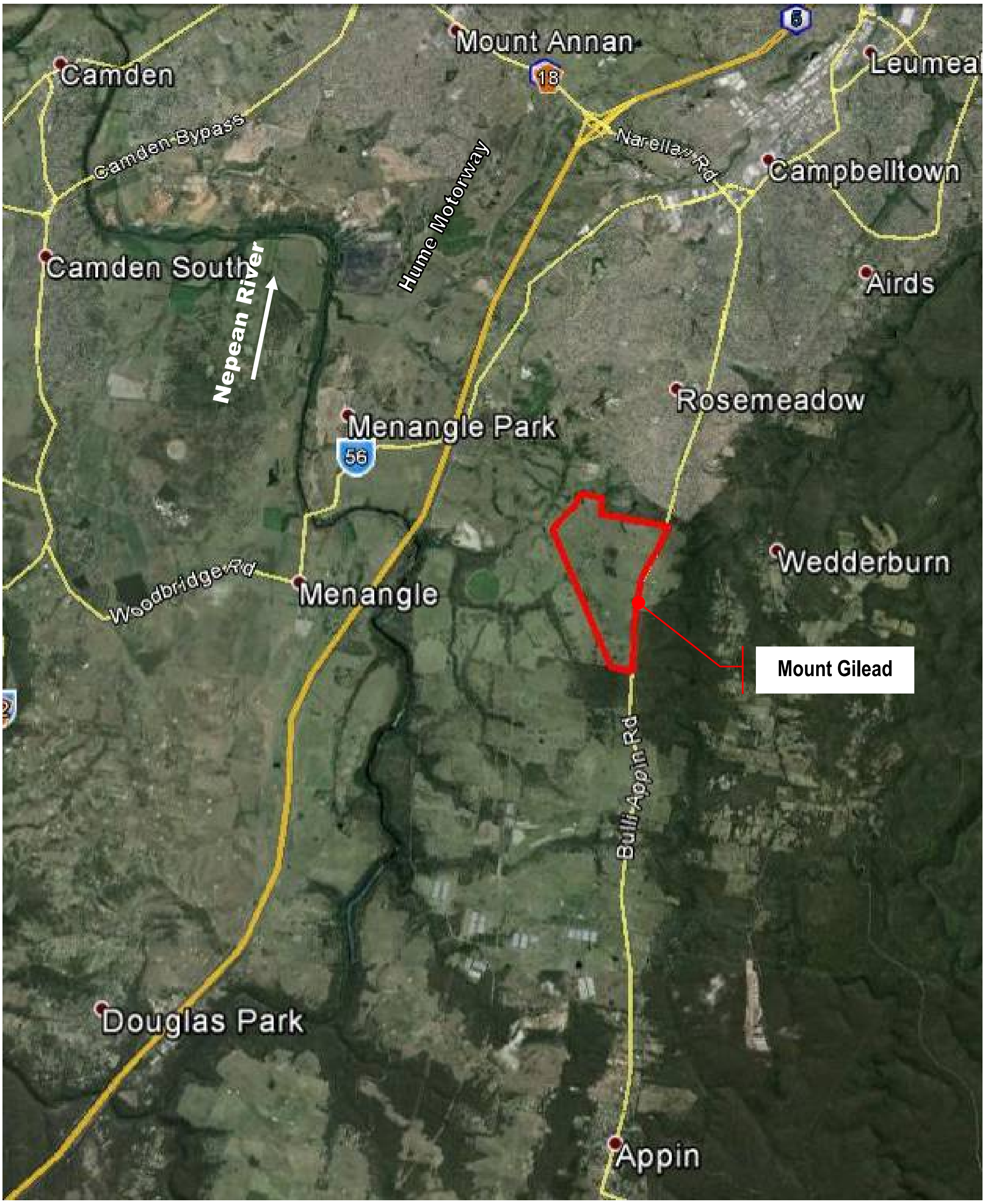
The Site is referred to as Part Lots 1 and 2 Deposited Plan 807555 and Lot 59 Deposited Plan 752042, which are in the ownership of Mount Gilead Pty Ltd, and Lot 61 Deposited Plan 752042, which is in the ownership of S & A Dzwonnik. It is zoned “Non-Urban” under the provisions of Interim Development Order No. 15 City of Campbelltown (IDO), which was gazetted on 27 September 1974 (refer to **Figure 1.3**).

The concept for the proposed urban development of the site is shown in the Mount Gilead Site Masterplan which was prepared by Cox Richardson (*dated 27th August 2014*) (*refer* **Appendix 1**). This concept has been prepared under a Planning Proposal that was submitted by Campbelltown City Council to the New South Wales Department of Planning and Infrastructure (DPI). The proposal involves rezoning of the site for urban purposes under an amendment to the *Campbelltown Local Environmental Plan 2014*. This will convert a largely rural landholding to urban land uses, which will require provision for services and drainage.

The 2010-2011 Metropolitan Development Plan Report outlines forward projections for urban land releases and the supply of residential allotments. It indicates a potential lot yield for the site of 1500 dwellings. Planning studies supporting the proposed rezoning are considering a lot yield that will deliver in the range of 1400 to 1700 dwellings. Any number above 1500 is to be justified on the basis of capacity of the site and infrastructure.

The proponents engaged WorleyParsons to prepare a Stormwater Management Strategy for the future development of the site that will occur following the proposed rezoning. The objective is to provide advice on options for servicing the future subdivision of the site for urban development purposes.

This report sets out the findings of investigations undertaken to develop a stormwater strategy and mechanisms for servicing the site. The adopted stormwater strategy is based on a total residential lot yield of 1700 dwellings as a conservative estimate.



Base Map Source: Google Earth 2013

Figure 1.1: Approximate Location and Extent of Mount Gilead Development Site

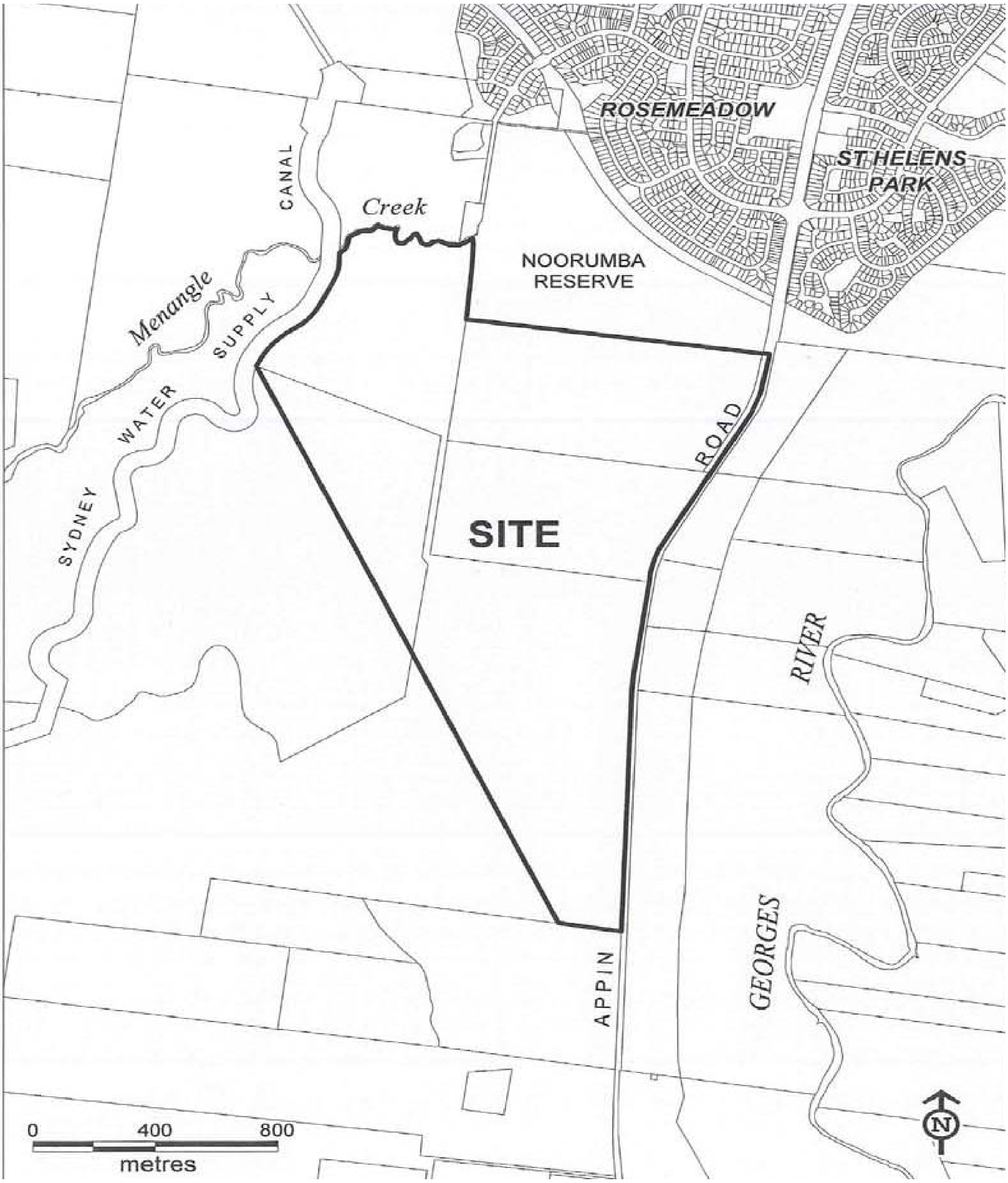


Figure 1.2: Site Map (*Source: CCC Planning Proposal*)

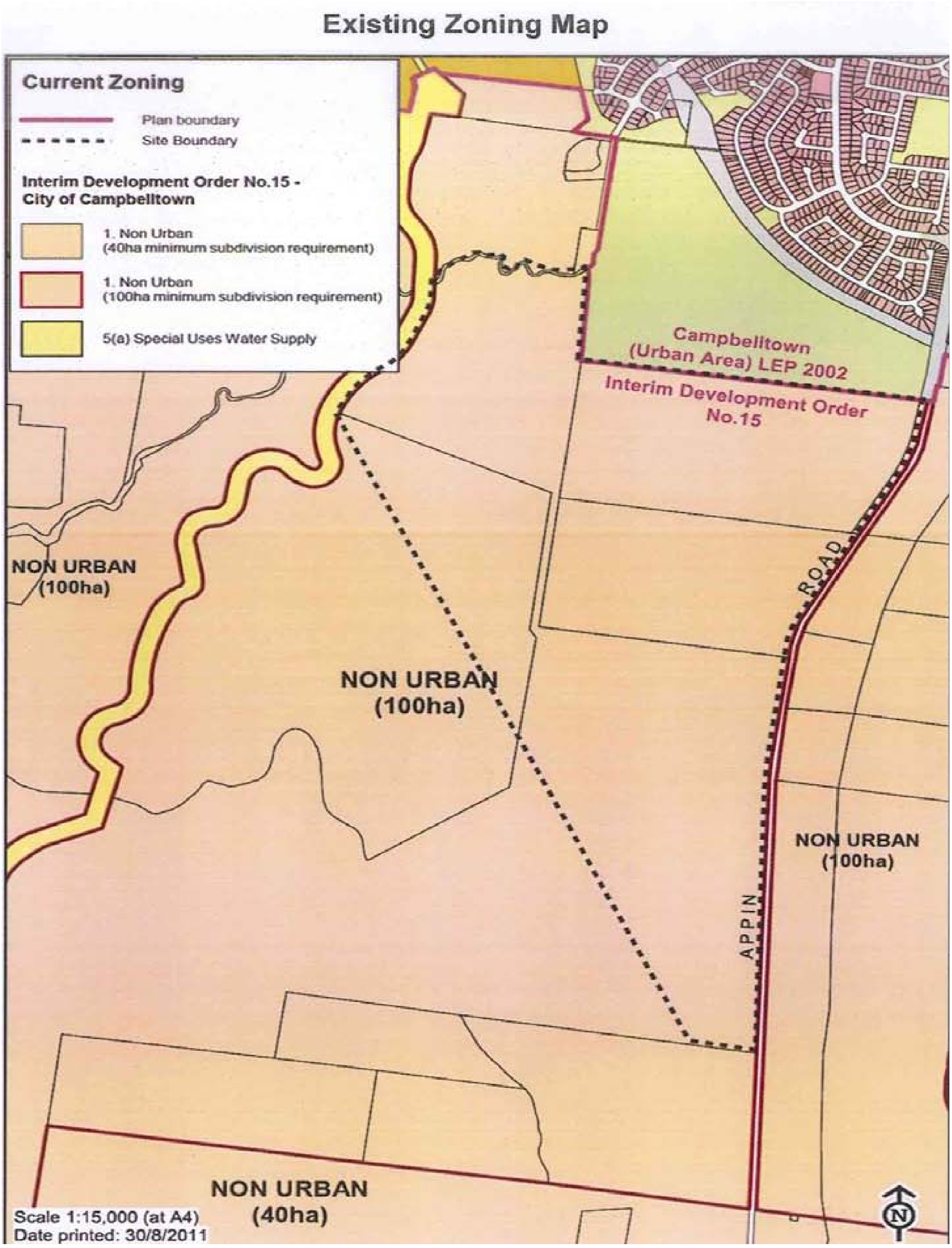


Figure 1.3: Zoning under IDO 15 (*Source CCC Planning Proposal*)

2 EXISTING SITE CONDITIONS

The site is located immediately to the south of the suburb of Rosemeadow and is bound to the:

- to the east by Appin Road (Non-Urban beyond);
- to the north by Noorumba Reserve;
- to the south by "Beulah" (Non-Urban);
- to the south-west by farmland (Non-Urban); and,
- partly to the north-west by the Sydney Water owned water supply channel known as the Upper Canal.

The site consists predominantly of open pasture land that is currently used for grazing livestock. Scattered eucalypts are located across much of the site and some limited stands of greater density are situated centrally within the site. The existing land surface grades generally towards the north-west at slopes of 3 to 5%. There are some steep areas, particularly in the north-western corner of the site.

A number of low order ephemeral watercourses exist within the site. These drain the site and discharge to four identifiable points along the site boundary as shown in **Figure 2.1**. These discharge points are described in the following.

- Discharge Point 1

  Catchments 1 and 2 drain to separate branches of an unnamed watercourse as shown in **Figure 2.2**. The confluence of the two tributaries is located just beyond the northern property boundary. The unnamed watercourse drains to a creek that passes through Noorumba Reserve and ultimately discharges to Menangle Creek. Menangle Creek in turn discharges to the Nepean River approximately 4 km downstream of the site boundary.

- Discharge Point 2

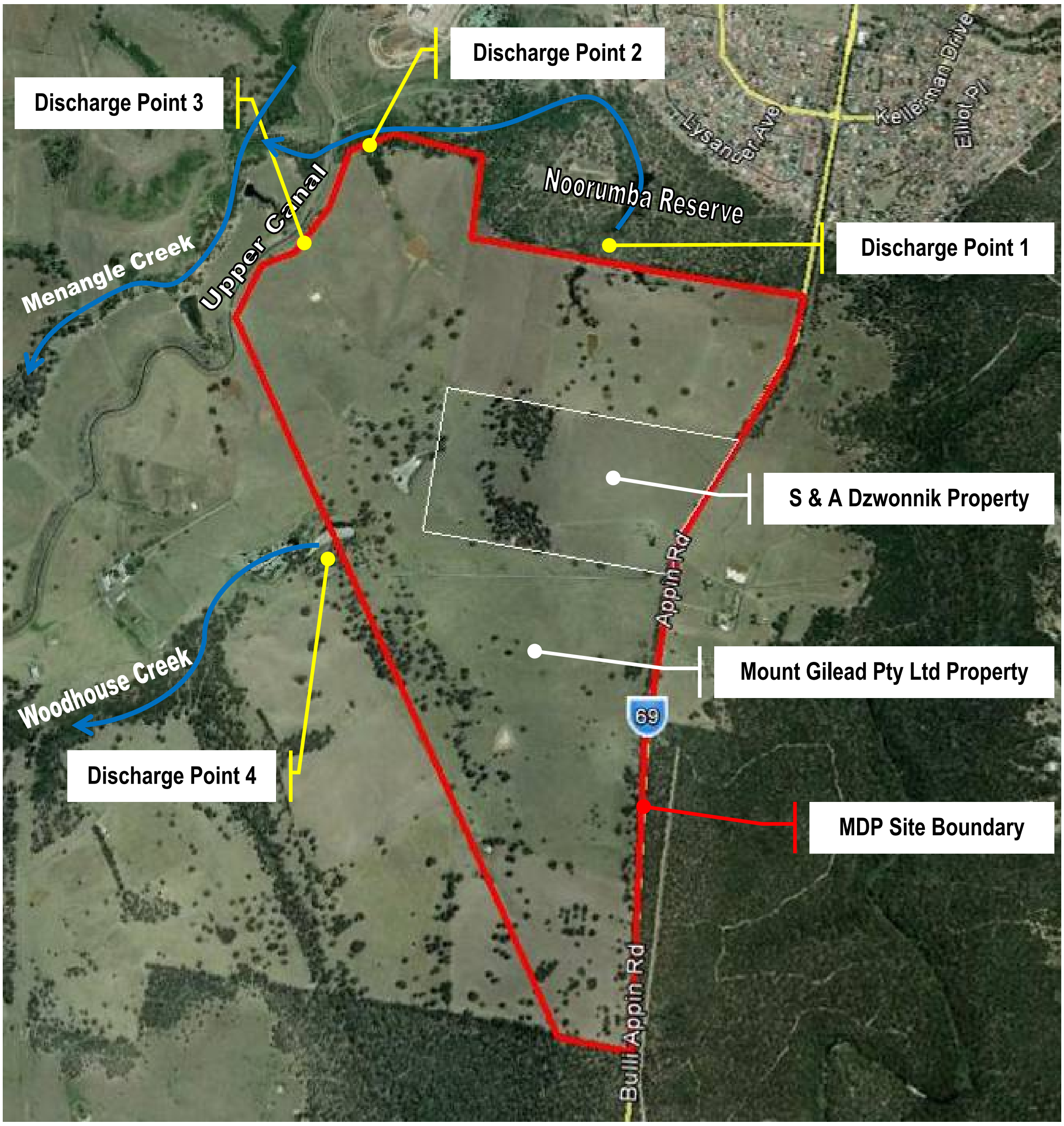
  Catchment 3 extends across most of the north-western portion of the site as shown in **Figure 2.2**. It drains to the northern-most of the aforementioned tributaries of the unnamed watercourse which ultimately discharges to Menangle Creek.

- Discharge Point 3

  Catchment 4 is also shown in **Figure 2.2**. It drains to Discharge Point 3 which is identified by a culvert that crosses under the Upper Canal near the northern-western site boundary. Catchment 4 ultimately discharges to Menangle Creek.

- Discharge Point 4

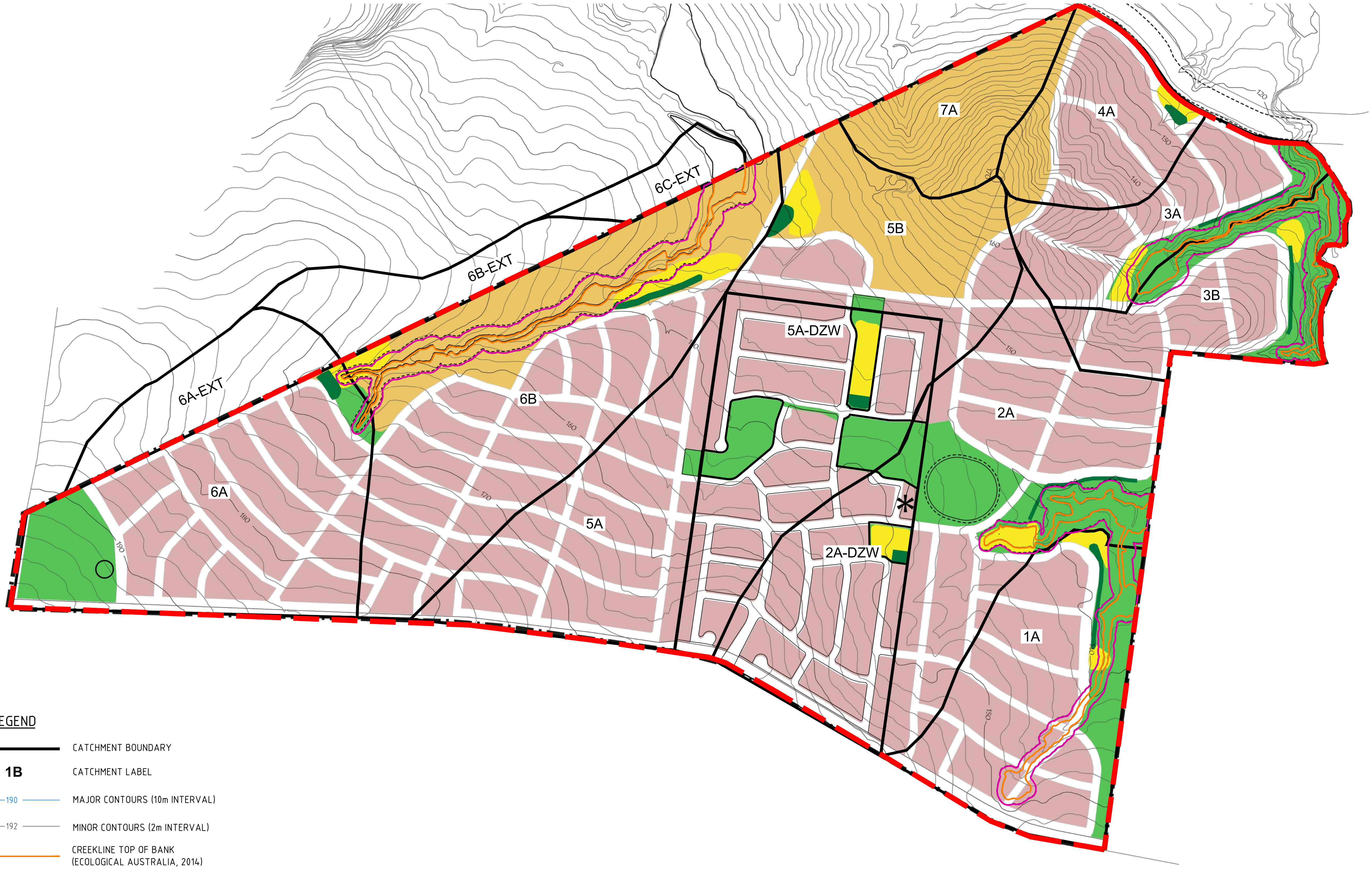
  Catchments 5 and 6 are identified in **Figure 2.2**. Both of these catchments drain in a north-westerly direction to a minor watercourse which follows a north-westerly alignment along the western boundary of the site. This watercourse then discharges via Woodhouse Creek to the Nepean River, approximately 2.5 km downstream of the site boundary.



Base Map Source: Google Earth 2013

Figure 2.1: Existing Stormwater Discharge Locations

Catchment 7 is also identified in **Figure 2.2**. It drains as overland flow in a westerly direction towards an existing farm dam located immediately south of the Upper Canal. No formal discharge point has been identified for the purpose of this assessment. It is noted that the proposed rezoning does not propose any future development of land within Catchment 7.



LEGEND

CATCHMENT BOUNDARY

1B CATCHMENT LABEL

190 MAJOR CONTOURS (10m INTERVAL)

192 MINOR CONTOURS (2m INTERVAL)

CREEKLINE TOP OF BANK (ECOLOGICAL AUSTRALIA, 2014)

RIPARIAN CORRIDOR BOUNDARY (ECOLOGICAL AUSTRALIA, 2014)

NOTES:

1. PROPOSED LAYOUT BASED ON MOUNT GILEAD SITE MASTER PLAN (27 AUGUST 2014)

80 0 80 160 240 320 400m

1:4000 (A1) 1:8000 (A3)

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to zero harm

ISSUE	DATE	ISSUE DESCRIPTION	DRAWN
D	04.09.14	FINAL	EN
C	18.07.14	FINAL DRAFT	EN
B	13.03.14	RE-ISSUED FOR COMMENT	EN
A	03.03.14	FOR COMMENT	EN

NORTH

MT GILEAD DEVELOPMENT REZONING
CATCHMENT PLAN

FIGURE 2.2

PLOT DATE & TIME: 4/9/2014 11:29:48 AM USER NAME: tim.michel LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\03252 - MT GILEAD DEVELOPMENT REZONING\12.0 DRAWINGS\SKETCHES\FIGURE 2.2.DWG
SAVE DATE & TIME: 4/9/2014 11:24:40 AM CTB FILE: Worley-Full.ctb Plotter:None

3 STATUTORY AND DEVELOPMENT CONTROL REQUIREMENTS

3.1 Statutory Planning Controls

The site is zoned "Non-Urban" under the provisions of IDO No. 15 City of Campbelltown (IDO), which was gazetted on 27th September 1974 (*refer* **Figure 1.3**).

Under the Planning Proposal submitted by Campbelltown City Council, the site will be rezoned for urban development purposes under an amendment to *Campbelltown Local Environmental Plan 2014*. The southern boundary of that LEP, which includes Noorumba Reserve, adjoins part of the northern boundary of the site (*refer* **Figure 1.3**). It is understood that the Planning Proposal will be placed on public exhibition upon completion of the various specialist studies that will be required to support the rezoning.

3.2 Development Control Plans

Council's requirements are outlined in a document titled, *'Campbelltown (Sustainable City) Development Control Plan 2012'* and Volume 2 of the Development Control Plan titled *Engineering Design for Development* (CCC DCP 2012). DCP 2012 includes specific requirements for Water Cycle Management and Stormwater Management. Items of relevance to the rezoning process include:

- A major/minor approach to drainage is to be taken for stormwater flows with flows up to the 100 year ARI event to be accommodated.
- Safe passage of the PMF is to be demonstrated for major systems.
- Development cannot result in water runoff causing flooding or erosion on adjacent properties.
- A treatment train approach to water quality is to be incorporated.
- Water quality control structures should be located generally off-line to creek paths or watercourses.
- Major detention storages must be located in lands designated as public reserves or adjacent to native vegetation corridors.

DCP 2012 indicates that the following pollutant reduction targets should be applied to new developments where specific advice relating to environmental management objectives cannot be found:

- Total Suspended Solids (TSS) 80%
- Total Phosphorus (TP) 45%
- Total Nitrogen (TN) 45%

These pollutant reduction targets have been superseded in most parts of New South Wales and replaced with stricter reduction targets of 85%, 65% and 45%, for TSS, TP and TN, respectively. These targets are considered current best practice for the Sydney region in terms of stormwater quality management and have been applied to nearby development areas such as the East Leppington Growth Centre.

4 STORMWATER QUALITY MANAGEMENT STRATEGY

4.1 Strategy Objectives

The objectives of the stormwater quality management strategy are to preserve the state of existing watercourses and to ensure that post-development pollutant loads are consistent with Council stormwater pollutant load reduction targets.

Specific water quality objectives are not detailed in Council's DCP (2012). However, a draft set of parameters for MUSIC modelling has been provided by Council and these parameters have generally been adopted in this strategy.

The following stormwater pollutant reduction targets have been adopted for the Mount Gilead site:

- Total Suspended Solids (TSS) 85% reduction in the average annual load.
- Total Phosphorus (TP) 70% reduction in the average annual load.
- Total Nitrogen (TN) 55% reduction in the average annual load.
- Gross Pollutants (GP) 90% reduction in the average annual load.

These targets have previously been applied at nearby development sites at Menangle and Glenlee and are stricter than the baseline targets outlined in Council's draft parameters for MUSIC modelling. Considering the proximity of the site to the Upper Canal and the Nepean River, these targets are considered appropriate to adopt for the Mount Gilead site.

The stormwater quality management strategy has been developed such that the S & A Dzwonnik and Mount Gilead Pty Ltd land parcels achieve these stormwater quality objectives independently of each other, accounting for the potential for the separate parcels of land to be developed at different times.

4.2 Overview of Strategy

A preliminary stormwater quality management strategy has been prepared for the proposed development based on an indicative master plan prepared by Cox Richardson (*acting on behalf of Old Mill Properties Pty Ltd*) and Design+Planning (*acting on behalf of the Dzwonnik's*) (refer to **Appendix 1**).

Discussions with Mount Gilead Pty Ltd, S & A Dzwonnik, Cox Richardson and Design+Planning established that there was a general preference for achieving stormwater quality objectives through the implementation of end-of-line stormwater treatment devices such as gross pollutant traps (GPTs) and bio-retention systems, as opposed to at-source measures such as swales and rain gardens.

The proposed stormwater quality management strategy for the site has been developed to incorporate GPTs and bio-retention systems within public open space areas. These proposed measures have been sized to meet the strategy objectives described in **Section 4.1**.

There is also a requirement to achieve a 40% reduction in potable water use throughout the development, as stipulated by the NSW Government's *Environmental Planning and Assessment Regulation 2000* (*EP&A Regulation*) and *State Environmental Planning Policy* (*Building Sustainability Index*) *2004* (*BASIX SEPP*).

In order to achieve this requirement it is envisaged that each residential lot will be equipped with a 3 kL rainwater tank that will be connected to provide for toilet flushing, washing machine operation, hot water systems and outdoor irrigation. The rainwater tanks will collect water from the rooves of dwellings and will therefore form an important part of the stormwater management strategy.

4.3 Water Quality Model Setup

The MUSIC software package was used to develop a water quality model for each of the catchments that extend across the site. MUSIC is a continual-run conceptual water quality assessment model developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH, now eWater*). MUSIC can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads generated by the catchment. MUSIC is able to conceptually simulate the performance of a series of stormwater treatment measures (*often referred to as the "treatment train"*) to assess whether a proposed water quality strategy is able to meet specified water quality objectives.

A MUSIC stormwater quality model was developed for the site to estimate the average annual pollutant loads that would be generated under existing and post-development conditions. The MUSIC model also incorporated end-of-line stormwater quality improvement devices to ensure that the stormwater pollutant reduction targets can be achieved.

The key model parameters adopted in the MUSIC model are summarised in the following sections.

4.3.1 Rainfall Data

In accordance with Council's draft parameters for MUSIC modelling, rainfall data used in the MUSIC model was sourced from the Bureau of Meteorology (BoM) daily rainfall gauge at Bringelly over an 11 year period from 1981 to 1991 inclusive. Accordingly, a daily time step has been adopted in the MUSIC model.

4.3.2 Evaporation Data

Monthly areal potential evapotranspiration (PET) values were obtained for the site from the online Bureau of Meteorology average monthly evapotranspiration maps, which are based on climatology data from over 750 weather stations across Australia for the period 1961 to 1990.

The adopted monthly areal PET values are presented in **Table 4-1**.

Table 4-1 Monthly Areal Evapotranspiration

Month	Areal Potential Evapotranspiration (mm/month)
January	165
February	125
March	115
April	65
May	55
June	45
July	45
August	60
September	85
October	120
November	145
December	155

4.3.3 Soil Parameters and Groundwater Properties

The soil profile parameters adopted in the MUSIC model affect the amount of stormwater runoff generated from pervious areas. A Phase 1 geotechnical investigation was undertaken for the site by URS in 2013. This investigation established that the site is typically underlain by '*shallow silty clay / clay soils overlying extremely weather shale and sandstone*' (*URS, 2013*).

On the basis of the reported soil type at the site, pervious area soil storage and field capacities have been adopted based on the values for Silty Clay presented in Table 3-7 of the *NSW Draft MUSIC Modelling Guidelines*.

The groundwater properties that were adopted in the MUSIC model are the values presented in Table 3-8 of the *NSW Draft MUSIC Modelling Guidelines* for Silty Clay soils.

A summary of the pervious area soil parameters and groundwater properties adopted in the MUSIC modelling are presented in **Table 4-2**.

Table 4-2 Adopted Soil Parameters in MUSIC

PARAMETER	VALUE
Pervious Area	
Soil Storage Capacity	54mm
Initial Storage	25%
Field Capacity	51mm
Coefficient – a	180
Coefficient – b	3
Groundwater Properties	
Initial Depth	10mm
Recharge Rate	25%
Baseflow Rate	4%
Deep Seepage Rate	0%

4.3.4 Land Uses

The existing scenario was modelled based on completely agricultural land use, which is consistent with existing land use. The post-development modelling scenario was based on land uses defined in the Site Masterplan (refer to **Appendix 1**) and broke these land uses down according to road, roof, general urban and open space areas. The percentage impervious for each of the adopted land uses is summarised in **Table 4-3**.

Table 4-3 Impervious Percentages for Each Land Use

Land Use	Percentage Impervious
Agricultural	5%
Roofs	100%
Roads	80%
General Urban (lots between 600 m^2 and 1000 m^2)	70%
General Urban (lots between 400 m^2 and 600 m^2)	80%
Open Space	5%

4.3.5 Pollutant Event Mean Concentrations

Pollutant Event Mean Concentrations (EMCs) for base flow and storm flow scenarios were adopted from Table 3-9 and Table 3-10 of the *Draft NSW MUSIC Modelling Guidelines* (*Sydney Metropolitan CMA, August 2010*).

A summary of adopted EMC values for each of the nominated land uses in the MUSIC models is presented in **Table 4-4**. These values are applied to source nodes within the MUSIC model to estimate mean annual pollutant loads exported from the site under pre-development and post-development scenarios.

Table 4-4 Adopted EMC Values

	Mean Pollutant Concentration (mg/L)					
	TSS		TP		TN	
Land Use	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**
Pre-Development Scenario						
Agricultural	20.0	141	0.09	0.60	1.1	3.0
Post-Development Scenario						
Road	15.8	269	0.14	0.50	1.3	2.2
Roof	-	20	-	0.13	-	1.5
General Urban / Open Space / Rural	15.8	141	0.14	0.25	1.3	2.0
Forest	7.9	79.4	0.03	0.08	0.7	0.8

4.3.6 Catchment Delineation

The site has been delineated into seven overall catchments based on the locations of discharge points from the site and 12 sub-catchments based on the proposed locations of stormwater quality control structures (refer to **Figure 2.2**) and catchment boundaries. Of the 12 sub-catchments, 10 are located with the Mount Gilead site and two are located within the Dzwonnik-owned property.

Across the Mount Gilead MDP site, it is unlikely that major earthworks would be required to facilitate urban development. In the absence of detailed earthworks design, which would be prepared at the subdivision development application phase, it is considered appropriate to adopt the same catchment delineation for the existing and post-development scenarios.

The adopted catchment areas are listed in **Table 4-5**. A detailed breakdown of existing catchment parameters is presented in **Appendix 2**.

Table 4-5 Catchment Areas

Catchment	Area (ha)
1	16.6
2	41.0
3	23.0
4	10.2
5	52.5
6	58.5
7	8.0
Total	**209.8**

4.4 Proposed Water Quality Control Measures

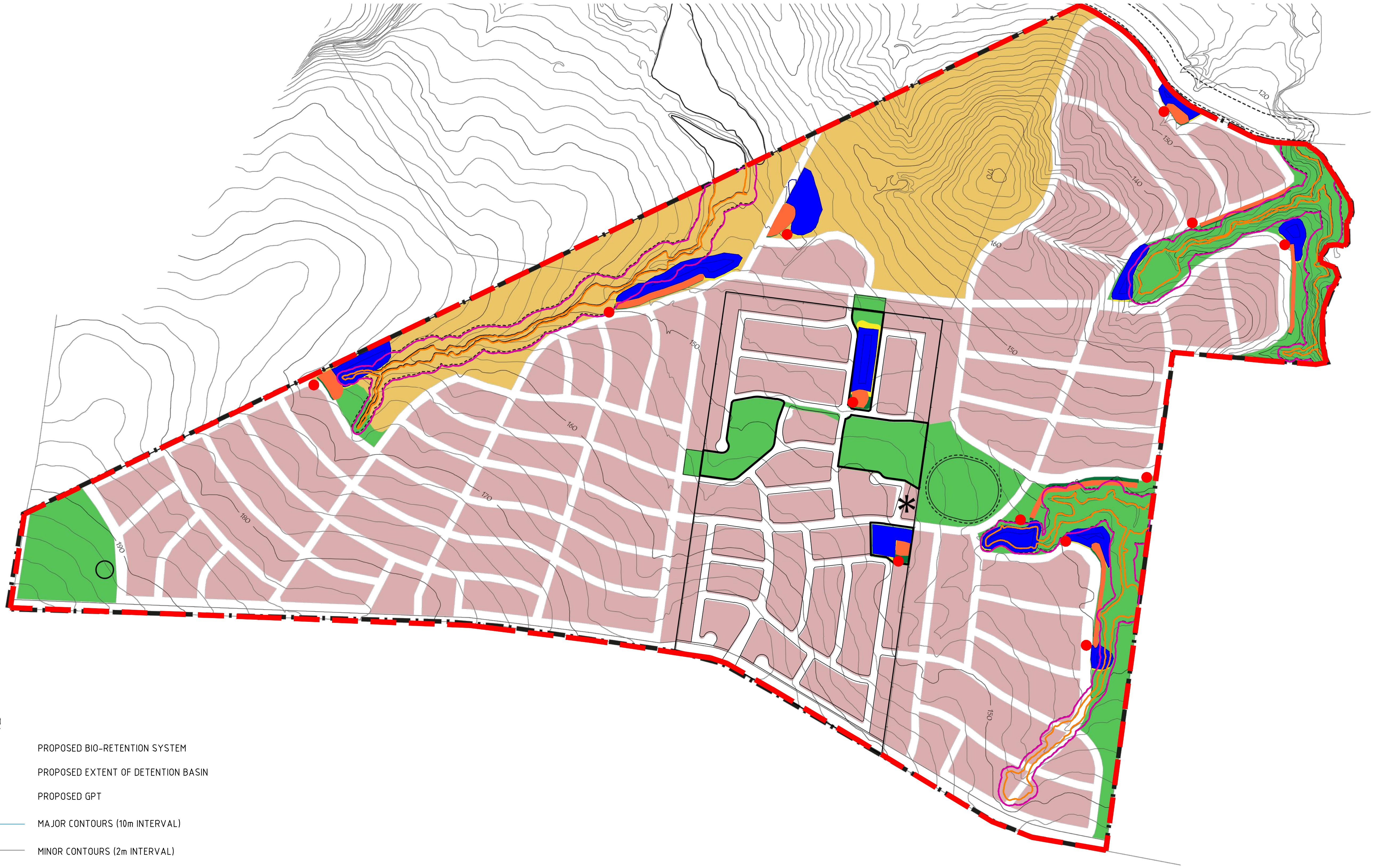
A series of water quality control measures are proposed to be adopted within the Mount Gilead site to satisfy stormwater runoff quality targets. These measures are presented in **Figure 4.1**. A general description of the proposed stormwater treatment train components is presented in the following sections.

4.4.1 Rainwater Tanks

As well as being required under BASIX legislation in NSW, rainwater tanks retain a significant proportion of stormwater that falls on roof areas. They therefore contribute to minimising the total volume of runoff discharging from individual lots.

A rainwater tank reuse system on individual lots can be installed in many different configurations, including placing the tank above or below ground and using gravity or pressure systems (pumps) to supply rainwater for non-potable domestic uses. These uses typically include toilet flushing, laundry, hot water installations, car washing and irrigation.

Considering rainwater tanks are likely to be fitted with first flush devices, it is likely that they would have minimal water quality benefit. However, in order to estimate the effect of rainwater tanks on the Stream Erosion Index (refer to **Section 6**), the MUSIC model was structured to include a 3 kL rainwater tank per lot with an assumed non-potable water reuse component.



LEGEND

PROPOSED BIO-RETENTION SYSTEM

PROPOSED EXTENT OF DETENTION BASIN

PROPOSED GPT

190 MAJOR CONTOURS (10m INTERVAL)

192 MINOR CONTOURS (2m INTERVAL)

CREEKLINE TOP OF BANK
(ECOLOGICAL AUSTRALIA, 2014)

RIPARIAN CORRIDOR BOUNDARY
(ECOLOGICAL AUSTRALIA, 2014)

NOTES:

1. PROPOSED LAYOUT BASED ON MOUNT GILEAD SITE MASTER PLAN (27 AUGUST 2014)

80 0 80 160 240 320 400m

1:4000 (A1) 1:8000 (A3)

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ISSUE	DATE	ISSUE DESCRIPTION	DRAWN
D	04.09.14	FINAL	EN
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A	03.03.14	FOR COMMENT	EN

NORTH

N

MT GILEAD DEVELOPMENT REZONING
PROPOSED STORMWATER QUALITY & QUANTITY MANAGEMENT STRATEGY

FIGURE 4.1

In order to determine the required size of catchment-wide water quality control measures (i.e. GPTs and bio-retention *systems*), the rainwater tanks were modelled with a high-flow by-pass set to zero to simulate all flow by-passing the tanks.

In accordance with the *Draft NSW MUSIC Modelling Guidelines*, the following non-potable water demands were adopted in the MUSIC model:

- Internal Rainwater Demands = 237 kL/lot/yr (*including toilet, laundry and hot water systems*)
- External Rainwater Demands = 112 kL/lot/yr

4.4.2 Gross Pollutant Traps

The proposed stormwater treatment train would consist of GPTs as a means of primary stormwater treatment. GPTs are designed to capture litter, debris, coarse sediment, as well as some oils and greases. A range of proprietary GPTs are available and the most appropriate GPT would be selected at the subdivision Development Application stage.

Pollutant capture efficiency differs between various proprietary GPTs. As prescribed in the *Draft NSW MUSIC Modelling Guidelines*, the pollutant removal rates adopted for the GPT treatment nodes in MUSIC are presented in **Table 4-6**.

High-flow by-passes for the GPTs have been adopted as half of the 1 year ARI post-development peak flow rate.

Table 4-6 GPT Treatment Node Inputs in MUSIC

Pollutant	Input	Output	% Reduction
TSS	0 mg/L	0 mg/L	0
	75 mg/L	75 mg/L	0
	1000 mg/L	350 mg/L	85
TP	0 mg/L	0 mg/L	0
	0.50 mg/L	0.50 mg/L	0
	1.00 mg/L	0.85 mg/L	15
TN	0 mg/L	0 mg/L	0
	0.5 mg/L	0.5 mg/L	0
	5.0 mg/L	4.3 mg/L	14
Gross Pollutants	0 kg/ML	0 kg/ML	0
	15 kg/ML	1.5 kg/ML	90

4.4.3 Bio-Retention Systems

The objective of bio-retention systems is to provide a filtering effect when stormwater runoff flows through a vegetation layer and sand and/or gravel filer media in order to remove pollutants from the runoff. Bio-retention systems generally consist of an open space containing landscaping of native grasses, shrubs and trees with an underlying filter media. Two examples of typical bio-retention systems are presented in **Figure 4.2**.

A number of bio-retention basins and/or swales are proposed to be located in open space areas adjacent to riparian corridors within the site (refer to **Figure 4.1**). These would be constructed to collect surface runoff from roads and general urban areas. The proposed bio-retention systems would generally be constructed outside riparian corridors, however it is noted that under planning reforms implemented by the Department of Planning Infrastructure in June 2012, detention basins would be permitted within riparian corridors.

Figure 4.2: Examples of bio-retention systems

The following general parameters have been adopted for the proposed bio-retention systems:

- High flow by-pass: Half of 1 year ARI peak flow
- Extended Detention Depth: 300 mm
- Saturated Hydraulic Conductivity: 90 mm/hour
- Filter Depth: 500 mm
- TN Content of Filter Media: 800 mg/kg
- Orthophosphate content: 50 mg/kg
- Exfiltration rate: 0 mm/hour
- Assumed to be vegetated with effective nutrient removing plants (exact species to be determined at subsequent stages of the development).

Specific parameters for proposed bio-retention systems are described further in **Section 4.6**.

4.5 Existing Scenario Modelling

A MUSIC model was prepared to reflect the existing catchment / site conditions and incorporated the parameters outlined in the preceding sections (*i.e., rainfall, evapotranspiration, percentage impervious, land use and EMC values*). The model was developed to estimate the mean annual pollutants load discharged at each of the site's discharge points under existing conditions.

The layout of the existing scenario MUSIC model is presented in **Figure 4.4**.

4.6 Post-Development Scenario Modelling

A separate MUSIC model was created for the post-development scenario and was based upon the land uses depicted in the Site Masterplan prepared by Cox Richardson (refer to **Appendix 1**). The layout of the post-development scenario is similar to that presented in **Figure 4.4**, however with a significant number of additional source nodes to account for the different land use types that would occur under this scenario.

The land use breakdown for each of the catchments under the post-development scenario is included in **Table 4-7**. Detailed catchment parameters for the post-development scenario are presented in **Appendix 2**.

Figure 4.4: Layout of Existing Scenario MUSIC Model

Table 4-7 Post-Development Scenario – Land Use Breakdown

Catchment No.	Total Area (ha)	Road Area (ha)	Roof Area (ha)	General Urban (ha)	Open Space (ha)	Rural (ha)	Forest (ha)
1	18.9	4.1	3.3	7.7	3.8	0.0	0.0
2	38.8	8.0	7.6	17.6	4.9	0.0	0.7
3	23.0	4.4	3.7	8.5	6.3	0.2	0.0
4	10.2	2.0	1.8	4.2	0.3	2.0	0.0
5	52.5	11.2	8.9	20.8	1.4	7.5	2.8
6	58.5	13.0	8.8	20.5	16.2	0.0	0.0
7	8.0	0.0	0.0	0.0	0.0	8.0	0.0
Total	**209.8**	**42.7**	**34.0**	**79.1**	**32.8**	**17.7**	**3.4**

Rainwater tanks, GPTs and bio-retention systems were included in the post-development scenario model to demonstrate the capacity of the proposed development to satisfy the objectives of the stormwater quality management strategy.

Key attributes of the proposed bio-retention systems within each of the catchments are summarised in **Table 4-8**. These attributes have been determined such that they will satisfy the pollutant reduction targets outlined in **Section 4.1**. Detailed parameters and assumptions relating to the proposed measures are included in **Appendix 3**.

4.7 Water Quality Modelling Results

The estimated mean annual pollutant loads from the site under pre-development and post-development conditions are listed in **Table 4-9**. For the post-development conditions scenario, pollutant loads are presented for scenarios both with and without treatment.

The capacity of the proposed stormwater quality improvement structures to meet the strategic objectives of the strategy is demonstrated by the percentage reductions relative to both existing and proposed (*no treatment*) conditions.

Table 4-8 Proposed Bio-Retention System Properties

Sub-Catchment (refer Figure 2.1)	Surface Area at base (Filter Area) (m^2)	Surface Area at crest of spillway (m^2)
1A	1200	1820
2A	1400	2150
3A	650	1120
3B	750	1230
4A	700	880
5B	1500	1750
6A	1250	1620
6B	1750	2280
2-DZW	580	700
5-DZW	790	920
TOTAL	**10570**	**14470**

Table 4-9 Summary of Stormwater Quality Modelling Results

Discharge Point (refer to Figure 4.4)	Pollutant	Pre-Development (kg/yr)	Post-Development - No Treatment (kg/yr)	Post-Development - With Treatment (kg/yr)	% Reduction (from Post-Development – No Treatment)
Junction 1 + 2	TSS	29300	58300	1690	97.1%
	TP	123	106	27.6	74.0%
	TN	499	724	196	72.9%
	GP	947	8590	0	100.0%
Junction 3	TSS	41000	67900	6150	90.9%
	TP	172	121	38.4	68.3%
	TN	698	833	281	66.3%
	GP	1320	9750	162	98.3%
Junction 4	TSS	46200	76300	6850	91.0%
	TP	194	136	43.4	68.1%
	TN	787	938	320	65.9%
	GP	1490	11000	172	98.4%
Junction 5 + 6	TSS	66400	112000	3320	97.0%
	TP	248	204	54.5	73.3%
	TN	1150	1420	404	71.5%
	GP	2050	15400	0	100.0%
Junction 7	TSS	50700	80100	10600	86.8%
	TP	209	142	49.6	65.1%
	TN	861	984	366	62.8%
	GP	1620	11300	442	96.1%
RECEIVING NODE (Mt Gilead + Dzwonnik)	**TSS**	**233600**	**394600**	**28610**	**93%**
	TP	**946**	**709**	**213.5**	**70%**
	TN	**3995**	**4899**	**1567**	**68%**
	GP	**7427**	**56040**	**776**	**99%**

5 STORMWATER QUANTITY MANAGEMENT STRATEGY

5.1 Strategy Objectives

Council's DCP (*refer* **Section 3.1**) outlines the key objectives of any stormwater quantity management strategy that is developed for urban development. These objectives are:

- flows up to the 100 year ARI event can be accommodated;
- safe passage of the PMF is provided; and,
- development does not result in water runoff causing flooding or erosion on adjacent properties.

In areas where urban development is proposed, it is customary for measures to be implemented to reduce peak discharges to pre-development levels so as to ensure that adjoining land owners are not exposed to an increase in peak flows. Volume 2 of Council's DCP (2012) endorses this guiding principle and states that the maximum discharge from the post-development site is not to exceed the pre-developed flows for all storms up to the 100-year ARI storm (1% AEP) and concentrated flows must be managed.

At this point in the rezoning / masterplanning stage, no design of the internal drainage network has been undertaken due to the very preliminary nature of design. The focus of the strategy at this point is to demonstrate that stormwater runoff under post-development conditions can be managed to ensure that post-development peak flow rates do not exceed pre-development peak flow rates at each of the site's discharge points.

5.2 Strategy Overview

The proposed development will require the provision of stormwater detention to ensure that peak discharges generated for the post-development scenario match existing peak discharges from the site for events up to the 1% Annual Exceedance Probability (AEP) event.

The required stormwater detention storage will be incorporated within a basin adjacent to each of the proposed bio-retention systems that are to be incorporated into the development (refer to **Figure 4.1**).

Each of the proposed detention basins will be designed with multi-stage outlets to provide the required stormwater detention volume and to limit discharges such that post-development peak discharge rates do not exceed pre-development peak discharge rates for a range of storm events up to the 1% AEP event.

As a minimum, the proposed detention basins will need to comply with the requirements outlined in Section 4.13.7 of *Campbelltown Sustainable City DCP 2012 (Volume 2)*.

5.3 Hydrologic Model Setup

The XP-RAFTS software package was used to develop a hydrologic model of the catchments that drain through the site. The hydrologic model was then used to simulate a range of design storms and predict peak flow rates from the development site under existing and post-development scenarios. The detention modelling capability within XP-RAFTS was employed to calculate the stormwater detention storage volumes required to ensure that post-development peak flow rates are less than or equal to pre-development peak flow rates at each of the proposed bio-retention systems within the site.

Key model parameters are summarised in **Tables 5-1**, **5-2** and **5-3**.

Table 5-1 Intensity-Frequency-Duration (IFD) Coefficients

	2 Year ARI	50 Year ARI
1 hour	32.79	62.60
12 hour	6.36	12.82
72 hour	1.85	4.03
Location Skew (g)	0	
FF_2	4.29	
FF_{50}	15.8	

Source: http://www.bom.gov.au/water/designRainfalls/ifd-arr87/index.shtml

Table 5-2 Rainfall Loss and Surface Roughness Parameters

	Pervious Catchment	Impervious Catchment
Initial Loss	15 mm	1.5 mm
Continuing Loss	2.5 mm/hour	0 mm/hour
Mannings "n" Roughness Coefficient		
Pre-Development	0.050	0.015
Post-Development	0.035	0.015

Table 5-3 Pre-Development and Post-Development Catchment Parameters

Catchment	Area (ha)	Slope (%)	Impervious Area (%)	
			Pre-Development	Post-Development [1]
1	18.9	4	5	70
2	38.8	4	5	74
3	23.0	6	5	70
4	10.2	11	5	70
5	52.5	4	5	74
6	58.5	4	5	70
7	8.0	14	5	5

1. Based on proposed lot sizes of between 600 m^2 and 1000 m^2, with the exception of the Dzwonnik's property in Catchments 2 and 5 where lot sizes are proposed to be between 400 m^2 and 600 m^2.

As there is no development proposed within Catchment 7, no on-site detention will be required in this catchment and it was therefore excluded from the hydrological model.

5.4 Design Event Simulations

The XP-RAFTS model was used to simulate the 50%, 5% and 1% AEP events and the Probable Maximum Flood (PMF) under both pre-development and post-development conditions. A post-development model with proposed stormwater detention was modelled in XP-RAFTS by adopting a stage-storage discharge relationship that attenuates post-development peak flow rates back to pre-development peak flow rates. The required detention volume to achieve attenuation of post-development flow rates to pre-development flow rates was determined using an iterative procedure based on simulation of the 50%, 5% and 1% AEP events.

5.5 Results

Table 5–4 lists the stormwater detention volume required at each of the proposed bio-retention systems. These volumes will satisfy the criterion to ensure post-development peak flow rates would be equal to or less than pre-development peak flow rates.

Table 5-4 Proposed Stormwater Detention Volumes and Storage Properties

Sub-Catchment	1% AEP Peak Flow Rate (m^3/s)		Required Detention Volume (m^3)	Volume per unit area (m^3/ha)
	Pre-Development	Post-Development		
1A	3.08	8.24	4540	241
2A	6.22	13.13	6140	250
3A	2.53	5.12	2570	236
3B	2.49	5.55	2160	179
4A	2.91	4.96	1490	146
5A	2.83	7.58	-	
5B	8.32	16.33	7610	502
6A	3.87	10.51	5940	244
6B	5.18	14.55	8490	249
2-DZW	2.67	6.87	3700	
5-DZW	3.02	9.26	5810	261

NB: Peak flow rates presented above are for the critical storm duration and correspond to the outlet discharge for each storage.

It is noted that the required detention volume for Catchment 5A is proposed to be provided within the detention system at the downstream end of Catchment 5B.

6 ASSESSMENT OF STREAM EROSION INDEX

An estimate of Stream Erosion Index (SEI) has been undertaken in order to assess the potential impact of development of the site on watercourses within and downstream of the site. The SEI is a measure used to predict the impact of increases in surface water runoff on creek bank and bed stability due to increases in impervious surfaces associated with residential development. SEI is defined as the ratio of post-development discharge greater than the 'stream forming flow' to pre-development discharge greater than the 'stream forming flow'.

Council has stipulated that a SEI of 1 should be demonstrated for the development. This is consistent with the stretch target for flow management outlined in Council's draft MUSIC modelling parameters. A SEI of 1 indicates that there would be no change in the stream forming flow, which indicates that there would be no negative impact on the geomorphology of watercourses within and downstream of the site as a result of development of the site.

The SEI has been estimated based on the methodology outlined in the *NSW Draft MUSIC Modelling Guidelines* (*Sydney Metropolitan CMA, 2010*), which is summarised as follows:

(i) Estimation of the critical flow (stream forming flow) for the receiving waterways above which mobilisation of bed material or shear erosion of bank material commences.

(ii) Development and simulation of a MUSIC model for pre-development and post-development conditions to estimate the mean annual runoff volume above the critical flow under both scenarios.

(iii) Calculation of the SEI, which is a ratio of the output mean annual flow under the pre-development and post-development scenarios.

6.1 Critical Flow for Receiving Waterways

The critical flow of a waterway is defined as the flow threshold below which no erosion is expected to occur within the waterway. This threshold is estimated as a percentage of the pre-development 2 year ARI peak flow. Based on the observed clayey substrata found at Mount Gilead, this percentage of the 2 year ARI peak flow is assumed to be 50%.

The critical flow was estimated based on the results of pre-development XP-RAFTS modelling described in **Section 5**.

6.2 Estimate of Mean Annual Flow

An estimate of mean annual flow above the critical flow for both pre-development and post-development conditions was undertaken using MUSIC. The MUSIC models used to determine the required stormwater quality control measures were adopted to determine the mean annual flows, with the following amendments:

- Rainwater tanks, as described in **Section 4.4.1**, were modelled with a high-flow by-pass set at 50% of the 1 year ARI peak flow (*approximately equivalent to a 3 month ARI peak flow*).

- In lieu of daily rainfall data from the Bringelly gauge, the SEI was determined using six-minute interval rainfall data from January 1980 to December 1990 (inclusive) from the BoM station at Penrith, in accordance with Table 3-1 of the *Draft NSW MUSIC Modelling Guidelines* (*Sydney Metropolitan CMA, 2010*).

6.3 Results

The results of the assessment of SEI are summarised in **Table 6-1**.

Table 6-1 Assessment of Stream Erosion Index

Catchments	Total Area (ha)	2 year ARI peak discharge (m^3/s)	Estimated critical flow (m^3/s)	Mean annual runoff above critical flow (ML/yr)		Stream Erosion Index
				Pre-Development	Post-Development	
1, 2, 3, 4	90.8	4.33	2.17	42.7	34.1	0.80
5, 6	111.0	5.30	2.65	65.9	63.3	0.96

6.4 Discussion

The results of the assessment of SEI demonstrate that based on a stream forming flow being 50% of the 2 year ARI peak flow, the SEI is less than 1. Accordingly, the SEI for all catchments within the Mount Gilead Site complies with Council's requirements.

It is noted that the MUSIC model used to determine the SEI does not incorporate the stormwater detention basins that are proposed to satisfy the stormwater quantity management requirements. These detention basins would provide inherent attenuation of flows and would further contribute to the objective of minimising impact of increases in surface water runoff on the geomorphology of watercourses within and downstream of the site.

In summary, the provision of stormwater quality and quantity management measures as described in **Section 4** and **Section 5** respectively will minimise the impact of development of the site on the stability of creek beds and banks within and outside the site.

7 CONSTRUCTION PHASE STORMWATER MANAGEMENT

During the construction of subdivision works within the Mount Gilead site, erosion and sediment control measures would be designed and implemented in accordance with *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004) and to the satisfaction of Council's requirements. The staged construction of the development would also be managed to minimise the impacts during construction.

Erosion and Sediment Control Plans would be prepared for each stage of the development prior to construction. These Plans would outline strategies to prevent migration of pollutants downstream during and immediately following construction. It is recommended that as a minimum the following measures be implemented:

- Stabilised site access shall be constructed at all entry and exit points to the subdivision works in order to prevent the migration of soil and sediments.
- At the upstream end of works, clean water shall be temporarily diverted around disturbed areas.
- Sediment fences shall installed at the downstream end of any disturbed areas.
- The area of soil disturbed at any one time shall be minimised where possible. Any stockpiled material shall be covered, kept moist or planted with hydromulch.
- Sediment basins shall be constructed as required throughout the subdivision works. It is anticipated the proposed bio-retention systems could be utilised as sediment basins during the construction works, subject to confirmation of required basin volume. If they were to be used during the construction phase, they would need to be fully rehabilitated prior to the construction of the bio-retention systems.
- Disturbed areas shall be rehabilitated as soon as practical.

These controls would ensure that there are no significant adverse impacts on the quality of stormwater in receiving waters during construction periods.

8 FLOOD ASSESSMENT

8.1 Objectives

The objective of this flood assessment is to provide information regarding potential flood constraints that may affect development of the site and to identify potential flood management measures.

A more detailed assessment of flood behaviour and flood impacts would be undertaken at subsequent phases of the development once proposed lot layouts have been confirmed and a site grading design has been undertaken.

8.2 Applicable Policies and Guidelines

The following policies, guidelines and studies are applicable to this flood assessment.

8.2.1 Australian Rainfall and Runoff (*1987*)

Australian Rainfall and Runoff (AR&R) is a document published in 1987 by Engineers Australia (EA). This document was prepared to provide engineers with guidelines for design flood estimation and is a widely accepted reference for all flood and stormwater related assessment and design in Australia.

8.2.2 NSW Floodplain Development Manual (*2005*)

The NSW Floodplain Development Manual (FDM) was published by the NSW Government in 2005. The FDM details the government's Flood Prone Land Policy, which has the primary objective of reducing the impact of flooding and flood liability on individual owners and occupiers of flood prone property. At the same time, the Policy recognises the importance of not sterilising flood prone land and emphasises the need for a merits based assessment.

8.2.3 NSW Government Guidelines

In October 2007, the NSW Department of Environment and Climate Change (DECC) released a guideline titled *Floodplain Risk Management: The Practical Consideration of Climate Change*. This guideline recommends that sensitivity analyses be undertaken to account for the potential impact of climate change on both sea level rise and flood producing rainfall, and that these impacts should be considered in flood assessments.

8.3 Hydraulic Modelling

One-dimensional flood modelling of the major creeklines within the Mount Gilead site was undertaken to define flood characteristics. The HEC-RAS software package was used to develop one-dimensional flood models of each tributary and these models were then used to simulate the 1% AEP and PMF events. The results of the modelling were used to determine preliminary flood extents within the site and potential constraints that flooding may pose on future development of the site.

HEC-RAS is a water surface profile program capable of analysing steady state gradually varied channel flow. Subcritical, supercritical and mixed-state water surface profiles computations are possible in HEC-RAS.

A brief description of the creeklines modelled as part of this Flood Assessment is presented in the following. The nomenclature adopted for each of the creeklines is consistent with the *Mount Gilead Rezoning Ecological Assessment* (*EcoLogical Australia, 2014*), extracts of which are included in **Appendix 4**.

- Reaches A, B and C, which discharge in a northerly direction towards Discharge Point 2.
- Reaches F, G, H and I, which discharge in a northerly direction towards Discharge Point 1 at the northern boundary of the Mount Gilead site and ultimately into Noorumba Reserve.
- Reaches K, L and M, which discharge parallel to the western site boundary in a northerly direction towards Discharge Point 4.
- An unnamed reach (not presented in the EcoLogical Australia report), which discharges in a south-westerly direction towards Discharge Point 4. It is noted that this reach is characterised by an existing farm dam, which is likely to be removed as part of future subdivision works.

HEC-RAS requires several parameters to be entered into a model such that a hydraulic analysis can be undertaken. The following data was used to setup the model.

8.3.1 Geometric Data

A proposed design surface has not yet been produced for the site. Therefore, the HEC-RAS model geometry was defined using digitised data taken from existing topographic mapping of the site. Cross-sections for use in the model were extracted from this digitised data at approximately 15 metre intervals and at significant changes in channel geometry. It has been assumed that the majority of the riparian corridors will not undergo significant changes and hence the flood extents produced from this information will be reasonably representative of the final site layout.

Notwithstanding, it is recommended that model cross sections be reviewed and updated where appropriate during the design phase to ensure that any proposed earthworks within the calculated flood extents is reliably represented.

8.3.2 Channel and Floodplain Roughness Values

Manning's 'n' values are used to represent the friction between water and a channel or floodplain. Generally, higher Manning's 'n' values imply increased friction and result in higher flood levels. The Manning's roughness coefficients adopted in this assessment were applied based on site observations of the channels and their associated floodplains.

The channels and floodplains at the site were observed to be relatively uniform and predominantly grassed. Hence a uniform Manning's 'n' value of 0.035 was adopted in the model. As the design development process progresses this should be reviewed and modified to represent any proposed changes in the surface conditions.

8.3.3 Boundary Conditions

The downstream boundary conditions for each watercourse were adopted as the 'normal depth' of the channel for the associated channel slope.

8.3.4 Flows

Peak flows for the 1% AEP and Probable Maximum Flood (PMF) events were extracted from the XP-RAFTS hydrologic model and applied to the HEC-RAS model at key locations.

The peak flows adopted in the HEC-RAS models are based on the post-development scenario which includes provision for detention, as outlined in the stormwater quantity management strategy presented in **Section 5**.

8.4 Flood Modelling Results

The 1% AEP and PMF flood extents based on the HEC-RAS modelling described above are presented in **Figure 8.1**. Peak water surface profiles along each of the creeklines that were modelled are included in **Appendix 5** in the form of long-sections and cross-sections.

The 1% AEP and PMF flood extents are generally contained within the riparian corridors nominated by EcoLogical Australia.

8.5 Design Considerations

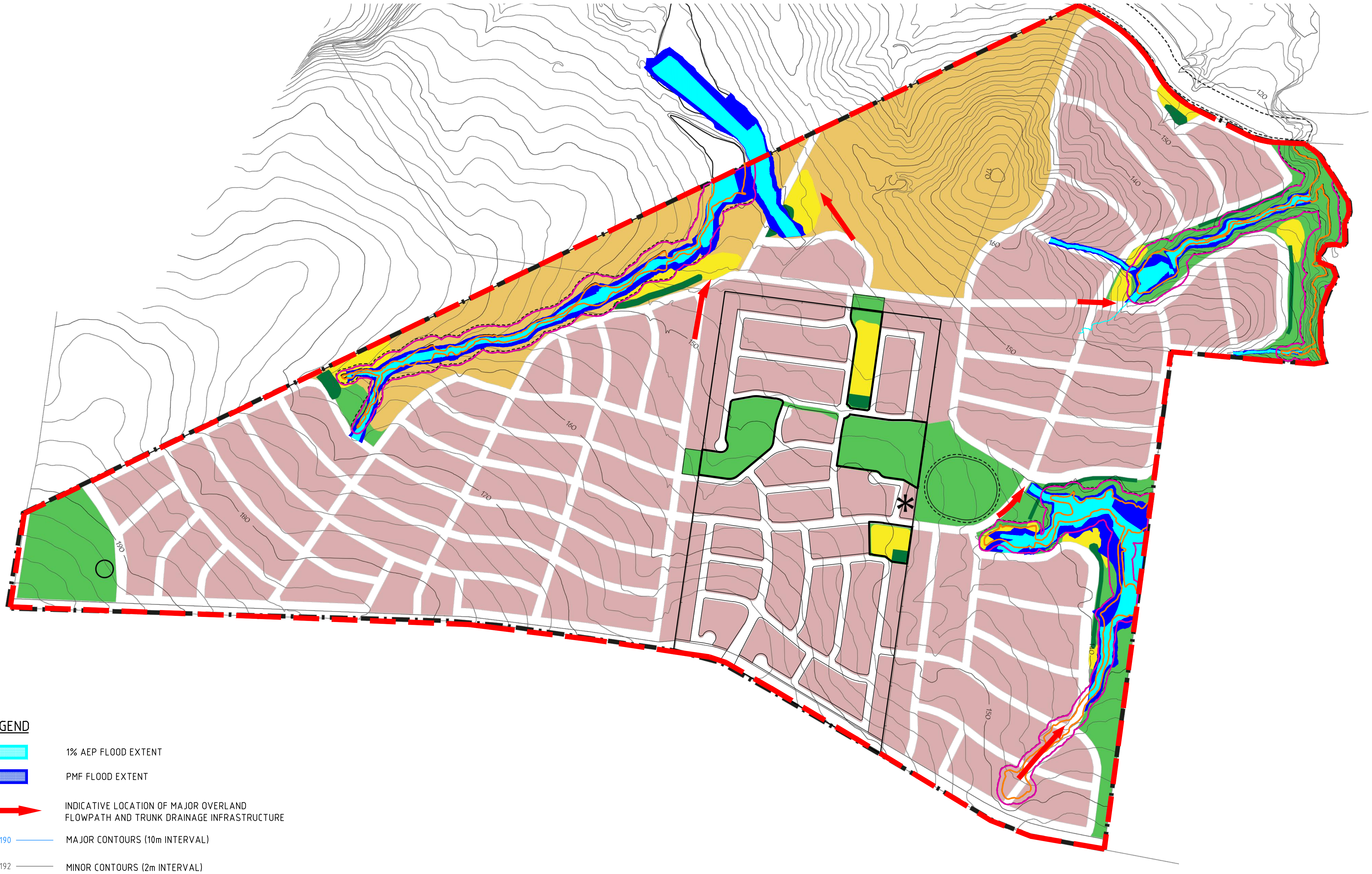
8.5.1 Major and Minor Drainage Systems

In accordance with Council's DCP (2012), a pit and pipe drainage network will be required to adequately convey flows up to at least the 5 year ARI (20% AEP) design storm event, with flows up to the 1% AEP event to be contained within roadways and dedicated overland flow paths.

In some instances, particularly at the bottom of individual catchments, it may be prudent to consider designing the pit and pipe drainage network to convey flows greater than the 5 year ARI. Doing so would minimise overland flow in order to demonstrate that it can be conveyed within road reserves or nominated flow paths at an acceptable flood hazard (*typically velocity x depth product less than 0.4*).

Figure 8.1 shows key locations within the site where careful consideration will need to be made at the DA design stage to ensure that overland flow can be safely conveyed within the road reserve. A preliminary assessment of major and minor drainage system requirements in these locations suggests that Council's DCP requirements can be achieved on the basis of the following:

- Overland flows can be safely contained within road reserves, assuming a carriageway width of 8 metres and a standard 150 mm high kerb and gutter.
- The minor drainage system could be designed to cater for flows up to the 20 year ARI where required in order to minimise overland flows.



LEGEND

1% AEP FLOOD EXTENT

PMF FLOOD EXTENT

INDICATIVE LOCATION OF MAJOR OVERLAND FLOWPATH AND TRUNK DRAINAGE INFRASTRUCTURE

190 MAJOR CONTOURS (10m INTERVAL)

192 MINOR CONTOURS (2m INTERVAL)

CREEKLINE TOP OF BANK (ECOLOGICAL AUSTRALIA, 2014)

RIPARIAN CORRIDOR BOUNDARY (ECOLOGICAL AUSTRALIA, 2014)

NOTES:

1. PROPOSED LAYOUT BASED ON MOUNT GILEAD SITE MASTER PLAN (27 AUGUST 2014)

80 0 80 160 240 320 400m

1:4000 (A1) 1:8000 (A3)

WorleyParsons resources & energy

OneWay to zero harm

ISSUE	DATE	ISSUE DESCRIPTION	DRAWN
D	04.09.14	FINAL	EN
C	18.07.14	FINAL DRAFT	EN
B	13.03.14	RE-ISSUED FOR COMMENT	EN
A	03.03.14	FOR COMMENT	EN

NORTH N

MT GILEAD DEVELOPMENT REZONING

PRELIMINARY 1% AEP & PMF FLOOD EXTENTS

FIGURE 8.1

PLOT DATE & TIME: 4/9/2014 11:29:57 AM USER NAME: tim.michel LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\03252 - MT GILEAD DEVELOPMENT REZONING\12.0 DRAWINGS\SKETCHES\FIGURE 2.2.DWG

SAVE DATE & TIME: 4/9/2014 11:24:40 AM CTB FILE: Worley-Full.ctb Plotter:None

- Assuming the site grading is designed to generally match existing site contours, stormwater drainage pipes no larger than 1200 mm in diameter (*equivalent to 2 x 900mm pipes*) could accommodate minor flows at the key locations shown on **Figure 8.1**. Box culverts could also be adopted as an alternative to pipes.

The design of the proposed landform for the site and the road network will be undertaken at the DA phase of the development and will be carried out with a view to incorporating the requirements of Council's DCP (2012) for the design of the major and minor drainage systems.

8.5.2 Minimum Habitable Floor Levels

As indicated in **Figure 8.1**, the predicted 1% AEP and PMF flood extents are located outside of areas designated for future development under the Mount Gilead Masterplan (*refer to* **Appendix 1**). Where and if residential development is proposed in flood affected areas, Council's DCP (2012) requires a minimum 500 mm freeboard above the predicted 1% AEP peak flood level adjacent to the property.

8.5.3 Flood Evacuation

As stipulated in Council's DCP (2012), development must consider the risks associated with flooding generated in storms greater than the 1% AEP event and up to the PMF. This assessment needs to consider flood emergency response management issues, including the potential need for evacuation.

Based on the preliminary flood extents presented in **Figure 8.1**, it is likely that some areas of future residential development could be affected by the PMF. However, the provisional road layout shown on the Mount Gilead Masterplan provides sufficient capacity for flood free evacuation of any areas affected by the PMF.

Once development layouts are confirmed at subsequent stages of the development, it is recommended that detailed Flood Evacuation Plans be prepared for any flood affected properties in order to confirm the following:

- Available flood free evacuation routes from any flood affected properties.
- Appropriate points of assembly for events greater than the 1% AEP flood.
- The time between the onset of rainfall in the catchment and initial inundation of the property, to determine the time available to initiate flood evacuation procedures.

8.5.4 Creek Stabilisation Works

Due to the steep nature of the site, it is likely that flow carried by watercourses within and adjacent to the site would run supercritical; that is, flow carried along hydraulically steep channels during major events would be turbulent and would travel relatively fast, exhibiting hydraulic jumps. These hydraulic jumps occur where flow conditions change from subcritical to supercritical and can result in the scouring of the waterway bed and banks.

In order to control the location of hydraulic jumps within the watercourses and thereby minimise the risk of scour, creek stabilisation works may be required. Examples of such works may include creek bank toe protection, rock riffles and rock lined drop structures.

The need or otherwise for creek stabilisation works within the site would be determined at subsequent phases of the development in conjunction with a more detailed assessment of flood behaviour, including further flood modelling. Specific requirements that will need to be accommodated at DA design are outlined in Section 4.13.2 of Council's DCP (2012).

9 CONCLUSIONS

9.1 Overview

Mount Gilead Pty Ltd and S & A Dzwonnik (the Proponents) are seeking to rezone a 210 hectare parcel of land located about five kilometres south of the Campbelltown City Centre. The land is currently zoned Non-Urban under Council's IDO No 15.

Based on a Preliminary Planning Proposal that was submitted by Campbelltown City Council to the Department of Planning & Infrastructure in 2012, it is proposed to rezone the site for urban purposes under the provisions of *Campbelltown (Urban Area) Local Environmental Plan 2002* (now superseded by *Campbelltown Local Environmental Plan 2014*).

The Planning Proposal indicates that the site has been identified as having a "Dwelling Potential" of 1700 lots. The Planning Proposal indicates an average allotment size of 600 m^2.

Council plans to place the Planning Proposal on public exhibition with all of the various specialist studies that have been developed to support the rezoning. This report addresses two aspects of the supporting documentation, namely the strategy for managing stormwater at the site post-development, and the potential for flooding to present as an impediment to the proposed development of the site.

9.2 Stormwater Management Strategy

The stormwater management strategy for the site involves the implementation of a treatment train approach to satisfy pre-determined stormwater quality objectives and includes rainwater tanks, GPTs and bio-retention systems. In order to satisfy stormwater quality management objectives, stormwater detention structures with multi-staged outlets will be provided adjacent to the proposed bio-retention systems in order to ensure that post-development peak discharges are equal to or less than pre-development peak discharges.

The results of detailed water quality modelling documented in this report indicates that the proposed treatment train achieves Council's requirements in regard to both the management of stormwater quantity and quality.

9.3 Flooding

Preliminary flood extents for the 1% AEP flood and PMF events were developed based on the existing land surface and predicted post-development peak flows. As shown on **Figure 8.1**, the 1% AEP flood and PMF flood extents are generally contained within riparian corridors and outside of proposed development areas. Hence, flooding up to the PMF is not predicted to impact on most areas proposed for residential development. Where and if residential development is proposed within flood affected areas, consideration of minimum habitable floor levels and flood free evacuation routes will need to be made during the subsequent development application stages.

10 REFERENCES

- BMT WBM, Sydney Metropolitan Catchment Management Authority, *Draft NSW MUSIC Modelling Guidelines*, August 2010.
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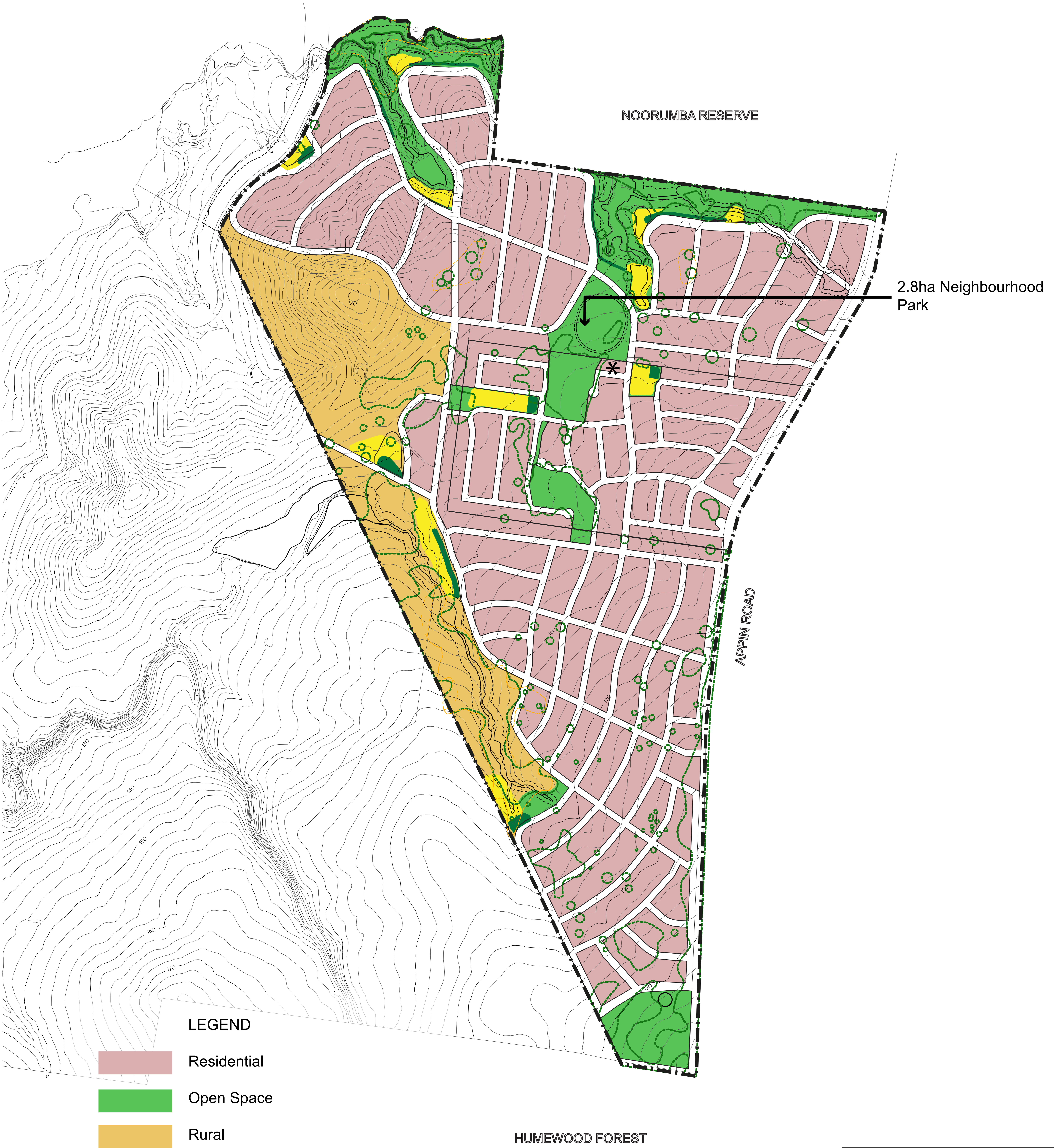
- Engineers Australia, *Australian Rainfall and Runoff – A Guide to Flood Estimation, Volume 1*, 1987, edited by D. H. Pilgrim.
- Landcom (now UrbanGrowth NSW), *Managing Urban Stormwater, Soils and Construction ('The Blue Book')*, Volume 1, 4th Edition, March 2004.
- NSW Department of Planning and Infrastructure, *Campbelltown Growth Centres Development Control Plan 2013*, March 2013.
- NSW Department of Planning and Infrastructure, *Planning Circular, Initiatives to improve housing supply*, issued 6 June 2012.
- URS, *Phase 1 Environmental and Geotechnical Site Assessment – Mount Gilead, Appin Road, Menangle NSW*, 30 August 2013.

Appendix 1 Mt Gilead Masterplan

(Source: Cox Richardson, 27th August 2014)



LEGEND

- Residential
- Open Space
- Rural
- Detention Basin
- Bio-Retention Basin
- * Indicative location of Community Hub
- ○ Proposed Water Tank

Proposed number of lots	
Mt Gilead	1250 lots
Dzwonnik	415 lots
Total	1665 lots

0 100 250 500m

Mount Gilead Master Plan - 27-08-14

COX

Appendix 2 Detailed Catchment Parameters

MOUNT GILEAD REZONING
MUSIC MODEL INPUT DATA FOR PRE-DEVELOPMENT AND POST-DEVELOPMENT CONDITIONS

Catchment Name	Total Catchment Area (ha)	PRE-DEVELOPMENT SCENARIO							POST-DEVELOPMENT SCENARIO									
		% Impervious	Impervious Area (ha)	Pervious Area (ha)	Catchment Slope				Road Reserve Area (ha)	Open Space / Riparian Corridor (ha)	Forest Area (ha)	Rural Area (ha)	Developable Urban Area (ha)	Roof Area (ha)	General Urban (ha)	Approx. number of urban lots in catchment	Impervious Area	Pervious Area
					top elev	bottom elev	dist	Slope	80%	5%	5%	5%		100%	70%		(based on Table 4.2 of DCP)	
1A	18.85	5%	0.94	17.91	160	138	550	4.0%	4.12	3.76			10.97	3.30	7.67	165	13.20	5.66
2A	24.58	5%	1.23	23.35	160	138	600	3.7%	4.61	4.92			15.05	4.52	10.53	226	17.21	7.37
3A	10.90	5%	0.55	10.36	168	120	714	6.7%	2.14	2.38		0.24	6.14	1.85	4.30	92	7.63	3.27
3B	12.09	5%	0.60	11.49	156	120	650	5.5%	2.21	3.87			6.01	1.81	4.20	90	8.46	3.63
4A	10.20	5%	0.51	9.69	170	124	409	11.2%	1.98	0.30		1.98	5.94	1.79	4.16	89	7.14	3.06
5A	17.42	5%	0.87	16.55	180	146	895	3.8%	4.46	0.19			12.78	3.84	8.94	192	12.19	5.23
5B	15.15	5%	0.76	14.39	170	140	622	4.8%	1.92	0.19		7.52	5.53	1.66	3.87	83	10.61	4.55
6A	24.37	5%	1.22	23.15	198	164	818	4.2%	6.76	4.12			13.49	4.05	9.43	203	17.06	7.31
6B	34.08	5%	1.70	32.38	182	140	1000	4.2%	6.21	12.11			15.76	4.74	11.02	237	23.86	10.22
7A	7.99	5%	0.40	7.59	170	134	250	14.4%	0.00	0.00		7.99	0.00	0.00	0.00	0	5.59	2.40
2A-DZW	14.18	5%	0.71	13.47	167	148	379	5.0%	3.44	0.00	0.65	0.00	10.09	3.03	7.06	152	11.34	2.84
5A-DZW	19.97	5%	1.00	18.97	167	142	783	3.2%	4.84	0.98	2.78		11.37	3.42	7.96	171	15.98	3.99
Total	**209.78**								**42.69**	**32.81**	**3.43**	**17.73**	**113.13**	**34.00**	**79.13**	**1700**		

Appendix 3 MUSIC Model Results and Stormwater Treatment Parameters

MOUNT GILEAD REZONING
MUSIC MODEL INPUT DATA FOR PRE-DEVELOPMENT AND POST-DEVELOPMENT CONDITIONS

Adopted number of lots	1700	
Approximate lot size	665 m^2	*based on estimated developable urban area and adopted number of lots*
Adopt Roof Size/lot of	200 m^2	
Therefore roof area =	30% of developable area	
Internal Rainwater Demands	237 kL/yr/dwelling	avg 3 occupants, toilet+laundry+hot water (from Draft MUSIC Guidelines table 3-12)
External Rainwater Demands	112 kL/yr/dwelling	(from Draft MUSIC Guidelines table 3-12)

Catchment Name	**RAINWATER TANK PARAMETERS**					**BIO-RETENTION BASIN PARAMETERS**					**DETENTION BASIN PARAMETERS**			
	Rainwater Tank Volume (kL)	**High Flow Bypass (m^3/s)**	**Tank Surface Area (m^2)**	**Internal Rainwater Demand (kL/day)**	**External Rainwater Demand (kL/yr)**	**Surface area at base (filter area) (m^2)**	**Surface Area at crest of spillway (m^2)**	**Extended detention depth (m)**	**Approximate Detention Volume (m^3)**	**Overflow Weir Width (m)**	**Surface Area at base of Detention Basin (m^2)**	**Surface Area at top of Detention Basin (m^2)**	**Max. Depth of Detention Basin (m)**	**Approximate Detention Volume (m^3)**
	(assume 3kL per lot)	**(5 l/s per lot, as per *Draft NSW MUSIC Modelling Guidelines*)**					**(top of extended detention depth)**	**(max. 0.3m)**						
1A	449	0.748	249	97	16751	1200	1820	0.3	440	12	610	4590	2.0	4580
2A	601	1.001	334	130	22425	1400	2150	0.3	520	14	1664	4970	2.0	6330
3A	277	0.461	154	60	10336	650	1120	0.3	260	7	477	2500	2.0	2710
3B	271	0.451	150	59	10112	750	1230	0.3	290	8	271	3100	2.0	2850
4A	268	0.447	149	58	10002	700	880	0.3	230	7	60	1900	2.0	1530
5A	576	0.960	320	125	21504									
5B	249	0.415	138	54	9304	1500	1750	0.3	480	15	2200	5790	2.0	7700
6A	608	1.013	338	132	22697	1250	1620	0.3	420	13	1553	4751	2.0	6010
6B	625	1.042	347	135	23348	1750	2280	0.3	600	18	1625	7730	2.0	8590
7A	0	0.000	0	0	0									
2A-DZW	455	0.758	253	98	16984	580	700	0.3	190	6	700	3335	2.0	3700
5A-DZW	513	0.855	285	111	19142	790	920	0.3	250	8	1421	4732	2.0	5830
Total	**4891**		**2717**	**1059**	**182606**	**10570**	**14470**		**3680**			**43398**		**49830**

MOUNT GILEAD REZONING
MUSIC MODEL RESULTS FOR PRE-DEVELOPMENT AND POST-DEVELOPMENT CONDITIONS

OUTLET ID	Catchment Area	Pollutant	Pre-Development (kg/yr)	Post-Development - No Treatment (kg/yr)	Post-Development - With Treatment (kg/yr)	% Reduction (from Post-Development - No Treatment)	% Reduction (from Pre-Development)	REDUCTION TARGET
1 + 2	**57.6**	TSS	29300	58300	1690	97.1%	94.2%	85%
		TP	123	106	27.6	74.0%	77.6%	70%
		TN	499	724	196	72.9%	60.7%	55%
		GP	947	8590	0	100.0%	100.0%	90%
3	**23.0**	TSS	41000	67900	6150	90.9%	85.0%	85%
		TP	172	121	38.4	68.3%	77.7%	70%
		TN	698	833	281	66.3%	59.7%	55%
		GP	1320	9750	162	98.3%	87.7%	90%
4	**10.2**	TSS	46200	76300	6850	91.0%	85.2%	85%
		TP	194	136	43.4	68.1%	77.6%	70%
		TN	787	938	320	65.9%	59.3%	55%
		GP	1490	11000	172	98.4%	88.5%	90%
5 + 6	**111.0**	TSS	66400	112000	3320	97.0%	95.0%	85%
		TP	248	204	54.5	73.3%	78.0%	70%
		TN	1150	1420	404	71.5%	64.9%	55%
		GP	2050	15400	0	100.0%	100.0%	90%
7	**8.0**	TSS	50700	80100	10600	86.8%	79.1%	85%
		TP	209	142	49.6	65.1%	76.3%	70%
		TN	861	984	366	62.8%	57.5%	55%
		GP	1620	11300	442	96.1%	72.7%	90%
TOTAL SITE (MT GILEAD + DZWONNIK)	**209.8**	**TSS**	**233600**	**394600**	**28610**	**93%**	**88%**	**85%**
		TP	**946**	**709**	**213.5**	**70%**	**77%**	**65%**
		TN	**3995**	**4899**	**1567**	**68%**	**61%**	**45%**
		GP	**7427**	**56040**	**776**	**99%**	**90%**	**90%**

Appendix 4 Extracts from Mount Gilead Ecological Assessment Report

(Source: EcoLogical Australia, 14th November 2013)

The highly managed nature of the study site and continuous grazing regimes has affected litter build up at the base of trees in CPW. Consequently, habitat for Cumberland Plain Land Snail was scant to absent.

Seven threatened fauna species were recorded during the site survey, as discussed above. Depending on the approval pathway selected for the proposal, further surveys may be required for some ecosystem credit species.

The study site does not contain any contiguous vegetated corridors to patches of vegetation off site. At best, the patches of vegetation on the study site form stepping stones. The primary corridor linking vegetation located north and south of the study site is east of Appin Rd.

4.5 KOALA HABITAT

Koala food tree species have been identified on the study site. These species are *Eucalyptus tereticornis* and *E. punctata* at low numbers in some patches of SSTF, with *E. tereticornis* more common in patches of CPW. However, the number of these trees does not exceed the 15% threshold for the study site to be considered “potential Koala habitat”.

Most historic Koala records are along and east of Appin Rd (**Figure 7**). There are no records on the study site or west of Appin Rd. Therefore, the site should not be considered core Koala habitat.

4.6 RIPARIAN ZONES

Mt Gilead is situated between two large catchment areas the George’s River Catchment in the south-east and Hawkesbury – Nepean Catchment to the north-west. The topography gently undulates across the study site. The landscape slopes down towards the north-west and south-west study site boundary. Several unnamed tributaries eventually flow into Menangle Creek. Menangle Creek continues to flow west where it converges with the Nepean and Woodhouse Creeks outside the study site and then into the Nepean River. An open water canal runs west of the study site as part of Sydney water’s supply to Prospect Reservoir (ELA 2006). The mapping of TofB and stream order is presented in **Figure 13**. This provides the required vegetative buffers for each riparian corridor. The results of the aquatic assessment are available in **Appendix D**, **Appendix D**: Description of riparian and aquatic habitat

Table 13. Three watercourses did not contain a defined channel.

The majority of the watercourses in the study site are considered substantially to slightly modified. Clearing of vegetation within the catchment and along TofB is noted along watercourses. Creek width varied between 1 to 10 metres and generally steep maximum recording was over 70 degree slope. Slumping and erosion (sheet, gully and undercut) are key impacts as a result of steep creek banks.

Aquatic habitat is limited due to the modification to watercourses. Even in areas of unmodified watercourse the aquatic vegetation is marginal over much of the study site. In areas where vegetation is available it provides suitable habitat for amphibians, birds and fish. Fish barriers are also noted throughout much of the study site.

The overall rating of the riparian and aquatic condition varied from degraded to moderate.

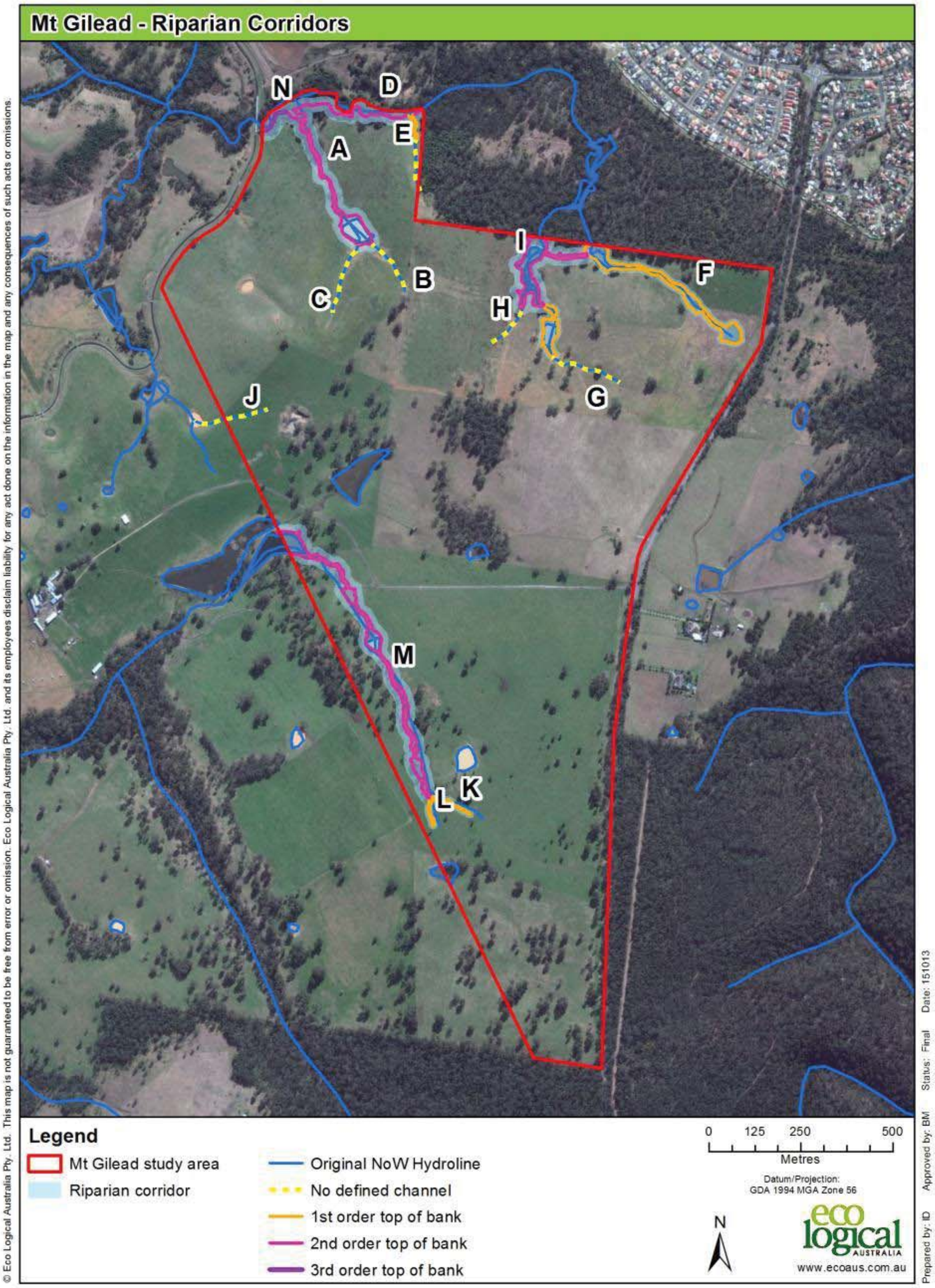


Figure 13: Top of Bank, Vegetated Riparian Zones and Reach number

Appendix D: Description of riparian and aquatic habitat

Table 13: Riparian and aquatic condition within study site

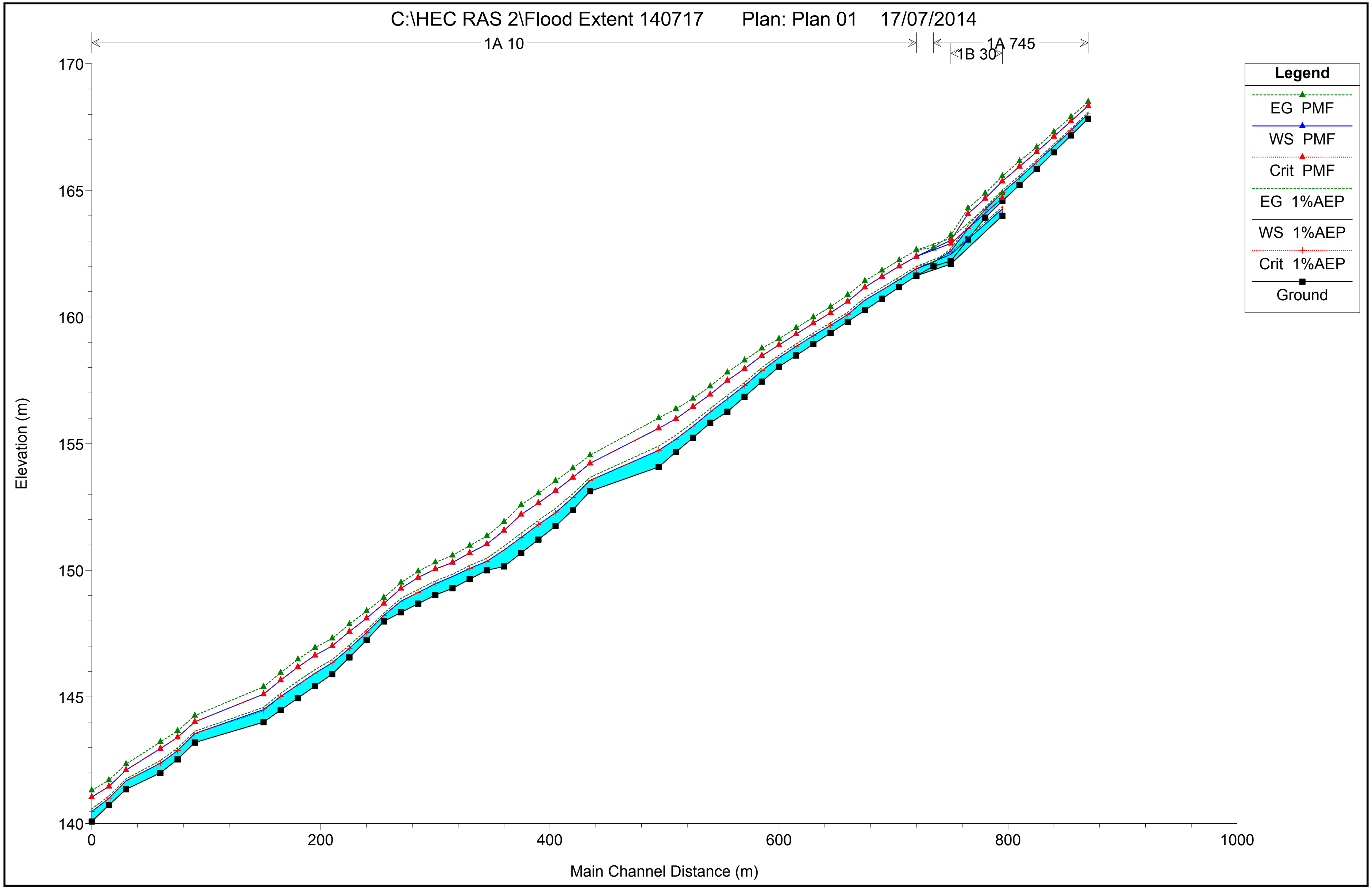
Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Reach A	2nd order stream (Strahler). Mostly modified channel. One low flow barrier. Mostly cleared catchment.	Substantially modified. Width reduced by up to 1/3 and/or some breaks in continuity. More than one stratum completely altered from reference (lost or <10% remaining). Reduced cover (75-50%) of dominant strata, and only one age class present. About 50% of the native vegetation remains, either in strips or patches. Quantities and/or cover of debris 50% higher or lower than reference.	Average channel width = 2 m. Bank slope = 30-70 degrees. Gully erosion = 10%. Slumping erosion = 10%. Sheet erosion = 10%. Undercut erosion = 0%.	Velocity = Stagnant. Riffle = 0%. Run = 90%. Pool = 10%. Depth (creek) = < 10 cm. Turbidity = Very turbid. Dominant substrate = Clay. Sub-dominant substrate = Clay. Aquatic vegetation richness = 1 species. Native aquatic vegetation abundance = Absent. Instream woody debris = Rare. Fish habitat = Class 3 - Minimal fish habitat. Bird habitat = Good. Frog habitat = Poor.	Degraded-Moderate
Reach B	No defined channel.				
Reach C	No defined channel.				
Reach D	2nd order stream (Strahler). Unmodified channel. No barriers. Partially cleared catchment.	Slightly modified. Width reduced by up to 1/3 and/or some breaks in continuity. Number of strata and cover within each similar to reference. Dominant strata with reference level of cover and at least three age classes present (juveniles, sub-adults and adults). Width reduced by up to 1/3 and/or some breaks in continuity. Quantities and cover of debris similar to reference.	Average channel width = 4 m. Bank slope = >70 degrees. Gully erosion = 5%. Slumping erosion = 20%. Sheet erosion = 0%. Undercut erosion = 20%.	Velocity = Slow (<0.1 m/s). Riffle = 5%. Run = 35%. Pool = 60%. Depth (creek) = 20-30 cm. Turbidity = Moderate. Dominant substrate = Clay. Sub-dominant substrate = Gravel. Aquatic vegetation richness = 4 species. Native aquatic vegetation abundance = Common. Instream woody debris = Abundant. Fish habitat = Class 2 - Moderate fish habitat. Bird habitat = Excellent. Frog habitat = Excellent.	Moderate

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Reach E	1st order stream (Strahler). Unmodified channel. No barriers. Mostly cleared catchment. No defined channel in upper section.	Substantially modified. Only small patches of well-separated native vegetation remain. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (<50%) of dominant strata, and only one age class present. About 50% of the native vegetation remains, either in strips or patches. Quantities and/or cover of debris 50% higher or lower than reference.	Average channel width = 1 m. Bank slope = >70 degrees. Gully erosion = 5%. Slumping erosion = 10%. Sheet erosion = 0%. Undercut erosion = 0%.	Velocity = Dry. Riffle = 50%. Run = 50%. Pool = 0%. Depth (creek) = Dry. Turbidity = Dry. Dominant substrate = Clay. Sub-dominant substrate = Boulder. Aquatic vegetation richness = 0 species. Native aquatic vegetation abundance = Absent. Instream woody debris = Abundant. Fish habitat = Class 4 - Unlikely fish habitat. Bird habitat = Excellent. Frog habitat = Good.	Degraded-Moderate
Reach F	1st order stream (Strahler). Heavily modified channel. Numerous low flow barriers without fish passage. Mostly cleared catchment. Lower dam receives diverted water from Reach I.	Severely modified. Little or no remaining native vegetation. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Dominant strata mostly absent. Little or no remaining native vegetation. Some evidence of unnatural loss of debris (e.g. through collection of firewood, trampling of leaf litter by stock).	Average channel width = 8 m. Bank slope = <30 degrees. Gully erosion = 5%. Slumping erosion = 0%. Sheet erosion = 5%. Undercut erosion = 0%.	Velocity = Stagnant. Riffle = 0%. Run = 80%. Pool = 20%. Depth (creek) = < 10 cm. Turbidity = Turbid. Dominant substrate = Clay. Sub-dominant substrate = Silt. Aquatic vegetation richness = 3 species. Native aquatic vegetation abundance = Common. Instream woody debris = Rare. Fish habitat = Class 3 - Minimal fish habitat. Bird habitat = Moderate. Frog habitat = Good.	Degraded
Reach G	1st order stream (Strahler). Partially modified channel. Numerous low flow barriers without fish passage. Mostly cleared catchment.	Severely modified. Width reduced by up to 1/3 and/or some breaks in continuity. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Only small patches of well-separated native vegetation remain. Very small quantities of debris present.	Average channel width = 6 m. Bank slope = <30 degrees. Gully erosion = 5%. Slumping erosion = 5%. Sheet erosion = 15%. Undercut erosion = 0%.	Velocity = Stagnant. Riffle = 0%. Run = 20%. Pool = 80%. Depth (creek) = 30-100 cm. Turbidity = Turbid. Dominant substrate = Clay. Sub-dominant substrate = Silt. Aquatic vegetation richness = 3 species. Native aquatic vegetation abundance = Rare. Instream woody debris = Rare. Fish habitat = Class 3 - Minimal fish habitat. Bird habitat = Moderate. Frog habitat = Good.	Degraded

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
	No defined channel in upper section.				
Reach H	No defined channel.				
Reach I	2nd order stream (Strahler). Mostly modified channel. One low flow barrier. Mostly cleared catchment. Dam overflow diverted to Reach F.	Severely modified. Only small patches of well-separated native vegetation remain. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Reduced cover (<50%) of dominant strata, and only one age class present. Only small patches of well-separated native vegetation remain. Very small quantities of debris present.	Average channel width = 10 m. Bank slope = <30 degrees. Gully erosion = 5%. Slumping erosion = 10%. Sheet erosion = 20%. Undercut erosion = 0%.	Velocity = Stagnant. Riffle = 0%. Run = 15%. Pool = 85%. Depth (creek) = 30-100 cm. Turbidity = Turbid. Dominant substrate = Clay. Sub-dominant substrate = Silt. Aquatic vegetation richness = 3 species. Native aquatic vegetation abundance = Common. Instream woody debris = Rare. Fish habitat = Class 3 - Minimal fish habitat. Bird habitat = Moderate. Frog habitat = Good.	Degraded
Reach J	No defined channel.				
Reach K	1st order stream (Strahler). Unmodified channel. Numerous low flow barriers without fish passage. Mostly cleared catchment.	Severely modified. Little or no remaining native vegetation. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Little or no remaining native vegetation. Very small quantities of debris present.	Average channel width = 1 m. Bank slope = <30 degrees. Gully erosion = 0%. Slumping erosion = 0%. Sheet erosion = 0%. Undercut erosion = 0%.	Velocity = Dry. Riffle = 5%. Run = 80%. Pool = 5%. Depth (creek) = Dry. Turbidity = Dry. Dominant substrate = Clay. Sub-dominant substrate = Boulder. Aquatic vegetation richness = 0 species. Native aquatic vegetation abundance = Absent. Instream woody debris = Rare. Fish habitat = Class 4 - Unlikely fish habitat. Bird habitat = Poor. Frog habitat = Poor.	Degraded

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Reach L	1st order stream (Strahler). Unmodified channel. Numerous low flow barriers without fish passage. Mostly cleared catchment.	Severely modified. Little or no remaining native vegetation. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Little or no remaining native vegetation. Very small quantities of debris present.	Average channel width = 3 m. Bank slope = <30 degrees. Gully erosion = 0%. Slumping erosion = 0%. Sheet erosion = 0%. Undercut erosion = 0%.	Velocity = Dry. Riffle = 5%. Run = 80%. Pool = 5%. Depth (creek) = Dry. Turbidity = Dry. Dominant substrate = Clay. Sub-dominant substrate = Boulder. Aquatic vegetation richness = 0 species. Native aquatic vegetation abundance = Absent. Instream woody debris = Occasional. Fish habitat = Class 4 - Unlikely fish habitat. Bird habitat = Poor. Frog habitat = Poor.	Degraded
Reach M	2nd order stream (Strahler). Partially modified channel. Numerous low flow barriers without fish passage. Mostly cleared catchment.	Severely modified. Only small patches of well-separated native vegetation remain. More than one stratum completely altered from reference (lost or <10% remaining). Reduced cover (<50%) of dominant strata, and only one age class present. Only small patches of well-separated native vegetation remain. Very small quantities of debris present.	Average channel width = 4 m. Bank slope = <30 degrees. Gully erosion = 5%. Slumping erosion = 15%. Sheet erosion = 5%. Undercut erosion = 0%.	Velocity = Stagnant. Riffle = 20%. Run = 60%. Pool = 20%. Depth (creek) = < 10 cm. Turbidity = Very turbid. Dominant substrate = Clay. Sub-dominant substrate = Boulder. Aquatic vegetation richness = 1 species. Native aquatic vegetation abundance = Occasional. Instream woody debris = Occasional. Fish habitat = Class 3 - Minimal fish habitat. Bird habitat = Moderate. Frog habitat = Moderate.	Degraded
Reach N	3rd order stream (Strahler). Unmodified channel. No barriers. Partially cleared catchment.	Slightly modified. Width reduced by up to 1/3 and/or some breaks in continuity. Number of strata and cover within each similar to reference. Dominant strata with reference level of cover and at least three age classes present (juveniles, sub-adults and adults). Width reduced by up to 1/3 and/or some breaks in continuity. Quantities and cover of debris similar to reference.	Average channel width = 5 m. Bank slope = <30 degrees. Gully erosion = 0%. Slumping erosion = 0%. Sheet erosion = 0%. Undercut erosion = 0%.	Velocity = Slow (<0.1 m/s). Riffle = 0%. Run = 20%. Pool = 80%. Depth (creek) = 30-100 cm. Turbidity = Moderate. Dominant substrate = Clay. Sub-dominant substrate = Gravel. Aquatic vegetation richness = 4 species. Native aquatic vegetation abundance = Abundant. Instream woody debris = Abundant. Fish habitat = Class 2 - Moderate fish habitat. Bird habitat = Excellent. Frog habitat = Excellent.	Moderate

Appendix 5 HEC-RAS Model Results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1A 10
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1B 30
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
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Main Channel Distance (m)
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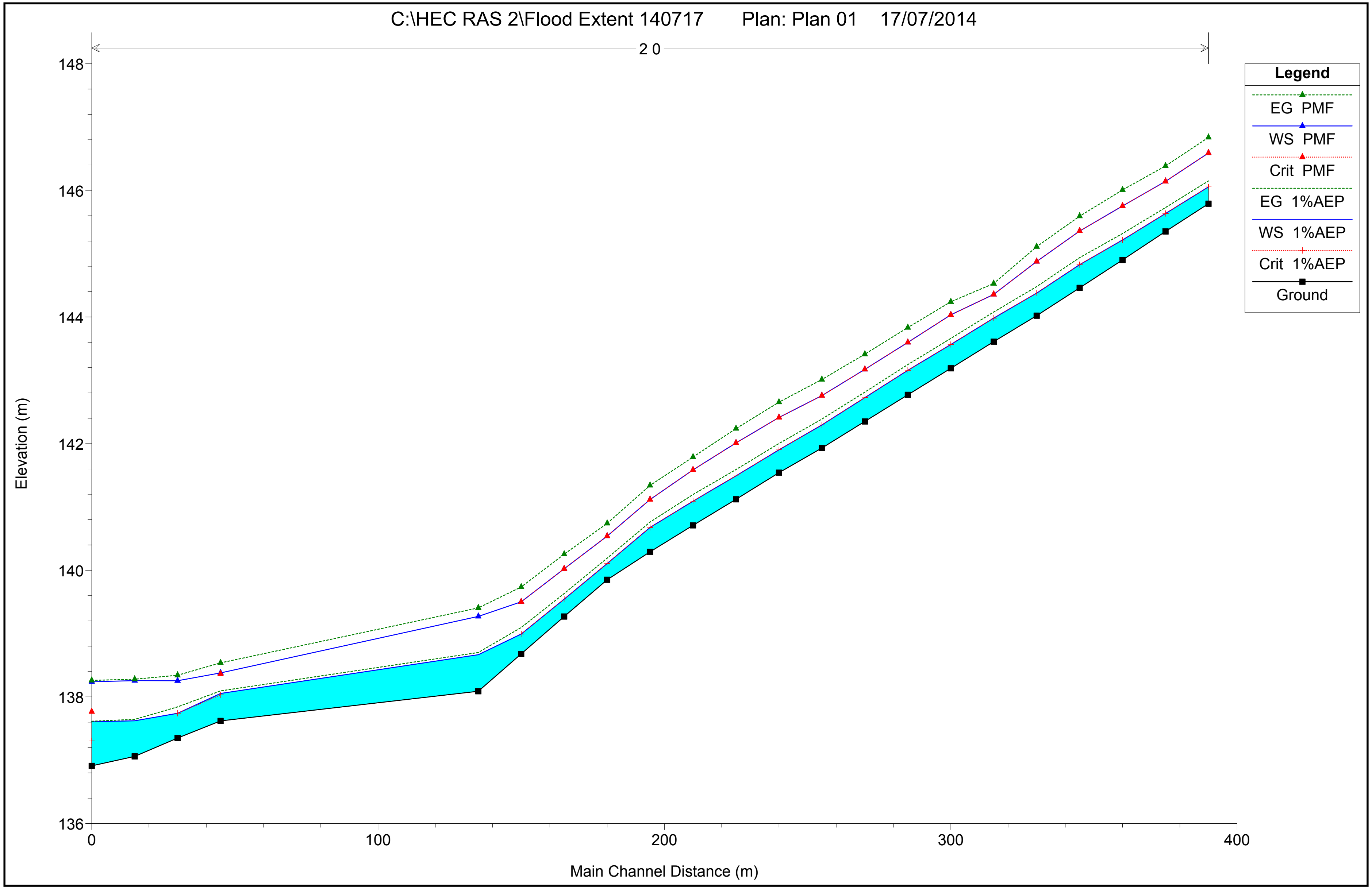
165
160
155
150
145
140
0
200
400
600
800
1000



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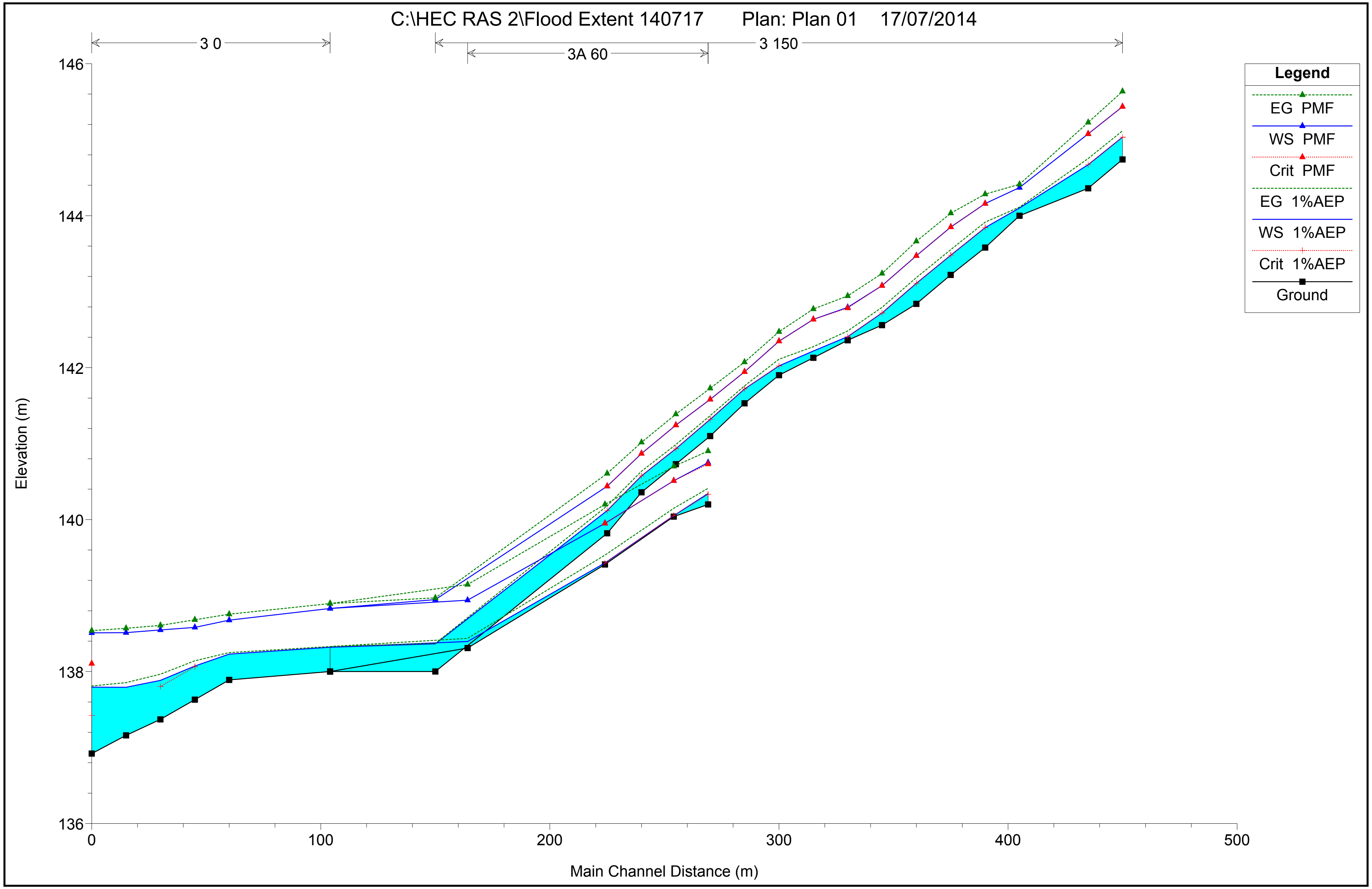
2 0
148
146
144
142
140
138
136
Elevation (m)
0
100
200
300
400
Main Channel Distance (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground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Elevation (m)
Main Channel Distance (m)
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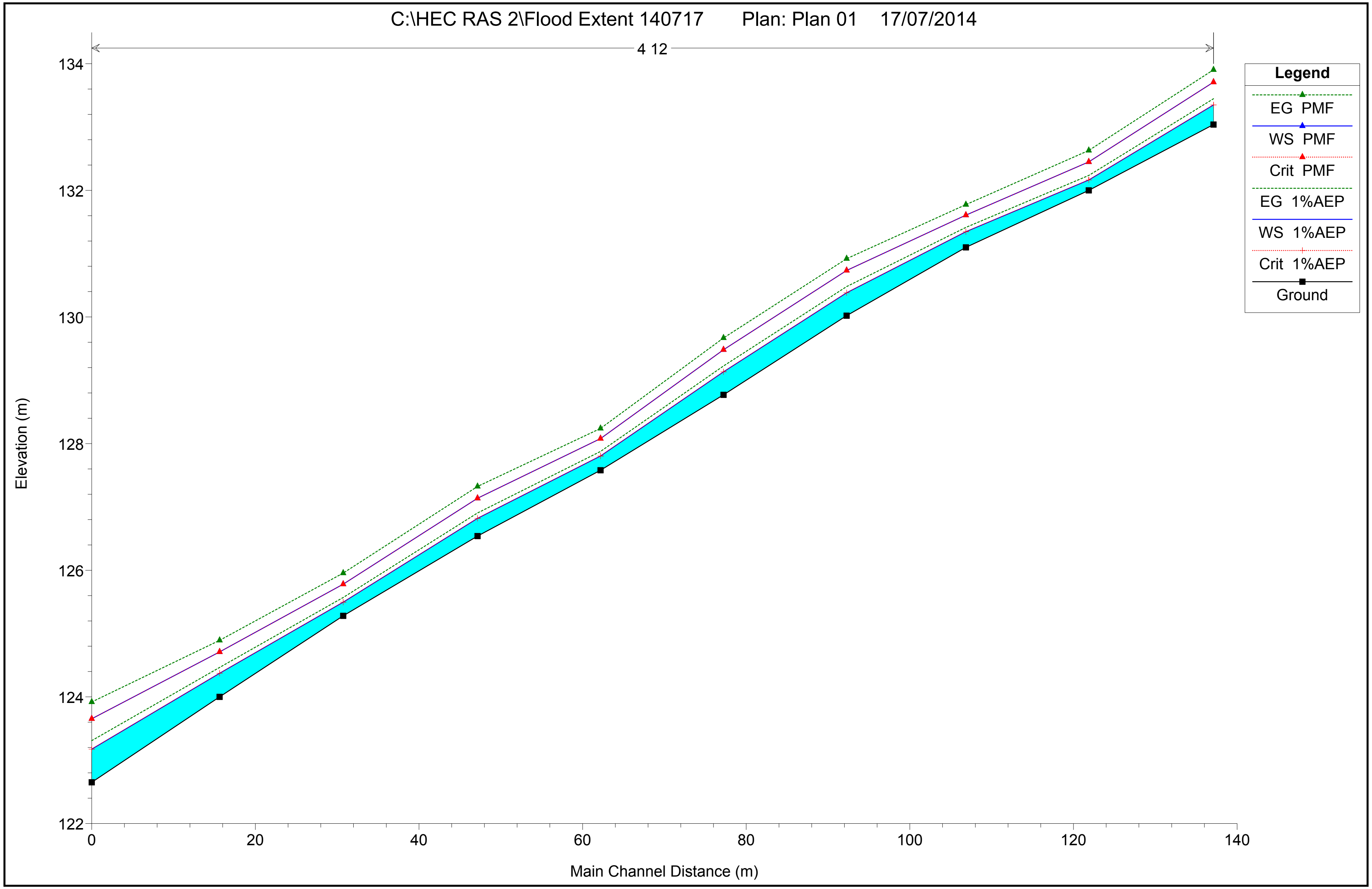
144
142
140
138
136
0
100
200
300
400
500
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground



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4 12
Elevation (m)
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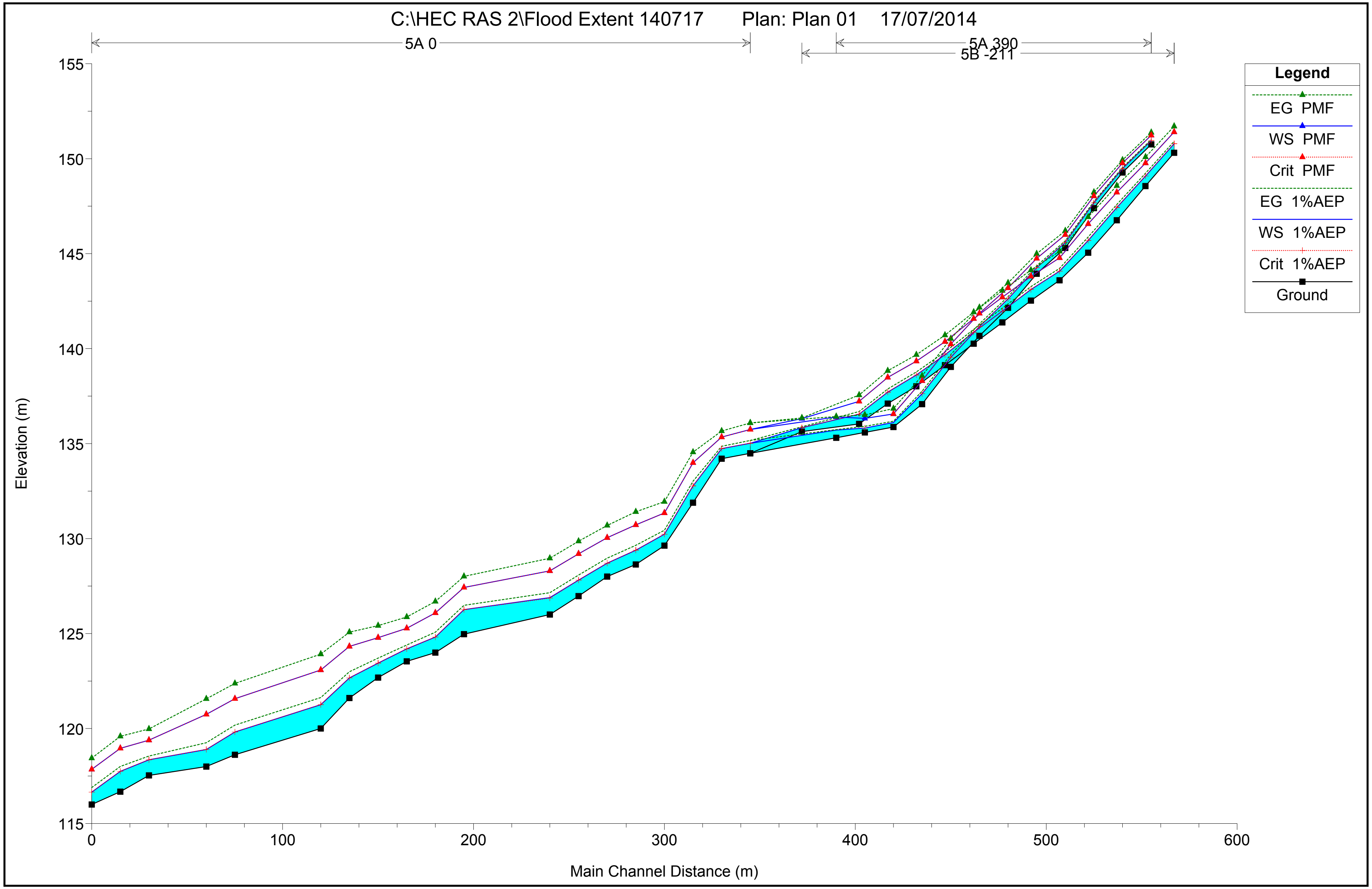
124
126
128
130
132
134
Main Channel Distance (m)
0
20
40
60
80
100
120
140
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground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5B -211
Legend
EG PMF
WS PMF
Crit PMF
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WS 1%AEP
Crit 1%AEP
Ground
Elevation (m)
Main Channel Distance (m)
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150
145
140
135
130
125
120
115
0
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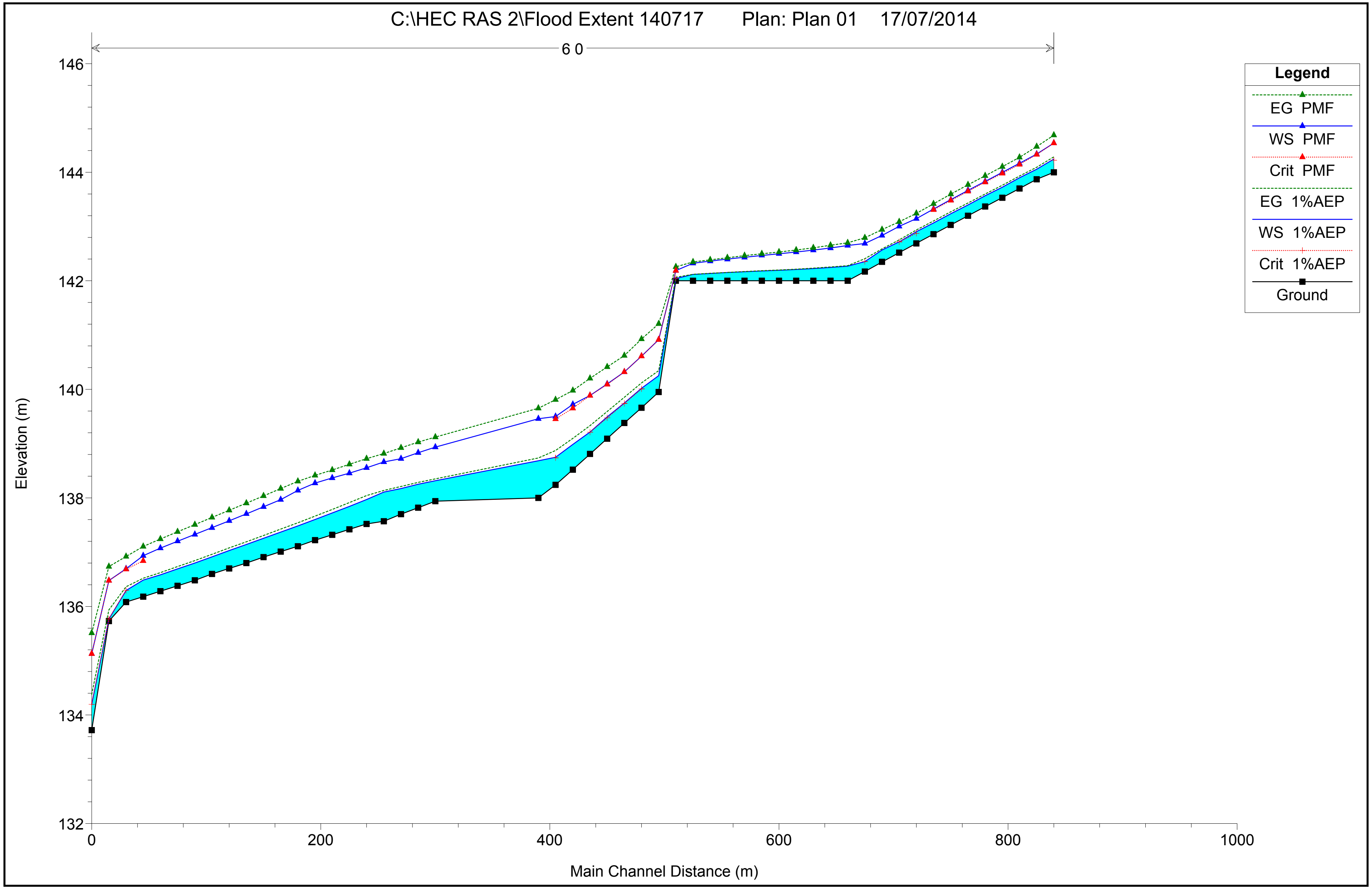
200
300
400
500
600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Elevation (m)
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144
142
140
138
136
134
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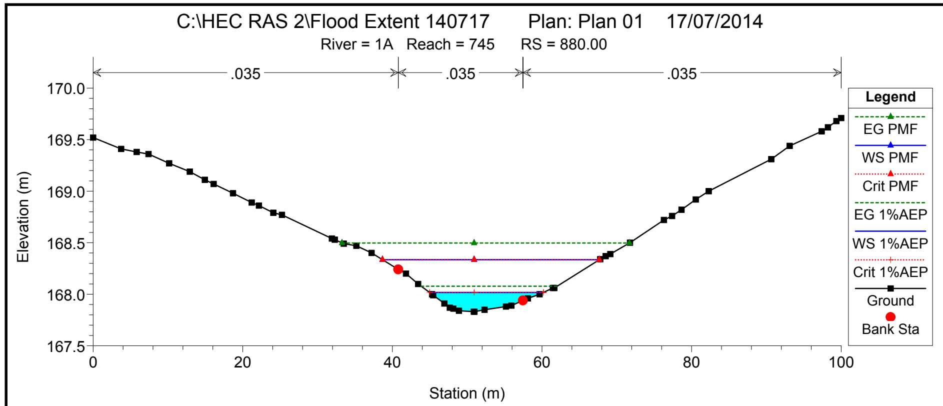
200
400
600
800
1000
Main Channel Distance (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground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River = 1A Reach = 745 RS = 880.00
.035 .035 .035
Elevation (m)
Station (m)
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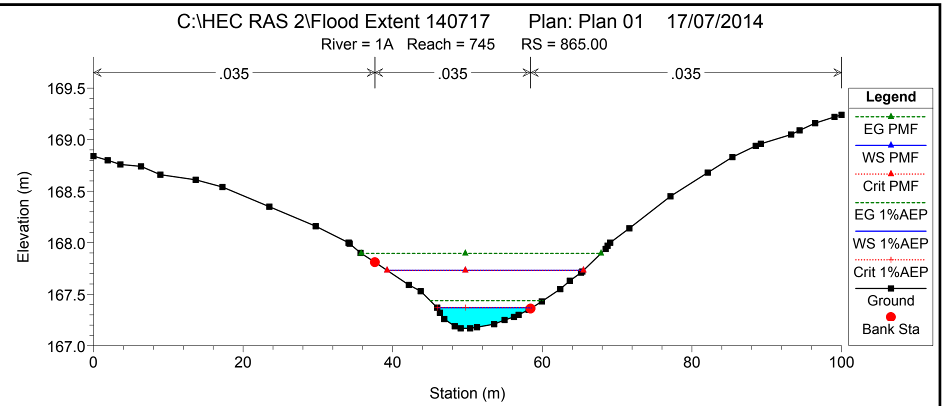
0 20 40 60 80 100
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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Elevation (m)
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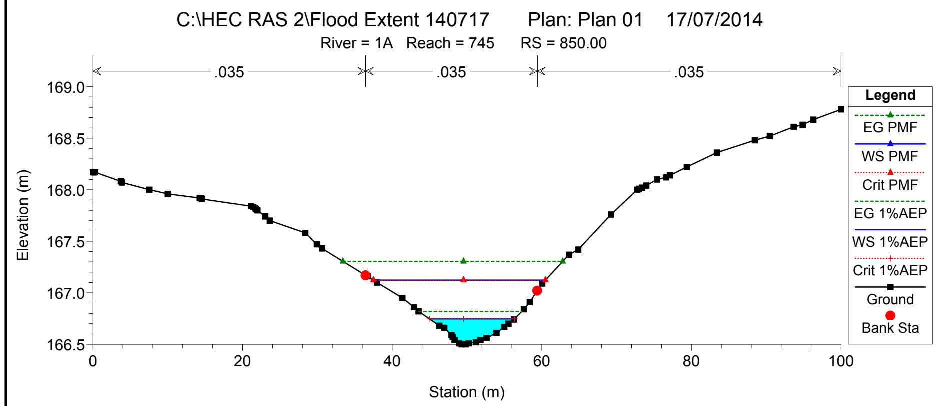
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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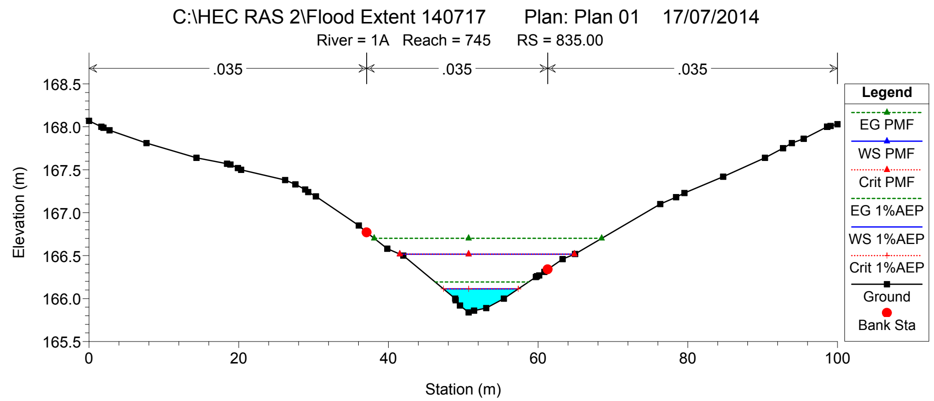
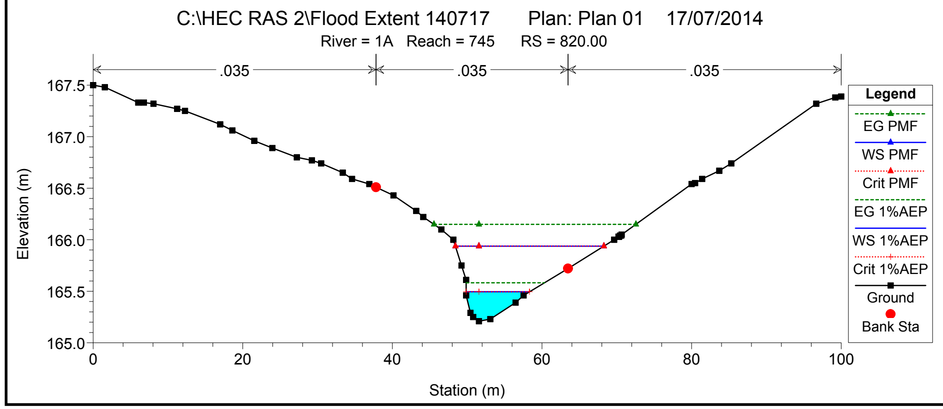
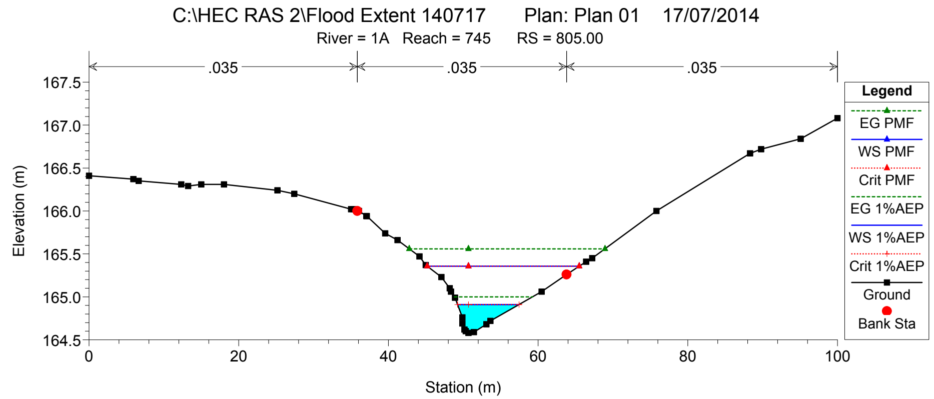
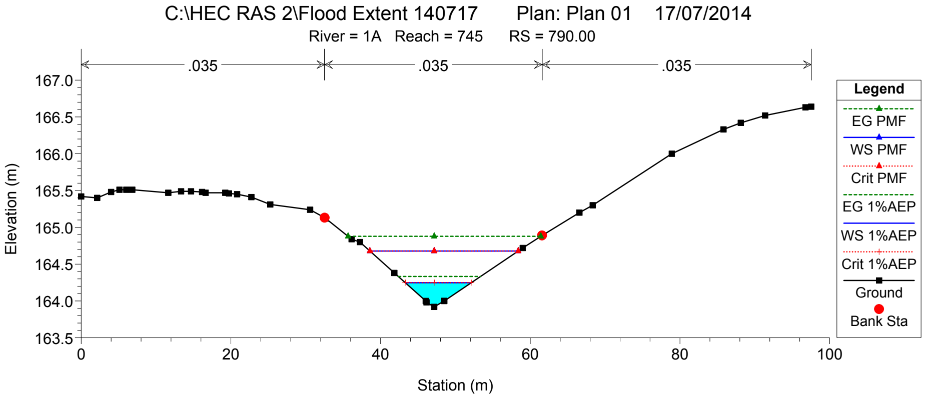
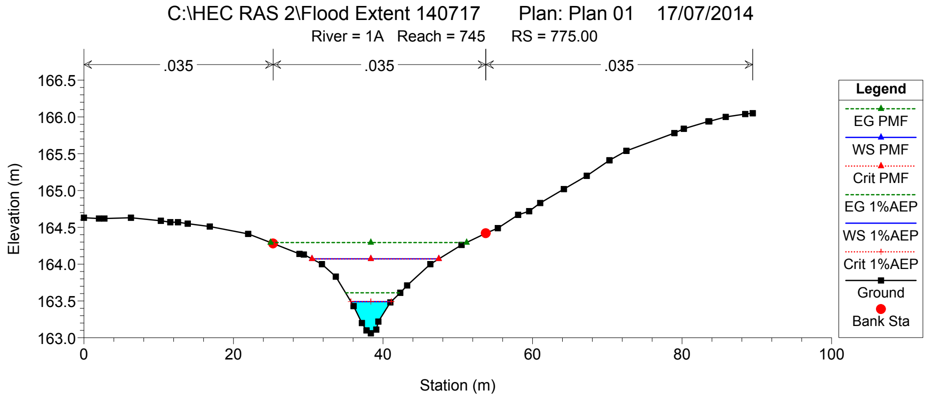
River = 1A Reach = 745 RS = 850.00
.035 .035 .035
Elevation (m)
Station (m)
169.0 168.5 168.0 167.5 167.0 166.5
0 20 40 60 80 100
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

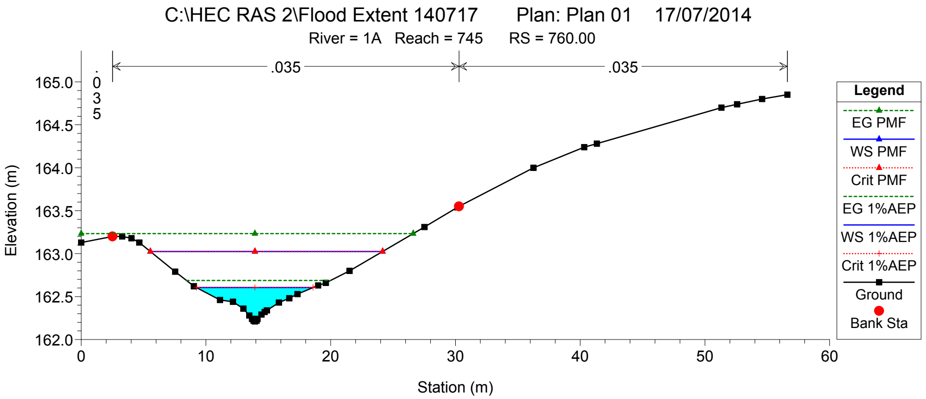

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 835.00
.035 .035 .035
Elevation (m)
Station (m)
168.5 168.0 167.5 167.0 166.5 166.0 165.5
0 20 40 60 80 100
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

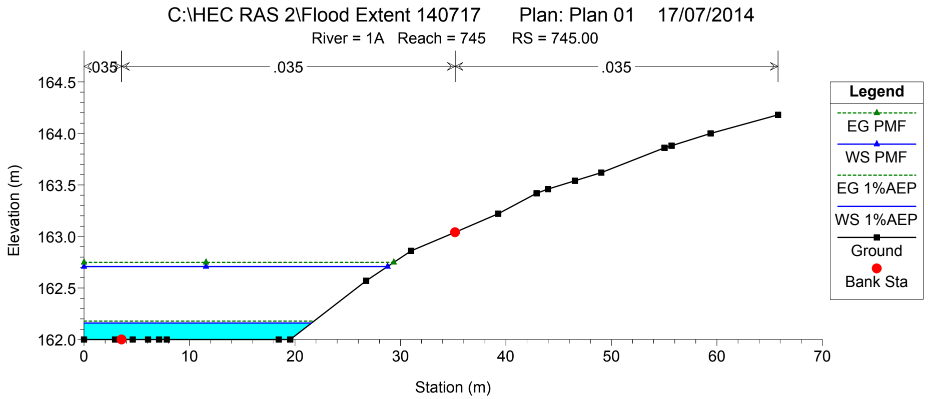

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 820.00
.035 .035 .035
Elevation (m)
Station (m)
167.5 167.0 166.5 166.0 165.5 165.0
0 20 40 60 80 100
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

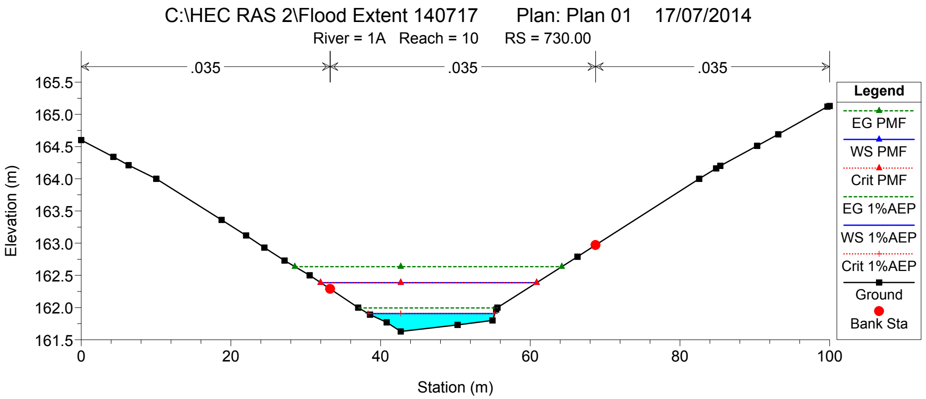

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 805.00
.035 .035 .035
Elevation (m)
Station (m)
167.5 167.0 166.5 166.0 165.5 165.0 164.5
0 20 40 60 80 100
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

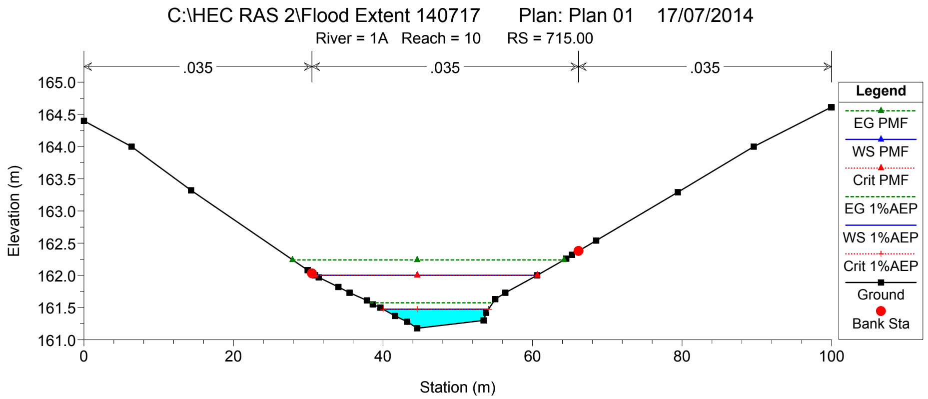

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 790.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

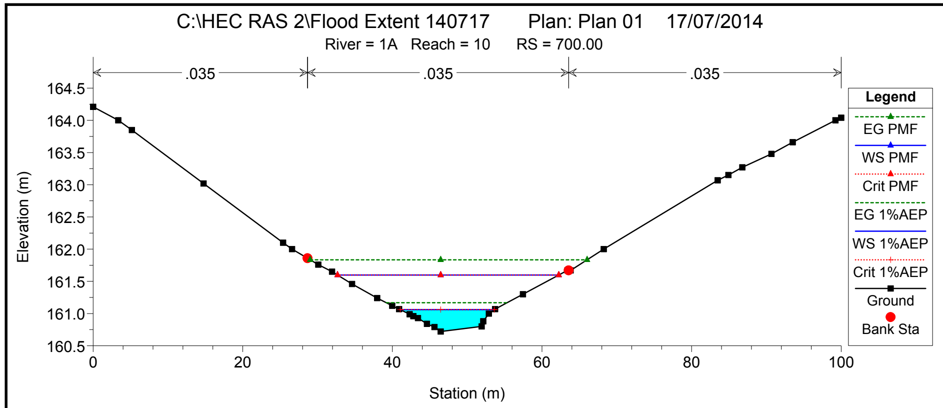

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 775.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

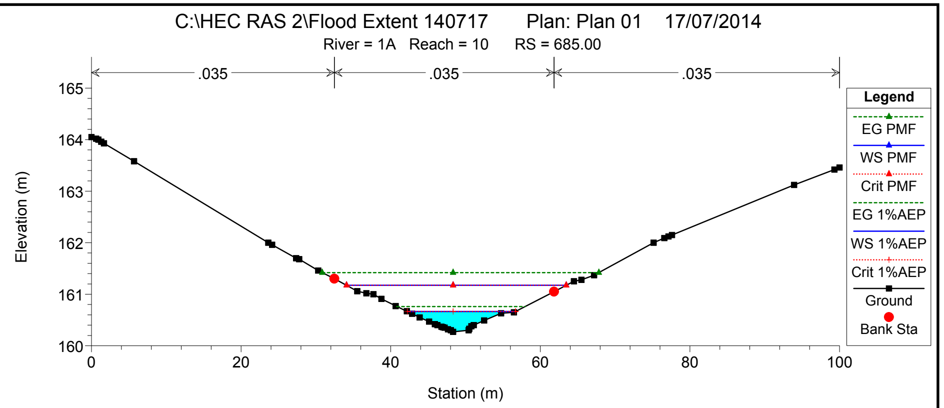

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 760.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

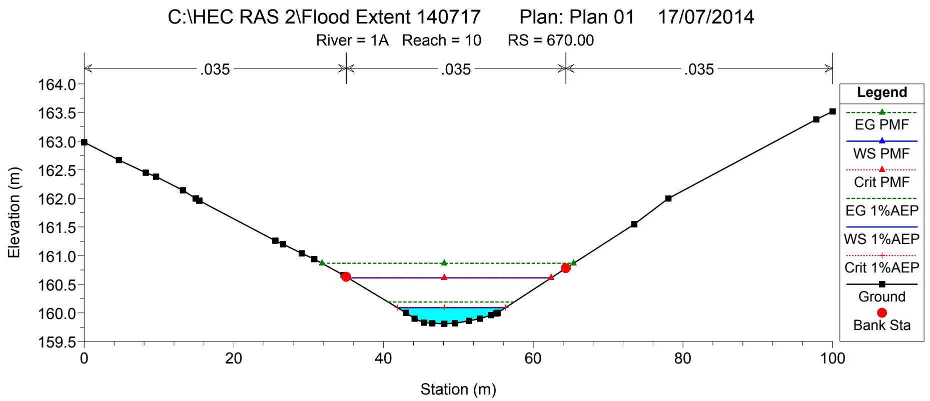

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 745 RS = 745.00
.035
.035
.035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

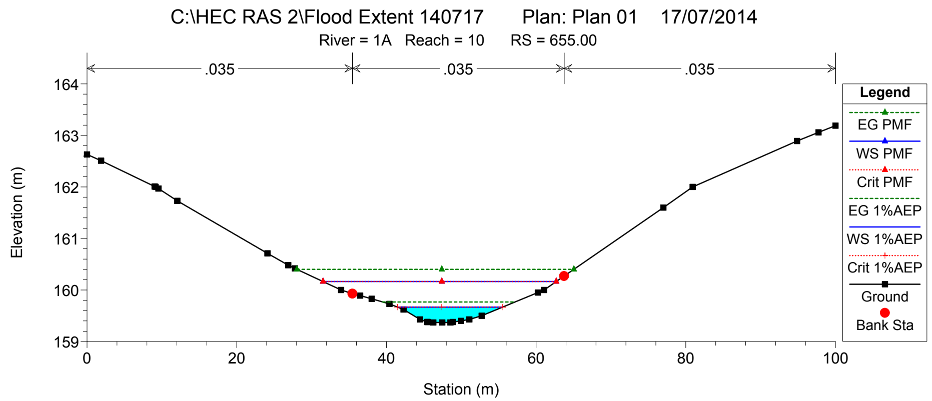

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 730.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

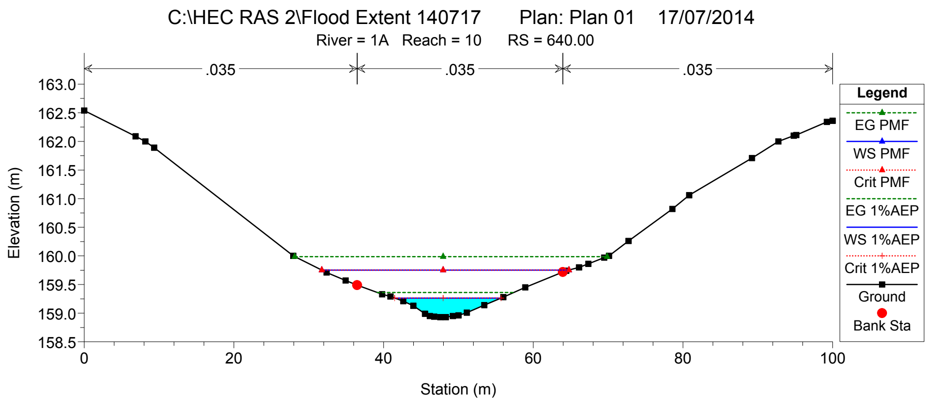

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 715.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

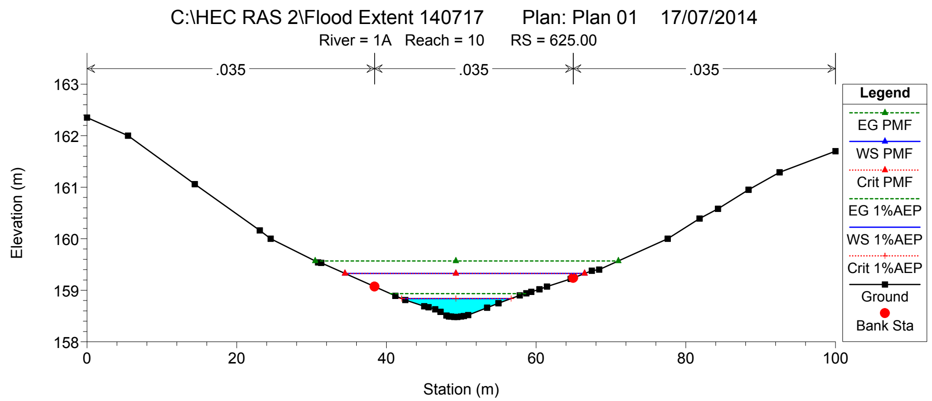

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 700.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

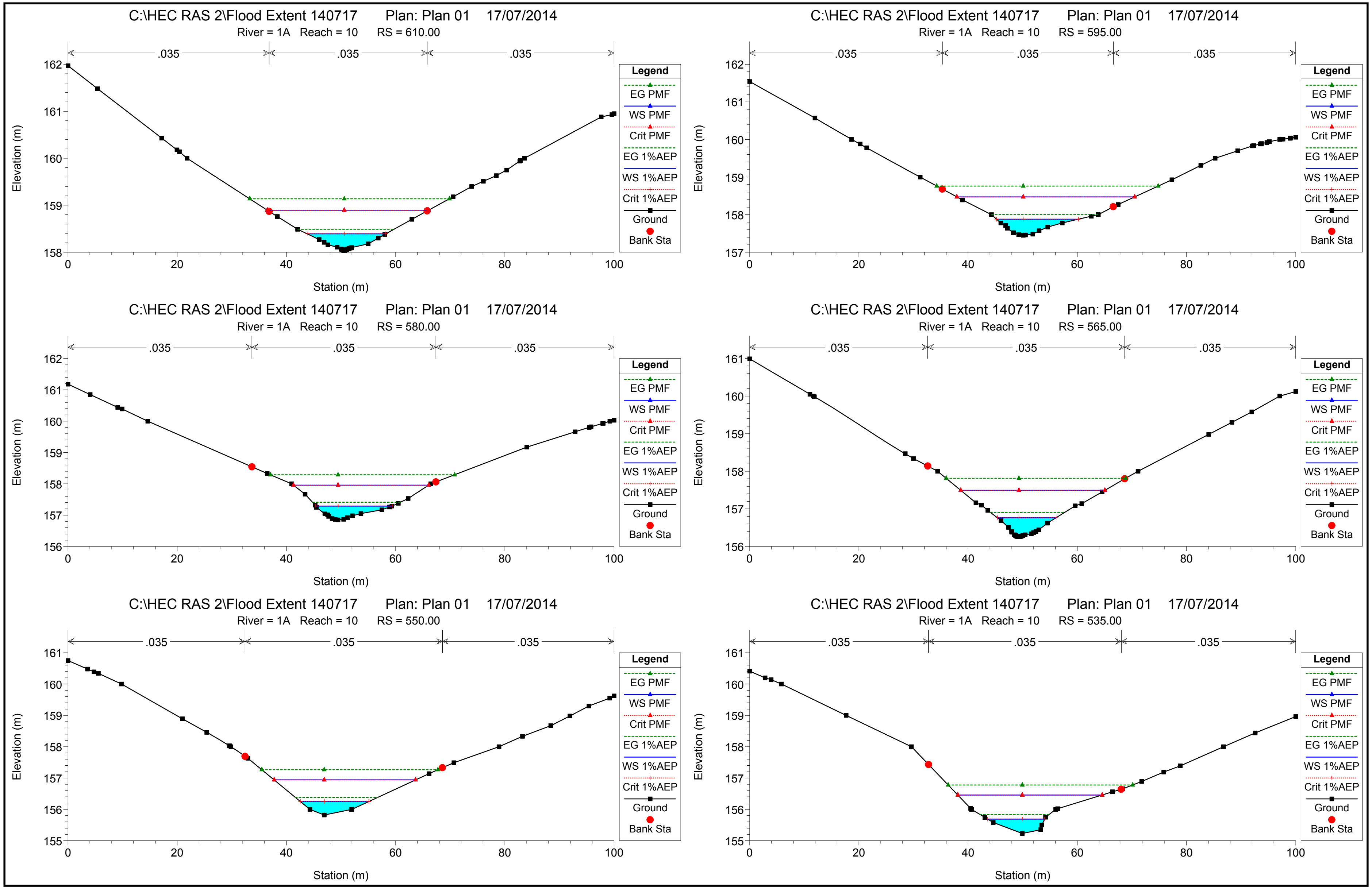

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 685.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

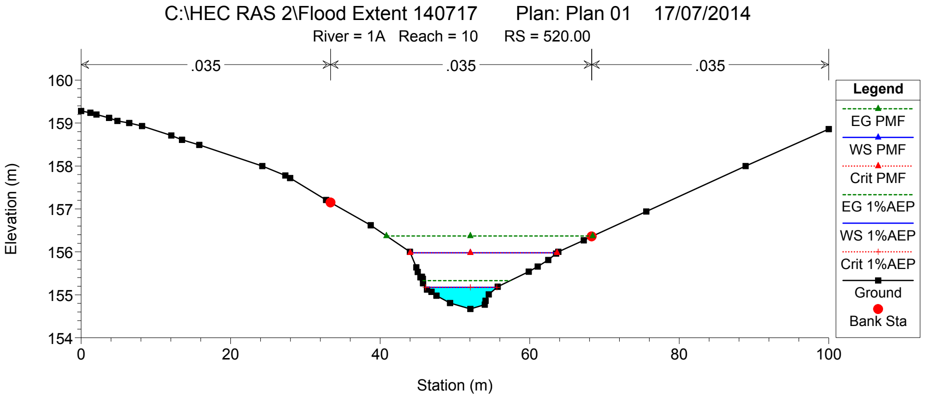

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 670.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

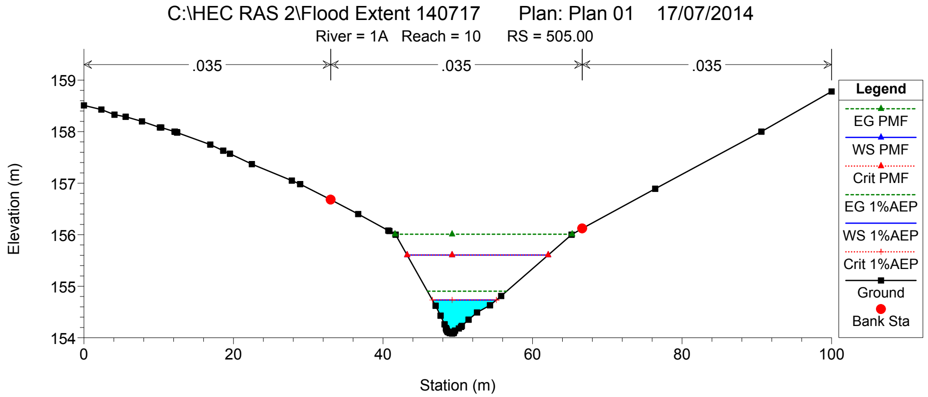

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 655.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

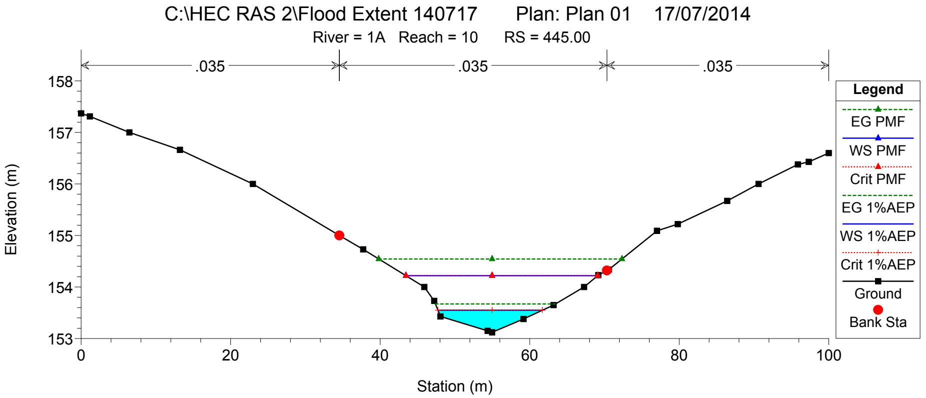

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 640.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

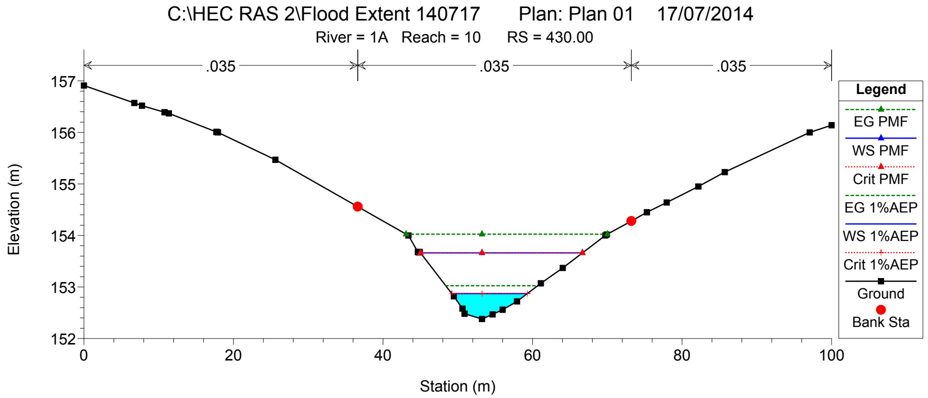

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 625.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

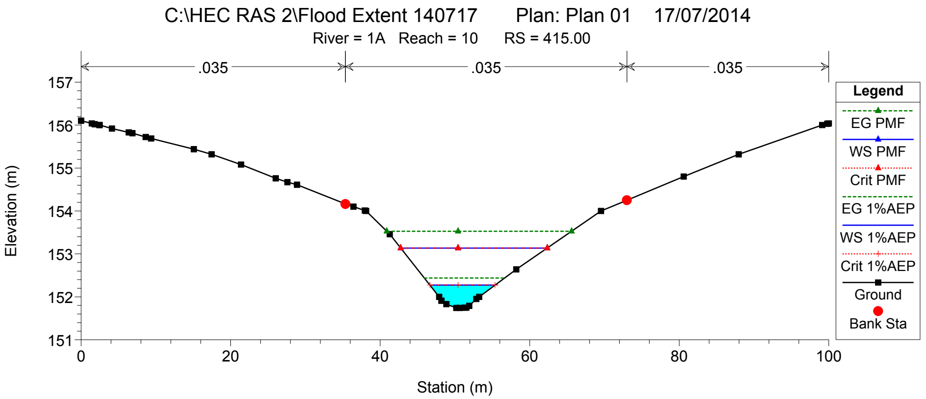

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 610.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 595.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 580.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 565.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 550.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 535.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

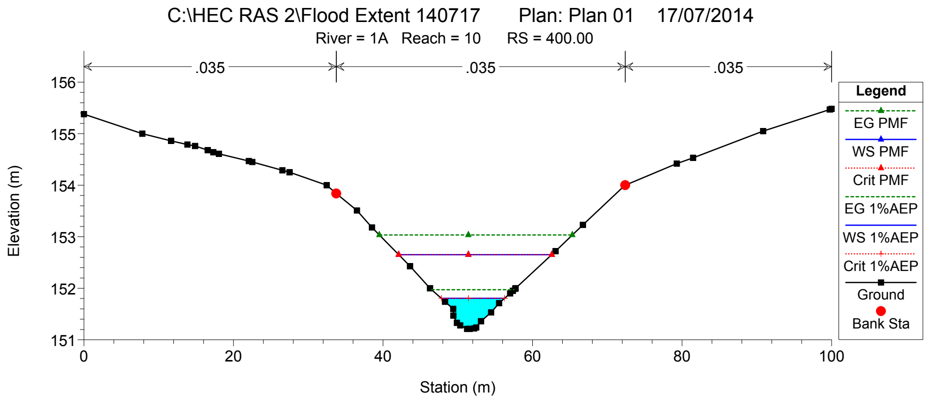

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 520.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

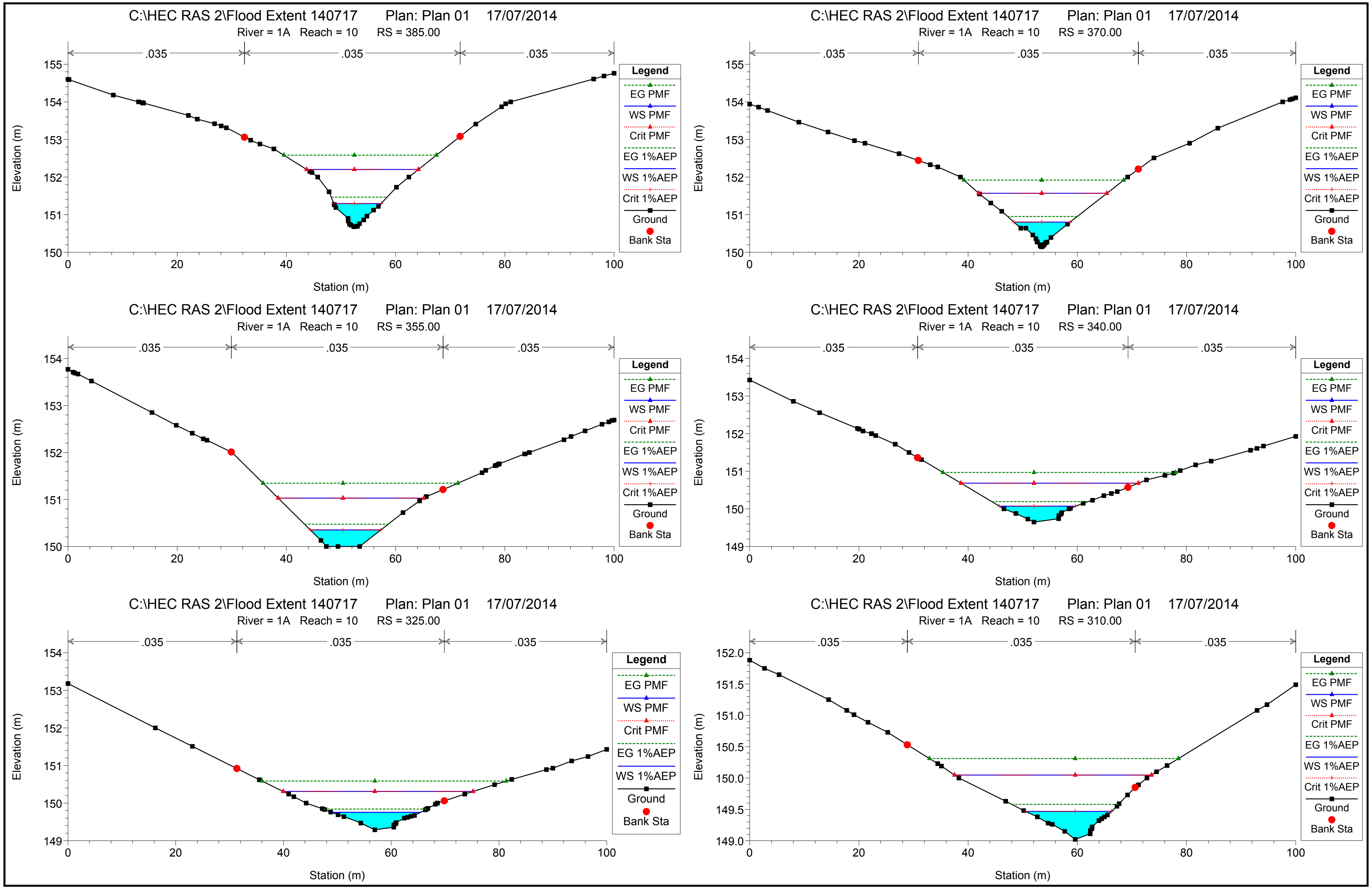

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 505.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 445.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

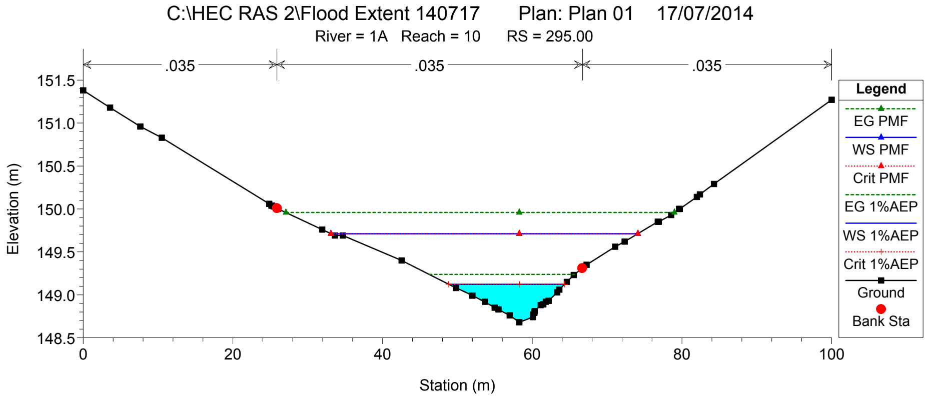

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 430.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 415.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

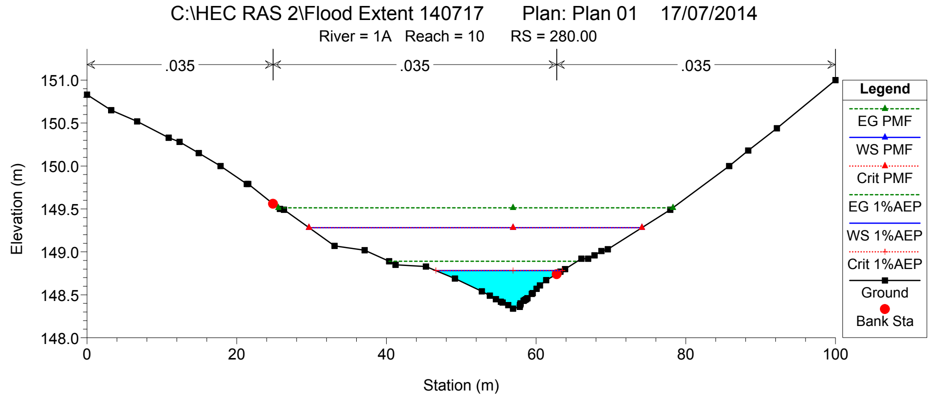

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 400.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)



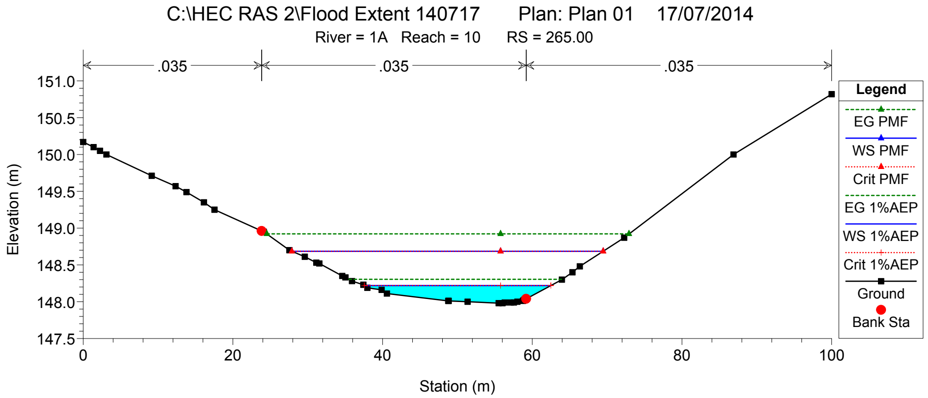
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 385.00
.035
.035
.035
Elevation (m)
155
154
153
152
151
150
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 370.00
.035
.035
.035
Elevation (m)
155
154
153
152
151
150
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 355.00
.035
.035
.035
Elevation (m)
154
153
152
151
150
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 340.00
.035
.035
.035
Elevation (m)
154
153
152
151
150
149
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 325.00
.035
.035
.035
Elevation (m)
154
153
152
151
150
149
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 310.00
.035
.035
.035
Elevation (m)
152.0
151.5
151.0
150.5
150.0
149.5
149.0
0
20
40
60
80
100
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



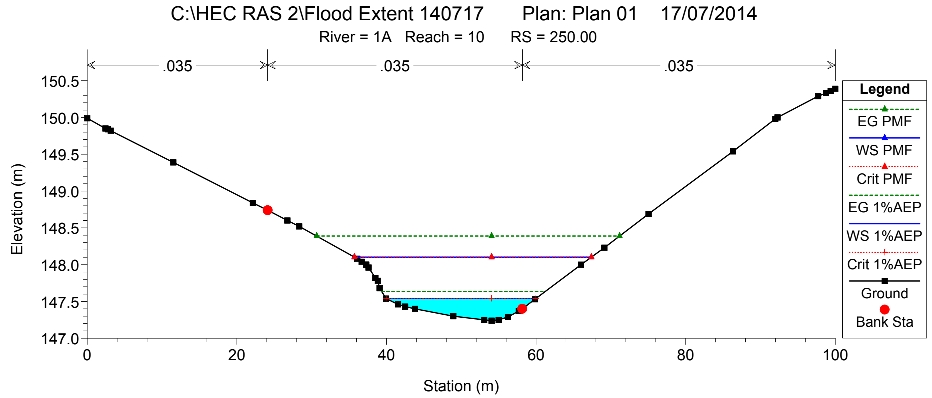
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 295.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



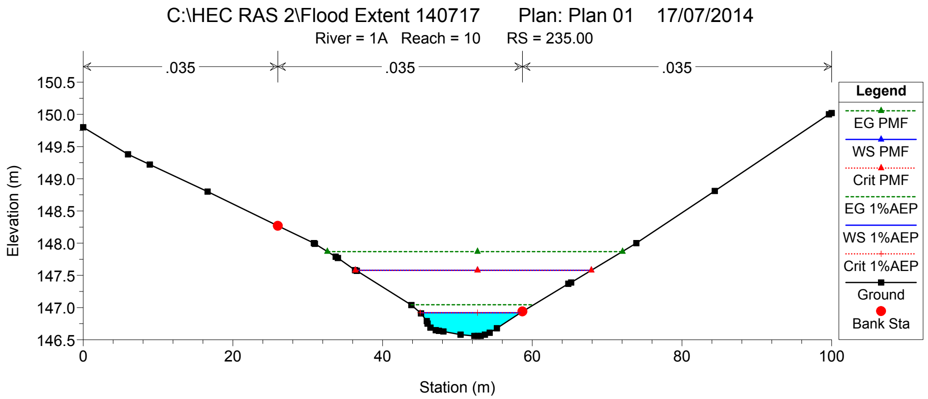
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 280.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



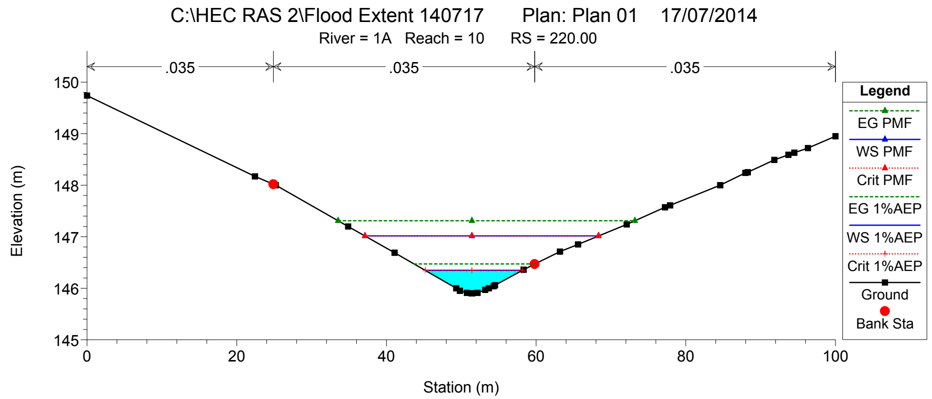
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 265.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



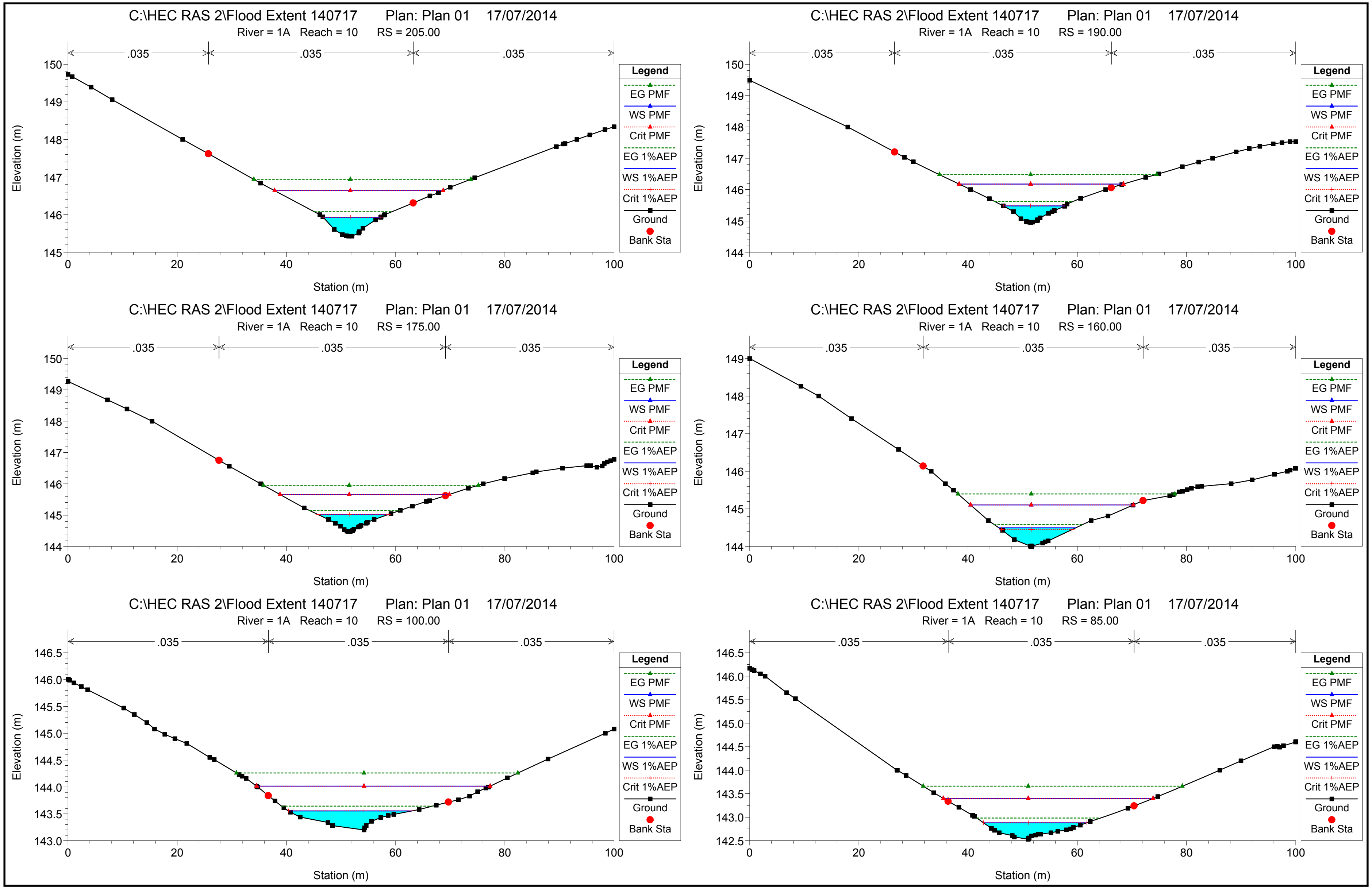
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 250.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



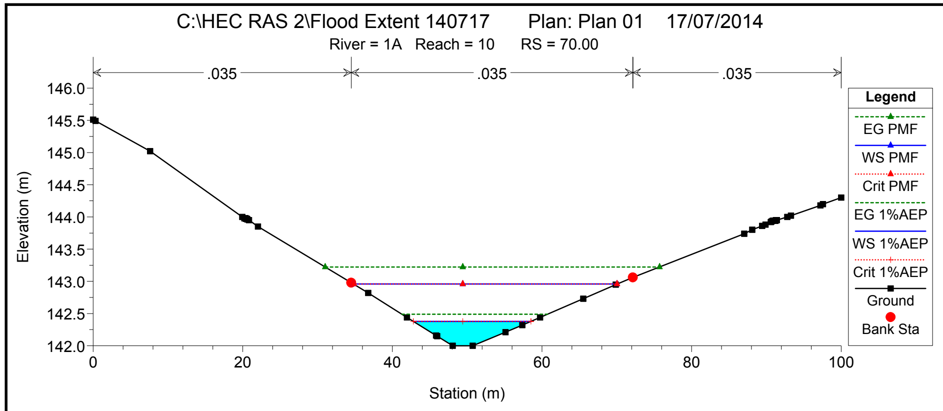
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 235.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

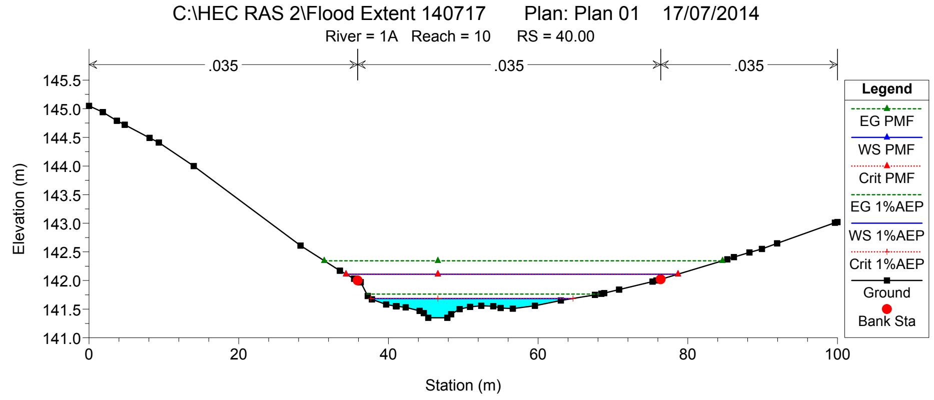


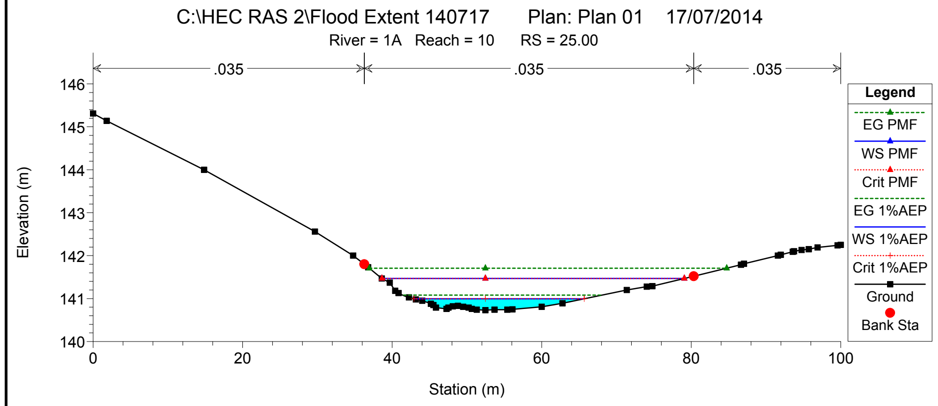
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 220.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 205.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 190.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 175.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 160.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 100.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 85.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 70.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1A Reach = 10 RS = 40.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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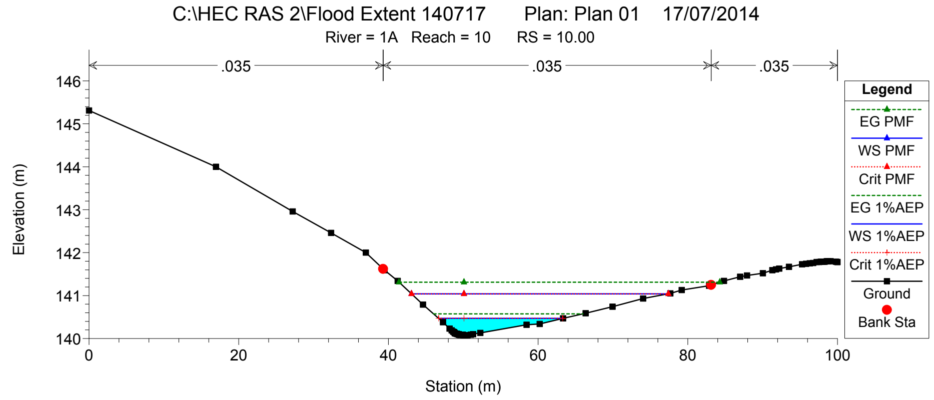
River = 1A Reach = 10 RS = 25.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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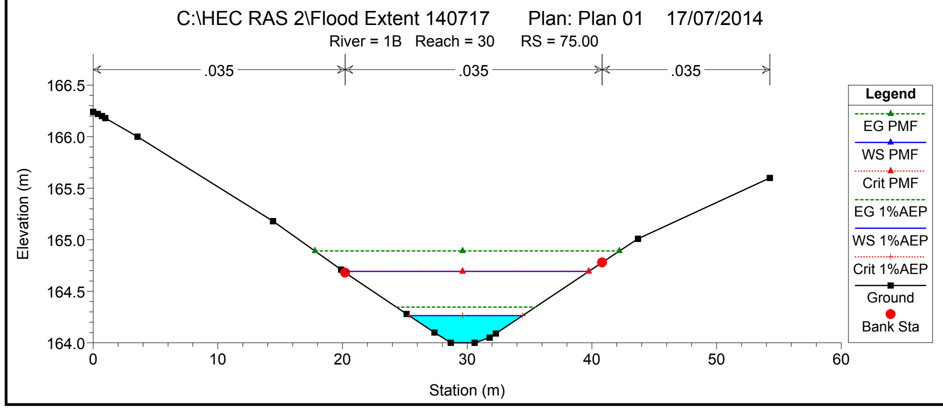
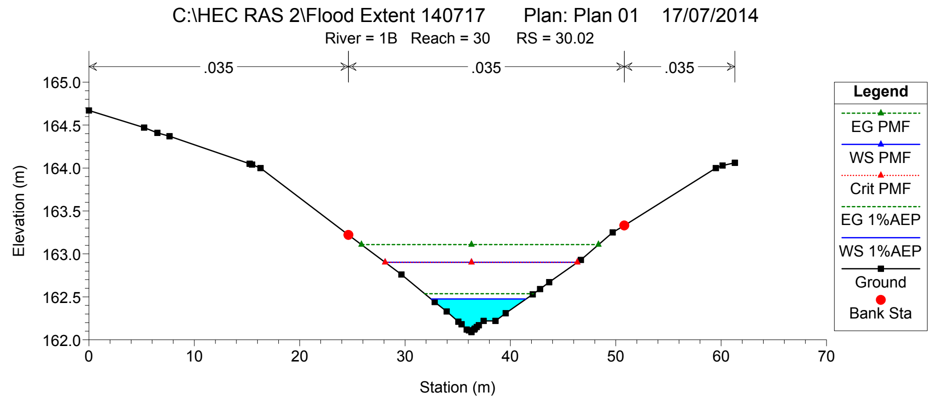
River = 1A Reach = 10 RS = 10.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 1B Reach = 30 RS = 75.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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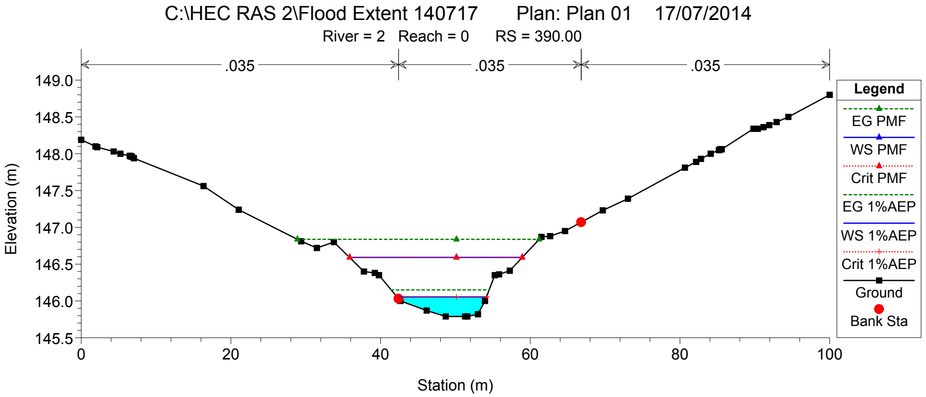
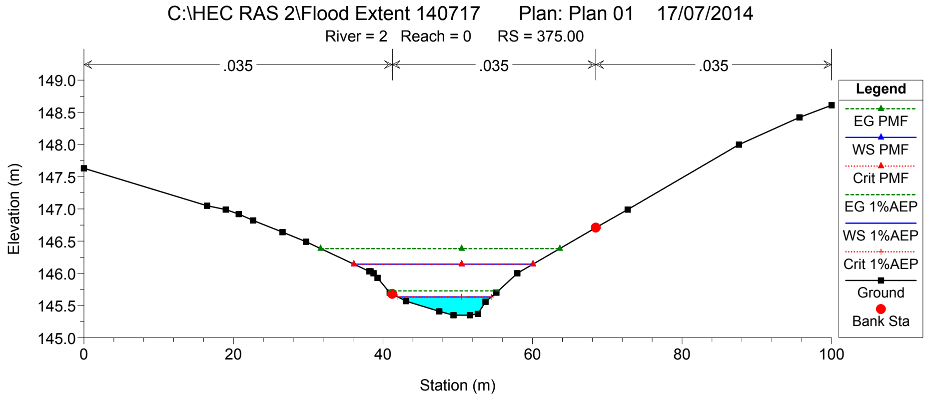
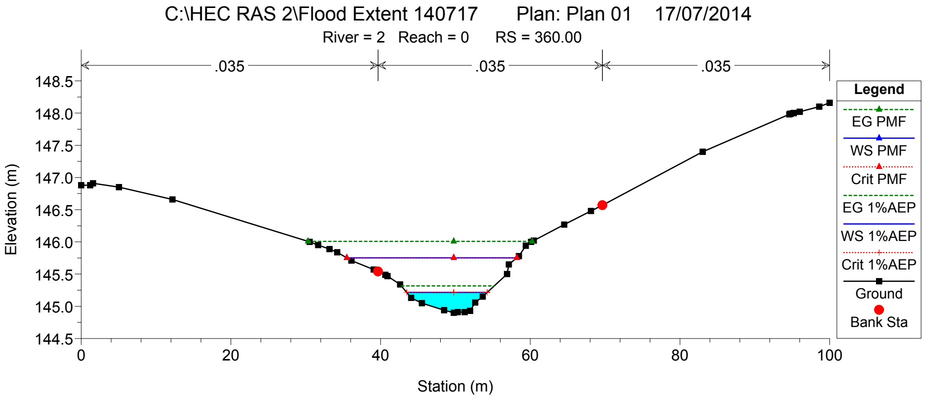
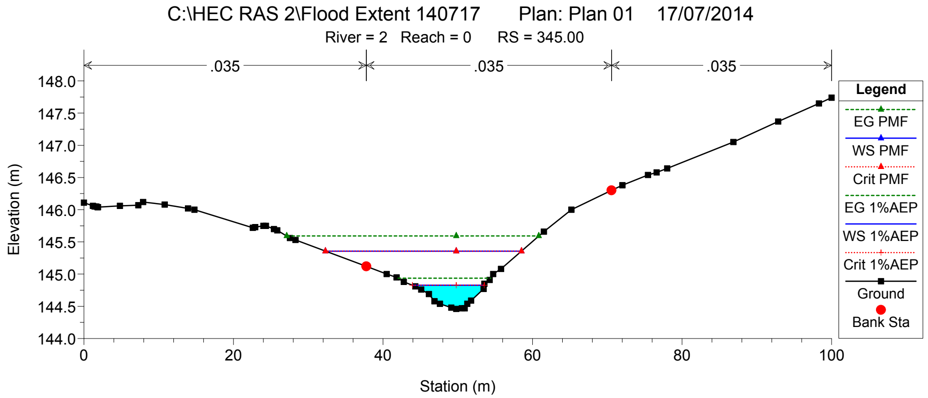
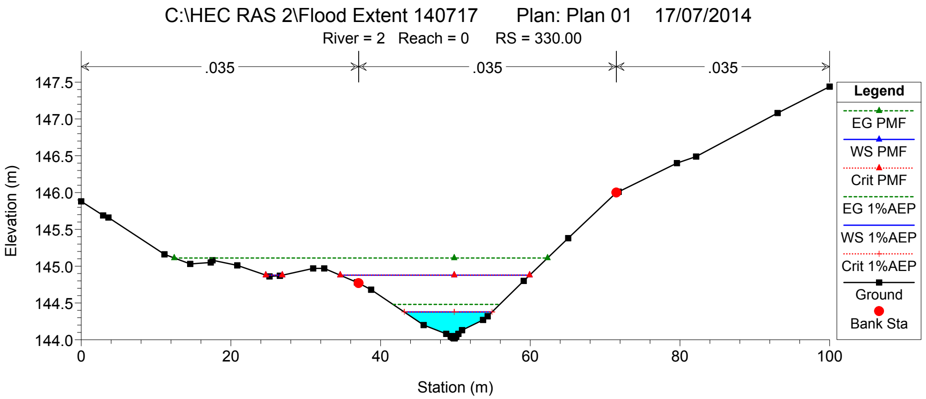
River = 1B Reach = 30 RS = 30.02
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

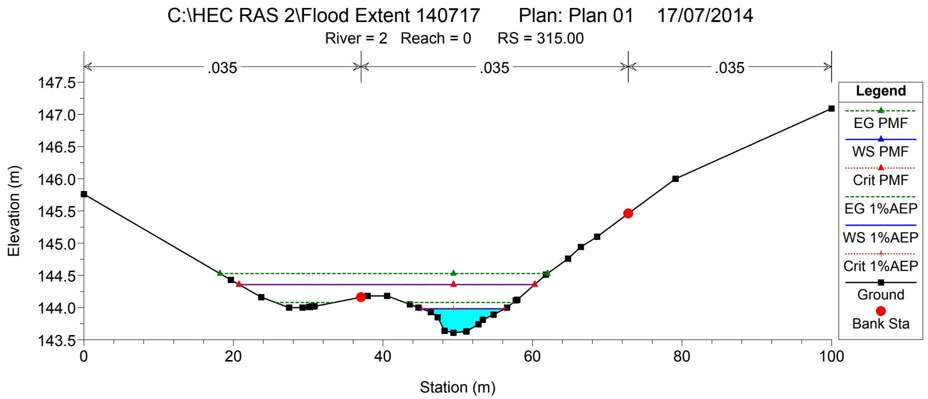

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 390.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

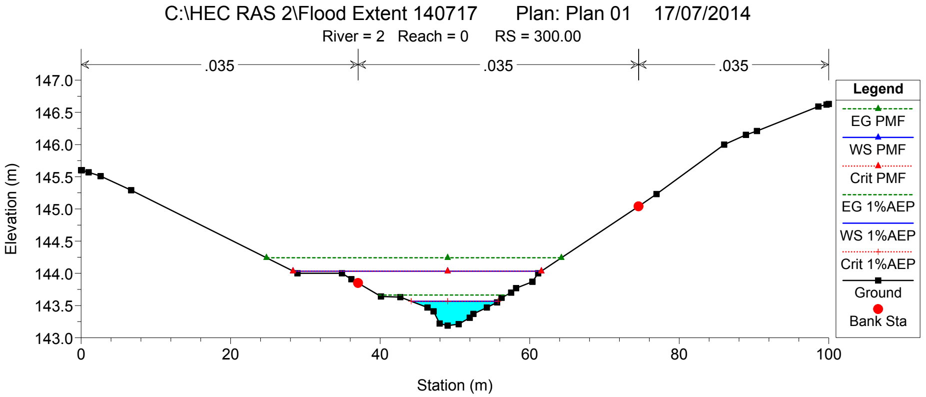

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 375.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

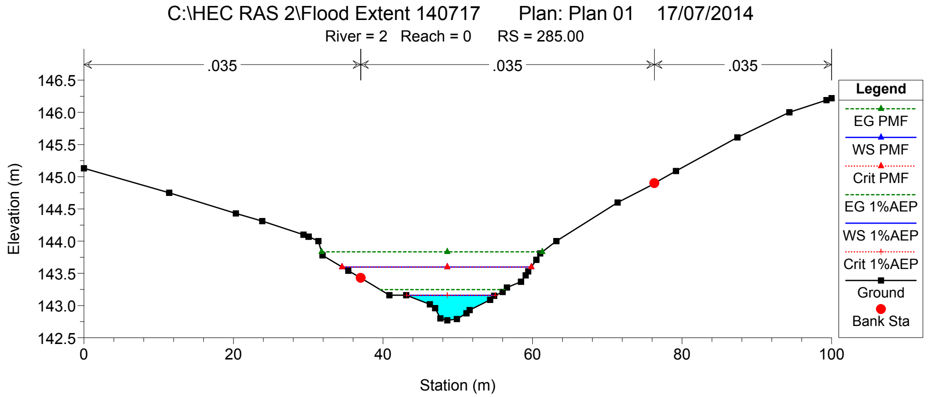

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 360.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

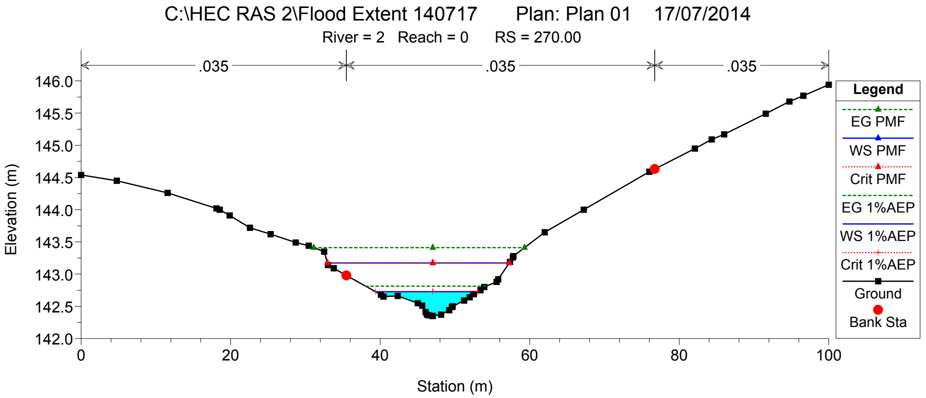

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 345.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

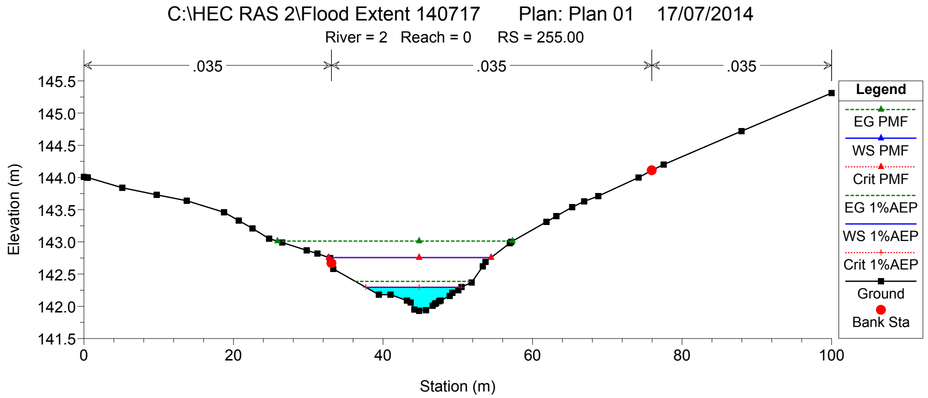

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 330.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

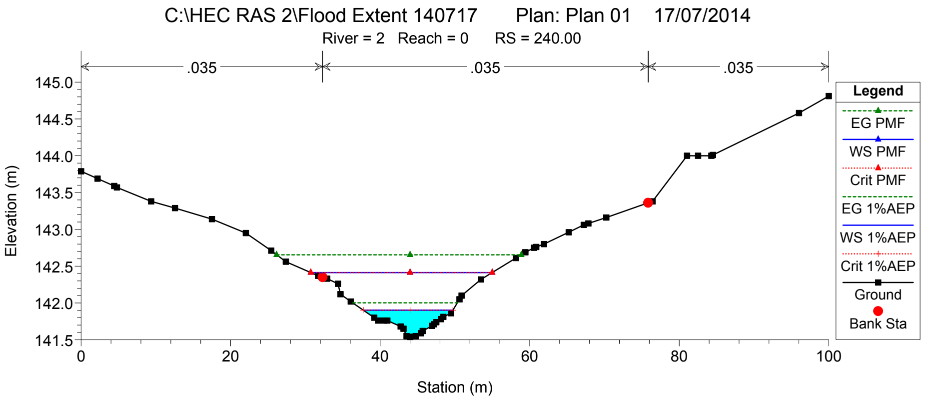

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 315.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

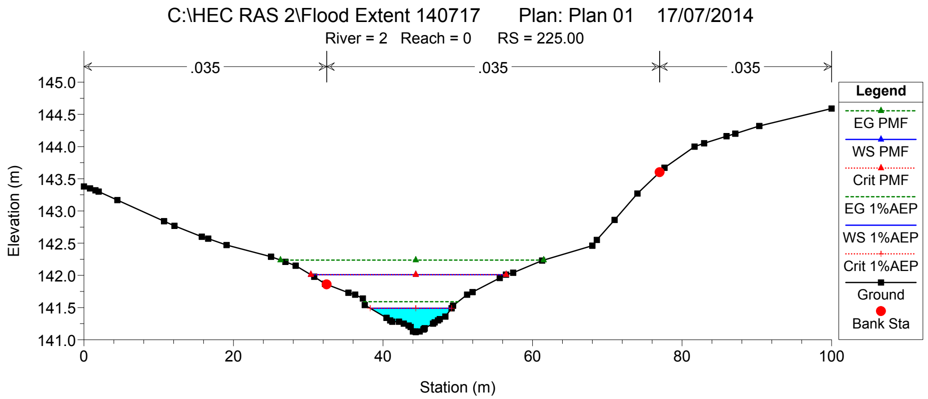

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 300.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

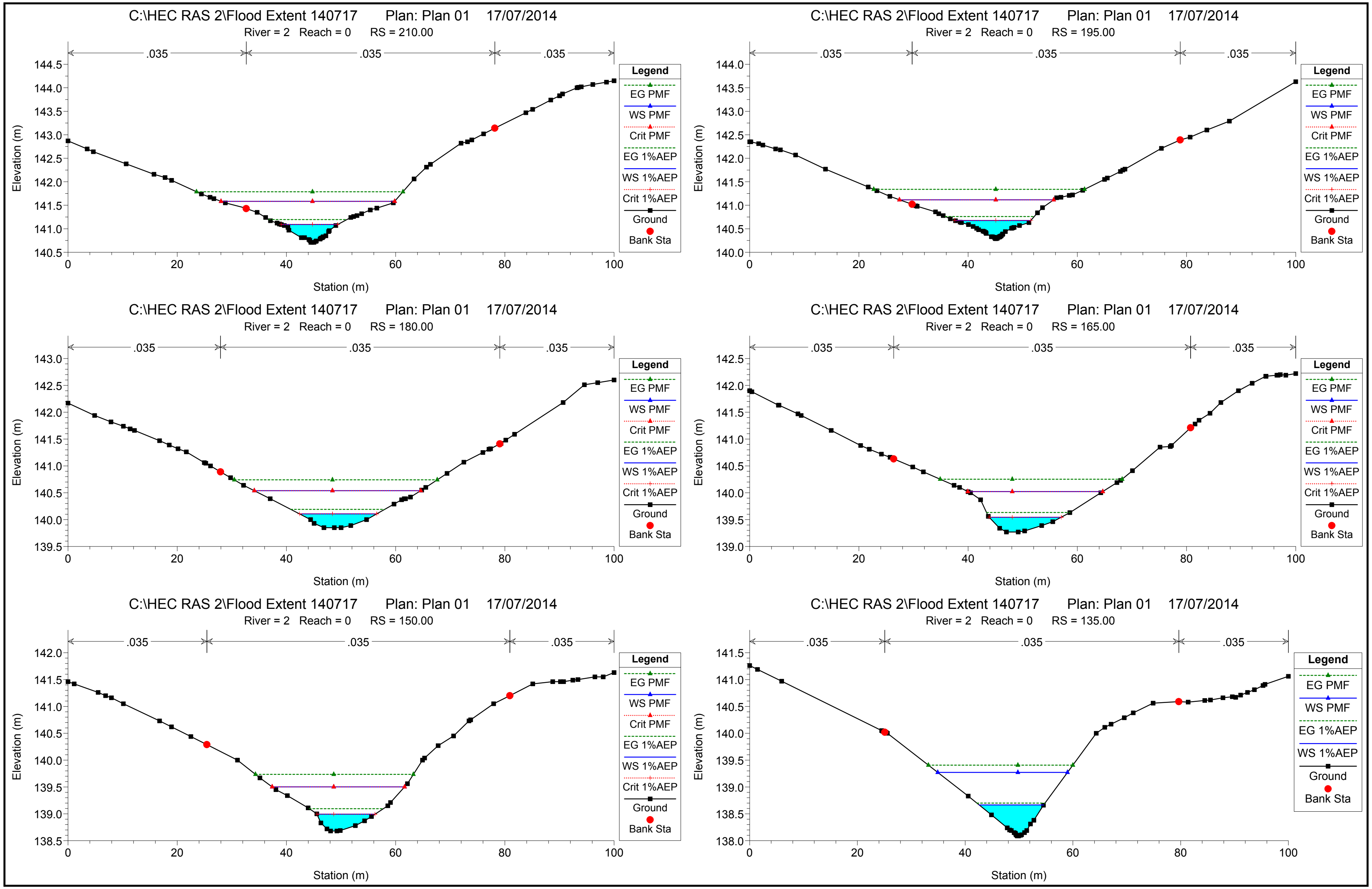

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 285.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 270.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

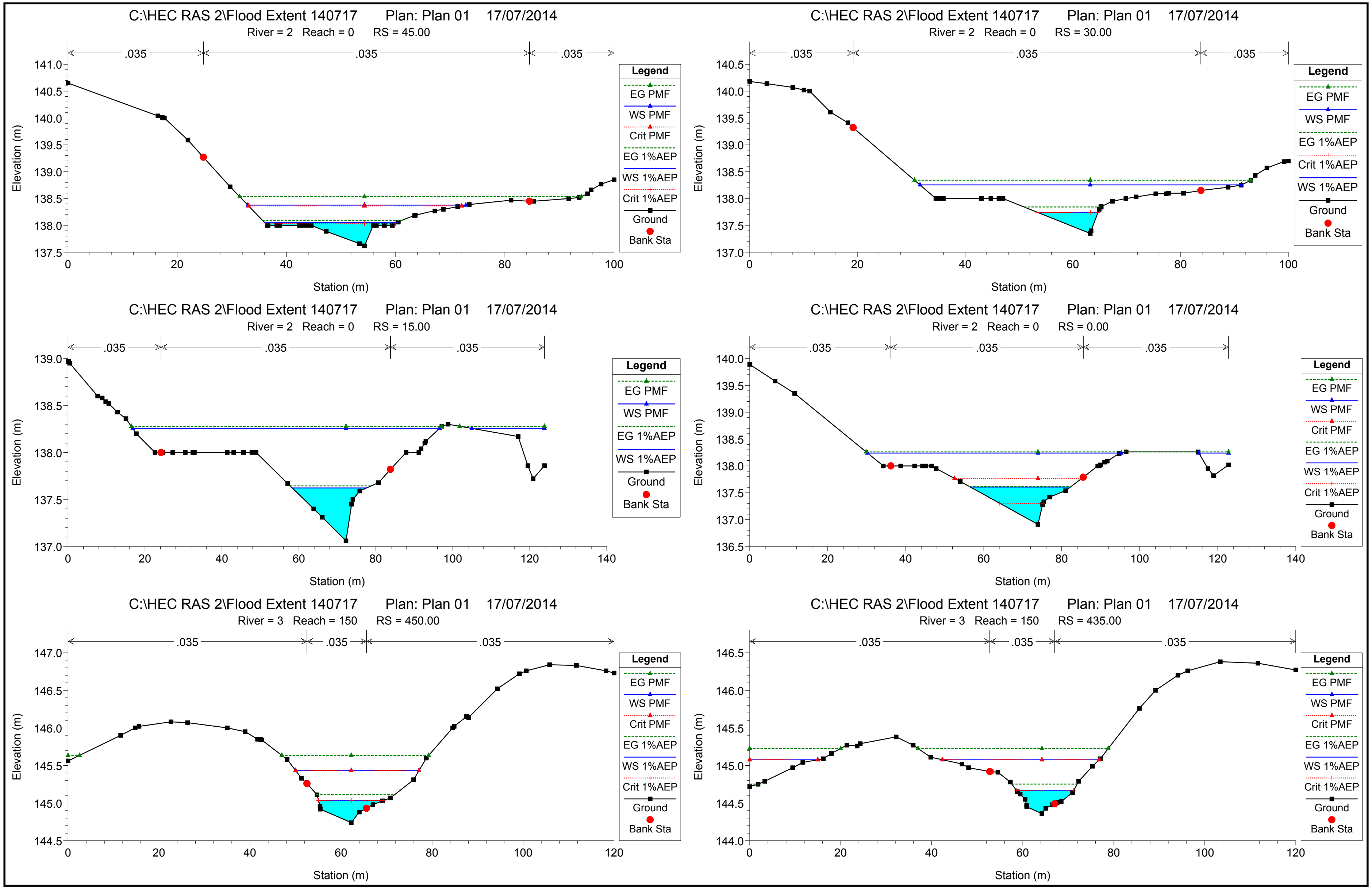

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 255.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 240.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

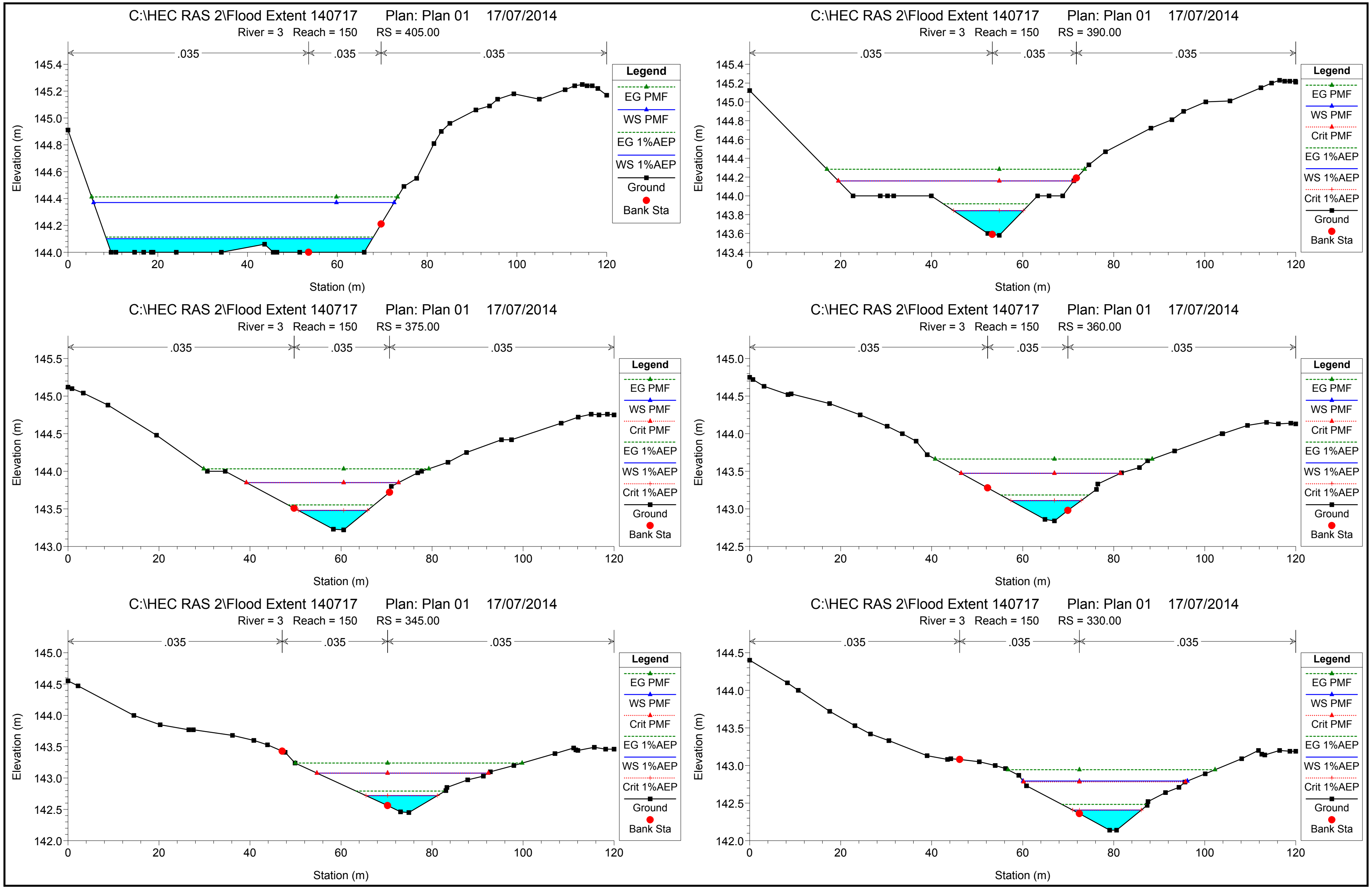

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 225.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 210.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 195.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 180.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 165.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 150.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 135.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 45.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 30.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 15.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 2 Reach = 0 RS = 0.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 450.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 435.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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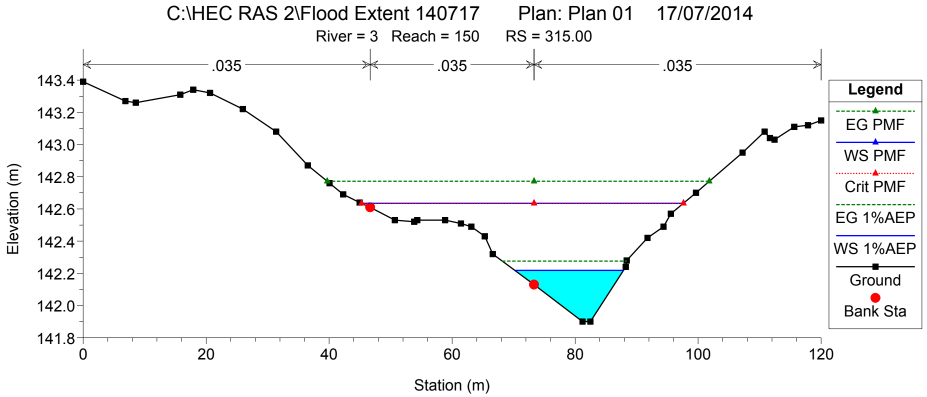
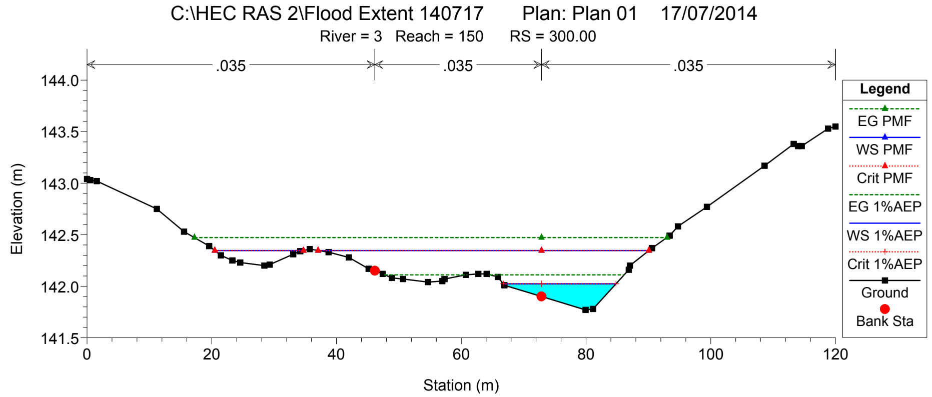
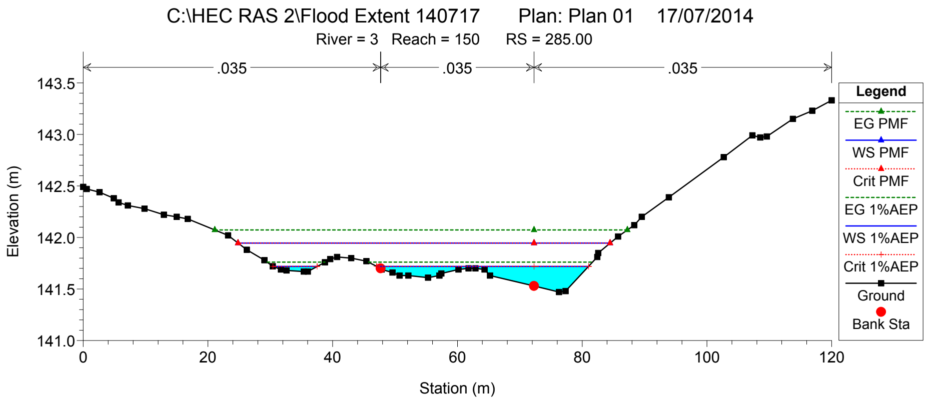
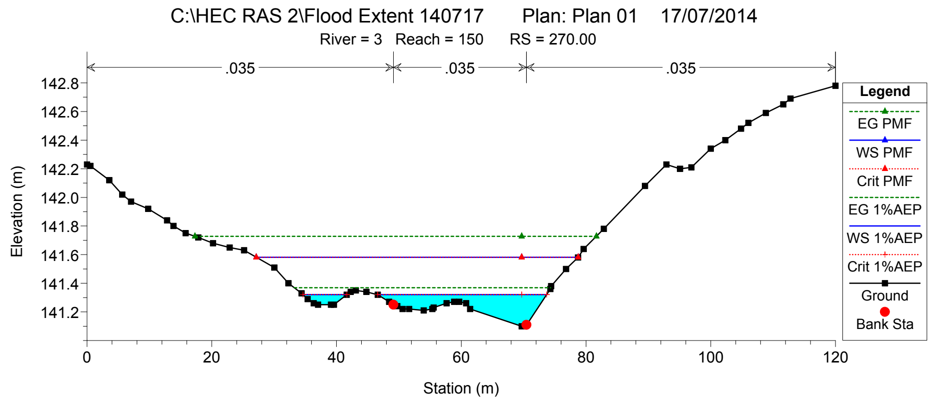
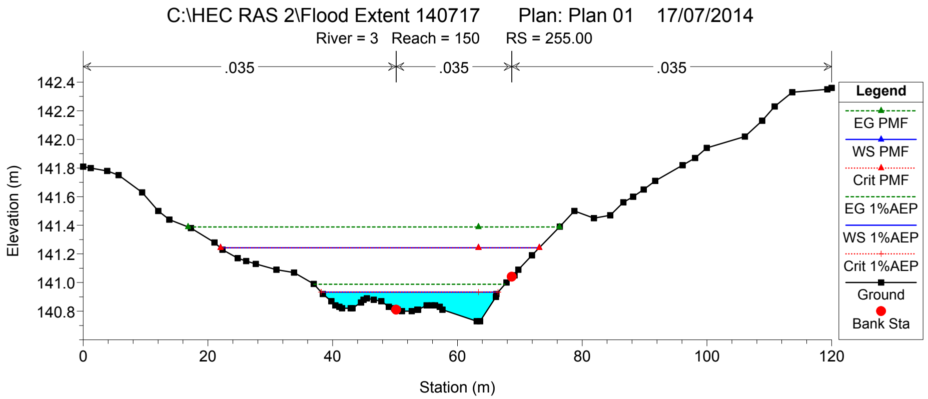
River = 3 Reach = 150 RS = 405.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 390.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 375.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 360.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 345.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 330.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

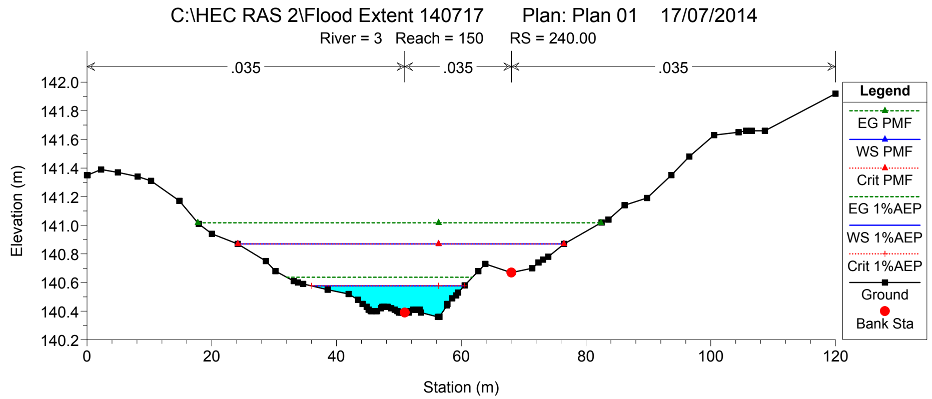

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 315.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

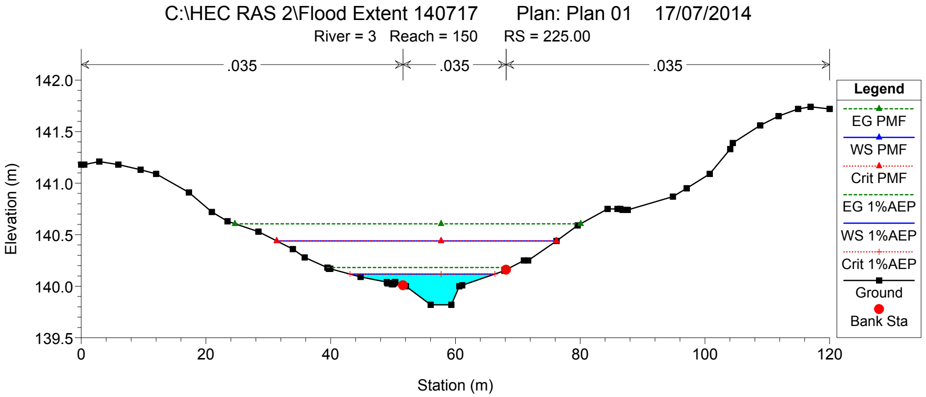

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 300.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)

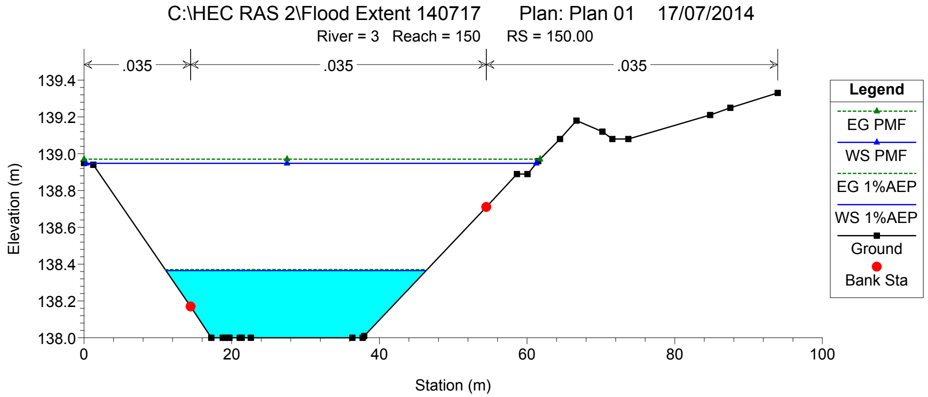

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 285.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 270.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 255.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 240.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 225.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 150 RS = 150.00
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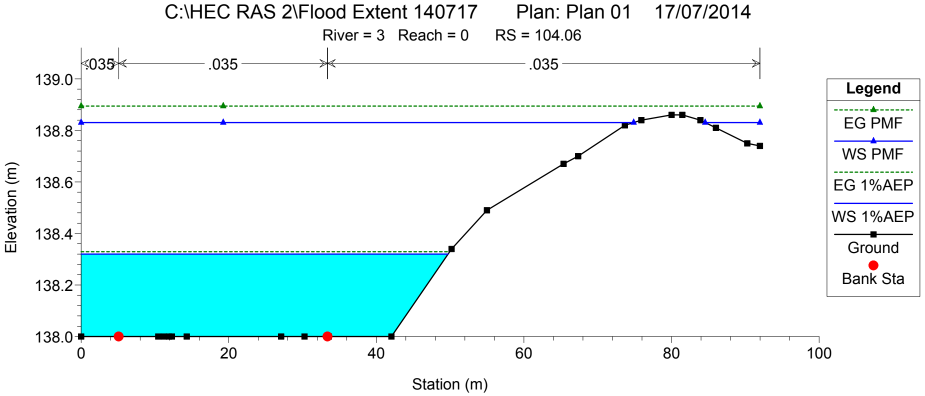
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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River = 3 Reach = 0 RS = 104.06
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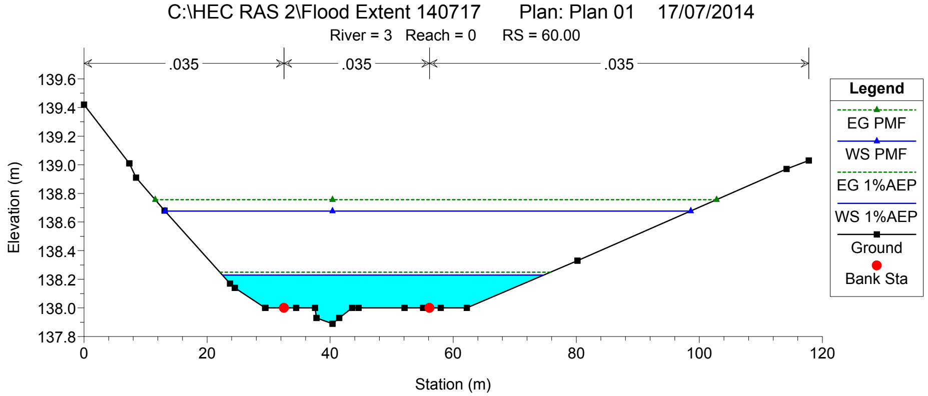
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 0 RS = 60.00
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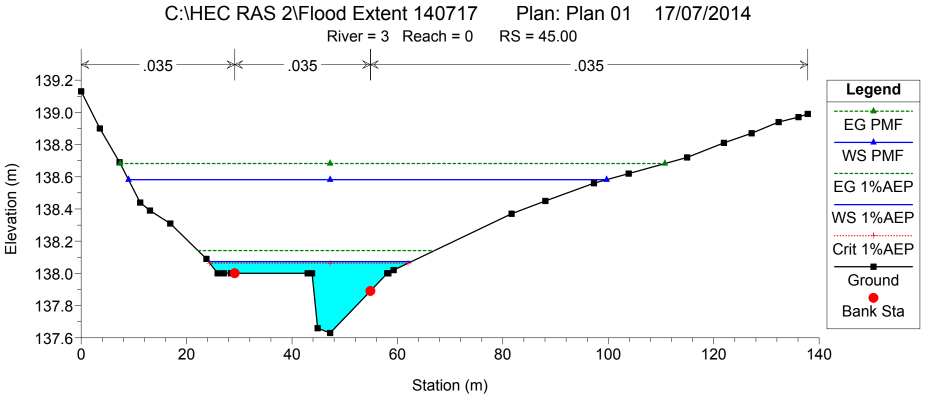
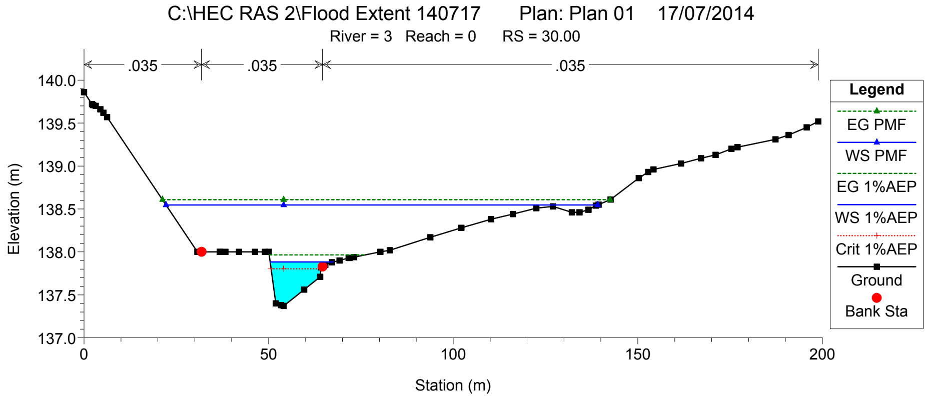
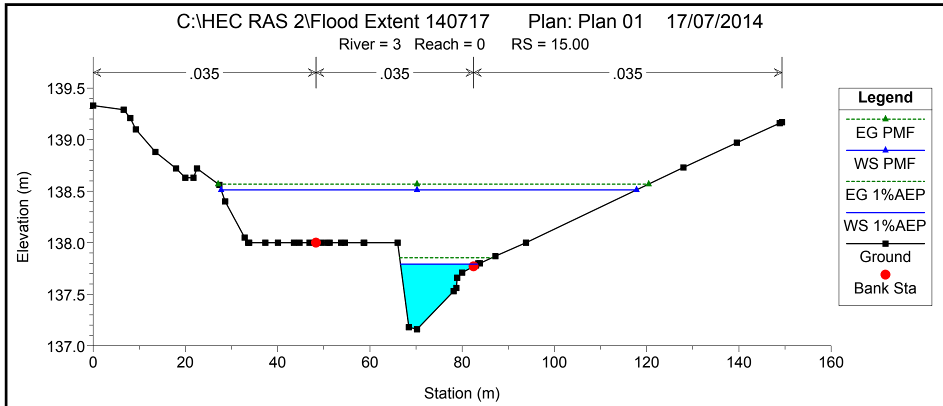
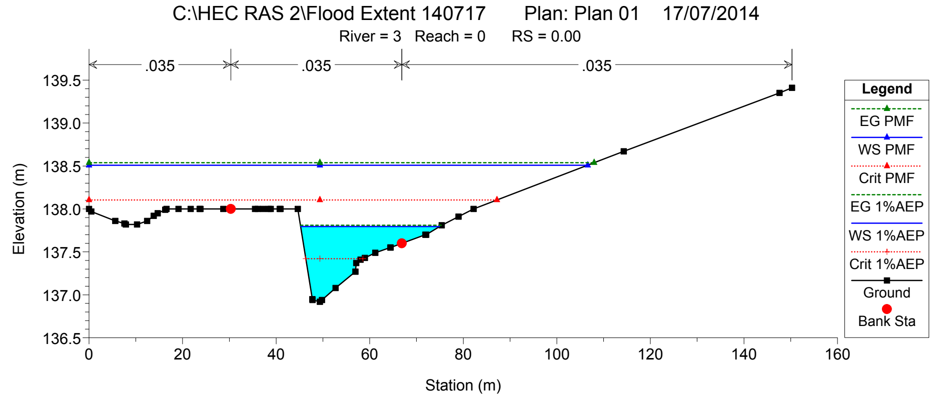
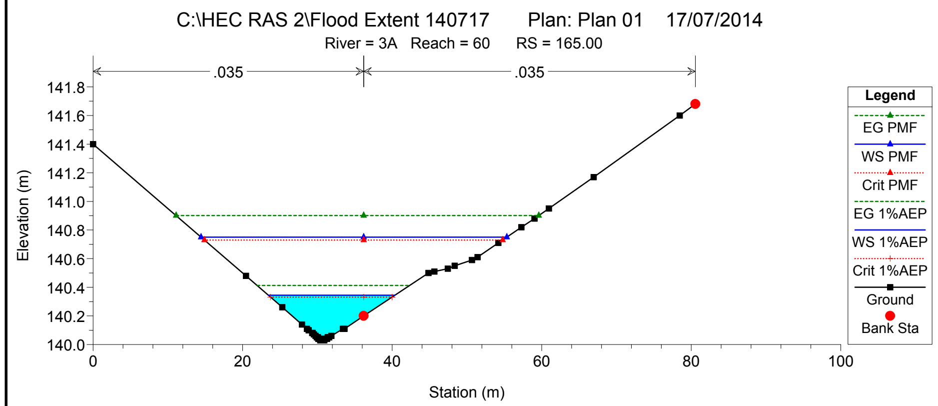
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

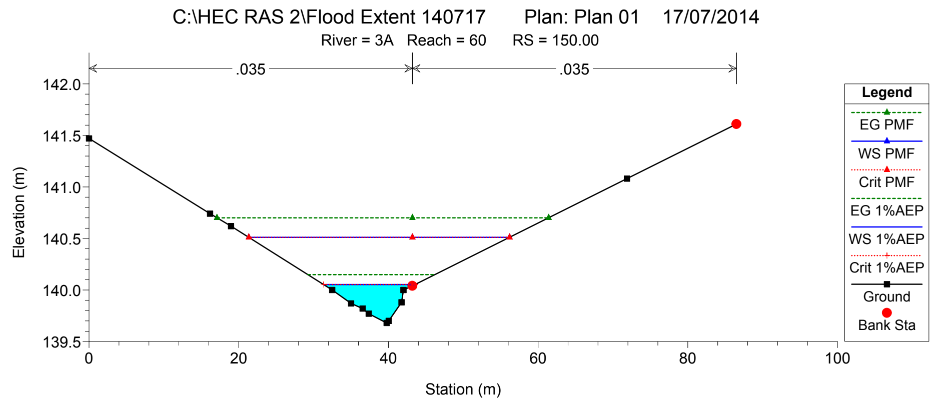

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 0 RS = 45.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

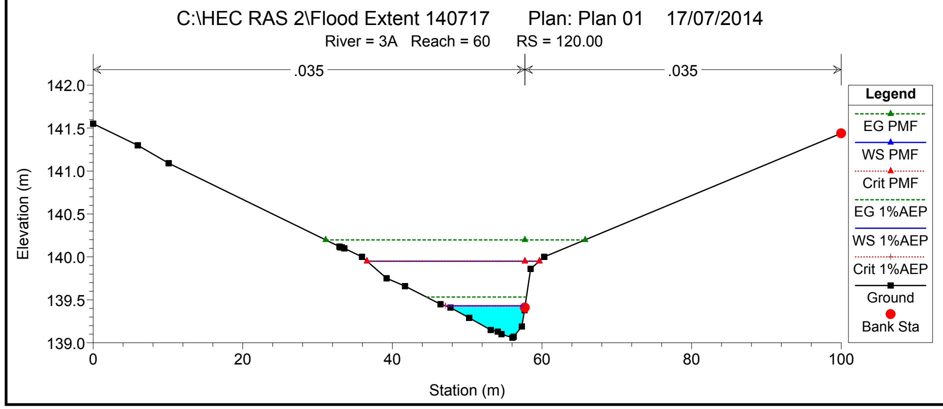

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 0 RS = 30.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

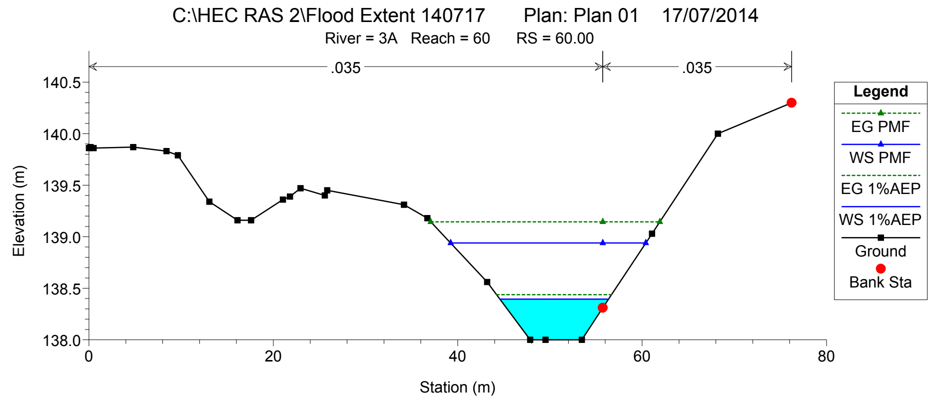

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 0 RS = 15.00
.035
.035
.035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
139.5
139.0
138.5
138.0
137.5
137.0
0
20
40
60
80
100
120
140
160

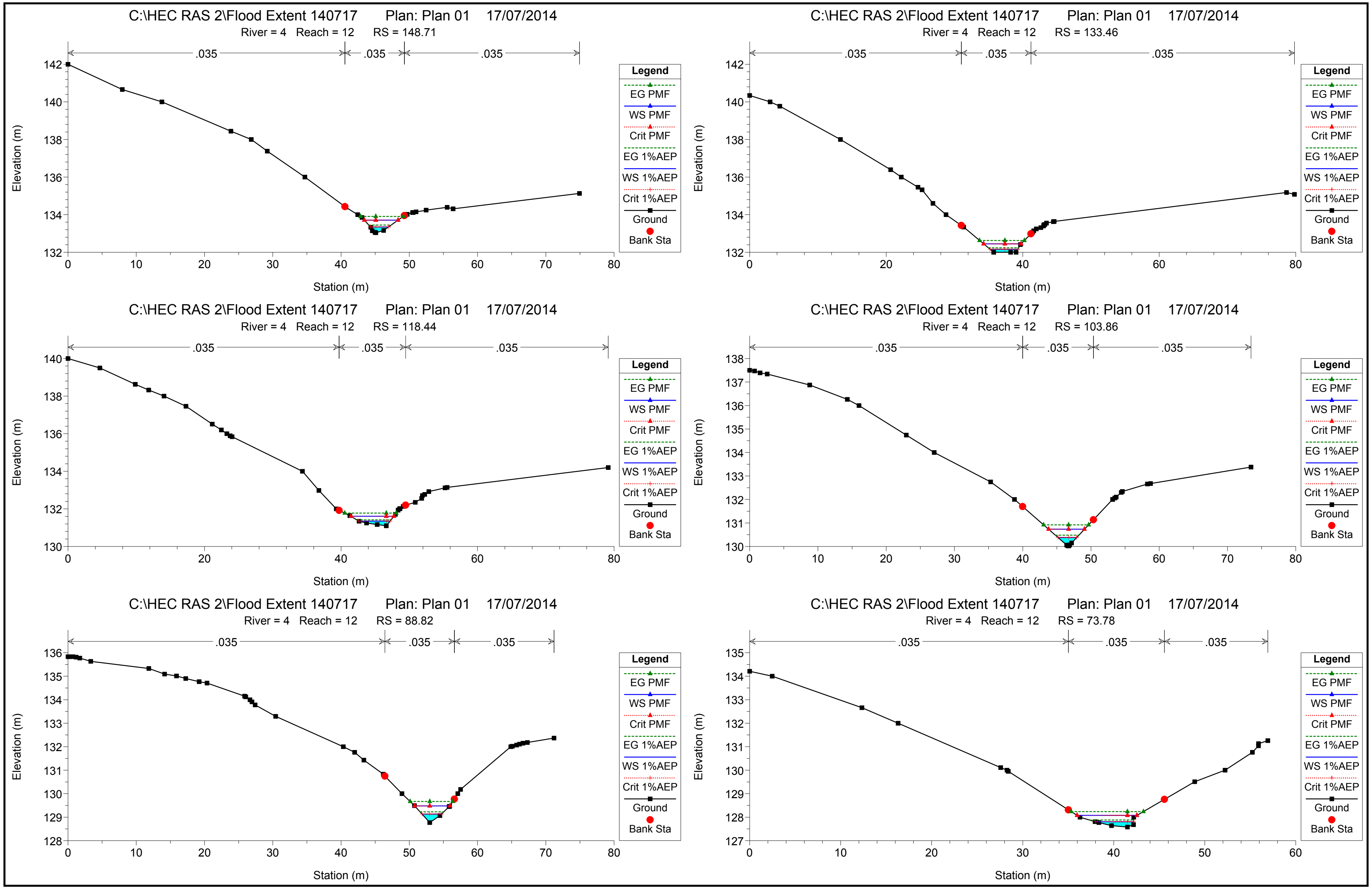

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3 Reach = 0 RS = 0.00
.035
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
139.5
139.0
138.5
138.0
137.5
137.0
136.5
0
20
40
60
80
100
120
140
160


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3A Reach = 60 RS = 165.00
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
141.8
141.6
141.4
141.2
141.0
140.8
140.6
140.4
140.2
140.0
0
20
40
60
80
100

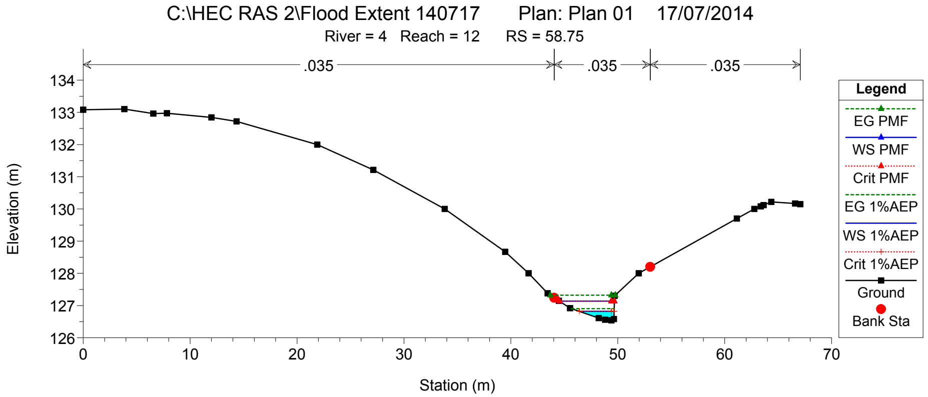

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3A Reach = 60 RS = 150.00
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
142.0
141.5
141.0
140.5
140.0
139.5
0
20
40
60
80
100


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3A Reach = 60 RS = 120.00
.035
.035
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
142.0
141.5
141.0
140.5
140.0
139.5
139.0
0
20
40
60
80
100


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 3A Reach = 60 RS = 60.00
.035
.035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
140.5
140.0
139.5
139.0
138.5
138.0
0
20
40
60
80



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 148.71
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 133.46
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 118.44
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 103.86
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 88.82
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 73.78
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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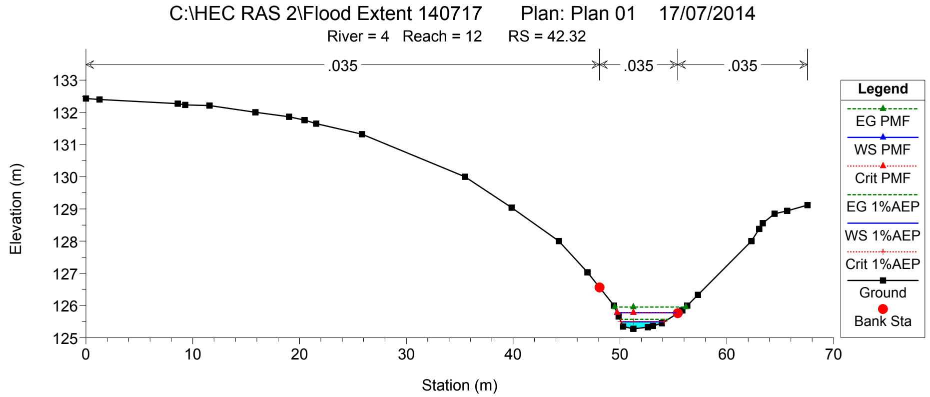
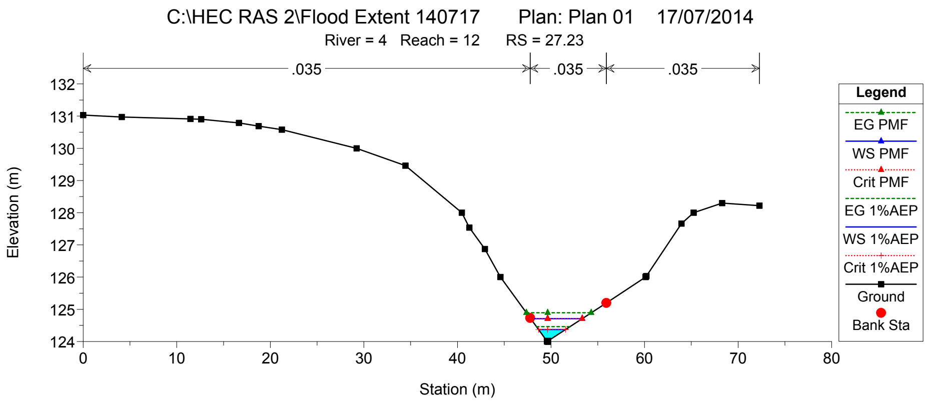
River = 4 Reach = 12 RS = 58.75
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 42.32
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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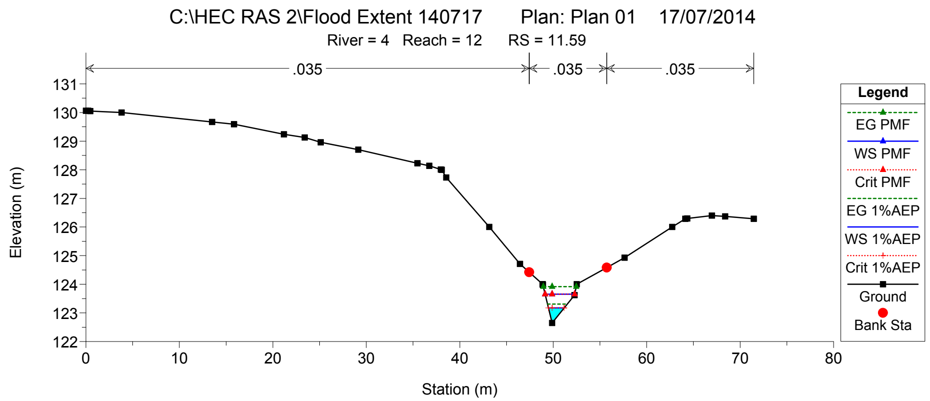
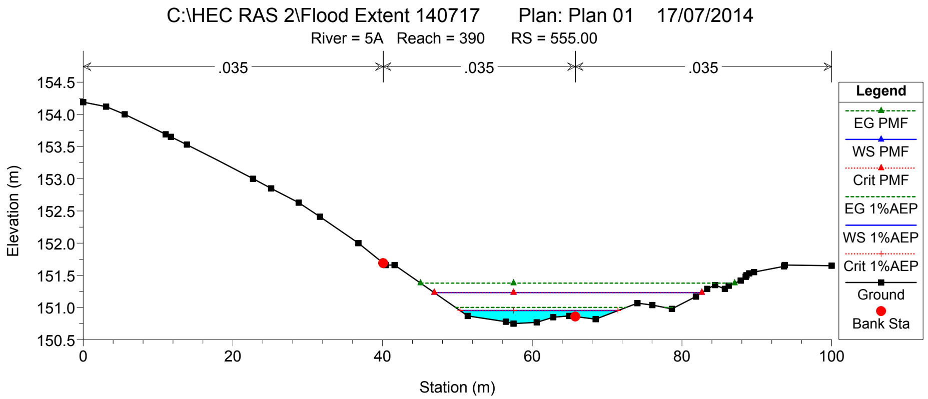
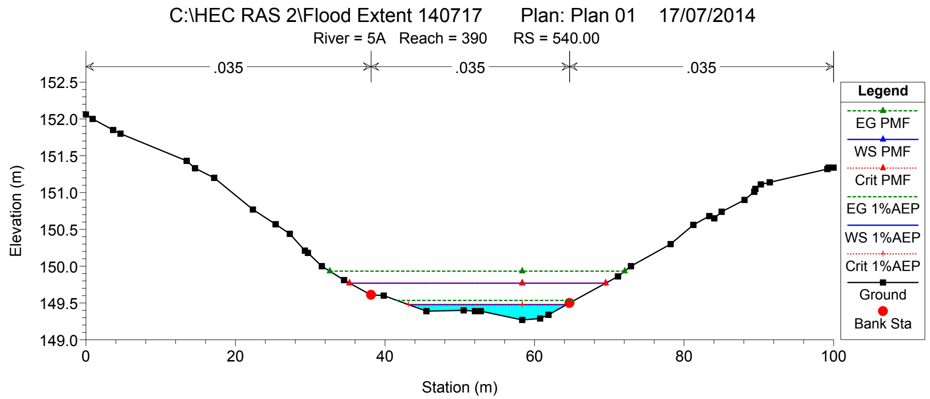
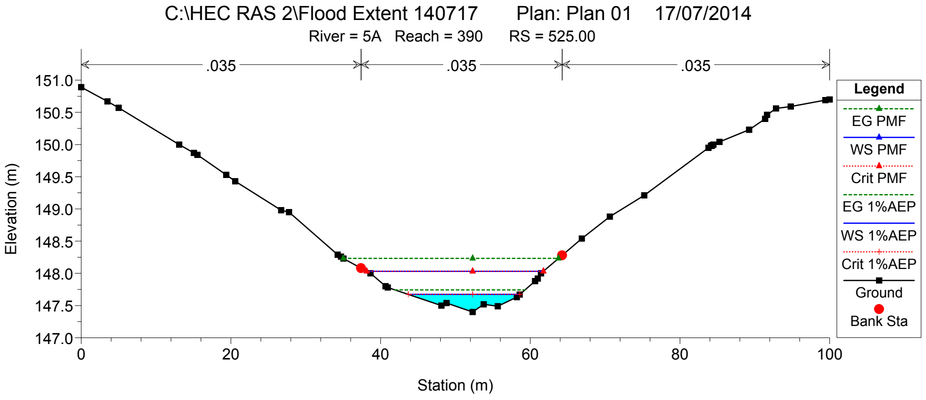
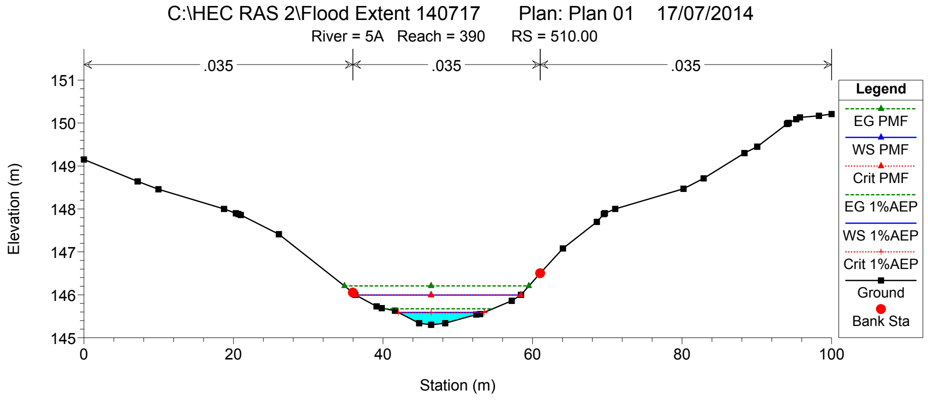
River = 4 Reach = 12 RS = 27.23
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

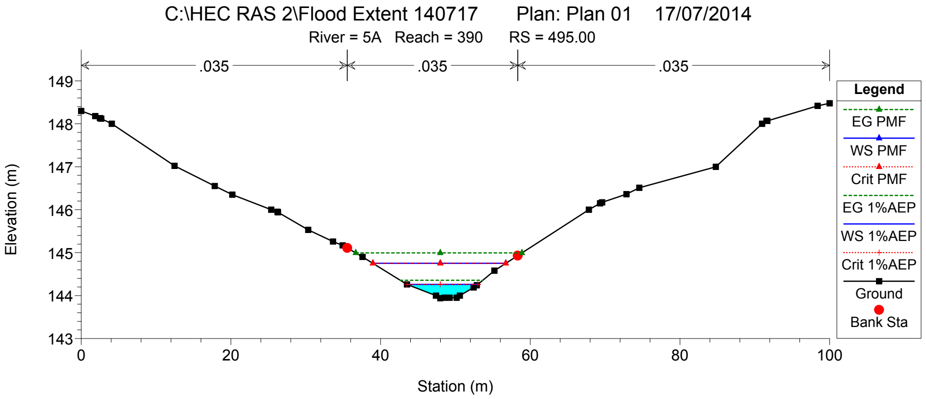

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 4 Reach = 12 RS = 11.59
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

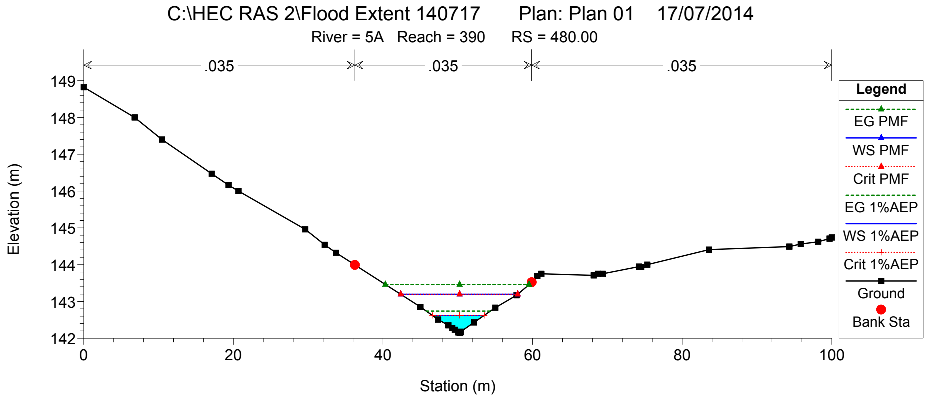

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 555.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

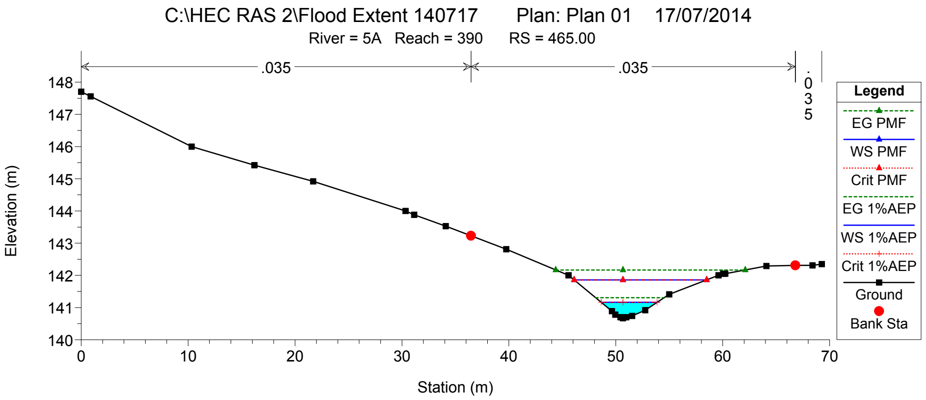

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 540.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

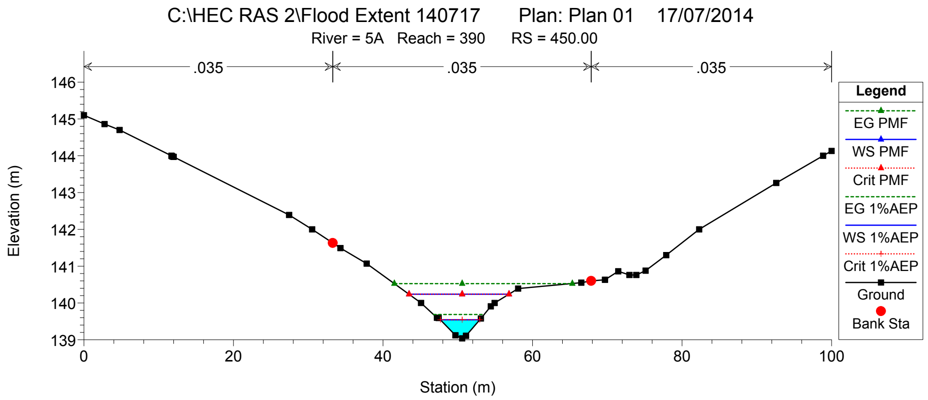

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 525.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

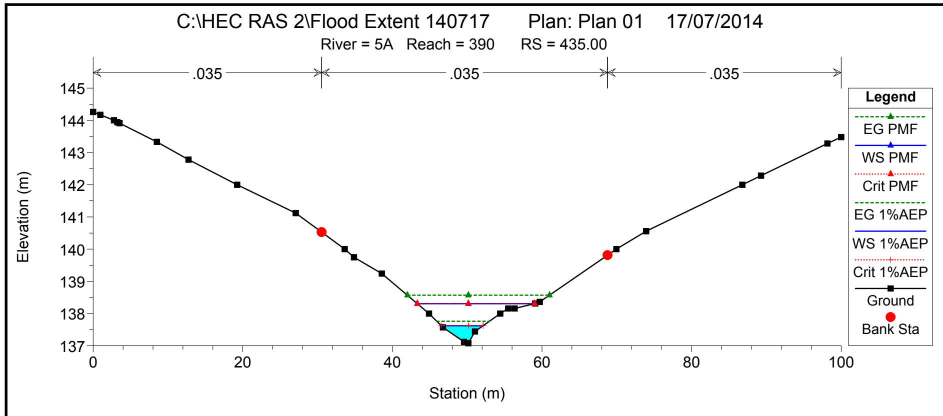

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 510.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

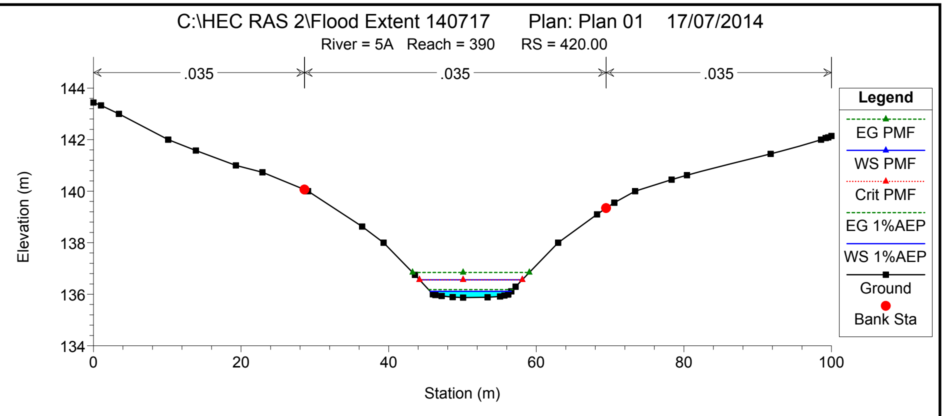

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 495.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

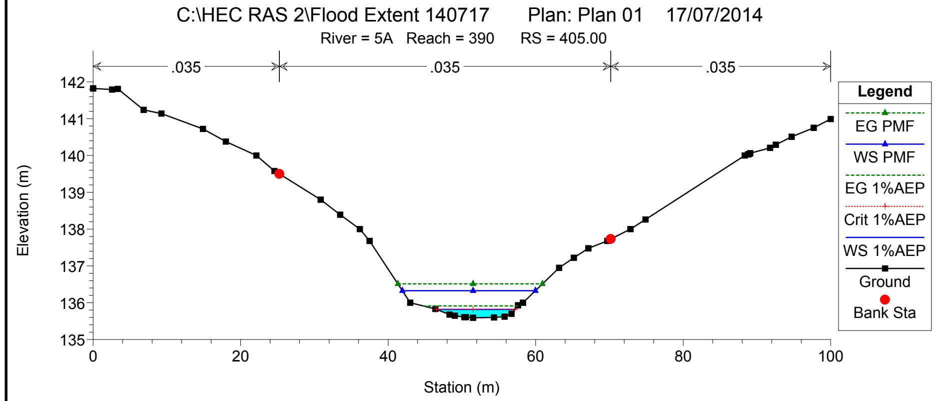

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 480.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

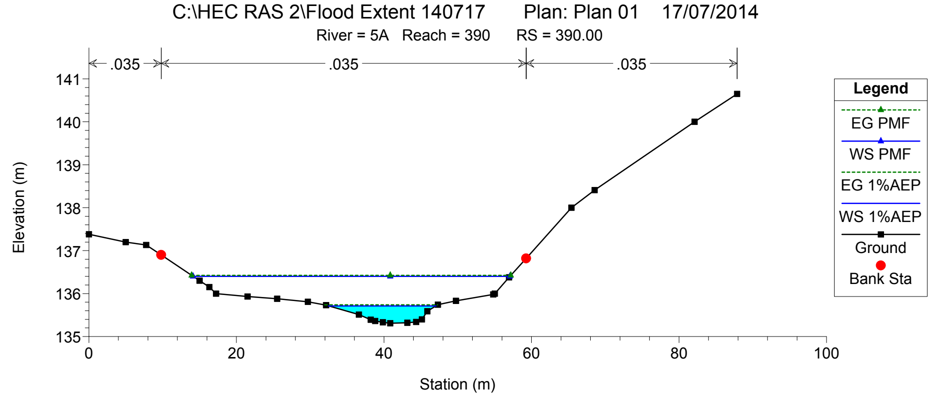

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 465.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

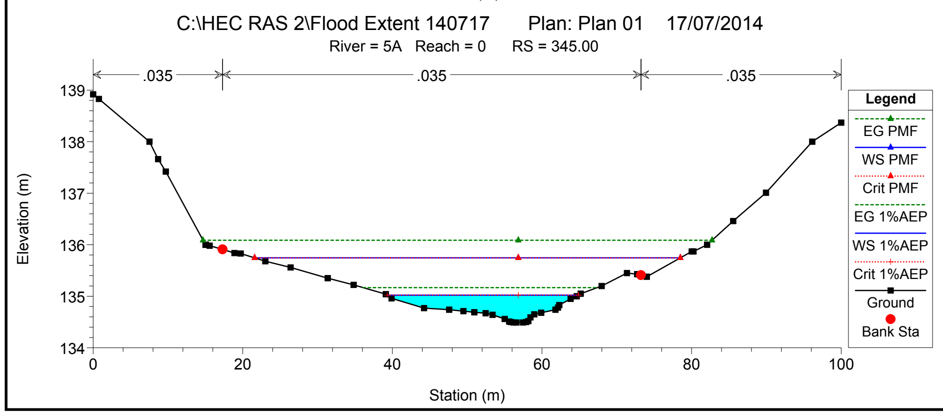

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 450.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

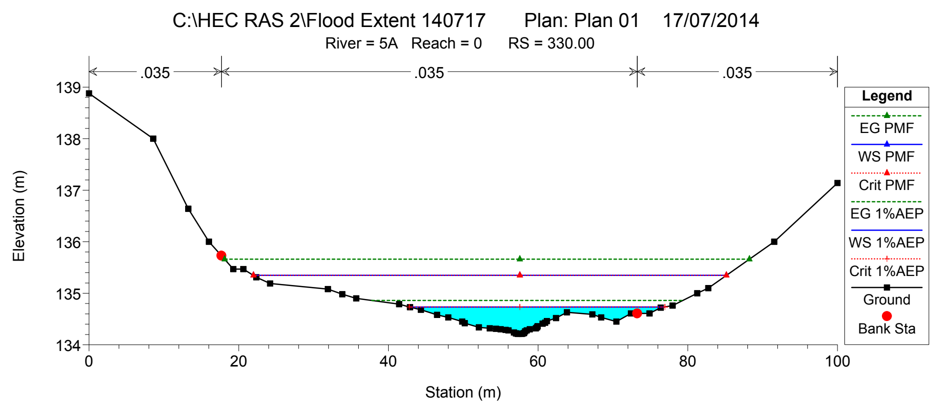

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 435.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

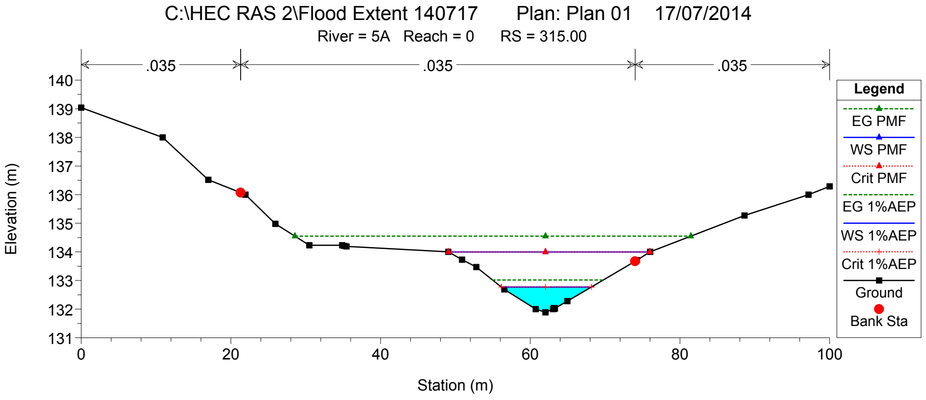

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 420.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

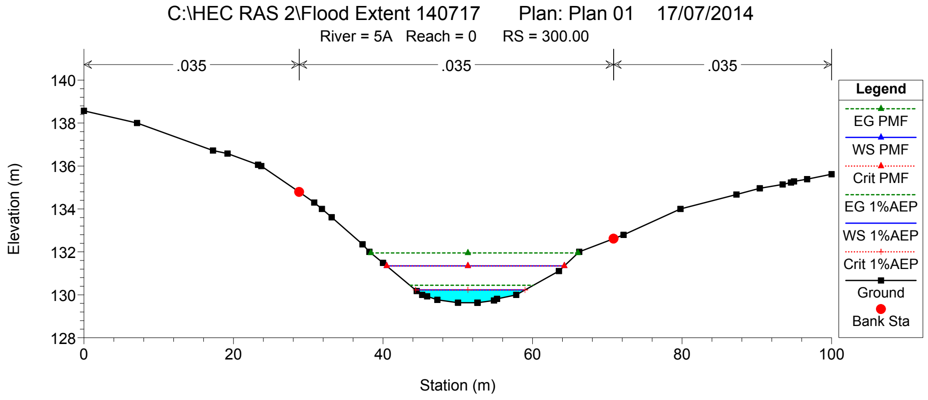

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 405.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
Crit 1%AEP
WS 1%AEP
Ground
Bank Sta

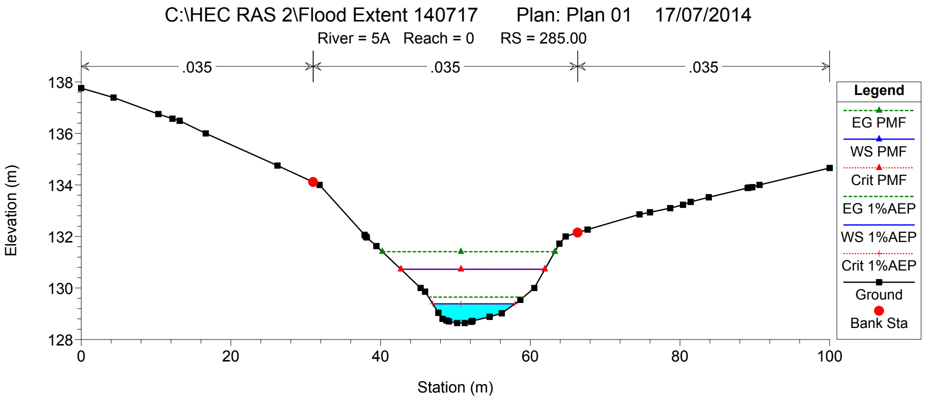

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 390 RS = 390.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

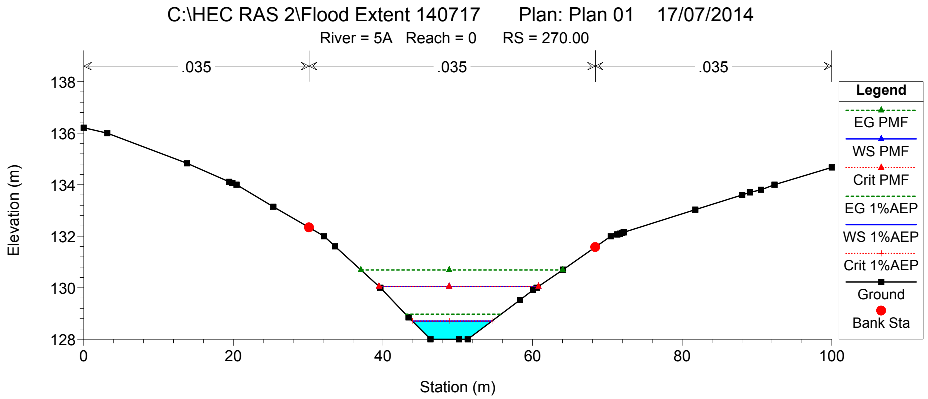

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 345.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

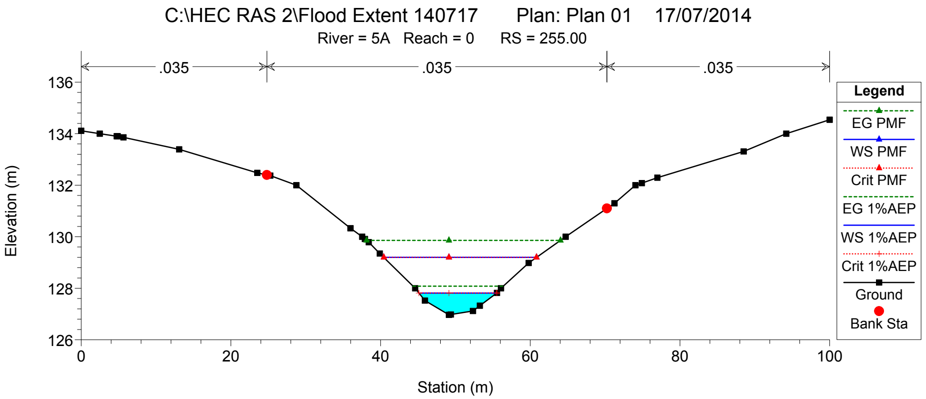

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 330.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

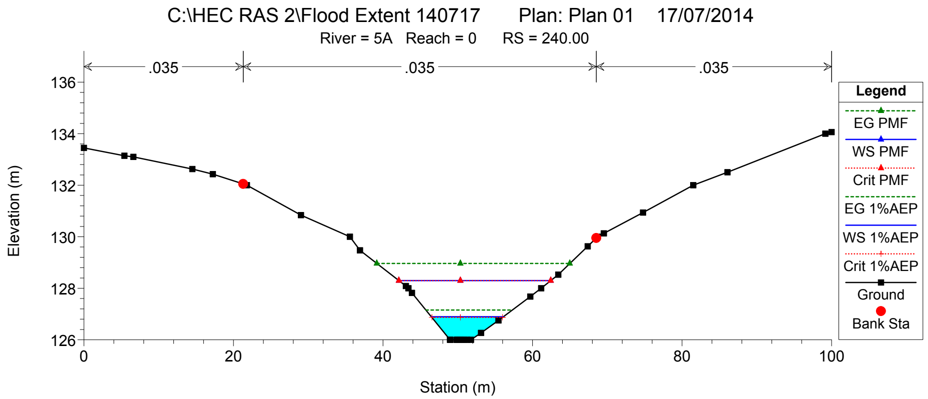

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 315.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

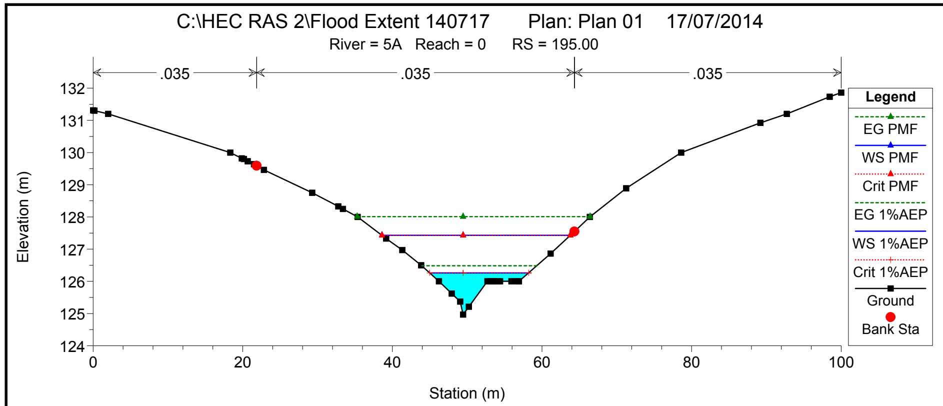

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 300.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

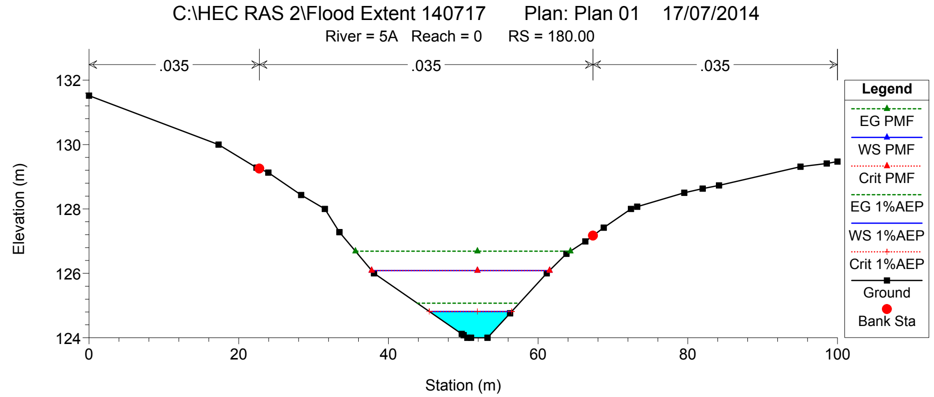

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 285.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

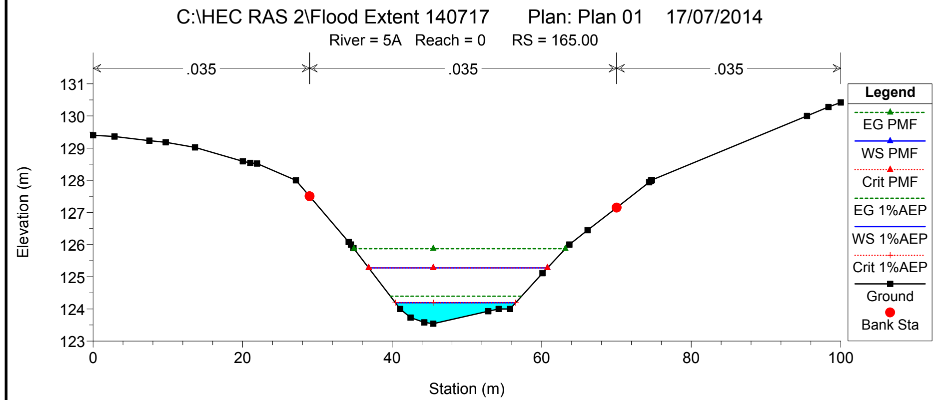

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 270.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

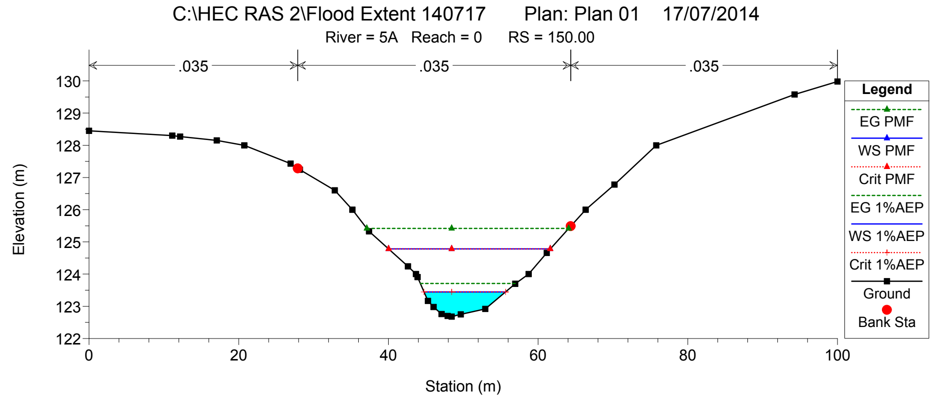

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 255.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

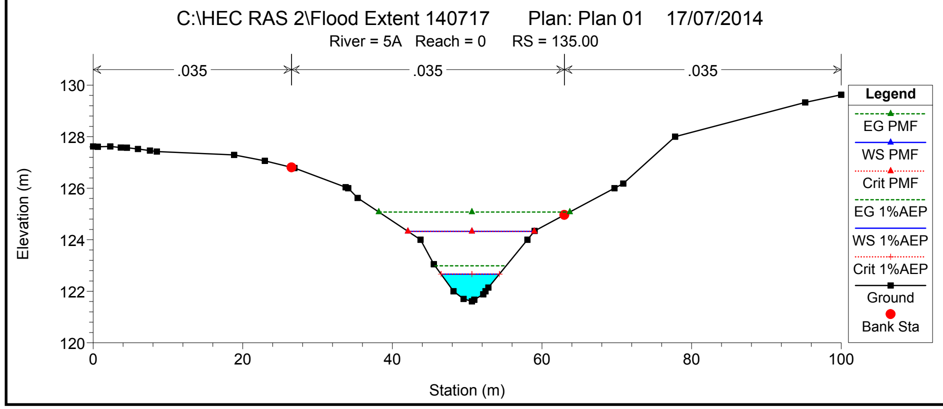

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 240.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

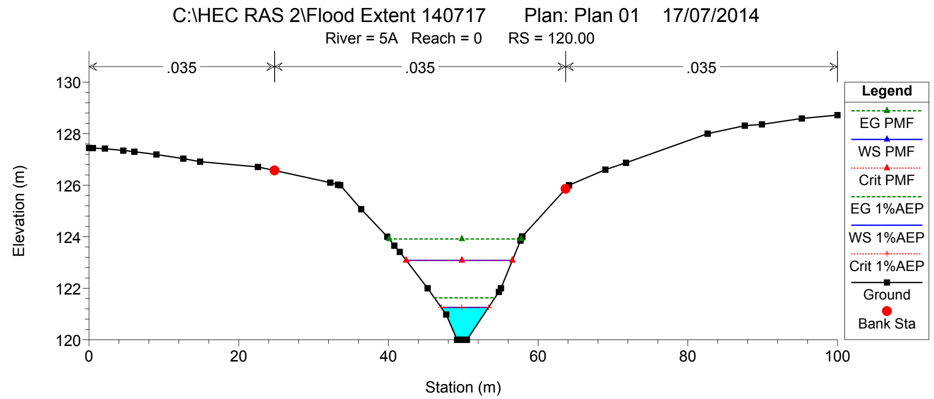

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 195.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

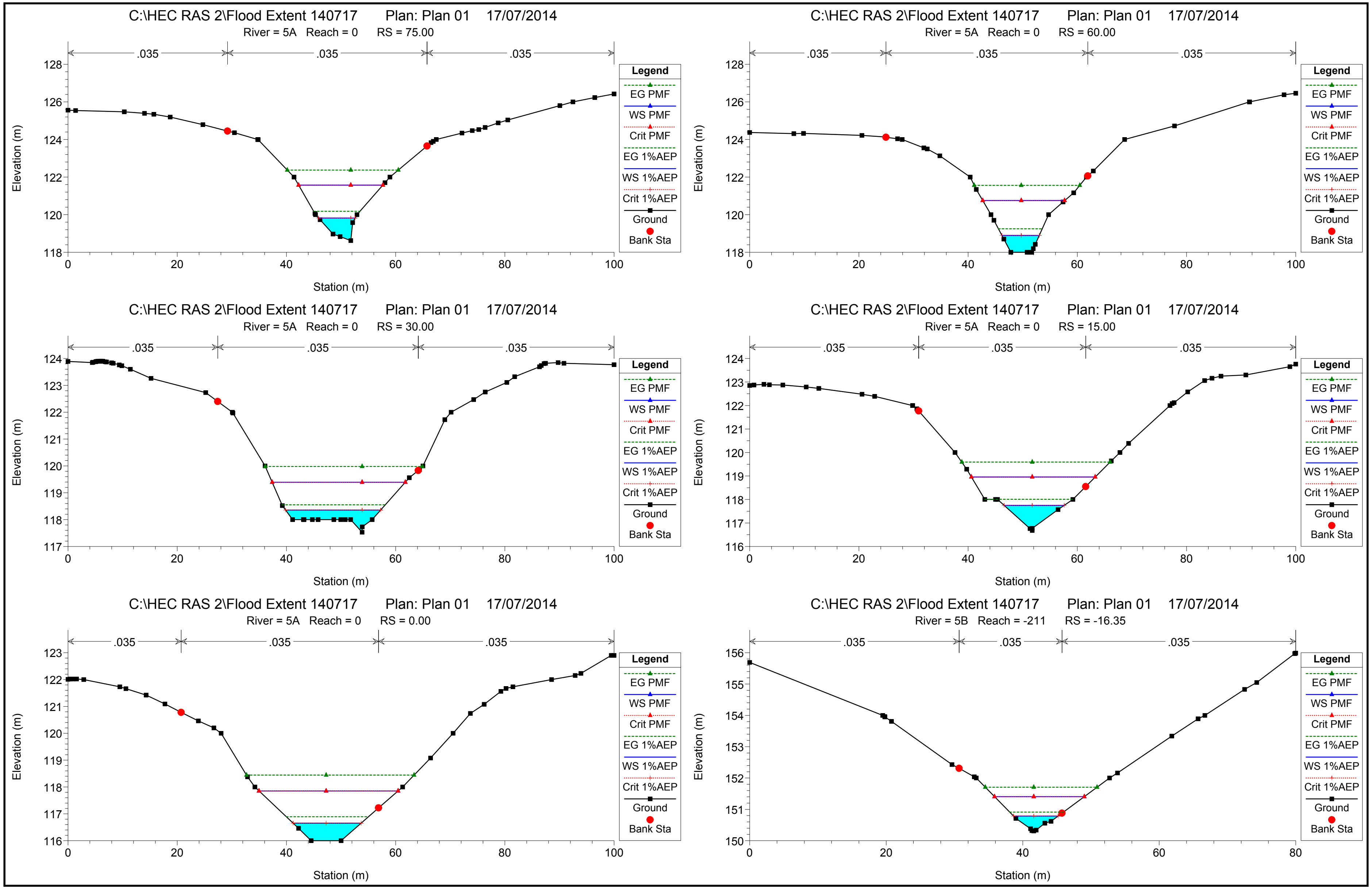

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 180.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 165.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta

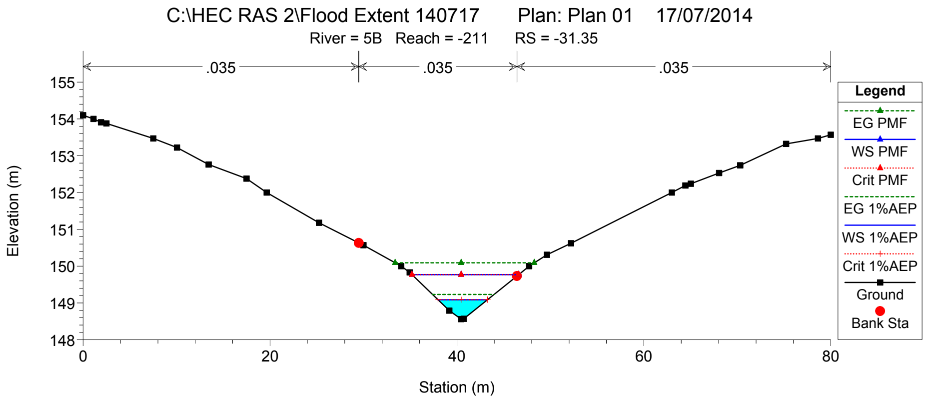

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 150.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 135.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 120.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 75.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 60.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 30.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 15.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5A Reach = 0 RS = 0.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -16.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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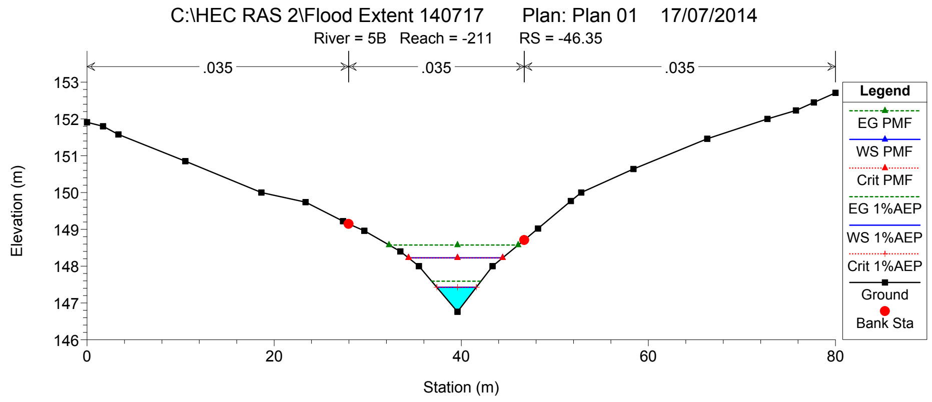
River = 5B Reach = -211 RS = -31.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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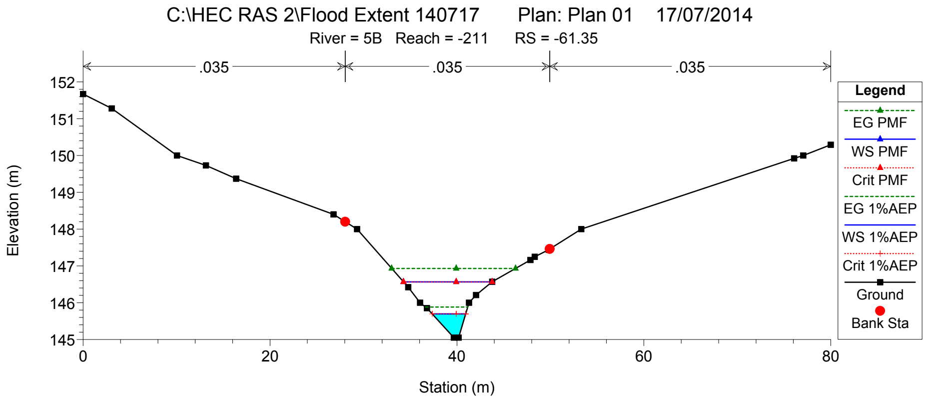
River = 5B Reach = -211 RS = -46.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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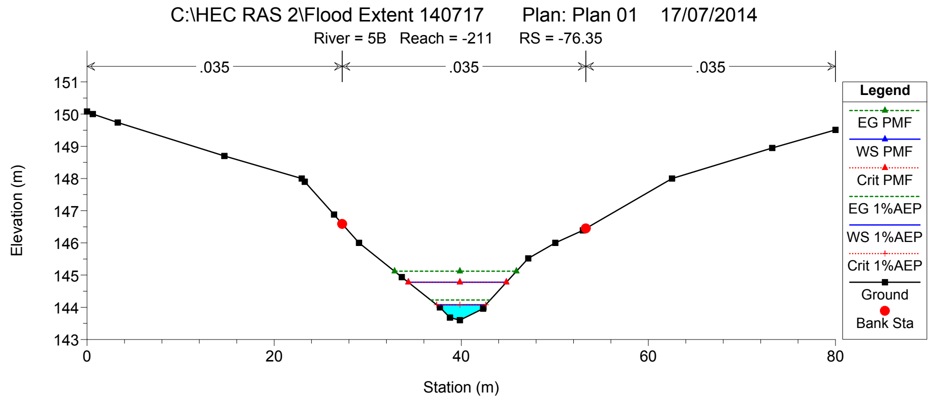
River = 5B Reach = -211 RS = -61.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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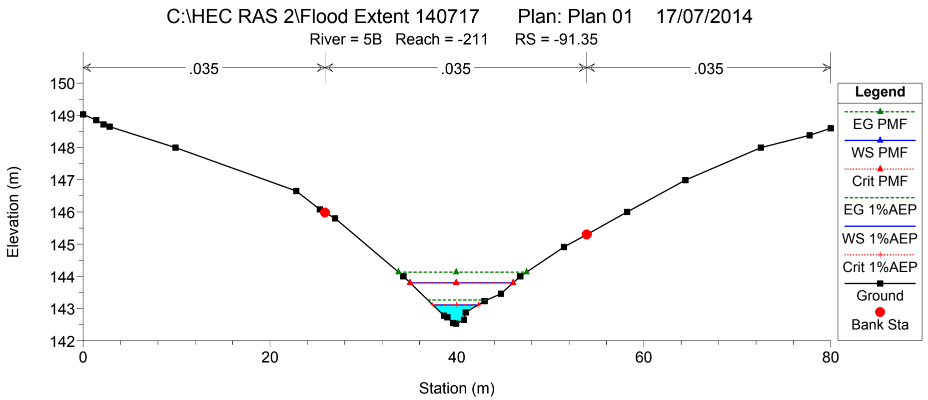
River = 5B Reach = -211 RS = -76.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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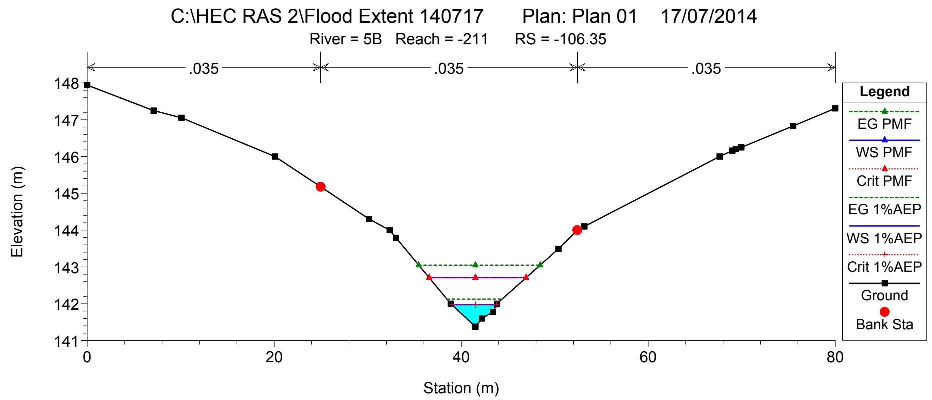
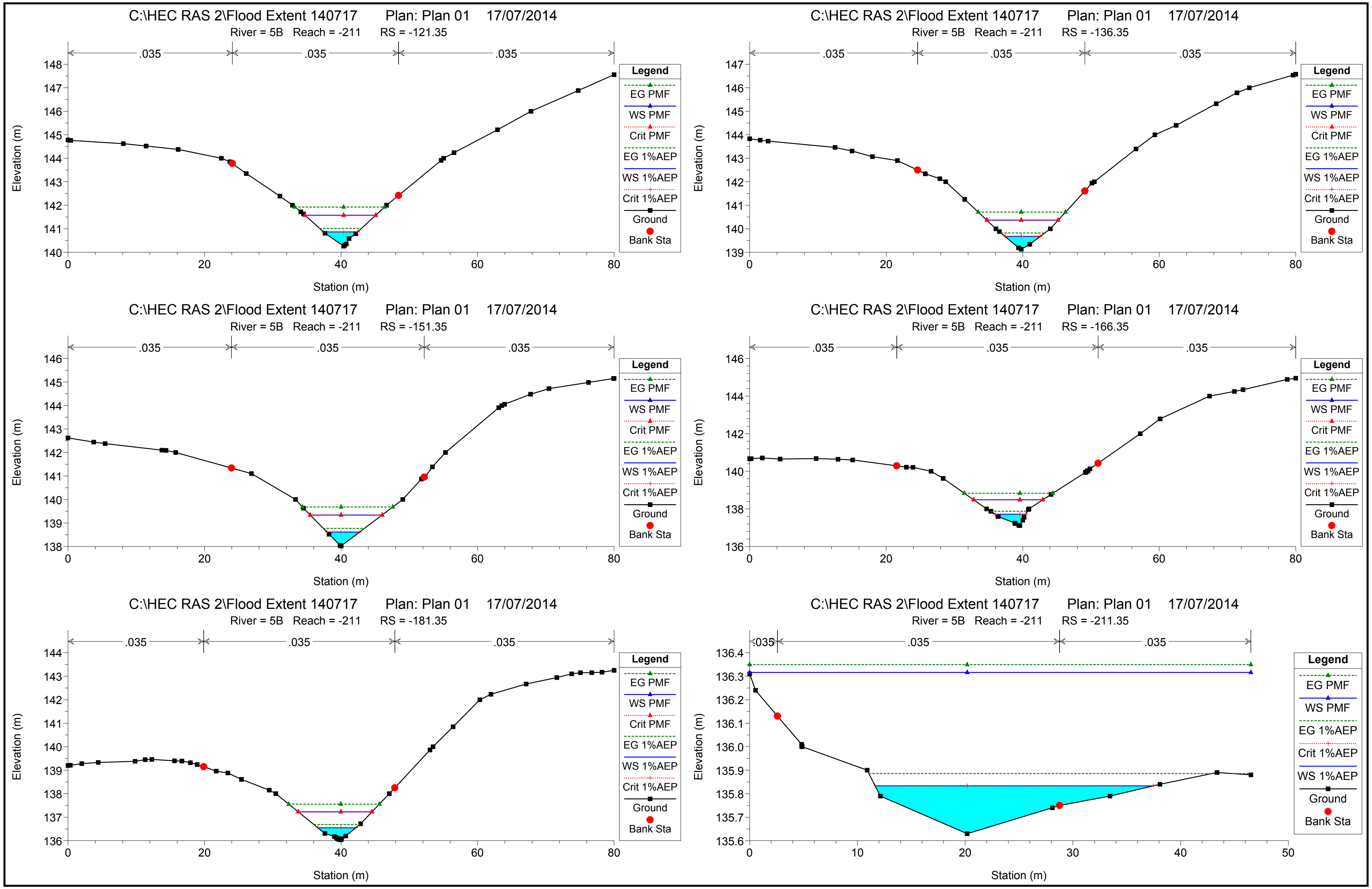
River = 5B Reach = -211 RS = -91.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -106.35
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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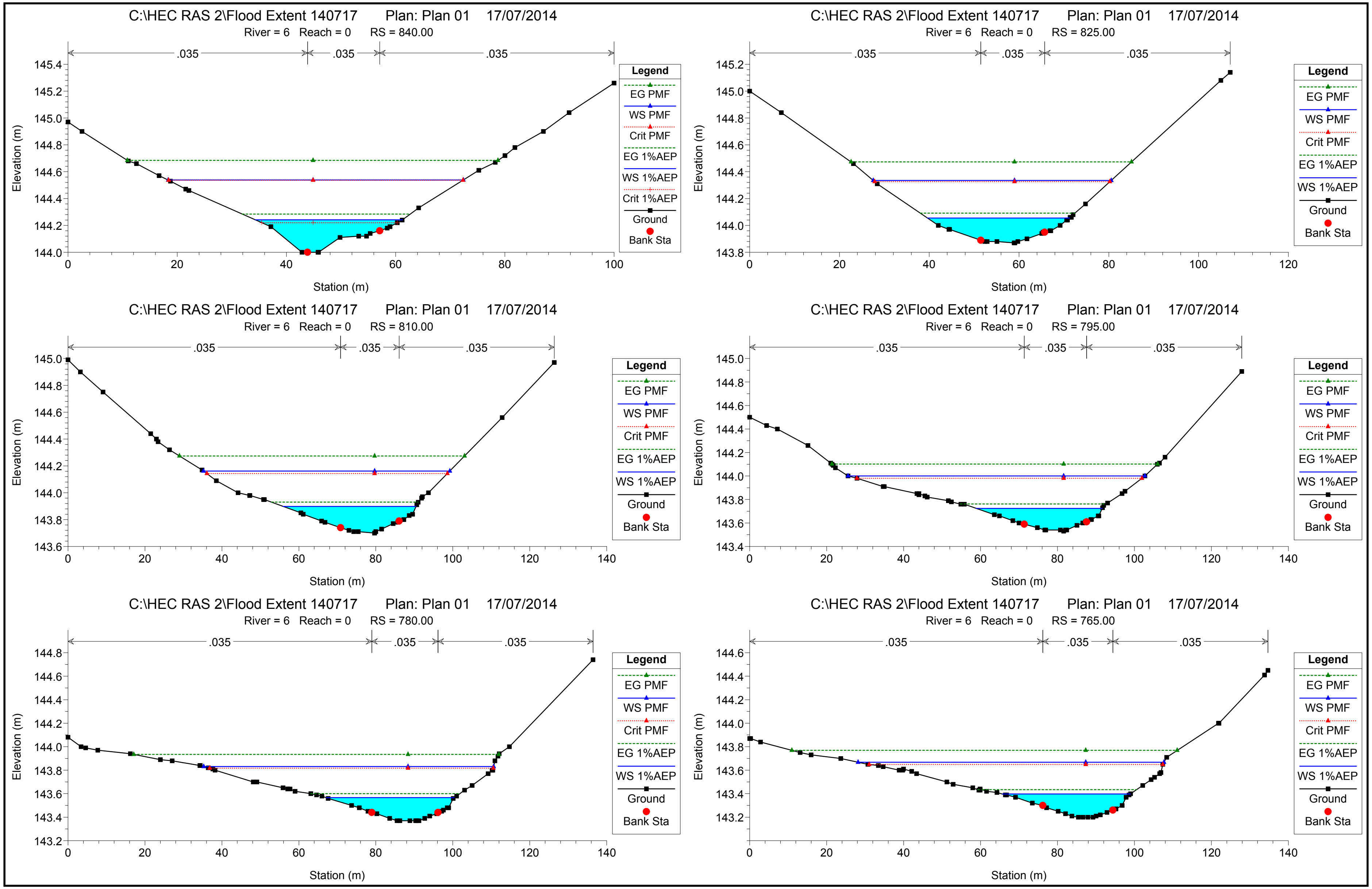
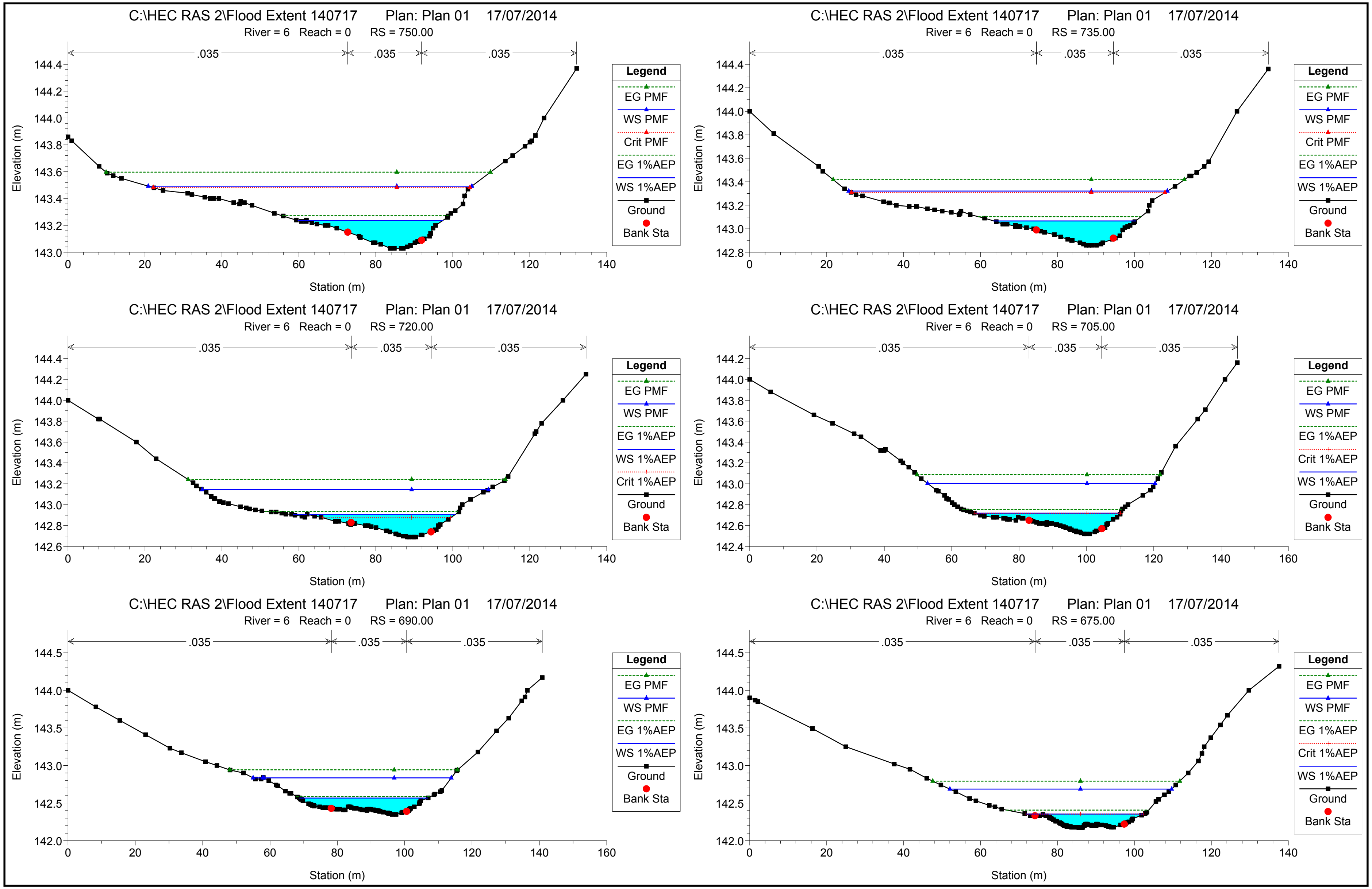
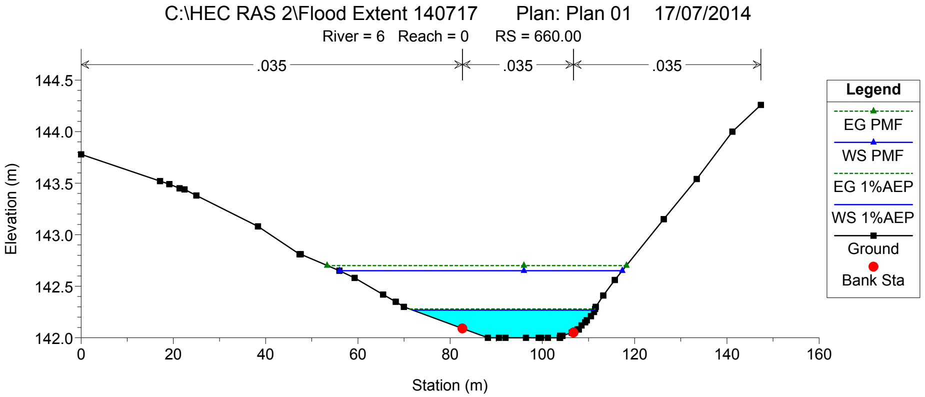
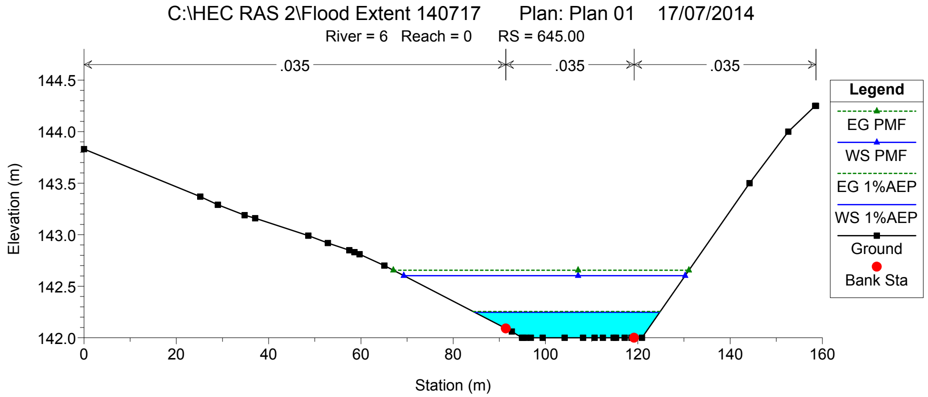
River = 5B Reach = -211 RS = -121.35
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -136.35
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -151.35
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -166.35
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -181.35
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 5B Reach = -211 RS = -211.35


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 840.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 825.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 810.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 795.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 780.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 765.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta



C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 750.00
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 735.00
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 720.00
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 705.00
Legend
EG PMF
WS PMF
EG 1%AEP
Crit 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 690.00
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 675.00
Legend
EG PMF
WS PMF
EG 1%AEP
Crit 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 660.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)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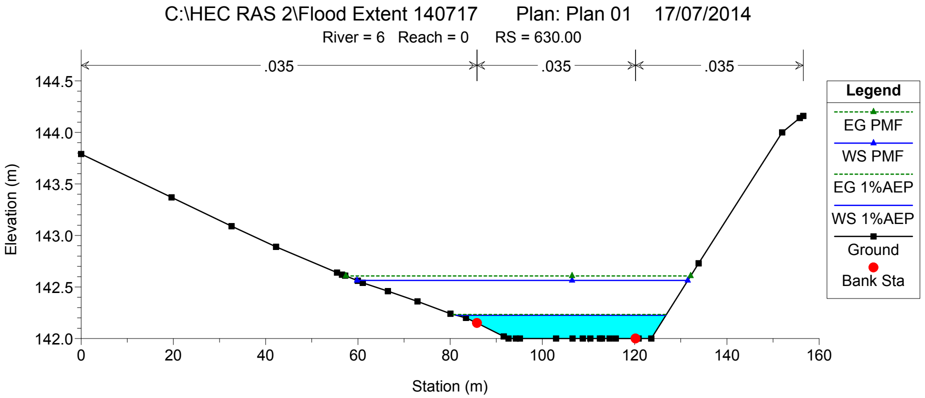
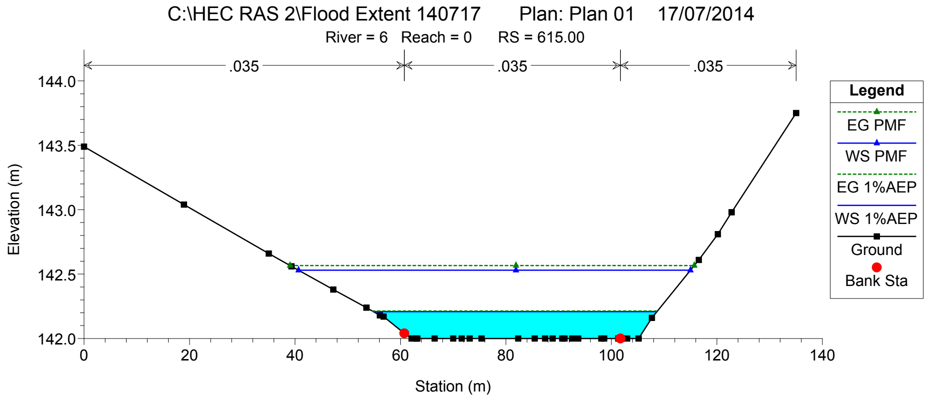
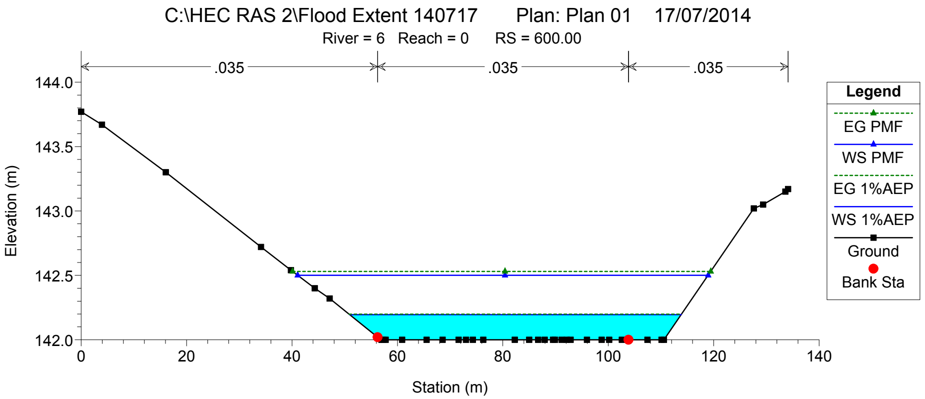
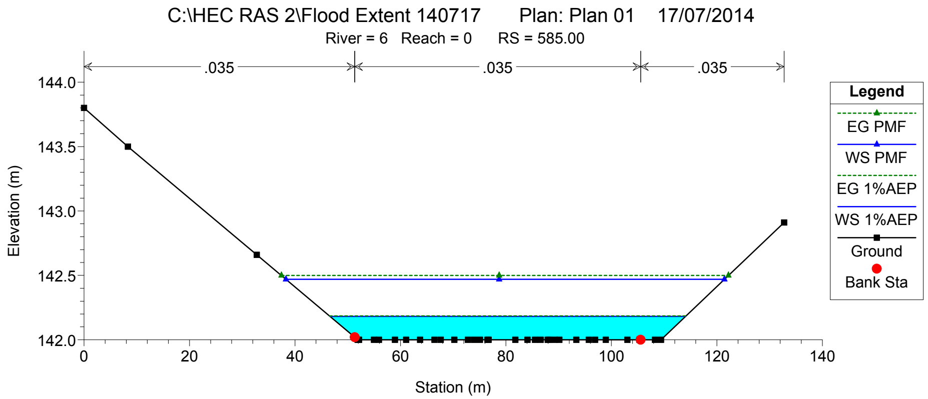
River = 6 Reach = 0 RS = 645.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 630.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 615.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 600.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)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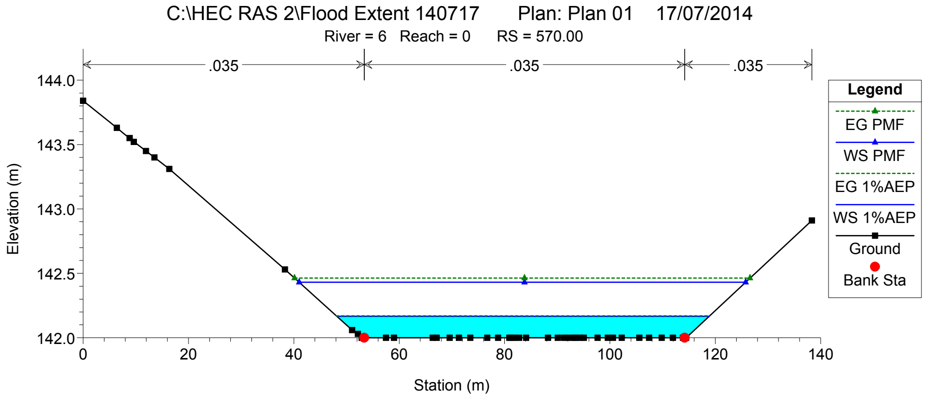
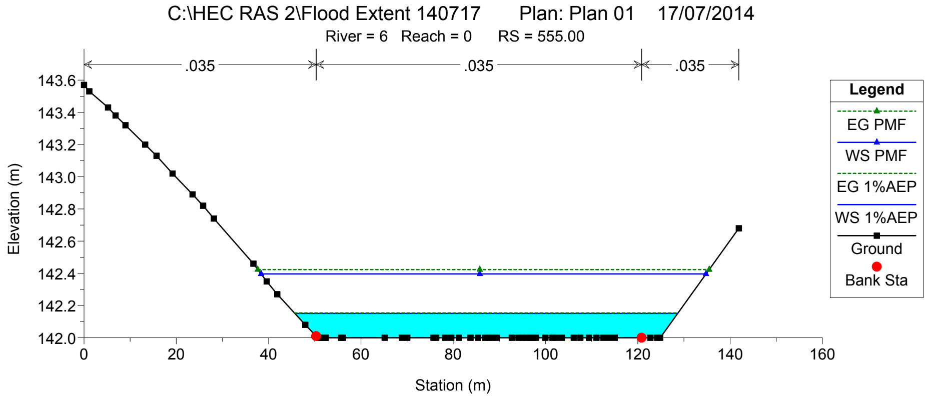
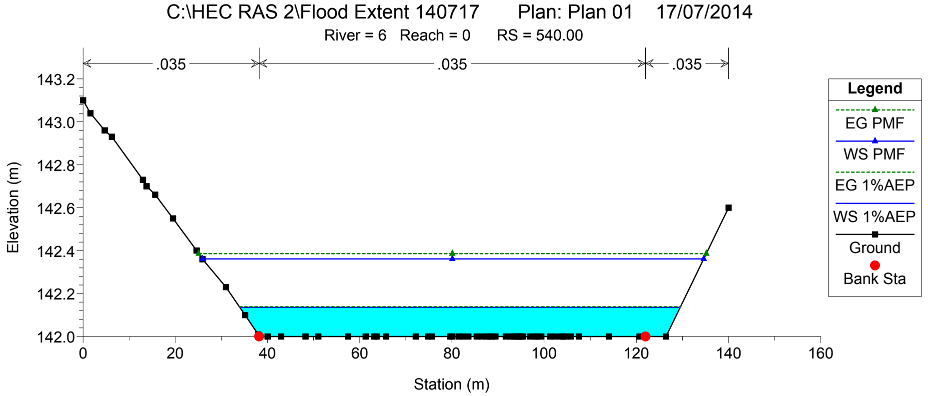
River = 6 Reach = 0 RS = 585.00
.035 .035 .035
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta
Elevation (m)
Station (m)


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 570.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 555.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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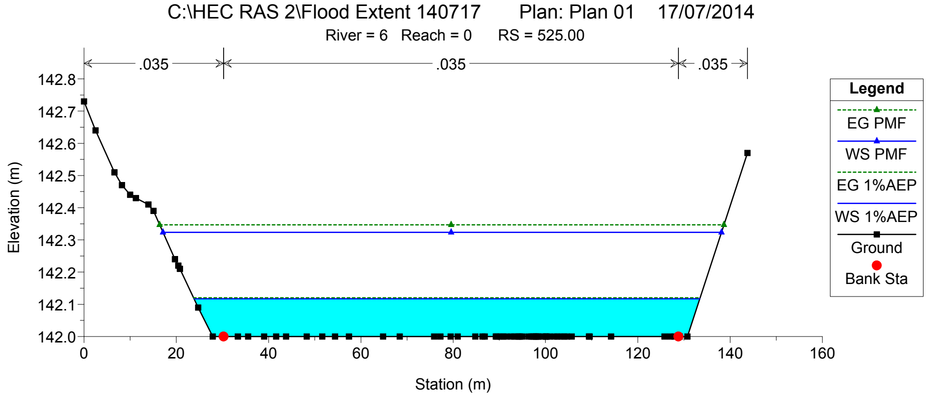
River = 6 Reach = 0 RS = 540.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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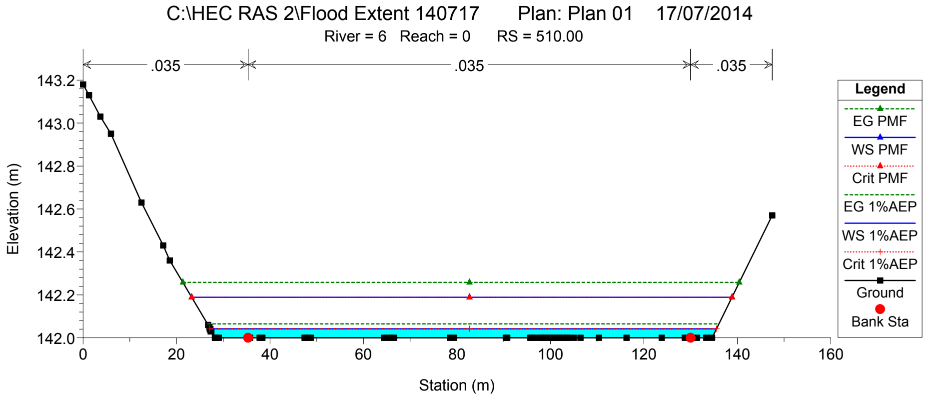
River = 6 Reach = 0 RS = 525.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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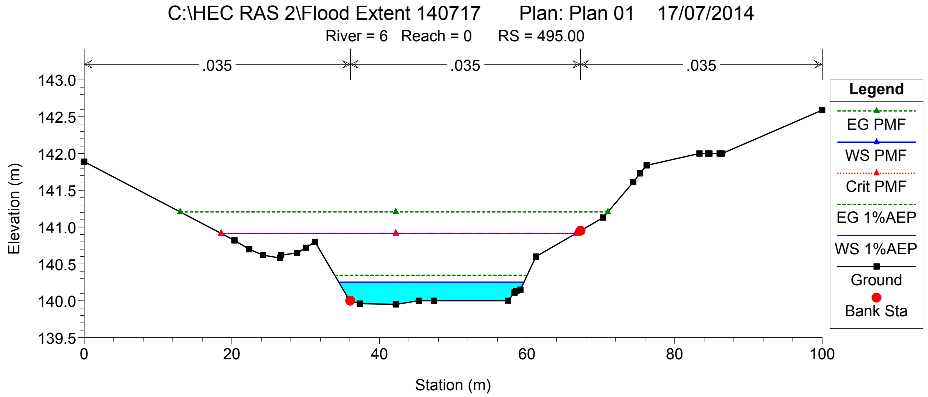
River = 6 Reach = 0 RS = 510.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta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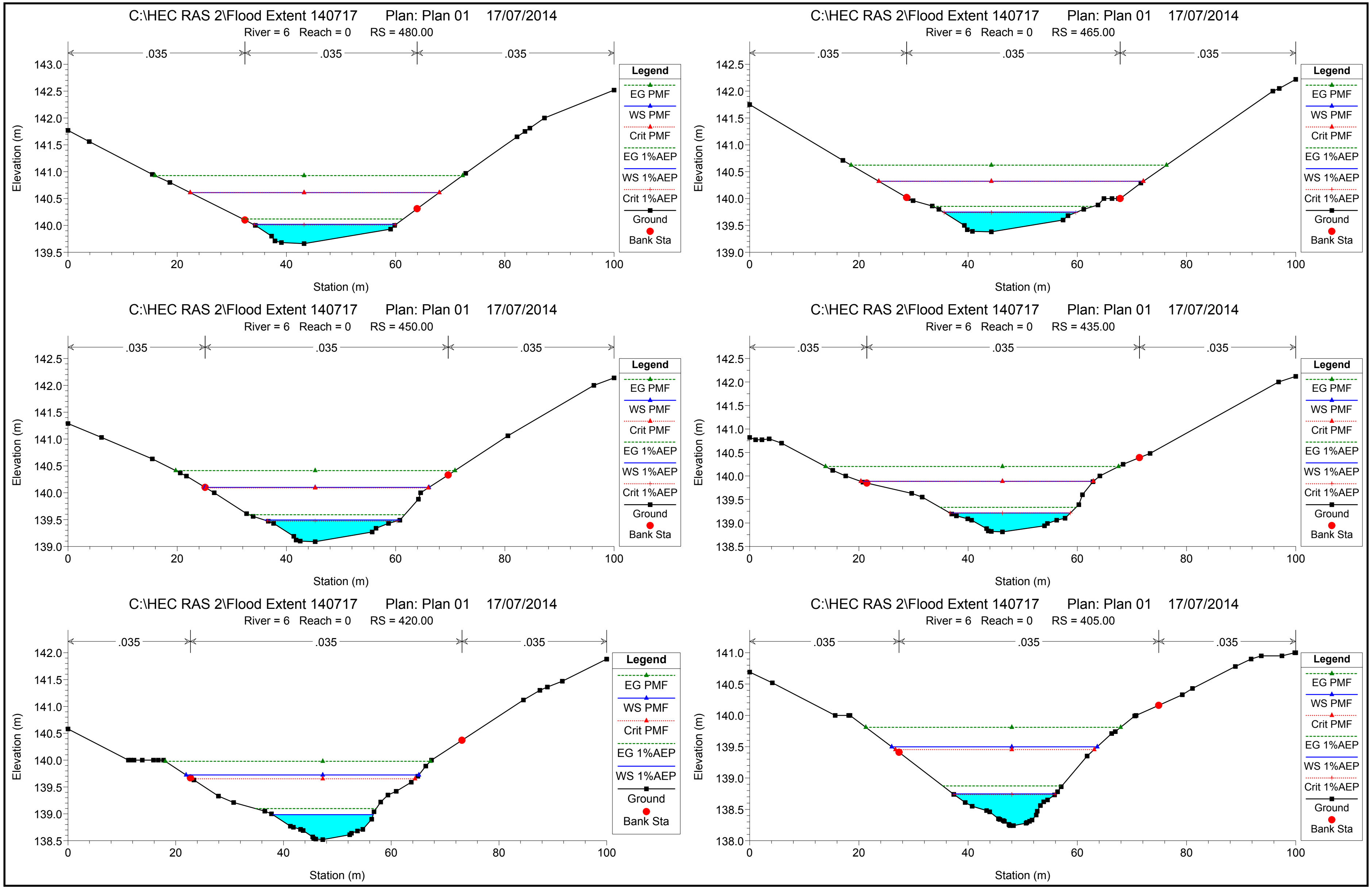
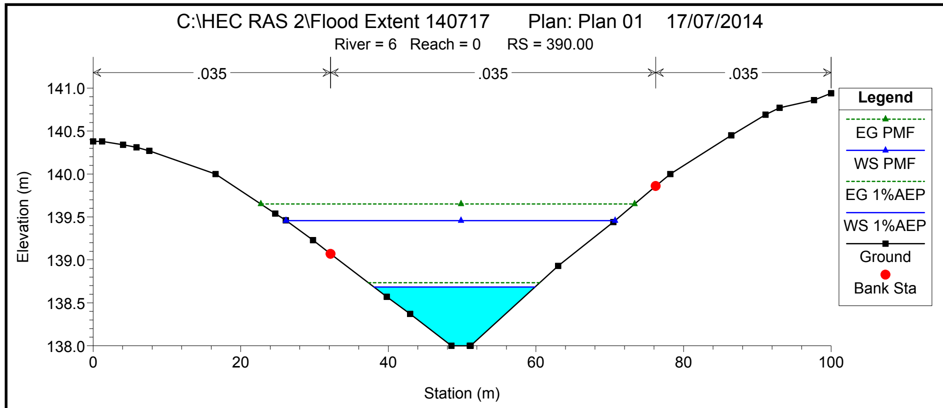
River = 6 Reach = 0 RS = 495.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 480.00
.035 .035 .035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 465.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 450.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 435.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 420.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 405.00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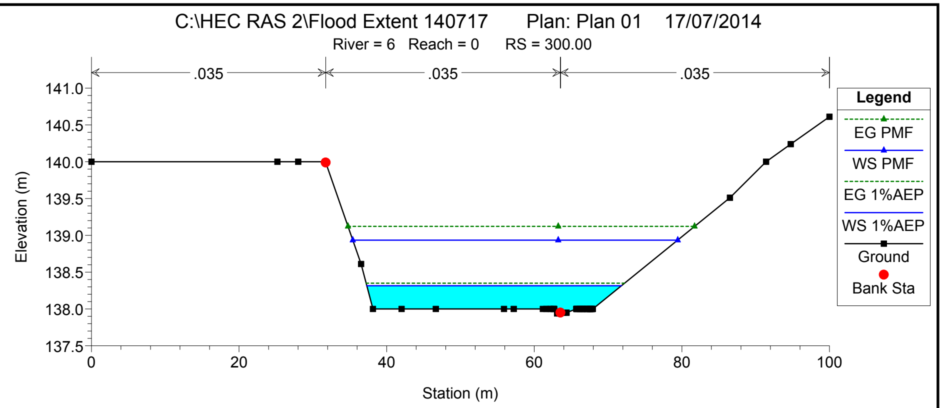
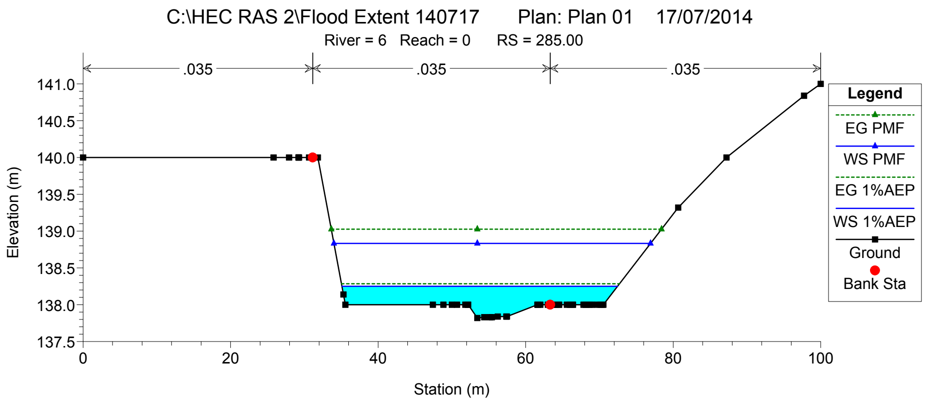
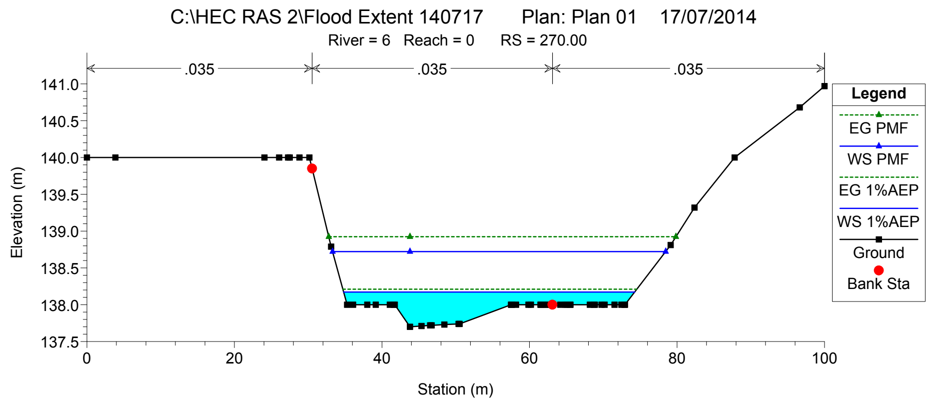
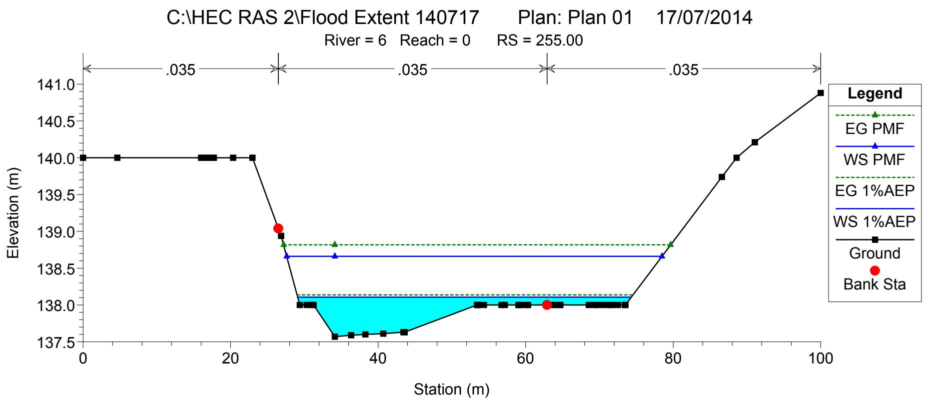
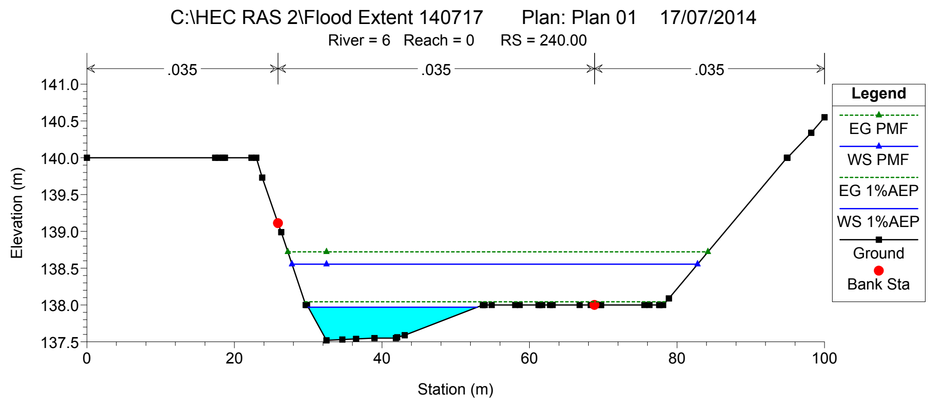
River = 6 Reach = 0 RS = 390.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

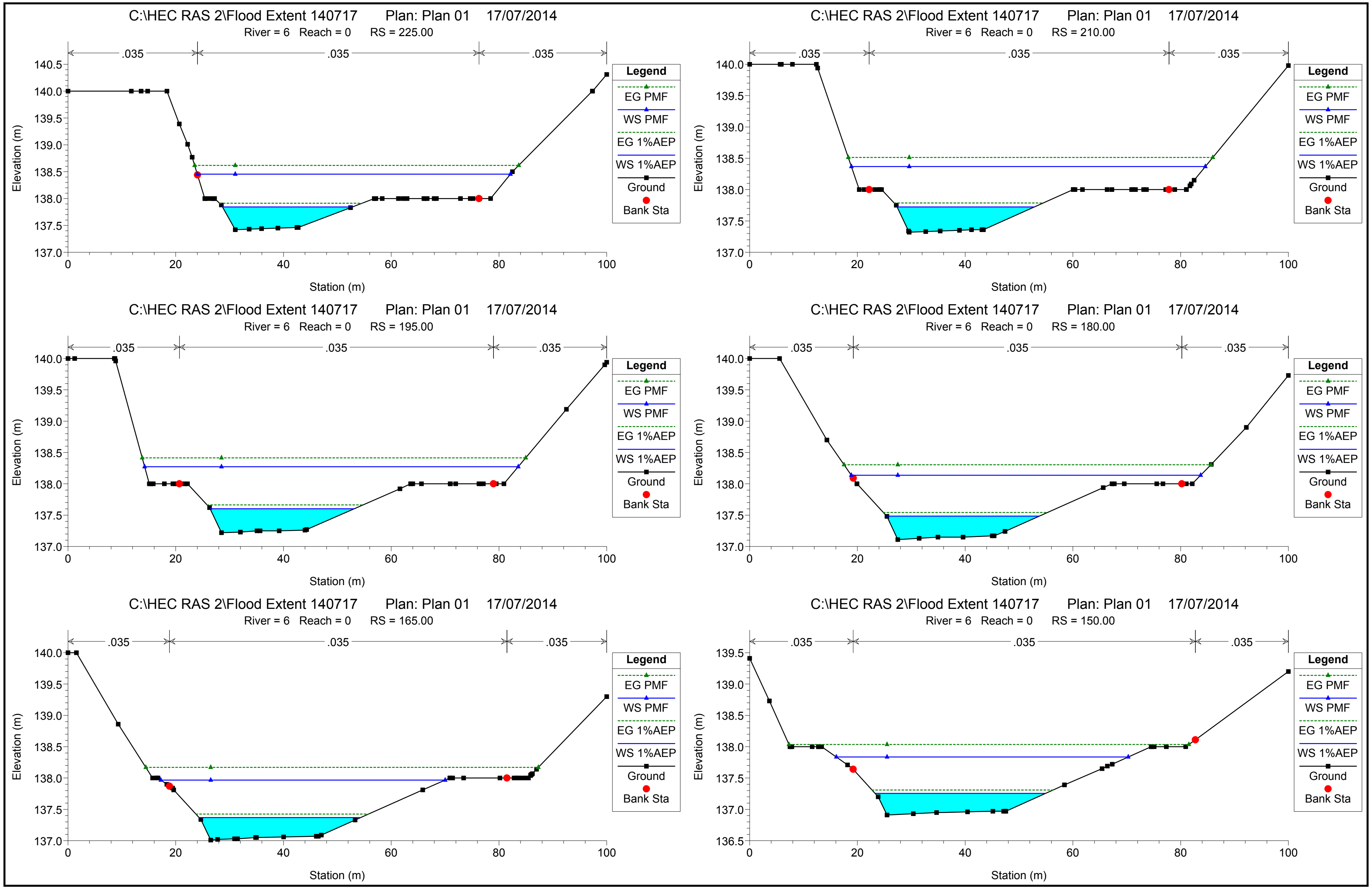

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 300.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta

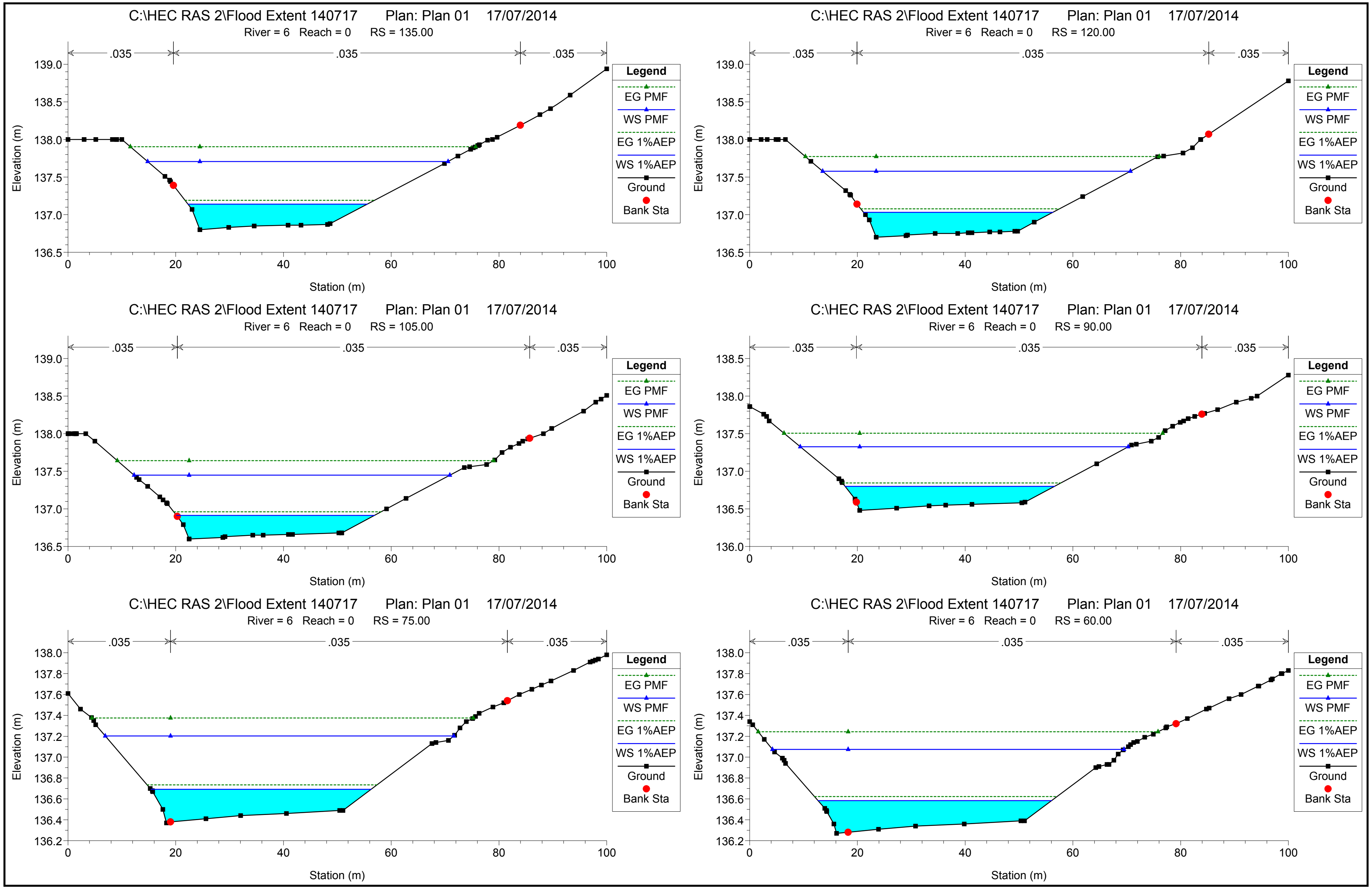

C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 285.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 270.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 255.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 240.00
.035
.035
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta


C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 225.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 210.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 195.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 180.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 165.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 150.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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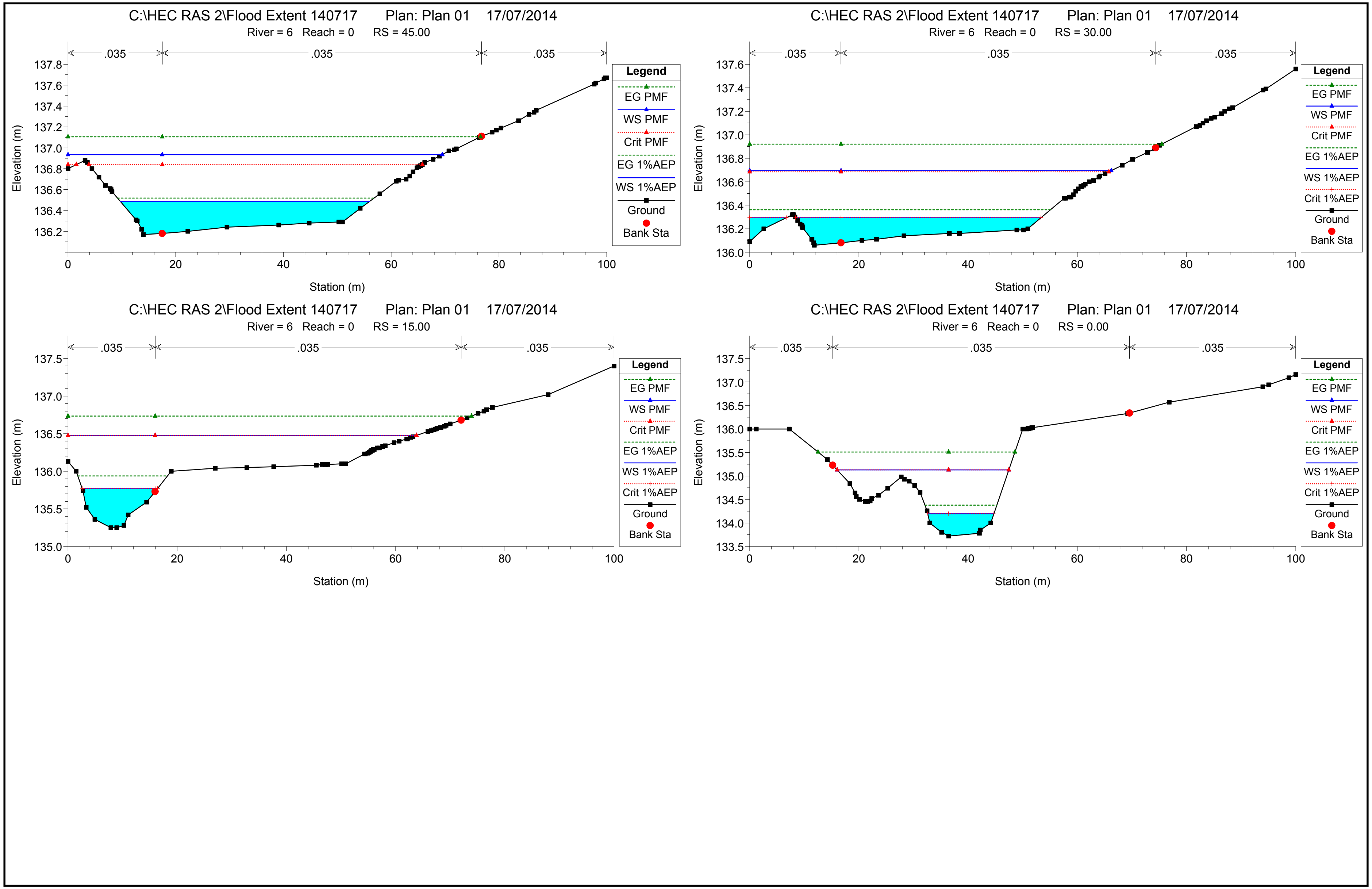
River = 6 Reach = 0 RS = 135.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 120.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 105.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 90.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 75.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 60.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
EG 1%AEP
WS 1%AEP
Ground
Bank Sta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River = 6 Reach = 0 RS = 45.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 30.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 15.00
C:\HEC RAS 2\Flood Extent 140717 Plan: Plan 01 17/07/2014
River = 6 Reach = 0 RS = 0.00
.035
Elevation (m)
Station (m)
Legend
EG PMF
WS PMF
Crit PMF
EG 1%AEP
WS 1%AEP
Crit 1%AEP
Ground
Bank Sta