



VALDOR ENGINEERING INC.

Municipal • Land Development • Water Resources
Site Development • Project Management • Contract Administration
Consulting Engineers – est. 1992

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September 2026

File: **23142**

Briarwood (Dundalk) Ltd.



Attention: **Enzo Di Giovanni**
President

Dear Mr. Di Giovanni:

Re: **Floodplain Analysis for Proposed Development (Condominium Apartments)**
Ida Street, Village of Dundalk
Township of Southgate, Ontario

Background

Valdor Engineering Inc. was retained by Briarwood (Dundalk) Ltd. to complete a hydrology/hydraulic analysis and floodplain mapping assignment using Visual OTTHYMO and HEC-RAS regarding a parcel of land of which a portion is proposed to be developed as residential condominium apartments. The full property (*i.e.* subject site) is located on the east side of Ida Street and North of Eco Parkway in Dundalk and within the Township of Southgate as shown on the Site Location Plan provided in **Figure 1**. While the full property (*i.e.* subject site) extends between Ida Street to east of the Rail Trail, the proposed development site is limited to a smaller portion of the subject site immediately northeast of Ida Street.

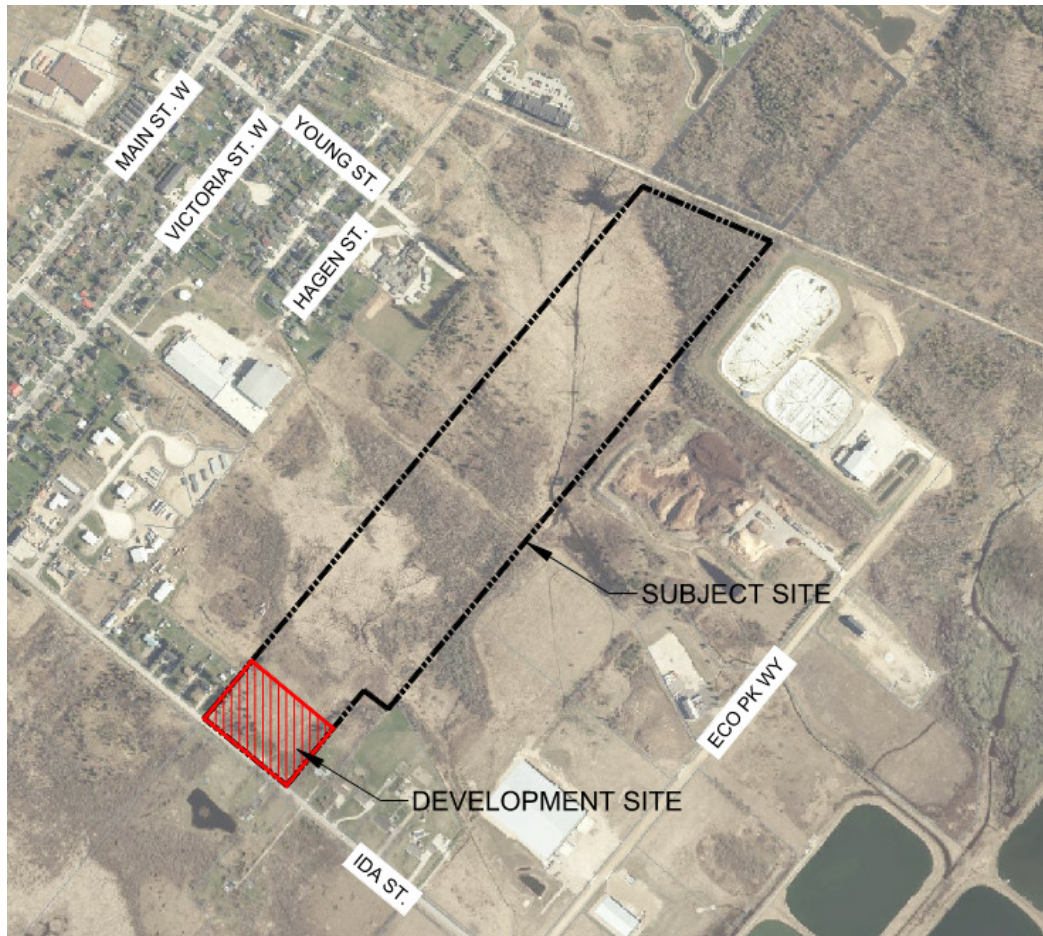
As shown in **Figure 2**, the proposed development site is located immediately to the southwest of Tributary 1A. The remainder of the subject site is traversed by Tributary 1B, Tributary 2A and Tributary 2B. The floodplain associated with Tributaries 1A, 1B, 2A and 2B is not currently mapped based on regulation mapping available from GRCA. As such, the development of a hydraulic model and delineation of the floodplain is required to confirm that the proposed development is located outside the flood hazard.



Professional Engineers
Ontario

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Figure 1: Site Location Plan (Dundalk, Ontario)



Methodology

Hydrology

A hydrologic model using Visual OTTHYMO (VO) was prepared to determine the peak flows to be used in the hydraulic model.

The contributing drainage areas to the ditch/watercourse within the subject site and other identified flow node locations are illustrated in **Figure 2**. The catchment areas were delineated based on contour mapping prepared using the Ontario Digital Surface Model (LiDAR-derived) Land Information Ontario (LIO) Dataset. The Ontario Digital Surface Model is a compilation of raster digital elevation data from multiple acquisition projects completed within Ontario. The hydrologic soil groups for each catchment were determined based on the soils mapping provided in *Soil Map of Dufferin County, Ontario* (Soil Survey Report No.38, 1964). Land uses for each catchment were determined based on satellite imagery. The initial abstraction values were determined using land type. The supporting calculations (**Tables A.1** through **A.3**) and hydrology model schematic (**Figure A.1**) and model output for the hydrologic model are provided in **Attachment 'A'**. The

identified Catchments 101 (29.73 ha), 102 (44.83 ha), and 103 (40.97 ha) drain to Tributary 1 and 201 (24.18 ha), 202 (36.26 ha), and 203 (301.0 ha) drain to Tributary 2. These two tributaries both drain into the Grand River. Flow Node #1 corresponds to the combined flows from Catchments 101 through 103 (115.53 ha). Flow Node #2 corresponds to the combined flows from Catchments 201 through 203 (361.44 ha).

To determine the Regulatory flow (the greater flow of the 100-year storm or the Regional storm), the 100-year storms for the 1-hour, 6-hour, 12-hour, and 24-hour AES and Regional storm (Hurricane Hazel) were analysed. It was determined that the Hazel storm distribution is the critical storm, resulting in a Regional storm flow of 14.586 m³/s at Flow Node #1 and 18.824 m³/s at Flow Node #2 (see **Table A.4**).

Hydraulics

Hydraulic modelling of the existing conditions was completed by Valdor using the HEC-RAS 4.1.0 hydraulic model (Hydrologic Engineering Center, U.S. Army Corps of Engineers, January 2010). Cross-section data was entered into the model based on the Classified Point Cloud bare earth LiDAR from the Ontario Digital Surface Model (LiDAR-derived) Land Information Ontario (LIO) Dataset. Refer to **Figure 3** for the locations of the HEC-RAS cross-sections. Flows referenced in the HEC-RAS model can be found on **Figure 2**.

Appropriate Manning’s roughness “n” values were selected for each land cover type in the hydraulic model based on a review of satellite imagery and using standard values as per the *HEC-RAS Hydraulic Reference Manual, Version 4.1* (U.S. Army Corps of Engineers, January 2010). For the main channel between bank stations, a value of $n = 0.035$ was selected, appropriate for “clean, straight, full, with stones and weeds but no rifts or deep pools”. For the meadow and treed areas, a composite value of $n = 0.080$ was chosen, and a value of $n = 0.013$ was chosen for pavement and roads.

Field measurements of existing culverts and channel widths were completed at four locations. Culvert GR_001 is located at the railroad trail off Hagan Street East. Culvert GR_002 is located at the intersection of Eco Parkway northeast of Ida Street. Culvert GR_003 is located on Eco Parkway to the southwest of the Lystek Sewage Treatment Plant. Culvert GR_004 is located on a trail northeast of Ida Street and northwest of Eco Parkway upstream of culvert GR_002. Hydraulic structure inventory sheets were prepared and are provided in **Attachment ‘B’**.

It is noted that a discrepancy between the topographic survey and the LiDAR was observed in completing the project design work. Upon further review, it was confirmed that the topographic survey was completed using the CGVD28 vertical datum while the LiDAR uses the CGVD2013 vertical datum. The difference between CGVD2013 and CGVD28 at the site location near Dundalk was obtained from MNR’s COSINE Station Report for Station 00820048005 (see COSINE report provided in **Attachment ‘A’**). To address this discrepancy, and based on discussions with the Township of Southgate, the HEC-RAS cross sections prepared using the

LiDAR surface data were adjusted by +0.414 m to reflect the CGVD28 vertical datum. As such, the floodline and contours presented in this report in **Figure 3** are based on vertical datum CGVD28 to be compliant with the Township of Southgate's vertical datum convention.

Comparison Between the LiDAR Data Set and Available Topographic Survey

A comparison was made between the 2017 LiDAR data set and the available topographic survey. Based on a comparison of elevations, it was determined that the LiDAR data set matched well with the topographic survey (transformed to CGVD2013) at most locations where reliable comparisons could be achieved. Typically, the elevations on open hard surfaces were found to be within 12 cm with an average difference of – 4 cm. The LiDAR data set for all surfaces including those areas with dense vegetation were found to be within 32 cm with an average difference of - 15 cm. A copy of the results of the comparison of elevations completed in and around the subject property is provided in **Table A.5** in **Attachment 'A'**.

Results

Existing Conditions Hydraulics

The results of the HEC-RAS model for existing conditions are summarized for the Hazel storm in **Table 1**. The full set of hydraulic results is provided in **Table B.1** in **Attachment 'B'**. The location of the HEC-RAS cross sections including the extent of the Regulatory floodplain through the subject site and upstream and downstream of the site for existing conditions is included in **Figure 3** and the set of cross-section graphical output for the Regulatory storm is provided in **Figure B.1** in **Attachment 'B'**.

Summary and Recommendations

Based on the results of the hydrologic and hydraulic investigations completed for existing conditions, the proposed development will be located outside of the floodplain as illustrated in **Figure 3**. As such, it is recommended that the site be approved for development.

Respectfully submitted,

VALDOR ENGINEERING INC.

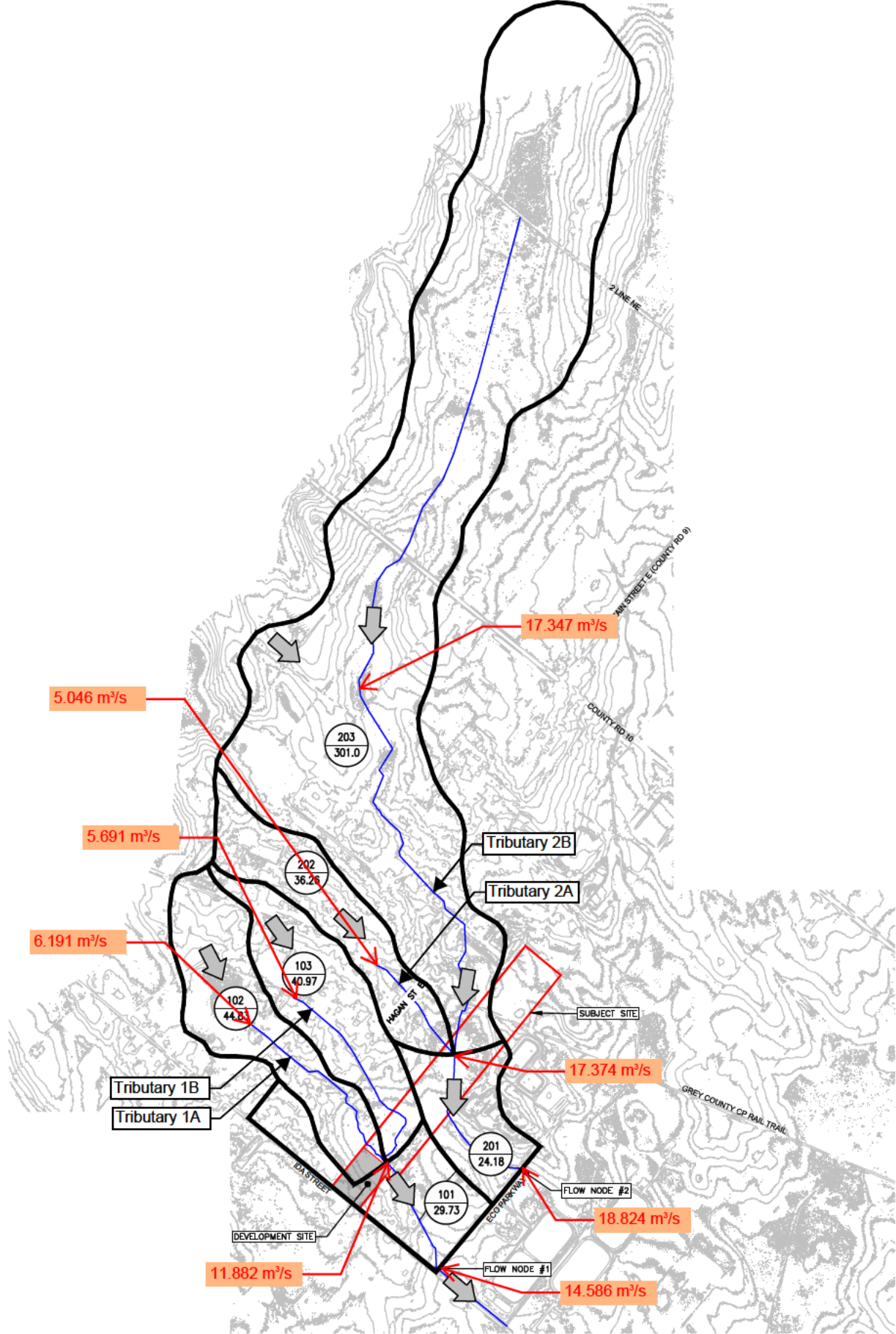


Bill Coffey, M.Sc., P.Eng.
Senior Advisor, Water Resources



Phoebe Yung, B.Eng.
Water Resource Analyst

This report was prepared by Valdor Engineering Inc. for the account of Briarwood (Dundalk) Ltd. The comments, recommendations and material in this report reflect Valdor Engineering Inc.'s best judgement in light of the information available to it at the time of preparation. Any use of which a third party makes of this report, or any reliance on, or decisions made based on it, are the responsibility of such third parties. Valdor Engineering Inc. accepts no responsibility whatsoever for any damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



LEGEND

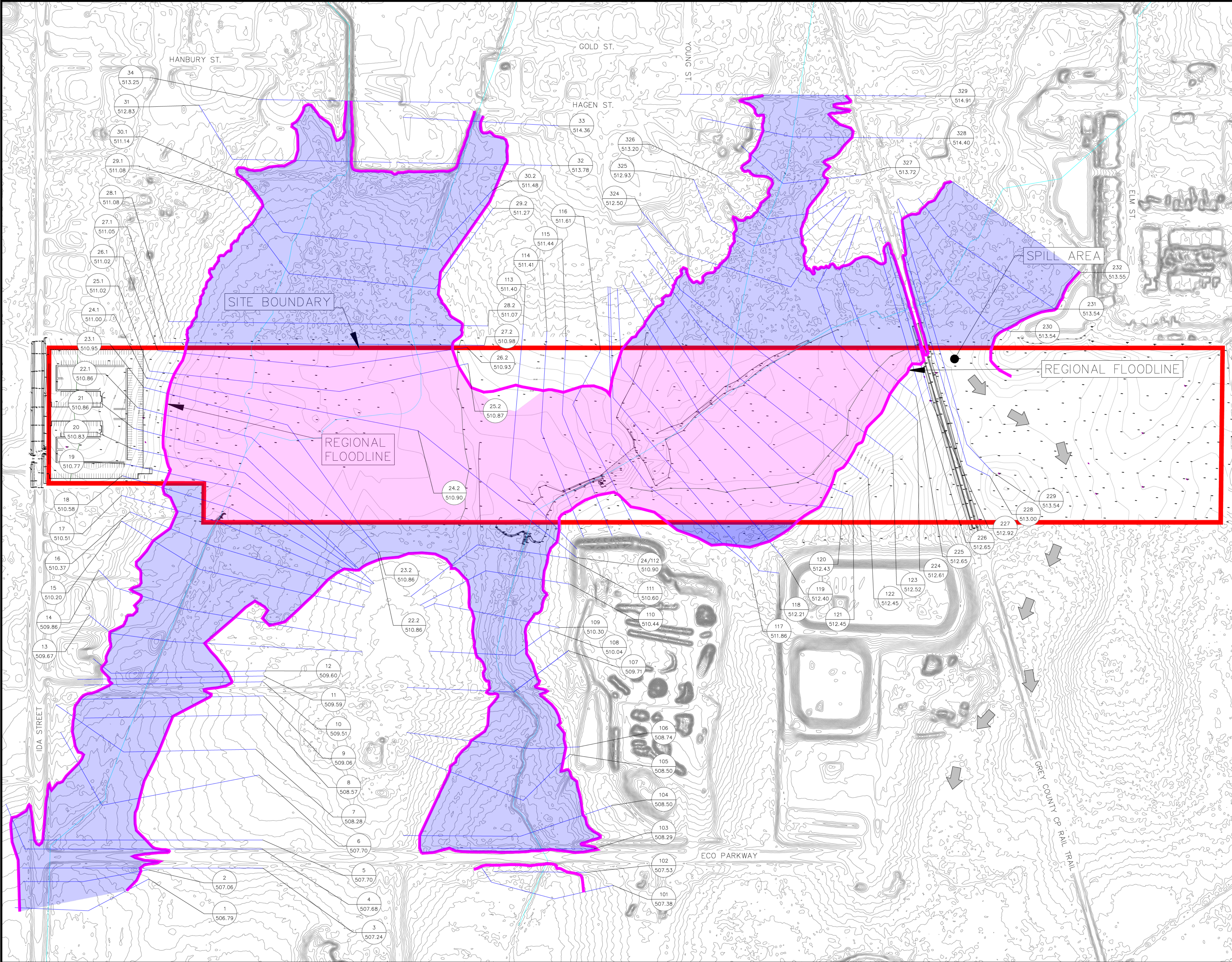
- 101

10.00

CATCHMENT ID

AREA (HA)
- DRAINAGE BOUNDARY
- DRAINAGE BOUNDARY
- OVERLAND FLOW

PROJECT BRIARWOOD DUNDALK SUBDIVISION GRAND RIVER CONSERVATION AREA	
TITLE DRAINAGE PLAN	
VALDOR ENGINEERING INC. Consulting Engineers - Project Managers 571 Christa Road, Unit 4, 2nd Floor Vaughan, Ontario, L4L 8A2 TEL (905)264-0054, FAX (905)264-0069 E-MAIL: info@valdor-engineering.com www.valdor-engineering.com	
PREPARED BY P.Y.	CHECKED BY B.C.
SCALE 1:25000	DATE JAN. 2024
PROJECT 23142	FIGURE 2



BEARING NOTES

POINT ID	NORTHING	EASTING

LEGEND

- EXISTING REGIONAL FLOODLINE
- HEC-RAS CROSS SECTION
- ELEVATION
- WATERCOURSE
- HEC-RAS CROSS-SECTION
- REGIONAL WATER SURFACE ELEVATION (m)

3					
2					
1					
No.	Revision	Date	By	App'd	
BENCHMARK:					
No.	Elevation:	Description:			

CONSULTANT:	REVIEWED BY
	C.E.T./C.Tech () OTHER () P. Eng ()
	ENGINEERING AND CORPORATE ASSETS DEPARTMENT
	DATE:

VALDOR ENGINEERING INC.
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DUNDALK SUBDIVISION

FLOODPLAIN MAPPING
EXISTING

Scale: 1/2000	Checked by: B.C.	Project No. 23142
Drawn by: P.Y.	Approved by: B.C.	
Designed by: P.Y.	Date: JUL 2026	Drawing No.
		Sheet No.

FIGURE 3

ATTACHMENT 'A'

Hydrology Model (VO)

Supporting Documentation and Calculations

Date:September 2026

**Table A.1: Summary of VO Model Parameters
Pre-Development Conditions**

[illegible]

VALDOR ENGINEERING INC.

File: 23142

Date: September 2026

Table A.2: Calculation of CN Values, Initial Abstractions and Runoff Coefficients									
Subcatchment	Area (ha)	Land Use and Land Cover		CN II	Area Weighted CN II	IA (mm)	Area Weighted IA (mm)	C-Value	Area Weighted C-Value
		Type	Area (ha)						
101	29.73	Row Crops (HSG 'BC')	0.00	85	71	7	6.4	0.35	0.34
		Forest (HSG 'BC')	2.28	63		10		0.25	
		Lawn (HSG 'BC')	6.41	68		5		0.11	
		Meadow (HSG 'BC')	15.45	65		8		0.28	
		Industrial (HSG 'BC')	3.46	90		2		0.70	
		Other Impervious	2.14	100		2		0.95	
102	44.83	Row Crops (HSG 'BC')	0.00	85	75	7	5.5	0.35	0.40
		Forest (HSG 'BC')	1.29	63		10		0.25	
		Lawn (HSG 'BC')	13.33	68		5		0.11	
		Meadow (HSG 'BC')	17.94	65		8		0.28	
		Industrial (HSG 'BC')	1.92	90		2		0.70	
		Other Impervious	10.35	100		2		0.95	
103	40.97	Row Crops (HSG 'BC')	0.00	85	77	7	4.7	0.35	0.39
		Forest (HSG 'BC')	0.00	63		10		0.25	
		Lawn (HSG 'BC')	19.44	68		5		0.11	
		Meadow (HSG 'BC')	8.73	65		8		0.28	
		Industrial (HSG 'BC')	3.05	90		2		0.70	
		Other Impervious	9.75	100		2		0.95	
201	24.18	Row Crops (HSG 'BC')	0.00	85	68	7	7.3	0.35	0.32
		Forest (HSG 'BC')	0.00	63		10		0.25	
		Lawn (HSG 'BC')	1.11	68		5		0.11	
		Meadow (HSG 'BC')	20.88	65		8		0.28	
		Industrial (HSG 'BC')	1.08	90		2		0.70	
		Other Impervious	1.11	100		2		0.95	
202	36.26	Row Crops (HSG 'BC')	0.00	85	77	7	4.7	0.35	0.40
		Forest (HSG 'BC')	0.00	63		10		0.25	
		Lawn (HSG 'BC')	16.34	68		5		0.11	
		Meadow (HSG 'BC')	8.41	65		8		0.28	
		Industrial (HSG 'BC')	2.71	90		2		0.70	
		Other Impervious	8.80	100		2		0.95	
203	301.00	Row Crops (HSG 'BC')	167.98	85	79	7	6.9	0.35	0.35
		Forest (HSG 'BC')	13.38	63		10		0.25	
		Lawn (HSG 'BC')	23.65	68		5		0.11	
		Meadow (HSG 'BC')	74.84	65		8		0.28	
		Industrial (HSG 'BC')	0.00	90		2		0.70	
		Other Impervious	21.15	100		2		0.95	

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Table A.3: SWM Analysis - Calculation of Time to Peak											
Subcatchment	A Area (ha)	L (m) Catchment Length	Highest Elevation (m)	Lowest Elevation (m)	Slope (m/m)	^{1,2} T _c Method	C _u (Uplands Coefficient)	Velocity (m/s)	^{1,2} T _c (s)	^{1,2} T _p (s)	^{1,2} T _p (hr)
101	29.73	265.00	516.50	512.75	0.01	Uplands (Short Grass Pasture and Lawns)	2.3	0.3	968.56	648.93	0.18
		1085.0	513.00	506.00	0.01	Uplands (Grassed Waterway Ditch)	4.6	0.4	2936.55	1967.49	0.55
201	24.18	290.0	515.25	511.75	0.01	Uplands (Short Grass Pasture and Lawns)	2.3	0.3	1147.72	768.97	0.21
		725.0	511.75	508.75	0.00414	Uplands (Grassed Waterway Ditch)	4.6	0.3	2450.13	1641.58	0.46
203	301.00	990.0	536.00	528.00	0.01	Uplands (Short Grass Pasture and Lawns)	2.3	0.2	4788.28	3208.15	0.89
		4250.0	528.00	512.00	0.00376	Uplands (Grassed Waterway Ditch)	4.6	0.3	15057.94	10088.82	2.80

Uplands Method

The Uplands Method is appropriate when the flow path consists of a number of different land covers. The average overland flow velocity is determined for a catchment based on the catchment slope and land cover type. The individual travel time for each land cover is summed to obtain the total travel time. The velocity used in the Uplands Method is calculated as follows:

$$V = (C_u)(S)^{0.5}$$

where,

V = average overland flow velocity (m/s)
C_u = V/S^{0.5} (Uplands coefficient)
S = average slope (m/m)

And the Uplands coefficient for different land covers is defined in the following table:

Table 7.3: Uplands Coefficients for Different Land Covers

Land Cover	C _u (V/S ^{0.5})
Forest with heavy ground litter, meadow (overland flow)	0.6
Fallow or minimum tillage cultivation (overland flow)	1.5
Short grass pasture and lawns (overland flow)	2.3
Cultivated, straight row (overland flow)	2.7
Nearly bare ground (overland flow)	3.0
Grassed waterway (ditch)	4.6
Paved areas (sheet flow) and shallow gutter flow	6.1

Source: modified from Figure 3.11, American Iron and Steel Institute, "Modern Sewer Design: Canadian Edition," Corrugated Steel Pipe Institute, 1996 and Stormwater Conveyance Modeling and Design, Heasted Methods, First Edition, 2003.

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Table A.4: Critical Storm		
Storm	Flow (Flow Node #1) (m3/s)	Flow (Flow Node #2) (m3/s)
100-YEAR 1-HR AES	10.608	4.774
100-YEAR 6-HR AES	12.626	6.676
100-YEAR 12-HR AES	9.101	6.929
100-YEAR 24-HR AES	6.057	6.876
HAZEL	14.586	18.824

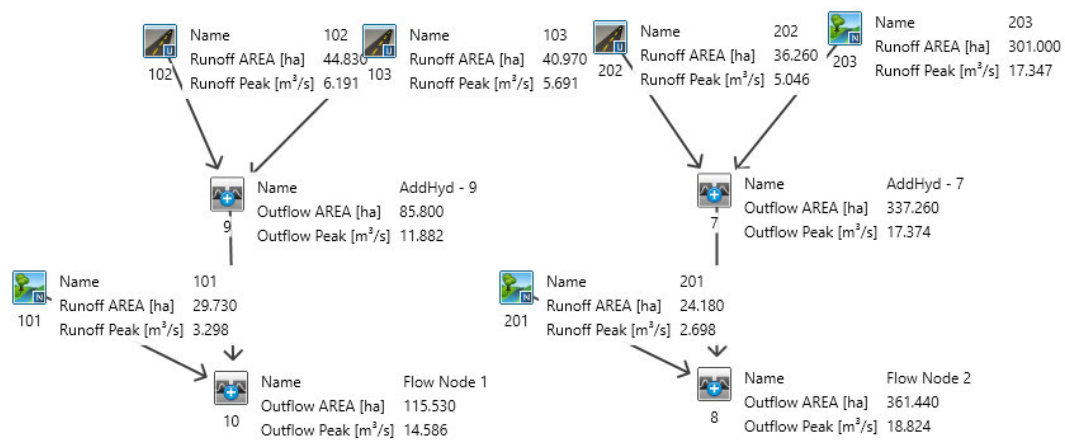


Figure A.1: VO Model Schematic

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*****
V   V   I   SSSSS U   U   A   L   (v 6.2.2019)
V   V   I   SS   U   U   A A   L
V   V   I   SS   U   U   AAAAA L
V   V   I   SS   U   U   A   A   L
VV   I   SSSSS UUUUU A   A   LLLL

OOO   TTTT   TTTT   H   H   Y   Y   M   M   OOO   TM
O   O   T   T   H   H   Y   Y   MM MM   O   O
O   O   T   T   H   H   Y   M   M   O   O
OOO   T   T   H   H   Y   M   M   OOO

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COMMENTS: _____

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hrs	mm/hr	hrs	mm/hr	'	hrs	mm/hr	hrs	mm/hr
0.00	6.00	3.00	13.00	'	9.00	53.00		
0.20	6.00	3.20	13.00		9.20	53.00		
0.40	6.00	3.40	13.00		9.40	53.00		
0.60	6.00	3.60	13.00		9.60	53.00		
0.80	6.00	3.80	13.00		9.80	53.00		
1.00	4.00	4.00	17.00		10.00	38.00		
1.20	4.00	4.20	17.00		10.20	38.00		
1.40	4.00	4.40	17.00		10.40	38.00		
1.60	4.00	4.60	17.00		10.60	38.00		
1.80	4.00	4.80	17.00		10.80	38.00		
2.00	6.00	5.00	13.00		11.00	13.00		
2.20	6.00	5.20	13.00		11.20	13.00		
2.40	6.00	5.40	13.00		11.40	13.00		
2.60	6.00	5.60	13.00		11.60	13.00		
2.80	6.00	5.80	13.00		11.80	13.00		

CALIB	Area (ha)= 24.18	Curve Number (CN)= 84.0
NASHYD (0201)	Ia (mm)= 7.30	# of Linear Res. (N)= 3.00
ID= 1 DT= 5.0 min	U.H. Tp(hrs)= 0.67	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

--- TRANSFORMED HYETOGRAPH ---			
TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr
0.083	6.00	3.083	13.00
0.167	6.00	3.167	13.00
0.250	6.00	3.250	13.00
0.333	6.00	3.333	13.00
0.417	6.00	3.417	13.00
0.500	6.00	3.500	13.00
0.583	6.00	3.583	13.00
0.667	6.00	3.667	13.00
0.750	6.00	3.750	13.00
0.833	6.00	3.833	13.00
0.917	6.00	3.917	13.00
1.000	6.00	4.000	13.00
1.083	4.00	4.083	17.00
1.167	4.00	4.167	17.00
1.250	4.00	4.250	17.00
1.333	4.00	4.333	17.00
1.417	4.00	4.417	17.00
1.500	4.00	4.500	17.00
1.583	4.00	4.583	17.00
1.667	4.00	4.667	17.00
1.750	4.00	4.750	17.00
1.833	4.00	4.833	17.00
1.917	4.00	4.917	17.00
2.000	4.00	5.000	17.00
2.083	6.00	5.083	13.00
2.167	6.00	5.167	13.00
2.250	6.00	5.250	13.00
2.333	6.00	5.333	13.00
2.417	6.00	5.417	13.00
2.500	6.00	5.500	13.00
2.583	6.00	5.583	13.00
2.667	6.00	5.667	13.00
2.750	6.00	5.750	13.00
2.833	6.00	5.833	13.00
2.917	6.00	5.917	13.00
3.000	6.00	6.000	13.00

Unit Hyd Qpeak (cms)= 1.378

PEAK FLOW (cms)= 2.698 (i)
TIME TO PEAK (hrs)= 10.583
RUNOFF VOLUME (mm)= 165.565
TOTAL RAINFALL (mm)= 212.000
RUNOFF COEFFICIENT = 0.781

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	Area (ha)= 301.00	Curve Number (CN)= 91.0
NASHYD (0203)	Ia (mm)= 6.90	# of Linear Res. (N)= 3.00
ID= 1 DT= 5.0 min	U.H. Tp(hrs)= 3.69	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

Unit Hyd Qpeak (cms) = 3.116

PEAK FLOW (cms) = 17.347 (i)
 TIME TO PEAK (hrs) = 13.250
 RUNOFF VOLUME (mm) = 182.720
 TOTAL RAINFALL (mm) = 212.000
 RUNOFF COEFFICIENT = 0.862

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0202)	Area (ha) = 36.26		
ID= 1 DT= 5.0 min	Total Imp(%) = 30.00	Dir. Conn.(%) = 20.00	

	IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha) = 10.88	25.38	
Dep. Storage	(mm) = 1.00	4.70	
Average Slope	(%) = 1.00	2.00	
Length	(m) = 491.66	40.00	
Mannings n	= 0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr

0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

Max.Eff.Inten.(mm/hr)= 53.00 59.16
 over (min) 10.00 20.00
 Storage Coeff. (min)= 8.56 (ii) 17.27 (ii)
 Unit Hyd. Tpeak (min)= 10.00 20.00
 Unit Hyd. peak (cms)= 0.12 0.06

TOTALS

PEAK FLOW (cms) = 1.07 3.98 5.046 (iii)
 TIME TO PEAK (hrs) = 10.00 10.00 10.00
 RUNOFF VOLUME (mm) = 211.00 183.62 189.10
 TOTAL RAINFALL (mm) = 212.00 212.00 212.00
 RUNOFF COEFFICIENT = 1.00 0.87 0.89

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
 YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 89.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0007)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0202):	36.26	5.046	10.00	189.10
+ ID2= 2 (0203):	301.00	17.347	13.25	182.72
=====				
ID = 3 (0007):	337.26	17.374	13.17	183.41

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0008)					
1 + 2 = 3		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
ID1=	1 (0201):	24.18	2.698	10.58	165.57
+	ID2= 2 (0007):	337.26	17.374	13.17	183.41

ID	= 3 (0008):	361.44	18.824	11.08	182.21

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				
NASHYD	(0101)	Area	(ha)= 29.73	Curve Number (CN)= 86.0
ID= 1	DT= 5.0 min	Ia	(mm)= 6.40	# of Linear Res. (N)= 3.00
		U.H. Tp(hrs)=	0.73	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----											
TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00				
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00				
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00				
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00				
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00				
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00				
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00				
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00				
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00				
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00				
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00				
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00				
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00				
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00				
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00				
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00				
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00				
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00				
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00				
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00				
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00				
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00				
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00				
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00				
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00				
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00				
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00				
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00				
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00				
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00				
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00				
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00				
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00				
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00				
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00				
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00				

Unit Hyd Qpeak (cms)= 1.556

PEAK FLOW (cms)= 3.298 (i)
 TIME TO PEAK (hrs)= 10.750
 RUNOFF VOLUME (mm)= 171.173
 TOTAL RAINFALL (mm)= 212.000
 RUNOFF COEFFICIENT = 0.807

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0102)				
ID=	1 DT= 5.0 min	Area (ha)	Total Imp(%)= 30.00	Dir. Conn.(%)= 20.00
		44.83		

		IMPERVIOUS		PERVIOUS (i)
Surface Area	(ha)=	13.45		31.38
Dep. Storage	(mm)=	1.00		5.50
Average Slope	(%)=	1.00		2.00
Length	(m)=	546.69		40.00
Mannings n	=	0.013		0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----											
TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00				
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00				
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00				
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00				
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00				
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00				
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00				
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00				
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00				
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00				
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00				
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00				
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00				
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00				
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00				
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00				
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00				
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00				
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00				
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00				
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00				
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00				
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00				
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00				
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00				
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00				
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00				
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00				
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00				
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00				
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00				
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00				
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00				
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00				
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00				
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00				

Max.Eff.Inten.(mm/hr)= 53.00 58.89
 over (min)= 10.00 20.00
 Storage Coeff. (min)= 9.13 (ii) 17.85 (ii)
 Unit Hyd. Tpeak (min)= 10.00 20.00
 Unit Hyd. peak (cms)= 0.12 0.06

TOTALS

PEAK FLOW (cms)= 1.32 4.87 6.191 (iii)
 TIME TO PEAK (hrs)= 10.00 10.00 10.00
 RUNOFF VOLUME (mm)= 211.00 180.75 186.80
 TOTAL RAINFALL (mm)= 212.00 212.00 212.00
 RUNOFF COEFFICIENT = 1.00 0.85 0.88

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 88.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	Area (ha)= 40.97
STANDHYD (0103)	Total Imp(%)= 30.00 Dir. Conn.(%)= 20.00
ID= 1 DT= 5.0 min	

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	12.29	28.68
Dep. Storage (mm)=	1.00	4.70
Average Slope (%)=	1.00	2.00
Length (m)=	522.62	40.00
Mannings n	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

Max.Eff.Inten. (mm/hr)=	53.00	59.16
over (min)	10.00	20.00
Storage Coeff. (min)=	8.88 (ii)	17.59 (ii)
Unit Hyd. Tpeak (min)=	10.00	20.00
Unit Hyd. peak (cms)=	0.12	0.06

TOTALS			
PEAK FLOW (cms)=	1.20	4.49	5.691 (iii)
TIME TO PEAK (hrs)=	10.00	10.00	10.00
RUNOFF VOLUME (mm)=	211.00	183.62	189.10
TOTAL RAINFALL (mm)=	212.00	212.00	212.00
RUNOFF COEFFICIENT =	1.00	0.87	0.89

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 89.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0009)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0102):	44.83	6.191	10.00	186.80
+ ID2= 2 (0103):	40.97	5.691	10.00	189.10
=====				
ID = 3 (0009):	85.80	11.882	10.00	187.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0101):	29.73	3.298	10.75	171.17
+ ID2= 2 (0009):	85.80	11.882	10.00	187.90
=====				
ID = 3 (0010):	115.53	14.586	10.08	183.59

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

File: 23142

07 Nov 2023

Hard Open Surfaces



Ontario Ministry of Natural Resources
and Forestry

COSINE Station Report

Retrieval Date: 2023-Nov-21

Control Survey Information Exchange

Station:

00820048005

AKA Names:

Number of Ref Sketches: 1

Networks [usage]: 3262 [FREE], 3262V [FREE], 3262V13 [FREE], C2ANDD2 [FREE], CBN31D [FREE]

Known Status:

Existing

Last Reported Visit:

Monument Type:

CAP

Station Type:

GPS

Location Description:

Dundalk - 6' RIB & brass cap, 30 cm below ground. - Station is located on southeast side of Hwy 10 jkust northerly of County Road 9.

No Photo

Horizontal (Ellipsoidal) Control Data

Datum: **NAD-1983:CSRS:CBNV6-2010.0** Horiz Order: CSRS Class D Ellipsoidal Order: Fourth Order

Latitude: N44° 10' 45.472483" Longitude: W80° 22' 54.257316" Ellipsoidal elev: 490.266

*UTM Zone: 17 E: E549419.106 N: N4891973.201 C. S. F.: 0.99955319 Mrd1 Conv: 0° 25' 51.2"

*MTM Zone: 10 E: E234299.427 N: N4893633.571 C. S. F.: 0.99988424 Mrd1 Conv: -0° 36' 52.2"

Datum: **NAD-1983:CSRS:CBNV3-1997.0** Horiz Order: CSRS Class D Ellipsoidal Order: Fourth Order

Latitude: N44° 10' 45.473050" Longitude: W80° 22' 54.258407" Ellipsoidal elev: 490.303

*UTM Zone: 17 E: E549419.081 N: N4891973.218 C. S. F.: 0.99955318 Mrd1 Conv: 0° 25' 51.2"

*MTM Zone: 10 E: E234299.403 N: N4893633.588 C. S. F.: 0.99988423 Mrd1 Conv: -0° 36' 52.3"

Datum: **NAD-1983:ORIG** Horiz Order: Second Order Ellipsoidal Order: Unclassified

Latitude: N44° 10' 45.476730" Longitude: W80° 22' 54.252670" Ellipsoidal elev: 490.XXX

*UTM Zone: 17 E: E549419.208 N: N4891973.332 C. S. F.: 0.99955314 Mrd1 Conv: 0° 25' 51.2"

*MTM Zone: 10 E: E234299.532 N: N4893633.701 C. S. F.: 0.99988419 Mrd1 Conv: -0° 36' 52.2"

Vertical (Geoidal) Control Data

Datum: CGVD2013	Vert Order: Second Order	Elevation: 525.163	
Geoid:	Meridional defl:	Prime vert defl:	Undulation:

Datum: CGVD28:78	Vert Order: Second Order	Elevation: 525.577	
Geoid:	Meridional defl:	Prime vert defl:	Undulation:

Maintenance / History

Date	Description
2019-Mar-20	Established by MTO Aug 2004.

Reference Sketches

Sketch 1 of 1

Ministry
of
Transportation
Ontario

MONUMENT POSITION SKETCH

DATE: AUG 2004	Job File:	Mon: 00820048005
TIES UPDATED	Map Sheet:	
	Order:	Elev.:
	MTM - Zone:	C.M.:

TYPE OF MONUMENT	RELATIONSHIP TO GROUND
6' RIB & BRASS CAP	- 30 cm

INTERVISIBLE WITH
20040077

LOCATION: DUNDALK

STATION IS LOCATED ON SOUTHEAST SIDE
OF HWY 10 JUST NORTHERLY OF CO RD 9

PURPOSE: LOCATE POINT ☒ PRECISE REFERENCE ☐

POSITION SKETCH

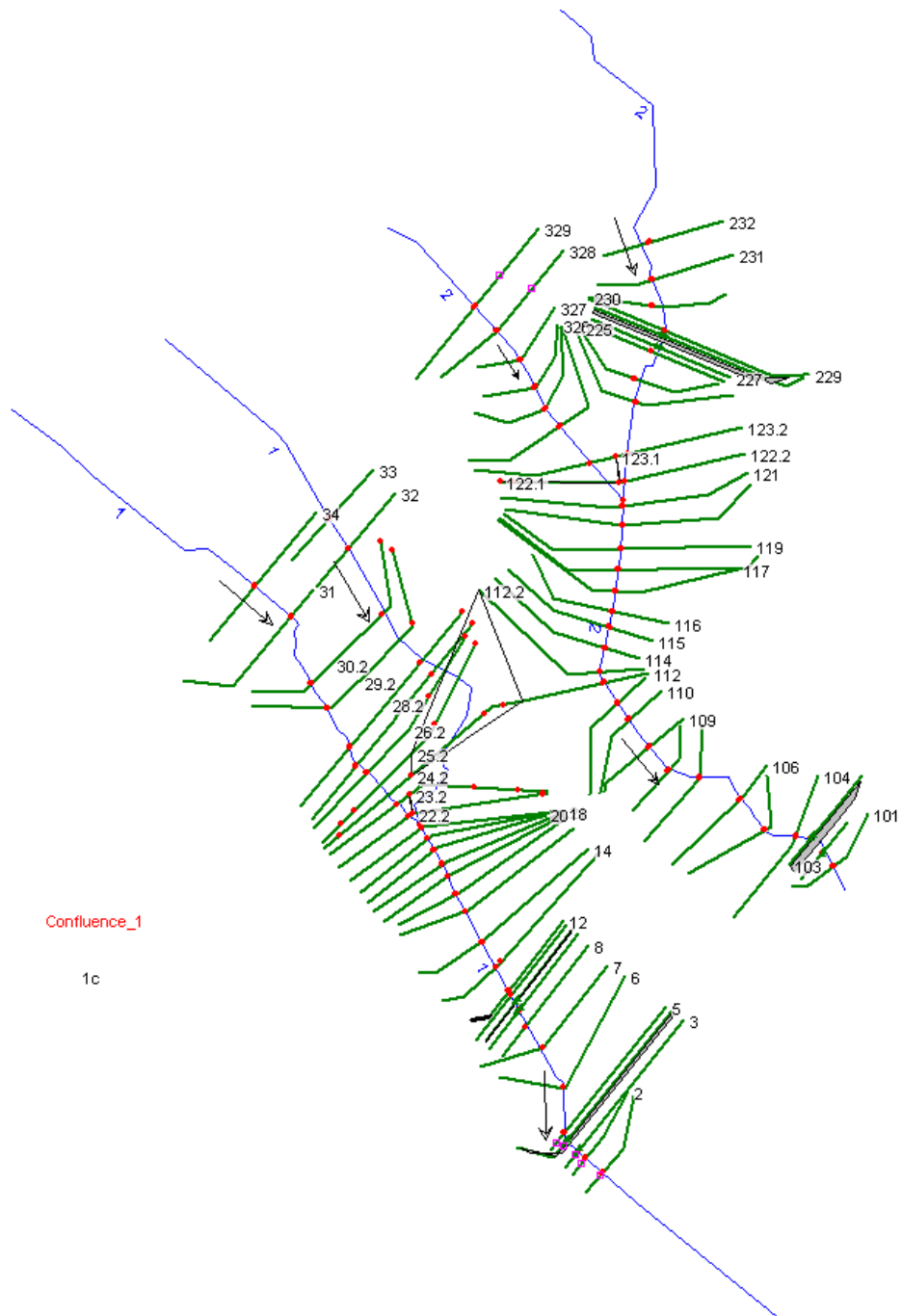
MONUMENT No.
00820048005

ATTACHMENT 'B'

Hydraulic Model (HEC-RAS)

Supporting Documentation and Calculations

1B



2A

Confluence_1

1c

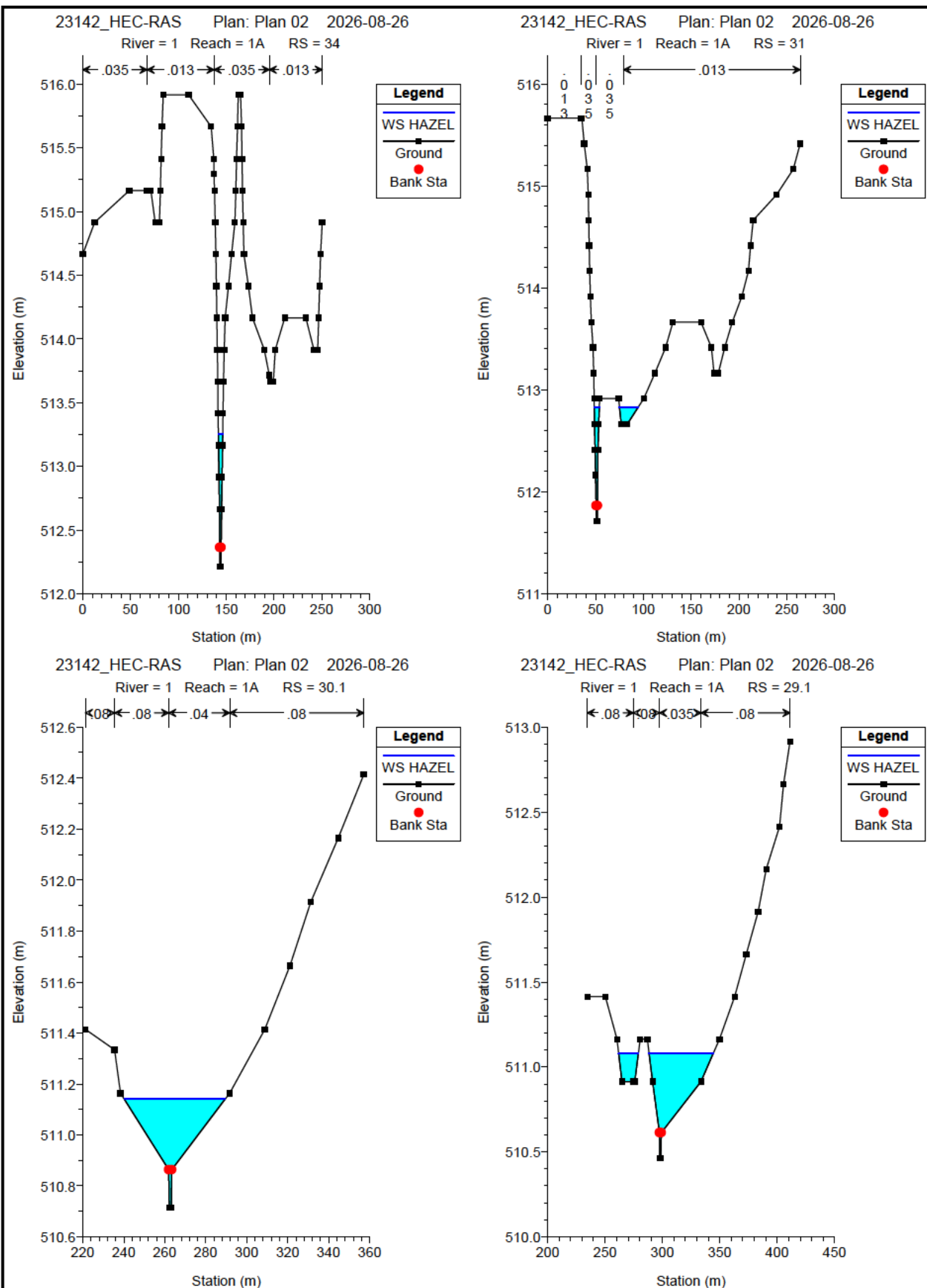
HEC-RAS Model Schematic

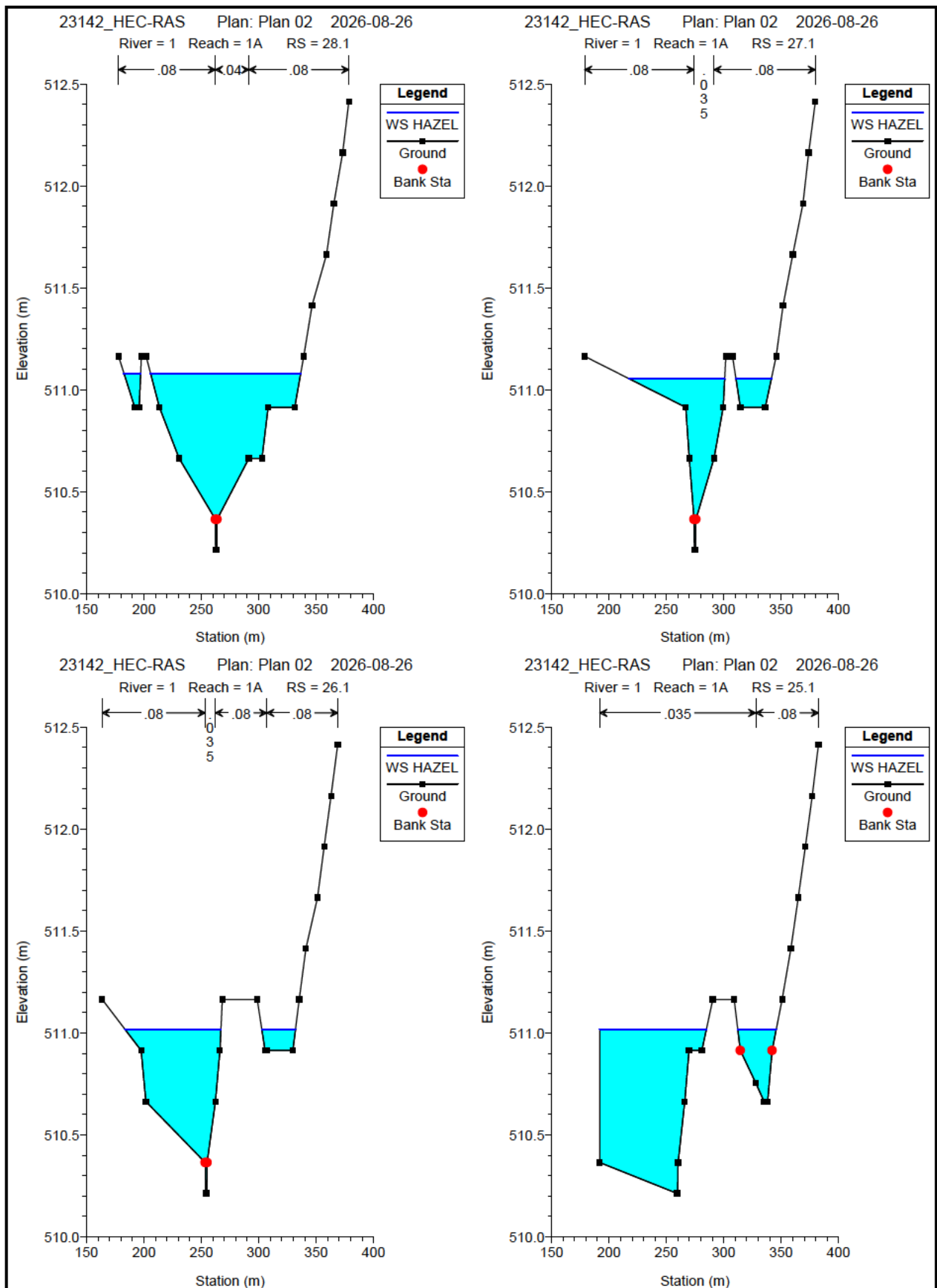
HEC-RAS Plan: Plan 02 Profile: HAZEL

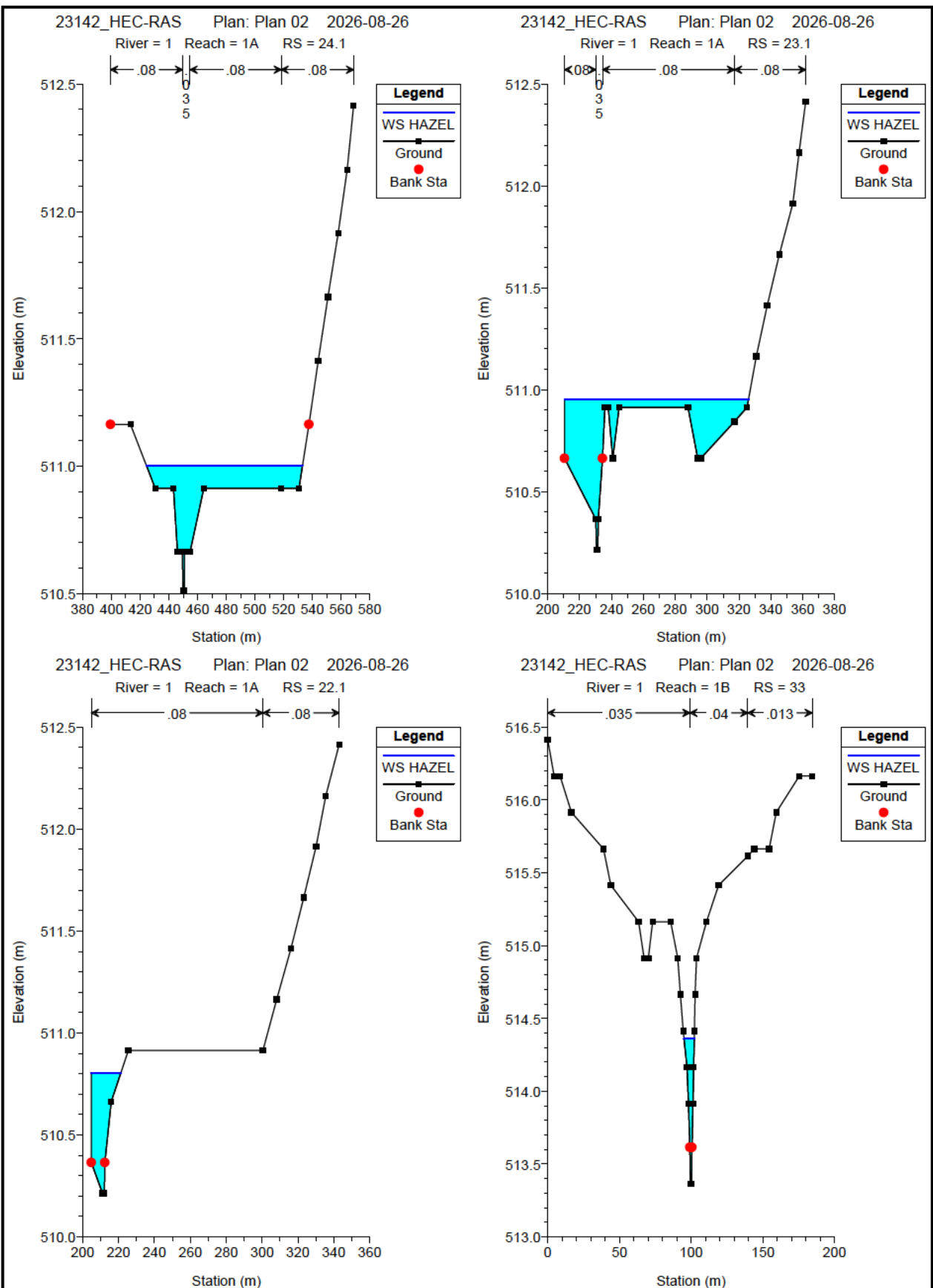
River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
2	2A	329	HAZEL	5.05	514.21	514.91	514.91	514.98	0.009456	1.79	7.52	42.28	0.73
2	2A	328	HAZEL	5.05	513.71	514.40	514.40	514.47	0.009172	1.75	7.40	48.24	0.72
2	2A	327	HAZEL	5.05	512.98	513.72	513.72	513.80	0.008249	1.79	8.39	48.10	0.70
2	2A	326	HAZEL	5.05	512.48	513.20		513.28	0.007344	1.85	8.57	46.55	0.65
2	2A	325	HAZEL	5.05	512.21	512.93	512.93	512.99	0.007943	1.88	9.43	69.59	0.68
2	2A	324	HAZEL	5.05	511.71	512.50	512.50	512.57	0.007126	1.71	9.07	63.39	0.65
2	2A	123.1	HAZEL	5.05	511.48	512.47		512.47	0.000263	0.15	43.44	120.27	0.06
2	2A	122.1	HAZEL	5.05	511.48	512.46		512.46	0.000653	0.23	33.02	119.65	0.09
2	2B	232	HAZEL	17.35	512.21	513.55		513.56	0.001245	1.05	58.54	182.33	0.30
2	2B	231	HAZEL	17.35	512.21	513.54		513.54	0.000095	0.29	121.97	183.98	0.08
2	2B	230	HAZEL	17.35	511.96	513.54		513.54	0.000094	0.32	111.26	157.65	0.08
2	2B	229	HAZEL	17.35	511.96	513.54		513.54	0.000035	0.20	207.61	305.37	0.05
2	2B	228	HAZEL	17.35	511.71	513.00	513.00	513.41	0.013524	3.35	7.14	165.32	0.97
2	2B	227.5		Culvert									
2	2B	227	HAZEL	17.35	511.58	512.92	512.78	512.94	0.002378	1.54	37.40	114.04	0.43
2	2B	226	HAZEL	17.35	511.71	512.65	512.65	512.84	0.015914	2.91	11.86	39.97	1.01
2	2B	225	HAZEL	17.35	511.48	512.65		512.66	0.000710	0.73	57.96	150.51	0.22
2	2B	224	HAZEL	17.35	511.46	512.61		512.63	0.001269	0.95	47.94	166.43	0.29
2	2B	123.2	HAZEL	17.35	511.46	512.52		512.54	0.001078	0.71	56.08	156.97	0.27
2	2B	123		Lat Struct									
2	2B	122.2	HAZEL	17.35	511.46	512.44		512.46	0.003111	1.11	44.58	157.54	0.44
2	2C	121	HAZEL	17.37	511.46	512.45		512.46	0.000728	0.85	77.41	288.82	0.22
2	2C	120	HAZEL	17.43	511.46	512.43		512.44	0.000626	0.59	77.45	291.32	0.20
2	2C	119	HAZEL	17.51	511.46	512.40		512.41	0.001335	0.84	56.64	215.91	0.29
2	2C	118	HAZEL	17.57	511.46	512.21	512.21	512.30	0.014451	2.34	20.21	120.00	0.92
2	2C	117	HAZEL	17.64	510.71	511.86	511.80	511.92	0.004756	1.84	22.71	73.74	0.57
2	2C	116	HAZEL	17.70	510.71	511.61	511.61	511.71	0.011987	2.45	19.24	106.43	0.87
2	2C	115	HAZEL	17.75	510.21	511.44		511.47	0.002056	1.27	30.67	119.38	0.38
2	2C	114	HAZEL	17.82	510.21	511.41		511.42	0.000957	0.85	54.27	142.41	0.26
2	2C	113	HAZEL	17.90	509.96	511.40		511.40	0.000361	0.59	88.81	186.14	0.16
2	2C	112.2		Lat Struct									
2	2C	112	HAZEL	29.26	510.21	510.90	510.90	511.32	0.091008	5.53	17.64	82.80	2.27
2	2C	111	HAZEL	18.01	509.21	510.60	510.60	510.75	0.008108	2.75	22.38	78.74	0.77
2	2C	110	HAZEL	18.07	509.21	510.44		510.48	0.002174	1.31	25.73	58.71	0.39
2	2C	109	HAZEL	18.18	508.71	510.30		510.36	0.002705	1.75	26.90	45.32	0.46
2	2C	108	HAZEL	18.27	508.46	510.04		510.18	0.005565	2.50	19.31	31.48	0.65
2	2C	107	HAZEL	18.38	507.71	509.71	509.71	509.91	0.004708	2.71	21.52	50.31	0.63
2	2C	106	HAZEL	18.55	507.21	508.74	508.74	508.88	0.006598	2.66	25.01	66.29	0.71
2	2C	105	HAZEL	18.68	506.21	508.50		508.52	0.000728	1.17	57.33	94.44	0.25
2	2C	104	HAZEL	18.78	506.21	508.50		508.50	0.000173	0.50	117.83	170.39	0.11
2	2C	103	HAZEL	18.82	505.71	508.29	507.22	508.44	0.002013	1.82	12.05	135.41	0.37
2	2C	102.5		Culvert									
2	2C	102	HAZEL	18.82	505.64	507.53	507.31	507.89	0.014502	2.82	7.60	31.87	0.66
2	2C	101	HAZEL	18.82	505.96	507.38	507.38	507.50	0.006704	2.55	30.43	106.88	0.70
1	1A	34	HAZEL	6.19	512.21	513.25	513.25	513.57	0.010004	2.80	2.81	4.60	0.89
1	1A	31	HAZEL	6.19	511.71	512.83	512.83	512.93	0.003629	1.77	5.33	24.76	0.54
1	1A	30.1	HAZEL	6.19	510.71	511.14	511.14	511.21	0.021570	1.93	7.19	49.10	0.98
1	1A	29.1	HAZEL	6.19	510.48	511.08		511.09	0.001168	0.66	17.09	72.89	0.28
1	1A	28.1	HAZEL	6.19	510.21	511.08		511.08	0.000145	0.26	52.49	145.22	0.09
1	1A	27.1	HAZEL	6.19	510.21	511.05		511.06	0.000706	0.64	22.19	114.07	0.23
1	1A	26.1	HAZEL	6.19	510.21	511.02		511.02	0.000442	0.49	36.53	113.34	0.18
1	1A	25.1	HAZEL	6.19	510.66	511.02		511.02	0.000029	0.04	61.97	126.33	0.02
1	1A	25		Lat Struct									
1	1A	24.1	HAZEL	6.19	510.51	511.00		511.01	0.010000	0.47	13.31	108.97	0.42
1	1A	23.1	HAZEL	6.19	510.21	510.95		510.96	0.002250	0.45	20.38	115.34	0.21
1	1A	23		Lat Struct									
1	1A	22.1	HAZEL	6.19	510.21	510.80		510.88	0.029233	1.33	5.39	16.48	0.59
1	1B	33	HAZEL	5.69	513.36	514.36	514.36	514.58	0.012738	2.50	3.08	7.17	0.82
1	1B	32	HAZEL	5.69	512.86	513.78	513.78	513.91	0.007670	2.10	4.72	17.50	0.72
1	1B	30.2	HAZEL	5.69	511.16	511.48		511.49	0.002394	0.35	16.34	66.61	0.22
1	1B	29.2	HAZEL	5.69	511.04	511.27	511.27	511.32	0.094915	1.01	5.66	57.34	1.02
1	1B	28.2	HAZEL	5.69	510.36	511.08		511.08	0.002130	0.28	20.78	109.37	0.20
1	1B	27.2	HAZEL	5.69	510.36	510.99		510.99	0.000881	0.32	18.66	91.79	0.21
1	1B	26.2	HAZEL	5.69	510.11	510.94		510.94	0.000582	0.35	19.10	117.06	0.27
1	1B	25.2	HAZEL	5.69	510.36	510.88		510.89	0.003671	0.51	13.21	86.23	0.40
1	1B	24.2	HAZEL	5.69	510.66	510.87		510.87	0.000362	0.08	39.10	169.79	0.06
1	1B	23.2	HAZEL	5.69	510.11	510.88		510.88	0.000599	0.17	40.77	167.08	0.09
1	1B	22.2	HAZEL	5.69	510.36	510.86		510.86	0.000203	0.10	61.71	175.24	0.05
1	1c	21	HAZEL	11.88	510.36	510.86		510.86	0.001014	0.48	65.83	246.29	0.23
1	1c	20	HAZEL	11.98	510.11	510.83		510.83	0.000504	0.45	68.20	238.56	0.18
1	1c	19	HAZEL	12.08	509.86	510.77		510.79	0.002523	1.19	38.78	173.64	0.41
1	1c	18	HAZEL	12.20	509.86	510.58		510.60	0.005350	1.46	28.73	146.12	0.57
1	1c	17	HAZEL	12.31	509.56	510.51		510.52	0.001438	0.81	35.09	141.07	0.27
1	1c	16	HAZEL	12.46	509.06	510.37	510.35	510.43	0.008051	2.13	19.35	95.65	0.61
1	1c	15	HAZEL	12.61	509.06	510.20	510.20	510.26	0.007638	2.10	15.57	134.30	0.64
1	1c	14	HAZEL	12.88	508.56	509.86	509.79	509.91	0.003733	1.60	13.90	56.59	0.46
1	1c	13	HAZEL	13.10	509.16	509.67	509.67	509.77	0.029399	0.57	10.39	55.37	0.48
1	1c	12	HAZEL	13.31	508.31	509.60		509.62	0.000884	0.78	30.09	78.28	0.22
1	1c	11	HAZEL	13.34	508.31	509.59		509.60	0.000904	0.78	33.56	100.08	0.22
1	1c	10	HAZEL	13.38	508.06	509.51	509.29	509.53	0.001795	1.20	37.89	95.96	0.32
1	1c	9.5		Culvert									
1	1c	9	HAZEL	13.47	507.81	509.06	508.99	509.07	0.002168	1.19	37.60	100.46	0.35

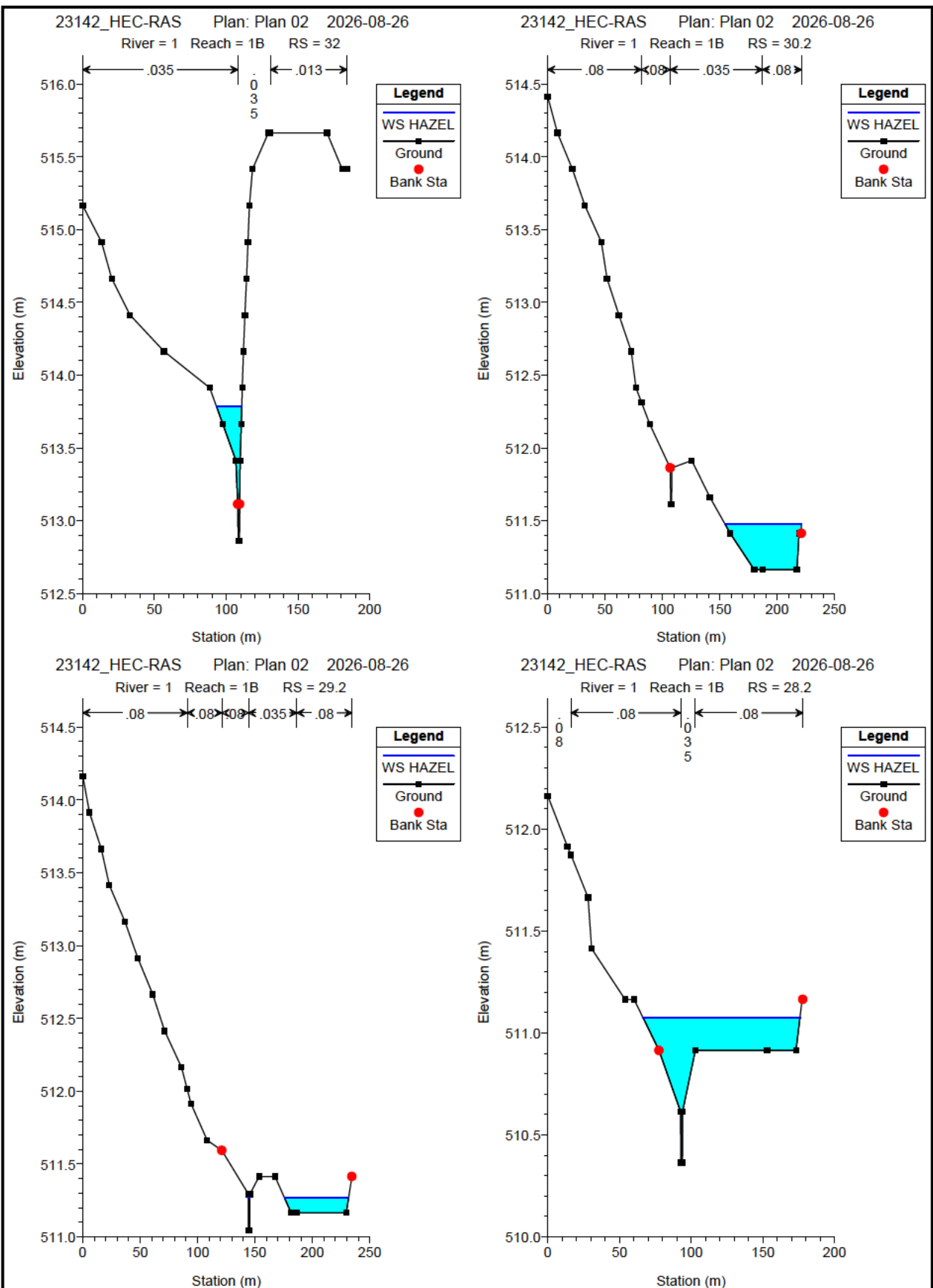
HEC-RAS Plan: Plan 02 Profile: HAZEL (Continued)

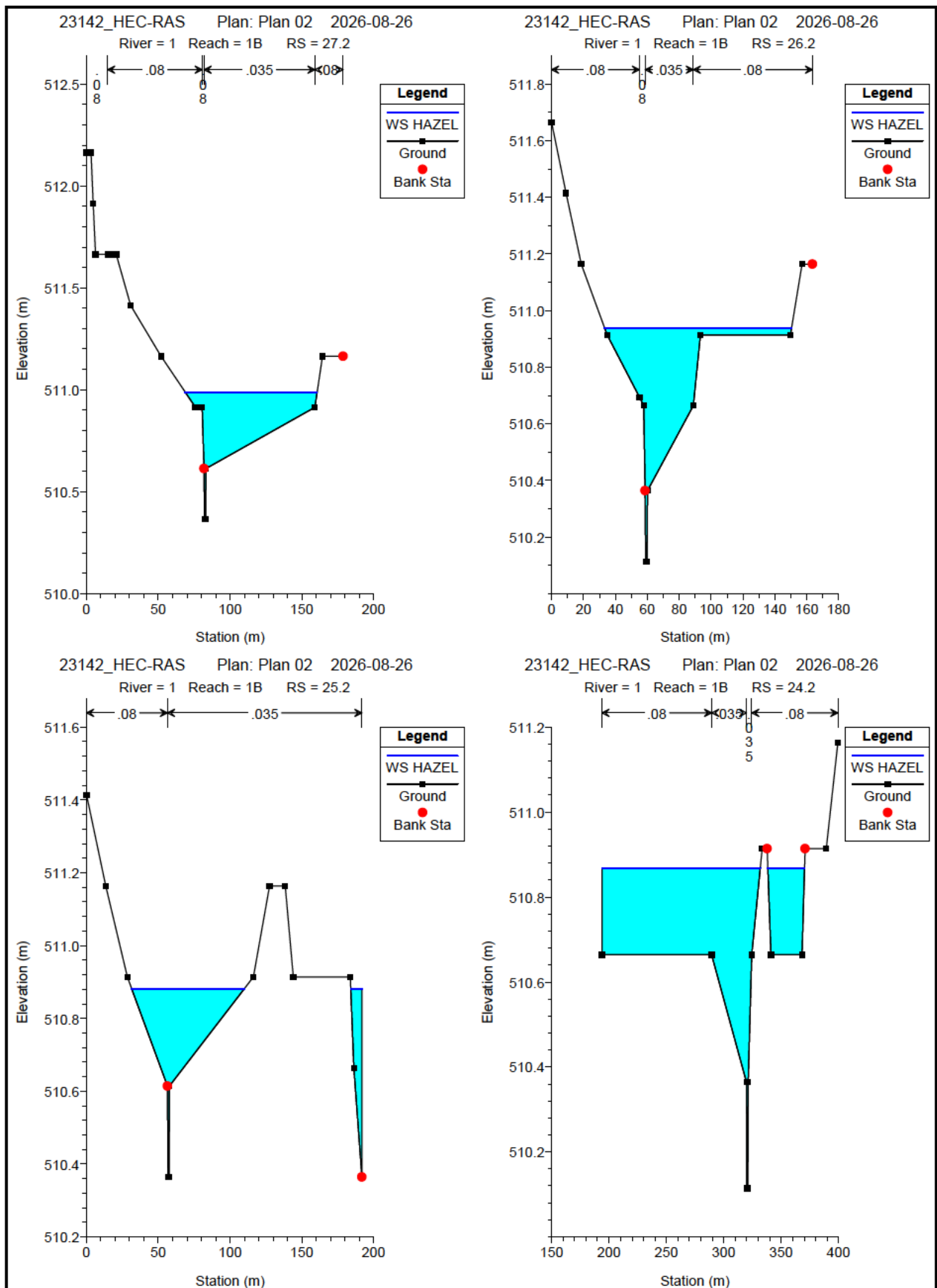
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	1c	8	HAZEL	13.80	507.81	508.57		508.62	0.007623	1.59	16.07	69.39	0.59
1	1c	7	HAZEL	13.81	507.56	508.28	508.28	508.38	0.014953	2.14	11.57	57.52	0.82
1	1c	6	HAZEL	14.17	506.56	507.70	507.70	507.86	0.012395	2.68	10.91	36.47	0.81
1	1c	5	HAZEL	14.51	506.06	507.70	507.22	507.71	0.000747	0.84	51.98	92.93	0.21
1	1c	4	HAZEL	14.59	505.70	507.68	507.11	507.69	0.000216	0.48	64.88	142.64	0.11
1	1c	3.5		Culvert									
1	1c	3	HAZEL	14.59	505.69	507.24	507.02	507.27	0.000728	0.75	21.38	53.70	0.19
1	1c	2	HAZEL	14.59	505.81	507.06	507.00	507.11	0.004169	1.66	21.34	69.69	0.48
1	1c	1	HAZEL	14.59	505.56	506.79	506.79	506.87	0.004812	1.76	12.72	75.08	0.51

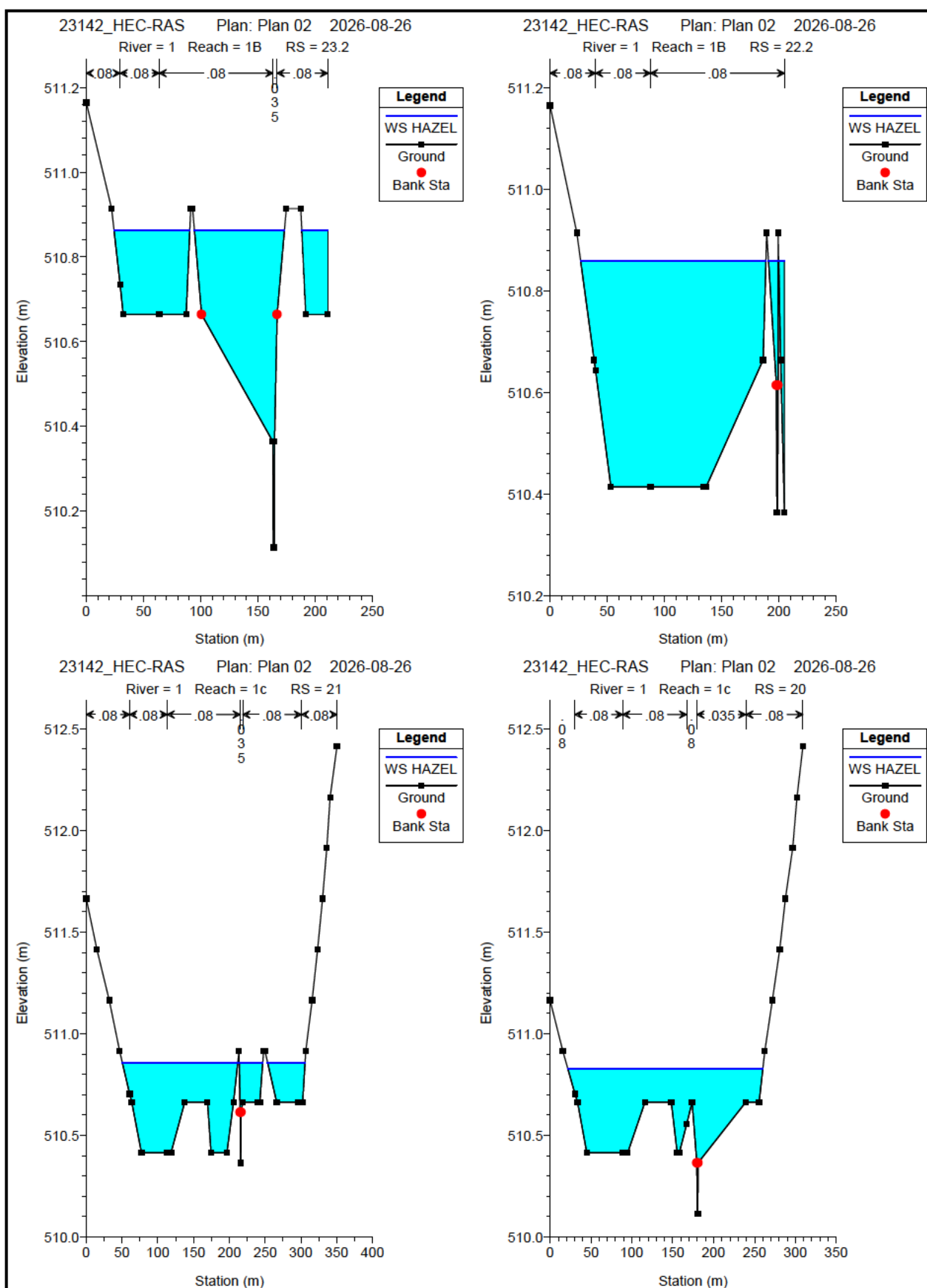


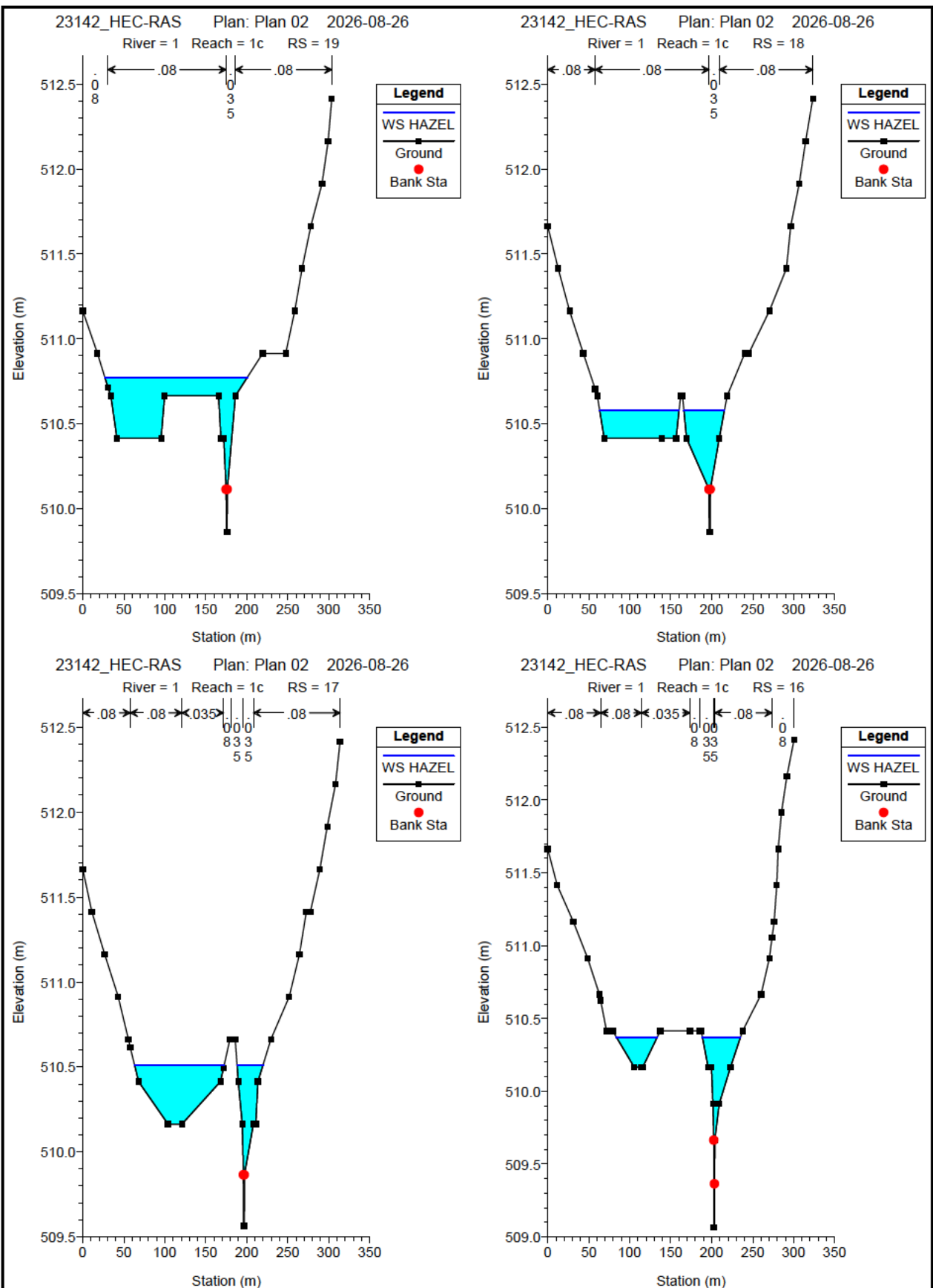


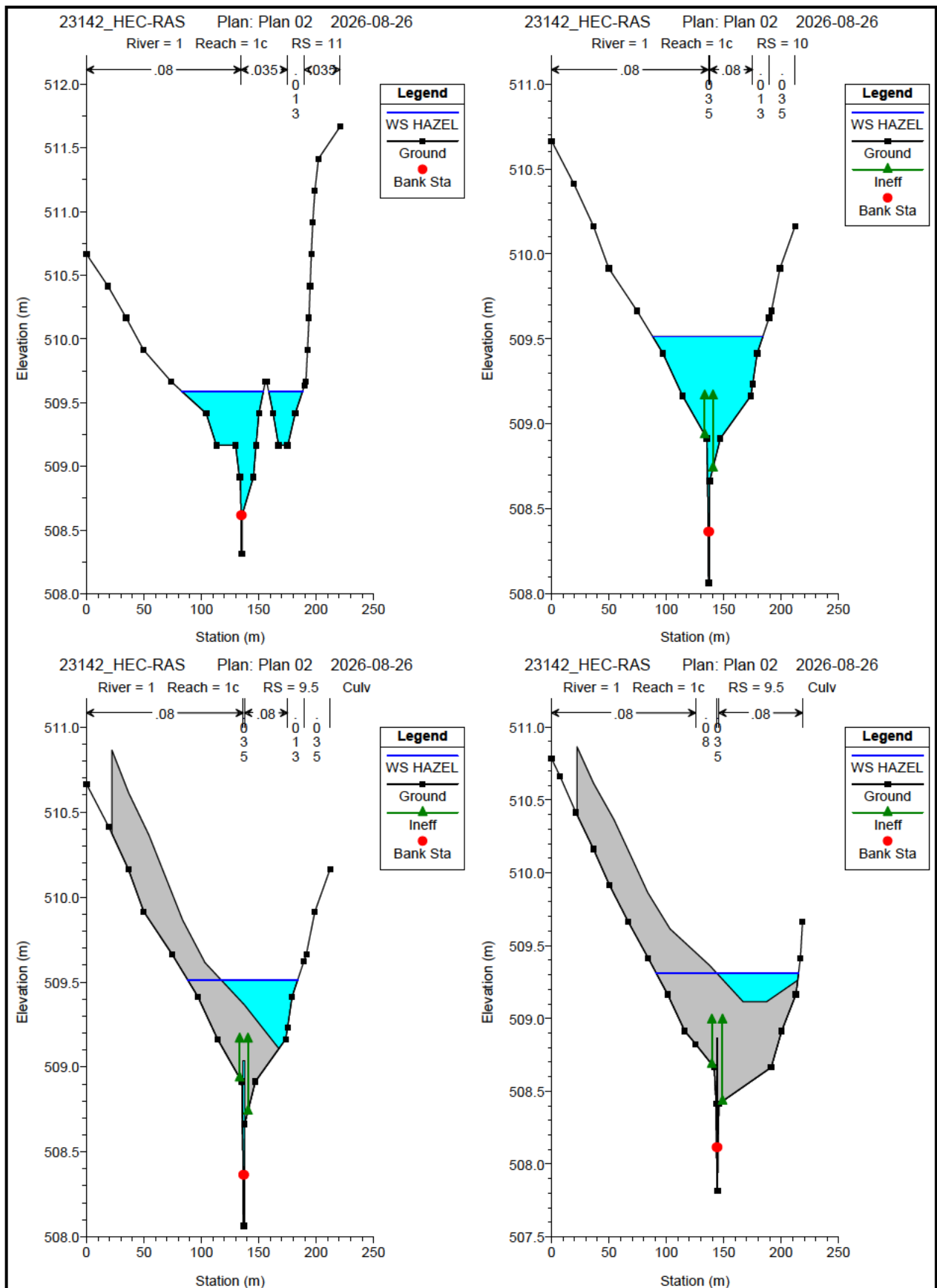


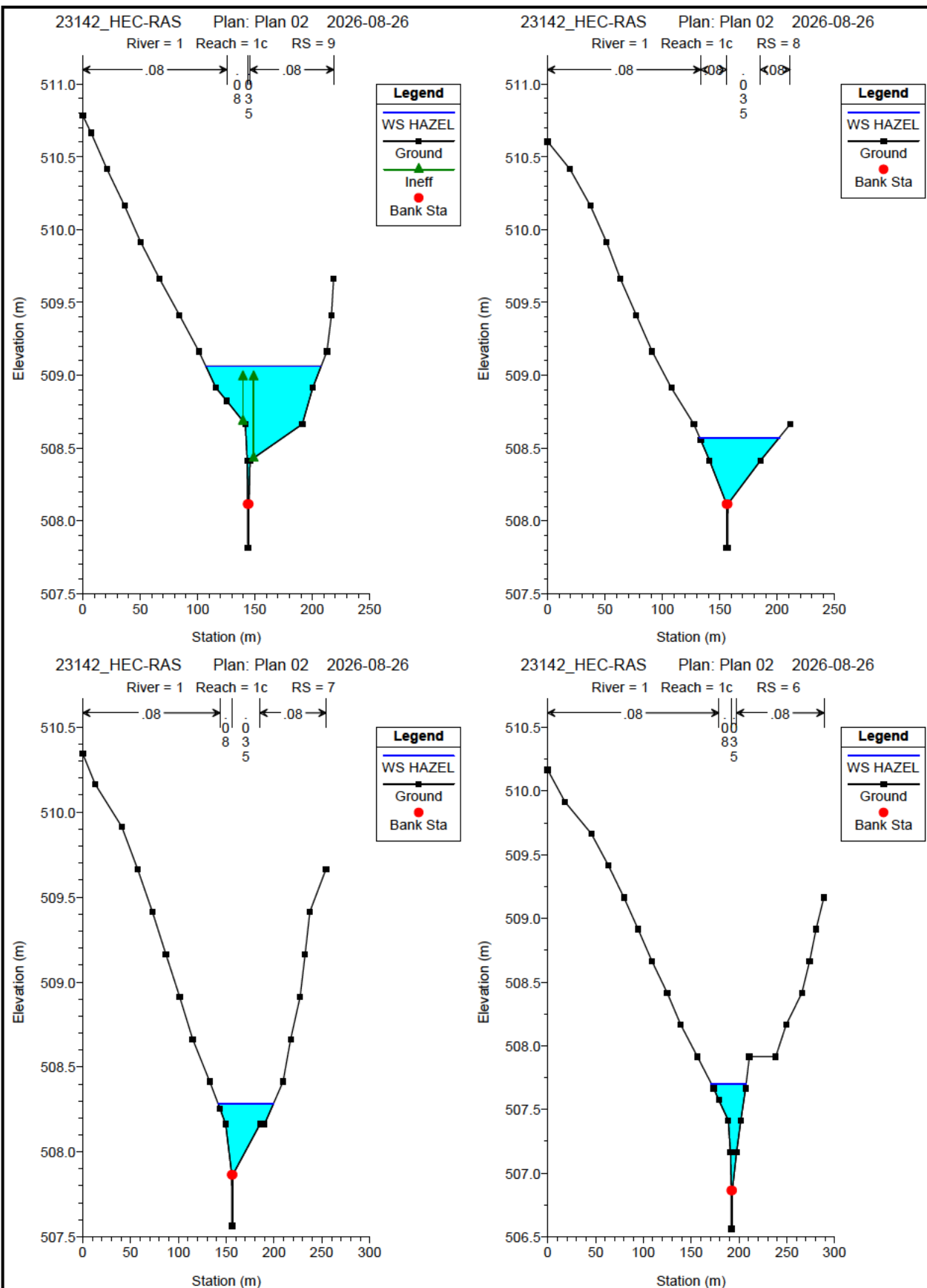


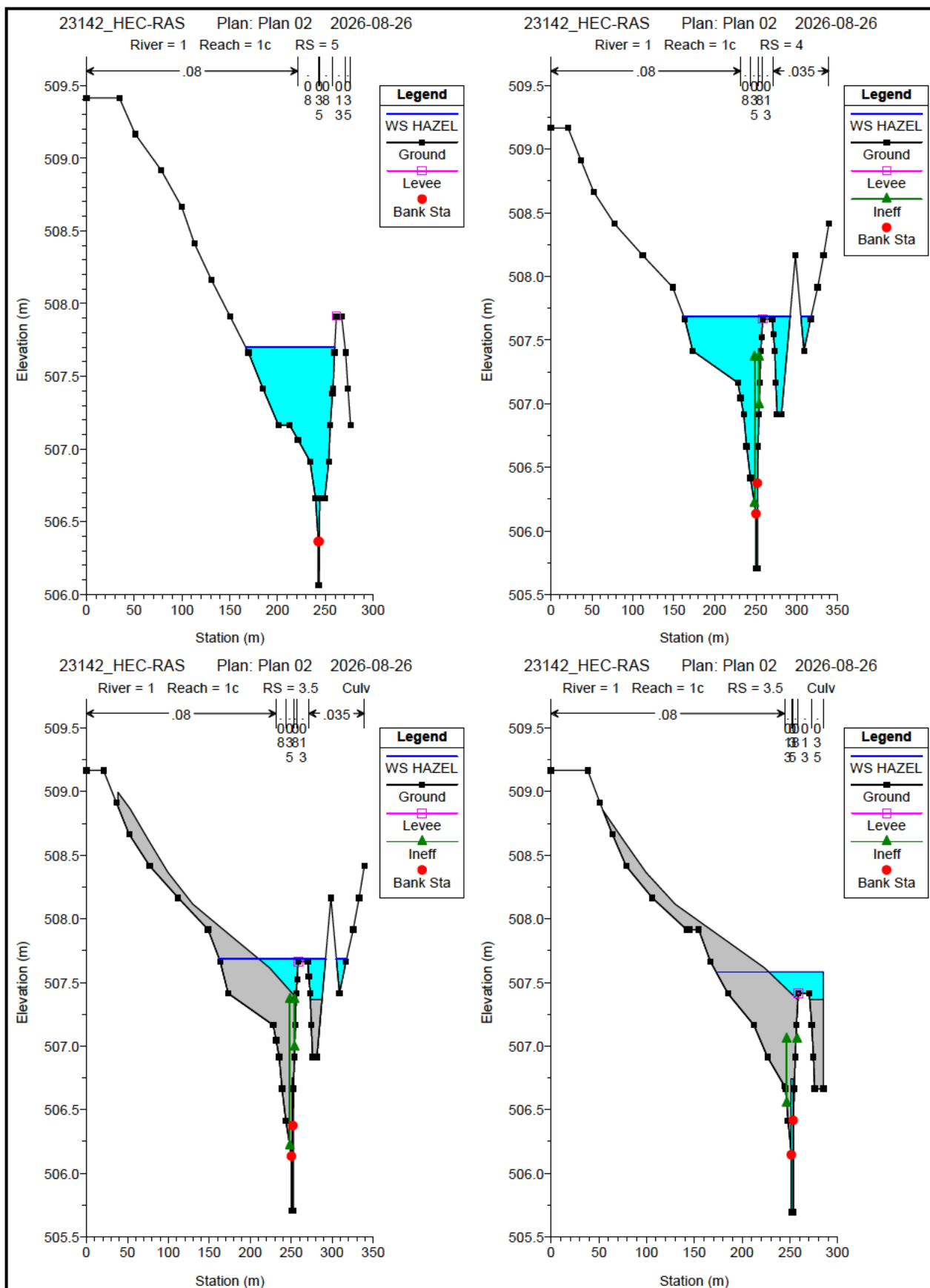


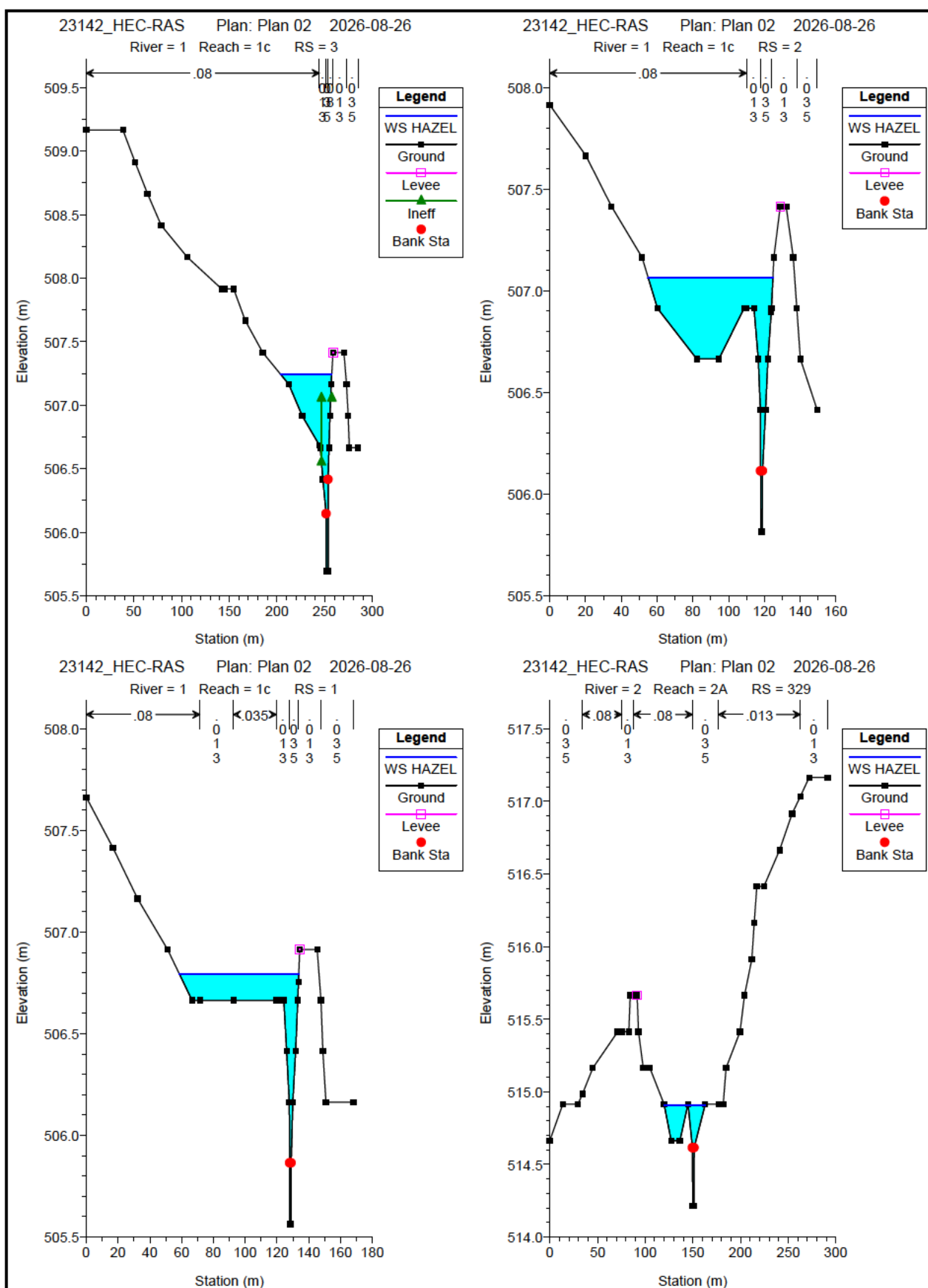


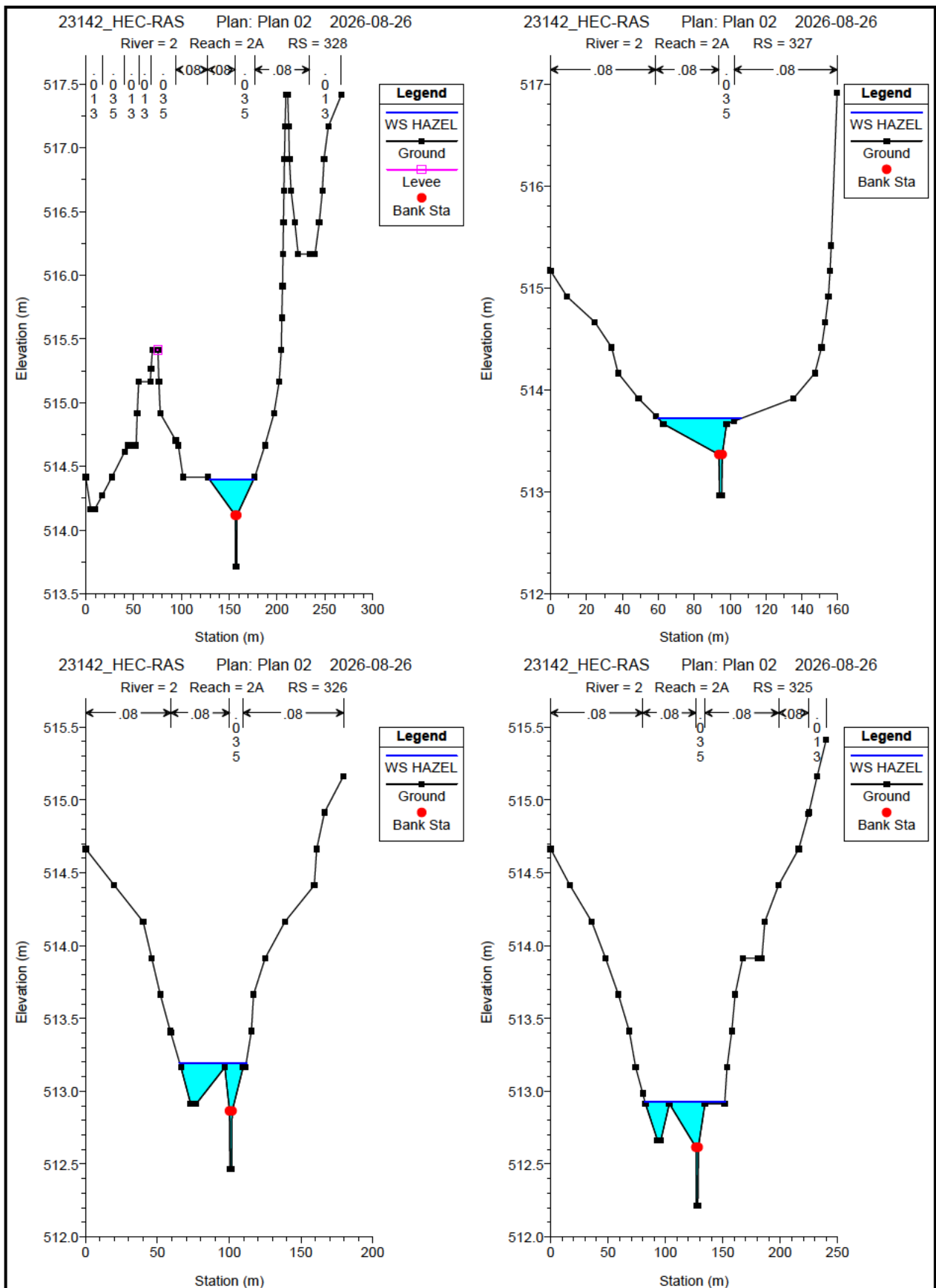


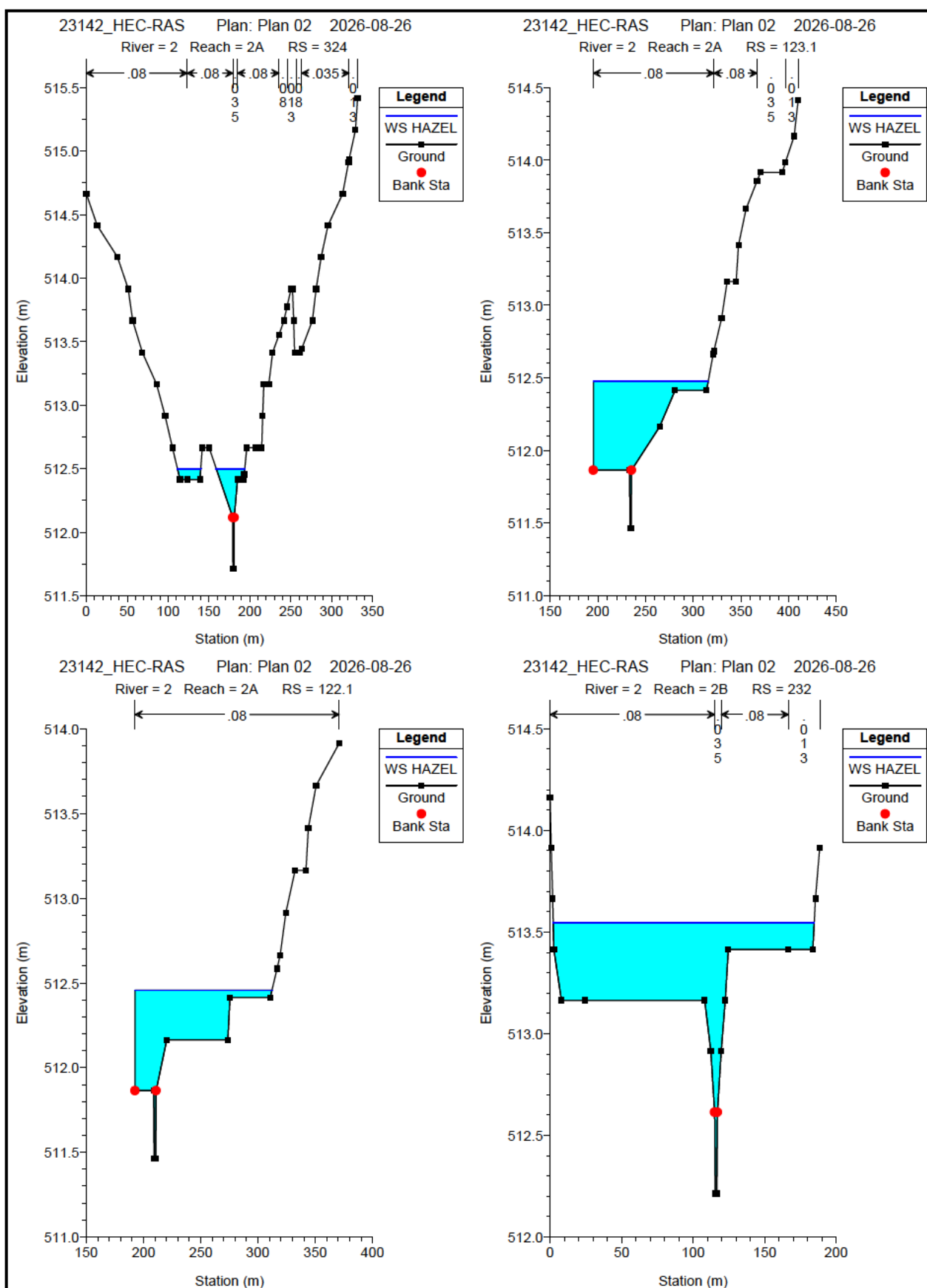


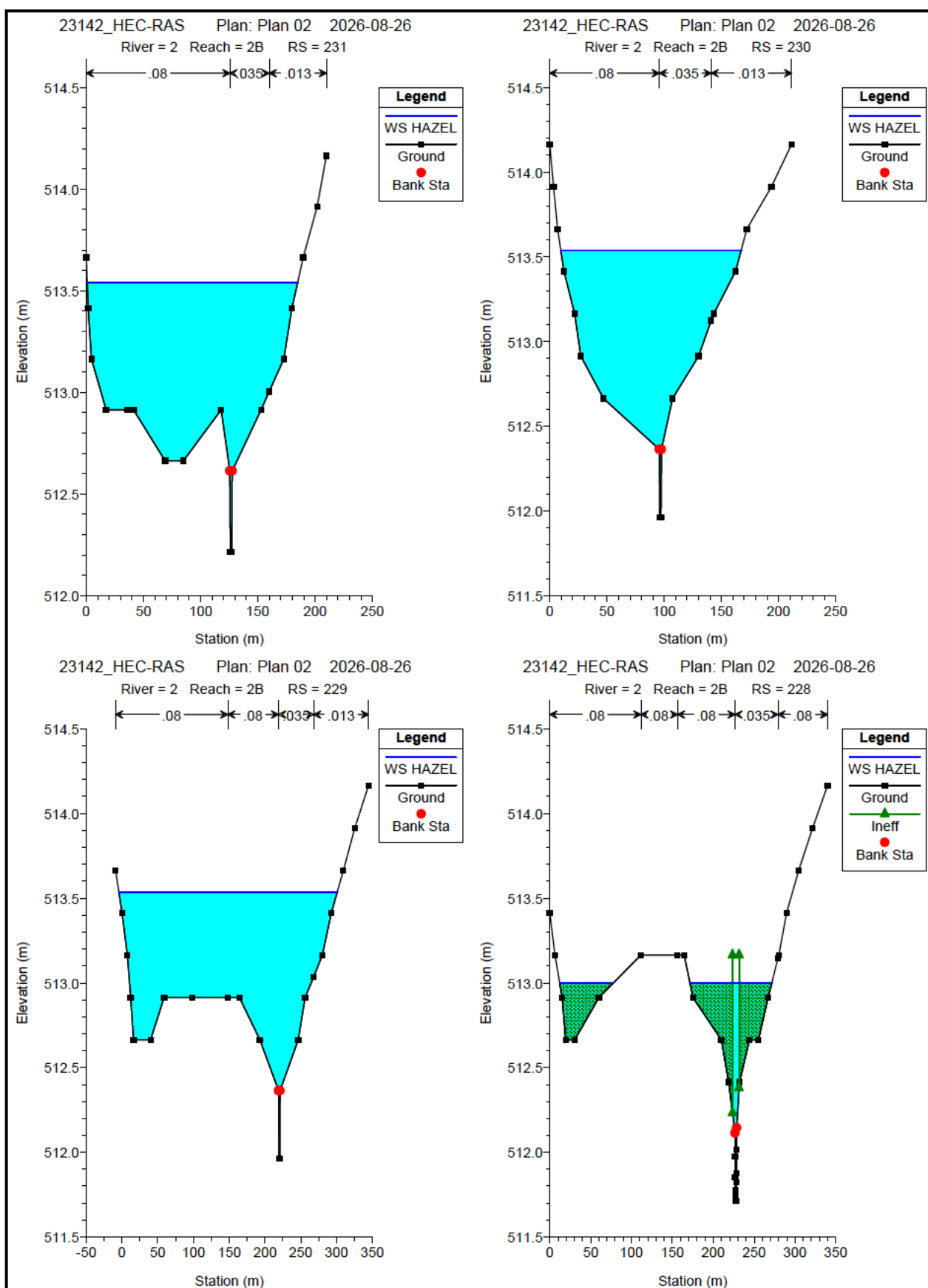


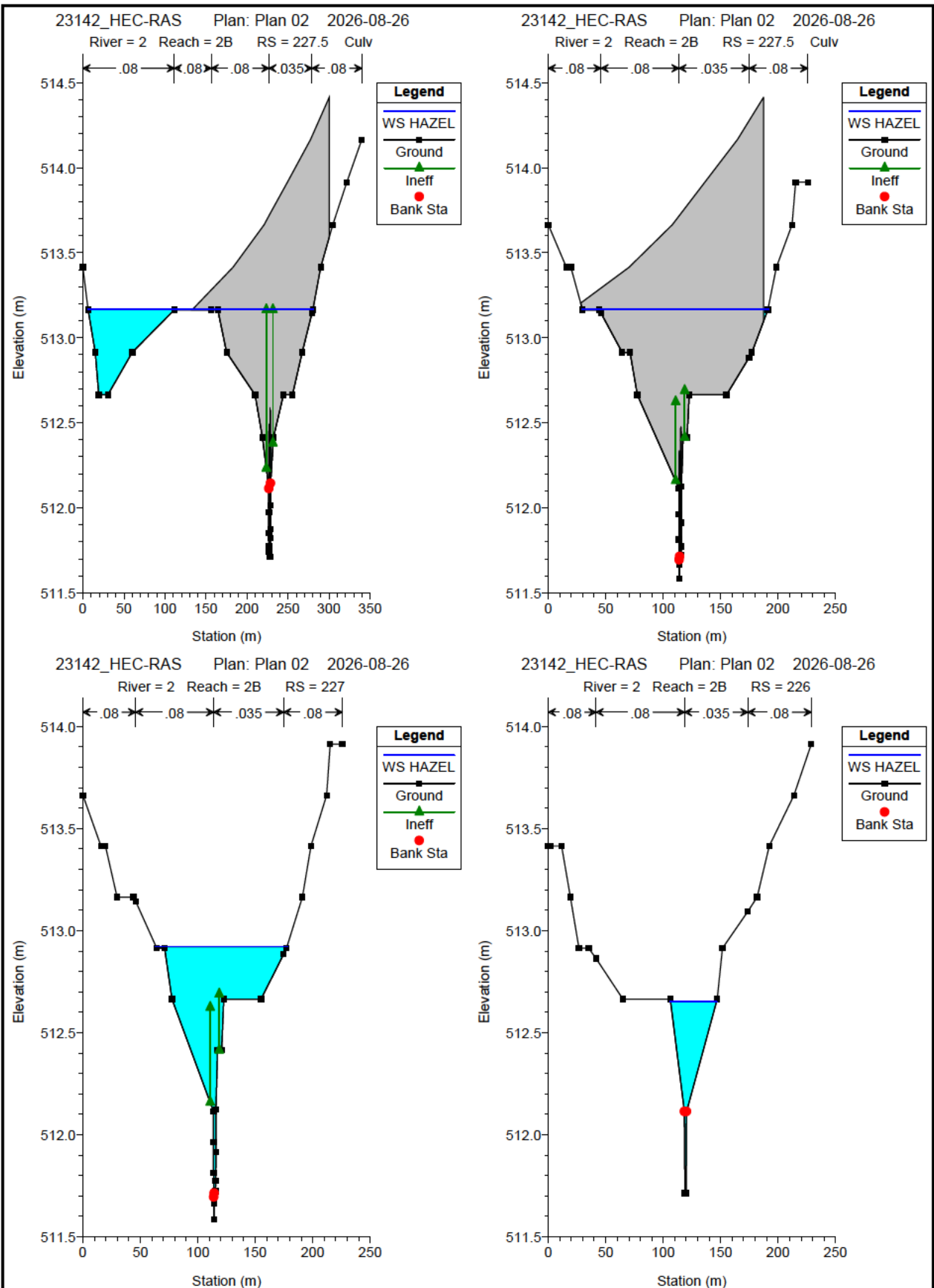


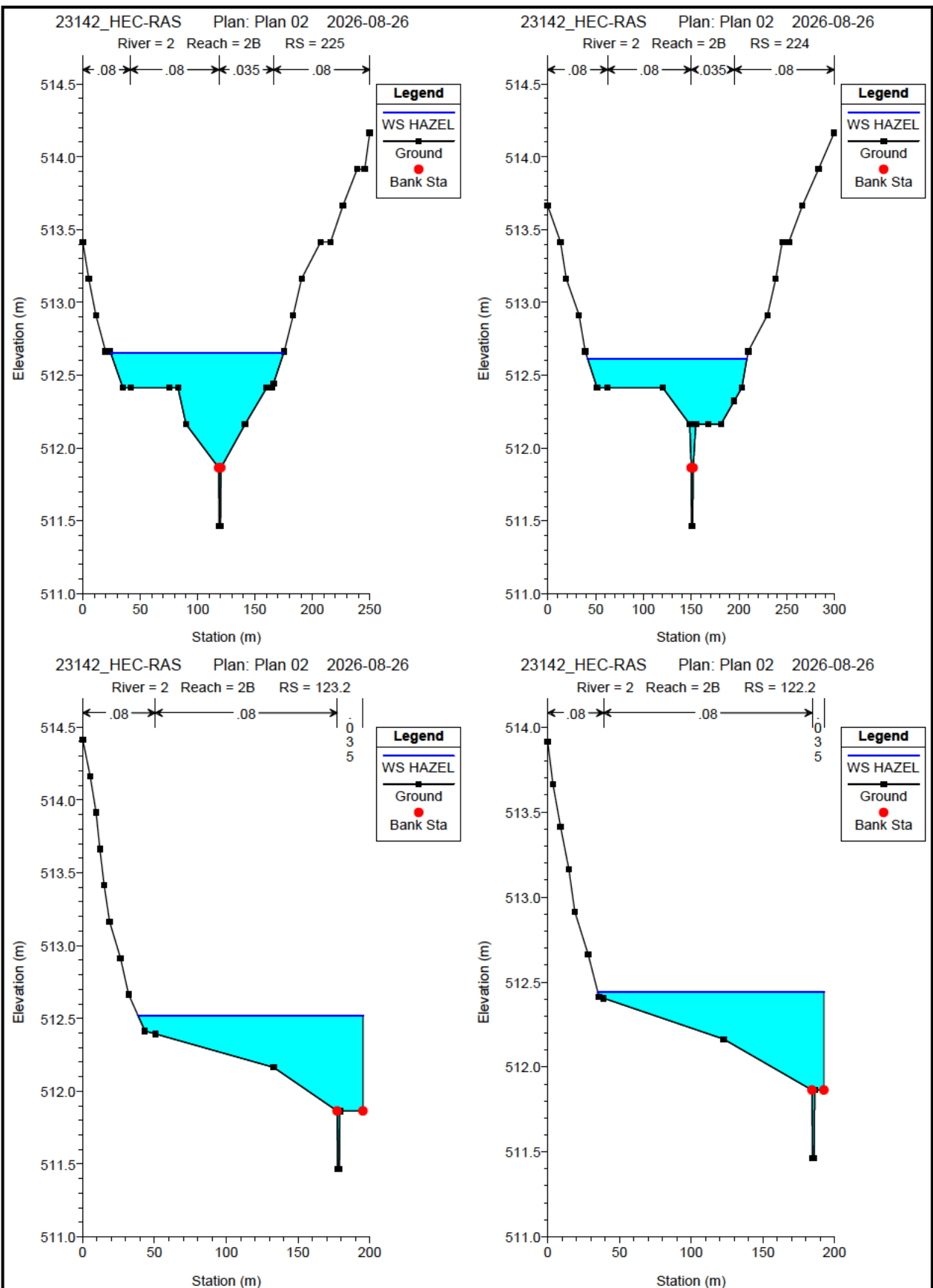


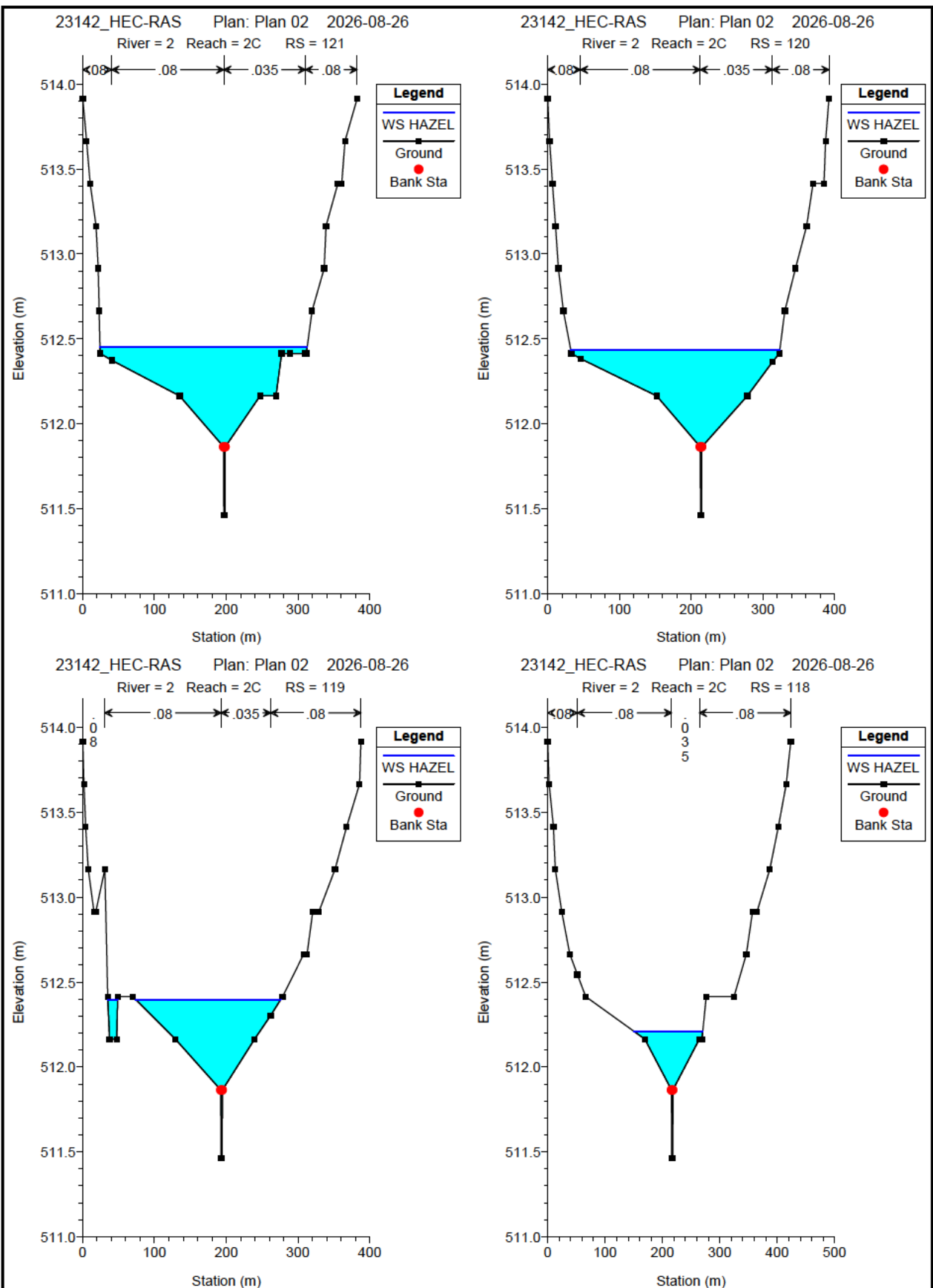


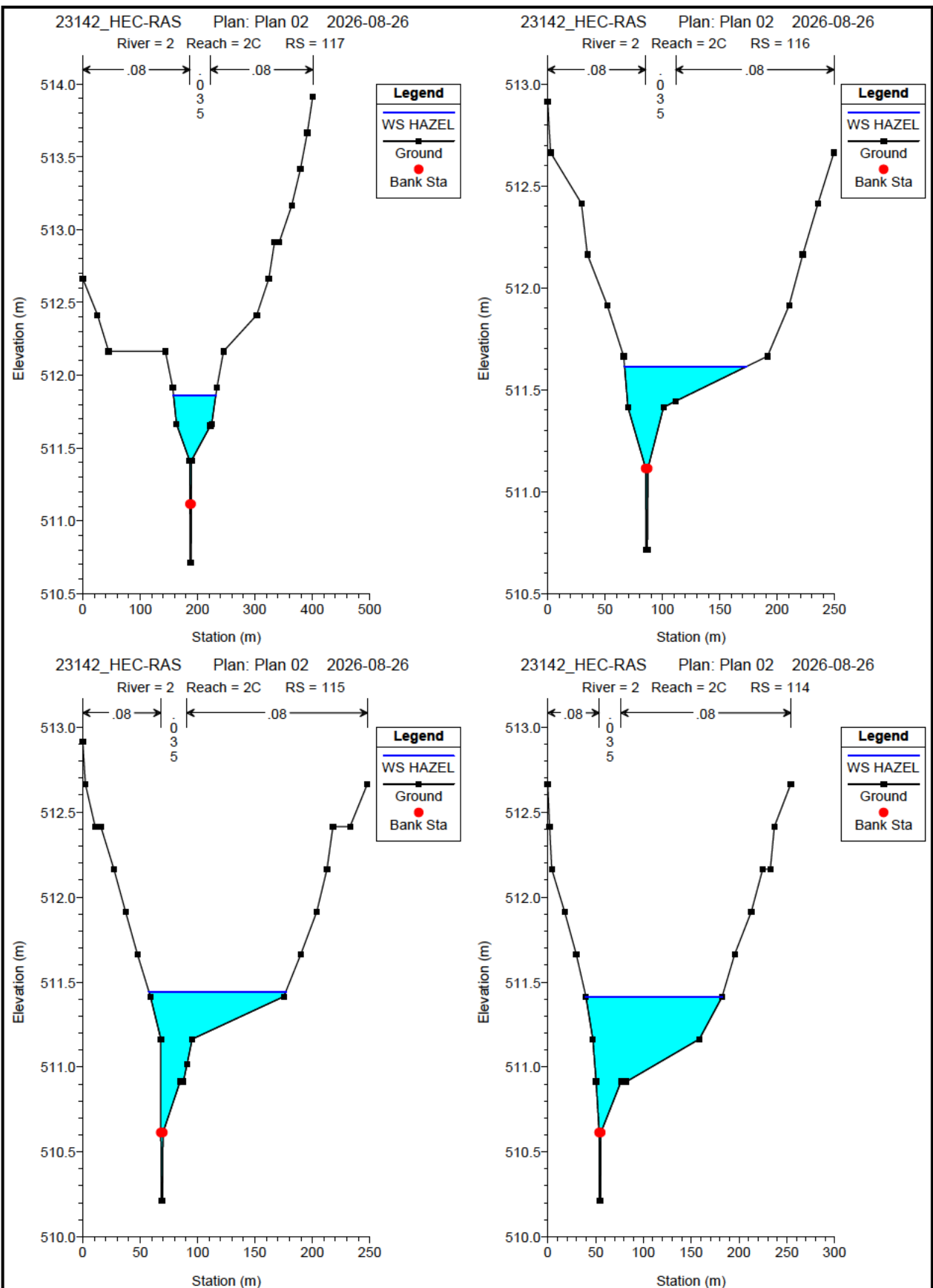


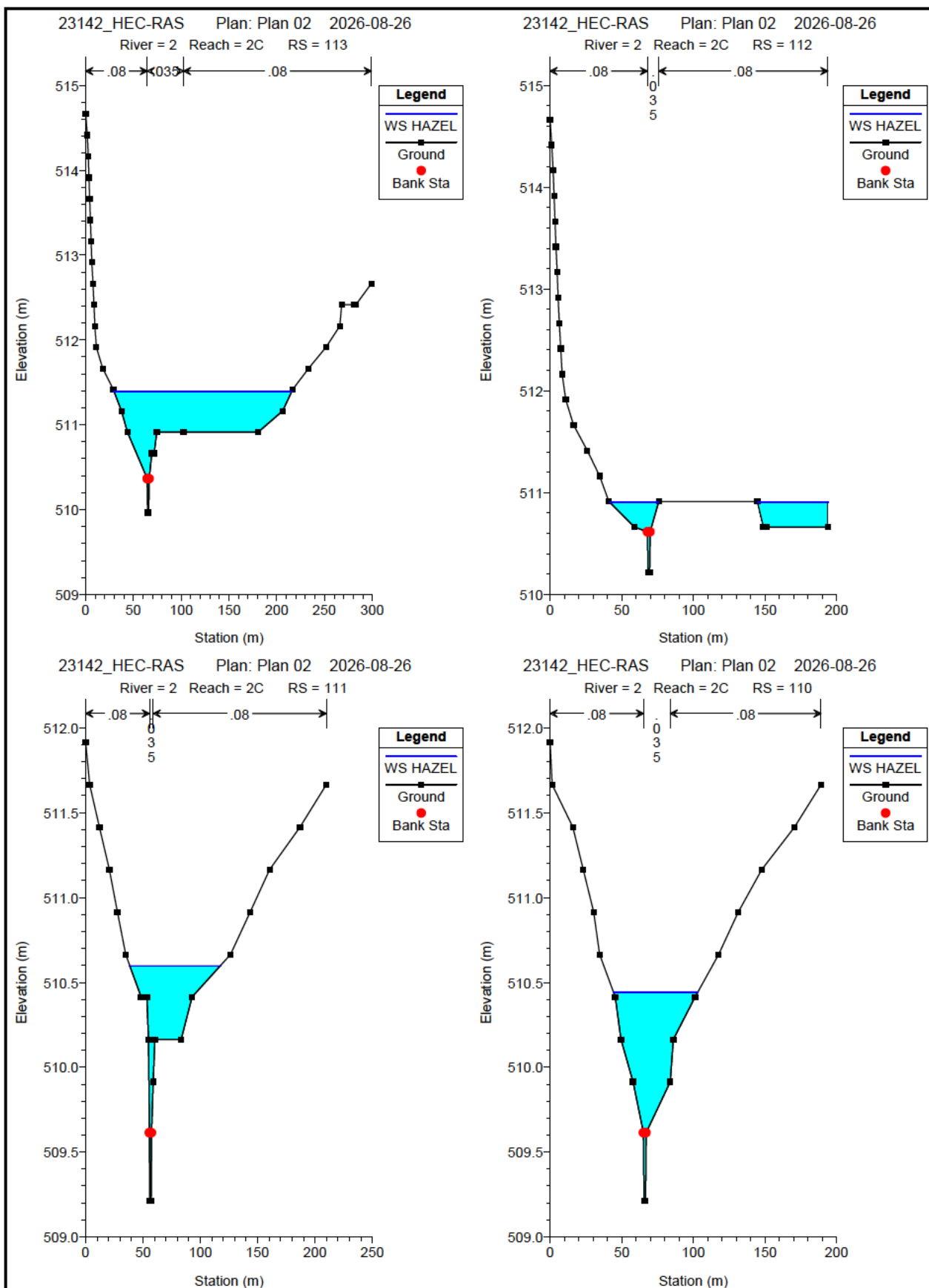


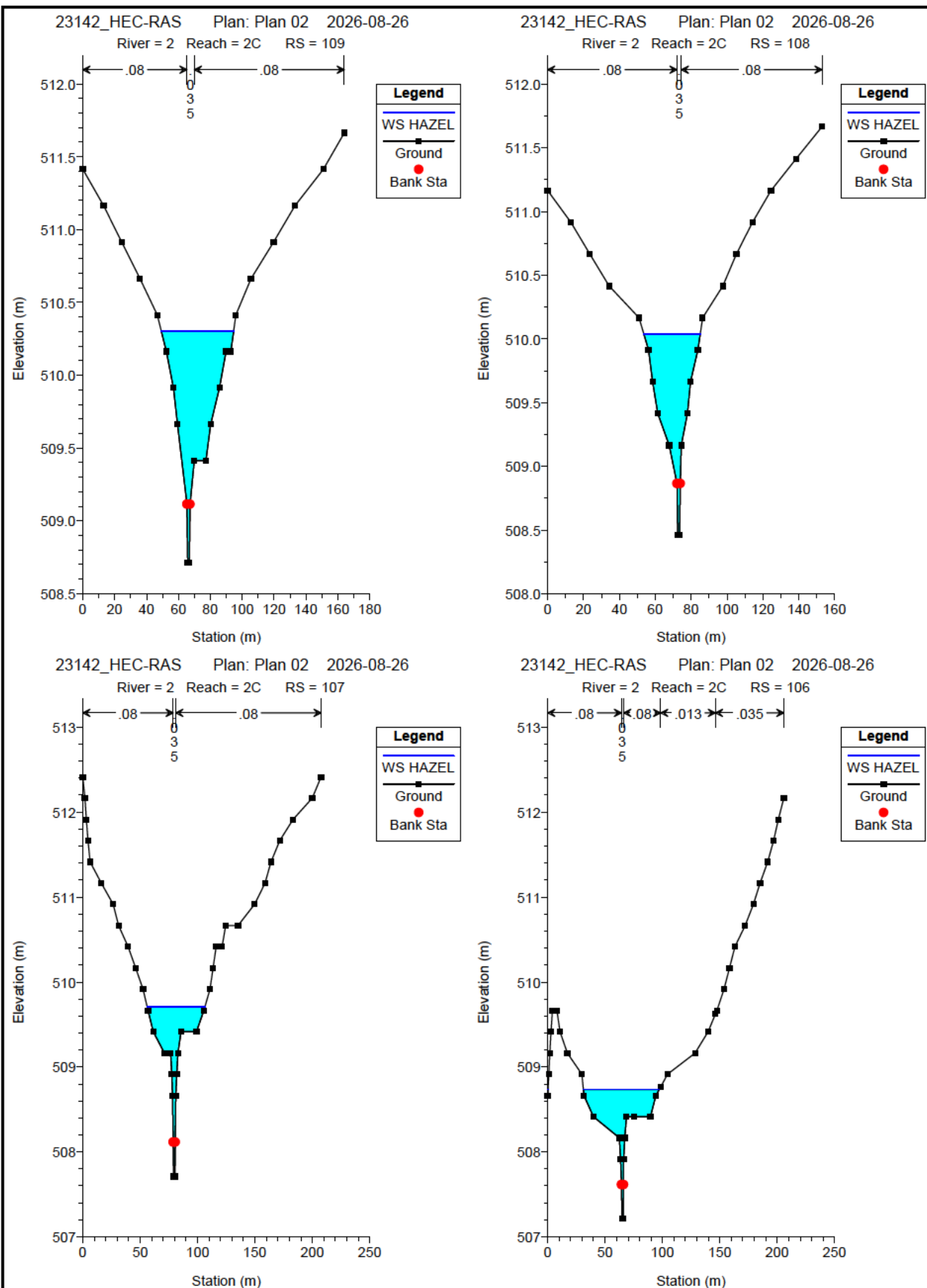


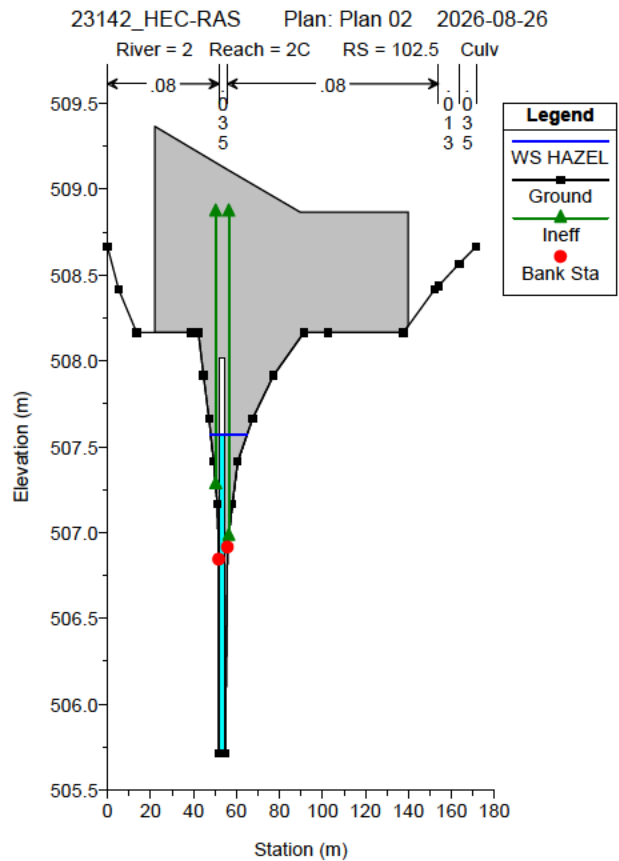
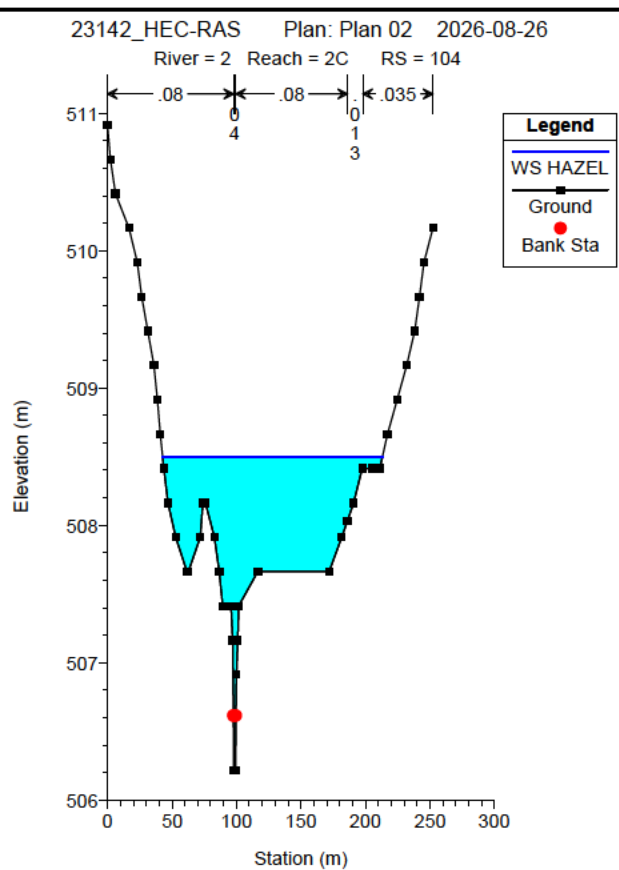


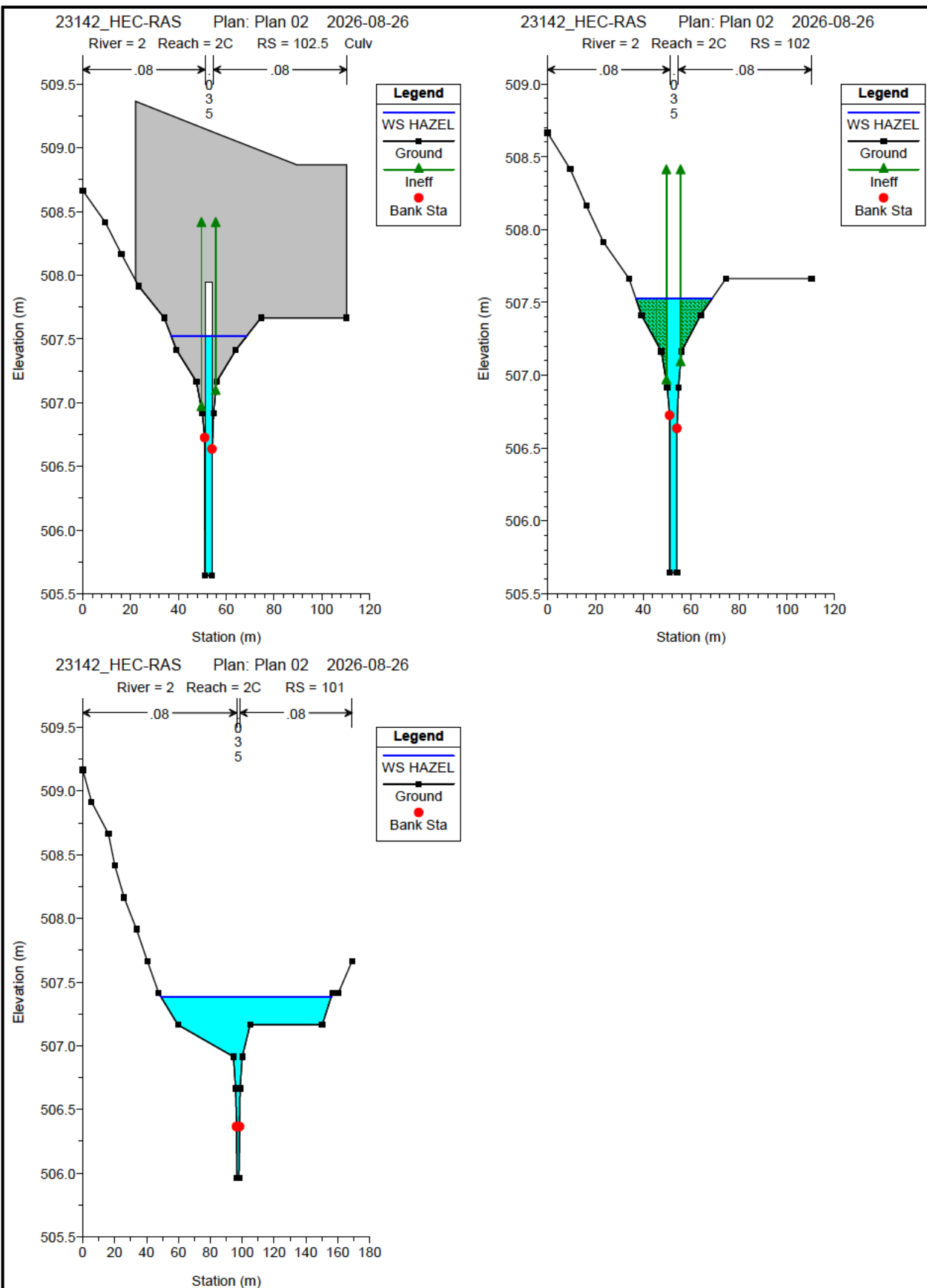








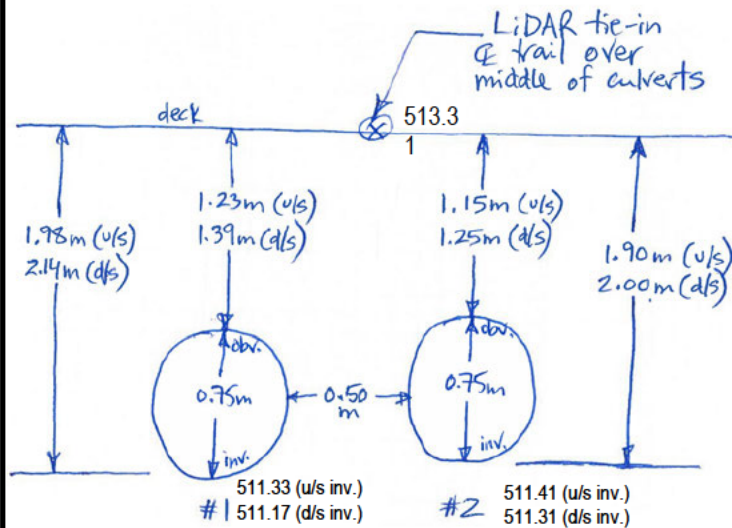




GR_001 - HYDRAULIC STRUCTURE INVENTORY SHEET

Watershed and Location Information	Structure Configuration and Dimensions		Current Flow Information
Date (mm/dd/yy): 11/14/23	Structure Type (Culvert/Bridge): Culvert		Flow Present (Y/N): N
Field Crew: BC/MC	Number of Openings: 2	Open Footing (Yes/No): No	Approx. Depth (mm): 720
Watershed Name: Grand River Watershed	Opening Shape: Circular	Material (Conc/Steel): HDPE (smooth int)	Approx. Velocity (m/s): n/a
River Name: Grand River	Opening Height(m): C1: 0.75 C2: 0.75	Opening Width/Span(m): C1: 0.75 C2: 0.75	Upstream Erosion (Y/N): N
Reach ID: Tributary 2	Opening Length in direction of flow (m): C1: 12.1 C2: 12.1		Downstream Erosion (Y/N): N
Municipality: Township of Southgate (Dundalk)	Inlet Type (Projecting/Mitered/Headwall): Projecting		Additional Flow Information / Field Notes:
Location (Road Name/Intersection): Rail Trail off Hagan St E	Skew Angle of Crossing (Degrees): n/a		
Latitude: 44.165992	Height from Obvert to Top of Road (m): C1: 1.23 C2: 1.15		
Longitude: -80.386271	Railing height (m): n/a	Depth of Siltation (mm): n/a	

Site Photograph and Additional Field Notes



Looking d/s
NTS

Sketch of Structure



Upstream Structure Face



Downstream Structure Face



Watercourse Looking Upstream

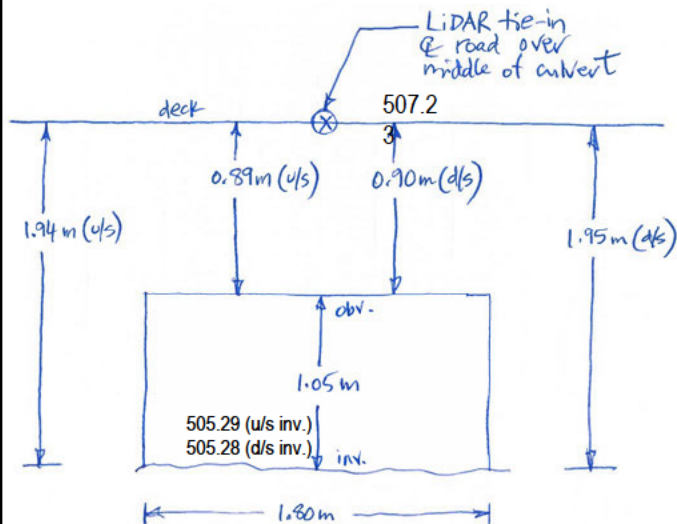


Watercourse Looking Downstream

GR_002 - HYDRAULIC STRUCTURE INVENTORY SHEET

Watershed and Location Information	Structure Configuration and Dimensions		Current Flow Information
Date (mm/dd/yy): 11/14/23	Structure Type (Culvert/Bridge): Culvert		Flow Present (Y/N): Y
Field Crew: BC/MC	Number of Openings: 1	Open Footing (Yes/No): No (imbedded)	Approx. Depth (mm): 250
Watershed Name: Grand River Watershed	Opening Shape: Rectangular	Material (Conc/Steel): Concrete	Approx. Velocity (m/s): n/a
River Name: Grand River	Opening Height(m): 1.050	Opening Width/Span(m): 1.800	Upstream Erosion (Y/N): N
Reach ID: Tributary 1	Opening Length in direction of flow (m): 14.5		Downstream Erosion (Y/N): N
Municipality: Township of Southgate (Dundalk)	Inlet Type (Projecting/Mitered/Headwall): Gabion Headwall		Additional Flow Information / Field Notes:
Location (Road Name/Intersection): Eco Parkway E of Ida St	Skew Angle of Crossing (Degrees): n/a		
Latitude: 44.155185	Height from Obvert to Top of Road (m): 0.89		
Longitude: -80.388024	Railing height (m): n/a	Depth of Siltation (mm): n/a	

Site Photograph and Additional Field Notes



Looking d/s
NTS

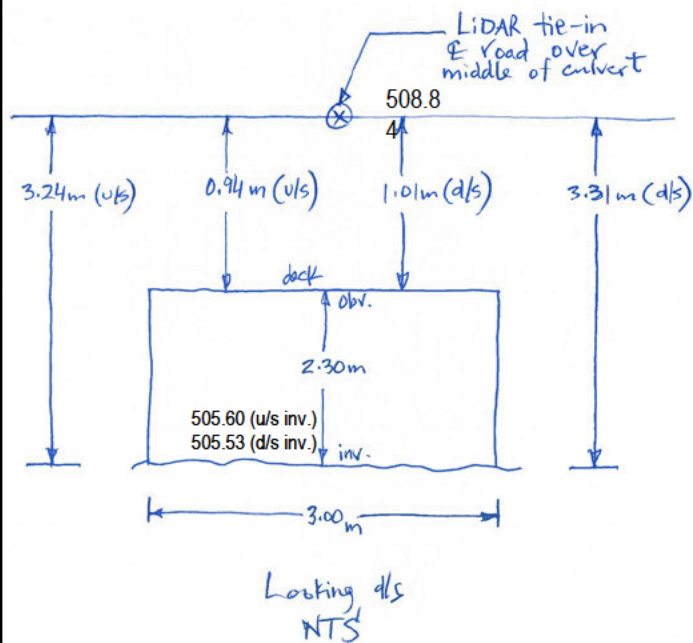
Sketch of Structure



GR_003 - HYDRAULIC STRUCTURE INVENTORY SHEET

Watershed and Location Information	Structure Configuration and Dimensions		Current Flow Information
Date (mm/dd/yy): 11/14/23	Structure Type (Culvert/Bridge): Culvert		Flow Present (Y/N): Y
Field Crew: BC/MC	Number of Openings: 1	Open Footing (Yes/No): No (imbedded)	Approx. Depth (mm): 300
Watershed Name: Grand River Watershed	Opening Shape: Rectangular	Material (Conc/Steel): Concrete	Approx. Velocity (m/s): n/a
River Name: Grand River	Opening Height(m): 2.30	Opening Width/Span(m): 3.00	Upstream Erosion (Y/N): N
Reach ID: Tributary 2	Opening Length in direction of flow (m): 17.0		Downstream Erosion (Y/N): N
Municipality: Township of Southgate (Dundalk)	Inlet Type (Projecting/Mitered/Headwall): Concrete Block Headwall		Additional Flow Information / Field Notes:
Location (Road Name/Intersection): Eco Parkway E of Ida St	Skew Angle of Crossing (Degrees): n/a		
Latitude: 44.159234	Height from Obvert to Top of Road (m): 0.94		
Longitude: -80.383408	Railing height (m): n/a	Depth of Siltation (mm): n/a	

Site Photograph and Additional Field Notes



Sketch of Structure



Upstream Structure Face



Downstream Structure Face



Watercourse Looking Upstream

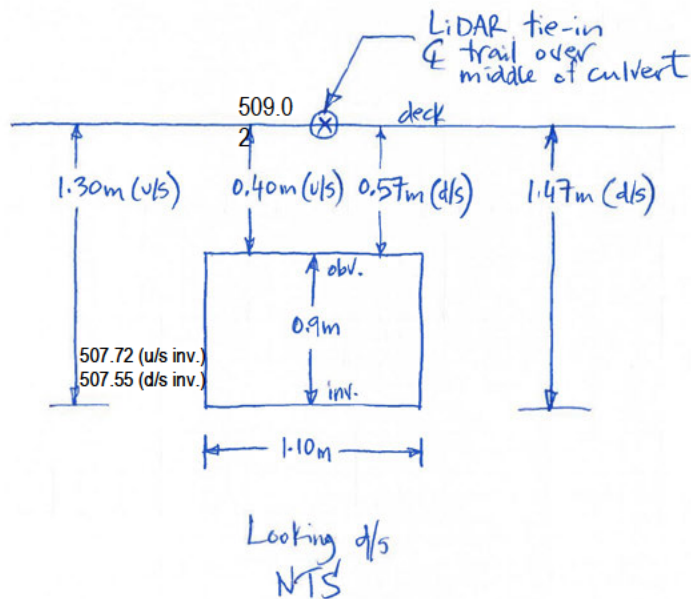


Watercourse Looking Downstream

GR_004 - HYDRAULIC STRUCTURE INVENTORY SHEET

Watershed and Location Information	Structure Configuration and Dimensions		Current Flow Information
Date (mm/dd/yy): 11/14/23	Structure Type (Culvert/Bridge): Culvert		Flow Present (Y/N): Y
Field Crew: BC/MC	Number of Openings: 1	Open Footing (Yes/No): No	Approx. Depth (mm): 200
Watershed Name: Grand River Watershed	Opening Shape: Rectangular	Material (Conc/Steel): Concrete	Approx. Velocity (m/s): n/a
River Name: Grand River	Opening Height(m): 0.90	Opening Width/Span(m): 1.10	Upstream Erosion (Y/N): N
Reach ID: Tributary 1	Opening Length in direction of flow (m): 4.1		Downstream Erosion (Y/N): N
Municipality: Township of Southgate (Dundalk)	Inlet Type (Projecting/Mitered/Headwall): Concrete Headwall w Wingwalls (u/s face)		Additional Flow Information / Field Notes:
Location (Road Name/Intersection): Trail E of Ida St N of EcoPky	Skew Angle of Crossing (Degrees): n/a		
Latitude: 44.157065	Height from Obvert to Top of Road (m): 0.40		
Longitude: -80.389051	Railing height (m): n/a	Depth of Siltation (mm): n/a	

Site Photograph and Additional Field Notes



Sketch of Structure



Upstream Structure Face



Downstream Structure Face



Watercourse Looking Upstream



Watercourse Looking Downstream