HYDROLOGY REPORT

MaineDOT developed a range of flows for Smelt Brook that flows under Smelt Brook Bridge based on USGS Regression Equations and StreamStats (MaineDOT, 2023). The range of flows for Smelt Brook are summarized in the table below.

SUMMARY

Drainage Area	1.2	mi^2
Q1.1	30	ft^3/s
Q10	135	ft^3/s
Q25	175	ft^3/s
Q50	210	ft^3/s
Q100	240	ft^3/s
Q500	320	ft^3/s

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

HYDRAULIC REPORT

The hydraulic performance of the existing bridge and the proposed bridge was analyzed using 1-dimensional unsteady flow hydraulic models. HEC RAS version 6.4.1 software developed by the Hydrologic Engineering Center for the U.S. Army Corps of Engineers was used to model the various flow and tidal conditions as outlined below.

Stream cross sections created from 2023 survey data were used to develop a model of Smelt Brook in the vicinity of the project. The modeled reach extends 350' upstream of the bridge to capture the upstream constriction at the old US Route One crossing and 285' downstream of the bridge into the tidal flat zone. The downstream distance is determined by engineering judgement to be sufficient to accurately capture the hydraulic behavior of the brook as the channel opens into the relatively wide tidal flat zone. The stream slope ranges from 0.4% at the downstream end of the reach to 7.9% at the upstream-most end of the modeled reach. The average stream slope at the proposed bridge location is 3.0%. There is a scour hole approximately 2' deep at the outlet of the existing bridge.

The streambed upstream of the existing bridge consists of gravel, cobbles, and small boulders. The banks of the brook are lined with medium brush and small trees upstream. Manning's n values were determined for channel sides and bottom based on *Open Channel hydraulics* by Chow (1959). Manning's n values of 0.055 and 0.070 were used to model the streambed channel and overbank roughness upstream. The downstream streambed consists of gravel, small boulders, and tidal flat material. Manning's n values of 0.035 and 0.060 were used to model the streambed channel and overbank roughness downstream.

EXISTING BRIDGE

The existing bridge, as shown in the 1936 plans, consists of ashlar masonry stacked stone abutments and a buried slab-type superstructure. The waterway opening is approximately 9'-0" wide and 13'-6" high. The inlet invert elevation is taken to be 2.5' and the outlet invert to be -1.7' based on survey data and the 1936 plans. The low chord is at elevation 13'.

RECOMMENDED REPLACEMENT BRIDGE

The proposed bridge will be located along the same highway alignment as the existing bridge and will be a precast NEBT beam composite concrete deck superstructure with integral abutments. The stream channel under the bridge will have a 9' wide flat bottom along the thalweg with 1.75:1 side slopes up to the abutments with 2'-6" shelves located at the abutments. The proposed inlet elevation is 1.6' and the proposed outlet elevation is -0.4'. The low chord will be located at elevation 23.6'.

ANALYSIS

The bridge hydraulics are influenced by stream flows and tidal cycles. The stream flows at Q1.1, Q10, Q50, Q100, Q500 were input as constant upstream boundary conditions. The tidal cycles were inputted using stage hydrographs to model the time-varying downstream boundary conditions. Stage hydrographs were developed for four tidal scenarios: average tides, average tide plus 4 ft of sea level rise (SLR), 2% annual chance (50 yr) storm tides, and 2% annual chance (50 yr) storm tides plus 4 ft of SLR.

Tidal data was collected from two sources; the NOAA Tide Gage in Eastport, Maine and MaineDOT data loggers installed at the Smelt Brook Bridge in Perry. A comparison of the recorded tidal levels at Eastport to the recorded tidal levels at Perry for the time period of June 8, 2023 to July 6, 2023 found that the Perry water elevations were on average 0.2 ft higher. For hydraulic modelling, the stage hydrographs representing average tides were the water surface elevations recorded at Perry for the 5-day period from June 8, 2023 to June 12, 2023. To represent the average tide plus SLR, the average tide stage hydrograph were adjusted up linearly by 4.0 ft.

The stage hydrographs representing 2% annual chance (50 yr) storm surge events were developed using the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Washington County dated 2017. The 2% annual chance stillwater elevation in Cobscook Bay is 14.0 ft. The average peak tide at Perry for the period from June 9, 2023 to June 13, 2023 was 9.8 ft. The tidal data was adjusted linearly upwards by 4.2 ft so the peak water surface elevation reached EL 14.0 ft. To represent the 2% annual chance storm tides plus SLR, the stage hydrograph was adjusted up linearly by 4.0 ft.

The range of stream flows and tidal cycles were analyzed in the HEC RAS model using twelve scenarios for the existing and proposed structures. The hydraulic results for these scenarios are summarized in the table below.

The hydraulic model was not calibrated with recorded water surface levels since this data was not available in the FEMA FIS for Smelt Brook. However, the accuracy of the model is improved by using the tidal data that was collected at the site for the downstream boundary conditions. Since it was anticipated that the tidal flows would play a larger role in the determination of water surface levels, a sensitivity study of the Manning’s n values used to model the channel and overbank roughness was not performed.

CONCLUSIONS

The results indicate that the tidal cycles govern the crossing hydraulics at high tide but have minimum impact at low tide. The proposed hydraulic opening meets the tidal transparency guidance of 0.25-feet allowable head difference between upstream and downstream at mean-higher-high-water (MHHW) as outlined in the General Design Criteria for Tidal Drainage Structures. At flows from Q1.1 to Q500, the water elevation at the inlet and outlet match the high tide elevation.

The proposed hydraulic opening provides 6.1' of freeboard at Q10 flows at MHW tides plus 4' of sea level rise including wave heights. This is greater than the 2' minimum per the General Design Criteria for Tidal Drainage Structures. For this calculation, a wave height of 4.4 ft was conservatively chosen. The 4.4 ft wave height is the significant wave height for a 1% (100 yr) annual chance obtained from FEMA FIS Coastal Transect Location #18 in Cobscook Bay. This is conservative since the wave height is for 1% annual event and the actual bridge location is in a fetch-restricted in a cove further inland from transect location #18.

Scour was not calculated because bedrock is located at or just below streambed. Heavy riprap is recommended to protect the coastal side slopes and slopes the in front of the abutments. At least fifty percent of the heavy riprap stones by volume have an average dimension greater than 24 inches (1000 lbs). The large stones will be used to anchor the toes of the riprap slopes. It is recommended to extend the heavy riprap up to Elevation 18.0 feet which is the greater of the 2% Annual Chance (50 yr) Storm Tide plus 4' sea level rise or the Mean High Water plus 4' sea level rise plus 4.4' wave height (17.3').

SUMMARY

Scenario	Value		Existing Structure	Recommended Structure
			9 ft span Buried Slab Bridge	Single Span Bridge
Total Area of Waterway Opening		ft^2	121	1227
$Q_{1.1}$ Avg. Tides	Peak Headwater: High Tide	ft	9.8	9.8
	Peak Tailwater: High Tide	ft	9.8	9.8
	PHHD: High Tide	ft	0.0	0.0
	Freeboard[2]: High Tide	ft	20.2	13.6
	Velocity at Peak High Tide	ft/s	0.39	0.07
	Headwater: Low Tide	ft	3.8	3.14
	Tailwater: Low Tide	ft	-0.76	-0.07
	Peak Velocity at Low Tide	ft/s	4.33	2.05

$Q_{1.1}$ Avg. Tides 4 ft SLR	Peak Headwater: High Tide	ft	13.8	13.8
	Peak Tailwater: High Tide	ft	13.8	13.8
	PHHD: High Tide	ft	0.0	0.0
	Freeboard[2]: High Tide	ft	16.2	9.6
	Velocity at Peak High Tide	ft/s	0.28	0.04
	Headwater: Low Tide	ft	3.8	3.14
	Tailwater: Low Tide	ft	-0.76	-0.07
	Peak Velocity at Low Tide	ft/s	4.33	2.05
$Q_{1.1}$ 2% annual chance coastal storm event	Peak Headwater: High Tide	ft	14.00	14.00
	Peak Tailwater: High Tide	ft	14.00	14.00
	PHHD: High Tide	ft	0.0	0.0
	Freeboard[2]: High Tide	ft	16.00	9.40
	Velocity at Peak High Tide	ft/s	0.28	0.04
	Headwater: Low Tide	ft	3.8	3.14
	Tailwater: Low Tide	ft	-0.76	-0.07
	Peak Velocity at Low Tide	ft/s	4.33	2.05
$Q_{1.1}$ 2% annual chance coastal storm event + 4 ft SLR	Peak Headwater: High Tide	ft	18.00	18.00
	Peak Tailwater: High Tide	ft	18.00	18.00
	PHHD: High Tide	ft	0.0	0.0
	Freeboard[2]: High Tide	ft	12.00	5.40
	Velocity at Peak High Tide	ft/s	0.17	0.03
	Headwater: Low Tide	ft	3.8	3.14
	Tailwater: Low Tide	ft	-0.76	-0.07
	Peak Velocity at Low Tide	ft/s	4.33	2.05
Q_{10} Avg. Tides	Headwater at MHHW:	ft	-	9.34
	Peak Headwater: High Tide	ft	9.85	9.8
	Peak Tailwater: High Tide	ft	9.79	9.8
	PHHD: High Tide	ft	0.06	0.0
	Freeboard[2]: High Tide	ft	20.15	13.6
	Velocity at Peak High Tide	ft/s	1.36	0.30
	Headwater: Low Tide	ft	5.0	4.19
	Tailwater: Low Tide	ft	0.91	0.77
	Peak Velocity at Low Tide	ft/s	6.62	4.17
Q_{10} Avg. Tides 4 ft SLR	Peak Headwater: High Tide	ft	13.83	13.8
	Peak Tailwater: High Tide	ft	13.8	13.8
	PHHD: High Tide	ft	0.03	0.0
	Freeboard[2]: High Tide	ft	16.17	9.6
	Velocity at Peak High Tide	ft/s	0.98	0.17
	Headwater: Low Tide	ft	5.0	4.19
	Tailwater: Low Tide	ft	0.91	0.77
	Peak Velocity at Low Tide	ft/s	6.62	4.17

Q_{50} Avg. Tides	Headwater at MHHW:	ft	-	9.34
	Peak Headwater: High Tide	ft	10	9.8
	Peak Tailwater: High Tide	ft	9.77	9.8
	PHHD: High Tide	ft	0.23	0.0
	Freeboard[2]: High Tide	ft	20	13.6
	Velocity at Peak High Tide	ft/s	2.7	0.47
	Headwater: Low Tide	ft	6.29	4.72
	Tailwater: Low Tide	ft	2.29	1.09
	Peak Velocity at Low Tide	ft/s	8.43	5.19
Q_{50} Avg. Tides 4 ft SLR	Peak Headwater: High Tide	ft	13.93	13.8
	Peak Tailwater: High Tide	ft	13.78	13.8
	PHHD: High Tide	ft	0.15	0.0
	Freeboard[2]: High Tide	ft	16.07	9.6
	Velocity at Peak High Tide	ft/s	1.96	0.26
	Headwater: Low Tide	ft	6.29	4.72
	Tailwater: Low Tide	ft	2.29	1.09
	Peak Velocity at Low Tide	ft/s	8.43	5.19
Q_{100} Avg. Tides	Headwater at MHHW:	ft	-	9.37
	Peak Headwater: High Tide	ft	10.06	9.82
	Peak Tailwater: High Tide	ft	9.76	9.8
	PHHD: High Tide	ft	0.3	0.02
	Freeboard[2]: High Tide	ft	19.94	13.58
	Velocity at Peak High Tide	ft/s	3.08	0.54
	Headwater: Low Tide	ft	6.62	4.91
	Tailwater: Low Tide	ft	2.66	1.19
	Peak Velocity at Low Tide	ft/s	8.83	5.56
Q_{100} Avg. Tides 4 ft SLR	Peak Headwater: High Tide	ft	13.97	13.8
	Peak Tailwater: High Tide	ft	13.78	13.8
	PHHD: High Tide	ft	0.19	0.0
	Freeboard[2]: High Tide	ft	16.03	9.6
	Velocity at Peak High Tide	ft/s	2.24	0.29
	Headwater: Low Tide	ft	6.62	4.91
	Tailwater: Low Tide	ft	2.66	1.19
	Peak Velocity at Low Tide	ft/s	8.83	5.56
Q_{500} Avg. Tides	Peak Headwater: High Tide	ft	10.27	9.84
	Peak Tailwater: High Tide	ft	9.73	9.8
	PHHD: High Tide	ft	0.54	0.04
	Freeboard[2]: High Tide	ft	19.73	13.56
	Velocity at Peak High Tide	ft/s	4.07	0.72
	Headwater: Low Tide	ft	7.45	5.83
	Tailwater: Low Tide	ft	3.59	1.42

	Peak Velocity at Low Tide	ft/s	9.75	6.44
Q_{500} Avg. Tides 4 ft SLR	Peak Headwater: High Tide	ft	14.1	13.8
	Peak Tailwater: High Tide	ft	13.76	13.8
	PHHD: High Tide	ft	0.34	0.0
	Freeboard[2]: High Tide	ft	15.9	9.6
	Velocity at Peak High Tide	ft/s	2.98	0.39
	Headwater: Low Tide	ft	7.45	5.83
	Tailwater: Low Tide	ft	3.59	1.42
	Peak Velocity at Low Tide	ft/s	9.75	6.44

Notes:

1. PHHD refers to the Hydraulic Head Difference between the peak headwater elevation and the peak tailwater elevation.
2. Freeboard is measured as the distance from the peak headwater elevation to the road surface elevation (approximately El. 30.0 ft) for the existing culvert crossing and from the peak headwater elevation to the low chord El. 23.4 ft for the proposed bridge structure.
3. Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

Summary of NOAA Tidal Information:

NOAA Tides and Currents	
MHHW	9.34 feet
MHW	8.86 feet
MLW	-9.49 feet
MLLW	-9.93 feet
NAVD88 Datum	0.00 feet
Great Diurnal Range	19.27 feet
Mean Range of Tide	18.35 feet
Max Tide	14.44 feet
Highest Astronomical Tide	12.83 feet

Summary of Tidal Heights:

Maximum Tidal Height Conditions	
Average Tide	9.8 feet
Average Tide + 4' Sea Level Rise (SLR)	13.8 feet = 9.8 + 4.0
2% Annual Chance (50 yr) Storm Tide	14.0 feet
2% Annual Chance (50 yr) Storm Tide +SLR	18.0 feet = 14.0 + 4.0
MHW + SLR + 4.4' Wave Height	17.5 feet = 8.9 + 4.0 + 4.4

Reported by: Benjamin Pomeroy
Date: June 14, 2024

Appendix C

Hydraulics Data

WIN:	26630.00	**Project Name:**	
Town:	Perry	**Stream Name:**	Smelt Brook
Route No.	US1	**Bridge Name:**	Smelt Brook
Asset ID:	2774	**Analysis by:**	csh
Lat:	44.95443 **Long:** -67.10316	**Date:**	8/15/2023

Peak Flow Calculations by USGS Regression Equations (Lombard/Hodgkins, 2021; Hodgkins, 1999 & Lombard/Hodgkins, 2015)

Enter data in blue cells only!

ver. 2021 Jan 01

	km^2	mi^2	ac	
				Enter data in [mi^2]
A	3.16	1.22	780.8	Watershed Area *DRNAREA*
W	0.26	0.1	63.6	Wetlands area (by NWI)
P_c	648574	4980917		watershed centroid (E, N; UTM 19N; meters)
County	Washington			*choose county from drop-down menu*

Worksheet prepared by:
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Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov

Watershed Characteristics from StreamStats

STORAGE	8.34	
STORNWI	8.15	NWI Wetlands %
SANDGRAVF	0.00	sand & gravel aquifer as decimal fraction of watershed A
ELEV	143.7	mean basin elevation (ft)
BSLDEM10M	12.7	mean basin slope (%)
COASTDIST	35.00	distance from the coast (mi)
ELEVMAX	317.4	maximum basin elevation (ft)
LC06WATER	0	percent of drainage basin land cover as open water
PRECIP	43.3	mean annual precipitation
STATSGOA	11	mean basin percentage of hydrological soil group A

References:

Hodgkins, G.A., 1999.
Estimating the magnitude of peak flows for streams in Maine
for Selected Recurrence Intervals
WRIR 99-4008, USGS Augusta, ME

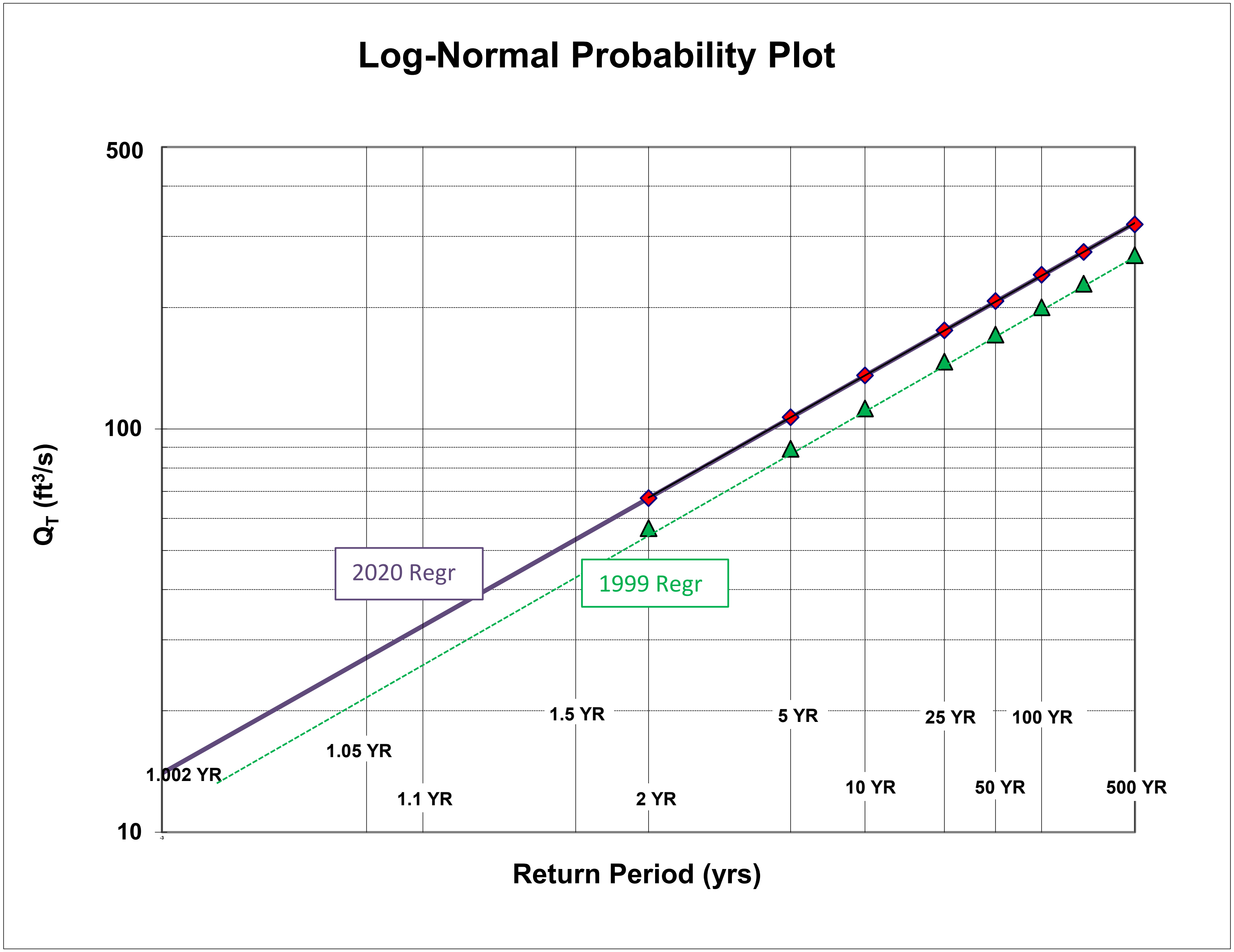
Lombard, P.J. & G.A. Hodgkins, 2015.
Peak flow regression equations for small, ungaged streams:
in Maine: Comparing Map-Based to Field-Based Variables
SIR 2015-4059, USGS, Augusta, ME

Lombard, P.J. & G.A. Hodgkins, 2020.
Estimating Flood Magnitude and Frequency on Gaged and
Ungaged Streams in Maine
SIR 2020-5092, USGS, Augusta, ME.

Ret Pd T (yr)	**I24**	**Q_T (ft^3/s) *1999 / 2015***	**Q_T (ft^3/s) *2020***	**Q_T (ft^3/s) *Design***
1.1			32	***30***
2	3.12	57	67	***65***
5	3.83	89	107	***105***
10	4.41	112	136	***135***
25	5.21	147	176	***175***
50	5.82	171	208	***210***
100	6.45	200	241	***240***
200	7.11	229	275	***275***
500	8.08	270	322	***320***

Calculated Bankfull Width: 11.5 **ft**

Instructions:
Enter values in blue cells only, watershed data from StreamStats
Copy I24 values from Stream Stats
Use results under "Design"
Check against gage data and FEMA studies if available
Questions? Check with ENV / Hydrology Section



Log-Normal Probability Plot
500
100
10
Q_T (ft³/s)
Return Period (yrs)
2020 Regr
1999 Regr
1.002 YR
1.05 YR
1.1 YR
1.5 YR
2 YR
5 YR
10 YR
25 YR
50 YR
100 YR
500 YR

WIN:	26630.00	**Project Name:**	0
Town:	Perry	**Stream Name:**	Smelt Brook
Route No.	US1	**Bridge Name:**	Smelt Brook
Asset ID:	2774	**Analysis by:**	csh
Lat:	44.95443 **Long:** -67.10316	**Date:**	8/15/2023

DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

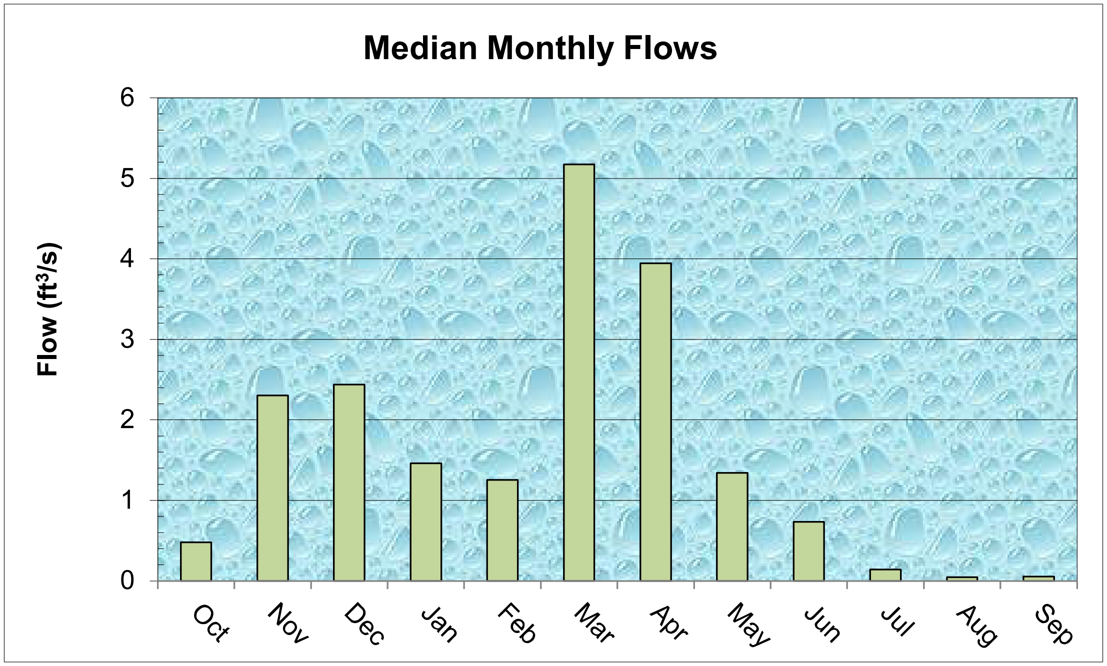
MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013, 2015)

	Value	Variable	Explanation
	1.22	*A*	Area (mi^2)
648574	4980917	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	35.03	*DIST*	Distance from Coastal reference line (mi)
	43.3	*pptA*	Mean Annual Precipitation (inches)
	0.00	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**1.46**	0.0414
Feb	**1.25**	0.0355
Mar	**5.17**	0.1466
Apr	**3.94**	0.1117
May	**1.34**	0.0380
Jun	**0.73**	0.0208
Jul	**0.14**	0.0040
Aug	**0.05**	0.0013
Sep	**0.05**	0.0015
Oct	**0.48**	0.0136
Nov	**2.30**	0.0652
Dec	**2.44**	0.0691

Q_{bf}	**6.4**	
ann avg	**2.7**	
ann med	**1.1**	
$Q_{1.002}$	**13.3**	
$Q_{1.01}$	**18.1**	
$Q_{1.05}$	**26.1**	
$Q_{1.1}$	**31.5**	
Q_{bf}	**21.6**	assume v = 4ft/s

W_{bf}	**11.5**	estimated bankfull width (ft)
d_{bf}	**0.6**	estimated bankfull depth (ft)
A_{bf}	**5.4**	estimated bankfull flow area (ft^2)

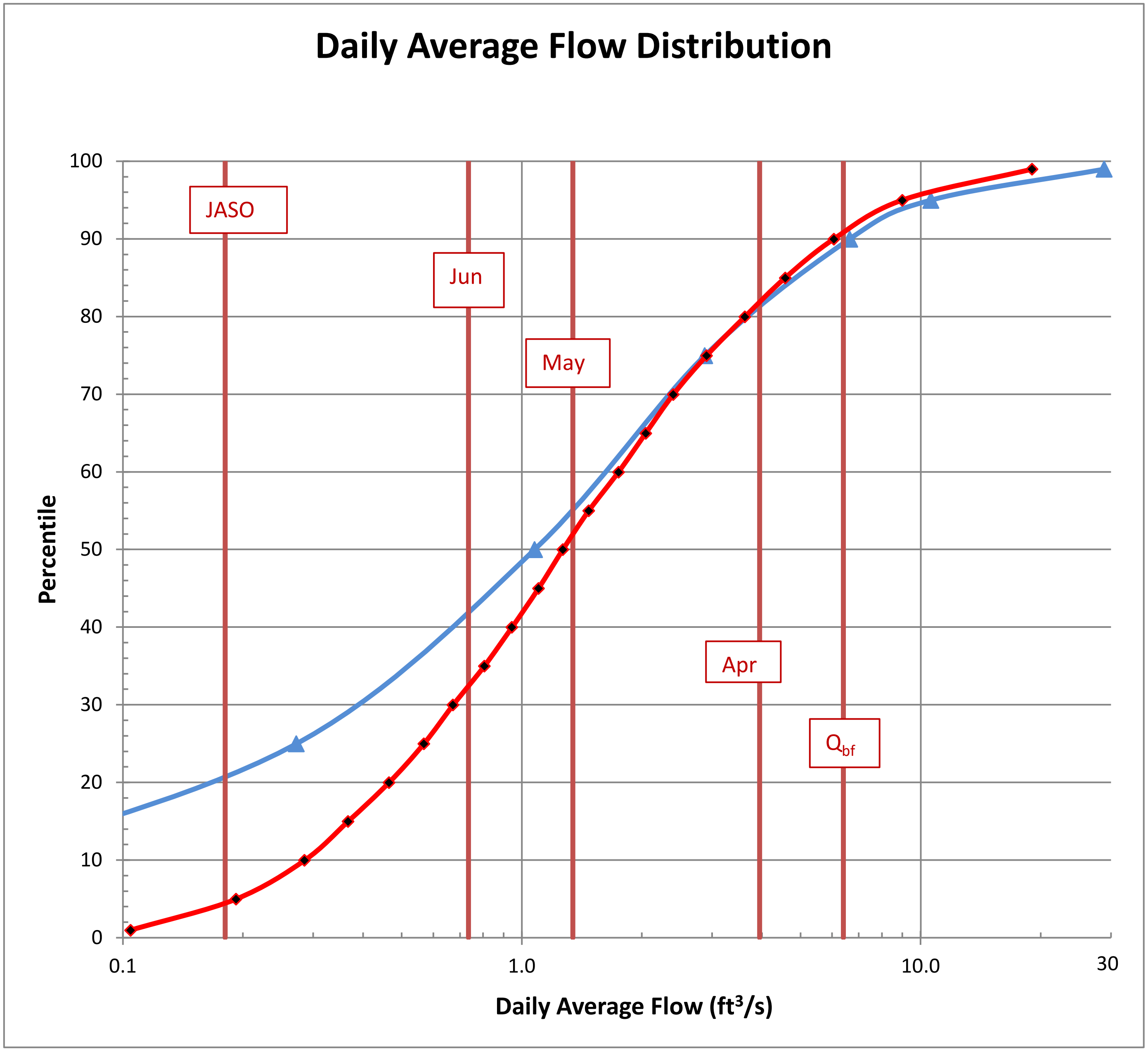


References

Dudley, 2013. FY2013 Progress Report - Phase 1 …, USFWS QRP Project

Dudley, 2004. Estimating Monthly Streamflows … , SIR 2004-5026

Dudley, 2015. Regression Equations for Monthly & Annual Mean..., USGS SIR 2015-5151



Daily Avg Flow Dist

A_{ws} = (mi^2) 1.2

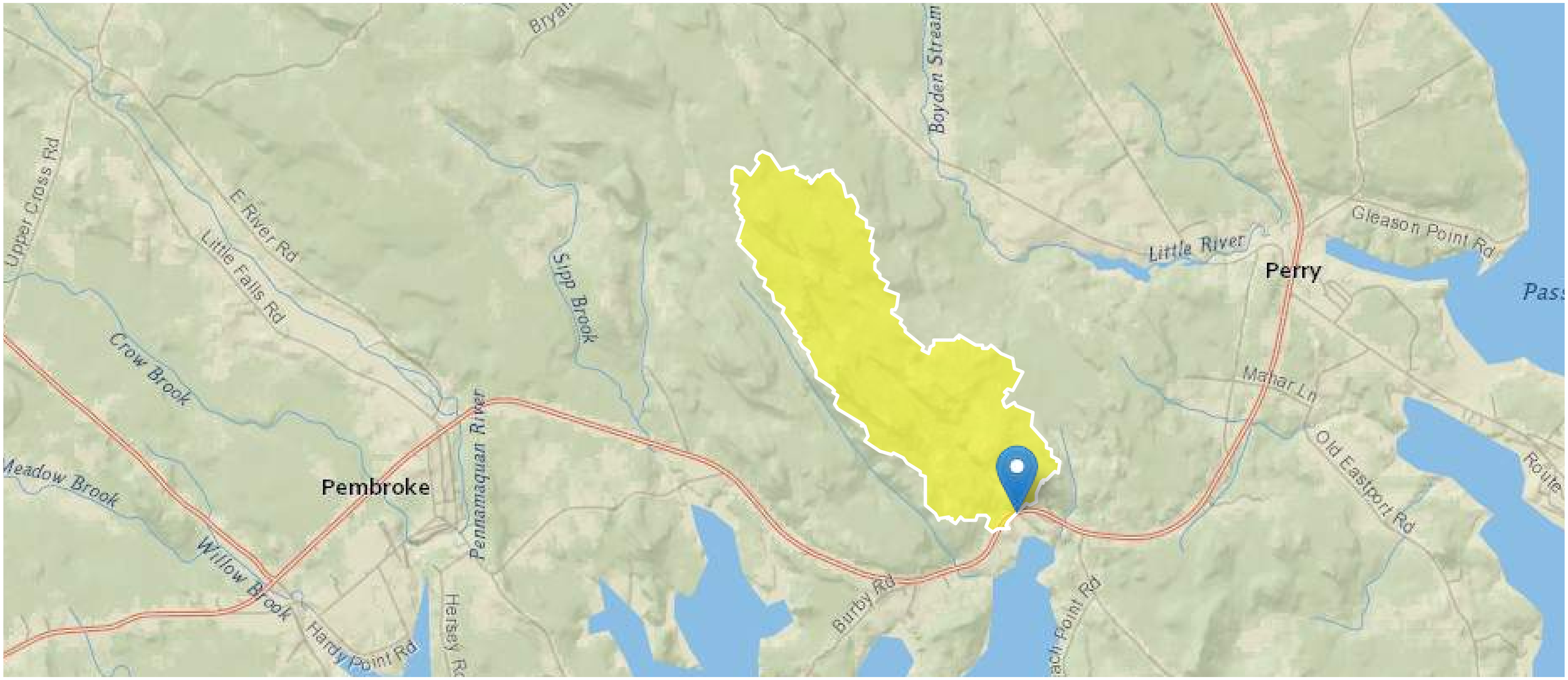
Q (ft^3/s)

Pctl	Median	84th pctl
1.00E-06	0.00	0.00
1	0.10	0.19
5	0.19	0.31
10	0.29	0.43
15	0.37	0.54
20	0.46	0.65
25	0.57	0.76
30	0.67	0.87
35	0.81	0.99
40	0.94	1.14
45	1.10	1.29
50	1.27	1.52
55	1.47	1.77
60	1.75	2.08
65	2.04	2.42
70	2.40	2.83
75	2.91	3.40
80	3.63	4.06
85	4.58	5.20
90	6.06	6.98
95	8.99	10.85
99	19.02	25.04

Q_{bf}	6.4
$Q_{1.002}$	13.3
$Q_{1.1}$	31.5
Q_{2}	66.3

Perry 26630 Smelt Brook Br #2774 US1

Region ID: ME
Workspace ID: ME20221108150558110000
Clicked Point (Latitude, Longitude): 44.95443, -67.10316
Time: 2022-11-08 10:06:22 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	12.7	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	648574.25	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	4980917.49	meters
COASTDIST	Shortest distance from the coastline to the basin centroid	35	miles
DRNAREA	Area that drains to a point on a stream	1.22	square miles
ELEV	Mean Basin Elevation	143.7	feet
ELEVMAX	Maximum basin elevation	317.4	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	6.45	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.41	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	7.11	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	5.21	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	3.12	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	8.08	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	5.82	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	3.83	inches
JULAVPRE	Mean July Precipitation	3.04	inches
LC06WATER	Percent of open water, class 11, from NLCD 2006	0	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	0.45	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.0755	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	0	percent

Parameter Code	Parameter Description	Value	Unit
PRDECFEB90	Basin average mean precipitation for December to February from PRISM 1961-1990	11.6	inches
PRECIP	Mean Annual Precipitation	43.3	inches
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0	dimensionless
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	0	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	11	percent
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	8.337	percent
STORNWI	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	8.15	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Statewide multiparameter peakflows SIR 2020 5092]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.22	square miles	0.26	5680
I24H2Y	24 Hour 2 Year Precipitation	3.12	inches	1.92	4.17
STORAGE	Percent Storage	8.337	percent	0	29.4
I24H5Y	24 Hour 5 Year Precipitation	3.83	inches	2.48	5.38
I24H10Y	24 Hour 10 Year Precipitation	4.41	inches	2.84	6.38
I24H25Y	24 Hour 25 Year Precipitation	5.21	inches	3.3	7.75
I24H50Y	24 Hour 50 Year Precipitation	5.82	inches	3.65	8.79

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
I24H100Y	24 Hour 100 Year Precipitation	6.45	inches	3.99	9.88
I24H200Y	24 Hour 200 YearPrecipitation	7.11	inches	5.26	11.1
I24H500Y	24 Hour 500 Year Precipitation	8.08	inches	5.95	13.1

Peak-Flow Statistics Flow Report [Statewide multiparameter peakflows SIR 2020 5092]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	67.3	ft^3/s	36	126	39.1
20-percent AEP flood	107	ft^3/s	58.1	197	38.1
10-percent AEP flood	136	ft^3/s	72.8	254	38.9
4-percent AEP flood	176	ft^3/s	92.9	333	39.9
2-percent AEP flood	208	ft^3/s	108	400	39.7
1-percent AEP flood	241	ft^3/s	126	462	40.7
0.5-percent AEP flood	275	ft^3/s	139	545	42.8
0.2-percent AEP flood	322	ft^3/s	160	647	43.8

Peak-Flow Statistics Citations

Lombard, P.J., and Hodgkins, G.A.,2020, Estimating flood magnitude and frequency on gaged and ungaged streams in Maine: U.S. Geological Survey Scientific Investigations Report 2020–5092, 56 p. (https://doi.org/10.3133/sir20205092)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.22	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0	dimensionless	0	0.212
ELEV	Mean Basin Elevation	143.7	feet	239	2120

Flow-Duration Statistics Disclaimers [Statewide Annual SIR 2015 5151]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Flow-Duration Statistics Flow Report [Statewide Annual SIR 2015 5151]

Statistic	Value	Unit
1 Percent Duration	0.00143	ft^3/s
5 Percent Duration	0.0121	ft^3/s
10 Percent Duration	0.0402	ft^3/s
25 Percent Duration	0.272	ft^3/s
50 Percent Duration	1.08	ft^3/s
75 Percent Duration	2.88	ft^3/s
90 Percent Duration	6.64	ft^3/s
95 Percent Duration	10.6	ft^3/s
99 Percent Duration	28.9	ft^3/s

Flow-Duration Statistics Citations

Dudley, R.W.,2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (http://dx.doi.org/10.3133/sir20155151)

Annual Flow Statistics

Annual Flow Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.22	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0	dimensionless	0	0.212
ELEV	Mean Basin Elevation	143.7	feet	239	2120

Annual Flow Statistics Disclaimers [Statewide Annual SIR 2015 5151]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Annual Flow Statistics Flow Report [Statewide Annual SIR 2015 5151]

Statistic	Value	Unit
Mean Annual Flow	2.72	ft^3/s

Annual Flow Statistics Citations

Dudley, R.W.,2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (http://dx.doi.org/10.3133/sir20155151)

FEMA Flood Insurance Study, Washington County, Maine, July 18, 2017

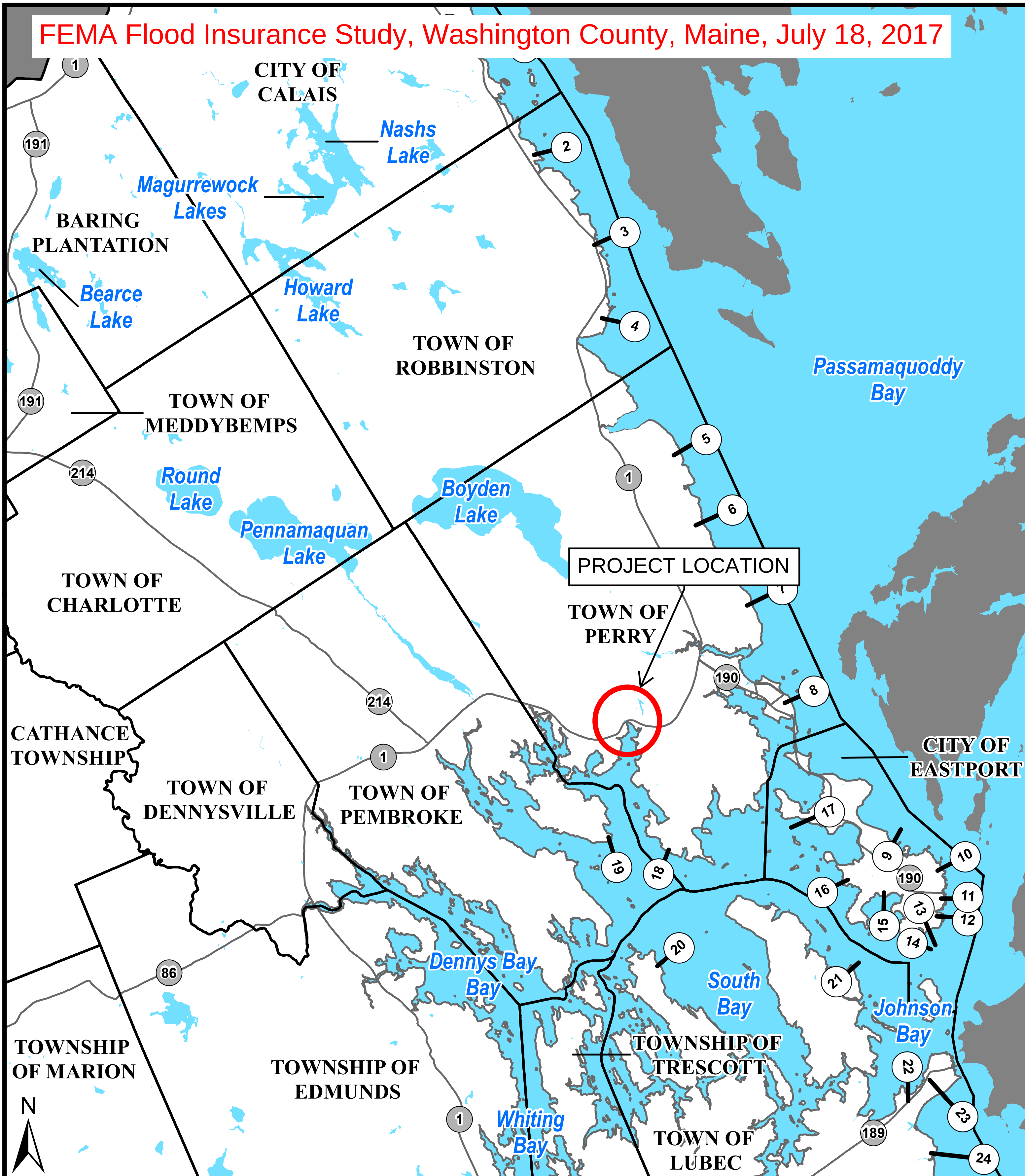


FIGURE 9

Federal Emergency Management Agency
WASHINGTON COUNTY, ME
(ALL JURISDICTIONS)

TRANSECT LOCATION MAP

Table 17: Coastal Transect Parameters – *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (feet)	Peak Wave Period T_p (seconds)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Cobscook Bay	15	3.9	2.8	13.5 *	* *	14.2 *	14.6 14.6-14.6	15.2 *
Cobscook Bay	16	3.4	2.6	13.6 *	* *	14.3 *	14.6 14.6-14.6	15.3 *
Cobscook Bay	17	4.3	3.0	13.7 *	* *	14.4 *	14.7 14.6-14.7	15.3 *
Cobscook Bay	18	4.4	3.0	13.4 *	* *	14.0 *	14.4 14.4-14.4	15.1 *
Cobscook Bay	19	4.1	2.9	13.4 *	* *	14.0 *	14.4 14.4-14.4	15.0 *
Cobscook Bay	20	4.6	3.0	13.1 *	* *	13.7 *	14.2 14.4-14.2	14.8 *
Cobscook Bay	21	3.8	2.7	13.4 *	* *	14.0 *	14.4 14.4-14.4	15.0 *

*Not calculated for this Flood Risk project

Datums for 8410140, Eastport ME

NOTICE: All data values are relative to the NAVD88.

Elevations on NAVD88

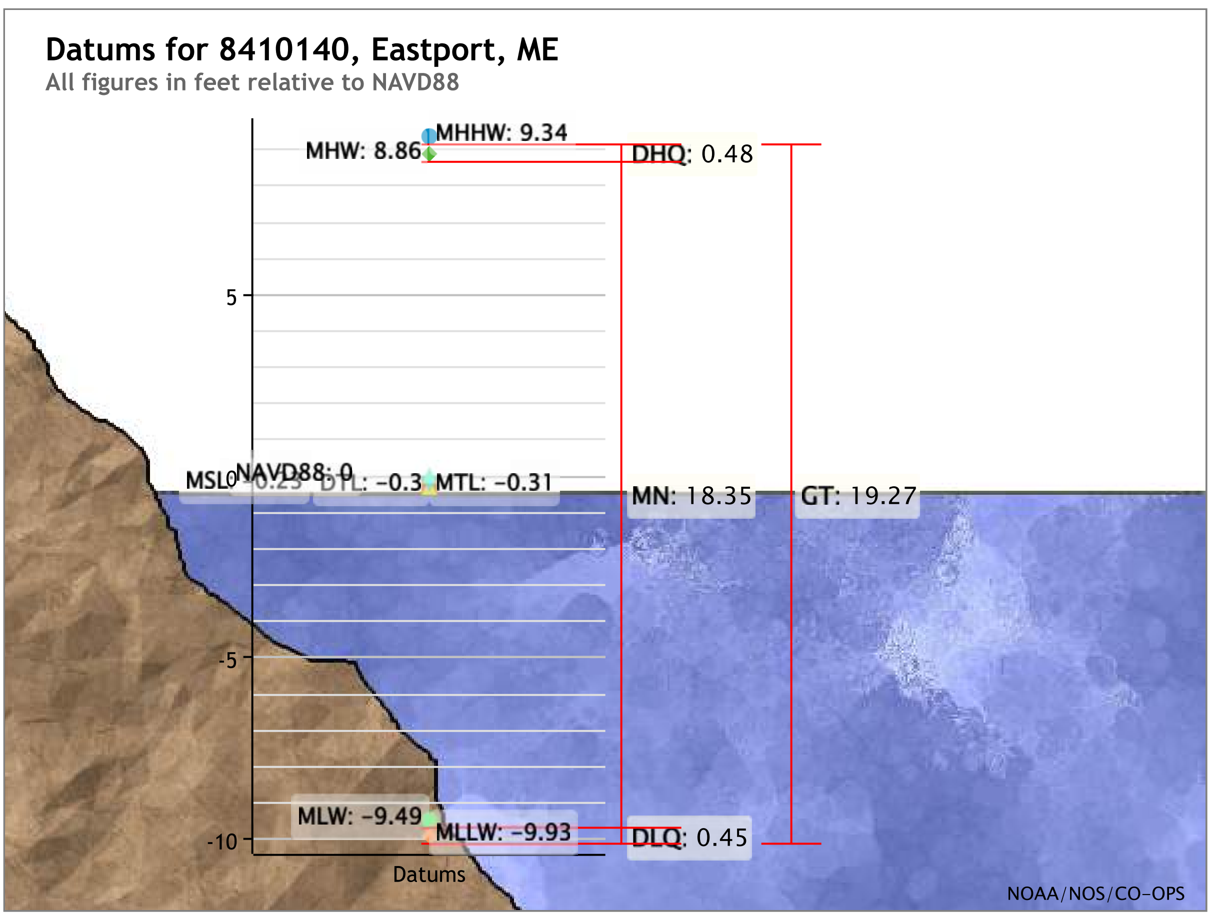
Station: 8410140, Eastport, ME
Status: Accepted (Apr 17 2003)
Units: Feet
Control Station:
T.M.: 0
Epoch: (/datum_options.html#NTDE) 1983-2001
Datum: NAVD88

Datum	Value	Description
MHHW (/datum_options.html#MHHW)	9.34	Mean Higher-High Water
MHW (/datum_options.html#MHW)	8.86	Mean High Water
MTL (/datum_options.html#MTL)	-0.31	Mean Tide Level
MSL (/datum_options.html#MSL)	-0.23	Mean Sea Level
DTL (/datum_options.html#DTL)	-0.30	Mean Diurnal Tide Level
MLW (/datum_options.html#MLW)	-9.49	Mean Low Water
MLLW (/datum_options.html#MLLW)	-9.93	Mean Lower-Low Water
NAVD88 (/datum_options.html)	0.00	North American Vertical Datum of 1988
STND (/datum_options.html#STND)	-14.73	Station Datum
GT (/datum_options.html#GT)	19.27	Great Diurnal Range
MN (/datum_options.html#MN)	18.35	Mean Range of Tide
DHQ (/datum_options.html#DHQ)	0.48	Mean Diurnal High Water Inequality

Datum	Value	Description
DLQ (/datum_options.html#DLQ)	0.45	Mean Diurnal Low Water Inequality
HWI (/datum_options.html#HWI)	3.30	Greenwich High Water Interval (in hours)
LWI (/datum_options.html#LWI)	9.69	Greenwich Low Water Interval (in hours)
Max Tide (/datum_options.html#MAXTIDE)	14.44	Highest Observed Tide
Max Tide Date & Time (/datum_options.html#MAXTIDEDT)	04/10/2020 08:54	Highest Observed Tide Date & Time
Min Tide (/datum_options.html#MINTIDE)	-14.61	Lowest Observed Tide
Min Tide Date & Time (/datum_options.html#MINTIDEDT)	08/09/1972 00:00	Lowest Observed Tide Date & Time
HAT (/datum_options.html#HAT)	12.83	Highest Astronomical Tide
HAT Date & Time	11/15/2016 15:48	HAT Date and Time
LAT (/datum_options.html#LAT)	-13.38	Lowest Astronomical Tide
LAT Date & Time	04/01/2033 10:48	LAT Date and Time

Tidal Datum Analysis Periods

01/01/1983 - 12/31/2001

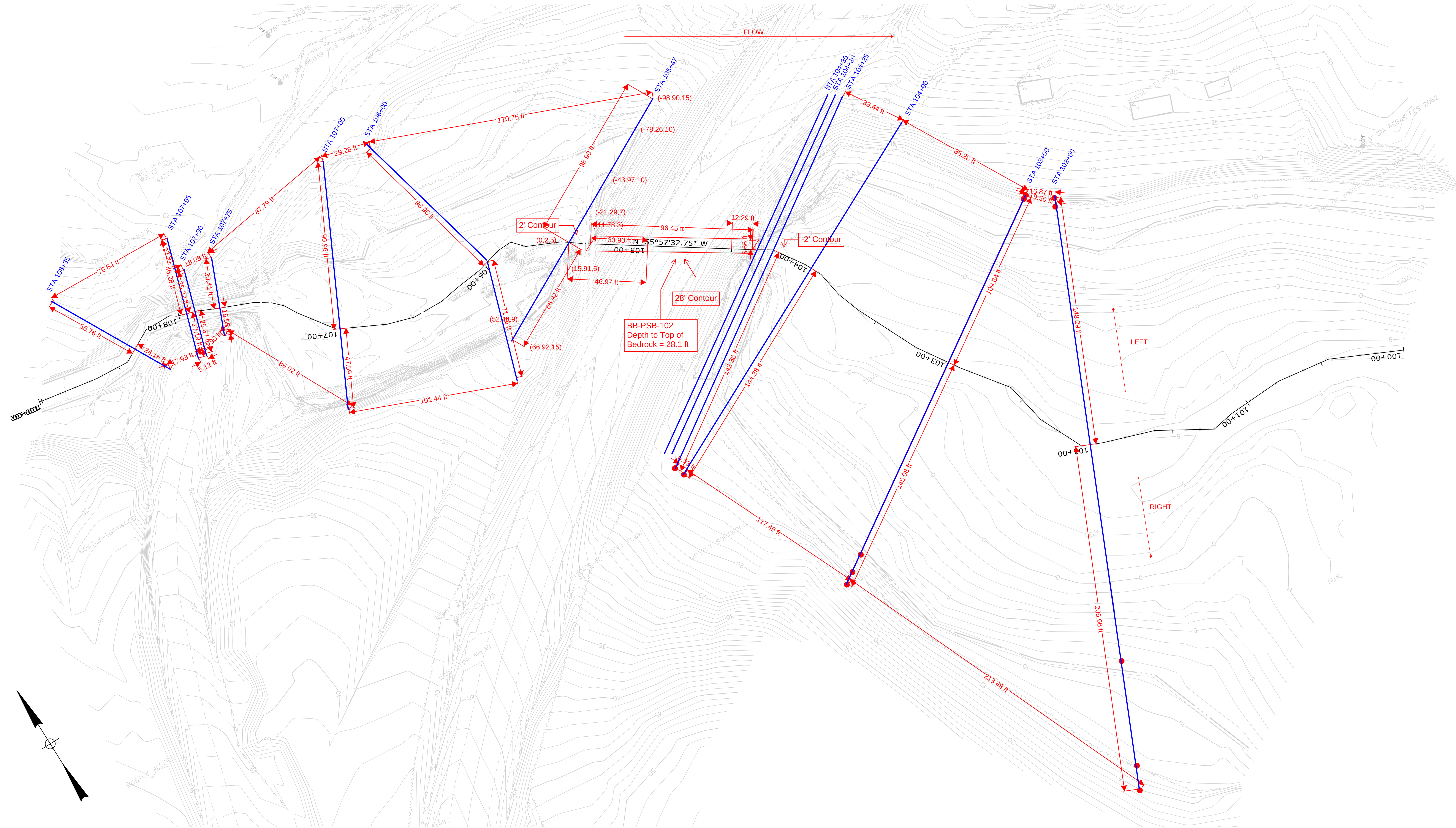


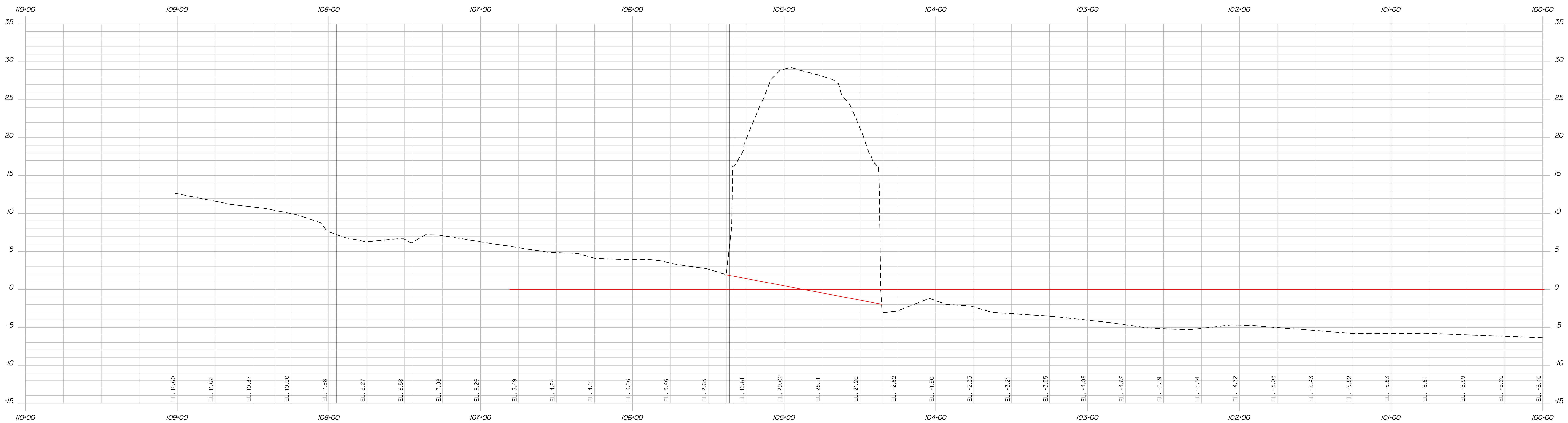
EXISTING HEC-RAS CROSS-SECTION LOCATIONS

Streambed Description:
Sandy gravel with some silt and scattered 100 lb to 1000 lb river stone on ledge and exposed ledge.

Channel Description:
Channel bottom between abutments is ledge. Channel banks are broad shallow sloped banks with ledge in places. No erosion noted.

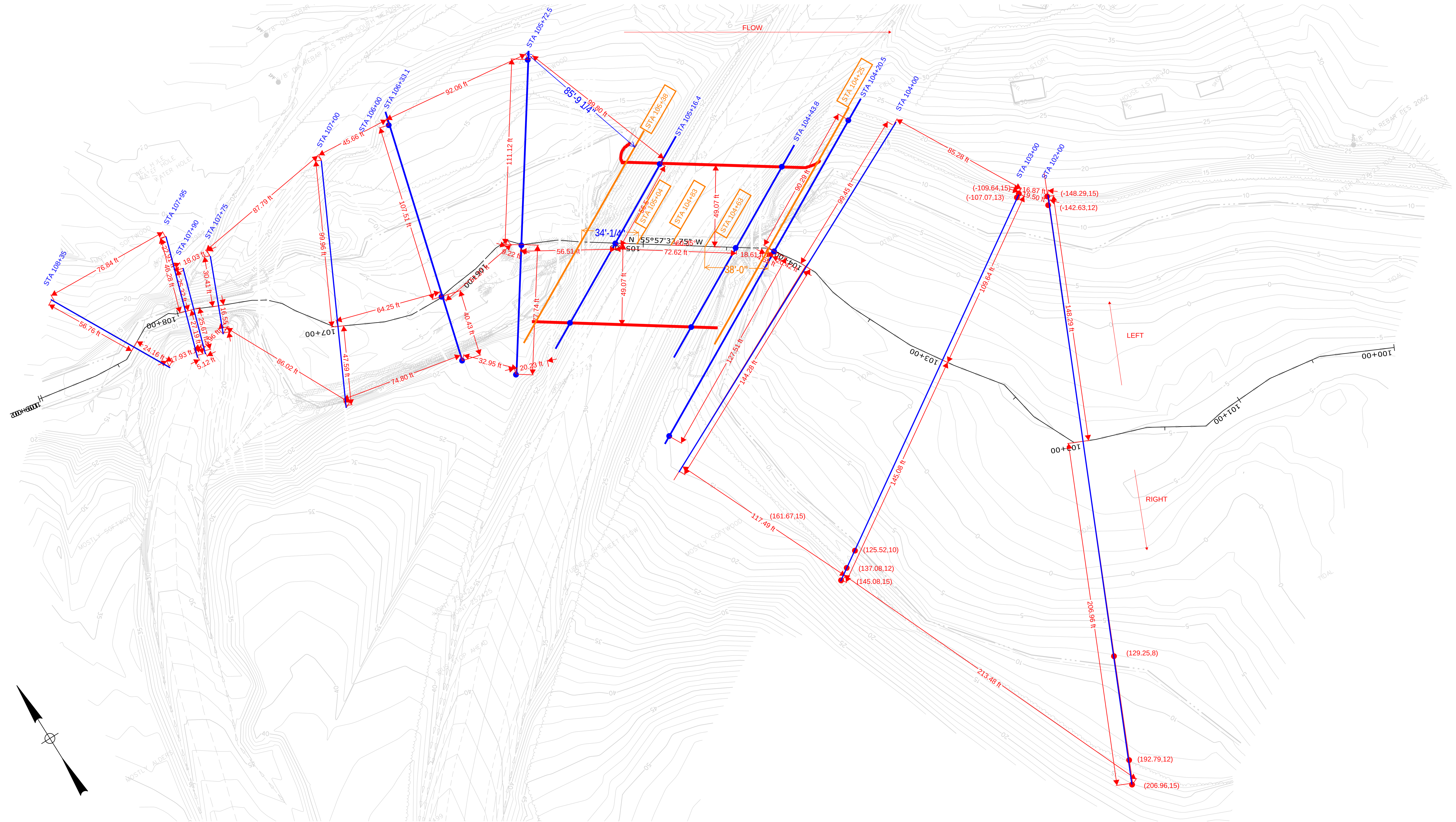
Substructure Description:
The substructure is constructed of mortared granite blocks forming two abutments with stepped wingwalls at each end likely founded on ledge. There are 8 courses of block on the north end and 10 courses at the south end. There is an 18" thick concrete cap on each abutment top course that supports the concrete deck slab. The deck slab supports an approximately 10' thick roadway bed. The substructure is in good condition.
Granite block joints are well mortared with approximately 5% or less mortar missing. On the SW wingwall, a block 4 courses from the top has displaced laterally into the channel 6". A concrete repair has been poured behind the wingwall at this block doubling the wall thickness. Weep holes at the bottom of the abutments are functional with groundwater observed flowing out the pipes.

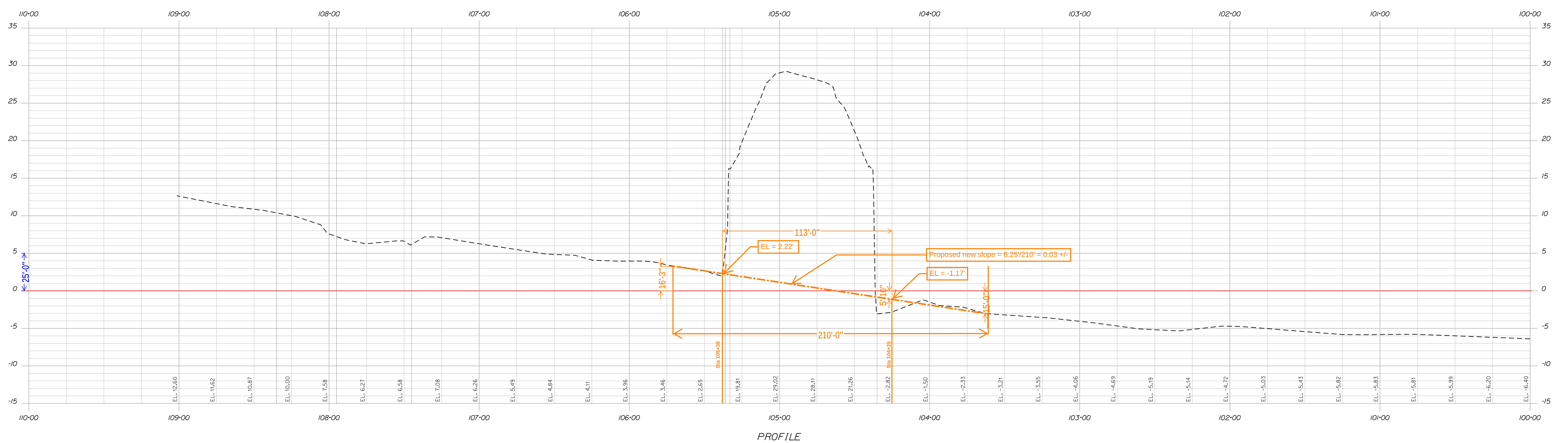




PROFILE

PROPOSED HEC-RAS CROSS-SECTION LOCATIONS





PROPOSED STRUCTURE MAXIMUM WATER DEPTHS

FIGURE 1: Q1.1, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 2: Q1.1, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 3: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 4: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT PLUS 4FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 5: Q10, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 6: Q10, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 7: Q50, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 8: Q50, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 9: Q100, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 10: Q100, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 11: Q500, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 12: Q500, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

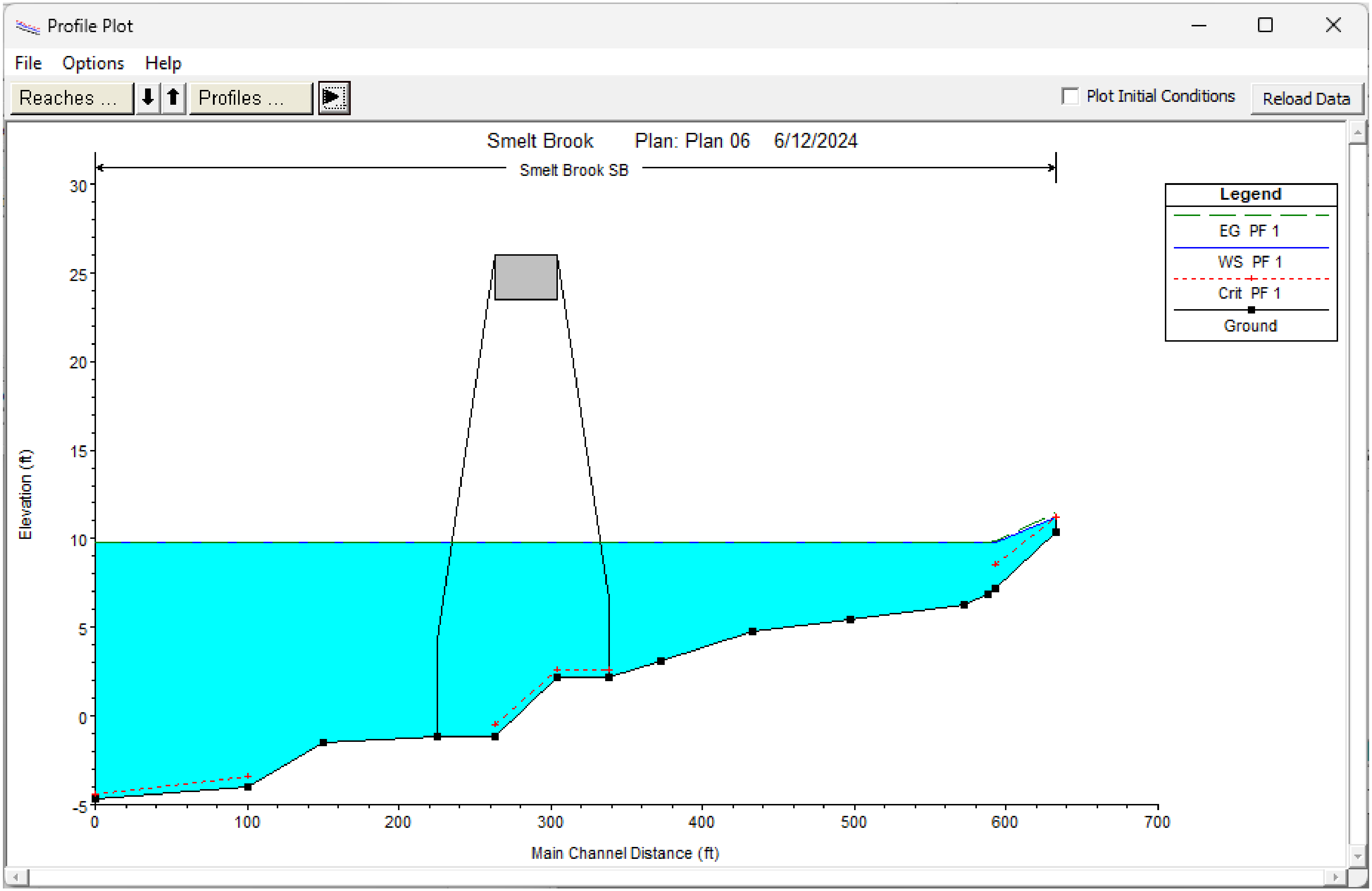


FIGURE 1: Q1.1, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

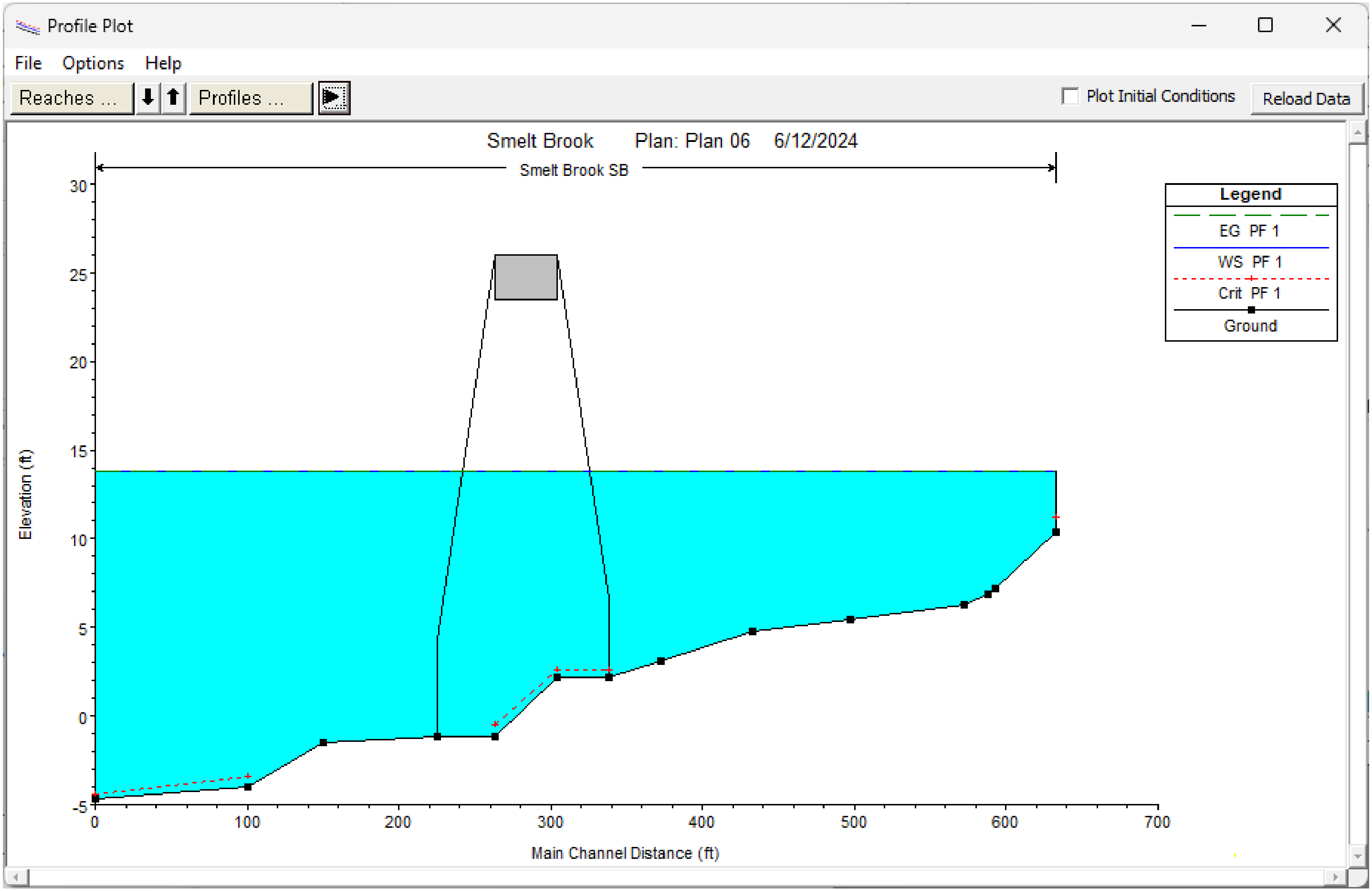


FIGURE 2: Q1.1, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

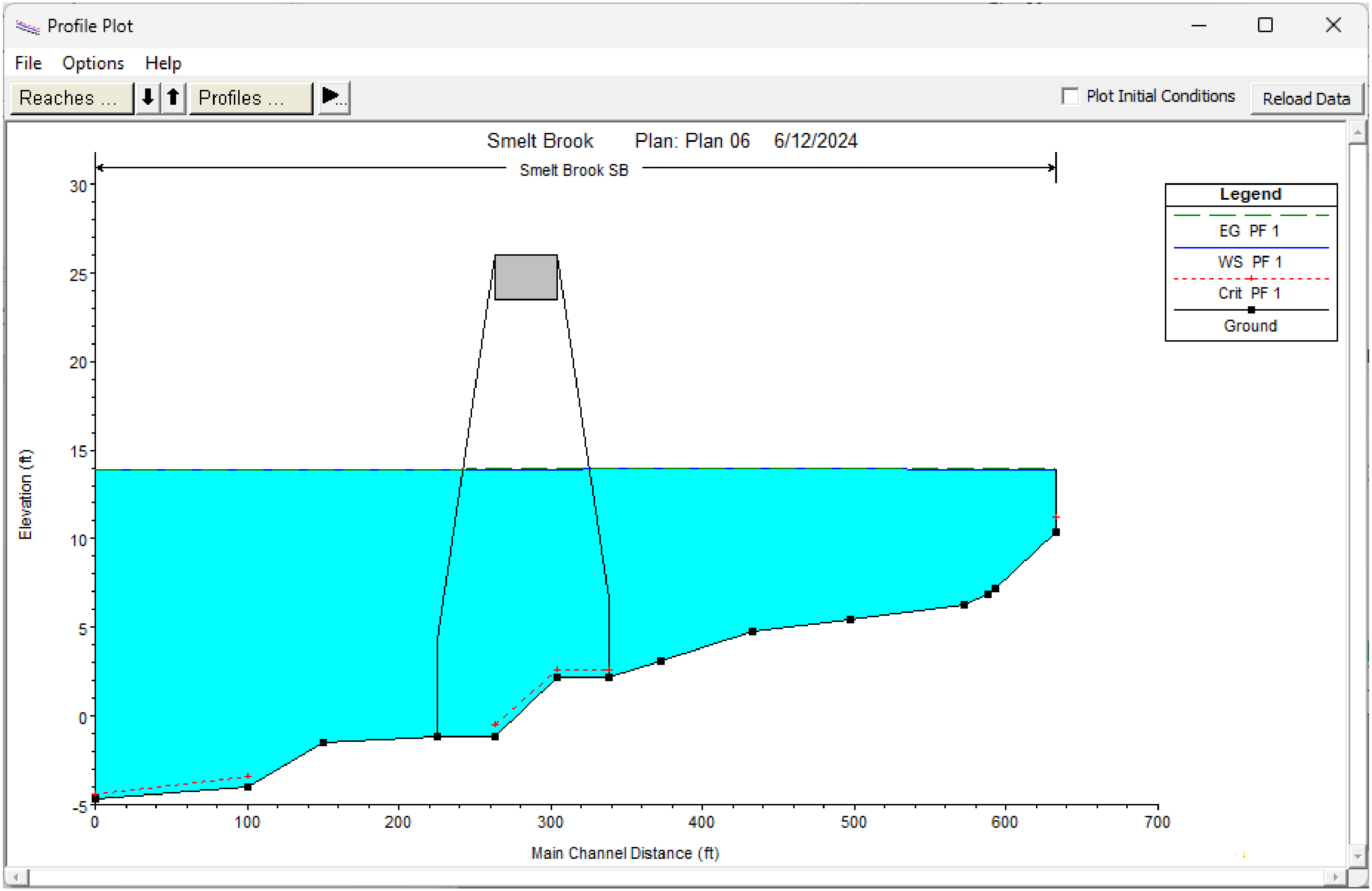


FIGURE 3: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

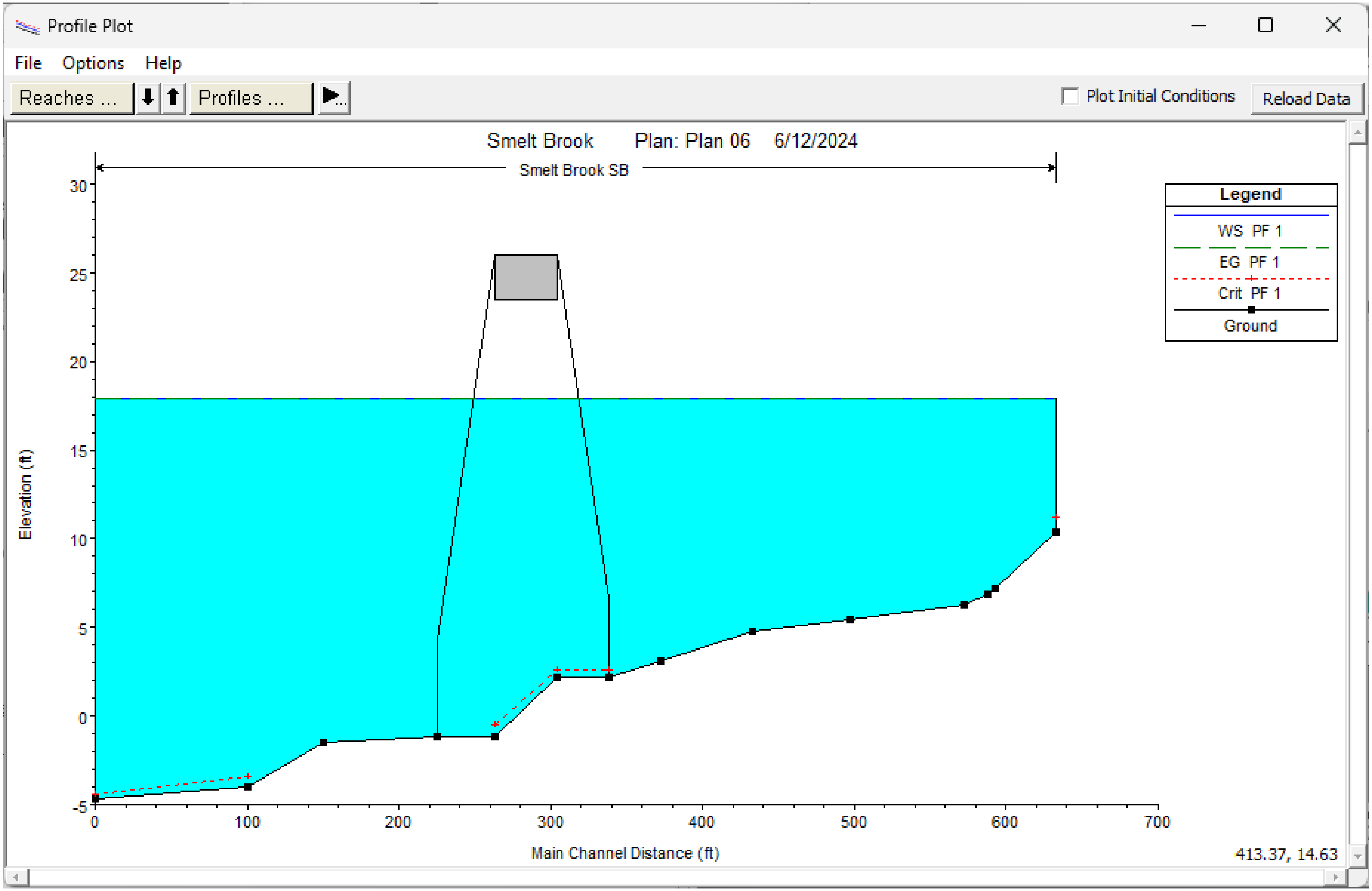


FIGURE 4: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT PLUS 4FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

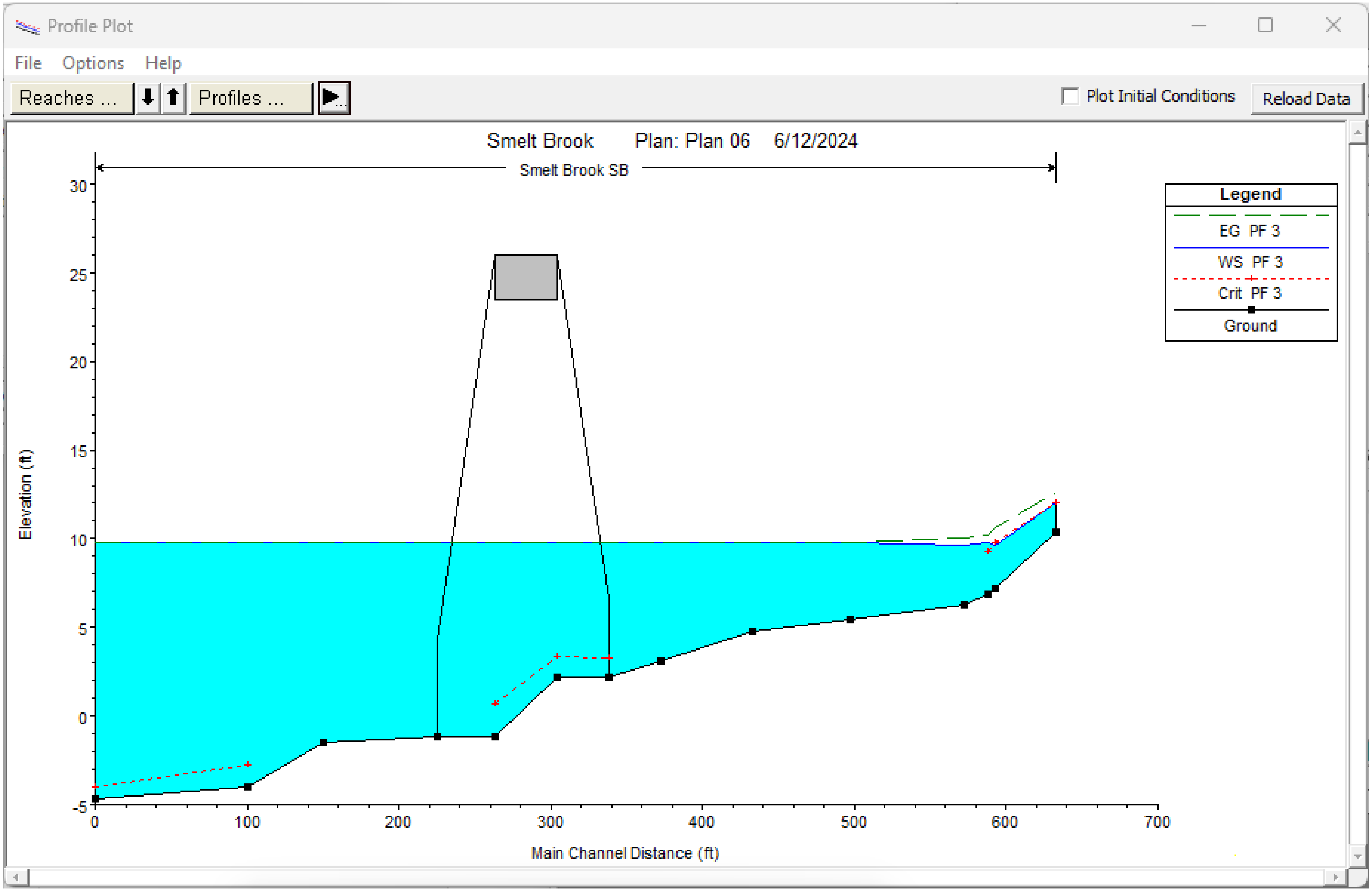


FIGURE 5: Q10, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

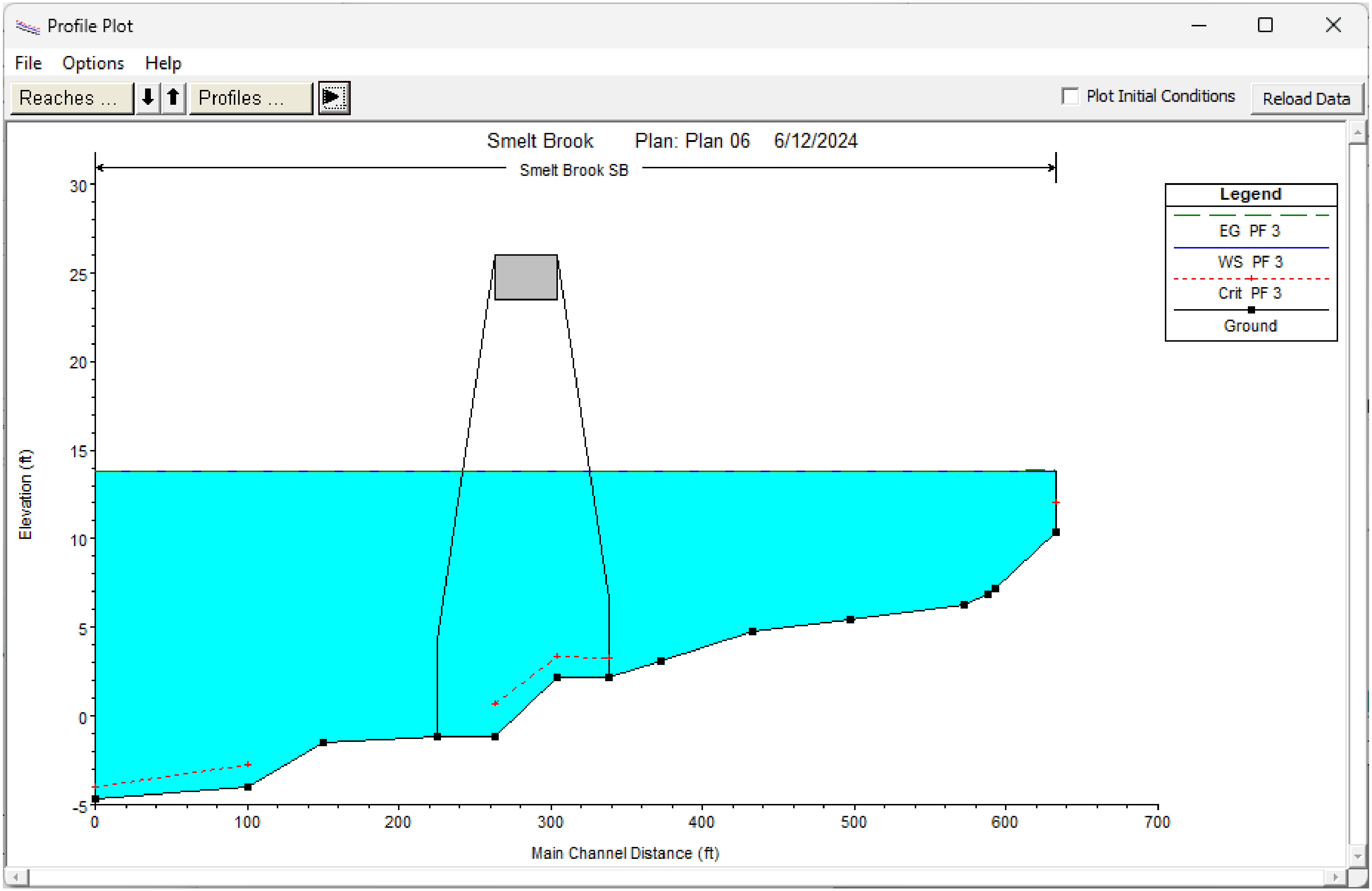


FIGURE 6: Q10, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

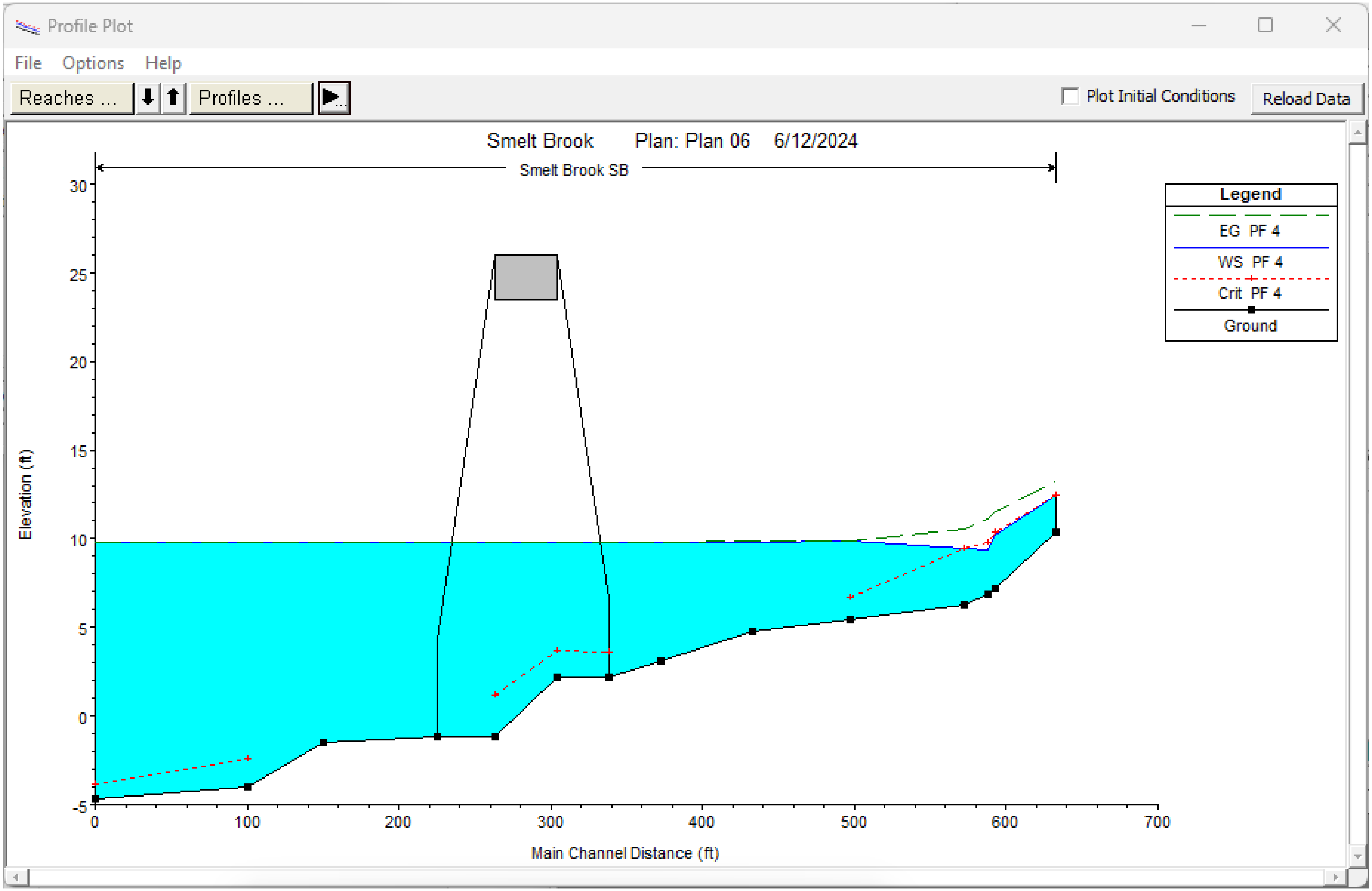


FIGURE 7: Q50, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

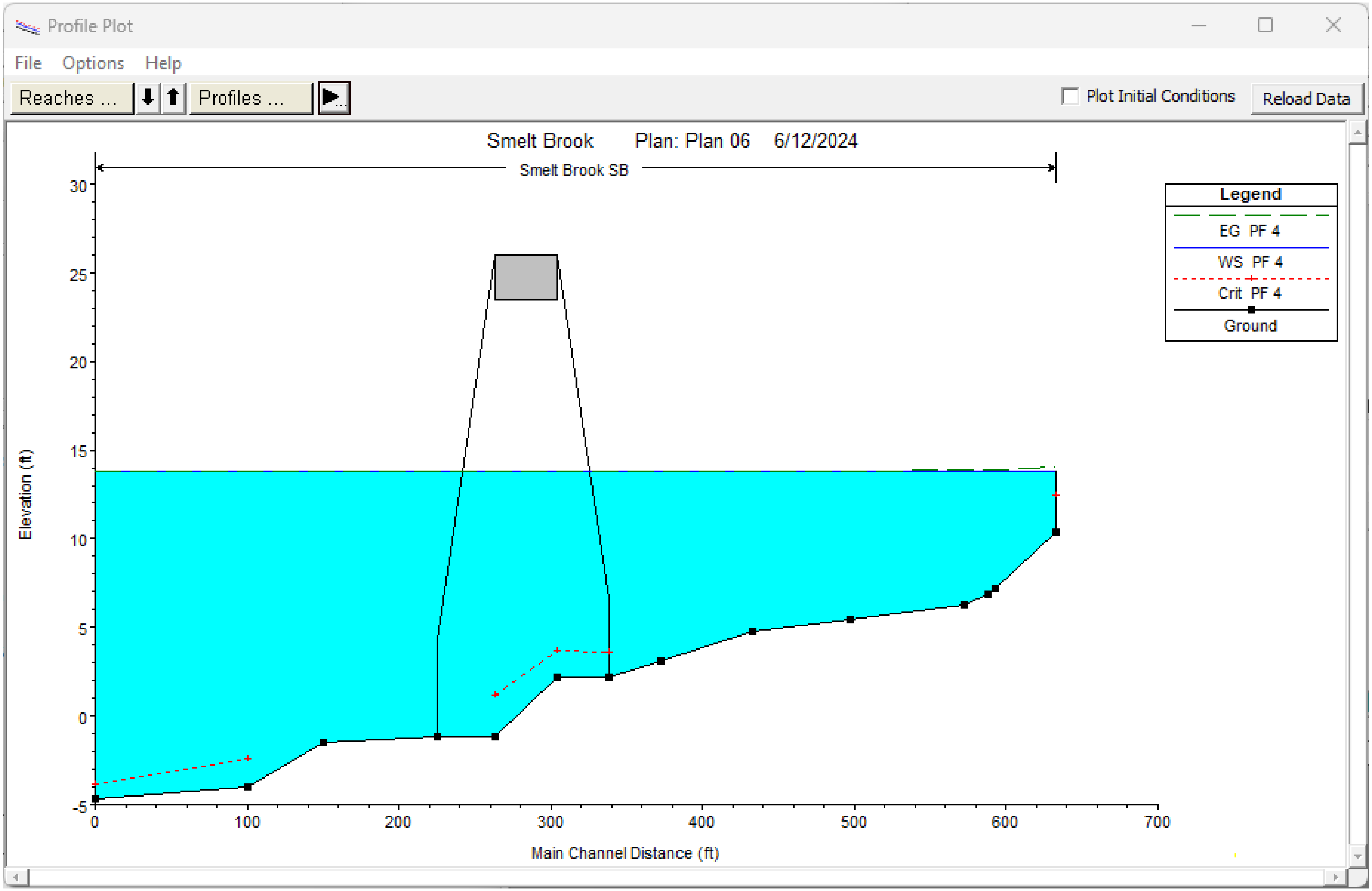


FIGURE 8: Q50, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

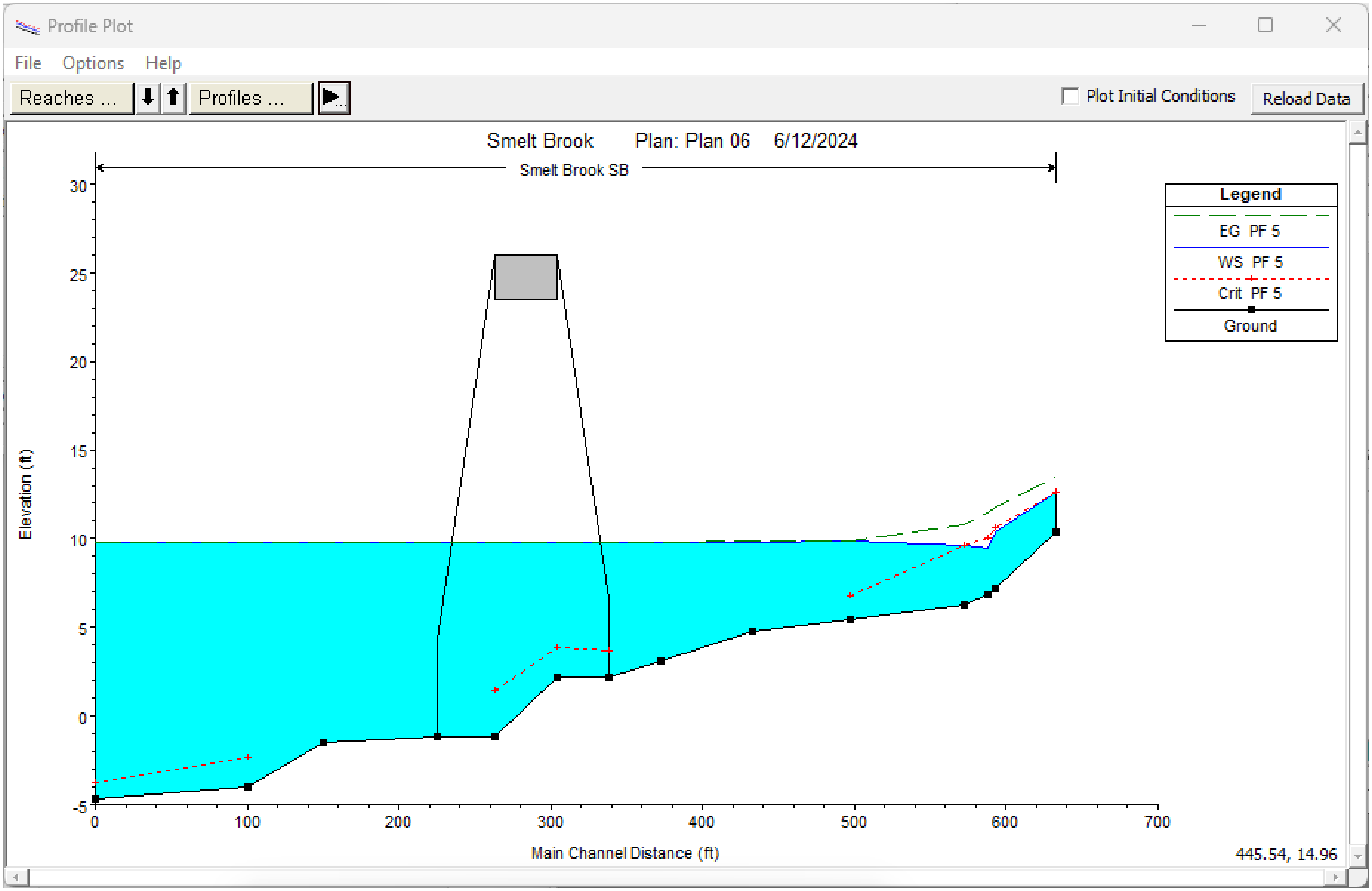


FIGURE 9: Q100, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

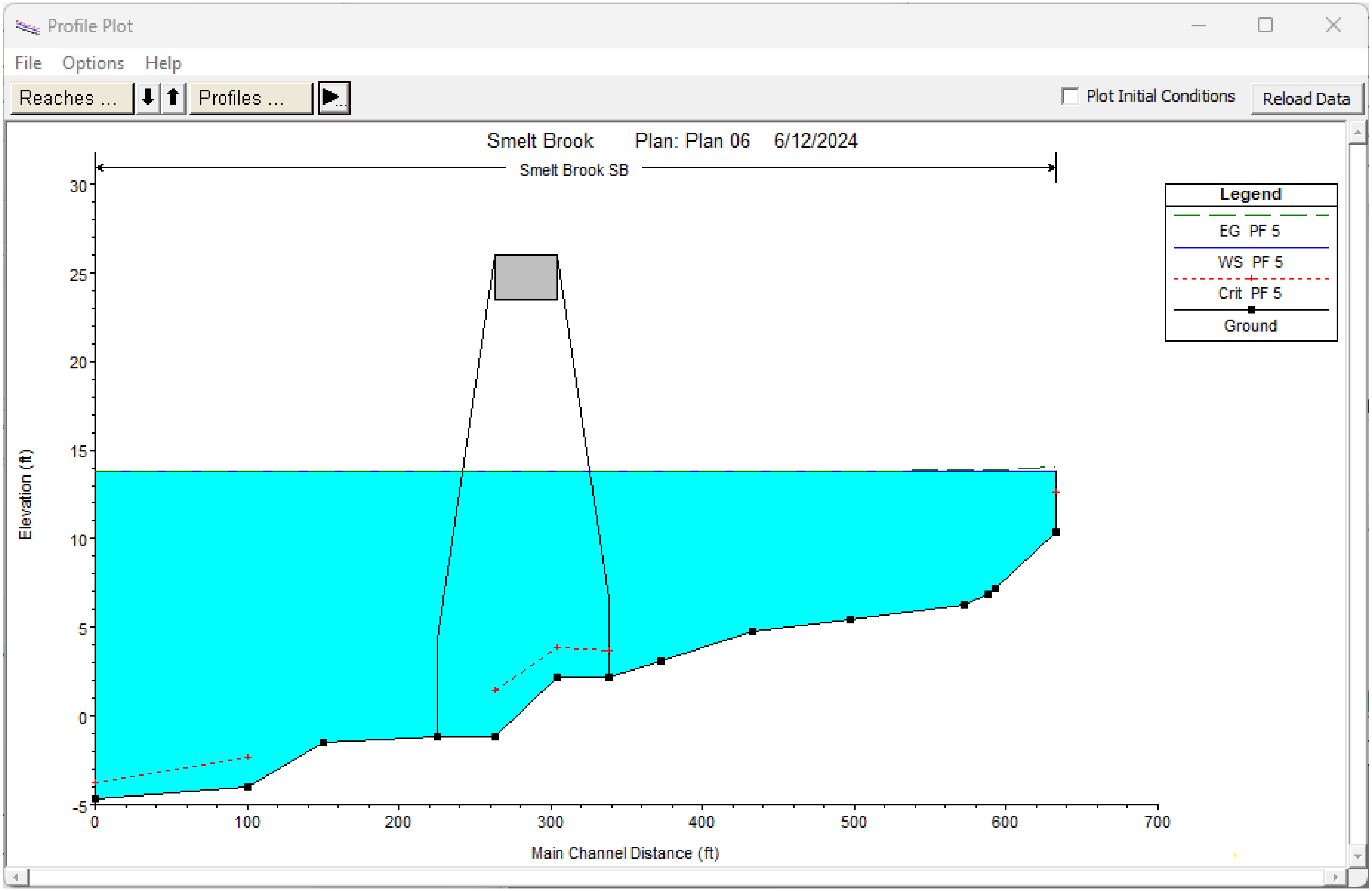


FIGURE 10: Q100, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

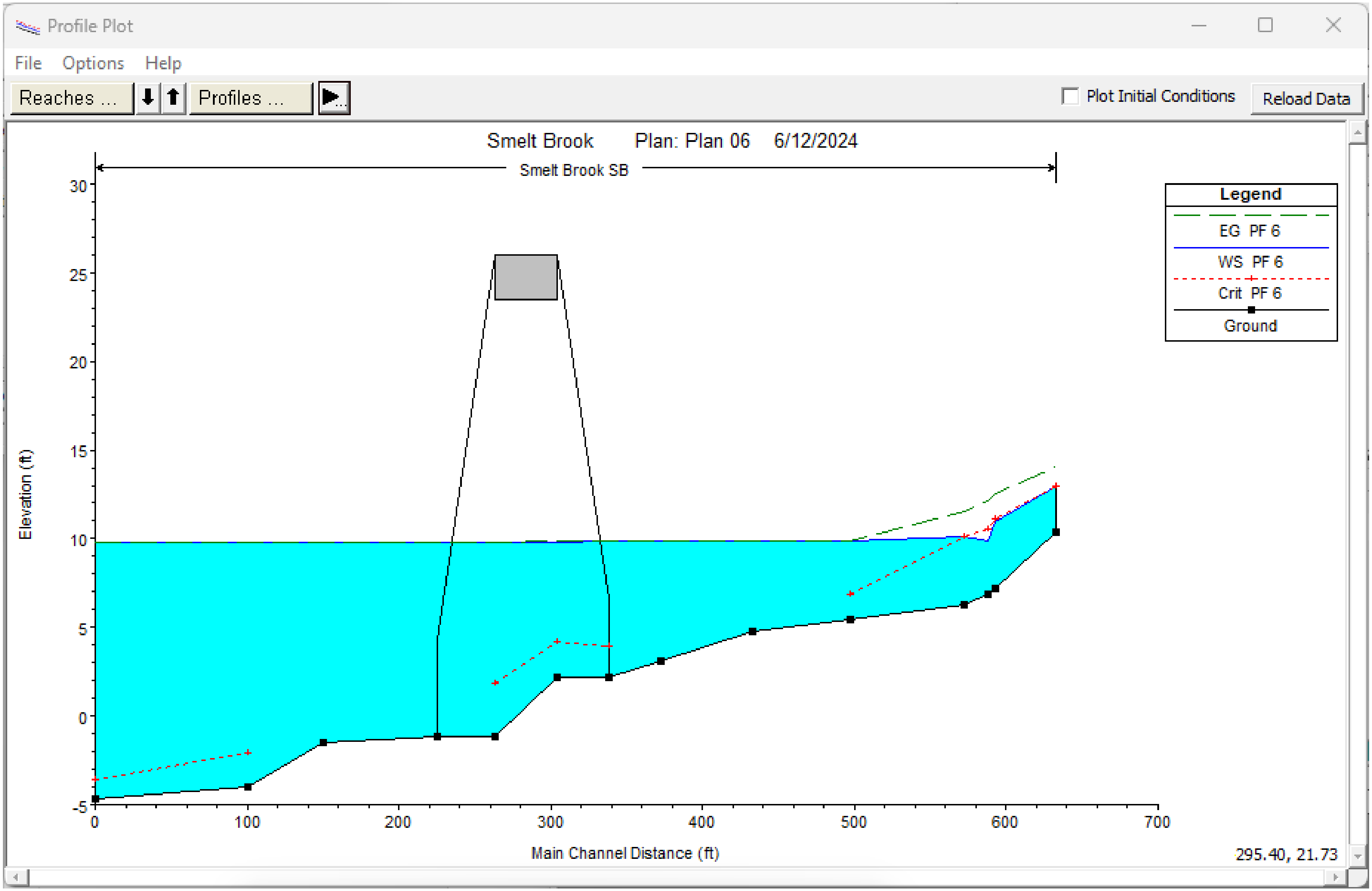


FIGURE 11: Q500, AVERAGE TIDES – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

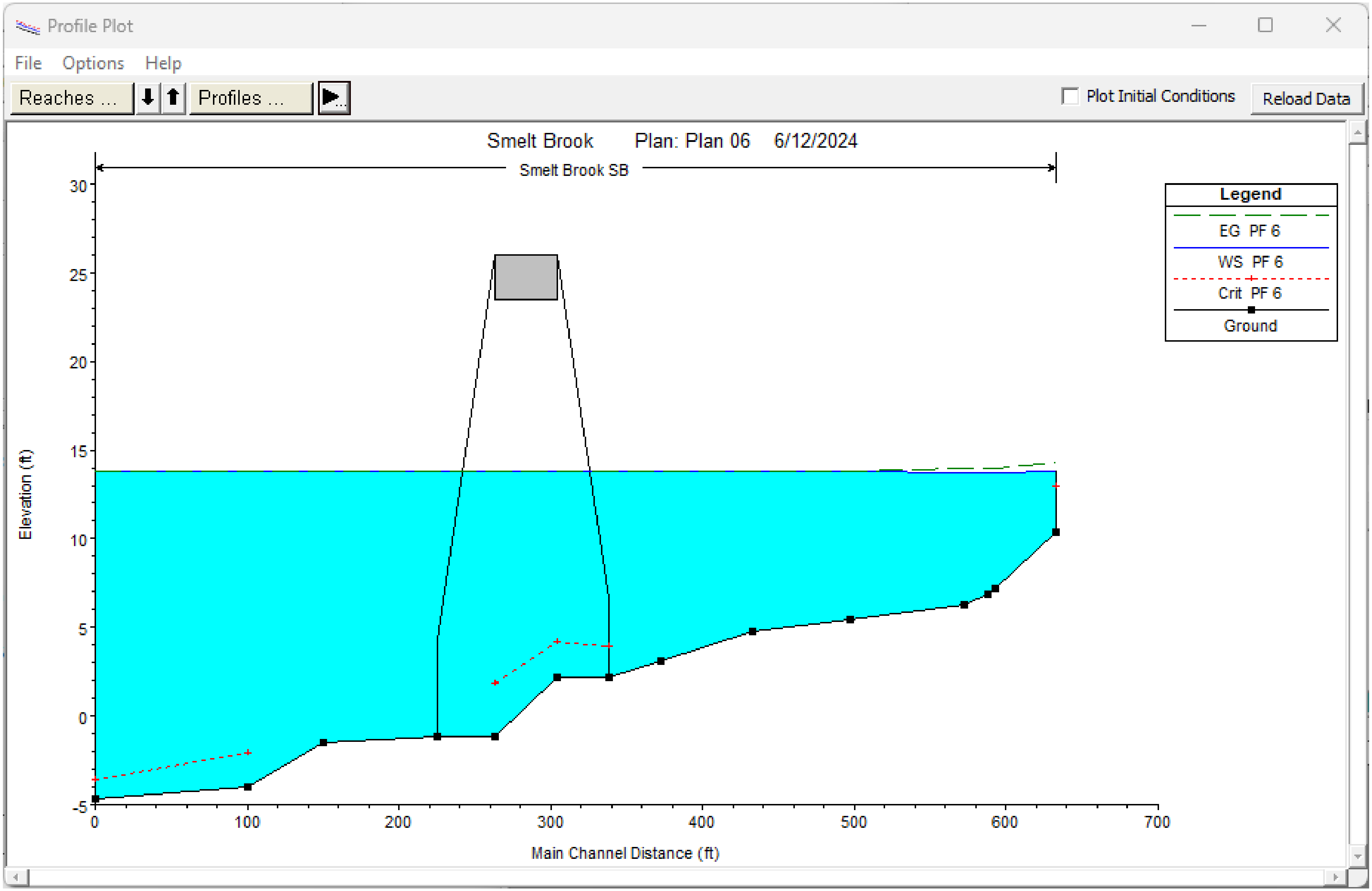


FIGURE 12: Q500, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM WATER DEPTHS, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

PROPOSED STRUCTURE MAXIMUM WATER VELOCITIES AT LOW TIDE

FIGURE 13: Q1.1, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 14: Q1.1, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 15: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 16: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT PLUS 4FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 17: Q10, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 18: Q10, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 19: Q50, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 20: Q50, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 21: Q100, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 22: Q100, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 23: Q500, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

FIGURE 24: Q500, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

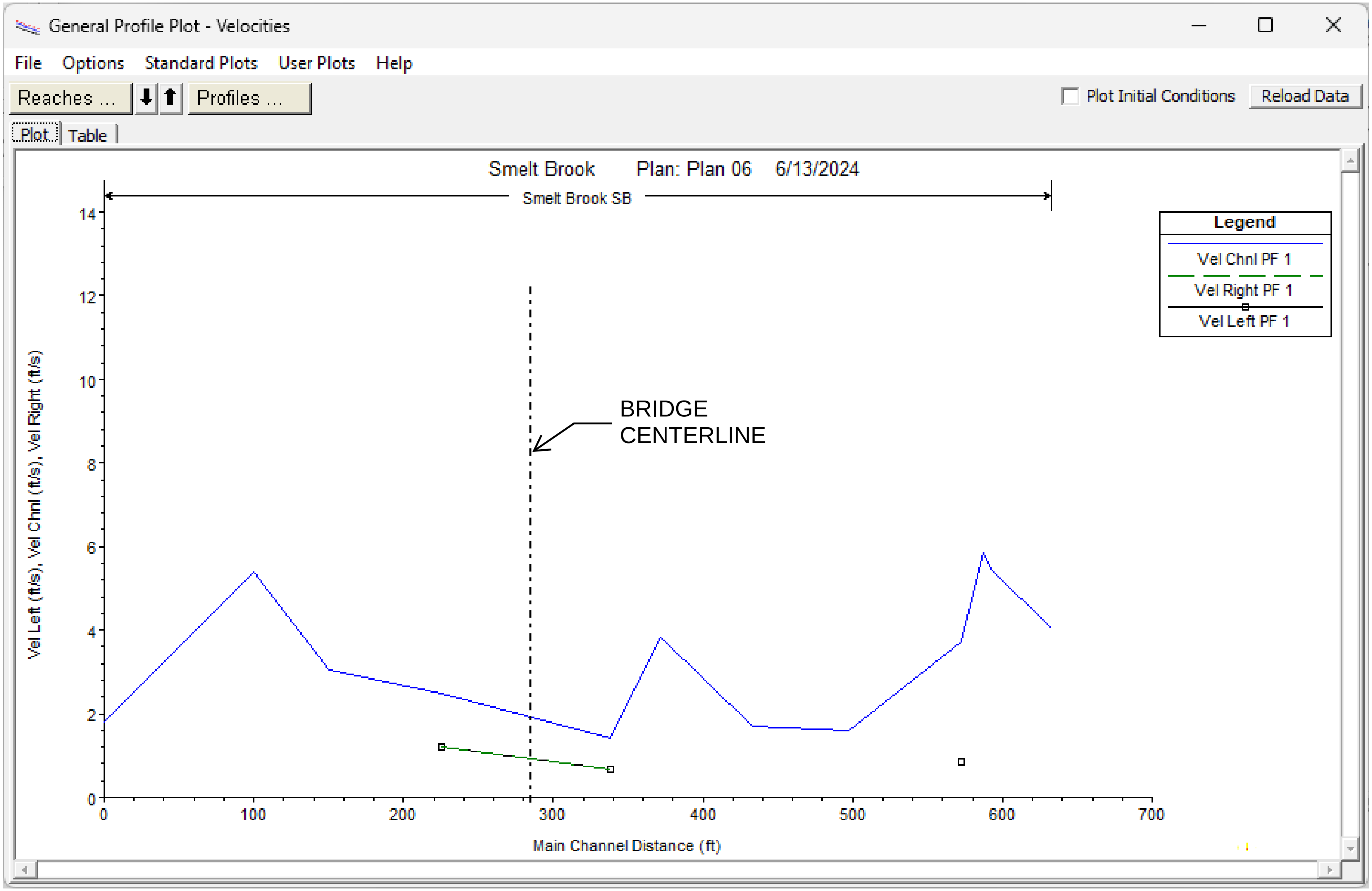


FIGURE 13: Q1.1, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

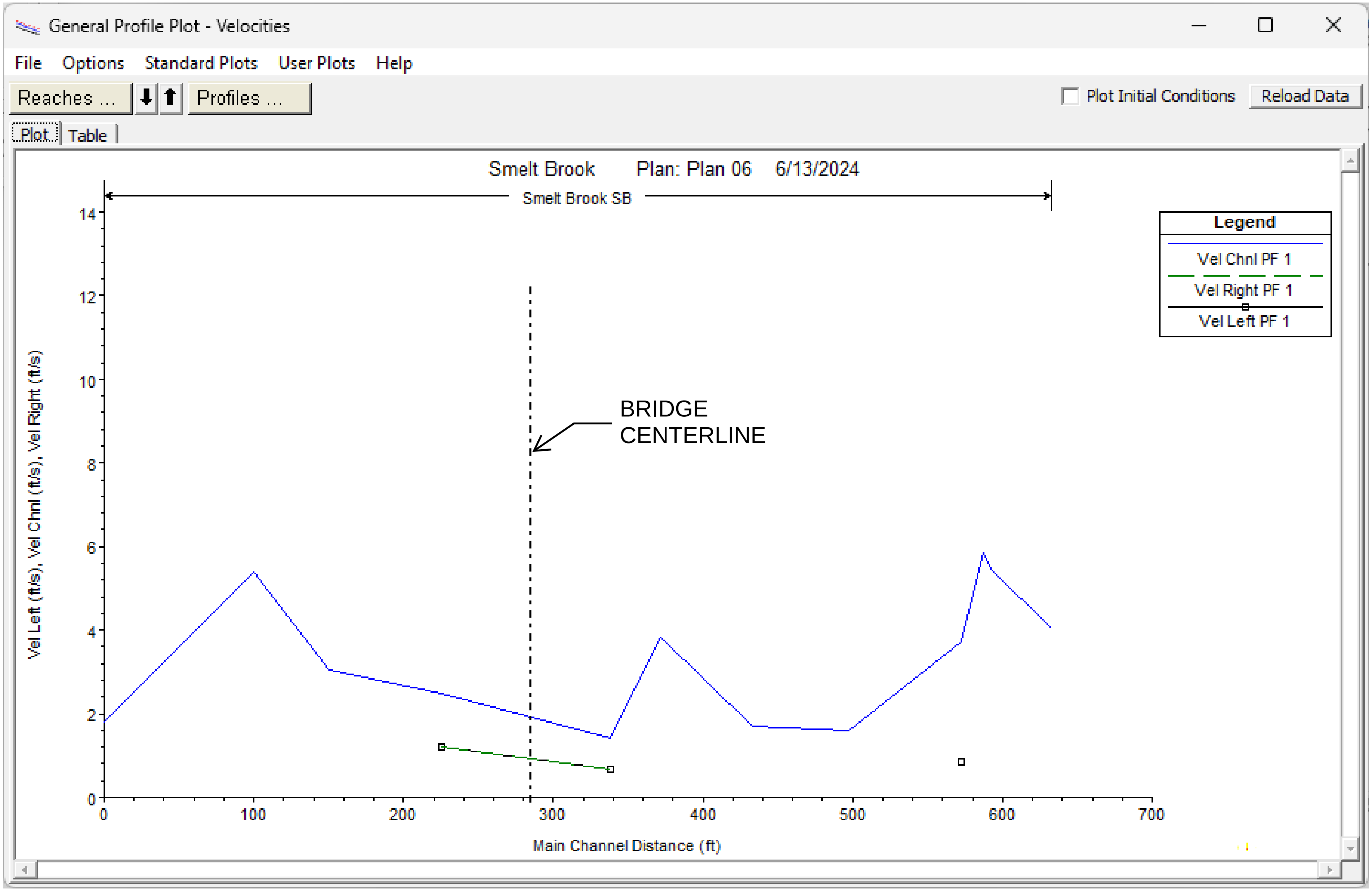


FIGURE 14: Q1.1, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

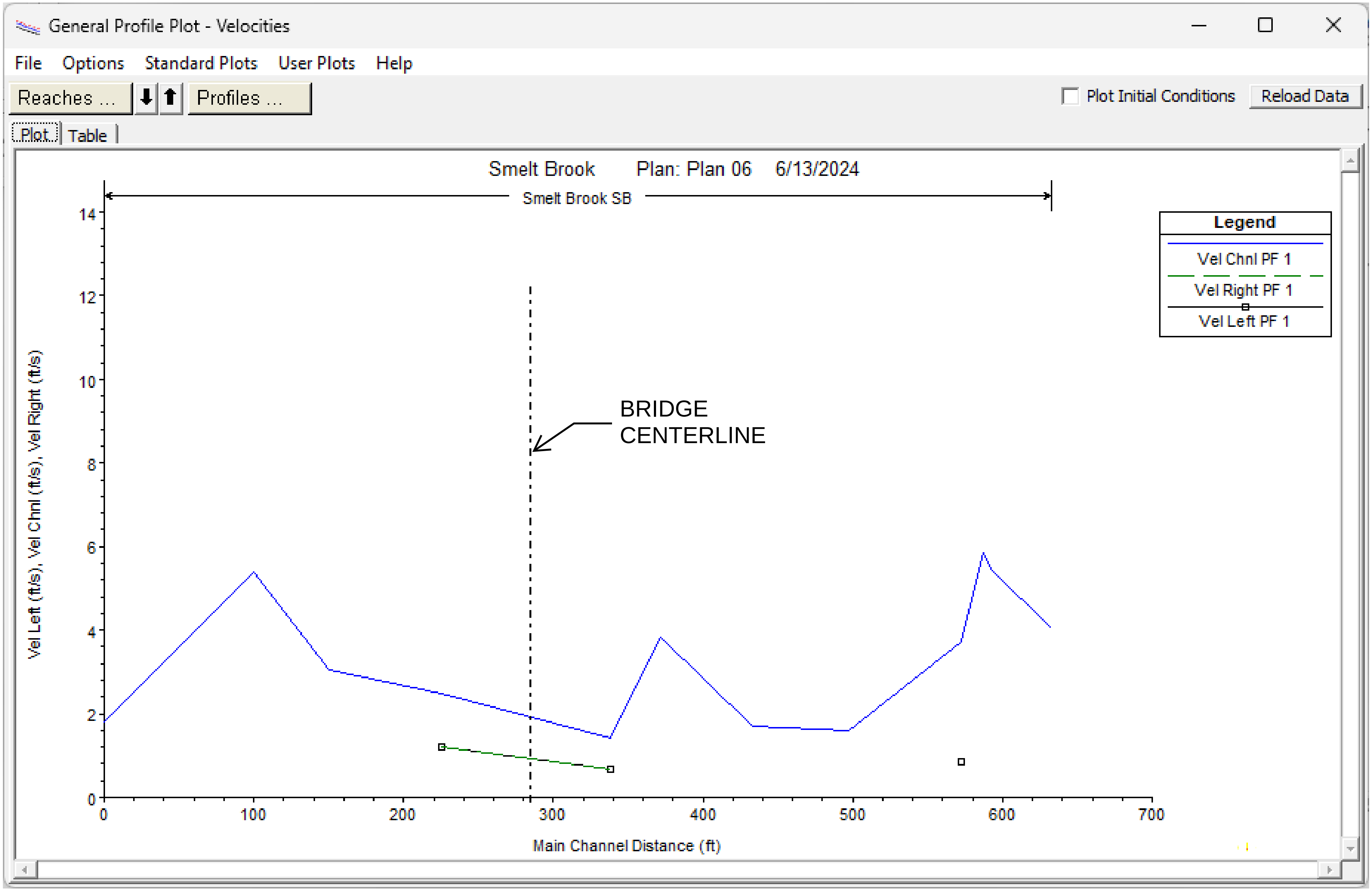


FIGURE 15: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

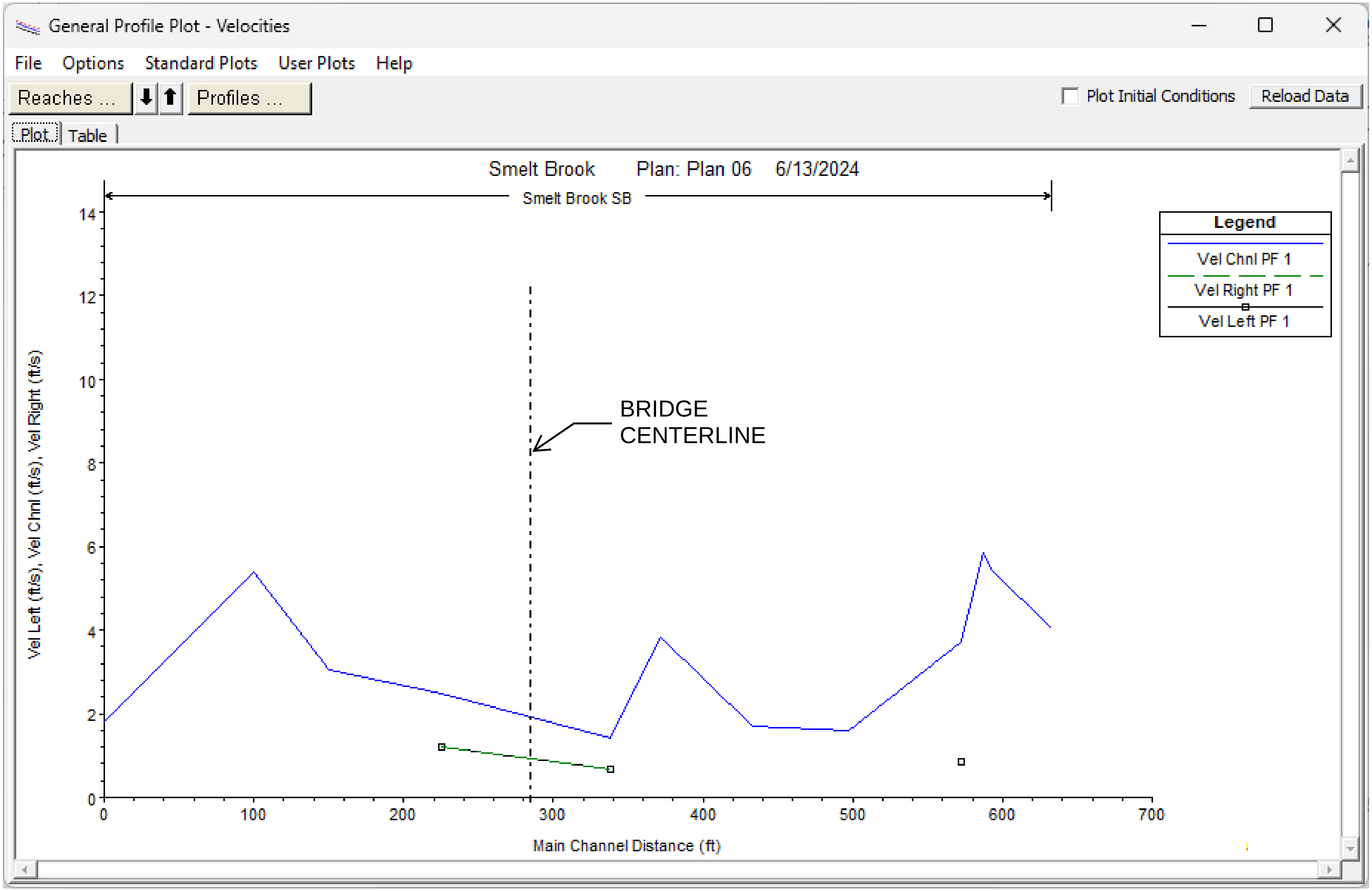


FIGURE 16: Q1.1, 2% ANNUAL CHANCE COASTAL STORM EVENT PLUS 4FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

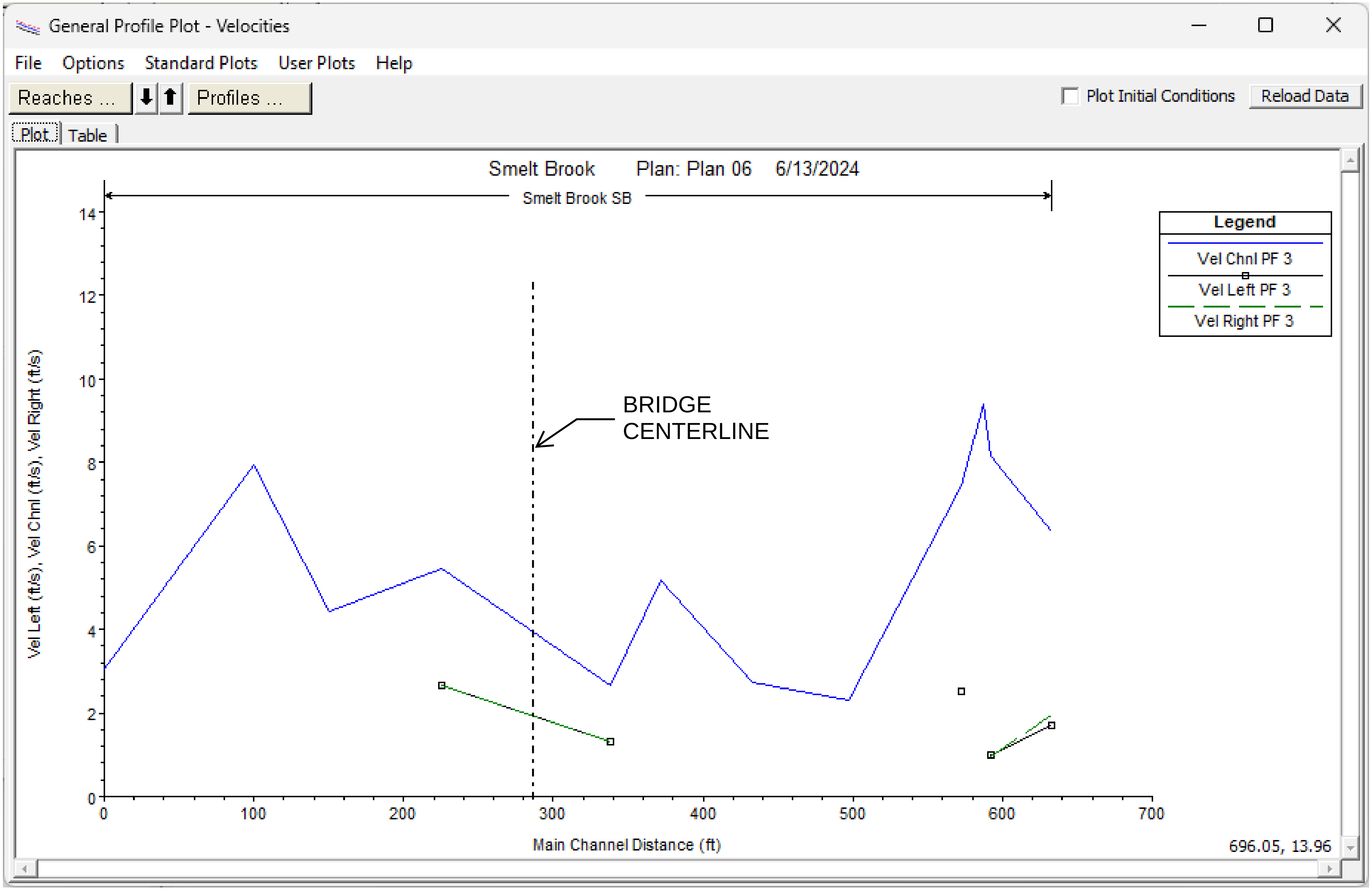


FIGURE 17: Q10, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

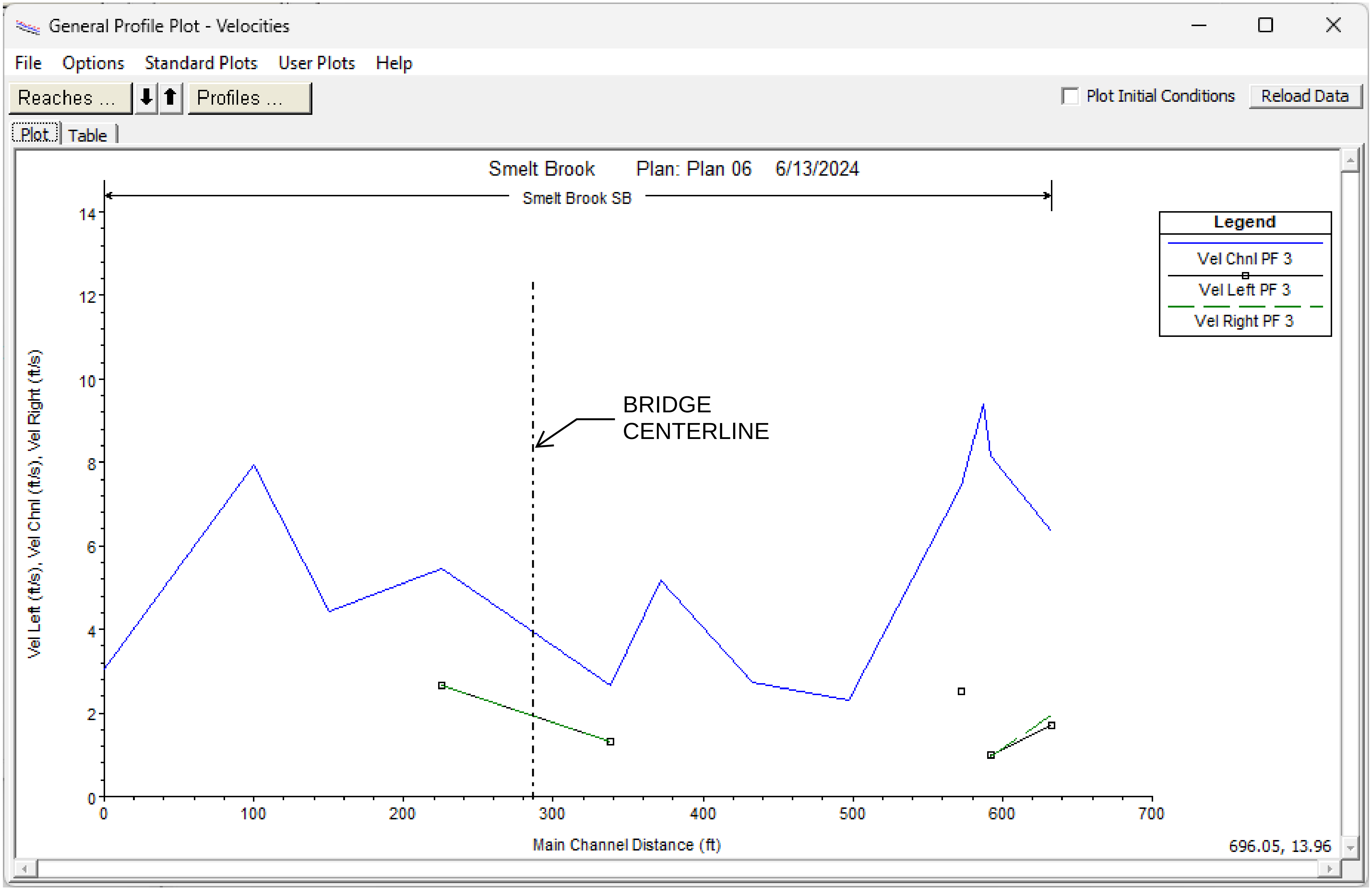


FIGURE 18: Q10, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

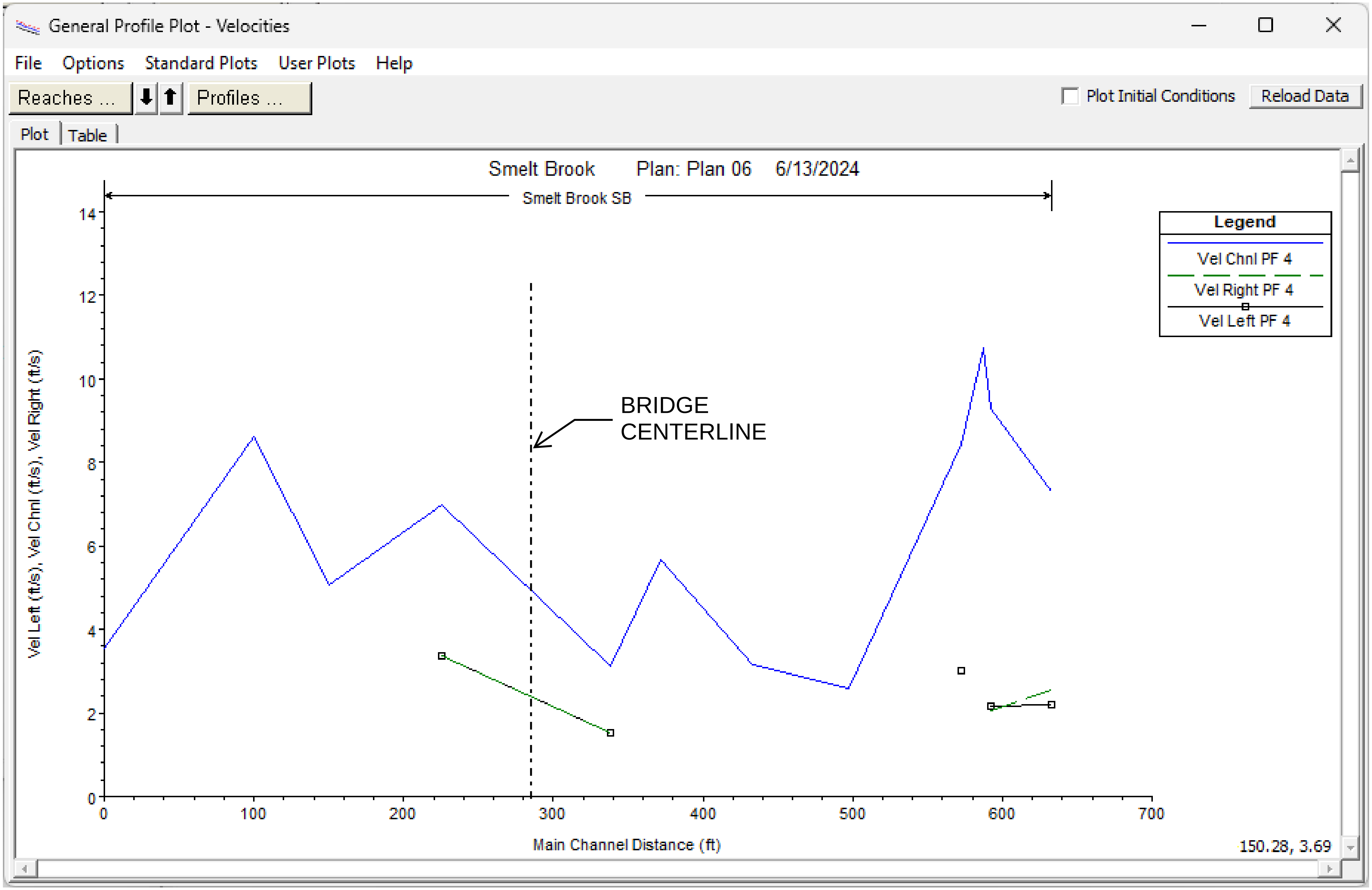


FIGURE 19: Q50, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

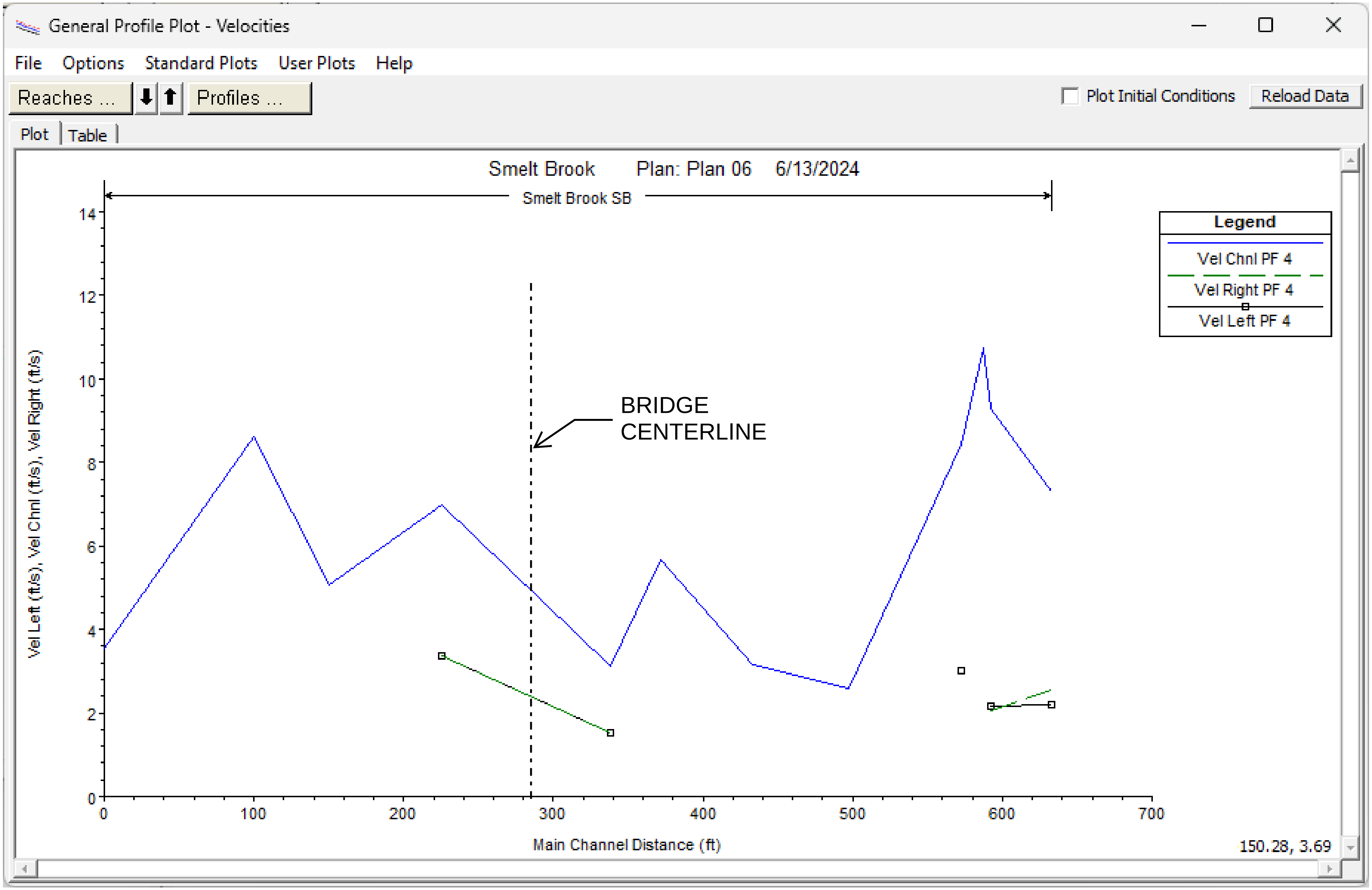


FIGURE 20: Q50, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

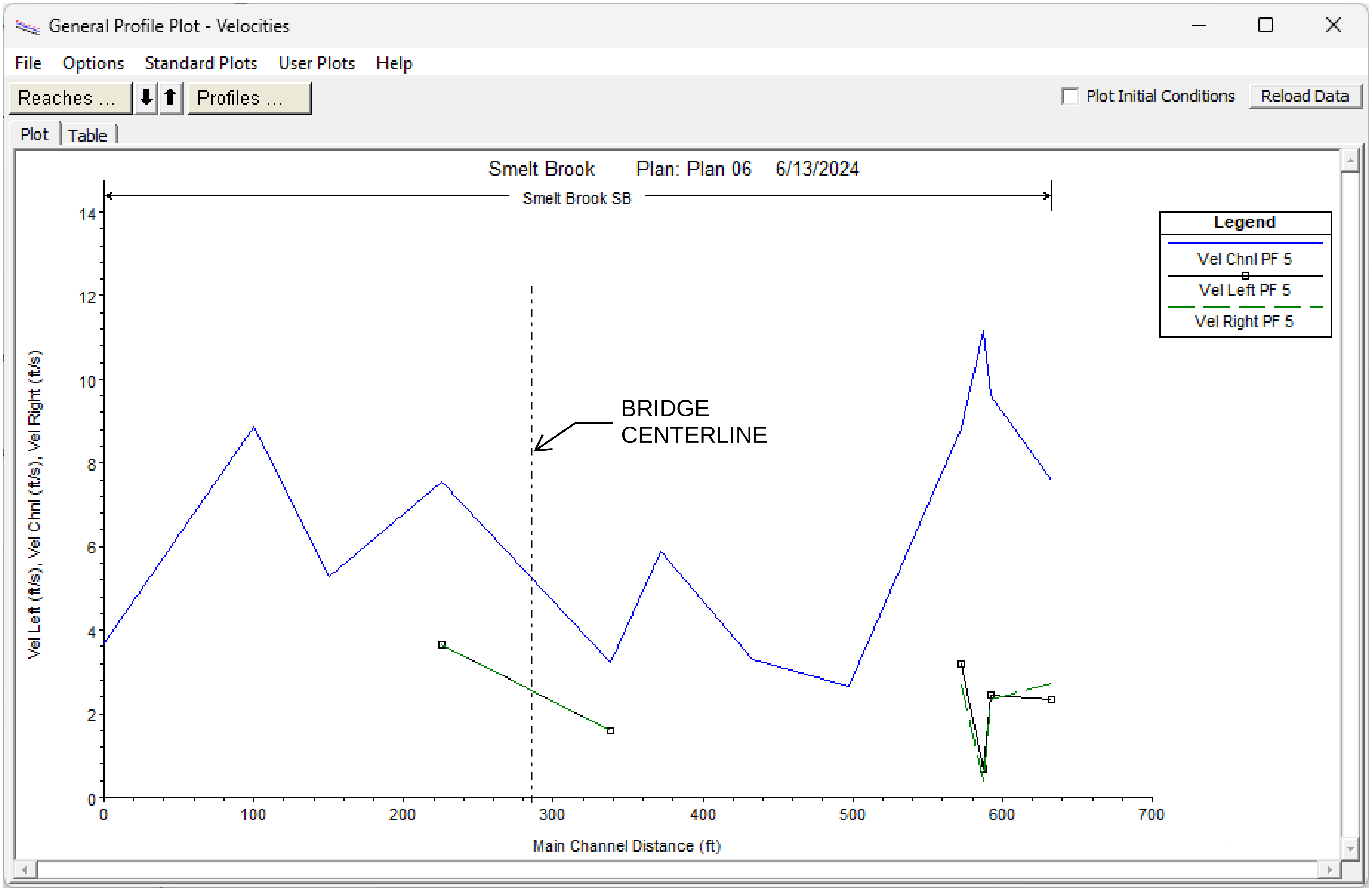


FIGURE 21: Q100, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

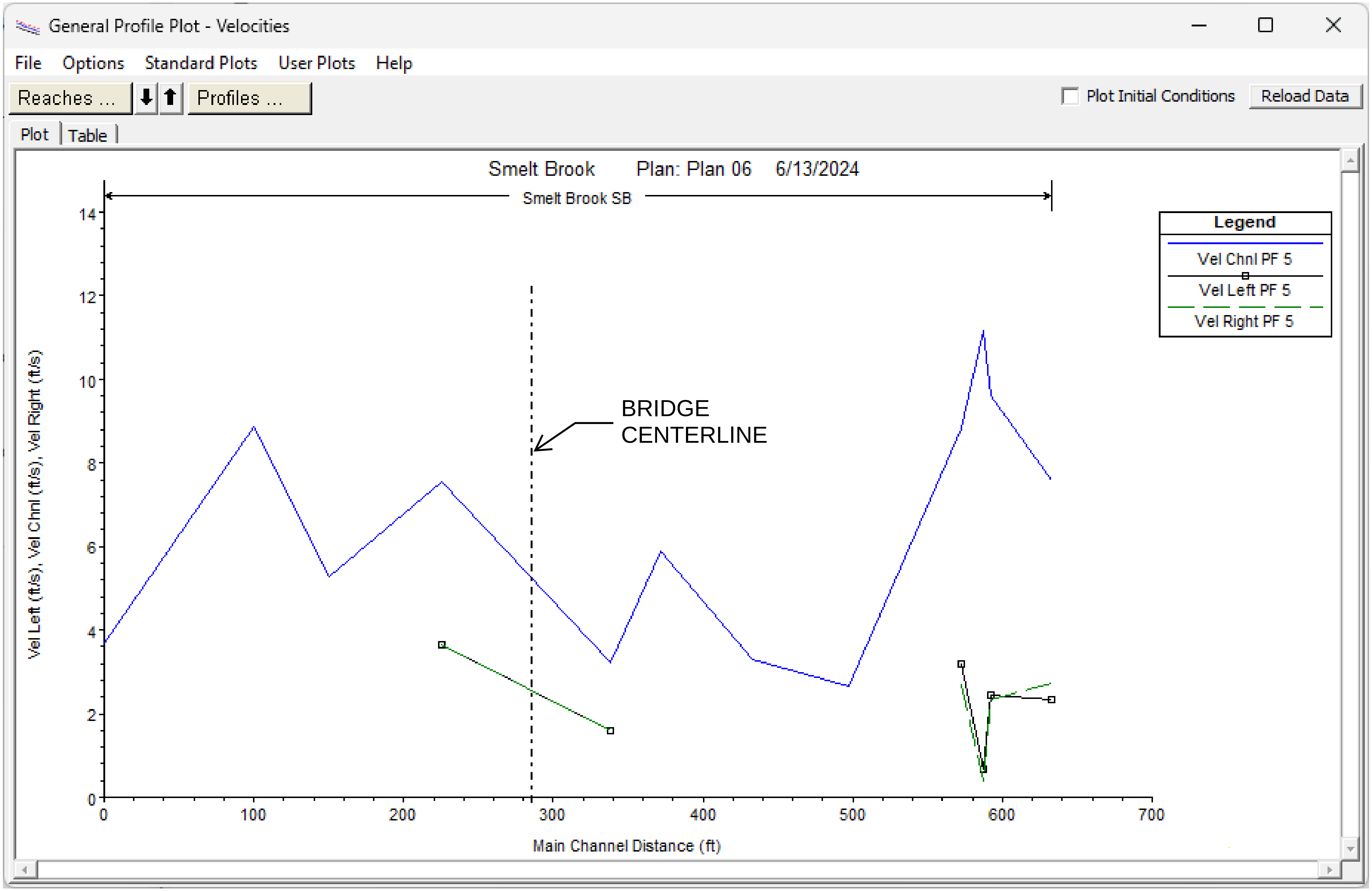


FIGURE 22: Q100, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

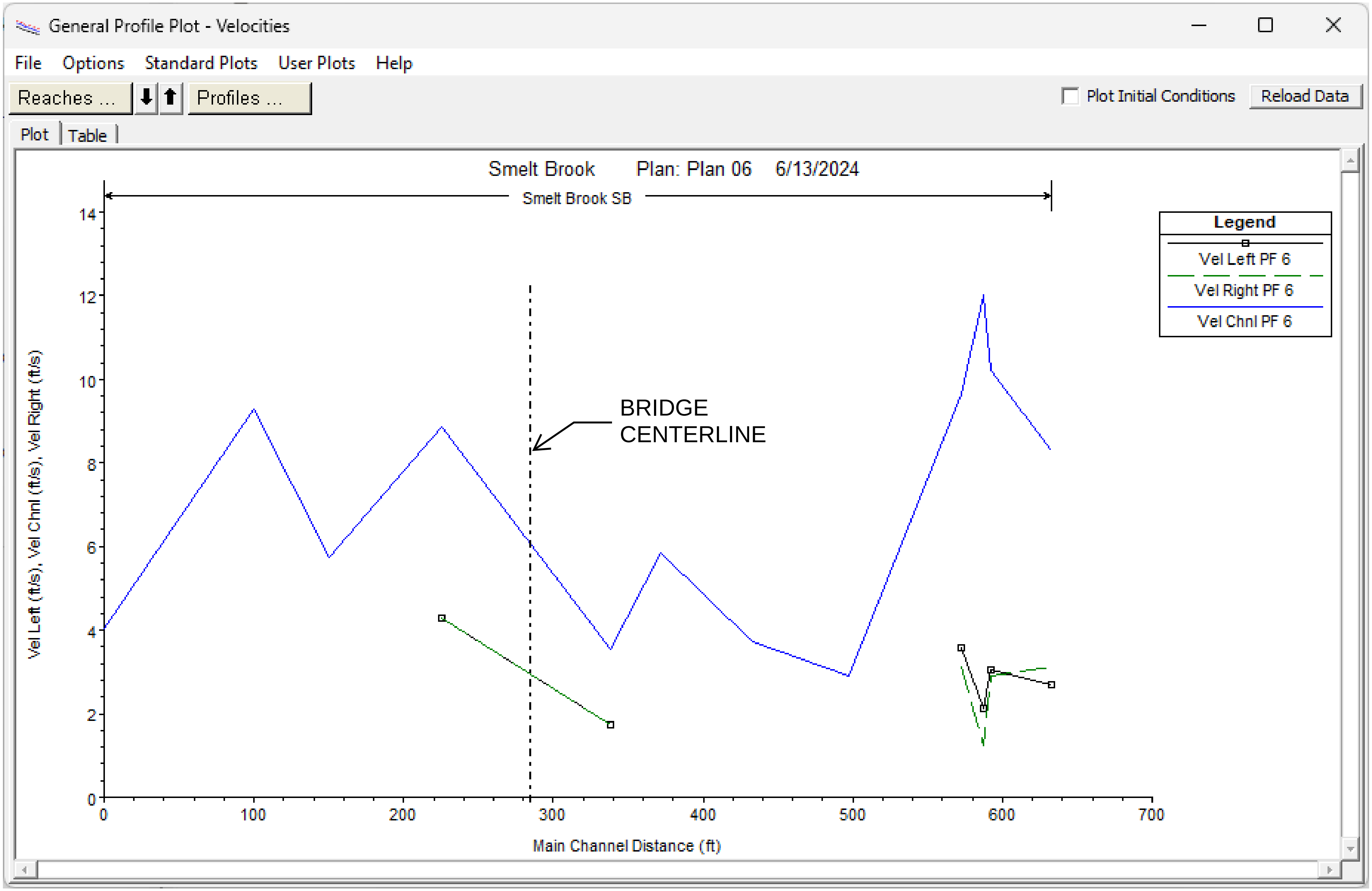


FIGURE 23: Q500, AVERAGE TIDES – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE

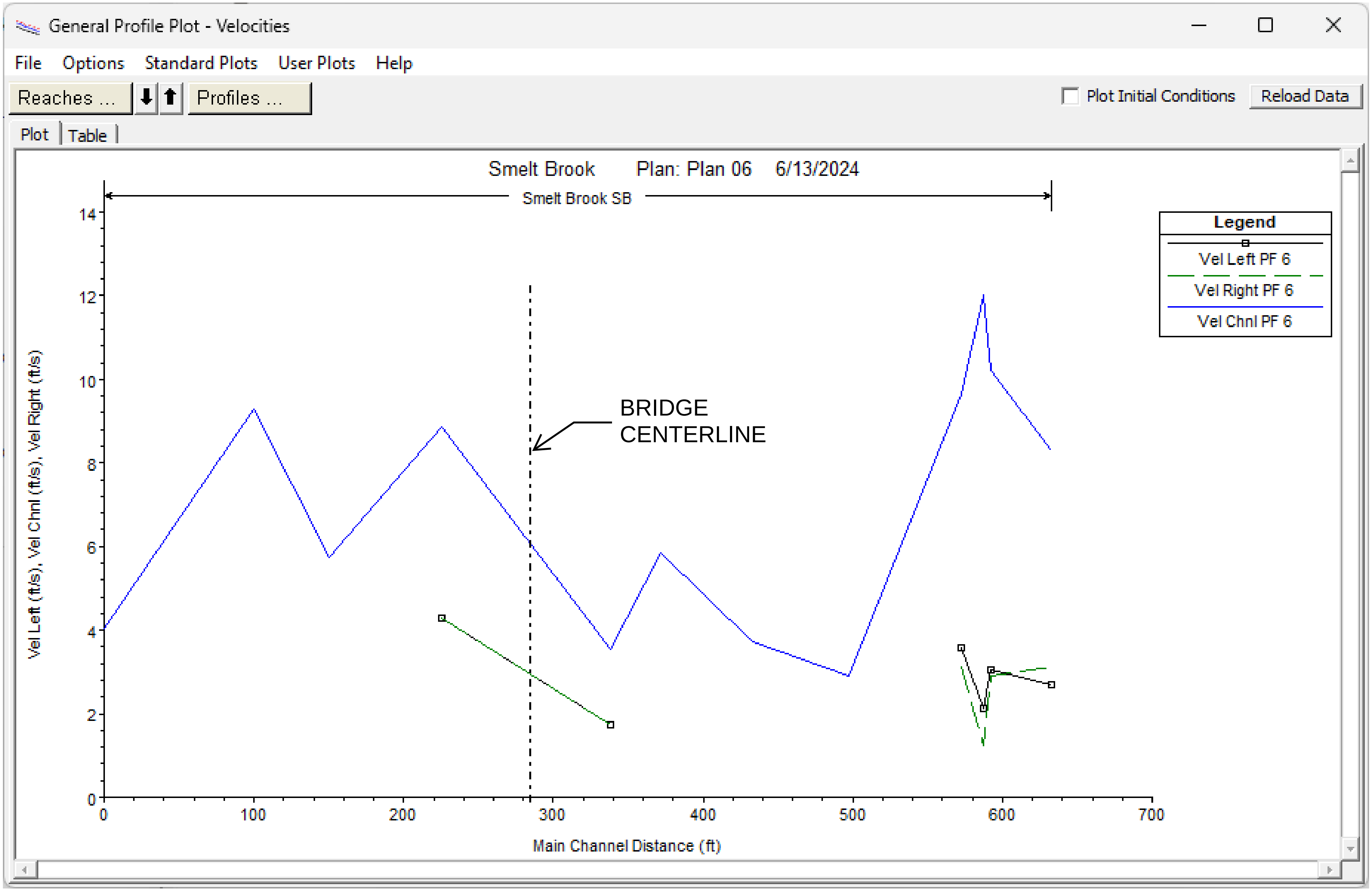


FIGURE 24: Q500, AVERAGE TIDES PLUS 4 FT SLR – MAXIMUM VELOCITIES AT LOW TIDE, PROPOSED SINGLE SPAN BRIDGE STRUCTURE