Hydrology, Hydraulics & Scour Report
June 2019

Prepared for: Maine Department of Transportation
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INTRODUCTION

PURPOSE

The purpose of this report is to present the results of a study conducted at the subject bridge sites to evaluate the hydraulic performance of the assumed replacement alternative considered. This investigation was conducted in a manner consistent with Federal Highway Administration (FHWA) and Maine Department of Transportation (MaineDOT) guidelines.

SCOPE

The scope of work for this report consists of gathering and reviewing pertinent hydrologic data for the Souadabscook Stream at the Project sites, and a detailed hydraulic analysis. Data collected, and hydraulic model computer outputs are presented in this report.

EXISTING STRUCTURES

There are a total of six existing structures that carry Interstate 95 over the Souadabscook Stream. The bridges are split into three groups, West, Center, and East. Each group has a northbound and a southbound bridge.

Each bridge is a 130’-0” three-span, continuous steel girder structure. All the abutments are pile supported and founded on fill material. The piers are in-water concrete wall piers founded on piles at the West and Center Bridges and founded directly on bedrock at the East Bridges.

ENGINEERING METHODS

HYDROLOGY

The Souadabscook Stream is the ninth largest tributary to the Penobscot River. It flows east-southeast for 18.9 miles from the outlet of Etna Pond to its confluence with the Penobscot River in Hampden. Hammond Pond, Hermon Pond, and Ben Annis Pond are all located in the Souadabscook Watershed.

USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015) were used to determine peak flows for the West, Center, and East Bridges. The maximum flows at the East Bridge were used for all three bridges. USGS data was provided by USGS StreamStats.

The East Bridge has a drainage area of 139 square miles. The watershed is estimated 15.79% storage areas and 6.86% developed (urban). The mean annual precipitation is 42.2 inches.

Existing plans (1961) report High Water Elevation = 130.5' NGVD, identical to the FEMA (1987) estimates of the 500-year Stillwater elevations for Hammond and Hermon Ponds. The FEMA Q500 at Manning Mill Road estimate is approximately the same as the value estimated from gage data on the adjacent Sebasticook River (6190 ft^3/s FEMA vs. 6435 ft^3/s gage, data through 2013). Taken together, these three sources provide reasonable estimates for the flood of record at 129.81 (NAVD) (130.5 NGVD).

Design Hydrology Summary	
Drainage Area	139 mi^2
Ordinary High Water ($Q_{1.1}$)	1,204 ft^3/s
(Q_{10})	3,639 ft^3/s
(Q_{25})	4,435 ft^3/s
Design Discharge (Q_{50})	5,036 ft^3/s
Check Discharge (Q_{100})	5,672 ft^3/s
Scour Check Discharge (Q_{500})	7,178 ft^3/s

HYDRAULICS

The 1987 Town of Hampden Flood Insurance Study (FIS) provided the peak discharge values at common locations as depicted below.

1987 Town of Hampden Flood Insurance Study (FIS) Peak Discharge Summary

Location	**10-Year**	**50-Year**	**100-Year**	**500-Year**
At U.S. Route 1A	3,310	4,680	5,220	6,630
At Manning Mill Road	3,090	4,380	4,880	6,190

Interstate 95 Northbound and Southbound each cross the Souadabscook Stream in three locations, referred to as the West, Center, and East Bridges, for a total of six bridges. The FIS reported the peak discharge of 4,880 cfs for the 100-year event at the Intersection of the Souadabscook Stream and Manning Mill Road. This is less than the 5,672 cfs flow estimated by MDOT.

Since the FIS only evaluated a single storm event, with a magnitude found to be about 15% less than recently estimated value, starting water surface elevations (SWSEL) could not be obtained from the FEMA FIS.

All elevations are based on North American Vertical Datum (NAVD) of 1988. Elevations based on the National Geodetic Vertical Datum (NGVD) of 1929 were converted to NAVD by subtracting 0.69 feet.

The existing bridge plans (1961) report a high-water Elevation of 130.5’ NGVD (EL 129.81’ NAVD). FEMA (1987) estimates of the 500-year stillwater elevations for Hammond and Hermon Ponds to be EL 130.5’ NGVD (EL 129.81’ NAVD).

An existing condition model was developed with a boundary condition of normal depth and estimated channel slopes. A downstream energy grade (EG) was set at 0.00262 for all storm events. Specific stream sections were surveyed and provided by the Maine DOT Survey Section. Geometric data for the existing bridge was taken from the existing bridge plans. All elevations were referenced to the project datum (NAVD 1988).

Manning’s “n” values were based on information from the FEMA study, with channel “n” of 0.03 and overbank “n” of 0.092.

The existing conditions model was compared with the FEMA FIS water surface elevations and velocities. In general, the existing conditions model water surface elevations were approximately one to one-and-a-half feet lower than the FEMA FIS. Subsequently, the velocities in the existing conditions model were higher than what was reported in the FEMA FIS.

The proposed bridge was modeled in HEC-RAS with the bottom chord for all bridges set at Elevation 130 for developing hydraulic clearances. Both abutments are assumed to be integral abutments placed in the same locations as the existing abutments such that the face-to-face distance between the abutments matches existing.

A two-span structure was modeled for hydraulic design purposes, but a single-span structure is also an allowed design-build alternative. The two-span structure was modeled because it will provide the most conservative estimate for the computed water surface elevations and velocities.

The proposed typical stream section at the structures was developed to meet the conditions of the U.S. Army Corps of Engineers Maine General Permit. The piers are assumed to be wall piers on buried footings, founded on piles or bedrock, with the top of the footings below the depth of the typical riprap section as defined in the Standard Details. See Figure 1 and Figure 2.

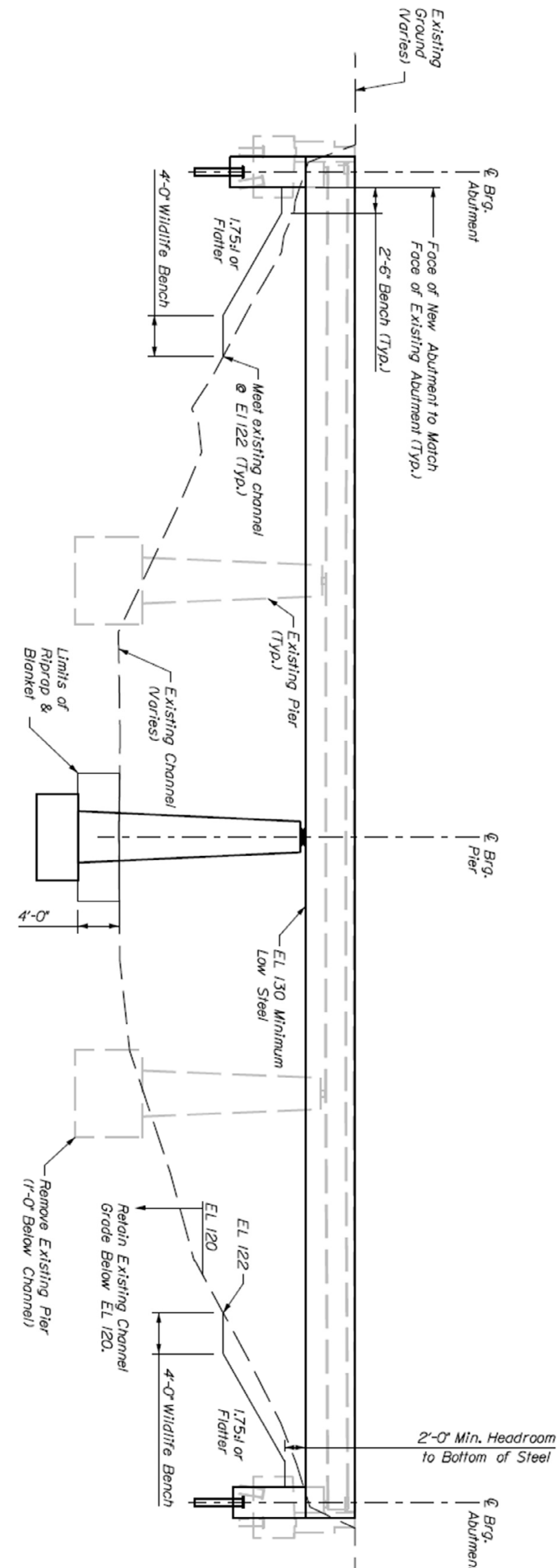


FIGURE 1: ASSUMED BRIDGE ELEVATION SCHEMATIC
Center Bridge Shown. West and East Bridges Similar.
Not to scale.

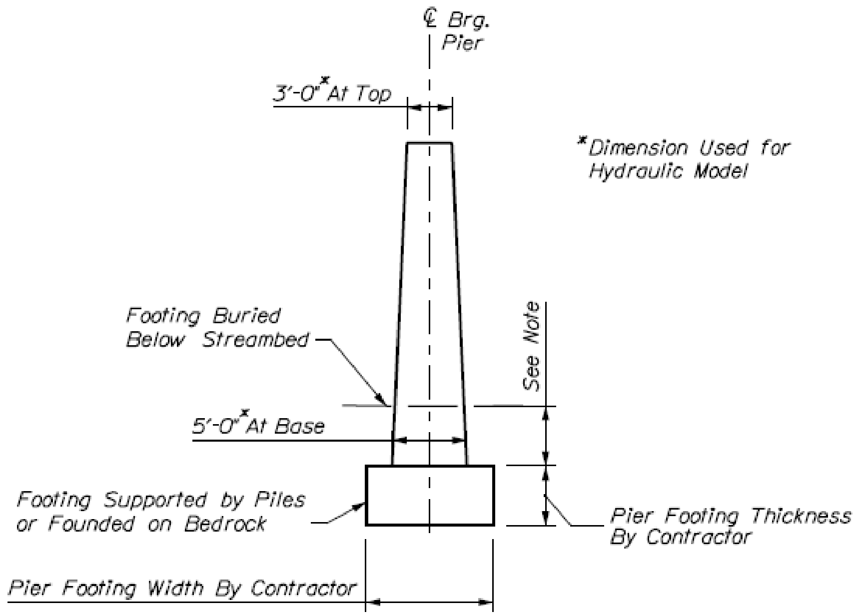


FIGURE 2: ASSUMED PIER GEOMETRY

Note:
The proposed top of footing for the pier is assumed to be placed below the MaineDOT Standard Detail riprap section.

West Bridge Hydraulic Summary						
Elevations, Velocities & Clearances	**Existing Structure 3-Span Steel Girder Bridge 130 feet**			**Assumed Structure 2-Span Steel Girder Bridge 130 feet**		
	Discharge Velocity (fps)	**Headwater Elevation (ft)**	**Clearance (ft)**	**Discharge Velocity (fps)**	**Headwater Elevation (ft)**	**Clearance (ft)**
Q1.1	1.97	122.01	9.69	2.01	121.93	8.07
Q10	3.58	125.48	6.22	3.68	125.23	4.77
Q25	3.93	126.4	5.3	4.07	126.08	3.92
Q50	4.17	127.06	4.64	4.33	126.68	3.32
Q100	4.6	127.27	4.43	4.59	127.29	2.71

Center Bridge Hydraulic Summary						
Elevations, Velocities & Clearances	**Existing Structure 3-Span Steel Girder Bridge 130 feet**			**Assumed Structure 2-Span Steel Girder Bridge 130 feet**		
	Discharge Velocity (fps)	**Headwater Elevation (ft)**	**Clearance (ft)**	**Discharge Velocity (fps)**	**Headwater Elevation (ft)**	**Clearance (ft)**
Q1.1	1.28	121.47	10.23	1.3	121.36	8.64
Q10	2.55	124.91	6.79	2.61	124.67	5.33
Q25	2.85	125.81	5.89	2.93	125.52	4.48
Q50	3.06	126.44	5.26	3.15	126.10	3.9
Q100	3.43	126.5	5.2	3.37	126.69	3.31

East Bridge Hydraulic Summary						
Elevations, Velocities & Clearances	Existing Structure 3-Span Steel Girder Bridge 130 feet			Assumed Structure 2-Span Steel Girder Bridge 130 feet		
	Discharge Velocity (fps)	Headwater Elevation (ft)	Clearance (ft)	Discharge Velocity (fps)	Headwater Elevation (ft)	Clearance (ft)
Q1.1	2.69	120.91	10.79	2.74	120.85	9.15
Q10	4.45	123.79	7.91	4.62	123.57	6.43
Q25	4.85	124.53	7.17	5.05	124.25	5.75
Q50	5.1	125.07	6.63	5.35	124.73	5.27
Q100	6.16	124.58	7.12	5.63	125.23	4.77

SCOUR

The project geotechnical engineer obtained borings and provided grain-size analyses of the existing channel bed material at various soil depths for estimating contraction scour. Since local scour can be increased by debris lodged on a substructure unit, the pier widths were increased by 25% (to 6.25 feet) to account for debris for local pier scour calculations. Total abutment scour was estimated with NCHRP 24-20 equations, and local pier scour was estimated with CSU equations.

Q100 and Q500 flood events were analyzed and the results are shown below.

West Bridge Scour Summary						
Element	100-Year Total Scour (ft)			500-Year Total Scour (ft)		
Abutment No. 1	**2.2**			**3.1**		
Abutment No. 2	**2.2**			**3.1**		
Element	Contraction	Local	Total	Contraction	Local	Total
Pier	2.30	9.12	**11.4**	2.79	8.75	**11.5**

Center Bridge Scour Summary						
Element	100-Year Total Scour (ft)			500-Year Total Scour (ft)		
Abutment No. 1	**5.0**			**8.9**		
Abutment No. 2	**5.0**			**8.9**		
Element	Contraction	Local	Total	Contraction	Local	Total
Pier	3.18	7.32	**10.5**	5.21	7.84	**13.1**

East Bridge Scour Summary						
	100-Year			500-Year		
Element	Total Scour (ft)			Total Scour (ft)		
Abutment No. 1	**12.2**			**17.4**		
Abutment No. 2	**12.2**			**17.4**		
Element	**Contraction**	**Local**	**Total**	**Contraction**	**Local**	**Total**
Pier*	1.95	8.58	**10.5**	1.88	8.75	**10.6**

*Bedrock was discovered 2.0' and 7.5' below the existing streambed at the East Bridges.

All values are in feet. Scour is measured from the bottom of the stream.

The existing riprap slopes below Elevation 120 shall be left in place and unaltered. Plain riprap shall be placed where existing piers are removed and around the proposed piers. Proposed slopes above Elevation 120 shall be protected with a layer of plain riprap in accordance with the Standard Details.

All bridges shall be founded on competent rock or on piles driven to rock. The structures shall meet all the requirements of AASHTO LRFD 2.6.4.4.2, with Q100 = design flood for scour and Q500 = check flood for scour.

The East Bridge substructures shall be designed for a scour depth equal to the depth of bedrock. Substructures shall be founded on competent rock. Weathered, fractured, or otherwise unsuitable rock shall be removed. See provided Geotechnical Data Reports for more information on bedrock depth and composition.

CONCLUSIONS AND RECOMMENDATIONS

The following are recommendations for inclusion into the Request for Proposal document as Technical proposal Responsiveness Requirements:

1. The bottom of steel for the proposed structures shall not be lower than Elevation 130 (NAVD88).

2. The length of the proposed bridge opening, measured from face-to-face of the abutments, shall be equal to or greater than the existing structures.

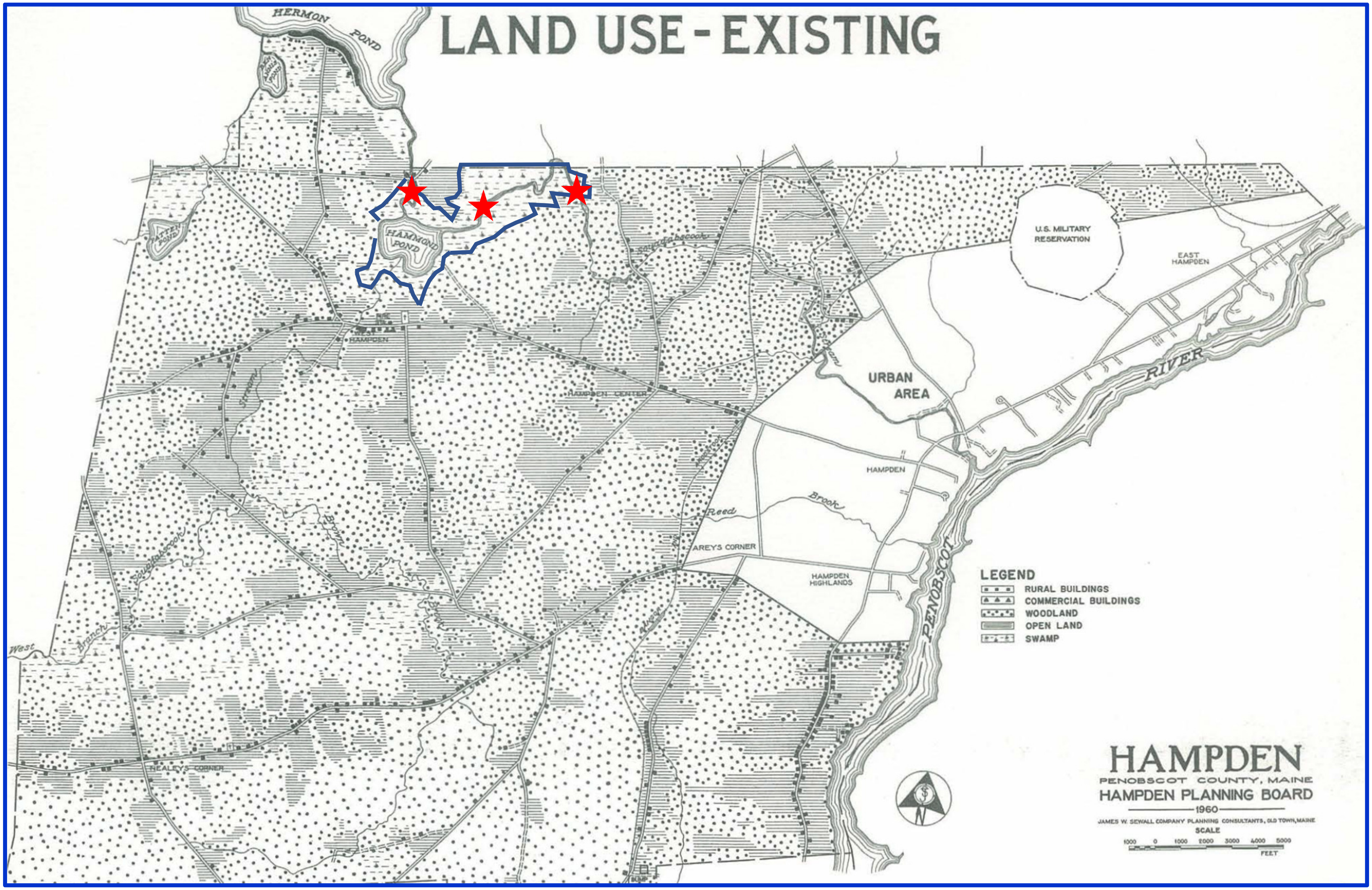
3. The proposed abutments shall not be closer than the existing abutments to the stream.

4. All bridge foundations shall be either founded directly on competent rock or be founded on piles driven into rock.

5. Efforts should be made to retain as much of the existing riprap slopes as feasible. Areas disturbed by work shall be protected with plain riprap installed in accordance with Standard Details and Specifications.

Hydrology, Hydraulic, & Scour Attachments

West Bridges
Center Bridges
East Bridges
Hermon Pond
Flow
Intersection with Manning Mill Road
Hammond Pond
Intersection with US Route 1A
Confluence with Penobscot River
WEST HAMPDEN
HAMPDEN CENTER
HAMPDEN STATION
Hampden
Hampden Academy
Western Ave
Rte 202
Main Rd N


LAND USE - EXISTING
HERMON POND
HAMMOND POND
U.S. MILITARY RESERVATION
EAST HAMPDEN
URBAN AREA
RIVER
HAMPDEN CENTER
HAMPDEN
Brook
Reed
AREYS CORNER
HAMPDEN HIGHLANDS
PENOBSCOT
West
HEALEYS CORNER
LEGEND
RURAL BUILDINGS
COMMERCIAL BUILDINGS
WOODLAND
OPEN LAND
SWAMP
HAMPDEN
PENOBSCOT COUNTY, MAINE
HAMPDEN PLANNING BOARD
1960
JAMES W. SEWALL COMPANY PLANNING CONSULTANTS, OLD TOWN, MAINE
SCALE
1000 0 1000 2000 3000 4000 5000
FEET

Environmental Office – Hydrology Section
16 State House Station
Augusta ME 04333-0016
207.557.1052
Charles.Hebson@maine.gov

Maine Department of Transportation

Memo

To: Jeff Folsom, Leanne Timberlake, Theresa McAuliffe, Ron Joy

From: Charles Hebson

Date: 22 April 2019

Re: 21728 Hampden I-95 Bridges - Hydrology

Executive Summary

Hydrology information for the Souadabscook River near the three I-95 bridges in Hampden are available from four sources: existing MaineDOT plans (1961), FEMA Flood Insurance Study (FIS; 1987), calculated for this project using USGS regression methods (Hodgkins, 1999), and calculated from USGS river gage data on the adjacent Sebasticook River. The water surface elevations from the plans and the FIS match exactly. The peak flow estimates from the FIS and scaled from the Sebasticook gage (Pittsfield, #01049000) are in close agreement. The FIS estimates are given at Manning Mill Rd, just downstream of the East Bridge (#1431). The regression equations applied directly at Manning Mill Rd are significantly (30% - 35%) higher than the FIS and scaled Sebasticook estimates. Given that the estimates from the plans, FIS and Sebasticook gage are all self-consistent, it is reasonable to conclude that these estimates are acceptable representations of the 500-yr water surface elevation and the range of design flows.

Table 1. Peak Flow Estimates, Souadabscook River @ Manning Mill Rd, Hampden, ME

	Peak Flows (ft^3/s)				Water Elev (ft NGVD)	
T (yrs)	FIS (1987)	USGS [1]	USGS [2]	Regr	Plans	FIS
10	3,090	3,445	2,935	4,170		
50	4,380	4,720	4,615	5,810		
100	4,880	5,285	5,145	6,560		
500	6,190	6,625	6,435	8,350	130.5 [3]	130.5

Note: 1. Sebasticook weighted gage/regression estimates scaled by watershed area ratio
2. Regression equations applied to Souadabscook River at Manning Mill Rd
3. Reported as “High Water” without an associated return period.

Discussion

The 1961 MaineDOT bridge plans report “High Water” as 130.5’ NGVD, for the years 1936 and 1955. The FEMA Flood Insurance Study (FIS; 1987) reports the same exact value for the 500-yr elevation. The FIS employed the widely used TR-20 rainfall-runoff model for the Souadabscook. The report states that the results were “checked against” the USGS regression equations (Morrill, 1975) current at the time. Given the exact agreement between the noted and modeled water levels, it is possible that the model was calibrated to the 130.5’ NGVD level. It is also possible that the modeled flows are somehow “calibrated” to the regression estimates. It is impossible to conclude what the situation is, since we do not know exactly how the water level data and regression estimates were used with the TR-20 model. Likewise, it is impossible to say whether gage data from the adjacent Sebasticook watershed were used in any way to check the model. However, it does seem to reasonable to infer that the TR-20 model results are not entirely independent of the regression calculations and reported water elevation.

Standard MaineDOT hydrology practice is to use the current USGS (Hodgkins, 1999) regression equations when gage data are unavailable. The results for Manning Mill Rd are given in Table 1 under column “Regr”. These values are significantly larger (35%) than the FIS estimates. The Souadabscook is ungaged but the adjacent Sebasticook River was gaged from 1928 through 2013. The Sebasticook regression and gage estimates are similarly inconsistent, as reported by Hodgkins (p. 13). When a river is gaged, the gage and regression estimates are combined to form a final weighted estimate:

$$Q_w = \{n/(n+e)\}Q_g + \{e/(n+e)\}Q_r$$

where Q_w = final weighted estimate
Q_g = estimate from gage data fitted to LP-III distribution
Q_r = estimate from regional regression equation
n = length of record
e = equivalent record length for regression estimate (Table 2)

The Sebasticook record was n = 68 years long with data through 1996 in the 1999 report, so the relative weight for regression (approx. 5.5 (68 + 5.5) = 0.075) is small compared to the gage weight (0.925). Thus, even though the regression estimates Q_r are larger than the gage estimate, the final weighted estimates are not much larger than the gage estimates Q_g, as show in Table 2. Since the 1999 report was published, 17 additional years of data (n = 85 years) were collected at the Sebasticook gage. The weighted estimates were updated using the program PeakFQ and methods in Hodgkins (1999). The updated estimates (“2013”) are shown in Table 2; the values are noticeably smaller than in the 1999 report because of the weighting. Note that the Flood of Record for the Sebasticook was recorded in 1987 and approximates the 500-yr event; we do not have corresponding water levels for the Souadabscook.

Given the close proximity between the Sebasticook and Souadabscook watersheds, simple area scaling was applied to the Sebasticook estimates to estimate Souadabscook flows at Manning Mill Rd. The Sebasticook gage watershed is 571 mi^2 while the Souadabscook is 140 mi^2 at Manning Mill. This difference in areas is outside the usual range for scaling. However, the likely similarities between the watersheds and the evident differences between the Sebasticook gage and regression estimates makes area scaling a useful approach. Simple area scaling, for annual maximum peak flows Q_T, from watershed 1 to watershed 2 is calculated as

$$Q_{T2} = (A_2/A_1)^{a_T} \times Q_{T1}$$

where a_T is an exponent that depends on return period T and A is watershed area. Values for "a" are given in Table 2, watershed areas A in Table 3. This equation was applied using the weighted Sebasticook estimates.

The scaled peak flow estimates for the Souadabscook at Manning Mill Rd are given in Table 1 under the headings "USGS (1996)" and "USGS (2013)". These estimates are remarkably consistent with the FIS values. Therefore, we conclude that an elevation of 130.5' NGVD and the area-scaled Sebasticook estimates (based on data through 2013) constitute a reasonable set of hydrologic values for further analysis. The reasoning for this is as follows:

1) The Sebasticook estimates are based on real flow data
2) The Sebasticook regression results are much bigger than the gage estimates, thus raising questions about the validity of the regression estimates
3) Besides watershed area, we expect the Souadabscook and Sebasticook to be similar
4) We there expect a similar discrepancy between regression estimates and real Soudabscook flows (were they known)
5) Thus, we prefer Sebasticook flows scaled to the Souadabscook watershed area, instead of regression estimates for the Souadabscook.
6) The resulting area-scaled peak flow estimates are very similar to the 1987 FIS flow estimates
7) Therefore we infer that the FIS water surface elevation (based on the FIS flows) of 130.5' NGVD is a reasonable estimate of extreme high water (100-yr to 500-yr)

Table 2. Peak Flow Estimates, Sebasticook River Gage (not scaled for area).

				N = 68		N = 85	
			Qr	Qg	Qw	Qg	Qw
T (yyrs)	a	e		(1996)	(1996)	(2013)	(2103)
10	0.783	4.00	11,537	10,266	10,337	8,681	8,809
50	0.757	5.33	15,453	13,512	13,653	13,210	13,342
100	0.748	5.86	17,146	14,923	15,100	14,520	14,689
500	0.729	6.89	21,203	18,134	18,416	17,620	17,889
FOR (1987)						17,659	

FOR = Flood of Record

Since the FIS hydrology was evaluated for the watershed at Manning Mill Rd, all other estimates were also made for this watershed outlet point. The three bridges are located at various points upstream of Manning Mill Rd, starting with the East Bride. Thus, bridge watersheds are somewhat smaller than at Manning Mill Rd. It is conservative to apply the Manning Mill Rd flows to the bridge locations, particularly West Bridge. The bridge watershed areas (as determined with StreamStats) are summarized in Table 3.

Table 3. Souadabscook Watershed Areas (mi^2) as Determined by StreamStats

	Manning Mill Rd		East Br #1431	Center Br #1432	West Br #1433	Sebasticook Gage [1]
	FIS	StreamStats				#01049000
Area (mi^2)	140.4	142.0	138.7	124.3	94.5	571.4
NWI (%)		14.1	15.8	14.7	16.3	15.6

Notes: 1. Sebasticook data from Hodgkins, 1999.

References

FEMA, 1987. Flood Insurance Study, Town of Hampden, Maine, Penobscot County.

Flynn, K.M., Kirby & Hummel, 2006. User's Manual for Program PeakFQ Annual Flood-Frequency Analysis Using Bulletin 17B Guidelines: U.S. Geological Survey, Techniques and Methods Book 4, Chapter B4.

Hodgkins, G., 1999. Water-Resources Investigations Report 99-4008, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals, U.S. Geological Survey, Augusta, Maine.

Morrill, R.A., 1975. Open-File Report 75-292, A Technique for Estimating the Frequency and Magnitude of Floods in Maine, U.S. Geological Survey, Augusta, Maine.

WIN:	21729.10	**Project Name:**	Hamden B#1431
Town:	Hamden	**Stream Name:**	Souadabscook Stream
Route No.	US 95	**Bridge Name:**	Souadabscook East SB Bridge
Asset ID:	1431	**Analysis by:**	DFB
Lat:	44.7655 **Long:** -68.89451	**Date:**	7/6/2017

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

Enter data in blue cells only!

	km^2	mi^2	ac	*Enter data in [mi^2]*
A	359.23	138.70	88768.0	Watershed Area *DRNAREA*
W	56.72	21.9	14016.5	Wetlands area (by NWI)
P_c	498806	4957576		watershed centroid (E, N; UTM 19N; meters)
County	Penobscot S			*choose county from drop-down menu*
pptA	39.5			mean annual precipitation (inches; by look-up)
SG	0.02			sand & gravel aquifer as decimal fraction of watershed A

Worksheet prepared by:

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ver. 2016 Feb 05

A (km^2)	359.23	**Conf Lvl**	0.67	
W (%)	15.79			NWI Wetlands % *STORNWI*

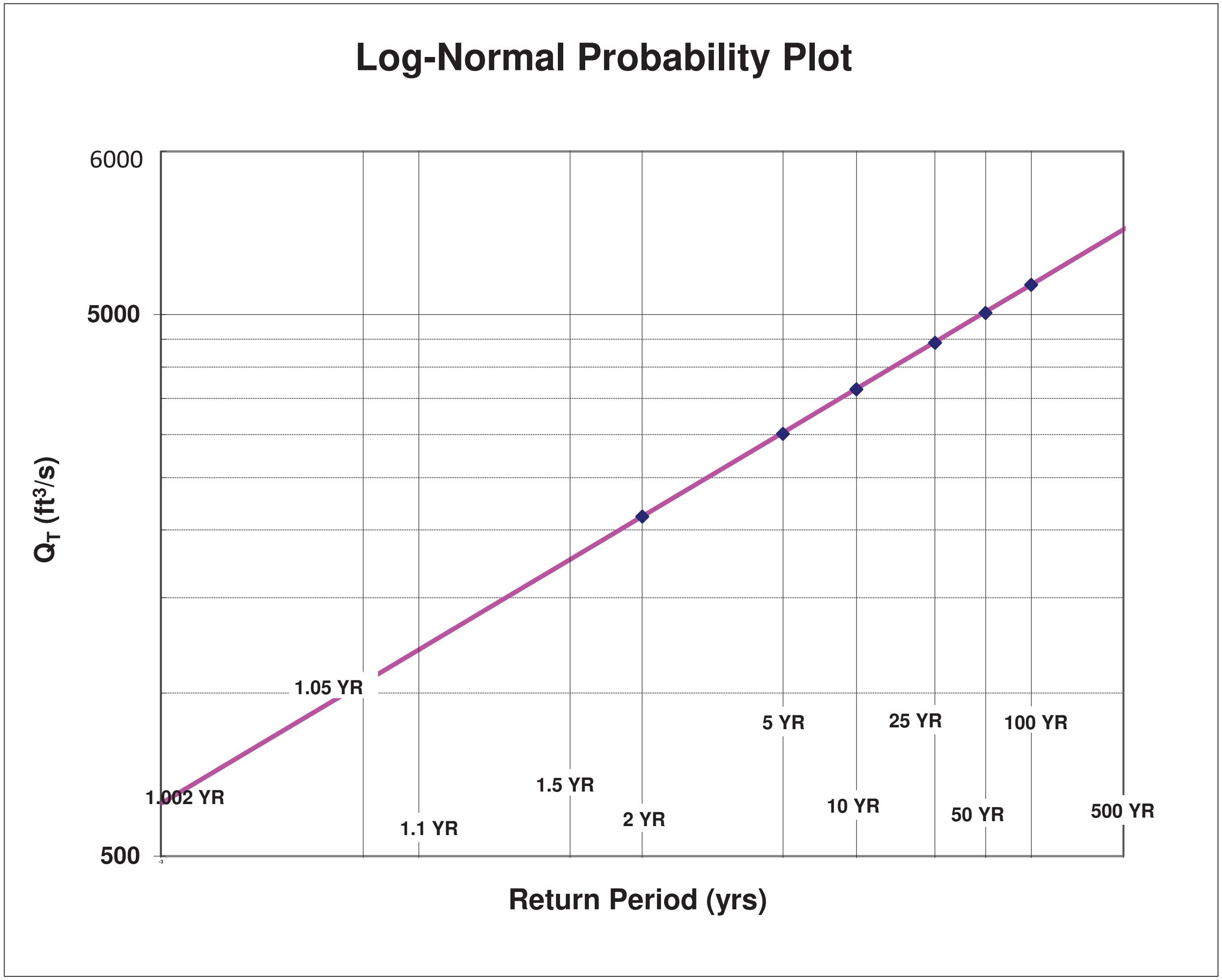
Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		34.09		1203.6
2		60.03		2119.6
5		85.34		3013.2
10		103.06		3639.1
25		125.59		4434.7
50		142.61		5035.6
100		160.65		5672.4
500		203.27		7177.6

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

$Q_T = b \times A^a \times 10^{-wW}$



Log-Normal Probability Plot
6000
5000
500
QT (ft3/s)
1.05 YR
5 YR
25 YR
100 YR
1.5 YR
1.002 YR
10 YR
500 YR
50 YR
2 YR
1.1 YR
Return Period (yrs)

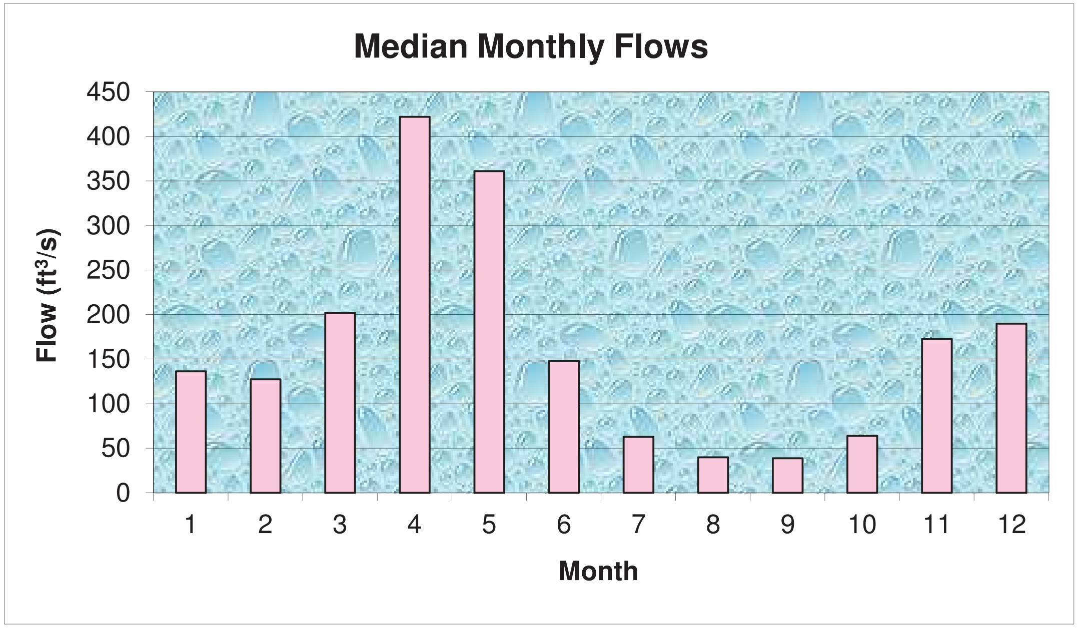
WIN:	21729.10	**Project Name:**	Hamden B#1431
Town:	Hamden	**Stream Name:**	Souadabscook Stream
Route No.	US 95	**Bridge Name:**	Souadabscook East SB Bridge
Asset ID:	1431	**Analysis by:**	DFB
Lat:	44.76552 **Long:** -68.89451	**Date:**	7/6/2017

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

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

	Value	Variable	Explanation
	138.70	*A*	Area (mi^2)
498806.4	4957576	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	68.80	*DIST*	Distance from Coastal reference line (mi)
	39.5	*pptA*	Mean Annual Precipitation (inches)
	0.02	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**136.50**	3.8682
Feb	**127.59**	3.6157
Mar	**202.08**	5.7267
Apr	**422.20**	11.9647
May	**360.95**	10.2288
Jun	**148.11**	4.1971
Jul	**63.06**	1.7872
Aug	**39.99**	1.1332
Sep	**38.83**	1.1004
Oct	**63.90**	1.8108
Nov	**172.87**	4.8989
Dec	**189.92**	5.3822



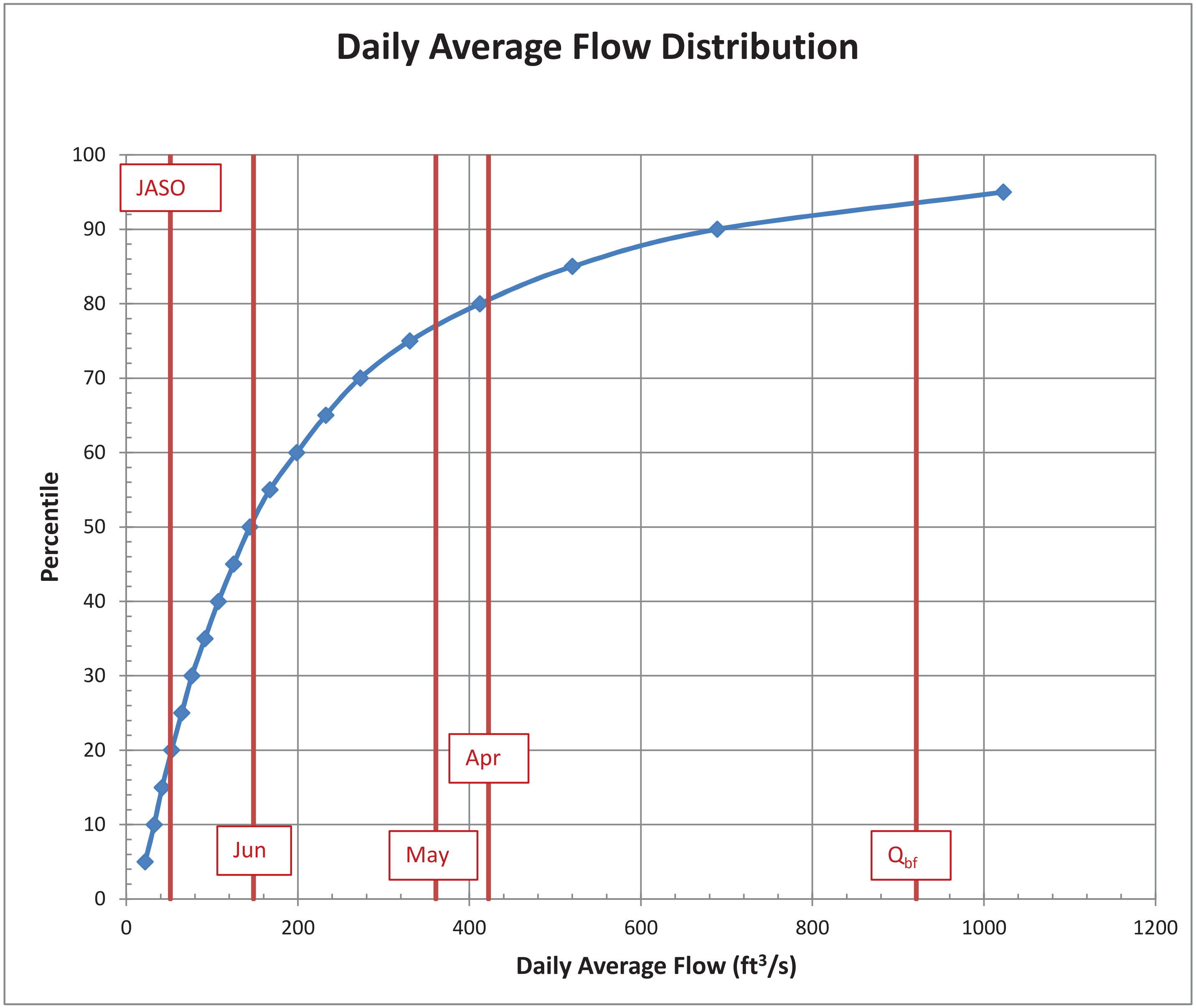
Q_{bf}	**921.2**	
ann avg	**257.6**	
ann med	**124.8**	
$Q_{1.002}$	**625.3**	
$Q_{1.01}$	**789.0**	
$Q_{1.05}$	**1044.5**	
Q_{bf}	**1121.3**	assume v = 4ft/s

W_{bf}	**88.2**	estimated bankfull width (ft)
d_{bf}	**3.2**	estimated bankfull depth (ft)
A_{bf}	**316.4**	estimated bankfull flow area (ft^2)

References

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

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



Daily Avg Flow Dist

A_{ws} = (mi^2) 138.7

Q (ft^3/s)

Pctl	Median	84th pctl
5	21.83	35.14
10	32.43	48.76
15	41.68	60.88
20	52.79	73.84
25	64.58	86.55
30	76.42	98.58
35	91.55	112.66
40	107.36	129.56
45	125.14	146.49
50	144.08	172.95
55	167.31	201.29
60	198.71	236.29
65	232.47	275.29
70	272.68	321.17
75	330.56	386.23
80	412.24	461.13
85	520.16	590.94
90	689.04	793.50
95	1022.60	1233.96

Q_{bf}	921.2
$Q_{1.002}$	625.3
$Q_{1.1}$	1203.6
Q_2	2119.6

Hampden 21729 B# 1431 on Souadabscook Stream

Region ID:

ME

Workspace ID:

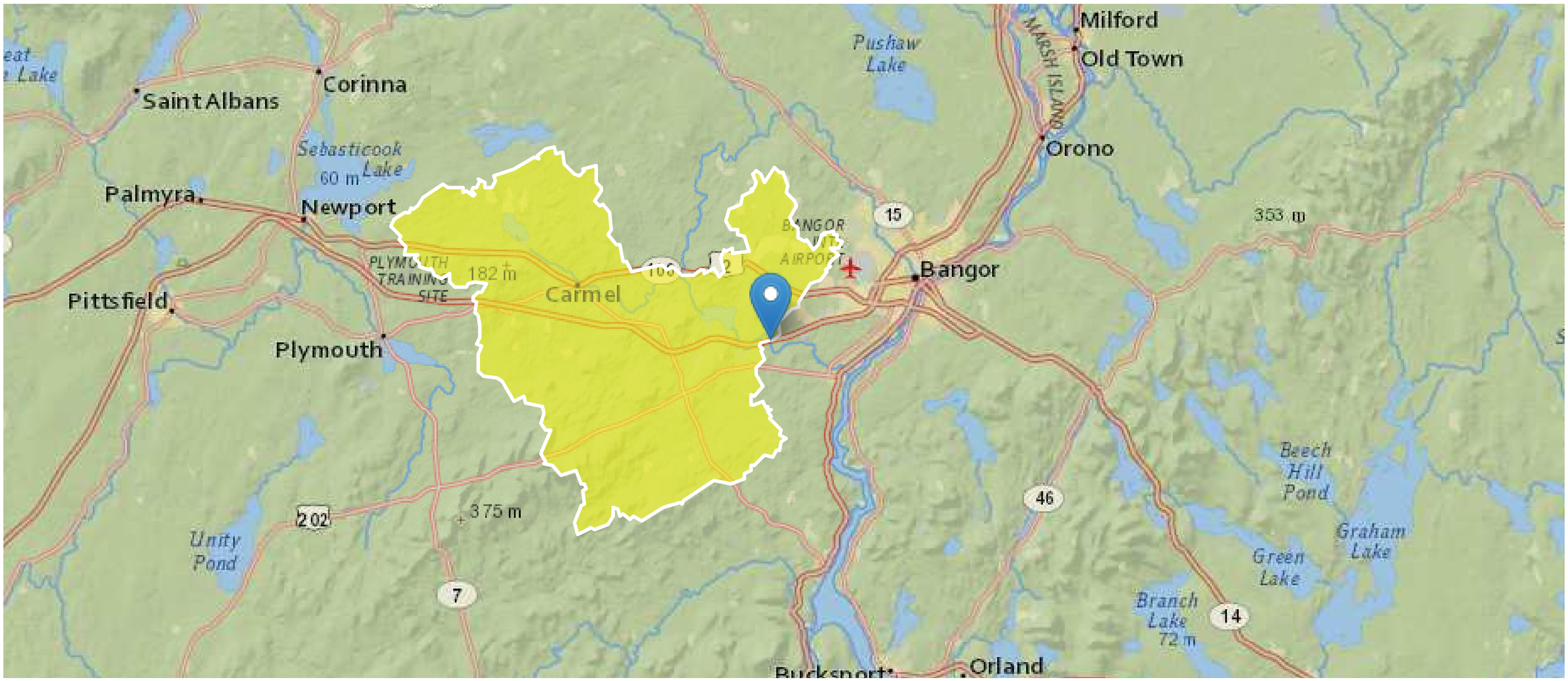
ME20170706093553398000

Clicked Point (Latitude, Longitude):

44.76552, -68.89451

Time:

2017-07-06 09:36:39 -0400



Basin Characteristics

1-11

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	138.7	square miles
STORNWI	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	15.79	percent
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.016	dimensionless
ELEV	Mean Basin Elevation	271.2	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.95	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	498806.39	
CENTROIDY	Basin centroid vertical (y) location in state plane units	4957576.38	
COASTDIST	Shortest distance from the coastline to the basin centroid	69.9	miles
ELEVMAX	Maximum basin elevation	1197.2	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	1.45	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.86	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.35	percent
PRECIP	Mean Annual Precipitation	42.2	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	1.65	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	0.57	percent

Bankfull Statistics Parameters [100 Percent (139 square miles) Central and Coastal Bankfull 2004 5042]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	138.7	square miles	2.92	298

Bankfull Statistics Flow Report [100 Percent (139 square miles) Central and Coastal Bankfull 2004 5042]

Statistic	Value	Unit
Bankfull Streamflow	921	ft^3/s
Bankfull Width	99.7	ft
Bankfull Depth	3.18	ft
Bankfull Area	316	ft^2

Bankfull Statistics Citations

Dudley, R.W.,2004, Hydraulic-Geometry Relations for Rivers in Coastal and Central Maine: U.S. Geological Survey Scientific Investigations Report 2004-5042, 30 p (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)

Peak-Flow Statistics Parameters [100 Percent (139 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	138.7	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	15.79	percent	0.7	26.7

Peak-Flow Statistics Flow Report [100 Percent (139 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	2120	ft^3/s	1190	3790	35.1	35.1	1.8
5 Year Peak Flood	3010	ft^3/s	1670	5430	36.1	36.1	2.5
10 Year Peak Flood	3640	ft^3/s	1990	6660	36.8	36.8	3.2
25 Year Peak Flood	4430	ft^3/s	2370	8310	38.6	38.6	4.1
50 Year Peak Flood	5040	ft^3/s	2630	9630	39.9	39.9	4.8
100 Year Peak Flood	5670	ft^3/s	2910	11100	41.2	41.2	5.4
500 Year Peak Flood	7180	ft^3/s	3480	14800	44.9	44.9	6.4

Peak-Flow Statistics Citations

Hodgkins, G. A.,1999, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p. (http://me.water.usgs.gov/99-4008.pdf)

Flow-Duration Statistics Parameters [100 Percent (139 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	138.7	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.016	dimensionless	0	0.212
ELEV	Mean Basin Elevation	271.2	feet	239	2120

Flow-Duration Statistics Flow Report [100 Percent (139 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
1 Percent Duration	2.88	ft^3/s	144
5 Percent Duration	8.91	ft^3/s	62
10 Percent Duration	16.7	ft^3/s	41
25 Percent Duration	46.8	ft^3/s	22
50 Percent Duration	124	ft^3/s	20
75 Percent Duration	310	ft^3/s	17
90 Percent Duration	661	ft^3/s	17
95 Percent Duration	994	ft^3/s	18
99 Percent Duration	1910	ft^3/s	29

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 Parameters [100 Percent (139 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	138.7	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.016	dimensionless	0	0.212
ELEV	Mean Basin Elevation	271.2	feet	239	2120

Annual Flow Statistics Flow Report [100 Percent (139 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
Mean Annual Flow	264	ft^3/s	16

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)

WIN:	21728.10		**Project Name:**	Hamden B#1432
Town:	Hamden		**Stream Name:**	Souadabscook
Route No.	US 95		**Bridge Name:**	Souadabscook Center SB Bridge
Asset ID:	1432		**Analysis by:**	DFB
Lat:	44.7627	**Long:** -68.90932	**Date:**	7/6/2017

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

Enter data in blue cells only!

	km^2	mi^2	ac	*Enter data in [mi^2]*
A	321.94	124.30	79552.0	Watershed Area *DRNAREA*
W	47.36	18.3	11702.1	Wetlands area (by NWI)
P_c	497638	4957010		watershed centroid (E, N; UTM 19N; meters)
County	Penobscot S			*choose county from drop-down menu*
pptA	39.5			mean annual precipitation (inches; by look-up)
SG	0.02			sand & gravel aquifer as decimal fraction of watershed A

A (km^2)	321.94	**Conf Lvl**	0.67
W (%)	14.71		NWI Wetlands % *STORNWI*

Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		32.75		1156.3
2		58.44		2063.5
5		83.79		2958.7
10		101.65		3589.4
25		124.47		4395.0
50		141.77		5005.8
100		160.09		5652.9
500		203.66		7191.3

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

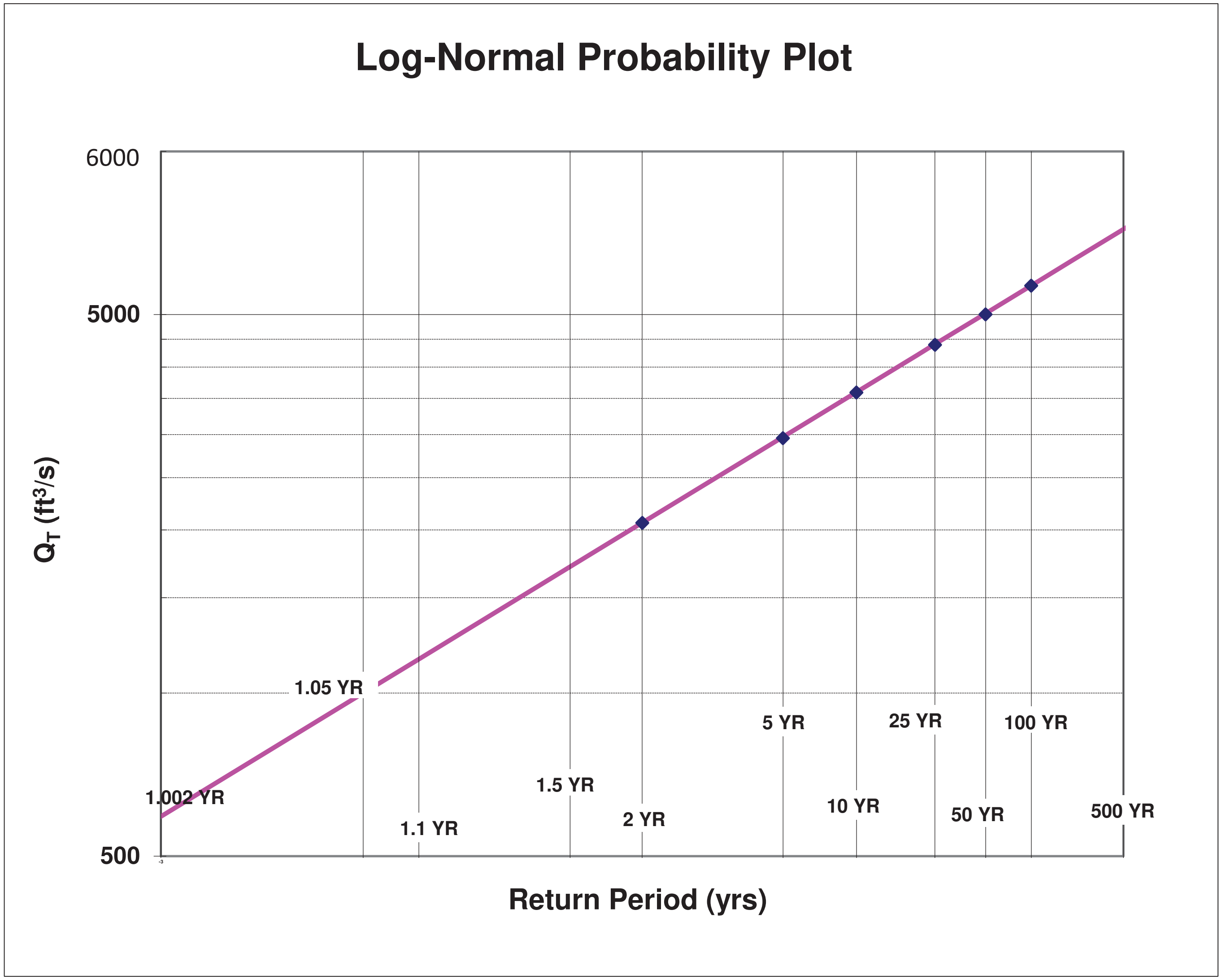
ver. 2016 Feb 05

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

$Q_T = b \times A^a \times 10^{-wW}$



Log-Normal Probability Plot
6000
5000
500
Q_T (ft³/s)
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
Return Period (yrs)

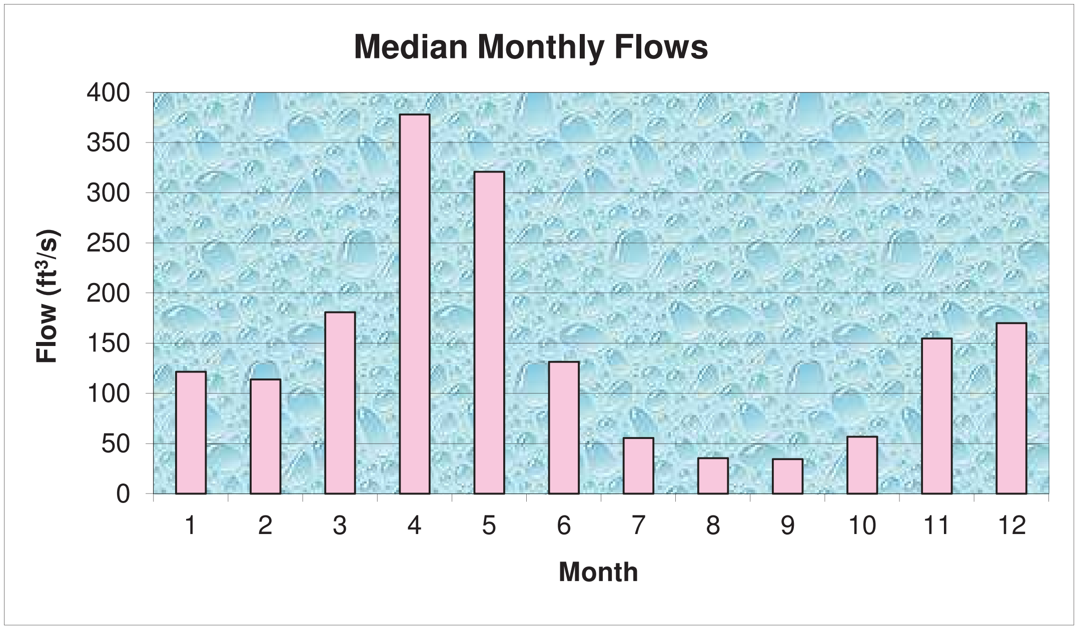
WIN:	21728.10	**Project Name:**	Hamden B#1432
Town:	Hamden	**Stream Name:**	Souadabscook
Route No.	US 95	**Bridge Name:**	Souadabscook Center SB Bridge
Asset ID:	1432	**Analysis by:**	DFB
Lat:	44.76267 **Long:** -68.90932	**Date:**	7/6/2017

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

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

	Value	Variable	Explanation
	124.30	*A*	Area (mi^2)
497637.9	4957010	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	68.86	*DIST*	Distance from Coastal reference line (mi)
	39.5	*pptA*	Mean Annual Precipitation (inches)
	0.02	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	121.77	3.4508
Feb	114.04	3.2318
Mar	180.95	5.1278
Apr	377.96	10.7108
May	321.13	9.1003
Jun	131.63	3.7301
Jul	55.73	1.5794
Aug	35.47	1.0053
Sep	34.55	0.9790
Oct	56.95	1.6138
Nov	154.85	4.3883
Dec	170.13	4.8213

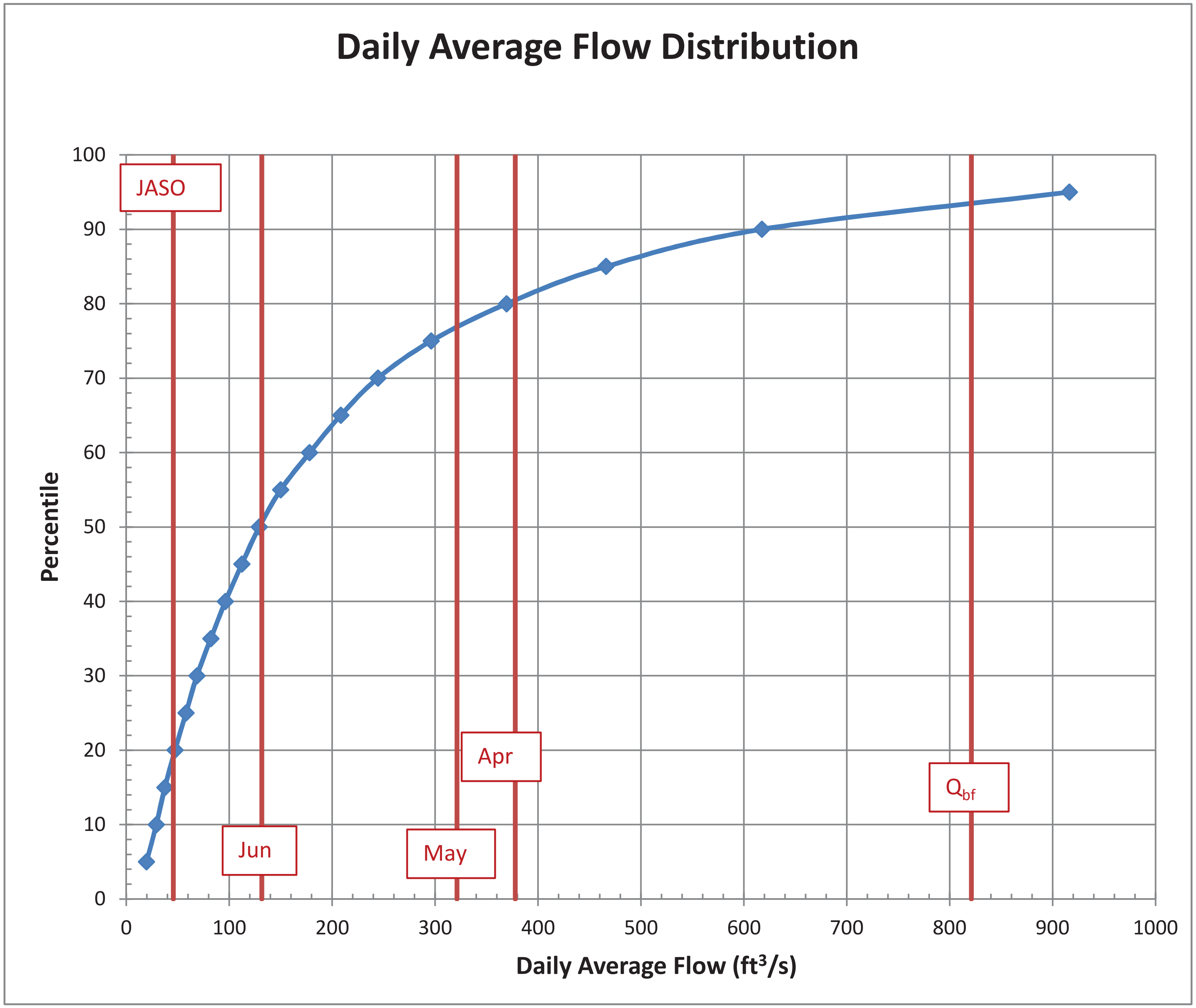


Q_{bf}	821.0	
ann avg	231.1	
ann med	111.8	
$Q_{1.002}$	591.5	
$Q_{1.01}$	750.5	
$Q_{1.05}$	1000.0	
Q_{bf}	1030.6	assume v = 4ft/s

W_{bf}	84.2	estimated bankfull width (ft)
d_{bf}	3.1	estimated bankfull depth (ft)
A_{bf}	287.9	estimated bankfull flow area (ft^2)

References

Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 …, USFWS QRP Project
Dudley, R.W., 2004. Estimating Monthly Streamflows … , SIR 2004-5026



Daily Avg Flow Dist

A_{ws} = (mi^2) 124.3

Q (ft^3/s)

Pctl	Median	84th pctl
5	19.57	31.49
10	29.06	43.70
15	37.36	54.56
20	47.31	66.17
25	57.87	77.57
30	68.48	88.34
35	82.05	100.97
40	96.22	116.11
45	112.15	131.28
50	129.12	154.99
55	149.94	180.40
60	178.08	211.76
65	208.33	246.71
70	244.37	287.83
75	296.24	346.13
80	369.44	413.26
85	466.16	529.59
90	617.50	711.12
95	916.43	1105.85

Q_{bf}	821.0
$Q_{1.002}$	591.5
$Q_{1.1}$	1156.3
Q_2	2063.5

Hampden 21278 B#1432 on Souadabscook Stream

Region ID:

ME

Workspace ID:

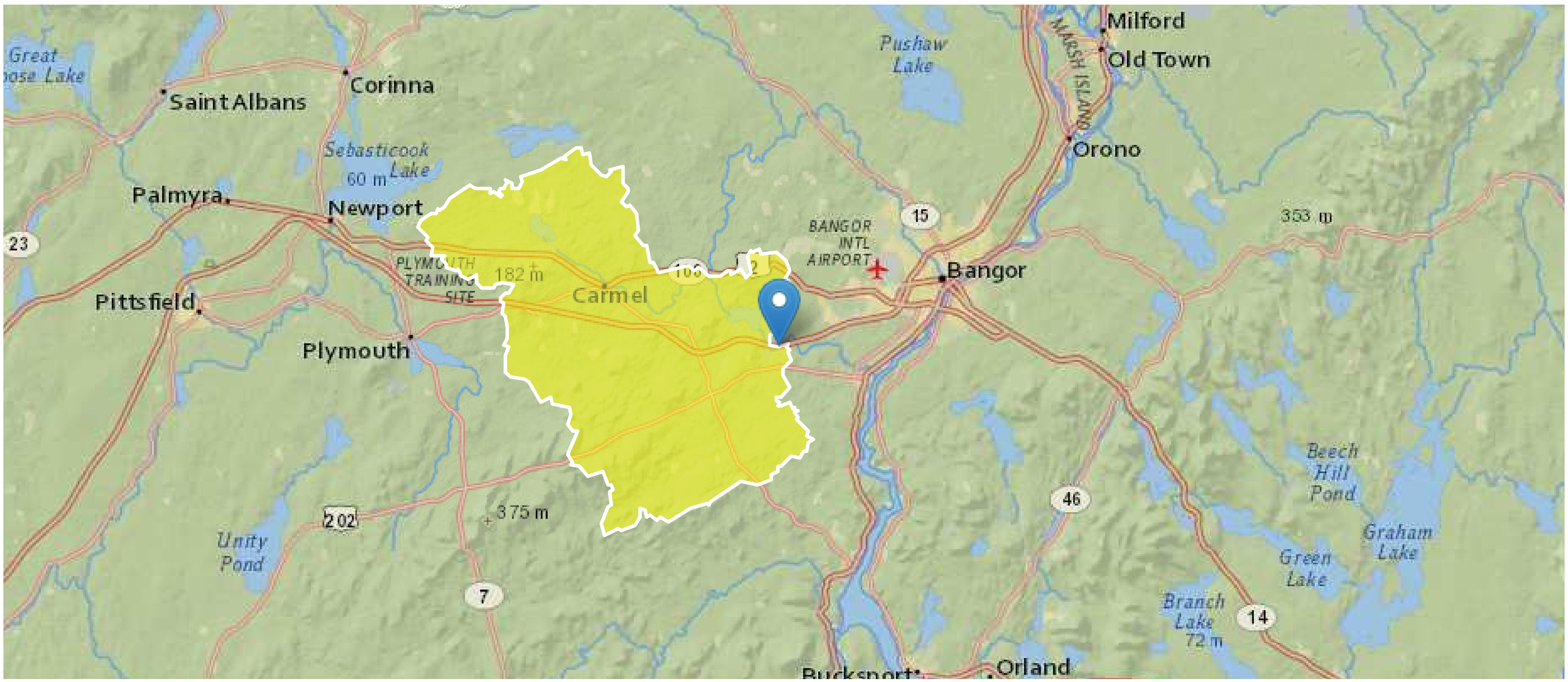
ME20170706092250781000

Clicked Point (Latitude, Longitude):

44.76266, -68.90934

Time:

2017-07-06 09:23:35 -0400



Basin Characteristics

1-20

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	124.3	square miles
STORNWI	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	14.71	percent
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.017	dimensionless
ELEV	Mean Basin Elevation	281.8	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.22	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	497637.9	
CENTROIDY	Basin centroid vertical (y) location in state plane units	4957010.36	
COASTDIST	Shortest distance from the coastline to the basin centroid	69.9	miles
ELEVMAX	Maximum basin elevation	1197.2	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	1.54	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.31	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.17	percent
PRECIP	Mean Annual Precipitation	42.3	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	1.69	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	0.38	percent

Bankfull Statistics Parameters [100 Percent (124 square miles) Central and Coastal Bankfull 2004 5042]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	124.3	square miles	2.92	298

Bankfull Statistics Flow Report [100 Percent (124 square miles) Central and Coastal Bankfull 2004 5042]

Statistic	Value	Unit
Bankfull Streamflow	821	ft^3/s
Bankfull Width	94.2	ft
Bankfull Depth	3.06	ft
Bankfull Area	288	ft^2

Bankfull Statistics Citations

Dudley, R.W.,2004, Hydraulic-Geometry Relations for Rivers in Coastal and Central Maine: U.S. Geological Survey Scientific Investigations Report 2004-5042, 30 p (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)

Peak-Flow Statistics Parameters [100 Percent (124 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	124.3	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	14.71	percent	0.7	26.7

Peak-Flow Statistics Flow Report [100 Percent (124 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	2060	ft^3/s	1150	3690	35.1	35.1	1.8
5 Year Peak Flood	2960	ft^3/s	1640	5330	36.1	36.1	2.5
10 Year Peak Flood	3590	ft^3/s	1960	6560	36.8	36.8	3.2
25 Year Peak Flood	4390	ft^3/s	2350	8230	38.6	38.6	4.1
50 Year Peak Flood	5010	ft^3/s	2620	9570	39.9	39.9	4.8
100 Year Peak Flood	5650	ft^3/s	2900	11000	41.2	41.2	5.4
500 Year Peak Flood	7190	ft^3/s	3490	14800	44.9	44.9	6.4

Peak-Flow Statistics Citations

Hodgkins, G. A.,1999, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p. (http://me.water.usgs.gov/99-4008.pdf)

Flow-Duration Statistics Parameters [100 Percent (124 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	124.3	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.017	dimensionless	0	0.212
ELEV	Mean Basin Elevation	281.8	feet	239	2120

Flow-Duration Statistics Flow Report [100 Percent (124 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
1 Percent Duration	2.49	ft^3/s	144
5 Percent Duration	7.8	ft^3/s	62
10 Percent Duration	14.7	ft^3/s	41
25 Percent Duration	41.9	ft^3/s	22
50 Percent Duration	111	ft^3/s	20
75 Percent Duration	279	ft^3/s	17
90 Percent Duration	595	ft^3/s	17
95 Percent Duration	896	ft^3/s	18
99 Percent Duration	1740	ft^3/s	29

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 Parameters [100 Percent (124 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	124.3	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.017	dimensionless	0	0.212
ELEV	Mean Basin Elevation	281.8	feet	239	2120

Annual Flow Statistics Flow Report [100 Percent (124 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
Mean Annual Flow	238	ft^3/s	16

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)

WIN:	21730.10		**Project Name:**	Hamden B#1433	
Town:	Hamden		**Stream Name:**	Souadabscook Stream	
Route No.	US 95		**Bridge Name:**	Souadabscook West SB Bridge	
Asset ID:	1433		**Analysis by:**	DFB	
Lat:	44.7634	**Long:** -68.91945	**Date:**	7/6/2017	

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

Enter data in blue cells only!

	km^2	mi^2	ac	
				Enter data in [mi^2]
A	244.76	94.50	60480.0	Watershed Area *DRNAREA*
W	39.82	15.4	9840.1	Wetlands area (by NWI)
P_c	495972	4959200		watershed centroid (E, N; UTM 19N; meters)
County	Penobscot S			*choose county from drop-down menu*
pptA	39.5			mean annual precipitation (inches; by look-up)
SG	0.01			sand & gravel aquifer as decimal fraction of watershed A

Worksheet prepared by:
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Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov
ver. 2016 Feb 05

A (km^2)	244.76	**Conf Lvl**	0.67	
W (%)	16.27			NWI Wetlands % *STORNWI*

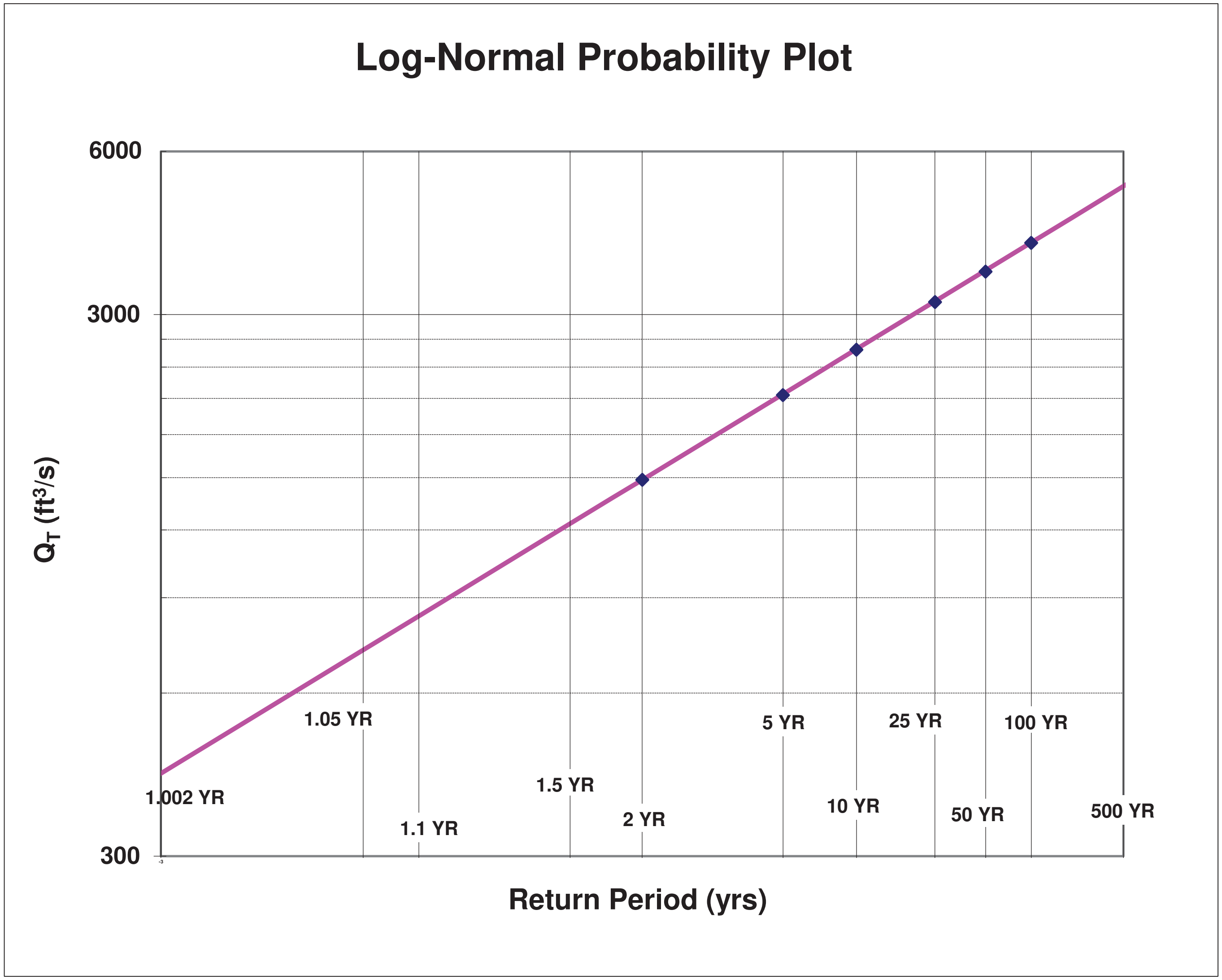
Ret Pd T (yr)	**Peak Flow Estimate** Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		23.60		833.3
2		42.10		1486.5
5		60.35		2130.9
10		73.18		2583.9
25		89.61		3164.0
50		102.05		3603.3
100		115.28		4070.4
500		146.59		5176.2

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

$Q_T = b \times A^a \times 10^{-wW}$


Log-Normal Probability Plot
6000
3000
300
QT (ft3/s)
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
Return Period (yrs)

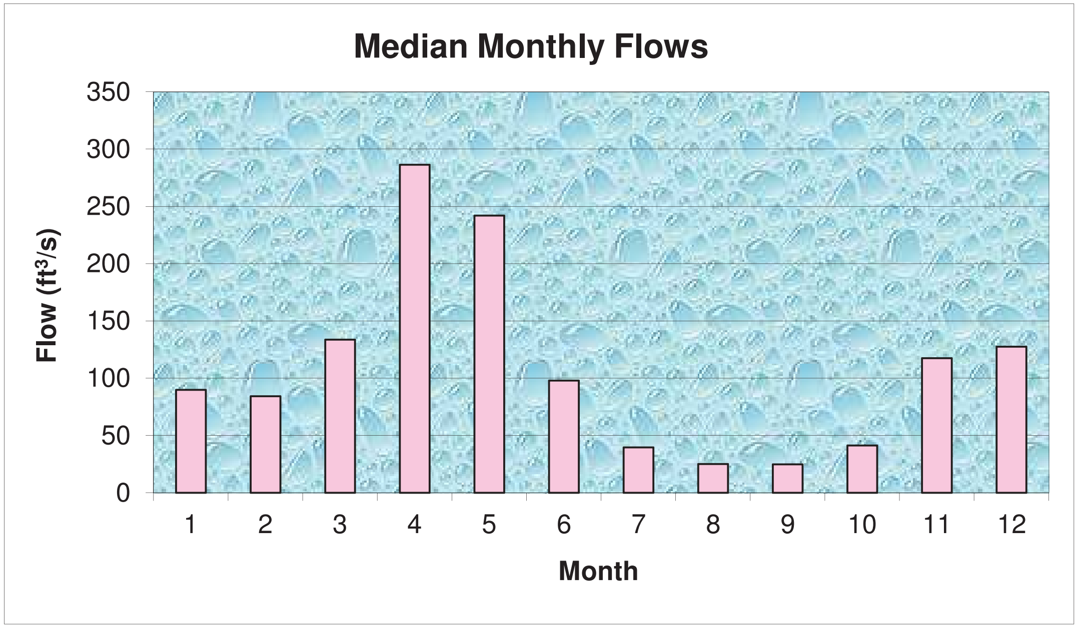
WIN:	21730.10	**Project Name:**	Hamden B#1433
Town:	Hamden	**Stream Name:**	Souadabscook Stream
Route No.	US 95	**Bridge Name:**	Souadabscook West SB Bridge
Asset ID:	1433	**Analysis by:**	DFB
Lat:	44.76337 **Long:** -68.91945	**Date:**	7/6/2017

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

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

	Value	Variable	Explanation
	94.50	*A*	Area (mi^2)
495971.6	4959200	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	70.54	*DIST*	Distance from Coastal reference line (mi)
	39.5	*pptA*	Mean Annual Precipitation (inches)
	0.01	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	89.99	2.5503
Feb	84.46	2.3936
Mar	133.86	3.7933
Apr	286.56	8.1206
May	242.18	6.8632
Jun	98.01	2.7774
Jul	39.73	1.1259
Aug	25.32	0.7176
Sep	24.88	0.7050
Oct	41.35	1.1719
Nov	117.60	3.3326
Dec	127.75	3.6202



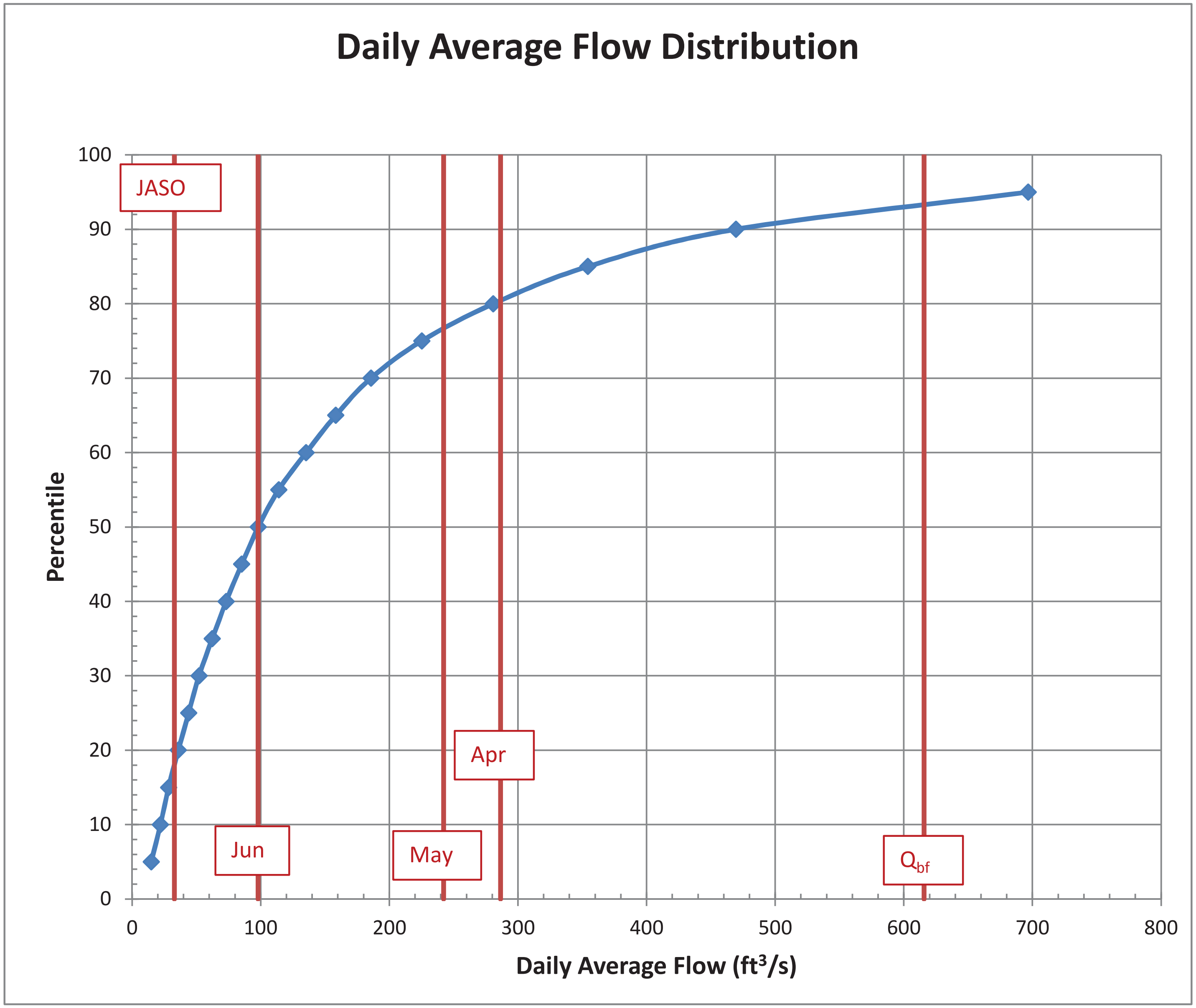
Q_{bf}	615.7	
ann avg	176.1	
ann med	84.8	
$Q_{1.002}$	426.5	
$Q_{1.01}$	541.0	
$Q_{1.05}$	720.8	
Q_{bf}	834.5	assume v = 4ft/s

W_{bf}	74.8	estimated bankfull width (ft)
d_{bf}	2.8	estimated bankfull depth (ft)
A_{bf}	227.4	estimated bankfull flow area (ft^2)

References

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

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



Daily Avg Flow Dist

A_{ws} = (mi^2) 94.5

Q (ft^3/s)

Pctl	Median	84th pctl
5	14.88	23.94
10	22.09	33.22
15	28.40	41.48
20	35.97	50.31
25	44.00	58.97
30	52.07	67.16
35	62.38	76.76
40	73.15	88.27
45	85.26	99.81
50	98.16	117.83
55	114.00	137.15
60	135.38	160.99
65	158.39	187.56
70	185.78	218.82
75	225.22	263.15
80	280.87	314.18
85	354.40	402.62
90	469.46	540.64
95	696.72	840.73

Q_{bf}	615.7
$Q_{1.002}$	426.5
$Q_{1.1}$	833.3
Q_2	1486.5

Hampden 21730.10 B#1433 on Souadabscook Stream

Region ID:

ME

Workspace ID:

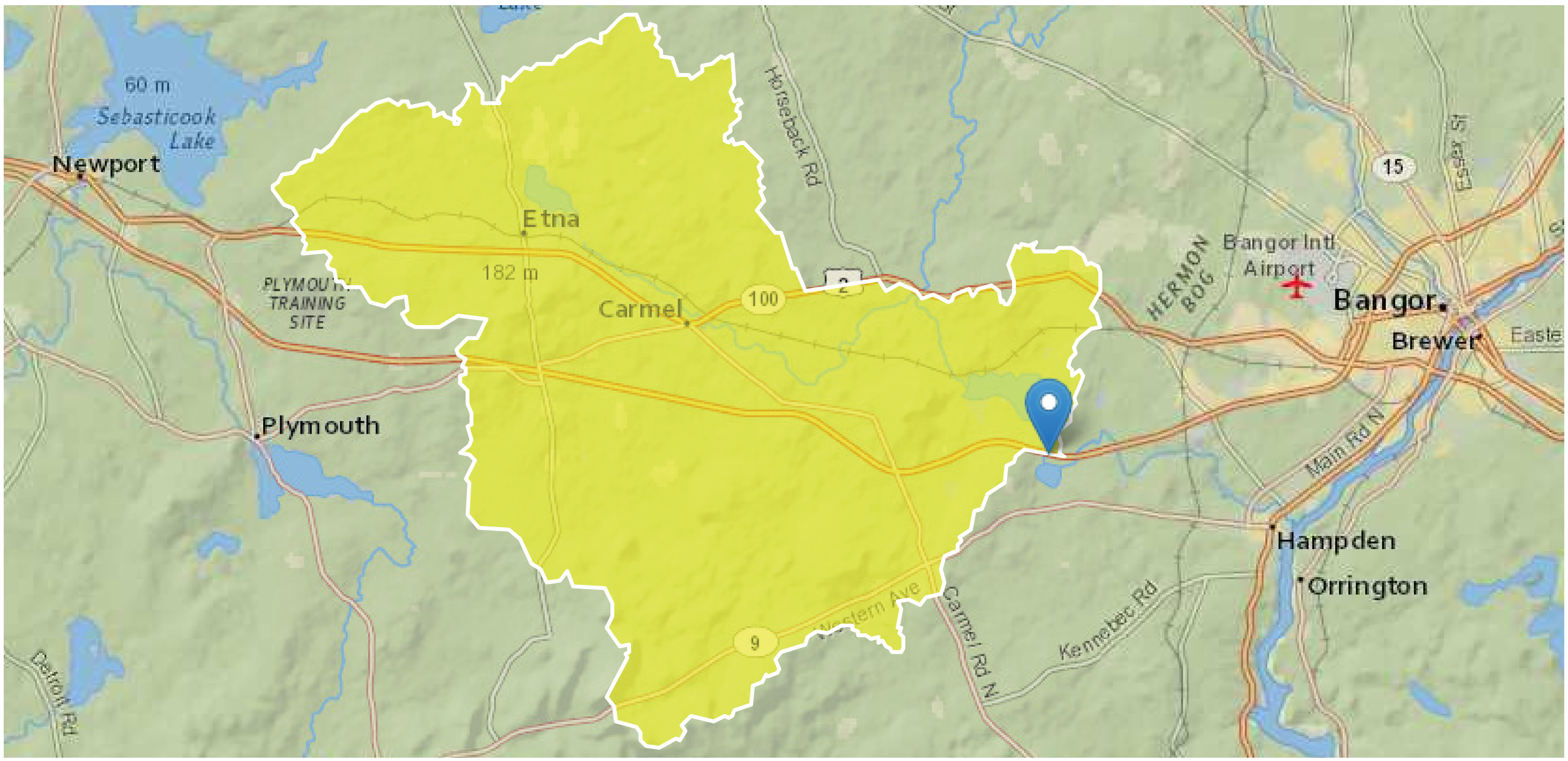
ME20170706085939593000

Clicked Point (Latitude, Longitude):

44.76337, -68.91945

Time:

2017-07-06 09:00:23 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	94.5	square miles
STORNWI	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	16.27	percent
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.007	dimensionless
ELEV	Mean Basin Elevation	275	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	6	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	495971.64	
CENTROIDY	Basin centroid vertical (y) location in state plane units	4959199.98	
COASTDIST	Shortest distance from the coastline to the basin centroid	71.7	miles
ELEVMAX	Maximum basin elevation	1197.2	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	1.83	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.5	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.24	percent
PRECIP	Mean Annual Precipitation	42.2	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	0.69	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	0.16	percent

Bankfull Statistics Parameters [100 Percent (94.4 square miles) Central and Coastal Bankfull 2004 5042]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	94.5	square miles	2.92	298

Bankfull Statistics Flow Report [100 Percent (94.4 square miles) Central and Coastal Bankfull 2004 5042]

Statistic	Value	Unit
Bankfull Streamflow	616	ft^3/s
Bankfull Width	81.7	ft
Bankfull Depth	2.79	ft
Bankfull Area	227	ft^2

Bankfull Statistics Citations

Dudley, R.W.,2004, Hydraulic-Geometry Relations for Rivers in Coastal and Central Maine: U.S. Geological Survey Scientific Investigations Report 2004-5042, 30 p (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)

Peak-Flow Statistics Parameters [100 Percent (94.4 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	94.5	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	16.27	percent	0.7	26.7

Peak-Flow Statistics Flow Report [100 Percent (94.4 square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	1490	ft^3/s	832	2660	35.1	35.1	1.8
5 Year Peak Flood	2130	ft^3/s	1180	3840	36.1	36.1	2.5
10 Year Peak Flood	2580	ft^3/s	1410	4730	36.8	36.8	3.2
25 Year Peak Flood	3160	ft^3/s	1690	5930	38.6	38.6	4.1
50 Year Peak Flood	3600	ft^3/s	1880	6890	39.9	39.9	4.8
100 Year Peak Flood	4070	ft^3/s	2080	7950	41.2	41.2	5.4
500 Year Peak Flood	5180	ft^3/s	2510	10700	44.9	44.9	6.4

Peak-Flow Statistics Citations

Hodgkins, G. A.,1999, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p. (http://me.water.usgs.gov/99-4008.pdf)

Flow-Duration Statistics Parameters [100 Percent (94.4 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	94.5	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.007	dimensionless	0	0.212
ELEV	Mean Basin Elevation	275	feet	239	2120

Flow-Duration Statistics Flow Report [100 Percent (94.4 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
1 Percent Duration	1.44	ft^3/s	144
5 Percent Duration	4.98	ft^3/s	62
10 Percent Duration	9.91	ft^3/s	41
25 Percent Duration	30.4	ft^3/s	22
50 Percent Duration	83.3	ft^3/s	20
75 Percent Duration	211	ft^3/s	17
90 Percent Duration	455	ft^3/s	17
95 Percent Duration	690	ft^3/s	18
99 Percent Duration	1360	ft^3/s	29

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 Parameters [100 Percent (94.4 square miles) Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	94.5	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.007	dimensionless	0	0.212
ELEV	Mean Basin Elevation	275	feet	239	2120

Annual Flow Statistics Flow Report [100 Percent (94.4 square miles) Statewide Annual SIR 2015 5151]

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

Statistic	Value	Unit	SEp
Mean Annual Flow	181	ft^3/s	16

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)

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Flood discharges on the Penobscot River in Hampden were computed from data contained in the Flood Insurance Study for the City of Bangor (Reference 5). Discharges from the Bangor study were in agreement with a log-Pearson Type III analysis of USGS stream gage No. 01034500 on the Penobscot River at West Enfield (References 6 and 4). That analysis utilized 82 years of gage records and was prepared for a Flood Plain Management Study in the Town of Howland (Reference 7). Discharges at sites in Hampden were computed using the following equation:

$$Q_s = Q_g \ (A_s/A_g)^{0.80}$$

where Q_s is the discharge at the site, Q_g is the discharge from the Bangor study, A_s is the drainage area of the site, A_g is the drainage area of the location in Bangor (8,024 square miles).

Discharges of Souadabscook Stream and Sucker Brook were generated from the SCS Technical Release No. 20 hydrologic evaluation model and checked against the USGS regression equation for Maine (References 8 and 9).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
PENOBSCOT RIVER					
Downstream of Souadabscook Stream	8,210.0	113,600	155,300	174,100	220,000
Upstream of corporate limits	8,027.3	111,500	152,500	171,100	216,100
SOUADABSCOOK STREAM					
At U. S. Route 1A	152.0	3,310	4,680	5,220	6,630
At Manning Mill Road	140.4	3,090	4,380	4,880	6,190
SUCKER BROOK					
At U. S. Route 1A	2.7	570	870	1,020	1,310

Water-surface elevations for Hammond, Hermon, and Ben Annis Ponds were generated from the SCS Technical Release No. 20 hydrologic evaluation model's reservoir routing procedure (Reference 8).

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Hammond Pond, Hermon Pond, and Ben Annis Pond and are summarized in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet)			
	10-YEAR	50-YEAR	100-YEAR	500-YEAR
HAMMOND POND				
Entire shoreline within community	126.3	128.4	129.0	130.5
HERMON POND				
Entire shoreline within community	126.3	128.4	129.0	130.5
BEN ANNIS POND				
Entire shoreline within community	126.3	128.4	129.0	130.5

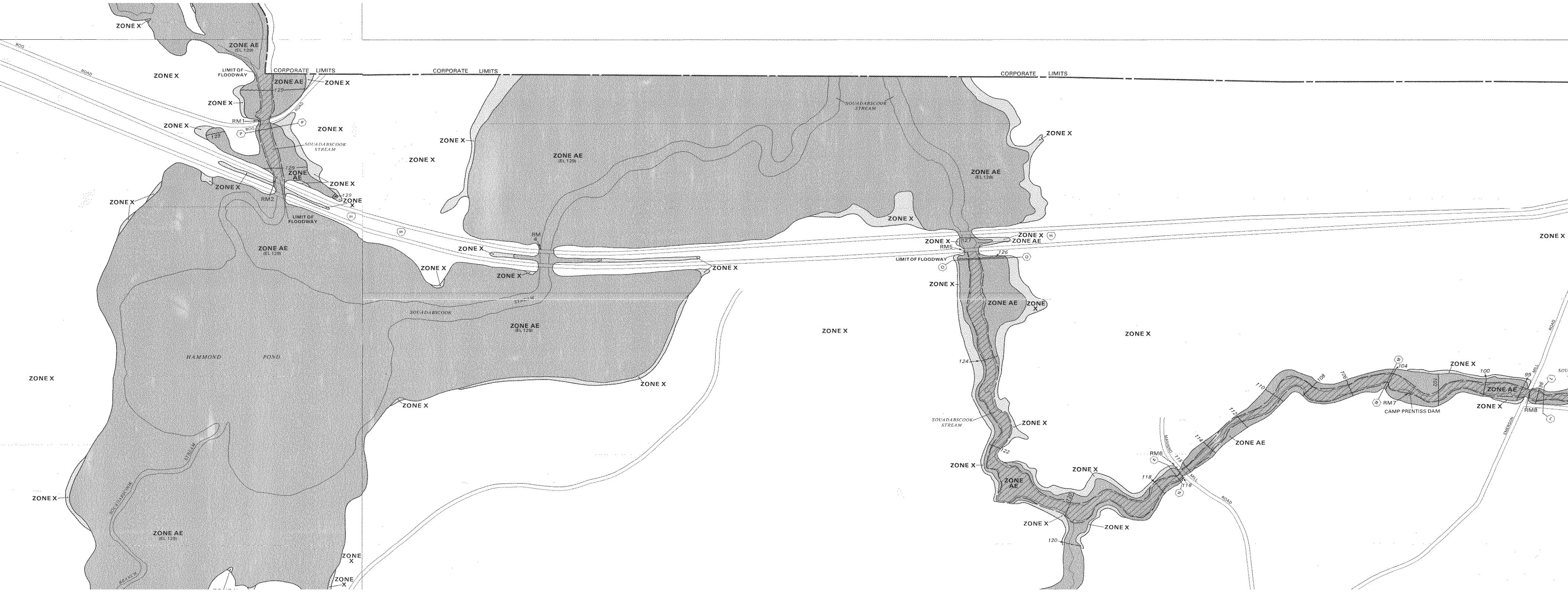
3.2 Hydraulic Analyses

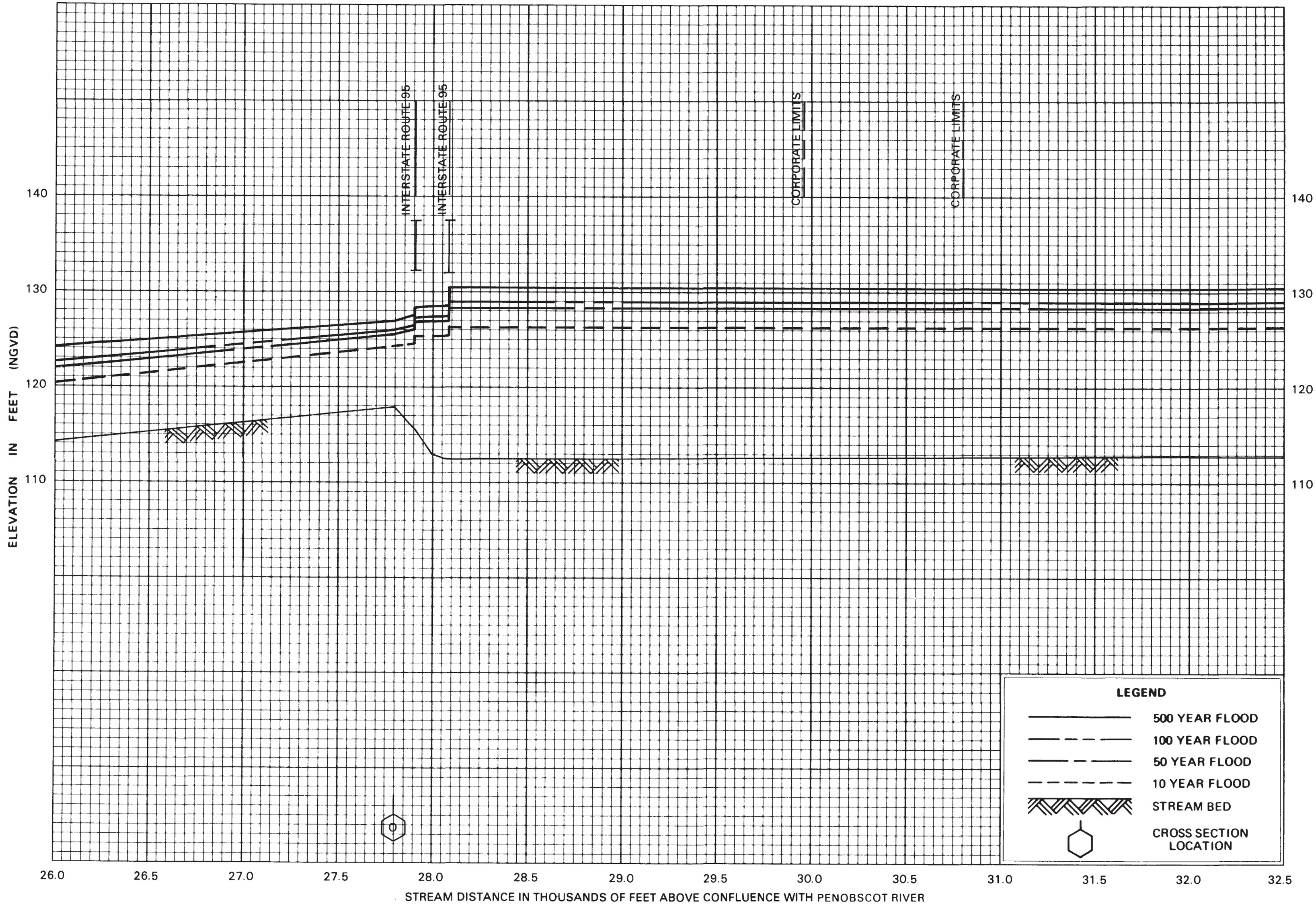
Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the streams studied by detailed methods were obtained from aerial photographs at a scale of 1:14,400 (Reference 10). The below-water sections were obtained from field surveys. All bridges, dams, and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the SCS WSP-2 computer program (Reference 11). Flood


ZONE X
ZONE AE
CORPORATE LIMITS
LIMIT OF FLOODWAY
SOUADABSCOOK STREAM
HAMMOND POND
ZONE AE (EL 129)
CAMP PRENTISS DAM
RM1
RM2
RM5
RM6
RM7
RM8



FLOOD PROFILES

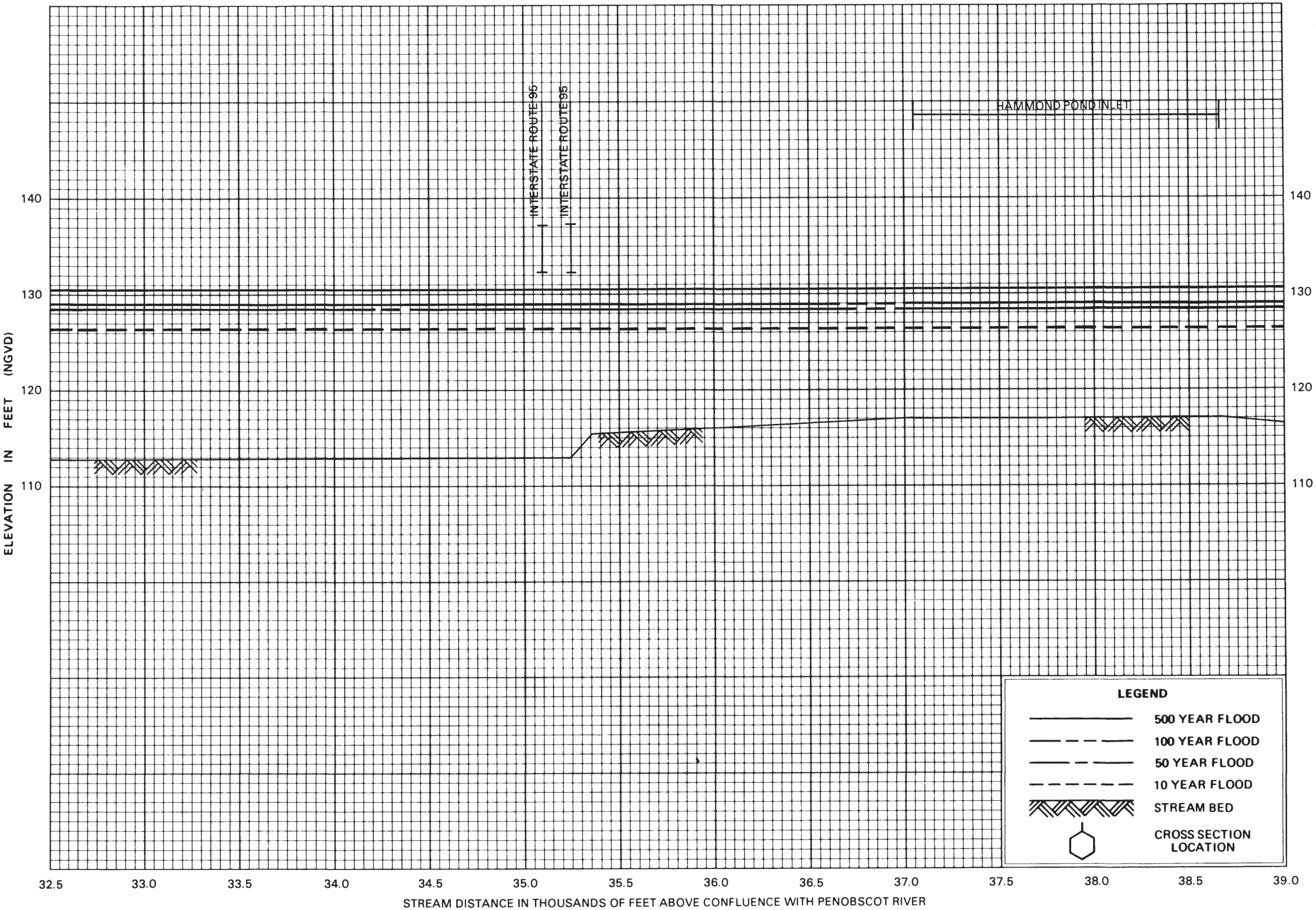
SOUADABSCOOK STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HAMPDEN, ME
(PENOBSCOT CO.)

22
08P

124486



FLOOD PROFILES

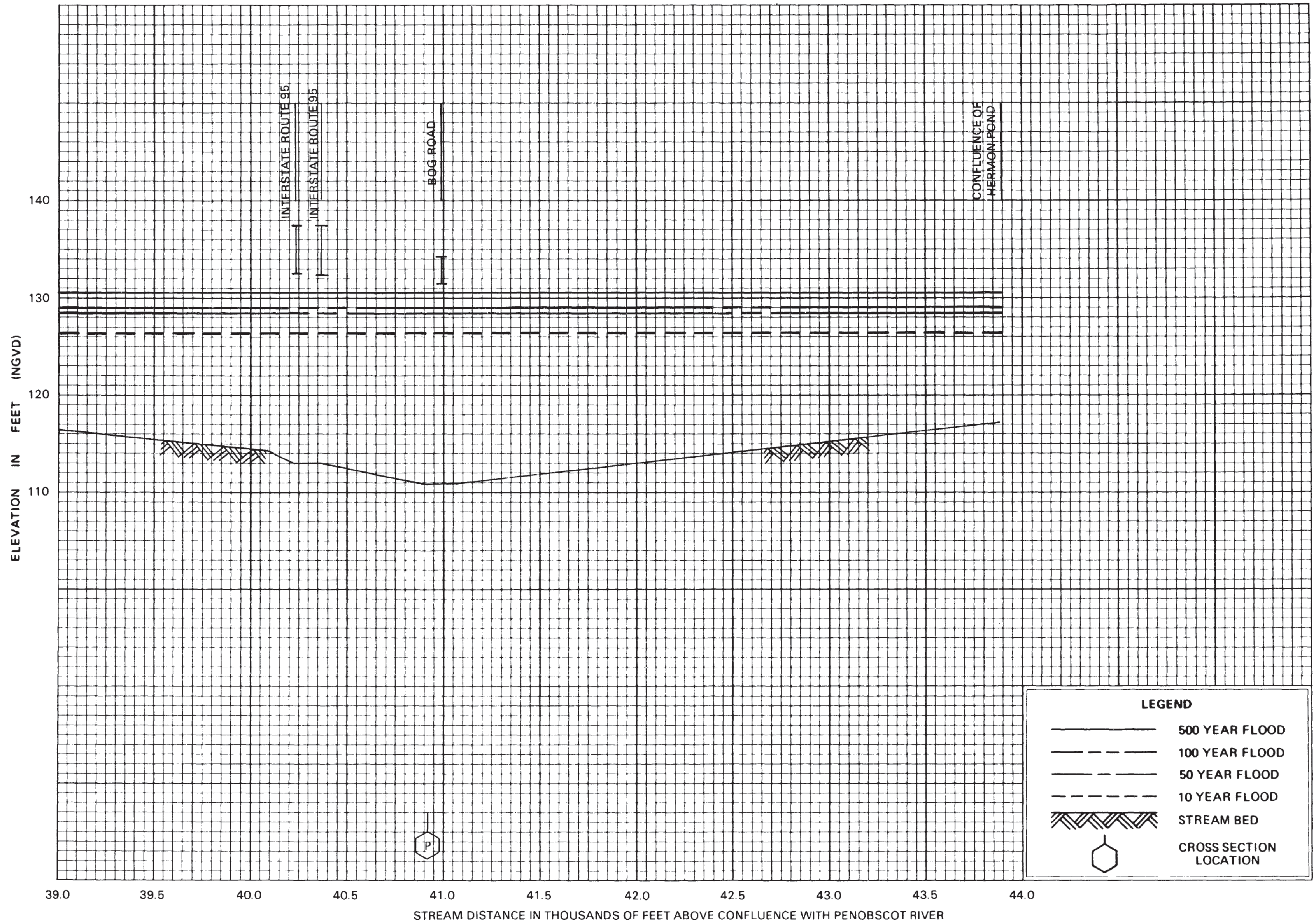
SOUADABSCOOK STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HAMPDEN, ME
(PENOBSCOT CO.)

09P 2-3

124486



FLOOD PROFILES

SOUADABSCOOK STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HAMPDEN, ME
(PENOBSCOT CO.)

2-40P

124486

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Souadabscook Stream (continued)								
J	17,725	55	474	10.3	88.2	88.2	89.2	1.0
K	17,900	101	799	6.1	89.8	89.8	90.8	1.0
L	19,100	56	469	10.5	95.7	95.7	96.7	1.0
M	20,685	107	601	8.1	104.1	104.1	105.1	1.0
N	23,195	57	522	9.3	117.6	117.6	118.6	1.0
O	27,800	101	813	5.9	126.0	126.0	127.0	1.0
P	40,920	115	1,207	2.9	129.0	129.0	130.0	1.0
Sucker Brook								
A	0	136	1,174	1.1	15.2	9.1[2]	10.1	1.0
B	1,150	115	916	1.2	15.2	9.4[2]	10.4	1.0
C	2,170	25	199	5.3	15.2	14.1[2]	15.1	1.0
D	3,255	23	193	5.4	23.8	23.8	24.8	1.0
E	3,410	62	397	2.6	26.7	26.7	27.7	1.0
F	3,970	46	216	4.7	30.5	30.5	31.5	1.0
G	4,115	253	992	1.0	31.0	31.0	32.0	1.0
H	4,950	31	154	6.6	46.8	46.8	47.8	1.0
I	5,510	71	619	1.6	56.2	56.2	57.2	1.0

[1]Feet above confluence with Penobscot River
[2]Elevation computed without consideration of backwater effects from Penobscot River

TABLE 3

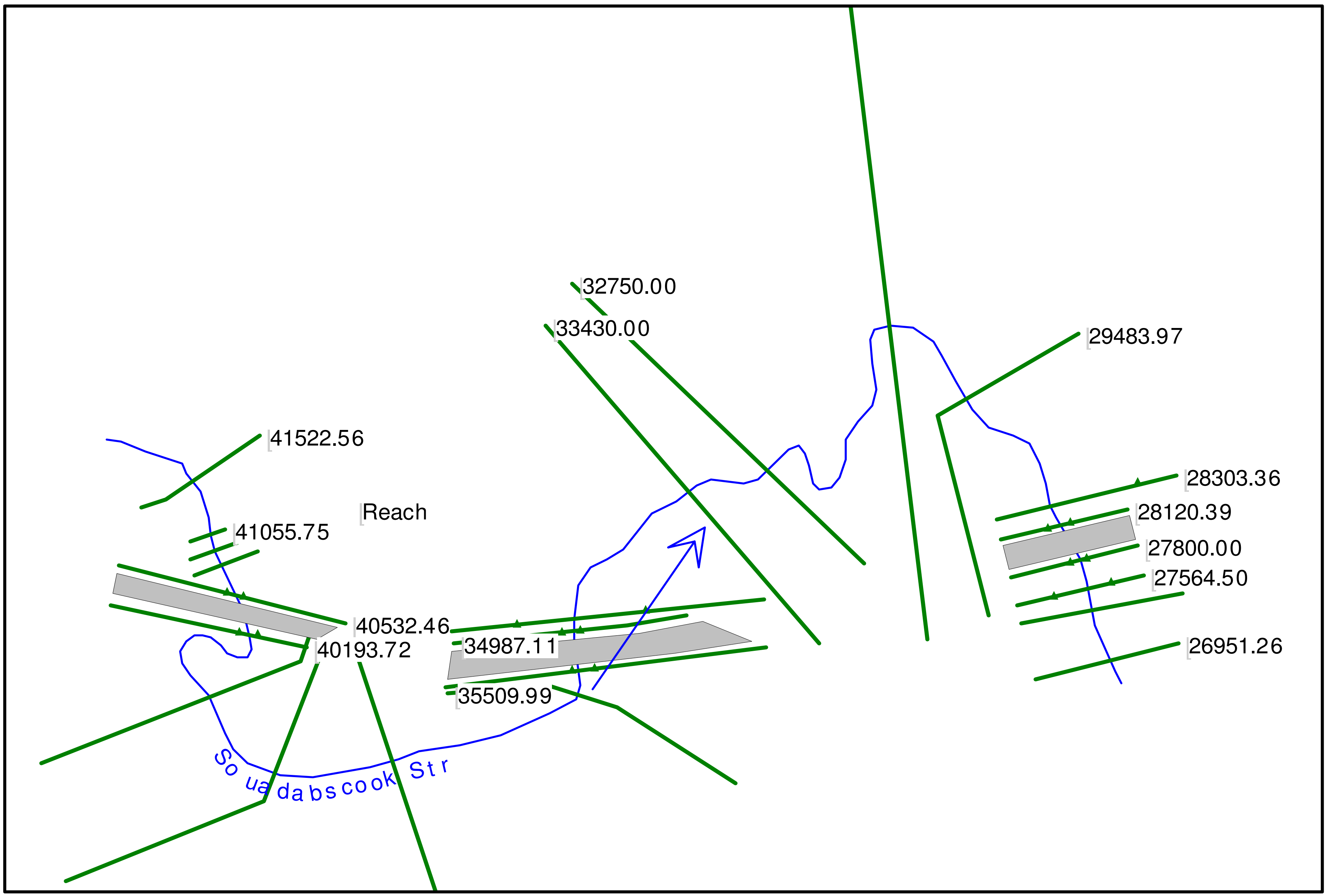
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HAMPDEN, ME

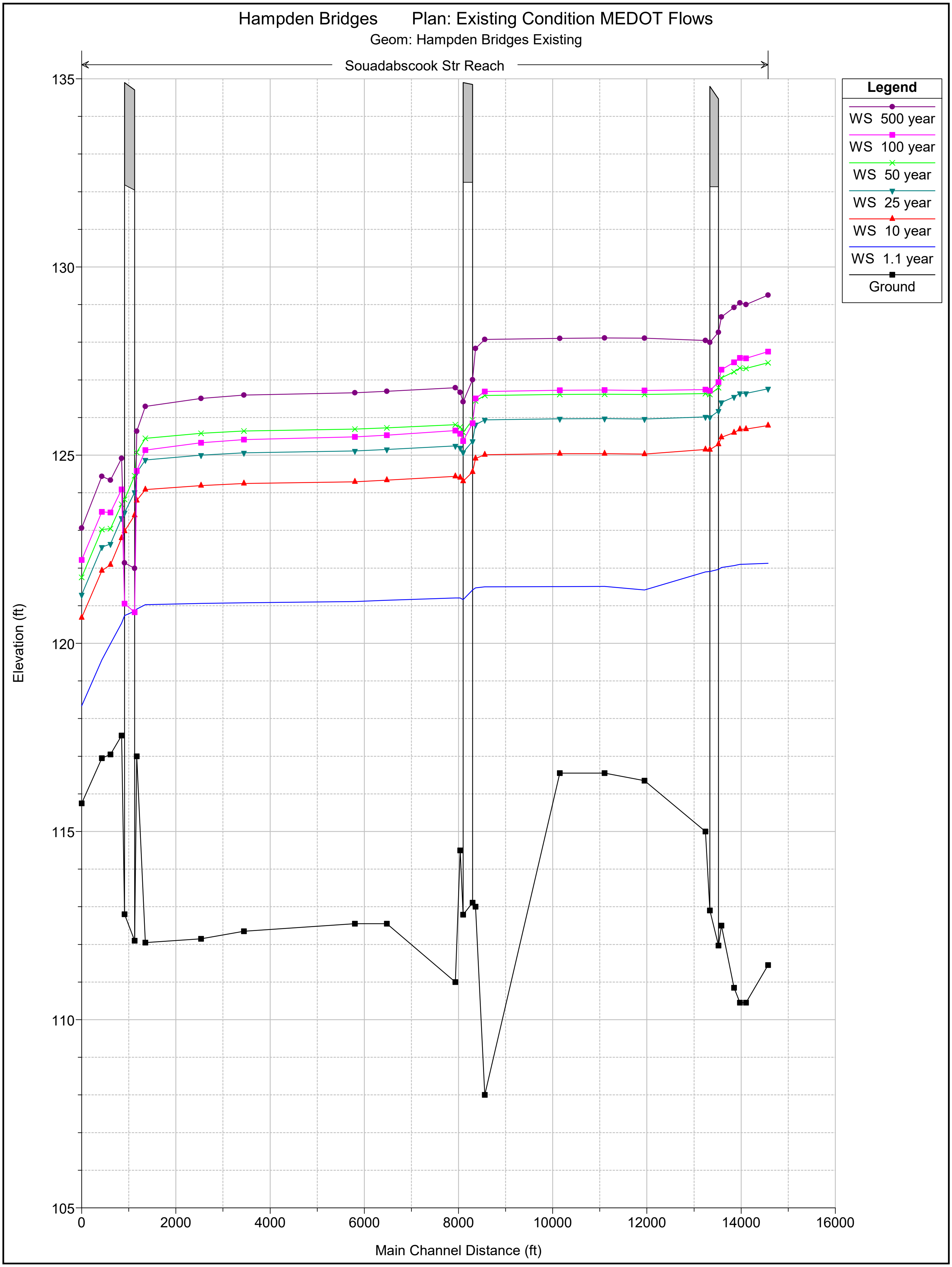
(PENOBSCOT CO.)

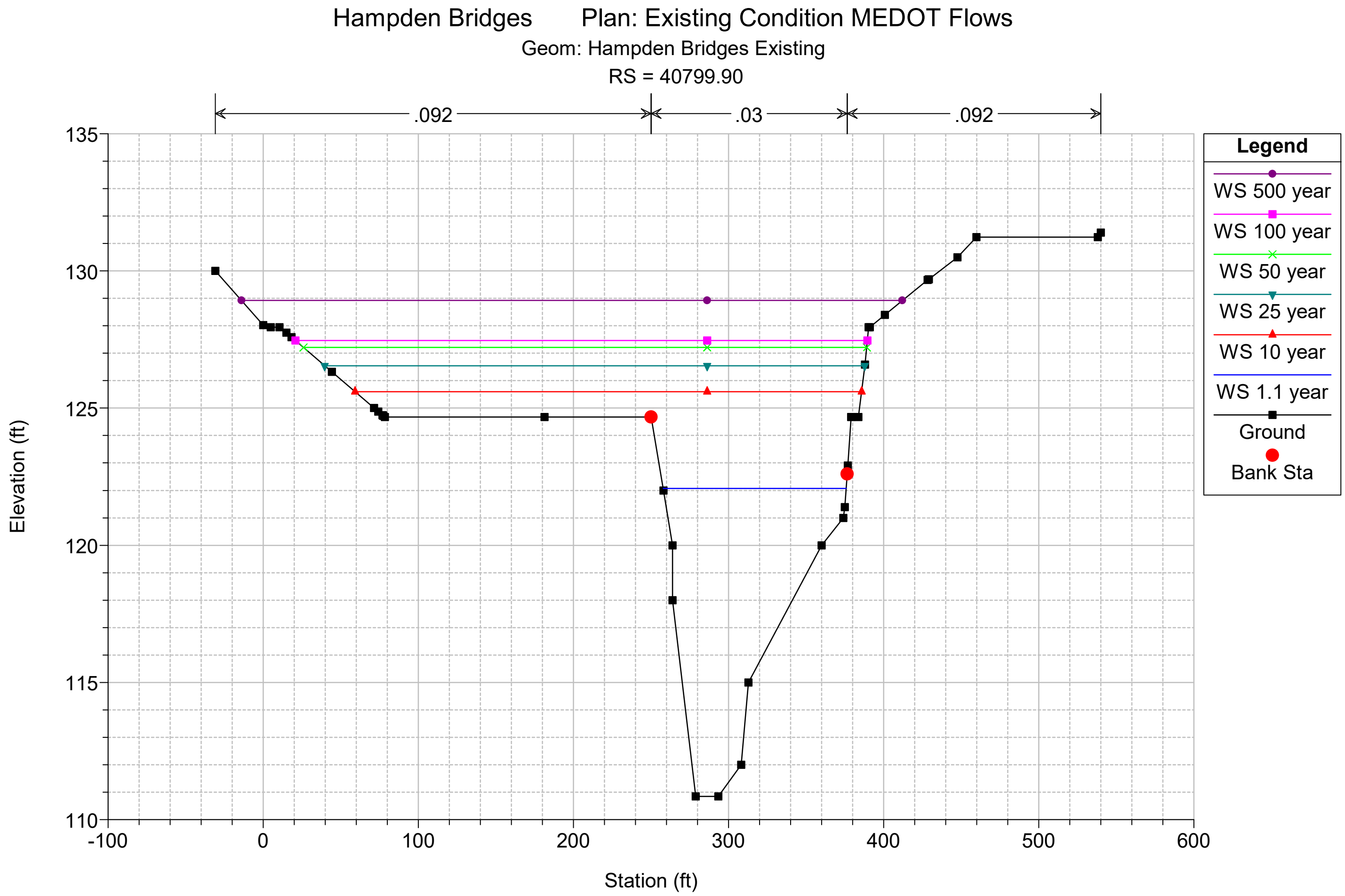
FLOODWAY DATA

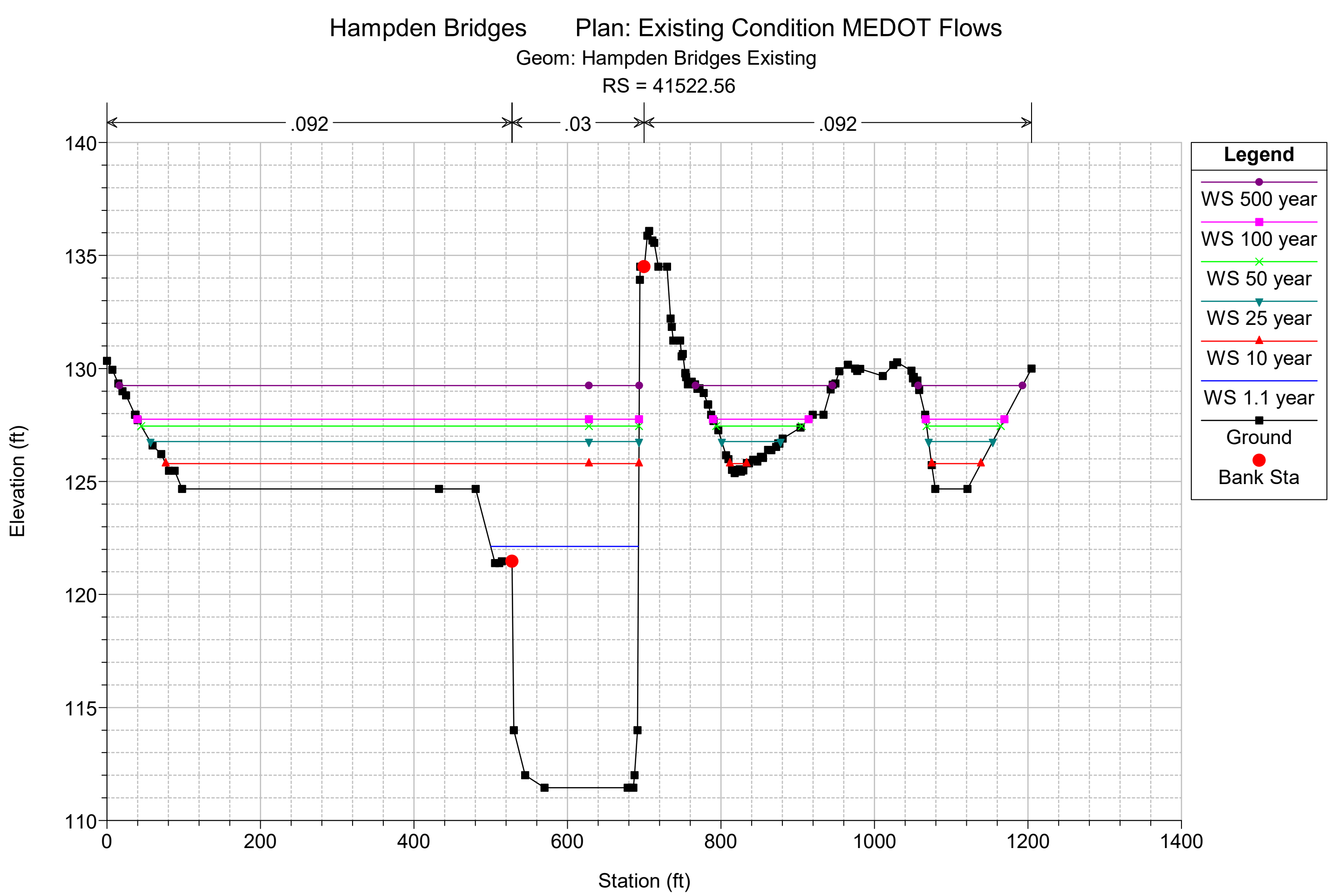
SOUADABSCOOK STREAM-SUCKER BROOK

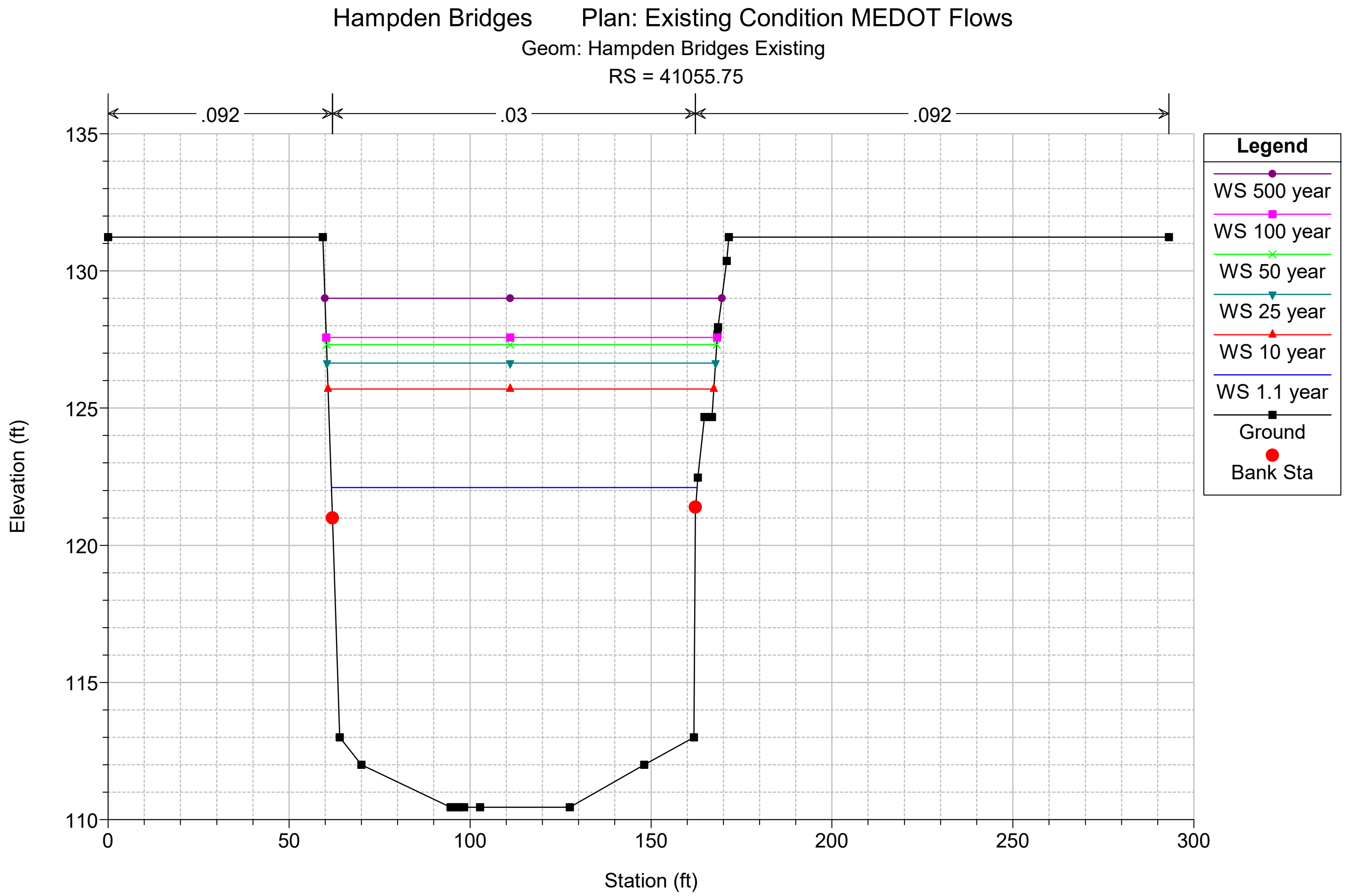


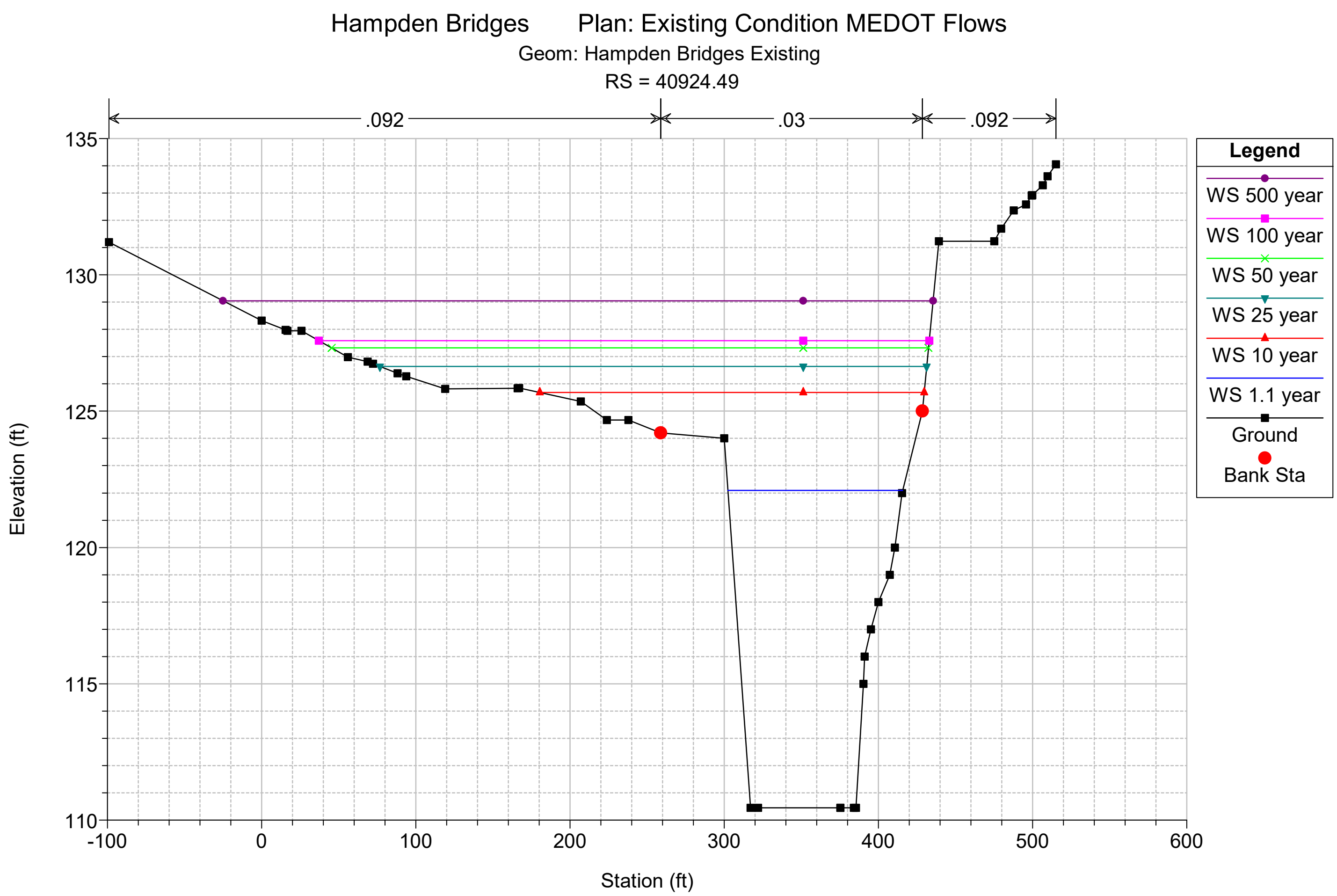
HEC-RAS Cross Section Location Map


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
Souadabscook Str Reach
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Elevation (ft)
Main Channel Distance (ft)
135
130
125
120
115
110
105
0
2000
4000
6000
8000
10000
12000
14000
16000


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 40799.90
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
-100
0
100
200
300
400
500
600


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 41522.56
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
140
135
130
125
120
115
110
0
200
400
600
800
1000
1200
1400


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 41055.75
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
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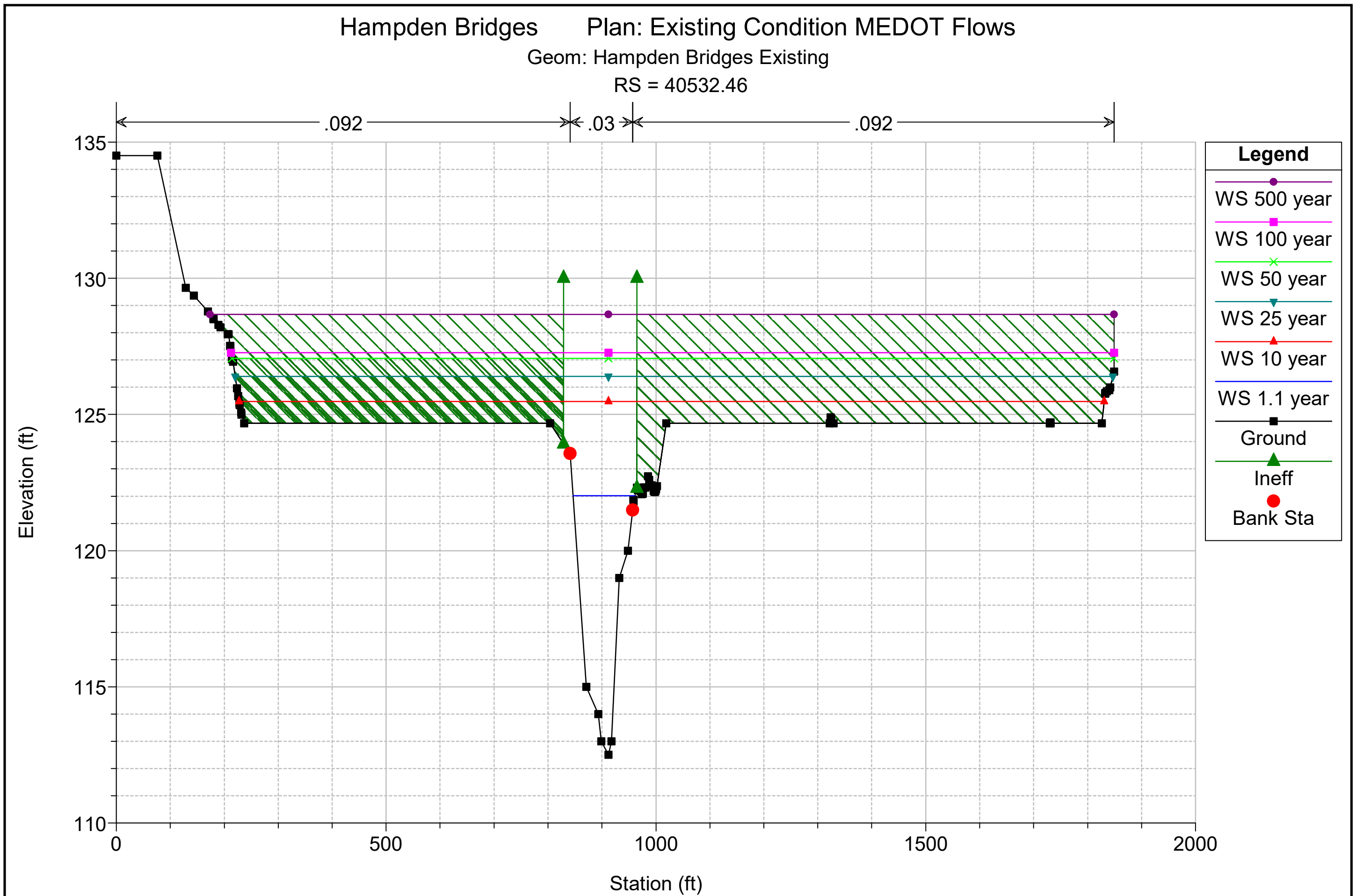
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
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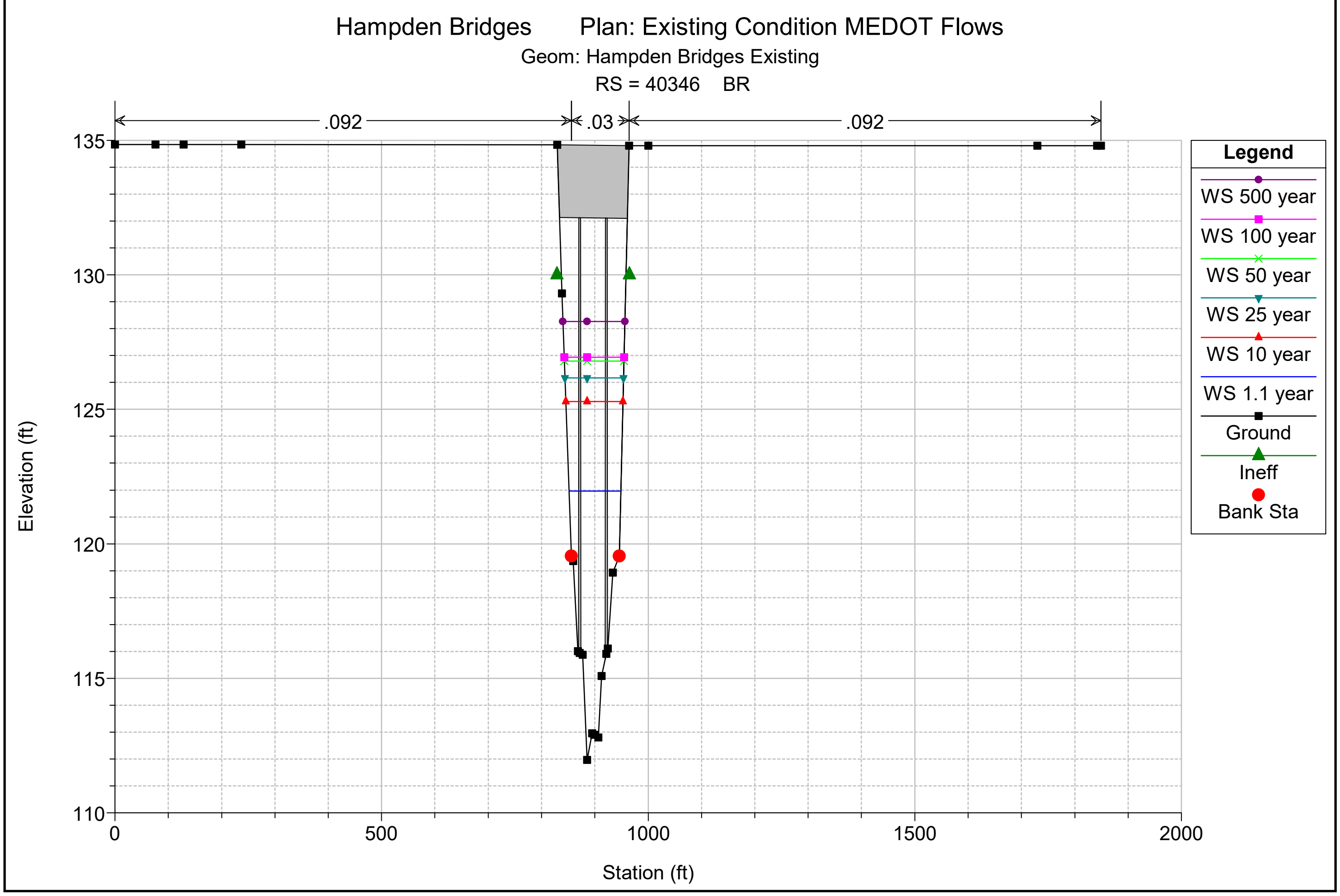
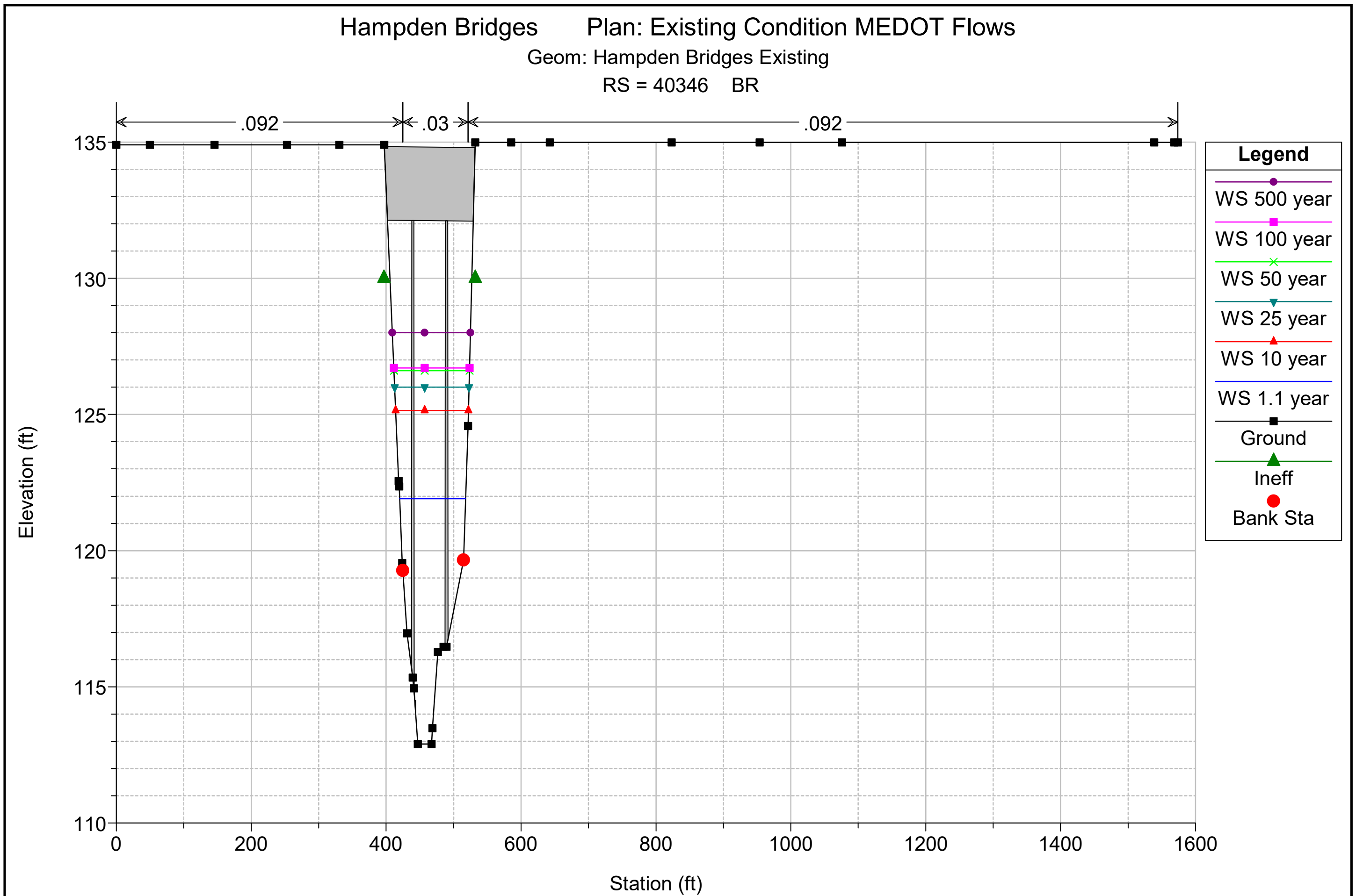
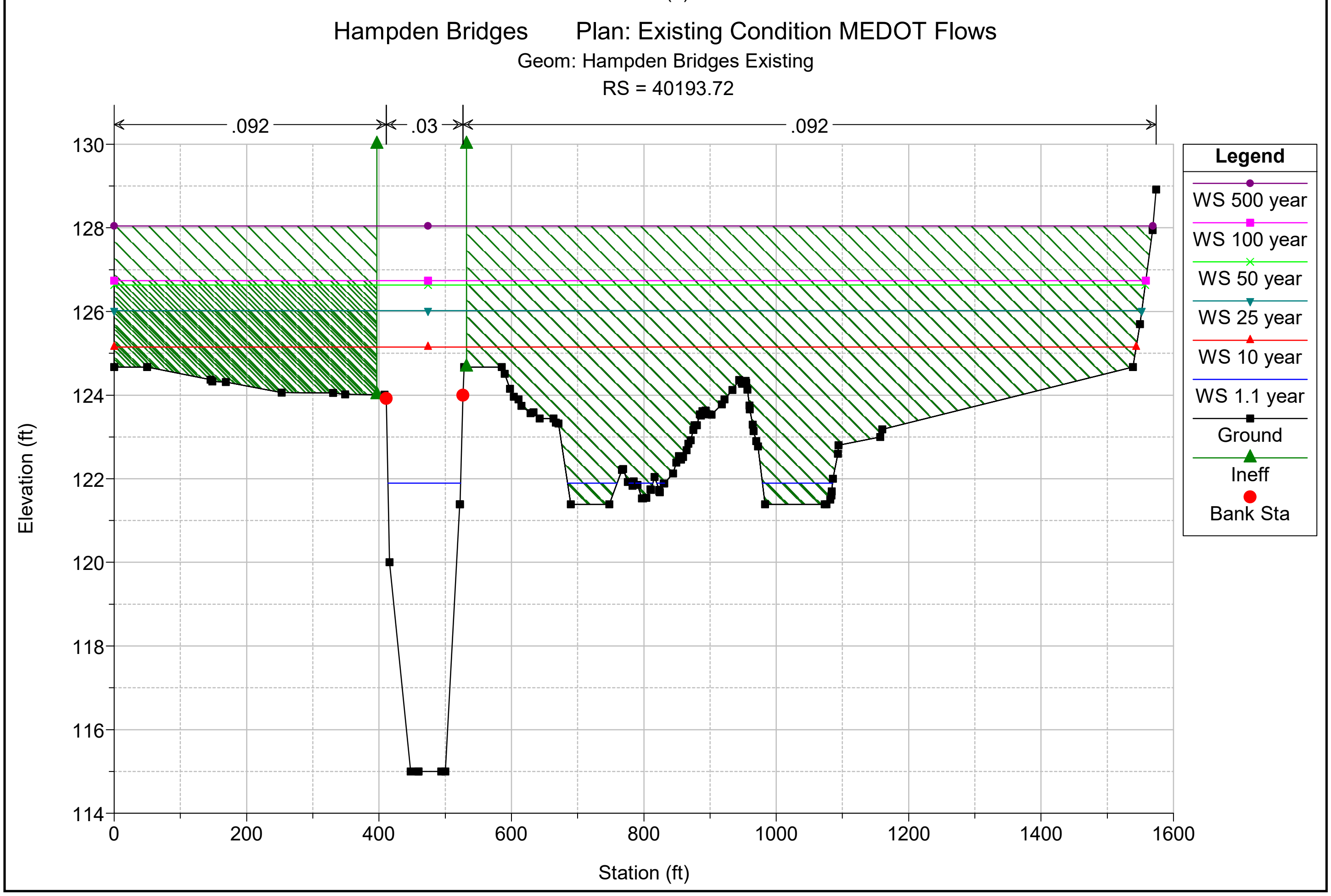
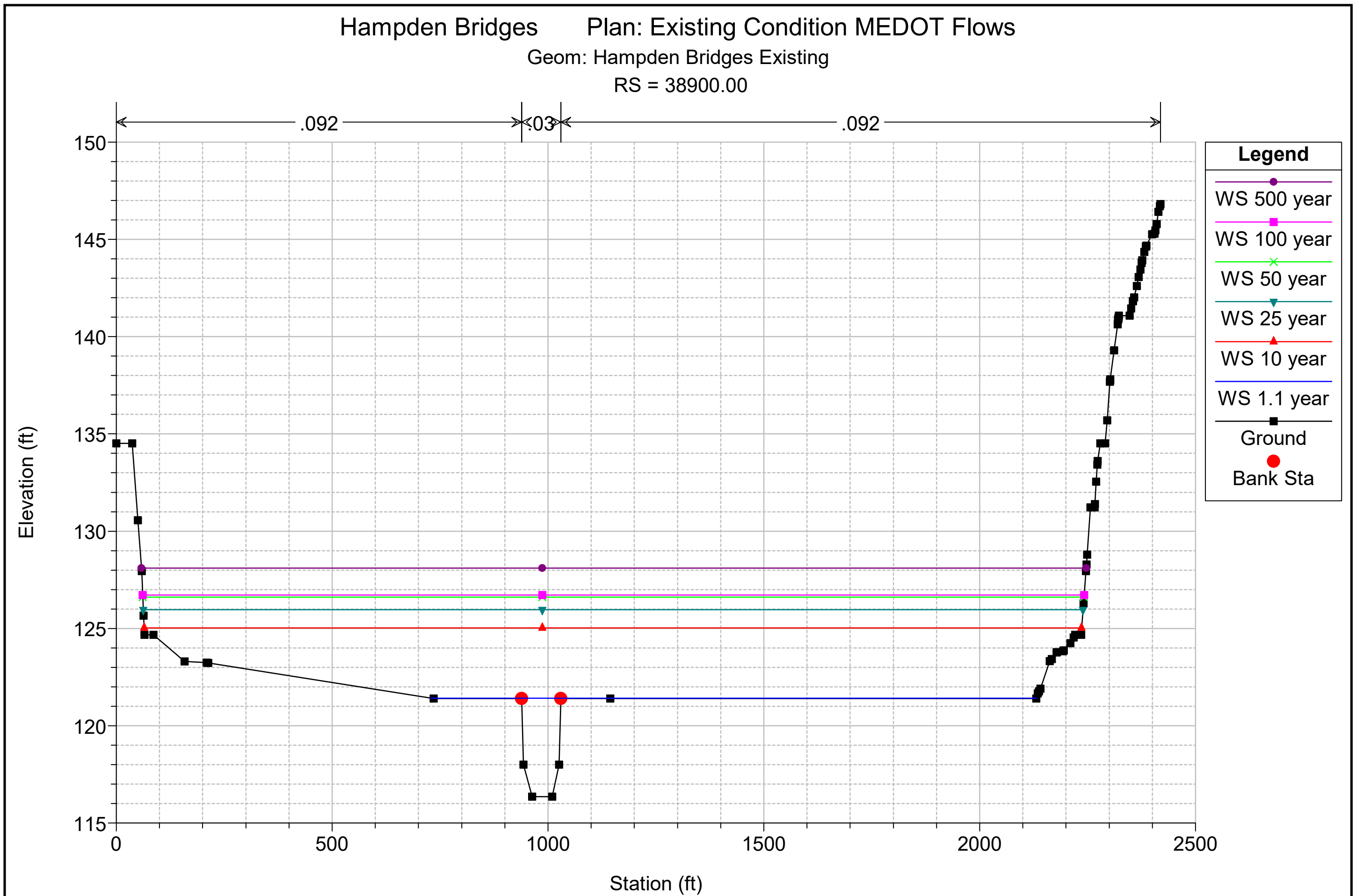
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
500
1000
1500
2000


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 40346 BR
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
500
1000
1500
2000


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 40346 BR
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
200
400
600
800
1000
1200
1400
1600


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 40193.72
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
130
128
126
124
122
120
118
116
114
0
200
400
600
800
1000
1200
1400
1600


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
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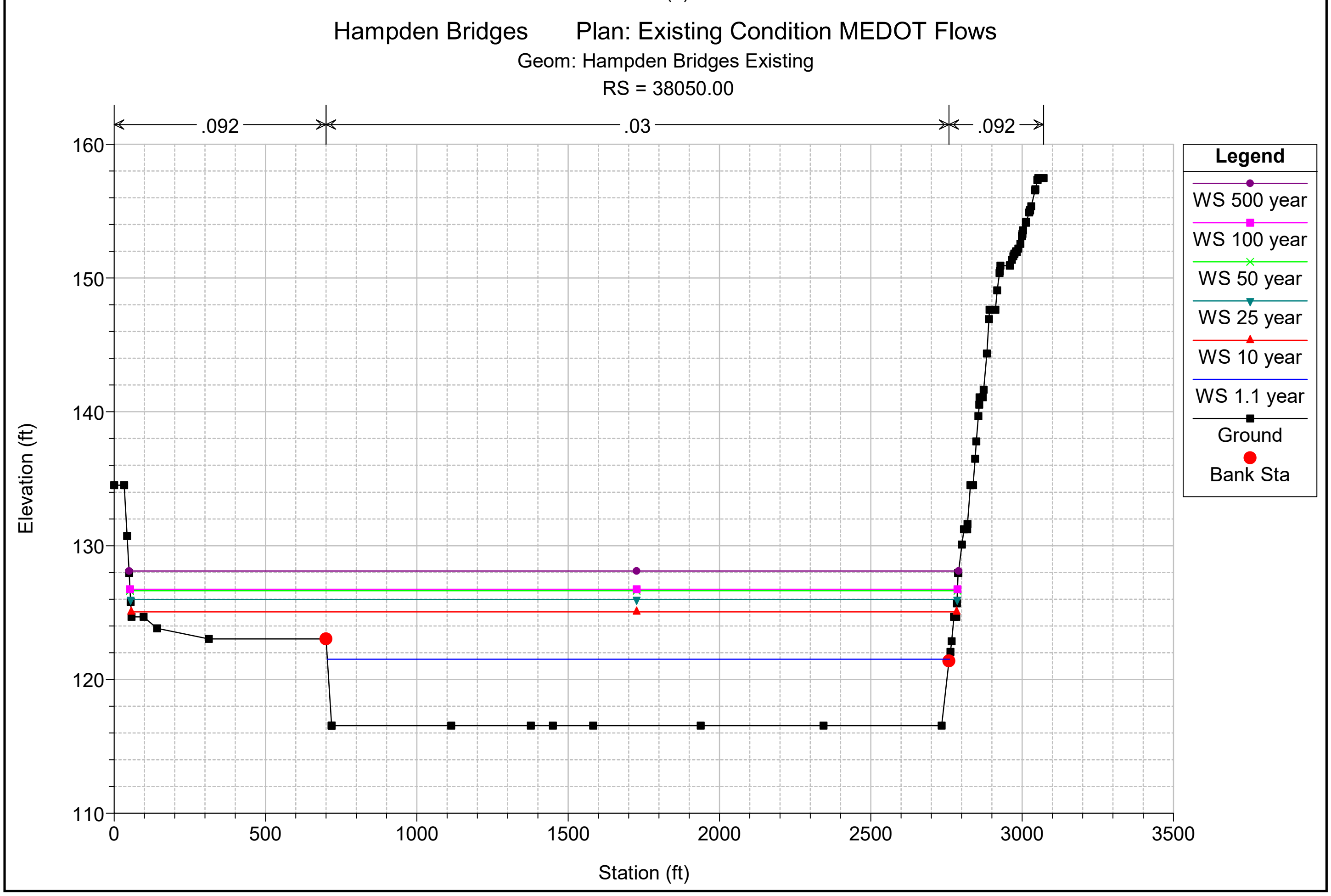
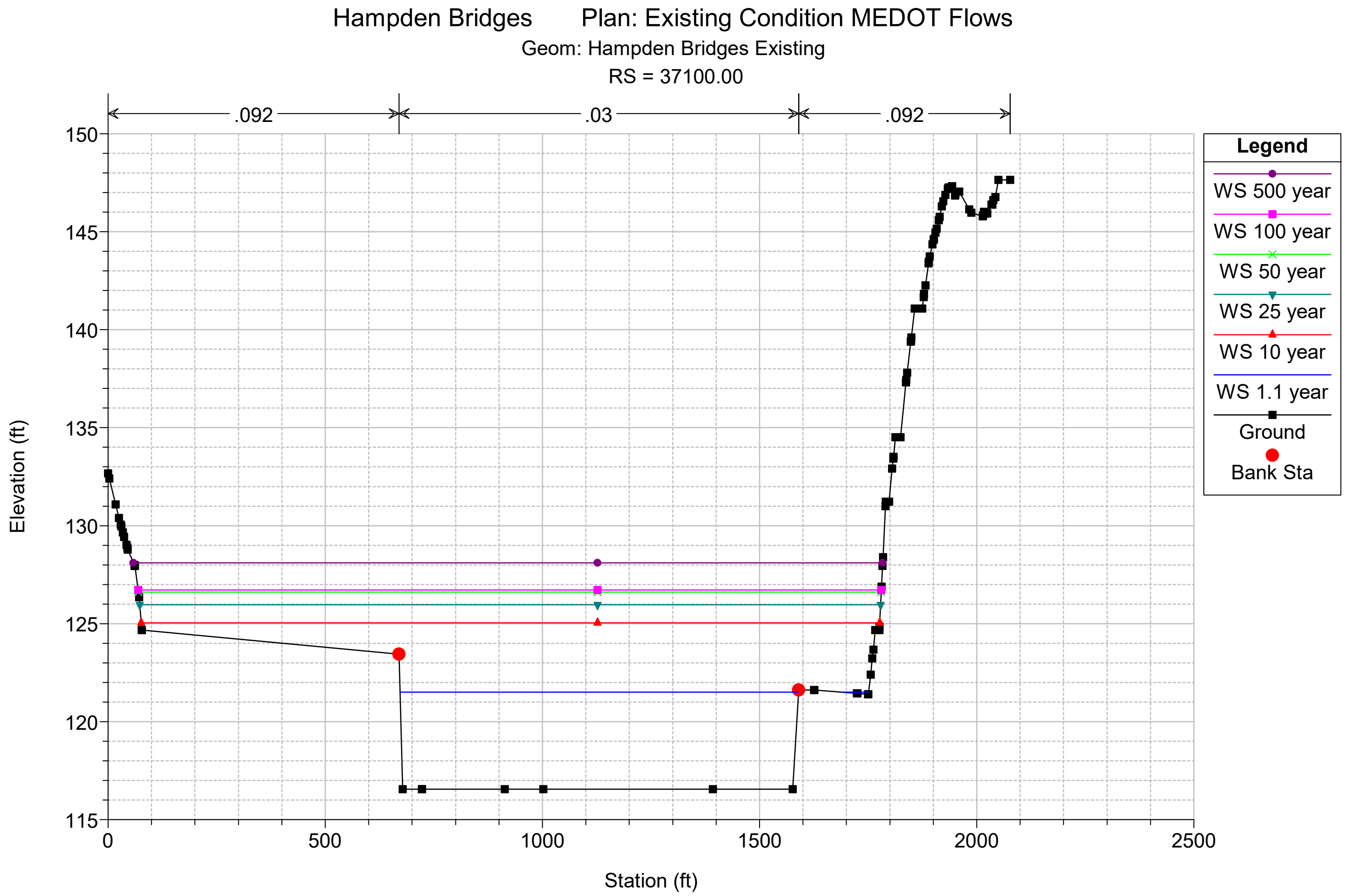
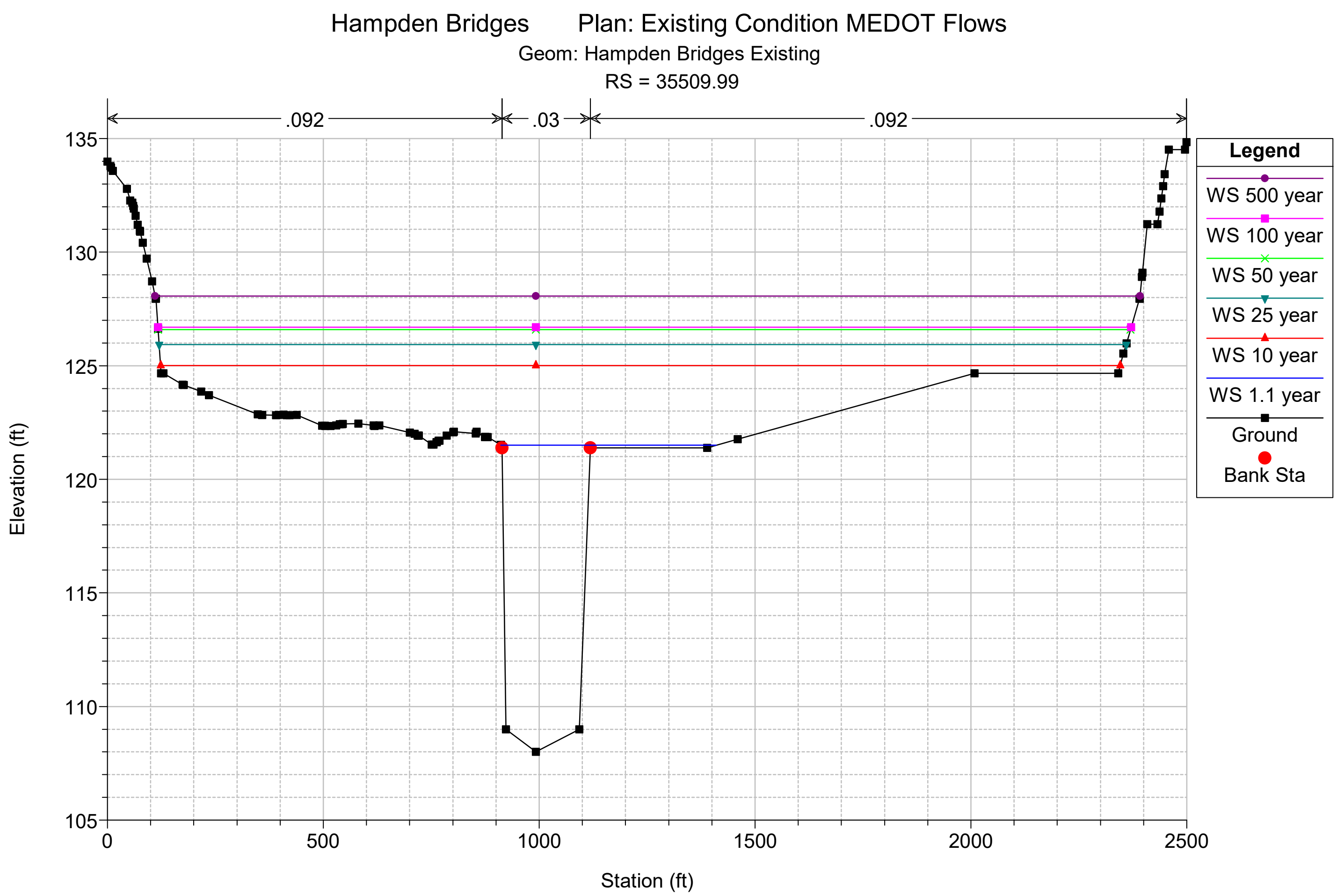
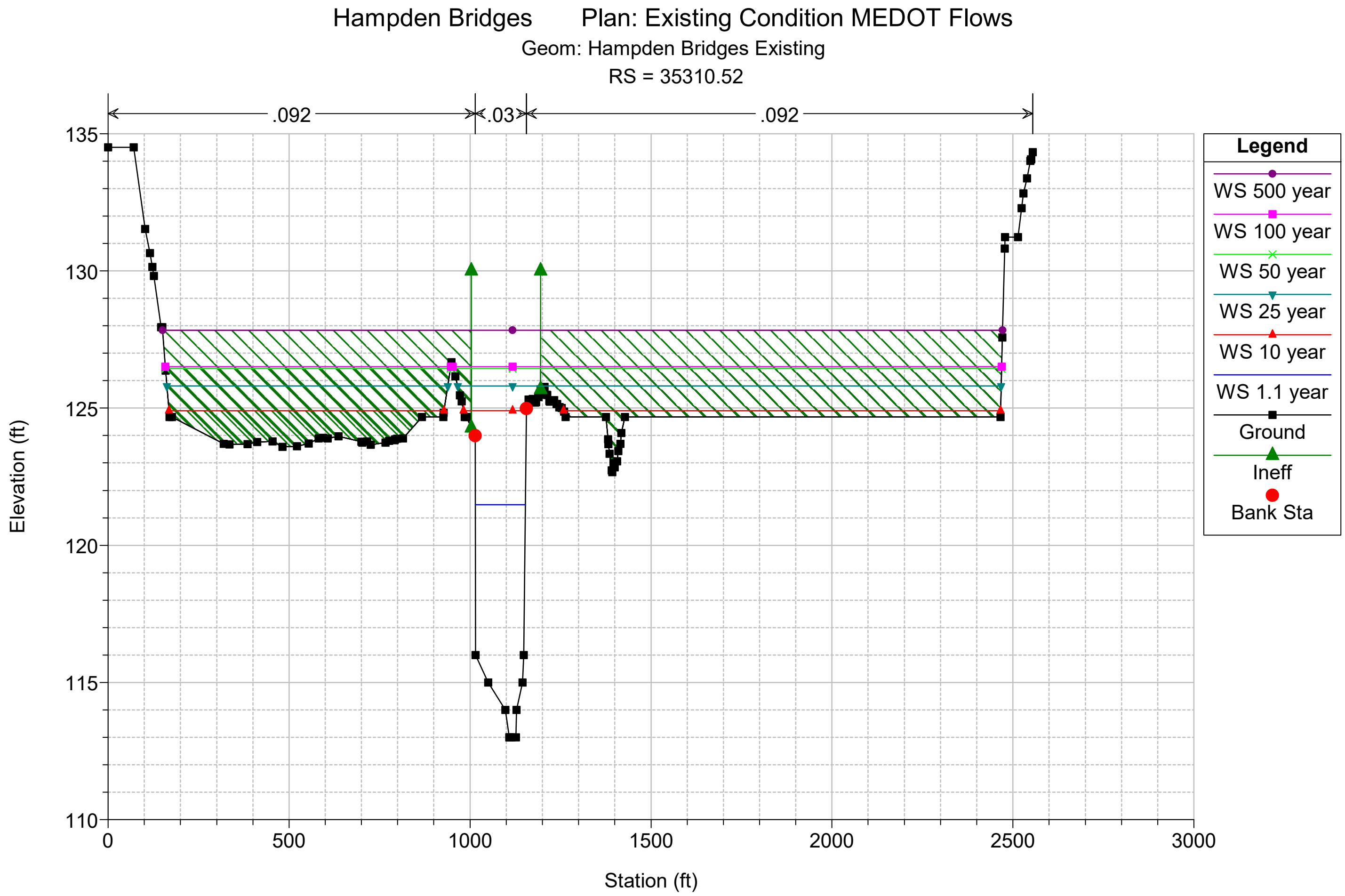
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)

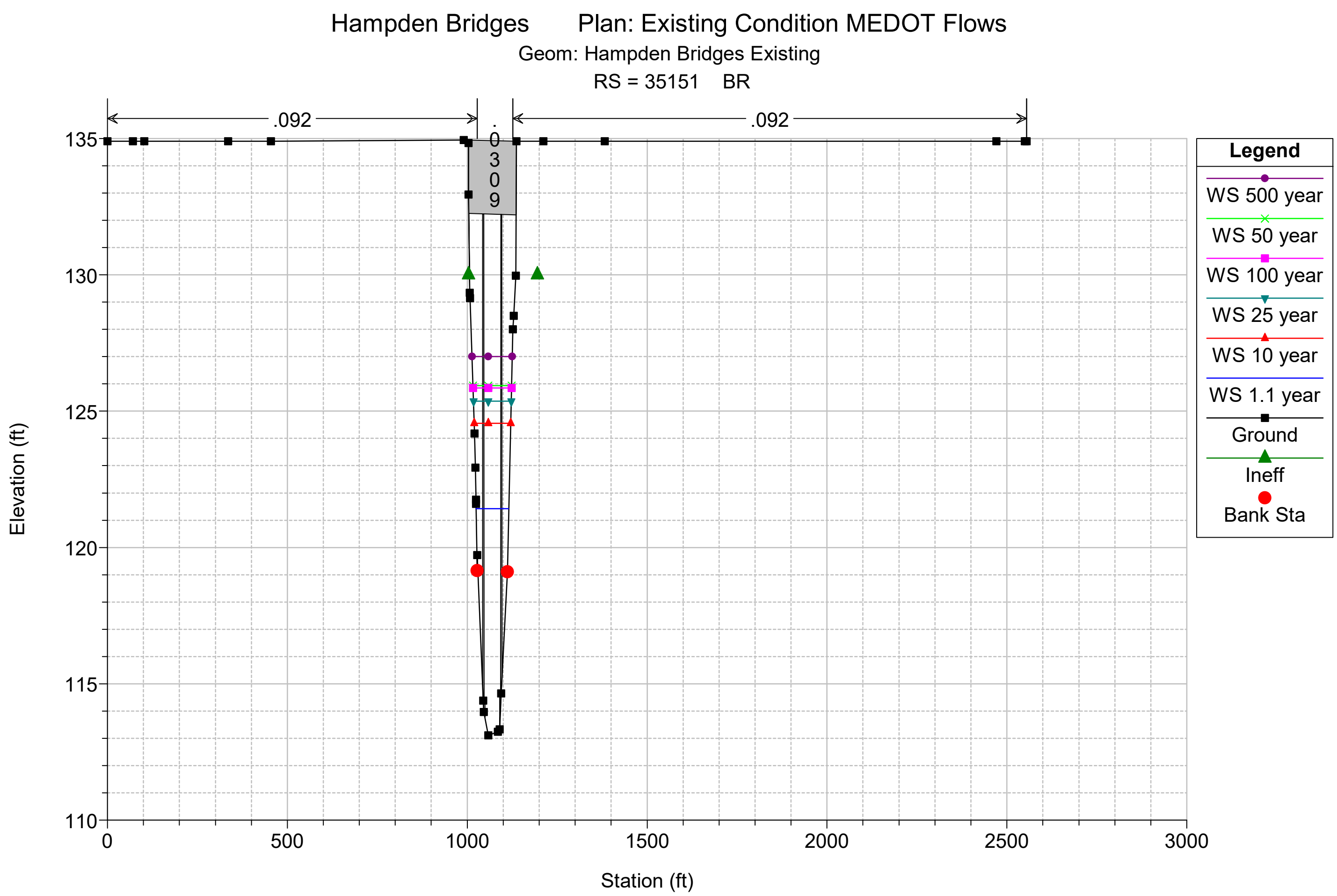

Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 38050.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 37100.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
150
145
140
135
130
125
120
115
0
500
1000
1500
2000
2500

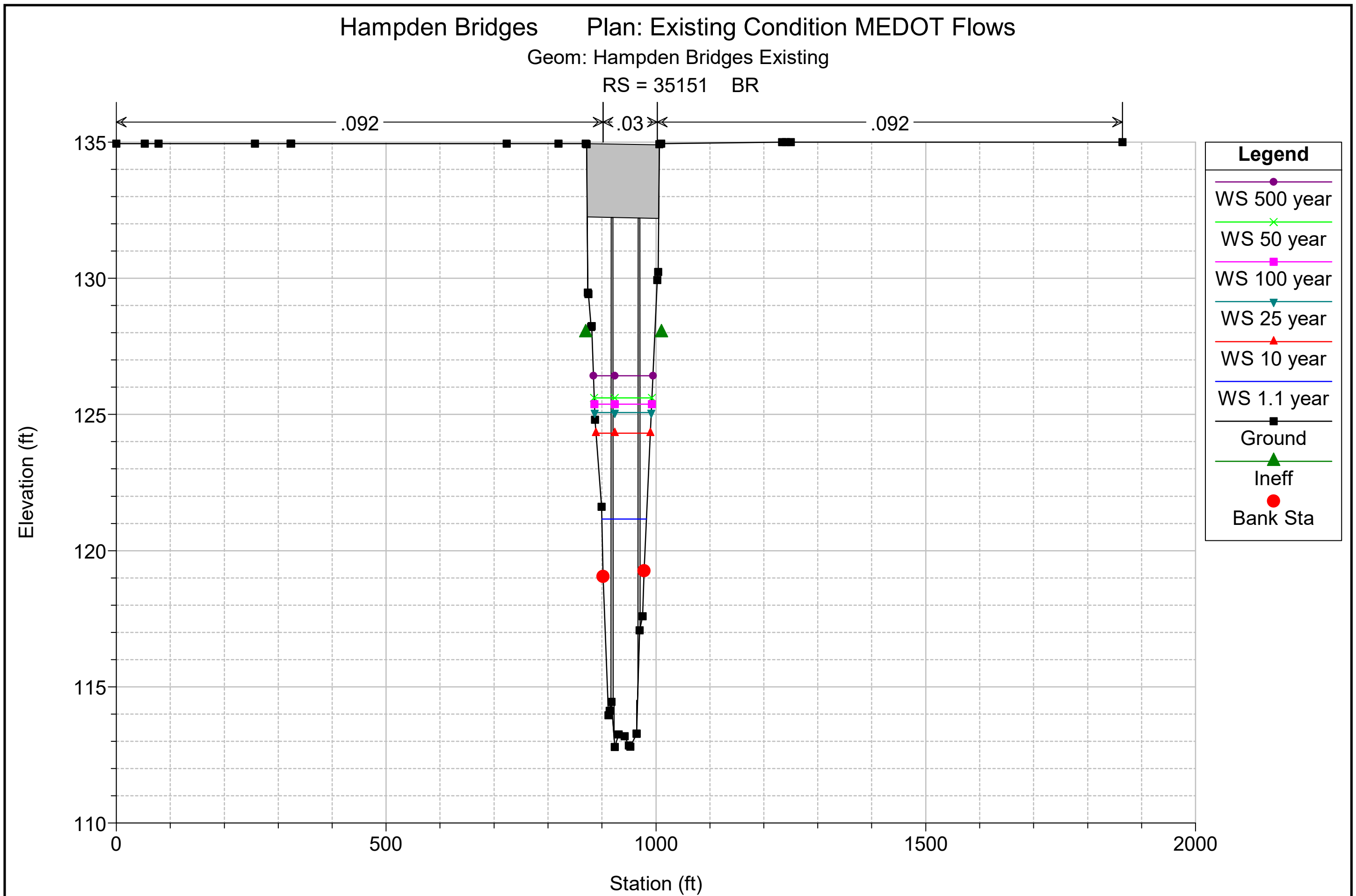

Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 35509.99
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
105
0
500
1000
1500
2000
2500

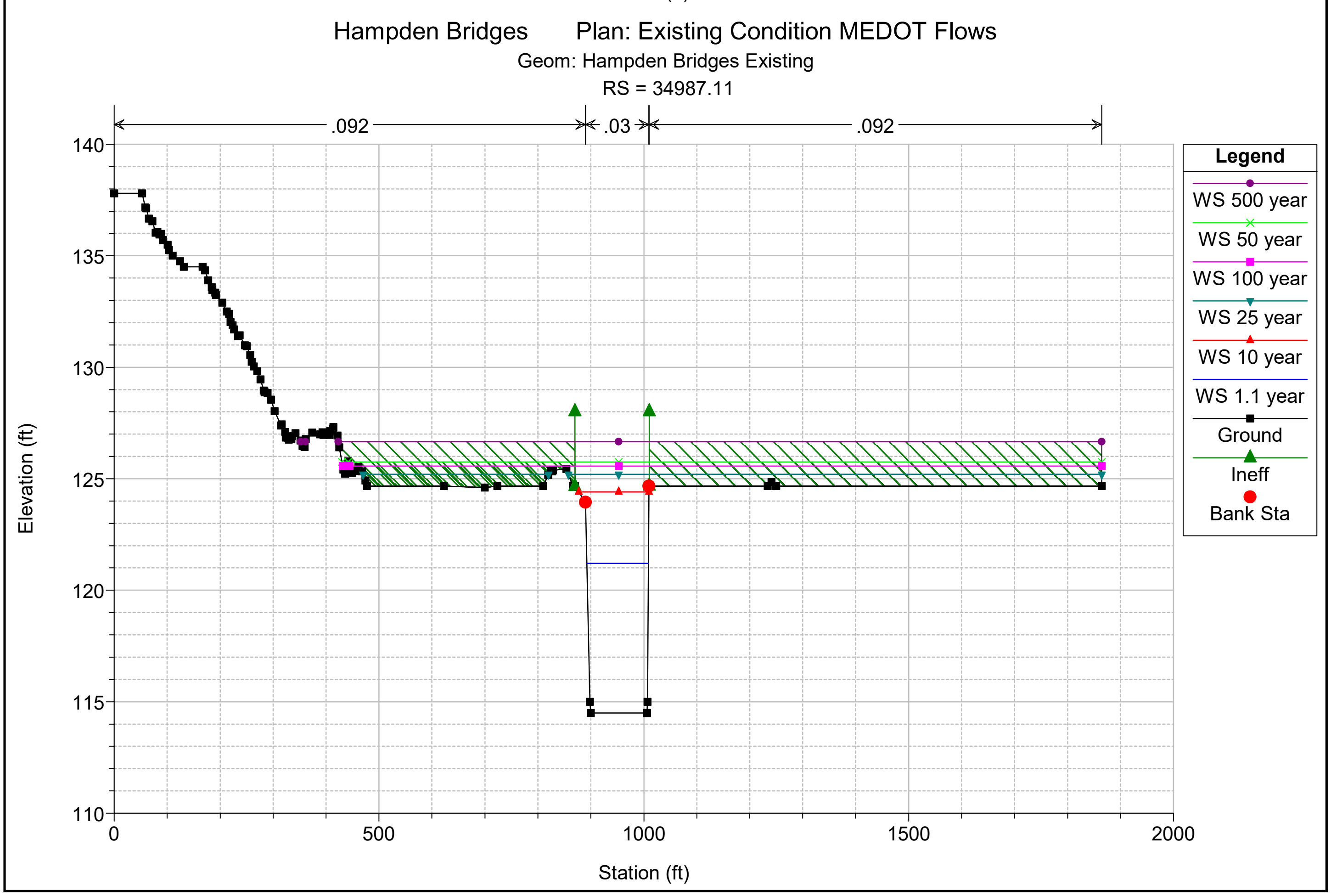


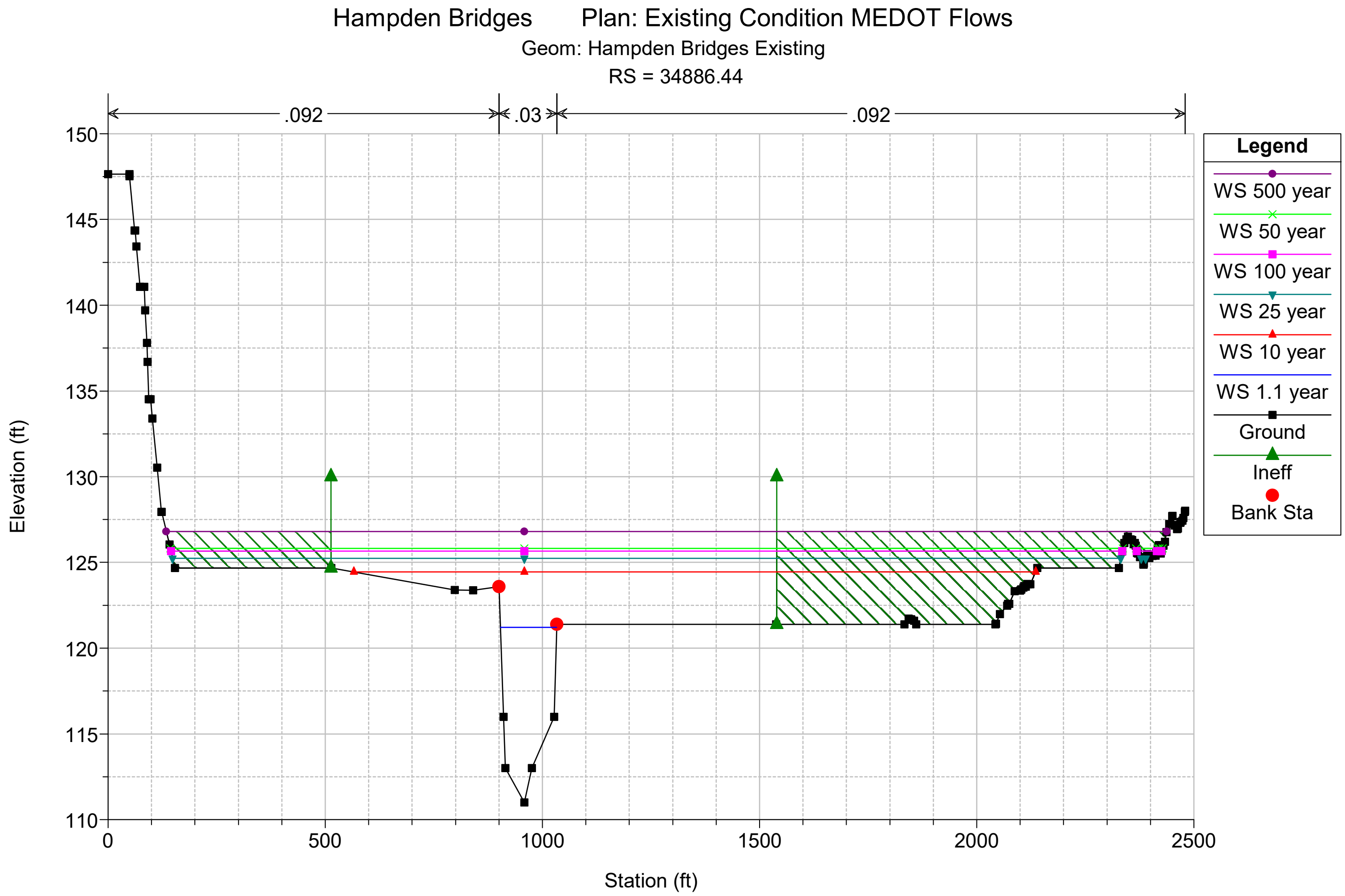
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 35310.52
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



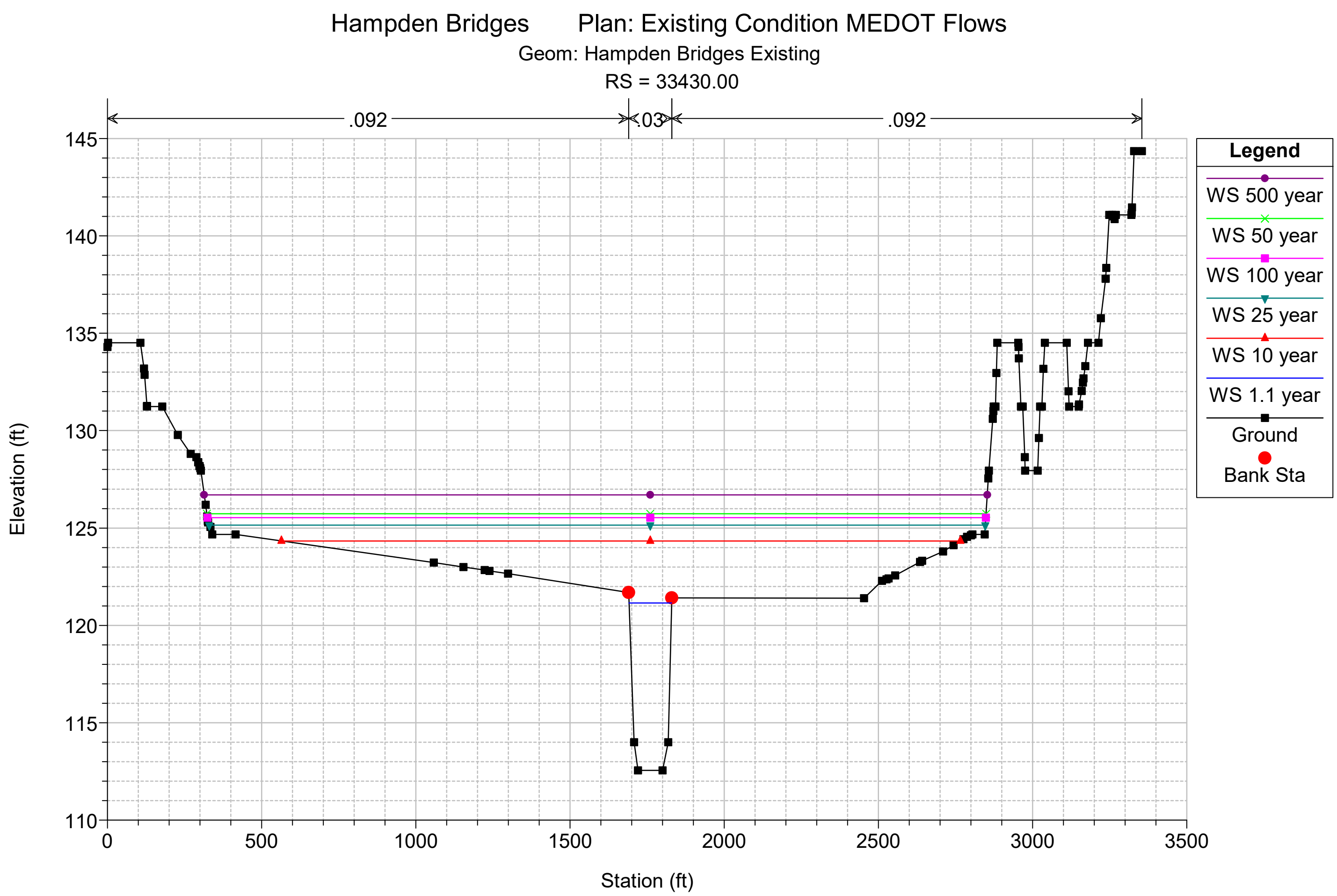
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 35151 BR
.092
.0309
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 35151 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

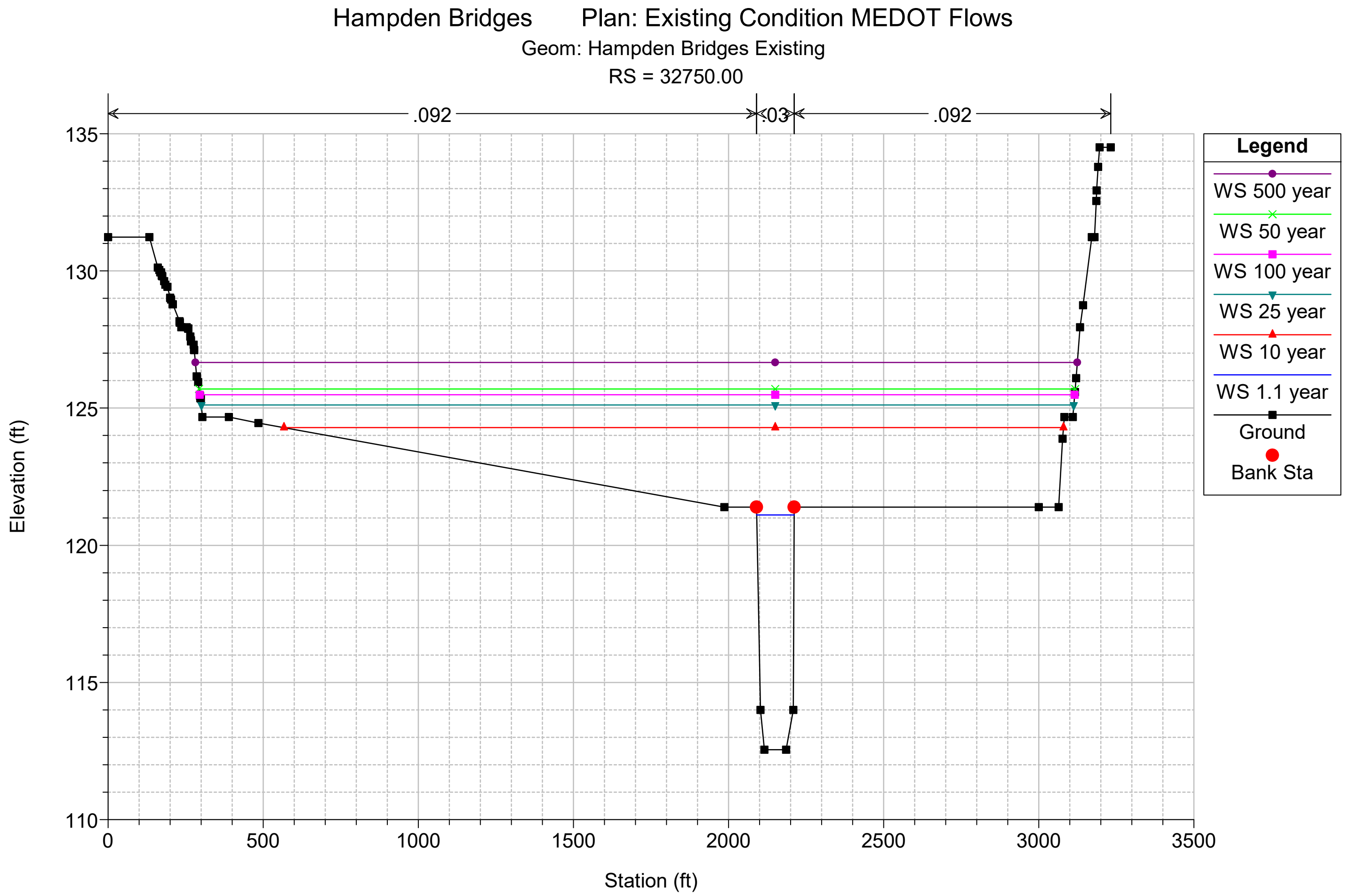

Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 34987.11
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



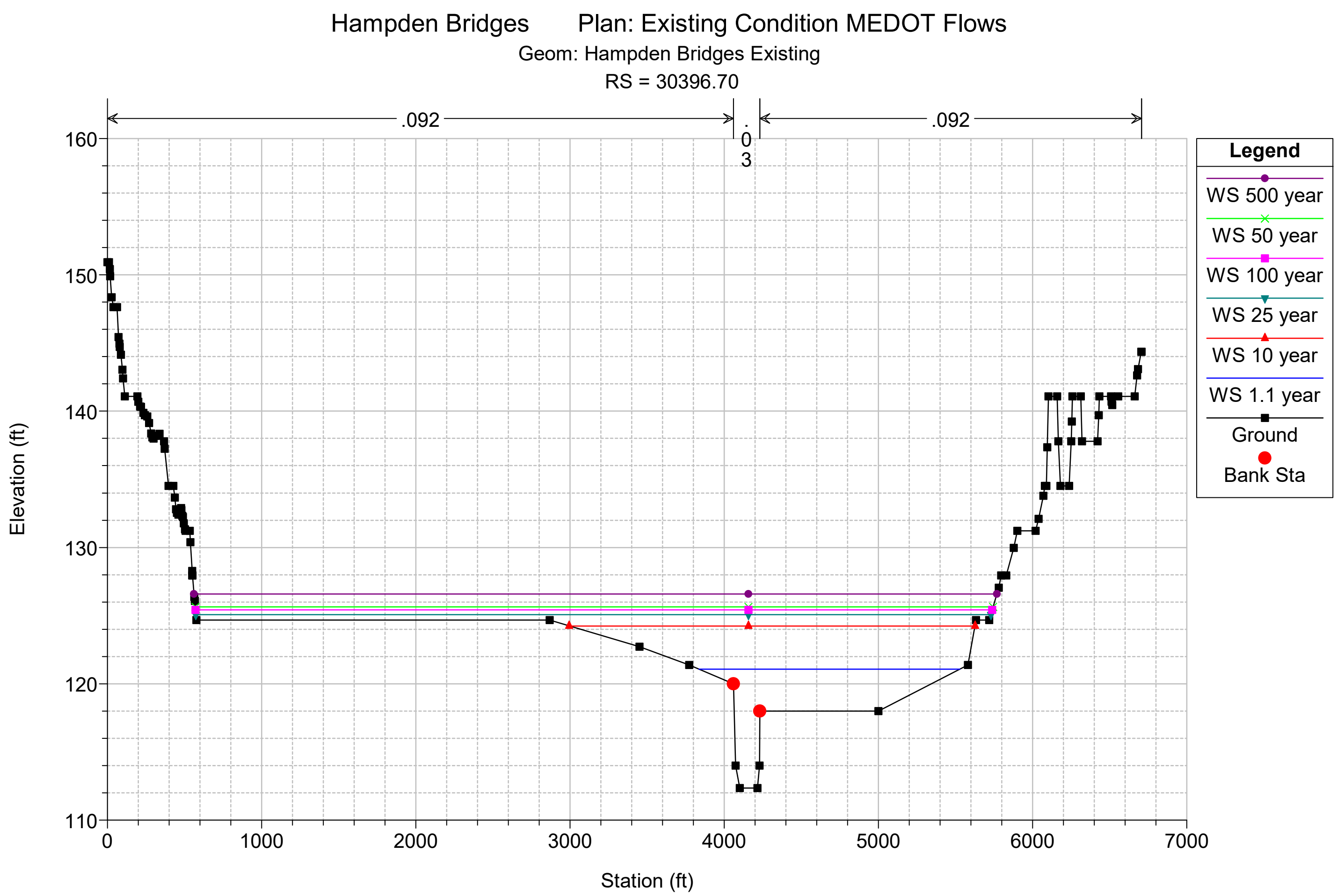
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 34886.44
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



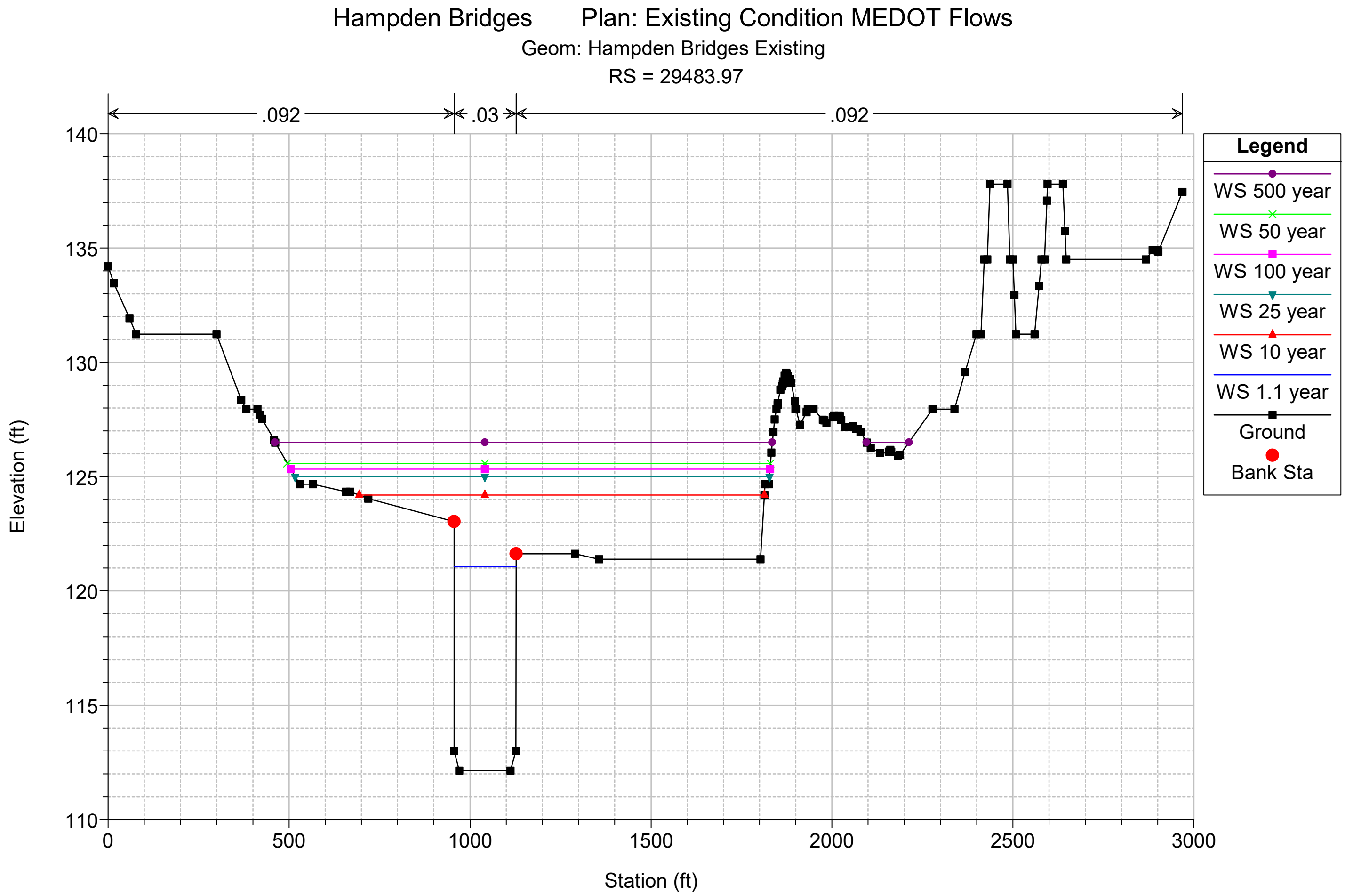
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 33430.00
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta



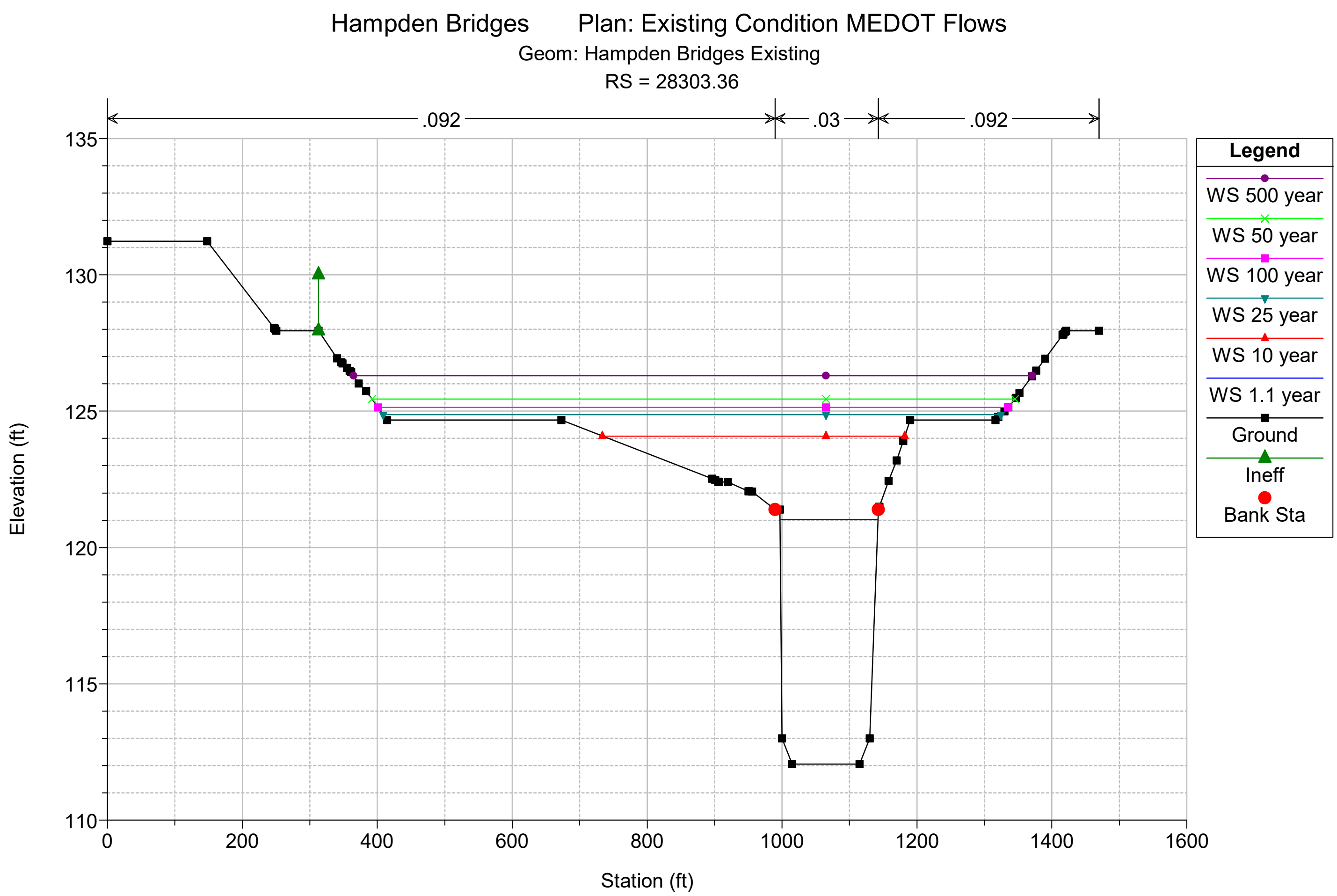
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 32750.00
.092
.03
.092
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



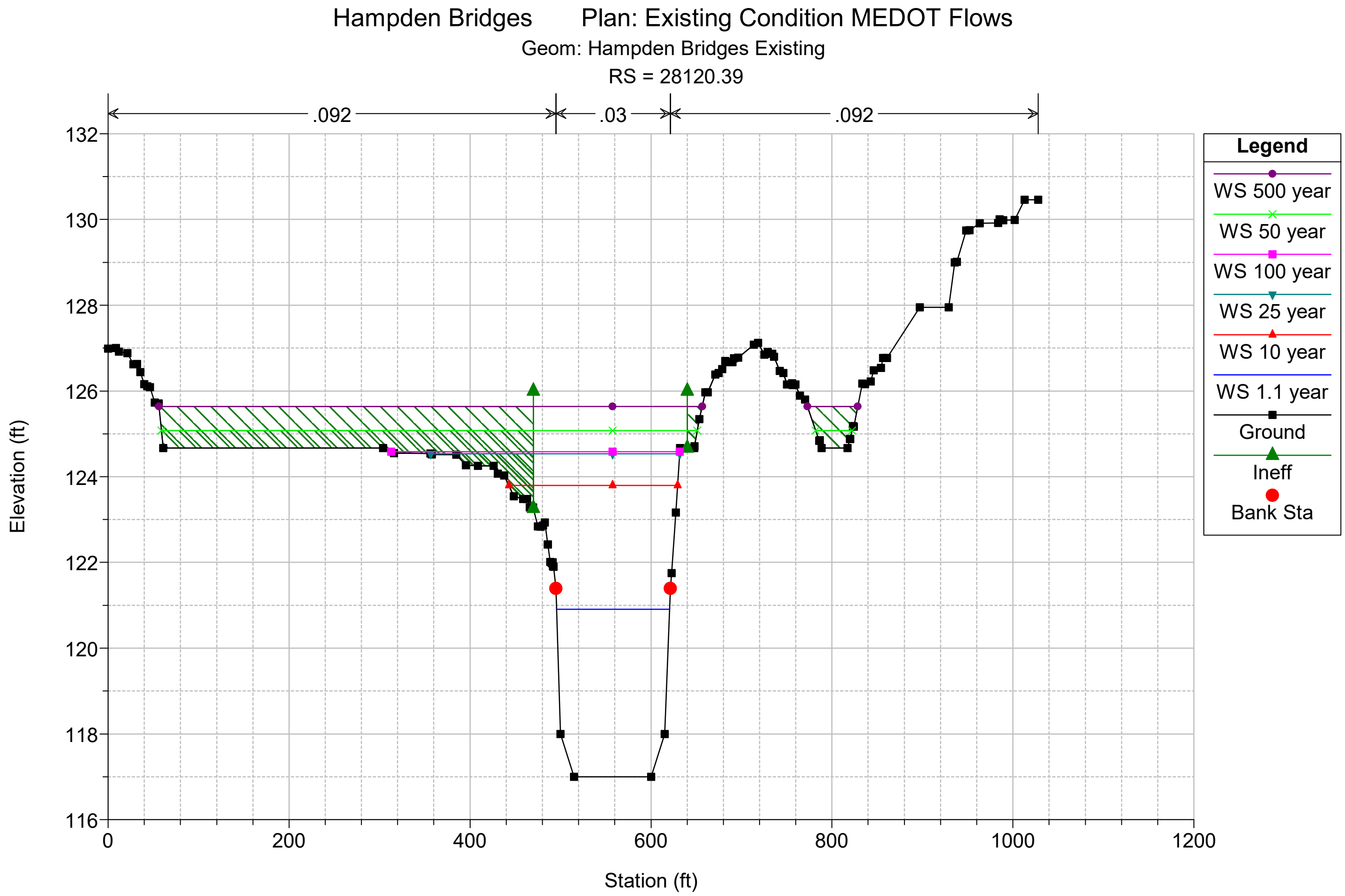
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 30396.70
.092
.03
.092
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



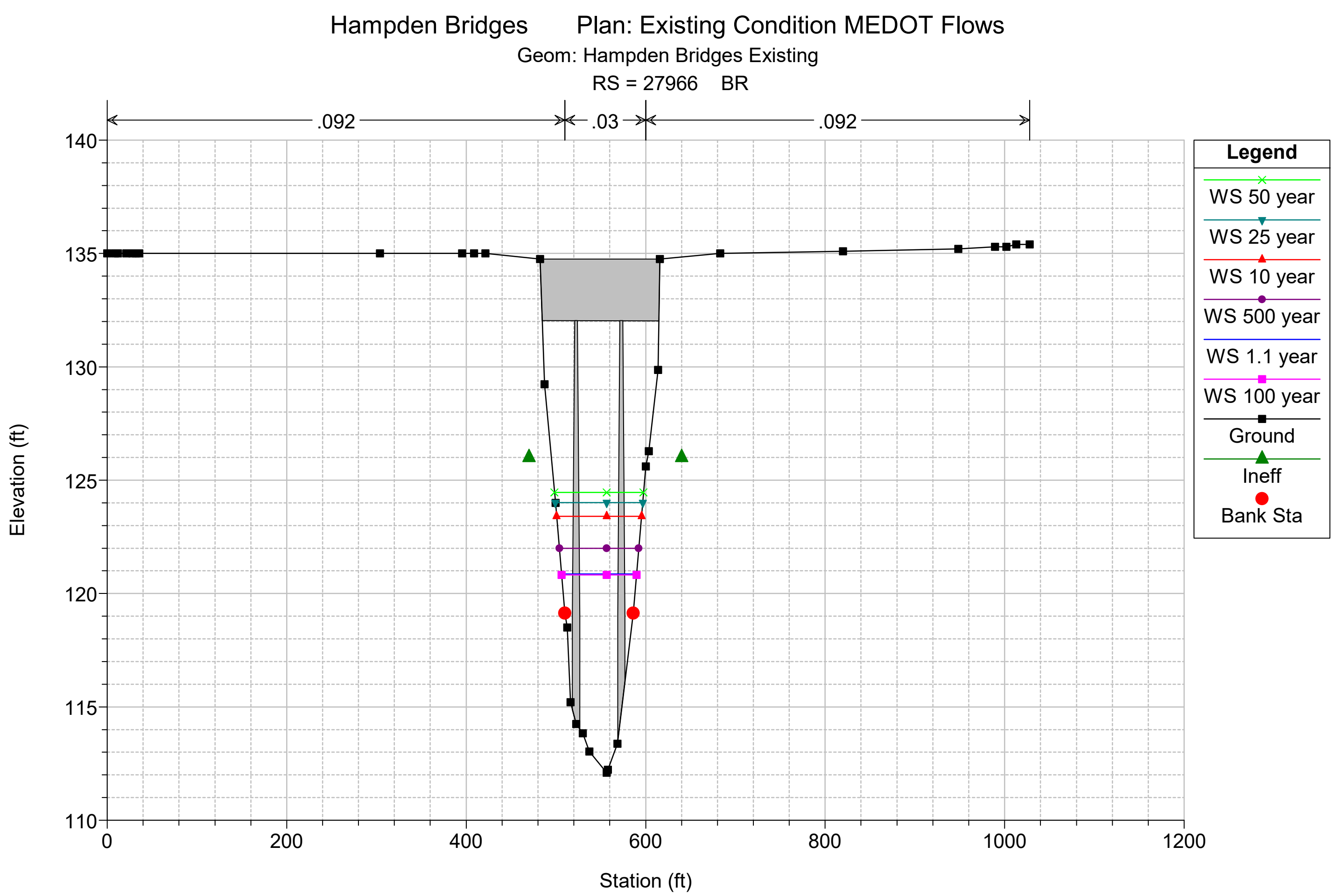
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 29483.97
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta



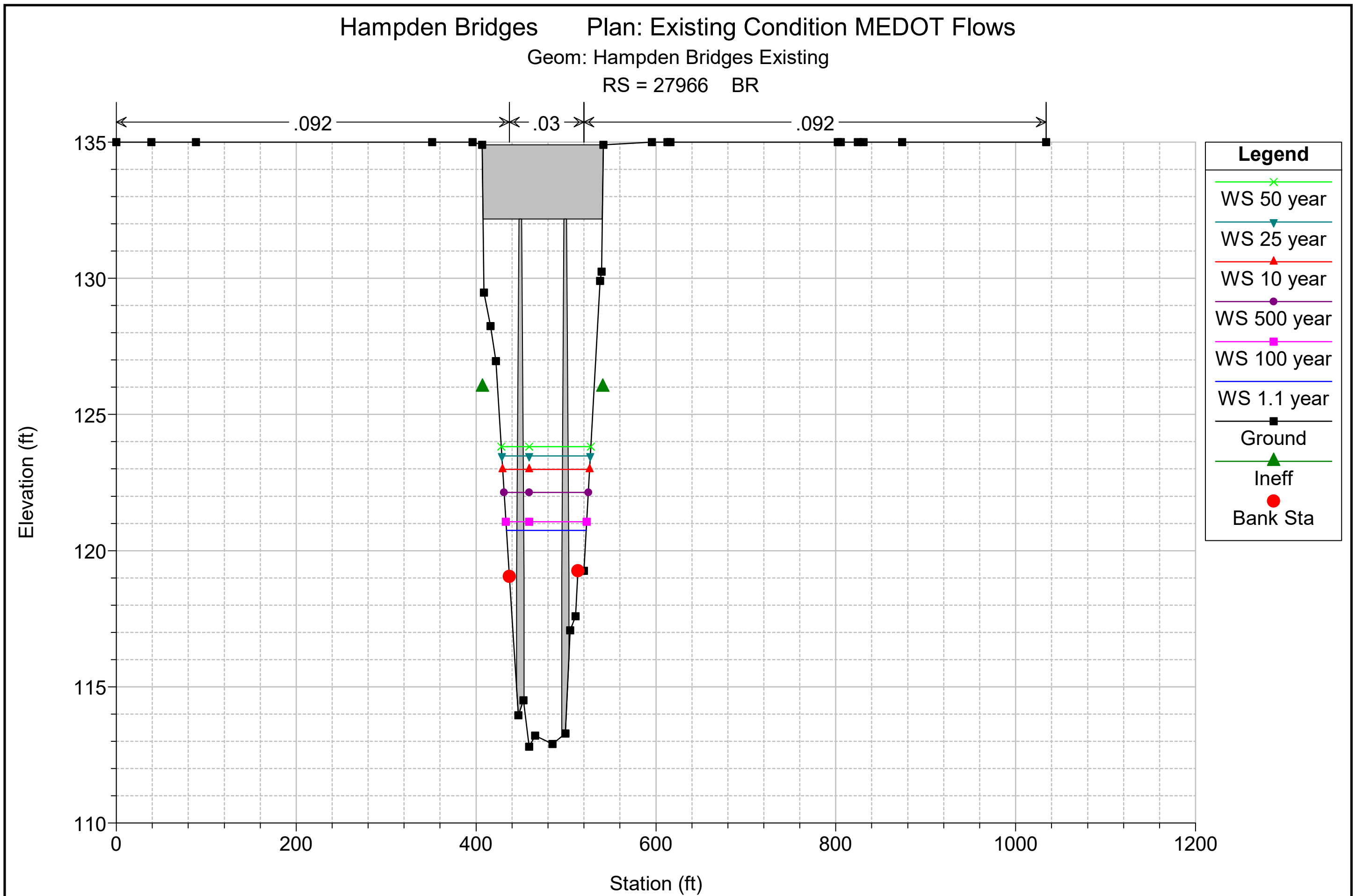
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 28303.36
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

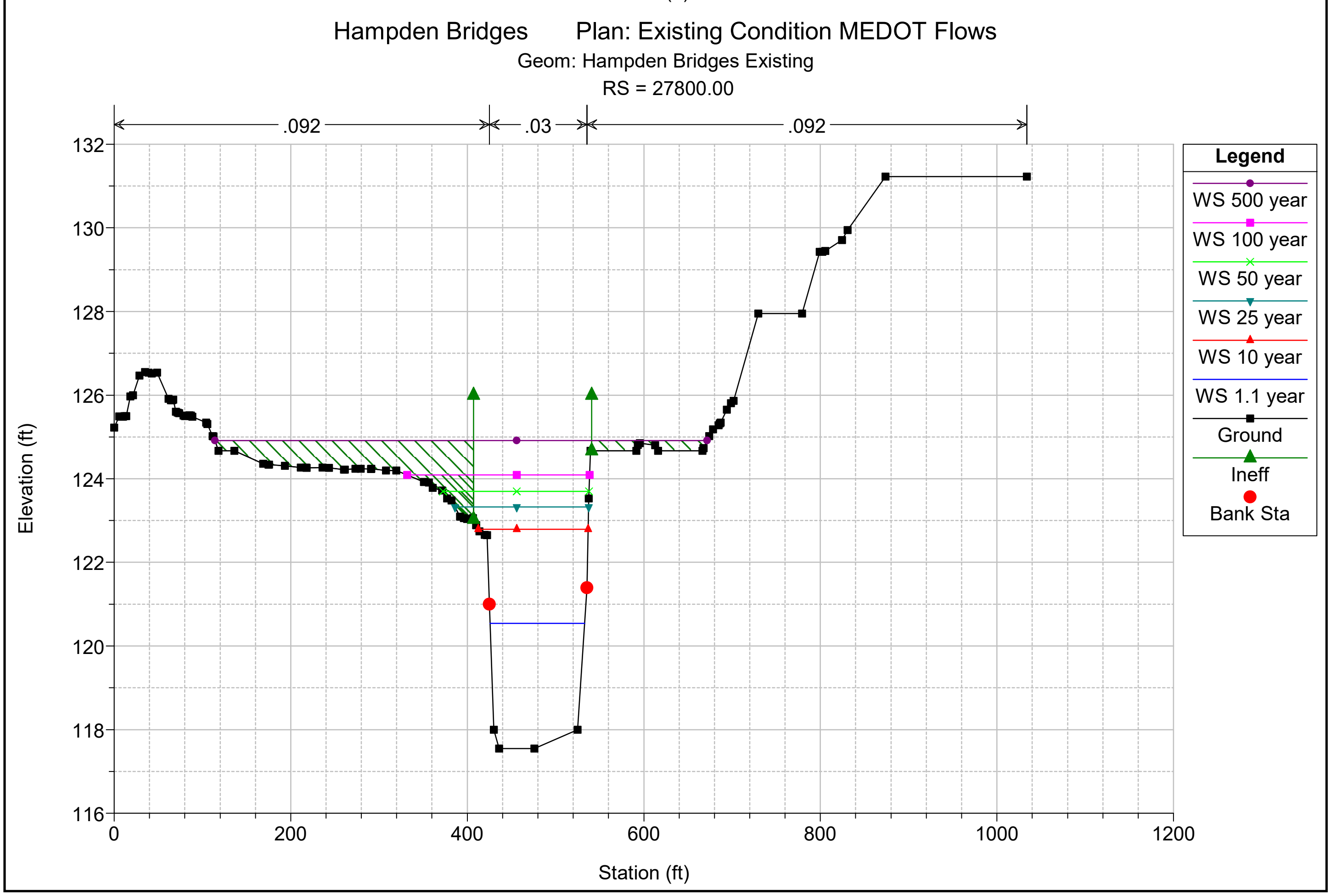


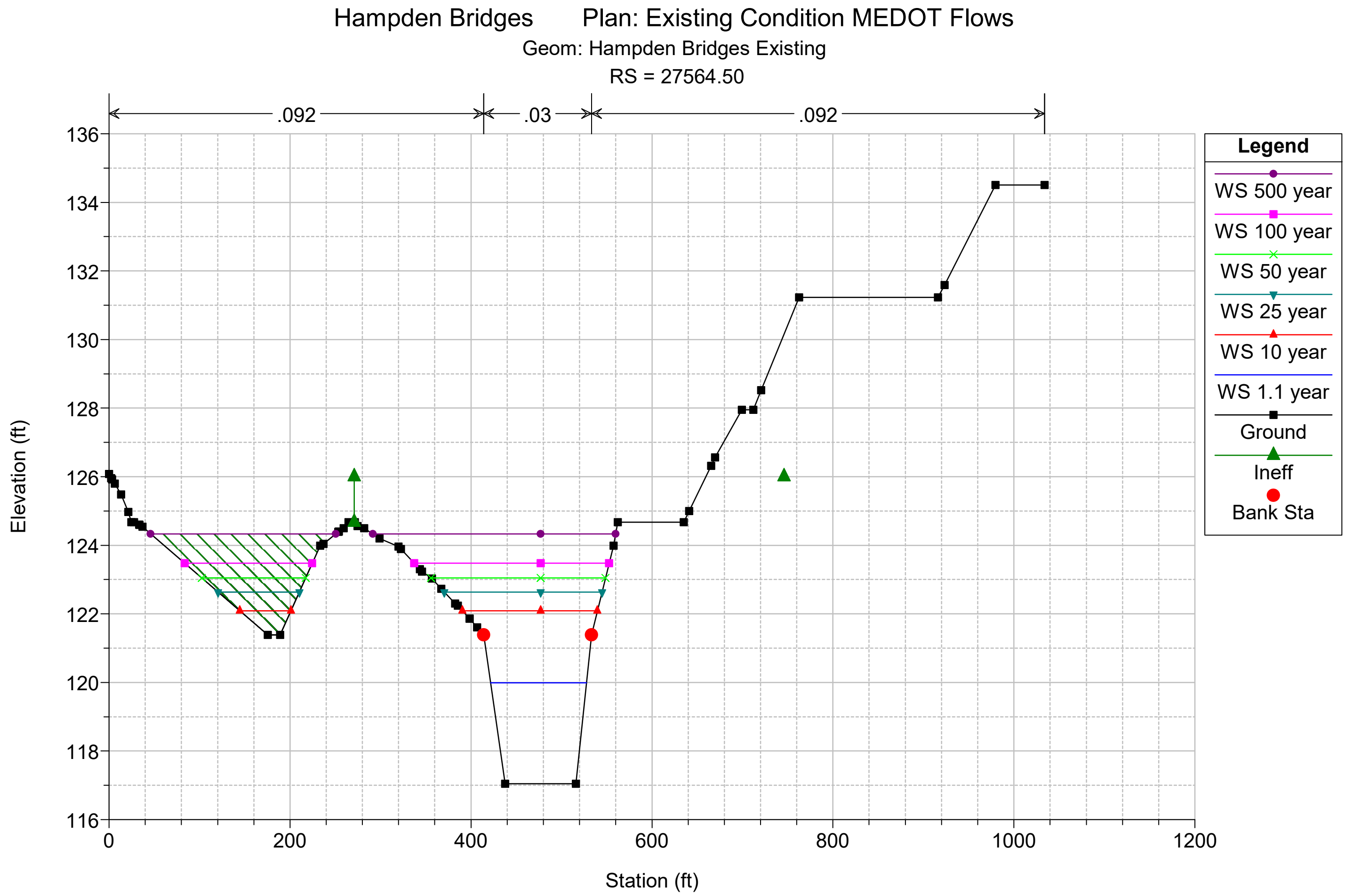
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 28120.39
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 50 year
WS 100 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



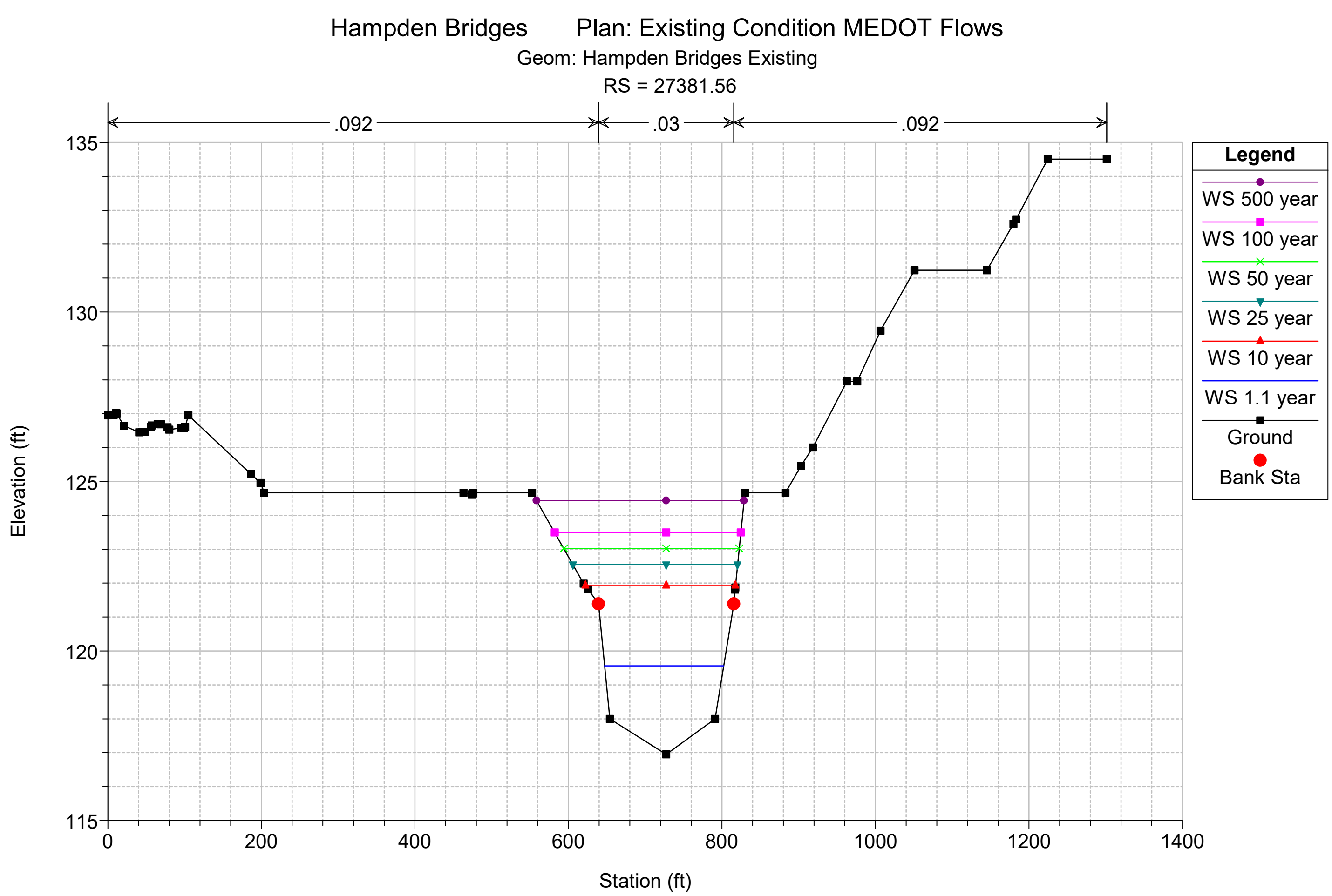
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 27966 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 50 year
WS 25 year
WS 10 year
WS 500 year
WS 1.1 year
WS 100 year
Ground
Ineff
Bank Sta


Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 27966 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 50 year
WS 25 year
WS 10 year
WS 500 year
WS 100 year
WS 1.1 year
Ground
Ineff
Bank Sta

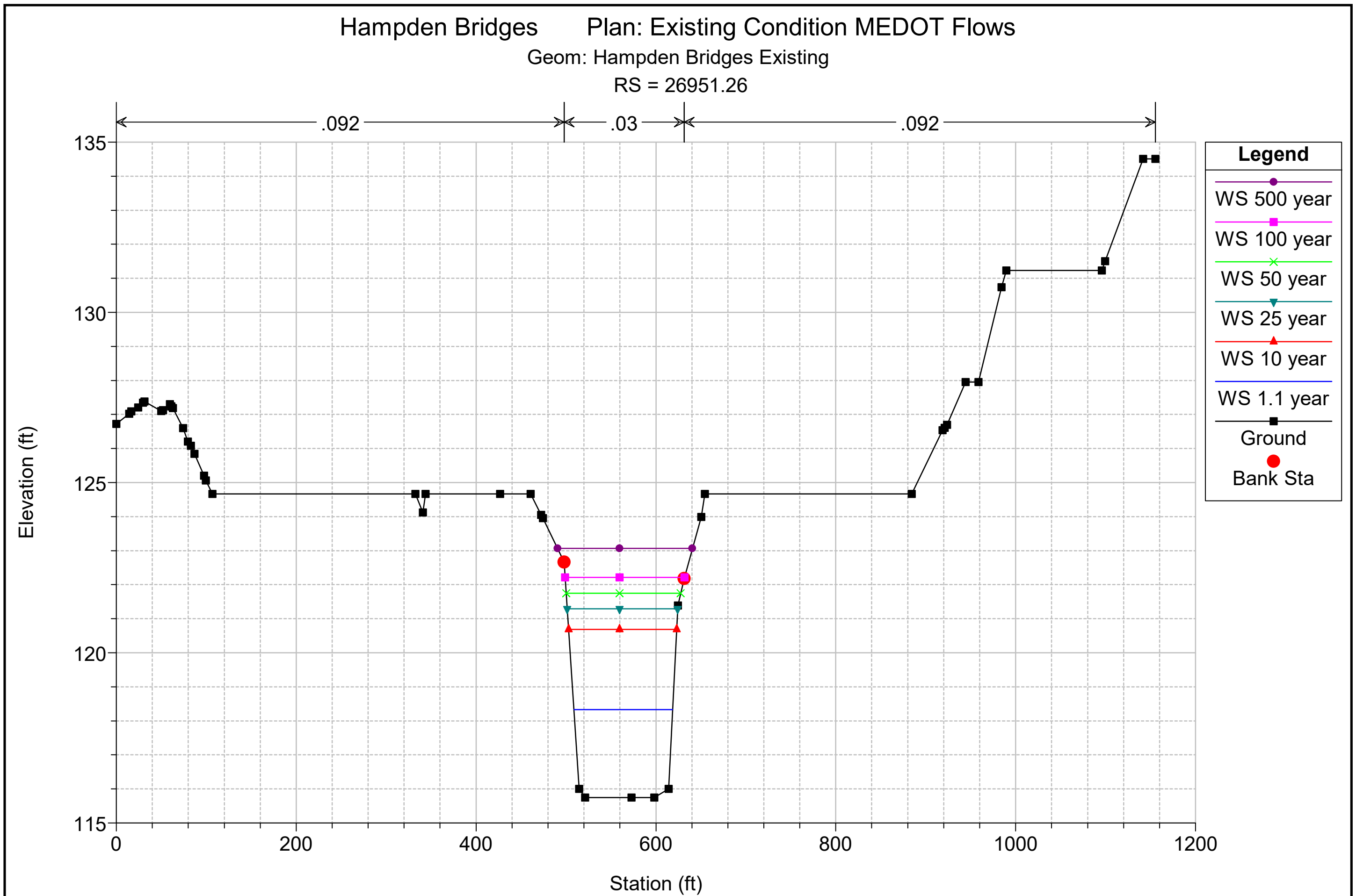

Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 27800.00
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



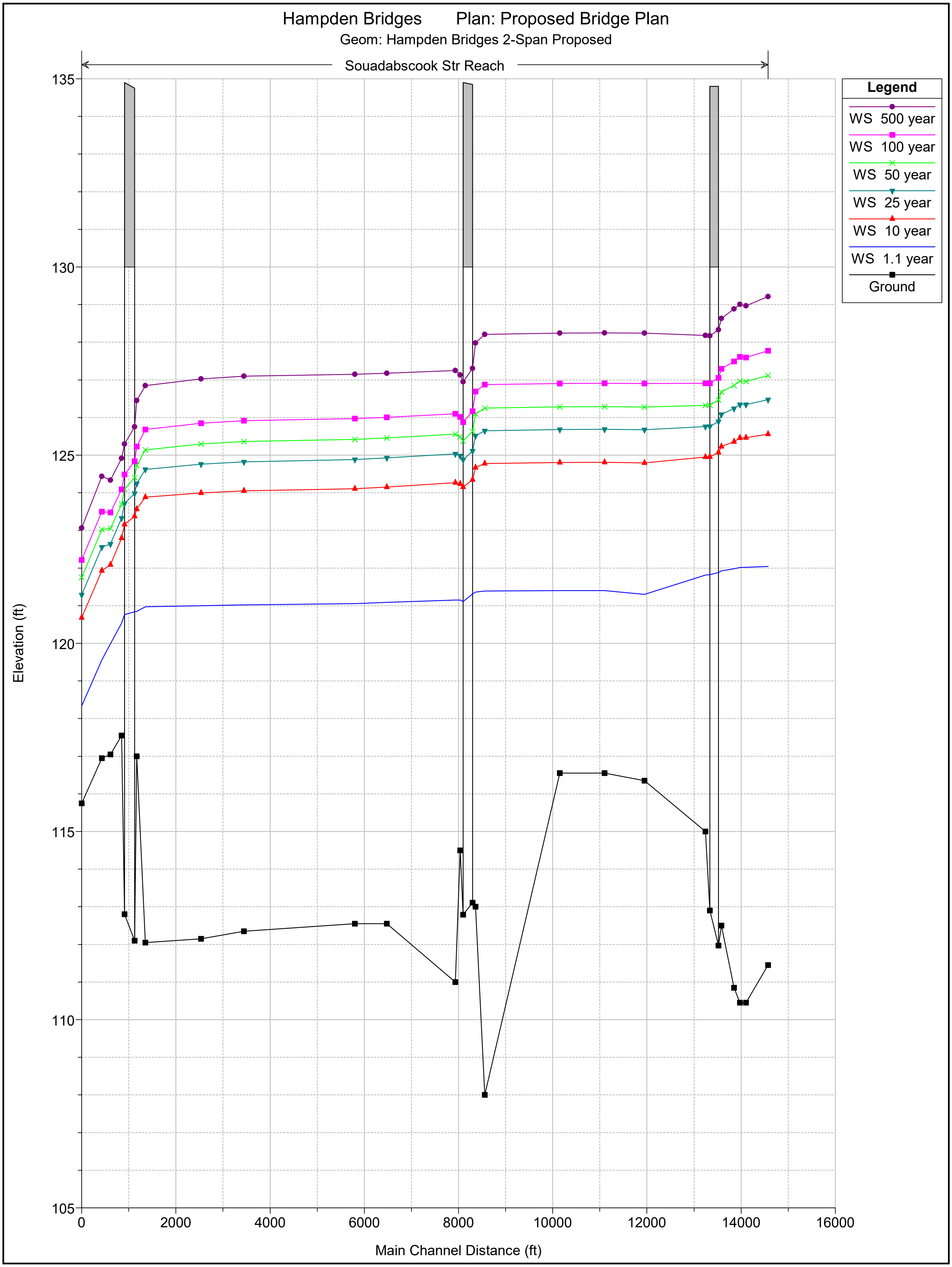
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 27564.50
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
136
134
132
130
128
126
124
122
120
118
116
0
200
400
600
800
1000
1200



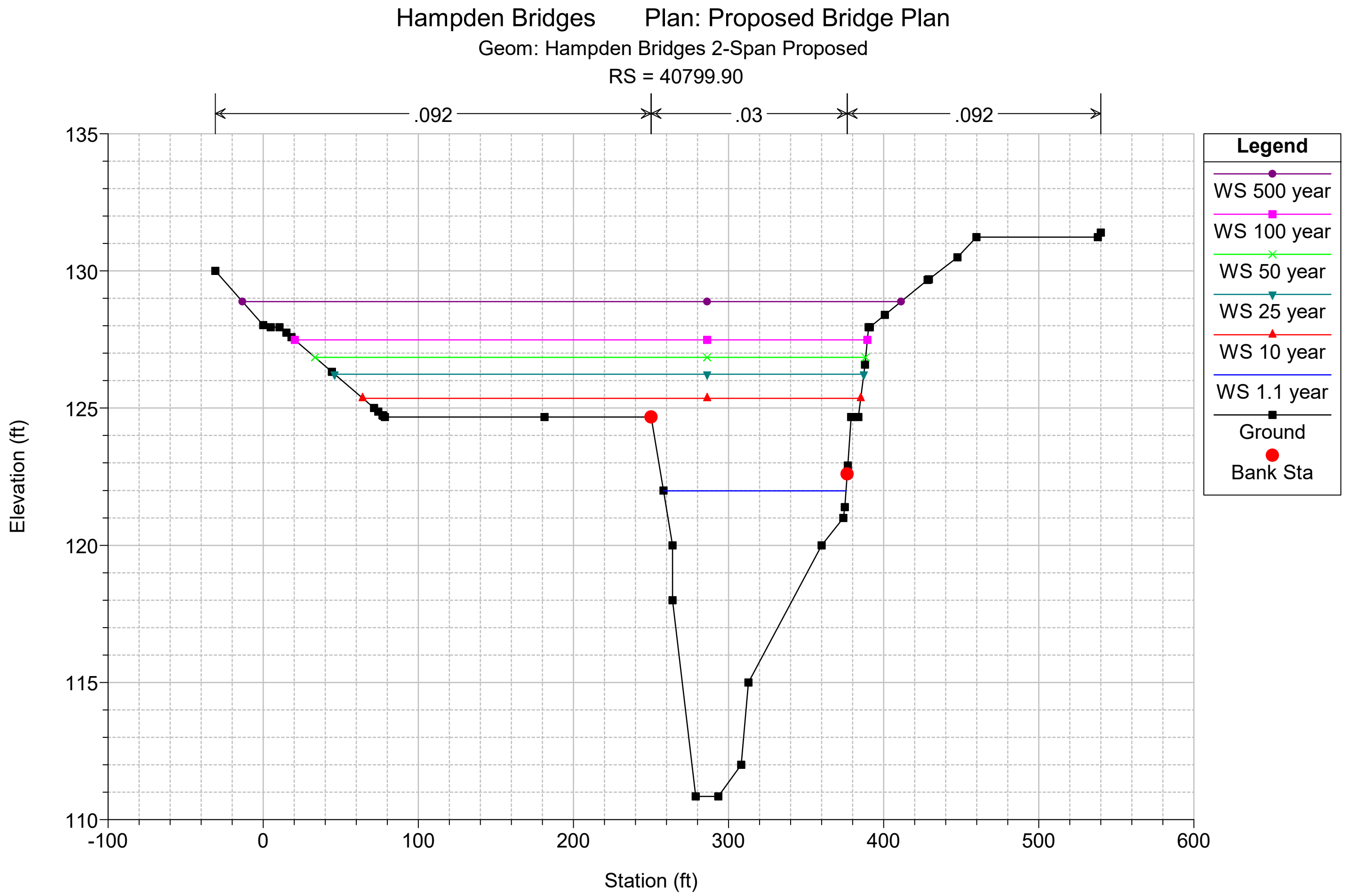
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 27381.56
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
0
200
400
600
800
1000
1200
1400

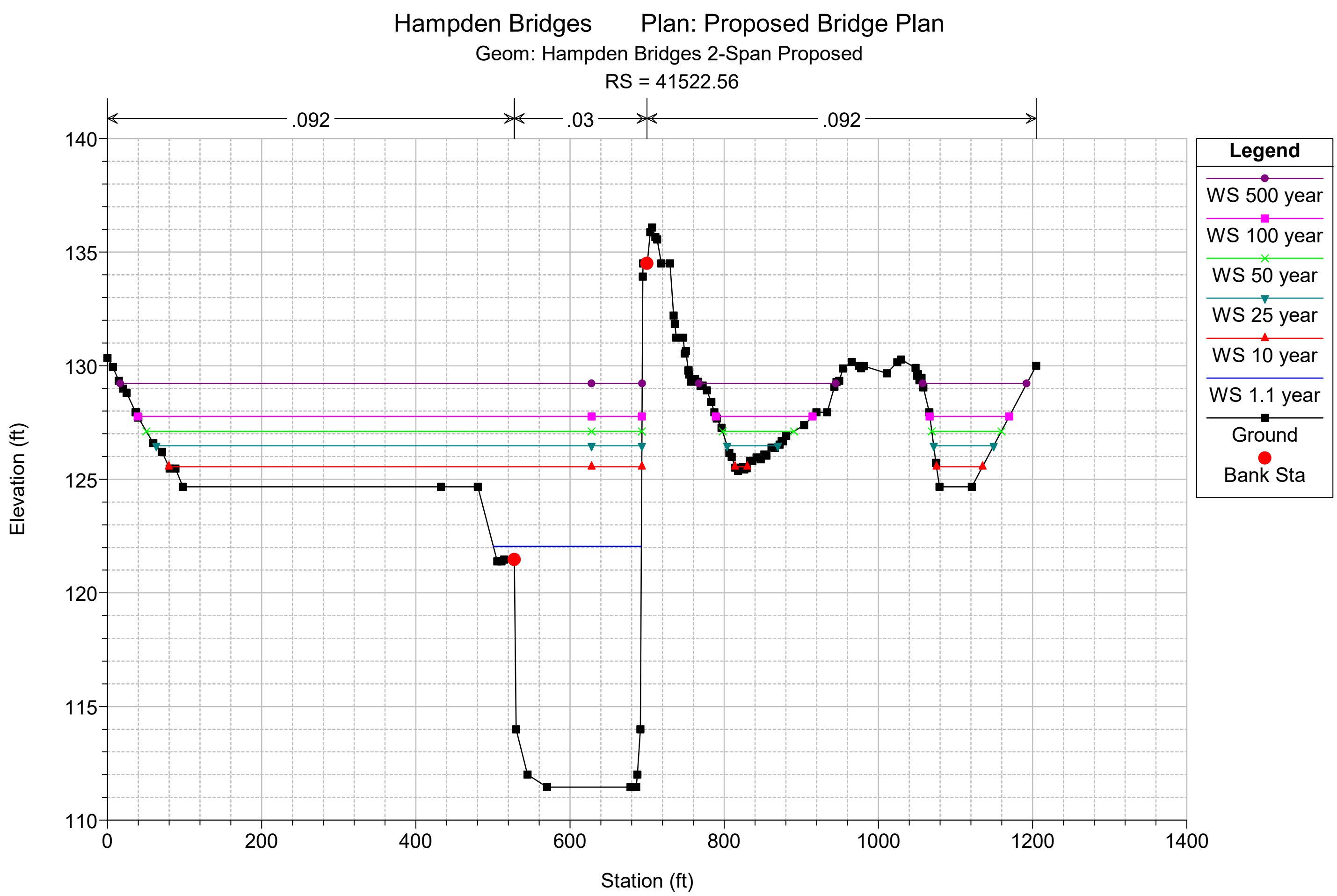


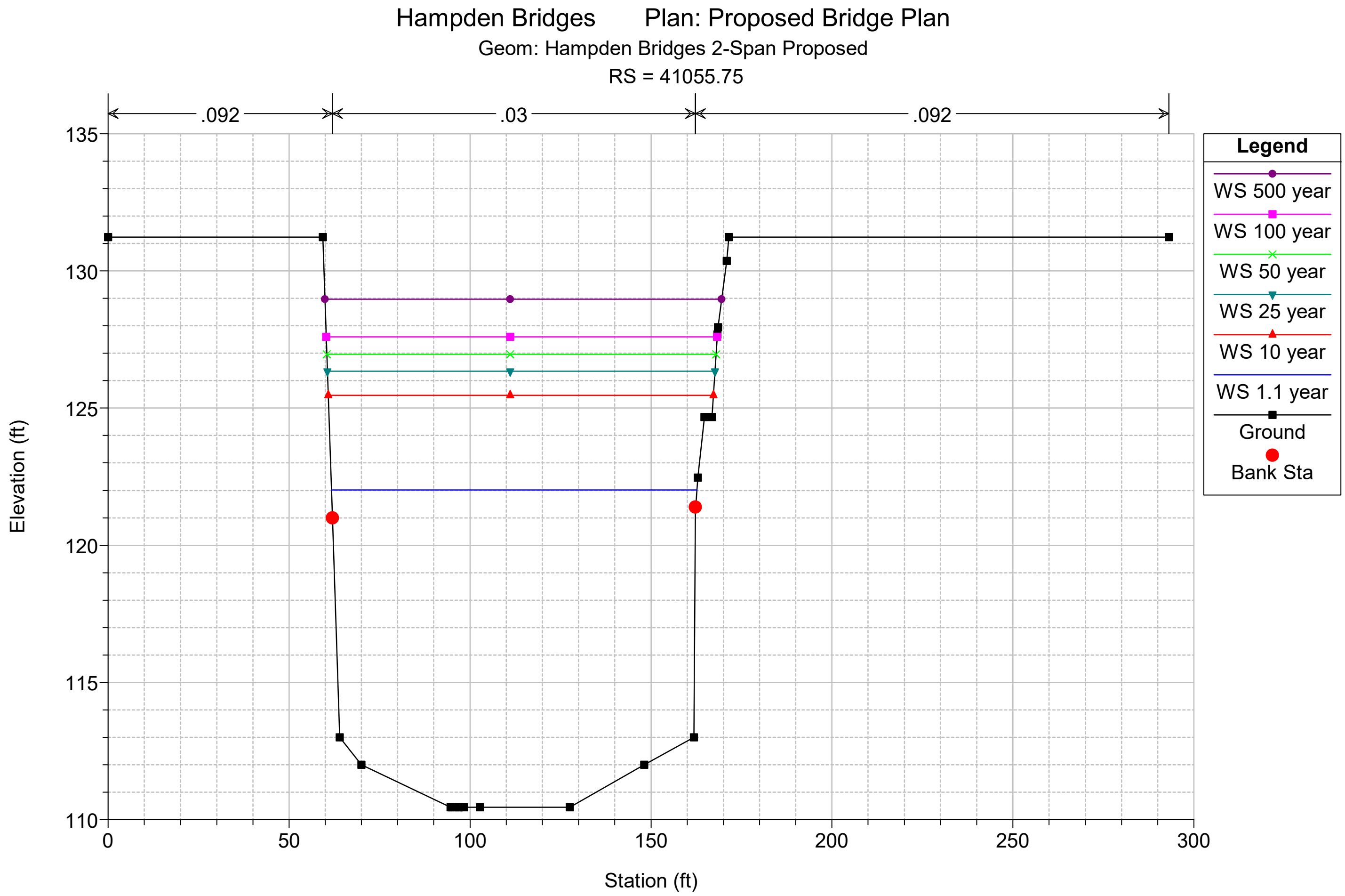
Hampden Bridges Plan: Existing Condition MEDOT Flows
Geom: Hampden Bridges Existing
RS = 26951.26
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
0
200
400
600
800
1000
1200

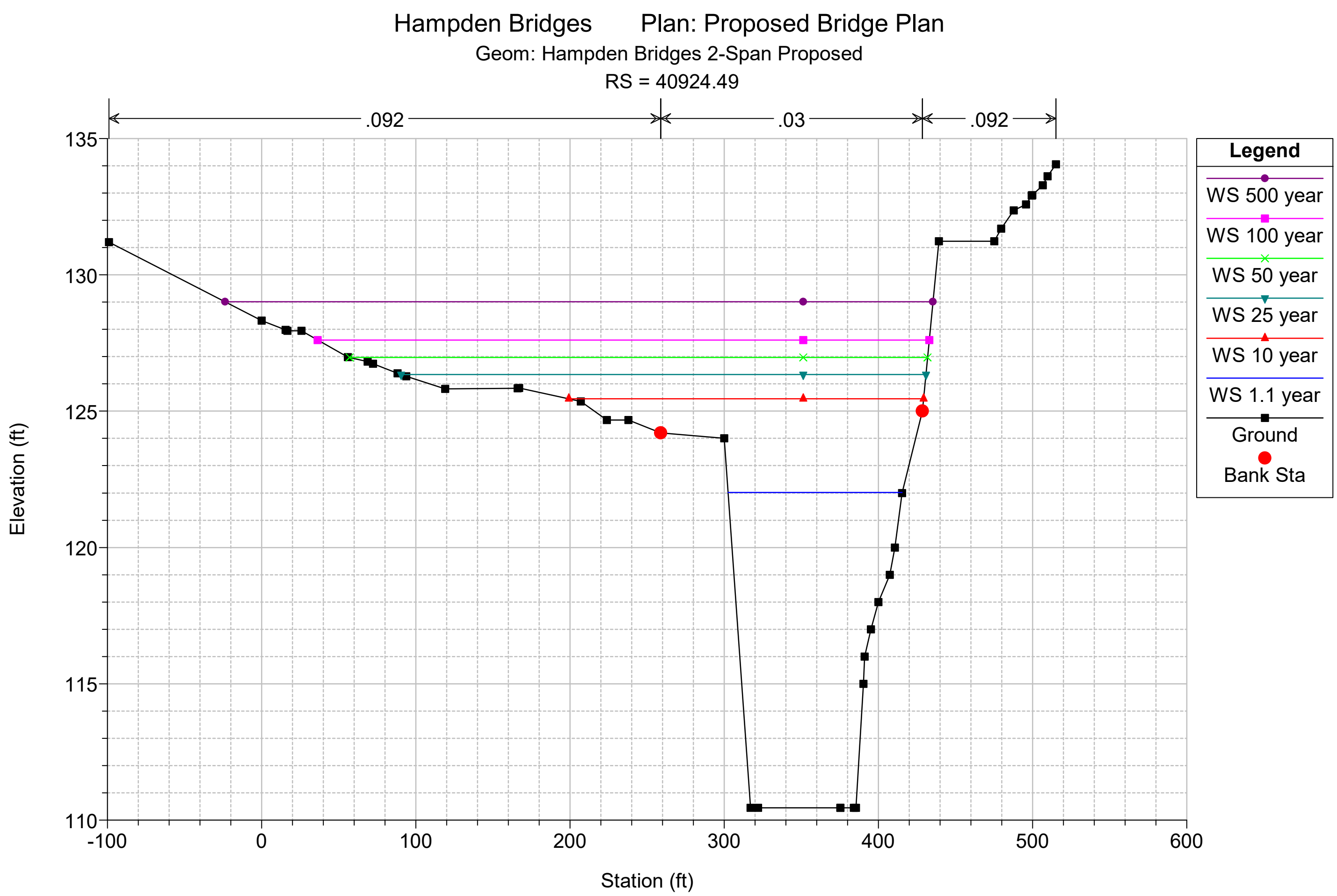


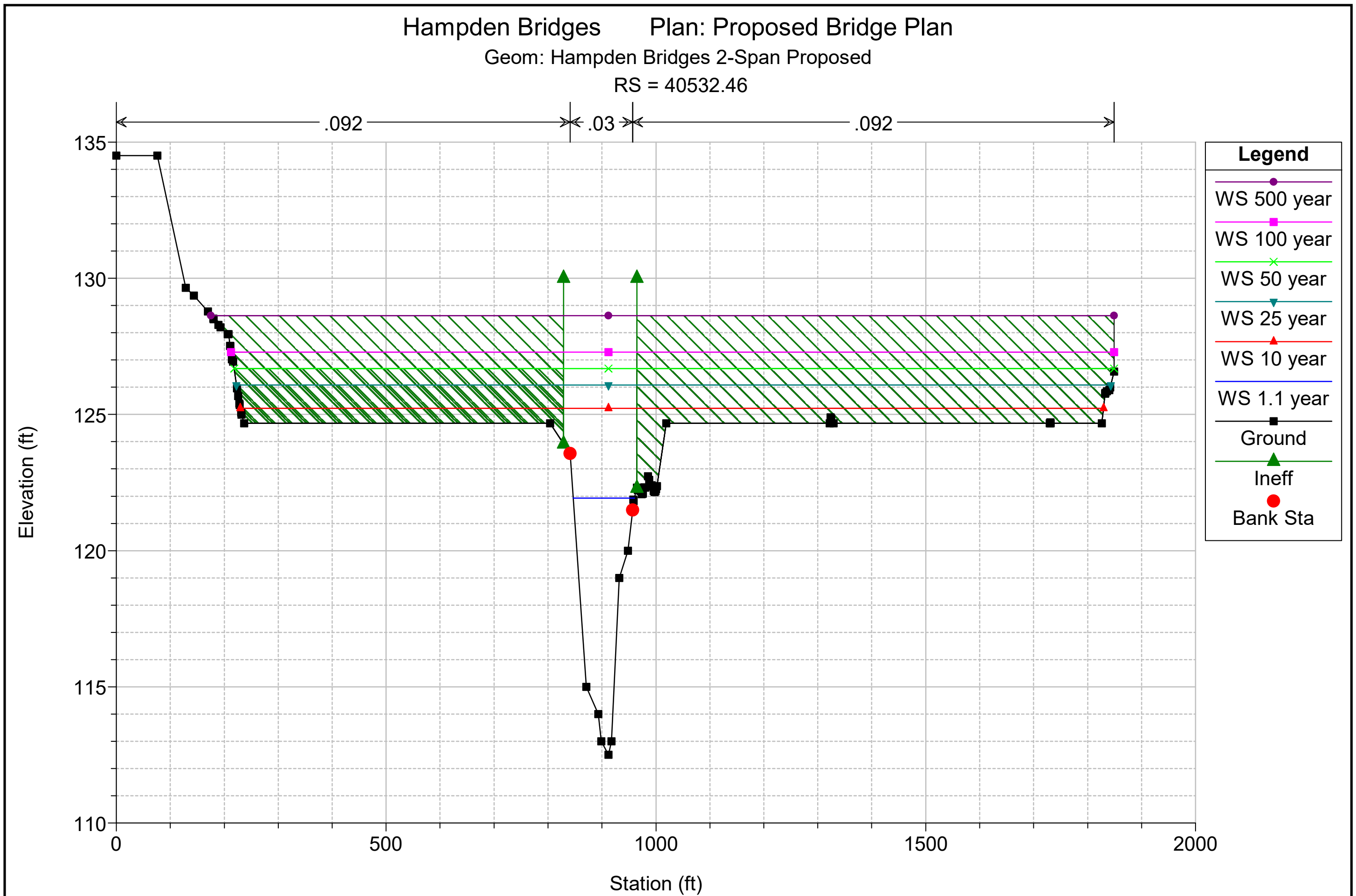
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
Souadabscook Str Reach
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Elevation (ft)
Main Channel Distance (ft)
135
130
125
120
115
110
105
0
2000
4000
6000
8000
10000
12000
14000
16000

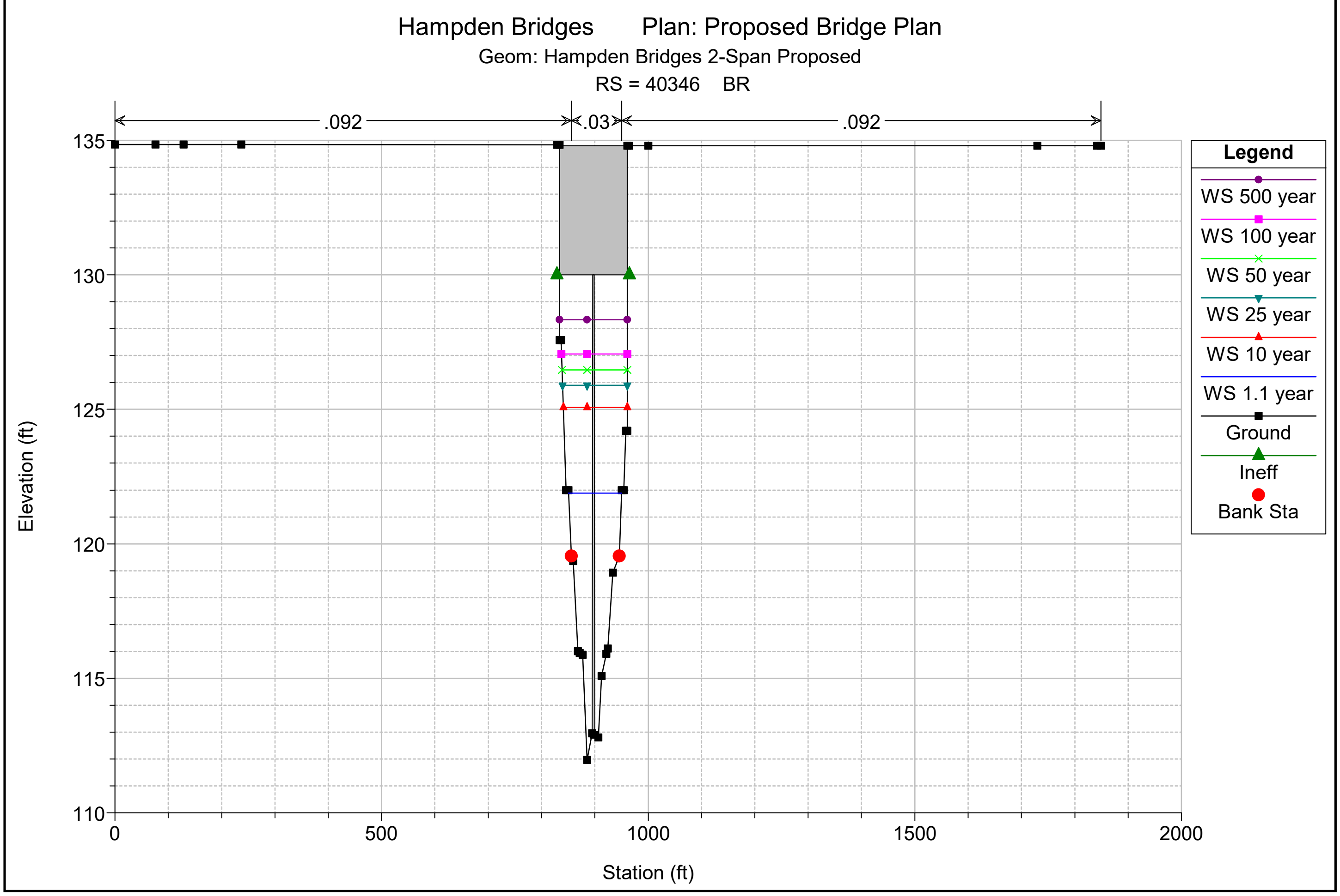

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40799.90
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
-100
0
100
200
300
400
500
600

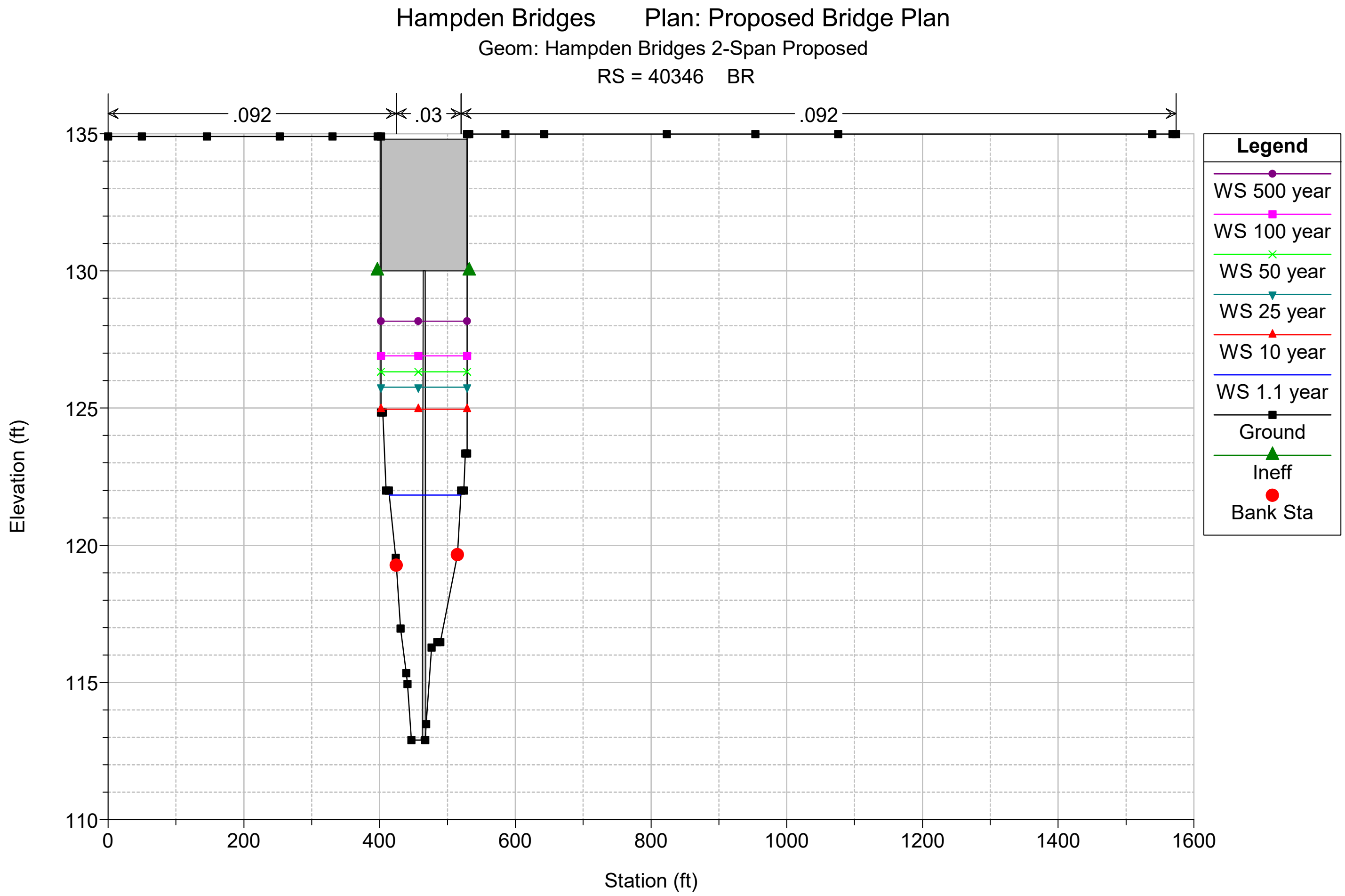

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 41522.56
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
140
135
130
125
120
115
110
0
200
400
600
800
1000
1200
1400

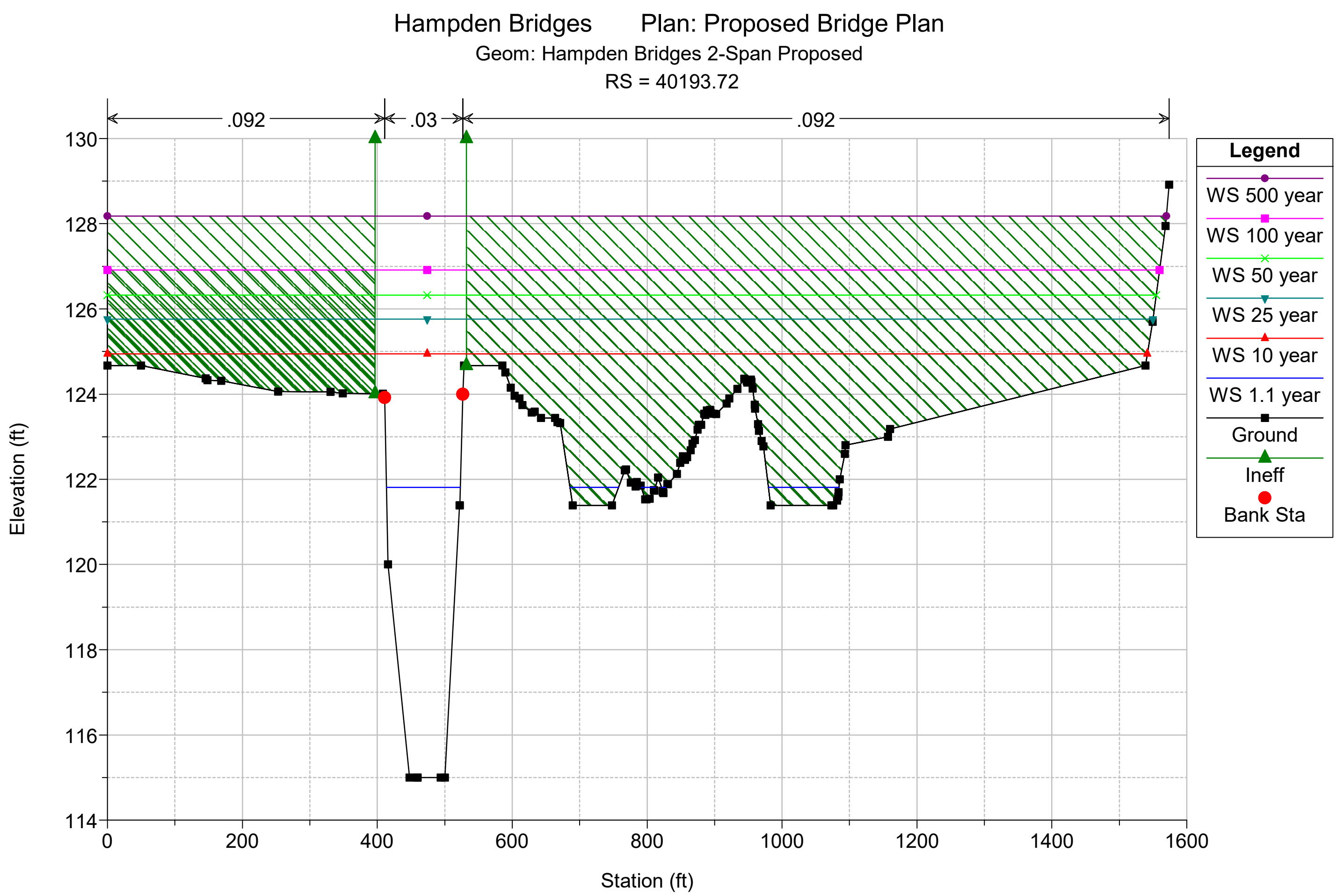

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 41055.75
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
50
100
150
200
250
300

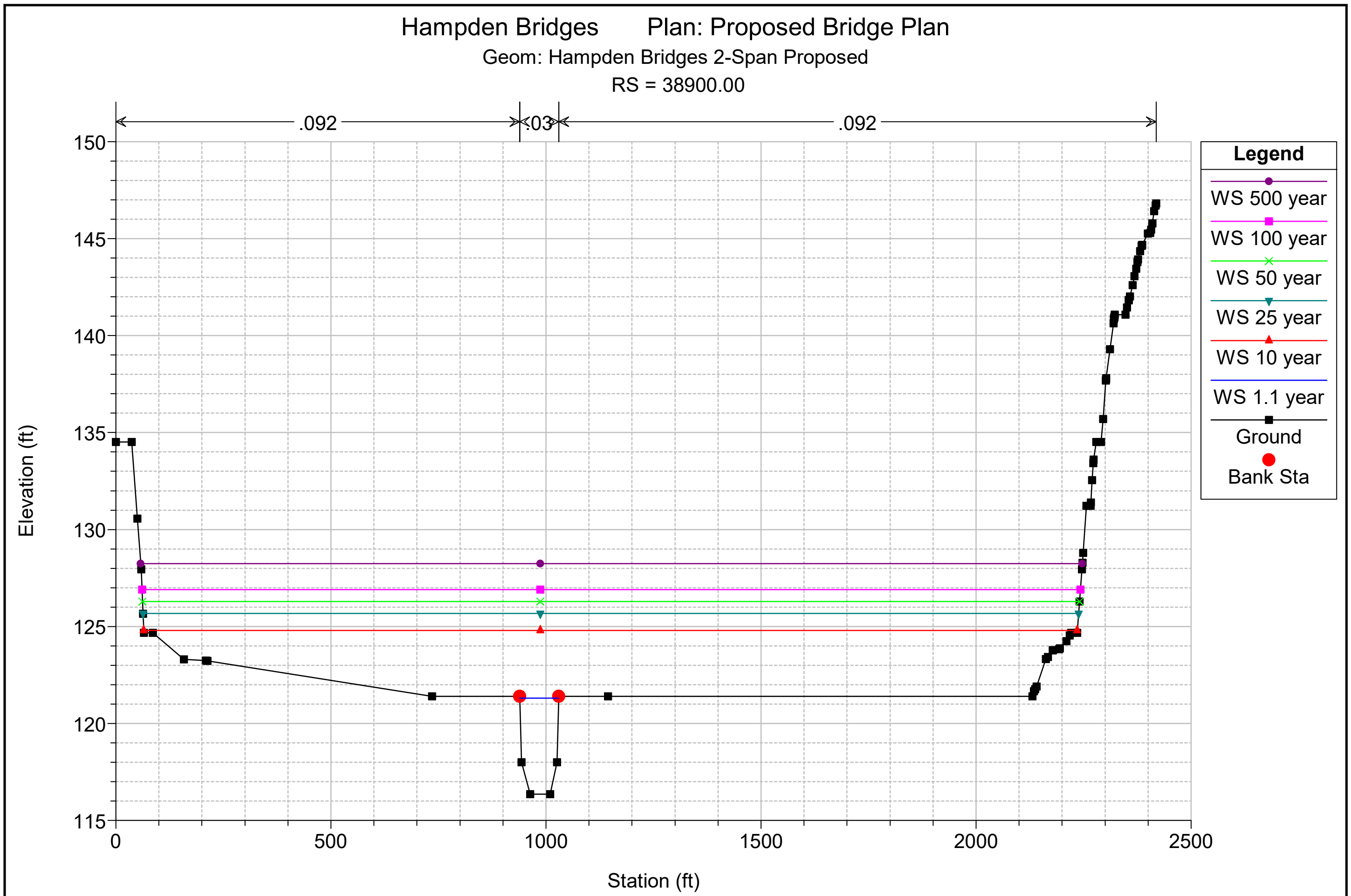

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40924.49
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
-100
0
100
200
300
400
500
600


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40532.46
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

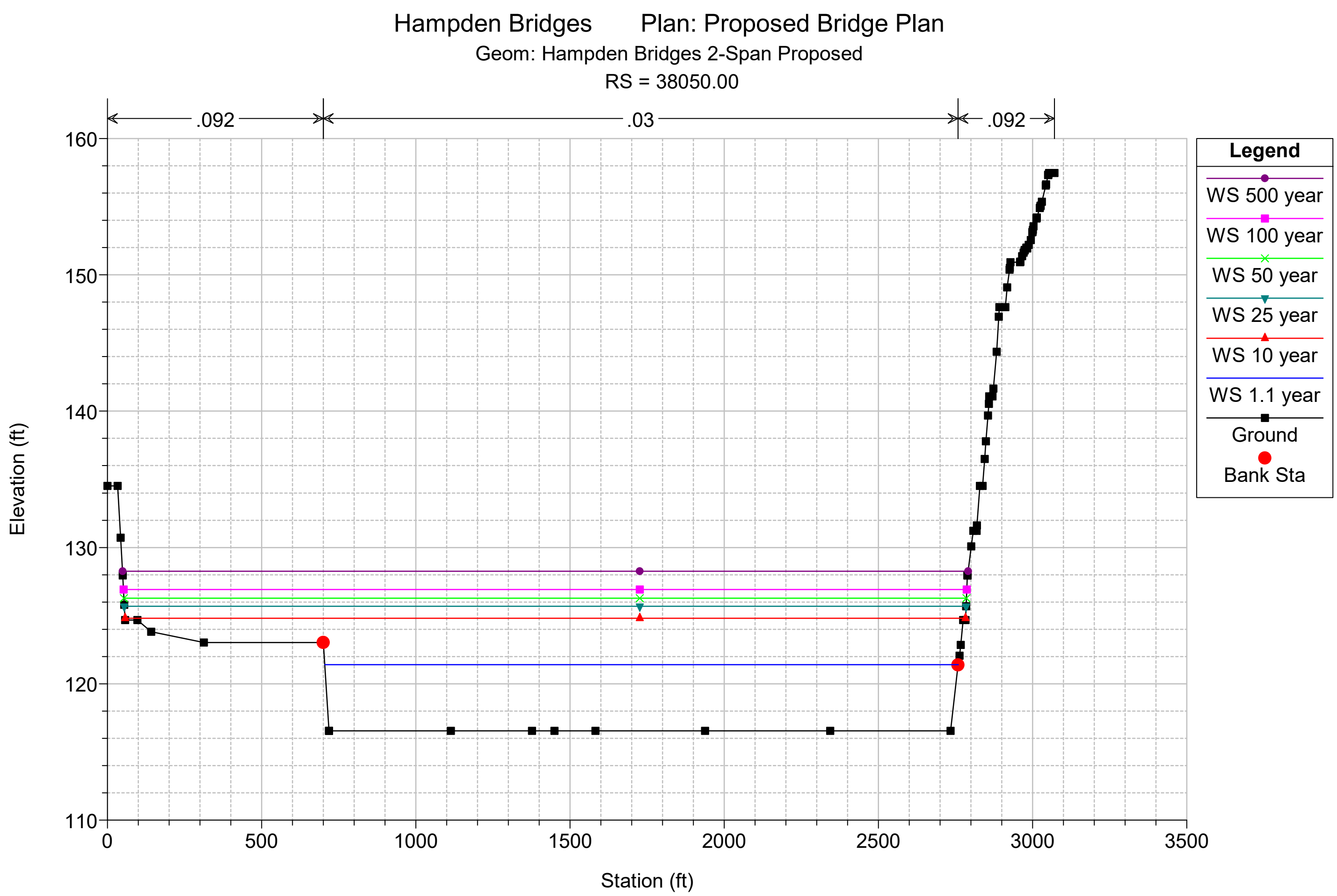

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40346 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40346 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

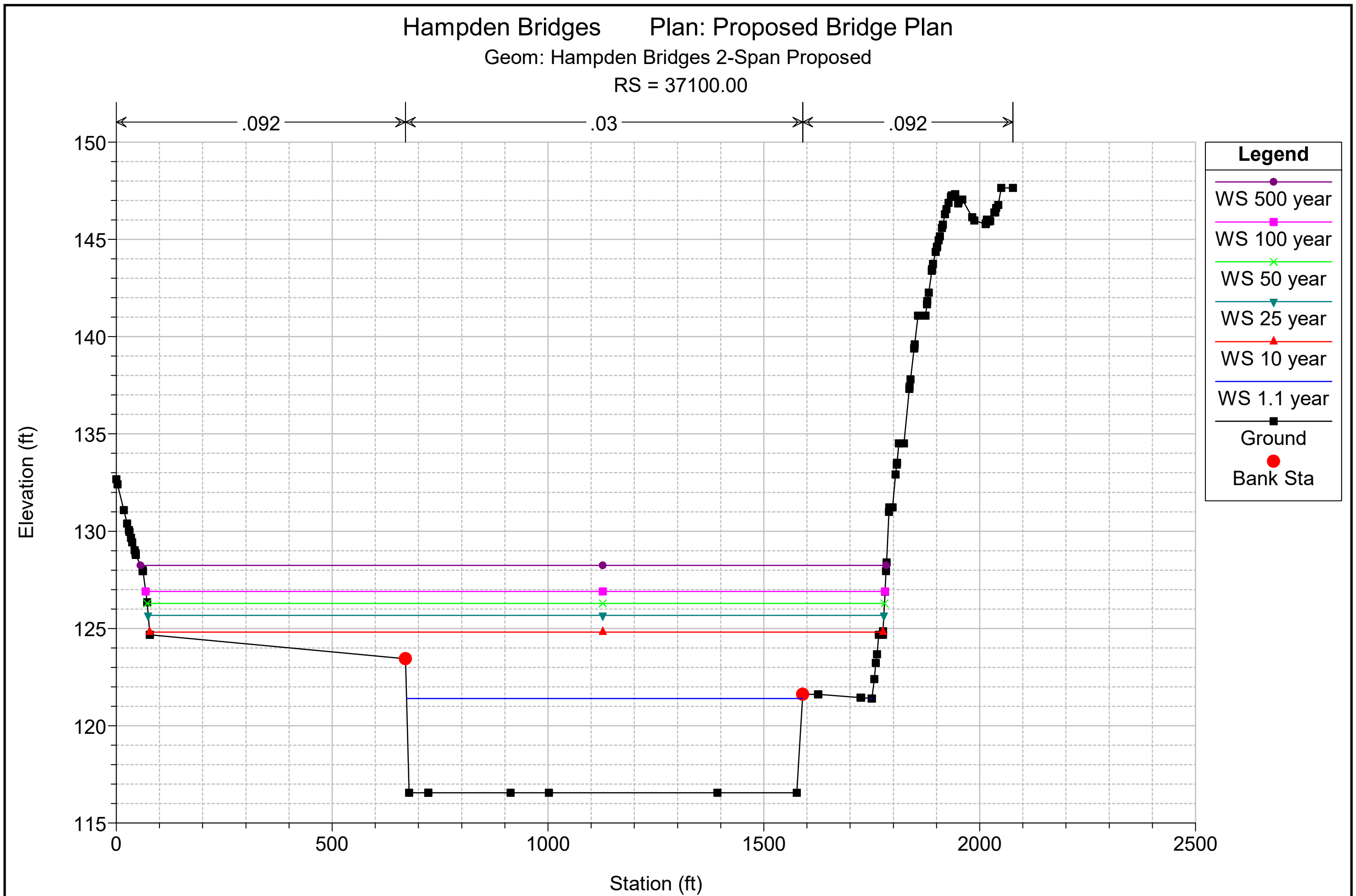

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 40193.72
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



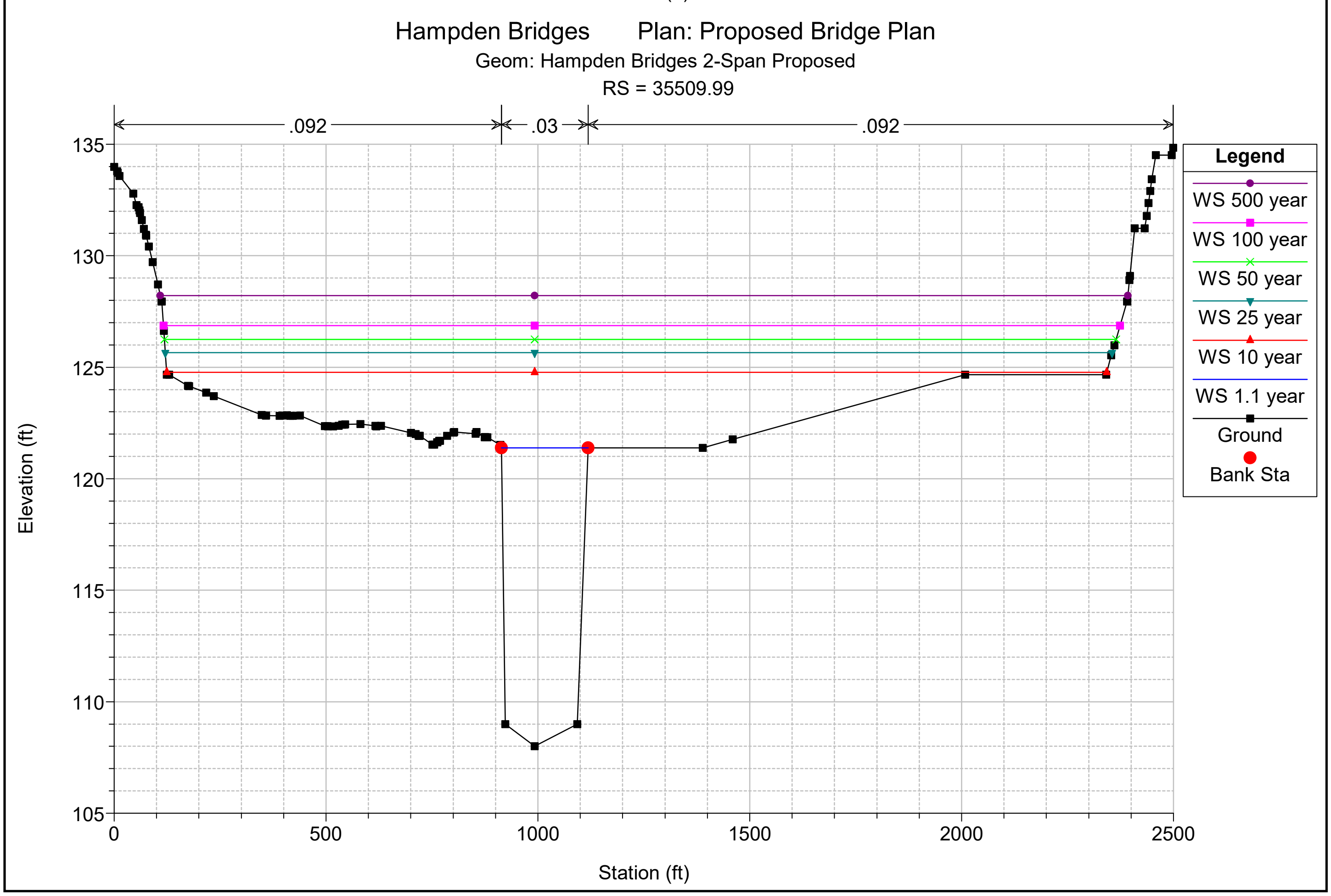
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 38900.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



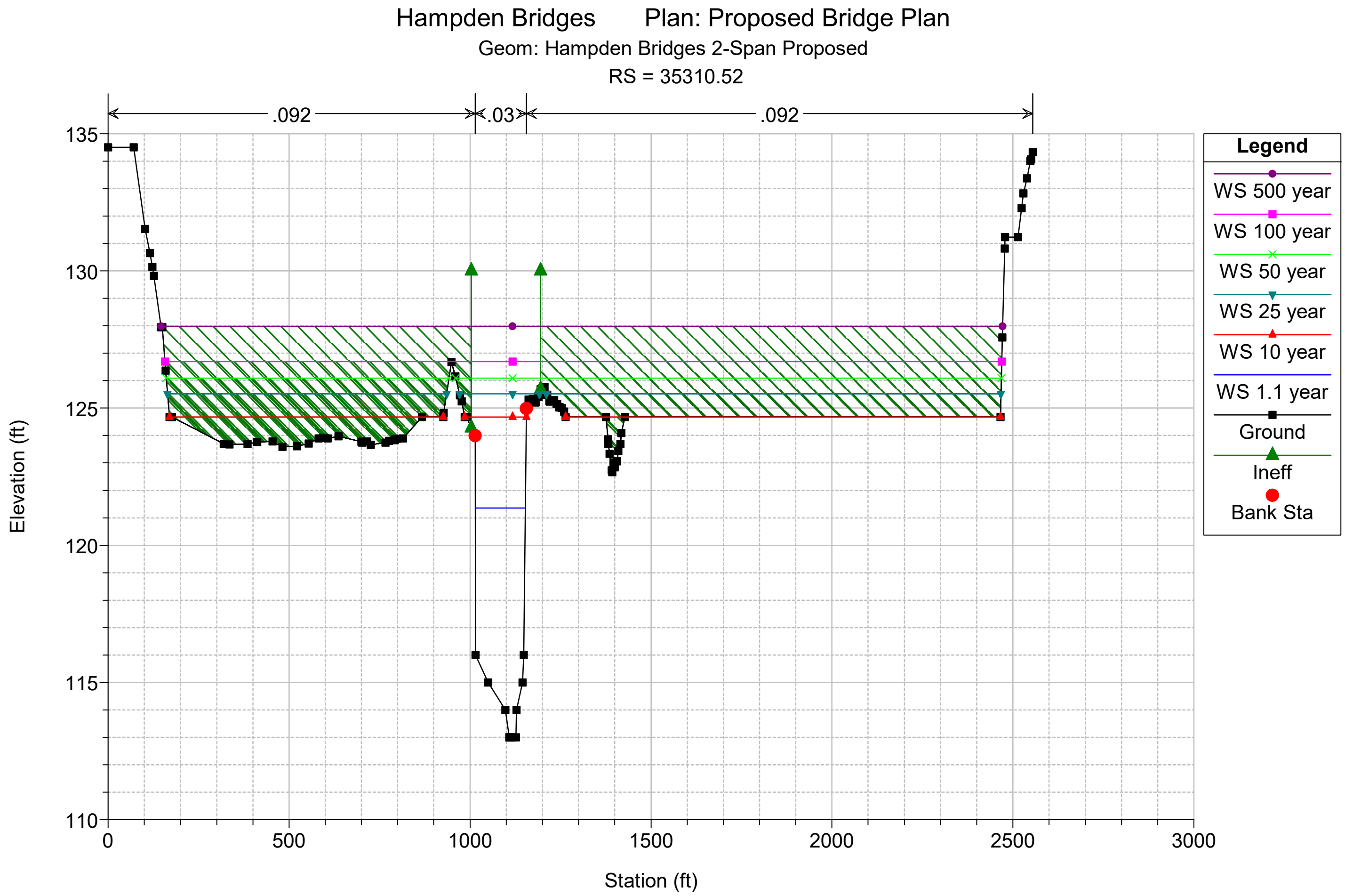
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 38050.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



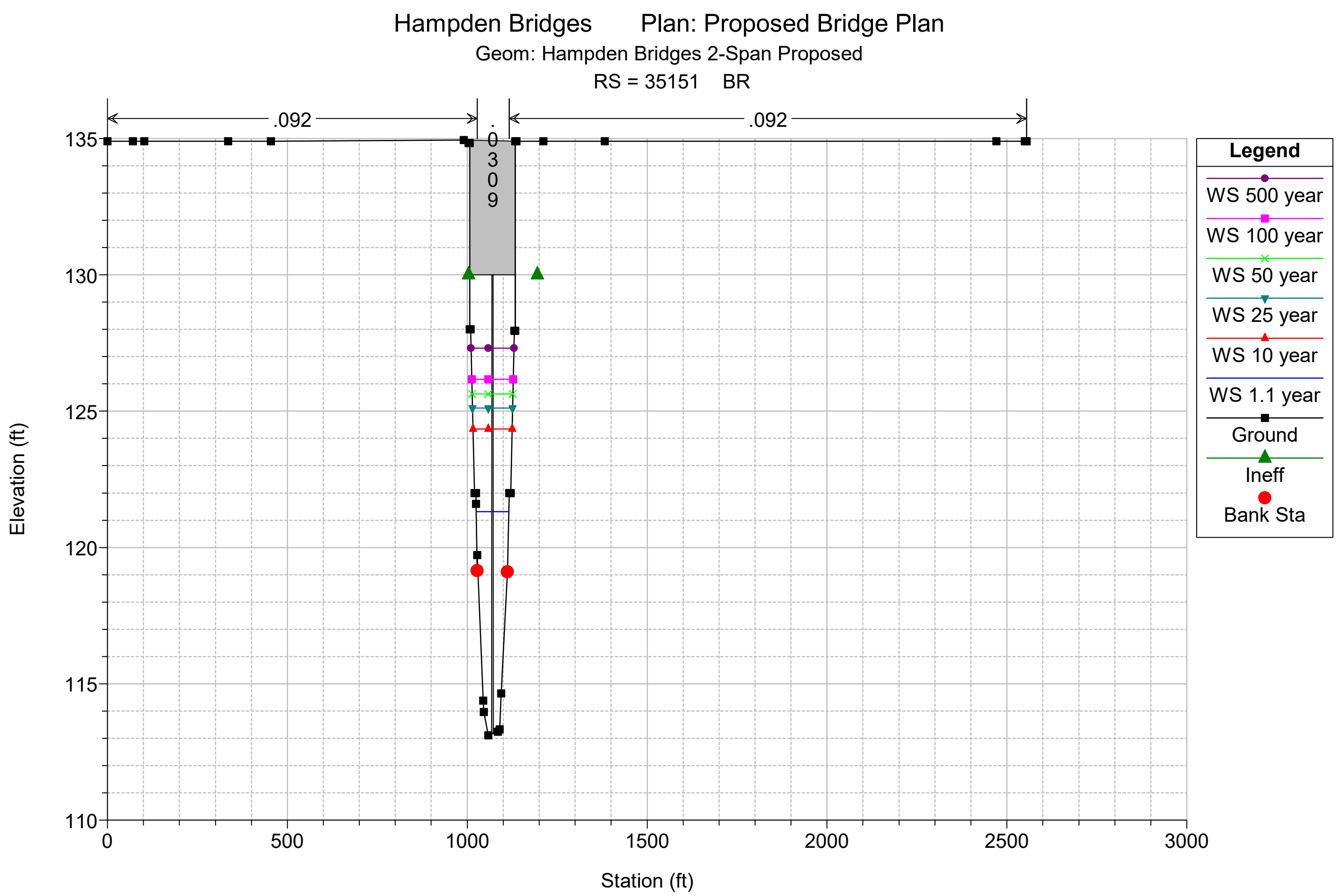
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 37100.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



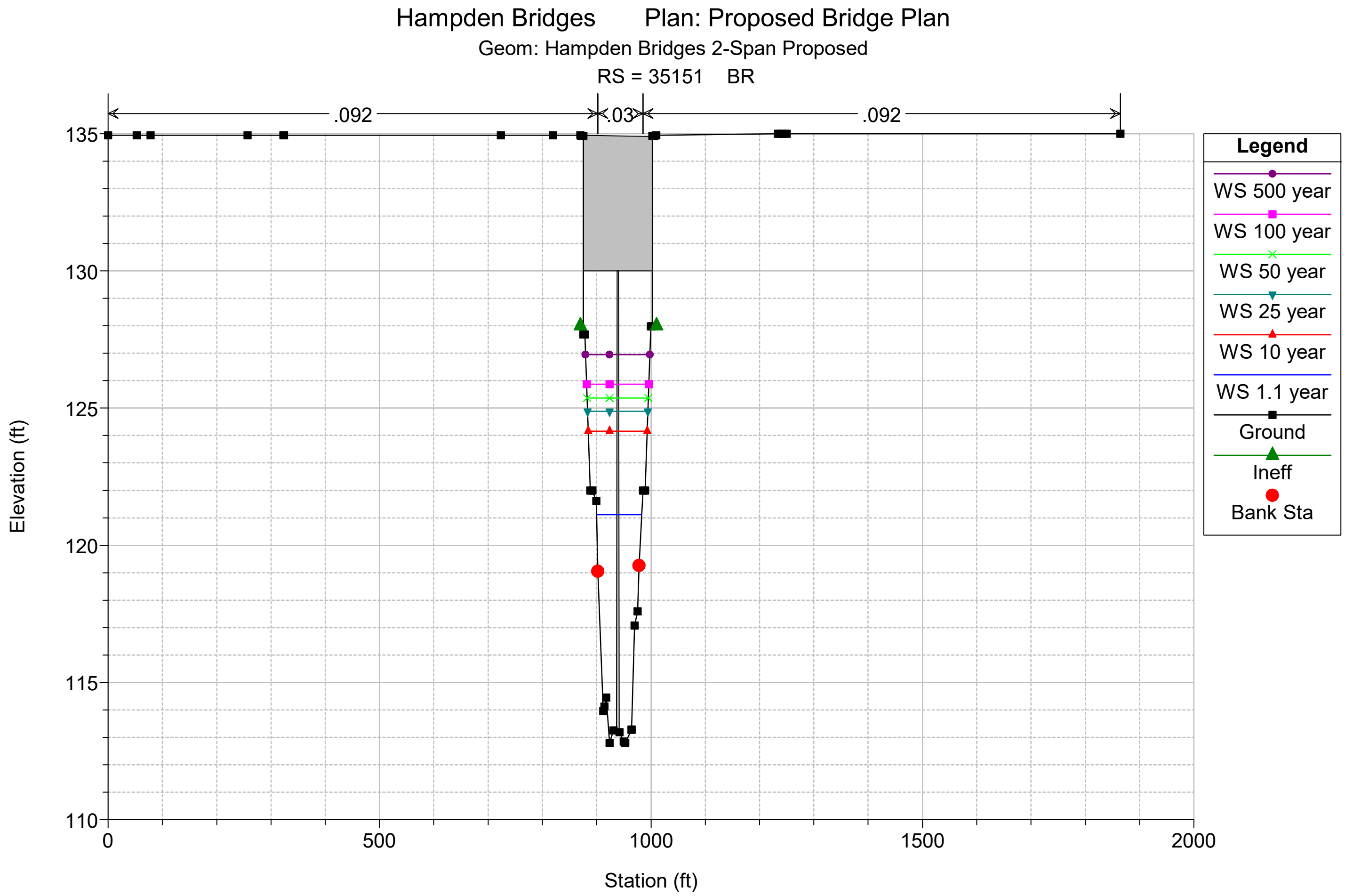
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 35509.99
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



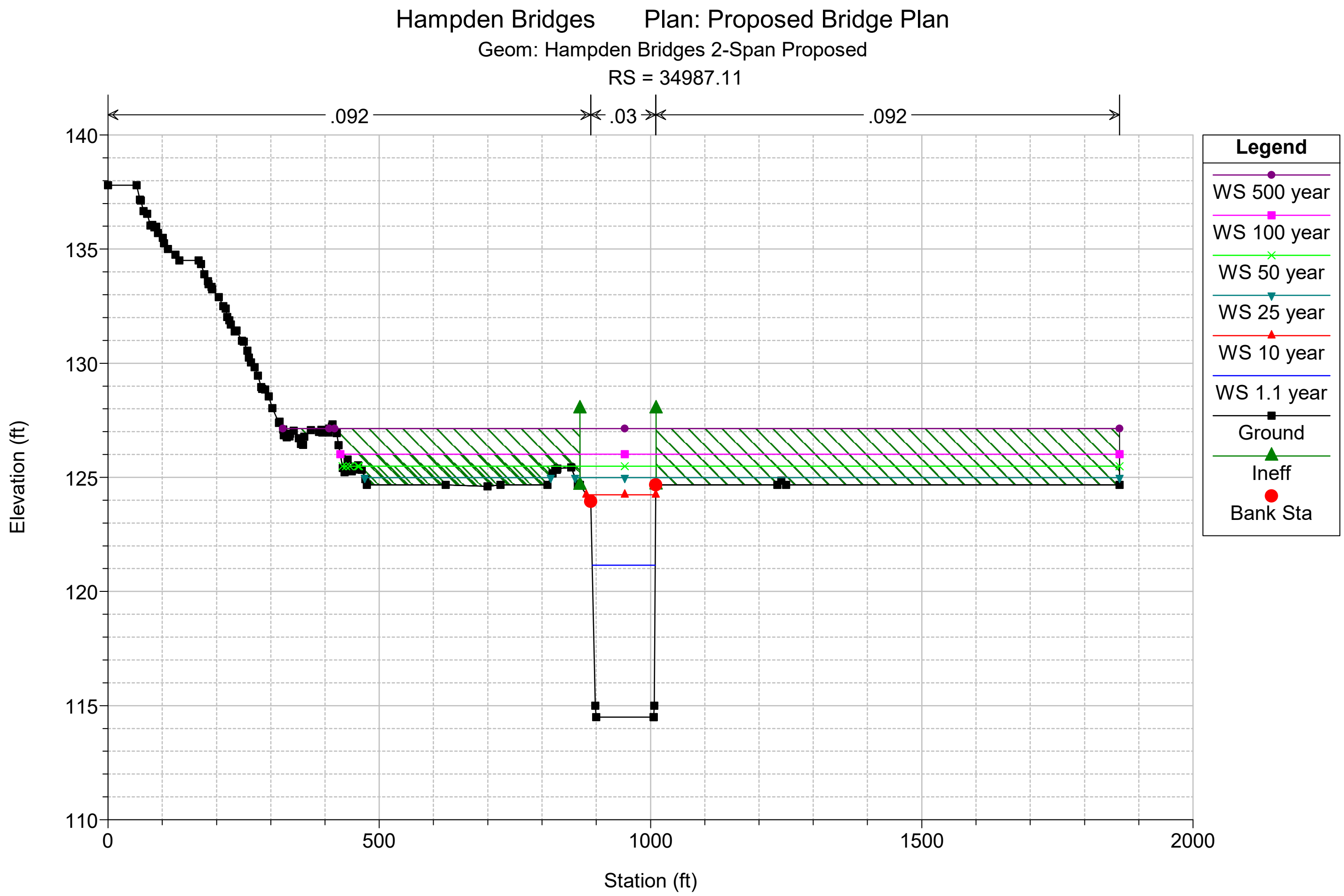
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 35310.52
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



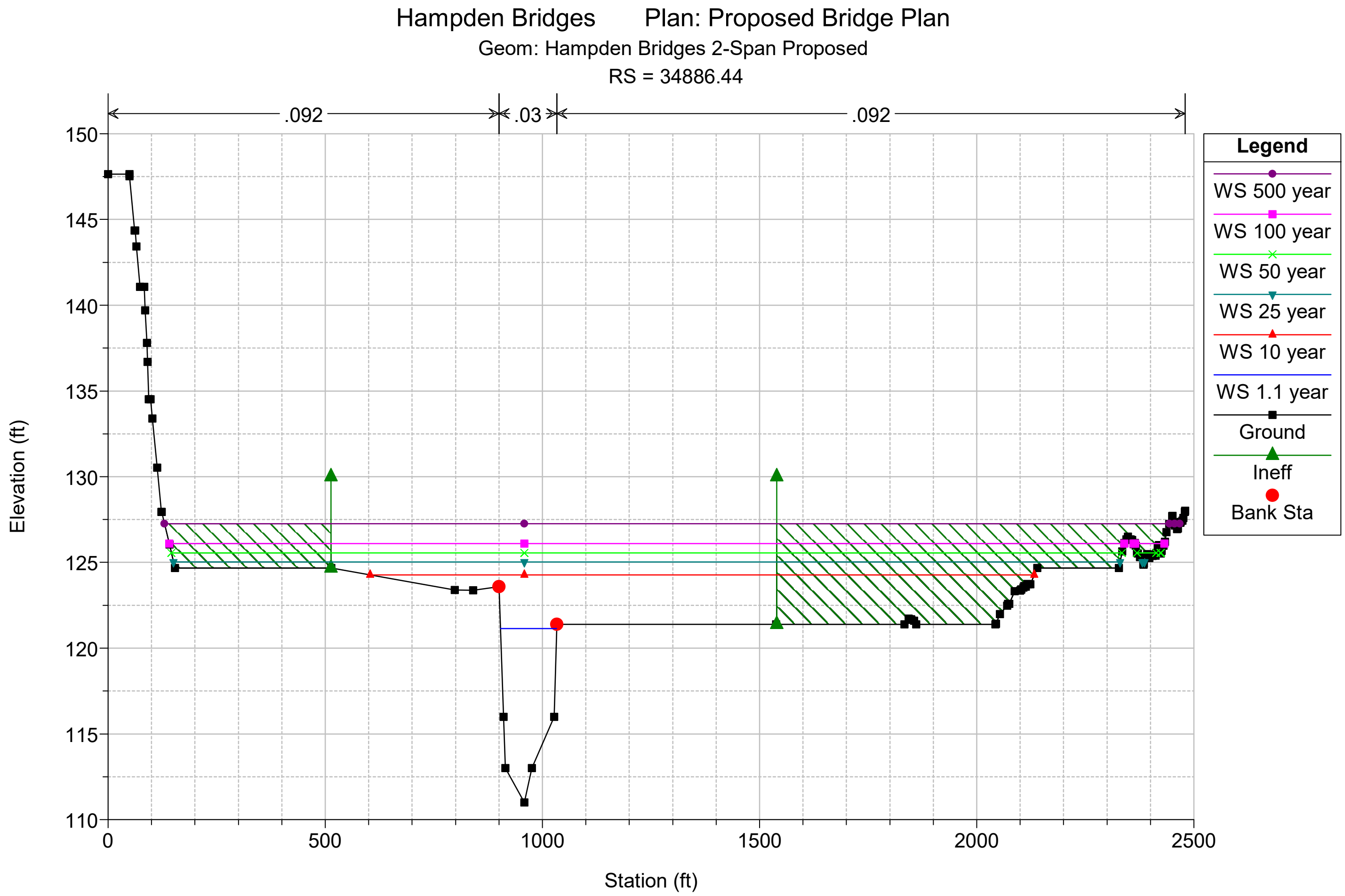
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 35151 BR
.092
.0309
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



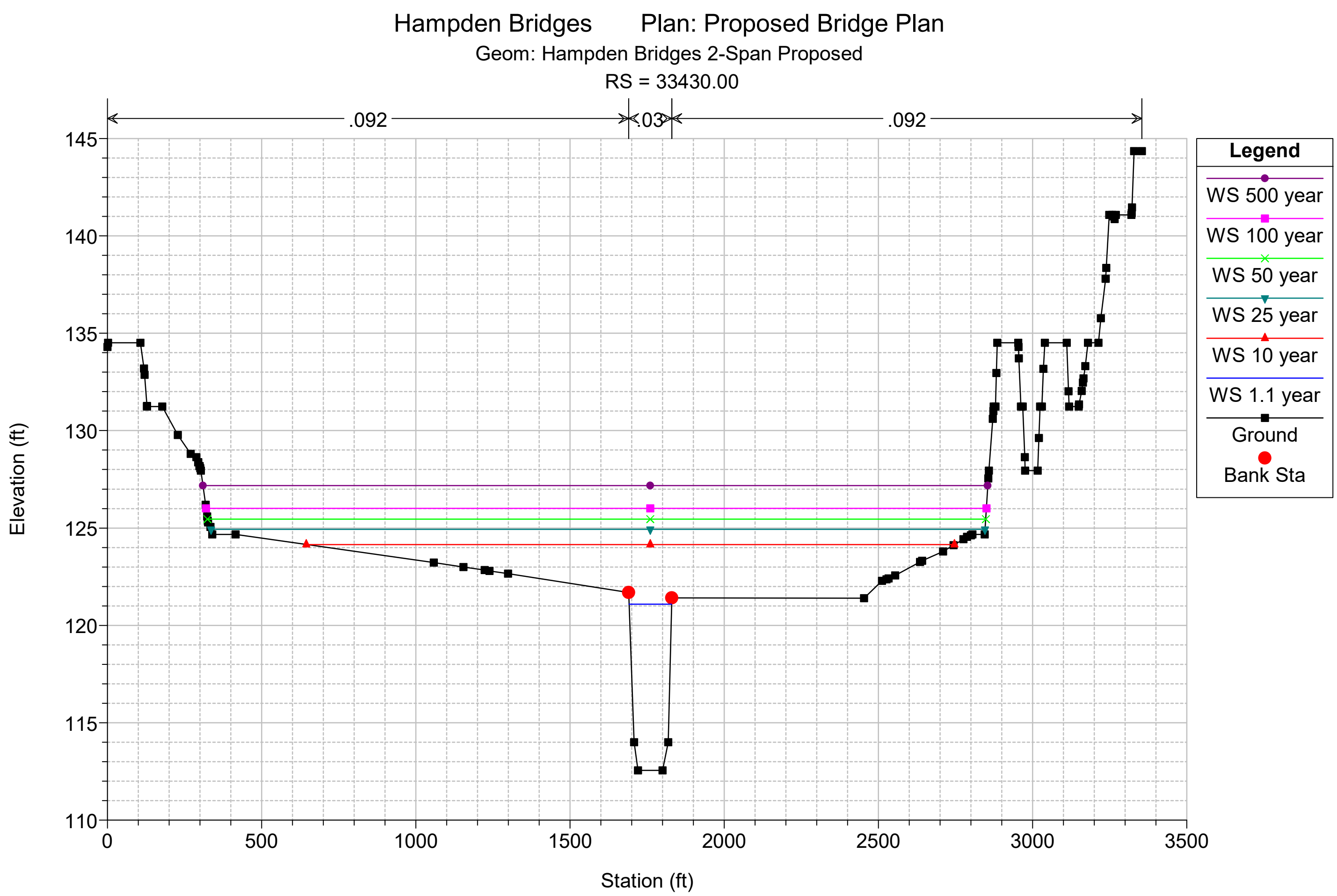
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 35151 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



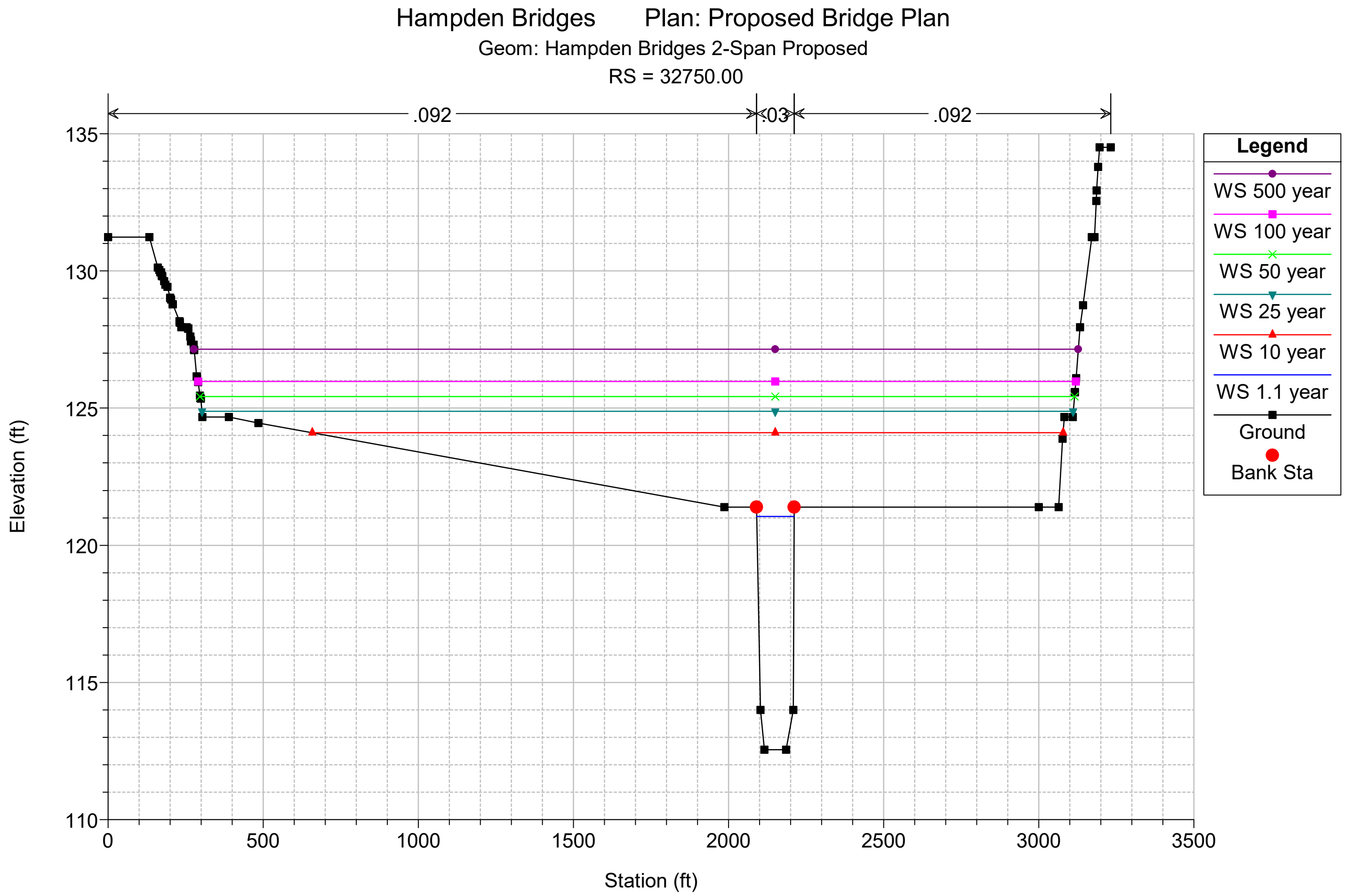
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 34987.11
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

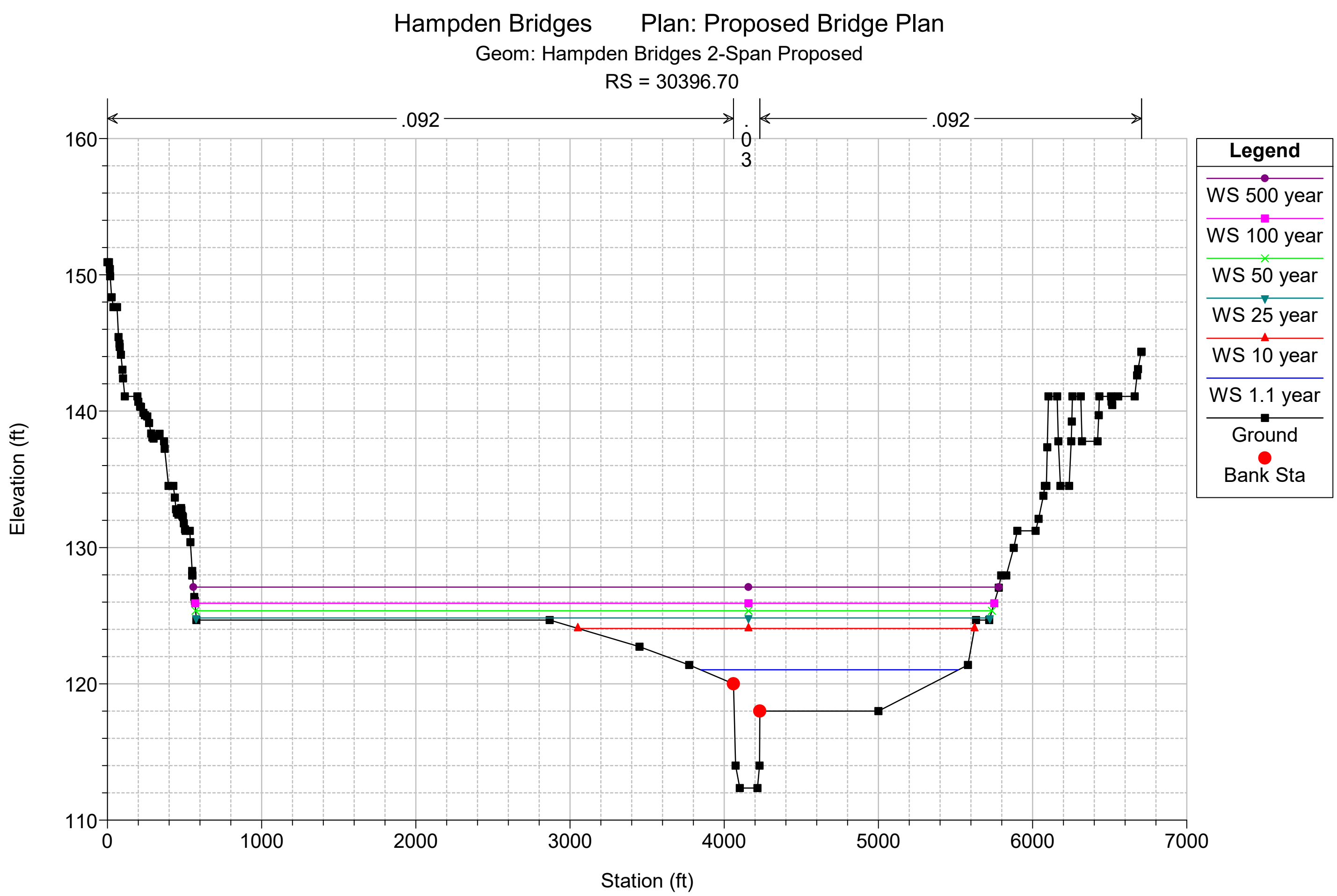


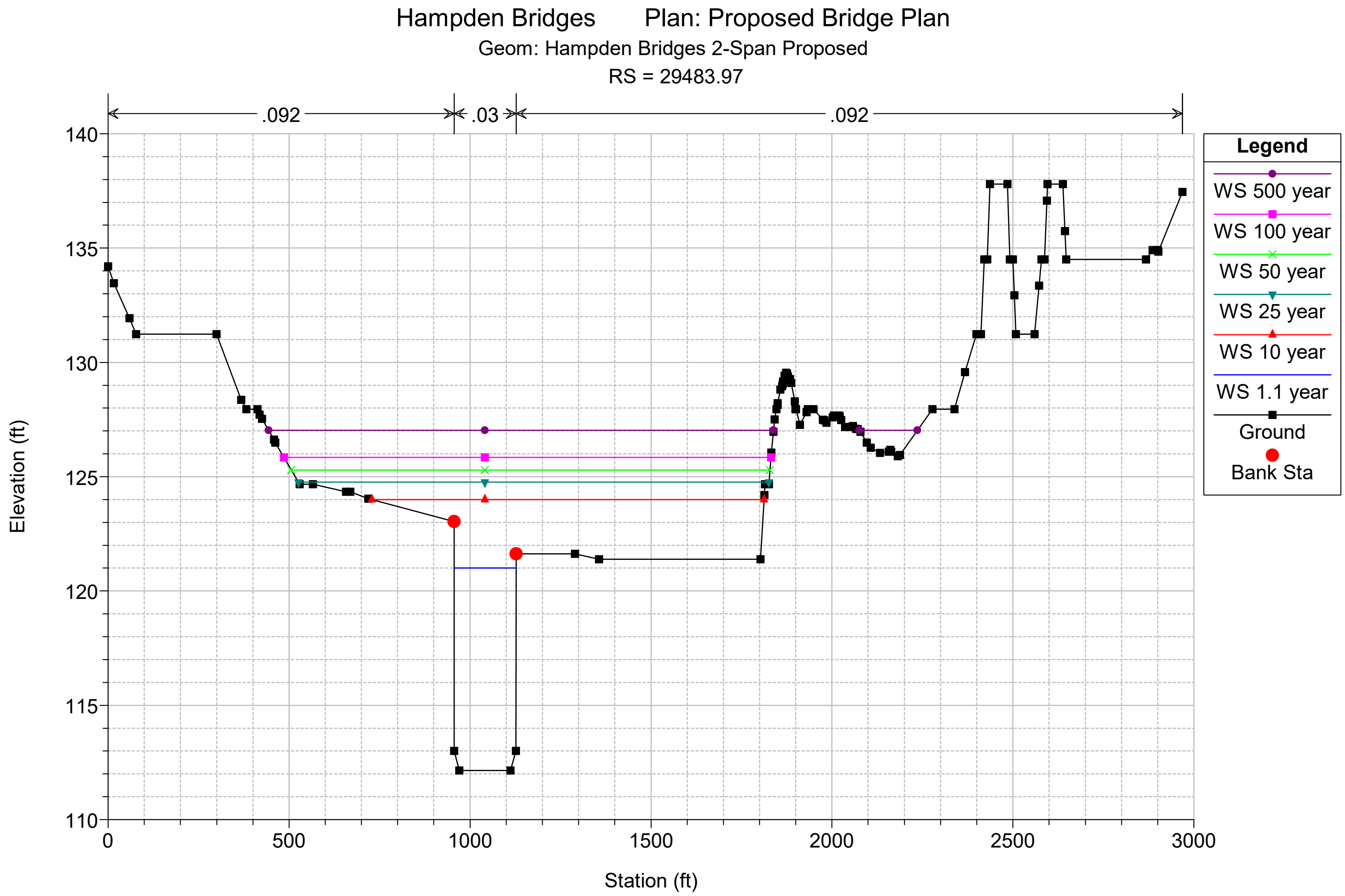
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 34886.44
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

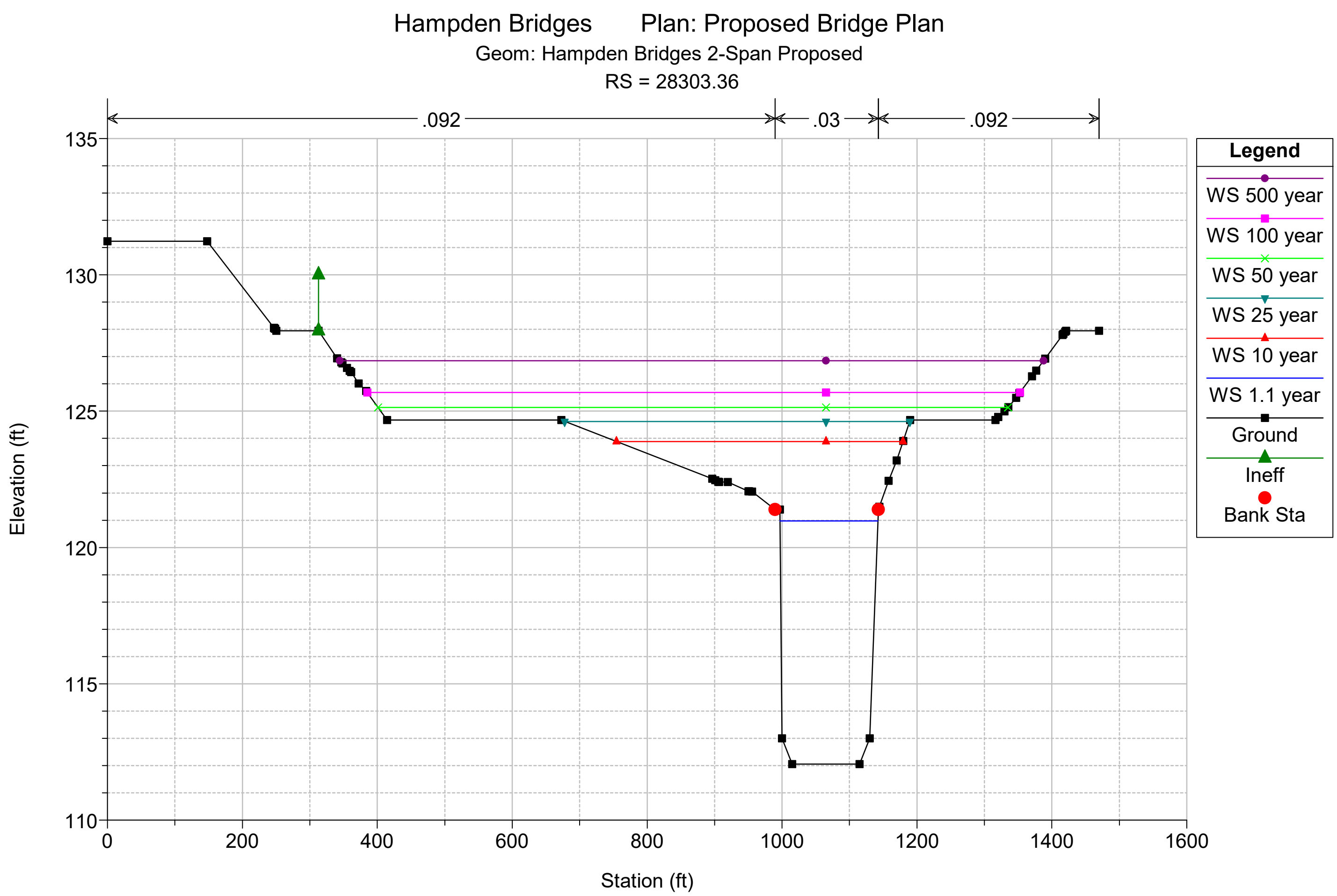


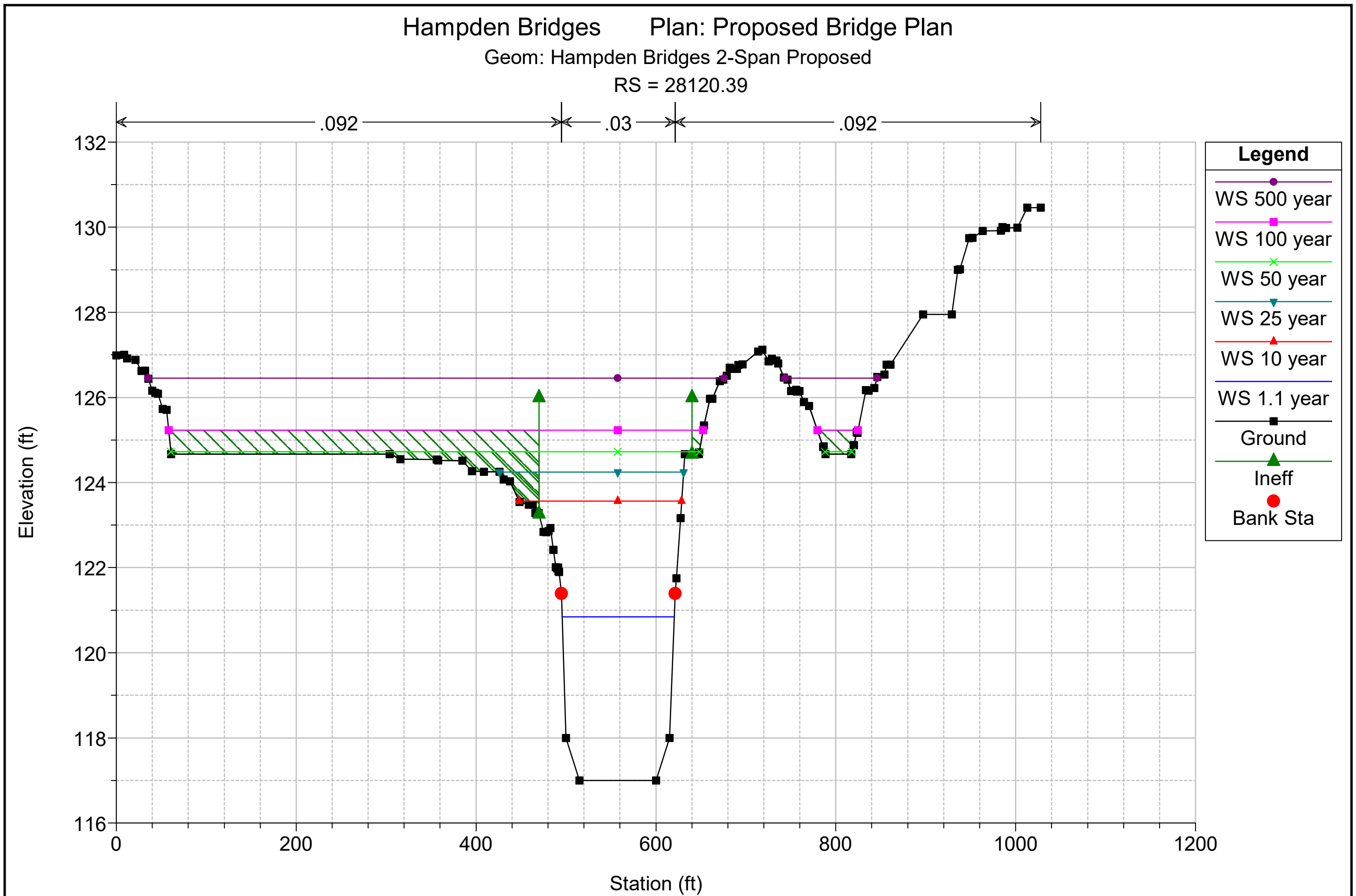
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 33430.00
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 32750.00
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
500
1000
1500
2000
2500
3000
3500

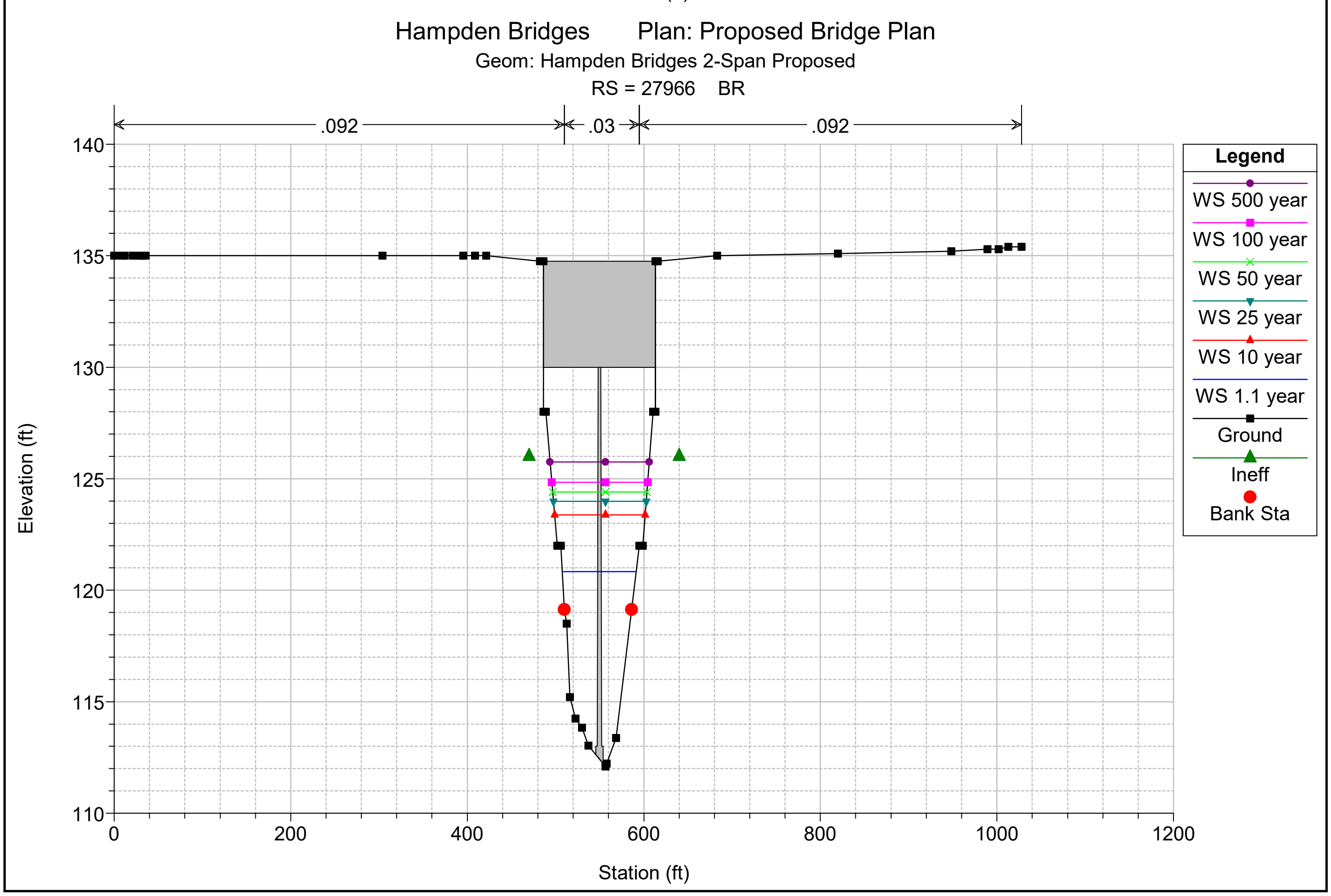

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 30396.70
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
160
150
140
130
120
110
0
1000
2000
3000
4000
5000
6000
7000


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 29483.97
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)
110
115
120
125
130
135
140
0
500
1000
1500
2000
2500
3000

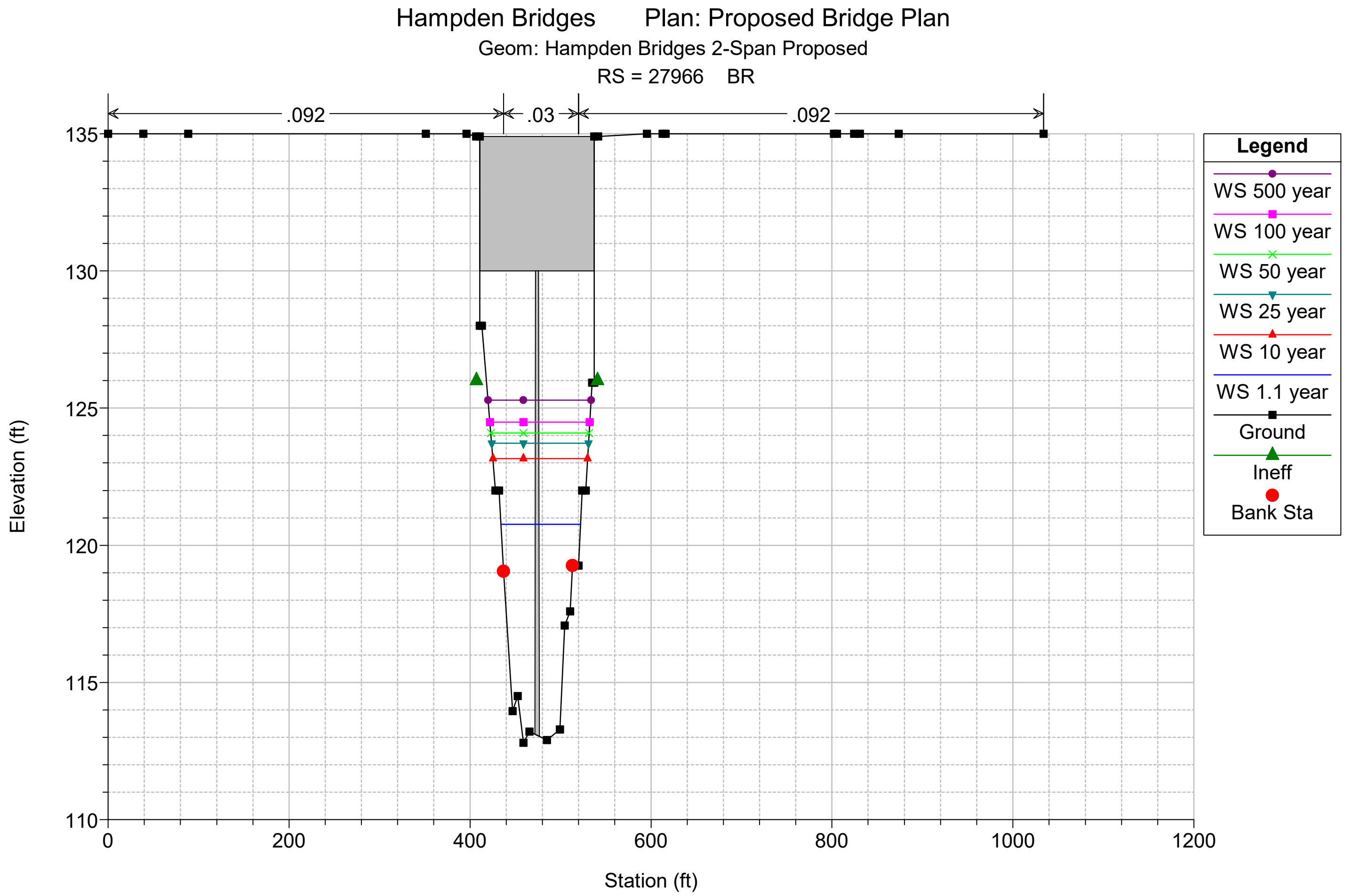

Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 28303.36
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
110
115
120
125
130
135
0
200
400
600
800
1000
1200
1400
1600



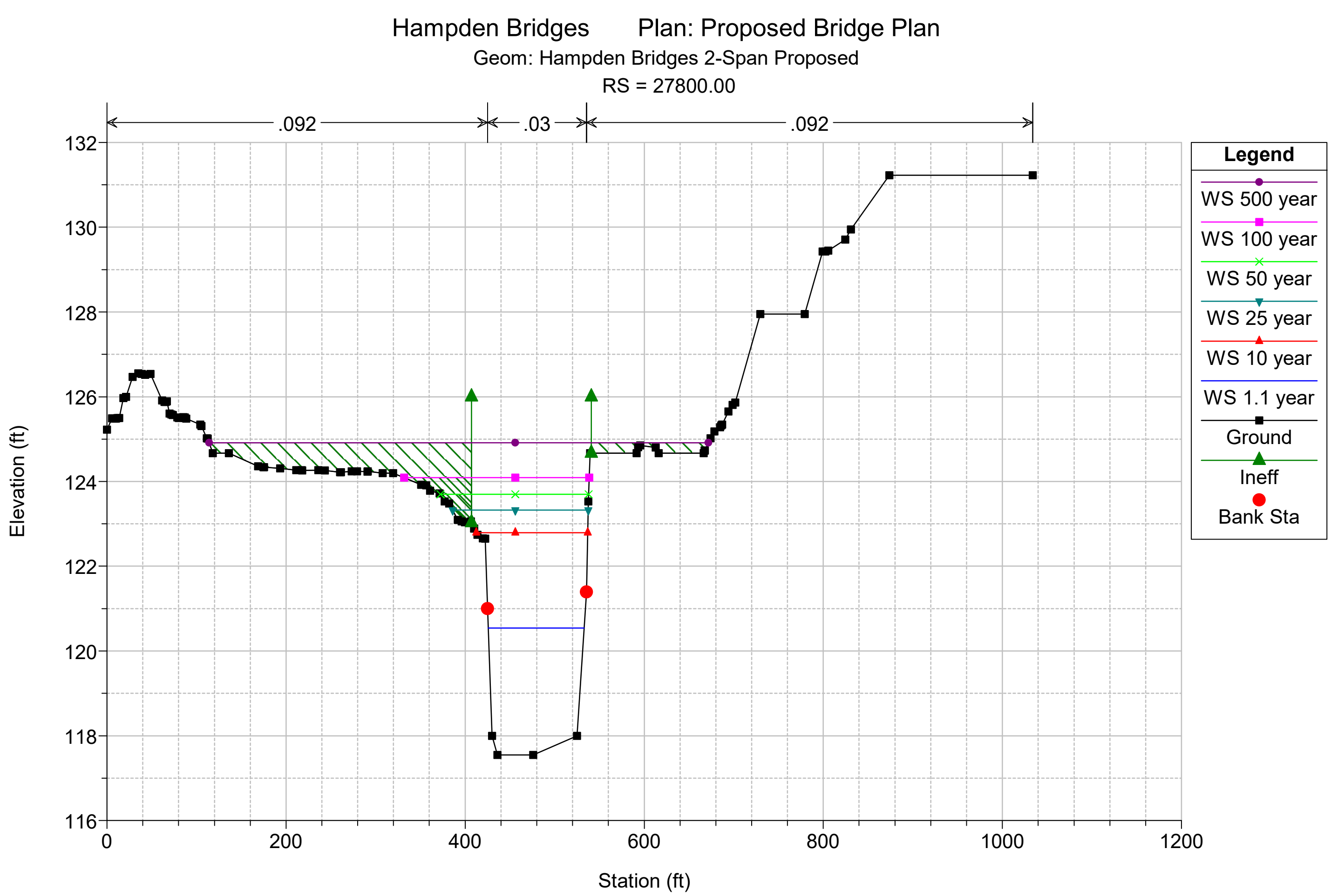
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 28120.39
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



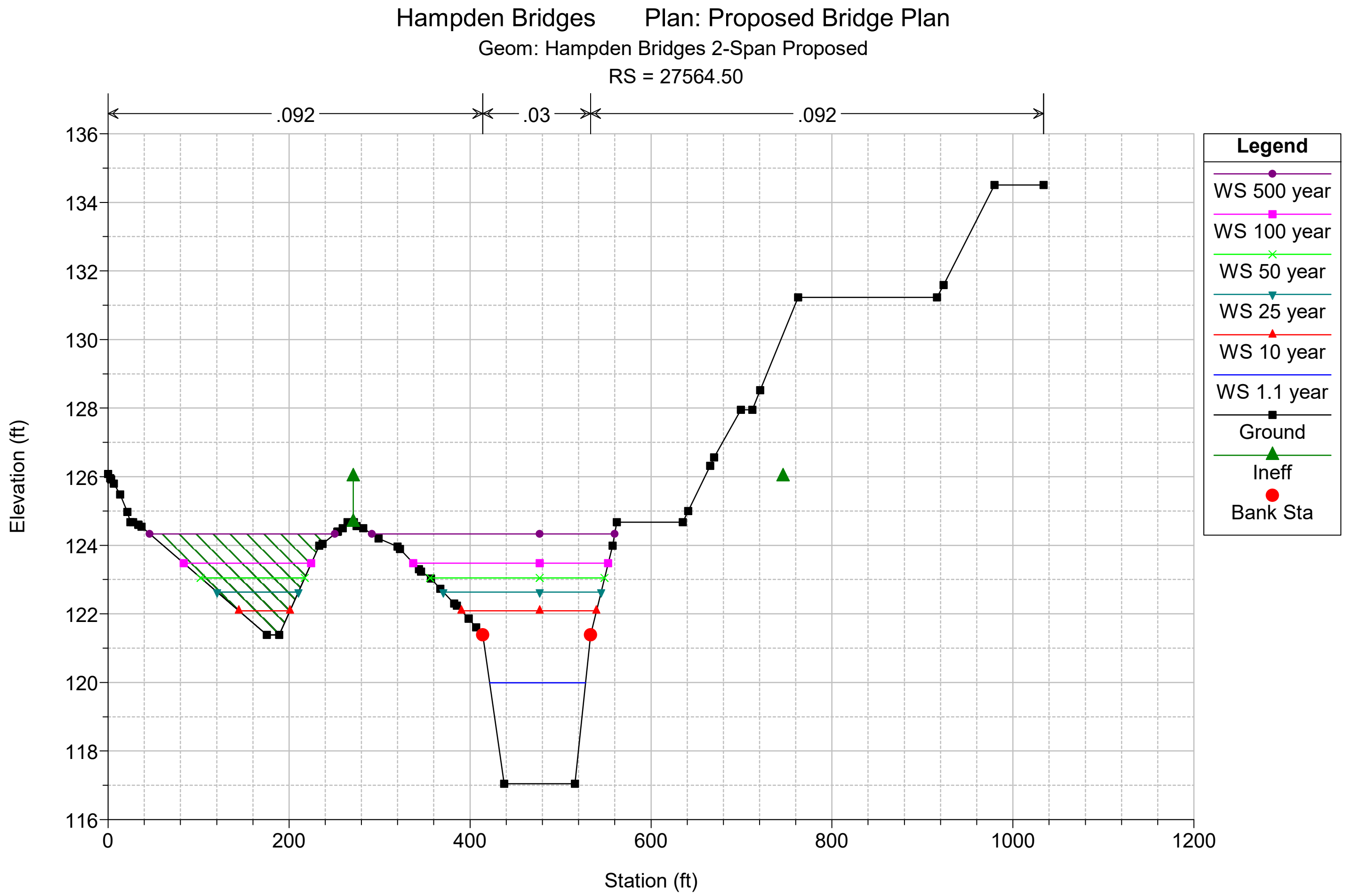
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 27966 BR
.092
.03
.092
Elevation (ft)
Station (ft)
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta

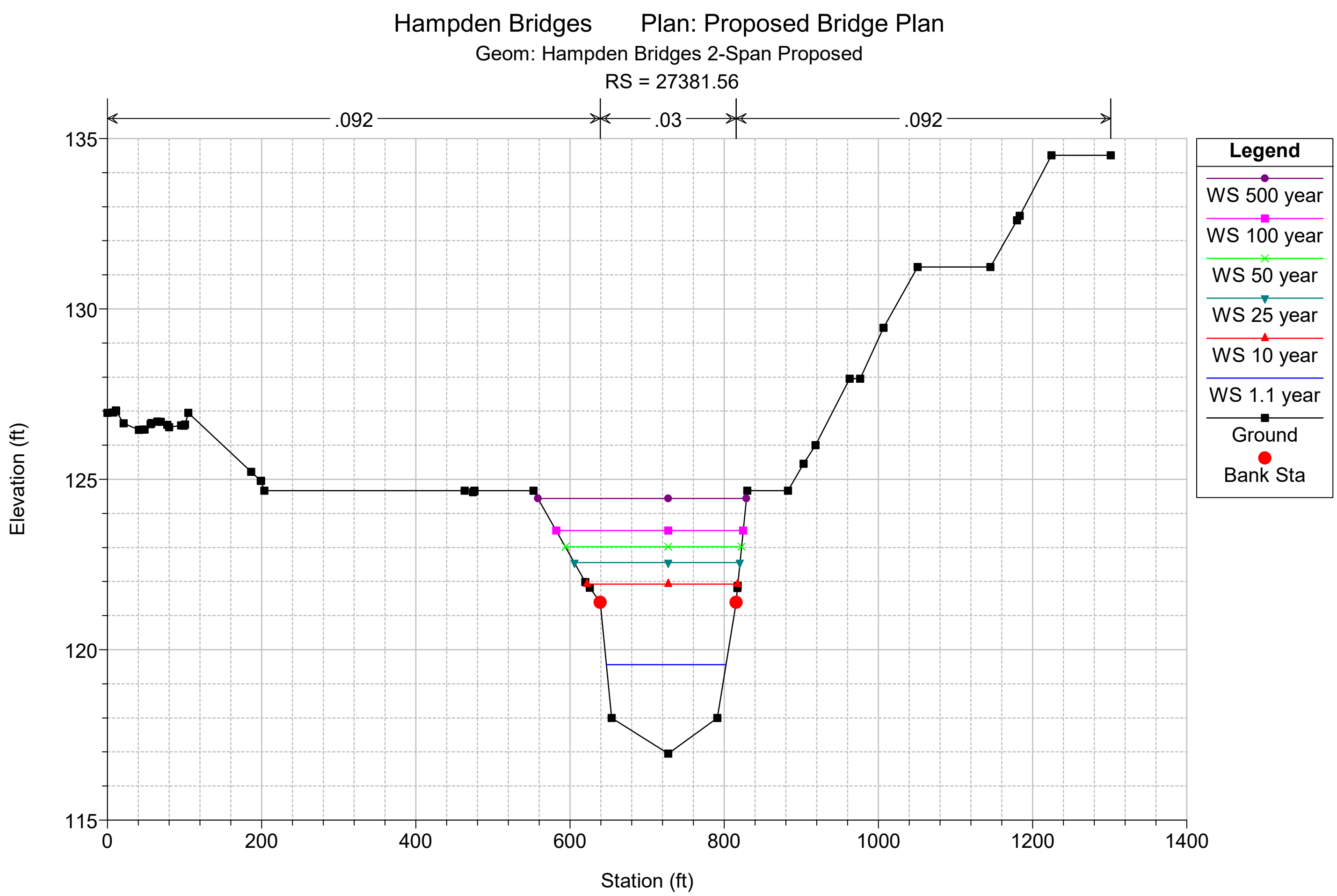


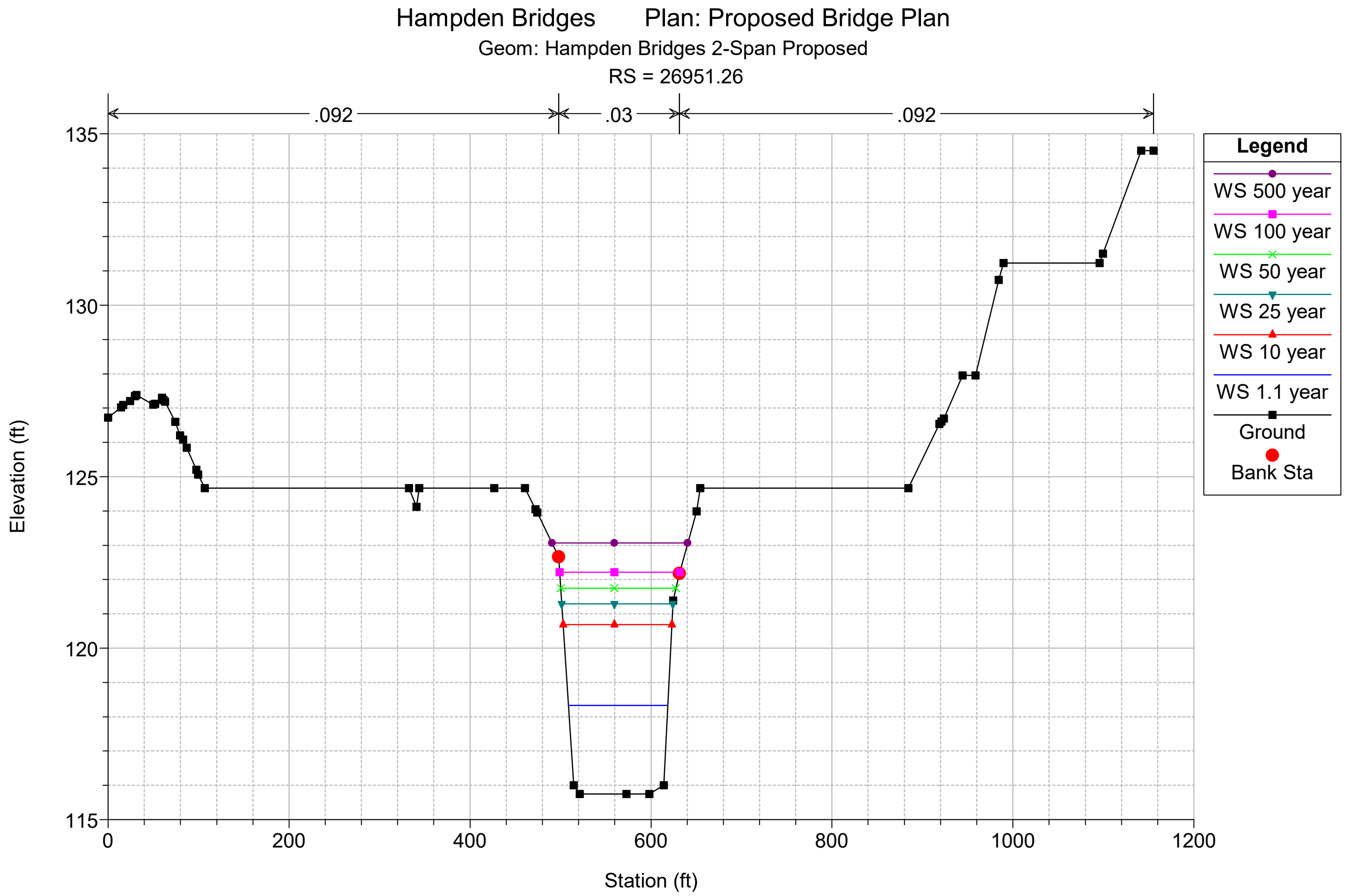
Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 27966 BR
.092
.03
.092
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
200
400
600
800
1000
1200
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta



Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 27800.00
.092
.03
.092
Elevation (ft)
Station (ft)
132
130
128
126
124
122
120
118
116
0
200
400
600
800
1000
1200
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 27564.50
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 27381.56
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
Station (ft)



Hampden Bridges Plan: Proposed Bridge Plan
Geom: Hampden Bridges 2-Span Proposed
RS = 26951.26
.092
.03
.092
Legend
WS 500 year
WS 100 year
WS 50 year
WS 25 year
WS 10 year
WS 1.1 year
Ground
Bank Sta
Elevation (ft)
135
130
125
120
115
0
200
400
600
800
1000
1200
Station (ft)

HEC-RAS River: Souadabscook Str Reach: Reach

Reach	River Sta	Profile	Plan	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
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	41522.56	1.1 year	exist MEDOT	1210.00	111.45	122.13	112.81	122.13	0.000010	0.71	1717.76	192.45	0.04
Reach	41522.56	1.1 year	PROPBRIDGE	1210.00	111.45	122.04	112.81	122.05	0.000010	0.72	1701.59	191.78	0.04
Reach	41522.56	10 year	exist MEDOT	3640.00	111.45	125.79	114.18	125.82	0.000033	1.55	2962.28	684.91	0.07
Reach	41522.56	10 year	PROPBRIDGE	3640.00	111.45	125.56	114.18	125.60	0.000035	1.58	2809.15	675.39	0.08
Reach	41522.56	25 year	exist MEDOT	4440.00	111.45	126.76	114.53	126.81	0.000038	1.72	3672.87	763.69	0.08
Reach	41522.56	25 year	PROPBRIDGE	4440.00	111.45	126.47	114.53	126.52	0.000041	1.77	3455.03	745.10	0.08
Reach	41522.56	50 year	exist MEDOT	5040.00	111.45	127.45	114.78	127.50	0.000040	1.83	4216.92	813.71	0.08
Reach	41522.56	50 year	PROPBRIDGE	5040.00	111.45	127.11	114.78	127.17	0.000044	1.89	3944.95	787.19	0.09
Reach	41522.56	100 year	exist MEDOT	5680.00	111.45	127.75	115.04	127.81	0.000047	2.00	4461.71	832.90	0.09
Reach	41522.56	100 year	PROPBRIDGE	5680.00	111.45	127.77	115.04	127.83	0.000047	2.00	4480.39	834.16	0.09
Reach	41522.56	500 year	exist MEDOT	7180.00	111.45	129.25	115.63	129.32	0.000051	2.20	5779.77	919.73	0.09
Reach	41522.56	500 year	PROPBRIDGE	7180.00	111.45	129.21	115.61	129.28	0.000051	2.21	5746.82	917.92	0.09
Reach	41055.75	1.1 year	exist MEDOT	1210.00	110.45	122.11		122.12	0.000026	1.12	1077.74	101.07	0.06
Reach	41055.75	1.1 year	PROPBRIDGE	1210.00	110.45	122.02		122.04	0.000027	1.13	1069.20	101.00	0.06
Reach	41055.75	10 year	exist MEDOT	3640.00	110.45	125.69		125.79	0.000090	2.53	1448.79	106.60	0.12
Reach	41055.75	10 year	PROPBRIDGE	3640.00	110.45	125.46		125.57	0.000095	2.57	1424.48	106.43	0.12
Reach	41055.75	25 year	exist MEDOT	4440.00	110.45	126.64		126.77	0.000108	2.90	1550.11	107.32	0.13
Reach	41055.75	25 year	PROPBRIDGE	4440.00	110.45	126.35		126.48	0.000115	2.95	1518.68	107.10	0.13
Reach	41055.75	50 year	exist MEDOT	5040.00	110.45	127.31		127.46	0.000121	3.15	1621.94	107.82	0.14
Reach	41055.75	50 year	PROPBRIDGE	5040.00	110.45	126.96		127.12	0.000130	3.22	1584.70	107.56	0.14
Reach	41055.75	100 year	exist MEDOT	5680.00	110.45	127.57		127.76	0.000145	3.49	1650.34	108.02	0.15
Reach	41055.75	100 year	PROPBRIDGE	5680.00	110.45	127.59		127.78	0.000144	3.49	1652.81	108.04	0.15
Reach	41055.75	500 year	exist MEDOT	7180.00	110.45	129.00		129.26	0.000174	4.05	1806.17	109.68	0.17
Reach	41055.75	500 year	PROPBRIDGE	7180.00	110.45	128.97		129.22	0.000176	4.06	1802.13	109.63	0.17
Reach	40924.49	1.1 year	exist MEDOT	1210.00	110.45	122.10		122.12	0.000033	1.19	1018.91	113.34	0.07
Reach	40924.49	1.1 year	PROPBRIDGE	1210.00	110.45	122.01		122.04	0.000034	1.20	1009.33	112.86	0.07
Reach	40924.49	10 year	exist MEDOT	3640.00	110.45	125.69		125.77	0.000132	2.38	1581.05	249.35	0.14
Reach	40924.49	10 year	PROPBRIDGE	3640.00	110.45	125.46		125.55	0.000144	2.45	1525.81	230.19	0.15
Reach	40924.49	25 year	exist MEDOT	4440.00	110.45	126.64		126.75	0.000138	2.61	1888.62	354.59	0.15
Reach	40924.49	25 year	PROPBRIDGE	4440.00	110.45	126.34		126.46	0.000154	2.70	1785.64	340.33	0.15
Reach	40924.49	50 year	exist MEDOT	5040.00	110.45	127.32		127.43	0.000141	2.75	2140.46	387.01	0.15
Reach	40924.49	50 year	PROPBRIDGE	5040.00	110.45	126.97		127.09	0.000159	2.86	2007.15	374.90	0.16
Reach	40924.49	100 year	exist MEDOT	5680.00	110.45	127.59		127.72	0.000163	3.01	2245.73	395.85	0.16
Reach	40924.49	100 year	PROPBRIDGE	5680.00	110.45	127.61		127.75	0.000162	3.00	2254.90	396.61	0.16
Reach	40924.49	500 year	exist MEDOT	7180.00	110.45	129.05		129.21	0.000164	3.28	2874.49	460.42	0.16
Reach	40924.49	500 year	PROPBRIDGE	7180.00	110.45	129.01		129.17	0.000166	3.29	2857.42	459.08	0.17
Reach	40799.90	1.1 year	exist MEDOT	1210.00	110.85	122.07		122.11	0.000110	1.68	719.47	118.06	0.12
Reach	40799.90	1.1 year	PROPBRIDGE	1210.00	110.85	121.98		122.03	0.000115	1.71	709.34	117.69	0.12
Reach	40799.90	10 year	exist MEDOT	3640.00	110.85	125.60		125.75	0.000221	3.12	1334.11	326.55	0.18
Reach	40799.90	10 year	PROPBRIDGE	3640.00	110.85	125.36		125.52	0.000243	3.21	1257.05	321.12	0.19
Reach	40799.90	25 year	exist MEDOT	4440.00	110.85	126.55		126.72	0.000227	3.38	1653.75	348.14	0.19
Reach	40799.90	25 year	PROPBRIDGE	4440.00	110.85	126.24		126.43	0.000255	3.51	1548.09	341.18	0.20
Reach	40799.90	50 year	exist MEDOT	5040.00	110.85	127.22		127.40	0.000229	3.54	1892.64	363.11	0.19
Reach	40799.90	50 year	PROPBRIDGE	5040.00	110.85	126.85		127.06	0.000261	3.69	1762.69	355.05	0.20
Reach	40799.90	100 year	exist MEDOT	5680.00	110.85	127.47		127.69	0.000266	3.88	1984.37	368.69	0.21
Reach	40799.90	100 year	PROPBRIDGE	5680.00	110.85	127.49		127.71	0.000264	3.87	1993.23	369.23	0.21
Reach	40799.90	500 year	exist MEDOT	7180.00	110.85	128.92		129.17	0.000262	4.18	2555.19	412.09	0.21
Reach	40799.90	500 year	PROPBRIDGE	7180.00	110.85	128.88		129.14	0.000266	4.20	2539.31	411.25	0.21
Reach	40532.46	1.1 year	exist MEDOT	1210.00	112.50	122.01	116.31	122.07	0.000167	1.97	613.73	114.72	0.15
Reach	40532.46	1.1 year	PROPBRIDGE	1210.00	112.50	121.93	116.31	121.99	0.000175	2.01	603.66	113.35	0.15
Reach	40532.46	10 year	exist MEDOT	3640.00	112.50	125.48	118.92	125.67	0.000300	3.58	1059.21	1603.59	0.21
Reach	40532.46	10 year	PROPBRIDGE	3640.00	112.50	125.23	118.92	125.44	0.000331	3.68	1025.57	1599.98	0.22
Reach	40532.46	25 year	exist MEDOT	4440.00	112.50	126.40	119.75	126.64	0.000317	3.93	1185.06	1626.77	0.22
Reach	40532.46	25 year	PROPBRIDGE	4440.00	112.50	126.08	119.75	126.34	0.000355	4.07	1141.80	1620.50	0.24
Reach	40532.46	50 year	exist MEDOT	5040.00	112.50	127.06	120.21	127.32	0.000327	4.17	1273.99	1635.26	0.23
Reach	40532.46	50 year	PROPBRIDGE	5040.00	112.50	126.68	120.21	126.97	0.000371	4.33	1222.86	1630.99	0.24
Reach	40532.46	100 year	exist MEDOT	5680.00	112.50	127.27	120.63	127.59	0.000387	4.60	1303.03	1636.65	0.25
Reach	40532.46	100 year	PROPBRIDGE	5680.00	112.50	127.29	120.63	127.62	0.000384	4.59	1306.43	1636.81	0.25
Reach	40532.46	500 year	exist MEDOT	7180.00	112.50	128.67	121.52	129.07	0.000404	5.11	1493.70	1675.45	0.26
Reach	40532.46	500 year	PROPBRIDGE	7180.00	112.50	128.63	121.52	129.03	0.000409	5.13	1488.23	1673.92	0.26
Reach	40346			Bridge									
Reach	40193.72	1.1 year	exist MEDOT	1210.00	115.00	121.90	117.37	121.96	0.000194	2.07	583.77	334.96	0.16
Reach	40193.72	1.1 year	PROPBRIDGE	1210.00	115.00	121.81	117.37	121.88	0.000203	2.11	574.64	314.06	0.16
Reach	40193.72	10 year	exist MEDOT	3640.00	115.00	125.15	119.59	125.37	0.000369	3.81	973.76	1543.61	0.23
Reach	40193.72	10 year	PROPBRIDGE	3640.00	115.00	124.95	119.59	125.18	0.000401	3.90	946.66	1541.54	0.24
Reach	40193.72	25 year	exist MEDOT	4440.00	115.00	126.02	120.13	126.29	0.000391	4.19	1091.24	1552.04	0.24
Reach	40193.72	25 year	PROPBRIDGE	4440.00	115.00	125.76	120.13	126.05	0.000431	4.31	1056.22	1549.82	0.26
Reach	40193.72	50 year	exist MEDOT	5040.00	115.00	126.63	120.49	126.94	0.000404	4.44	1174.44	1557.31	0.25
Reach	40193.72	50 year	PROPBRIDGE	5040.00	115.00	126.33	120.49	126.65	0.000451	4.59	1132.70	1554.67	0.26
Reach	40193.72	100 year	exist MEDOT	5680.00	115.00	126.74	120.87	127.12	0.000494	4.95	1188.82	1558.23	0.28
Reach	40193.72	100 year	PROPBRIDGE	5680.00	115.00	126.91	120.87	127.28	0.000466	4.87	1211.75	1559.68	0.27
Reach	40193.72	500 year	exist MEDOT	7180.00	115.00	128.05	121.68	128.52	0.000517	5.51	1365.36	1569.09	0.29
Reach	40193.72	500 year	PROPBRIDGE	7180.00	115.00	128.18	121.68	128.64	0.000496	5.44	1383.34	1569.78	0.29
Reach	38900.00	1.1 year	exist MEDOT	1210.00	116.35	121.42	118.59	121.56	0.000520	2.99	437.86	1403.65	0.25
Reach	38900.00	1.1 year	PROPBRIDGE	1210.00	116.35	121.30	118.59	121.45	0.000566	3.08	393.31	90.78	0.26
Reach	38900.00	10 year	exist MEDOT	3640.00	116.35	125.03		125.05	0.000097	1.92	7233.60	2171.83	0.12
Reach	38900.00	10 year	PROPBRIDGE	3640.00	116.35	124.79		124.82	0.000118	2.08	6724.70	2170.55	0.13
Reach	38900.00	25 year	exist MEDOT	4440.00	116.35	125.96		125.98	0.000073	1.79	9259.93	2176.91	0.11
Reach	38900.00	25 year	PROPBRIDGE	4440.00	116.35	125.67		125.70	0.000089	1.94	8636.94	2175.36	0.12
Reach	38900.00	50 year	exist MEDOT	5040.00	116.35	126.61		126.63	0.000062	1.74	10681.14	2180.45	0.10

HEC-RAS River: Souadabscook Str Reach: Reach (Continued)

Reach	River Sta	Profile	Plan	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
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	38900.00	50 year	PROPBRIDGE	5040.00	116.35	126.28		126.30	0.000076	1.88	9956.42	2178.64	0.11
Reach	38900.00	100 year	exist MEDOT	5680.00	116.35	126.72		126.74	0.000074	1.91	10917.72	2181.04	0.11
Reach	38900.00	100 year	PROPBRIDGE	5680.00	116.35	126.90		126.92	0.000067	1.84	11313.80	2182.02	0.10
Reach	38900.00	500 year	exist MEDOT	7180.00	116.35	128.11		128.12	0.000057	1.83	13945.70	2188.64	0.10
Reach	38900.00	500 year	PROPBRIDGE	7180.00	116.35	128.24		128.26	0.000054	1.79	14246.48	2189.45	0.09
Reach	38050.00	1.1 year	exist MEDOT	1210.00	116.55	121.51		121.51	0.000001	0.12	10096.28	2055.59	0.01
Reach	38050.00	1.1 year	PROPBRIDGE	1210.00	116.55	121.40		121.40	0.000001	0.12	9869.27	2054.55	0.01
Reach	38050.00	10 year	exist MEDOT	3640.00	116.55	125.04		125.04	0.000001	0.21	18508.74	2726.95	0.01
Reach	38050.00	10 year	PROPBRIDGE	3640.00	116.55	124.81		124.81	0.000001	0.21	17878.29	2725.94	0.01
Reach	38050.00	25 year	exist MEDOT	4440.00	116.55	125.97		125.97	0.000001	0.23	21040.87	2730.93	0.01
Reach	38050.00	25 year	PROPBRIDGE	4440.00	116.55	125.68		125.69	0.000001	0.24	20265.14	2729.78	0.01
Reach	38050.00	50 year	exist MEDOT	5040.00	116.55	126.62		126.62	0.000001	0.24	22818.60	2733.51	0.01
Reach	38050.00	50 year	PROPBRIDGE	5040.00	116.55	126.29		126.29	0.000001	0.25	21914.86	2732.20	0.01
Reach	38050.00	100 year	exist MEDOT	5680.00	116.55	126.73		126.73	0.000001	0.27	23118.61	2733.94	0.01
Reach	38050.00	100 year	PROPBRIDGE	5680.00	116.55	126.91		126.91	0.000001	0.26	23612.53	2734.66	0.01
Reach	38050.00	500 year	exist MEDOT	7180.00	116.55	128.11		128.11	0.000001	0.30	26904.99	2741.14	0.02
Reach	38050.00	500 year	PROPBRIDGE	7180.00	116.55	128.25		128.25	0.000001	0.29	27280.63	2742.26	0.02
Reach	37100.00	1.1 year	exist MEDOT	1210.00	116.55	121.51		121.51	0.000004	0.27	4504.98	981.96	0.02
Reach	37100.00	1.1 year	PROPBRIDGE	1210.00	116.55	121.40		121.40	0.000004	0.28	4399.77	921.68	0.02
Reach	37100.00	10 year	exist MEDOT	3640.00	116.55	125.04		125.04	0.000005	0.46	8924.89	1700.58	0.03
Reach	37100.00	10 year	PROPBRIDGE	3640.00	116.55	124.80		124.81	0.000006	0.48	8531.15	1699.23	0.03
Reach	37100.00	25 year	exist MEDOT	4440.00	116.55	125.96		125.97	0.000005	0.50	10504.36	1706.01	0.03
Reach	37100.00	25 year	PROPBRIDGE	4440.00	116.55	125.68		125.68	0.000006	0.52	10019.10	1704.34	0.03
Reach	37100.00	50 year	exist MEDOT	5040.00	116.55	126.61		126.62	0.000005	0.53	11615.08	1710.49	0.03
Reach	37100.00	50 year	PROPBRIDGE	5040.00	116.55	126.28		126.29	0.000006	0.55	11048.94	1707.88	0.03
Reach	37100.00	100 year	exist MEDOT	5680.00	116.55	126.72		126.73	0.000006	0.59	11800.58	1711.41	0.03
Reach	37100.00	100 year	PROPBRIDGE	5680.00	116.55	126.90		126.91	0.000006	0.57	12110.43	1712.93	0.03
Reach	37100.00	500 year	exist MEDOT	7180.00	116.55	128.10		128.11	0.000006	0.64	14175.00	1725.02	0.03
Reach	37100.00	500 year	PROPBRIDGE	7180.00	116.55	128.24		128.25	0.000006	0.63	14411.97	1728.02	0.03
Reach	35509.99	1.1 year	exist MEDOT	1210.00	108.00	121.50		121.50	0.000004	0.50	2458.07	498.37	0.03
Reach	35509.99	1.1 year	PROPBRIDGE	1210.00	108.00	121.39		121.39	0.000004	0.50	2404.42	204.44	0.03
Reach	35509.99	10 year	exist MEDOT	3640.00	108.00	125.01		125.03	0.000012	1.04	7310.71	2222.79	0.05
Reach	35509.99	10 year	PROPBRIDGE	3640.00	108.00	124.78		124.79	0.000013	1.07	6791.24	2218.83	0.05
Reach	35509.99	25 year	exist MEDOT	4440.00	108.00	125.94		125.95	0.000013	1.11	9376.52	2239.83	0.05
Reach	35509.99	25 year	PROPBRIDGE	4440.00	108.00	125.65		125.67	0.000014	1.16	8733.36	2233.98	0.05
Reach	35509.99	50 year	exist MEDOT	5040.00	108.00	126.59		126.60	0.000013	1.16	10836.05	2252.30	0.05
Reach	35509.99	50 year	PROPBRIDGE	5040.00	108.00	126.25		126.27	0.000015	1.21	10083.36	2245.91	0.05
Reach	35509.99	100 year	exist MEDOT	5680.00	108.00	126.69		126.71	0.000016	1.29	11066.86	2254.27	0.05
Reach	35509.99	100 year	PROPBRIDGE	5680.00	108.00	126.87		126.89	0.000015	1.26	11479.71	2257.82	0.05
Reach	35509.99	500 year	exist MEDOT	7180.00	108.00	128.07		128.09	0.000017	1.37	14202.28	2281.28	0.06
Reach	35509.99	500 year	PROPBRIDGE	7180.00	108.00	128.21		128.23	0.000016	1.35	14518.86	2283.59	0.06
Reach	35310.52	1.1 year	exist MEDOT	1210.00	113.00	121.47	115.83	121.50	0.000056	1.28	945.26	138.36	0.09
Reach	35310.52	1.1 year	PROPBRIDGE	1210.00	113.00	121.36	115.83	121.39	0.000059	1.30	929.78	138.25	0.09
Reach	35310.52	10 year	exist MEDOT	3640.00	113.00	124.91	117.34	125.01	0.000136	2.55	1434.13	2141.39	0.14
Reach	35310.52	10 year	PROPBRIDGE	3640.00	113.00	124.67	117.34	124.78	0.000147	2.61	1397.96	2128.04	0.15
Reach	35310.52	25 year	exist MEDOT	4440.00	113.00	125.81	117.75	125.94	0.000152	2.85	1590.13	2277.82	0.15
Reach	35310.52	25 year	PROPBRIDGE	4440.00	113.00	125.52	117.75	125.65	0.000166	2.93	1534.20	2247.64	0.16
Reach	35310.52	50 year	exist MEDOT	5040.00	113.00	126.44	118.03	126.58	0.000162	3.06	1710.46	2302.46	0.16
Reach	35310.52	50 year	PROPBRIDGE	5040.00	113.00	126.10	118.03	126.25	0.000179	3.15	1644.81	2288.64	0.17
Reach	35310.52	100 year	exist MEDOT	5680.00	113.00	126.50	118.32	126.69	0.000201	3.43	1722.77	2305.08	0.18
Reach	35310.52	100 year	PROPBRIDGE	5680.00	113.00	126.69	118.32	126.87	0.000191	3.37	1758.85	2311.98	0.17
Reach	35310.52	500 year	exist MEDOT	7180.00	113.00	127.83	118.97	128.06	0.000222	3.87	1976.73	2320.88	0.19
Reach	35310.52	500 year	PROPBRIDGE	7180.00	113.00	127.98	118.97	128.20	0.000214	3.82	2004.24	2325.03	0.19
Reach	35151			Bridge									
Reach	34987.11	1.1 year	exist MEDOT	1210.00	114.50	121.20	116.08	121.24	0.000095	1.61	751.51	116.26	0.11
Reach	34987.11	1.1 year	PROPBRIDGE	1210.00	114.50	121.15	116.08	121.19	0.000098	1.62	745.31	116.20	0.11
Reach	34987.11	10 year	exist MEDOT	3640.00	114.50	124.41	117.77	124.57	0.000239	3.22	1132.97	132.67	0.18
Reach	34987.11	10 year	PROPBRIDGE	3640.00	114.50	124.24	117.77	124.40	0.000253	3.28	1110.95	127.91	0.19
Reach	34987.11	25 year	exist MEDOT	4440.00	114.50	125.19	118.22	125.40	0.000272	3.62	1242.47	1356.92	0.20
Reach	34987.11	25 year	PROPBRIDGE	4440.00	114.50	124.98	118.22	125.20	0.000292	3.70	1213.08	1346.10	0.21
Reach	34987.11	50 year	exist MEDOT	5040.00	114.50	125.75	118.55	125.98	0.000293	3.90	1319.83	1433.68	0.21
Reach	34987.11	50 year	PROPBRIDGE	5040.00	114.50	125.49	118.55	125.74	0.000318	3.99	1284.31	1423.54	0.22
Reach	34987.11	100 year	exist MEDOT	5680.00	114.50	125.57	118.88	125.88	0.000394	4.47	1294.99	1428.15	0.24
Reach	34987.11	100 year	PROPBRIDGE	5680.00	114.50	126.01	118.88	126.30	0.000343	4.28	1357.37	1436.64	0.23
Reach	34987.11	500 year	exist MEDOT	7180.00	114.50	126.67	119.61	127.07	0.000451	5.10	1448.58	1449.85	0.26
Reach	34987.11	500 year	PROPBRIDGE	7180.00	114.50	127.13	119.61	127.50	0.000396	4.91	1513.43	1532.32	0.25
Reach	34886.44	1.1 year	exist MEDOT	1210.00	111.00	121.20	114.31	121.23	0.000046	1.25	967.55	129.59	0.08
Reach	34886.44	1.1 year	PROPBRIDGE	1210.00	111.00	121.15	114.31	121.18	0.000047	1.26	960.65	129.45	0.08
Reach	34886.44	10 year	exist MEDOT	3640.00	111.00	124.44	116.32	124.50	0.000093	2.23	3158.97	1570.05	0.12
Reach	34886.44	10 year	PROPBRIDGE	3640.00	111.00	124.27	116.32	124.34	0.000101	2.29	2997.27	1529.26	0.13
Reach	34886.44	25 year	exist MEDOT	4440.00	111.00	125.24	116.76	125.32	0.000097	2.38	3980.43	2193.93	0.13
Reach	34886.44	25 year	PROPBRIDGE	4440.00	111.00	125.03	116.76	125.11	0.000106	2.46	3764.94	2184.58	0.13
Reach	34886.44	50 year	exist MEDOT	5040.00	111.00	125.81	117.08	125.89	0.000097	2.47	4561.99	2249.35	0.13
Reach	34886.44	50 year	PROPBRIDGE	5040.00	111.00	125.56	117.08	125.64	0.000108	2.57	4302.37	2233.92	0.13
Reach	34886.44	100 year	exist MEDOT	5680.00	111.00	125.65	117.41	125.75	0.000132	2.85	4399.13	2239.35	0.15
Reach	34886.44	100 year	PROPBRIDGE	5680.00	111.00	126.10	117.41	126.18	0.000110	2.66	4854.70	2268.30	0.13
Reach	34886.44	500 year	exist MEDOT	7180.00	111.00	126.79	118.13	126.90	0.000132	3.04	5569.22	2303.08	0.15
Reach	34886.44	500 year	PROPBRIDGE	7180.00	111.00	127.25	118.13	127.34	0.000111	2.85	6039.67	2325.83	0.14
Reach	33430.00	1.1 year	exist MEDOT	1210.00	112.55	121.14		121.17	0.000040	1.18	1027.64	138.35	0.08

HEC-RAS River: Souadabscook Str Reach: Reach (Continued)

Reach	River Sta	Profile	Plan	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
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	33430.00	1.1 year	PROPBRIDGE	1210.00	112.55	121.09		121.11	0.000041	1.19	1020.08	138.14	0.08
Reach	33430.00	10 year	exist MEDOT	3640.00	112.55	124.34		124.38	0.000069	1.94	5179.24	2201.51	0.11
Reach	33430.00	10 year	PROPBRIDGE	3640.00	112.55	124.15		124.21	0.000077	2.02	4790.33	2102.73	0.11
Reach	33430.00	25 year	exist MEDOT	4440.00	112.55	125.15		125.19	0.000064	1.97	7154.23	2516.50	0.10
Reach	33430.00	25 year	PROPBRIDGE	4440.00	112.55	124.93		124.98	0.000074	2.08	6589.76	2510.41	0.11
Reach	33430.00	50 year	exist MEDOT	5040.00	112.55	125.73		125.77	0.000059	1.95	8608.63	2526.83	0.10
Reach	33430.00	50 year	PROPBRIDGE	5040.00	112.55	125.46		125.50	0.000069	2.07	7931.04	2523.49	0.11
Reach	33430.00	100 year	exist MEDOT	5680.00	112.55	125.53		125.59	0.000084	2.30	8115.45	2524.34	0.12
Reach	33430.00	100 year	PROPBRIDGE	5680.00	112.55	126.01		126.05	0.000064	2.06	9314.78	2530.53	0.10
Reach	33430.00	500 year	exist MEDOT	7180.00	112.55	126.70		126.74	0.000071	2.25	11064.75	2539.25	0.11
Reach	33430.00	500 year	PROPBRIDGE	7180.00	112.55	127.18		127.21	0.000055	2.04	12288.21	2545.22	0.10
Reach	32750.00	1.1 year	exist MEDOT	1210.00	112.55	121.11		121.13	0.000048	1.30	933.78	121.03	0.08
Reach	32750.00	1.1 year	PROPBRIDGE	1210.00	112.55	121.05		121.08	0.000049	1.31	927.07	120.91	0.08
Reach	32750.00	10 year	exist MEDOT	3640.00	112.55	124.29		124.33	0.000068	1.93	6176.49	2512.65	0.10
Reach	32750.00	10 year	PROPBRIDGE	3640.00	112.55	124.11		124.15	0.000077	2.02	5716.79	2420.13	0.11
Reach	32750.00	25 year	exist MEDOT	4440.00	112.55	125.11		125.15	0.000061	1.91	8405.36	2812.17	0.10
Reach	32750.00	25 year	PROPBRIDGE	4440.00	112.55	124.88		124.92	0.000071	2.03	7756.30	2808.50	0.11
Reach	32750.00	50 year	exist MEDOT	5040.00	112.55	125.69		125.72	0.000054	1.87	10041.53	2824.26	0.09
Reach	32750.00	50 year	PROPBRIDGE	5040.00	112.55	125.42		125.46	0.000064	2.00	9266.78	2818.65	0.10
Reach	32750.00	100 year	exist MEDOT	5680.00	112.55	125.48		125.53	0.000079	2.22	9448.24	2820.21	0.11
Reach	32750.00	100 year	PROPBRIDGE	5680.00	112.55	125.97		126.00	0.000059	1.97	10823.90	2829.77	0.10
Reach	32750.00	500 year	exist MEDOT	7180.00	112.55	126.66		126.69	0.000064	2.13	12774.01	2843.05	0.10
Reach	32750.00	500 year	PROPBRIDGE	7180.00	112.55	127.15		127.17	0.000050	1.92	14169.12	2850.80	0.09
Reach	30396.70	1.1 year	exist MEDOT	1210.00	112.35	121.08		121.08	0.000011	0.65	4682.26	1690.00	0.04
Reach	30396.70	1.1 year	PROPBRIDGE	1210.00	112.35	121.02		121.02	0.000011	0.66	4586.89	1668.52	0.04
Reach	30396.70	10 year	exist MEDOT	3640.00	112.35	124.24		124.25	0.000016	0.99	11517.70	2632.58	0.05
Reach	30396.70	10 year	PROPBRIDGE	3640.00	112.35	124.05		124.06	0.000018	1.03	11021.46	2572.92	0.05
Reach	30396.70	25 year	exist MEDOT	4440.00	112.35	125.06		125.07	0.000018	1.08	14674.44	5155.50	0.05
Reach	30396.70	25 year	PROPBRIDGE	4440.00	112.35	124.82		124.83	0.000020	1.14	13446.26	5147.88	0.06
Reach	30396.70	50 year	exist MEDOT	5040.00	112.35	125.64		125.65	0.000017	1.08	17690.66	5174.14	0.05
Reach	30396.70	50 year	PROPBRIDGE	5040.00	112.35	125.36		125.37	0.000019	1.15	16228.14	5165.11	0.06
Reach	30396.70	100 year	exist MEDOT	5680.00	112.35	125.41		125.42	0.000024	1.28	16489.80	5166.72	0.06
Reach	30396.70	100 year	PROPBRIDGE	5680.00	112.35	125.92		125.93	0.000018	1.14	19098.55	5182.82	0.06
Reach	30396.70	500 year	exist MEDOT	7180.00	112.35	126.60		126.61	0.000020	1.25	22634.15	5207.16	0.06
Reach	30396.70	500 year	PROPBRIDGE	7180.00	112.35	127.10		127.11	0.000016	1.13	25260.32	5223.33	0.05
Reach	29483.97	1.1 year	exist MEDOT	1210.00	112.15	121.06		121.07	0.000016	0.80	1510.31	171.43	0.05
Reach	29483.97	1.1 year	PROPBRIDGE	1210.00	112.15	121.00		121.01	0.000016	0.81	1500.51	171.42	0.05
Reach	29483.97	10 year	exist MEDOT	3640.00	112.15	124.19		124.23	0.000043	1.59	4064.71	1119.61	0.08
Reach	29483.97	10 year	PROPBRIDGE	3640.00	112.15	124.00		124.03	0.000046	1.63	3850.22	1083.28	0.08
Reach	29483.97	25 year	exist MEDOT	4440.00	112.15	125.00		125.04	0.000047	1.73	5061.15	1310.22	0.09
Reach	29483.97	25 year	PROPBRIDGE	4440.00	112.15	124.76		124.80	0.000051	1.79	4742.79	1300.01	0.09
Reach	29483.97	50 year	exist MEDOT	5040.00	112.15	125.58		125.62	0.000048	1.81	5830.24	1334.56	0.09
Reach	29483.97	50 year	PROPBRIDGE	5040.00	112.15	125.29		125.34	0.000054	1.88	5445.38	1322.44	0.09
Reach	29483.97	100 year	exist MEDOT	5680.00	112.15	125.33		125.38	0.000067	2.11	5489.64	1323.83	0.10
Reach	29483.97	100 year	PROPBRIDGE	5680.00	112.15	125.85		125.89	0.000055	1.96	6181.90	1345.54	0.09
Reach	29483.97	500 year	exist MEDOT	7180.00	112.15	126.51		126.57	0.000069	2.27	7125.55	1491.07	0.11
Reach	29483.97	500 year	PROPBRIDGE	7180.00	112.15	127.03		127.08	0.000058	2.12	7914.00	1555.85	0.10
Reach	28303.36	1.1 year	exist MEDOT	1210.00	112.05	121.03	113.55	121.04	0.000026	1.00	1214.59	145.35	0.06
Reach	28303.36	1.1 year	PROPBRIDGE	1210.00	112.05	120.97	113.55	120.99	0.000026	1.00	1206.20	145.24	0.06
Reach	28303.36	10 year	exist MEDOT	3640.00	112.05	124.09	115.06	124.16	0.000081	2.13	2047.56	448.39	0.11
Reach	28303.36	10 year	PROPBRIDGE	3640.00	112.05	123.89	115.06	123.96	0.000087	2.18	1959.96	424.76	0.12
Reach	28303.36	25 year	exist MEDOT	4440.00	112.05	124.87	115.47	124.96	0.000095	2.41	2513.37	915.67	0.12
Reach	28303.36	25 year	PROPBRIDGE	4440.00	112.05	124.62	115.47	124.71	0.000101	2.45	2304.69	511.51	0.13
Reach	28303.36	50 year	exist MEDOT	5040.00	112.05	125.45	115.75	125.54	0.000099	2.54	3048.60	953.12	0.13
Reach	28303.36	50 year	PROPBRIDGE	5040.00	112.05	125.14	115.75	125.25	0.000111	2.64	2761.73	934.12	0.13
Reach	28303.36	100 year	exist MEDOT	5680.00	112.05	125.13	116.05	125.27	0.000141	2.98	2754.18	933.58	0.15
Reach	28303.36	100 year	PROPBRIDGE	5680.00	112.05	125.68	116.05	125.80	0.000115	2.78	3277.51	967.51	0.14
Reach	28303.36	500 year	exist MEDOT	7180.00	112.05	126.30	116.70	126.45	0.000148	3.25	3881.97	1006.01	0.16
Reach	28303.36	500 year	PROPBRIDGE	7180.00	112.05	126.85	116.70	126.98	0.000122	3.03	4447.67	1043.33	0.14
Reach	28120.39	1.1 year	exist MEDOT	1210.00	117.00	120.91	118.65	121.02	0.000547	2.69	449.00	124.96	0.25
Reach	28120.39	1.1 year	PROPBRIDGE	1210.00	117.00	120.85	118.65	120.96	0.000579	2.74	441.22	124.75	0.26
Reach	28120.39	10 year	exist MEDOT	3640.00	117.00	123.79	120.27	124.10	0.000689	4.45	854.06	186.41	0.31
Reach	28120.39	10 year	PROPBRIDGE	3640.00	117.00	123.57	120.27	123.90	0.000778	4.62	818.11	180.74	0.33
Reach	28120.39	25 year	exist MEDOT	4440.00	117.00	124.53	120.71	124.90	0.000706	4.85	973.03	275.09	0.32
Reach	28120.39	25 year	PROPBRIDGE	4440.00	117.00	124.25	120.71	124.64	0.000812	5.05	926.93	204.58	0.34
Reach	28120.39	50 year	exist MEDOT	5040.00	117.00	125.07	121.01	125.47	0.000711	5.10	1063.37	632.25	0.32
Reach	28120.39	50 year	PROPBRIDGE	5040.00	117.00	124.73	121.01	125.17	0.000832	5.35	1004.77	617.79	0.35
Reach	28120.39	100 year	exist MEDOT	5680.00	117.00	124.58	121.33	125.16	0.001130	6.16	980.63	318.98	0.40
Reach	28120.39	100 year	PROPBRIDGE	5680.00	117.00	125.23	121.33	125.71	0.000843	5.63	1089.87	639.35	0.35
Reach	28120.39	500 year	exist MEDOT	7180.00	117.00	125.64	122.00	126.33	0.001131	6.74	1159.29	655.76	0.41
Reach	28120.39	500 year	PROPBRIDGE	7180.00	117.00	126.45	122.00	126.90	0.000696	5.63	2245.33	742.74	0.33
Reach	27966			Bridge									
Reach	27800.00	1.1 year	exist MEDOT	1210.00	117.55	120.54	119.38	120.81	0.001978	4.22	286.83	107.09	0.45
Reach	27800.00	1.1 year	PROPBRIDGE	1210.00	117.55	120.54	119.38	120.81	0.001978	4.22	286.83	107.09	0.45
Reach	27800.00	10 year	exist MEDOT	3640.00	117.55	122.79	121.18	123.51	0.002343	6.80	539.19	124.48	0.55
Reach	27800.00	10 year	PROPBRIDGE	3640.00	117.55	122.79	121.18	123.51	0.002343	6.80	539.19	124.48	0.55
Reach	27800.00	25 year	exist MEDOT	4440.00	117.55	123.32	121.65	124.19	0.002458	7.47	607.51	151.28	0.57
Reach	27800.00	25 year	PROPBRIDGE	4440.00	117.55	123.32	121.65	124.19	0.002458	7.47	607.51	151.28	0.57
Reach	27800.00	50 year	exist MEDOT	5040.00	117.55	123.70	121.97	124.67	0.002527	7.92	655.99	165.53	0.58
Reach	27800.00	50 year	PROPBRIDGE	5040.00	117.55	123.70	121.97	124.67	0.002527	7.92	656.02	165.54	0.58

HEC-RAS River: Souadabscook Str Reach: Reach (Continued)

Reach	River Sta	Profile	Plan	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
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	27800.00	100 year	exist MEDOT	5680.00	117.55	124.09	122.31	125.16	0.002562	8.33	707.87	206.70	0.59
Reach	27800.00	100 year	PROPBRIDGE	5680.00	117.55	124.09	122.31	125.16	0.002560	8.33	707.97	206.79	0.59
Reach	27800.00	500 year	exist MEDOT	7180.00	117.55	124.91	123.07	126.23	0.002670	9.25	817.02	557.64	0.62
Reach	27800.00	500 year	PROPBRIDGE	7180.00	117.55	124.91	123.07	126.23	0.002670	9.25	817.02	557.64	0.62
Reach	27564.50	1.1 year	exist MEDOT	1210.00	117.05	119.99	118.93	120.30	0.002353	4.47	270.48	105.82	0.49
Reach	27564.50	1.1 year	PROPBRIDGE	1210.00	117.05	119.99	118.93	120.30	0.002353	4.47	270.48	105.82	0.49
Reach	27564.50	10 year	exist MEDOT	3640.00	117.05	122.09	120.80	122.87	0.002977	7.11	521.97	205.70	0.60
Reach	27564.50	10 year	PROPBRIDGE	3640.00	117.05	122.09	120.80	122.87	0.002977	7.11	521.97	205.70	0.60
Reach	27564.50	25 year	exist MEDOT	4440.00	117.05	122.64	121.29	123.55	0.002949	7.66	610.61	264.12	0.61
Reach	27564.50	25 year	PROPBRIDGE	4440.00	117.05	122.64	121.29	123.55	0.002949	7.66	610.61	264.12	0.61
Reach	27564.50	50 year	exist MEDOT	5040.00	117.05	123.05	121.62	124.03	0.002870	7.98	686.25	307.79	0.61
Reach	27564.50	50 year	PROPBRIDGE	5040.00	117.05	123.05	121.62	124.03	0.002869	7.98	686.34	307.85	0.61
Reach	27564.50	100 year	exist MEDOT	5680.00	117.05	123.47	121.95	124.52	0.002782	8.28	773.37	356.14	0.61
Reach	27564.50	100 year	PROPBRIDGE	5680.00	117.05	123.48	121.95	124.52	0.002780	8.28	773.64	356.27	0.61
Reach	27564.50	500 year	exist MEDOT	7180.00	117.05	124.33	122.70	125.55	0.002703	8.96	978.39	473.26	0.62
Reach	27564.50	500 year	PROPBRIDGE	7180.00	117.05	124.33	122.70	125.55	0.002703	8.96	978.39	473.26	0.62
Reach	27381.56	1.1 year	exist MEDOT	1210.00	116.95	119.56		119.81	0.002756	4.03	300.04	155.03	0.51
Reach	27381.56	1.1 year	PROPBRIDGE	1210.00	116.95	119.56		119.81	0.002756	4.03	300.04	155.03	0.51
Reach	27381.56	10 year	exist MEDOT	3640.00	116.95	121.93		122.35	0.001778	5.22	702.70	195.56	0.46
Reach	27381.56	10 year	PROPBRIDGE	3640.00	116.95	121.93		122.35	0.001778	5.22	702.70	195.56	0.46
Reach	27381.56	25 year	exist MEDOT	4440.00	116.95	122.56		123.02	0.001613	5.48	831.66	214.62	0.45
Reach	27381.56	25 year	PROPBRIDGE	4440.00	116.95	122.56		123.02	0.001613	5.48	831.66	214.62	0.45
Reach	27381.56	50 year	exist MEDOT	5040.00	116.95	123.02		123.51	0.001498	5.63	935.04	228.43	0.44
Reach	27381.56	50 year	PROPBRIDGE	5040.00	116.95	123.02		123.51	0.001497	5.63	935.15	228.45	0.44
Reach	27381.56	100 year	exist MEDOT	5680.00	116.95	123.50		124.01	0.001403	5.79	1046.30	242.42	0.43
Reach	27381.56	100 year	PROPBRIDGE	5680.00	116.95	123.50		124.01	0.001402	5.79	1046.63	242.46	0.43
Reach	27381.56	500 year	exist MEDOT	7180.00	116.95	124.44		125.03	0.001306	6.20	1287.72	270.29	0.43
Reach	27381.56	500 year	PROPBRIDGE	7180.00	116.95	124.44		125.03	0.001306	6.20	1287.72	270.29	0.43
Reach	26951.26	1.1 year	exist MEDOT	1210.00	115.75	118.33	117.43	118.66	0.002622	4.55	265.97	109.67	0.52
Reach	26951.26	1.1 year	PROPBRIDGE	1210.00	115.75	118.33	117.43	118.66	0.002622	4.55	265.97	109.67	0.52
Reach	26951.26	10 year	exist MEDOT	3640.00	115.75	120.68	119.17	121.40	0.002623	6.80	535.61	120.09	0.57
Reach	26951.26	10 year	PROPBRIDGE	3640.00	115.75	120.68	119.17	121.40	0.002623	6.80	535.61	120.09	0.57
Reach	26951.26	25 year	exist MEDOT	4440.00	115.75	121.29	119.63	122.11	0.002619	7.28	609.49	122.79	0.58
Reach	26951.26	25 year	PROPBRIDGE	4440.00	115.75	121.29	119.63	122.11	0.002619	7.28	609.49	122.79	0.58
Reach	26951.26	50 year	exist MEDOT	5040.00	115.75	121.75	119.98	122.64	0.002622	7.56	667.01	127.27	0.58
Reach	26951.26	50 year	PROPBRIDGE	5040.00	115.75	121.75	119.96	122.64	0.002621	7.56	667.08	127.28	0.58
Reach	26951.26	100 year	exist MEDOT	5680.00	115.75	122.22	120.32	123.16	0.002625	7.81	727.30	132.53	0.59
Reach	26951.26	100 year	PROPBRIDGE	5680.00	115.75	122.22	120.30	123.16	0.002621	7.81	727.69	132.57	0.59
Reach	26951.26	500 year	exist MEDOT	7180.00	115.75	123.06	121.03	124.20	0.002622	8.54	845.82	149.96	0.60
Reach	26951.26	500 year	PROPBRIDGE	7180.00	115.75	123.06	121.03	124.20	0.002622	8.54	845.82	149.96	0.60

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 1.1 year

E.G. US. (ft)	122.07	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	122.01	E.G. Elev (ft)	122.05	122.00
Q Total (cfs)	1210.00	W.S. Elev (ft)	121.97	121.91
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	116.59	117.05
Q Weir (cfs)		Max Chl Dpth (ft)	10.00	9.01
Weir Sta Lft (ft)		Vel Total (ft/s)	2.34	2.37
Weir Sta Rgt (ft)		Flow Area (sq ft)	517.97	509.61
Weir Submerg		Froude # Chl	0.17	0.17
Weir Max Depth (ft)		Specif Force (cu ft)	1950.12	1825.81
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	5.81	5.67
Min El Prs (ft)	132.13	W.P. Total (ft)	116.35	116.38
Delta EG (ft)	0.11	Conv. Total (cfs)	71364.2	69288.8
Delta WS (ft)	0.12	Top Width (ft)	89.12	89.81
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.05	0.02
BR Open Vel (ft/s)	2.37	C & E Loss (ft)	0.00	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	0.08	0.08
BR Sel Method	Energy only	Power Total (lb/ft s)	0.19	0.20

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 10 year

E.G. US. (ft)	125.67	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.48	E.G. Elev (ft)	125.61	125.47
Q Total (cfs)	3640.00	W.S. Elev (ft)	125.29	125.14
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	119.67	119.76
Q Weir (cfs)		Max Chl Dpth (ft)	13.32	12.24
Weir Sta Lft (ft)		Vel Total (ft/s)	4.38	4.45
Weir Sta Rgt (ft)		Flow Area (sq ft)	831.91	817.96
Weir Submerg		Froude # Chl	0.26	0.27
Weir Max Depth (ft)		Specif Force (cu ft)	4606.31	4393.61
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	8.34	8.15
Min El Prs (ft)	132.13	W.P. Total (ft)	141.85	141.44
Delta EG (ft)	0.30	Conv. Total (cfs)	136993.2	133145.6
Delta WS (ft)	0.33	Top Width (ft)	99.74	100.42
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.13	0.05
BR Open Vel (ft/s)	4.45	C & E Loss (ft)	0.00	0.05
BR Sluice Coef		Shear Total (lb/sq ft)	0.26	0.27
BR Sel Method	Energy only	Power Total (lb/ft s)	1.13	1.20

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 25 year

E.G. US. (ft)	126.64	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.40	E.G. Elev (ft)	126.56	126.41
Q Total (cfs)	4440.00	W.S. Elev (ft)	126.17	126.00
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	120.24	120.32
Q Weir (cfs)		Max Chl Dpth (ft)	14.20	13.10
Weir Sta Lft (ft)		Vel Total (ft/s)	4.82	4.90
Weir Sta Rgt (ft)		Flow Area (sq ft)	921.03	905.49
Weir Submerg		Froude # Chl	0.28	0.29
Weir Max Depth (ft)		Specif Force (cu ft)	5557.47	5316.89
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	8.98	8.80
Min El Prs (ft)	132.13	W.P. Total (ft)	148.61	147.85
Delta EG (ft)	0.35	Conv. Total (cfs)	156637.1	152478.9
Delta WS (ft)	0.38	Top Width (ft)	102.55	102.92
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.15	0.05
BR Open Vel (ft/s)	4.90	C & E Loss (ft)	0.00	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	0.31	0.32
BR Sel Method	Energy only	Power Total (lb/ft s)	1.50	1.59

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 50 year

E.G. US. (ft)	127.32	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	127.06	E.G. Elev (ft)	127.24	127.07
Q Total (cfs)	5040.00	W.S. Elev (ft)	126.79	126.61
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	120.65	120.73
Q Weir (cfs)		Max Chl Dpth (ft)	14.82	13.71
Weir Sta Lft (ft)		Vel Total (ft/s)	5.11	5.20
Weir Sta Rgt (ft)		Flow Area (sq ft)	985.45	968.66
Weir Submerg		Froude # Chl	0.29	0.30
Weir Max Depth (ft)		Specif Force (cu ft)	6294.17	6032.81
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	9.43	9.25
Min El Prs (ft)	132.13	W.P. Total (ft)	153.38	152.37
Delta EG (ft)	0.38	Conv. Total (cfs)	171039.0	166649.3
Delta WS (ft)	0.42	Top Width (ft)	104.54	104.69
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.16	0.05
BR Open Vel (ft/s)	5.20	C & E Loss (ft)	0.00	0.08
BR Sluice Coef		Shear Total (lb/sq ft)	0.35	0.36
BR Sel Method	Energy only	Power Total (lb/ft s)	1.78	1.89

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 100 year

E.G. US. (ft)	127.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	127.27	E.G. Elev (ft)	127.49	127.28
Q Total (cfs)	5680.00	W.S. Elev (ft)	126.94	126.71
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	121.07	121.14
Q Weir (cfs)		Max Chl Dpth (ft)	14.97	13.81
Weir Sta Lft (ft)		Vel Total (ft/s)	5.67	5.80
Weir Sta Rgt (ft)		Flow Area (sq ft)	1000.93	979.12
Weir Submerg		Froude # Chl	0.32	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	6650.50	6347.90
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	9.53	9.33
Min El Prs (ft)	132.13	W.P. Total (ft)	154.51	153.11
Delta EG (ft)	0.47	Conv. Total (cfs)	174520.4	169013.2
Delta WS (ft)	0.53	Top Width (ft)	105.01	104.98
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.20	0.07
BR Open Vel (ft/s)	5.80	C & E Loss (ft)	0.01	0.10
BR Sluice Coef		Shear Total (lb/sq ft)	0.43	0.45
BR Sel Method	Energy only	Power Total (lb/ft s)	2.43	2.62

Plan: exist MEDOT Souadabscook Str Reach RS: 40346 Profile: 500 year

E.G. US. (ft)	129.07	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	128.67	E.G. Elev (ft)	128.95	128.71
Q Total (cfs)	7180.00	W.S. Elev (ft)	128.26	128.00
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.99	122.05
Q Weir (cfs)		Max Chl Dpth (ft)	16.29	15.10
Weir Sta Lft (ft)		Vel Total (ft/s)	6.28	6.43
Weir Sta Rgt (ft)		Flow Area (sq ft)	1142.50	1116.64
Weir Submerg		Froude # Chl	0.34	0.35
Weir Max Depth (ft)		Specif Force (cu ft)	8492.83	8131.72
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	10.46	10.27
Min El Prs (ft)	132.13	W.P. Total (ft)	164.65	162.69
Delta EG (ft)	0.56	Conv. Total (cfs)	206728.7	200418.2
Delta WS (ft)	0.62	Top Width (ft)	109.23	108.72
BR Open Area (sq ft)	1586.19	Frctn Loss (ft)	0.23	0.07
BR Open Vel (ft/s)	6.43	C & E Loss (ft)	0.01	0.12
BR Sluice Coef		Shear Total (lb/sq ft)	0.52	0.55
BR Sel Method	Energy only	Power Total (lb/ft s)	3.28	3.54

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 1.1 year

E.G. US. (ft)	121.50	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	121.47	E.G. Elev (ft)	121.51	121.27
Q Total (cfs)	1210.00	W.S. Elev (ft)	121.42	121.16
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	116.22	115.91
Q Weir (cfs)		Max Chl Dpth (ft)	8.31	8.37
Weir Sta Lft (ft)		Vel Total (ft/s)	2.43	2.55
Weir Sta Rgt (ft)		Flow Area (sq ft)	498.84	474.16
Weir Submerg		Froude # Chl	0.17	0.17
Weir Max Depth (ft)		Specif Force (cu ft)	1858.00	1825.82
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	6.03	6.35
Min El Prs (ft)	132.25	W.P. Total (ft)	112.94	103.61
Delta EG (ft)	0.26	Conv. Total (cfs)	66375.5	66861.2
Delta WS (ft)	0.27	Top Width (ft)	82.73	74.62
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)		
BR Open Vel (ft/s)	2.55	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.09	0.09
BR Sel Method	Momentum	Power Total (lb/ft s)	0.22	0.24

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 10 year

E.G. US. (ft)	125.01	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.91	E.G. Elev (ft)	124.92	124.72
Q Total (cfs)	3640.00	W.S. Elev (ft)	124.55	124.31
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	119.02	118.71
Q Weir (cfs)		Max Chl Dpth (ft)	11.44	11.52
Weir Sta Lft (ft)		Vel Total (ft/s)	4.70	4.94
Weir Sta Rgt (ft)		Flow Area (sq ft)	775.08	736.45
Weir Submerg		Froude # Chl	0.28	0.29
Weir Max Depth (ft)		Specif Force (cu ft)	4298.45	4195.27
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.25	7.89
Min El Prs (ft)	132.25	W.P. Total (ft)	137.99	135.64
Delta EG (ft)	0.45	Conv. Total (cfs)	121321.3	118494.7
Delta WS (ft)	0.51	Top Width (ft)	93.95	93.33
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)	0.19	0.03
BR Open Vel (ft/s)	4.94	C & E Loss (ft)	0.01	0.12
BR Sluice Coef		Shear Total (lb/sq ft)	0.32	0.32
BR Sel Method	Energy only	Power Total (lb/ft s)	1.48	1.58

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 25 year

E.G. US. (ft)	125.94	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.81	E.G. Elev (ft)	125.82	125.58
Q Total (cfs)	4440.00	W.S. Elev (ft)	125.37	125.07
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	119.69	119.39
Q Weir (cfs)		Max Chl Dpth (ft)	12.26	12.28
Weir Sta Lft (ft)		Vel Total (ft/s)	5.20	5.49
Weir Sta Rgt (ft)		Flow Area (sq ft)	853.17	809.40
Weir Submerg		Froude # Chl	0.30	0.31
Weir Max Depth (ft)		Specif Force (cu ft)	5157.59	4994.92
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.75	8.29
Min El Prs (ft)	132.25	W.P. Total (ft)	145.03	143.17
Delta EG (ft)	0.54	Conv. Total (cfs)	137460.2	132770.9
Delta WS (ft)	0.62	Top Width (ft)	97.48	97.63
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)	0.22	0.03
BR Open Vel (ft/s)	5.49	C & E Loss (ft)	0.02	0.15
BR Sluice Coef		Shear Total (lb/sq ft)	0.38	0.39
BR Sel Method	Energy only	Power Total (lb/ft s)	1.99	2.17

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 50 year

E.G. US. (ft)	126.58	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.44	E.G. Elev (ft)	126.45	126.19
Q Total (cfs)	5040.00	W.S. Elev (ft)	125.94	125.60
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	120.12	119.85
Q Weir (cfs)		Max Chl Dpth (ft)	12.83	12.81
Weir Sta Lft (ft)		Vel Total (ft/s)	5.54	5.85
Weir Sta Rgt (ft)		Flow Area (sq ft)	909.30	862.08
Weir Submerg		Froude # Chl	0.31	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	5816.35	5610.27
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	9.10	8.63
Min El Prs (ft)	132.25	W.P. Total (ft)	149.95	147.73
Delta EG (ft)	0.60	Conv. Total (cfs)	149156.6	143190.0
Delta WS (ft)	0.69	Top Width (ft)	99.93	99.88
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)	0.24	0.03
BR Open Vel (ft/s)	5.85	C & E Loss (ft)	0.02	0.18
BR Sluice Coef		Shear Total (lb/sq ft)	0.43	0.45
BR Sel Method	Energy only	Power Total (lb/ft s)	2.40	2.64

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 100 year

E.G. US. (ft)	126.69	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.50	E.G. Elev (ft)	126.52	126.16
Q Total (cfs)	5680.00	W.S. Elev (ft)	125.85	125.38
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	120.55	120.32
Q Weir (cfs)		Max Chl Dpth (ft)	12.74	12.59
Weir Sta Lft (ft)		Vel Total (ft/s)	6.31	6.77
Weir Sta Rgt (ft)		Flow Area (sq ft)	900.34	839.51
Weir Submerg		Froude # Chl	0.36	0.38
Weir Max Depth (ft)		Specif Force (cu ft)	5988.41	5706.55
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	9.04	8.49
Min El Prs (ft)	132.25	W.P. Total (ft)	149.17	145.79
Delta EG (ft)	0.81	Conv. Total (cfs)	147285.1	138714.8
Delta WS (ft)	0.94	Top Width (ft)	99.54	98.92
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)	0.32	0.05
BR Open Vel (ft/s)	6.77	C & E Loss (ft)	0.04	0.24
BR Sluice Coef		Shear Total (lb/sq ft)	0.56	0.60
BR Sel Method	Energy only	Power Total (lb/ft s)	3.54	4.08

Plan: exist MEDOT Souadabscook Str Reach RS: 35151 Profile: 500 year

E.G. US. (ft)	128.06	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	127.83	E.G. Elev (ft)	127.85	127.43
Q Total (cfs)	7180.00	W.S. Elev (ft)	127.01	126.42
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.53	121.39
Q Weir (cfs)		Max Chl Dpth (ft)	13.90	13.63
Weir Sta Lft (ft)		Vel Total (ft/s)	7.05	7.60
Weir Sta Rgt (ft)		Flow Area (sq ft)	1018.49	944.63
Weir Submerg		Froude # Chl	0.38	0.42
Weir Max Depth (ft)		Specif Force (cu ft)	7584.11	7171.04
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	9.74	9.14
Min El Prs (ft)	132.25	W.P. Total (ft)	159.17	154.67
Delta EG (ft)	0.99	Conv. Total (cfs)	172102.7	159713.9
Delta WS (ft)	1.17	Top Width (ft)	104.54	103.31
BR Open Area (sq ft)	1625.91	Frctn Loss (ft)	0.38	0.05
BR Open Vel (ft/s)	7.60	C & E Loss (ft)	0.05	0.30
BR Sluice Coef		Shear Total (lb/sq ft)	0.70	0.77
BR Sel Method	Energy only	Power Total (lb/ft s)	4.90	5.86

Plan: exist MEDOT   Souadabscook Str   Reach RS: 27966   Profile: 1.1 year

E.G. US. (ft)	121.02	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	120.91	E.G. Elev (ft)	121.00	120.89
Q Total (cfs)	1210.00	W.S. Elev (ft)	120.86	120.74
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	115.84	116.09
Q Weir (cfs)		Max Chl Dpth (ft)	8.76	7.94
Weir Sta Lft (ft)		Vel Total (ft/s)	2.97	3.04
Weir Sta Rgt (ft)		Flow Area (sq ft)	407.20	398.09
Weir Submerg		Froude # Chl	0.21	0.22
Weir Max Depth (ft)		Specif Force (cu ft)	1592.25	1464.35
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	5.92	5.39
Min El Prs (ft)	132.04	W.P. Total (ft)	95.16	99.95
Delta EG (ft)	0.21	Conv. Total (cfs)	55154.4	51902.3
Delta WS (ft)	0.37	Top Width (ft)	68.84	73.84
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)	0.11	0.06
BR Open Vel (ft/s)	3.04	C & E Loss (ft)	0.00	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	0.13	0.14
BR Sel Method	Energy only	Power Total (lb/ft s)	0.38	0.41

Plan: exist MEDOT   Souadabscook Str   Reach RS: 27966   Profile: 10 year

E.G. US. (ft)	124.10	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	123.79	E.G. Elev (ft)	124.02	123.65
Q Total (cfs)	3640.00	W.S. Elev (ft)	123.41	122.98
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	119.03	119.22
Q Weir (cfs)		Max Chl Dpth (ft)	11.31	10.18
Weir Sta Lft (ft)		Vel Total (ft/s)	6.07	6.33
Weir Sta Rgt (ft)		Flow Area (sq ft)	599.29	574.64
Weir Submerg		Froude # Chl	0.38	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	3465.37	3173.50
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.32	6.88
Min El Prs (ft)	132.04	W.P. Total (ft)	117.68	118.27
Delta EG (ft)	0.59	Conv. Total (cfs)	91027.9	83953.7
Delta WS (ft)	1.00	Top Width (ft)	81.83	83.58
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)	0.37	0.13
BR Open Vel (ft/s)	6.33	C & E Loss (ft)	0.01	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	0.51	0.57
BR Sel Method	Energy only	Power Total (lb/ft s)	3.09	3.61

Plan: exist MEDOT   Souadabscook Str   Reach RS: 27966   Profile: 25 year

E.G. US. (ft)	124.90	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.53	E.G. Elev (ft)	124.80	124.34
Q Total (cfs)	4440.00	W.S. Elev (ft)	124.01	123.47
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	119.76	120.04
Q Weir (cfs)		Max Chl Dpth (ft)	11.91	10.67
Weir Sta Lft (ft)		Vel Total (ft/s)	6.83	7.20
Weir Sta Rgt (ft)		Flow Area (sq ft)	650.07	616.28
Weir Submerg		Froude # Chl	0.41	0.45
Weir Max Depth (ft)		Specif Force (cu ft)	4114.14	3755.56
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.65	7.19
Min El Prs (ft)	132.04	W.P. Total (ft)	123.06	122.29
Delta EG (ft)	0.71	Conv. Total (cfs)	100733.9	91788.4
Delta WS (ft)	1.21	Top Width (ft)	84.93	85.72
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)	0.45	0.15
BR Open Vel (ft/s)	7.20	C & E Loss (ft)	0.01	0.00
BR Sluice Coef		Shear Total (lb/sq ft)	0.64	0.74
BR Sel Method	Energy only	Power Total (lb/ft s)	4.38	5.30

Plan: exist MEDOT Souadabscook Str Reach RS: 27966 Profile: 50 year

E.G. US. (ft)	125.47	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.07	E.G. Elev (ft)	125.37	124.85
Q Total (cfs)	5040.00	W.S. Elev (ft)	124.45	123.82
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	120.29	120.56
Q Weir (cfs)		Max Chl Dpth (ft)	12.35	11.02
Weir Sta Lft (ft)		Vel Total (ft/s)	7.33	7.80
Weir Sta Rgt (ft)		Flow Area (sq ft)	687.85	646.44
Weir Submerg		Froude # Chl	0.44	0.49
Weir Max Depth (ft)		Specif Force (cu ft)	4624.57	4213.20
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.88	7.41
Min El Prs (ft)	132.04	W.P. Total (ft)	126.99	125.13
Delta EG (ft)	0.81	Conv. Total (cfs)	108005.1	97510.9
Delta WS (ft)	1.38	Top Width (ft)	87.24	87.23
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)	0.51	0.16
BR Open Vel (ft/s)	7.80	C & E Loss (ft)	0.01	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.74	0.86
BR Sel Method	Energy only	Power Total (lb/ft s)	5.40	6.72

Plan: exist MEDOT Souadabscook Str Reach RS: 27966 Profile: 100 year

E.G. US. (ft)	125.16	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.58	E.G. Elev (ft)	123.95	123.99
Q Total (cfs)	5680.00	W.S. Elev (ft)	120.83	121.06
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	120.83	121.06
Q Weir (cfs)		Max Chl Dpth (ft)	8.73	8.26
Weir Sta Lft (ft)		Vel Total (ft/s)	14.02	13.46
Weir Sta Rgt (ft)		Flow Area (sq ft)	405.20	421.86
Weir Submerg		Froude # Chl	0.98	0.95
Weir Max Depth (ft)		Specif Force (cu ft)	3967.04	3898.27
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	5.90	5.61
Min El Prs (ft)	132.04	W.P. Total (ft)	94.91	102.56
Delta EG (ft)	-1.40	Conv. Total (cfs)	54789.3	56077.0
Delta WS (ft)	2.27	Top Width (ft)	68.69	75.22
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)		
BR Open Vel (ft/s)	14.02	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	2.86	2.63
BR Sel Method	Momentum	Power Total (lb/ft s)	40.16	35.47

Plan: exist MEDOT Souadabscook Str Reach RS: 27966 Profile: 500 year

E.G. US. (ft)	126.33	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.64	E.G. Elev (ft)	125.50	125.45
Q Total (cfs)	7180.00	W.S. Elev (ft)	121.99	122.14
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.99	122.14
Q Weir (cfs)		Max Chl Dpth (ft)	9.89	9.34
Weir Sta Lft (ft)		Vel Total (ft/s)	14.69	14.20
Weir Sta Rgt (ft)		Flow Area (sq ft)	488.82	505.71
Weir Submerg		Froude # Chl	0.97	0.95
Weir Max Depth (ft)		Specif Force (cu ft)	5333.81	5227.07
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	6.55	6.33
Min El Prs (ft)	132.04	W.P. Total (ft)	105.21	111.38
Delta EG (ft)	-1.62	Conv. Total (cfs)	70227.2	71184.8
Delta WS (ft)	2.57	Top Width (ft)	74.63	79.92
BR Open Area (sq ft)	1512.98	Frctn Loss (ft)		
BR Open Vel (ft/s)	14.69	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	3.03	2.88
BR Sel Method	Momentum	Power Total (lb/ft s)	44.54	40.94

Plan: PROPBRIDGE Souadabscook Str Reach RS: 40346 Profile: 1.1 year

E.G. US. (ft)	121.99	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	121.93	E.G. Elev (ft)	121.97	121.91
Q Total (cfs)	1210.00	W.S. Elev (ft)	121.88	121.83
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	116.90	117.31
Q Weir (cfs)		Max Chl Dpth (ft)	9.91	8.93
Weir Sta Lft (ft)		Vel Total (ft/s)	2.32	2.33
Weir Sta Rgt (ft)		Flow Area (sq ft)	522.26	519.92
Weir Submerg		Froude # Chl	0.17	0.17
Weir Max Depth (ft)		Specif Force (cu ft)	1866.35	1754.15
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	5.47	5.14
Min El Prs (ft)	130.00	W.P. Total (ft)	116.20	120.31
Delta EG (ft)	0.11	Conv. Total (cfs)	72882.3	71282.8
Delta WS (ft)	0.11	Top Width (ft)	95.56	101.17
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.05	0.02
BR Open Vel (ft/s)	2.33	C & E Loss (ft)	0.00	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	0.08	0.08
BR Sel Method	Energy only	Power Total (lb/ft s)	0.18	0.18

Plan: PROPBRIDGE Souadabscook Str Reach RS: 40346 Profile: 10 year

E.G. US. (ft)	125.44	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.23	E.G. Elev (ft)	125.38	125.27
Q Total (cfs)	3640.00	W.S. Elev (ft)	125.07	124.96
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	119.74	119.81
Q Weir (cfs)		Max Chl Dpth (ft)	13.10	12.06
Weir Sta Lft (ft)		Vel Total (ft/s)	4.17	4.13
Weir Sta Rgt (ft)		Flow Area (sq ft)	872.26	881.63
Weir Submerg		Froude # Chl	0.26	0.27
Weir Max Depth (ft)		Specif Force (cu ft)	4491.33	4347.46
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	7.51	7.17
Min El Prs (ft)	130.00	W.P. Total (ft)	145.15	150.95
Delta EG (ft)	0.26	Conv. Total (cfs)	146933.7	144729.0
Delta WS (ft)	0.28	Top Width (ft)	116.13	122.99
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.11	0.05
BR Open Vel (ft/s)	4.17	C & E Loss (ft)	0.00	0.04
BR Sluice Coef		Shear Total (lb/sq ft)	0.23	0.23
BR Sel Method	Energy only	Power Total (lb/ft s)	0.96	0.95

Plan: PROPBRIDGE Souadabscook Str Reach RS: 40346 Profile: 25 year

E.G. US. (ft)	126.34	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.08	E.G. Elev (ft)	126.27	126.14
Q Total (cfs)	4440.00	W.S. Elev (ft)	125.90	125.76
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	120.29	120.36
Q Weir (cfs)		Max Chl Dpth (ft)	13.93	12.86
Weir Sta Lft (ft)		Vel Total (ft/s)	4.59	4.53
Weir Sta Rgt (ft)		Flow Area (sq ft)	968.13	980.99
Weir Submerg		Froude # Chl	0.28	0.28
Weir Max Depth (ft)		Specif Force (cu ft)	5420.76	5273.00
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	8.23	7.97
Min El Prs (ft)	130.00	W.P. Total (ft)	149.27	154.18
Delta EG (ft)	0.29	Conv. Total (cfs)	169086.3	166996.8
Delta WS (ft)	0.33	Top Width (ft)	117.66	123.08
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.13	0.05
BR Open Vel (ft/s)	4.59	C & E Loss (ft)	0.00	0.05
BR Sluice Coef		Shear Total (lb/sq ft)	0.28	0.28
BR Sel Method	Energy only	Power Total (lb/ft s)	1.28	1.27

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 40346   Profile: 50 year

E.G. US. (ft)	126.97	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.68	E.G. Elev (ft)	126.89	126.76
Q Total (cfs)	5040.00	W.S. Elev (ft)	126.47	126.33
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	120.68	120.76
Q Weir (cfs)		Max Chl Dpth (ft)	14.50	13.43
Weir Sta Lft (ft)		Vel Total (ft/s)	4.87	4.80
Weir Sta Rgt (ft)		Flow Area (sq ft)	1035.56	1050.28
Weir Submerg		Froude # Chl	0.29	0.30
Weir Max Depth (ft)		Specif Force (cu ft)	6133.74	5984.76
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	8.72	8.53
Min El Prs (ft)	130.00	W.P. Total (ft)	152.13	156.43
Delta EG (ft)	0.32	Conv. Total (cfs)	185153.3	183173.7
Delta WS (ft)	0.35	Top Width (ft)	118.72	123.14
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.14	0.05
BR Open Vel (ft/s)	4.87	C & E Loss (ft)	0.00	0.05
BR Sluice Coef		Shear Total (lb/sq ft)	0.31	0.32
BR Sel Method	Energy only	Power Total (lb/ft s)	1.53	1.52

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 40346   Profile: 100 year

E.G. US. (ft)	127.62	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	127.29	E.G. Elev (ft)	127.54	127.39
Q Total (cfs)	5680.00	W.S. Elev (ft)	127.05	126.91
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	121.09	121.17
Q Weir (cfs)		Max Chl Dpth (ft)	15.08	14.01
Weir Sta Lft (ft)		Vel Total (ft/s)	5.14	5.06
Weir Sta Rgt (ft)		Flow Area (sq ft)	1105.75	1121.92
Weir Submerg		Froude # Chl	0.30	0.31
Weir Max Depth (ft)		Specif Force (cu ft)	6922.23	6773.30
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	9.23	9.11
Min El Prs (ft)	130.00	W.P. Total (ft)	155.09	158.76
Delta EG (ft)	0.34	Conv. Total (cfs)	202270.7	200426.7
Delta WS (ft)	0.38	Top Width (ft)	119.82	123.20
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.14	0.06
BR Open Vel (ft/s)	5.14	C & E Loss (ft)	0.00	0.06
BR Sluice Coef		Shear Total (lb/sq ft)	0.35	0.35
BR Sel Method	Energy only	Power Total (lb/ft s)	1.80	1.79

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 40346   Profile: 500 year

E.G. US. (ft)	129.03	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	128.63	E.G. Elev (ft)	128.94	128.77
Q Total (cfs)	7180.00	W.S. Elev (ft)	128.33	128.17
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.95	121.96
Q Weir (cfs)		Max Chl Dpth (ft)	16.36	15.27
Weir Sta Lft (ft)		Vel Total (ft/s)	5.69	5.62
Weir Sta Rgt (ft)		Flow Area (sq ft)	1261.67	1277.38
Weir Submerg		Froude # Chl	0.32	0.32
Weir Max Depth (ft)		Specif Force (cu ft)	8836.22	8684.61
Min El Weir Flow (ft)	134.81	Hydr Depth (ft)	10.23	10.36
Min El Prs (ft)	130.00	W.P. Total (ft)	163.22	163.81
Delta EG (ft)	0.40	Conv. Total (cfs)	241089.9	239580.5
Delta WS (ft)	0.45	Top Width (ft)	123.36	123.34
BR Open Area (sq ft)	1467.71	Frctn Loss (ft)	0.16	0.06
BR Open Vel (ft/s)	5.69	C & E Loss (ft)	0.00	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	0.43	0.44
BR Sel Method	Energy only	Power Total (lb/ft s)	2.44	2.46

Plan: PROPBRIDGE Souadabscook Str Reach RS: 35151 Profile: 1.1 year

E.G. US. (ft)	121.39	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	121.36	E.G. Elev (ft)	121.40	121.21
Q Total (cfs)	1210.00	W.S. Elev (ft)	121.31	121.11
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	116.22	115.94
Q Weir (cfs)		Max Chl Dpth (ft)	8.20	8.32
Weir Sta Lft (ft)		Vel Total (ft/s)	2.36	2.47
Weir Sta Rgt (ft)		Flow Area (sq ft)	513.49	489.26
Weir Submerg		Froude # Chl	0.17	0.17
Weir Max Depth (ft)		Specif Force (cu ft)	1866.55	1839.28
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	5.94	6.20
Min El Prs (ft)	130.00	W.P. Total (ft)	105.17	98.32
Delta EG (ft)	0.20	Conv. Total (cfs)	73317.6	73329.1
Delta WS (ft)	0.21	Top Width (ft)	86.38	78.94
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)		
BR Open Vel (ft/s)	2.47	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.08	0.08
BR Sel Method	Momentum	Power Total (lb/ft s)	0.20	0.21

Plan: PROPBRIDGE Souadabscook Str Reach RS: 35151 Profile: 10 year

E.G. US. (ft)	124.78	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.67	E.G. Elev (ft)	124.69	124.54
Q Total (cfs)	3640.00	W.S. Elev (ft)	124.35	124.15
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	118.89	118.67
Q Weir (cfs)		Max Chl Dpth (ft)	11.24	11.36
Weir Sta Lft (ft)		Vel Total (ft/s)	4.50	4.67
Weir Sta Rgt (ft)		Flow Area (sq ft)	809.51	779.72
Weir Submerg		Froude # Chl	0.27	0.28
Weir Max Depth (ft)		Specif Force (cu ft)	4300.14	4210.54
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.72	7.43
Min El Prs (ft)	130.00	W.P. Total (ft)	131.18	131.63
Delta EG (ft)	0.38	Conv. Total (cfs)	137895.4	134916.6
Delta WS (ft)	0.44	Top Width (ft)	104.85	104.96
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)	0.14	0.03
BR Open Vel (ft/s)	4.67	C & E Loss (ft)	0.01	0.11
BR Sluice Coef		Shear Total (lb/sq ft)	0.27	0.27
BR Sel Method	Energy only	Power Total (lb/ft s)	1.21	1.26

Plan: PROPBRIDGE Souadabscook Str Reach RS: 35151 Profile: 25 year

E.G. US. (ft)	125.65	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.52	E.G. Elev (ft)	125.54	125.36
Q Total (cfs)	4440.00	W.S. Elev (ft)	125.11	124.88
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	119.53	119.32
Q Weir (cfs)		Max Chl Dpth (ft)	12.00	12.09
Weir Sta Lft (ft)		Vel Total (ft/s)	4.98	5.18
Weir Sta Rgt (ft)		Flow Area (sq ft)	890.82	856.84
Weir Submerg		Froude # Chl	0.30	0.31
Weir Max Depth (ft)		Specif Force (cu ft)	5142.16	5008.01
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.27	7.96
Min El Prs (ft)	130.00	W.P. Total (ft)	135.87	136.02
Delta EG (ft)	0.45	Conv. Total (cfs)	156619.3	151960.1
Delta WS (ft)	0.53	Top Width (ft)	107.69	107.59
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)	0.17	0.03
BR Open Vel (ft/s)	5.18	C & E Loss (ft)	0.02	0.13
BR Sluice Coef		Shear Total (lb/sq ft)	0.33	0.34
BR Sel Method	Energy only	Power Total (lb/ft s)	1.64	1.74

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 35151   Profile: 50 year

E.G. US. (ft)	126.25	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.10	E.G. Elev (ft)	126.13	125.93
Q Total (cfs)	5040.00	W.S. Elev (ft)	125.63	125.37
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	119.96	119.76
Q Weir (cfs)		Max Chl Dpth (ft)	12.52	12.58
Weir Sta Lft (ft)		Vel Total (ft/s)	5.32	5.54
Weir Sta Rgt (ft)		Flow Area (sq ft)	947.43	910.16
Weir Submerg		Froude # Chl	0.31	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	5777.71	5609.21
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.64	8.32
Min El Prs (ft)	130.00	W.P. Total (ft)	139.05	138.99
Delta EG (ft)	0.51	Conv. Total (cfs)	169882.7	163960.1
Delta WS (ft)	0.60	Top Width (ft)	109.62	109.37
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)	0.18	0.03
BR Open Vel (ft/s)	5.54	C & E Loss (ft)	0.02	0.15
BR Sluice Coef		Shear Total (lb/sq ft)	0.37	0.39
BR Sel Method	Energy only	Power Total (lb/ft s)	1.99	2.14

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 35151   Profile: 100 year

E.G. US. (ft)	126.87	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.69	E.G. Elev (ft)	126.73	126.51
Q Total (cfs)	5680.00	W.S. Elev (ft)	126.17	125.88
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	120.39	120.22
Q Weir (cfs)		Max Chl Dpth (ft)	13.06	13.08
Weir Sta Lft (ft)		Vel Total (ft/s)	5.64	5.88
Weir Sta Rgt (ft)		Flow Area (sq ft)	1006.58	965.71
Weir Submerg		Froude # Chl	0.32	0.34
Weir Max Depth (ft)		Specif Force (cu ft)	6476.63	6269.94
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	9.02	8.69
Min El Prs (ft)	130.00	W.P. Total (ft)	142.33	142.04
Delta EG (ft)	0.57	Conv. Total (cfs)	183915.1	176626.1
Delta WS (ft)	0.68	Top Width (ft)	111.61	111.19
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)	0.20	0.04
BR Open Vel (ft/s)	5.88	C & E Loss (ft)	0.02	0.17
BR Sluice Coef		Shear Total (lb/sq ft)	0.42	0.44
BR Sel Method	Energy only	Power Total (lb/ft s)	2.38	2.58

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 35151   Profile: 500 year

E.G. US. (ft)	128.20	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	127.98	E.G. Elev (ft)	128.03	127.77
Q Total (cfs)	7180.00	W.S. Elev (ft)	127.31	126.95
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.32	121.24
Q Weir (cfs)		Max Chl Dpth (ft)	14.20	14.16
Weir Sta Lft (ft)		Vel Total (ft/s)	6.32	6.61
Weir Sta Rgt (ft)		Flow Area (sq ft)	1136.07	1087.04
Weir Submerg		Froude # Chl	0.35	0.37
Weir Max Depth (ft)		Specif Force (cu ft)	8148.81	7853.60
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	9.81	9.45
Min El Prs (ft)	130.00	W.P. Total (ft)	149.29	148.52
Delta EG (ft)	0.70	Conv. Total (cfs)	215175.1	204808.5
Delta WS (ft)	0.85	Top Width (ft)	115.83	115.08
BR Open Area (sq ft)	1457.75	Frctn Loss (ft)	0.23	0.04
BR Open Vel (ft/s)	6.61	C & E Loss (ft)	0.03	0.22
BR Sluice Coef		Shear Total (lb/sq ft)	0.53	0.56
BR Sel Method	Energy only	Power Total (lb/ft s)	3.34	3.71

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 1.1 year

E.G. US. (ft)	120.96	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	120.85	E.G. Elev (ft)	120.94	120.87
Q Total (cfs)	1210.00	W.S. Elev (ft)	120.83	120.77
Q Bridge (cfs)	1210.00	Crit W.S. (ft)	115.98	115.95
Q Weir (cfs)		Max Chl Dpth (ft)	8.73	7.97
Weir Sta Lft (ft)		Vel Total (ft/s)	2.60	2.57
Weir Sta Rgt (ft)		Flow Area (sq ft)	465.33	471.15
Weir Submerg		Froude # Chl	0.18	0.18
Weir Max Depth (ft)		Specif Force (cu ft)	1704.60	1680.74
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	5.85	5.62
Min El Prs (ft)	130.00	W.P. Total (ft)	98.83	102.47
Delta EG (ft)	0.15	Conv. Total (cfs)	67328.8	67657.0
Delta WS (ft)	0.31	Top Width (ft)	79.59	83.78
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.07	0.04
BR Open Vel (ft/s)	2.60	C & E Loss (ft)	0.00	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.09	0.09
BR Sel Method	Energy only	Power Total (lb/ft s)	0.25	0.24

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 10 year

E.G. US. (ft)	123.90	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	123.57	E.G. Elev (ft)	123.84	123.63
Q Total (cfs)	3640.00	W.S. Elev (ft)	123.38	123.16
Q Bridge (cfs)	3640.00	Crit W.S. (ft)	118.67	118.68
Q Weir (cfs)		Max Chl Dpth (ft)	11.28	10.36
Weir Sta Lft (ft)		Vel Total (ft/s)	5.25	5.27
Weir Sta Rgt (ft)		Flow Area (sq ft)	693.29	690.84
Weir Submerg		Froude # Chl	0.33	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	3683.25	3582.73
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.02	6.86
Min El Prs (ft)	130.00	W.P. Total (ft)	123.98	125.24
Delta EG (ft)	0.38	Conv. Total (cfs)	116228.8	114357.3
Delta WS (ft)	0.77	Top Width (ft)	98.74	100.75
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.21	0.09
BR Open Vel (ft/s)	5.27	C & E Loss (ft)	0.00	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.34	0.35
BR Sel Method	Energy only	Power Total (lb/ft s)	1.80	1.84

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 25 year

E.G. US. (ft)	124.64	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.25	E.G. Elev (ft)	124.58	124.32
Q Total (cfs)	4440.00	W.S. Elev (ft)	123.98	123.71
Q Bridge (cfs)	4440.00	Crit W.S. (ft)	119.37	119.36
Q Weir (cfs)		Max Chl Dpth (ft)	11.88	10.91
Weir Sta Lft (ft)		Vel Total (ft/s)	5.89	5.94
Weir Sta Rgt (ft)		Flow Area (sq ft)	753.85	747.23
Weir Submerg		Froude # Chl	0.36	0.37
Weir Max Depth (ft)		Specif Force (cu ft)	4353.70	4218.66
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.44	7.24
Min El Prs (ft)	130.00	W.P. Total (ft)	127.97	128.97
Delta EG (ft)	0.45	Conv. Total (cfs)	129583.9	126561.9
Delta WS (ft)	0.92	Top Width (ft)	101.30	103.18
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.25	0.11
BR Open Vel (ft/s)	5.94	C & E Loss (ft)	0.00	0.03
BR Sluice Coef		Shear Total (lb/sq ft)	0.43	0.45
BR Sel Method	Energy only	Power Total (lb/ft s)	2.54	2.65

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 50 year

E.G. US. (ft)	125.17	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	124.73	E.G. Elev (ft)	125.10	124.81
Q Total (cfs)	5040.00	W.S. Elev (ft)	124.40	124.09
Q Bridge (cfs)	5040.00	Crit W.S. (ft)	119.81	119.84
Q Weir (cfs)		Max Chl Dpth (ft)	12.30	11.29
Weir Sta Lft (ft)		Vel Total (ft/s)	6.33	6.41
Weir Sta Rgt (ft)		Flow Area (sq ft)	796.77	786.76
Weir Submerg		Froude # Chl	0.38	0.39
Weir Max Depth (ft)		Specif Force (cu ft)	4869.59	4706.68
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	7.73	7.50
Min El Prs (ft)	130.00	W.P. Total (ft)	130.74	131.53
Delta EG (ft)	0.50	Conv. Total (cfs)	139194.3	135231.9
Delta WS (ft)	1.03	Top Width (ft)	103.08	104.85
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.29	0.12
BR Open Vel (ft/s)	6.41	C & E Loss (ft)	0.00	0.03
BR Sluice Coef		Shear Total (lb/sq ft)	0.50	0.52
BR Sel Method	Energy only	Power Total (lb/ft s)	3.16	3.32

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 100 year

E.G. US. (ft)	125.71	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	125.23	E.G. Elev (ft)	125.63	125.31
Q Total (cfs)	5680.00	W.S. Elev (ft)	124.84	124.49
Q Bridge (cfs)	5680.00	Crit W.S. (ft)	120.28	120.30
Q Weir (cfs)		Max Chl Dpth (ft)	12.74	11.69
Weir Sta Lft (ft)		Vel Total (ft/s)	6.75	6.86
Weir Sta Rgt (ft)		Flow Area (sq ft)	841.94	828.31
Weir Submerg		Froude # Chl	0.40	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	5440.45	5247.16
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.02	7.77
Min El Prs (ft)	130.00	W.P. Total (ft)	133.60	134.18
Delta EG (ft)	0.55	Conv. Total (cfs)	149424.6	144434.4
Delta WS (ft)	1.14	Top Width (ft)	104.92	106.57
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.32	0.12
BR Open Vel (ft/s)	6.86	C & E Loss (ft)	0.00	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.57	0.60
BR Sel Method	Energy only	Power Total (lb/ft s)	3.84	4.09

Plan: PROPBRIDGE   Souadabscook Str   Reach RS: 27966   Profile: 500 year

E.G. US. (ft)	126.90	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	126.45	E.G. Elev (ft)	126.79	126.40
Q Total (cfs)	7180.00	W.S. Elev (ft)	125.75	125.29
Q Bridge (cfs)	7180.00	Crit W.S. (ft)	121.31	121.29
Q Weir (cfs)		Max Chl Dpth (ft)	13.65	12.49
Weir Sta Lft (ft)		Vel Total (ft/s)	7.64	7.84
Weir Sta Rgt (ft)		Flow Area (sq ft)	939.47	915.83
Weir Submerg		Froude # Chl	0.44	0.46
Weir Max Depth (ft)		Specif Force (cu ft)	6809.71	6535.77
Min El Weir Flow (ft)	134.91	Hydr Depth (ft)	8.64	8.32
Min El Prs (ft)	130.00	W.P. Total (ft)	139.61	139.62
Delta EG (ft)	0.67	Conv. Total (cfs)	171862.7	164087.0
Delta WS (ft)	1.54	Top Width (ft)	108.79	110.12
BR Open Area (sq ft)	1441.68	Frctn Loss (ft)	0.39	0.14
BR Open Vel (ft/s)	7.84	C & E Loss (ft)	0.01	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.73	0.78
BR Sel Method	Energy only	Power Total (lb/ft s)	5.60	6.15

McFarland Johnson

CALCULATION COVER PAGE

PROJECT: Hampden, I-95 over Souadabscook Stream West, Center, and East Bridges (Br. Nos. 5951, 1433, 5950, 1432, 5949, 1431)	MJ JOB NO.: 18084.99
CLIENT: Maine Department of Transportation (MEDOT)	WIN NO.:
SUBJECT/ TITLE: Approximate Scour Depths for the Request for Proposals Document	FEDERAL JOB NO.:

REV. NO.	ORIGINATOR'S SIGNATURE / DATE	CHECKER'S SIGNATURE / DATE
	Tim Aguilar 5/1/2019	Ronald L Joy 5/3/2019

CALCULATION OBJECTIVE: Estimate scour depths.

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS:

- The preliminary hydraulic (HEC-RAS) model prepared for the MEDOT Request for Proposals (RFP) (based on 2-span layout). Controls over the simple span alternative.
- Scour depths were calculations for the West, Center, and East bridges.
- Pier foundations consist of a 5-foot wide wall pier (at the base). See attached sketch.
- Estimate Contraction Scour, considering borings and particle size (mm) analyses.
- Design Discharge = Q100 (Maintain normal FOS) (BDG 2.3.9.2)
- Check Discharge = Q500 Super Flood (FOS=1.0) (BDG 2.3.9.2)
- Bottom of footing to be placed on rock, or piles designed for Extreme Event scour load case.
- Increase 5-foot pier width by 25% for local scour to account for collection of debris. (BDG 2.3.11.1)
- Incorporate CSU HEC-18 Equation 7.1. [Note: The HEC-18 alternative Florida DOT method not considered, since bridge does not include wide piers. ($y/a < 0.2$)]
- K1 = 1.0 (Round Nose Pier) (HEC-18 Table 7.1) K2=1.0 (Piers aligned with channel. 0 degree angle of attack) (HEC-18 Table 7.2) K3=1.1 (No dunes) (HEC-18 Table 7.3)

REFERENCES / DESIGN FILES:

REFERENCE TITLE:	LOCATION:	REASON FOR REFERENCE:
HEC-RAS Model	M:\18084.99 MaineDOT Hampden Bridges\Design\H&H\HEC-RAS	Hydraulic Design File
HEC 18 – Evaluating Scour at Bridges (5th Edition) (April 2012)	http://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12003.pdf	Primary scour reference.
MeDOT Bridge Design Guide (BDG) Complete 2003 BDG with Updates to 2018.PDF	https://www.maine.gov/mdot/bdg/	Primary client reference.

CONCLUSIONS:

Scour depths were calculated at Q100 and Q500 for the total abutment scour, local pier scour, and contraction scour. For a summary of scour depths, see attached chart.

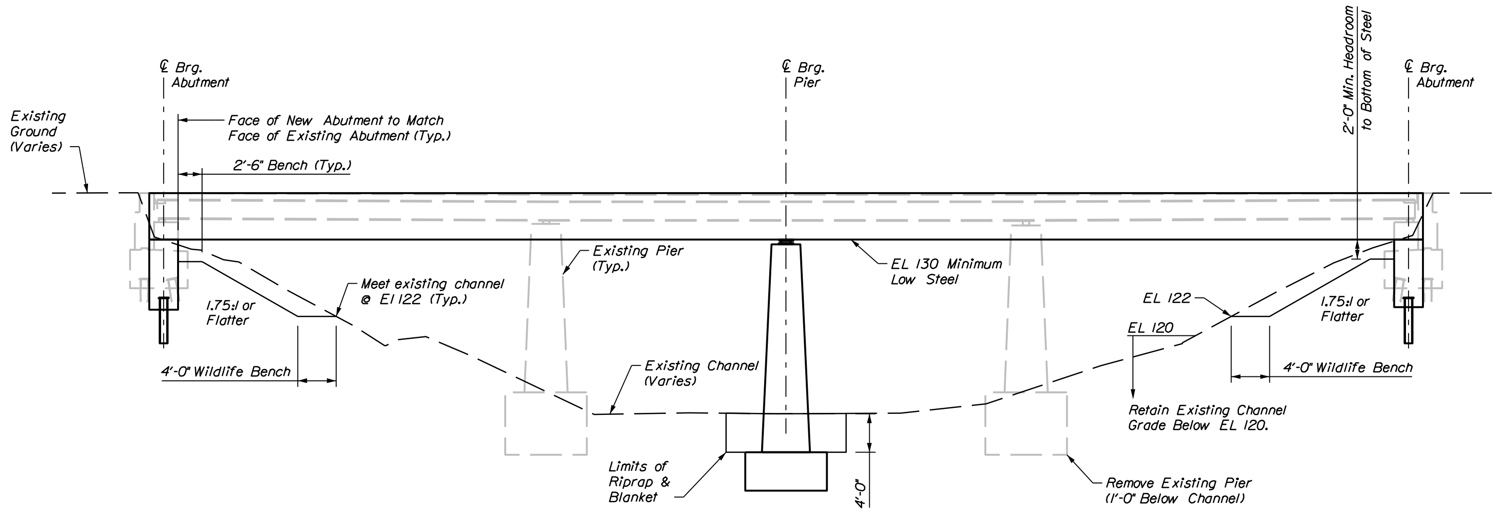


FIGURE 1: ASSUMED BRIDGE ELEVATION SCHEMATIC

Center Bridge Shown. West and East Bridges Similar.
Not to scale.

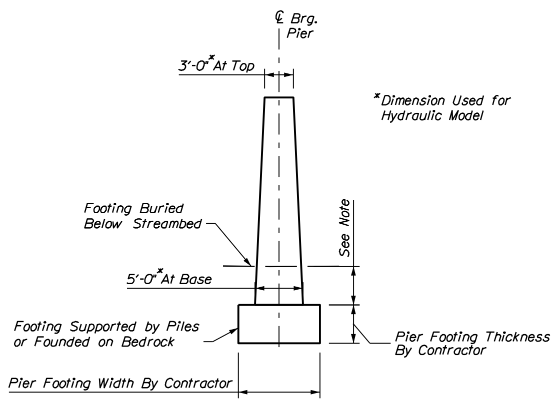


FIGURE 2: ASSUMED PIER GEOMETRY

Note:
The proposed top of footing for the pier is assumed to be placed below the MaineDOT Standard Detail riprap section.

Scour Depth Summary

Project Description: I-95 over Souadabscook Stream, West, Center, and East Bridges

Project Number:	18084.99	
Calcs By:	TEPA	5/1/2019
Check By:		

	West Bridge			
Q100	**Abutment Scour[3]**	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	2.15	9.12	2.30	**11.42**
	Center Bridge			
	Abutment Scour[3]	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	5.00	7.32	3.18	**10.50**
	East Bridge			
	Abutment Scour[3]	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	12.17	8.58	1.95	**10.53**

	West Bridge			
Q500	**Abutment Scour[3]**	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	3.10	8.75	2.79	**11.54**
	Center Bridge			
	Abutment Scour[3]	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	8.94	7.84	5.21	**13.05**
	East Bridge			
	Abutment Scour[3]	Local Pier Scour	Contraction Scour	**Total Pier Scour**
	17.39	8.75	1.88	**10.63**

Notes

1) Depths are given in feet.

2) Some of the scour depths calculated may exceed depth of bedrock. For these values, the assumed scour depth for design should be the bedrock depth.

3) NCHRP 24-20 was used for abutment scour. This calculation provides the total scour, and therefore includes contraction scour.

4) Pier scour was calculated using CSU Equations. Contraction scour was then added to this value to determine the total scour.

M:\18084.99 MaineDOT Hampden Bridges\Design\H&H\Scour\Hampden Scour Design\Scour Depth Summary Charts

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West, Center, and East Bridges	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Raw Data from Borings

West Bridge (RS 40346)

Location	*Boring ID*	*Depth (ft)*	*D50 (mm)*	*D85 (mm)*
W Abut	BB-HSS-101	6.5	1.0239	8.5294
W Abut	BB-HSS-102	4.5	0.2441	1.1291
Pier	BB-HSS-103	12	0.074	0.1169
Pier	BB-HSS-104	3.4	3.2307	11.1119
E Abut	BB-HSS-105	30	0.074	0.1229
E Abut	BB-HSS-106	35	0.1211	0.238

Center Bridge (RS 35151)

Location	*Sample No.*	*Depth (ft)*	*D50 (mm)*	*D85 (mm)*
W Abut	BB-HSS-107	18.5	2.3752	8.3426
W Abut	BB-HSS-108	5	3.3617	13.9141
Pier	BB-HSS-109	0	7.3178	23.5608
Pier	BB-HSS-110	0	6.3242	16.5421
E Abut	BB-HSS-111	8	0.425	7.523
E Abut	BB-HSS-112	15.5	2.1187	8.4443

East Bridge (RS 27966)

Location	*Sample No.*	*Depth (ft)*	*D50 (mm)*	*D85 (mm)*
W Abut	BB-HSS-113	10.5	0.074	0.1403
W Abut	BB-HSS-114	11	1.6168	7.5704
Pier	BB-HSS-115	4.5	0.1677	4.9308
E Abut	BB-HSS-117	16	0.6794	9.4773
E Abut	BB-HSS-118	5	0.5274	5.4272
E Abut	BB-HSS-118	15	1.7018	9.1176

Design D50 (mm)

Bridge	*LOB*	*Channel*	*ROB*
West Bridge	0.10	1.65	0.63
Center Bridge	2.87	6.82	1.27
East Bridge	0.97	0.17	0.85

Design D85 (mm)

Bridge	*LOB*	*Channel*	*ROB*
West Bridge	0.18	5.61	4.83
Center Bridge	11.13	20.05	7.98
East Bridge	8.01	4.93	3.86

Design D50 (ft)

Bridge	*LOB*	*Channel*	*ROB*
West Bridge	0.000328	0.005413	0.002067
Center Bridge	0.009416	0.022375	0.004167
East Bridge	0.003182	0.000558	0.002789

Design D85 (ft)

Bridge	*LOB*	*Channel*	*ROB*
West Bridge	0.000591	0.018406	0.015846
Center Bridge	0.036516	0.065781	0.026181
East Bridge	0.026280	0.016175	0.012664

NCHRP 24-20 Scour Calculations

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:	18084.99
		Calculated By:	TEPA 5/1/2019
		Checked By:	

Flood Event: **100 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$ scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A\, y_c \text{ or } y_{max} = \alpha_B\, y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length* over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			RS 40799.90			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
5680	366.12	1941.89	5.30	11.17	0.00541	0.48	2.36	254.61	3.93	10.89	5412.33	0.44	2.32	13.06	40.8340

Bridge			RS 40346 BR U			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
5680	108.43	1019.34	9.4009	11.17	0.00541	0	0	0	5.57	9.4	5680	0	0	0	52.3580

NOTE: q1 & q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

q2c/q1 = 1.28222 , use chart to calculate αA
αA = 1.76 from chart.
yc = 6.56356 ft (Eq. 8.5)
y_{max} = 11.5519 ft

CALCULATED SCOUR
y_s = 2.15096 ft

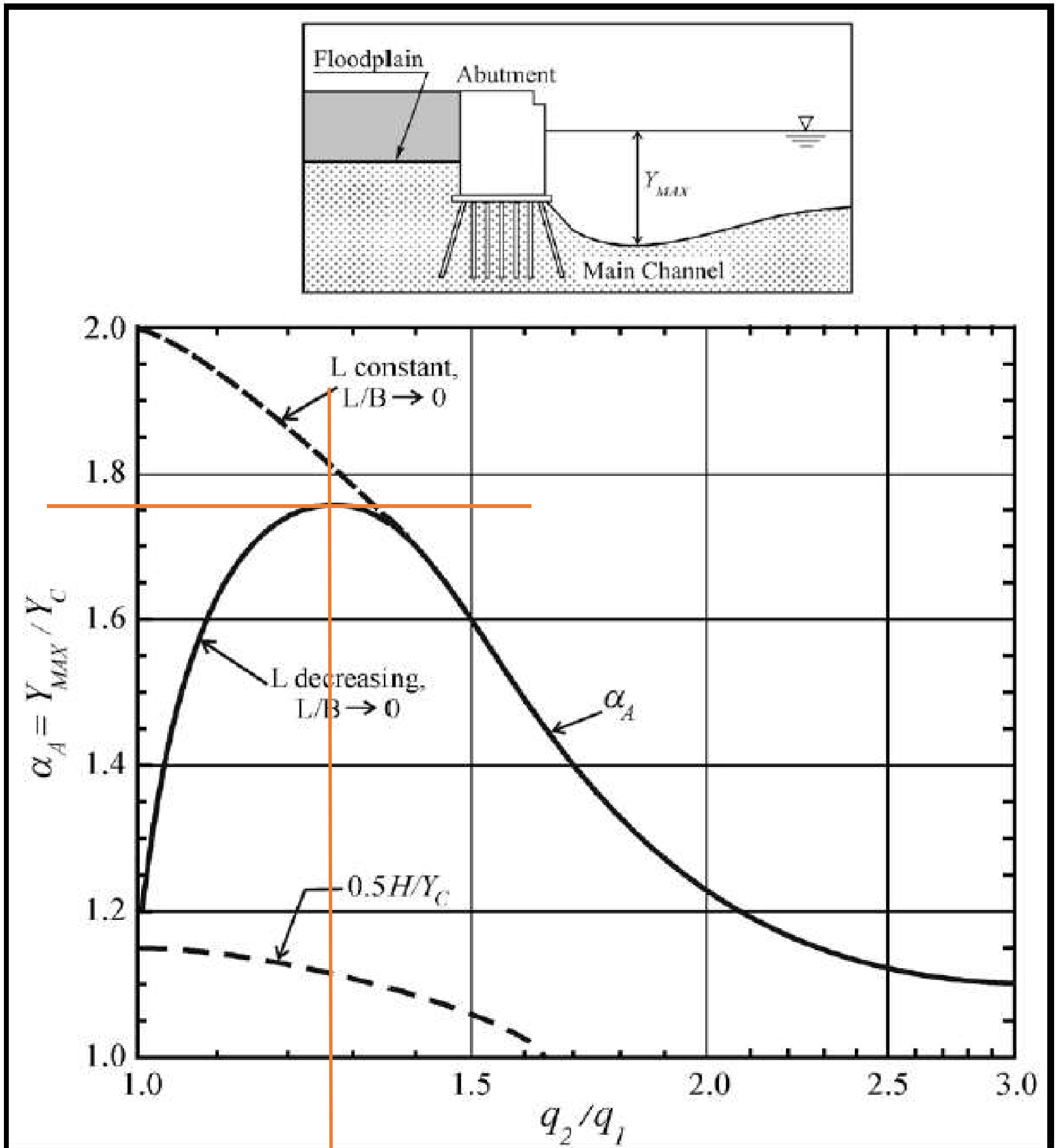


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 40799.90 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40799.90 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.58	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.23	Reach Len. (ft)	237.36	267.44	303.63
W.S. Elev (ft)	127.35	Flow Area (sq ft)	534.52	1377.74	29.63
Crit W.S. (ft)		Area (sq ft)	534.52	1377.74	29.63
E.G. Slope (ft/ft)	0.000277	Flow (cfs)	254.61	5412.33	13.06
Q Total (cfs)	5680.00	Top Width (ft)	226.82	126.52	12.78
Top Width (ft)	366.12	Avg. Vel. (ft/s)	0.48	3.93	0.44
Vel Total (ft/s)	2.92	Hydr. Depth (ft)	2.36	10.89	2.32
Max Chl Dpth (ft)	16.50	Conv. (cfs)	15285.3	324924.2	783.9
Conv. Total (cfs)	340993.4	Wetted Per. (ft)	226.88	132.60	14.13
Length Wtd. (ft)	266.85	Shear (lb/sq ft)	0.04	0.18	0.04
Min Ch El (ft)	110.85	Stream Power (lb/ft s)	0.02	0.71	0.02
Alpha	1.72	Cum Volume (acre-ft)	1020.73	1141.90	1087.30
Frctn Loss (ft)	0.09	Cum SA (acres)	415.26	106.67	248.03
C & E Loss (ft)	0.01				

Bridge Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 40346 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 Profile: 100 year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	127.48	E.G. Elev (ft)	127.39	127.22
W.S. US. (ft)	127.15	W.S. Elev (ft)	126.86	126.67
Q Total (cfs)	5680.00	Crit W.S. (ft)	121.08	121.15
Q Bridge (cfs)	5680.00	Max Chl Dpth (ft)	14.89	13.77
Q Weir (cfs)		Vel Total (ft/s)	5.57	5.67
Weir Sta Lft (ft)		Flow Area (sq ft)	1019.34	1002.14
Weir Sta Rgt (ft)		Froude # Chl	0.32	0.32
Weir Submerg		Specif Force (cu ft)	6595.87	6338.01
Weir Max Depth (ft)		Hydr Depth (ft)	9.40	9.23
Min El Weir Flow (ft)	134.81	W.P. Total (ft)	141.93	140.57
Min El Prs (ft)	130.00	Conv. Total (cfs)	192944.1	188465.7
Delta EG (ft)	0.41	Top Width (ft)	108.43	108.56
Delta WS (ft)	0.46	Frctn Loss (ft)	0.16	0.06
BR Open Area (sq ft)	1375.71	C & E Loss (ft)	0.01	0.08
BR Open Vel (ft/s)	5.67	Shear Total (lb/sq ft)	0.39	0.40
BR Sluice Coef		Power Total (lb/ft s)	2.17	2.29
BR Sel Method	Energy only			

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **100 Years** **RS 40532.46**

Units: English

Description of Streambed Material :

D_{50} of Streambed Material: **0.005413** ft Particle size in a mixture of which 50% are smaller.

D95 of Streambed Material: ft Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u y^{1/6} D_{50}^{1/3}$

Required User Inputs:

y =	**10.38**	ft	Average depth of flow upstream of the bridge.
V =	**4.66**	ft/s	Upstream Velocity (from HEC-RAS)

Calculated Inputs:

D50 =	0.00541339	ft	Particle size in a mixture of which 50% are smaller.
Ku =	11.17		Equation constant based on units.
Vc =	2.90	ft/s	

Type of Scour = ***Live-Bed Scour***

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 40532.46 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40532.46 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.48	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.092	0.030	0.092
W.S. Elev (ft)	127.15	Reach Len. (ft)	62.50	62.50	62.50
Crit W.S. (ft)	120.63	Flow Area (sq ft)	40.92	1204.66	41.04
E.G. Slope (ft/ft)	0.000402	Area (sq ft)	1549.27	1204.66	2312.14
Q Total (cfs)	5680.00	Flow (cfs)	30.03	5610.67	39.30
Top Width (ft)	1635.86	Top Width (ft)	627.54	116.02	892.30
Vel Total (ft/s)	4.41	Avg. Vel. (ft/s)	0.73	4.66	0.96
Max Chl Dpth (ft)	14.65	Hydr. Depth (ft)	3.41	10.38	5.14
Conv. Total (cfs)	283155.6	Conv. (cfs)	1497.1	279699.2	1959.2
Length Wtd. (ft)	62.50	Wetted Per. (ft)	12.01	118.69	8.08
Min Ch El (ft)	112.50	Shear (lb/sq ft)	0.09	0.25	0.13
Alpha	1.10	Stream Power (lb/ft s)	0.06	1.19	0.12
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	1015.05	1133.97	1079.14
C & E Loss (ft)	0.06	Cum SA (acres)	412.94	105.92	244.87

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> *West Bridge, Center Pier*

Enter Storm Event and Total Flow ==> *Q100 - 5680 CFS*

Correction for Pier Nose Shape:

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> **2**

K1 = 1.00

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> *5.00* feet at base of wall

Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> **0** Degrees

Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> **12**

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> **10.38** ft Reference ==> HEC-RAS

y1 = 10.38 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> **4.66** fps Reference ==> HEC-RAS

Ve = 4.66 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = **0.25**

CALCULATE TOTAL LOCAL PIER SCOUR

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 =	10.38	feet	ys / y1 =	0.88		
K1 =	1.00					
K2 =	1.00					
K3 =	1.10					
a =	6.25	feet	ys =	0.88	X	10.38
Fr =	0.25					

ys = Pier Scour Depth = 9.1 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Live Bed Contraction Scour

Flood Event: **100 Years**

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$y_s = y_2 - y_o =$ (average contraction scour depth)

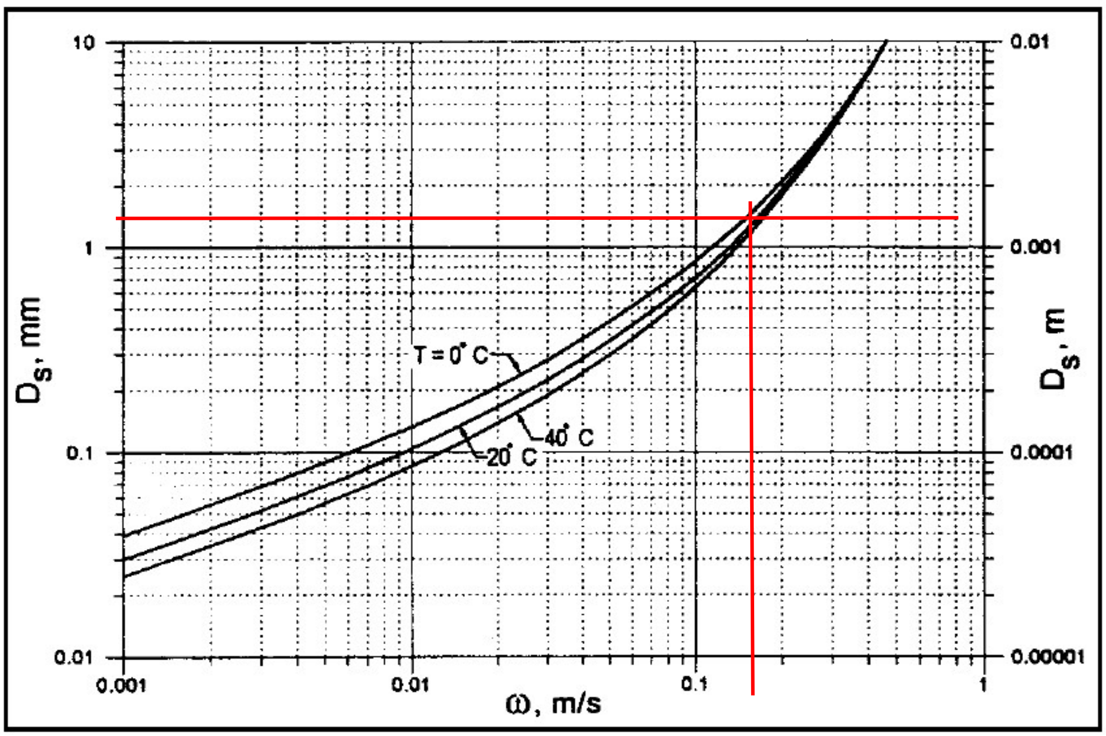
Required User Inputs:

y1 =	**10.38**	ft	Average depth of mainstream channel
D50 =	**1.65**	mm	
Q1 =	**5610.67**	CFS	flow in upstream channel transporting sediment
Q2 =	**5680**	CFS	flow in contracted channel
W1 =	**116.02**	ft	Top width of upstream main channel that is transporting bed material
W2 =	**81.1**	ft	Top with of main channel in contracted section less pier widths
y_o =	**10.89**	ft	Average existing depth in the contracted section.
EGL Slope =	**0.000867**	ft/ft	slope of energy grade line (from bridge cross section)
T =	**0.5904**	ft/s	fall velocity of bed material (from chart below)

Calculated Inputs:

g =	32.2	ft/s2	constant
V* =	0.538315	ft/s2	shear velocity in upstream section
k1 =	0.64		
y_2 =	13.19	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth:	**2.30** ft	*Live Bed Contraction Scour*



Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach: Reach RS: 40532.46 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40532.46 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.48	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.33	Reach Len. (ft)	62.50	62.50	62.50
W.S. Elev (ft)	127.15	Flow Area (sq ft)	40.92	1204.66	41.04
Crit W.S. (ft)	120.63	Area (sq ft)	1549.27	1204.66	2312.14
E.G. Slope (ft/ft)	0.000402	Flow (cfs)	30.03	5610.67	39.30
Q Total (cfs)	5680.00	Top Width (ft)	627.54	116.02	892.30
Top Width (ft)	1635.86	Avg. Vel. (ft/s)	0.73	4.66	0.96
Vel Total (ft/s)	4.41	Hydr. Depth (ft)	3.41	10.38	5.14
Max Chl Dpth (ft)	14.65	Conv. (cfs)	1497.1	279699.2	1959.2
Conv. Total (cfs)	283155.6	Wetted Per. (ft)	12.01	118.69	8.08
Length Wtd. (ft)	62.50	Shear (lb/sq ft)	0.09	0.25	0.13
Min Ch El (ft)	112.50	Stream Power (lb/ft s)	0.06	1.19	0.12
Alpha	1.10	Cum Volume (acre-ft)	1015.05	1133.97	1079.14
Frctn Loss (ft)	0.04	Cum SA (acres)	412.94	105.92	244.87
C & E Loss (ft)	0.06				

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach: Reach RS: 40346 BR U Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 BR U Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.39	Wt. n-Val.	0.092	0.030	0.030
Vel Head (ft)	0.53	Reach Len. (ft)	182.00	182.00	182.00
W.S. Elev (ft)	126.86	Flow Area (sq ft)	49.51	937.64	32.19
Crit W.S. (ft)	121.08	Area (sq ft)	49.51	937.64	32.19
E.G. Slope (ft/ft)	0.000867	Flow (cfs)	51.31	5535.16	93.53
Q Total (cfs)	5680.00	Top Width (ft)	13.53	86.10	8.80
Top Width (ft)	108.43	Avg. Vel. (ft/s)	1.04	5.90	2.91
Vel Total (ft/s)	5.57	Hydr. Depth (ft)	3.66	10.89	3.66
Max Chl Dpth (ft)	14.89	Conv. (cfs)	1743.1	188023.9	3177.1
Conv. Total (cfs)	192944.1	Wetted Per. (ft)	15.38	115.10	11.44
Length Wtd. (ft)	182.00	Shear (lb/sq ft)	0.17	0.44	0.15
Min Ch El (ft)	111.97	Stream Power (lb/ft s)	0.18	2.60	0.44
Alpha	1.10	Cum Volume (acre-ft)	1013.91	1132.43	1077.46
Frctn Loss (ft)	0.16	Cum SA (acres)	412.48	105.78	244.23
C & E Loss (ft)	0.01				

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 Years** **RS 40532.46**

Units: English

Description of Streambed Material :

D_{50} of Streambed Material: **0.005413** ft — Particle size in a mixture of which 50% are smaller.

D95 of Streambed Material: ft — Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u\, y^{1/6}\, D_{50}^{1/3}$

Required User Inputs:

y = **11.70** ft — Average depth of flow upstream of the bridge.

V = **5.21** ft/s — Upstream Velocity (from HEC-RAS)

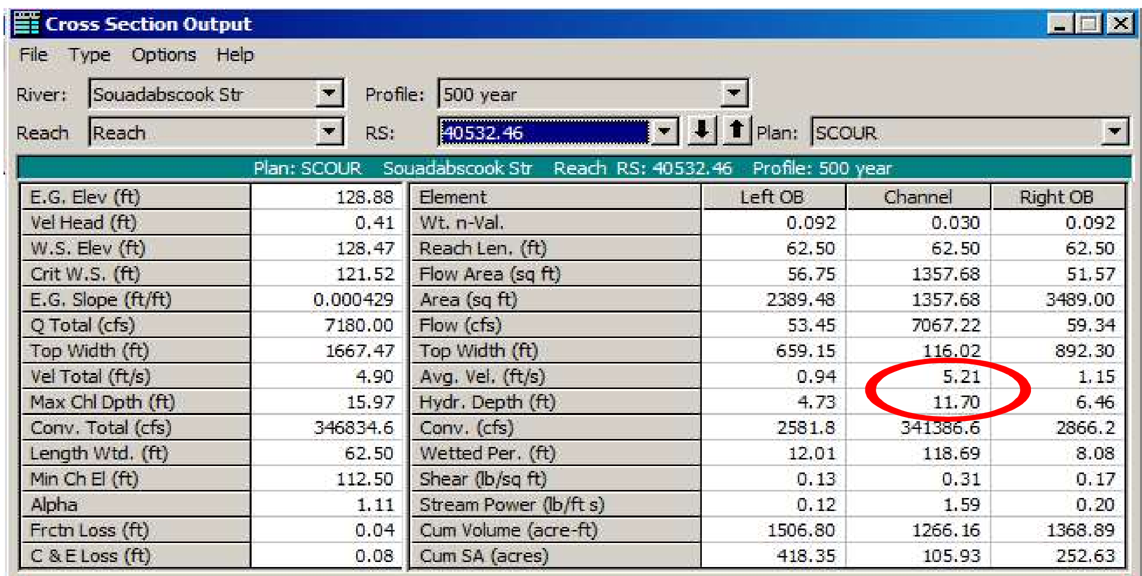
Calculated Inputs:

D50 = 0.00541339 ft — Particle size in a mixture of which 50% are smaller.

Ku = 11.17 — Equation constant based on units.

Vc = 2.96 ft/s

Type of Scour = ***Live-Bed Scour***



Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach: Reach RS: 40532.46 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40532.46 Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.88	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.41	Reach Len. (ft)	62.50	62.50	62.50
W.S. Elev (ft)	128.47	Flow Area (sq ft)	56.75	1357.68	51.57
Crit W.S. (ft)	121.52	Area (sq ft)	2389.48	1357.68	3489.00
E.G. Slope (ft/ft)	0.000429	Flow (cfs)	53.45	7067.22	59.34
Q Total (cfs)	7180.00	Top Width (ft)	659.15	116.02	892.30
Top Width (ft)	1667.47	Avg. Vel. (ft/s)	0.94	5.21	1.15
Vel Total (ft/s)	4.90	Hydr. Depth (ft)	4.73	11.70	6.46
Max Chl Dpth (ft)	15.97	Conv. (cfs)	2581.8	341386.6	2866.2
Conv. Total (cfs)	346834.6	Wetted Per. (ft)	12.01	118.69	8.08
Length Wtd. (ft)	62.50	Shear (lb/sq ft)	0.13	0.31	0.17
Min Ch El (ft)	112.50	Stream Power (lb/ft s)	0.12	1.59	0.20
Alpha	1.11	Cum Volume (acre-ft)	1506.80	1266.16	1368.89
Frctn Loss (ft)	0.04	Cum SA (acres)	418.35	105.93	252.63
C & E Loss (ft)	0.08				

NCHRP 24-20 Scour Calculations

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$

scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A\, y_c \text{ or } y_{max} = \alpha_B\, y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length* over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			**RS 40799.90**			**From HEC Ras**									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
7180	407.83	2475.11	6.07	11.17	0.00541	0.62	3.47	536.25	4.27	12.26	6622.57	0.38	1.77	21.18	48.4486

Bridge			**RS 40346 BR U**			**From HEC Ras**									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
7180	112.36	1156.38	10.2917	11.17	0.00541	0	0	0	6.21	10.29	7180	0	0	0	63.9009

NOTE: q1 & q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

q2c/q1 = 1.31894 , use chart to calculate αA
αA = 1.74 from chart.
yc = 7.69425 ft (Eq. 8.5)
y_{max} = 13.388 ft

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

CALCULATED SCOUR
y_s = 3.09625 ft

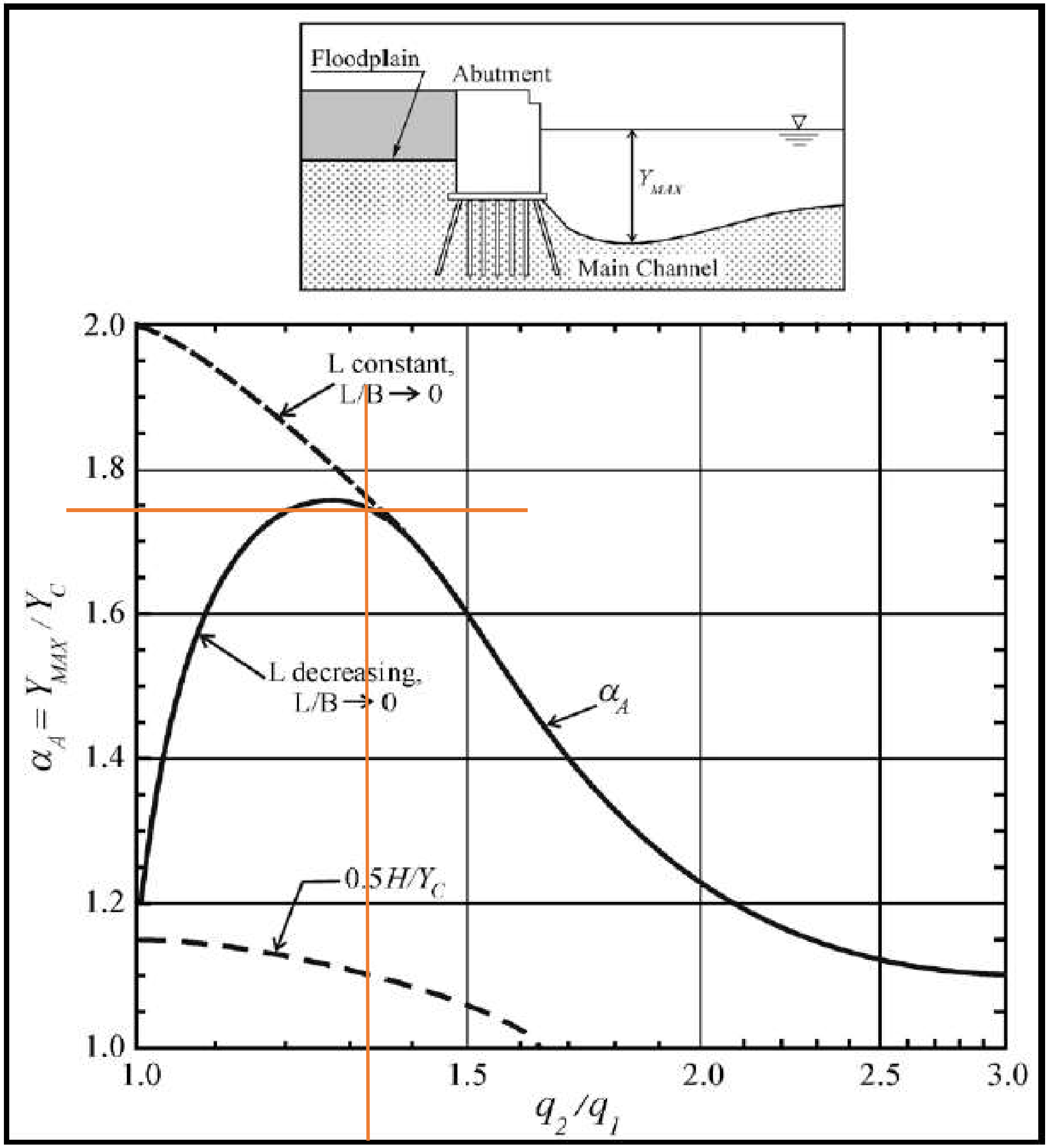


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str | Profile: 500 year

Reach: Reach | RS: 40799.90 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40799.90 Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.99	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.26	Reach Len. (ft)	237.36	267.44	303.63
W.S. Elev (ft)	128.73	Flow Area (sq ft)	867.99	1551.74	55.38
Crit W.S. (ft)		Area (sq ft)	867.99	1551.74	55.38
E.G. Slope (ft/ft)	0.000279	Flow (cfs)	536.25	6622.57	21.18
Q Total (cfs)	7180.00	Top Width (ft)	250.00	126.52	31.31
Top Width (ft)	407.83	Avg. Vel. (ft/s)	0.62	4.27	0.38
Vel Total (ft/s)	2.90	Hydr. Depth (ft)	3.47	12.26	1.77
Max Chl Dpth (ft)	17.88	Conv. (cfs)	32078.2	396159.5	1267.2
Conv. Total (cfs)	429504.9	Wetted Per. (ft)	250.78	132.60	32.83
Length Wtd. (ft)	266.41	Shear (lb/sq ft)	0.06	0.20	0.03
Min Ch El (ft)	110.85	Stream Power (lb/ft s)	0.04	0.87	0.01
Alpha	2.00	Cum Volume (acre-ft)	1515.68	1275.09	1381.24
Frctn Loss (ft)	0.09	Cum SA (acres)	420.82	106.67	255.85
C & E Loss (ft)	0.02				

File Type Options Help

River: Souadabscook Str | Profile: 500 year

Reach: Reach | RS: 40346 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 Profile: 500 year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	128.88	E.G. Elev (ft)	128.77	128.58
W.S. US. (ft)	128.47	W.S. Elev (ft)	128.10	127.89
Q Total (cfs)	7180.00	Crit W.S. (ft)	121.97	122.03
Q Bridge (cfs)	7180.00	Max Chl Dpth (ft)	16.13	14.99
Q Weir (cfs)		Vel Total (ft/s)	6.21	6.32
Weir Sta Lft (ft)		Flow Area (sq ft)	1156.38	1136.17
Weir Sta Rgt (ft)		Froude # Chl	0.34	0.35
Weir Submerg		Specif Force (cu ft)	8374.90	8072.63
Weir Max Depth (ft)		Hydr Depth (ft)	10.29	10.14
Min El Weir Flow (ft)	134.81	W.P. Total (ft)	148.97	147.17
Min El Prs (ft)	130.00	Conv. Total (cfs)	229403.7	224271.3
Delta EG (ft)	0.48	Top Width (ft)	112.36	112.05
Delta WS (ft)	0.54	Frctn Loss (ft)	0.18	0.07
BR Open Area (sq ft)	1375.71	C & E Loss (ft)	0.01	0.11
BR Open Vel (ft/s)	6.32	Shear Total (lb/sq ft)	0.47	0.49
BR Sluice Coef		Power Total (lb/ft s)	2.95	3.12
BR Sel Method	Energy only			

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> *West Bridge, Center Pier*

Correction for Pier Nose Shape: Enter Storm Event and Total Flow ==> *Q500 - 7180 CFS*

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> 4

K1 = 0.90

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> *5.00* feet at base of wall
Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> 0 Degrees
Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> 12

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> 11.7 ft Reference ==> HEC-RAS

y1 = 11.70 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> 5.21 fps Reference ==> HEC-RAS

Ve = 5.21 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = **0.27**

CALCULATE TOTAL LOCAL PIER SCOUR

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 = 11.70 feet
K1 = 0.90
K2 = 1.00
K3 = 1.10
a = 6.25 feet
Fr = 0.27

ys / y1 = 0.75

ys = 0.75 X 11.70

ys = Pier Scour Depth = 8.8 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Live Bed Contraction Scour

Flood Event: **500 Years**

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$y_s = y_2 - y_o$ = (average contraction scour depth)

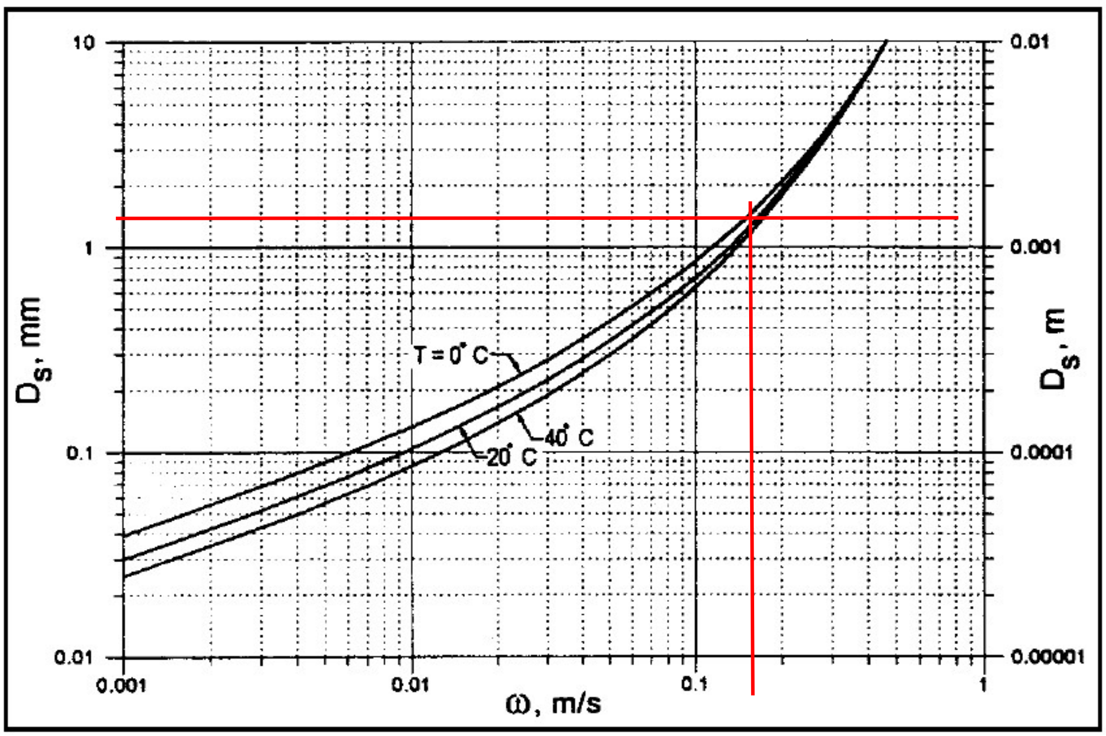
Required User Inputs:

y1 =	**11.7**	ft	Average depth of mainstream channel
D50 =	**1.65**	mm	
Q1 =	**7067.22**	CFS	flow in upstream channel transporting sediment
Q2 =	**7180**	CFS	flow in contracted channel
W1 =	**116.02**	ft	Top width of upstream main channel that is transporting bed material
W2 =	**81.24**	ft	Top with of main channel in contracted section less pier widths
y_o =	**12.11**	ft	Average existing depth in the contracted section.
EGL Slope =	**0.00098**	ft/ft	slope of energy grade line (from bridge cross section)
T =	**0.5904**	ft/s	fall velocity of bed material (from chart below)

Calculated Inputs:

g =	32.2	ft/s2	constant
V* =	0.607623	ft/s2	shear velocity in upstream section
k1 =	0.64		
y_2 =	14.90	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth:	**2.79** ft	*Live Bed Contraction Scour*



Cross Section Output

File Type Options Help

River: Souadabscook Str | Profile: 500 year

Reach: Reach | RS: 40532.46 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40532.46 Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.88	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.41	Reach Len. (ft)	62.50	62.50	62.50
W.S. Elev (ft)	128.47	Flow Area (sq ft)	56.75	1357.68	51.57
Crit W.S. (ft)	121.52	Area (sq ft)	2389.48	1357.68	3489.00
E.G. Slope (ft/ft)	0.000429	Flow (cfs)	53.45	7067.22	59.34
Q Total (cfs)	7180.00	Top Width (ft)	659.15	116.02	892.30
Top Width (ft)	1667.47	Avg. Vel. (ft/s)	0.94	5.21	1.15
Vel Total (ft/s)	4.90	Hydr. Depth (ft)	4.73	11.70	6.46
Max Chl Dpth (ft)	15.97	Conv. (cfs)	2581.8	341386.6	2866.2
Conv. Total (cfs)	346834.6	Wetted Per. (ft)	12.01	118.69	8.08
Length Wtd. (ft)	62.50	Shear (lb/sq ft)	0.13	0.31	0.17
Min Ch El (ft)	112.50	Stream Power (lb/ft s)	0.12	1.59	0.20
Alpha	1.11	Cum Volume (acre-ft)	1506.80	1266.16	1368.89
Frctn Loss (ft)	0.04	Cum SA (acres)	418.35	105.93	252.63
C & E Loss (ft)	0.08				

Cross Section Output

File Type Options Help

River: Souadabscook Str | Profile: 500 year

Reach: Reach | RS: 40346 BR U | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 BR U Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.77	Wt. n-Val.	0.092	0.030	0.030
Vel Head (ft)	0.67	Reach Len. (ft)	182.00	182.00	182.00
W.S. Elev (ft)	128.10	Flow Area (sq ft)	67.73	1044.60	44.04
Crit W.S. (ft)	121.97	Area (sq ft)	67.73	1044.60	44.04
E.G. Slope (ft/ft)	0.000980	Flow (cfs)	82.86	6946.12	151.02
Q Total (cfs)	7180.00	Top Width (ft)	15.83	86.24	10.29
Top Width (ft)	112.36	Avg. Vel. (ft/s)	1.22	6.65	3.43
Vel Total (ft/s)	6.21	Hydr. Depth (ft)	4.28	12.11	4.28
Max Chl Dpth (ft)	16.13	Conv. (cfs)	2647.3	221931.3	4825.1
Conv. Total (cfs)	229403.7	Wetted Per. (ft)	17.99	117.59	13.38
Length Wtd. (ft)	182.00	Shear (lb/sq ft)	0.23	0.54	0.20
Min Ch El (ft)	111.97	Stream Power (lb/ft s)	0.28	3.61	0.69
Alpha	1.12	Cum Volume (acre-ft)	1505.04	1264.44	1366.36
Frctn Loss (ft)	0.18	Cum SA (acres)	417.86	105.78	251.98
C & E Loss (ft)	0.01				

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, Center Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **100 Years** **RS 35310.52**
Units: English

Description of Streambed Material :
D_{50} of Streambed Material: **0.022375** ft — Particle size in a mixture of which 50% are smaller.
D95 of Streambed Material: ft — Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u\, y^{1/6}\, D_{50}^{1/3}$

Required User Inputs:

y =	**11.62**	ft	Average depth of flow upstream of the bridge.
V =	**3.44**	ft/s	Upstream Velocity (from HEC-RAS)

Calculated Inputs:

D50 =	0.02237533	ft	Particle size in a mixture of which 50% are smaller.
Ku =	11.17		Equation constant based on units.
Vc =	4.74	ft/s	

Type of Scour = ***Clear-Water Scour***

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 35310.52 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35310.52 Profile: 100 year

E.G. Elev (ft)	126.63
Vel Head (ft)	0.18
W.S. Elev (ft)	126.45
Crit W.S. (ft)	118.32
E.G. Slope (ft/ft)	0.000205
Q Total (cfs)	5680.00
Top Width (ft)	2302.89
Vel Total (ft/s)	3.32
Max Chl Dpth (ft)	13.45
Conv. Total (cfs)	397011.7
Length Wtd. (ft)	59.00
Min Ch El (ft)	113.00
Alpha	1.07
Frctn Loss (ft)	0.02
C & E Loss (ft)	0.13

Element	Left OB	Channel	Right OB
Wt. n-Val.	0.092	0.030	0.092
Reach Len. (ft)	59.00	59.00	59.00
Flow Area (sq ft)	23.77	1644.02	44.68
Area (sq ft)	1999.24	1644.02	2327.47
Flow (cfs)	9.61	5659.14	11.25
Top Width (ft)	848.51	141.50	1312.88
Avg. Vel. (ft/s)	0.40	3.44	0.25
Hydr. Depth (ft)	2.31	11.62	1.14
Conv. (cfs)	671.7	395553.4	786.6
Wetted Per. (ft)	10.27	153.56	39.25
Shear (lb/sq ft)	0.03	0.14	0.01
Stream Power (lb/ft s)	0.01	0.47	0.00
Cum Volume (acre-ft)	493.97	314.77	764.02
Cum SA (acres)	258.22	27.37	167.17

NCHRP 24-20 Scour Calculations			
Project Description :	I-95 over Souadabscook Stream, Center Bridge	Project Number:	18084.99
		Calculated By: TEPA	5/1/2019
		Checked By:	

Flood Event: **100 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$

scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A\, y_c \text{ or } y_{max} = \alpha_B\, y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			RS 35509.99			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
5680	2253.26	10949.2	4.86	11.17	0.02238	0.16	3.93	514.58	1.3	17.01	4511.29	0.15	3.46	654.13	17.6798

Bridge			RS 35151 BR U			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
5680	103.39	943.68	9.12738	11.17	0.02238	0	0	0	6.02	9.13	5680	0	0	0	54.9626

NOTE: q1& q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

q2c/q1 = 3.10878 , use chart to calculate αA
α_B = 1.1 from chart.
yc = 12.8466 ft (Eq. 8.6)
y_{max} = 14.1313 ft

Designers Note: q2c/q1 > 3, therefore conservatively use lowest value on chart

CALCULATED SCOUR
y_s = 5.00131 ft

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

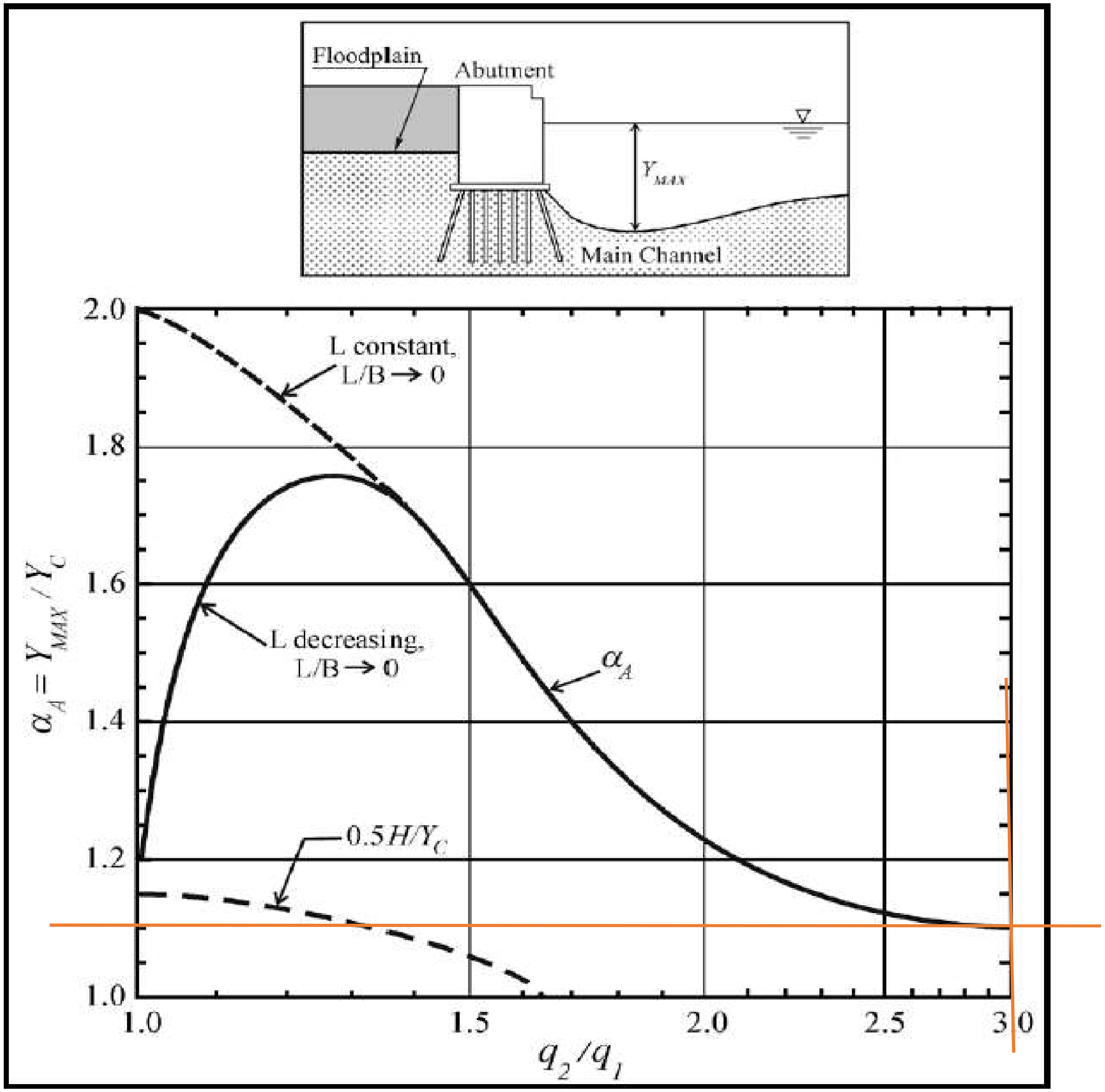


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str | Profile: 100 year

Reach: Reach | RS: 35509.99 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35509.99 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.66	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.02	Reach Len. (ft)	238.86	199.47	180.10
W.S. Elev (ft)	126.64	Flow Area (sq ft)	3135.30	3477.44	4336.42
Crit W.S. (ft)		Area (sq ft)	3135.30	3477.44	4336.42
E.G. Slope (ft/ft)	0.000017	Flow (cfs)	514.58	4511.29	654.13
Q Total (cfs)	5680.00	Top Width (ft)	797.15	204.44	1251.67
Top Width (ft)	2253.26	Avg. Vel. (ft/s)	0.16	1.30	0.15
Vel Total (ft/s)	0.52	Hydr. Depth (ft)	3.93	17.01	3.46
Max Chl Dpth (ft)	18.64	Conv. (cfs)	126146.6	1105917.0	160355.1
Conv. Total (cfs)	1392418.0	Wetted Per. (ft)	797.44	213.73	1251.75
Length Wtd. (ft)	200.15	Shear (lb/sq ft)	0.00	0.02	0.00
Min Ch El (ft)	108.00	Stream Power (lb/ft s)	0.00	0.02	0.00
Alpha	4.99	Cum Volume (acre-ft)	508.04	326.49	777.80
Frctn Loss (ft)	0.01	Cum SA (acres)	262.74	28.16	172.47
C & E Loss (ft)	0.02				

Bridge Output

File Type Options Help

River: Souadabscook Str | Profile: 100 year

Reach: Reach | RS: 35151 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35151 Profile: 100 year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	126.63	E.G. Elev (ft)	126.48	126.23
W.S. US. (ft)	126.45	W.S. Elev (ft)	125.87	125.53
Q Total (cfs)	5680.00	Crit W.S. (ft)	120.39	120.22
Q Bridge (cfs)	5680.00	Max Chl Dpth (ft)	12.76	12.74
Q Weir (cfs)		Vel Total (ft/s)	6.02	6.39
Weir Sta Lft (ft)		Flow Area (sq ft)	943.68	889.50
Weir Sta Rgt (ft)		Froude # Chl	0.34	0.36
Weir Submerg		Specif Force (cu ft)	6171.89	5925.20
Weir Max Depth (ft)		Hydr Depth (ft)	9.13	8.61
Min El Weir Flow (ft)	134.91	W.P. Total (ft)	133.25	132.81
Min El Prs (ft)	130.00	Conv. Total (cfs)	175002.3	165912.2
Delta EG (ft)	0.64	Top Width (ft)	103.39	103.31
Delta WS (ft)	0.76	Frctn Loss (ft)	0.22	0.04
BR Open Area (sq ft)	1399.21	C & E Loss (ft)	0.03	0.20
BR Open Vel (ft/s)	6.39	Shear Total (lb/sq ft)	0.47	0.49
BR Sluice Coef		Power Total (lb/ft s)	2.80	3.13
BR Sel Method	Energy only			

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> Center Bridge, Center Pier

Correction for Pier Nose Shape:

Enter Storm Event and Total Flow ==> Q100 - 5680 CFS

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> 4

K1 = 0.90

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> 5.00 feet at base of wall
Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> 0 Degrees
Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> 12

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> 11.62 ft Reference ==> HEC-RAS

y1 = 11.62 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> 3.44 fps Reference ==> HEC-RAS

Ve = 3.44 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = **0.18**

C A L C U L A T E T O T A L L O C A L P I E R S C O U R

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 = 11.62 feet ys / y1 = 0.63
K1 = 0.90
K2 = 1.00
K3 = 1.10
a = 6.25 feet ys = 0.63 X 11.62
Fr = 0.18

ys = Pier Scour Depth = 7.3 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	Farmington, Maine. Hamlin Br No. 3286	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Clear-Water Contraction Scour

Flood Event: **100 Years** Units: English

Laursen's Equation:

$y_2=[(K_u*Q^2)/(D_m^{2/3}*W^2)]^{3/7}$

Required User Inputs:

Q =	**5680**	CFS	Discharge through the bridge or on the set-back overbank area associated with W.
W =	**75.34**	ft	Top width of the contracted section less pier width(s).
y_o =	**10.85**	ft	Average existing depth in the contracted section.

Calculated Inputs:

D_m =	**0.02797**	ft	Diameter of the smallest nontransportable particle (1.25xD50).
D_{50} =	**0.02238**	ft	Median diameter of bed material. Assumed 6mm for scour design.
K_u =	**0.0077**		Equation constant base on units.
y_2 =	**14.03**	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth: **3.18** ft *Clear-Water Contraction Scour*

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach: Reach RS: 35151 BR U Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35151 BR U Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.48	Wt. n-Val.	0.092	0.031	0.031
Vel Head (ft)	0.61	Reach Len. (ft)	201.00	201.00	201.00
W.S. Elev (ft)	125.87	Flow Area (sq ft)	32.91	871.63	39.14
Crit W.S. (ft)	120.39	Area (sq ft)	32.91	871.63	39.14
E.G. Slope (ft/ft)	0.001053	Flow (cfs)	31.38	5523.91	124.71
Q Total (cfs)	5680.00	Top Width (ft)	11.47	80.34	11.58
Top Width (ft)	103.39	Avg. Vel. (ft/s)	0.95	6.34	3.19
Vel Total (ft/s)	6.02	Hydr. Depth (ft)	2.87	10.85	3.38
Max Chl Dpth (ft)	12.76	Conv. (cfs)	966.9	170193.3	3842.2
Conv. Total (cfs)	175002.3	Wetted Per. (ft)	13.42	106.43	13.41
Length Wtd. (ft)	201.00	Shear (lb/sq ft)	0.16	0.54	0.19
Min Ch El (ft)	113.11	Stream Power (lb/ft s)	0.15	3.41	0.61
Alpha	1.08	Cum Volume (acre-ft)	492.59	313.06	762.42
Frctn Loss (ft)	0.22	Cum SA (acres)	257.64	27.22	166.27
C & E Loss (ft)	0.03				

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, Center Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 Years** **RS 35310.52**
Units: English

Description of Streambed Material :
D_{50} of Streambed Material: **0.022375** ft Particle size in a mixture of which 50% are smaller.
D95 of Streambed Material: ft Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u\, y^{1/6}\, D_{50}^{1/3}$

Required User Inputs:

y =	**12.87**	ft	Average depth of flow upstream of the bridge.
V =	**3.91**	ft/s	Upstream Velocity (from HEC-RAS)

Calculated Inputs:

D50 =	0.02237533	ft	Particle size in a mixture of which 50% are smaller.
Ku =	11.17		Equation constant based on units.
Vc =	4.82	ft/s	

Type of Scour = ***Clear-Water Scour***

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 500 year
Reach: Reach RS: 35310.52 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35310.52 Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.94	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.24	Reach Len. (ft)	59.00	59.00	59.00
W.S. Elev (ft)	127.70	Flow Area (sq ft)	36.61	1820.95	93.73
Crit W.S. (ft)	118.97	Area (sq ft)	3073.07	1820.95	3970.42
E.G. Slope (ft/ft)	0.000230	Flow (cfs)	20.94	7118.02	41.04
Q Total (cfs)	7180.00	Top Width (ft)	863.19	141.50	1315.13
Top Width (ft)	2319.82	Avg. Vel. (ft/s)	0.57	3.91	0.44
Vel Total (ft/s)	3.68	Hydr. Depth (ft)	3.57	12.87	2.39
Max Chl Dpth (ft)	14.70	Conv. (cfs)	1379.7	469016.1	2704.4
Conv. Total (cfs)	473100.1	Wetted Per. (ft)	10.27	153.56	39.25
Length Wtd. (ft)	59.00	Shear (lb/sq ft)	0.05	0.17	0.03
Min Ch El (ft)	113.00	Stream Power (lb/ft s)	0.03	0.67	0.02
Alpha	1.12	Cum Volume (acre-ft)	783.19	344.40	952.94
Frctn Loss (ft)	0.03	Cum SA (acres)	262.50	27.38	174.10
C & E Loss (ft)	0.17				

NCHRP 24-20 Scour Calculations

Project Description :	I-95 over Souadabscook Stream, Center Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$

scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A\, y_c \text{ or } y_{max} = \alpha_B\, y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			RS 35509.99			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
7180	2278.58	13910.3	6.10	11.17	0.02238	0.2	5.21	844.11	1.39	18.32	5206.27	0.19	4.71	1129.62	18.7280

Bridge			RS 35151 BR U			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
7180	112.36	1156.38	10.2917	11.17	0.02238	0	0	0	6.21	10.29	7180	0	0	0	63.9009

NOTE: q1& q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

q2c/q1 = 3.41205, use chart to calculate αA
α_B = 1.1 from chart.
yc = 17.48 ft (Eq. 8.6)
y_{max} = 19.228 ft

Designers Note: q2c/q1 > 3, therefore conservatively use lowest value on chart

CALCULATED SCOUR

y_s = 8.93798 ft

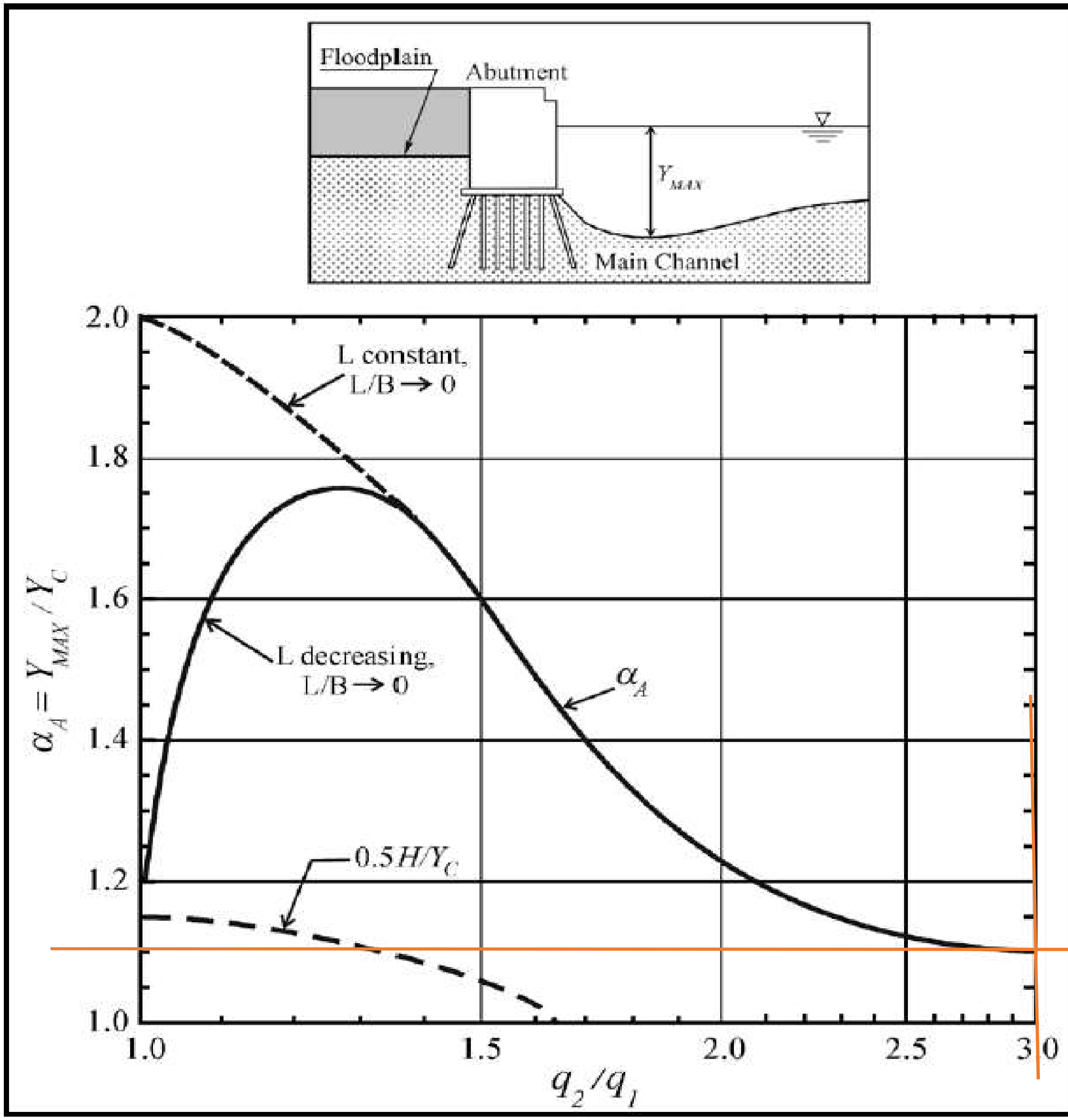


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach Reach RS: 35509.99 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35509.99 Profile: 500 year

E.G. Elev (ft)	127.97
Vel Head (ft)	0.02
W.S. Elev (ft)	127.94
Crit W.S. (ft)	
E.G. Slope (ft/ft)	0.000017
Q Total (cfs)	7180.00
Top Width (ft)	2278.58
Vel Total (ft/s)	0.52
Max Chl Dpth (ft)	19.94
Conv. Total (cfs)	1725428.0
Length Wtd. (ft)	200.26
Min Ch El (ft)	108.00
Alpha	5.30
Frctn Loss (ft)	0.01
C & E Loss (ft)	0.02

Element	Left OB	Channel	Right OB
Wt. n-Val.	0.092	0.030	0.092
Reach Len. (ft)	238.86	199.47	180.10
Flow Area (sq ft)	4180.39	3744.60	5985.26
Area (sq ft)	4180.39	3744.60	5985.26
Flow (cfs)	844.11	5206.27	1129.62
Top Width (ft)	802.33	204.44	1271.81
Avg. Vel. (ft/s)	0.20	1.39	0.19
Hydr. Depth (ft)	5.21	18.32	4.71
Conv. (cfs)	202849.0	1251120.0	271458.8
Wetted Per. (ft)	802.78	213.73	1271.93
Shear (lb/sq ft)	0.01	0.02	0.01
Stream Power (lb/ft s)	0.00	0.03	0.00
Cum Volume (acre-ft)	803.08	357.14	973.52
Cum SA (acres)	267.06	28.17	179.45

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach Reach RS: 40346 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 Profile: 500 year

E.G. US. (ft)	128.88
W.S. US. (ft)	128.47
Q Total (cfs)	7180.00
Q Bridge (cfs)	7180.00
Q Weir (cfs)	
Weir Sta Lft (ft)	
Weir Sta Rgt (ft)	
Weir Submerg	
Weir Max Depth (ft)	
Min El Weir Flow (ft)	134.81
Min El Prs (ft)	130.00
Delta EG (ft)	0.48
Delta WS (ft)	0.54
BR Open Area (sq ft)	1375.71
BR Open Vel (ft/s)	6.32
BR Sluice Coef	
BR Sel Method	Energy only

Element	Inside BR US	Inside BR DS
E.G. Elev (ft)	128.77	128.58
W.S. Elev (ft)	128.10	127.89
Crit W.S. (ft)	121.97	122.03
Max Chl Dpth (ft)	16.13	14.99
Vel Total (ft/s)	6.21	6.32
Flow Area (sq ft)	1156.38	1136.17
Froude # Chl	0.34	0.35
Specif Force (cu ft)	8374.90	8072.63
Hydr Depth (ft)	10.29	10.14
W.P. Total (ft)	148.97	147.17
Conv. Total (cfs)	229403.7	224271.3
Top Width (ft)	112.36	112.05
Frctn Loss (ft)	0.18	0.07
C & E Loss (ft)	0.01	0.11
Shear Total (lb/sq ft)	0.47	0.49
Power Total (lb/ft s)	2.95	3.12

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> *Center Bridge, Center Pier*

Enter Storm Event and Total Flow ==> *Q500 - 7180 CFS*

Correction for Pier Nose Shape:

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> 4

K1 = 0.90

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> *5.00* feet at base of wall

Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> 0 Degrees

Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> 12

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> 12.87 ft Reference ==> HEC-RAS

y1 = 12.87 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> 3.91 fps Reference ==> HEC-RAS

Ve = 3.91 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = 0.19

CALCULATE TOTAL LOCAL PIER SCOUR

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 = 12.87 feet ys / y1 = 0.61
K1 = 0.90
K2 = 1.00
K3 = 1.10
a = 6.25 feet ys = 0.61 X 12.87
Fr = 0.19

ys = Pier Scour Depth = 7.8 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	Farmington, Maine. Hamlin Br No. 3286	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Clear-Water Contraction Scour

Flood Event: **500 Years** Units: English

Laursen's Equation:

$y_2=[(K_u*Q^2)/(D_m^{2/3}*W^2)]^{3/7}$

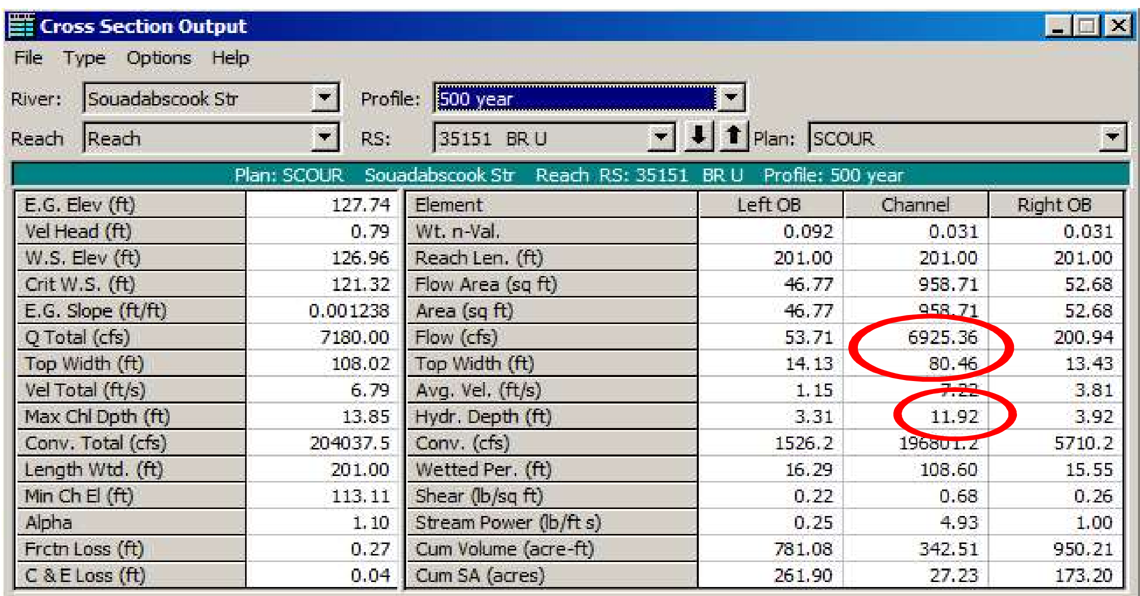
Required User Inputs:

Q =	**7180**	CFS	Discharge through the bridge or on the set-back overbank area associated with W.
W =	**75.46**	ft	Top width of the contracted section less pier width(s).
y_o =	**11.92**	ft	Average existing depth in the contracted section.

Calculated Inputs:

D_m =	**0.02797**	ft	Diameter of the smallest nontransportable particle (1.25xD50).
D_{50} =	**0.02238**	ft	Median diameter of bed material. Assumed 6mm for scour design.
K_u =	**0.0077**		Equation constant base on units.
y_2 =	**17.13**	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth:	**5.21** ft	*Clear-Water Contraction Scour*



		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.74	Wt. n-Val.	0.092	0.031	0.031
Vel Head (ft)	0.79	Reach Len. (ft)	201.00	201.00	201.00
W.S. Elev (ft)	126.96	Flow Area (sq ft)	46.77	958.71	52.68
Crit W.S. (ft)	121.32	Area (sq ft)	46.77	958.71	52.68
E.G. Slope (ft/ft)	0.001238	Flow (cfs)	53.71	6925.36	200.94
Q Total (cfs)	7180.00	Top Width (ft)	14.13	80.46	13.43
Top Width (ft)	108.02	Avg. Vel. (ft/s)	1.15	7.22	3.81
Vel Total (ft/s)	6.79	Hydr. Depth (ft)	3.31	11.92	3.92
Max Chl Dpth (ft)	13.85	Conv. (cfs)	1526.2	196801.2	5710.2
Conv. Total (cfs)	204037.5	Wetted Per. (ft)	16.29	108.60	15.55
Length Wtd. (ft)	201.00	Shear (lb/sq ft)	0.22	0.68	0.26
Min Ch El (ft)	113.11	Stream Power (lb/ft s)	0.25	4.93	1.00
Alpha	1.10	Cum Volume (acre-ft)	781.08	342.51	950.21
Frctn Loss (ft)	0.27	Cum SA (acres)	261.90	27.23	173.20
C & E Loss (ft)	0.04				

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, East Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **100 Years** **RS 28120.39**
Units: English

Description of Streambed Material :
D_{50} of Streambed Material: **0.000558** ft Particle size in a mixture of which 50% are smaller.
D95 of Streambed Material: ft Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u\, y^{1/6}\, D_{50}^{1/3}$

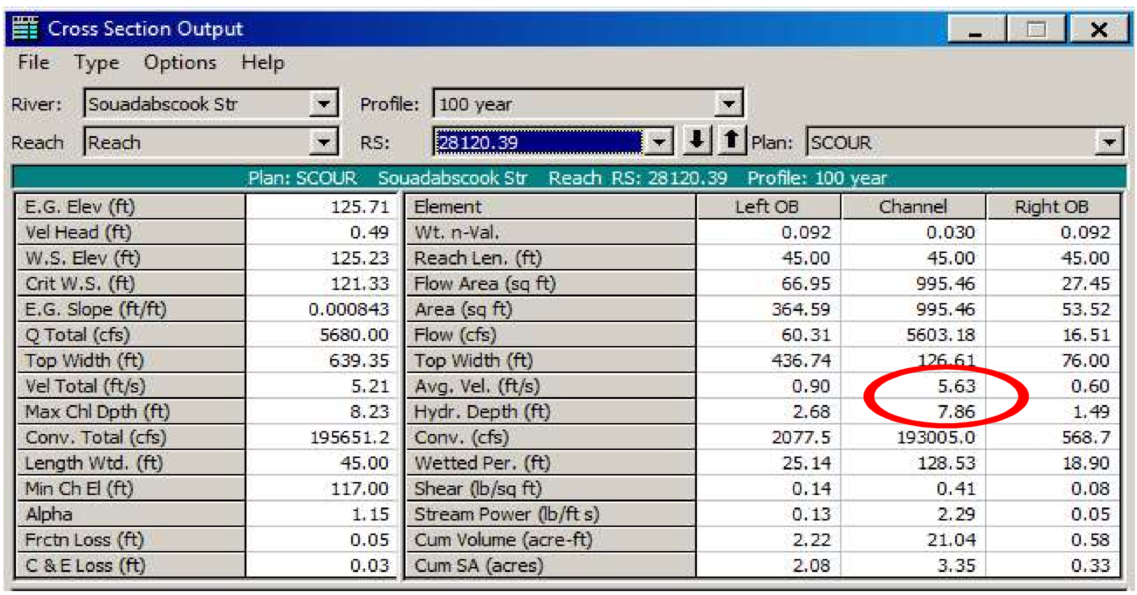
Required User Inputs:

y = **7.86** ft Average depth of flow upstream of the bridge.
V = **5.63** ft/s Upstream Velocity (from HEC-RAS)

Calculated Inputs:

D50 = 0.00055774 ft Particle size in a mixture of which 50% are smaller.
Ku = 11.17 Equation constant based on units.
Vc = 1.30 ft/s

Type of Scour = ***Live-Bed Scour***


Cross Section Output
File Type Options Help
River: Souadabscook Str Profile: 100 year
Reach: Reach RS: 28120.39 Plan: SCOUR
Plan: SCOUR Souadabscook Str Reach RS: 28120.39 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	125.71	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.49	Reach Len. (ft)	45.00	45.00	45.00
W.S. Elev (ft)	125.23	Flow Area (sq ft)	66.95	995.46	27.45
Crit W.S. (ft)	121.33	Area (sq ft)	364.59	995.46	53.52
E.G. Slope (ft/ft)	0.000843	Flow (cfs)	60.31	5603.18	16.51
Q Total (cfs)	5680.00	Top Width (ft)	436.74	126.61	76.00
Top Width (ft)	639.35	Avg. Vel. (ft/s)	0.90	5.63	0.60
Vel Total (ft/s)	5.21	Hydr. Depth (ft)	2.68	7.86	1.49
Max Chl Dpth (ft)	8.23	Conv. (cfs)	2077.5	193005.0	568.7
Conv. Total (cfs)	195651.2	Wetted Per. (ft)	25.14	128.53	18.90
Length Wtd. (ft)	45.00	Shear (lb/sq ft)	0.14	0.41	0.08
Min Ch El (ft)	117.00	Stream Power (lb/ft s)	0.13	2.29	0.05
Alpha	1.15	Cum Volume (acre-ft)	2.22	21.04	0.58
Frctn Loss (ft)	0.05	Cum SA (acres)	2.08	3.35	0.33
C & E Loss (ft)	0.03				

NCHRP 24-20 Scour Calculations				
Project Description :	I-95 over Souadabscook Stream, East Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **100 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$ scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A y_c \text{ or } y_{max} = \alpha_B y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			RS 29483.97			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
5680	1345.54	6181.9	4.59	11.17	0.00056	0.18	1.78	838.85	1.96	13.59	2331.28	0.32	4.28	3011.77	10.7557

Bridge			RS 27966 BR U			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
5680	104.92	841.94	8.02459	11.17	0.00056	0	0	0	6.75	8.02	5680	0	0	0	54.1350

NOTE: q1 & q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

q2c/q1 = 5.03315 , use chart to calculate α_B
α_B = 1.1 from chart.
yc = 18.357 ft (Eq. 8.6)
y_{max} = 20.1927 ft

Designers Note: q2c/q1 > 3, therefore conservatively use lowest value on chart

CALCULATED SCOUR

y_s = 12.1727 ft

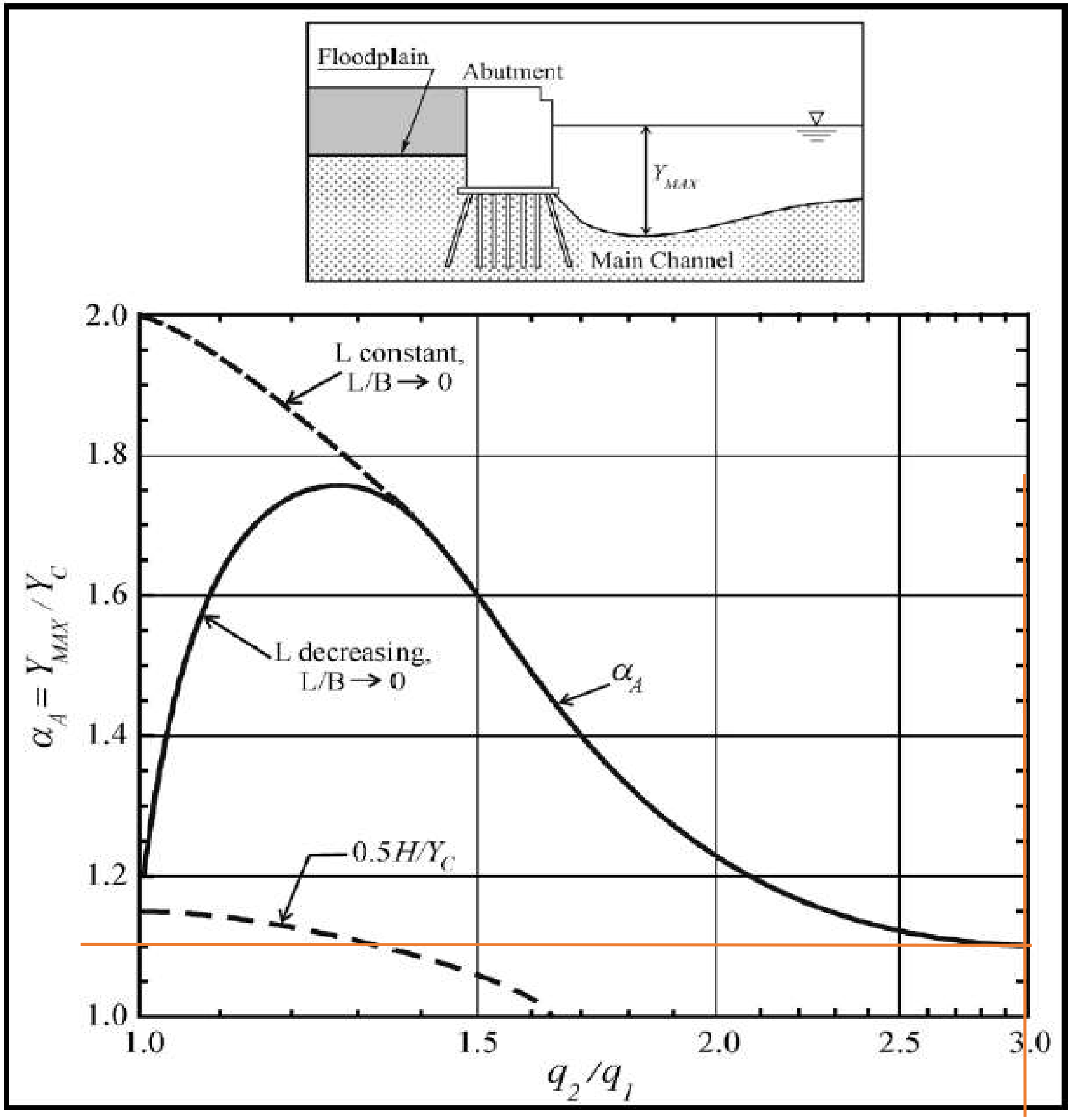


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str | Profile: 100 year

Reach: Reach | RS: 29483.97 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 29483.97 Profile: 100 year

E.G. Elev (ft)	125.89
Vel Head (ft)	0.05
W.S. Elev (ft)	125.85
Crit W.S. (ft)	
E.G. Slope (ft/ft)	0.000055
Q Total (cfs)	5680.00
Top Width (ft)	1345.54
Vel Total (ft/s)	0.92
Max Chl Dpth (ft)	13.70
Conv. Total (cfs)	764066.8
Length Wtd. (ft)	1181.36
Min Ch El (ft)	112.15
Alpha	3.70
Frctn Loss (ft)	0.09
C & E Loss (ft)	0.01

Element	Left OB	Channel	Right OB
Wt. n-Val.	0.092	0.030	0.092
Reach Len. (ft)	1179.44	1180.61	1189.53
Flow Area (sq ft)	838.85	2331.28	3011.77
Area (sq ft)	838.85	2331.28	3011.77
Flow (cfs)	148.04	4578.86	953.11
Top Width (ft)	470.74	171.50	703.30
Avg. Vel. (ft/s)	0.18	1.96	0.32
Hydr. Depth (ft)	1.78	13.59	4.28
Conv. (cfs)	19913.7	615942.3	128210.8
Wetted Per. (ft)	470.76	189.23	703.85
Shear (lb/sq ft)	0.01	0.04	0.01
Stream Power (lb/ft s)	0.00	0.08	0.00
Cum Volume (acre-ft)	31.46	84.84	46.19
Cum SA (acres)	19.00	8.34	13.44

Bridge Output

File Type Options Help

River: Souadabscook Str | Profile: 100 year

Reach: Reach | RS: 27966 | Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 27966 Profile: 100 year

E.G. US. (ft)	125.71
W.S. US. (ft)	125.23
Q Total (cfs)	5680.00
Q Bridge (cfs)	5680.00
Q Weir (cfs)	
Weir Sta Lft (ft)	
Weir Sta Rgt (ft)	
Weir Submerg	
Weir Max Depth (ft)	
Min El Weir Flow (ft)	134.91
Min El Prs (ft)	130.00
Delta EG (ft)	0.55
Delta WS (ft)	1.14
BR Open Area (sq ft)	1441.68
BR Open Vel (ft/s)	6.86
BR Sluice Coef	
BR Sel Method	Energy only

Element	Inside BR US	Inside BR DS
E.G. Elev (ft)	125.63	125.31
W.S. Elev (ft)	124.84	124.49
Crit W.S. (ft)	120.28	120.30
Max Chl Dpth (ft)	12.74	11.69
Vel Total (ft/s)	6.75	6.86
Flow Area (sq ft)	841.94	828.31
Froude # Chl	0.40	0.41
Specif Force (cu ft)	5440.45	5247.16
Hydr Depth (ft)	8.02	7.77
W.P. Total (ft)	133.60	134.18
Conv. Total (cfs)	149424.6	144434.4
Top Width (ft)	104.92	106.57
Frctn Loss (ft)	0.32	0.12
C & E Loss (ft)	0.00	0.02
Shear Total (lb/sq ft)	0.57	0.60
Power Total (lb/ft s)	3.84	4.09

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> *East Bridge, Center Pier*

Correction for Pier Nose Shape:

Enter Storm Event and Total Flow ==> *Q100 - 5680 CFS*

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> **4**

K1 = 0.90

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> *5.00* feet at base of wall

Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> **0** Degrees

Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> **12**

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> **7.86** ft Reference ==> HEC-RAS

y1 = 7.86 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> **5.63** fps Reference ==> HEC-RAS

Ve = 5.63 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = **0.35**

CALCULATE TOTAL LOCAL PIER SCOUR

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 =	7.86	feet	ys / y1 =	1.09		
K1 =	0.90					
K2 =	1.00					
K3 =	1.10					
a =	6.25	feet	ys =	1.09	X	7.86
Fr =	0.35					

ys = Pier Scour Depth = 8.6 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	Farmington, Maine. Hamlin Br No. 3286	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Live Bed Contraction Scour

Flood Event: **100 Years**

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$y_s = y_2 - y_o$ = (average contraction scour depth)

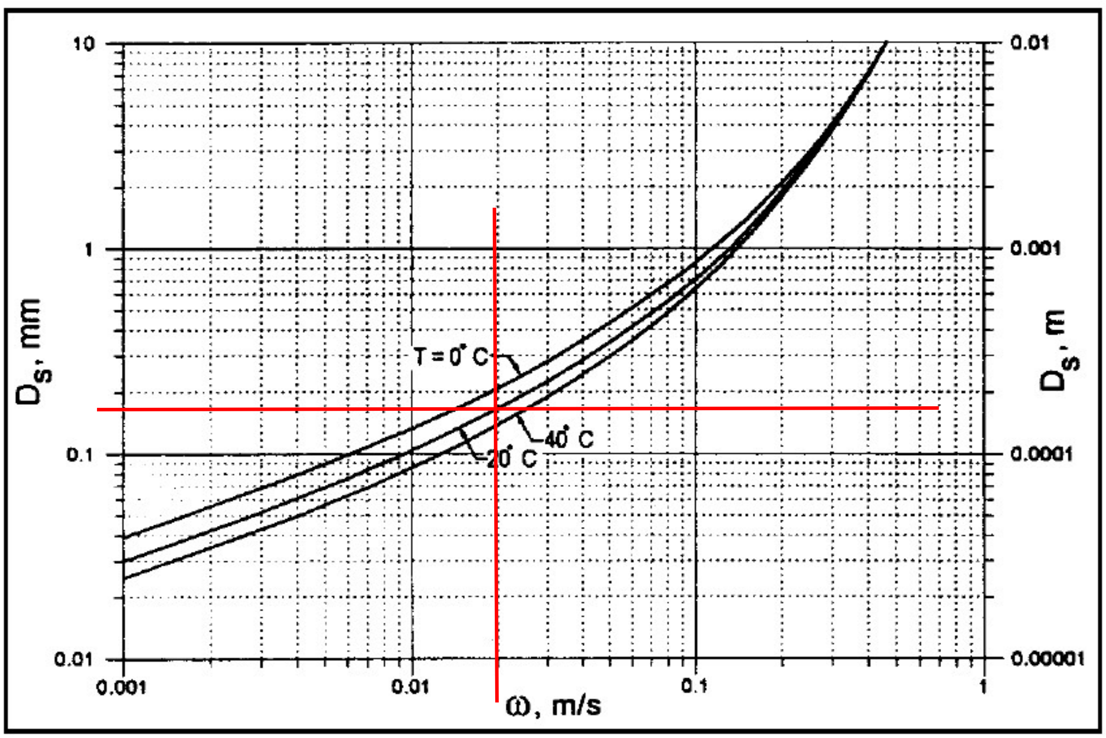
Required User Inputs:

y1 =	**7.86**	ft	Average depth of mainstream channel
D50 =	**0.17**	mm	
Q1 =	**5603.18**	CFS	flow in upstream channel transporting sediment
Q2 =	**5680**	CFS	flow in contracted channel
W1 =	**126.61**	ft	Top width of upstream main channel that is transporting bed material
W2 =	**67.45**	ft	Top with of main channel in contracted section less pier widths
y_o =	**10.33**	ft	Average existing depth in the contracted section.
EGL Slope =	**0.001445**	ft/ft	slope of energy grade line (from bridge cross section)
T =	**0.0656**	ft/s	fall velocity of bed material (from chart below)

Calculated Inputs:

g =	32.2	ft/s2	constant
V* =	0.604746	ft/s2	shear velocity in upstream section
k1 =	0.69		
y_2 =	12.28	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth:	**1.95** ft	*Live Bed Contraction Scour*



Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach: Reach RS: 28120.39 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 28120.39 Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	125.71	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.49	Reach Len. (ft)	45.00	45.00	45.00
W.S. Elev (ft)	125.23	Flow Area (sq ft)	66.95	995.46	27.45
Crit W.S. (ft)	121.33	Area (sq ft)	364.59	995.46	53.52
E.G. Slope (ft/ft)	0.000843	Flow (cfs)	60.31	5603.18	16.51
Q Total (cfs)	5680.00	Top Width (ft)	436.74	126.61	76.00
Top Width (ft)	639.35	Avg. Vel. (ft/s)	0.90	5.63	0.60
Vel Total (ft/s)	5.21	Hydr. Depth (ft)	2.68	7.86	1.49
Max Chl Dpth (ft)	8.23	Conv. (cfs)	2077.5	193005.0	568.7
Conv. Total (cfs)	195651.2	Wetted Per. (ft)	25.14	128.53	18.90
Length Wtd. (ft)	45.00	Shear (lb/sq ft)	0.14	0.41	0.08
Min Ch El (ft)	117.00	Stream Power (lb/ft s)	0.13	2.29	0.05
Alpha	1.15	Cum Volume (acre-ft)	2.22	21.04	0.58
Frctn Loss (ft)	0.05	Cum SA (acres)	2.08	3.35	0.33
C & E Loss (ft)	0.03				

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach: Reach RS: 27966 BR U Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 27966 BR U Profile: 100 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	125.63	Wt. n-Val.	0.092	0.030	0.036
Vel Head (ft)	0.80	Reach Len. (ft)	212.00	212.00	212.00
W.S. Elev (ft)	124.84	Flow Area (sq ft)	37.61	748.06	56.26
Crit W.S. (ft)	120.28	Area (sq ft)	37.61	748.06	56.26
E.G. Slope (ft/ft)	0.001445	Flow (cfs)	41.21	5443.52	195.27
Q Total (cfs)	5680.00	Top Width (ft)	14.25	72.45	18.22
Top Width (ft)	104.92	Avg. Vel. (ft/s)	1.10	7.28	3.47
Vel Total (ft/s)	6.75	Hydr. Depth (ft)	2.64	10.33	3.09
Max Chl Dpth (ft)	12.74	Conv. (cfs)	1084.0	143203.6	5137.0
Conv. Total (cfs)	149424.6	Wetted Per. (ft)	15.78	98.45	19.37
Length Wtd. (ft)	212.00	Shear (lb/sq ft)	0.22	0.69	0.26
Min Ch El (ft)	112.10	Stream Power (lb/ft s)	0.24	4.99	0.91
Alpha	1.12	Cum Volume (acre-ft)	2.01	20.14	0.52
Frctn Loss (ft)	0.32	Cum SA (acres)	1.85	3.25	0.28
C & E Loss (ft)	0.00				

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, East Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 Years** **RS 28120.39**
Units: English

Description of Streambed Material :
D_{50} of Streambed Material: **0.000558** ft — Particle size in a mixture of which 50% are smaller.
D95 of Streambed Material: ft — Particle size in a mixture of which 95% are smaller.

Determine Critical Velocity

$Vc = K_u\, y^{1/6}\, D_{50}^{1/3}$

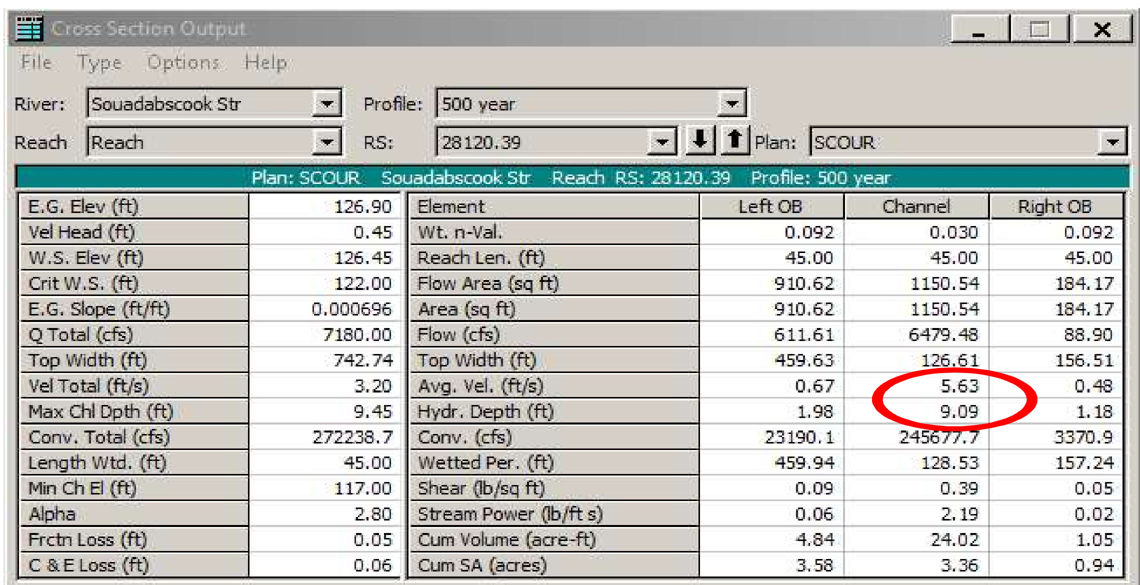
Required User Inputs:

y =	**9.09**	ft	Average depth of flow upstream of the bridge.
V =	**5.63**	ft/s	Upstream Velocity (from HEC-RAS)

Calculated Inputs:

D50 =	0.00055774	ft	Particle size in a mixture of which 50% are smaller.
Ku =	11.17		Equation constant based on units.
Vc =	1.33	ft/s	

Type of Scour = ***Live-Bed Scour***



		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.90	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.45	Reach Len. (ft)	45.00	45.00	45.00
W.S. Elev (ft)	126.45	Flow Area (sq ft)	910.62	1150.54	184.17
Crit W.S. (ft)	122.00	Area (sq ft)	910.62	1150.54	184.17
E.G. Slope (ft/ft)	0.000696	Flow (cfs)	611.61	6479.48	88.90
Q Total (cfs)	7180.00	Top Width (ft)	459.63	126.61	156.51
Top Width (ft)	742.74	Avg. Vel. (ft/s)	0.67	5.63	0.48
Vel Total (ft/s)	3.20	Hydr. Depth (ft)	1.98	9.09	1.18
Max Chl Dpth (ft)	9.45	Conv. (cfs)	23190.1	245677.7	3370.9
Conv. Total (cfs)	272238.7	Wetted Per. (ft)	459.94	128.53	157.24
Length Wtd. (ft)	45.00	Shear (lb/sq ft)	0.09	0.39	0.05
Min Ch El (ft)	117.00	Stream Power (lb/ft s)	0.06	2.19	0.02
Alpha	2.80	Cum Volume (acre-ft)	4.84	24.02	1.05
Frctn Loss (ft)	0.05	Cum SA (acres)	3.58	3.36	0.94
C & E Loss (ft)	0.06				

NCHRP 24-20 Scour Calculations				
Project Description :	I-95 over Souadabscook Stream, East Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Flood Event: **500 years**

y_c = Flow depth including clear-water contraction scour, ft (m)
q_{2c} = unit discharge in the constricted opening accounting for non-uniform flow distribution, ft2/s (m2/s)
K_u = 11.17 (English units) or 6.19 (SI units)
D_{50} = Particle size with 50 percent finer, ft (m)

$$y_c = y_1\left(\frac{q_{2c}}{q_1}\right)^{6/7}$$ scour equation (eq. 8.5, HEC 18)

y_{max} = Maximum flow depth resulting from abutment scour, ft (m)
y_c = Flow depth including live-bed or clear-water contraction scour, ft (m)
α_A = Amplification factor for live-bed conditions
α_B = Amplification factor for clear-water conditions
y_s = Abutment scour depth, ft (m)
y_0 = Flow depth prior to scour, ft (m)

$$y_{max} = \alpha_A y_c \text{ or } y_{max} = \alpha_B y_c$$

$$y_s = y_{max} - y_0$$

The scour type for NCHRP 24-20 is determined by a ratio of L/Bf, or embankment length over the total floodplain width. If this ratio is greater than 75%, then live-bed scour occurs. If it is less than 75% then clearwater scour occurs. Since the interstate is acting more like a causeway for this stream, L/Bf > 75% by inspection and live-bed scour
*The embankment length is equal to the total area in a cross section intercepted by the flow, minus the bridge opening.

Scour Type: Live-Bed Scour

Upstream			RS 29483.97			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q1**
7180	1555.85	7914	5.09	11.17	0.00056	0.24	2.77	1419.33	2.12	14.77	2533.65	0.37	4.54	3961.02	10.9846

Bridge			RS 27966 BR U			From HEC Ras									
Q	**W**	**Area**	**yo**	**Ku**	**D50**	**L OB Vel**	**L OB D**	**L OB Flow**	**Ch Vel**	**CH D**	**CH Flow**	**R OB Vel**	**R OB D**	**R OB Flow**	**q2c**
7180	108.79	939.47	8.63563	11.17	0.00056	0	0	0	7.64	8.64	7180	0	0	0	66.0096

NOTE: q1 & q2c = (Velocity x Depth) for L OB, R OB, and Ch, weighted by flow

KEY:
L OB D = Left Overback Depth (ft)
R OB Vel = Right Overbank Velocity (ft/s)
CH Flow = Channel Flow (cfs)

q2c/q1 = 6.0093 , use chart to calculate α_B
α_B = 1.1 from chart.
yc = 23.6587 ft (Eq. 8.6)
y_{max} = 26.0246 ft

Designers Note: q2c/q1 > 3, therefore conservatively use lowest value on chart

CALCULATED SCOUR

y_s = 17.389 ft

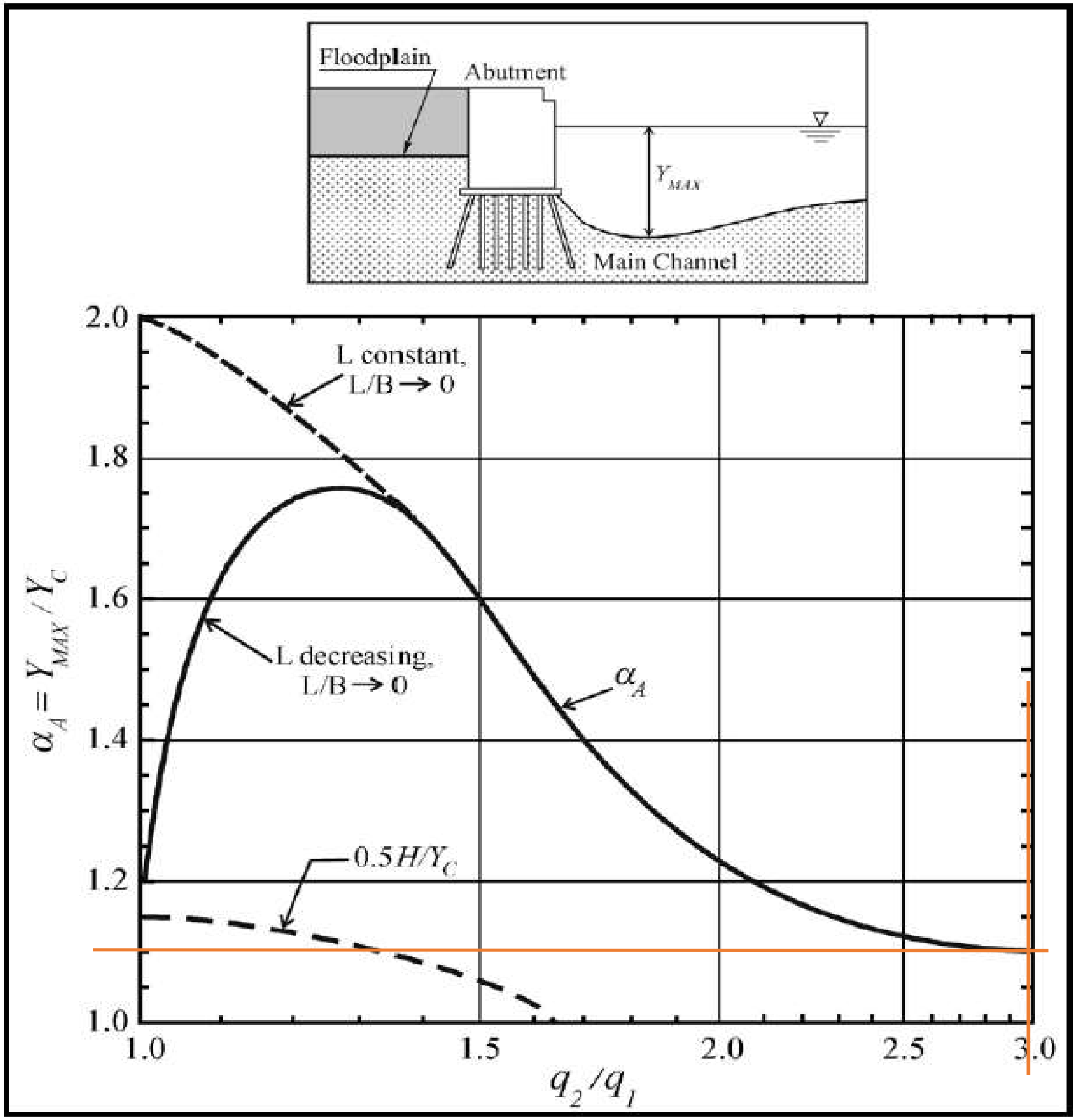


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach Reach RS: 29483.97 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 29483.97 Profile: 500 year

E.G. Elev (ft)	127.08
Vel Head (ft)	0.05
W.S. Elev (ft)	127.03
Crit W.S. (ft)	
E.G. Slope (ft/ft)	0.000058
Q Total (cfs)	7180.00
Top Width (ft)	1555.85
Vel Total (ft/s)	0.91
Max Chl Dpth (ft)	14.88
Conv. Total (cfs)	945646.1
Length Wtd. (ft)	1181.54
Min Ch El (ft)	112.15
Alpha	4.13
Frctn Loss (ft)	0.10
C & E Loss (ft)	0.01

Element	Left OB	Channel	Right OB
Wt. n-Val.	0.092	0.030	0.092
Reach Len. (ft)	1179.44	1180.61	1189.53
Flow Area (sq ft)	1419.33	2533.65	3961.02
Area (sq ft)	1419.33	2533.65	3961.02
Flow (cfs)	343.14	5372.67	1464.20
Top Width (ft)	512.72	171.50	871.63
Avg. Vel. (ft/s)	0.24	2.12	0.37
Hydr. Depth (ft)	2.77	14.77	4.54
Conv. (cfs)	45193.3	707610.1	192842.8
Wetted Per. (ft)	512.75	189.23	872.30
Shear (lb/sq ft)	0.01	0.05	0.02
Stream Power (lb/ft s)	0.00	0.10	0.01
Cum Volume (acre-ft)	54.67	93.69	64.13
Cum SA (acres)	21.77	8.34	17.10

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach Reach RS: 27966 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 27966 Profile: 500 year

E.G. US. (ft)	126.90
W.S. US. (ft)	126.45
Q Total (cfs)	7180.00
Q Bridge (cfs)	7180.00
Q Weir (cfs)	
Weir Sta Lft (ft)	
Weir Sta Rgt (ft)	
Weir Submerg	
Weir Max Depth (ft)	
Min El Weir Flow (ft)	134.91
Min El Prs (ft)	130.00
Delta EG (ft)	0.67
Delta WS (ft)	1.54
BR Open Area (sq ft)	1441.68
BR Open Vel (ft/s)	7.84
BR Sluice Coef	
BR Sel Method	Energy only

Element	Inside BR US	Inside BR DS
E.G. Elev (ft)	126.79	126.40
W.S. Elev (ft)	125.75	125.29
Crit W.S. (ft)	121.31	121.29
Max Chl Dpth (ft)	13.65	12.49
Vel Total (ft/s)	7.64	7.84
Flow Area (sq ft)	939.47	915.83
Froude # Chl	0.44	0.46
Specif Force (cu ft)	6809.71	6535.77
Hydr Depth (ft)	8.64	8.32
W.P. Total (ft)	139.61	139.62
Conv. Total (cfs)	171862.7	164087.0
Top Width (ft)	108.79	110.12
Frctn Loss (ft)	0.39	0.14
C & E Loss (ft)	0.01	0.02
Shear Total (lb/sq ft)	0.73	0.78
Power Total (lb/ft s)	5.60	6.15

Pier Scour - Colorado State University (CSU) Equation

Imperial Units

Enter Pier Description ==> *East Bridge, Center Pier*

Enter Storm Event and Total Flow ==> *Q500 - 7180 CFS*

Correction for Pier Nose Shape:

K1 = Pier Nose Shape Coefficient (HEC-18 Table 2)

Type of Pier	K1	Type
Square Nose	1.10	Type 1
Round Nose	1.00	Type 2
Circular Cylinder	1.00	Type 3
Sharp Nose	0.90	Type 4
Group of Cylinders	1.00	Type 5

Enter Type of Pier (1, 2, 3, 4 or 5) ==> 4

K1 = 0.90

Correction for Piers Skewed to Flow

Enter Pier Width (a) ==> *5.00* feet at base of wall
Design Pier Width (a) ==> 6.25 feet increase by 25%, MEDOT BDG 2.3.11.1

K2 = Coefficient Factor for Angle of Attack of the Flow (HEC-18 Table 3)

Enter Attack Angle (0, 15, 30, 45 or 90) ==> 0 Degrees
Enter (Pier Length / Pier Width) Ratio (4, 8, or 12) ==> 12

K2 = 1.00

Correction Faction for Bed Condition

K3 = Coefficient Factor for Bed Condition (HEC-18 Table 1) ==> Assume Clear-Water Scour / Antidune Flow

K3 = 1.10

Depth of Flow at Pier

y1 = Flow Depth Directly Upstream of the Pier

Enter y1 ==> 9.09 ft Reference ==> HEC-RAS

y1 = 9.09 feet

Velocity of Flow Directly Upstream of Pier

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second)

Enter V1 ==> 5.63 fps Reference ==> HEC-RAS

Ve = 5.63 ft per sec

Froude Number

Fr1 = (V1) / { [(g) (y1)] ^ 0.5 } = Froude

V1 = Mean Velocity of Flow Directly Upstream of the Pier (feet per second) - Entered Above
g = 32.2 feet / sec^2
y1 = Flow Depth Directly Upstream of the Pier - Entered Above

Fr = 0.33

CALCULATE TOTAL LOCAL PIER SCOUR

ys / y1 = (2.0)(K1)(K2)(K3) [(a / y1) ^ 0.65] (Fr ^ 0.43)

y1 = 9.09 feet ys / y1 = 0.96
K1 = 0.90
K2 = 1.00
K3 = 1.10
a = 6.25 feet ys = 0.96 X 9.09
Fr = 0.33

ys = Pier Scour Depth = 8.7 feet

BRIDGE SCOUR CALCULATIONS

Project Description :	I-95 over Souadabscook Stream, West Bridge	Project Number:		18084.99
		Calculated By:	TEPA	5/1/2019
		Checked By:		

Live Bed Contraction Scour

Flood Event: **500 Years**

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$y_s = y_2 - y_o$ = (average contraction scour depth)

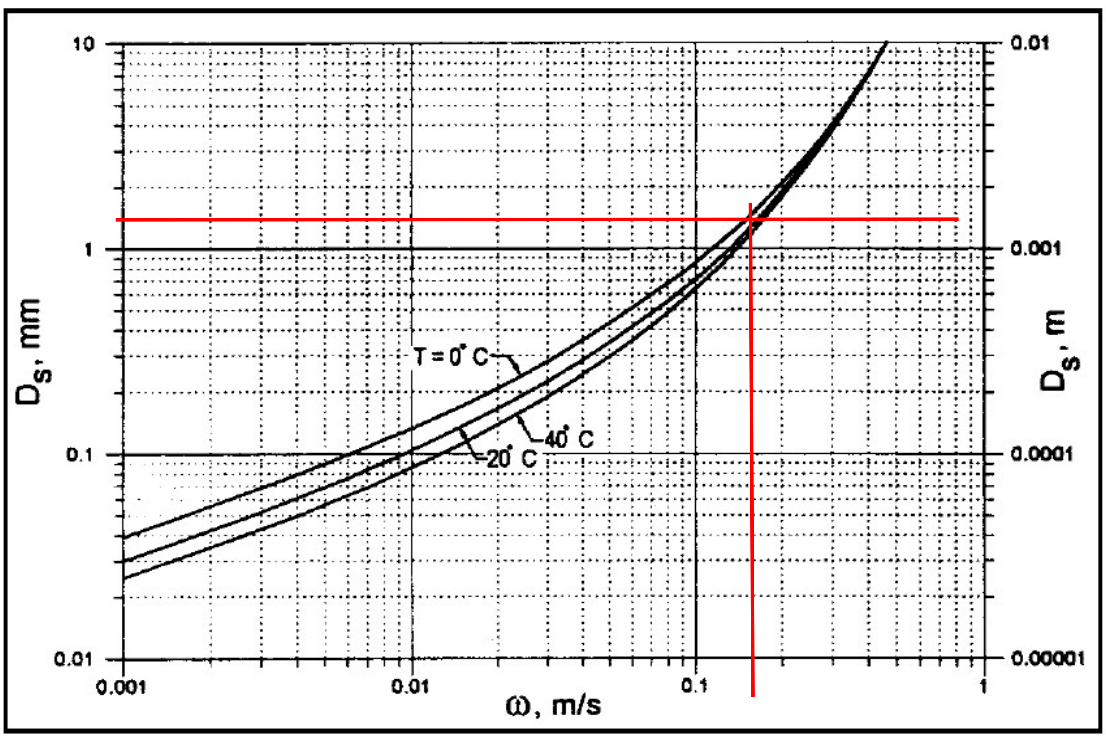
Required User Inputs:

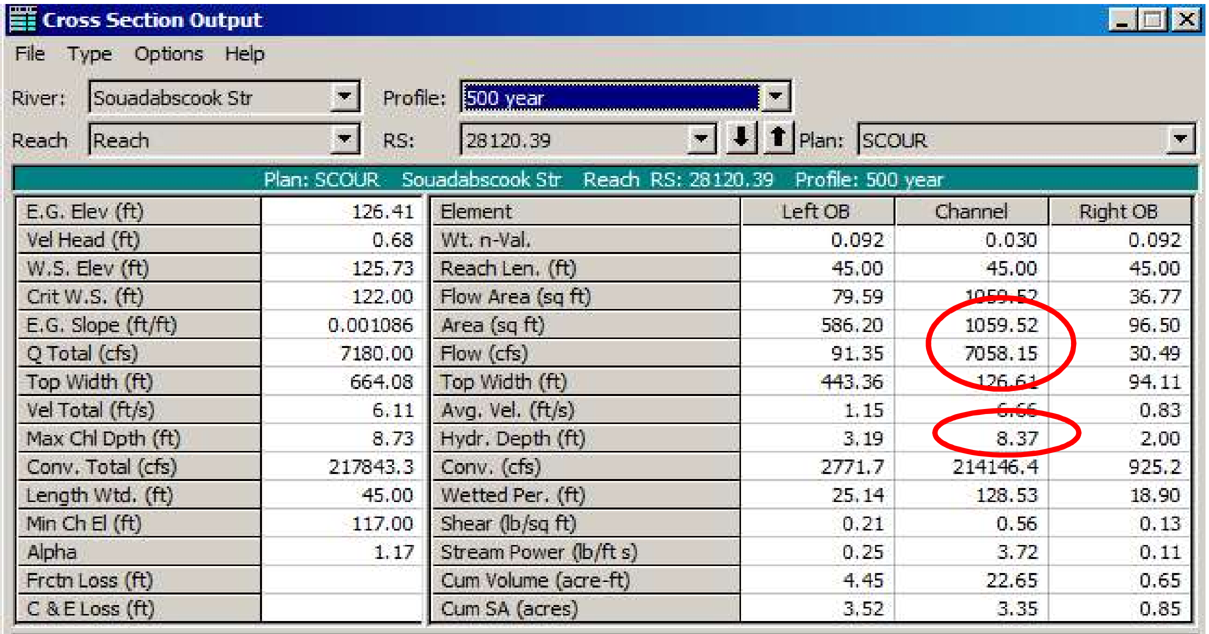
y1 =	**8.37**	ft	Average depth of mainstream channel
D50 =	**0.17**	mm	
Q1 =	**7058.15**	CFS	flow in upstream channel transporting sediment
Q2 =	**7180**	CFS	flow in contracted channel
W1 =	**126.61**	ft	Top width of upstream main channel that is transporting bed material
W2 =	**67.55**	ft	Top with of main channel in contracted section less pier widths
y_o =	**11.22**	ft	Average existing depth in the contracted section.
EGL Slope =	**0.001745**	ft/ft	slope of energy grade line (from bridge cross section)
T =	**0.0656**	ft/s	fall velocity of bed material (from chart below)

Calculated Inputs:

g =	32.2	ft/s2	constant
V* =	0.685786	ft/s2	shear velocity in upstream section
k1 =	0.69		
y_2 =	13.10	ft	Average equilibrium depth in the contracted section after contraction scour.

Calculated Scour Depth: **1.88** ft *Live Bed Contraction Scour*





Cross Section Output

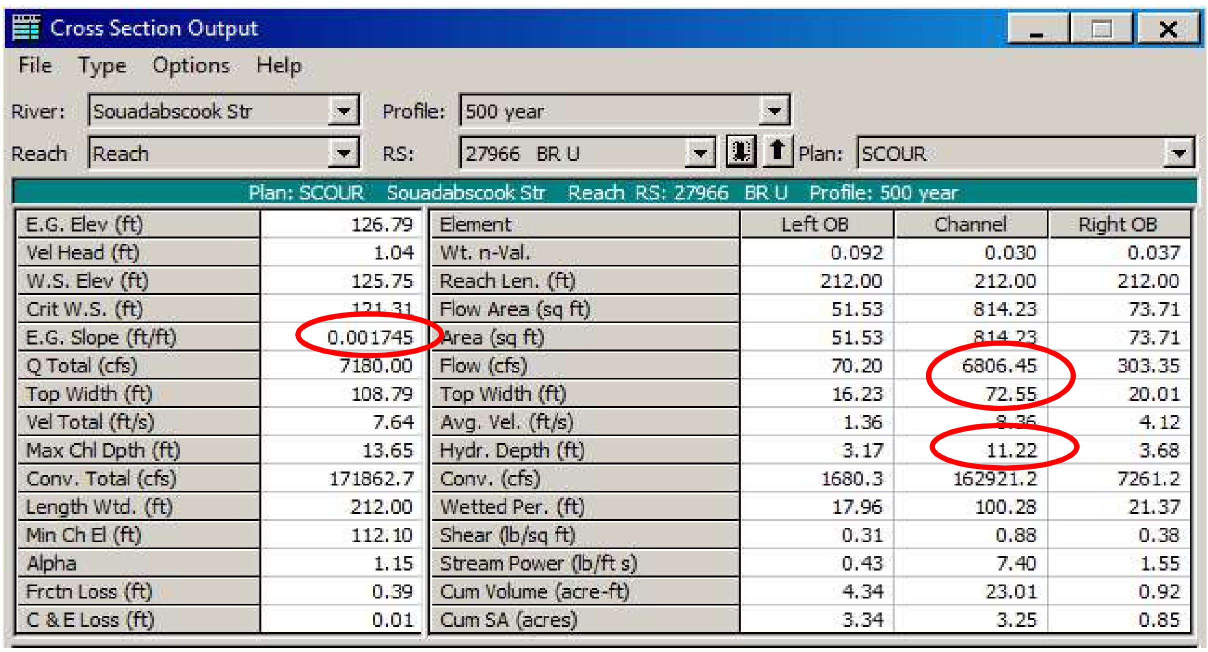
File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach: Reach RS: 28120.39 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 28120.39 Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.41	Wt. n-Val.	0.092	0.030	0.092
Vel Head (ft)	0.68	Reach Len. (ft)	45.00	45.00	45.00
W.S. Elev (ft)	125.73	Flow Area (sq ft)	79.59	1059.52	36.77
Crit W.S. (ft)	122.00	Area (sq ft)	586.20	1059.52	96.50
E.G. Slope (ft/ft)	0.001086	Flow (cfs)	91.35	7058.15	30.49
Q Total (cfs)	7180.00	Top Width (ft)	443.36	126.61	94.11
Top Width (ft)	664.08	Avg. Vel. (ft/s)	1.15	6.66	0.83
Vel Total (ft/s)	6.11	Hydr. Depth (ft)	3.19	8.37	2.00
Max Chl Dpth (ft)	8.73	Conv. (cfs)	2771.7	214146.4	925.2
Conv. Total (cfs)	217843.3	Wetted Per. (ft)	25.14	128.53	18.90
Length Wtd. (ft)	45.00	Shear (lb/sq ft)	0.21	0.56	0.13
Min Ch El (ft)	117.00	Stream Power (lb/ft s)	0.25	3.72	0.11
Alpha	1.17	Cum Volume (acre-ft)	4.45	22.65	0.65
Frctn Loss (ft)		Cum SA (acres)	3.52	3.35	0.85
C & E Loss (ft)					



Cross Section Output

File Type Options Help

River: Souadabscook Str Profile: 500 year

Reach: Reach RS: 27966 BR U Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 27966 BR U Profile: 500 year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.79	Wt. n-Val.	0.092	0.030	0.037
Vel Head (ft)	1.04	Reach Len. (ft)	212.00	212.00	212.00
W.S. Elev (ft)	125.75	Flow Area (sq ft)	51.53	814.23	73.71
Crit W.S. (ft)	121.31	Area (sq ft)	51.53	814.23	73.71
E.G. Slope (ft/ft)	0.001745	Flow (cfs)	70.20	6806.45	303.35
Q Total (cfs)	7180.00	Top Width (ft)	16.23	72.55	20.01
Top Width (ft)	108.79	Avg. Vel. (ft/s)	1.36	8.36	4.12
Vel Total (ft/s)	7.64	Hydr. Depth (ft)	3.17	11.22	3.68
Max Chl Dpth (ft)	13.65	Conv. (cfs)	1680.3	162921.2	7261.2
Conv. Total (cfs)	171862.7	Wetted Per. (ft)	17.96	100.28	21.37
Length Wtd. (ft)	212.00	Shear (lb/sq ft)	0.31	0.88	0.38
Min Ch El (ft)	112.10	Stream Power (lb/ft s)	0.43	7.40	1.55
Alpha	1.15	Cum Volume (acre-ft)	4.34	23.01	0.92
Frctn Loss (ft)	0.39	Cum SA (acres)	3.34	3.25	0.85
C & E Loss (ft)	0.01				

TABLE I
Summary of D_{50} Laboratory Results
Interstate 95 over Souadabscook Stream West
Bridge Nos. 5951 and 1433
Hampden, Maine
MaineDOT WIN 21730.00 and 21730.10

Boring Location	Boring No.	Sample No.	Depth	D_{50} (mm)	Deposit
West Abutment	BB-HSS-101	4D	6.5 - 8.5	1.0239	Fill
	BB-HSS-102	3D	4.5 - 6.5	0.2441	Fill
Pier(s)	BB-HSS-103	3D	12.0 - 14.0	< #200 SIEVE	Marine Clay
	BB-HSS-104	2D	3.4-3.9	3.2307	Alluvial Deposit
East Abutment	BB-HSS-105	12D	30.0 - 32.0	< #200 SIEVE	Marine Silt
	BB-HSS-106	10D	35.0 - 37.0	0.1211	Marine Sand

TABLE II

Summary of D_{50} Laboratory Results

Interstate 95 over Souadabscook Stream Center
Bridge Nos. 5950 and 1432
Hampden, Maine
MaineDOT WIN 21728.00 and WIN 21728.10

Boring Location	Boring No.	Sample No.	Depth	D_{50} (mm)	Deposit
West Abutment	BB-HSS-107	10D	18.5 - 20.5	2.3752	Fill
	BB-HSS-108	3D	5.0 - 7.0	3.3617	Fill
Pier(s)	BB-HSS-109	1D	0.0 - 1.5	7.3178	Alluvial Deposit
	BB-HSS-110	1D	0.0 - 2.0	6.3242	Alluvial Deposit
East Abutment	BB-HSS-111	4D	8.0 - 10.0	0.4250	Fill
	BB-HSS-112	8D	15.5 - 17.5	2.1187	Fill

TABLE III
Summary of D_{50} Laboratory Results
Interstate 95 over Souadabscook Stream East
Bridge Nos. 5949 and 1431
Hampden, Maine
MaineDOT WIN 21729.00 and WIN 21729.10

Boring Location	Boring No.	Sample No.	Depth	D_{50} (mm)	Deposit
West Abutment	BB-HSS-113	6DA	10.5 - 12.3	< #200 SIEVE	Fill
	BB-HSS-114	6D	11.0 - 12.5	1.6168	Fill
Pier(s)	BB-HSS-115	2DA	4.5 - 6.2	0.1677	Alluvial Deposit
East Abutment	BB-HSS-117	8D	16.0 - 18.0	0.6794	Fill
	BB-HSS-118	2D	5.0 - 7.0	0.5274	Fill
	BB-HSS-118	7D	15.0 - 17.0	1.7018	Alluvial Deposit

Riprap Design Calculations

Project Description:	I-95 over Souadabscook Stream, West Bridge		
	Project Number:	18084.99	
	Calcs By:	TEPA	5/3/2019
	Check By:		

Purpose: To calculate the required riprap size for the design flow event.

References: HEC 23, Vol II, DG 14.

If Fr > 0.8, this sheet uses Eq. 14.2, otherwise this sheet uses Eq 14.1

Note: The set-back ratio is << 5. Use the average velocity based on the entire contracted area through the bridge.

Constants

S_s = 2.65 assumed Riprap specific gravity

g = 32.2 ft/s

Is it a vertical wall abutment? = Y (Y or N)

K = 1.02 for Fr <= 0.8

K = 0.69 for Fr > 0.8

Hyrdaulic Data from HEC-RAS

Upstream:

Storm Event Q100

Channel Velocity = 5.14 fps

Channel Depth = 9.23 ft

Froude # = 0.3

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left[\frac{V^2}{gy}\right]$$

Eq 14.1, HEC 23 Vol II

Downstream:

Storm Event Q100

Channel Velocity = 5.06 fps

Channel Depth = 9.11 ft

Froude # = 0.31

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left[\frac{V^2}{gy}\right]^{0.14}$$

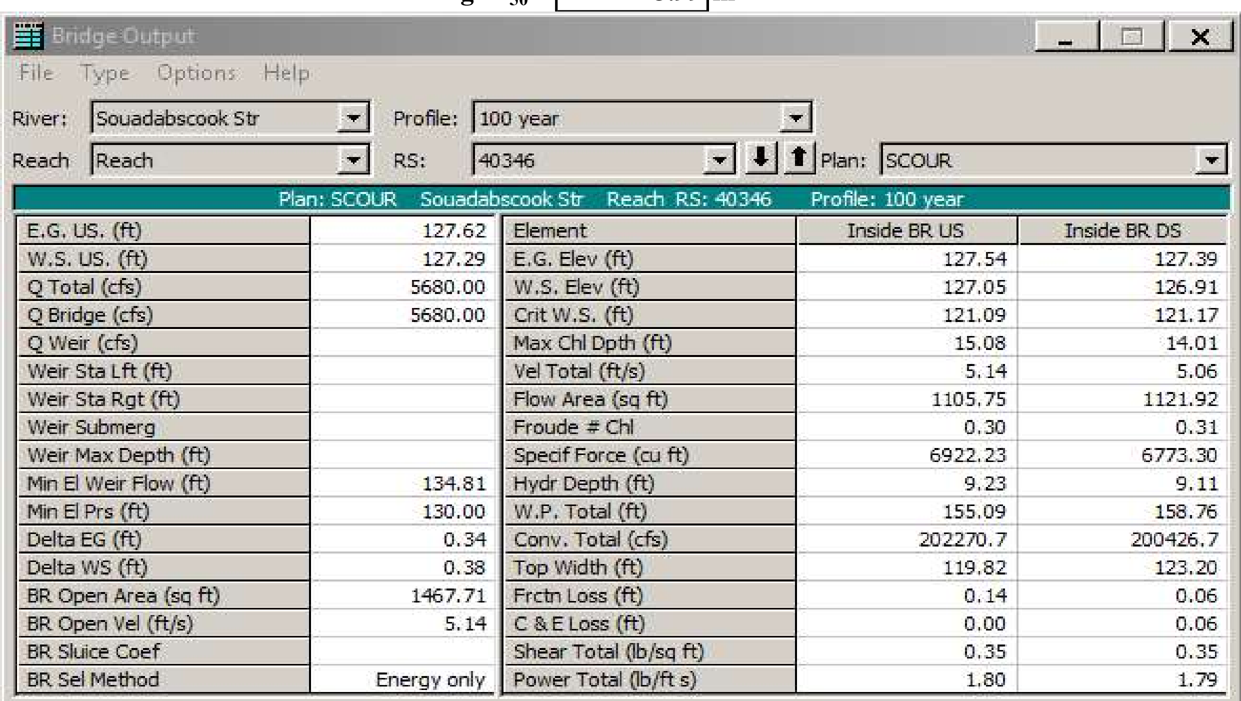
Eq 14.2, HEC 23 Vol II

Output

Upstream d_{50} = 0.51 ft

Downstream d_{50} = 0.49 ft

Average d_{50} = 5.99 in



Bridge Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 40346 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 40346 Profile: 100 year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	127.62	E.G. Elev (ft)	127.54	127.39
W.S. US. (ft)	127.29	W.S. Elev (ft)	127.05	126.91
Q Total (cfs)	5680.00	Crit W.S. (ft)	121.09	121.17
Q Bridge (cfs)	5680.00	Max Chl Dpth (ft)	15.08	14.01
Q Weir (cfs)		Vel Total (ft/s)	5.14	5.06
Weir Sta Lft (ft)		Flow Area (sq ft)	1105.75	1121.92
Weir Sta Rgt (ft)		Froude # Chl	0.30	0.31
Weir Submerg		Specif Force (cu ft)	6922.23	6773.30
Weir Max Depth (ft)		Hydr Depth (ft)	9.23	9.11
Min El Weir Flow (ft)	134.81	W.P. Total (ft)	155.09	158.76
Min El Prs (ft)	130.00	Conv. Total (cfs)	202270.7	200426.7
Delta EG (ft)	0.34	Top Width (ft)	119.82	123.20
Delta WS (ft)	0.38	Frctn Loss (ft)	0.14	0.06
BR Open Area (sq ft)	1467.71	C & E Loss (ft)	0.00	0.06
BR Open Vel (ft/s)	5.14	Shear Total (lb/sq ft)	0.35	0.35
BR Sluice Coef		Power Total (lb/ft s)	1.80	1.79
BR Sel Method	Energy only			

Riprap Design Calculations

Project Description: I-95 over Souadabscook Stream, Center Bridge

Project Number: 18084.99

Calcs By: TEPA 5/3/2019

Check By:

Purpose: To calculate the required riprap size for the design flow event.

References: HEC 23, Vol II, DG 14.

If Fr > 0.8, sheet uses Eq. 14.2, otherwise the sheet uses Eq 14.1

Note: The set-back ratio is << 5. Use the average velocity based on the entire contracted area through the bridge.

Constants

S_s =	2.65	assumed Riprap specific gravity
g =	32.2	ft/s
Is it a vertical wall abutment? =	Y	(Y or N)
K =	1.02	for Fr <= 0.8
K =	0.69	for Fr > 0.8

Hyrdaulic Data from HEC-RAS

Upstream:	Storm Event	Q100	
	Channel Velocity =	5.64	fps
	Channel Depth =	9.02	ft
	Froude # =	0.32	
Downstream:	Storm Event	Q100	
	Channel Velocity =	5.88	fps
	Channel Depth =	8.69	ft
	Froude # =	0.34	

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left[\frac{V^2}{gy}\right]$$

Eq 14.1, HEC 23 Vol II

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left[\frac{V^2}{gy}\right]^{0.14}$$

Eq 14.2, HEC 23 Vol II

Output

Upstream d_{50} =	0.61	ft
Downstream d_{50} =	0.66	ft
Average d_{50} =	**7.65**	**in**

Bridge Output

File Type Options Help

River: Souadabscook Str Profile: 100 year

Reach Reach RS: 35151 Plan: SCOUR

Plan: SCOUR Souadabscook Str Reach RS: 35151 Profile: 100 year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	126.87	E.G. Elev (ft)	126.73	126.51
W.S. US. (ft)	126.69	W.S. Elev (ft)	126.17	125.88
Q Total (cfs)	5680.00	Crit W.S. (ft)	120.39	120.22
Q Bridge (cfs)	5680.00	Max Chl Dpth (ft)	13.06	13.08
Q Weir (cfs)		Vel Total (ft/s)	5.64	5.88
Weir Sta Lft (ft)		Flow Area (sq ft)	1006.58	965.71
Weir Sta Rgt (ft)		Froude # Chl	0.32	0.34
Weir Submerg		Specif Force (cu ft)	6476.63	6269.94
Weir Max Depth (ft)		Hydr Depth (ft)	9.02	8.69
Min El Weir Flow (ft)	134.91	W.P. Total (ft)	142.33	142.04
Min El Prs (ft)	130.00	Conv. Total (cfs)	183915.1	176626.1
Delta EG (ft)	0.57	Top Width (ft)	111.61	111.19
Delta WS (ft)	0.68	Frctn Loss (ft)	0.20	0.04
BR Open Area (sq ft)	1457.75	C & E Loss (ft)	0.02	0.17
BR Open Vel (ft/s)	5.88	Shear Total (lb/sq ft)	0.42	0.44
BR Sluice Coef		Power Total (lb/ft s)	2.38	2.58
BR Sel Method	Energy only			