Hydrology and Hydraulic Report

Wagner No. 2 Bridge #2905
over
Hoch Brook

Waldoboro, Maine

WIN 18230.00

Maine Department of Transportation
Bridge Program

TABLE OF CONTENTS

HYDROLOGY REPORT

The drainage basin characteristics for Wagner No. 2 Bridge on State Route 32 (Winslows Mills Road) in Waldoboro over Hoch Brook were provided by the MaineDOT Environmental Office Hydrology Unit. The peak flows were calculated using the USGS peak flow regression equations for small, ungaged streams in Maine (see USGS Water-Resources Investigations Report 99-4008). The majority of Hoch Brook is not located in a FEMA detailed study area, and the brook itself has not been evaluated in a flood insurance study (FIS). However, the bridge is located within the Medomak River floodplain. The flood flows reported by MaineDOT were calculated with the NRCS TR-20 rainfall/runoff model. The USGS peak flow regression equations are considered more reliable and are the basis of the peak flow rate summary below.

SUMMARY

Drainage Area	2.00	mi^2
Q1.1	26.5	ft^3/s
Q2	51.5	ft^3/s
Q5	78.5	ft^3/s
Q10	95.7	ft^3/s
Q25	125.3	ft^3/s
Q50	141.6	ft^3/s
Q100	165.7	ft^3/s
Q500	216.1	ft^3/s

Reported by: Anna Giraldi, PE
Date: October 23, 2017

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

HYDRAULIC REPORT

The existing and proposed bridges were analyzed using GeoHECRAS version 1.4.0.13401, developed by CivilGEO Engineering Software. Although the existing structure can be considered a culvert for hydraulic modeling purposes, it was unknown whether the replacement structure would be a bridge or culvert, so HEC-RAS was utilized rather than HY-8. The proposed structure, whether a bridge or culvert, will have stream simulation and banks extending though the structure as the channel is part of a critical salmon habitat. Therefore, the bridge modeling function was required rather than the culvert modeling function. In order to ensure an accurate comparison between existing and proposed, the bridge modeling function was also utilized for the existing structure.

Hoch Brook has not been evaluated in a FEMA FIS, so no comparison to FEMA could be done for Hoch Brook flood flows. However, the bridge is located within the Medomak River floodplain. Therefore, a hydraulic analysis was completed on the culvert for just the Hoch Brook flood flows, and a backwater analysis was also completed taking the FEMA flood elevations for the Medomak River at the bridge location into account. The hydraulic model for this project represents a 1018 foot long section of Hoch Brook, including the Wagner No. 2 Bridge on State Route 32. Three cross sections downstream and four cross sections upstream were used to model the stream.

The hydraulic analysis assumes steady flow and default coefficients for expansion and contraction. All of the calculated flood flows were analyzed using a normal depth boundary condition with a downstream slope of 0.0057 ft/ft and an upstream slope of 0.0025 ft/ft. In order to determine the upstream and downstream slopes, a Topographic Map was used. The next contour upstream, located approximately 6780 feet from the bridge, was used to calculate the upstream slope. A contour from survey at the Hoch Brook confluence with the Medomak River approximately 530 feet downstream was used to determine the slope downstream. The normal depth downstream boundary condition is typically used far enough downstream that it does not affect the results in the study area because it assumes uniform flow, which does not normally exist in natural streams. To verify this assumption, the downstream normal slope was increased in the model from 0.0057 to 0.1140, which is an increase of 20 times the original slope. The change in the upstream water surface elevation was approximately 0.1 inches. Alternatively, the downstream normal was decreased from 0.0057 to 0.00029, which is a decrease of 20 times the original slope. The change in upstream water surface elevation was approximately 1.2 inches. Therefore, the effect of the downstream normal slope on the study area results is negligible.

The bridge is in a rural area. The upstream reach consists of a large, flat wetland with meandering stream that overflows its banks during flood flows and fills the wetland. The wetland is bounded by a line of trees and shrubs. The downstream reach has well defined banks lined with trees and brush. A large mowed field is adjacent to the south side of the bank immediately downstream of the bridge, and the north bank is steeper and more vegetated. It appears the bridge is located at the outlet of the wetland, so there is a notable difference in channel slope between the upstream and downstream reaches. Just upstream of the bridge, a natural constriction consisting of wetland vegetation has formed limited flow to the bridge. A large drainage ditch along the side of the road also feeds into the brook just upstream of the bridge. Based on this geometry, the hydraulic model utilizes a Manning's n of 0.085 for the vegetated banks consisting of medium brush and trees (average of 0.070 (medium brush and trees, in winter) and 0.100 (medium brush and trees, in summer)). A Manning's n of 0.045 was utilized for the upstream grassy wetland banks. The channel was modeled using a Manning's n of 0.035 (clean, straight, full, no rifts or deep pool but with stone and weeds) for all cross sections.

A hydraulic analysis for the existing structure was completed for just Hoch Brook without the influence of the Medomak River to calibrate the model. Measurements for high water marks were taken in the field, one at the apparent ordinary high water and one at the high water mark. The measured ordinary high water elevation was then compared to the Q1.1 flood flow elevation and the Q2 flood flow elevation. The difference in elevation was 10.4 inches and 5.6 inches, respectively, with the field measurement higher than the results of the model. The Q100 flood flow elevation was then compared to the measured high water mark. The difference in elevation was 1.6 inches with the field measurement higher than the results of the model. The differences in elevations were considered acceptable for calibration of the model.

An additional backwater analysis was completed to account for the influence of the Medomak River, which utilizes downstream water surface elevations provided by FEMA's FIS as downstream boundary conditions for the hydraulic model. This model assumes peak flows for Hoch Brook occur concurrently with the peak flows of the Medomak River. It should be noted that the Hoch Brook peak flows will not necessarily occur concurrently with the Medomak River peak flows. However, the considerable difference in drainage areas between the two reaches means the Hoch Brook flood water effects on the channel at the crossing location will be negligible as compared to the Medomak River flood water.

EXISTING BRIDGE

The existing bridge is a cast-in-place concrete deck founded on mass concrete abutments that sit on a concrete slab. The clear span of the bridge is 14'-0" and the rise is 6'-6"

according to existing plans and field measurements. The superstructure is currently in serious condition with longitudinal cracks and efflorescence underneath the whole length of the deck. The abutments are in poor condition and also have cracking and efflorescence. The existing bridge appears to be at the outlet of the upstream wetland, and the downstream channel width is significantly smaller than the upstream wetland boundaries. Therefore, although there is an increase in water velocities for some floods through the bridge, this appears to be as much a result of the change in reach geomorphology as the presence of the bridge.

The existing bridge is considered a culvert with a hydraulic opening of 77.8 square feet. It is hydraulically adequate for the Hoch Brook flood flows with a headwater to depth (HW/D) ratio of 0.52, which satisfies Maine BDG Section 2.3.10.2 that states that the HW/D ratio should be approximately equal to or less than 0.9. For the Q50 and Q100 flood events, the model reports upstream water surface elevations of 66.74 feet and 66.85 feet, respectively, and discharge velocities of 7.00 ft/s and 7.37 ft/s, respectively, see Appendix E for more information. However, as it is within the influence of the Medomak River 50, 100 and 500-year floods, the existing bridge and a large stretch of Route 32 are submerged according to FEMA's Flood Insurance Rate Maps (FIRM). The existing roadway elevation is slightly below elevation 73 feet and the 50, 100 and 500-year backwater elevations are at 73.9, 75, and 76.2 feet respectively.

PROPOSED 14-FOOT CONCRETE BOX CULVERT

A measured bank full width (BFW) of 10 feet was determined by the MaineDOT Environmental Office. Therefore a minimum structure width of 12 feet would be needed based on 1.2 BFW. The existing structure width is 14 feet, and although it meets hydraulic requirements for the Hoch Brook flood flows, the bridge is substantially undersized for the Medomak River backwater. Therefore, the decision was made to meet or exceed the existing span and opening area by maintaining the existing 14-foot structure width. The proposed bridge also needs to be designed based on Habitat Connectivity Design (HCD) as Hoch Brook is a critical salmon habitat. Simulated stream banks that match the upstream and downstream banks will extend through the proposed structure. For the hydraulic design, these banks were represented as sloped banks with a flat shelf following the same slope as the culvert.

A channel alignment was developed based on survey to follow the thalweg of the channel. An existing channel profile was cut from the survey along the channel alignment, and was used to develop the proposed bridge profile. Refer to the Habitat Connectivity Design Report for additional information with respect to the development of the stream profile, high and low vertical adjustment potential profiles, and connectivity design. The proposed stream bed slope at the bridge was determined to be 0.5%.

A box culvert is recommended for the replacement structure. The Bridge Design Guide (BDG), dated August 2003, Section 8.3.1 says to design the structure long enough to preclude the need for wingwalls and instead use beveled ends. In the analysis, a 14-foot wide by 11-foot tall structure was modeled with banks along both interior walls as noted above. This results in a hydraulic opening of 94.2 square feet. The HW/D ratio is 0.36 for the Q50 flood of the Hoch Brook riverine flow, which is less than the required 0.90 HW/D ratio. For the Q50 and Q100 flood events, the proposed model reports water surface elevations of 65.28 feet and 65.5 feet, respectively, and discharge velocities of 4.90 ft/s and 5.37 ft/s, respectively, see Appendix E for more information. These results show decreases in both water surface elevations and velocities compared to existing for all flood events. No scour analysis was performed as the preferred option is a closed bottom structure.

It should be noted that water surface elevations for the smaller flood events do not significantly change. Therefore, fish passage is not adversely affected by the replacement structure. Refer to the Habitat Connectivity Design Report for more information.

As noted previously, the bridge has not been designed to accommodate the Medomak River backwater, however the roadway profile has been set to be above the Q50 backwater elevation.

CONCLUSIONS

The recommended 14-foot wide by 11-foot tall concrete box culvert with beveled ends buried approximately 2 feet and banks along both interior walls will satisfy the maximum HW/D ratio of 0.9 specified in Section 2.3.10.2 of the BDG if backwater from the Medomak River is neglected. If designed as specified in the Habitat Connectivity Design Report, salmon passage will be improved over the existing structure, as velocities will decrease and a low flow channel will be provided.

SUMMARY

		Hoch Brook - No Backwater		Medomak River Backwater
		Existing Structure	Recommended Structure	
		14' Span Concrete Deck	14' Concrete Box Culvert	
Total Area of Waterway Opening	ft^2	78	94	
Headwater elevation @ $Q_{1.1}$	ft	65.28	63.72	
Headwater elevation @ Q_2	ft	65.72	64.19	
Headwater elevation @ Q_5	ft	66.08	64.59	
Headwater elevation @ Q_{10}	ft	72.33	64.80	72.32
Headwater elevation @ Q_{25}	ft	72.85	65.12	
Headwater elevation @ Q_{50}	ft	73.91	65.28	73.92
Headwater elevation @ Q_{100}	ft	75.00	65.50	75.00
Headwater elevation @ Q_{500}	ft	76.20	65.92	76.20
Headwater/structure depth @ Q_{50}		0.52	0.36	
Outlet Velocity @ $Q_{1.1}$	ft/s	3.75	2.56	
Outlet Velocity @ Q_2	ft/s	4.99	3.08	
Outlet Velocity @ Q_5	ft/s	5.76	3.57	
Outlet Velocity @ Q_{10}	ft/s	6.13	3.95	1.01
Outlet Velocity @ Q_{25}	ft/s	6.73	4.57	
Outlet Velocity @ Q_{50}	ft/s	7.00	4.9	0.85
Outlet Velocity @ Q_{100}	ft/s	7.37	5.37	0.51
Outlet Velocity @ Q_{500}	ft/s	8.07	6.33	0.35

Reported by: Anna Giraldi, PE
Date: December 28, 2017

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

Appendix A

Hydrology and Hydraulics Data

Project Name:		**PIN:**	18230
Stream Name:	Hook Brook	**Town:**	Waldoboro
Bridge Name:	Wagner No. 2	**Bridge No.**	2905
Route No.	ME32 / Winslows Mills Rd	**USGS Quad:**	
Analysis by:	CSH	**Date:**	12/29/2015

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

Enter data in blue cells only!

	km^2	mi^2	ac	
A	5.18	2.00	1280.0	Watershed Area
W	1.17	0.45	288.0	Wetlands area (by NWI)
P_c	465409.5	4888699		watershed centroid (E, N; UTM 19N; meters)
County	Waldo			*choose county from drop-down menu*
pptA	47.2			mean annual precipitation (inches; by look-up)
SG	0.00			sand & gravel aquifer as decimal fraction of watershed A

Enter data in [mi^2]

A (km^2) 5.18 **Conf Lvl** 0.67

W (%) 22.50

Worksheet prepared by:
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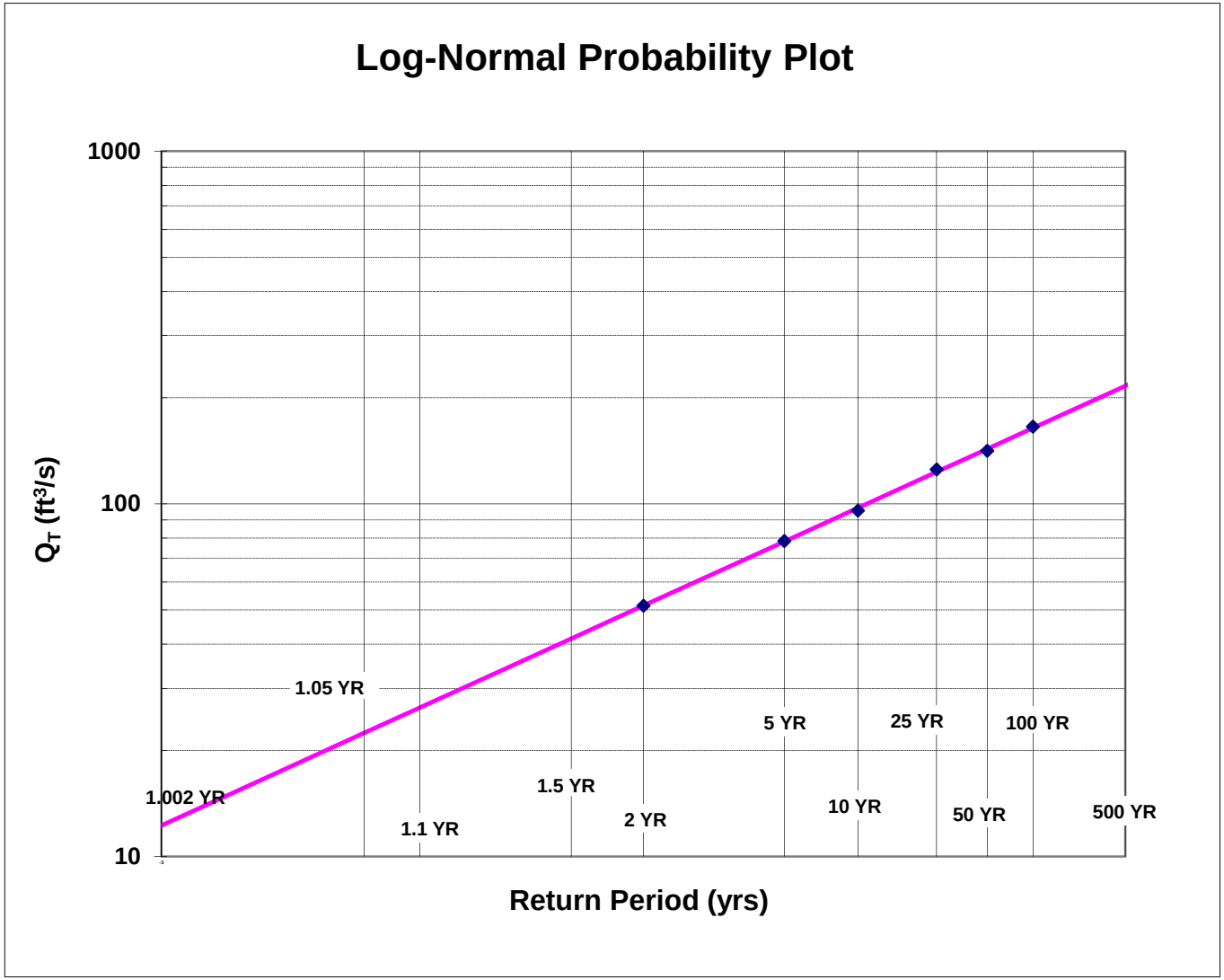
Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		0.75		26.5
2		1.46		51.5
5		2.22		78.5
10		2.71		95.7
25		3.55		125.3
50		4.01		141.6
100		4.69		165.7
500		6.12		216.1

Reference:

Hodgkins, G., 1999.
Estimating the magnitude of peak flows for streams in Maine for selected recurrence intervals
Water-Resources Investigations Report 99-4008
US Geological Survey, Augusta, Maine

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


Log-Normal Probability Plot
1000
100
10
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)

Project Name:	0	**PIN:**	18230
Stream Name:	Hook Brook	**Town:**	Waldoboro
Bridge Name:	Wagner No. 2	**Bridge No.**	2905
Route No.	ME32 / Winslows Mills Rd	**USGS Quad:**	0
Analysis by:	CSH	**Date:**	12/29/2015

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

MAINE MONTHLY MEDIAN FLOWS BY USGS REGRESSION EQUATIONS (2004)

Worksheet prepared by:
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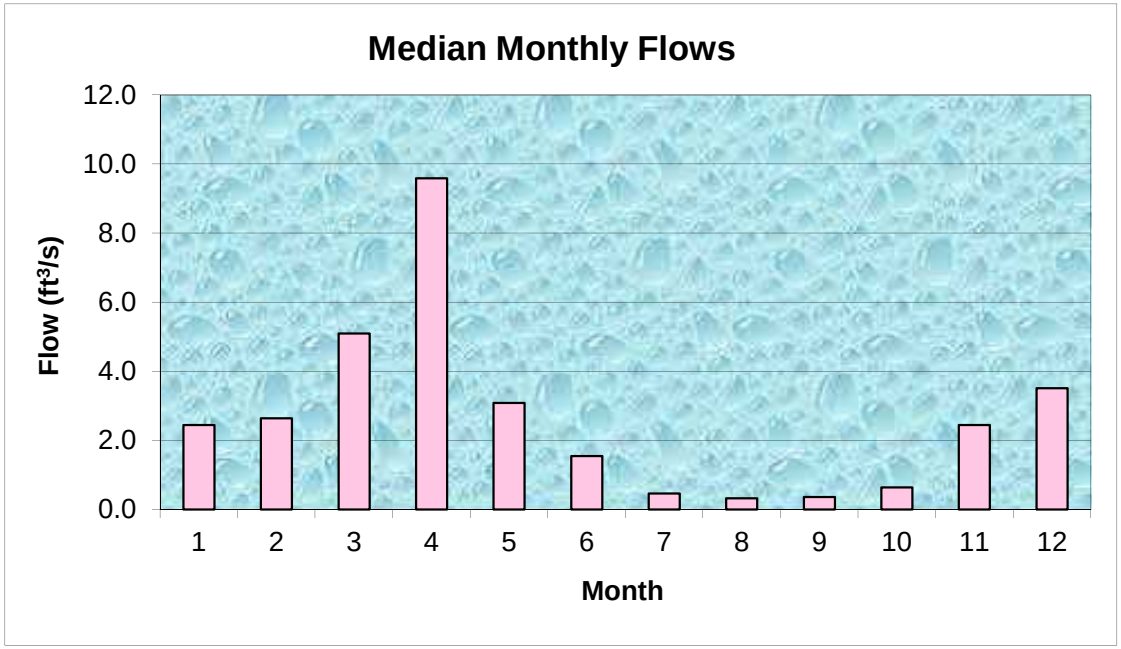
	Value	Variable	Explanation
	2.000	*A*	Area (mi^2)
465409.5	4888699	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	42.30	*DIST*	Distance from Coastal reference line (mi)
	47.2	*pptA*	Mean Annual Precipitation (inches)
	0.00	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**2.45**	0.0694
Feb	**2.64**	0.0748
Mar	**5.10**	0.1445
Apr	**9.59**	0.2717
May	**3.09**	0.0876
Jun	**1.55**	0.0439
Jul	**0.47**	0.0132
Aug	**0.33**	0.0094
Sep	**0.36**	0.0102
Oct	**0.65**	0.0183
Nov	**2.45**	0.0695
Dec	**3.51**	0.0996



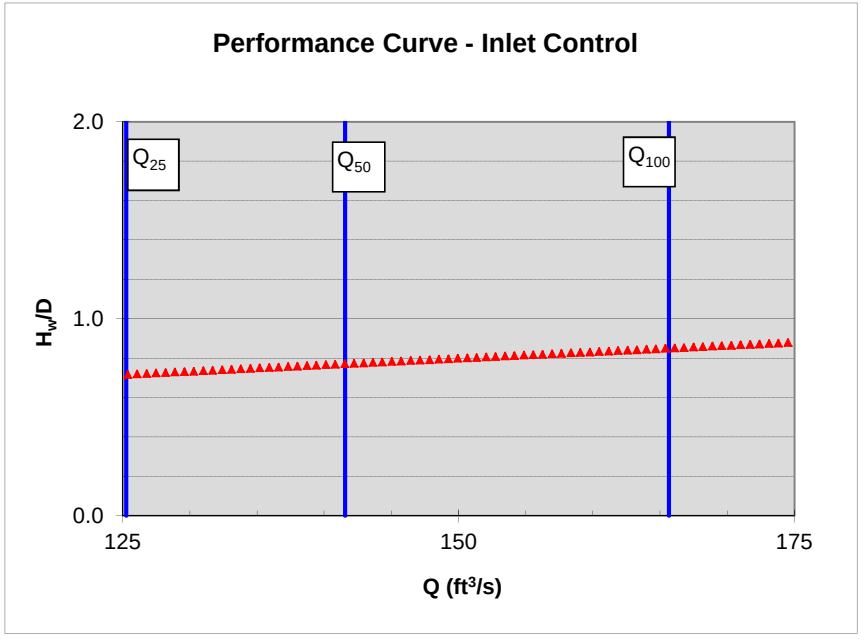
Q_{bf}	**10.7**
ann avg	**4.3**
ann med	**2.3**
$Q_{1.002}$	**12.2**
$Q_{1.01}$	16.1
$Q_{1.05}$	22.4

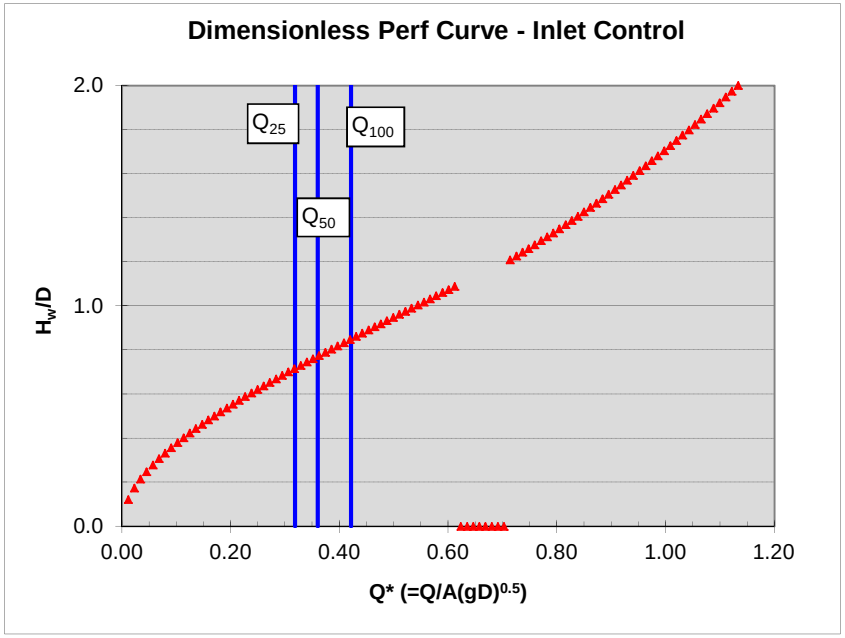
W_{bf}	11.0	estimated bankfull width
d_{bf}	0.9	
Q_{bf}	37.5	assume v = 4ft/s

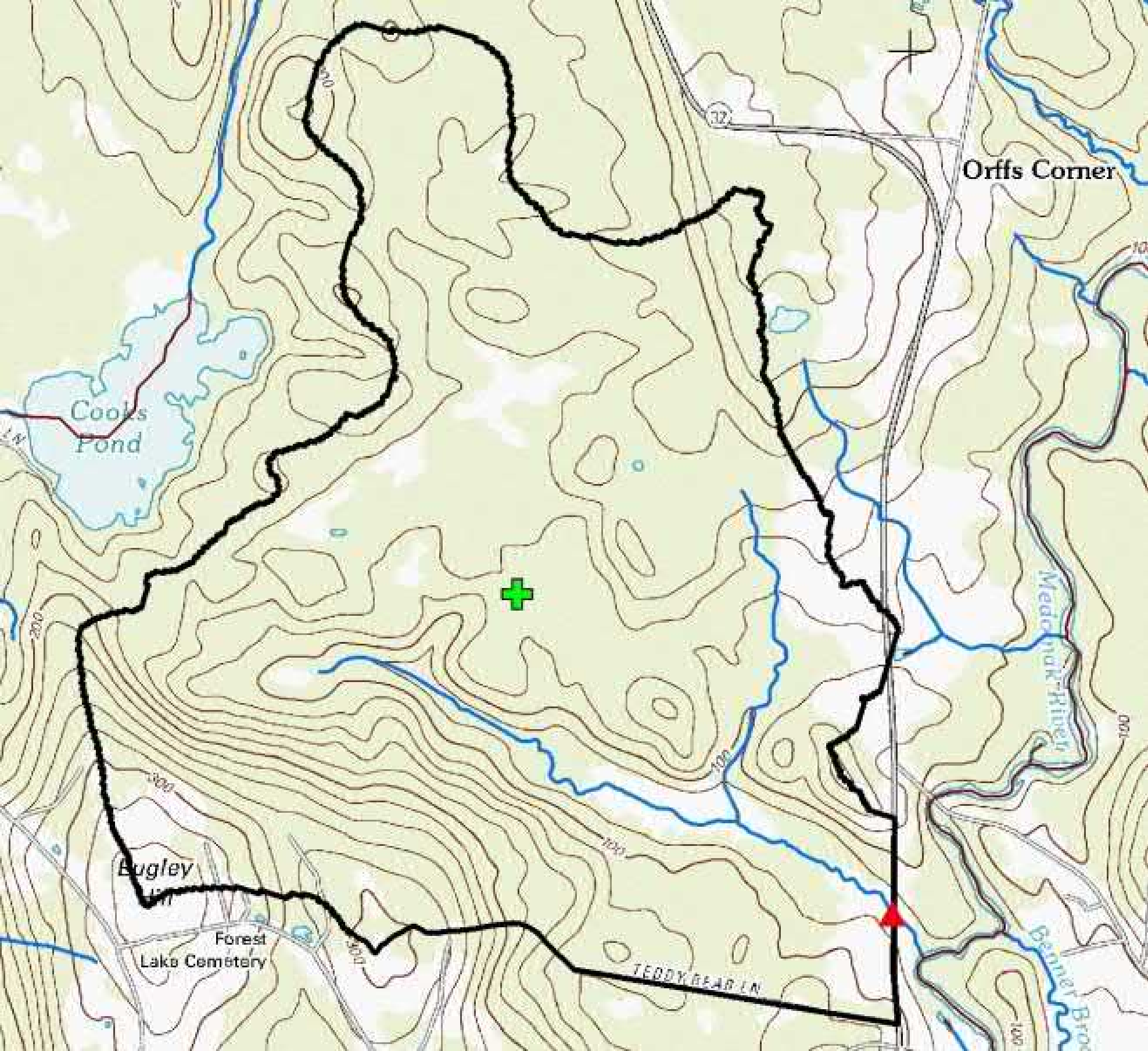
NOTE: ***This page is for preliminary sizing only.***
Final design should be done with HY8 or HDS-5

Preliminary Culvert Sizing - Round Pipes

Type:	Circ RCP Proj		Q_{25}	125.3		
D (ft)	6		Q_{50}	141.6	trial D =	5.47
w (ft)	*9*	*box width*	Q_{100}	165.7		
Slope (ft/ft)	0.02					
A (ft^2)	28.27					
g	32.2					






Orffs Corner
Cooks Pond
Bugley Hill
Forest Lake Cemetery
TEDDY BEAR LN
Meadowbrook River
Bennet Brook

StreamStats Version 3.0

Basin Characteristics Ungaged Site Report

Date: Tues Dec 29, 2015 1:13:56 PM GMT-5
Study Area: Maine
NAD 1983 Latitude: 44.1413 (44 08 29)
NAD 1983 Longitude: -69.4171 (-69 25 02)

Label	Value	Units	Definition
DRNAREA	2	square miles	Area that drains to a point on a stream
STORNWI	22.55	percent	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory
ELEV	161.2	feet	Mean Basin Elevation
PRECIP	45.3	inches	Mean Annual Precipitation
PRDECFEB90	11.8	inches	Basin average mean precipitation for December to February from PRISM 1961-1990
SANDGRAVAP	0	percent	Percentage of land surface underlain by sand and gravel aquifers
COASTDIST	43.1	miles	Shortest distance from the coastline to the basin centroid
CENTROIDX	465409.5	State plane coordinates	Basin centroid horizontal (x) location in state plane coordinates
CENTROIDY	4888698.61	State plane coordinates	Basin centroid vertical (y) location in state plane units
SANDGRAVAF	0	dimensionless	Fraction of land surface underlain by sand and gravel aquifers
LC11IMP	0.18	percent	Percentage of impervious area determined from NLCD 2011 impervious dataset
LC11DEV	0.81	percent	Percentage of land-use from NLCD 2011 classes 21-24

StreamStats Version 3.0

Flow Statistics Ungaged Site Report

Date: Tues Dec 29, 2015 1:15:27 PM GMT-5
Study Area: Maine
NAD 1983 Latitude: 44.1413 (44 08 29)
NAD 1983 Longitude: -69.4171 (-69 25 02)
Drainage Area: 2 mi2

Regional Hydraulic Geometry Basin Characteristics			
100% Central and Coastal Bankfull 2004 5042 (2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	2 (below min value 2.92)	2.92	298

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Regional Median Flows Basin Characteristics
100% Undefined Region (2.0 mi2)

The selected watershed is entirely in an area for which flow equations were not defined.

Monthly Mean Flows Basin Characteristics			
100% Statewide Mean Monthly SIR 2004 5026 (2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	2 (below min value 9.79)	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.00	0	0.455
Mean Annual Precipitation (inches)	45.3	37.8	47.9
Distance From Coast To Basin Centroid (miles)	43.1	42.7	193

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Monthly Median Flows Basin Characteristics			
100% Statewide Median Monthly SIR 2004 5026 (2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**

Drainage Area (square miles)	2 (below min value 9.79)	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.00	0	0.455
Mean Annual Precipitation (inches)	45.3	37.8	47.9
Distance From Coast To Basin Centroid (miles)	43.1	42.7	193

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak Flow Basin Characteristics

100% Statewide Peak Flow Full WRI 99 4008 (2 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	2	0.93	1653
Percentage of Storage from NWI (percent)	22.55	0.7	26.7

Annual Flows Basin Characteristics

100% Statewide Annual SIR 2004 5026 (2 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	2 (below min value 9.79)	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.00	0	0.455
Basin Ave Precip Dec Feb PRISM 1990 (inches)	11.8	7.71	12.6

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Regional Hydraulic Geometry Statistics

Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
BFFLOW	10.7	ft3/s				
BFWDTH	11	ft				
BFDPTH	0.75	ft				
BFAREA	8.26	ft2				

http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)
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

Monthly Mean Flows Statistics

Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	

					90-Percent Prediction Interval	
					Min	Max
Q1	4.01	ft3/s				
Q2	4.11	ft3/s				
Q3	9.93	ft3/s				
Q4	10.6	ft3/s				
Q5	4.47	ft3/s				
Q6	2.8	ft3/s				
Q7	1.01	ft3/s				
Q8	0.74	ft3/s				
Q9	0.9	ft3/s				
Q10	2.15	ft3/s				
Q11	4.82	ft3/s				
Q12	5.56	ft3/s				

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.

Monthly Median Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
JAND50	2.41	ft3/s				
FEBD50	2.6	ft3/s				
MARD50	4.99	ft3/s				
APRD50	8.48	ft3/s				
MAYD50	3.12	ft3/s				
JUND50	1.55	ft3/s				
JULD50	0.47	ft3/s				
AUGD50	0.33	ft3/s				
SEPD50	0.36	ft3/s				
OCTD50	0.65	ft3/s				
NOVD50	2.45	ft3/s				
DECD50	3.48	ft3/s				

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.

Peak Flow Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
PK2	38.5	ft3/s	35	1.8	21	70.4
PK5	59.5	ft3/s	36	2.5	32.1	110
PK10	74.9	ft3/s	37	3.2	39.7	141
PK25	95.8	ft3/s	39	4.1	49.3	186
PK50	112	ft3/s	40	4.8	56.3	223
PK100	130	ft3/s	41	5.4	63.7	265
PK500	173	ft3/s	45	6.4	79.6	376

http://me.water.usgs.gov/99-4008.pdf (http://me.water.usgs.gov/99-4008.pdf)
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.

Annual Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
QA	4.27	ft3/s				
MEDAN	2.26	ft3/s				
M7D10Y	0.0519	ft3/s				

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.

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JOB Wagner 2, ME JOB NO. 17-0140

SHEET NO. OF

CALCULATED BY AEG DATE 9/25/17

CHECKED BY SRB DATE 9/28/17

SUBJECT Brook Slope Calculations SCALE

Upstream:

from Topographic MAP USA in GeoHECRAS

L = 680' next contour is 80'

elevation at X-section 1220 ≈ 63

$$S = \frac{80 - 63}{680} = 0.0025$$

Down stream:

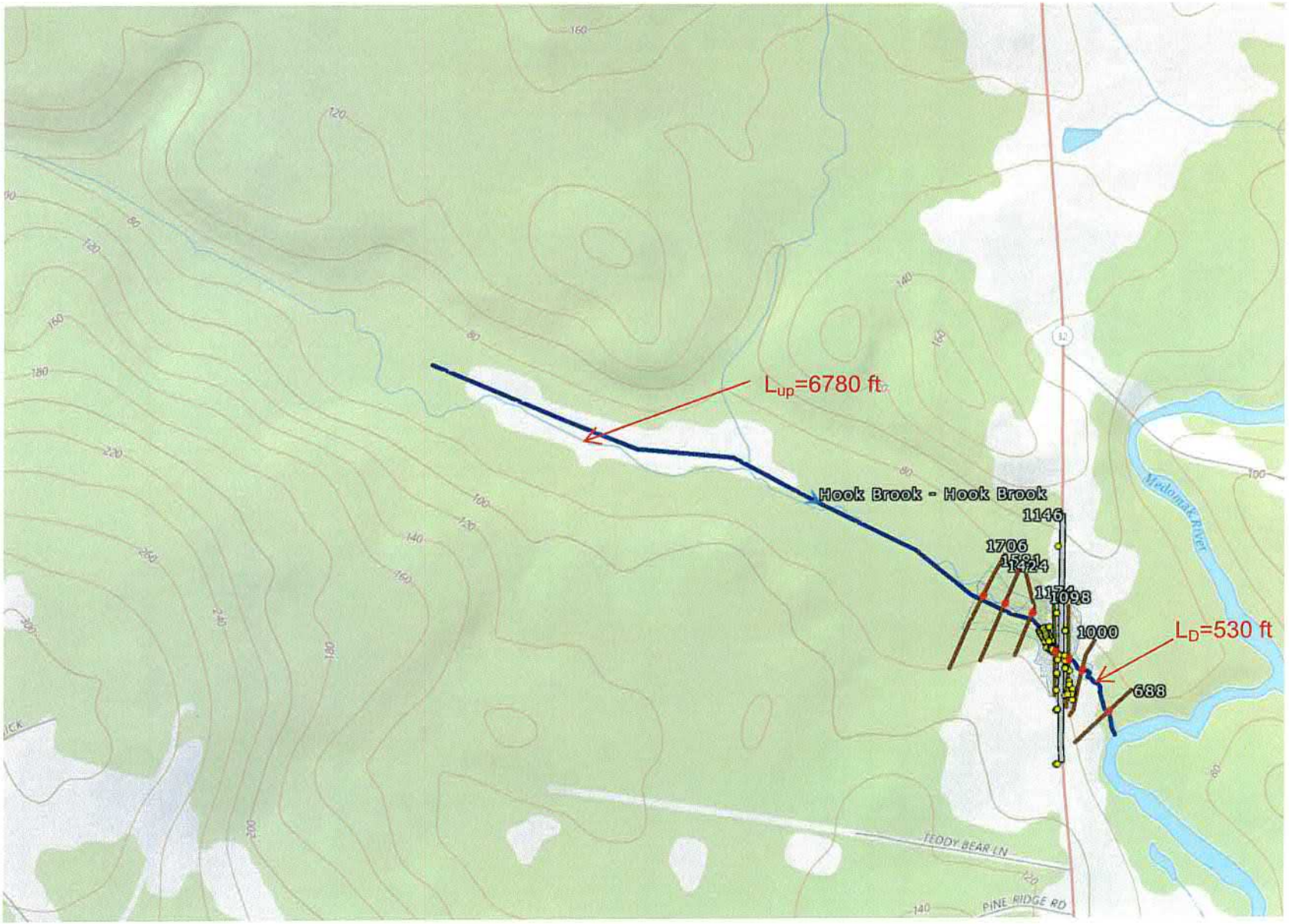
from Topographic MAP USA in GeoHECRAS

L = 530'

from survey: outlet to Medomak River el = 59'

elevation at X-section 1083 ≈ 62

$$S = \frac{62 - 59}{530} = 0.0057$$


L_{up}=6780 ft
Hook Brook - Hook Brook
1146
1706
1524
1098
1000
L_D=530 ft
688
TEDDY BEAR LN
PINE RIDGE RD
Medomak River

CONSULTING ENGINEERS
Commercial Street, Manchester, NH 03101
(603) 668-8223 • Fax. (603) 668-8802
cld@cldengineers.com • www.cldengineers.com
New Hampshire • Vermont • Maine

JOB Wagner 2, ME JOB NO. 17-0140

SHEET NO. OF

CALCULATED BY AEG DATE 9/25/17

CHECKED BY SRB DATE 10/3/17

SUBJECT placement of existing culvert SCALE

upstream section

℄ reach at horizontal section 290.63

culvert at 290.63 - 7' = 283.63

290.63 + 7' = 297.63

downstream section

℄ reach at horizontal section 288.52

culvert at 288.52 - 7' = 281.52

288.52 + 7' = 295.52

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JOB Wagner 2, ME JOB NO. 17-0140

SHEET NO. OF

CALCULATED BY AEG DATE 9/25/17

CHECKED BY SRB DATE 10/3/17

SUBJECT Bottom of chord elevations SCALE

from existing plans:

low chord = 71.06 (NGVD29)

NAVD88 el. 71.06 - 0.697 = 70.368

from survey 70.169 & 69.993

use 70.0' for low chord

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New Hampshire • Vermont • Maine

JOB Wagner No. 2 JOB NO. 17-0140

SHEET NO. OF

CALCULATED BY AEG DATE 11/17

CHECKED BY SRB DATE 11/17

SUBJECT Headwater / structure depth SCALE

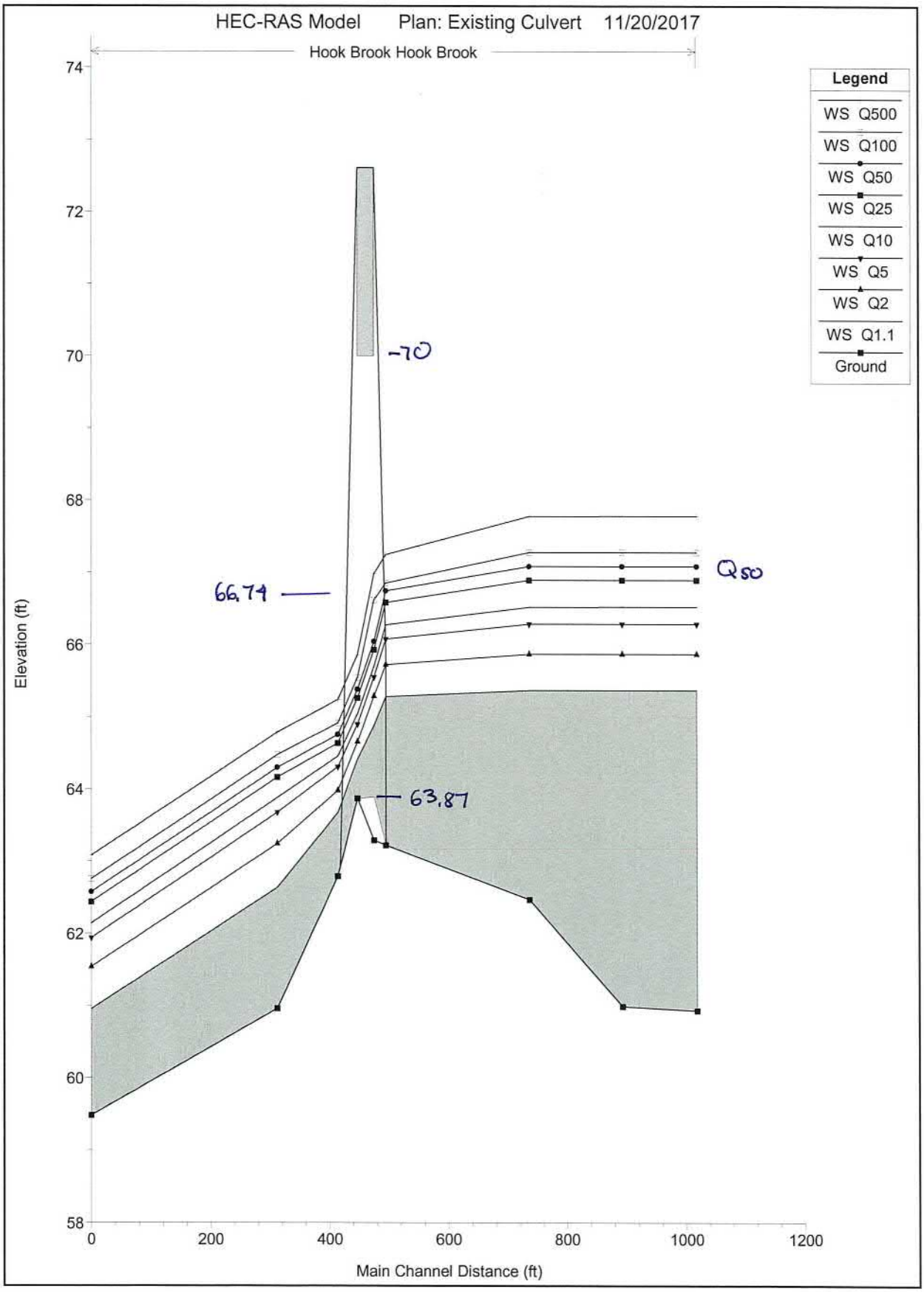
Existing Bridge

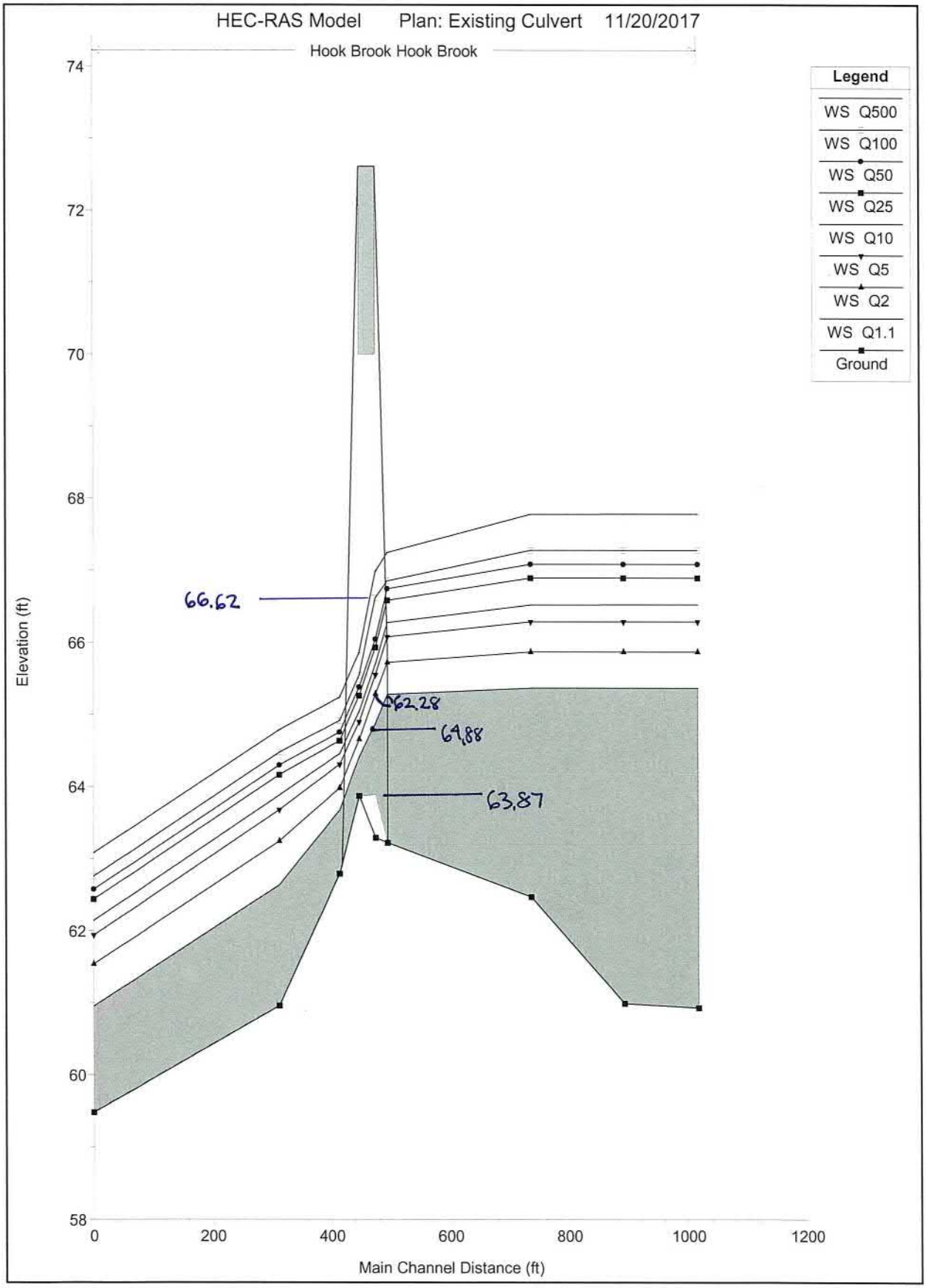
Q50 el. = 66.74 (X-section 1174)

HW = 66.74 − 63.22 = 3.52

D = 70 − 63.22 = 6.78

HW/D = 3.52 / 6.78 = 0.52 < 0.9 OK


HEC-RAS Model Plan: Existing Culvert 11/20/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
74
72
70
68
66
64
62
60
58
Elevation (ft)
0
200
400
600
800
1000
1200
Main Channel Distance (ft)
~70
66.74
Q50
63.87


HEC-RAS Model Plan: Existing Culvert 11/20/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
66.62
62.28
64.88
63.87
Elevation (ft)
Main Channel Distance (ft)
74
72
70
68
66
64
62
60
58
0
200
400
600
800
1000
1200

FUSS & O'NEILL	Prepared By	Date	Checked By	Date	Project No
	AEG	11/17	SRB	11/17	17-0140
					Sheet No of

Place internal x-section to account for concrete bottom of culvert

64.56 - 0.692 = 63.87 (see existing plans)

per field measurements OHW is 4.25' from low chord

70 - 4.25' = 65.75

$Q_{1.1}$ is at el. 64.88 at upstream side of culverts

$Q_{2.0}$ is at el 65.28 -"-

$Q_{1.1}$ is 65.75 - 64.88 = 0.87' = 10.4"

$Q_{2.0}$ 65.75 - 65.28 = 0.47' = 5.6"

Say high watermark at 3'-3" from low chord

70 - 3.25 = 66.75

Q_{100} = 66.62

66.75 - 66.62 = 0.13' = 1.6" between high watermark and Q_{100} water surface el.

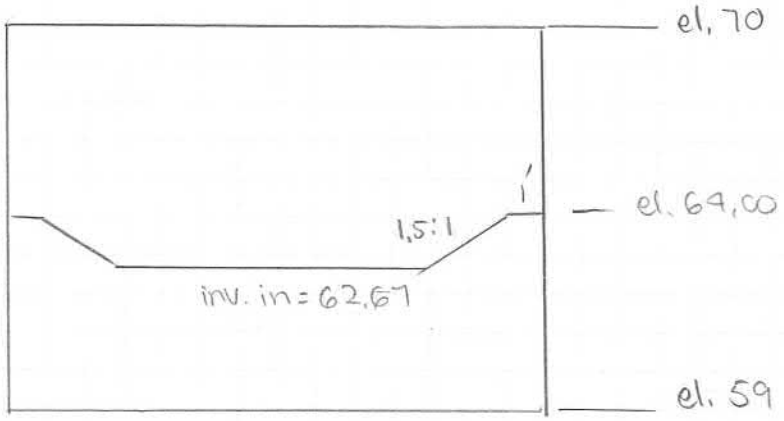
FUSS & O'NEILL

Prepared By	Date	Checked By	Date	Project No
AEG	11/17	SRB	11/17	17-0140

Box culvert X-Section

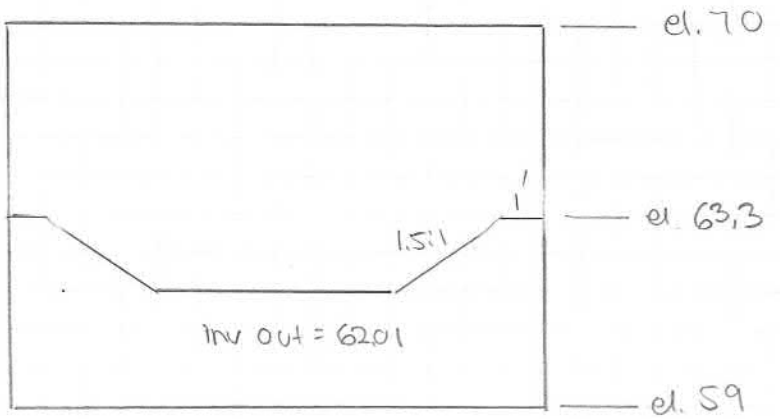
Sheet No of

14'



upstream

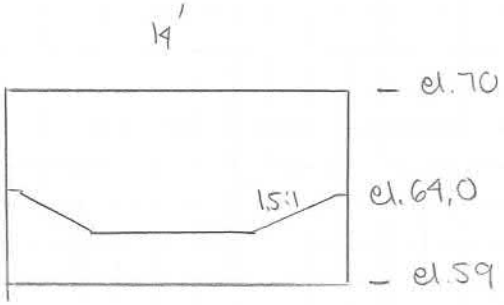
D = 70 - 59 = 11'



downstream

FUSS & O'NEILL	Prepared By	Date	Checked By	Date	Project No
	AEG	11/17	SRB	11/17	17-0140

HEC-RAS X-sections for proposed culvert — Sheet No of



BFW = 10' SO OK

roadway at Sta 1146

place upstream X-section at 1146 + 79/2 + 10' = 1196 +-

place downstream X-section at 1146 - 79/2 - 10' = 1096 +-

existing upstream X-section is at 1174 so move to 1196 +-

existing downstream X-section is at 1098 so keep

proposed bridge is skewed 23° from ℄ alignment

upstream: 283.63 - 2' = 281.63 ≈ 282 & 297

downstream: 281.52 - 2 = 279.52 ≈ 280 & 295

skew proposed culvert

FUSS & O'NEILL

Prepared By	Date	Checked By	Date	Project No
AEG	11/17	SRG	11/17	17-0140

Sheet No
of

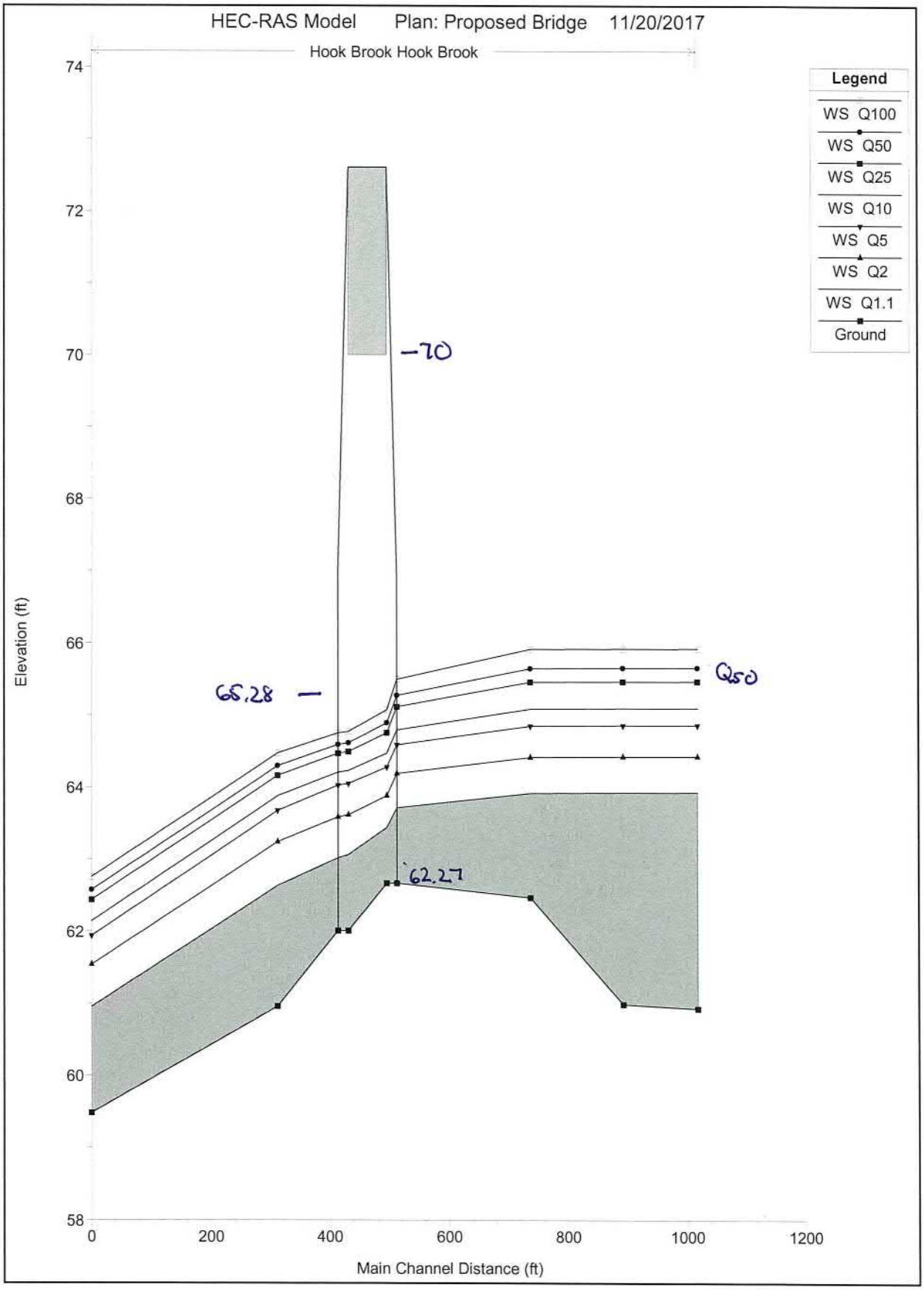
Proposed Bridge

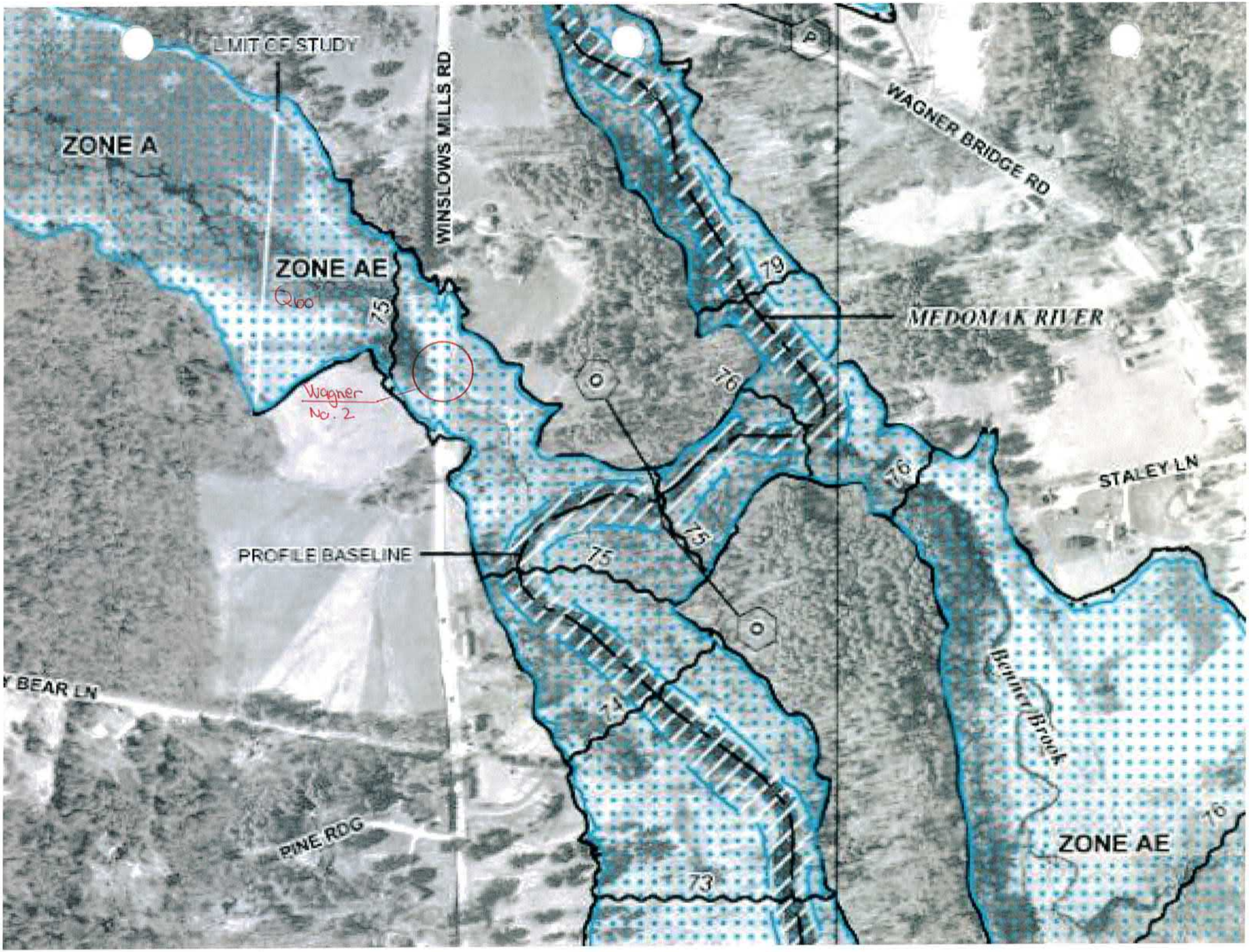
Q50 el = 65.28 (X-section 1192)

HW = 65.28 − 62.67 = 2.61

D = 70 − 62.67 = 7.33

HW/D = 2.61/7.33 = 0.36 < 0.9 OK


HEC-RAS Model Plan: Proposed Bridge 11/20/2017
Hook Brook Hook Brook
Legend
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
74
72
70
68
66
64
62
60
58
Elevation (ft)
0
200
400
600
800
1000
1200
Main Channel Distance (ft)
-70
65.28
Q50
62.27


LIMIT OF STUDY
ZONE A
ZONE AE
Q100
75
Wagner No. 2
WINSLOWS MILLS RD
WAGNER BRIDGE RD
MEDOMAK RIVER
P
O
79
76
76
75
75
STALEY LN
PROFILE BASELINE
BEAR LN
74
73
PINE RDG
Benner Brook
ZONE AE
76

NOTES TO USERS

...ap is for use in administering the National Flood In... ...ram. It does ...ssarily identify all areas subject to flooding, particu... ...ocal drainage ...s of small size. The **community map repository** should be consulted for ...e updated or additional flood hazard information.

...en more detailed information in areas where **Base Flood Elevations** (BFEs) ...**floodways** have been determined, users are encouraged to consult the Flood ...and Floodway Data and/or Summary of Stillwater Elevations tables contained ...he Flood Insurance Study (FIS) Report that accompanies this FIRM. Users ...be aware that BFEs shown on the FIRM represent rounded whole-foot ...ns. These BFEs are intended for flood insurance rating purposes only and ...not be used as the sole source of flood elevation information. Accordingly, ...evation data presented in the FIS Report should be utilized in conjunction with ...M for purposes of construction and/or floodplain management.

...d **Base Flood Elevations** shown on this map apply only landward of 0.0 ...orth American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be ...that coastal flood elevations are also provided in the Summary of Stillwater ...ons table in the Flood Insurance Study Report for this jurisdiction. Elevations ...in the Summary of Stillwater Elevations table should be used for construction ...floodplain management purposes when they are higher than the elevations ...on this FIRM.

...ries of the **floodways** were computed at cross sections and interpolated ...n cross sections. The floodways were based on hydraulic considerations with ...to requirements of the National Flood Insurance Program. Floodway widths ...ner pertinent floodway data are provided in the Flood Insurance Study Report ...jurisdiction.

...Zone category has been divided by a **Limit of Moderate Wave Action** ...A). The LIMWA represents the approximate landward limit of the 1.5-foot ...g wave. The effects of wave hazards between the VE Zone and the LIMWA ...ween the shoreline and the LIMWA for areas where VE Zones are not identified) ...similar to, but less severe than those in the VE Zone.

...areas not in Special Flood Hazard Areas may be protected by **flood control ...ures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance ...Report for information on flood control structures for this jurisdiction.

...ojection used in the preparation of this map was Universal Transverse ...or (UTM) zone 19. The **horizontal datum** was NAD 83, GRS 1980 ...id. Differences in datum, spheroid, projection or UTM zones used in the ...ion of FIRMs for adjacent jurisdictions may result in slight positional ...ces in map features across jurisdiction boundaries. These differences do not ...e accuracy of this FIRM.

...levations on this map are referenced to the North American Vertical Datum of ...These flood elevations must be compared to structure and ground elevations ...ced to the same **vertical datum**. For information regarding conversion ...n the National Geodetic Vertical Datum of 1929 and the North American ... Datum of 1988, visit the National Geodetic Survey website at ...ww.ngs.noaa.gov or contact the National Geodetic Survey in the following ...:

...formation Services ...NGS12 ...d Geodetic Survey ...3, #9202 ...ssp West Highway ...pring, Maryland 20910-3282 ...13-3242

...on current elevation, description, and/or location information for **bench marks** ...on this map, please contact the Information Services Branch of the National ...ic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

...Map information shown on this FIRM was derived from the Maine Office ...graphic Information Systems (MEGIS) at a scale of 1:6,000 or better from ...raphy dated May 2013.

...**rofile baselines** depicted on this map represent the hydraulic modeling baselines ...ich the flood profiles in the FIS report. As a result of improved topographic data, ...**rofile baseline**, in some cases, may deviate significantly from the channel ...ne or appear outside the SFHA.

...ap reflects more detailed and up-to-date **stream channel configurations** ...ose shown on the previous FIRM for this jurisdiction. The floodplains and ...ys that were transferred from the previous FIRM may have been adjusted ...orm to these new stream channel configurations. As a result, the ... Profiles and Floodway Data tables for multiple streams in the Flood ...ce Study Report (which contains authoritative hydraulic data) may reflect ...channel distances that differ from what is shown on this map.

...ate limits shown on this map are based on the best data available at the time ...ication. Because changes due to annexations or de-annexations may have ...d after this map was published, map users should contact appropriate ...nity officials to verify current corporate limit locations.

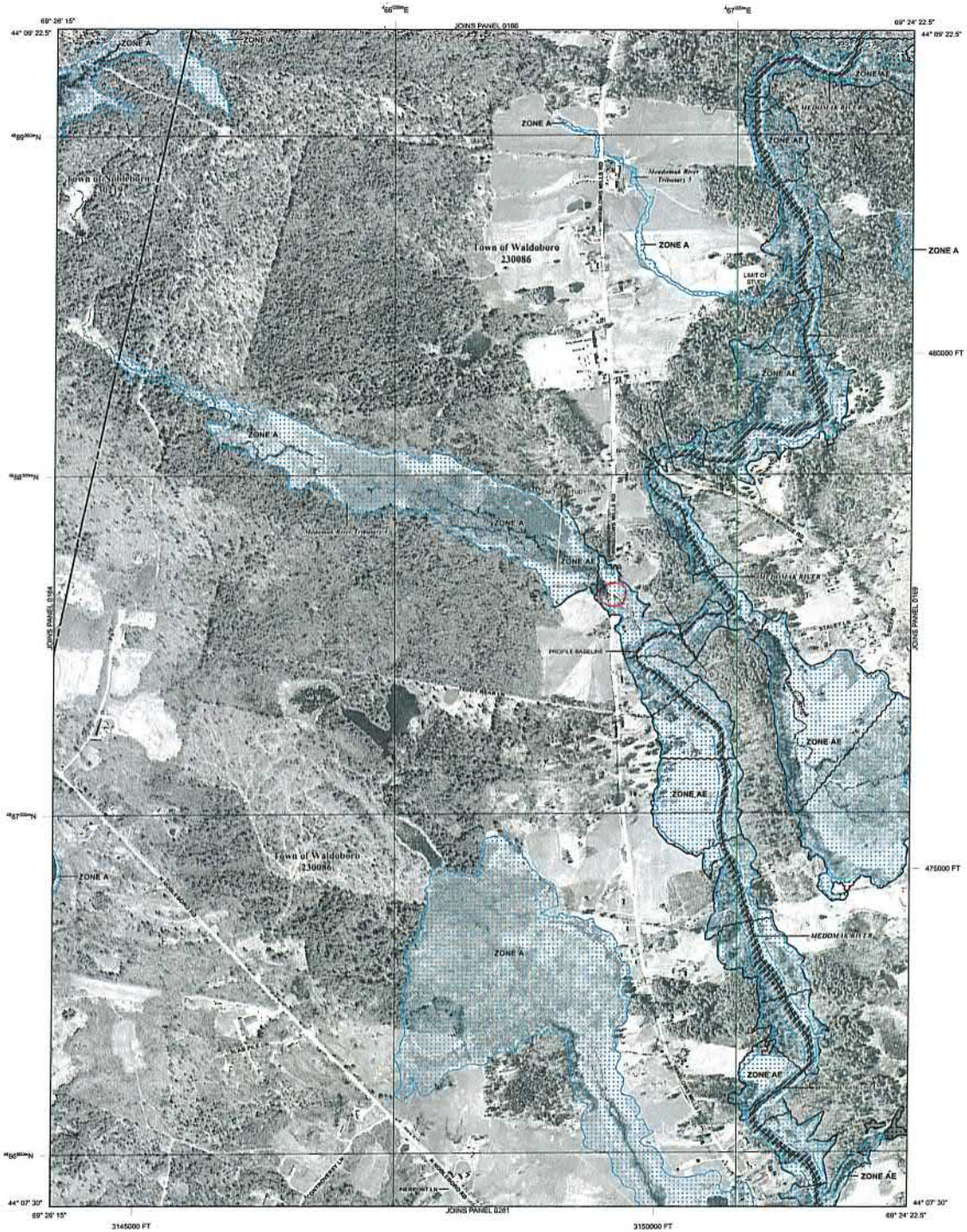
...refer to the separately printed **Map Index** for an overview map of the ...showing the layout of map panels; community map repository addresses; ...Listing of Communities table containing National Flood Insurance Program ...or each community as well as a listing of the panels on which each community ...ed.

...ormation on available products associated with this FIRM visit the **Map ...s Center (MSC)** website at http://msc.fema.gov. Available products may ... previously issued Letters of Map Change, a Flood Insurance Study Report, ...digital versions of this map. Many of these products can be ordered or ...d directly from the MSC website.

...have **questions about this map**, how to order products, or the National ...Insurance Program in general, please call the **FEMA Map Information ...nge (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA ...i at http://www.fema.gov/business/nfip.

...f Maine Floodway Note: Under the Maine Revised Statutes Annotated ...A.) Title 30 § 439–A, 7C where the floodway is not designated on the Flood ...ce Rate Map, the floodway is considered to be the channel of a river or other ...course and the adjacent land areas to a distance of one-half the width of ...dplain, as measured from the normal high water mark to the upland limit of ...dplain, unless a technical evaluation certified by a registered professional ...er is provided demonstrating the actual floodway based upon approved FEMA ...ng methods.

...ostal structures that are certified to provide protection from the 1-percent-...annual flood are shown on this panel. However, all structures taken into ...ation for the purpose of coastal flood hazard analysis and mapping are present ...FIRM database in S_Gen_Struct.



LEGEND

...D HAZARD AREAS (SFHAs) SUBJECT TO ...D BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual cha... ...greater flood), also known as the base flood, is the flood tha... a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area... the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard ... include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surf... elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevat... determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); averag... depths determined. For areas of alluvial fan flooding, velocities also deter...
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chanc... flood by a flood control system that was subsequently decertified. Zone ... AR indicates that the former flood control system is being restored to pro... protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal Flood ... protection system under construction; no Base Flood Elevations determin...
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Ele... determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevati... determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept ... encroachment so that the 1% annual chance flood can be carried without substantial increas... flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with ... average depths of less than 1 foot or with drainage areas less than 1 square ... mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and bound... dividing Special Flood Hazard Areas of different Base Flood El... flood depths, or flood velocities.
- Limit of Moderate Wave Action
- Limit of Moderate Wave Action coincident with Zone Bound...
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevati... feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Data... 1983 (NAD 83) Western Hemisphere
- 3180000 FT — 5000-foot ticks: Maine State Plane West Zone ... (FIPS Zone 1802), Transverse Mercator projection
- 4868000 mN — 1000-meter Universal Transverse Mercator grid values, zone 1...
- DX5510 — Bench mark (see explanation in Notes to Users section of this ... panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 16, 2015

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0168D

FIRM

FLOOD INSURANCE RATE MAP

LINCOLN COUNTY, MAINE (ALL JURISDICTIONS)

PANEL 168 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYO...

CONTAINS:

COMMUNITY	NUMBER	PANEL	SU...
NOBLEBORO, TOWN OF	230219	0168	
WALDOBORO, TOWN OF	230086	0168	

Notice to User: The **Map Number** shown ... should be used when placing map orde... **Community Number** shown above sho... used on insurance applications for the s... community.

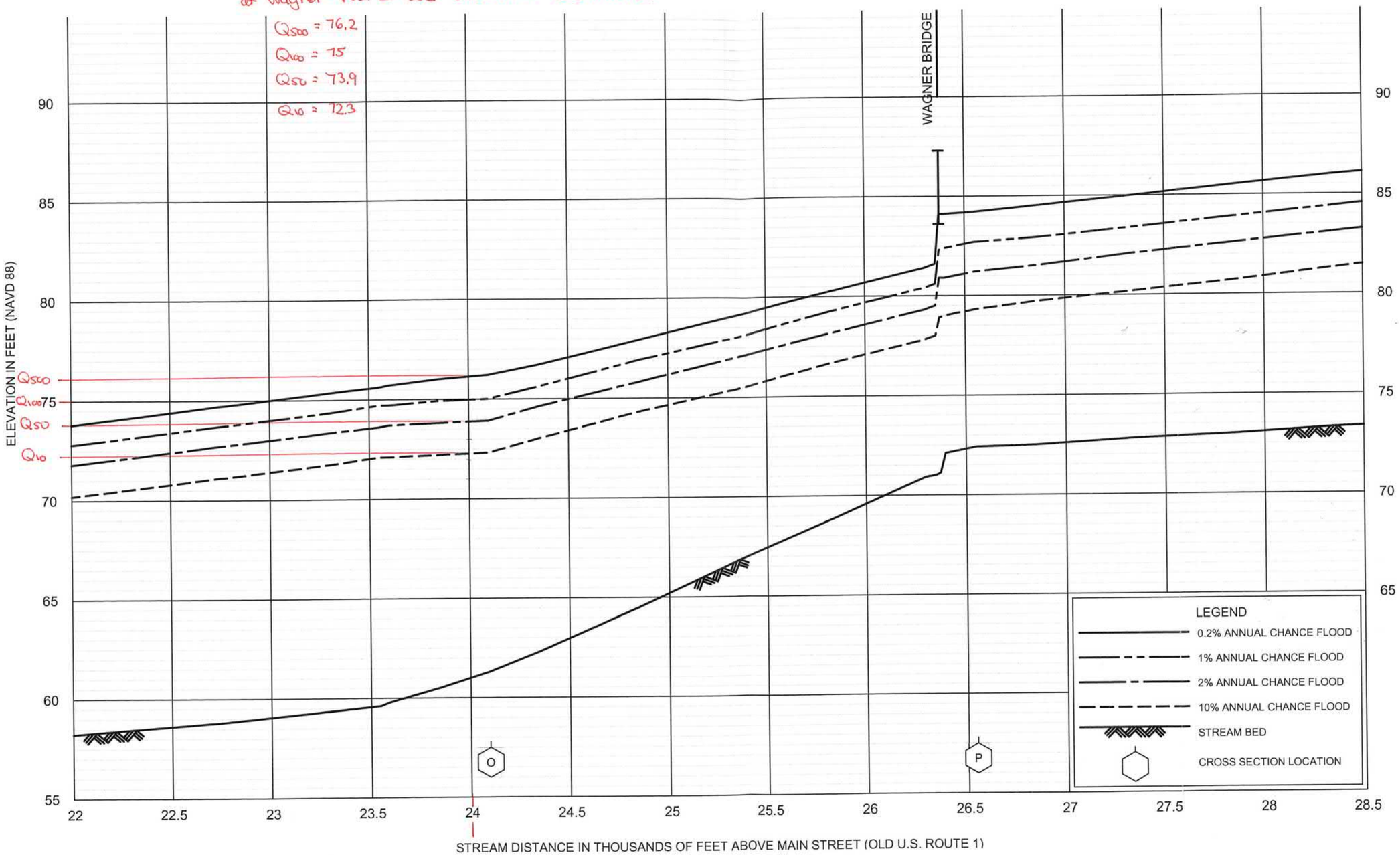
MAP NUME... 23015C01...

EFFECTIVE D... JULY 16, 2...

Federal Emergency Management Ag...

at Wagner No. 2 use backwater elevations:

Q_{500} = 76.2
Q_{100} = 75
Q_{50} = 73.9
Q_{10} = 72.3



approximate location of Wagner No. 2 Bridge

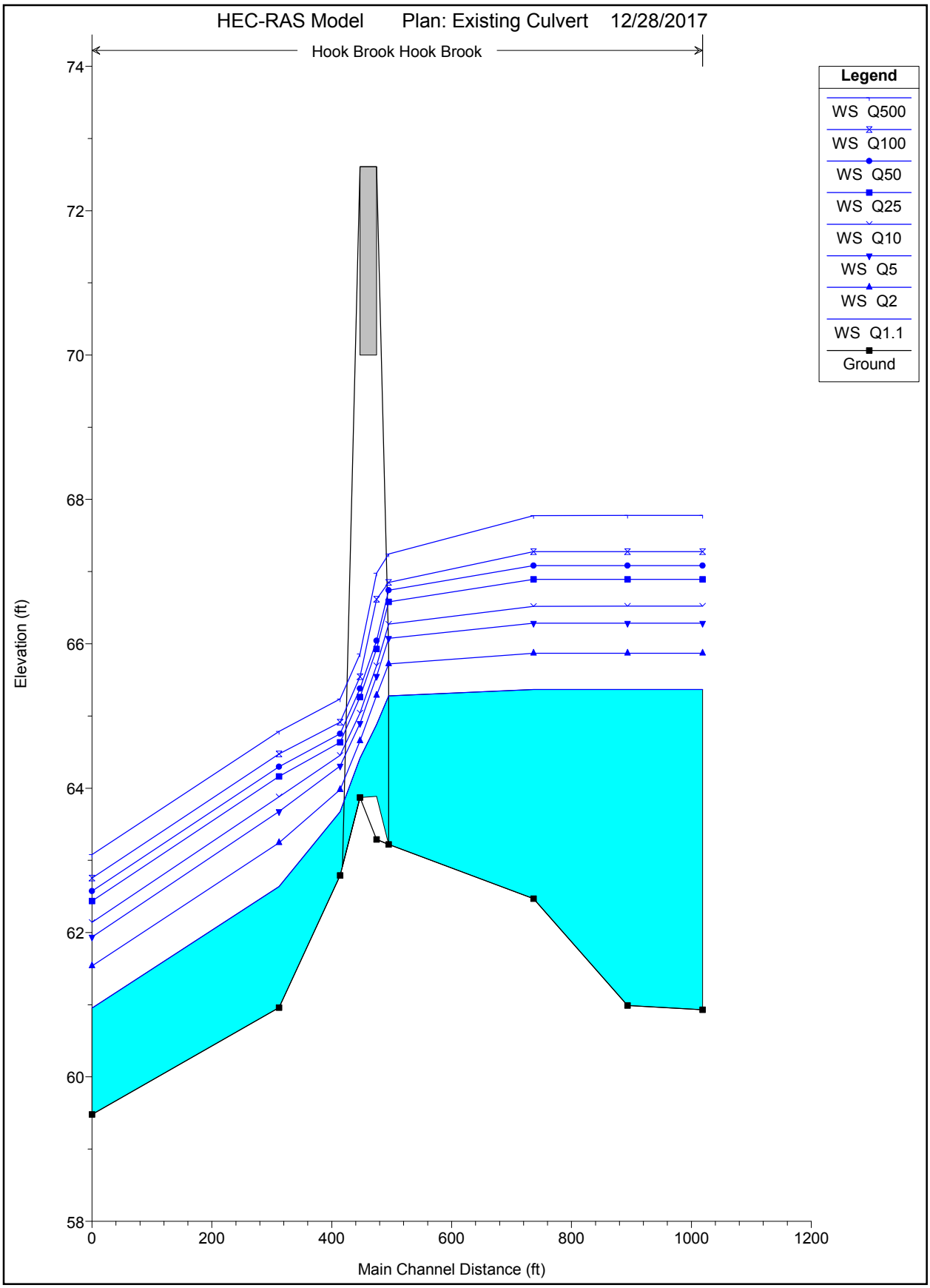
FLOOD PROFILES

MEDOMAK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, ME

(ALL JURISDICTIONS)


HEC-RAS Model Plan: Existing Culvert 12/28/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Elevation (ft)
74
72
70
68
66
64
62
60
58
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

HEC-RAS Plan: existing culvert River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hook Brook	1706	Q1.1	26.50	60.93	65.37		65.37	0.000002	0.14	417.93	313.44	0.01
Hook Brook	1706	Q2	51.50	60.93	65.87		65.87	0.000003	0.18	578.79	326.38	0.02
Hook Brook	1706	Q5	78.50	60.93	66.29		66.29	0.000004	0.22	717.07	337.11	0.02
Hook Brook	1706	Q10	95.70	60.93	66.52		66.52	0.000004	0.23	797.03	343.16	0.02
Hook Brook	1706	Q25	125.30	60.93	66.89		66.89	0.000004	0.26	926.30	352.72	0.02
Hook Brook	1706	Q50	141.60	60.93	67.08		67.08	0.000004	0.27	994.12	357.63	0.02
Hook Brook	1706	Q100	165.70	60.93	67.28		67.28	0.000005	0.29	1063.75	362.61	0.02
Hook Brook	1706	Q500	216.10	60.93	67.78		67.78	0.000005	0.32	1248.44	375.49	0.02
Hook Brook	1581	Q1.1	26.50	60.99	65.37	61.69	65.37	0.000002	0.14	382.22	244.02	0.01
Hook Brook	1581	Q2	51.50	60.99	65.87	61.90	65.87	0.000003	0.20	521.68	301.88	0.02
Hook Brook	1581	Q5	78.50	60.99	66.29	62.07	66.29	0.000004	0.24	648.95	308.93	0.02
Hook Brook	1581	Q10	95.70	60.99	66.52	62.17	66.52	0.000004	0.26	722.03	312.91	0.02
Hook Brook	1581	Q25	125.30	60.99	66.89	62.31	66.89	0.000004	0.29	839.43	319.20	0.02
Hook Brook	1581	Q50	141.60	60.99	67.08	62.38	67.08	0.000005	0.30	900.68	322.43	0.02
Hook Brook	1581	Q100	165.70	60.99	67.28	62.48	67.28	0.000005	0.32	963.31	325.70	0.02
Hook Brook	1581	Q500	216.10	60.99	67.78	62.65	67.78	0.000006	0.35	1128.40	334.17	0.02
Hook Brook	1424	Q1.1	26.50	62.47	65.37	63.11	65.37	0.000004	0.16	291.02	199.68	0.02
Hook Brook	1424	Q2	51.50	62.47	65.87	63.36	65.87	0.000006	0.23	394.64	210.68	0.02
Hook Brook	1424	Q5	78.50	62.47	66.29	63.48	66.29	0.000007	0.28	483.74	217.22	0.03
Hook Brook	1424	Q10	95.70	62.47	66.52	63.55	66.52	0.000008	0.30	535.26	221.41	0.03
Hook Brook	1424	Q25	125.30	62.47	66.89	63.66	66.89	0.000009	0.34	618.71	228.12	0.03
Hook Brook	1424	Q50	141.60	62.47	67.08	63.73	67.08	0.000010	0.36	662.57	231.57	0.03
Hook Brook	1424	Q100	165.70	62.47	67.28	63.80	67.28	0.000011	0.39	707.62	235.06	0.03
Hook Brook	1424	Q500	216.10	62.47	67.78	63.94	67.78	0.000011	0.43	826.96	244.11	0.03
Hook Brook	1174	Q1.1	26.50	63.22	65.28	64.59	65.36	0.001787	2.36	13.86	37.19	0.34
Hook Brook	1174	Q2	51.50	63.22	65.72	65.11	65.85	0.002314	3.19	20.21	73.82	0.40
Hook Brook	1174	Q5	78.50	63.22	66.08	65.40	66.26	0.002734	3.87	25.30	118.73	0.45
Hook Brook	1174	Q10	95.70	63.22	66.27	65.56	66.49	0.002930	4.23	28.13	138.47	0.47
Hook Brook	1174	Q25	125.30	63.22	66.58	65.80	66.86	0.003172	4.75	32.58	168.40	0.50
Hook Brook	1174	Q50	141.60	63.22	66.74	65.91	67.04	0.003273	5.01	34.86	189.87	0.51
Hook Brook	1174	Q100	165.70	63.22	66.85	66.08	67.23	0.003895	5.60	36.43	203.62	0.56
Hook Brook	1174	Q500	216.10	63.22	67.25	66.40	67.72	0.004175	6.28	42.11	221.80	0.59
Hook Brook	1146		Bridge									
Hook Brook	1098	Q1.1	26.50	62.79	63.67	63.67	63.94	0.023398	4.16	6.37	12.04	1.01
Hook Brook	1098	Q2	51.50	62.79	63.98	63.98	64.38	0.019957	5.06	10.18	14.02	0.99
Hook Brook	1098	Q5	78.50	62.79	64.31	64.24	64.77	0.014719	5.46	14.60	16.28	0.90
Hook Brook	1098	Q10	95.70	62.79	64.45	64.40	64.98	0.014391	5.85	16.67	17.26	0.91
Hook Brook	1098	Q25	125.30	62.79	64.63	64.63	65.32	0.015733	6.68	19.19	18.44	0.97
Hook Brook	1098	Q50	141.60	62.79	64.75	64.75	65.49	0.015424	6.97	20.84	19.21	0.98
Hook Brook	1098	Q100	165.70	62.79	64.91	64.91	65.74	0.015140	7.36	23.09	20.28	0.98
Hook Brook	1098	Q500	216.10	62.79	65.23	65.23	66.22	0.014417	8.05	27.60	22.39	0.99
Hook Brook	1000	Q1.1	26.50	60.96	62.64	62.03	62.72	0.004734	2.33	11.35	10.25	0.39
Hook Brook	1000	Q2	51.50	60.96	63.24	62.43	63.37	0.004652	2.86	18.12	12.06	0.40
Hook Brook	1000	Q5	78.50	60.96	63.68	62.76	63.85	0.004637	3.36	28.05	51.46	0.42
Hook Brook	1000	Q10	95.70	60.96	63.88	62.95	64.06	0.004448	3.50	40.04	64.35	0.41
Hook Brook	1000	Q25	125.30	60.96	64.16	63.22	64.33	0.004064	3.63	59.62	73.67	0.40
Hook Brook	1000	Q50	141.60	60.96	64.30	63.36	64.46	0.003910	3.69	69.75	78.06	0.40
Hook Brook	1000	Q100	165.70	60.96	64.47	63.91	64.64	0.003736	3.76	84.13	83.89	0.40
Hook Brook	1000	Q500	216.10	60.96	64.79	64.17	64.94	0.003495	3.90	111.27	94.02	0.39
Hook Brook	688	Q1.1	26.50	59.48	60.95	60.54	61.10	0.005701	3.09	8.57	8.14	0.53
Hook Brook	688	Q2	51.50	59.48	61.54	60.98	61.76	0.005703	3.75	13.72	9.49	0.55
Hook Brook	688	Q5	78.50	59.48	61.94	61.36	62.24	0.005708	4.42	19.24	18.18	0.57
Hook Brook	688	Q10	95.70	59.48	62.14	61.56	62.48	0.005704	4.74	23.43	22.66	0.58
Hook Brook	688	Q25	125.30	59.48	62.44	61.95	62.82	0.005704	5.18	30.98	29.05	0.60
Hook Brook	688	Q50	141.60	59.48	62.57	62.15	62.98	0.005709	5.38	35.19	32.05	0.60
Hook Brook	688	Q100	165.70	59.48	62.76	62.38	63.19	0.005701	5.64	41.44	36.07	0.61
Hook Brook	688	Q500	216.10	59.48	63.08	62.76	63.55	0.005701	6.08	54.27	43.15	0.62

HEC-RAS Plan: existing culvert River: Hook Brook Reach: Hook Brook

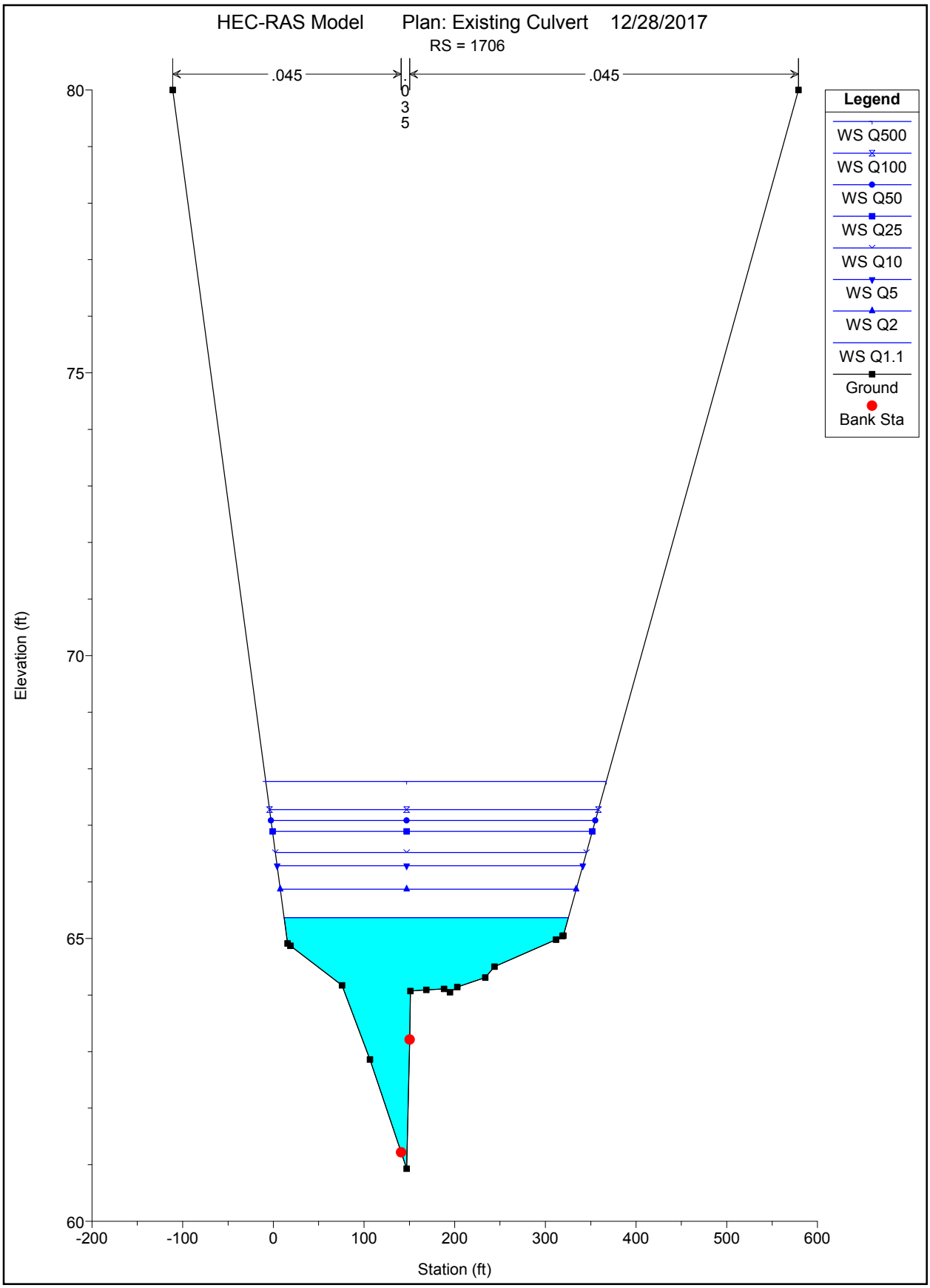
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Hook Brook	1706	Q1.1	65.37	65.37	0.00	0.00	0.00	14.55	5.20	6.75	313.44
Hook Brook	1706	Q2	65.87	65.87	0.00	0.00	0.00	26.82	7.76	16.92	326.38
Hook Brook	1706	Q5	66.29	66.29	0.00	0.00	0.00	39.52	10.05	28.94	337.11
Hook Brook	1706	Q10	66.52	66.52	0.00	0.00	0.00	47.41	11.34	36.95	343.16
Hook Brook	1706	Q25	66.89	66.89	0.00	0.00	0.00	60.74	13.36	51.19	352.72
Hook Brook	1706	Q50	67.08	67.08	0.00	0.00	0.00	67.98	14.40	59.22	357.63
Hook Brook	1706	Q100	67.28	67.28	0.00	0.00	0.00	78.84	16.12	70.74	362.61
Hook Brook	1706	Q500	67.78	67.78	0.00	0.00	0.00	100.75	19.02	96.33	375.49
Hook Brook	1581	Q1.1	65.37	65.37	0.00	0.00	0.00	8.70	5.99	11.80	244.02
Hook Brook	1581	Q2	65.87	65.87	0.00	0.00	0.00	17.61	9.58	24.31	301.88
Hook Brook	1581	Q5	66.29	66.29	0.00	0.00	0.00	27.60	12.44	38.46	308.93
Hook Brook	1581	Q10	66.52	66.52	0.00	0.00	0.00	34.00	14.05	47.65	312.91
Hook Brook	1581	Q25	66.89	66.89	0.00	0.00	0.00	45.06	16.55	63.68	319.20
Hook Brook	1581	Q50	67.08	67.08	0.00	0.00	0.00	51.16	17.83	72.61	322.43
Hook Brook	1581	Q100	67.28	67.28	0.00	0.00	0.00	60.10	19.96	85.64	325.70
Hook Brook	1581	Q500	67.78	67.78	0.00	0.00	0.00	78.96	23.52	113.62	334.17
Hook Brook	1424	Q1.1	65.37	65.37	0.00	0.00	0.01	9.45	4.56	12.49	199.68
Hook Brook	1424	Q2	65.87	65.87	0.00	0.01	0.01	18.18	7.43	25.89	210.68
Hook Brook	1424	Q5	66.29	66.29	0.00	0.01	0.02	27.57	10.19	40.75	217.22
Hook Brook	1424	Q10	66.52	66.52	0.00	0.01	0.02	33.46	11.84	50.40	221.41
Hook Brook	1424	Q25	66.89	66.89	0.00	0.01	0.03	43.60	14.55	67.15	228.12
Hook Brook	1424	Q50	67.08	67.08	0.00	0.01	0.03	49.20	15.97	76.42	231.57
Hook Brook	1424	Q100	67.28	67.28	0.00	0.01	0.04	57.53	18.20	89.97	235.06
Hook Brook	1424	Q500	67.78	67.78	0.00	0.01	0.05	76.04	22.18	117.89	244.11
Hook Brook	1174	Q1.1	65.36	65.28	0.08	0.08	0.07		22.57	3.93	37.19
Hook Brook	1174	Q2	65.85	65.72	0.13	0.09	0.08		39.24	12.26	73.82
Hook Brook	1174	Q5	66.26	66.08	0.19	0.10	0.10		56.17	22.33	118.73
Hook Brook	1174	Q10	66.49	66.27	0.22	0.11	0.11		66.60	29.10	138.47
Hook Brook	1174	Q25	66.86	66.58	0.27	0.11	0.12		84.07	41.23	168.40
Hook Brook	1174	Q50	67.04	66.74	0.30	0.12	0.13		93.52	48.08	189.87
Hook Brook	1174	Q100	67.23	66.85	0.38				108.34	57.36	203.62
Hook Brook	1174	Q500	67.72	67.25	0.47				137.00	79.10	221.80
Hook Brook	1146		Bridge								
Hook Brook	1098	Q1.1	63.94	63.67	0.27	0.92	0.09		26.50		12.04
Hook Brook	1098	Q2	64.38	63.98	0.40			0.00	51.50		14.02
Hook Brook	1098	Q5	64.77	64.31	0.46	0.78	0.14	0.38	78.12		16.28
Hook Brook	1098	Q10	64.98	64.45	0.53	0.75	0.18	0.93	94.77		17.26
Hook Brook	1098	Q25	65.32	64.63	0.68			1.94	123.36		18.44
Hook Brook	1098	Q50	65.49	64.75	0.74	0.71	0.29	2.68	138.92		19.21
Hook Brook	1098	Q100	65.74	64.91	0.83	0.68	0.33	3.84	161.86		20.28
Hook Brook	1098	Q500	66.22	65.23	0.98	0.64	0.41	6.53	209.57		22.39
Hook Brook	1000	Q1.1	62.72	62.64	0.08	1.62	0.01		26.50		10.25
Hook Brook	1000	Q2	63.37	63.24	0.13	1.60	0.01		51.44	0.06	12.06
Hook Brook	1000	Q5	63.85	63.68	0.17	1.60	0.01	0.27	76.89	1.34	51.46
Hook Brook	1000	Q10	64.06	63.88	0.18	1.57	0.02	0.89	88.30	6.51	64.35
Hook Brook	1000	Q25	64.33	64.16	0.17	1.49	0.02	2.90	103.20	19.20	73.67
Hook Brook	1000	Q50	64.46	64.30	0.17	1.46	0.02	4.42	110.41	26.78	78.06
Hook Brook	1000	Q100	64.64	64.47	0.16	1.42	0.03	7.09	120.33	38.28	83.89
Hook Brook	1000	Q500	64.94	64.79	0.16	1.37	0.03	15.15	138.71	62.24	94.02
Hook Brook	688	Q1.1	61.10	60.95	0.15				26.50		8.14
Hook Brook	688	Q2	61.76	61.54	0.22				51.50		9.49
Hook Brook	688	Q5	62.24	61.94	0.30			0.32	77.32	0.86	18.18
Hook Brook	688	Q10	62.48	62.14	0.34			0.97	92.13	2.60	22.66
Hook Brook	688	Q25	62.82	62.44	0.38			2.80	115.05	7.45	29.05
Hook Brook	688	Q50	62.98	62.57	0.40			4.10	126.59	10.92	32.05
Hook Brook	688	Q100	63.19	62.76	0.43			6.33	142.48	16.88	36.07
Hook Brook	688	Q500	63.55	63.08	0.47			11.89	172.52	31.69	43.15

HEC-RAS Plan: existing culvert River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Hook Brook	1146	Q1.1	65.36	70.00	77.79		26.50	72.62		1.41
Hook Brook	1146	Q2	65.85	70.00	77.79		51.50	72.62		1.47
Hook Brook	1146	Q5	66.26	70.00	77.79		78.50	72.62		1.49
Hook Brook	1146	Q10	66.49	70.00	77.79		95.70	72.62		1.51
Hook Brook	1146	Q25	66.86	70.00	77.79		125.30	72.62		1.54
Hook Brook	1146	Q50	67.04	70.00	77.79		141.60	72.62		1.55
Hook Brook	1146	Q100	67.23	70.00	77.79		165.70	72.62		1.49
Hook Brook	1146	Q500	67.72	70.00	77.79		216.10	72.62		1.50

HEC-RAS Plan: existing culvert River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Hook Brook	1424	Q1.1	65.37	65.37	63.11	0.00	0.01	199.68	9.45	4.56	12.49	0.16
Hook Brook	1424	Q2	65.87	65.87	63.36	0.01	0.01	210.68	18.18	7.43	25.89	0.23
Hook Brook	1424	Q5	66.29	66.29	63.48	0.01	0.02	217.22	27.57	10.19	40.75	0.28
Hook Brook	1424	Q10	66.52	66.52	63.55	0.01	0.02	221.41	33.46	11.84	50.40	0.30
Hook Brook	1424	Q25	66.89	66.89	63.66	0.01	0.03	228.12	43.60	14.55	67.15	0.34
Hook Brook	1424	Q50	67.08	67.08	63.73	0.01	0.03	231.57	49.20	15.97	76.42	0.36
Hook Brook	1424	Q100	67.28	67.28	63.80	0.01	0.04	235.06	57.53	18.20	89.97	0.39
Hook Brook	1424	Q500	67.78	67.78	63.94	0.01	0.05	244.11	76.04	22.18	117.89	0.43
Hook Brook	1174	Q1.1	65.36	65.28	64.59	0.08	0.07	37.19		22.57	3.93	2.36
Hook Brook	1174	Q2	65.85	65.72	65.11	0.09	0.08	73.82		39.24	12.26	3.19
Hook Brook	1174	Q5	66.26	66.08	65.40	0.10	0.10	118.73		56.17	22.33	3.87
Hook Brook	1174	Q10	66.49	66.27	65.56	0.11	0.11	138.47		66.60	29.10	4.23
Hook Brook	1174	Q25	66.86	66.58	65.80	0.11	0.12	168.40		84.07	41.23	4.75
Hook Brook	1174	Q50	67.04	66.74	65.91	0.12	0.13	189.87		93.52	48.08	5.01
Hook Brook	1174	Q100	67.23	66.85	66.08			203.62		108.34	57.36	5.60
Hook Brook	1174	Q500	67.72	67.25	66.40			221.80		137.00	79.10	6.28
Hook Brook	1146 BR U	Q1.1	65.20	64.88	64.88	0.46	0.05	10.93		23.97	2.53	4.74
Hook Brook	1146 BR U	Q2	65.68	65.28	65.28	0.43	0.01	14.24		41.00	10.50	5.53
Hook Brook	1146 BR U	Q5	66.06	65.55	65.55	0.42	0.00	14.24		57.50	21.00	6.40
Hook Brook	1146 BR U	Q10	66.28	65.70	65.70	0.42	0.01	14.24		67.65	28.05	6.87
Hook Brook	1146 BR U	Q25	66.62	65.93	65.93	0.41	0.00	14.24		84.64	40.66	7.56
Hook Brook	1146 BR U	Q50	66.79	66.04	66.04	0.41	0.01	14.24		93.83	47.77	7.90
Hook Brook	1146 BR U	Q100	67.15	66.62	66.21			14.24		102.41	63.29	6.72
Hook Brook	1146 BR U	Q500	67.64	66.98	66.54			14.24		129.58	86.52	7.46
Hook Brook	1146 BR D	Q1.1	64.63	64.41	64.38	0.67	0.02	14.30	0.84	25.66		3.75
Hook Brook	1146 BR D	Q2	65.03	64.65	64.65	0.65	0.01	14.30	2.27	49.23		4.99
Hook Brook	1146 BR D	Q5	65.40	64.90	64.90	0.53	0.02	14.30	4.00	74.50		5.76
Hook Brook	1146 BR D	Q10	65.61	65.04	65.04	0.51	0.02	14.30	5.16	90.54		6.13
Hook Brook	1146 BR D	Q25	65.94	65.26	65.26	0.53	0.00	14.30	7.17	118.13		6.73
Hook Brook	1146 BR D	Q50	66.12	65.38	65.38	0.51	0.00	14.30	8.29	133.31		7.00
Hook Brook	1146 BR D	Q100	66.36	65.55	65.55			14.30	9.98	155.72		7.37
Hook Brook	1146 BR D	Q500	66.84	65.86	65.86			14.30	13.52	202.58		8.07
Hook Brook	1098	Q1.1	63.94	63.67	63.67	0.92	0.09	12.04		26.50		4.16
Hook Brook	1098	Q2	64.38	63.98	63.98			14.02	0.00	51.50		5.06
Hook Brook	1098	Q5	64.77	64.31	64.24	0.78	0.14	16.28	0.38	78.12		5.46
Hook Brook	1098	Q10	64.98	64.45	64.40	0.75	0.18	17.26	0.93	94.77		5.85
Hook Brook	1098	Q25	65.32	64.63	64.63			18.44	1.94	123.36		6.68
Hook Brook	1098	Q50	65.49	64.75	64.75	0.71	0.29	19.21	2.68	138.92		6.97
Hook Brook	1098	Q100	65.74	64.91	64.91	0.68	0.33	20.28	3.84	161.86		7.36
Hook Brook	1098	Q500	66.22	65.23	65.23	0.64	0.41	22.39	6.53	209.57		8.05
Hook Brook	1000	Q1.1	62.72	62.64	62.03	1.62	0.01	10.25		26.50		2.33
Hook Brook	1000	Q2	63.37	63.24	62.43	1.60	0.01	12.06		51.44	0.06	2.86
Hook Brook	1000	Q5	63.85	63.68	62.76	1.60	0.01	51.46	0.27	76.89	1.34	3.36
Hook Brook	1000	Q10	64.06	63.88	62.95	1.57	0.02	64.35	0.89	88.30	6.51	3.50
Hook Brook	1000	Q25	64.33	64.16	63.22	1.49	0.02	73.67	2.90	103.20	19.20	3.63
Hook Brook	1000	Q50	64.46	64.30	63.36	1.46	0.02	78.06	4.42	110.41	26.78	3.69
Hook Brook	1000	Q100	64.64	64.47	63.91	1.42	0.03	83.89	7.09	120.33	38.28	3.76
Hook Brook	1000	Q500	64.94	64.79	64.17	1.37	0.03	94.02	15.15	138.71	62.24	3.90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.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Bank Sta
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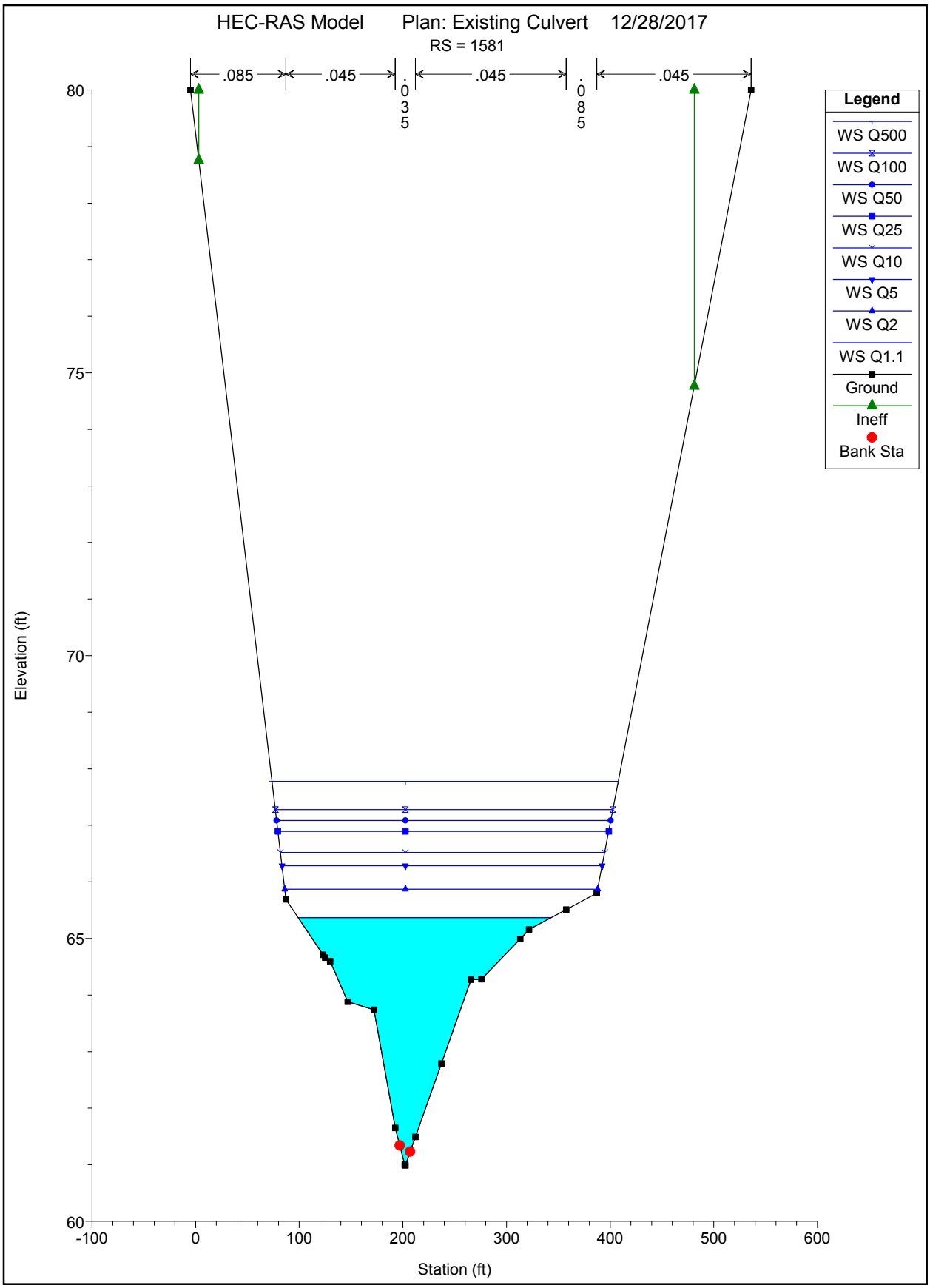
75
70
65
60
-200
-100
0
100
200
300
400
500
600
Station (ft)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.045
.035
.045
.085
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
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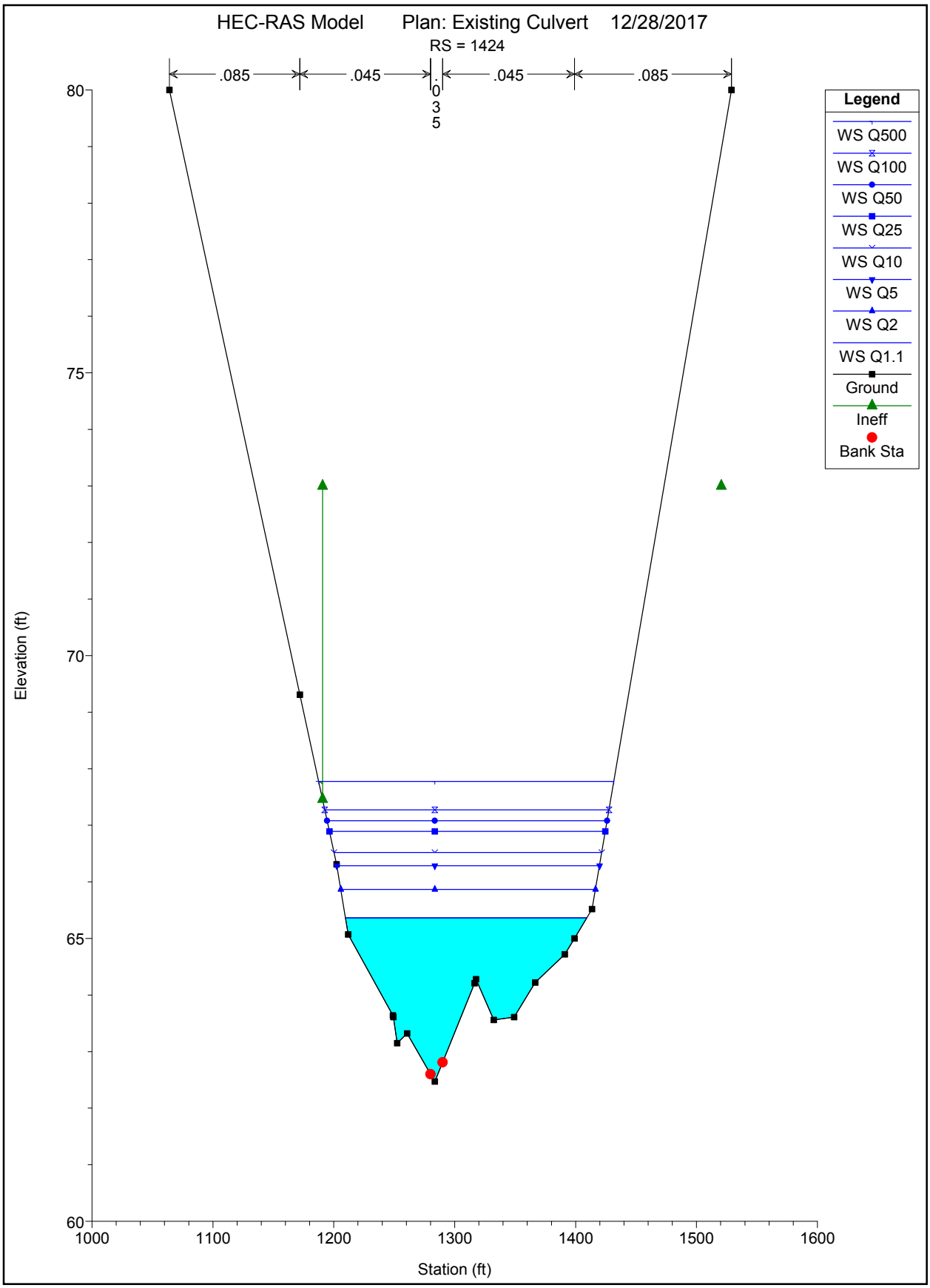
75
70
65
60
-100
0
100
200
300
400
500
600
Station (ft)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.035
.045
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
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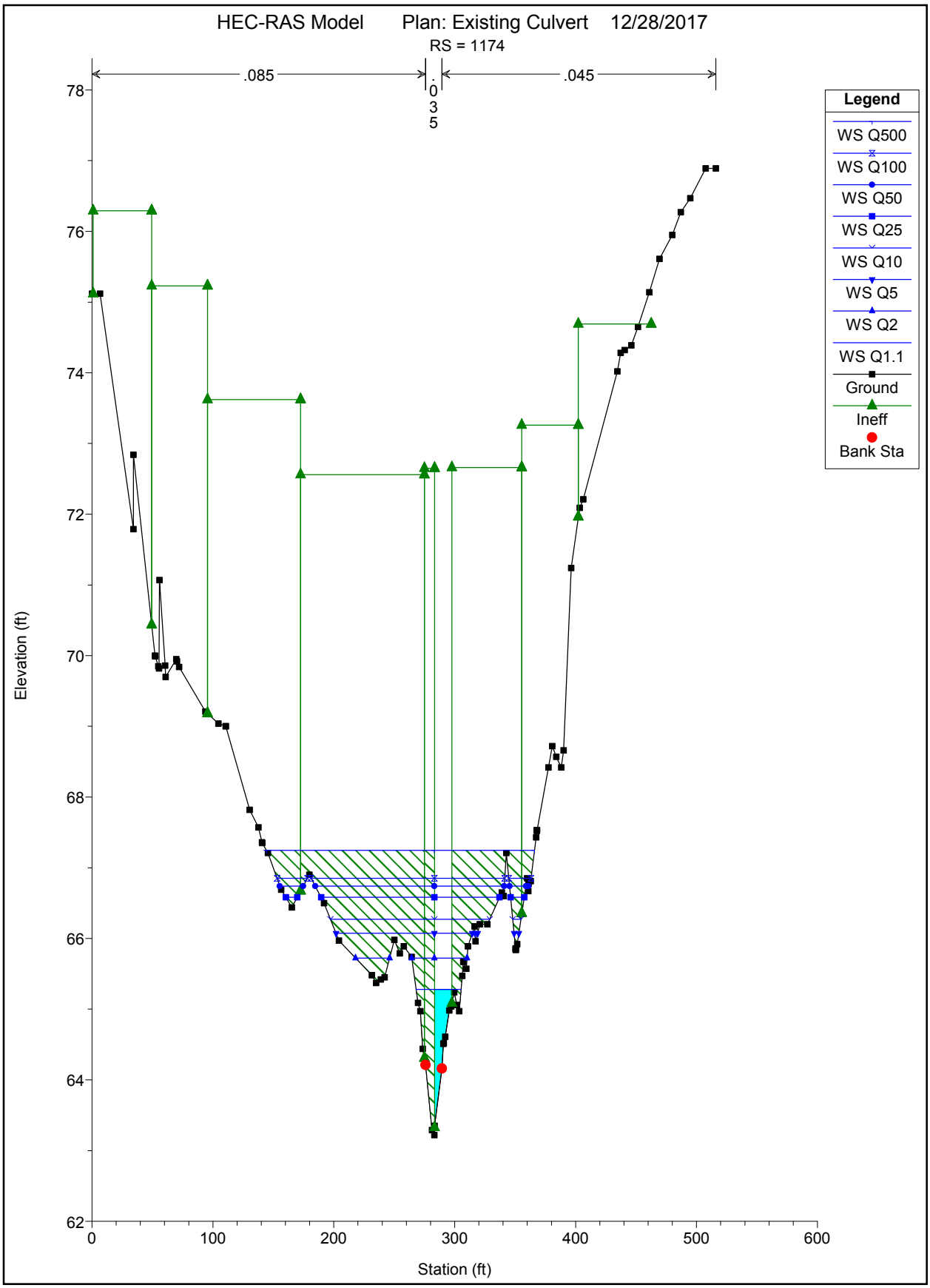
70
65
60
1000
1100
1200
1300
1400
1500
1600
Station (ft)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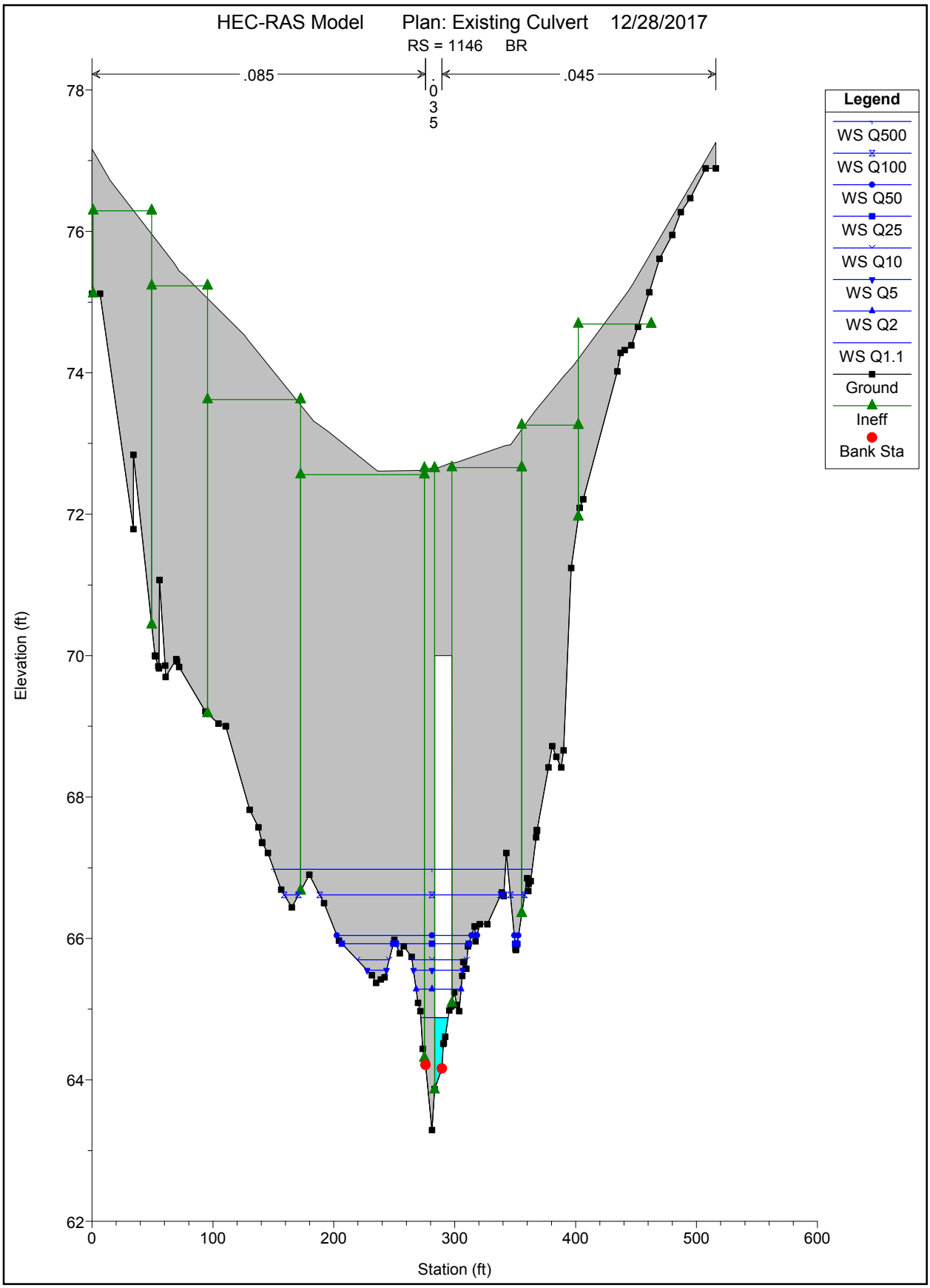
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600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12/28/2017
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Legend
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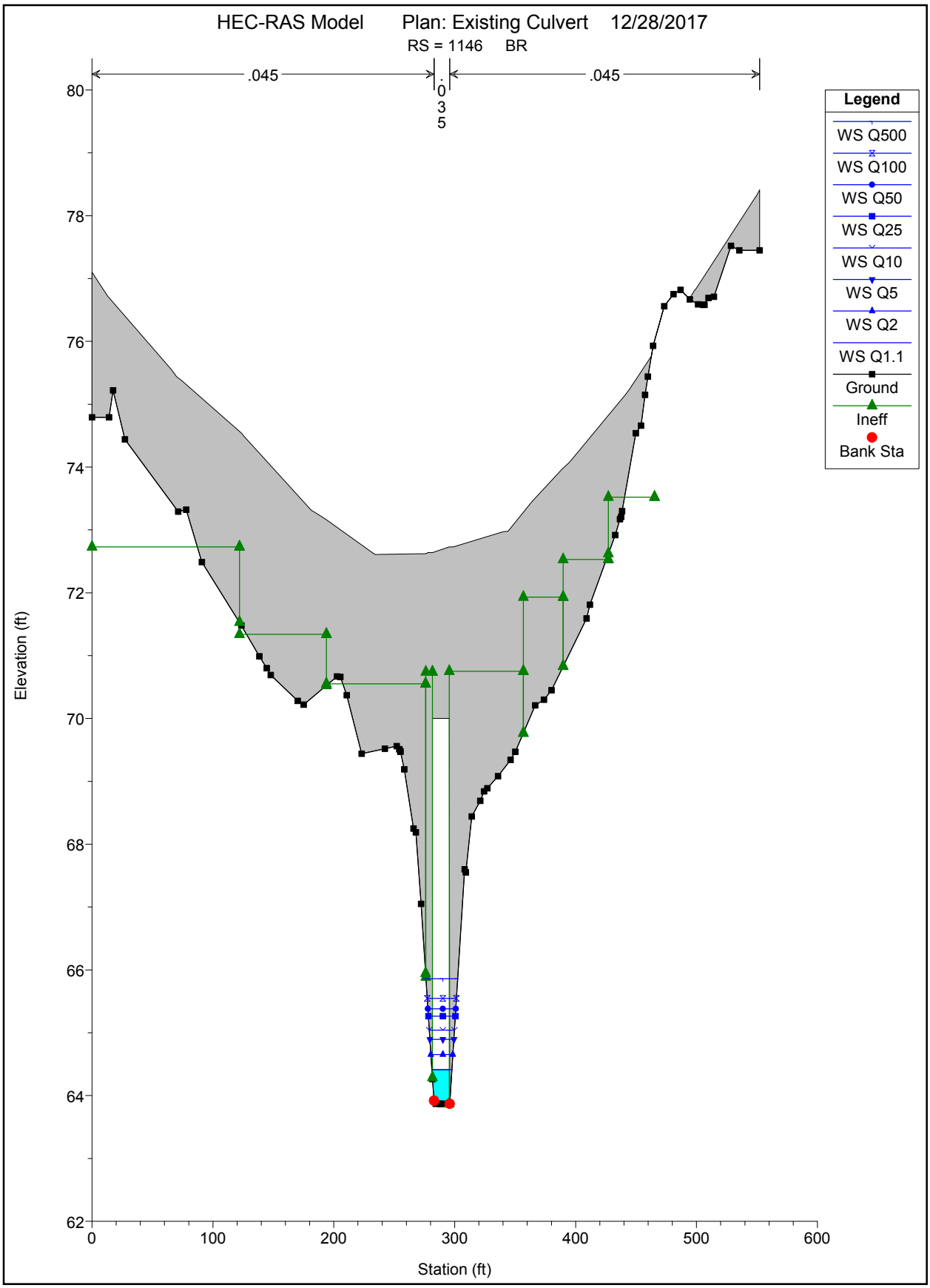
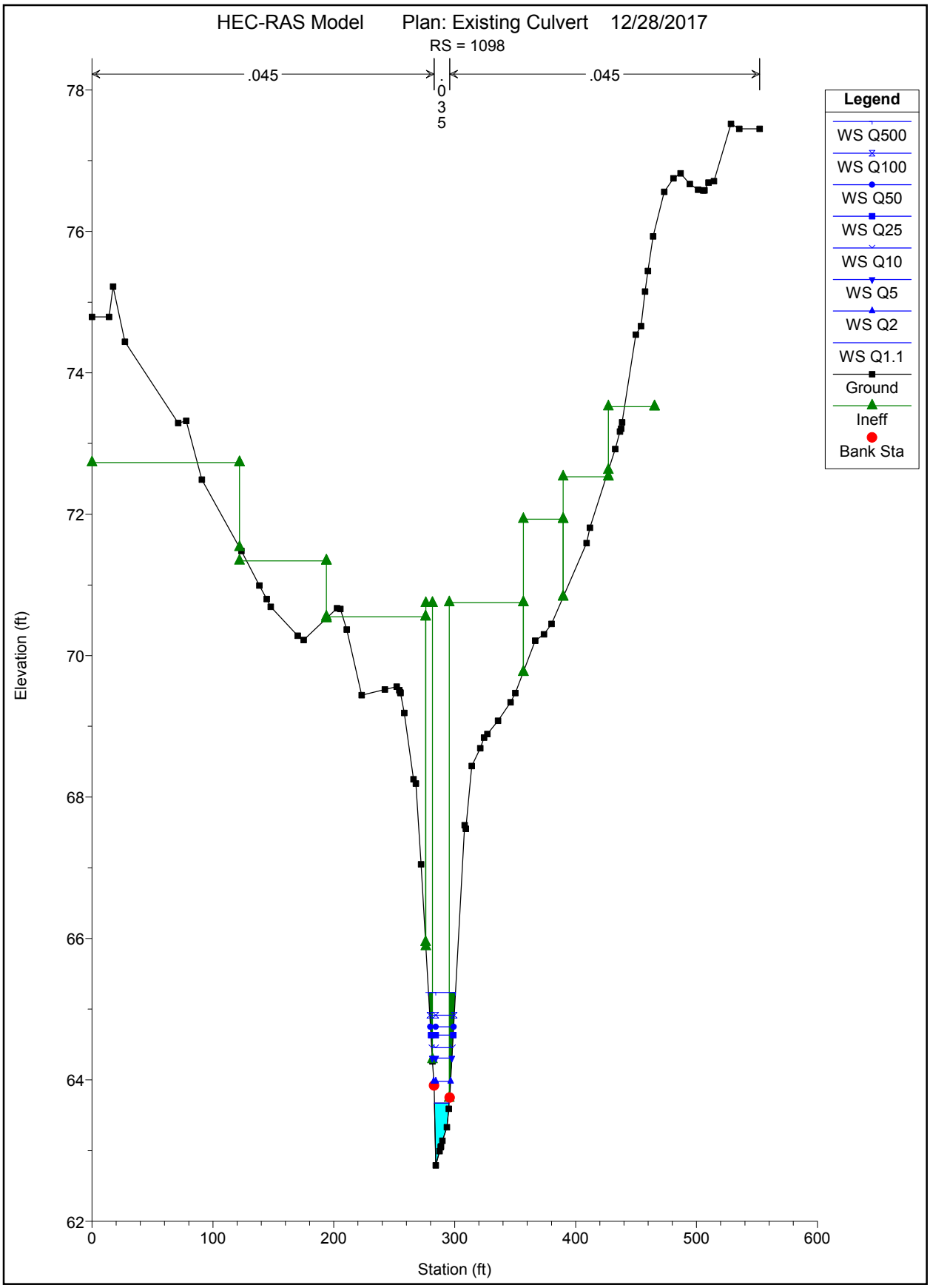
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Existing Culvert 12/28/2017
RS = 1146 BR
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600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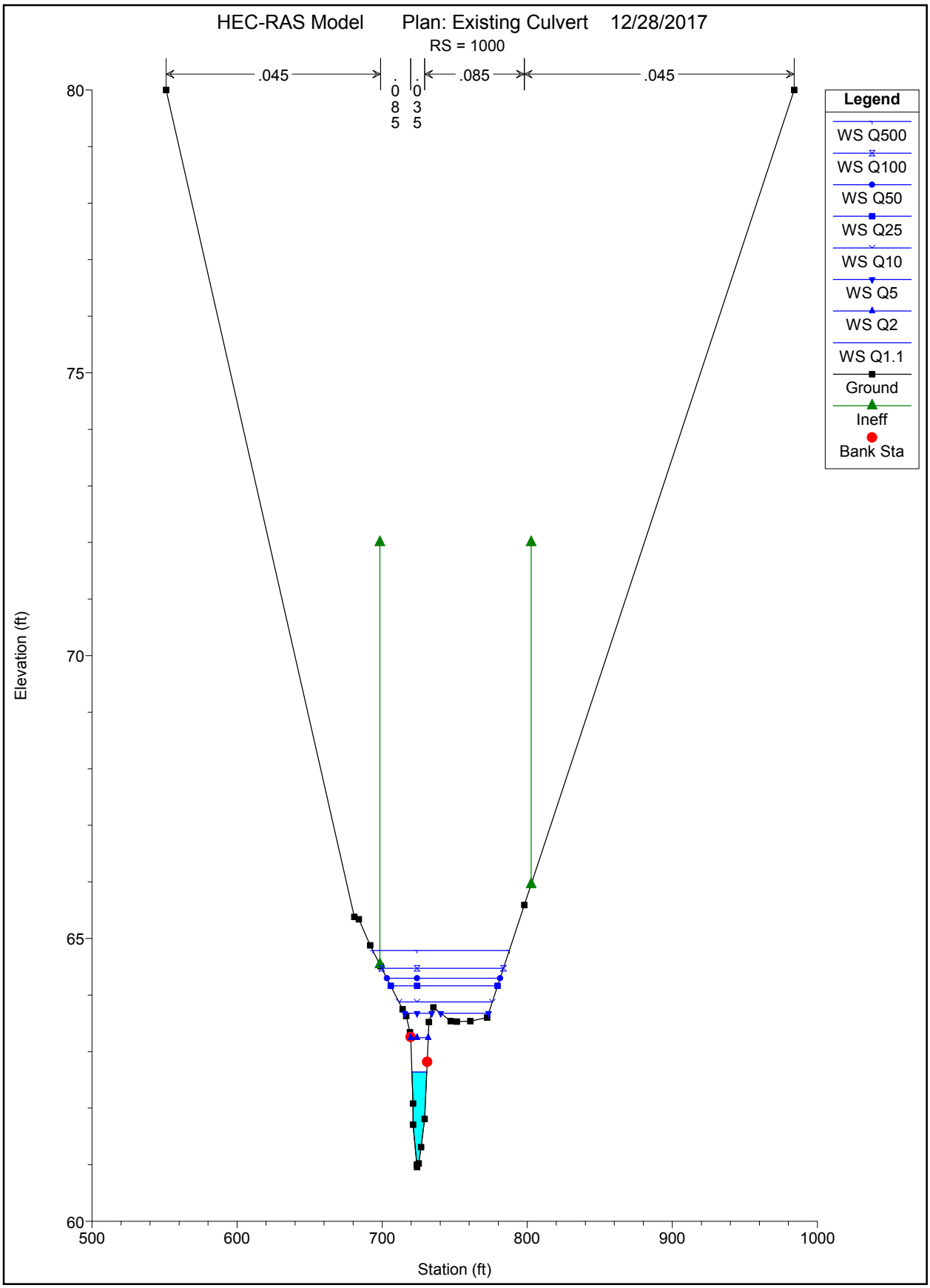
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600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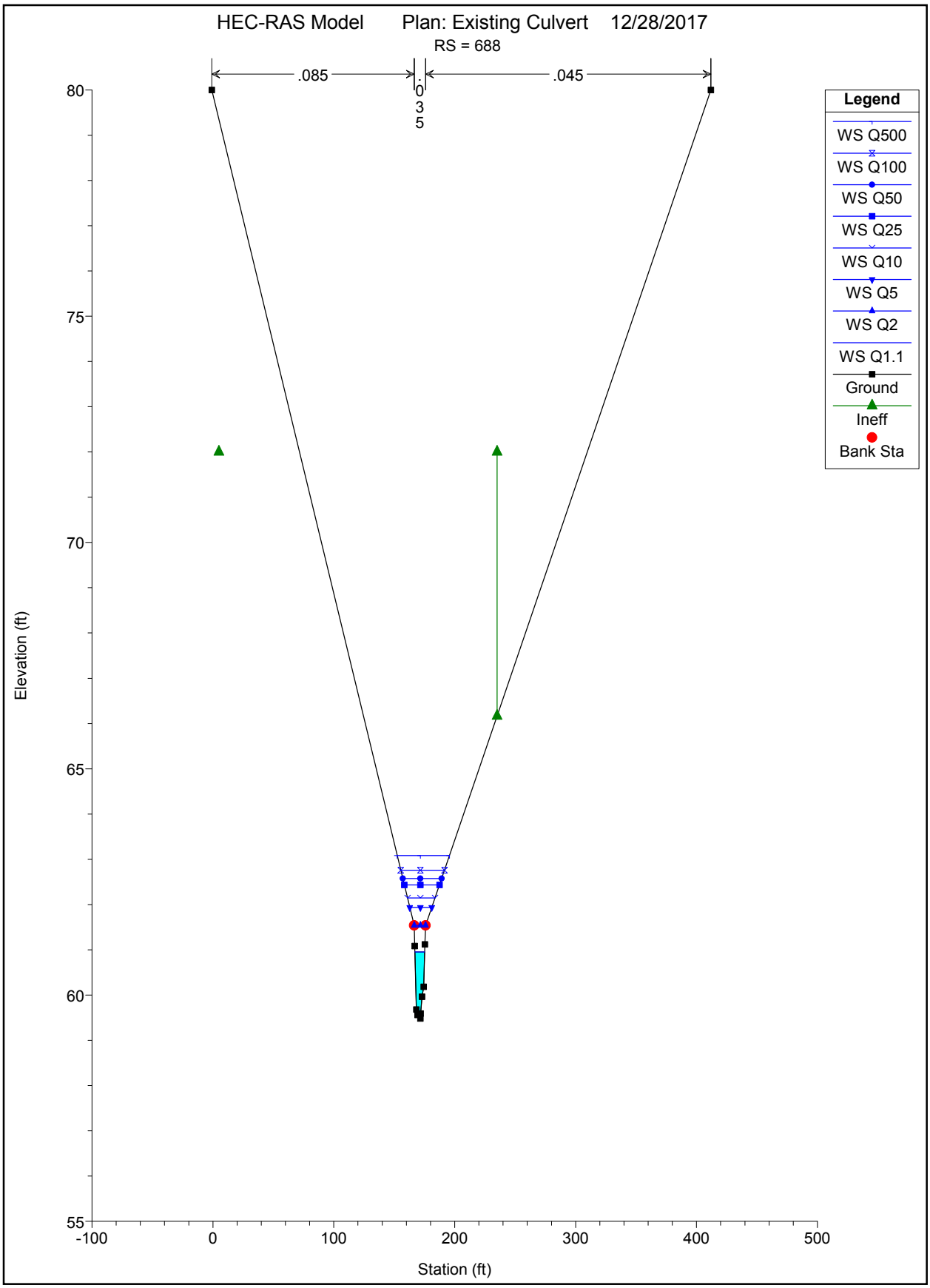
.045
.085
.045
.085
.035
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
500
600
700
800
900
1000
Station (ft)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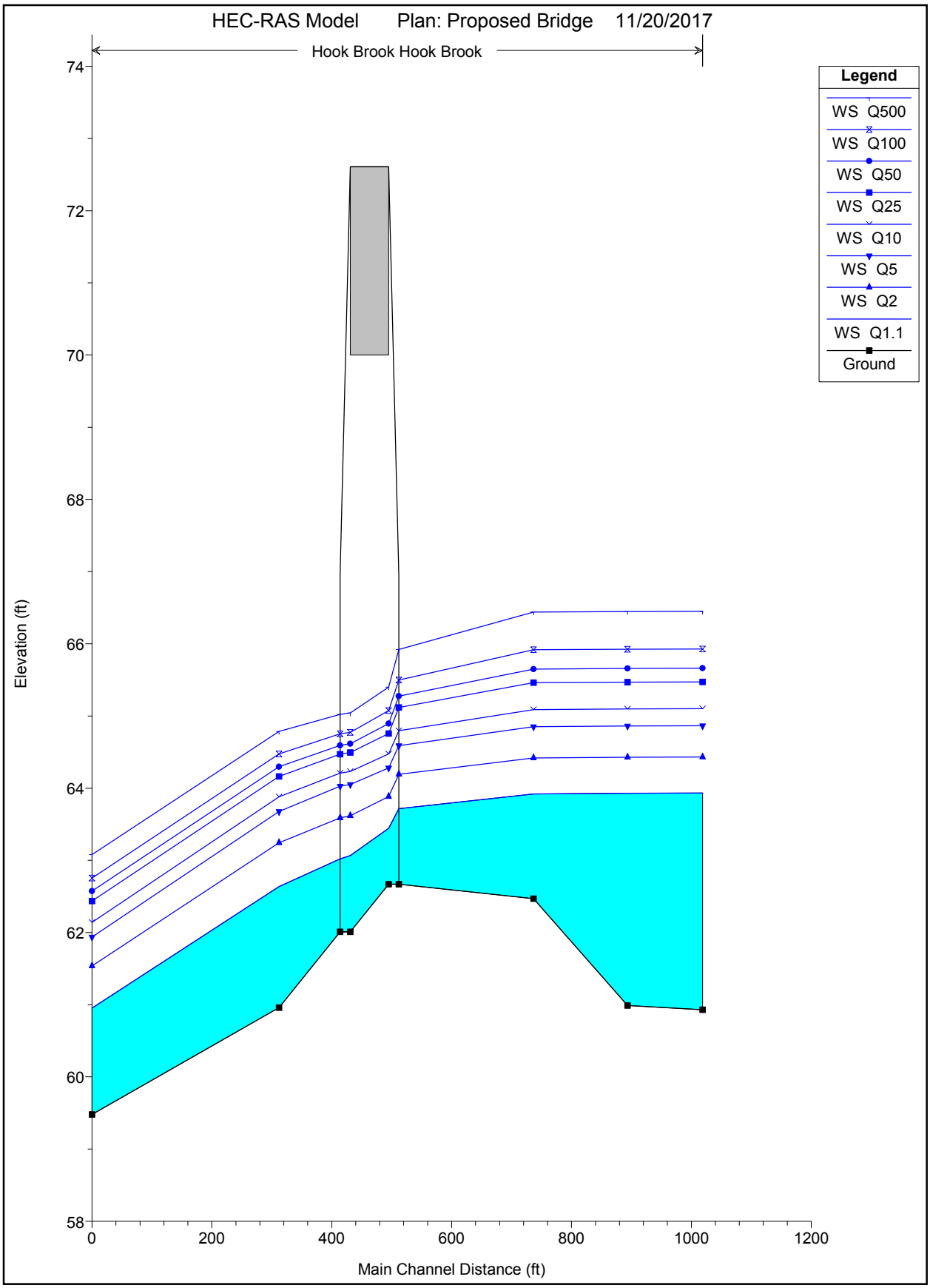
RS = 688
.085
.045
0.035
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
75
70
65
60
55
-100
0
100
200
300
400
500


HEC-RAS Model Plan: Proposed Bridge 11/20/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Elevation (ft)
74
72
70
68
66
64
62
60
58
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

HEC-RAS Plan: Proposed Bridge River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hook Brook	1706	Q1.1	26.50	60.93	63.93		63.93	0.000029	0.40	102.46	69.62	0.05
Hook Brook	1706	Q2	51.50	60.93	64.43		64.44	0.000051	0.60	166.92	185.94	0.06
Hook Brook	1706	Q5	78.50	60.93	64.87		64.87	0.000053	0.67	265.97	276.61	0.06
Hook Brook	1706	Q10	95.70	60.93	65.10		65.10	0.000045	0.65	335.79	306.62	0.06
Hook Brook	1706	Q25	125.30	60.93	65.47		65.48	0.000034	0.60	451.36	316.17	0.05
Hook Brook	1706	Q50	141.60	60.93	65.66		65.66	0.000031	0.59	511.54	321.04	0.05
Hook Brook	1706	Q100	165.70	60.93	65.93		65.93	0.000027	0.57	598.11	327.90	0.05
Hook Brook	1706	Q500	216.10	60.93	66.45		66.45	0.000022	0.55	771.85	341.26	0.04
Hook Brook	1581	Q1.1	26.50	60.99	63.93	61.69	63.93	0.000014	0.32	137.46	113.62	0.03
Hook Brook	1581	Q2	51.50	60.99	64.43	61.90	64.43	0.000024	0.46	201.45	149.75	0.04
Hook Brook	1581	Q5	78.50	60.99	64.86	62.07	64.86	0.000029	0.55	274.39	189.06	0.05
Hook Brook	1581	Q10	95.70	60.99	65.10	62.17	65.10	0.000030	0.58	321.49	209.86	0.05
Hook Brook	1581	Q25	125.30	60.99	65.47	62.31	65.47	0.000032	0.64	407.81	258.18	0.05
Hook Brook	1581	Q50	141.60	60.99	65.66	62.38	65.66	0.000030	0.64	459.11	284.35	0.05
Hook Brook	1581	Q100	165.70	60.99	65.93	62.48	65.93	0.000027	0.63	538.50	302.82	0.05
Hook Brook	1581	Q500	216.10	60.99	66.44	62.65	66.45	0.000022	0.61	698.23	311.62	0.05
Hook Brook	1424	Q1.1	26.50	62.47	63.92	63.11	63.92	0.000230	0.77	60.13	102.21	0.12
Hook Brook	1424	Q2	51.50	62.47	64.42	63.36	64.42	0.000158	0.79	122.78	147.41	0.10
Hook Brook	1424	Q5	78.50	62.47	64.85	63.48	64.86	0.000112	0.77	193.47	177.16	0.09
Hook Brook	1424	Q10	95.70	62.47	65.09	63.55	65.09	0.000095	0.76	236.93	189.69	0.08
Hook Brook	1424	Q25	125.30	62.47	65.46	63.66	65.46	0.000072	0.73	309.98	203.06	0.08
Hook Brook	1424	Q50	141.60	62.47	65.65	63.73	65.65	0.000065	0.72	348.96	207.25	0.07
Hook Brook	1424	Q100	165.70	62.47	65.92	63.80	65.92	0.000057	0.71	405.05	211.45	0.07
Hook Brook	1424	Q500	216.10	62.47	66.44	63.94	66.44	0.000046	0.71	517.32	219.94	0.06
Hook Brook	1192	Q1.1	26.50	62.67	63.72	63.24	63.79	0.002739	2.28	12.62	30.70	0.39
Hook Brook	1192	Q2	51.50	62.67	64.19	63.55	64.32	0.002794	2.96	19.04	44.55	0.42
Hook Brook	1192	Q5	78.50	62.67	64.59	63.84	64.77	0.002897	3.52	24.41	65.38	0.45
Hook Brook	1192	Q10	95.70	62.67	64.80	63.99	65.01	0.003017	3.85	27.22	80.44	0.47
Hook Brook	1192	Q25	125.30	62.67	65.12	64.23	65.39	0.003187	4.35	31.55	97.32	0.49
Hook Brook	1192	Q50	141.60	62.67	65.28	64.35	65.58	0.003283	4.60	33.68	103.64	0.50
Hook Brook	1192	Q100	165.70	62.67	65.50	64.52	65.85	0.003394	4.94	36.68	119.36	0.52
Hook Brook	1192	Q500	216.10	62.67	65.92	64.85	66.36	0.003576	5.57	42.42	143.82	0.54
Hook Brook	1146		Bridge									
Hook Brook	1098	Q1.1	26.50	62.01	63.02	62.58	63.10	0.002919	2.29	12.32	13.68	0.40
Hook Brook	1098	Q2	51.50	62.01	63.59	62.88	63.70	0.002288	2.74	20.44	15.23	0.39
Hook Brook	1098	Q5	78.50	62.01	64.03	63.15	64.18	0.002243	3.20	26.76	17.51	0.40
Hook Brook	1098	Q10	95.70	62.01	64.21	63.33	64.39	0.002467	3.56	29.37	18.36	0.42
Hook Brook	1098	Q25	125.30	62.01	64.47	63.55	64.71	0.002857	4.13	33.15	19.58	0.46
Hook Brook	1098	Q50	141.60	62.01	64.59	63.67	64.87	0.003080	4.43	34.92	20.15	0.49
Hook Brook	1098	Q100	165.70	62.01	64.75	63.84	65.09	0.003430	4.86	37.21	20.89	0.52
Hook Brook	1098	Q500	216.10	62.01	65.02	64.15	65.49	0.004222	5.74	41.08	22.15	0.58
Hook Brook	1000	Q1.1	26.50	60.96	62.64	62.03	62.72	0.004734	2.33	11.35	10.25	0.39
Hook Brook	1000	Q2	51.50	60.96	63.24	62.43	63.37	0.004652	2.86	18.12	12.06	0.40
Hook Brook	1000	Q5	78.50	60.96	63.68	62.76	63.85	0.004637	3.36	28.05	51.46	0.42
Hook Brook	1000	Q10	95.70	60.96	63.88	62.95	64.06	0.004448	3.50	40.04	64.35	0.41
Hook Brook	1000	Q25	125.30	60.96	64.16	63.22	64.33	0.004064	3.63	59.62	73.67	0.40
Hook Brook	1000	Q50	141.60	60.96	64.30	63.36	64.46	0.003910	3.69	69.75	78.06	0.40
Hook Brook	1000	Q100	165.70	60.96	64.47	63.91	64.64	0.003736	3.76	84.13	83.89	0.40
Hook Brook	1000	Q500	216.10	60.96	64.79	64.17	64.94	0.003495	3.90	111.27	94.02	0.39
Hook Brook	688	Q1.1	26.50	59.48	60.95	60.54	61.10	0.005701	3.09	8.57	8.14	0.53
Hook Brook	688	Q2	51.50	59.48	61.54	60.98	61.76	0.005703	3.75	13.72	9.49	0.55
Hook Brook	688	Q5	78.50	59.48	61.94	61.36	62.24	0.005708	4.42	19.24	18.18	0.57
Hook Brook	688	Q10	95.70	59.48	62.14	61.56	62.48	0.005704	4.74	23.43	22.66	0.58
Hook Brook	688	Q25	125.30	59.48	62.44	61.95	62.82	0.005704	5.18	30.98	29.05	0.60
Hook Brook	688	Q50	141.60	59.48	62.57	62.15	62.98	0.005709	5.38	35.19	32.05	0.60
Hook Brook	688	Q100	165.70	59.48	62.76	62.38	63.19	0.005701	5.64	41.44	36.07	0.61
Hook Brook	688	Q500	216.10	59.48	63.08	62.76	63.55	0.005701	6.08	54.27	43.15	0.62

HEC-RAS Plan: Proposed Bridge River: Hook Brook Reach: Hook Brook

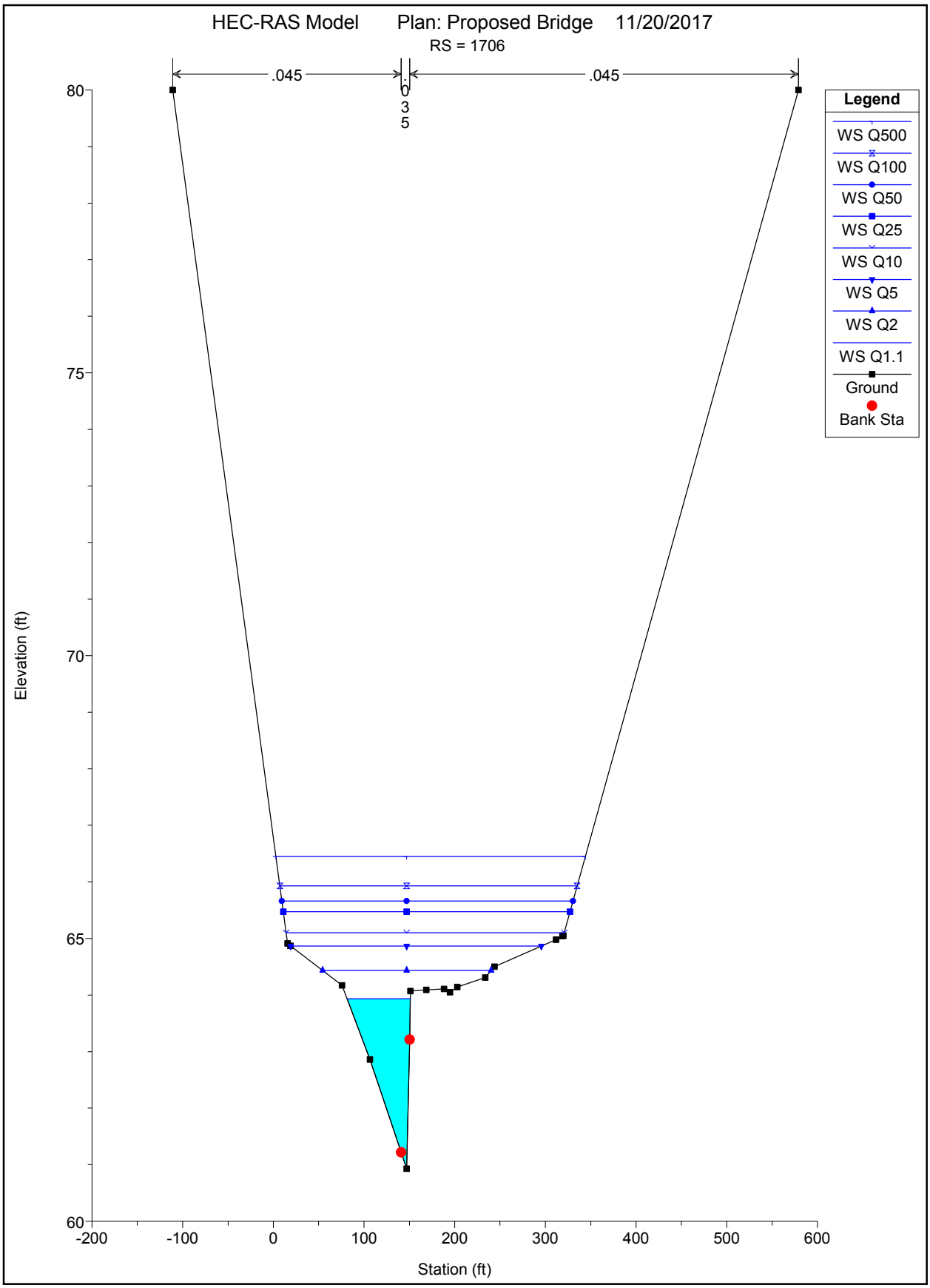
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Hook Brook	1706	Q1.1	63.93	63.93	0.00	0.00	0.00	16.92	9.57	0.01	69.62
Hook Brook	1706	Q2	64.44	64.43	0.00	0.00	0.00	31.94	17.06	2.51	185.94
Hook Brook	1706	Q5	64.87	64.87	0.00	0.00	0.00	45.26	21.75	11.49	276.61
Hook Brook	1706	Q10	65.10	65.10	0.00	0.00	0.00	54.27	22.49	18.94	306.62
Hook Brook	1706	Q25	65.48	65.47	0.00	0.00	0.00	67.94	23.08	34.28	316.17
Hook Brook	1706	Q50	65.66	65.66	0.00	0.00	0.00	75.24	23.56	42.81	321.04
Hook Brook	1706	Q100	65.93	65.93	0.00	0.00	0.00	85.84	24.35	55.52	327.90
Hook Brook	1706	Q500	66.45	66.45	0.00	0.00	0.00	107.58	26.20	82.32	341.26
Hook Brook	1581	Q1.1	63.93	63.93	0.00	0.01	0.00	5.57	8.89	12.04	113.62
Hook Brook	1581	Q2	64.43	64.43	0.00	0.01	0.00	13.92	15.23	22.35	149.75
Hook Brook	1581	Q5	64.86	64.86	0.00	0.01	0.00	23.36	20.47	34.67	189.06
Hook Brook	1581	Q10	65.10	65.10	0.00	0.01	0.00	29.72	23.17	42.81	209.86
Hook Brook	1581	Q25	65.47	65.47	0.00	0.01	0.00	41.88	27.57	55.85	258.18
Hook Brook	1581	Q50	65.66	65.66	0.00	0.01	0.00	47.56	28.92	65.12	284.35
Hook Brook	1581	Q100	65.93	65.93	0.00	0.01	0.00	56.92	30.11	78.68	302.82
Hook Brook	1581	Q500	66.45	66.44	0.00	0.00	0.00	76.54	32.49	107.07	311.62
Hook Brook	1424	Q1.1	63.92	63.92	0.00	0.12	0.01	10.71	10.20	5.59	102.21
Hook Brook	1424	Q2	64.42	64.42	0.00	0.09	0.01	19.98	14.44	17.08	147.41
Hook Brook	1424	Q5	64.86	64.85	0.00	0.07	0.02	28.91	17.35	32.23	177.16
Hook Brook	1424	Q10	65.09	65.09	0.00	0.06	0.02	34.36	18.82	42.52	189.69
Hook Brook	1424	Q25	65.46	65.46	0.00	0.05	0.03	44.60	20.74	59.96	203.06
Hook Brook	1424	Q50	65.65	65.65	0.00	0.04	0.03	50.20	21.87	69.53	207.25
Hook Brook	1424	Q100	65.92	65.92	0.00	0.04	0.03	58.46	23.56	83.67	211.45
Hook Brook	1424	Q500	66.44	66.44	0.00	0.03	0.04	75.66	27.17	113.27	219.94
Hook Brook	1192	Q1.1	63.79	63.72	0.08	0.09	0.04	0.66	24.79	1.05	30.70
Hook Brook	1192	Q2	64.32	64.19	0.13	0.08	0.05	1.26	46.82	3.42	44.55
Hook Brook	1192	Q5	64.77	64.59	0.18	0.08	0.05	1.90	70.25	6.36	65.38
Hook Brook	1192	Q10	65.01	64.80	0.21	0.08	0.06	2.30	85.11	8.29	80.44
Hook Brook	1192	Q25	65.39	65.12	0.27	0.08	0.06	2.99	110.58	11.73	97.32
Hook Brook	1192	Q50	65.58	65.28	0.30	0.08	0.07	3.37	124.57	13.66	103.64
Hook Brook	1192	Q100	65.85	65.50	0.35	0.09	0.08	3.93	145.21	16.56	119.36
Hook Brook	1192	Q500	66.36	65.92	0.44	0.09	0.10	5.10	188.24	22.76	143.82
Hook Brook	1146		Bridge								
Hook Brook	1098	Q1.1	63.10	63.02	0.08	0.37	0.00	0.91	25.22	0.38	13.68
Hook Brook	1098	Q2	63.70	63.59	0.11	0.32	0.01	2.86	47.36	1.27	15.23
Hook Brook	1098	Q5	64.18	64.03	0.15	0.32	0.01	5.40	70.69	2.40	17.51
Hook Brook	1098	Q10	64.39	64.21	0.18	0.33	0.00	6.97	85.62	3.10	18.36
Hook Brook	1098	Q25	64.71	64.47	0.24	0.34	0.04	9.73	111.23	4.33	19.58
Hook Brook	1098	Q50	64.87	64.59	0.28	0.35	0.06	11.28	125.30	5.02	20.15
Hook Brook	1098	Q100	65.09	64.75	0.34	0.36	0.09	13.57	146.08	6.04	20.89
Hook Brook	1098	Q500	65.49	65.02	0.47	0.39	0.16	18.42	189.48	8.20	22.15
Hook Brook	1000	Q1.1	62.72	62.64	0.08	1.62	0.01		26.50		10.25
Hook Brook	1000	Q2	63.37	63.24	0.13	1.60	0.01		51.44	0.06	12.06
Hook Brook	1000	Q5	63.85	63.68	0.17	1.60	0.01	0.27	76.89	1.34	51.46
Hook Brook	1000	Q10	64.06	63.88	0.18	1.57	0.02	0.89	88.30	6.51	64.35
Hook Brook	1000	Q25	64.33	64.16	0.17	1.49	0.02	2.90	103.20	19.20	73.67
Hook Brook	1000	Q50	64.46	64.30	0.17	1.46	0.02	4.42	110.41	26.78	78.06
Hook Brook	1000	Q100	64.64	64.47	0.16	1.42	0.03	7.09	120.33	38.28	83.89
Hook Brook	1000	Q500	64.94	64.79	0.16	1.37	0.03	15.15	138.71	62.24	94.02
Hook Brook	688	Q1.1	61.10	60.95	0.15				26.50		8.14
Hook Brook	688	Q2	61.76	61.54	0.22				51.50		9.49
Hook Brook	688	Q5	62.24	61.94	0.30			0.32	77.32	0.86	18.18
Hook Brook	688	Q10	62.48	62.14	0.34			0.97	92.13	2.60	22.66
Hook Brook	688	Q25	62.82	62.44	0.38			2.80	115.05	7.45	29.05
Hook Brook	688	Q50	62.98	62.57	0.40			4.10	126.59	10.92	32.05
Hook Brook	688	Q100	63.19	62.76	0.43			6.33	142.48	16.88	36.07
Hook Brook	688	Q500	63.55	63.08	0.47			11.89	172.52	31.69	43.15

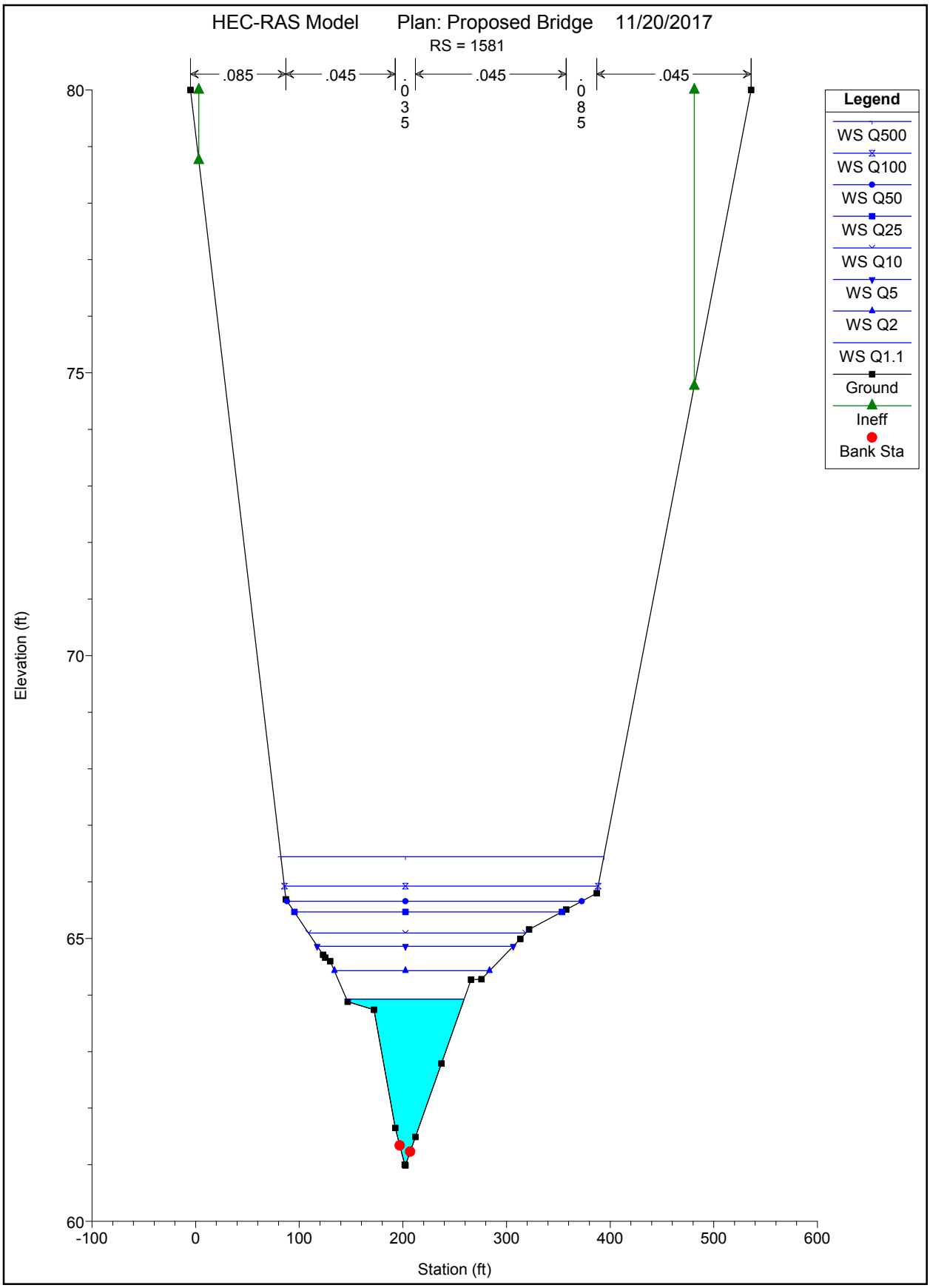
HEC-RAS Plan: Proposed Bridge River: Hook Brook Reach: Hook Brook

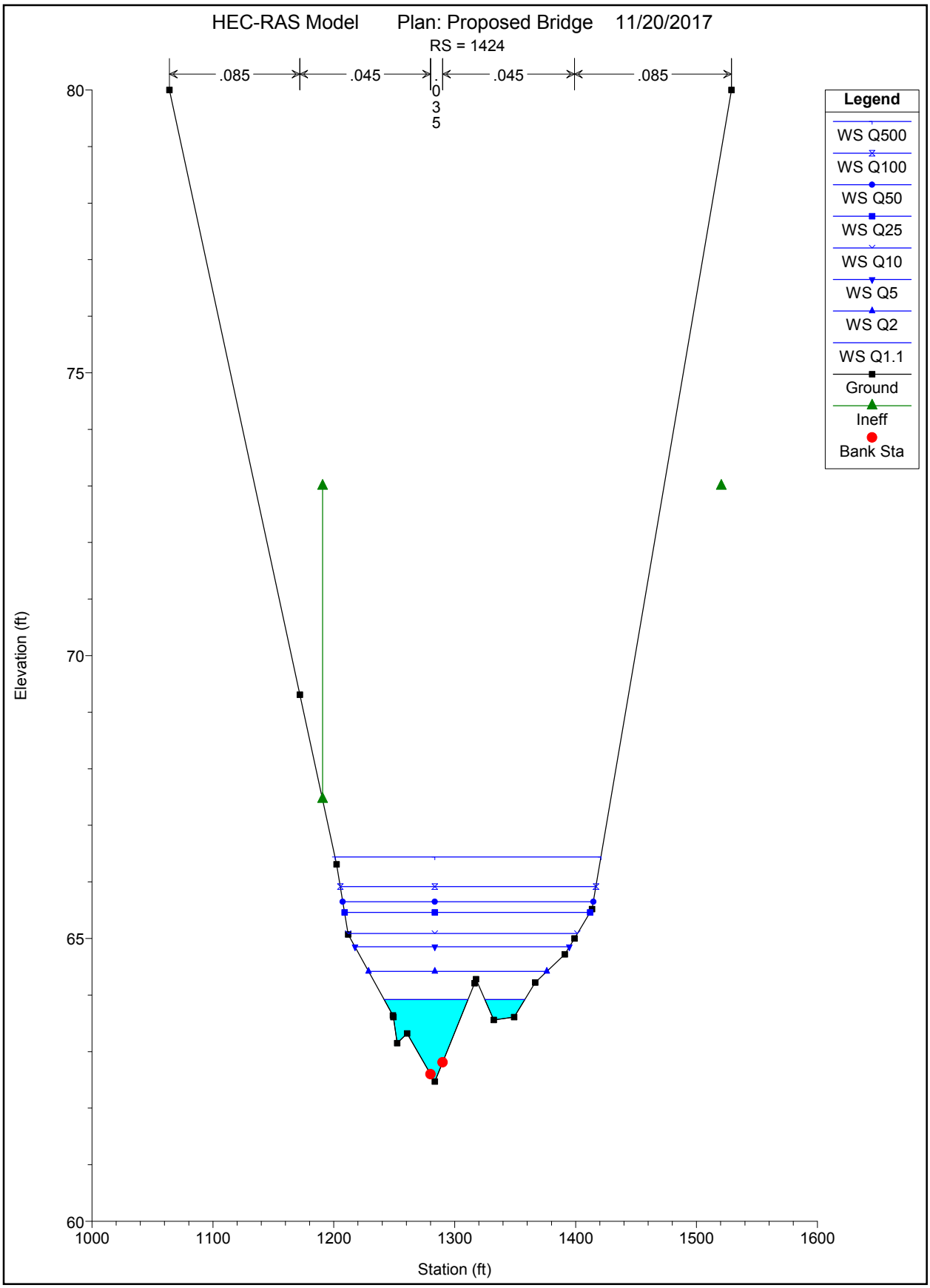
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Hook Brook	1146	Q1.1	63.79	70.00	94.24		26.50	72.65		0.70
Hook Brook	1146	Q2	64.32	70.00	94.24		51.50	72.65		0.62
Hook Brook	1146	Q5	64.77	70.00	94.24		78.50	72.65		0.59
Hook Brook	1146	Q10	65.01	70.00	94.24		95.70	72.65		0.62
Hook Brook	1146	Q25	65.39	70.00	94.24		125.30	72.65		0.67
Hook Brook	1146	Q50	65.58	70.00	94.24		141.60	72.65		0.70
Hook Brook	1146	Q100	65.85	70.00	94.24		165.70	72.65		0.76
Hook Brook	1146	Q500	66.36	70.00	94.24		216.10	72.65		0.87

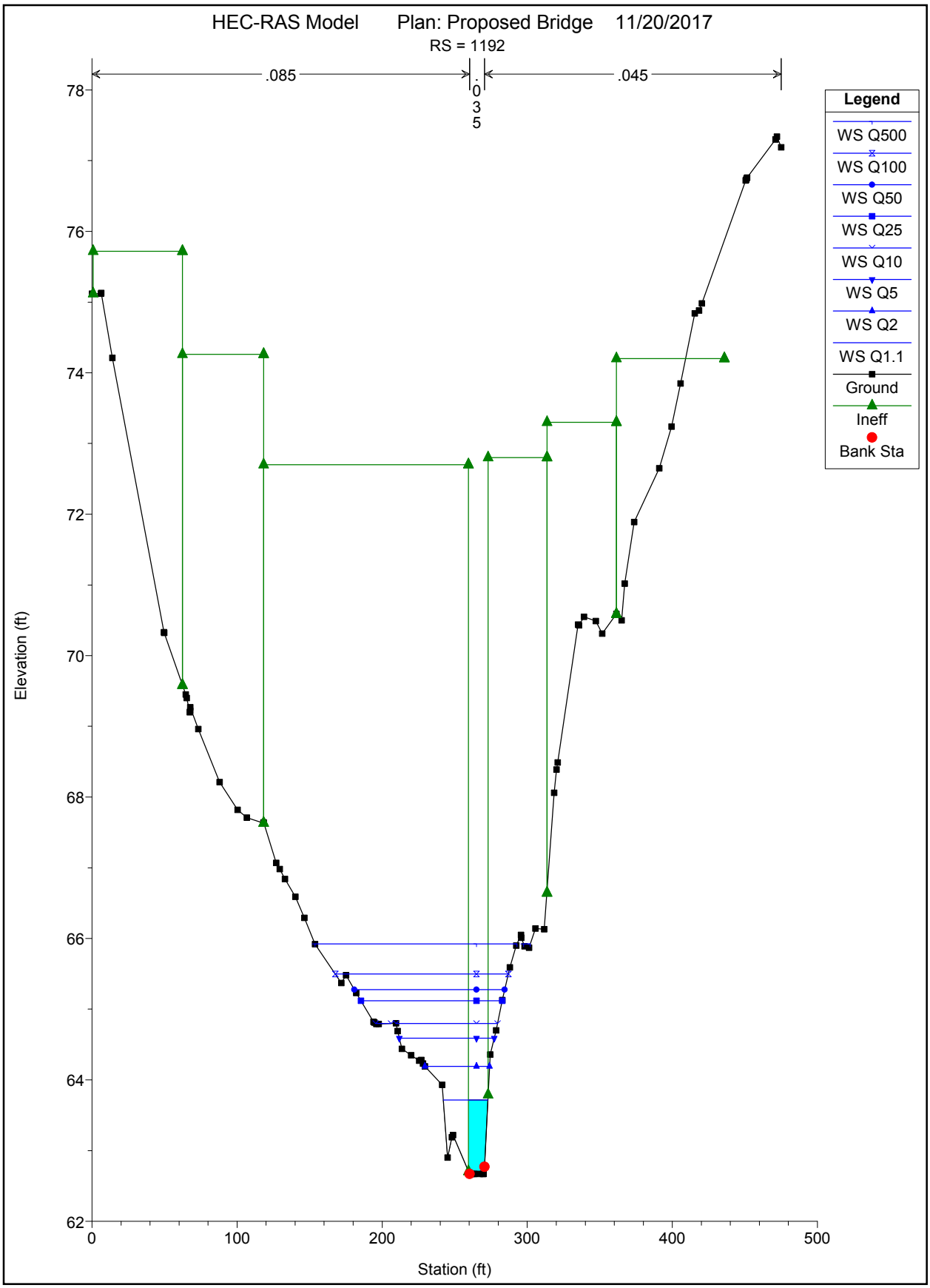
HEC-RAS Plan: Proposed Bridge River: Hook Brook Reach: Hook Brook

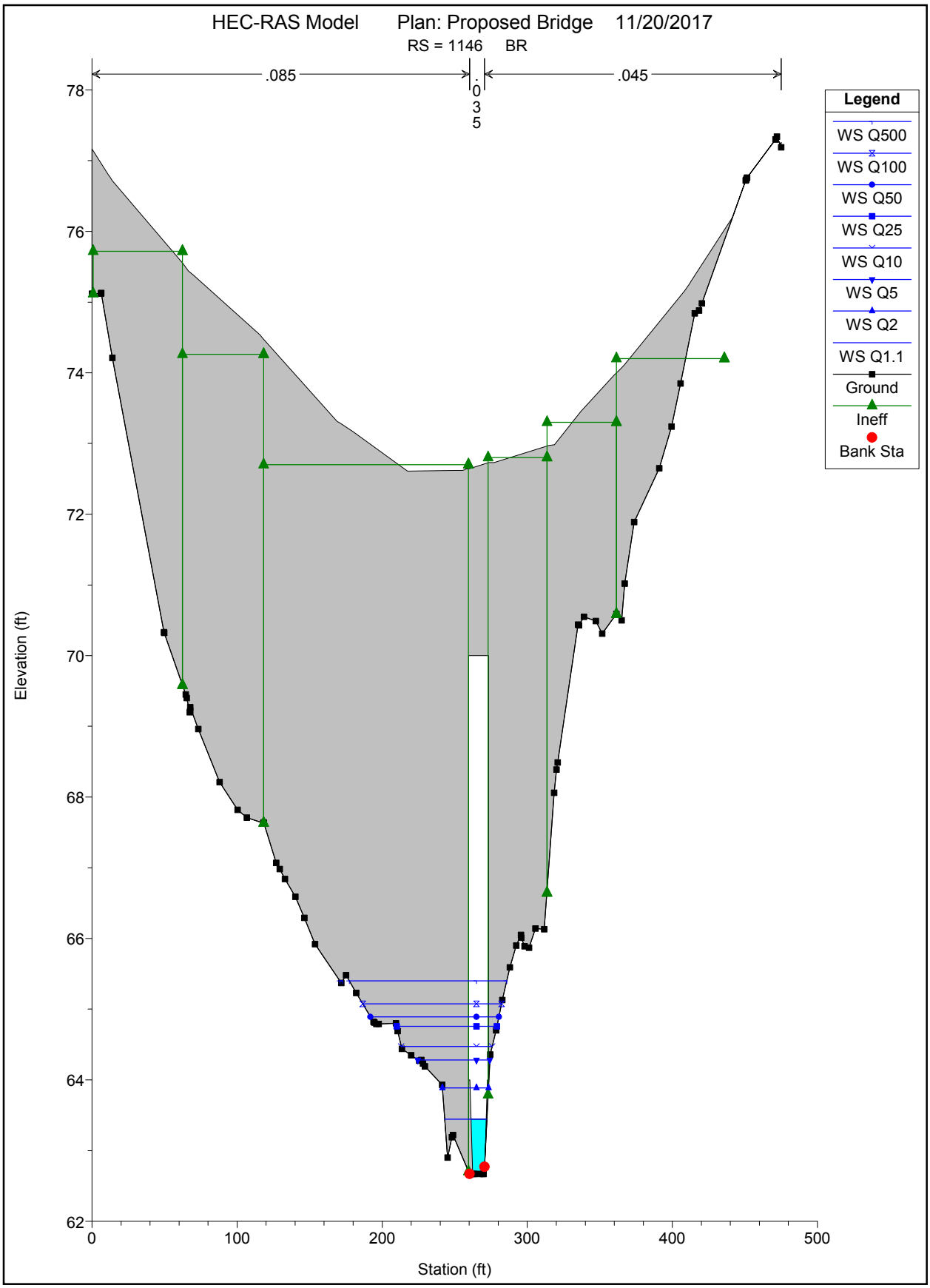
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Hook Brook	1424	Q1.1	63.92	63.92	63.11	0.12	0.01	102.21	10.71	10.20	5.59	0.77
Hook Brook	1424	Q2	64.42	64.42	63.36	0.09	0.01	147.41	19.98	14.44	17.08	0.79
Hook Brook	1424	Q5	64.86	64.85	63.48	0.07	0.02	177.16	28.91	17.35	32.23	0.77
Hook Brook	1424	Q10	65.09	65.09	63.55	0.06	0.02	189.69	34.36	18.82	42.52	0.76
Hook Brook	1424	Q25	65.46	65.46	63.66	0.05	0.03	203.06	44.60	20.74	59.96	0.73
Hook Brook	1424	Q50	65.65	65.65	63.73	0.04	0.03	207.25	50.20	21.87	69.53	0.72
Hook Brook	1424	Q100	65.92	65.92	63.80	0.04	0.03	211.45	58.46	23.56	83.67	0.71
Hook Brook	1424	Q500	66.44	66.44	63.94	0.03	0.04	219.94	75.66	27.17	113.27	0.71
Hook Brook	1192	Q1.1	63.79	63.72	63.24	0.09	0.04	30.70	0.66	24.79	1.05	2.28
Hook Brook	1192	Q2	64.32	64.19	63.55	0.08	0.05	44.55	1.26	46.82	3.42	2.96
Hook Brook	1192	Q5	64.77	64.59	63.84	0.08	0.05	65.38	1.90	70.25	6.36	3.52
Hook Brook	1192	Q10	65.01	64.80	63.99	0.08	0.06	80.44	2.30	85.11	8.29	3.85
Hook Brook	1192	Q25	65.39	65.12	64.23	0.08	0.06	97.32	2.99	110.58	11.73	4.35
Hook Brook	1192	Q50	65.58	65.28	64.35	0.08	0.07	103.64	3.37	124.57	13.66	4.60
Hook Brook	1192	Q100	65.85	65.50	64.52	0.09	0.08	119.36	3.93	145.21	16.56	4.94
Hook Brook	1192	Q500	66.36	65.92	64.85	0.09	0.10	143.82	5.10	188.24	22.76	5.57
Hook Brook	1146 BR U	Q1.1	63.66	63.44	63.34	0.44	0.06	10.44		25.83	0.67	3.79
Hook Brook	1146 BR U	Q2	64.18	63.88	63.69	0.34	0.08	11.65		49.43	2.07	4.47
Hook Brook	1146 BR U	Q5	64.64	64.28	63.96	0.31	0.08	13.81	0.10	74.02	4.38	4.88
Hook Brook	1146 BR U	Q10	64.87	64.47	64.17	0.32	0.08	13.81	0.20	89.30	6.20	5.21
Hook Brook	1146 BR U	Q25	65.24	64.76	64.43	0.35	0.09	13.81	0.38	115.49	9.43	5.75
Hook Brook	1146 BR U	Q50	65.43	64.89	64.55	0.36	0.09	13.81	0.48	129.88	11.24	6.04
Hook Brook	1146 BR U	Q100	65.68	65.07	64.73	0.39	0.09	13.81	0.61	151.14	13.95	6.45
Hook Brook	1146 BR U	Q500	66.17	65.40	65.06	0.45	0.09	13.81	0.87	195.51	19.72	7.29
Hook Brook	1146 BR D	Q1.1	63.17	63.07	62.66	0.06	0.01	11.32	0.01	26.49	0.00	2.56
Hook Brook	1146 BR D	Q2	63.76	63.62	63.01	0.05	0.02	13.81	0.50	50.60	0.40	3.08
Hook Brook	1146 BR D	Q5	64.24	64.05	63.29	0.04	0.02	13.81	1.47	75.61	1.42	3.57
Hook Brook	1146 BR D	Q10	64.47	64.23	63.49	0.05	0.03	13.81	2.03	91.60	2.08	3.95
Hook Brook	1146 BR D	Q25	64.80	64.49	63.74	0.06	0.03	13.81	2.98	119.03	3.29	4.57
Hook Brook	1146 BR D	Q50	64.97	64.62	63.86	0.06	0.04	13.81	3.50	134.12	3.98	4.90
Hook Brook	1146 BR D	Q100	65.20	64.77	64.04	0.07	0.05	13.81	4.26	156.41	5.03	5.37
Hook Brook	1146 BR D	Q500	65.63	65.04	64.38	0.08	0.06	13.81	5.80	203.01	7.28	6.33
Hook Brook	1098	Q1.1	63.10	63.02	62.58	0.37	0.00	13.68	0.91	25.22	0.38	2.29
Hook Brook	1098	Q2	63.70	63.59	62.88	0.32	0.01	15.23	2.86	47.36	1.27	2.74
Hook Brook	1098	Q5	64.18	64.03	63.15	0.32	0.01	17.51	5.40	70.69	2.40	3.20
Hook Brook	1098	Q10	64.39	64.21	63.33	0.33	0.00	18.36	6.97	85.62	3.10	3.56
Hook Brook	1098	Q25	64.71	64.47	63.55	0.34	0.04	19.58	9.73	111.23	4.33	4.13
Hook Brook	1098	Q50	64.87	64.59	63.67	0.35	0.06	20.15	11.28	125.30	5.02	4.43
Hook Brook	1098	Q100	65.09	64.75	63.84	0.36	0.09	20.89	13.57	146.08	6.04	4.86
Hook Brook	1098	Q500	65.49	65.02	64.15	0.39	0.16	22.15	18.42	189.48	8.20	5.74
Hook Brook	1000	Q1.1	62.72	62.64	62.03	1.62	0.01	10.25		26.50		2.33
Hook Brook	1000	Q2	63.37	63.24	62.43	1.60	0.01	12.06		51.44	0.06	2.86
Hook Brook	1000	Q5	63.85	63.68	62.76	1.60	0.01	51.46	0.27	76.89	1.34	3.36
Hook Brook	1000	Q10	64.06	63.88	62.95	1.57	0.02	64.35	0.89	88.30	6.51	3.50
Hook Brook	1000	Q25	64.33	64.16	63.22	1.49	0.02	73.67	2.90	103.20	19.20	3.63
Hook Brook	1000	Q50	64.46	64.30	63.36	1.46	0.02	78.06	4.42	110.41	26.78	3.69
Hook Brook	1000	Q100	64.64	64.47	63.91	1.42	0.03	83.89	7.09	120.33	38.28	3.76
Hook Brook	1000	Q500	64.94	64.79	64.17	1.37	0.03	94.02	15.15	138.71	62.24	3.90

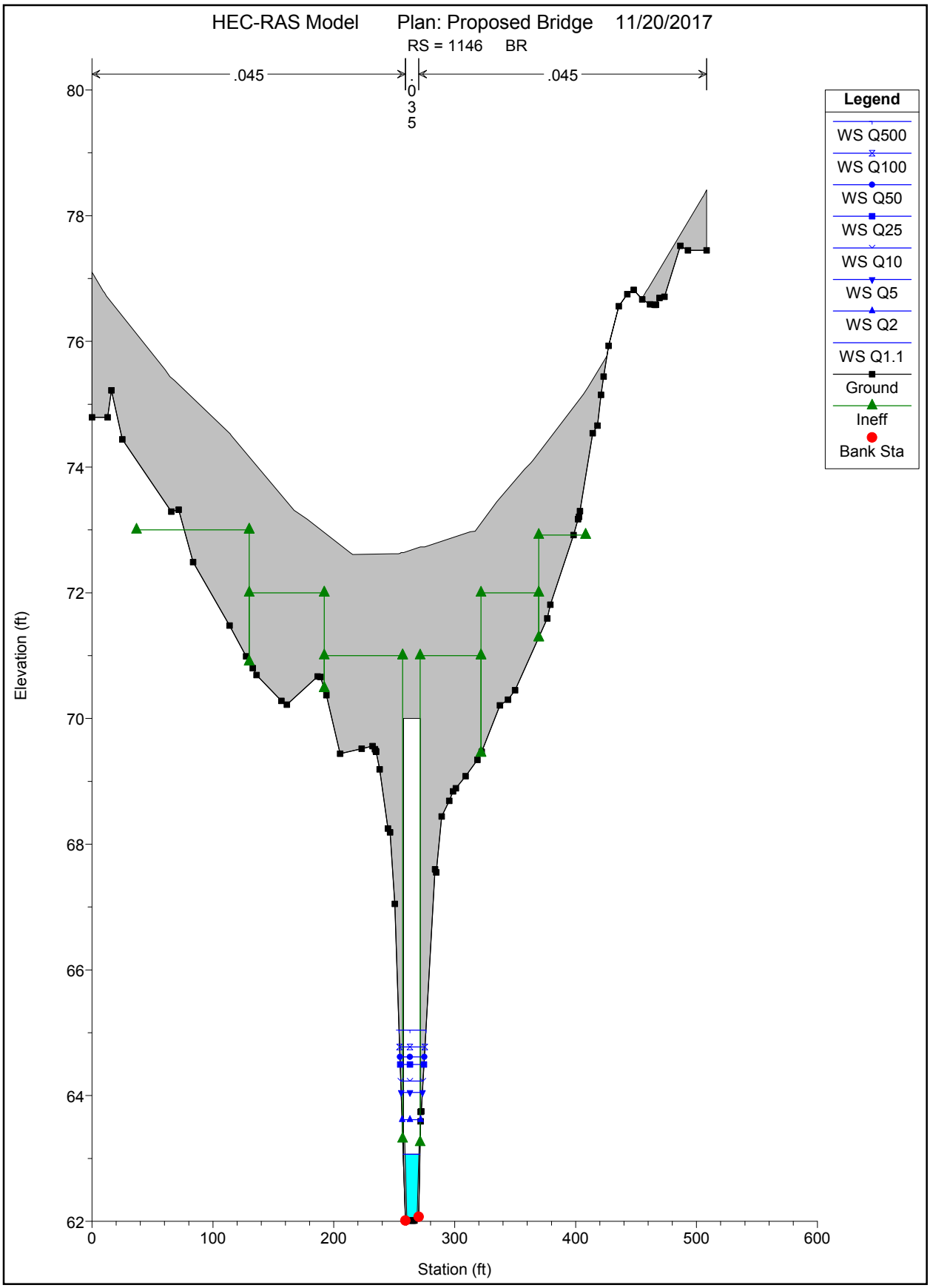

HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1706
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Bank Sta
Elevation (ft)
80
75
70
65
60
-200
-100
0
100
200
300
400
500
600
Station (ft)

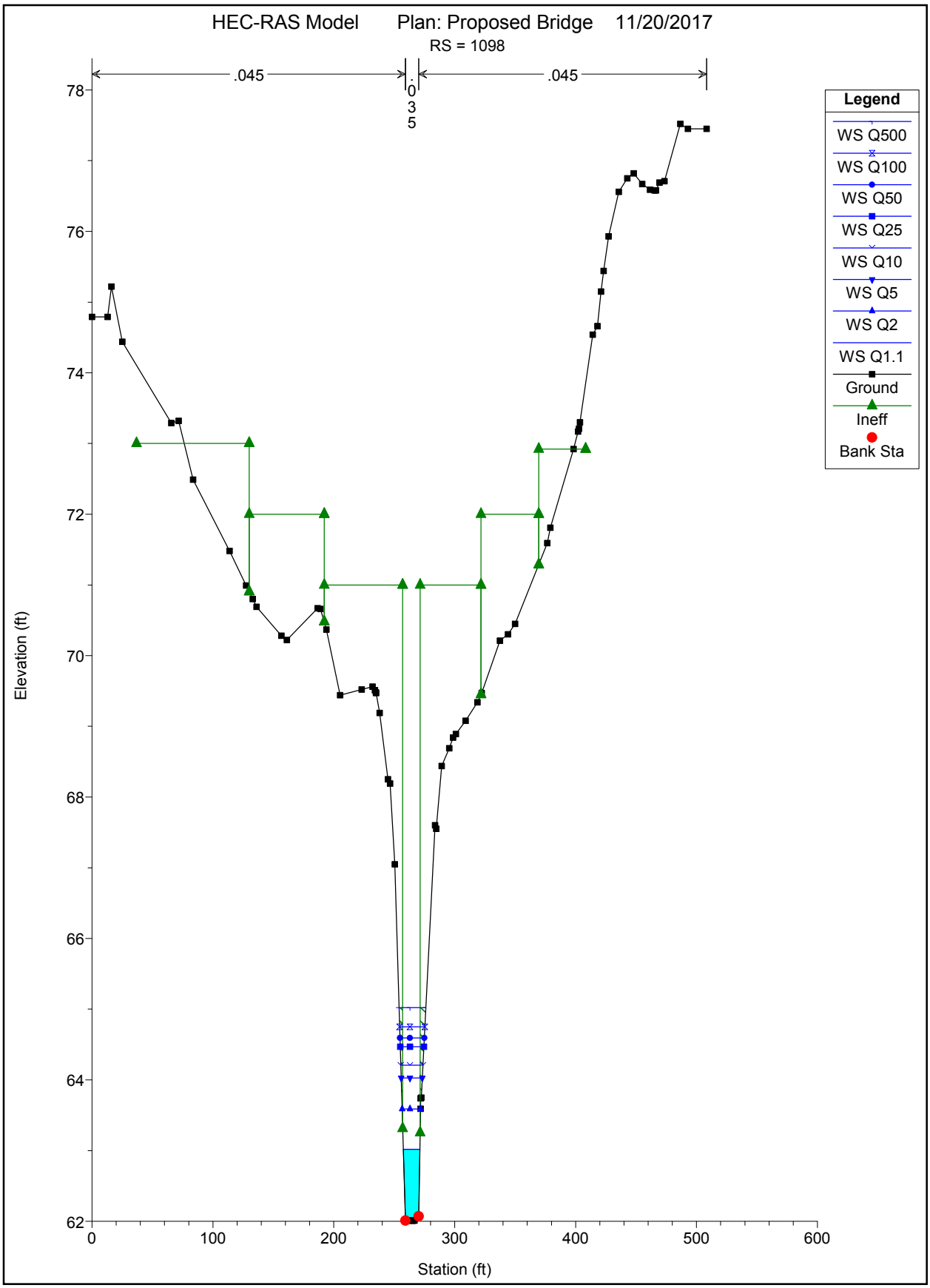

HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1581
.085
.045
.035
.045
.085
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
-100
0
100
200
300
400
500
600
Station (ft)

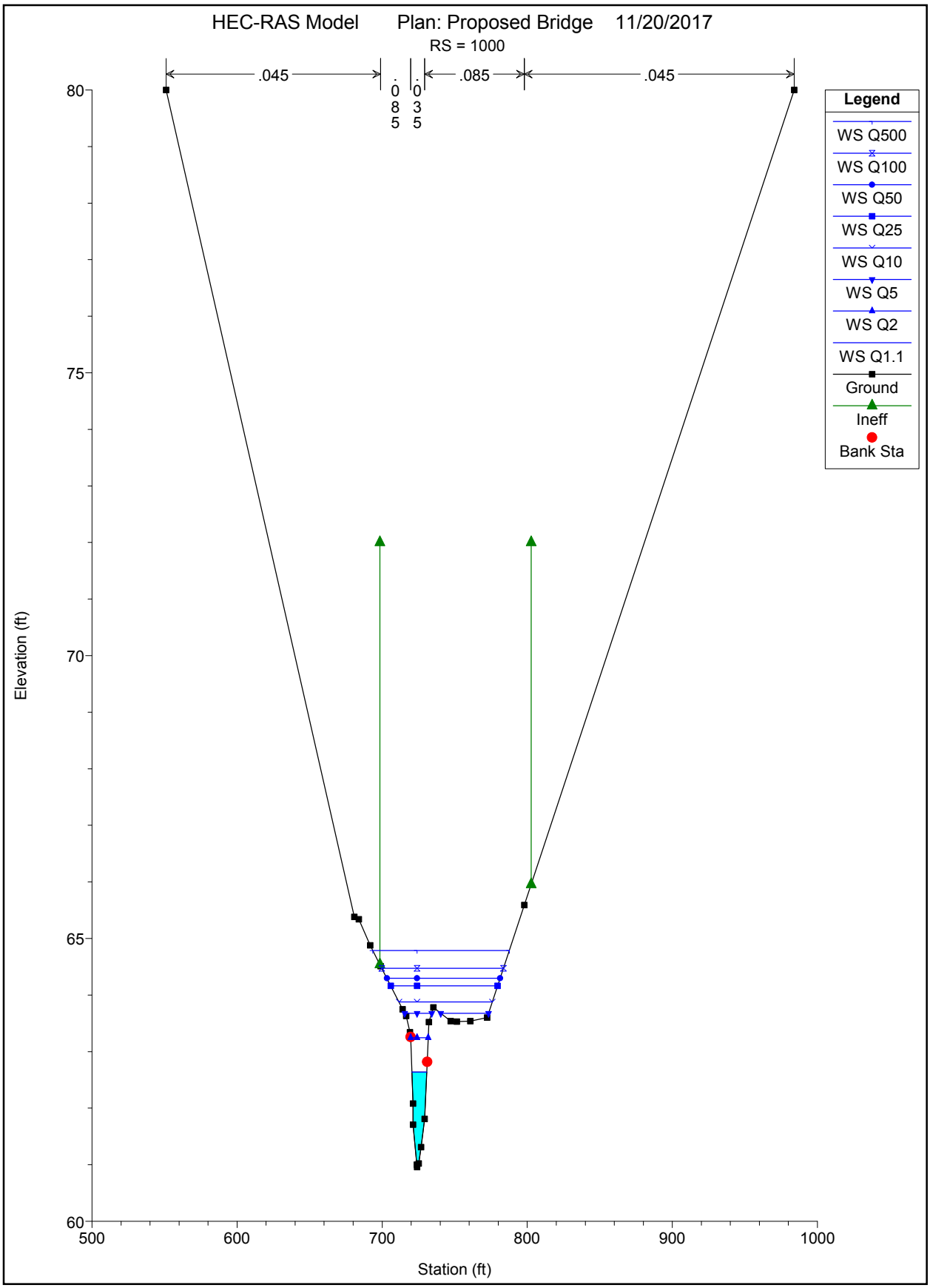

HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1424
.085
.045
.035
.045
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
1000
1100
1200
1300
1400
1500
1600
Station (ft)

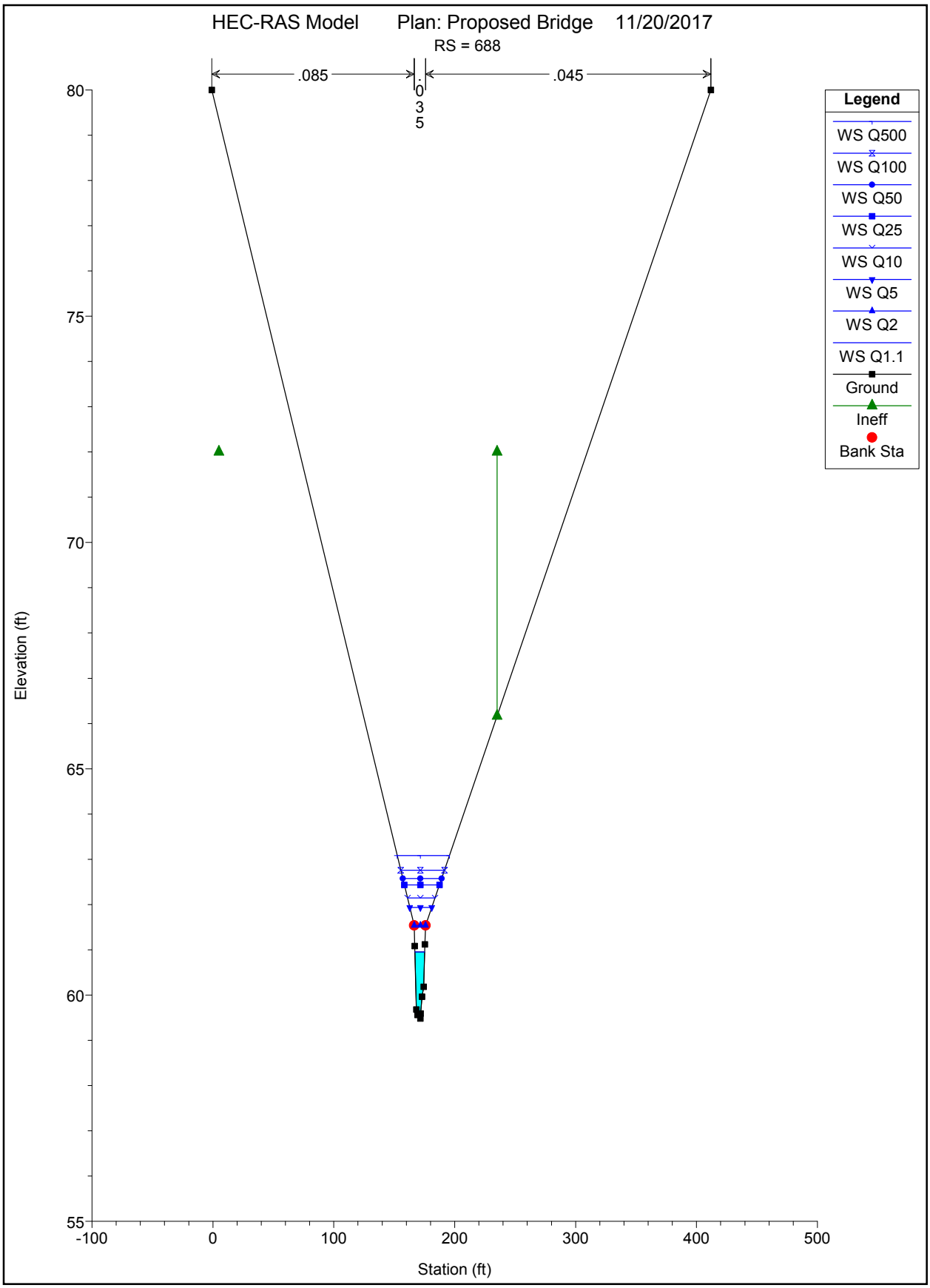

HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1192
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500

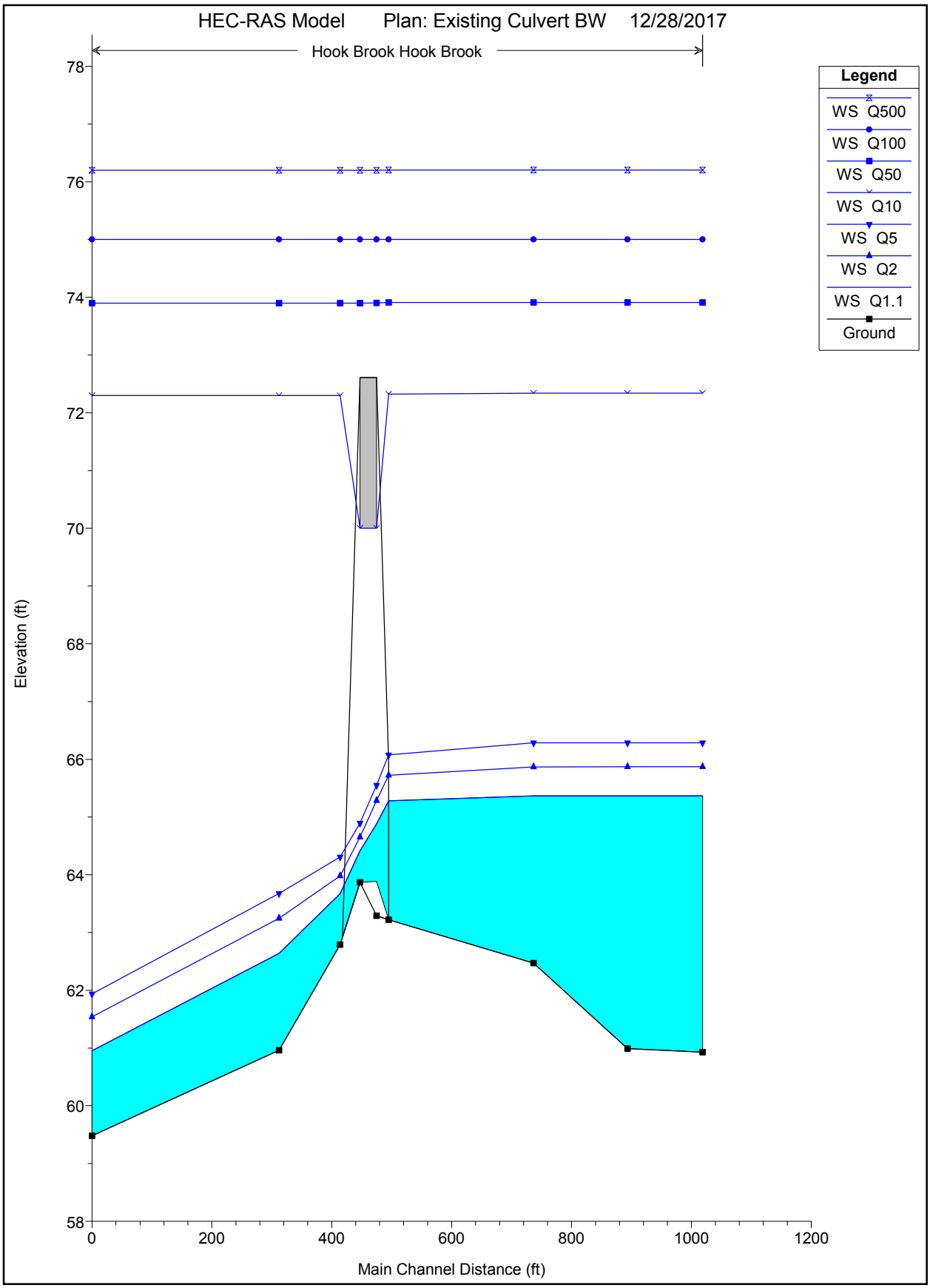

HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1146
BR
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500


HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1146
BR
.045
.045
.03
5
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 1098
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Proposed Bridge 11/20/2017
RS = 1000
.045
.085
.045
.085
.035
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
75
70
65
60
500
600
700
800
900
1000


HEC-RAS Model
Plan: Proposed Bridge
11/20/2017
RS = 688
.085
.045
0.035
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
75
70
65
60
55
-100
0
100
200
300
400
500


HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Elevation (ft)
78
76
74
72
70
68
66
64
62
60
58
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

HEC-RAS Plan: Exist Culvert BW River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hook Brook	1706	Q1.1	26.50	60.93	65.37		65.37	0.000002	0.14	417.93	313.44	0.01
Hook Brook	1706	Q2	51.50	60.93	65.87		65.87	0.000003	0.18	578.79	326.38	0.02
Hook Brook	1706	Q5	78.50	60.93	66.29		66.29	0.000004	0.22	717.07	337.11	0.02
Hook Brook	1706	Q10	95.70	60.93	72.34		72.34	0.000000	0.05	3228.31	492.84	0.00
Hook Brook	1706	Q50	141.60	60.93	73.91		73.91	0.000000	0.06	4035.09	533.30	0.00
Hook Brook	1706	Q100	165.70	60.93	75.00		75.00	0.000000	0.06	4633.07	561.41	0.00
Hook Brook	1706	Q500	216.10	60.93	76.20		76.20	0.000000	0.07	5324.42	592.26	0.00
Hook Brook	1581	Q1.1	26.50	60.99	65.37	61.69	65.37	0.000002	0.14	382.22	244.02	0.01
Hook Brook	1581	Q2	51.50	60.99	65.87	61.90	65.87	0.000003	0.20	521.68	301.88	0.02
Hook Brook	1581	Q5	78.50	60.99	66.29	62.07	66.29	0.000004	0.24	648.95	308.93	0.02
Hook Brook	1581	Q10	95.70	60.99	72.34	62.17	72.34	0.000000	0.06	2828.55	411.35	0.00
Hook Brook	1581	Q50	141.60	60.99	73.91	62.38	73.91	0.000000	0.07	3496.30	437.96	0.00
Hook Brook	1581	Q100	165.70	60.99	75.00	62.48	75.00	0.000000	0.07	3984.57	456.44	0.00
Hook Brook	1581	Q500	216.10	60.99	76.20	62.65	76.20	0.000000	0.08	4533.28	476.72	0.00
Hook Brook	1424	Q1.1	26.50	62.47	65.37	63.11	65.37	0.000004	0.16	291.02	199.68	0.02
Hook Brook	1424	Q2	51.50	62.47	65.87	63.36	65.87	0.000006	0.23	394.64	210.68	0.02
Hook Brook	1424	Q5	78.50	62.47	66.29	63.48	66.29	0.000007	0.28	483.74	217.22	0.03
Hook Brook	1424	Q10	95.70	62.47	72.34	63.55	72.34	0.000000	0.07	2009.24	326.57	0.00
Hook Brook	1424	Q50	141.60	62.47	73.91	63.73	73.91	0.000000	0.09	2665.26	354.98	0.00
Hook Brook	1424	Q100	165.70	62.47	75.00	63.80	75.00	0.000000	0.09	3063.86	374.72	0.00
Hook Brook	1424	Q500	216.10	62.47	76.20	63.94	76.20	0.000000	0.10	3525.94	396.37	0.00
Hook Brook	1174	Q1.1	26.50	63.22	65.28	64.59	65.36	0.001787	2.36	13.86	37.19	0.34
Hook Brook	1174	Q2	51.50	63.22	65.72	65.11	65.85	0.002314	3.19	20.21	73.82	0.40
Hook Brook	1174	Q5	78.50	63.22	66.08	65.40	66.26	0.002734	3.87	25.30	118.73	0.45
Hook Brook	1174	Q10	95.70	63.22	72.33	65.56	72.34	0.000031	0.98	115.11	375.10	0.06
Hook Brook	1174	Q50	141.60	63.22	73.91	65.91	73.91	0.000000	0.14	2219.50	416.10	0.01
Hook Brook	1174	Q100	165.70	63.22	75.00	66.08	75.00	0.000000	0.14	2631.61	450.64	0.01
Hook Brook	1174	Q500	216.10	63.22	76.20	66.40	76.20	0.000000	0.15	3380.14	485.49	0.01
Hook Brook	1146		Bridge									
Hook Brook	1098	Q1.1	26.50	62.79	63.67	63.67	63.94	0.023398	4.16	6.37	12.04	1.01
Hook Brook	1098	Q2	51.50	62.79	63.98	63.98	64.38	0.019957	5.06	10.18	14.02	0.99
Hook Brook	1098	Q5	78.50	62.79	64.31	64.24	64.77	0.014719	5.46	14.60	16.28	0.90
Hook Brook	1098	Q10	95.70	62.79	72.30	64.40	72.30	0.000002	0.25	832.85	324.07	0.01
Hook Brook	1098	Q50	141.60	62.79	73.90	64.75	73.90	0.000001	0.23	1440.54	396.15	0.01
Hook Brook	1098	Q100	165.70	62.79	75.00	64.91	75.00	0.000001	0.20	1905.18	451.86	0.01
Hook Brook	1098	Q500	216.10	62.79	76.20	65.23	76.20	0.000001	0.19	2458.42	468.02	0.01
Hook Brook	1000	Q1.1	26.50	60.96	62.64	62.03	62.72	0.004734	2.33	11.35	10.25	0.39
Hook Brook	1000	Q2	51.50	60.96	63.24	62.43	63.37	0.004652	2.86	18.12	12.06	0.40
Hook Brook	1000	Q5	78.50	60.96	63.68	62.76	63.85	0.004637	3.36	28.05	51.46	0.42
Hook Brook	1000	Q10	95.70	60.96	72.30	62.95	72.30	0.000001	0.12	1487.00	265.24	0.01
Hook Brook	1000	Q50	141.60	60.96	73.90	63.36	73.90	0.000001	0.13	1939.28	300.10	0.01
Hook Brook	1000	Q100	165.70	60.96	75.00	63.91	75.00	0.000001	0.13	2282.56	324.07	0.01
Hook Brook	1000	Q500	216.10	60.96	76.20	64.17	76.20	0.000001	0.14	2687.13	350.21	0.01
Hook Brook	688	Q1.1	26.50	59.48	60.95	60.54	61.10	0.005701	3.09	8.57	8.14	0.53
Hook Brook	688	Q2	51.50	59.48	61.54	60.98	61.76	0.005703	3.75	13.72	9.49	0.55
Hook Brook	688	Q5	78.50	59.48	61.94	61.36	62.24	0.005708	4.42	19.24	18.18	0.57
Hook Brook	688	Q10	95.70	59.48	72.30	61.56	72.30	0.000001	0.16	1380.84	244.62	0.01
Hook Brook	688	Q50	141.60	59.48	73.90	62.15	73.90	0.000001	0.18	1800.20	279.58	0.01
Hook Brook	688	Q100	165.70	59.48	75.00	62.38	75.00	0.000001	0.18	2120.96	303.62	0.01
Hook Brook	688	Q500	216.10	59.48	76.20	62.76	76.20	0.000001	0.20	2501.04	329.84	0.01

HEC-RAS Plan: Exist Culvert BW River: Hook Brook Reach: Hook Brook

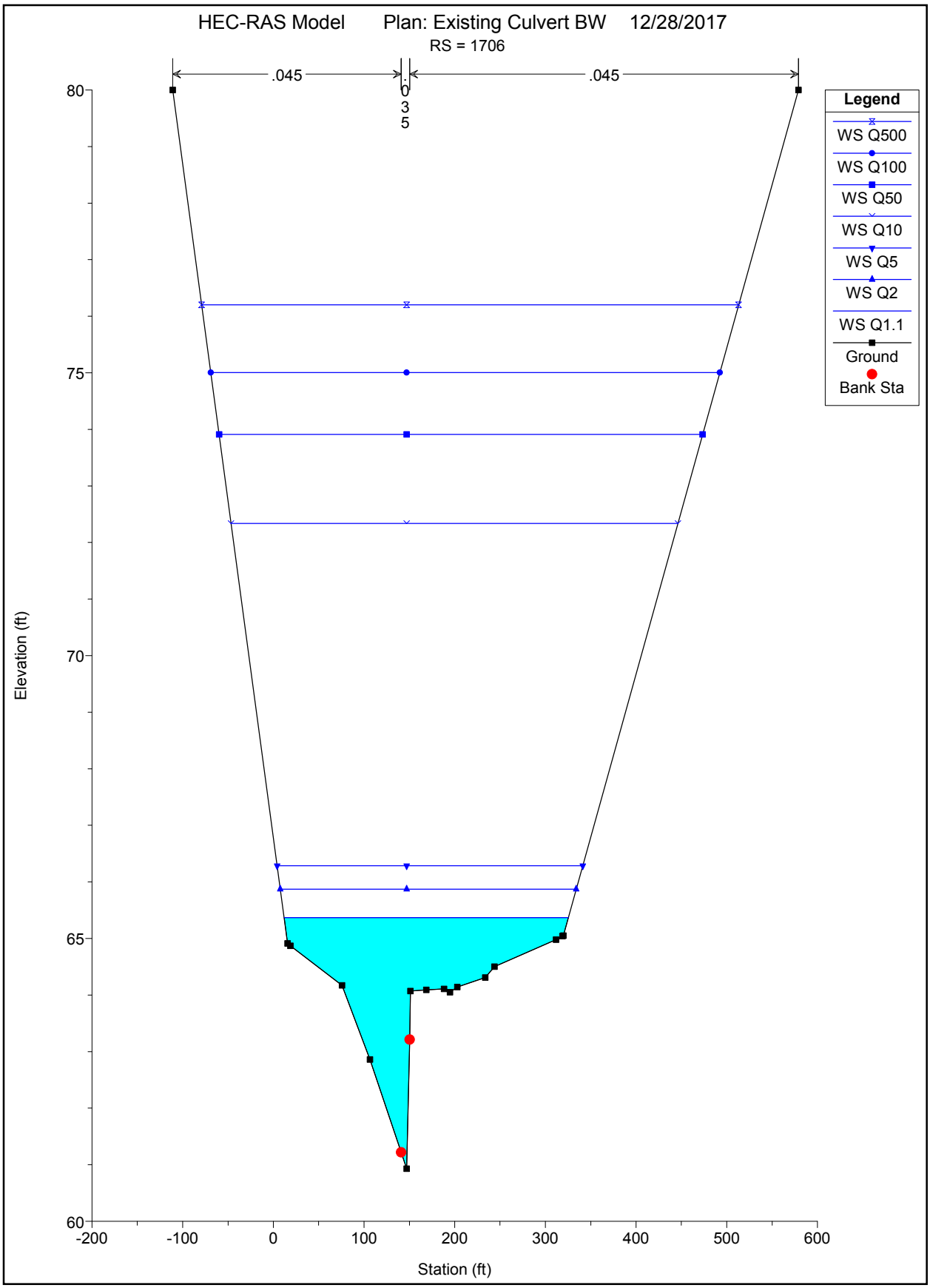
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Hook Brook	1706	Q1.1	65.37	65.37	0.00	0.00	0.00	14.55	5.20	6.75	313.44
Hook Brook	1706	Q2	65.87	65.87	0.00	0.00	0.00	26.82	7.76	16.92	326.38
Hook Brook	1706	Q5	66.29	66.29	0.00	0.00	0.00	39.52	10.05	28.94	337.11
Hook Brook	1706	Q10	72.34	72.34	0.00	0.00	0.00	40.63	5.21	49.86	492.84
Hook Brook	1706	Q50	73.91	73.91	0.00	0.00	0.00	59.08	7.03	75.49	533.30
Hook Brook	1706	Q100	75.00	75.00	0.00	0.00	0.00	68.44	7.78	89.48	561.41
Hook Brook	1706	Q500	76.20	76.20	0.00	0.00	0.00	88.38	9.62	118.11	592.26
Hook Brook	1581	Q1.1	65.37	65.37	0.00	0.00	0.00	8.70	5.99	11.80	244.02
Hook Brook	1581	Q2	65.87	65.87	0.00	0.00	0.00	17.61	9.58	24.31	301.88
Hook Brook	1581	Q5	66.29	66.29	0.00	0.00	0.00	27.60	12.44	38.46	308.93
Hook Brook	1581	Q10	72.34	72.34	0.00	0.00	0.00	35.23	6.44	54.03	411.35
Hook Brook	1581	Q50	73.91	73.91	0.00	0.00	0.00	51.91	8.73	80.96	437.96
Hook Brook	1581	Q100	75.00	75.00	0.00	0.00	0.00	60.47	9.70	95.53	456.44
Hook Brook	1581	Q500	76.20	76.20	0.00	0.00	0.00	78.20	12.00	125.90	476.72
Hook Brook	1424	Q1.1	65.37	65.37	0.00	0.00	0.01	9.45	4.56	12.49	199.68
Hook Brook	1424	Q2	65.87	65.87	0.00	0.01	0.01	18.18	7.43	25.89	210.68
Hook Brook	1424	Q5	66.29	66.29	0.00	0.01	0.02	27.57	10.19	40.75	217.22
Hook Brook	1424	Q10	72.34	72.34	0.00	0.00	0.00	35.79	7.23	52.68	326.57
Hook Brook	1424	Q50	73.91	73.91	0.00	0.00	0.00	55.98	9.84	75.78	354.98
Hook Brook	1424	Q100	75.00	75.00	0.00	0.00	0.00	66.42	11.09	88.20	374.72
Hook Brook	1424	Q500	76.20	76.20	0.00	0.00	0.00	87.73	13.94	114.43	396.37
Hook Brook	1174	Q1.1	65.36	65.28	0.08	0.08	0.07		22.57	3.93	37.19
Hook Brook	1174	Q2	65.85	65.72	0.13	0.09	0.08		39.24	12.26	73.82
Hook Brook	1174	Q5	66.26	66.08	0.19	0.10	0.10		56.17	22.33	118.73
Hook Brook	1174	Q10	72.34	72.33	0.01				52.52	43.18	375.10
Hook Brook	1174	Q50	73.91	73.91	0.00	0.00	0.00	58.70	19.15	63.75	416.10
Hook Brook	1174	Q100	75.00	75.00	0.00	0.00	0.00	73.03	22.31	70.36	450.64
Hook Brook	1174	Q500	76.20	76.20	0.00	0.00	0.00	101.18	26.26	88.66	485.49
Hook Brook	1146		Bridge								
Hook Brook	1098	Q1.1	63.94	63.67	0.27	0.92	0.09		26.50		12.04
Hook Brook	1098	Q2	64.38	63.98	0.40			0.00	51.50		14.02
Hook Brook	1098	Q5	64.77	64.31	0.46	0.78	0.14	0.38	78.12		16.28
Hook Brook	1098	Q10	72.30	72.30	0.00	0.00	0.00	34.24	29.98	31.48	324.07
Hook Brook	1098	Q50	73.90	73.90	0.00	0.00	0.00	59.76	31.83	50.02	396.15
Hook Brook	1098	Q100	75.00	75.00	0.00	0.00	0.00	75.94	30.20	59.56	451.86
Hook Brook	1098	Q500	76.20	76.20	0.00	0.00	0.00	106.22	32.35	77.52	468.02
Hook Brook	1000	Q1.1	62.72	62.64	0.08	1.62	0.01		26.50		10.25
Hook Brook	1000	Q2	63.37	63.24	0.13	1.60	0.01		51.44	0.06	12.06
Hook Brook	1000	Q5	63.85	63.68	0.17	1.60	0.01	0.27	76.89	1.34	51.46
Hook Brook	1000	Q10	72.30	72.30	0.00	0.00	0.00	33.38	14.20	48.12	265.24
Hook Brook	1000	Q50	73.90	73.90	0.00	0.00	0.00	50.88	18.15	72.57	300.10
Hook Brook	1000	Q100	75.00	75.00	0.00	0.00	0.00	60.43	19.44	85.83	324.07
Hook Brook	1000	Q500	76.20	76.20	0.00	0.00	0.00	79.84	23.21	113.06	350.21
Hook Brook	688	Q1.1	61.10	60.95	0.15				26.50		8.14
Hook Brook	688	Q2	61.76	61.54	0.22				51.50		9.49
Hook Brook	688	Q5	62.24	61.94	0.30			0.32	77.32	0.86	18.18
Hook Brook	688	Q10	72.30	72.30	0.00			21.19	18.01	56.50	244.62
Hook Brook	688	Q50	73.90	73.90	0.00			32.27	23.27	86.06	279.58
Hook Brook	688	Q100	75.00	75.00	0.00			38.36	25.04	102.30	303.62
Hook Brook	688	Q500	76.20	76.20	0.00			50.75	30.01	135.33	329.84

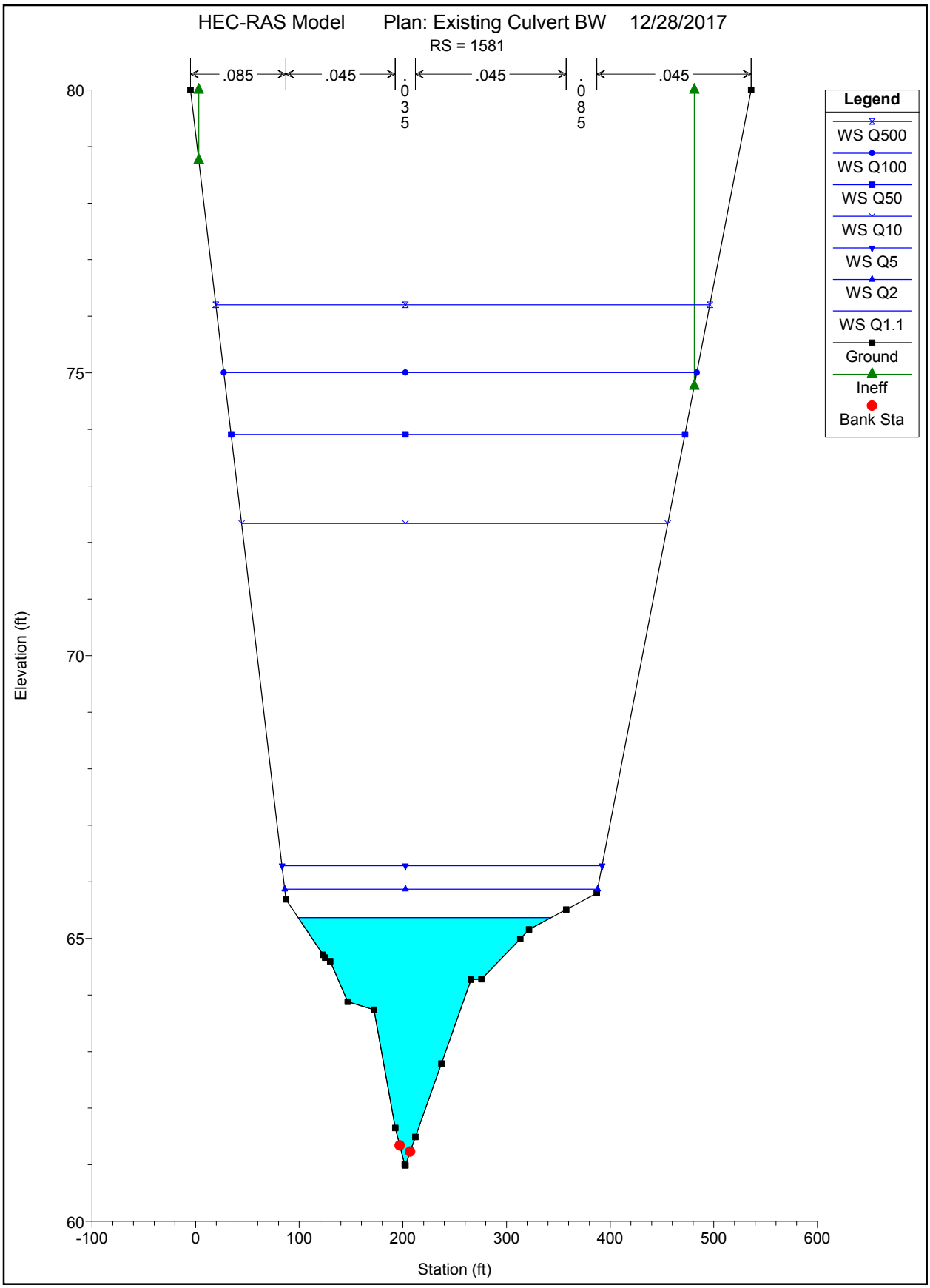
HEC-RAS Plan: Exist Culvert BW River: Hook Brook Reach: Hook Brook

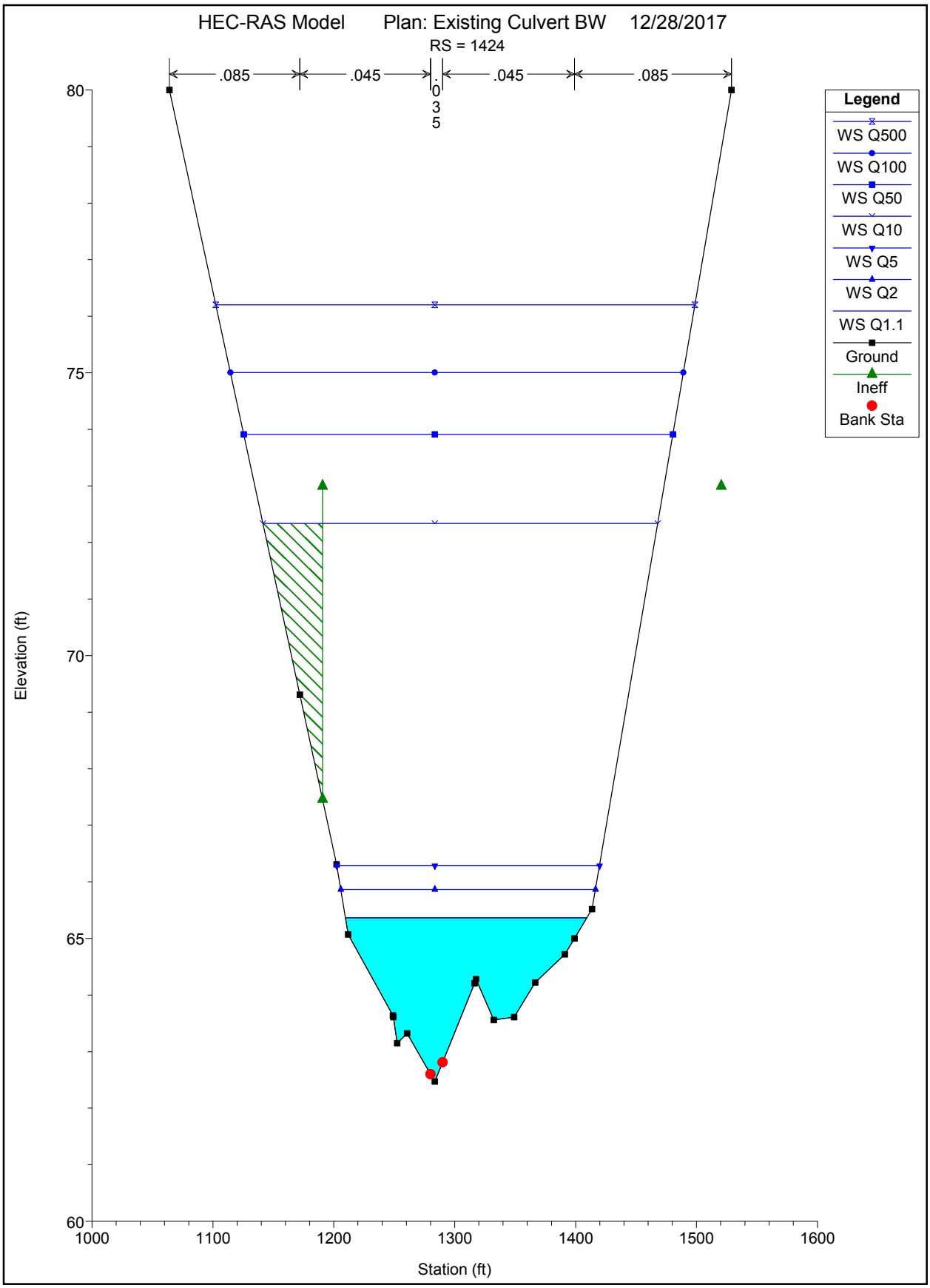
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Hook Brook	1146	Q1.1	65.36	70.00	77.79		26.50	72.62		1.41
Hook Brook	1146	Q2	65.85	70.00	77.79		51.50	72.62		1.47
Hook Brook	1146	Q5	66.26	70.00	77.79		78.50	72.62		1.49
Hook Brook	1146	Q10	72.34	70.00	77.79	72.33	95.70	72.62		0.04
Hook Brook	1146	Q50	73.91	70.00	77.79		141.60	72.62		0.01
Hook Brook	1146	Q100	75.00	70.00	77.79		165.70	72.62		0.00
Hook Brook	1146	Q500	76.20	70.00	77.79		216.10	72.62		0.00

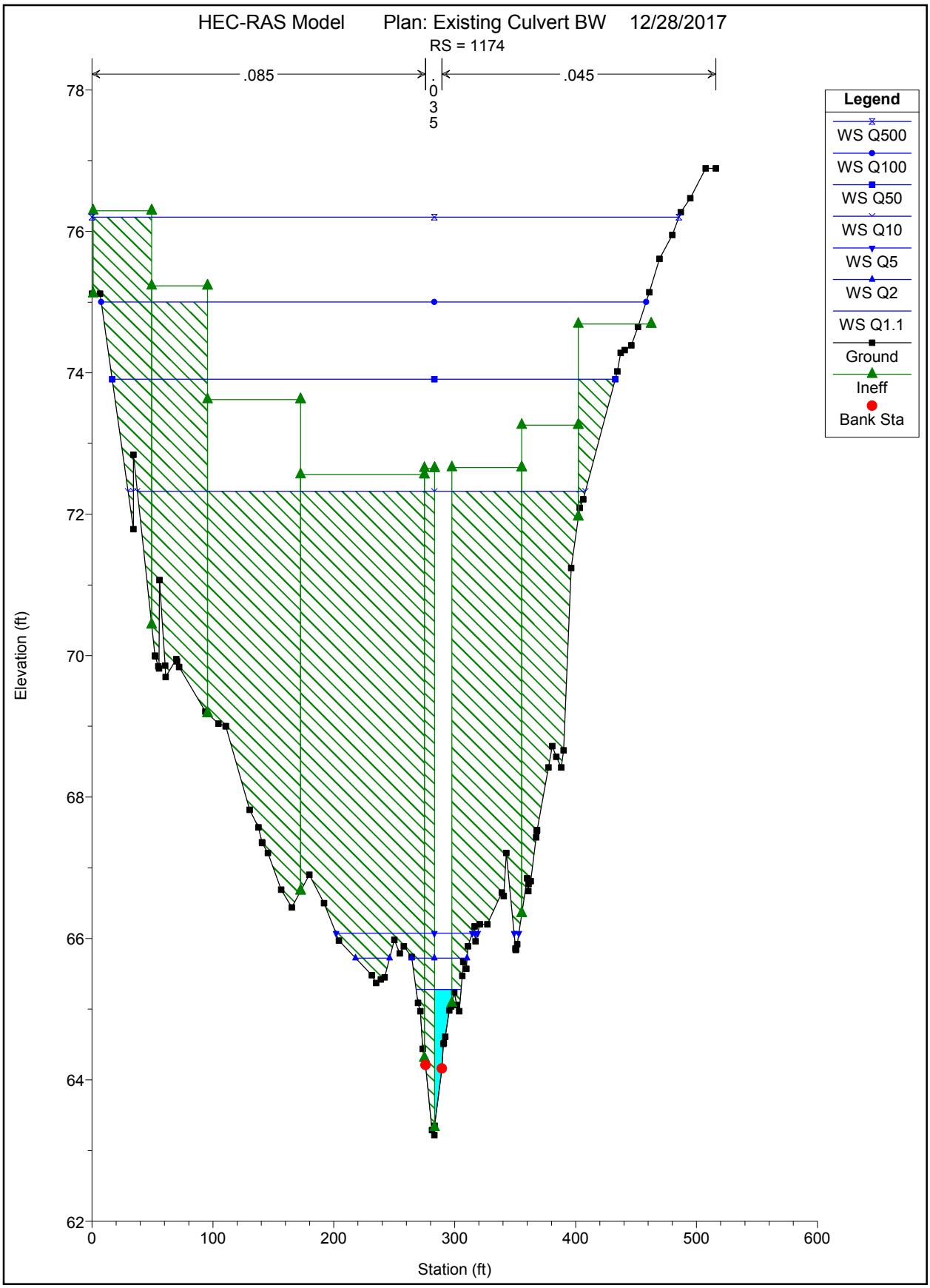
HEC-RAS Plan: Exist Culvert BW River: Hook Brook Reach: Hook Brook

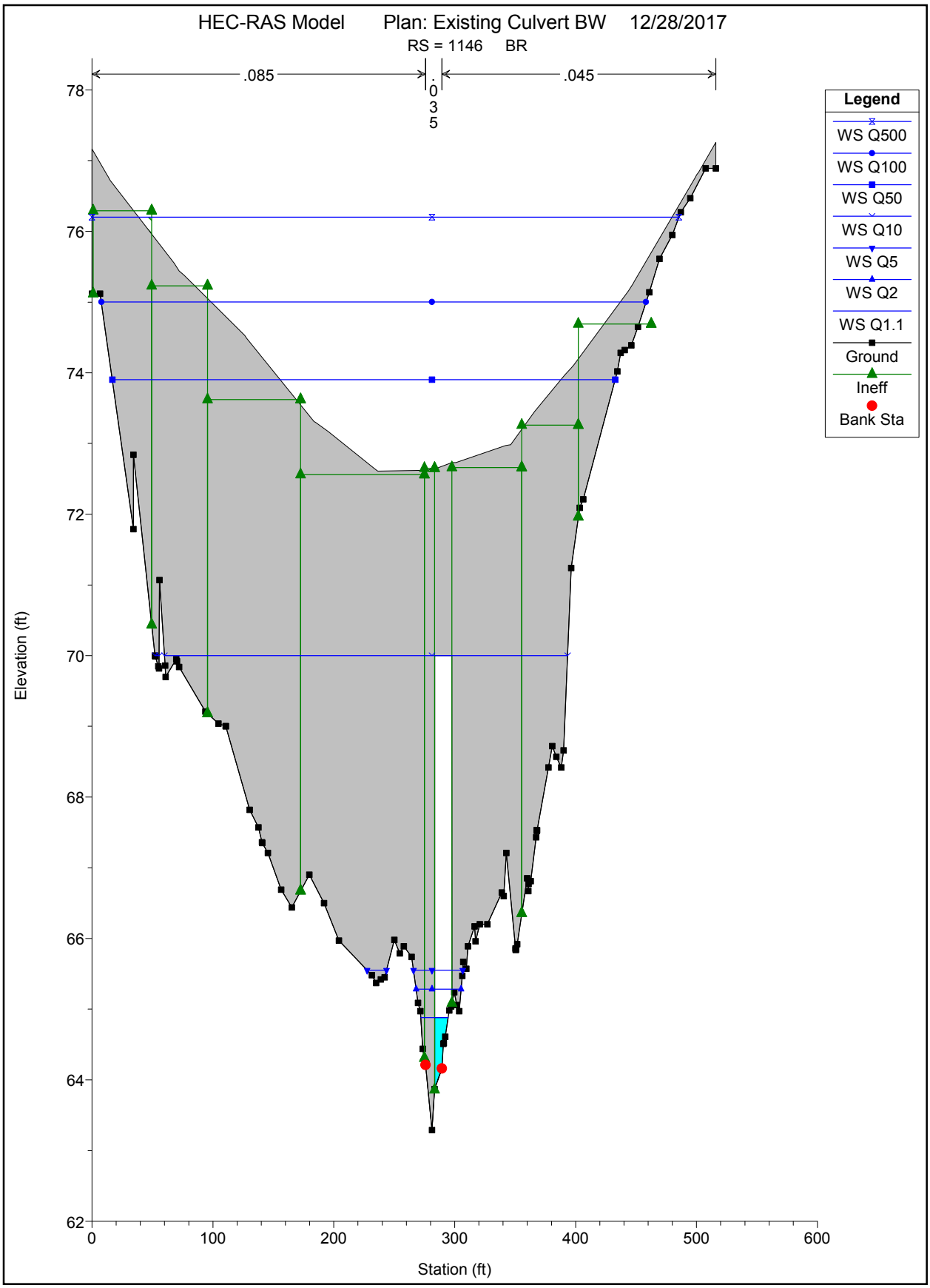
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Hook Brook	1424	Q1.1	65.37	65.37	63.11	0.00	0.01	199.68	9.45	4.56	12.49	0.16
Hook Brook	1424	Q2	65.87	65.87	63.36	0.01	0.01	210.68	18.18	7.43	25.89	0.23
Hook Brook	1424	Q5	66.29	66.29	63.48	0.01	0.02	217.22	27.57	10.19	40.75	0.28
Hook Brook	1424	Q10	72.34	72.34	63.55	0.00	0.00	326.57	35.79	7.23	52.68	0.07
Hook Brook	1424	Q50	73.91	73.91	63.73	0.00	0.00	354.98	55.98	9.84	75.78	0.09
Hook Brook	1424	Q100	75.00	75.00	63.80	0.00	0.00	374.72	66.42	11.09	88.20	0.09
Hook Brook	1424	Q500	76.20	76.20	63.94	0.00	0.00	396.37	87.73	13.94	114.43	0.10
Hook Brook	1174	Q1.1	65.36	65.28	64.59	0.08	0.07	37.19		22.57	3.93	2.36
Hook Brook	1174	Q2	65.85	65.72	65.11	0.09	0.08	73.82		39.24	12.26	3.19
Hook Brook	1174	Q5	66.26	66.08	65.40	0.10	0.10	118.73		56.17	22.33	3.87
Hook Brook	1174	Q10	72.34	72.33	65.56			375.10		52.52	43.18	0.98
Hook Brook	1174	Q50	73.91	73.91	65.91	0.00	0.00	416.10	58.70	19.15	63.75	0.14
Hook Brook	1174	Q100	75.00	75.00	66.08	0.00	0.00	450.64	73.03	22.31	70.36	0.14
Hook Brook	1174	Q500	76.20	76.20	66.40	0.00	0.00	485.49	101.18	26.26	88.66	0.15
Hook Brook	1146 BR U	Q1.1	65.20	64.88	64.88	0.46	0.05	10.93		23.97	2.53	4.74
Hook Brook	1146 BR U	Q2	65.68	65.28	65.28	0.43	0.01	14.24		41.00	10.50	5.53
Hook Brook	1146 BR U	Q5	66.06	65.55	65.55	0.42	0.00	14.24		57.50	21.00	6.40
Hook Brook	1146 BR U	Q10	72.34	70.00	65.70			14.24		51.43	44.27	1.46
Hook Brook	1146 BR U	Q50	73.91	73.90	66.04	0.00	0.00	232.05	26.65	46.97	67.98	0.90
Hook Brook	1146 BR U	Q100	75.00	75.00	66.21	0.00	0.00	338.35	46.06	34.93	84.70	0.52
Hook Brook	1146 BR U	Q500	76.20	76.20	66.54	0.00	0.00	441.14	70.79	30.50	114.81	0.36
Hook Brook	1146 BR D	Q1.1	64.63	64.41	64.38	0.67	0.02	14.30	0.84	25.66		3.75
Hook Brook	1146 BR D	Q2	65.03	64.65	64.65	0.65	0.01	14.30	2.27	49.23		4.99
Hook Brook	1146 BR D	Q5	65.40	64.90	64.90	0.53	0.02	14.30	4.00	74.50		5.76
Hook Brook	1146 BR D	Q10	72.30	70.00	65.04			14.30	6.82	88.88		1.15
Hook Brook	1146 BR D	Q50	73.90	73.90	65.38	0.00	0.00	231.63	45.43	74.59	21.58	0.79
Hook Brook	1146 BR D	Q100	75.00	75.00	65.55	0.00	0.00	338.25	73.88	46.55	45.28	0.43
Hook Brook	1146 BR D	Q500	76.20	76.20	65.86	0.00	0.00	431.58	106.82	35.28	74.00	0.28
Hook Brook	1098	Q1.1	63.94	63.67	63.67	0.92	0.09	12.04		26.50		4.16
Hook Brook	1098	Q2	64.38	63.98	63.98			14.02	0.00	51.50		5.06
Hook Brook	1098	Q5	64.77	64.31	64.24	0.78	0.14	16.28	0.38	78.12		5.46
Hook Brook	1098	Q10	72.30	72.30	64.40	0.00	0.00	324.07	34.24	29.98	31.48	0.25
Hook Brook	1098	Q50	73.90	73.90	64.75	0.00	0.00	396.15	59.76	31.83	50.02	0.23
Hook Brook	1098	Q100	75.00	75.00	64.91	0.00	0.00	451.86	75.94	30.20	59.56	0.20
Hook Brook	1098	Q500	76.20	76.20	65.23	0.00	0.00	468.02	106.22	32.35	77.52	0.19
Hook Brook	1000	Q1.1	62.72	62.64	62.03	1.62	0.01	10.25		26.50		2.33
Hook Brook	1000	Q2	63.37	63.24	62.43	1.60	0.01	12.06		51.44	0.06	2.86
Hook Brook	1000	Q5	63.85	63.68	62.76	1.60	0.01	51.46	0.27	76.89	1.34	3.36
Hook Brook	1000	Q10	72.30	72.30	62.95	0.00	0.00	265.24	33.38	14.20	48.12	0.12
Hook Brook	1000	Q50	73.90	73.90	63.36	0.00	0.00	300.10	50.88	18.15	72.57	0.13
Hook Brook	1000	Q100	75.00	75.00	63.91	0.00	0.00	324.07	60.43	19.44	85.83	0.13
Hook Brook	1000	Q500	76.20	76.20	64.17	0.00	0.00	350.21	79.84	23.21	113.06	0.14

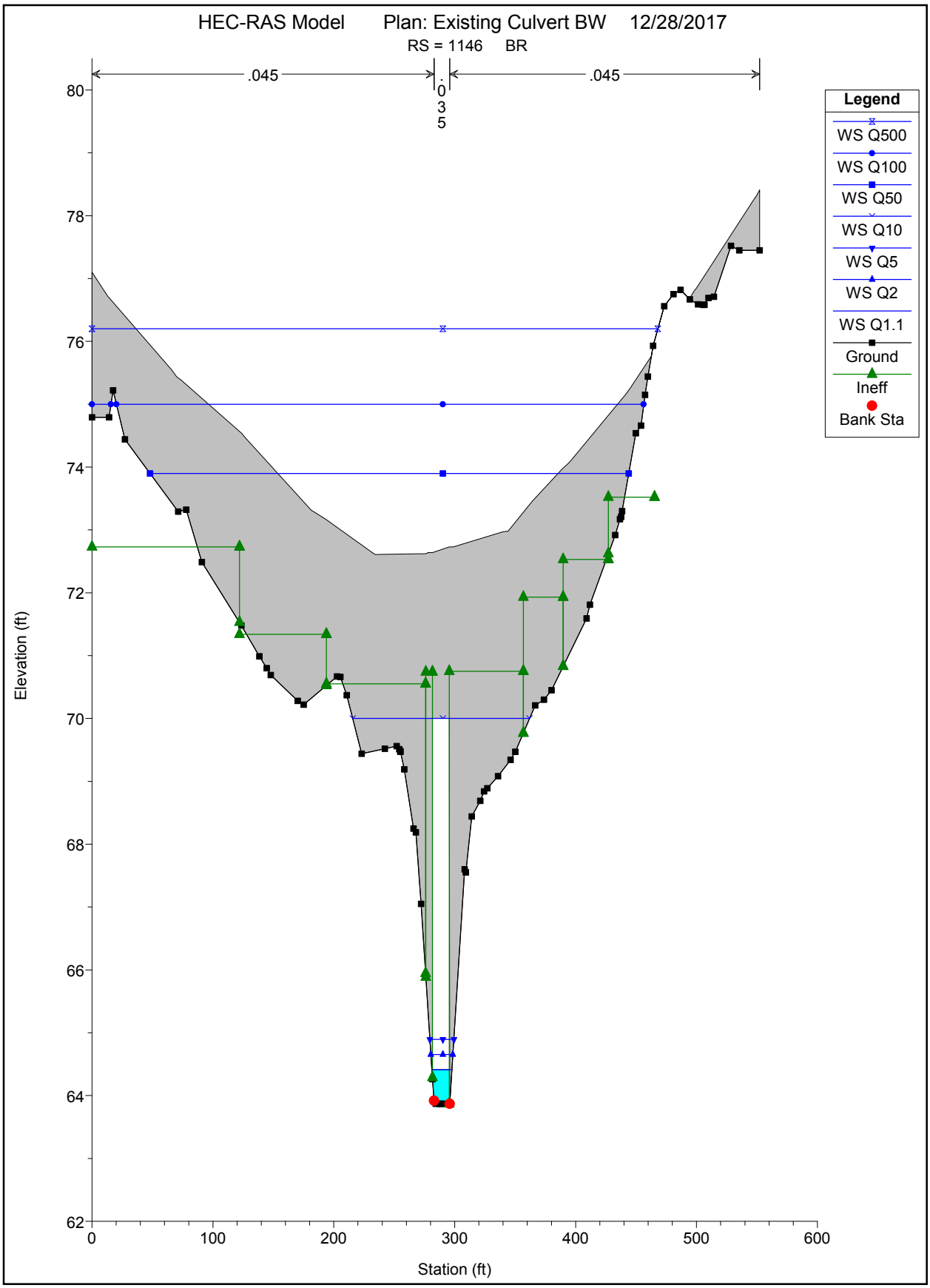

HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
RS = 1706
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Bank Sta
Elevation (ft)
80
75
70
65
60
-200
-100
0
100
200
300
400
500
600
Station (ft)

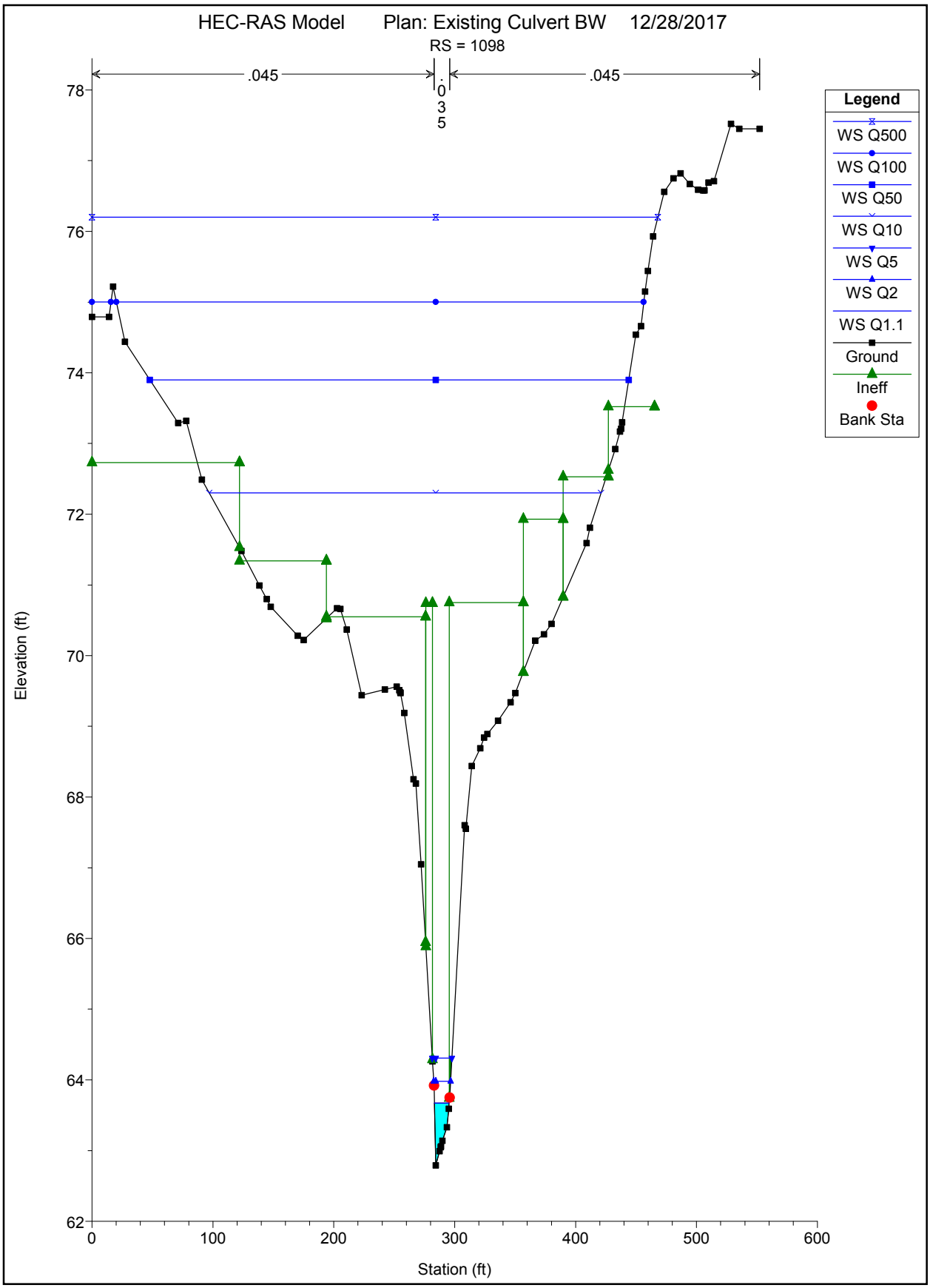

HEC-RAS Model
Plan: Existing Culvert BW
12/28/2017
RS = 1581
.085
.045
.035
.045
.085
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
-100
0
100
200
300
400
500
600
Station (ft)

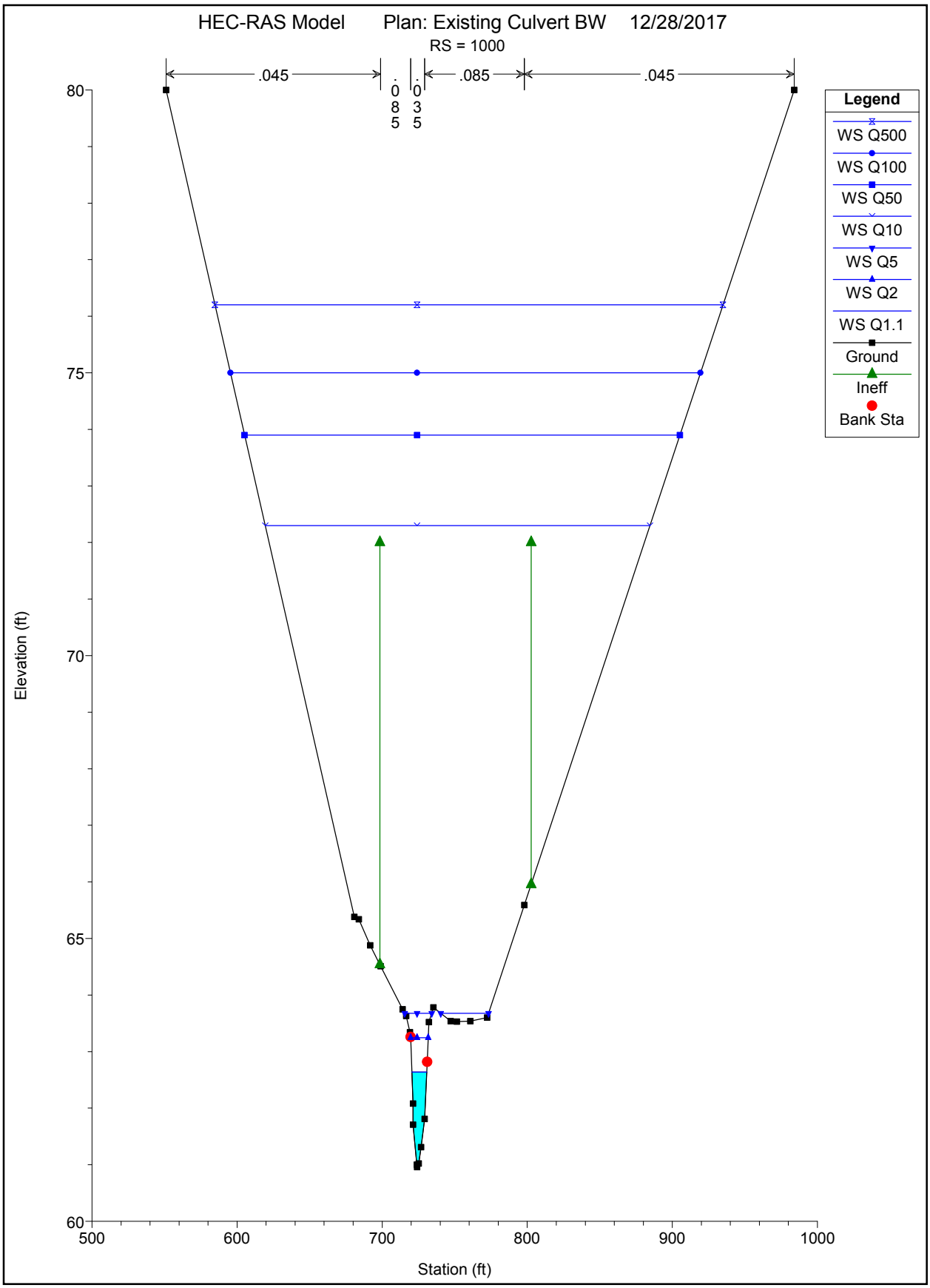

HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
RS = 1424
.085
.045
.035
.045
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
1000
1100
1200
1300
1400
1500
1600
Station (ft)

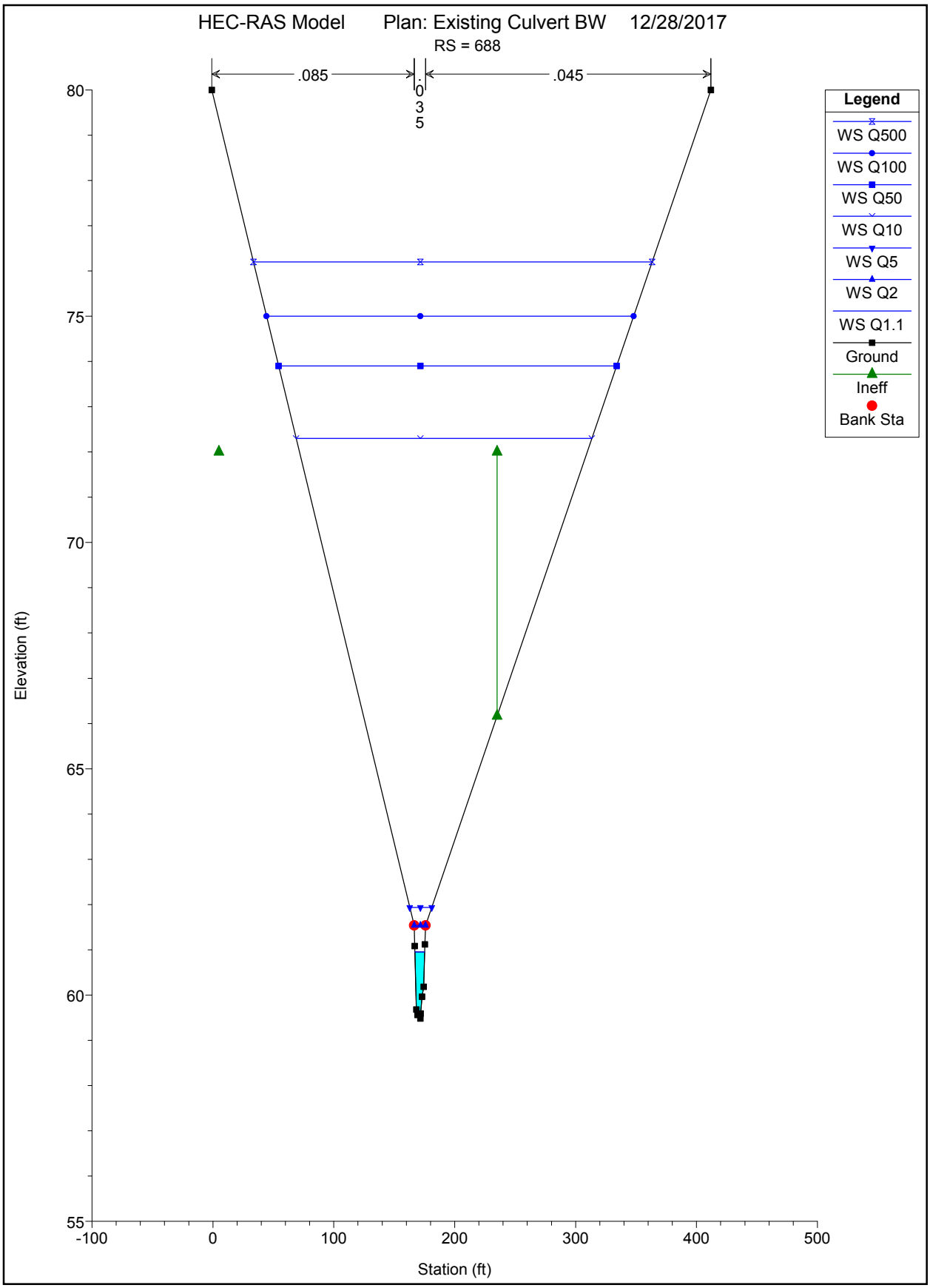

HEC-RAS Model
Plan: Existing Culvert BW
12/28/2017
RS = 1174
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600

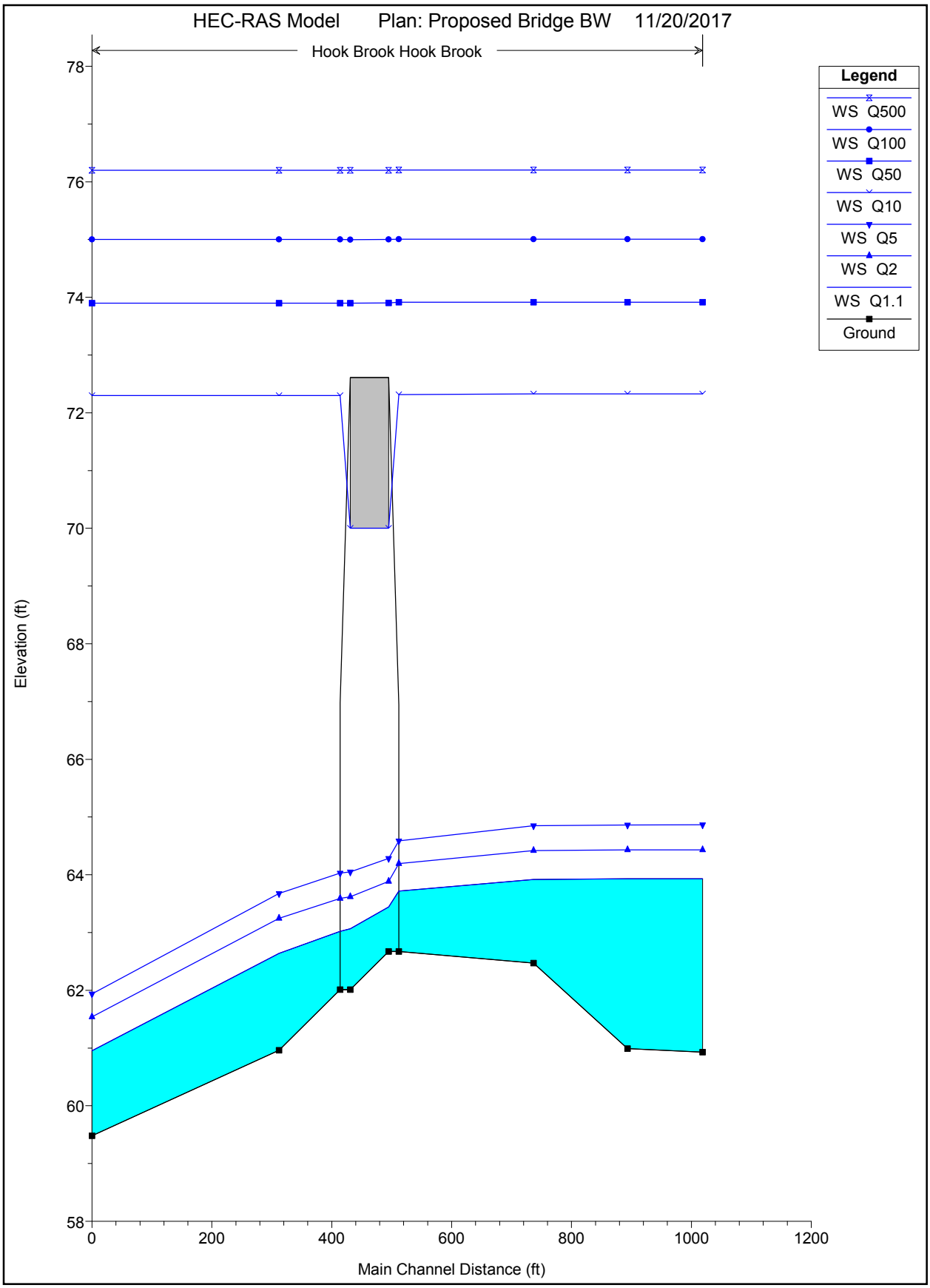

HEC-RAS Model
Plan: Existing Culvert BW
12/28/2017
RS = 1146
BR
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model
Plan: Existing Culvert BW
12/28/2017
RS = 1146
BR
.045
.045
.035
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
RS = 1098
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
RS = 1000
.045
.085
.045
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
500
600
700
800
900
1000
Station (ft)


HEC-RAS Model Plan: Existing Culvert BW 12/28/2017
RS = 688
.085
.045
0.035
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
75
70
65
60
55
-100
0
100
200
300
400
500


HEC-RAS Model Plan: Proposed Bridge BW 11/20/2017
Hook Brook Hook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Elevation (ft)
78
76
74
72
70
68
66
64
62
60
58
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

HEC-RAS Plan: Prop Bridge BW River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hook Brook	1706	Q1.1	26.50	60.93	63.93		63.93	0.000029	0.40	102.46	69.62	0.05
Hook Brook	1706	Q2	51.50	60.93	64.43		64.44	0.000051	0.60	166.92	185.94	0.06
Hook Brook	1706	Q5	78.50	60.93	64.87		64.87	0.000053	0.67	265.97	276.61	0.06
Hook Brook	1706	Q10	95.70	60.93	72.33		72.33	0.000000	0.05	3222.40	492.53	0.00
Hook Brook	1706	Q50	141.60	60.93	73.92		73.92	0.000000	0.06	4038.00	533.44	0.00
Hook Brook	1706	Q100	165.70	60.93	75.01		75.01	0.000000	0.06	4634.20	561.47	0.00
Hook Brook	1706	Q500	216.10	60.93	76.20		76.20	0.000000	0.07	5324.92	592.28	0.00
Hook Brook	1581	Q1.1	26.50	60.99	63.93	61.69	63.93	0.000014	0.32	137.46	113.62	0.03
Hook Brook	1581	Q2	51.50	60.99	64.43	61.90	64.43	0.000024	0.46	201.45	149.75	0.04
Hook Brook	1581	Q5	78.50	60.99	64.86	62.07	64.86	0.000029	0.55	274.39	189.06	0.05
Hook Brook	1581	Q10	95.70	60.99	72.33	62.17	72.33	0.000000	0.06	2823.62	411.14	0.00
Hook Brook	1581	Q50	141.60	60.99	73.92	62.38	73.92	0.000000	0.07	3498.70	438.05	0.00
Hook Brook	1581	Q100	165.70	60.99	75.01	62.48	75.01	0.000000	0.07	3985.48	456.48	0.00
Hook Brook	1581	Q500	216.10	60.99	76.20	62.65	76.20	0.000000	0.08	4533.67	476.74	0.00
Hook Brook	1424	Q1.1	26.50	62.47	63.92	63.11	63.92	0.000230	0.77	60.13	102.21	0.12
Hook Brook	1424	Q2	51.50	62.47	64.42	63.36	64.42	0.000158	0.79	122.78	147.41	0.10
Hook Brook	1424	Q5	78.50	62.47	64.85	63.48	64.86	0.000112	0.77	193.47	177.16	0.09
Hook Brook	1424	Q10	95.70	62.47	72.33	63.55	72.33	0.000000	0.07	2005.91	326.35	0.00
Hook Brook	1424	Q50	141.60	62.47	73.92	63.73	73.92	0.000000	0.09	2667.21	355.08	0.00
Hook Brook	1424	Q100	165.70	62.47	75.01	63.80	75.01	0.000000	0.09	3064.61	374.75	0.00
Hook Brook	1424	Q500	216.10	62.47	76.20	63.94	76.20	0.000000	0.10	3526.27	396.39	0.00
Hook Brook	1192	Q1.1	26.50	62.67	63.72	63.24	63.79	0.002739	2.28	12.62	30.70	0.39
Hook Brook	1192	Q2	51.50	62.67	64.19	63.55	64.32	0.002794	2.96	19.04	44.55	0.42
Hook Brook	1192	Q5	78.50	62.67	64.59	63.84	64.77	0.002897	3.52	24.41	65.38	0.45
Hook Brook	1192	Q10	95.70	62.67	72.32	63.99	72.33	0.000018	0.81	128.80	352.01	0.05
Hook Brook	1192	Q50	141.60	62.67	73.92	64.35	73.92	0.000001	0.17	1931.16	389.53	0.01
Hook Brook	1192	Q100	165.70	62.67	75.00	64.52	75.01	0.000000	0.15	2700.16	413.35	0.01
Hook Brook	1192	Q500	216.10	62.67	76.20	64.85	76.20	0.000001	0.17	3379.74	441.52	0.01
Hook Brook	1146		Bridge									
Hook Brook	1098	Q1.1	26.50	62.01	63.02	62.58	63.10	0.002919	2.29	12.32	13.68	0.40
Hook Brook	1098	Q2	51.50	62.01	63.59	62.88	63.70	0.002288	2.74	20.44	15.23	0.39
Hook Brook	1098	Q5	78.50	62.01	64.03	63.15	64.18	0.002243	3.20	26.76	17.51	0.40
Hook Brook	1098	Q10	95.70	62.01	72.30	63.33	72.30	0.000002	0.28	784.62	298.30	0.02
Hook Brook	1098	Q50	141.60	62.01	73.90	63.67	73.90	0.000001	0.26	1349.96	364.66	0.01
Hook Brook	1098	Q100	165.70	62.01	75.00	63.84	75.00	0.000001	0.22	1777.66	415.94	0.01
Hook Brook	1098	Q500	216.10	62.01	76.20	64.15	76.20	0.000001	0.22	2286.92	430.81	0.01
Hook Brook	1000	Q1.1	26.50	60.96	62.64	62.03	62.72	0.004734	2.33	11.35	10.25	0.39
Hook Brook	1000	Q2	51.50	60.96	63.24	62.43	63.37	0.004652	2.86	18.12	12.06	0.40
Hook Brook	1000	Q5	78.50	60.96	63.68	62.76	63.85	0.004637	3.36	28.05	51.46	0.42
Hook Brook	1000	Q10	95.70	60.96	72.30	62.95	72.30	0.000001	0.12	1487.00	265.24	0.01
Hook Brook	1000	Q50	141.60	60.96	73.90	63.36	73.90	0.000001	0.13	1939.28	300.10	0.01
Hook Brook	1000	Q100	165.70	60.96	75.00	63.91	75.00	0.000001	0.13	2282.56	324.07	0.01
Hook Brook	1000	Q500	216.10	60.96	76.20	64.17	76.20	0.000001	0.14	2687.13	350.21	0.01
Hook Brook	688	Q1.1	26.50	59.48	60.95	60.54	61.10	0.005701	3.09	8.57	8.14	0.53
Hook Brook	688	Q2	51.50	59.48	61.54	60.98	61.76	0.005703	3.75	13.72	9.49	0.55
Hook Brook	688	Q5	78.50	59.48	61.94	61.36	62.24	0.005708	4.42	19.24	18.18	0.57
Hook Brook	688	Q10	95.70	59.48	72.30	61.56	72.30	0.000001	0.16	1380.84	244.62	0.01
Hook Brook	688	Q50	141.60	59.48	73.90	62.15	73.90	0.000001	0.18	1800.20	279.58	0.01
Hook Brook	688	Q100	165.70	59.48	75.00	62.38	75.00	0.000001	0.18	2120.96	303.62	0.01
Hook Brook	688	Q500	216.10	59.48	76.20	62.76	76.20	0.000001	0.20	2501.04	329.84	0.01

HEC-RAS Plan: Prop Bridge BW River: Hook Brook Reach: Hook Brook

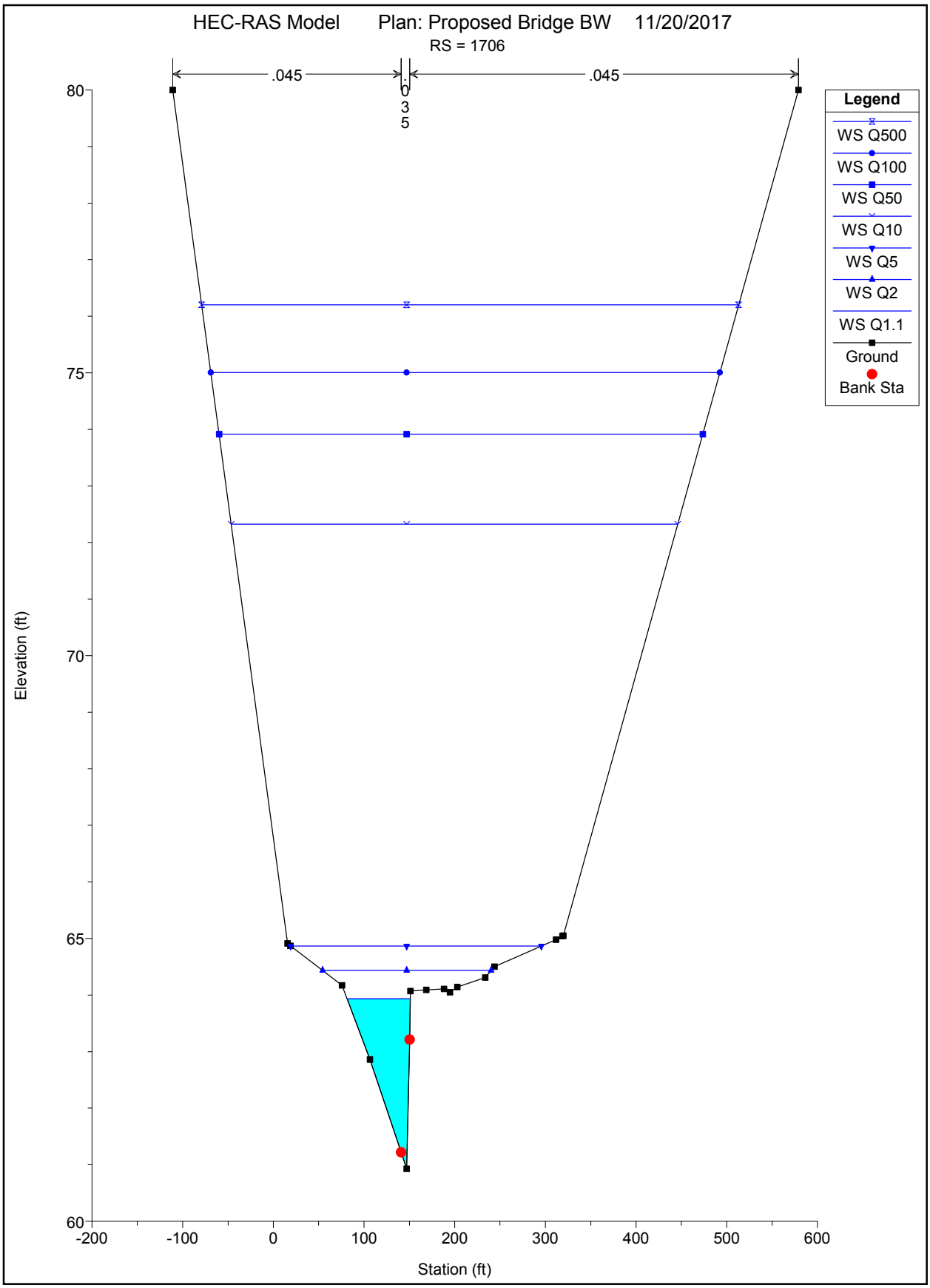
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Hook Brook	1706	Q1.1	63.93	63.93	0.00	0.00	0.00	16.92	9.57	0.01	69.62
Hook Brook	1706	Q2	64.44	64.43	0.00	0.00	0.00	31.94	17.06	2.51	185.94
Hook Brook	1706	Q5	64.87	64.87	0.00	0.00	0.00	45.26	21.75	11.49	276.61
Hook Brook	1706	Q10	72.33	72.33	0.00	0.00	0.00	40.63	5.21	49.85	492.53
Hook Brook	1706	Q50	73.92	73.92	0.00	0.00	0.00	59.08	7.03	75.50	533.44
Hook Brook	1706	Q100	75.01	75.01	0.00	0.00	0.00	68.44	7.78	89.48	561.47
Hook Brook	1706	Q500	76.20	76.20	0.00	0.00	0.00	88.38	9.62	118.11	592.28
Hook Brook	1581	Q1.1	63.93	63.93	0.00	0.01	0.00	5.57	8.89	12.04	113.62
Hook Brook	1581	Q2	64.43	64.43	0.00	0.01	0.00	13.92	15.23	22.35	149.75
Hook Brook	1581	Q5	64.86	64.86	0.00	0.01	0.00	23.36	20.47	34.67	189.06
Hook Brook	1581	Q10	72.33	72.33	0.00	0.00	0.00	35.23	6.45	54.02	411.14
Hook Brook	1581	Q50	73.92	73.92	0.00	0.00	0.00	51.91	8.73	80.96	438.05
Hook Brook	1581	Q100	75.01	75.01	0.00	0.00	0.00	60.46	9.70	95.53	456.48
Hook Brook	1581	Q500	76.20	76.20	0.00	0.00	0.00	78.20	12.00	125.91	476.74
Hook Brook	1424	Q1.1	63.92	63.92	0.00	0.12	0.01	10.71	10.20	5.59	102.21
Hook Brook	1424	Q2	64.42	64.42	0.00	0.09	0.01	19.98	14.44	17.08	147.41
Hook Brook	1424	Q5	64.86	64.85	0.00	0.07	0.02	28.91	17.35	32.23	177.16
Hook Brook	1424	Q10	72.33	72.33	0.00	0.00	0.00	35.79	7.23	52.68	326.35
Hook Brook	1424	Q50	73.92	73.92	0.00	0.00	0.00	55.99	9.83	75.78	355.08
Hook Brook	1424	Q100	75.01	75.01	0.00	0.00	0.00	66.42	11.09	88.20	374.75
Hook Brook	1424	Q500	76.20	76.20	0.00	0.00	0.00	87.73	13.94	114.43	396.39
Hook Brook	1192	Q1.1	63.79	63.72	0.08	0.09	0.04	0.66	24.79	1.05	30.70
Hook Brook	1192	Q2	64.32	64.19	0.13	0.08	0.05	1.26	46.82	3.42	44.55
Hook Brook	1192	Q5	64.77	64.59	0.18	0.08	0.05	1.90	70.25	6.36	65.38
Hook Brook	1192	Q10	72.33	72.32	0.01			2.21	81.08	12.41	352.01
Hook Brook	1192	Q50	73.92	73.92	0.00	0.00	0.00	73.10	19.55	48.95	389.53
Hook Brook	1192	Q100	75.01	75.00	0.00	0.00	0.00	91.97	19.88	53.85	413.35
Hook Brook	1192	Q500	76.20	76.20	0.00	0.00	0.00	117.98	24.17	73.95	441.52
Hook Brook	1146		Bridge								
Hook Brook	1098	Q1.1	63.10	63.02	0.08	0.37	0.00	0.91	25.22	0.38	13.68
Hook Brook	1098	Q2	63.70	63.59	0.11	0.32	0.01	2.86	47.36	1.27	15.23
Hook Brook	1098	Q5	64.18	64.03	0.15	0.32	0.01	5.40	70.69	2.40	17.51
Hook Brook	1098	Q10	72.30	72.30	0.00	0.00	0.00	31.78	31.97	31.95	298.30
Hook Brook	1098	Q50	73.90	73.90	0.00	0.00	0.00	56.90	33.90	50.80	364.66
Hook Brook	1098	Q100	75.00	75.00	0.00	0.00	0.00	73.07	32.06	60.57	415.94
Hook Brook	1098	Q500	76.20	76.20	0.00	0.00	0.00	103.02	34.16	78.92	430.81
Hook Brook	1000	Q1.1	62.72	62.64	0.08	1.62	0.01		26.50		10.25
Hook Brook	1000	Q2	63.37	63.24	0.13	1.60	0.01		51.44	0.06	12.06
Hook Brook	1000	Q5	63.85	63.68	0.17	1.60	0.01	0.27	76.89	1.34	51.46
Hook Brook	1000	Q10	72.30	72.30	0.00	0.00	0.00	33.38	14.20	48.12	265.24
Hook Brook	1000	Q50	73.90	73.90	0.00	0.00	0.00	50.88	18.15	72.57	300.10
Hook Brook	1000	Q100	75.00	75.00	0.00	0.00	0.00	60.43	19.44	85.83	324.07
Hook Brook	1000	Q500	76.20	76.20	0.00	0.00	0.00	79.84	23.21	113.06	350.21
Hook Brook	688	Q1.1	61.10	60.95	0.15				26.50		8.14
Hook Brook	688	Q2	61.76	61.54	0.22				51.50		9.49
Hook Brook	688	Q5	62.24	61.94	0.30			0.32	77.32	0.86	18.18
Hook Brook	688	Q10	72.30	72.30	0.00			21.19	18.01	56.50	244.62
Hook Brook	688	Q50	73.90	73.90	0.00			32.27	23.27	86.06	279.58
Hook Brook	688	Q100	75.00	75.00	0.00			38.36	25.04	102.30	303.62
Hook Brook	688	Q500	76.20	76.20	0.00			50.75	30.01	135.33	329.84

HEC-RAS Plan: Prop Bridge BW River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Hook Brook	1146	Q1.1	63.79	70.00	94.24		26.50	72.65		0.70
Hook Brook	1146	Q2	64.32	70.00	94.24		51.50	72.65		0.62
Hook Brook	1146	Q5	64.77	70.00	94.24		78.50	72.65		0.59
Hook Brook	1146	Q10	72.33	70.00	94.24	72.32	95.70	72.65		0.02
Hook Brook	1146	Q50	73.92	70.00	94.24		141.60	72.65		0.02
Hook Brook	1146	Q100	75.01	70.00	94.24		165.70	72.65		0.00
Hook Brook	1146	Q500	76.20	70.00	94.24		216.10	72.65		0.00

HEC-RAS Plan: Prop Bridge BW River: Hook Brook Reach: Hook Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Hook Brook	1424	Q1.1	63.92	63.92	63.11	0.12	0.01	102.21	10.71	10.20	5.59	0.77
Hook Brook	1424	Q2	64.42	64.42	63.36	0.09	0.01	147.41	19.98	14.44	17.08	0.79
Hook Brook	1424	Q5	64.86	64.85	63.48	0.07	0.02	177.16	28.91	17.35	32.23	0.77
Hook Brook	1424	Q10	72.33	72.33	63.55	0.00	0.00	326.35	35.79	7.23	52.68	0.07
Hook Brook	1424	Q50	73.92	73.92	63.73	0.00	0.00	355.08	55.99	9.83	75.78	0.09
Hook Brook	1424	Q100	75.01	75.01	63.80	0.00	0.00	374.75	66.42	11.09	88.20	0.09
Hook Brook	1424	Q500	76.20	76.20	63.94	0.00	0.00	396.39	87.73	13.94	114.43	0.10
Hook Brook	1192	Q1.1	63.79	63.72	63.24	0.09	0.04	30.70	0.66	24.79	1.05	2.28
Hook Brook	1192	Q2	64.32	64.19	63.55	0.08	0.05	44.55	1.26	46.82	3.42	2.96
Hook Brook	1192	Q5	64.77	64.59	63.84	0.08	0.05	65.38	1.90	70.25	6.36	3.52
Hook Brook	1192	Q10	72.33	72.32	63.99			352.01	2.21	81.08	12.41	0.81
Hook Brook	1192	Q50	73.92	73.92	64.35	0.00	0.00	389.53	73.10	19.55	48.95	0.17
Hook Brook	1192	Q100	75.01	75.00	64.52	0.00	0.00	413.35	91.97	19.88	53.85	0.15
Hook Brook	1192	Q500	76.20	76.20	64.85	0.00	0.00	441.52	117.98	24.17	73.95	0.17
Hook Brook	1146 BR U	Q1.1	63.66	63.44	63.34	0.44	0.06	10.44		25.83	0.67	3.79
Hook Brook	1146 BR U	Q2	64.18	63.88	63.69	0.34	0.08	11.65		49.43	2.07	4.47
Hook Brook	1146 BR U	Q5	64.64	64.28	63.96	0.31	0.08	13.81	0.10	74.02	4.38	4.88
Hook Brook	1146 BR U	Q10	72.33	70.00	64.17			13.81	0.35	83.48	11.87	1.12
Hook Brook	1146 BR U	Q50	73.91	73.90	64.55	0.01	0.00	213.67	21.90	87.57	32.13	1.00
Hook Brook	1146 BR U	Q100	75.00	75.00	64.73	0.00	0.00	311.51	43.17	62.30	60.24	0.63
Hook Brook	1146 BR U	Q500	76.20	76.20	65.06	0.00	0.00	406.04	68.84	50.13	97.14	0.45
Hook Brook	1146 BR D	Q1.1	63.17	63.07	62.66	0.06	0.01	11.32	0.01	26.49	0.00	2.56
Hook Brook	1146 BR D	Q2	63.76	63.62	63.01	0.05	0.02	13.81	0.50	50.60	0.40	3.08
Hook Brook	1146 BR D	Q5	64.24	64.05	63.29	0.04	0.02	13.81	1.47	75.61	1.42	3.57
Hook Brook	1146 BR D	Q10	72.30	70.00	63.49			13.81	2.35	87.87	5.49	1.01
Hook Brook	1146 BR D	Q50	73.90	73.90	63.86	0.00	0.00	213.15	36.04	85.01	20.55	0.85
Hook Brook	1146 BR D	Q100	75.00	75.00	64.04	0.00	0.00	311.33	65.30	57.35	43.04	0.51
Hook Brook	1146 BR D	Q500	76.20	76.20	64.38	0.00	0.00	397.26	99.72	44.26	72.12	0.35
Hook Brook	1098	Q1.1	63.10	63.02	62.58	0.37	0.00	13.68	0.91	25.22	0.38	2.29
Hook Brook	1098	Q2	63.70	63.59	62.88	0.32	0.01	15.23	2.86	47.36	1.27	2.74
Hook Brook	1098	Q5	64.18	64.03	63.15	0.32	0.01	17.51	5.40	70.69	2.40	3.20
Hook Brook	1098	Q10	72.30	72.30	63.33	0.00	0.00	298.30	31.78	31.97	31.95	0.28
Hook Brook	1098	Q50	73.90	73.90	63.67	0.00	0.00	364.66	56.90	33.90	50.80	0.26
Hook Brook	1098	Q100	75.00	75.00	63.84	0.00	0.00	415.94	73.07	32.06	60.57	0.22
Hook Brook	1098	Q500	76.20	76.20	64.15	0.00	0.00	430.81	103.02	34.16	78.92	0.22
Hook Brook	1000	Q1.1	62.72	62.64	62.03	1.62	0.01	10.25		26.50		2.33
Hook Brook	1000	Q2	63.37	63.24	62.43	1.60	0.01	12.06		51.44	0.06	2.86
Hook Brook	1000	Q5	63.85	63.68	62.76	1.60	0.01	51.46	0.27	76.89	1.34	3.36
Hook Brook	1000	Q10	72.30	72.30	62.95	0.00	0.00	265.24	33.38	14.20	48.12	0.12
Hook Brook	1000	Q50	73.90	73.90	63.36	0.00	0.00	300.10	50.88	18.15	72.57	0.13
Hook Brook	1000	Q100	75.00	75.00	63.91	0.00	0.00	324.07	60.43	19.44	85.83	0.13
Hook Brook	1000	Q500	76.20	76.20	64.17	0.00	0.00	350.21	79.84	23.21	113.06	0.14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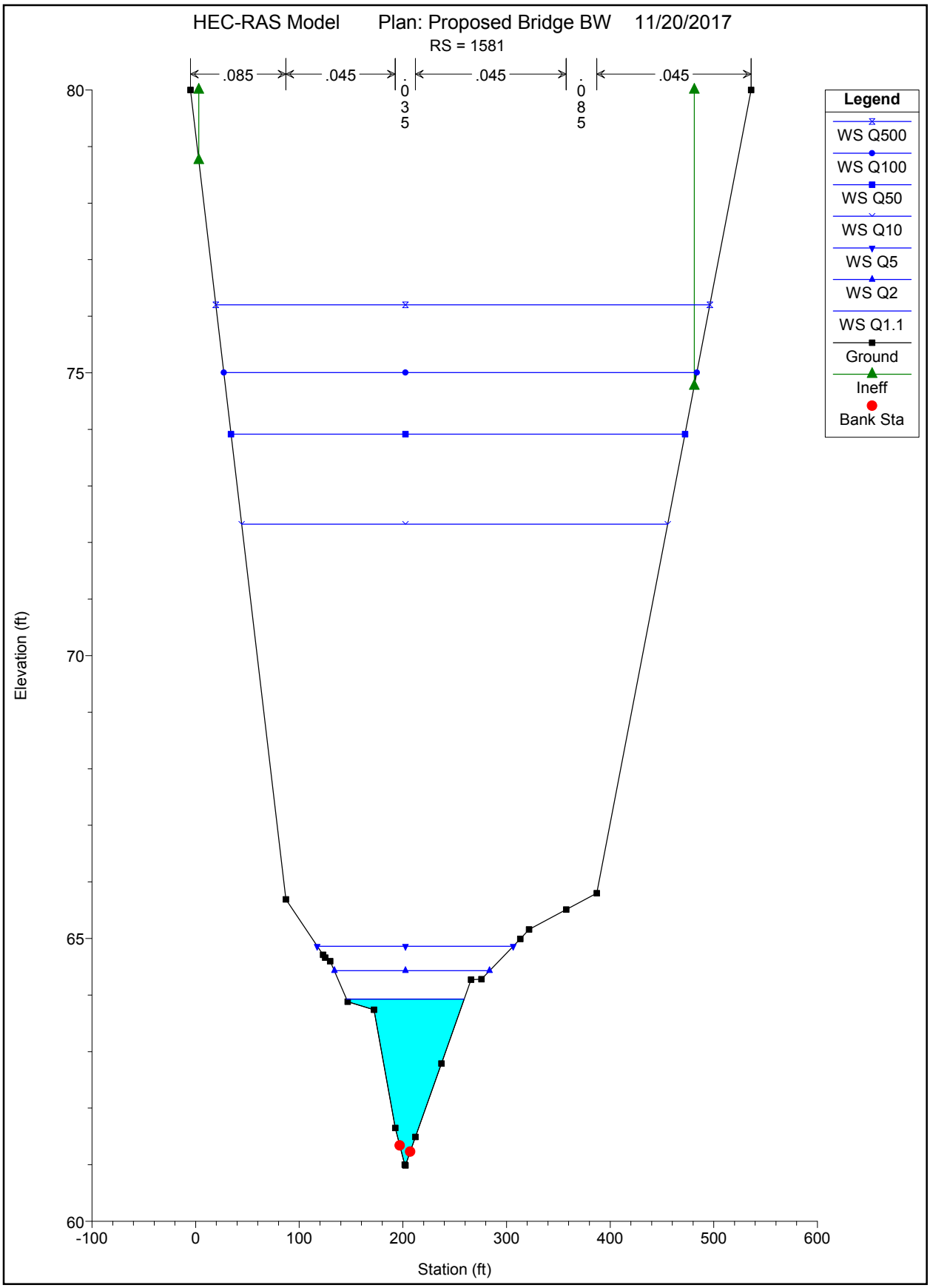
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Bank Sta
Elevation (ft)
80
75
70
65
60
-200
-100
0
100
200
300
400
500
600
Station (ft)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Plan: Proposed Bridge BW
11/20/2017
RS = 1581
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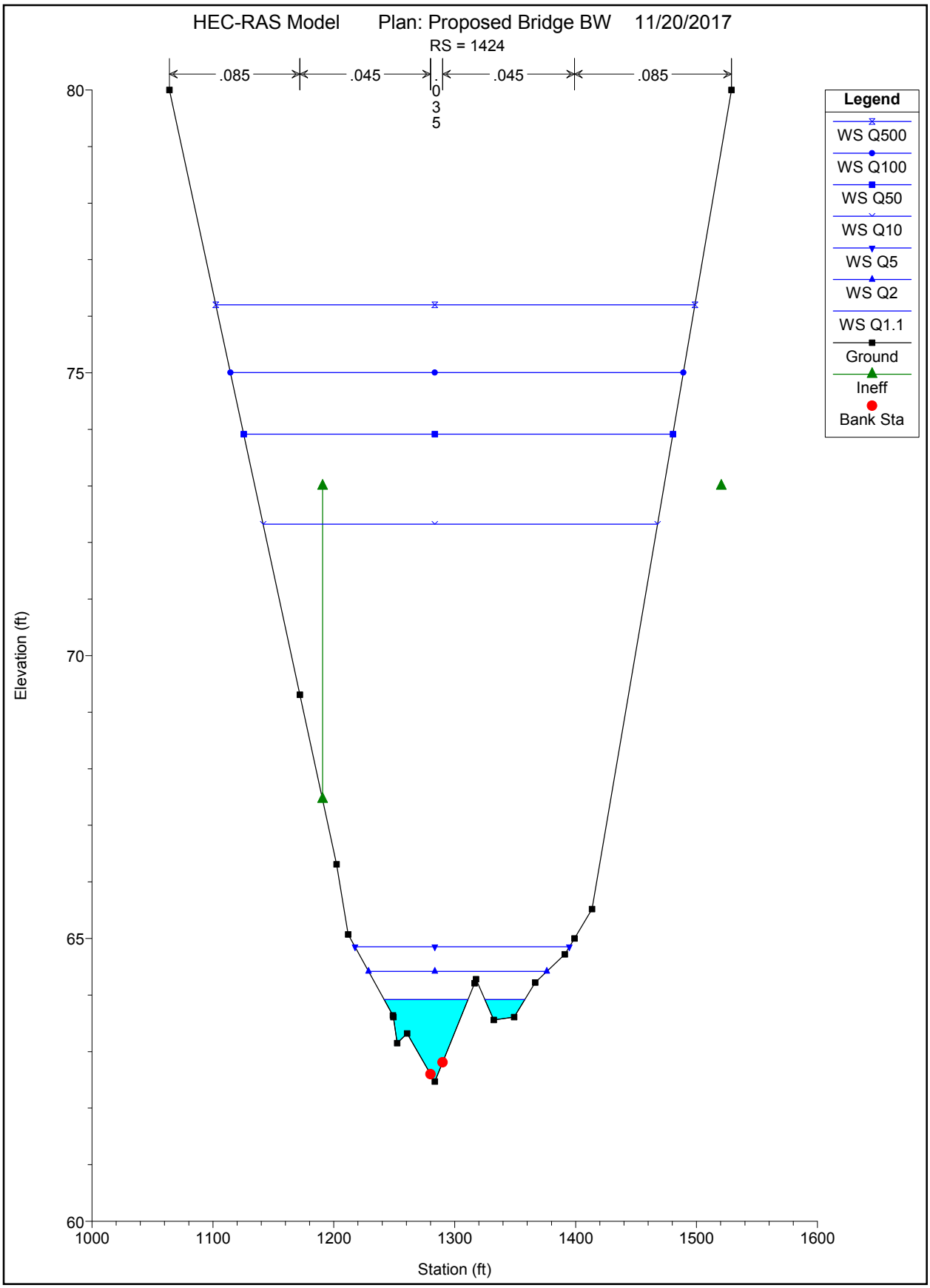
.045
.035
.045
.085
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
-100
0
100
200
300
400
500
600
Station (ft)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Plan: Proposed Bridge BW
11/20/2017
RS = 1424
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.045
.035
.045
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
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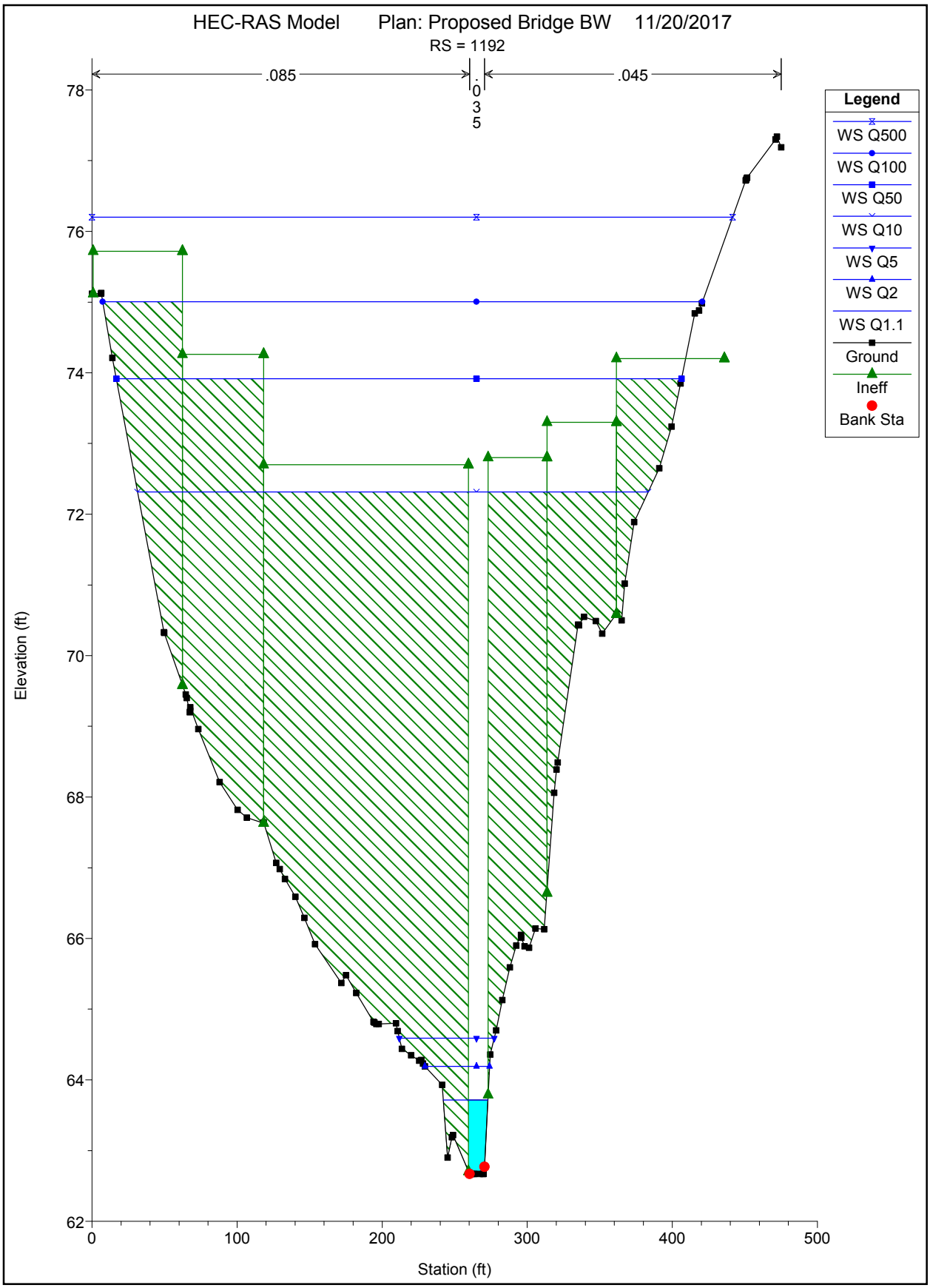
75
70
65
60
1000
1100
1200
1300
1400
1500
1600
Station (ft)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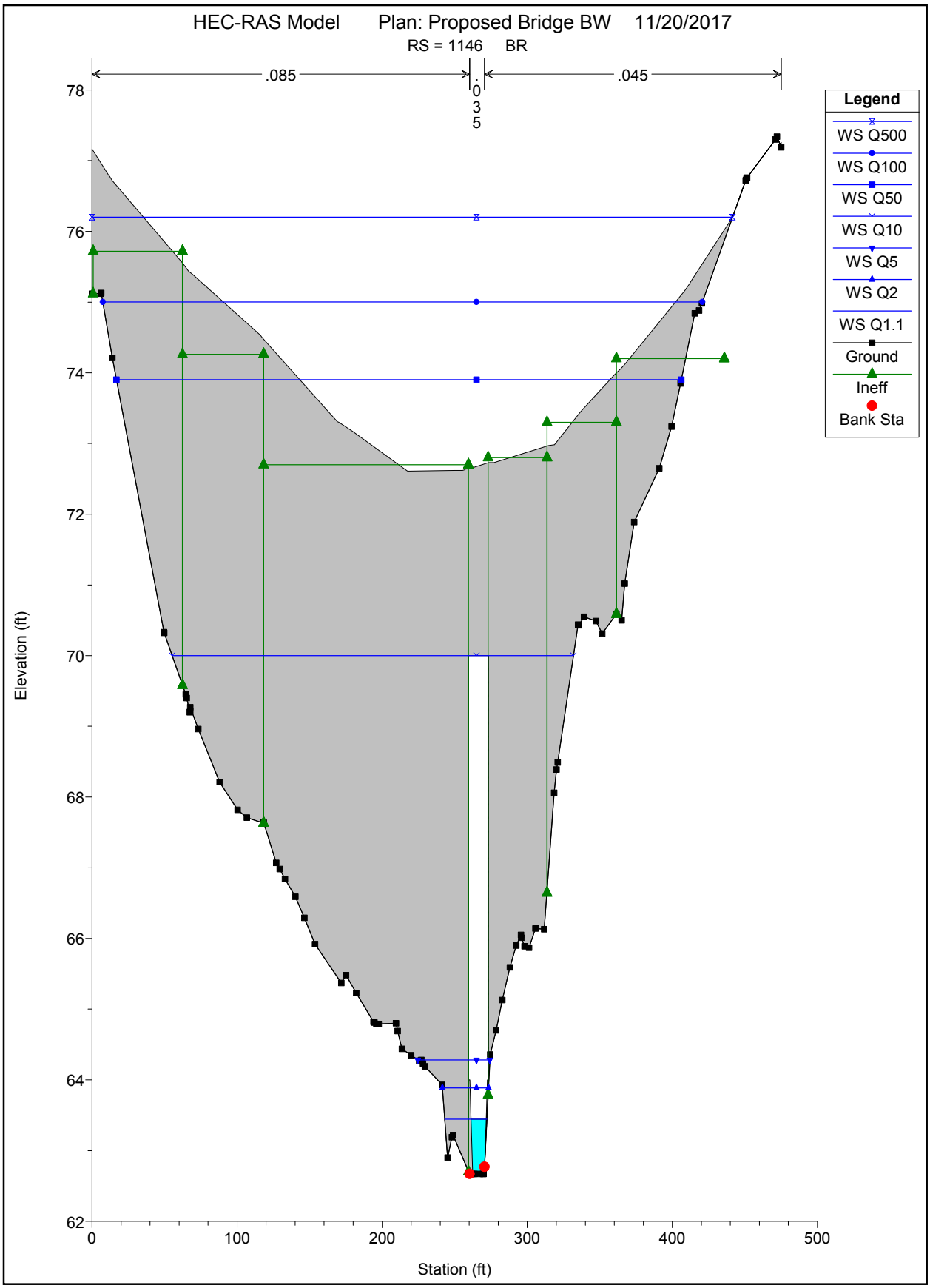
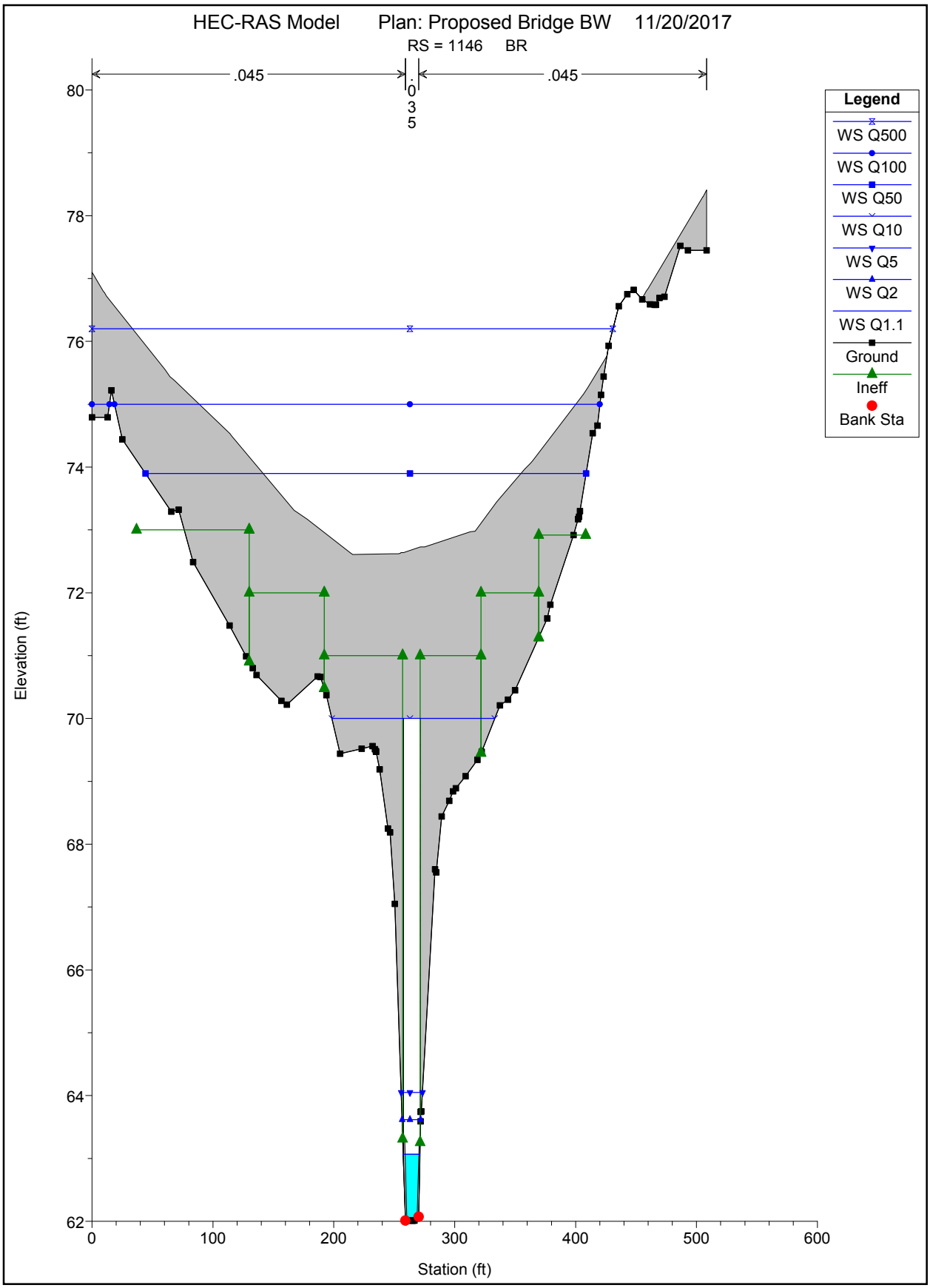
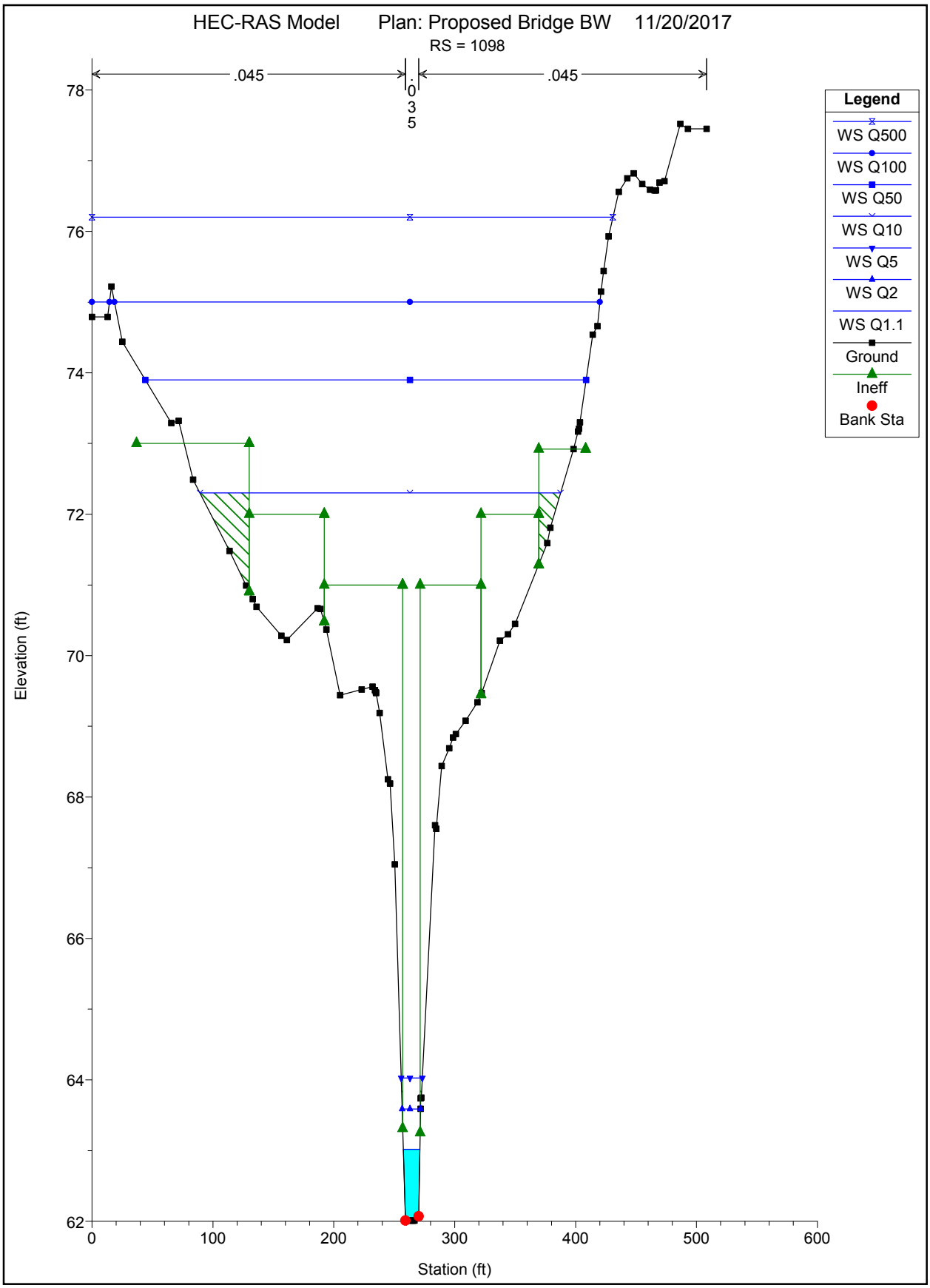
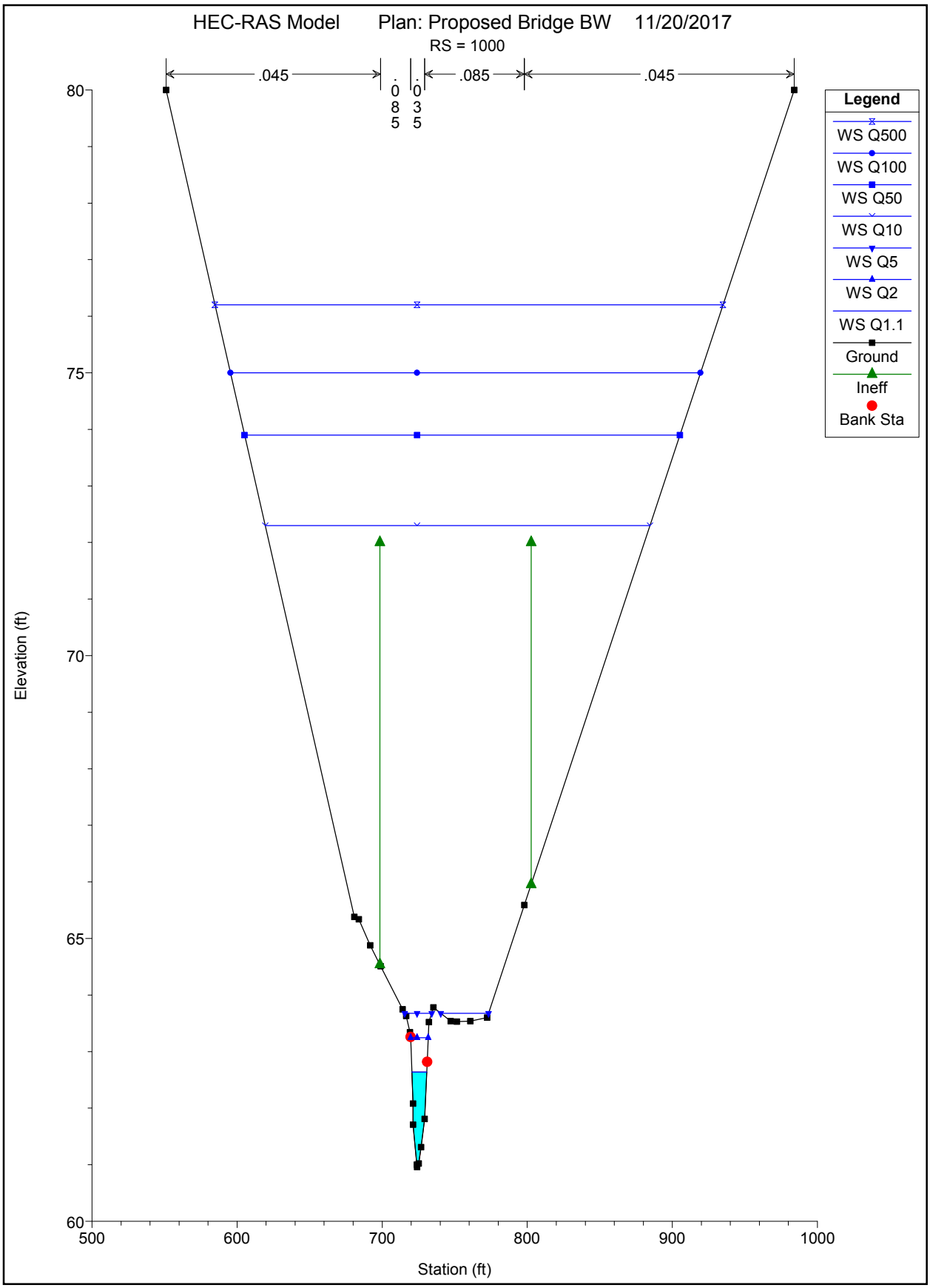
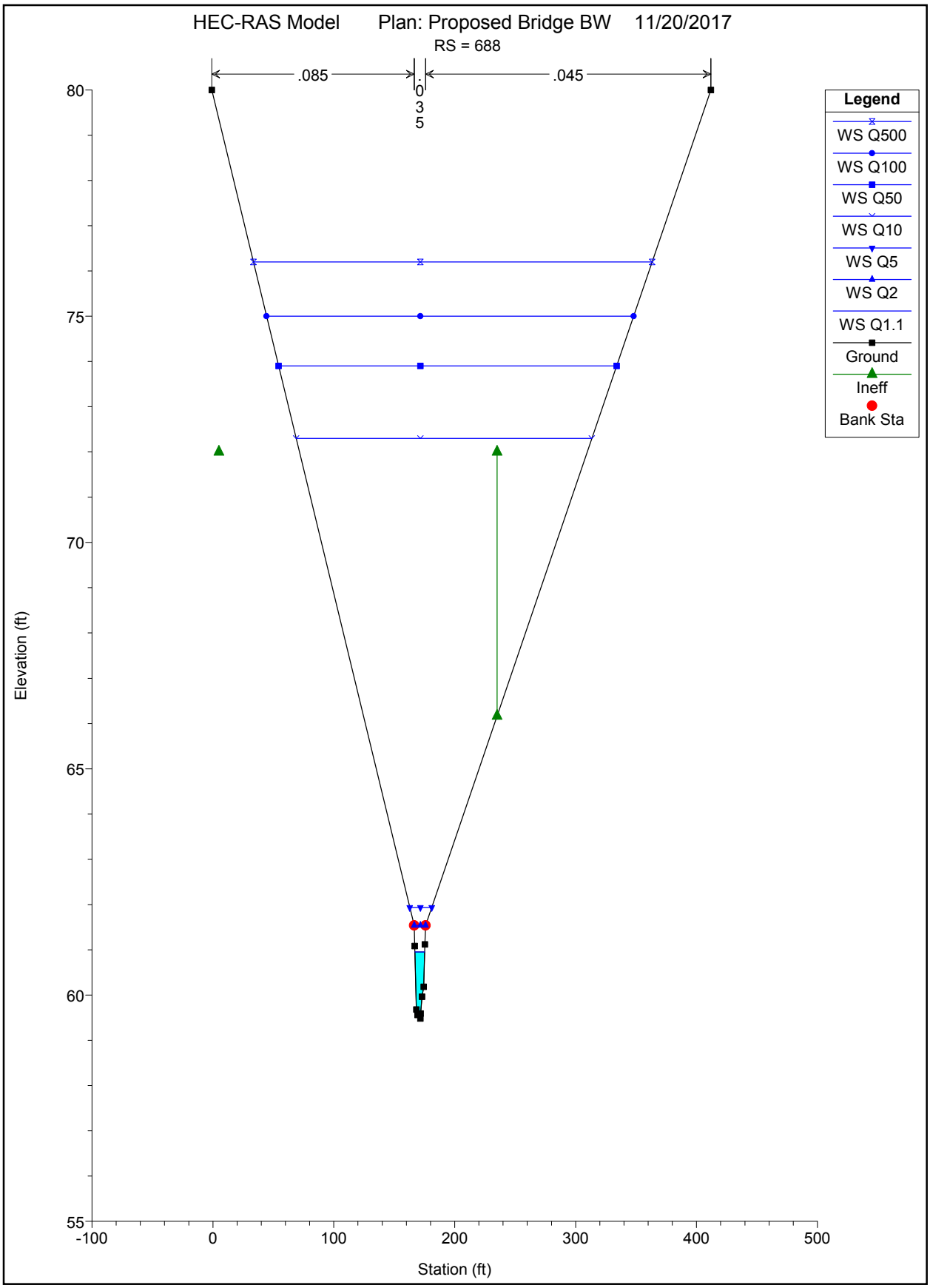
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500


HEC-RAS Model
Plan: Proposed Bridge BW
11/20/2017
RS = 1146
BR
.085
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500


HEC-RAS Model
Plan: Proposed Bridge BW
11/20/2017
RS = 1146
BR
.045
.045
.035
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Proposed Bridge BW 11/20/2017
RS = 1098
.045
.035
.045
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
78
76
74
72
70
68
66
64
62
0
100
200
300
400
500
600


HEC-RAS Model Plan: Proposed Bridge BW 11/20/2017
RS = 1000
.045
.085
.045
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
80
75
70
65
60
500
600
700
800
900
1000
Station (ft)


HEC-RAS Model
Plan: Proposed Bridge BW
11/20/2017
RS = 688
.085
.045
0
3
5
Legend
WS Q500
WS Q100
WS Q50
WS Q10
WS Q5
WS Q2
WS Q1.1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
80
75
70
65
60
55
-100
0
100
200
300
400
500