Ballentine Associates, P.A.

FINAL
FLOOD ANALYSIS
for
FORDHAM BLVD. APARTMENTS
CHAPEL HILL, NORTH CAROLINA

PREPARED FOR:

RAM REALTY SERVICES
1930 Camden Rd.
Charlotte, NC 28203

Prepared by:

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NORTH CAROLINA PROFESSIONAL SEAL 029127 ENGINEER GEORGE J. RETSCHLE
20 APR 17

Issue Dates	Description
26 Jan 17	Preliminary Study
21 Apr 17	Final Study

Purpose of Study

Ram Realty Services desires to redevelop the existing Days Inn hotel property and a portion of what is currently the Village Plaza Shopping Center property in the NW quadrant of the US 15/501 & S. Elliot Road intersection. The redevelopment will require that fill be placed in the floodplain of Booker Creek and the purpose of this study is to determine the effects that this project will have on the Booker Creek base flood elevations and to demonstrate compliance with The Town of Chapel Hill's Flood Damage Prevention Ordinance, which is located in Chapter 5, Article IV, of the Chapel Hill Code of Ordinances.

Description of Study

This study was performed using HEC-RAS 5.0, which was developed by the US Army Corps of Engineers and is an acronym for Hydraulic Engineering Center River Analysis System. The study was performed in the following three parts:

1. Duplicate Effective:

   The effective HEC-RAS computer model input data and current, effective Flood Insurance Study (FIS) were obtained from the North Carolina Flood Mapping Program (NCFMP). The published FIS identification is #37135CV000, with an effective date of 2/2/2007, and revised on 5/16/2008. Pertinent sections of the published FIS can be found in Appendix A.

   The HEC-RAS model input data obtained from NCFMP was run using our HEC-RAS software and the results were compared to those published in the effective FIS. The results of this Duplicate Effective Model match the published FIS. Refer to Appendix A.

   Note: Because the Duplicate Effective model on file with NCFMP was corrected and updated in August 2015 as part of the Eastgate Building D Flood Study as discussed below, it is considered outdated for the purposes of this Fordham Boulevard Multi-Family Flood Study. The remainder of this study is therefore based on the "Proposed Conditions" model that was approved by the Town of Chapel Hill as part of the Eastgate Building D study.

2. Existing Conditions – with Eastgate Bldg D:

   In August of 2015, an application was submitted to construct Building D at Eastgate Shopping Center, just upstream from the subject site. A flood study entitled "Flood Analysis for Eastgate Shopping Center", prepared by Ballentine Associates and dated 26 Aug 15, was submitted as part of that application. The Eastgate Building D study was based on the same Duplicate Effective model as described in #1 above, except that a correction was made to the effective model to better represent the obstruction to overland flow created by the existing Eastgate buildings when the existing Eastgate culvert is surcharged. A new "Corrected Effective" model was created as part of the Eastgate Building D study reflecting this correction. The final model created as part of the Eastgate Building D study was the "Proposed Conditions" model, which is the Corrected Effective Model with additional conveyance removed to replicate the proposed Building D. A copy of the 2015 Eastgate Building D study is included in Appendix B.

The "Existing Conditions – with Eastgate Bldg D" model is exactly the same as the "Proposed Conditions" model approved with the 2015 Eastgate Building D study. Appendix B includes the results of a recent HEC RAS run of this model and it shows that the results are identical to those produced by the 2015 Eastgate Building D "Proposed Conditions" model.

3. Existing Conditions – with Eastgate Bldg D + New Sections:

   This "Existing Conditions – with Eastgate Bldg D + New Sections" model was created by adding six field-surveyed cross-sections to the "Existing Conditions – with Eastgate Bldg D" model along the length of the site, which increases the accuracy of the model for the area of the site. The model was run with the additional cross-sections and compared to the results of the "Existing Conditions – with Eastgate Bldg D" model. The more accurate "Existing Conditions – with Eastgate Bldg D + New Sections" model shows that the existing Base Flood Elevations are a maximum of 0.34' higher than those computed by the "Existing Conditions – with Eastgate Bldg D" model.

4. Proposed Conditions:

   The proposed redevelopment will consist of constructing a retaining wall just outside the floodway for most of the project's length and placing fill in the floodway fringe in order to elevate the habitable structures to a minimum of 2 feet above the 100-Yr. WSE. The "Proposed Conditions" model was created by modifying the cross sections in the "Existing Conditions – with Eastgate Bldg D + New Sections" model to reflect the proposed retaining wall and fill. These cross section geometry adjustments were the only changes made to the "Existing Conditions – with Eastgate Bldg D + New Sections" model in order to create the Proposed Conditions Model.

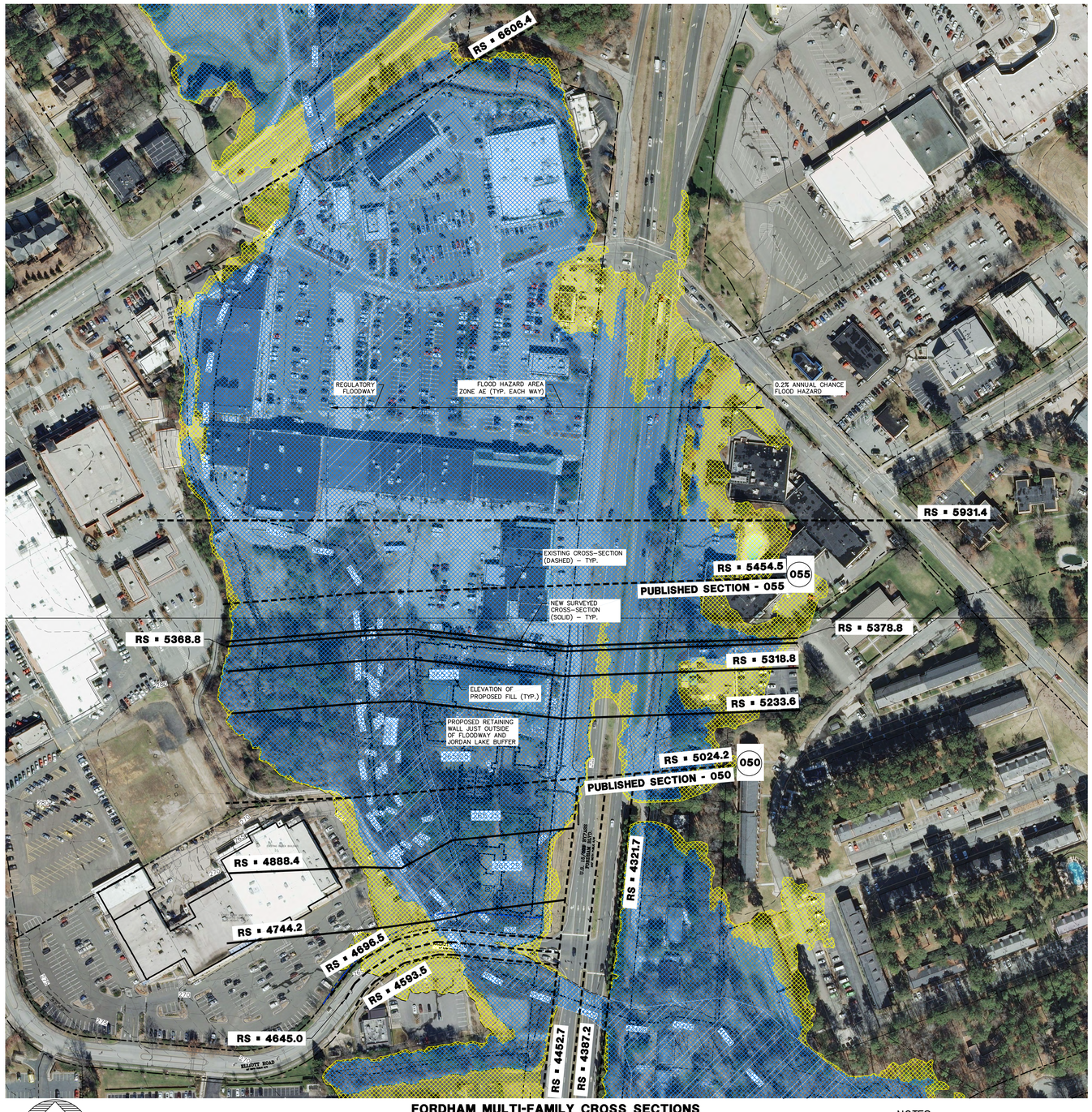
   The base flood elevations calculated by the Proposed Conditions Model increased slightly as compared to the "Existing Conditions – with Eastgate Bldg D + New Sections" model, with the maximum rise being 0.17' at Section 5454.5 (published section #55), which is just upstream of the subject property. Refer to Appendix D for output and exhibits related to the Proposed Conditions Model.

Conclusion

Section 5-60 (9) of Chapter 5, Article IV, of the Chapel Hill Code of Ordinances states:

Cutting and filling shall be permitted within the special flood hazard area outside of the floodway only if the cutting or filling will not increase the water surface elevation of the base flood more than one-half (0.5) foot at any point within the community.

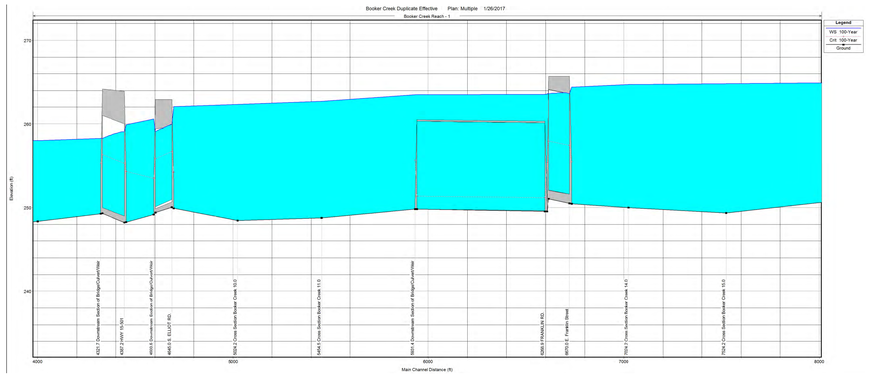
This study shows that the proposed fill in the floodway fringe will result in a maximum increase in the water surface elevation of the base flood of 0.17 feet at the worst location.



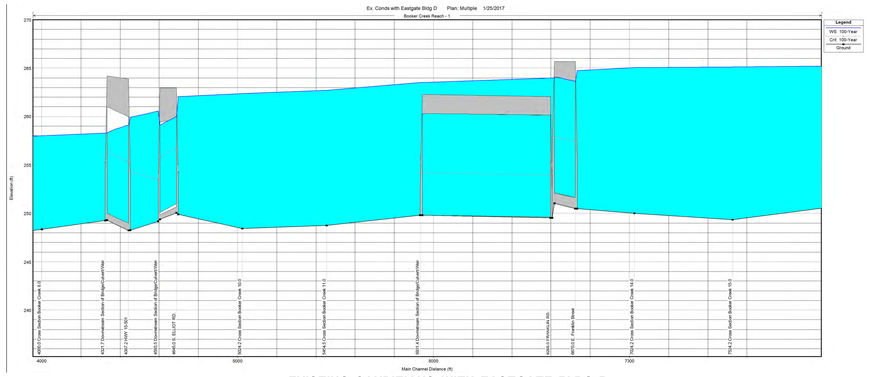
FORDHAM MULTI-FAMILY CROSS SECTIONS

(GRAPHIC SCALE IN FEET)
1 inch = 100 ft.

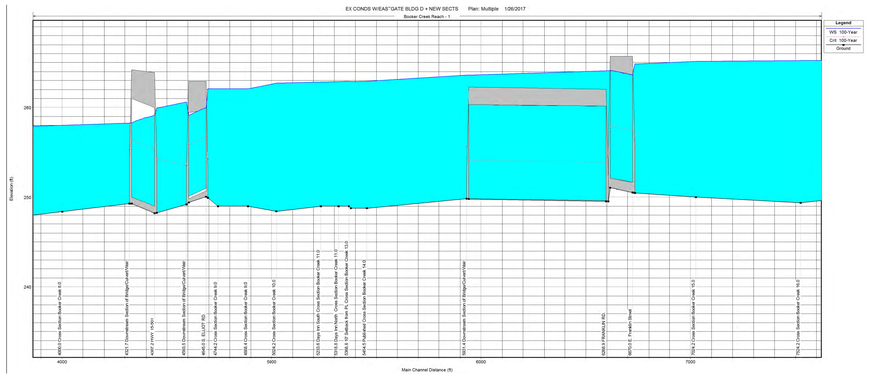
NC GRID NAD 83



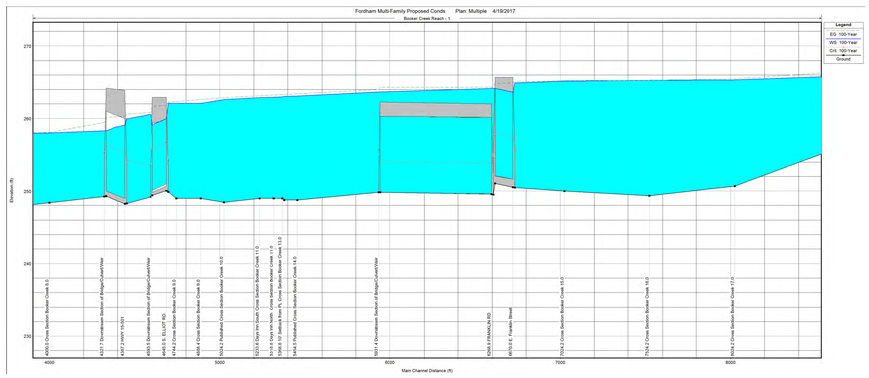
DUPLICATE EFFECTIVE



EXISTING CONDITIONS WITH EASTGATE BLDG D



EXISTING CONDITIONS WITH EASTGATE BLDG D + NEW SECTIONS



PROPOSED CONDITIONS

NOTES

1. EXISTING TOPOGRAPHY SHOWN ON THE SUBJECT PROPERTY WAS OBTAINED BY BALLENTINE ASSOCIATES, P.A. THROUGH FIELD SURVEY. ALL OTHER TOPOGRAPHIC INFORMATION SHOWN IS BASED ON TOWN OF CHAPEL HILL GIS DATA.
2. HEC-RAS MODEL AND REGULATORY FLOODWAY AND FLOOD HAZARD INFORMATION SHOWN WAS DOWNLOADED FROM THE NORTH CAROLINA FLOOD RISK INFORMATION SYSTEM (FRIS) WEBSITE. FLOODWAY AND FLOOD HAZARD INFORMATION IS AN ARC-VIEW SHAPEFILE INTERPOLATED INTO AUTOCAD CIVIL 3D THROUGH GEOREFERENCED DATA FILES.
3. THE LAST COLUMN IN THE TABLE BELOW COMPARES THE PROPOSED CONDITIONS WITH THE MOST ACCURATE AND CURRENT MODEL OF THE EXISTING CONDITIONS AVAILABLE TO US AND BEST REPRESENTS THIS PROJECT'S IMPACT.
4. THE SMALL RISE RESULTING FROM THIS PROJECT DOES NOT CREATE A DISCERNABLE CHANGE IN THE HORIZONTAL LOCATION OF THE SPECIAL FLOOD HAZARD ZONE LIMIT.

BASE FLOOD ELEVATIONS SUMMARY TABLE

SECTION	PUBLISHED SECTION #	DUPLICATE EFFECTIVE	EXISTING CONDITIONS WITH EASTGATE BLDG D	EXISTING CONDITIONS W/EASTGATE BLDG D + NEW SECTIONS	CHANGE (EX CONDS W/EASTGATE BLDG D + NEW SECTS COMPARED TO EX CONDS W/EASTGATE BLDG D)	PROPOSED CONDITIONS		CHANGE (PROPOSED CONDITIONS COMPARED TO EX CONDS W/EASTGATE BLDG D + NEW SECTS)
6606.4		263.55	263.97	264.06	0.09 FT	264.12		0.06 FT
5931.4		263.49	263.49	263.61	0.12 FT	263.68		0.07 FT
5454.5	55	262.72	262.72	262.90	0.18 FT	263.07		**0.17** FT
5378.8				262.88		263.04	US limit of site	0.16 FT
5368.8				262.90	Site Area	263		0.10 FT
5318.8				262.89		262.92		0.03 FT
5233.6				262.83		262.86		0.03 FT
5024.2	50	262.35	262.35	262.69	0.34 FT	262.6	Approx location of service drive connection to 15/501	-0.09 FT
4888.4				262.07		262.06		-0.01 FT
4744.2				262.06		262.05		-0.01 FT
4696.5		262.05	262.05	262.05	0 FT	262.05	DS limit of site	0.00 FT

BOOKER CREEK PROFILES FROM STA. 4000.0 TO STA. 6733.6

REVIEW DRAWING NOT FOR CONSTRUCTION

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Ballentine Associates, P.A. CORPORATE SEAL C328 NORTH CAROLINA Chapel Hill

NORTH CAROLINA PROFESSIONAL SEAL 029127 ENGINEER GEORGE J. RESTICE
NOT FOR CONSTRUCTION

NUM	REVISIONS	DATE

ISSUED	DATE
PRELIMINARY STUDY ISSUED	26 JAN 17
TO TEAM SHOWING SITE PLAN	7 FEB 17
UPDATED TO SHOW LATEST SITE LAYOUT	16 FEB 17

SHEET
X-1

N:\Projects\116026.00 Fordham Blvd Apartments\1_Dwg\BA-Model Files\Flood Mapping.dwg, 4/20/2017 6:23:34 PM, Leef

Appendix A

Effective FIS &
Duplicate Effective Model Output

Northing: = 797,957, Easting = 1,989,441

Northing: = 797,957, Easting = 1,995,546

Without Base Flood Elevation (BFE)
Zone A, V, A99
With BFE or Depth
Zone AE, AO, AH, VE, AR

Regulatory Floodway

0.2% Annual Chance Flood Hazard

Future Conditions 1% Annual Chance Flood Hazard Zone X

Areas Determined to be Outside the 0.2% Annual Chance Flood Hazard
Zone X

Jurisdiction Boundary

FIRM Panel Boundary

North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 125 250 500 Feet

0 25 50 100 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

Panel(s):9789,9799

CONTAINS:

COMMUNITY	CID
TOWN OF CHAPEL HILL	370180

Notice to User: The Map Number(s) shown below should be used when placing map orders; the Community Number(s) shown above should be used on insurance applications for the subject community.

SELECTED PANELS:

MAP NUMBER	EFFECTIVE DATE
3710978900J	2/2/2007
3710979900K	2/2/2007

Northing: = 793,240, Easting = 1,989,441

Northing: = 793,240, Easting = 1,995,546

This is an official copy of a portion of the above referenced flood map. This map incorporates changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov.

Duplicate Effective

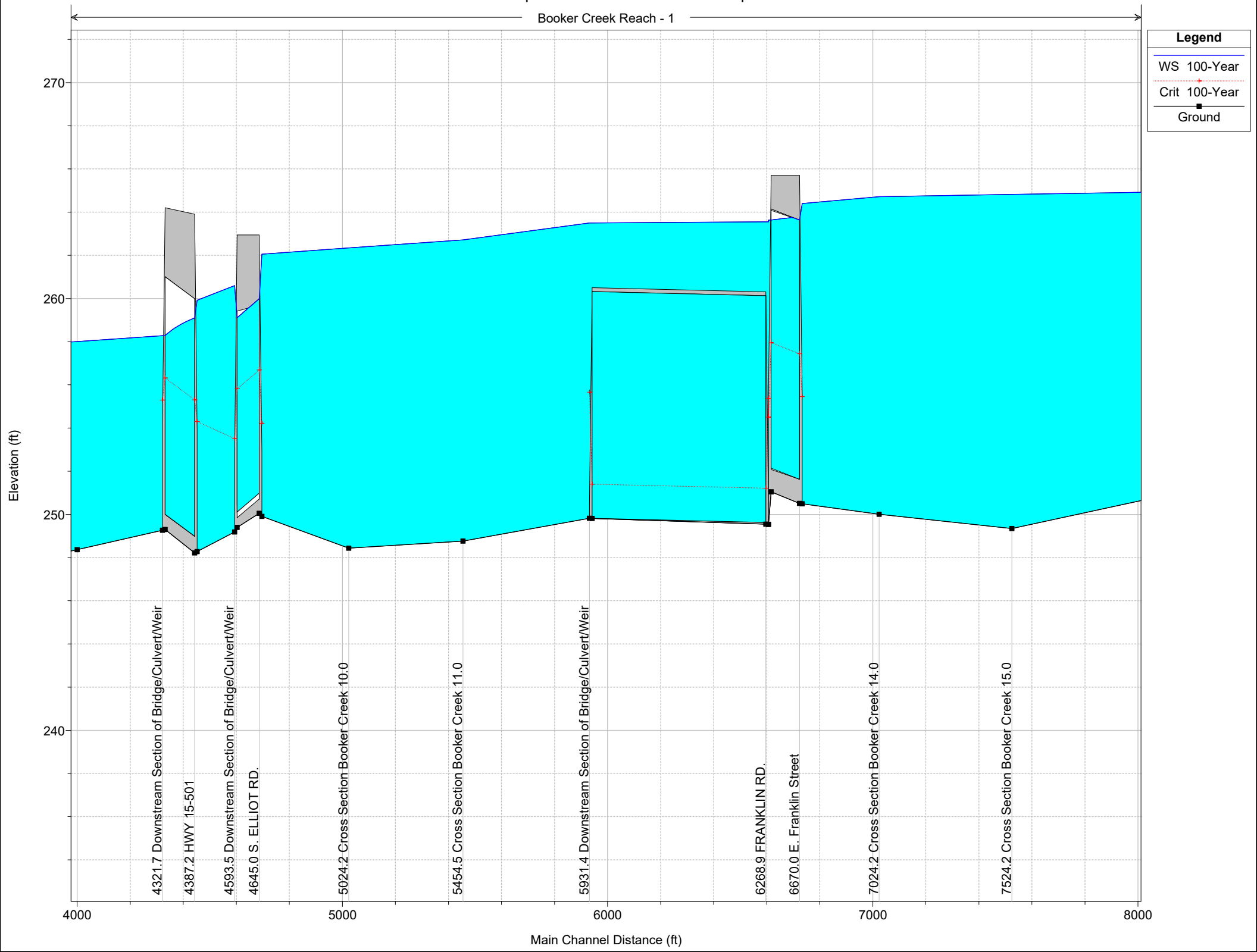
HEC-RAS Plan: Plan01 River: Booker Creek Reach: Reach - 1 Profile: 100-Year

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)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001016	4.03	571.84	164.95	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.79	170.84	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010015	8.85	141.83	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019561	10.91	101.80	37.54	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016017	10.29	104.46	31.11	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014848	10.69	164.19	67.86	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.31	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.91	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.21	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.82	133.60	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004363	5.30	228.09	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.72	428.22	431.64	0.004285	7.82	190.60	35.56	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.53	427.53	429.79	0.018270	12.18	111.23	28.45	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029823	11.85	103.30	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016562	10.30	283.21	124.92	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000581	3.31	1626.03	396.04	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.39		387.44	0.000240	2.59	1897.52	309.67	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.13	2159.38	366.02	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.49	381.49	383.37	0.011994	13.35	335.44	137.15	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020081	12.15	172.79	53.49	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019404	11.94	190.49	60.38	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022002	12.82	131.88	35.47	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006820	8.94	214.81	47.68	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017889	11.91	162.38	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005531	8.26	281.37	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010355	8.99	368.52	127.18	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.87	0.013242	11.32	251.85	110.80	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021241	13.31	153.62	34.63	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.39		303.96	0.002392	6.78	669.34	229.33	0.39
Reach - 1	15183.4	100-Year	1840.00	292.43	302.57	299.08	303.13	0.002438	6.58	696.10	436.01	0.39
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.32	299.32	301.72	0.017666	12.58	169.01	46.70	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005133	8.95	504.39	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.64	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.94	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.54	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.19	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	279.99	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011160	13.86	357.02	96.42	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010668	12.50	401.31	125.42	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014977	13.31	267.36	82.88	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011100	11.22	451.00	206.32	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.66		270.71	0.000968	3.39	2451.47	743.01	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.26	0.001739	5.19	1981.15	560.18	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.20	0.002377	5.84	1739.53	535.10	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002670	5.87	1471.95	491.43	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.48		268.20	0.003820	7.59	685.32	165.13	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.51		266.24	0.005363	8.05	862.26	329.93	0.50
Reach - 1	8024.2	100-Year	2670.00	250.67	264.92		265.09	0.000850	4.25	1940.37	582.77	0.21
Reach - 1	7524.2	100-Year	2860.00	249.35	264.83		264.86	0.000228	2.34	4034.63	766.40	0.11
Reach - 1	7024.2	100-Year	2860.00	250.01	264.72		264.74	0.000222	2.22	3652.16	595.24	0.11
Reach - 1	6733.5	100-Year	2860.00	250.49	264.40	255.45	264.60	0.000437	3.63	801.47	423.25	0.18
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	263.63	254.50	263.83	0.000417	3.58	812.99	440.27	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	263.55	255.37	263.81	0.000757	4.52	1894.44	740.09	0.21
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.49	255.66	263.80	0.000899	4.85	1644.98	727.95	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.72		263.15	0.002067	6.78	1840.41	905.09	0.35

HEC-RAS Plan: Plan01 River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

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)	
Reach - 1	5024.2	100-Year	2860.00	248.44	262.35		262.49	0.000919	4.61	2236.15	462.61	0.24
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.22	262.26	0.000477	3.70	895.77	220.60	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.60	253.50	260.83	0.000593	3.95	836.46	209.15	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001782	6.63	538.92	631.41	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.30	259.44	0.004391	8.76	391.36	413.53	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001650	4.44	2313.37	557.32	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000351	2.25	4839.51	946.43	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003284	7.52	500.06	908.83	0.46
Reach - 1	3157.2		Bridge									
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.96	256.11	0.006022	9.10	385.91	879.17	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.90	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.45	770.54	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.86	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

Booker Creek Duplicate Effective Plan: Multiple 1/26/2017



Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

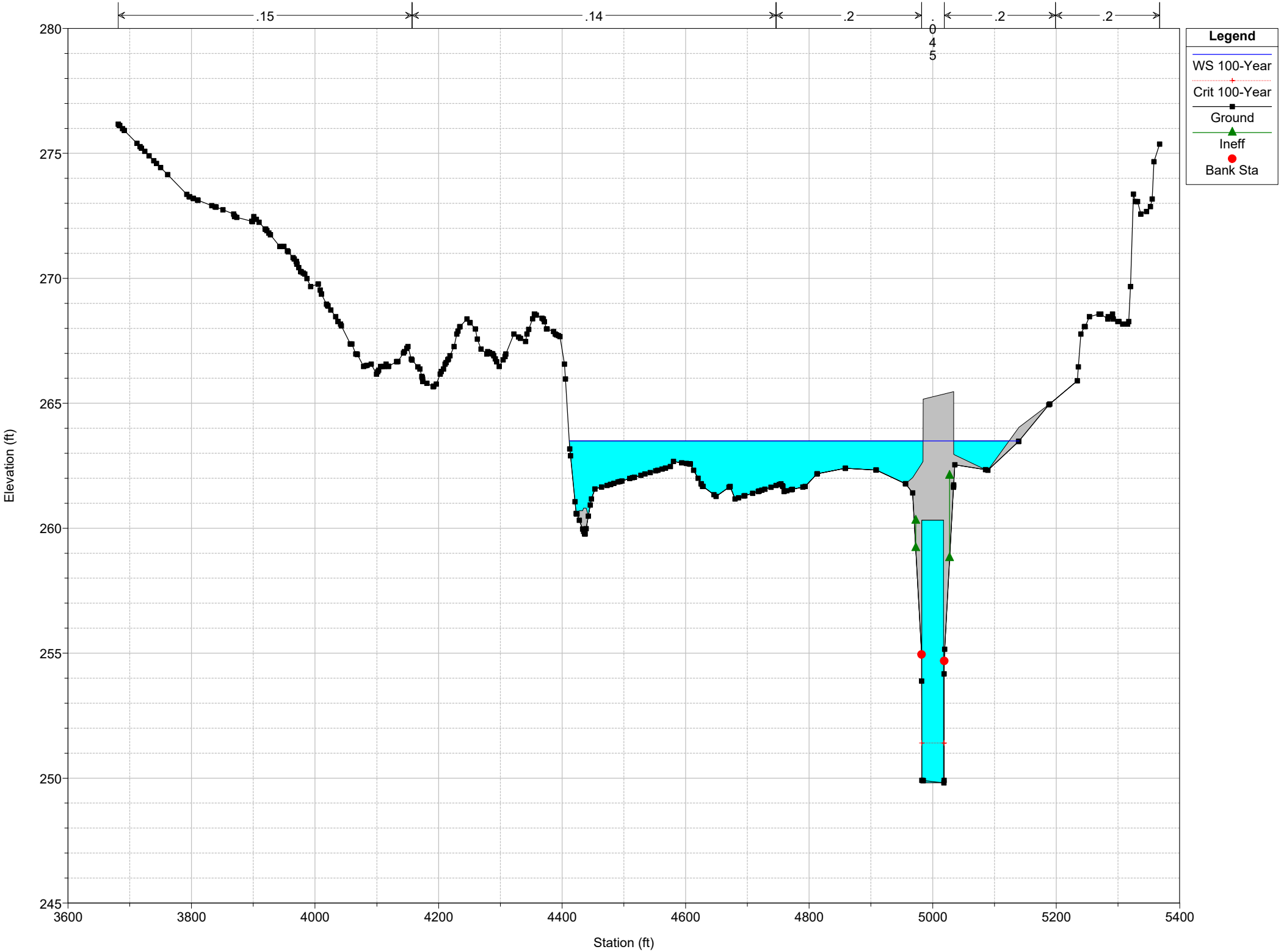
RS = 6606.4 Upstream Section of Bridge/Culvert/Weir

Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 6268.9 Culv FRANKLIN RD.

Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 6268.9 Culv FRANKLIN RD.

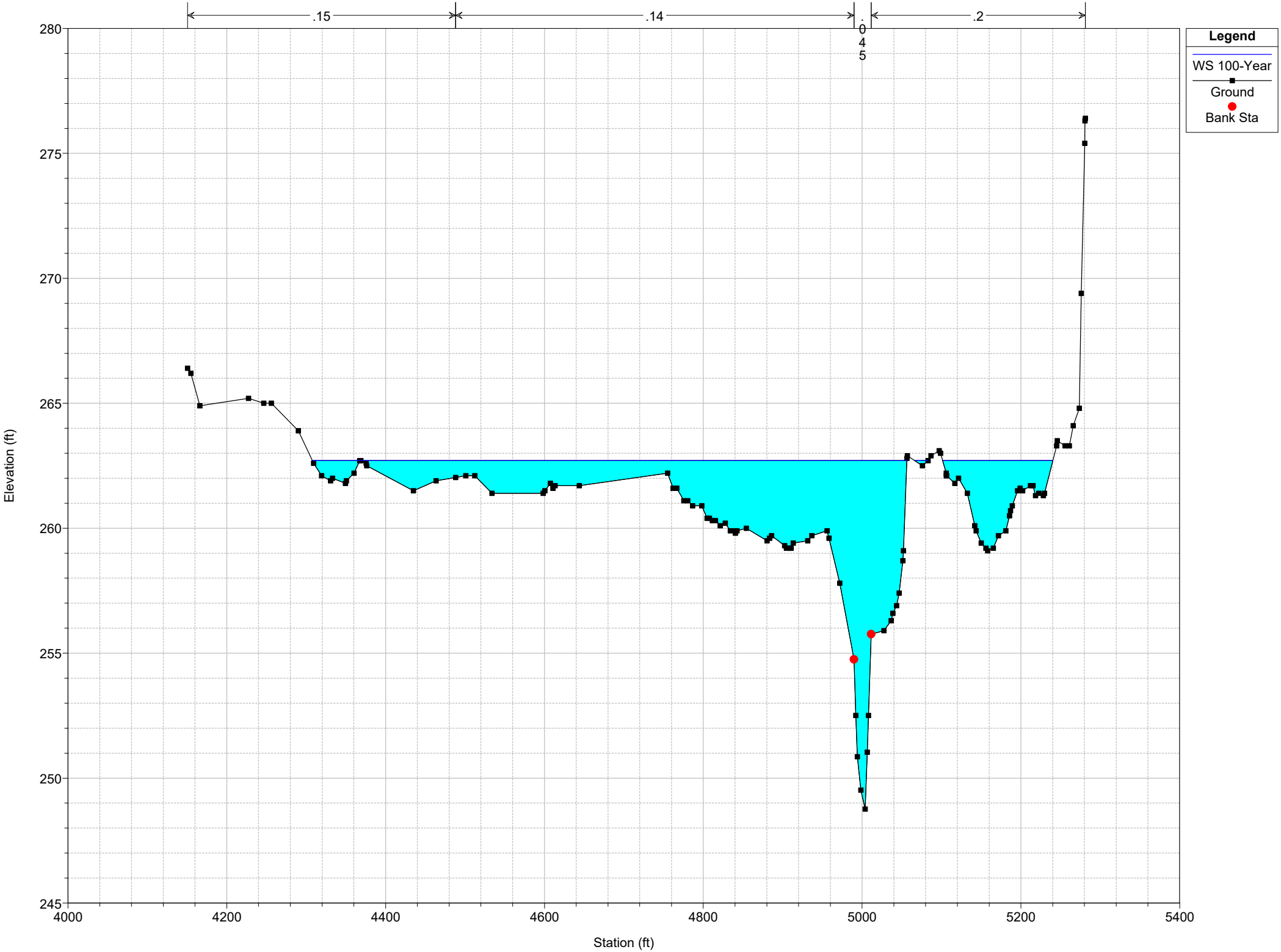


Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 5931.4 Downstream Section of Bridge/Culvert/Weir

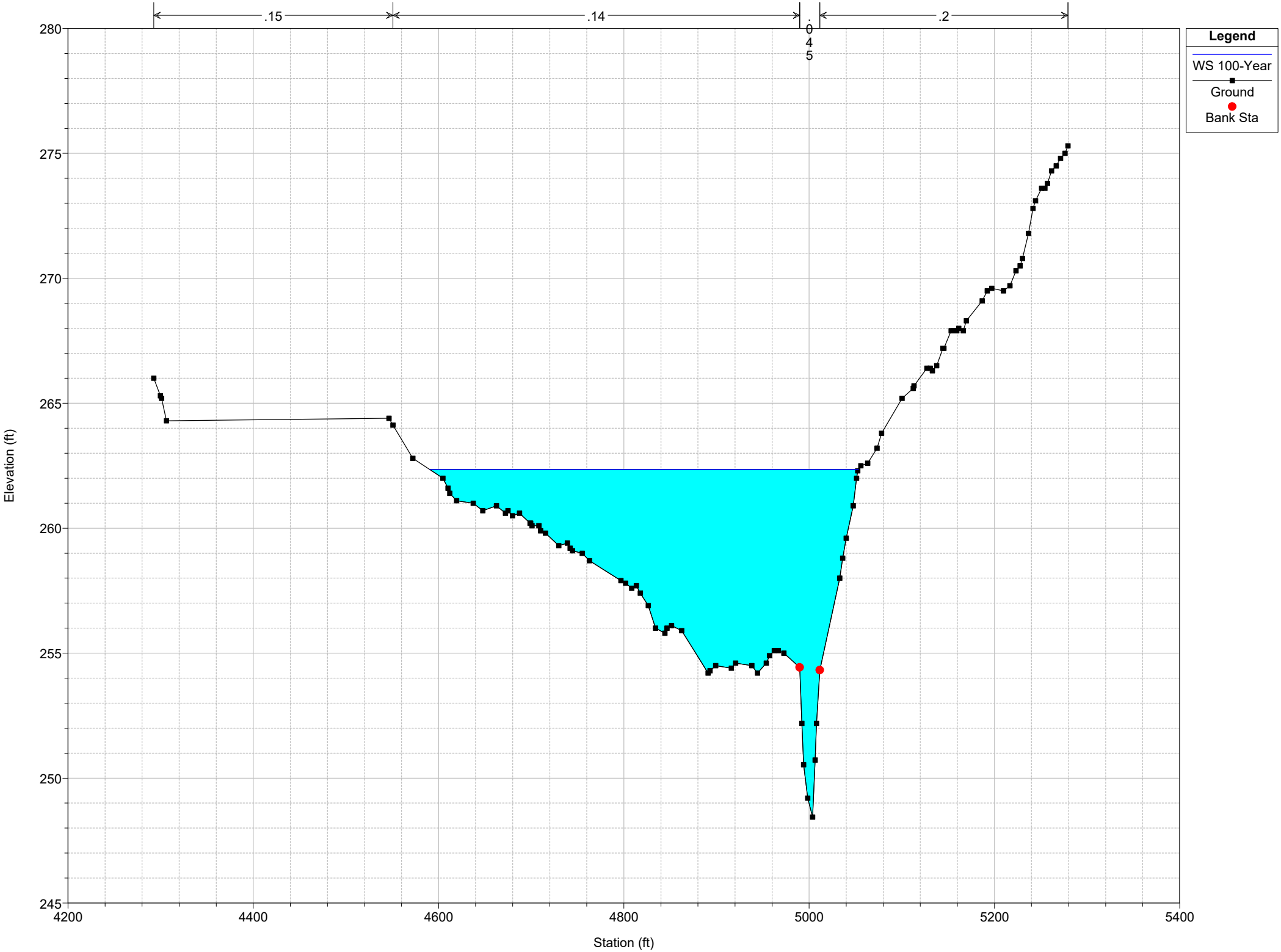
Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 5454.5 Cross Section Booker Creek 11.0



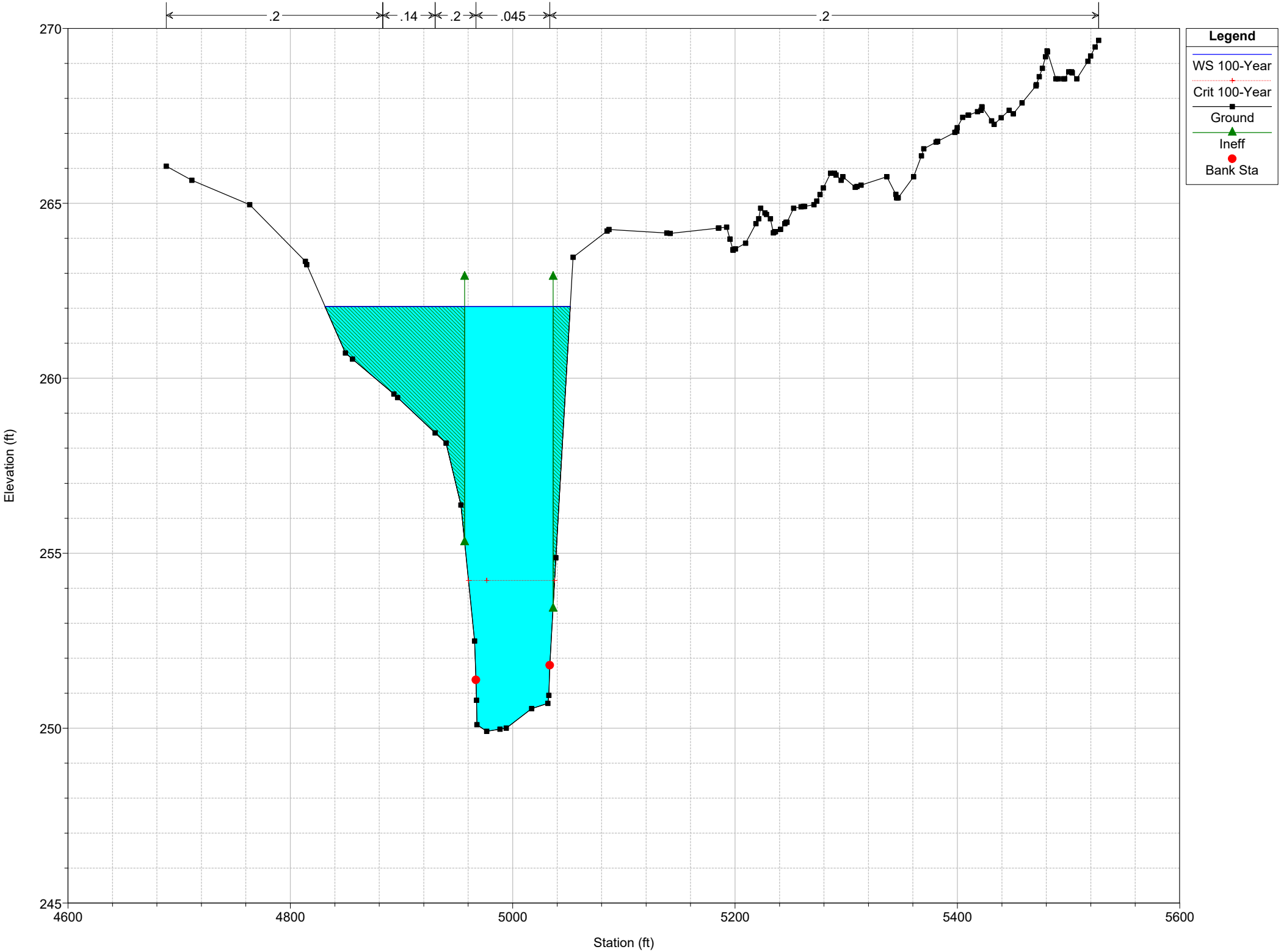
Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 5024.2 Cross Section Booker Creek 10.0



Booker Creek Duplicate Effective Plan: Multiple 1/26/2017

RS = 4696.5 Upstream Section of Bridge/Culvert/Weir



Appendix B

Existing Conditions – with Eastgate Bldg. D

&

August 2015 Eastgate Building D Flood Study

Existing Conditions with Eastgate Building D

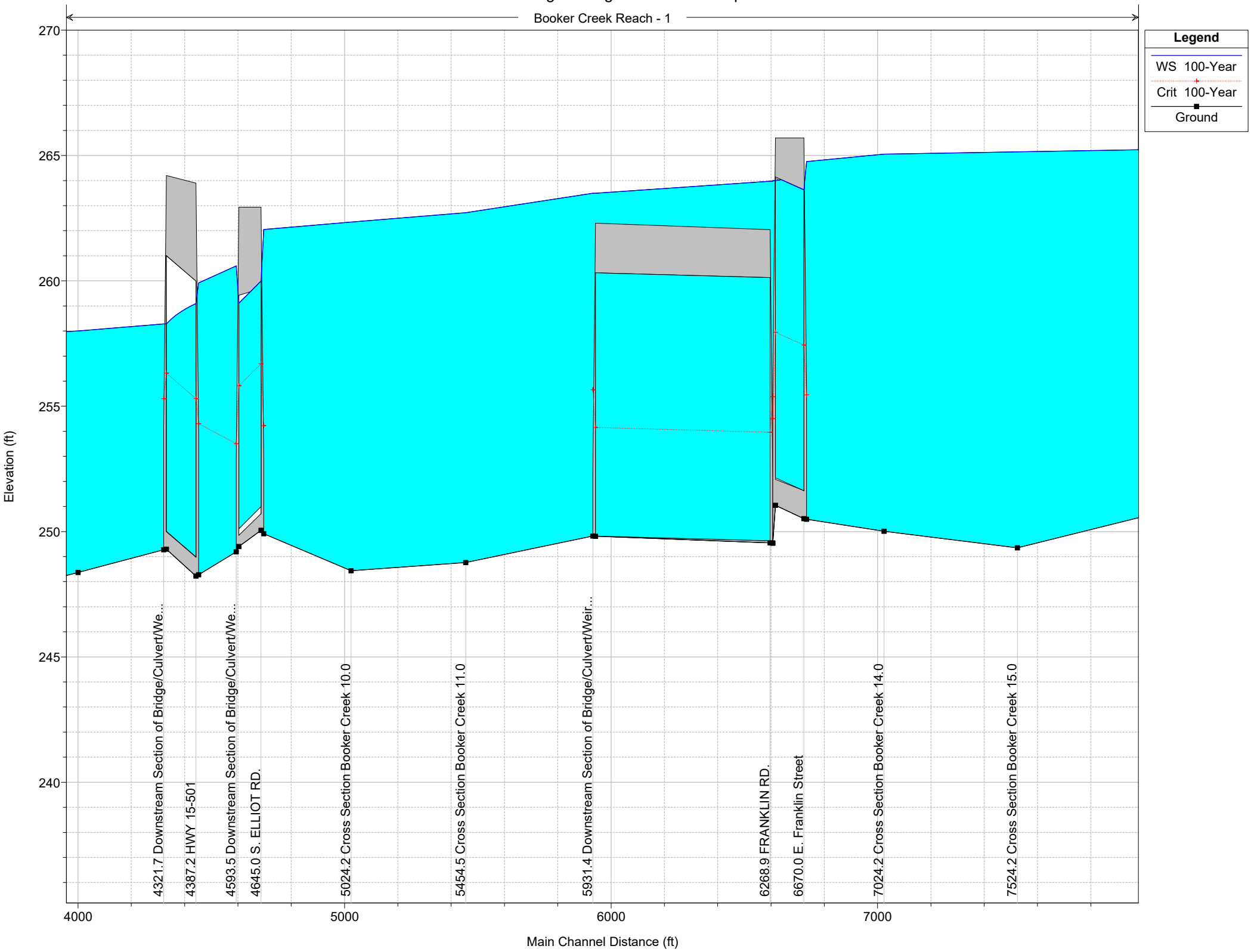
HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year

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)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001016	4.03	571.84	164.95	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.79	170.84	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010015	8.85	141.83	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019561	10.91	101.80	37.54	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016017	10.29	104.46	31.11	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014848	10.69	164.19	67.86	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.31	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.91	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.21	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.82	133.60	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004363	5.30	228.09	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.72	428.22	431.64	0.004285	7.82	190.60	35.56	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.53	427.53	429.79	0.018270	12.18	111.23	28.45	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029823	11.85	103.30	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016562	10.30	283.21	124.92	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000581	3.31	1626.03	396.04	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.39		387.44	0.000240	2.59	1897.52	309.67	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.13	2159.38	366.02	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.49	381.49	383.37	0.011994	13.35	335.44	137.15	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020081	12.15	172.79	53.49	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019404	11.94	190.49	60.38	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022002	12.82	131.88	35.47	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006820	8.94	214.81	47.68	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017889	11.91	162.38	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005531	8.26	281.37	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010355	8.99	368.52	127.18	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.87	0.013242	11.32	251.85	110.80	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021241	13.31	153.62	34.63	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.39		303.96	0.002392	6.78	669.34	229.33	0.39
Reach - 1	15183.4	100-Year	1840.00	292.43	302.57	299.08	303.13	0.002438	6.58	696.10	436.01	0.39
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.32	299.32	301.72	0.017666	12.58	169.01	46.70	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005133	8.95	504.39	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.64	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.94	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.54	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.19	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	279.99	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011160	13.86	357.02	96.42	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010668	12.50	401.31	125.42	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014977	13.31	267.36	82.88	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011097	11.22	451.07	206.34	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.66		270.72	0.000968	3.39	2451.99	743.06	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.26	0.001738	5.19	1981.79	560.25	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.20	0.002375	5.84	1740.08	535.15	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002667	5.87	1472.78	491.48	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.48		268.21	0.003808	7.58	686.41	165.20	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.71		266.35	0.004681	7.64	927.35	334.81	0.46
Reach - 1	8024.2	100-Year	2670.00	250.67	265.24		265.37	0.000703	3.93	2123.14	590.12	0.19
Reach - 1	7524.2	100-Year	2860.00	249.35	265.15		265.17	0.000197	2.21	4284.02	783.09	0.10
Reach - 1	7024.2	100-Year	2860.00	250.01	265.05		265.08	0.000190	2.09	3854.60	604.42	0.10
Reach - 1	6733.5	100-Year	2860.00	250.49	264.76	255.45	264.95	0.000399	3.53	823.81	450.49	0.17
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	264.00	254.50	264.18	0.000381	3.48	835.75	462.93	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	263.97	255.37	264.18	0.000615	4.16	2206.68	755.01	0.19
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.49	255.66	263.80	0.000899	4.85	1644.98	727.95	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.72		263.15	0.002067	6.78	1840.41	905.09	0.35
Reach - 1	5024.2	100-Year	2860.00	248.44	262.35		262.49	0.000919	4.61	2236.15	462.61	0.24
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.22	262.26	0.000477	3.70	895.77	220.60	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.60	253.50	260.83	0.000593	3.95	836.46	209.15	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001782	6.63	538.92	631.41	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.30	259.44	0.004391	8.76	391.36	413.53	0.52

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

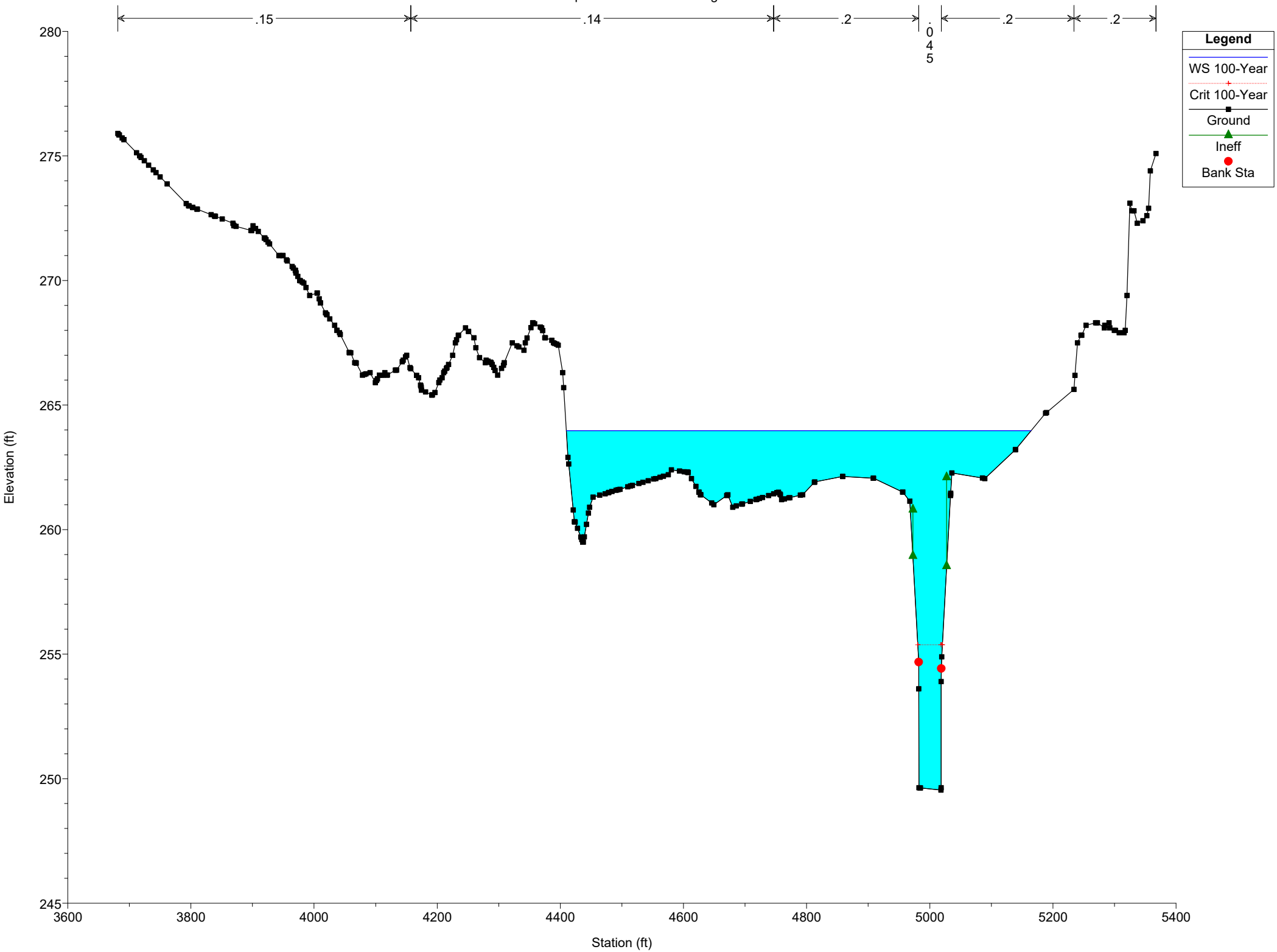
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001650	4.44	2313.37	557.32	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000351	2.25	4839.51	946.43	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003284	7.52	500.06	908.83	0.46
Reach - 1	3157.2		Bridge									
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.96	256.11	0.006022	9.10	385.91	879.17	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.90	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.45	770.54	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.86	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017



Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 6606.4 Upstream Section of Bridge/Culvert/Weir

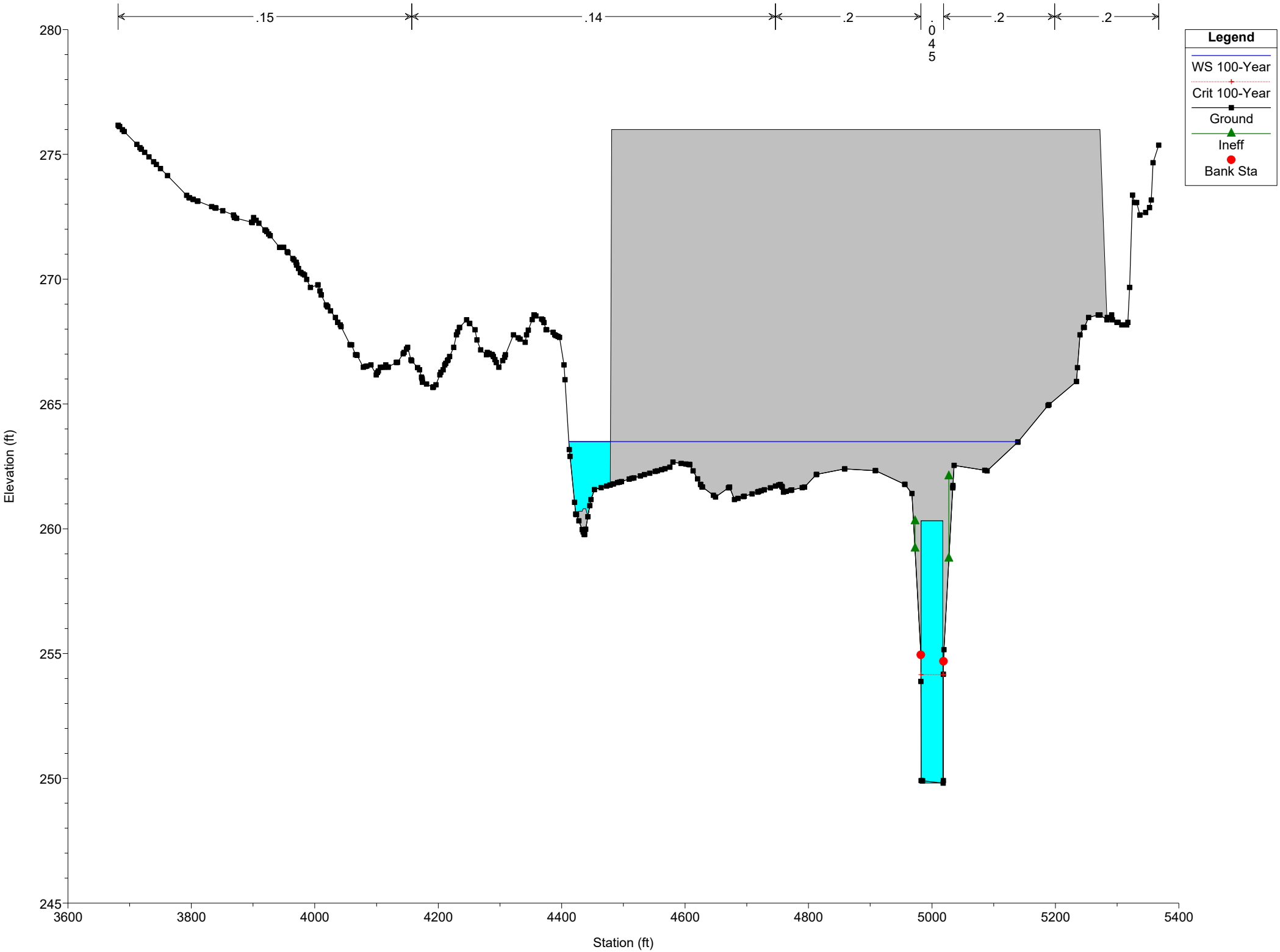


Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 6268.9 Culv FRANKLIN RD.

Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 6268.9 Culv FRANKLIN RD.



Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

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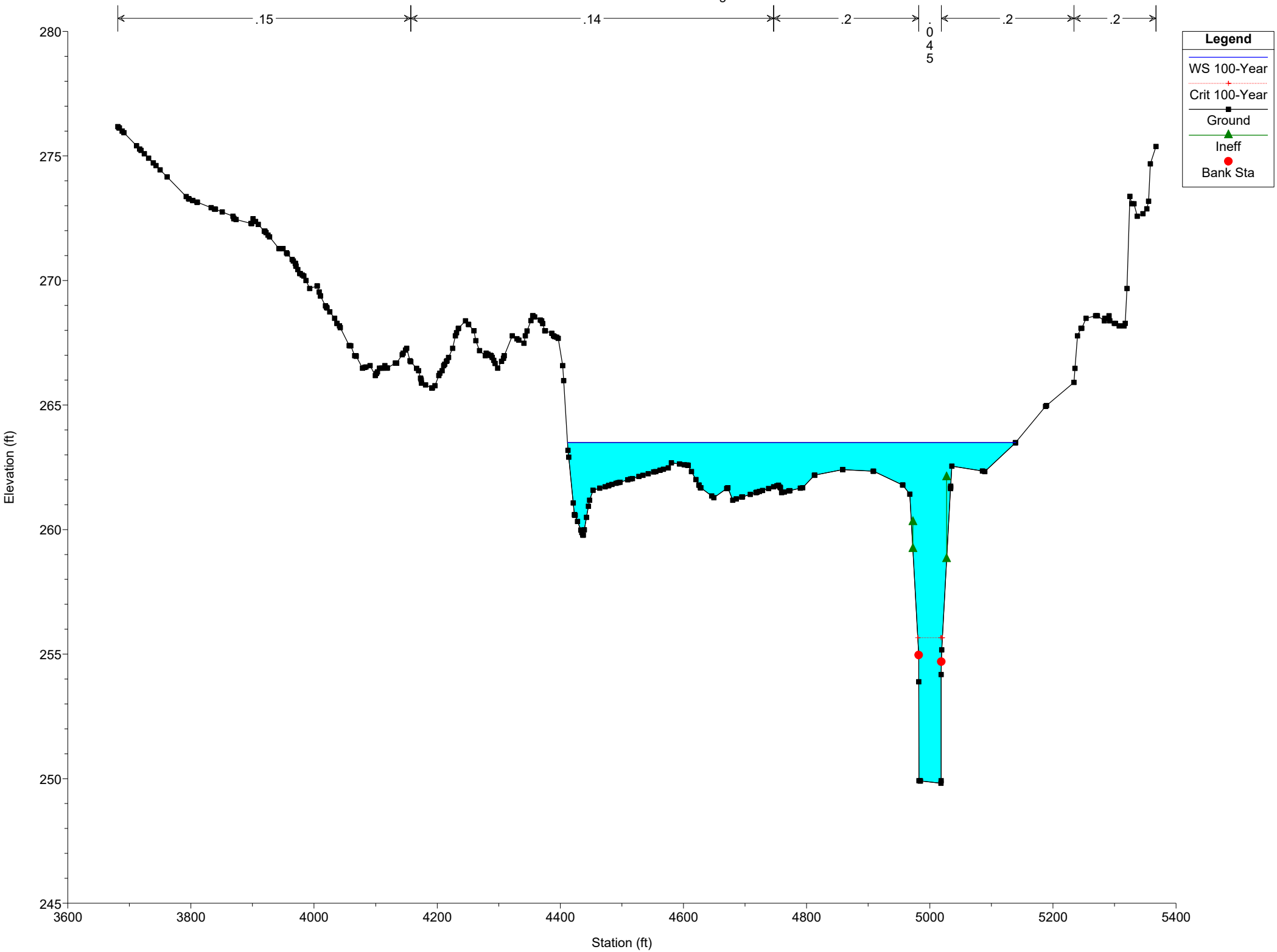
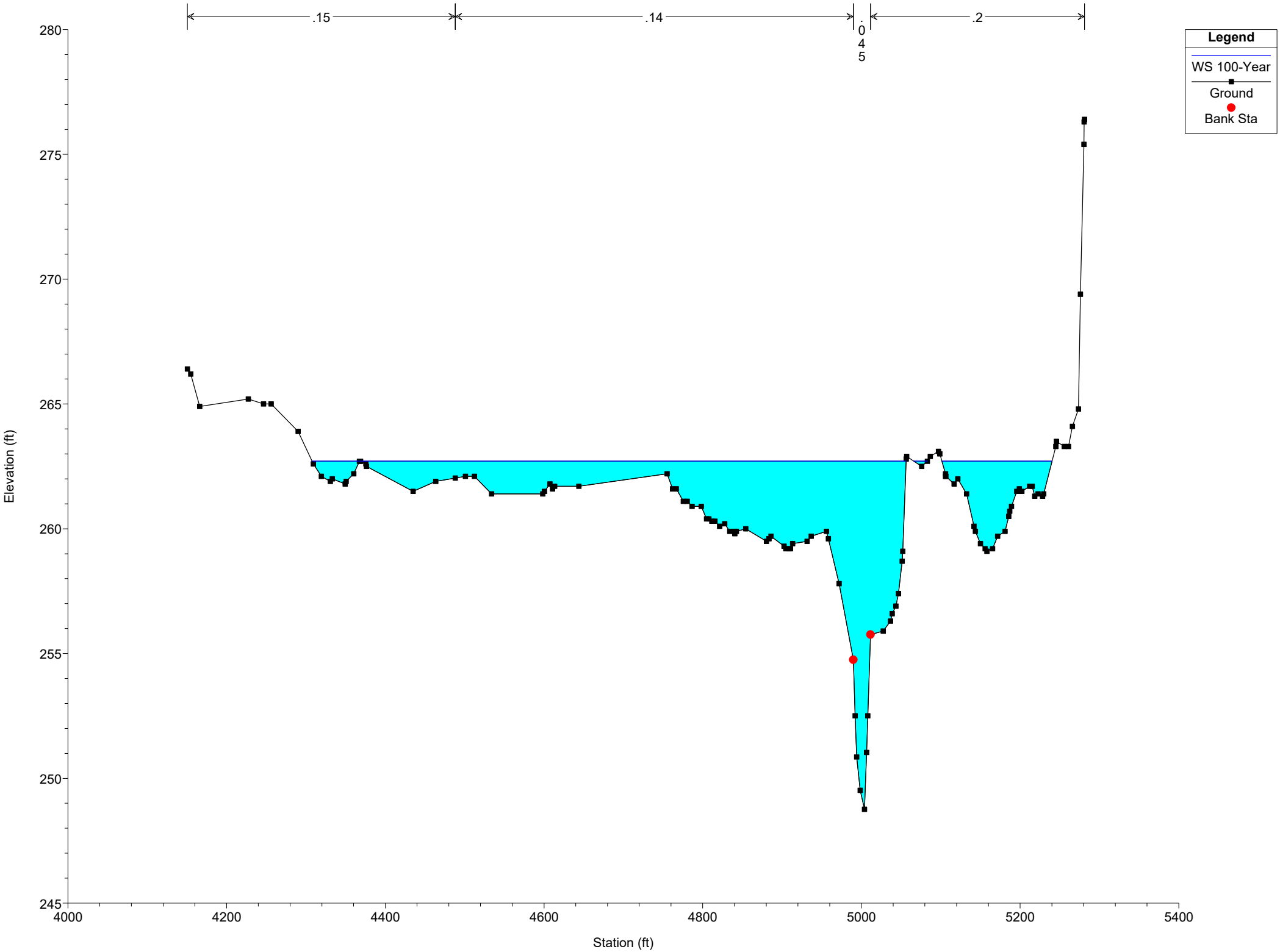


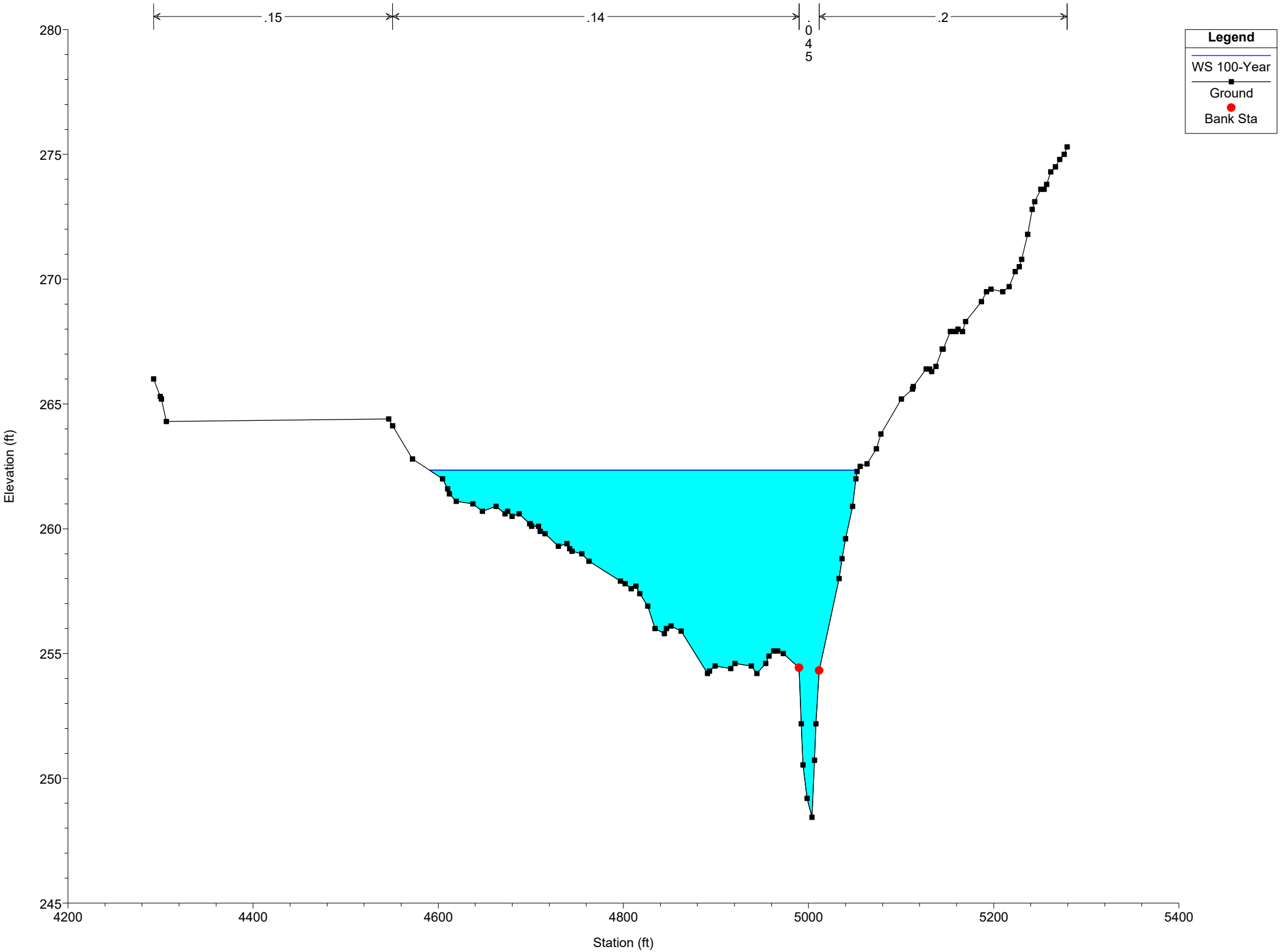
Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 5454.5 Cross Section Booker Creek 11.0



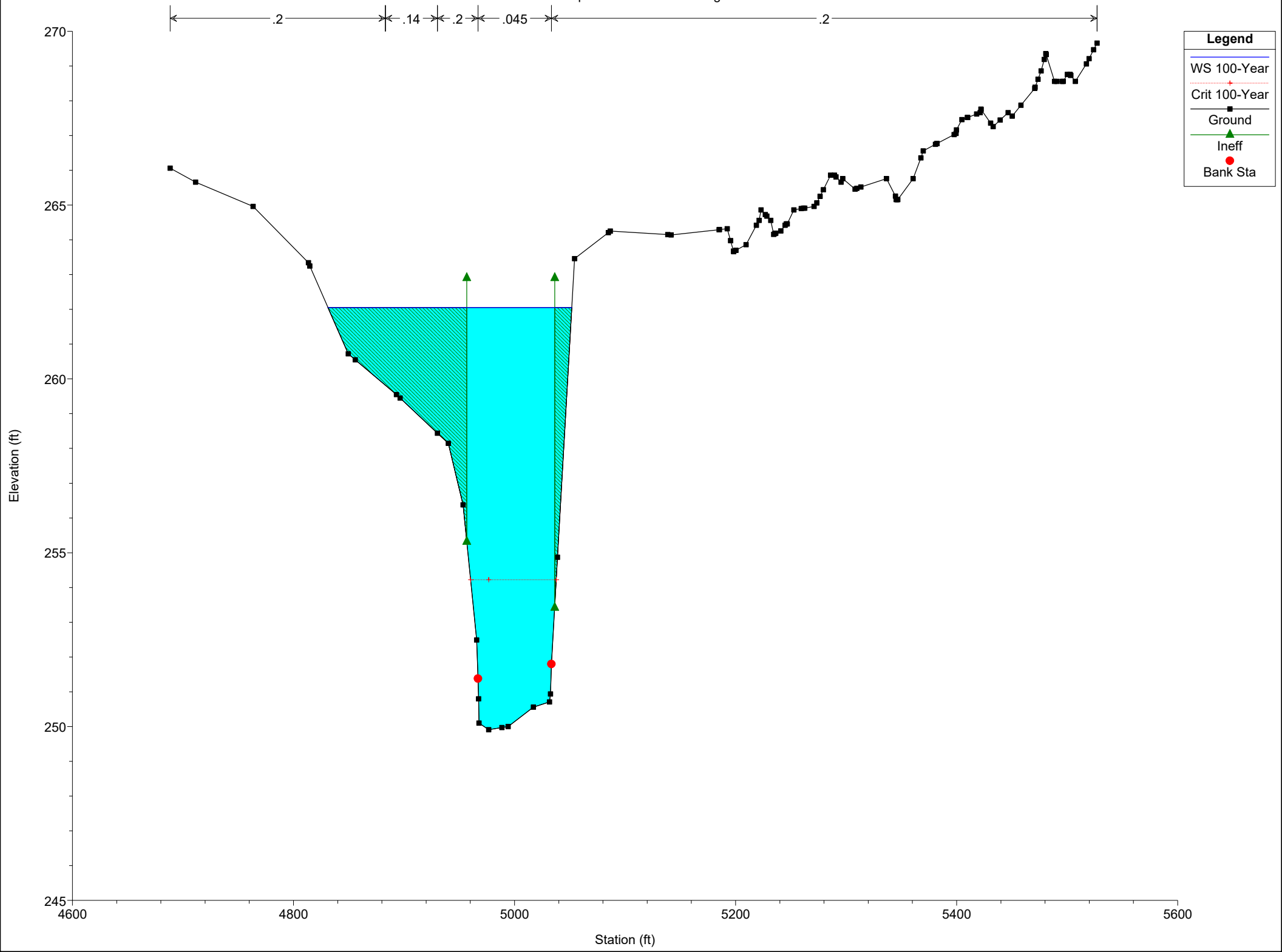
Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 5024.2 Cross Section Booker Creek 10.0



Ex. Conds with Eastgate Bldg D Plan: Multiple 1/25/2017

RS = 4696.5 Upstream Section of Bridge/Culvert/Weir



Ballentine Associates, P.A.

FLOOD ANALYSIS
for
EASTGATE SHOPPING CENTER
CHAPEL HILL, NORTH CAROLINA

PREPARED FOR:

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NORTH CAROLINA PROFESSIONAL SEAL 029127 ENGINEER GEORGE J. RETSCHLE III

26 AUG 15

Issue Dates	Description
26 Aug 15	Town of Chapel Hill

Purpose of Study

Eastgate Shopping Center desires to replace the existing BP gas station at the east end of the shopping center alongside US 15/501 with a ±7,600 s.f. retail building. The purpose of this study was to determine the effects that this project will have on the Booker Creek base flood elevations.

Description of Study

This study was performed using HEC-RAS, which was developed by the US Army Corps of Engineers and is an acronym for Hydraulic Engineering Center River Analysis System.

The effective HEC-RAS model and published FIS were obtained from the North Carolina Flood Mapping Program (NCFMP). The study was then performed in the following three parts:

1. Duplicate Effective Model

   The HEC-RAS data obtained from NCFMP was run and the results were compared to those published in the effective FIS (FIS #37135CV000, effective on 2/2/2007, revised on 5/16/2008). The results of the Duplicate Effective Model match the published FIS. Refer to Appendix A.

2. Corrected Effective Model

   Upon review of the Effective Model, we noted that the existing Eastgate Shopping Center buildings were not adequately modeled. Booker Creek is carried through the shopping center in a box culvert and accordingly, the Effective Model includes a culvert routine at river station 6268.9 to model the effects of the culvert and any overland flow that will occur when the culvert's capacity is exceeded. We believe the culvert itself was correctly modeled in the Effective study, but we do not believe the existing buildings were properly accounted for in terms of their effect on overland flow. To better model the obstruction that the existing shopping center buildings present to overland flow, we revised the decking elevations in the culvert sections such that the cross-sectional area occupied by the buildings is modeled as part of the decking/roadway and not used as conveyance area in the calculations, using the eastern tip of the existing buildings (measured from a line parallel to the flow direction) as the limit of the "decking". This was the only change made to the model, as compared to the Duplicate Effective model.

   Please note that the options available in HEC-RAS for modeling buildings situated on top of culverts are very limited, but we believe the simple methodology we have used sufficiently and properly removes the building areas from the conveyance calculations.

   The base flood elevations calculated by the Corrected Effective Model increased slightly as compared to the Duplicate Effective Model, with the maximum rise being 0.16'. Refer to Appendix B for output and exhibits related to the Corrected Effective Model.

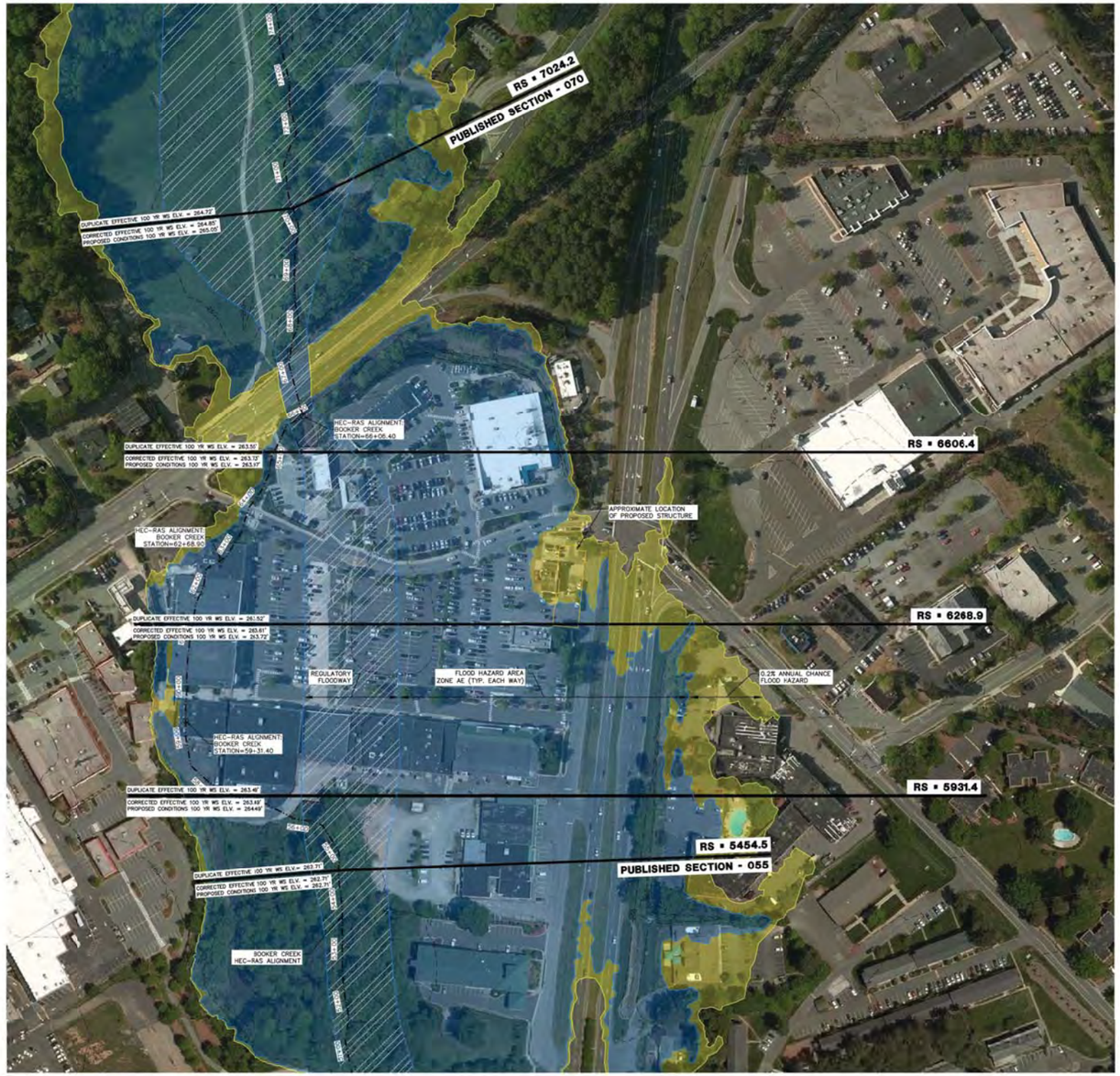
3. Proposed Conditions Model

The proposed building will extend approximately 66 feet east of the easternmost tip of the existing Eastgate buildings, as measured from a line parallel with the flow direction. To model the effects of the proposed building, the Corrected Effective Model was revised such that the culvert "deck" representing the existing buildings was extended an additional 66 feet toward the east. This was the only change made to the Corrected Effective Model in order to create the Proposed Conditions Model.

The base flood elevations calculated by the Proposed Conditions Model increased slightly as compared to the Corrected Effective Model, with the maximum rise being 0.24'. Refer to Appendix C for output and exhibits related to the Proposed Conditions Model.

Conclusion

The replacement of the existing BP gas station at Eastgate Shopping Center with a ±7,600 s.f. retail building will result in a maximum increase in the base flood elevation of 0.24', as compared to the Corrected Effective Model. A summary exhibit is included on the next page, which provides the key graphics and data relevant to this study. Detailed output and exhibits are included in the appendices.



EASTGATE HEC-RAS CROSS SECTIONS

NO GRID NORTH

(GRAPHIC SCALE IN FEET)
1 inch = 100 ft.

HEC-RAS MODEL - CULVERT BUILD OUTPUT TABLE

Plan: MULTIPLE - Booker Creek Reach : 1 RS: 6268.9 Culv Group: Culvert #1 Profile: 100-Year			
Q Culv Group (cfs)	329.18	Culv Full Len (ft)	655.00
# Barrels	1.00	Culv Vel US (ft/s)	0.90
Q Barrel (cfs)	329.18	Culv Vel DS (ft/s)	0.90
E.G. US. (ft)	263.81	Culv Inv El Up (ft)	249.63
W.S. US. (ft)	263.50	Culv Inv El Dn (ft)	249.82
E.G. DS (ft)	263.80	Culv Frictn Ls (ft)	0.01
W.S. DS (ft)	263.49	Culv Exit Loss (ft)	0.00
Delta EG (ft)	0.01	Culv Entr Loss (ft)	0.00
Delta WS (ft)	0.05	Q Weir (cfs)	2530.87
E.G. IC (ft)	259.17	Weir Sta Lft (ft)	4410.13
E.G. OC (ft)	263.81	Weir Sta Rgt (ft)	5133.43
Culvert Control	Outlet	Weir Submerg	0.99
Culv WS Inlet (ft)	260.13	Weir Max Depth (ft)	3.51
Culv WS Outlet (ft)	260.32	Weir Avg Depth (ft)	1.99
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	1338.31
Culv Crt Depth (ft)	1.40	Min El Weir Flow (ft)	260.81

NOTES

1. EXISTING TOPOGRAPHY SHOWN WAS OBTAINED FROM TOWN OF CHAPEL HILL GIS. DATA WAS DOWNLOADED IN SHAPEFILE FORMAT AND WAS INTERPOLATED INTO AUTOCAD CIVIL 3D THROUGH GEOSPATIAL REFERENCING. THE GIS DISCLAIMER IS AS FOLLOWS:

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3. THE APPROXIMATE LOCATION OF THE PROPOSED STRUCTURE, AND ESTIMATIONS USED FOR CALCULATING THE LOCATION OF EXISTING STRUCTURES WITHIN THE CORRECTED EFFECTIVE, WERE BASED ON INFORMATION PROVIDED BY ROYAL WATER RESOURCES, PLLC.

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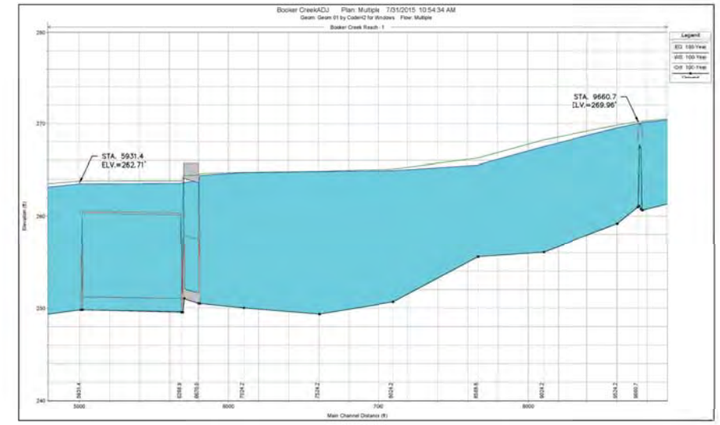
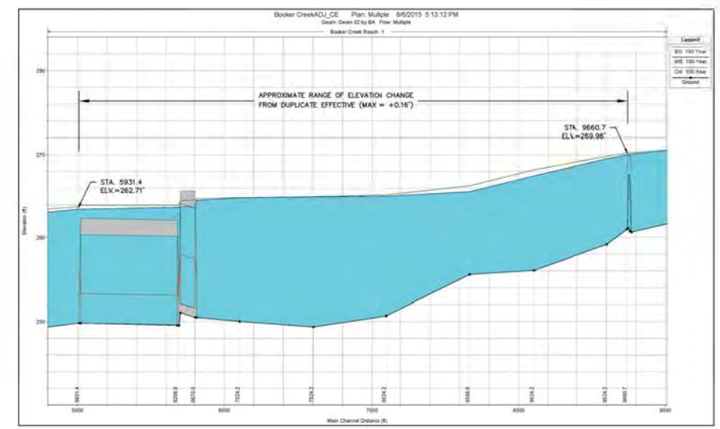
HEC-RAS PROFILE DUPLICATE EFFECTIVE



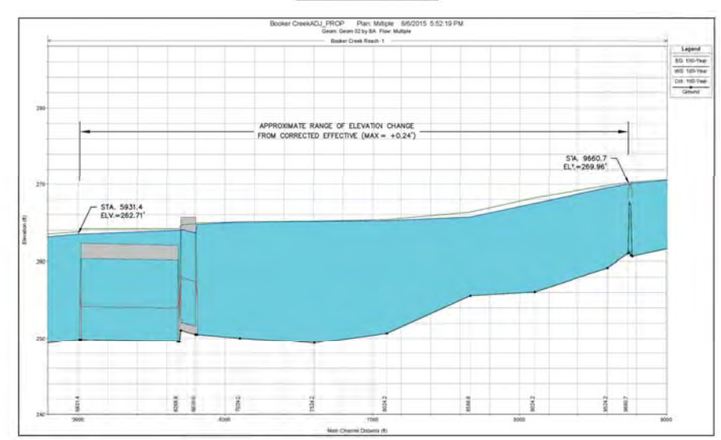
BOOKER CREEK PROFILE FROM STA. 5931.4 TO STA. 9660.7

HEC-RAS PROFILE CORRECTED EFFECTIVE



BOOKER CREEK PROFILE FROM STA. 5931.4 TO STA. 9660.7

HEC-RAS PROFILE PROPOSED CONDITIONS



BOOKER CREEK PROFILE FROM STA. 5931.4 TO STA. 9660.7

REVIEW DRAWING
NOT FOR CONSTRUCTION

BALLENTINE ASSOCIATES, P.A.
221 PROVIDENCE ROAD, CHAPEL HILL, N.C. 27514
(919) 929 - 0481 (919) 489 - 4789

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CORPORATE SEAL C328

NORTH CAROLINA PROFESSIONAL SEAL 20137 ENGINEER GREGORY J. REYNOLDS

NUM	REVISIONS	DATE

OWNER INFORMATION
ROYAL WATER RESOURCES, PLLC
295 HILLSBORO STREET
PITTSBORO, NC 27312

OWNERS REPRESENTATIVE:
FRED ROYAL
PH. (919) 369-8397
FAX
EMAIL

ISSUED	DATE
TO CLIENT/TOWN OF CHAPEL HILL	10 AUG 15

EASTGATE SHOPPING CENTER 100 YEAR FLOOD MAPPING MODEL

CHAPEL HILL, NC

HEC-RAS ANALYSIS EXHIBIT

JOB #: 115012.00
DATE: 07 AUG 15
SCALE: AS NOTED
DRAWN BY: W.R.B.
REVIEWED BY: G.J.R.

SHEET
X-1

Appendix A

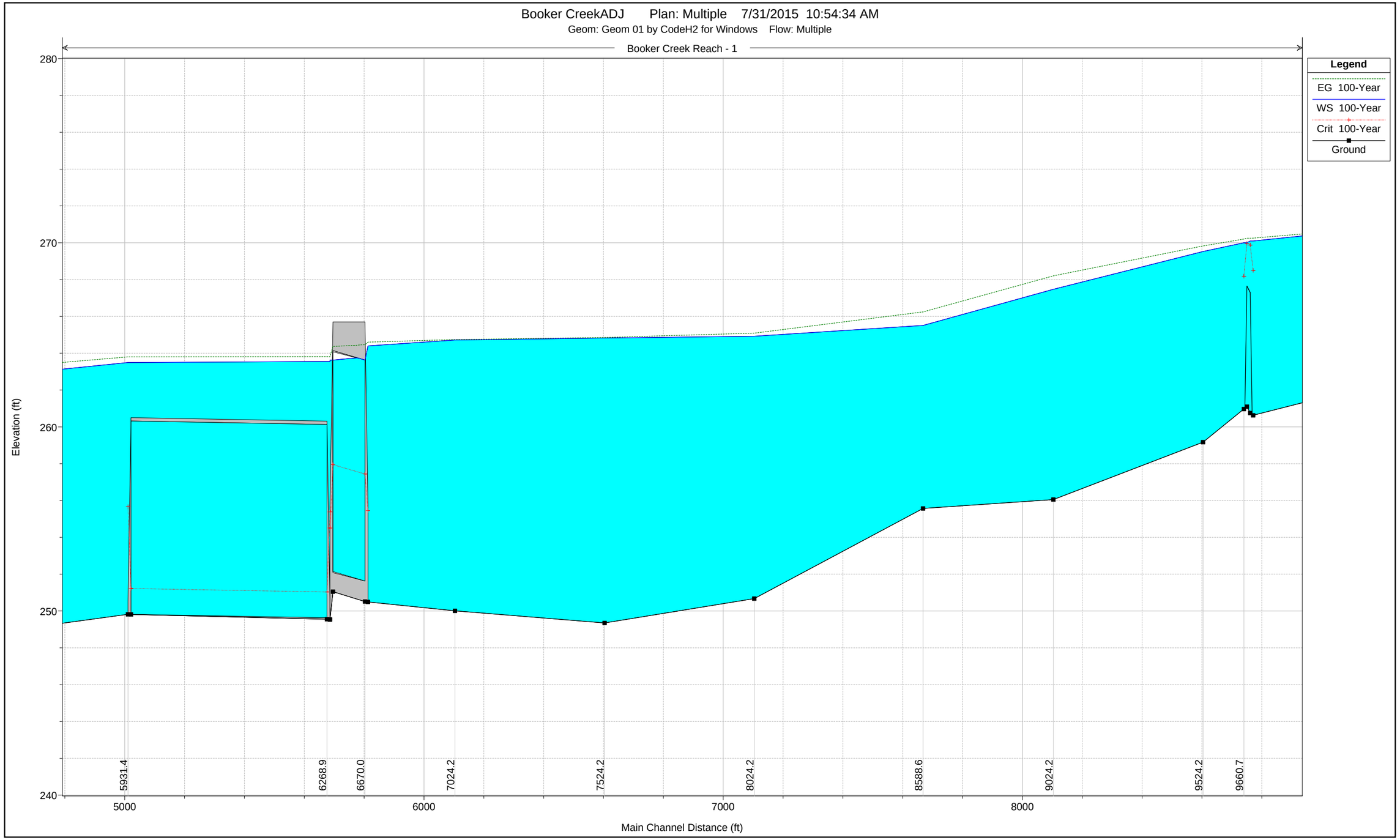
Duplicate Effective Model

HEC-RAS Plan: MULTIPLE River: Booker Creek Reach: Reach - 1 Profile: 100-Year

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)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001017	4.03	571.60	164.94	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.53	170.83	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010011	8.85	141.86	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019577	10.91	101.77	37.53	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016003	10.28	104.49	31.12	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014858	10.70	164.13	67.85	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.33	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.92	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.20	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.83	133.61	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004359	5.30	228.15	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.73	428.23	431.64	0.004280	7.82	190.69	35.58	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.54	427.54	429.79	0.018159	12.16	111.47	28.47	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029849	11.85	103.27	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016574	10.30	283.11	124.91	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000582	3.31	1624.88	396.02	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.38		387.44	0.000240	2.59	1896.56	309.64	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.14	2158.22	366.00	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.48	381.48	383.37	0.012095	13.39	333.45	135.04	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020104	12.15	172.70	53.47	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019421	11.94	190.42	60.37	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022024	12.83	131.82	35.46	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006822	8.94	214.78	47.67	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017883	11.91	162.41	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005532	8.26	281.36	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010350	8.99	368.59	127.19	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.86	0.013253	11.32	251.71	110.79	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021265	13.32	153.56	34.62	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.24		303.85	0.002577	6.96	635.59	218.69	0.41
Reach - 1	15183.4	100-Year	1840.00	292.43	302.35	299.08	302.96	0.002648	6.75	615.82	335.92	0.41
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.31	299.31	301.72	0.017784	12.60	168.54	46.55	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005132	8.95	504.46	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.70	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.96	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.55	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.20	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	280.00	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011170	13.86	356.88	96.40	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010676	12.50	401.16	125.41	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014988	13.32	267.27	82.85	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011097	11.22	451.07	206.34	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.65		270.71	0.000970	3.39	2449.52	742.84	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.25	0.001744	5.20	1978.97	559.95	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.20	0.002378	5.84	1739.38	535.09	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002671	5.87	1471.82	491.42	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.48		268.20	0.003820	7.59	685.31	165.13	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.51		266.24	0.005363	8.05	862.28	329.93	0.50
Reach - 1	8024.2	100-Year	2670.00	250.67	264.92		265.09	0.000851	4.25	1940.07	582.76	0.21
Reach - 1	7524.2	100-Year	2860.00	249.35	264.83		264.86	0.000228	2.34	4034.18	766.38	0.11
Reach - 1	7024.2	100-Year	2860.00	250.01	264.72		264.74	0.000222	2.22	3651.78	595.22	0.11
Reach - 1	6733.5	100-Year	2860.00	250.49	264.40	255.45	264.60	0.000437	3.63	801.44	423.20	0.18
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	263.63	254.51	263.83	0.000418	3.58	812.65	439.94	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	263.55	255.38	263.81	0.000760	4.53	1889.74	739.86	0.21
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.49	255.66	263.80	0.000900	4.85	1644.43	727.92	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.71		263.14	0.002071	6.79	1838.33	904.86	0.35
Reach - 1	5024.2	100-Year	2860.00	248.44	262.34		262.49	0.000920	4.62	2234.86	462.45	0.24
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.23	262.26	0.000478	3.70	895.55	220.55	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.59	253.50	260.83	0.000593	3.95	836.32	209.13	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001783	6.63	538.84	631.25	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.28	259.44	0.004392	8.76	391.34	413.51	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001652	4.44	2312.71	557.29	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000352	2.25	4838.10	946.42	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003286	7.52	499.95	908.80	0.46
Reach - 1	3157.2		Bridge									

HEC-RAS Plan: MULTIPLE River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

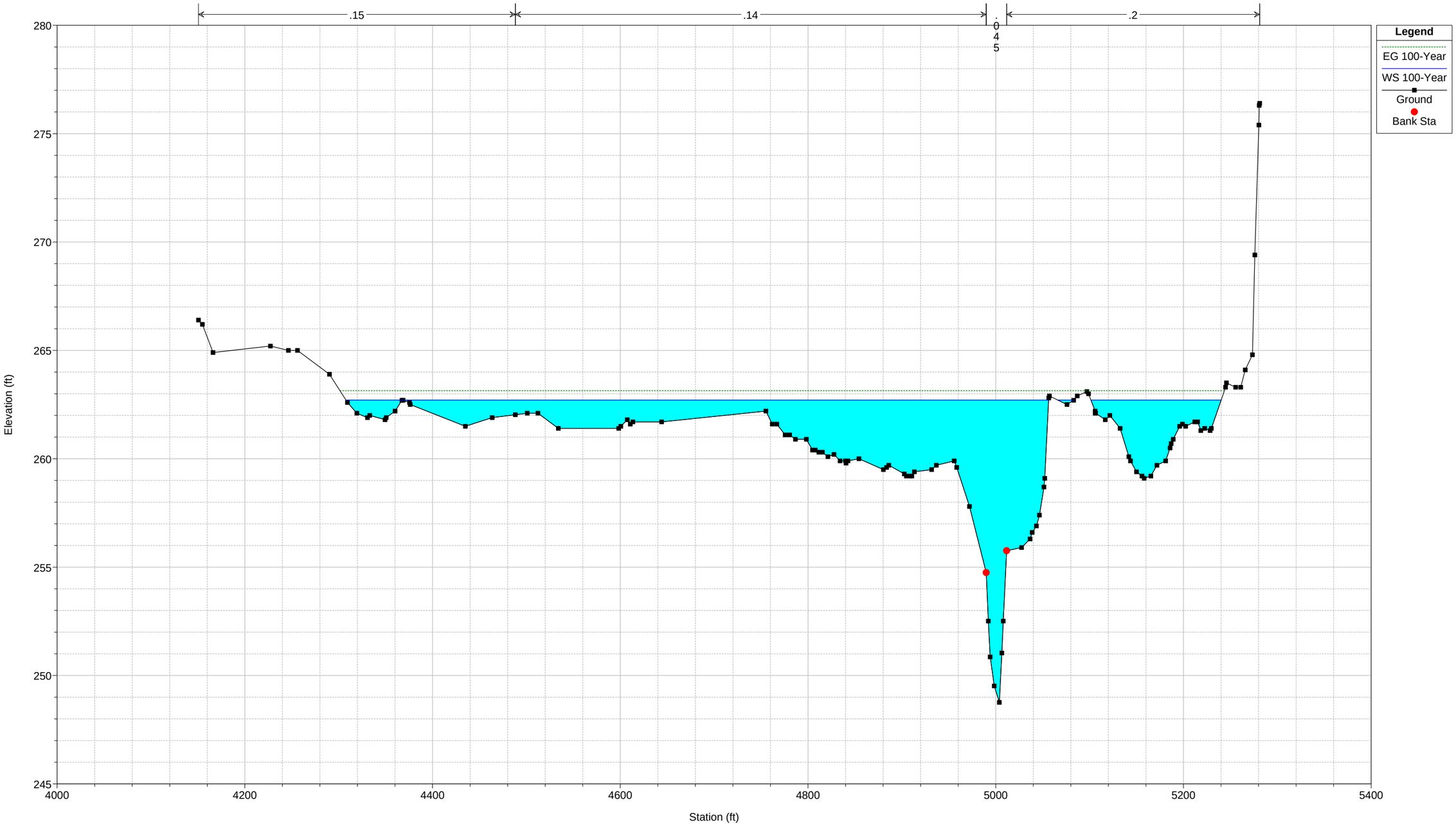
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.95	256.11	0.006020	9.10	385.97	879.19	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.91	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.47	770.55	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.87	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

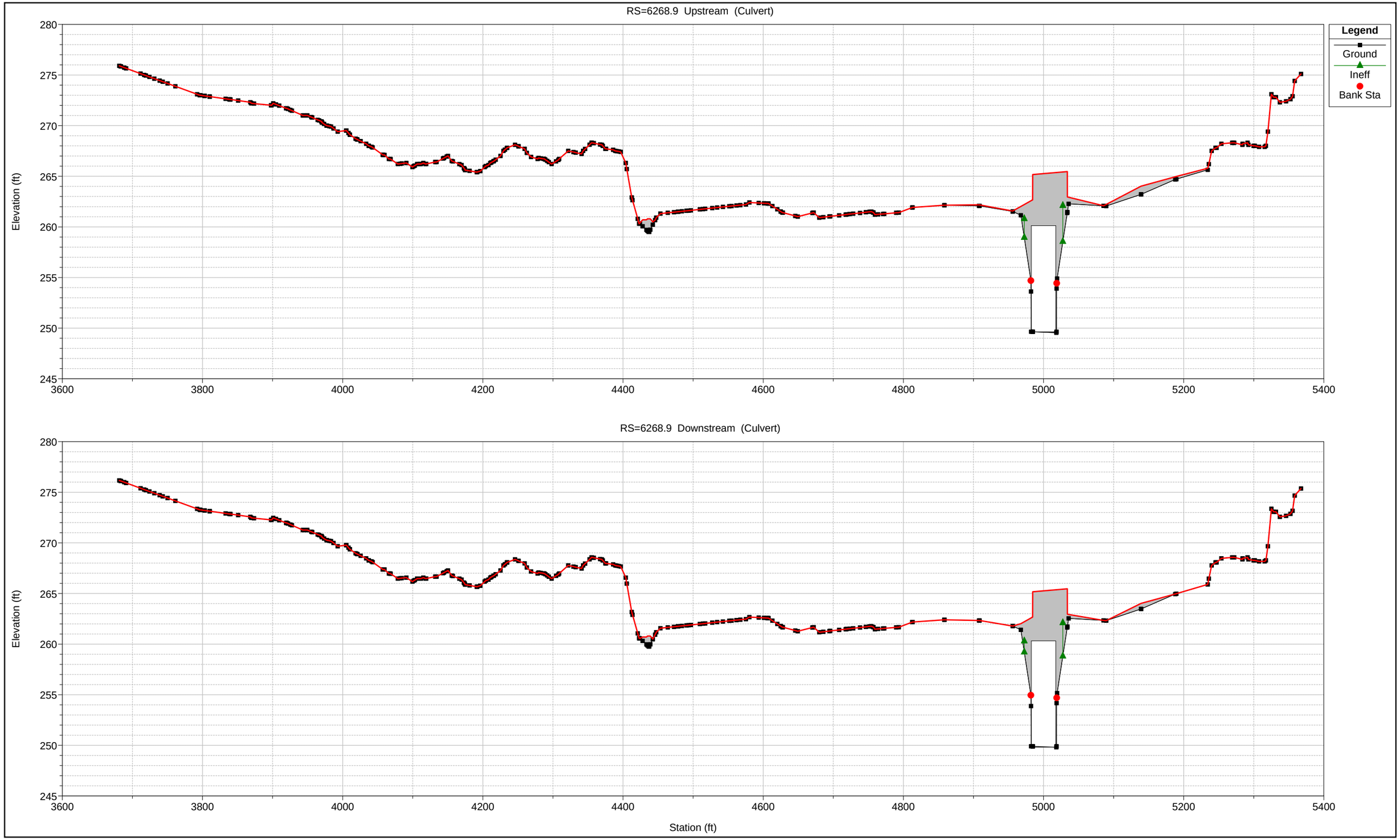

Booker CreekADJ Plan: Multiple 7/31/2015 10:54:34 AM
Geom: Geom 01 by CodeH2 for Windows Flow: Multiple
Booker Creek Reach - 1
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Elevation (ft)
280
270
260
250
240
5931.4
6268.9
6670.0
7024.2
7524.2
8024.2
8588.6
9024.2
9524.2
9660.7
5000
6000
7000
8000
Main Channel Distance (ft)

Booker CreekADJ Plan: Multiple 7/31/2015 10:54:34 AM

Geom: Geom 01 by CodeH2 for Windows Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 5454.5 Cross Section Booker Creek 11.0

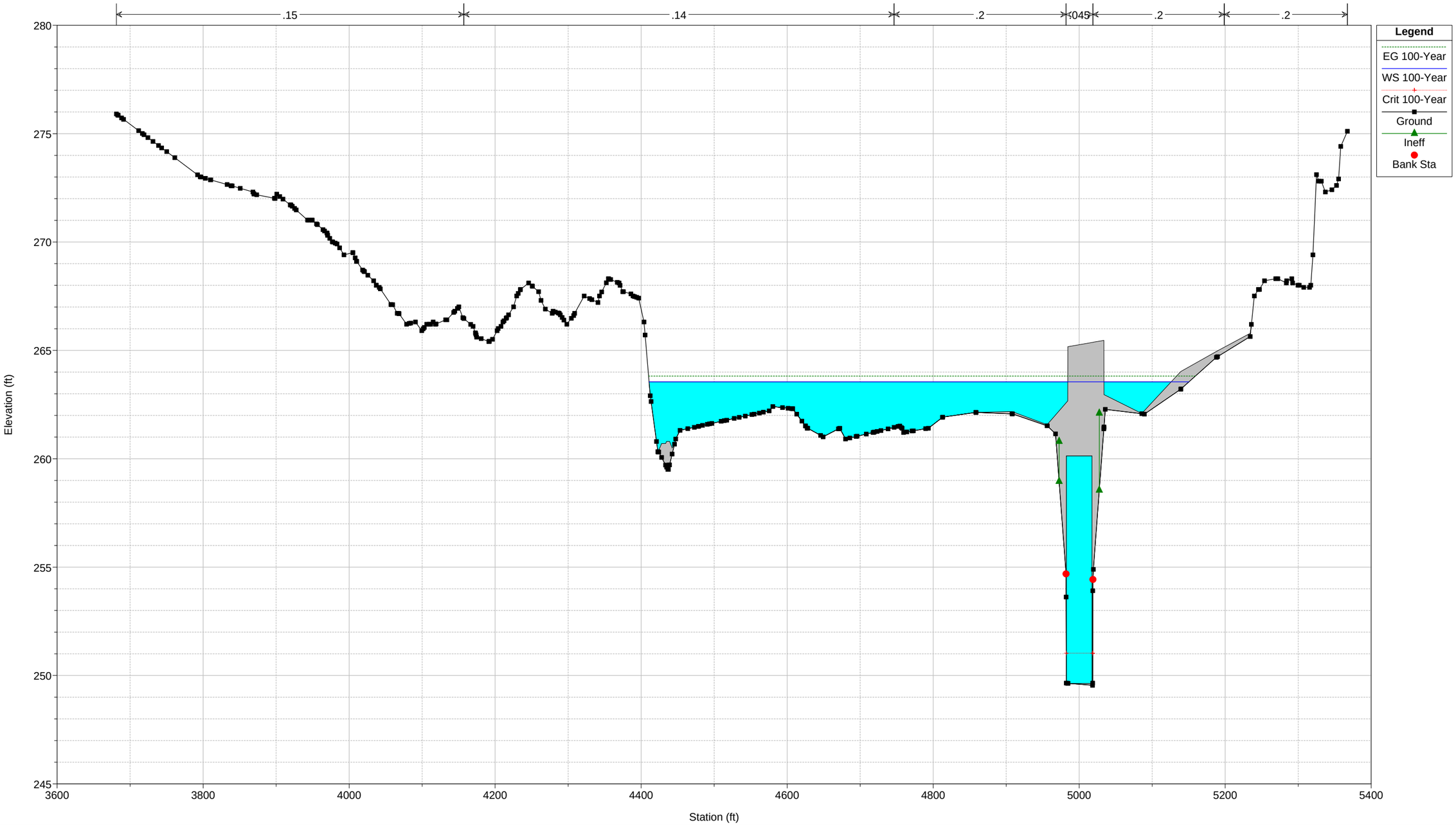



RS=6268.9 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
RS=6268.9 Downstream (Culvert)
Elevation (ft)
Station (ft)

Booker CreekADJ Plan: Multiple 7/31/2015 10:54:34 AM

Geom: Geom 01 by CodeH2 for Windows Flow: Multiple

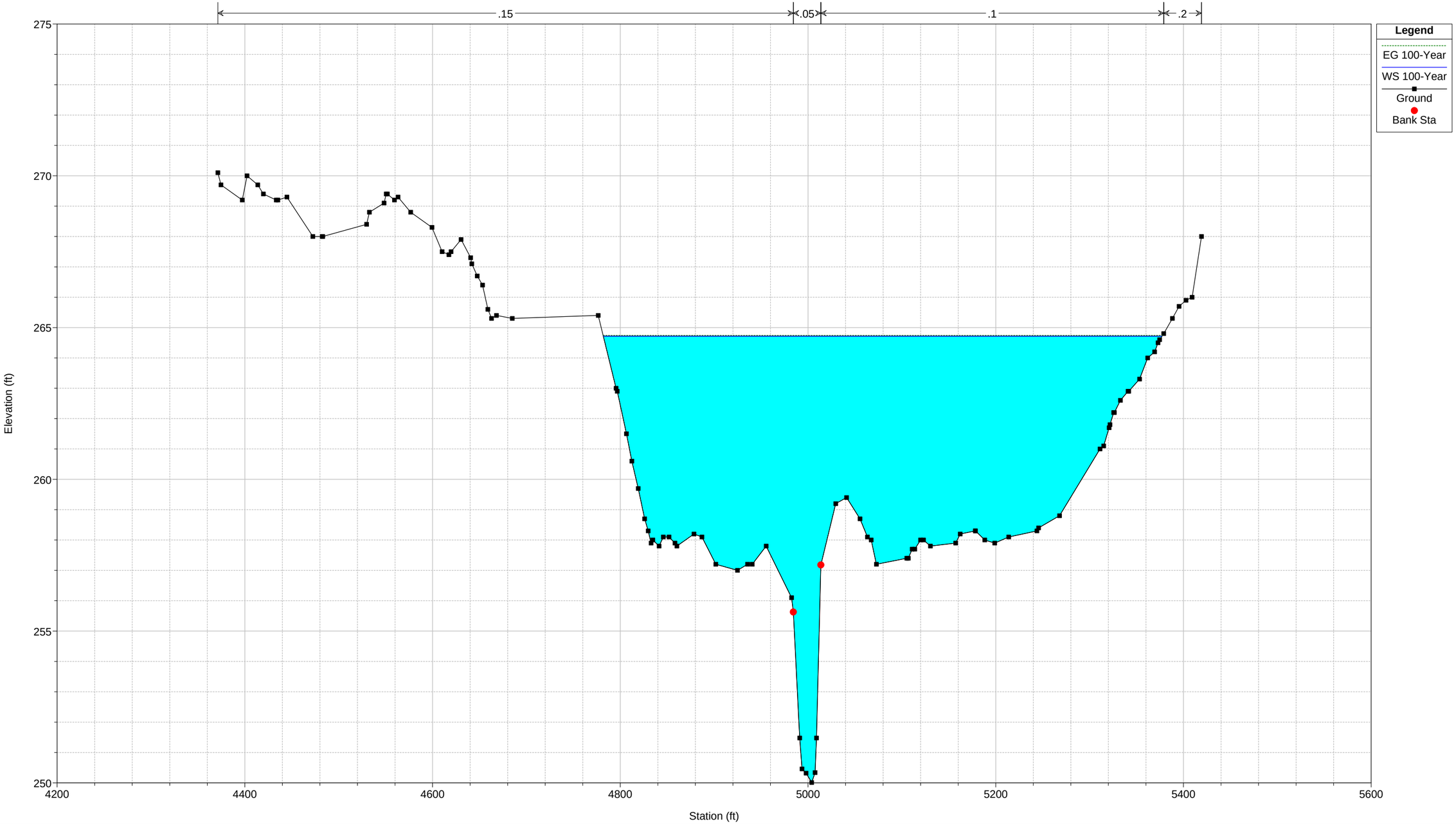
River = Booker Creek Reach = Reach - 1 RS = 6268.9 Culv FRANKLIN RD.



Booker CreekADJ Plan: Multiple 7/31/2015 10:54:34 AM

Geom: Geom 01 by CodeH2 for Windows Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 7024.2 Cross Section Booker Creek 14.0



Appendix B

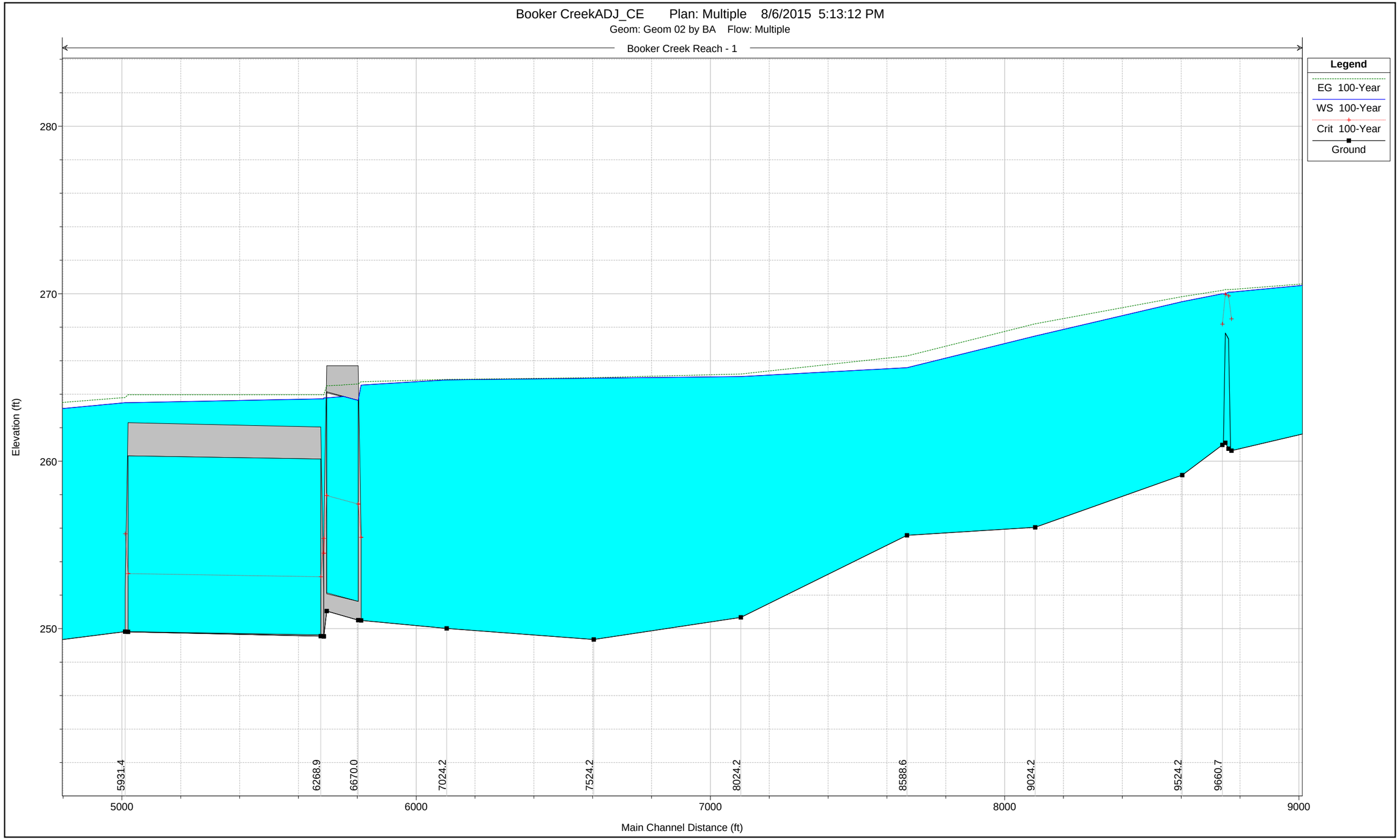
Corrected Effective Model

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year

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)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001017	4.03	571.60	164.94	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.53	170.83	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010011	8.85	141.86	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019577	10.91	101.77	37.53	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016003	10.28	104.49	31.12	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014858	10.70	164.13	67.85	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.33	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.92	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.20	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.83	133.61	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004359	5.30	228.15	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.73	428.23	431.64	0.004280	7.82	190.69	35.58	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.54	427.54	429.79	0.018159	12.16	111.47	28.47	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029849	11.85	103.27	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016574	10.30	283.11	124.91	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000582	3.31	1624.88	396.02	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.38		387.44	0.000240	2.59	1896.56	309.64	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.14	2158.22	366.00	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.48	381.48	383.37	0.012095	13.39	333.45	135.04	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020104	12.15	172.70	53.47	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019421	11.94	190.42	60.37	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022024	12.83	131.82	35.46	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006822	8.94	214.78	47.67	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017883	11.91	162.41	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005532	8.26	281.36	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010350	8.99	368.59	127.19	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.86	0.013253	11.32	251.71	110.79	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021265	13.32	153.56	34.62	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.24		303.85	0.002577	6.96	635.59	218.69	0.41
Reach - 1	15183.4	100-Year	1840.00	292.43	302.35	299.08	302.96	0.002648	6.75	615.82	335.92	0.41
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.31	299.31	301.72	0.017784	12.60	168.54	46.55	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005132	8.95	504.46	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.70	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.96	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.55	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.20	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	280.00	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011170	13.86	356.88	96.40	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010676	12.50	401.16	125.41	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014988	13.32	267.27	82.85	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011098	11.22	451.06	206.34	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.65		270.71	0.000970	3.39	2449.50	742.84	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.25	0.001744	5.20	1978.93	559.95	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.20	0.002378	5.84	1739.35	535.09	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002671	5.87	1471.77	491.42	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.48		268.20	0.003821	7.59	685.25	165.13	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.59		266.28	0.005085	7.89	887.54	331.98	0.48
Reach - 1	8024.2	100-Year	2670.00	250.67	265.05		265.21	0.000786	4.11	2014.94	585.78	0.20
Reach - 1	7524.2	100-Year	2860.00	249.35	264.96		264.99	0.000214	2.28	4136.36	771.56	0.11
Reach - 1	7024.2	100-Year	2860.00	250.01	264.86		264.88	0.000208	2.17	3735.10	599.20	0.11
Reach - 1	6733.5	100-Year	2860.00	250.49	264.55	255.45	264.75	0.000421	3.59	810.69	437.27	0.17
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	263.78	254.51	263.97	0.000402	3.54	822.21	448.97	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	263.73	255.38	263.96	0.000695	4.37	2021.69	746.21	0.21
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.49	255.66	263.80	0.000900	4.85	1644.43	727.92	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.71		263.14	0.002071	6.79	1838.33	904.86	0.35
Reach - 1	5024.2	100-Year	2860.00	248.44	262.34		262.49	0.000920	4.62	2234.86	462.45	0.24
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.23	262.26	0.000478	3.70	895.55	220.55	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.59	253.50	260.83	0.000593	3.95	836.32	209.13	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001783	6.63	538.84	631.25	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.28	259.44	0.004392	8.76	391.34	413.51	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001652	4.44	2312.71	557.29	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000352	2.25	4838.10	946.42	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003286	7.52	499.95	908.80	0.46
Reach - 1	3157.2		Bridge									

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

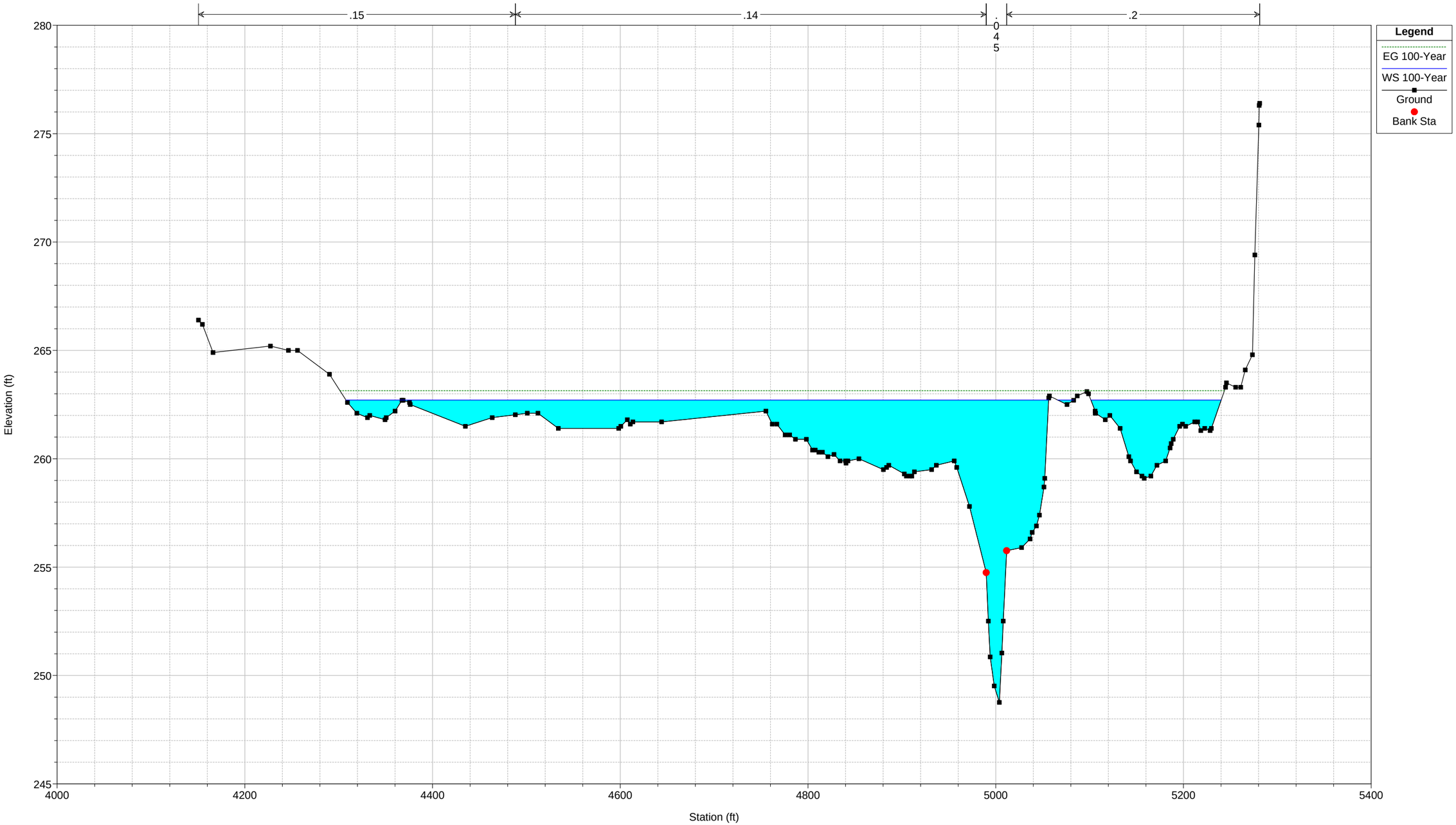
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.95	256.11	0.006020	9.10	385.97	879.19	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.91	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.47	770.55	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.87	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

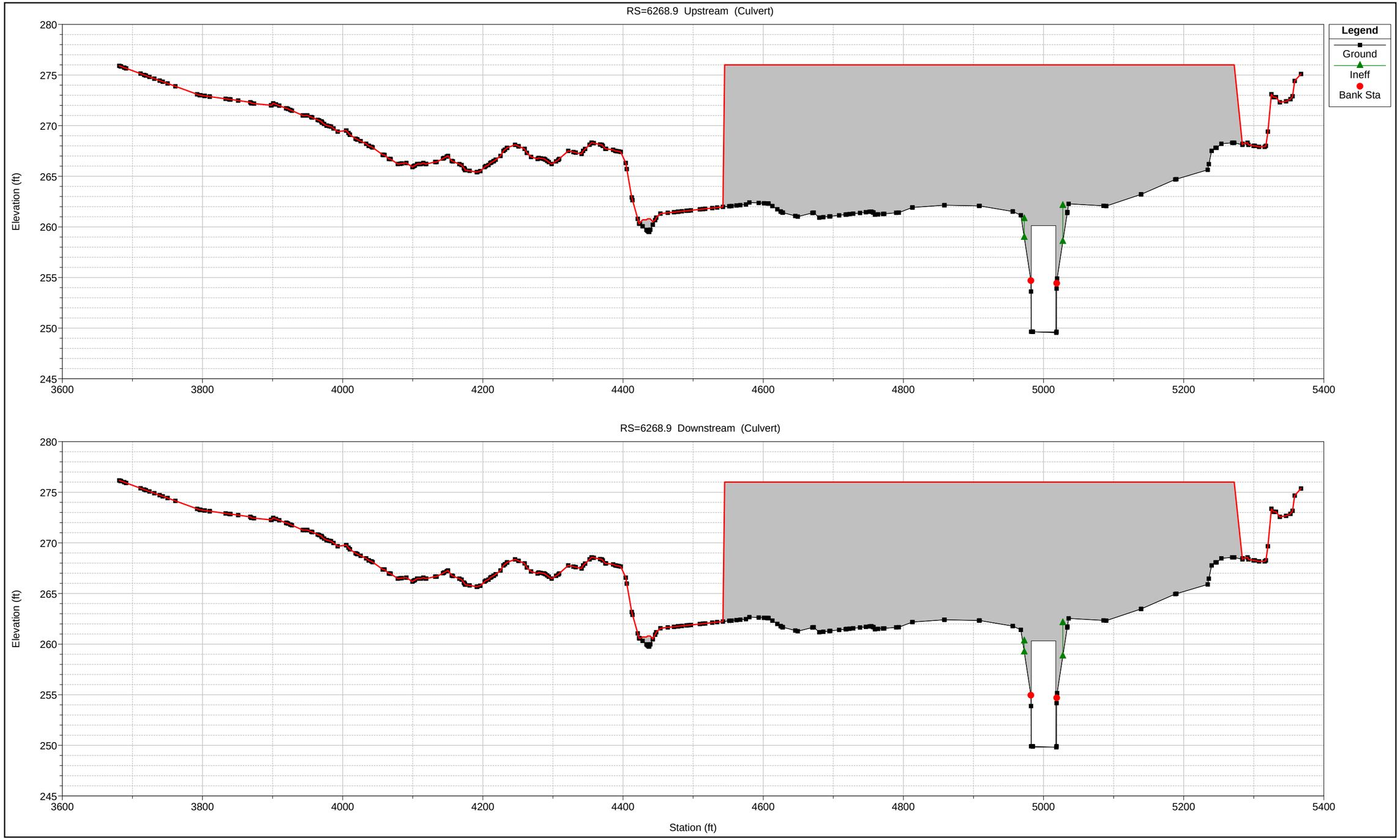

Booker CreekADJ_CE Plan: Multiple 8/6/2015 5:13:12 PM
Geom: Geom 02 by BA Flow: Multiple
Booker Creek Reach - 1
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Elevation (ft)
280
270
260
250
5931.4
6268.9
6670.0
7024.2
7524.2
8024.2
8588.6
9024.2
9524.2
9660.7
5000
6000
7000
8000
9000
Main Channel Distance (ft)

Booker CreekADJ_CE Plan: Multiple 8/6/2015 5:13:12 PM

Geom: Geom 02 by BA Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 5454.5 Cross Section Booker Creek 11.0

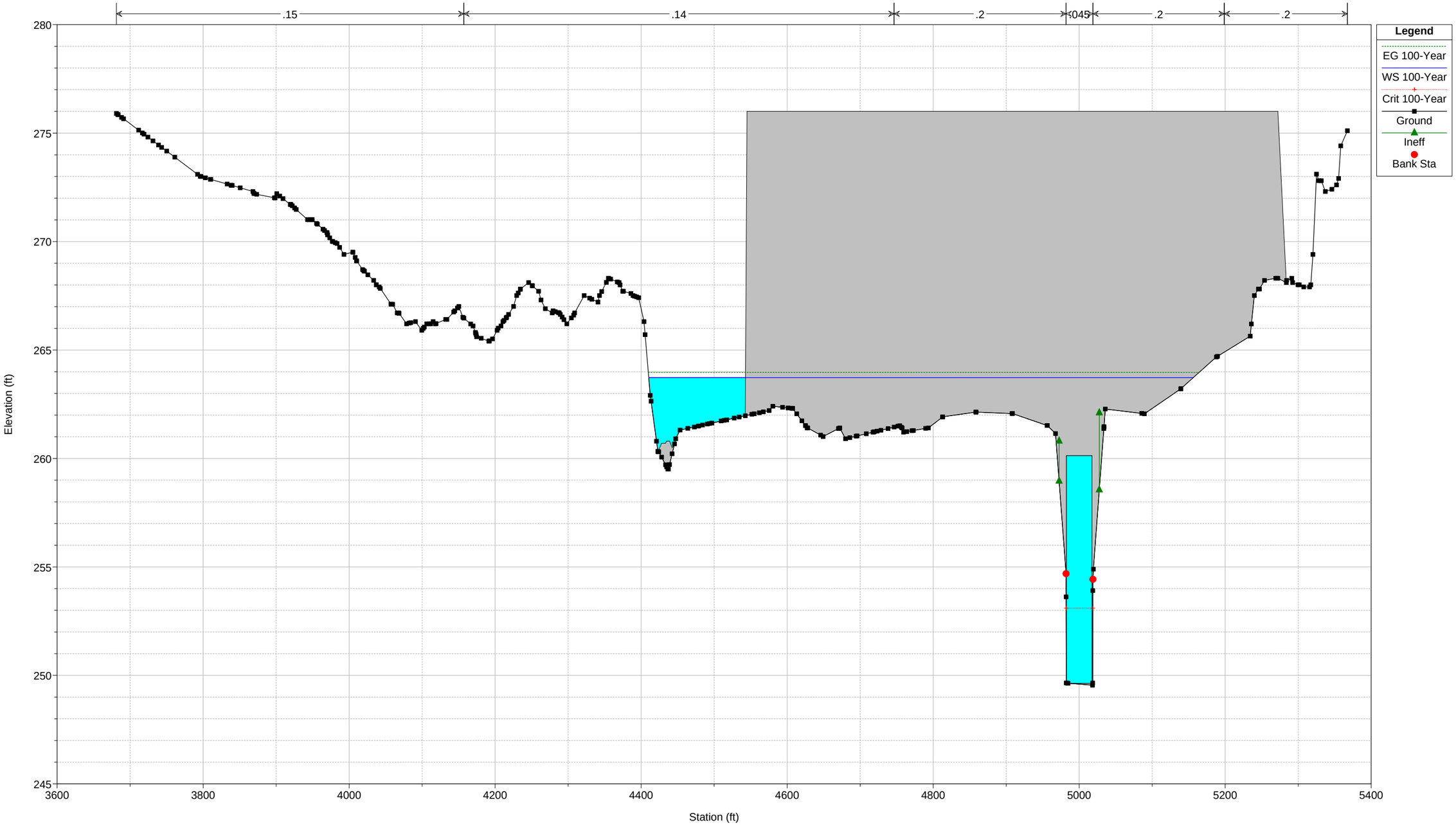



RS=6268.9 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
RS=6268.9 Downstream (Culvert)
Elevation (ft)
Station (ft)

Booker CreekADJ_CE Plan: Multiple 8/6/2015 5:13:12 PM

Geom: Geom 02 by BA Flow: Multiple

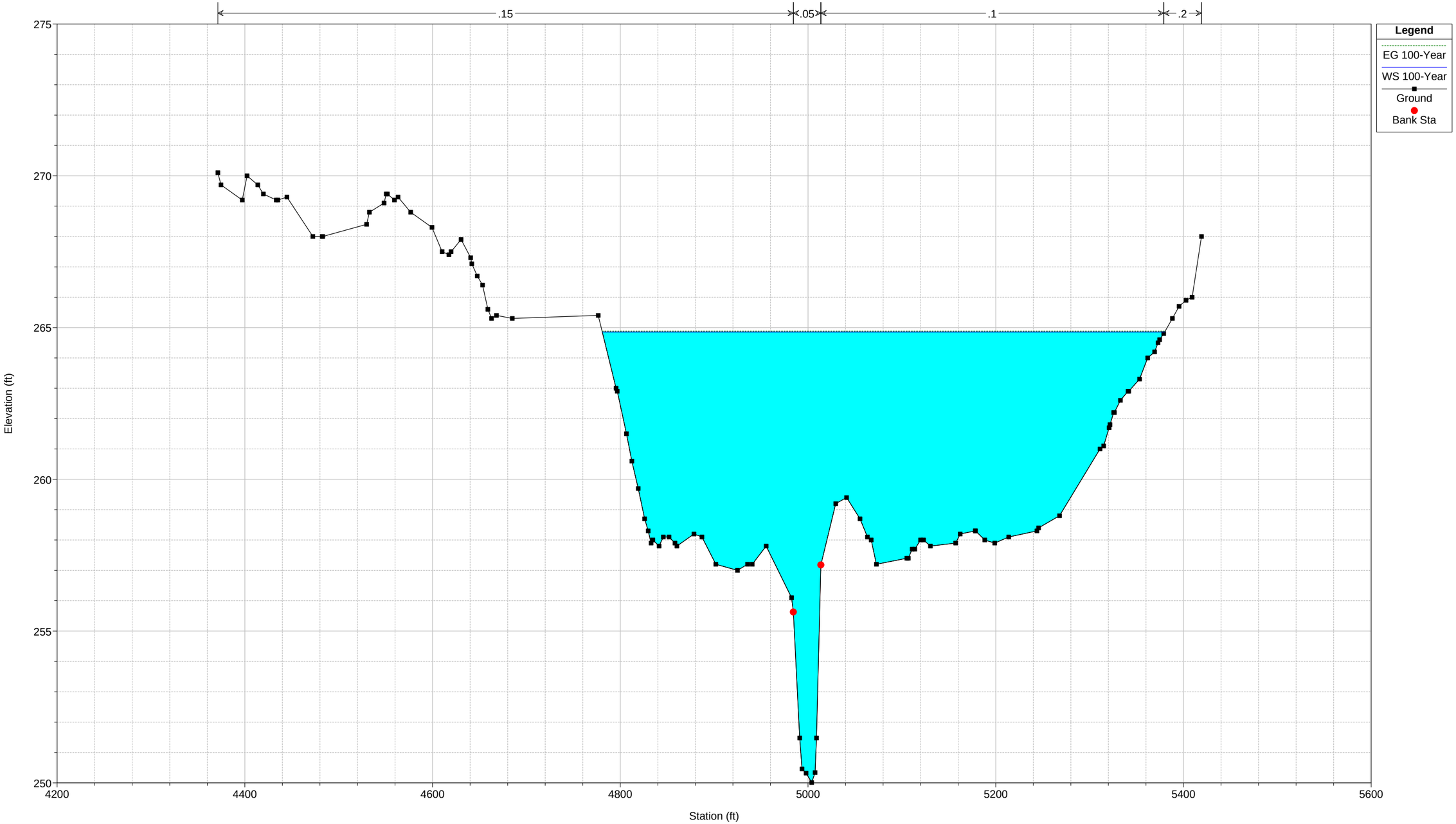
River = Booker Creek Reach = Reach - 1 RS = 6268.9 Culv FRANKLIN RD.



Booker CreekADJ_CE Plan: Multiple 8/6/2015 5:13:12 PM

Geom: Geom 02 by BA Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 7024.2 Cross Section Booker Creek 14.0



Appendix C

Proposed Conditions Model

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year

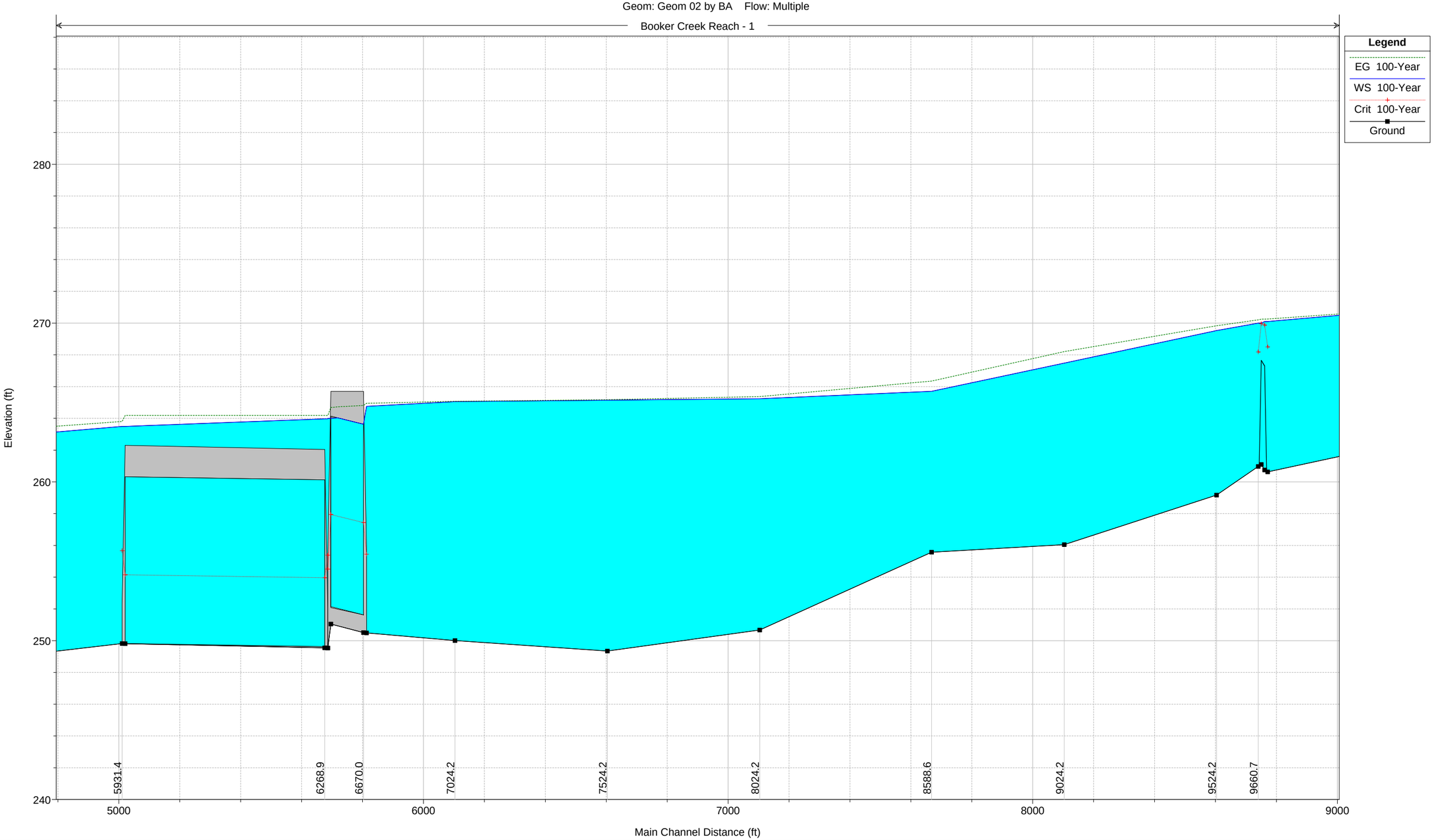
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001017	4.03	571.60	164.94	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.53	170.83	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010011	8.85	141.86	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019577	10.91	101.77	37.53	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016003	10.28	104.49	31.12	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014858	10.70	164.13	67.85	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.33	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.92	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.20	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.83	133.61	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004359	5.30	228.15	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.73	428.23	431.64	0.004280	7.82	190.69	35.58	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.54	427.54	429.79	0.018159	12.16	111.47	28.47	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029849	11.85	103.27	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016574	10.30	283.11	124.91	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000582	3.31	1624.88	396.02	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.38		387.44	0.000240	2.59	1896.56	309.64	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.14	2158.22	366.00	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.48	381.48	383.37	0.012095	13.39	333.45	135.04	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020104	12.15	172.70	53.47	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019421	11.94	190.42	60.37	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022024	12.83	131.82	35.46	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006822	8.94	214.78	47.67	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017883	11.91	162.41	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005532	8.26	281.36	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010350	8.99	368.59	127.19	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.86	0.013253	11.32	251.71	110.79	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021265	13.32	153.56	34.62	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.24		303.85	0.002577	6.96	635.59	218.69	0.41
Reach - 1	15183.4	100-Year	1840.00	292.43	302.35	299.08	302.96	0.002648	6.75	615.82	335.92	0.41
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.31	299.31	301.72	0.017784	12.60	168.54	46.55	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005132	8.95	504.46	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.70	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.96	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.55	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.20	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	280.00	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011170	13.86	356.88	96.40	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010676	12.50	401.16	125.41	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014988	13.32	267.27	82.85	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011094	11.22	451.15	206.36	0.84
Reach - 1	10024.2	100-Year	2280.00	262.00	270.65		270.71	0.000970	3.39	2450.09	742.89	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.25	0.001743	5.20	1979.62	560.02	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.20	0.002376	5.84	1739.94	535.14	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002667	5.87	1472.64	491.48	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.48		268.21	0.003808	7.58	686.41	165.20	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.70		266.35	0.004681	7.64	927.32	334.81	0.46
Reach - 1	8024.2	100-Year	2670.00	250.67	265.24		265.37	0.000703	3.93	2122.79	590.11	0.19
Reach - 1	7524.2	100-Year	2860.00	249.35	265.15		265.17	0.000197	2.21	4283.50	783.08	0.10
Reach - 1	7024.2	100-Year	2860.00	250.01	265.05		265.08	0.000190	2.09	3854.16	604.40	0.10
Reach - 1	6733.5	100-Year	2860.00	250.49	264.76	255.45	264.95	0.000399	3.53	823.77	450.46	0.17
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	264.00	254.51	264.18	0.000381	3.48	835.71	462.88	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	263.97	255.38	264.18	0.000615	4.16	2206.06	754.98	0.19
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.49	255.66	263.80	0.000900	4.85	1644.43	727.92	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.71		263.14	0.002071	6.79	1838.33	904.86	0.35
Reach - 1	5024.2	100-Year	2860.00	248.44	262.34		262.49	0.000920	4.62	2234.86	462.45	0.24
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.23	262.26	0.000478	3.70	895.55	220.55	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.59	253.50	260.83	0.000593	3.95	836.32	209.13	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001783	6.63	538.84	631.25	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.28	259.44	0.004392	8.76	391.34	413.51	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001652	4.44	2312.71	557.29	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000352	2.25	4838.10	946.42	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003286	7.52	499.95	908.80	0.46
Reach - 1	3157.2		Bridge									

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

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)	
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.95	256.11	0.006020	9.10	385.97	879.19	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.91	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.47	770.55	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.87	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

Booker CreekADJ_PROP Plan: Multiple 8/6/2015 5:52:19 PM

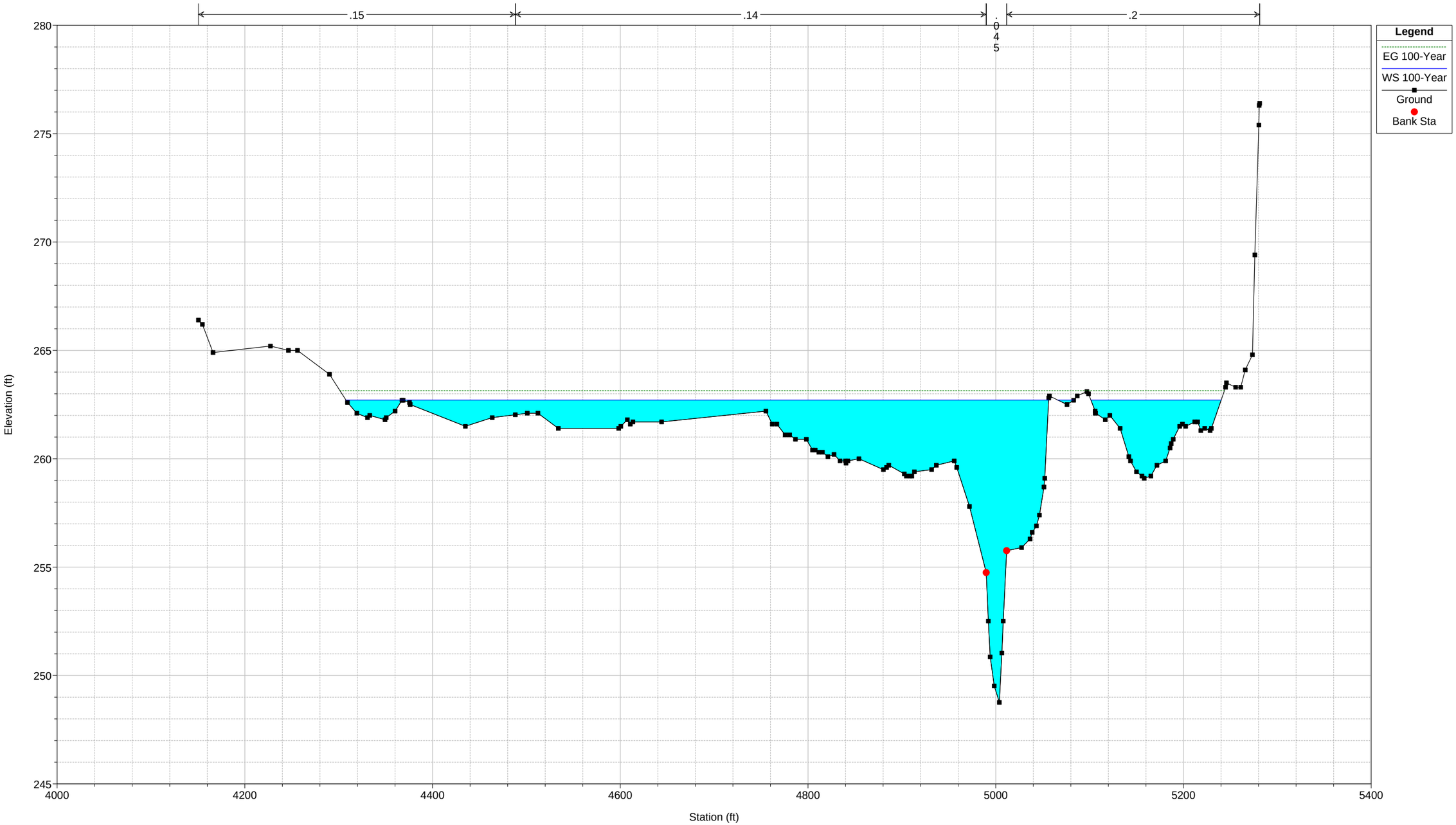
Geom: Geom 02 by BA Flow: Multiple

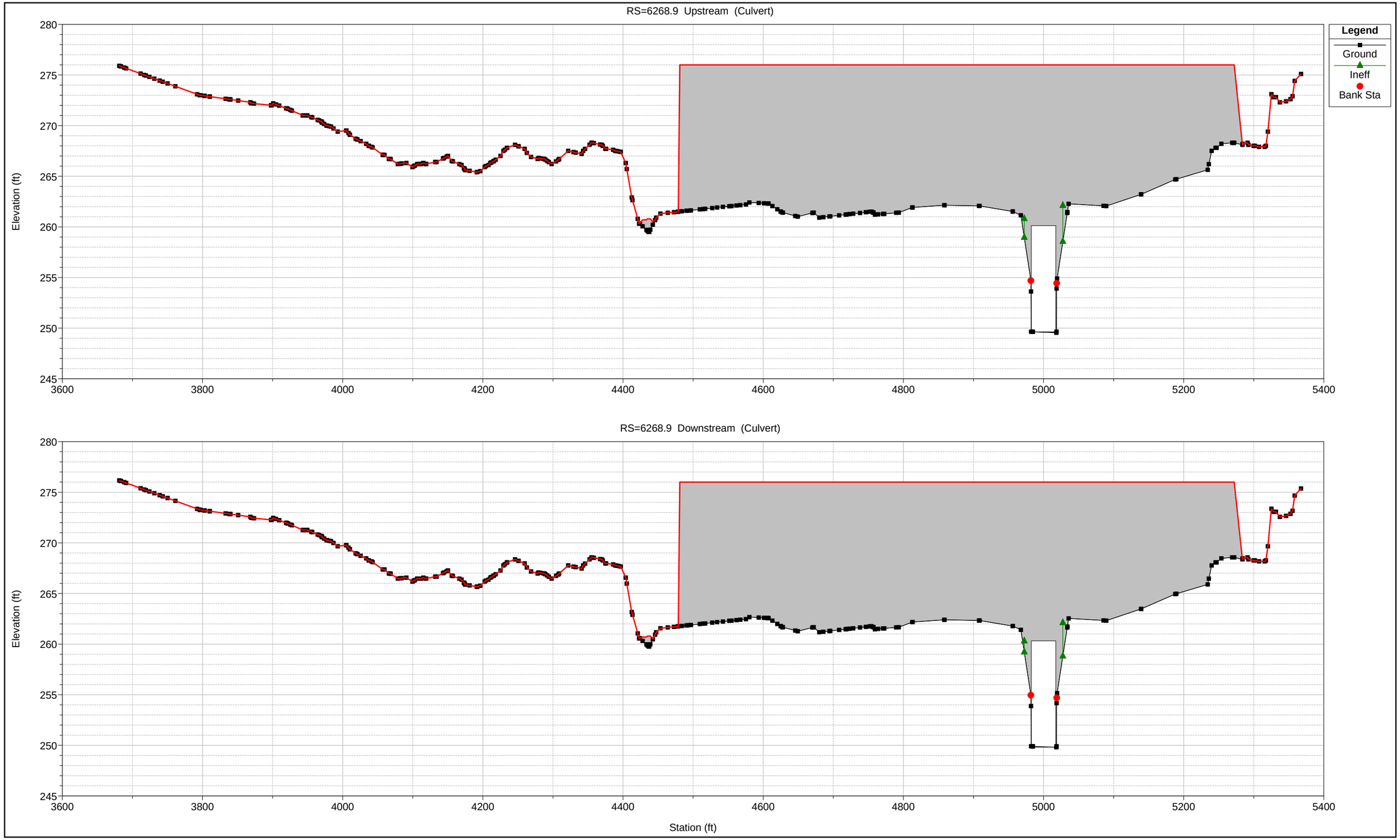


Booker CreekADJ_PROP Plan: Multiple 8/6/2015 5:52:19 PM

Geom: Geom 02 by BA Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 5454.5 Cross Section Booker Creek 11.0

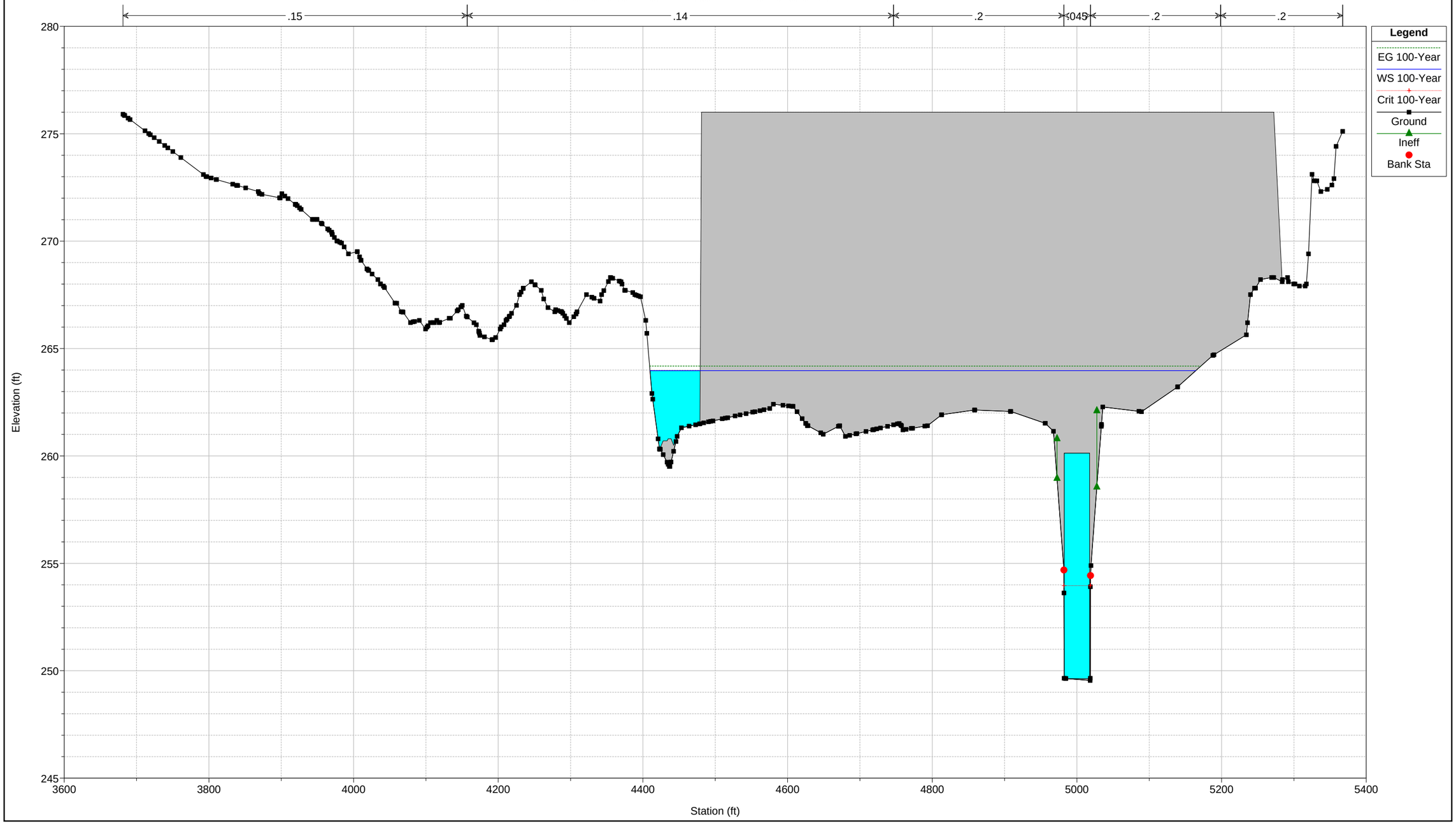



RS=6268.9 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
RS=6268.9 Downstream (Culvert)
Elevation (ft)
Station (ft)

Booker CreekADJ_PROP Plan: Multiple 8/6/2015 5:52:19 PM

Geom: Geom 02 by BA Flow: Multiple

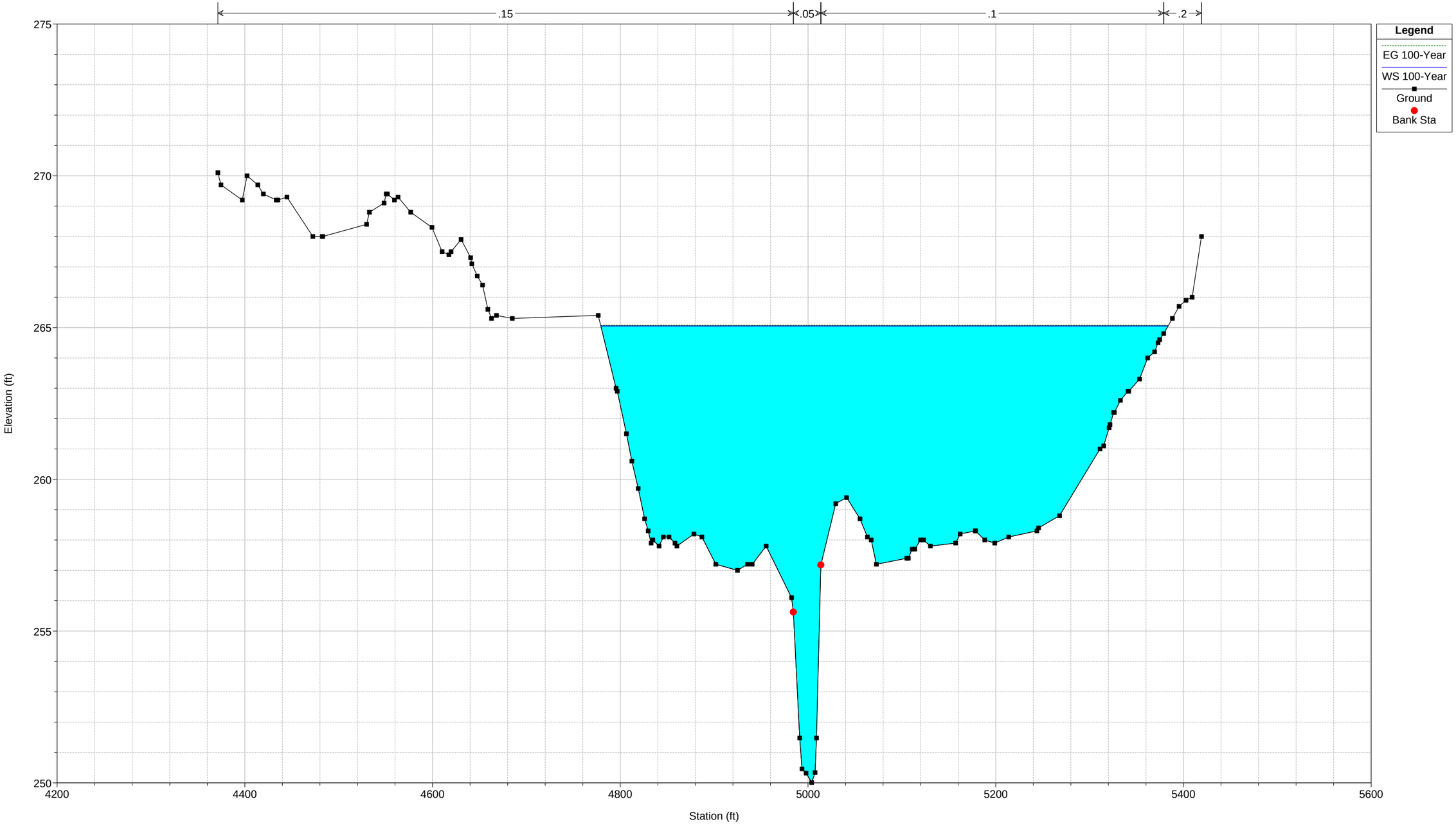
River = Booker Creek Reach = Reach - 1 RS = 6268.9 Culv FRANKLIN RD.



Booker CreekADJ_PROP Plan: Multiple 8/6/2015 5:52:19 PM

Geom: Geom 02 by BA Flow: Multiple

River = Booker Creek Reach = Reach - 1 RS = 7024.2 Cross Section Booker Creek 14.0



Appendix C

Existing Conditions – with Eastgate Bldg. D + New Sections

Existing Conditions with Eastgate Building D + New Sections

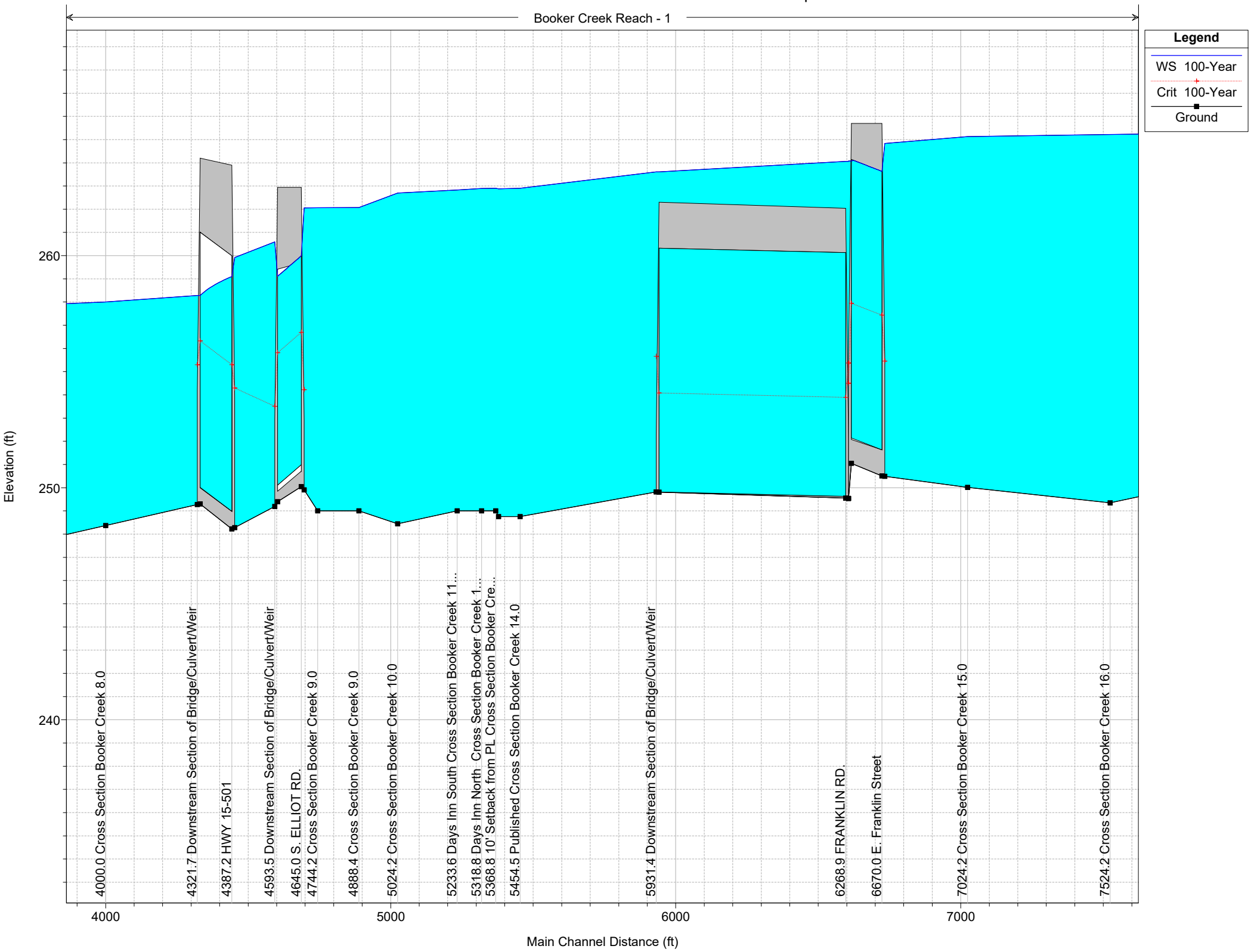
HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year

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)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001016	4.03	571.84	164.95	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.79	170.84	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010015	8.85	141.83	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019561	10.91	101.80	37.54	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016017	10.29	104.46	31.11	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014848	10.69	164.19	67.86	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.31	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.91	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.21	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.82	133.60	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004363	5.30	228.09	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.72	428.22	431.64	0.004285	7.82	190.60	35.56	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.53	427.53	429.79	0.018270	12.18	111.23	28.45	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029823	11.85	103.30	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016562	10.30	283.21	124.92	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000581	3.31	1626.03	396.04	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.39		387.44	0.000240	2.59	1897.52	309.67	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.13	2159.38	366.02	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.49	381.49	383.37	0.011994	13.35	335.44	137.15	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020081	12.15	172.79	53.49	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019404	11.94	190.49	60.38	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022002	12.82	131.88	35.47	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006820	8.94	214.81	47.68	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017889	11.91	162.38	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005531	8.26	281.37	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010355	8.99	368.52	127.18	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.87	0.013242	11.32	251.85	110.80	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021241	13.31	153.62	34.63	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.39		303.96	0.002392	6.78	669.34	229.33	0.39
Reach - 1	15183.4	100-Year	1840.00	292.43	302.57	299.08	303.13	0.002438	6.58	696.10	436.01	0.39
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.32	299.32	301.72	0.017666	12.58	169.01	46.70	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005133	8.95	504.39	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.64	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.94	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.54	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.19	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	279.99	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011160	13.86	357.02	96.42	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010668	12.50	401.31	125.42	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014977	13.31	267.36	82.88	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011105	11.22	450.90	206.29	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.65		270.71	0.000969	3.39	2450.77	742.95	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.26	0.001741	5.20	1980.32	560.09	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.21	0.002374	5.84	1740.44	535.18	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002665	5.87	1473.30	491.52	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.49		268.21	0.003800	7.58	687.11	165.24	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.75		266.38	0.004528	7.54	943.58	335.96	0.46
Reach - 1	8024.2	100-Year	2670.00	250.67	265.31		265.44	0.000674	3.86	2164.65	592.06	0.19
Reach - 1	7524.2	100-Year	2860.00	249.35	265.22		265.25	0.000190	2.18	4341.18	784.29	0.10
Reach - 1	7024.2	100-Year	2860.00	250.01	265.13		265.15	0.000184	2.06	3900.70	606.43	0.10
Reach - 1	6733.5	100-Year	2860.00	250.49	264.84	255.45	265.03	0.000391	3.51	828.83	455.24	0.17
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	264.08	254.50	264.26	0.000373	3.46	840.81	469.07	0.17
Reach - 1	6606.4	100-Year	2860.00	249.54	264.06	255.37	264.26	0.000588	4.08	2275.22	758.25	0.19
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.61	255.66	263.90	0.000850	4.74	1726.51	731.94	0.23
Reach - 1	5454.5	100-Year	2860.00	248.76	262.90		263.29	0.001874	6.53	2009.73	923.96	0.34

HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

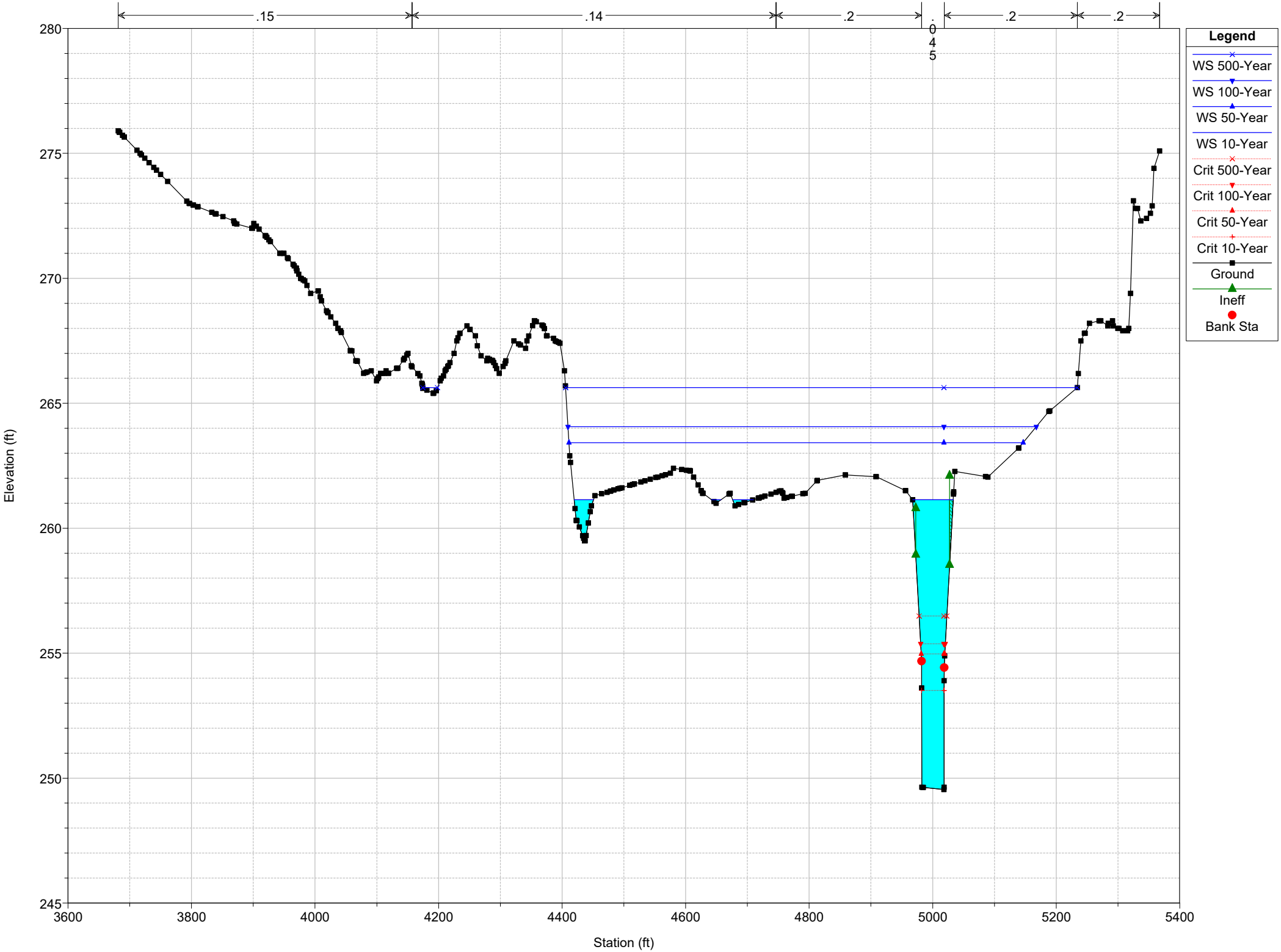
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	5378.8	100-Year	2860.00	248.76	262.88		263.14	0.001024	5.23	2209.26	978.32	0.26
Reach - 1	5368.8	100-Year	2860.00	249.00	262.90		263.11	0.000839	4.77	2420.66	887.01	0.23
Reach - 1	5318.8	100-Year	2860.00	249.00	262.89		263.05	0.000824	4.49	2259.90	755.17	0.22
Reach - 1	5233.6	100-Year	2860.00	249.00	262.83		262.99	0.000720	4.27	2227.29	740.17	0.21
Reach - 1	5024.2	100-Year	2860.00	248.44	262.69		262.82	0.000788	4.36	2400.83	488.22	0.22
Reach - 1	4888.4	100-Year	2860.00	249.00	262.07		262.57	0.001376	5.94	921.04	326.99	0.31
Reach - 1	4744.2	100-Year	2860.00	249.00	262.06		262.30	0.000679	4.19	1134.38	205.14	0.22
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.22	262.26	0.000477	3.70	895.77	220.60	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.60	253.50	260.83	0.000593	3.95	836.46	209.15	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001782	6.63	538.92	631.41	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.30	259.44	0.004391	8.76	391.36	413.53	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001650	4.44	2313.37	557.32	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000351	2.25	4839.51	946.43	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003284	7.52	500.06	908.83	0.46
Reach - 1	3157.2		Bridge									
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.96	256.11	0.006022	9.10	385.91	879.17	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.90	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.45	770.54	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.86	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017



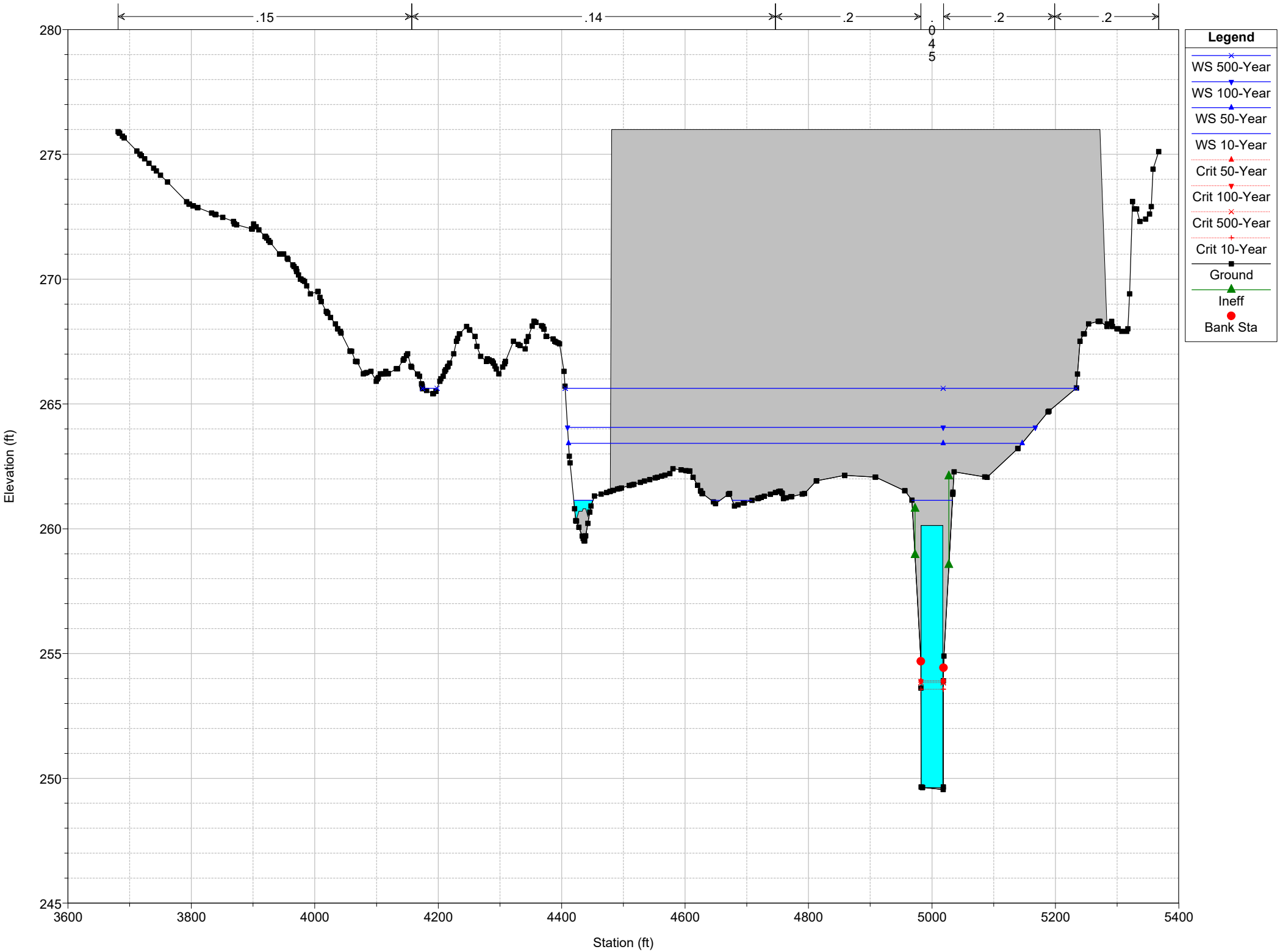
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 6606.4 Upstream Section of Bridge/Culvert/Weir



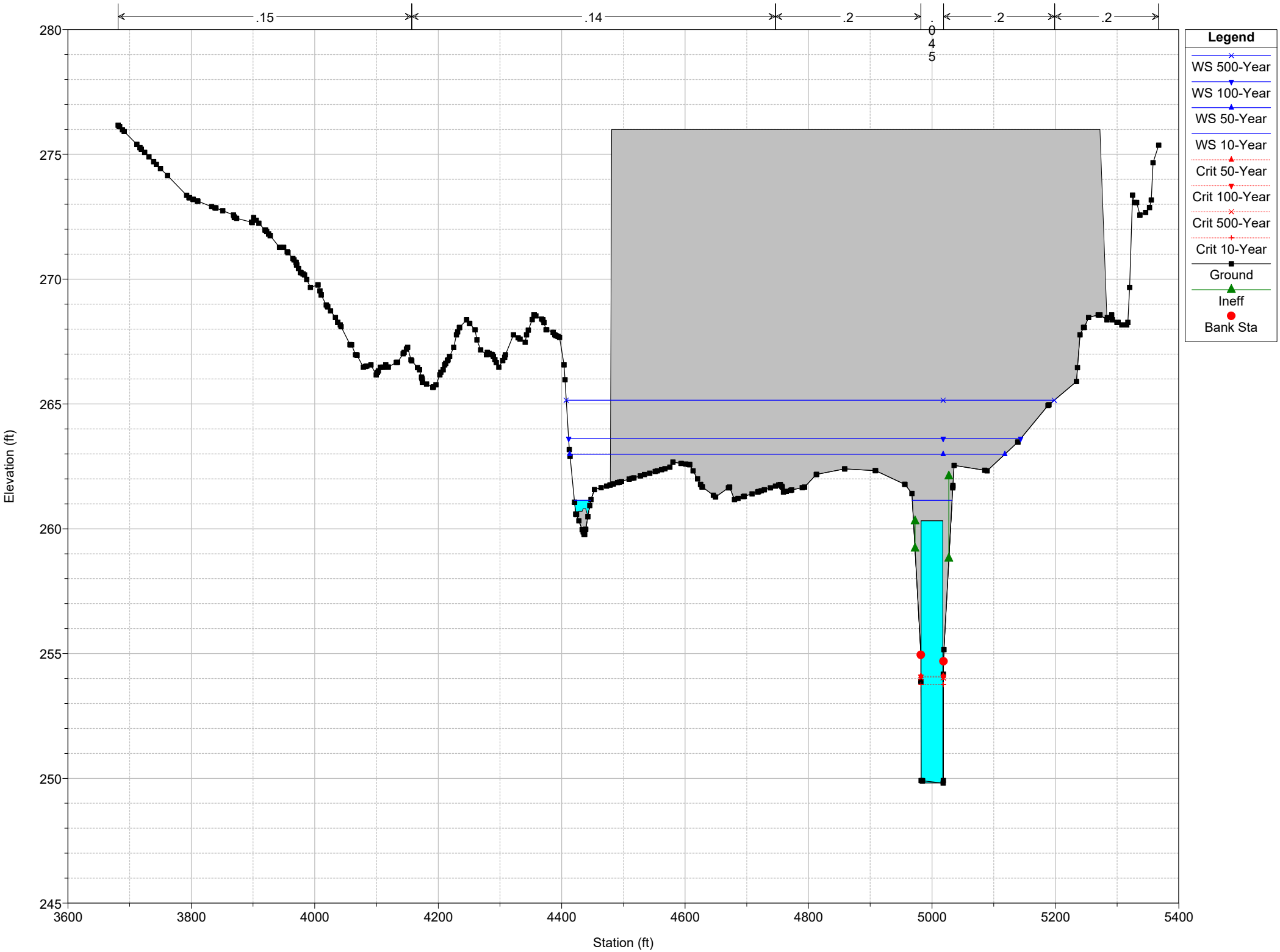
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 6268.9 Culv FRANKLIN RD.



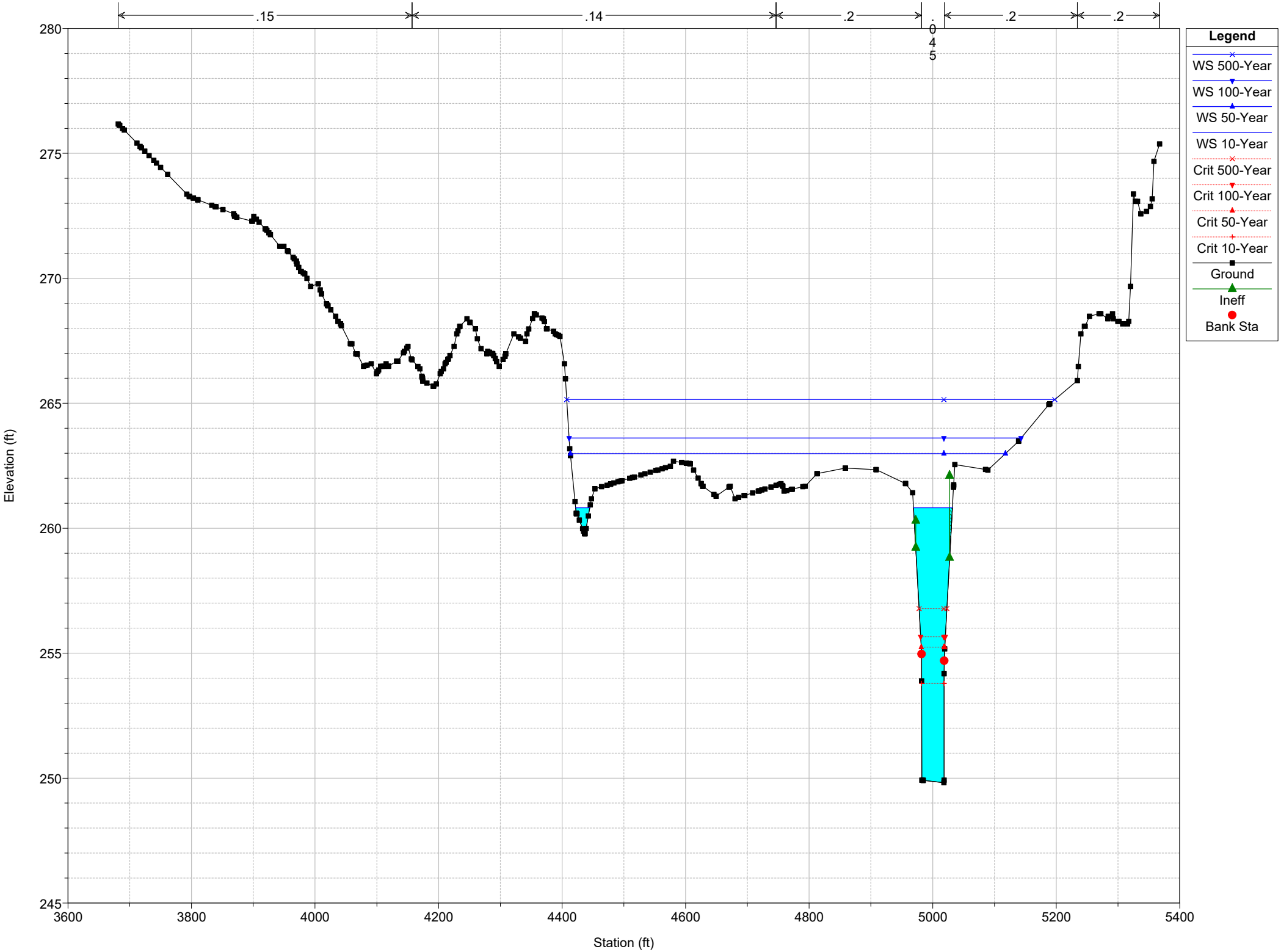
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 6268.9 Culv FRANKLIN RD.



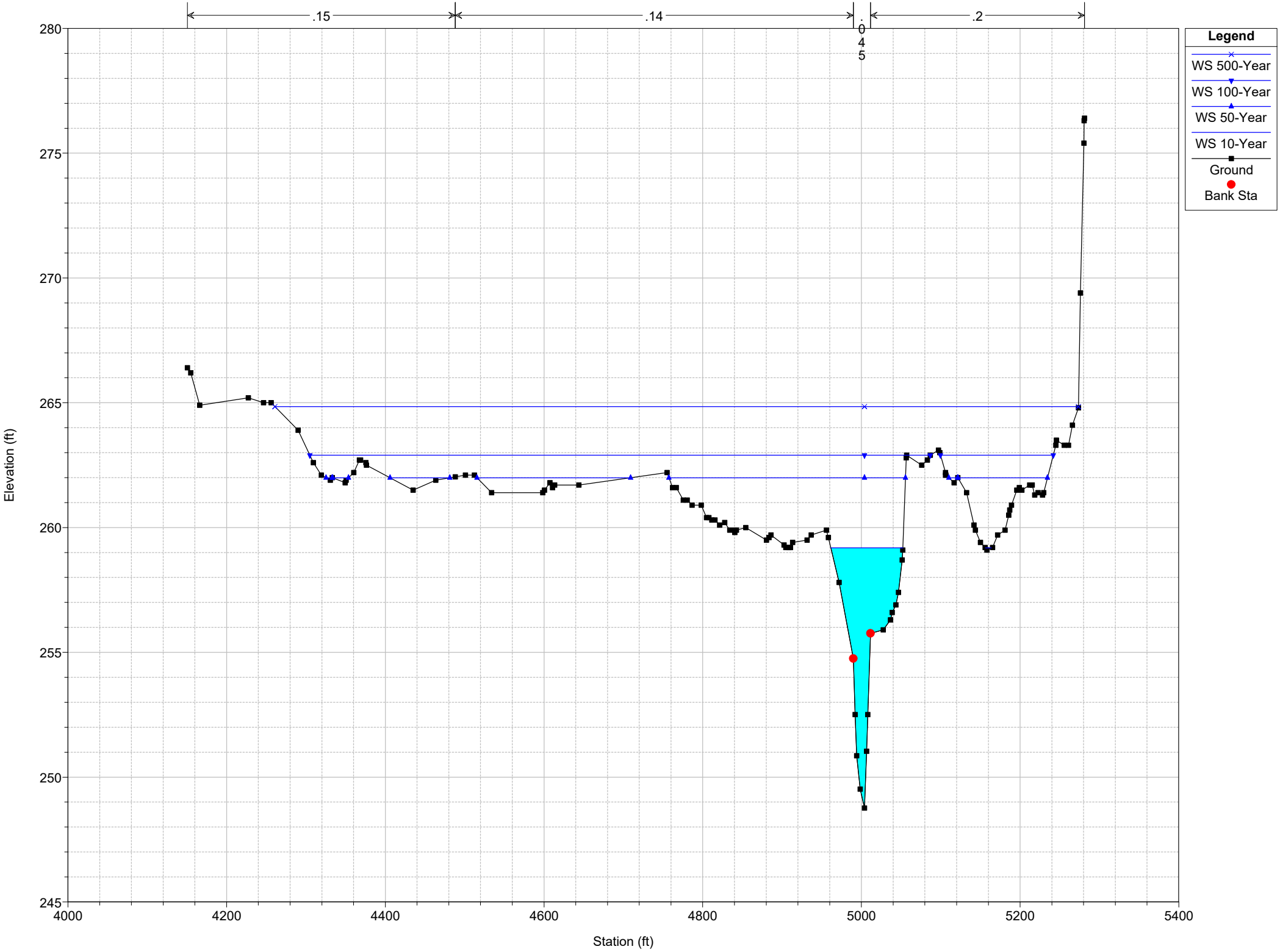
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5931.4 Downstream Section of Bridge/Culvert/Weir



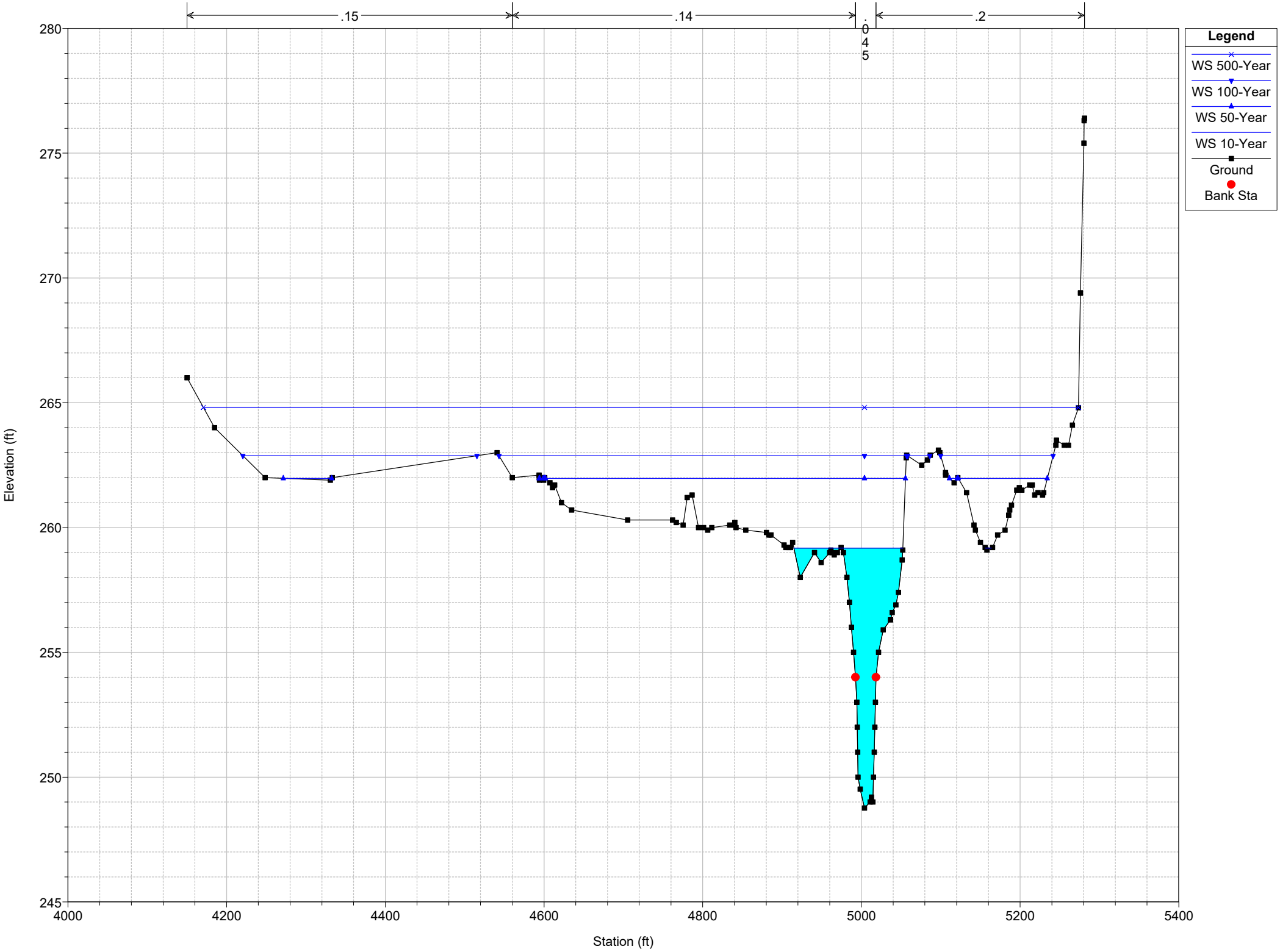
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5454.5 Published Cross Section Booker Creek 14.0



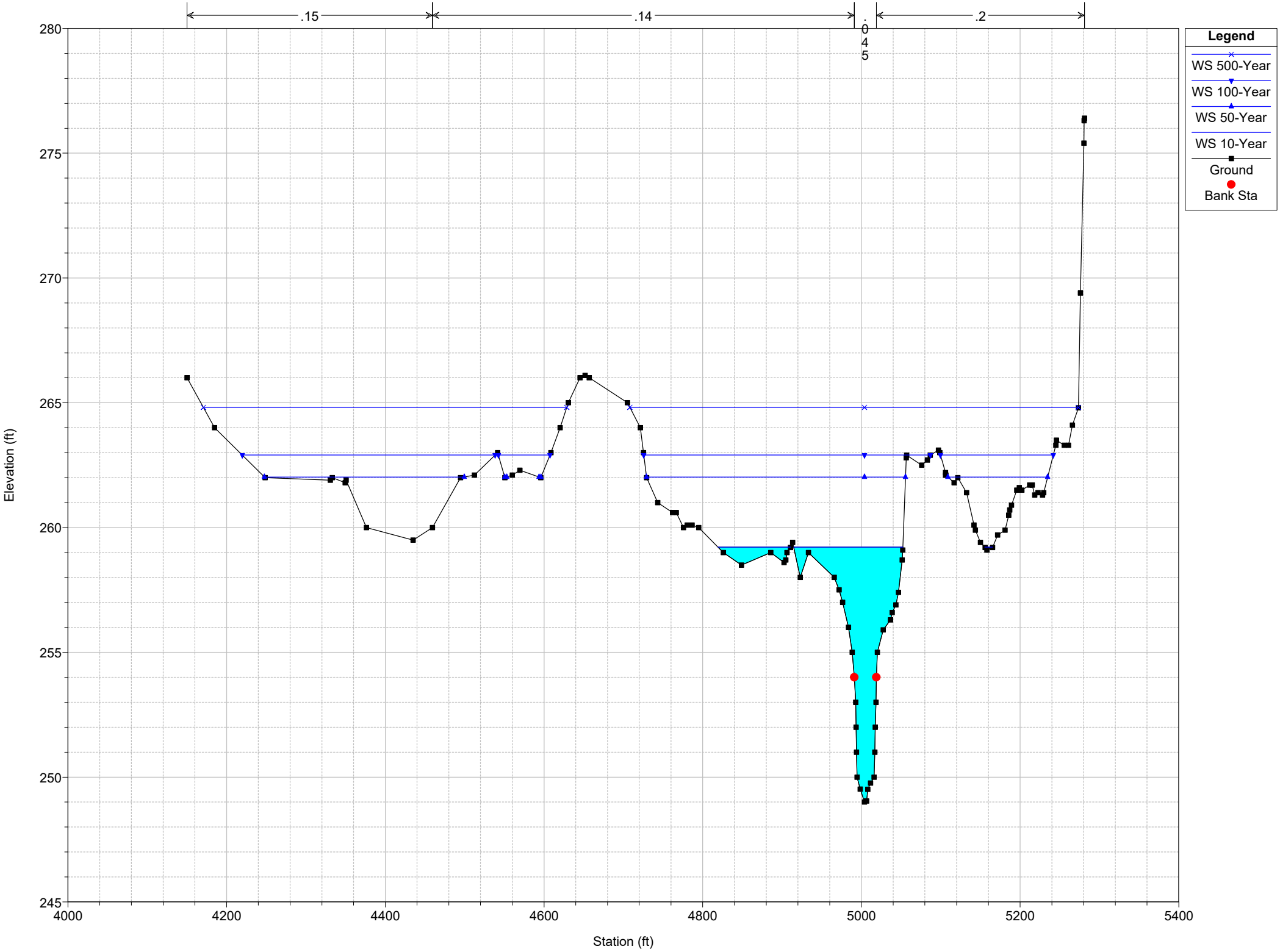
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5378.8 Property Line Cross Section Booker Creek 13.0



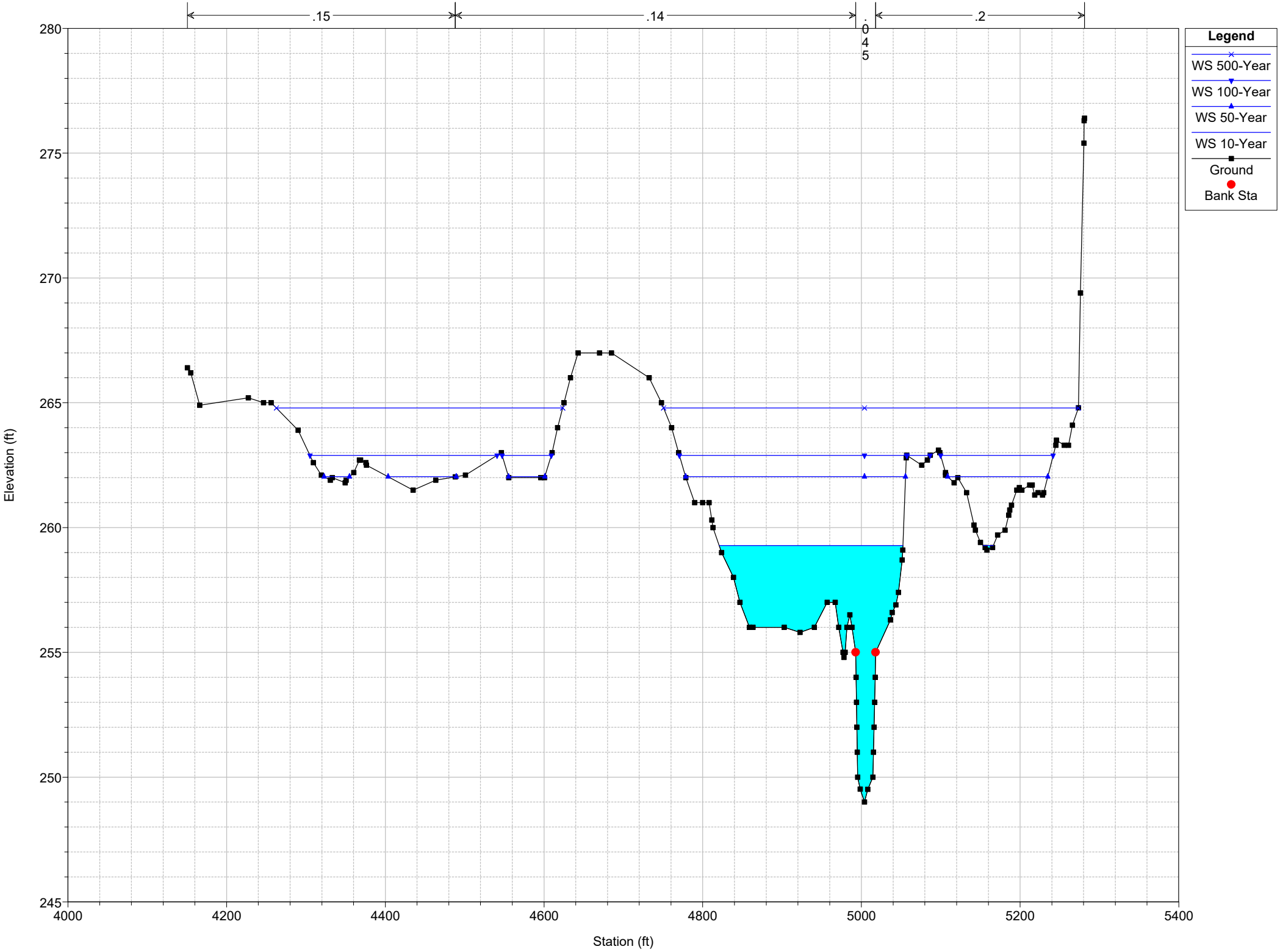
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5368.8 10' Setback from PL Cross Section Booker Creek 13.0



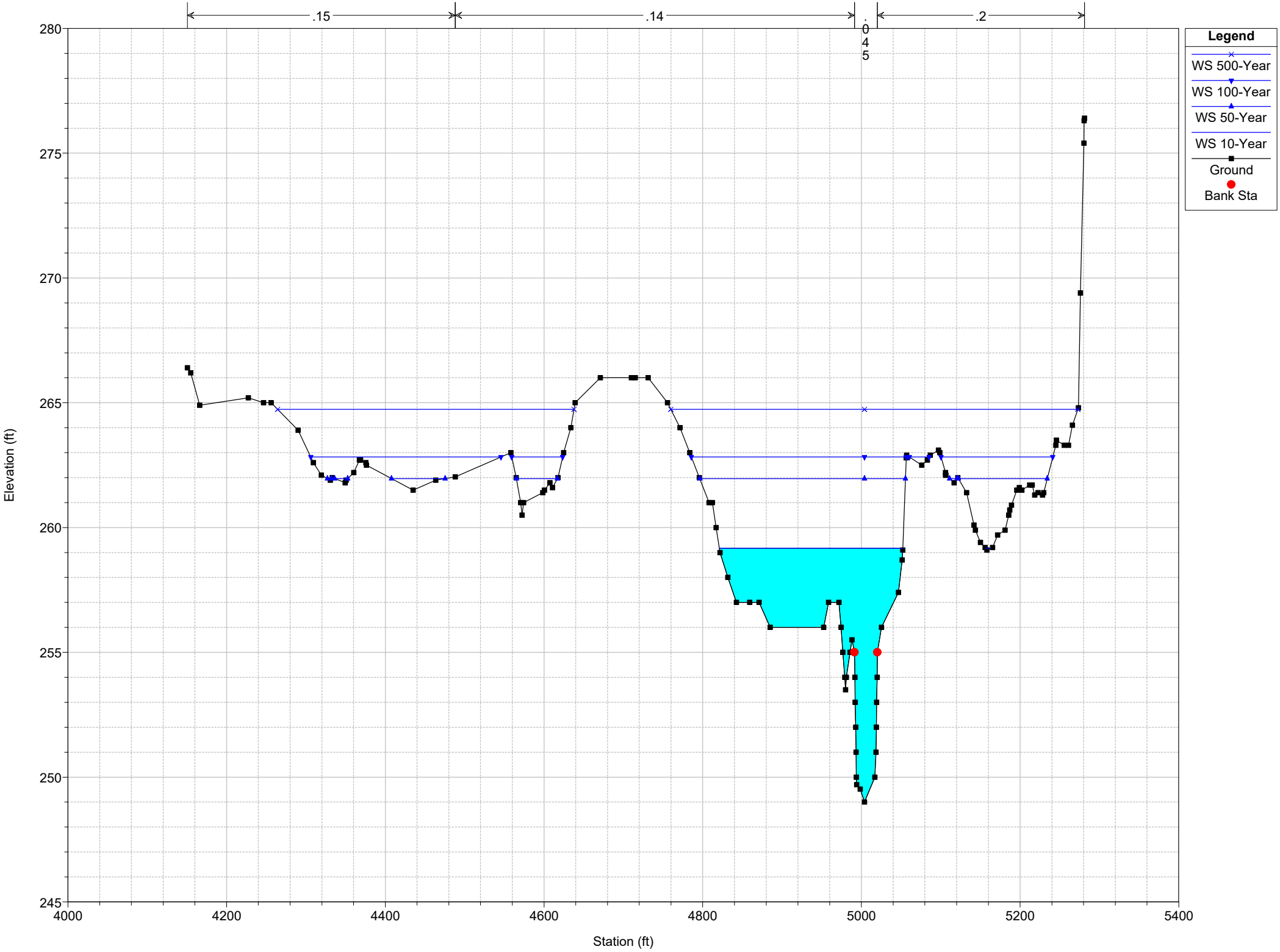
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5318.8 Days Inn North Cross Section Booker Creek 11.0



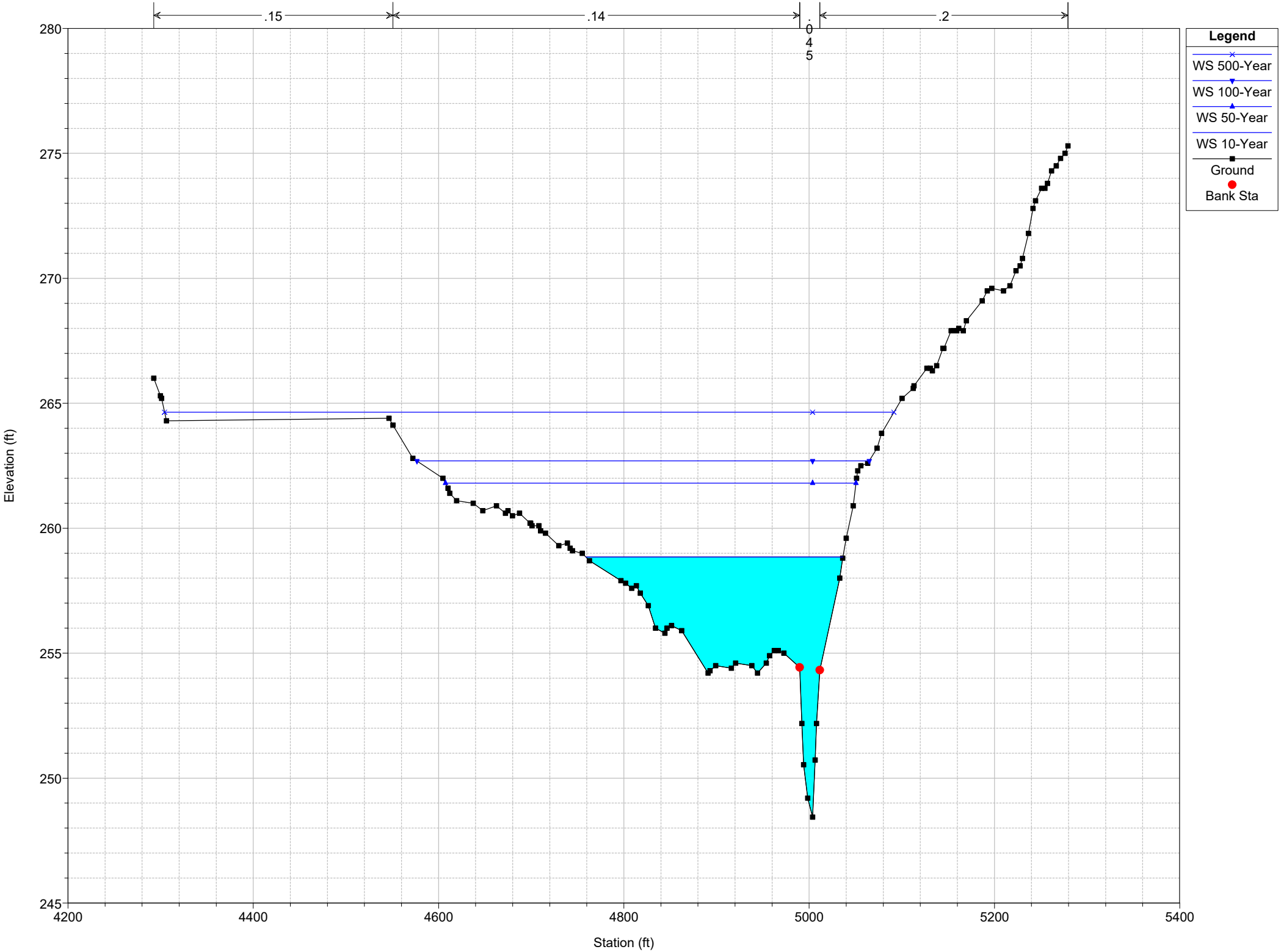
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5233.6 Days Inn South Cross Section Booker Creek 11.0



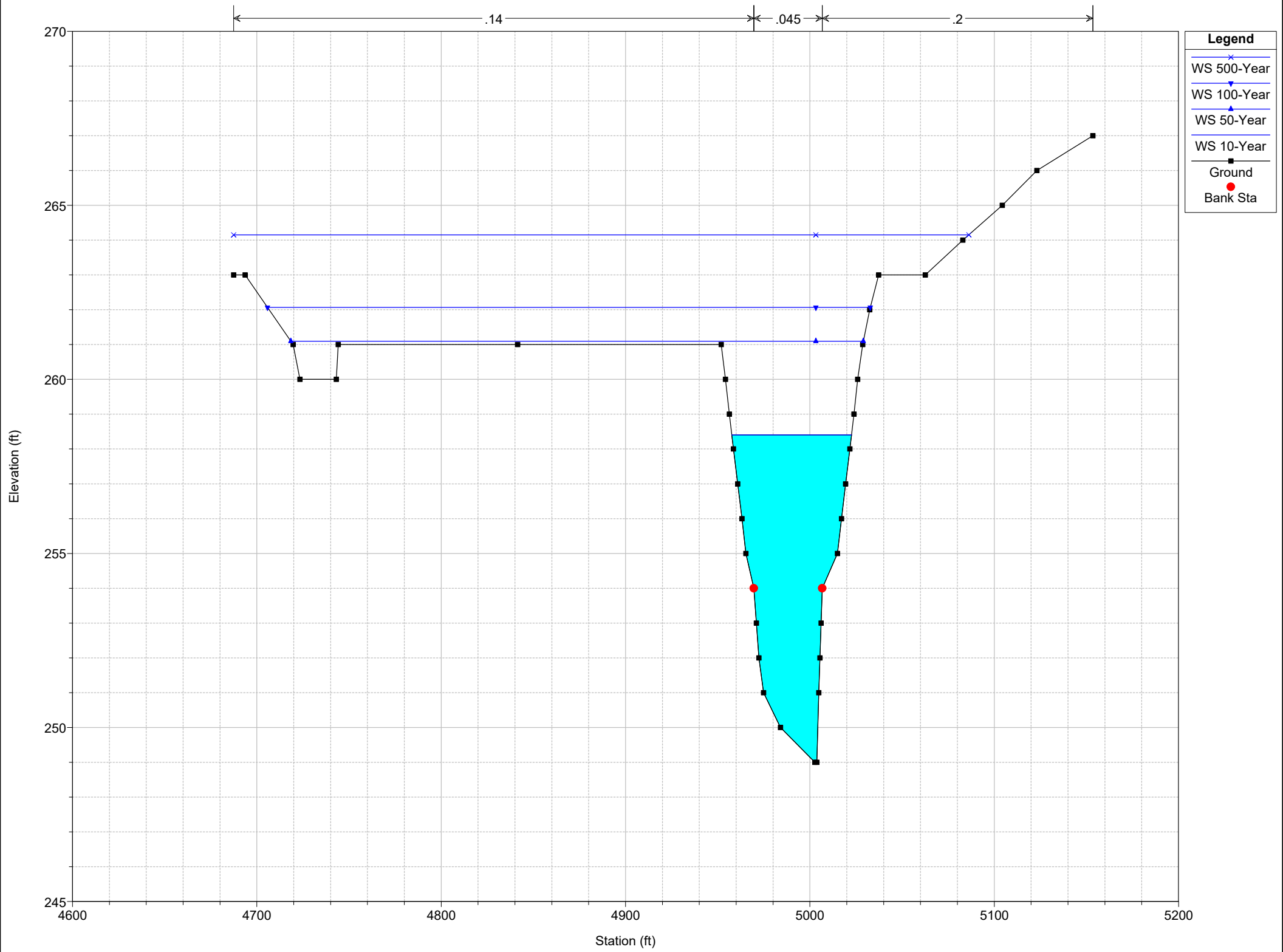
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 5024.2 Cross Section Booker Creek 10.0



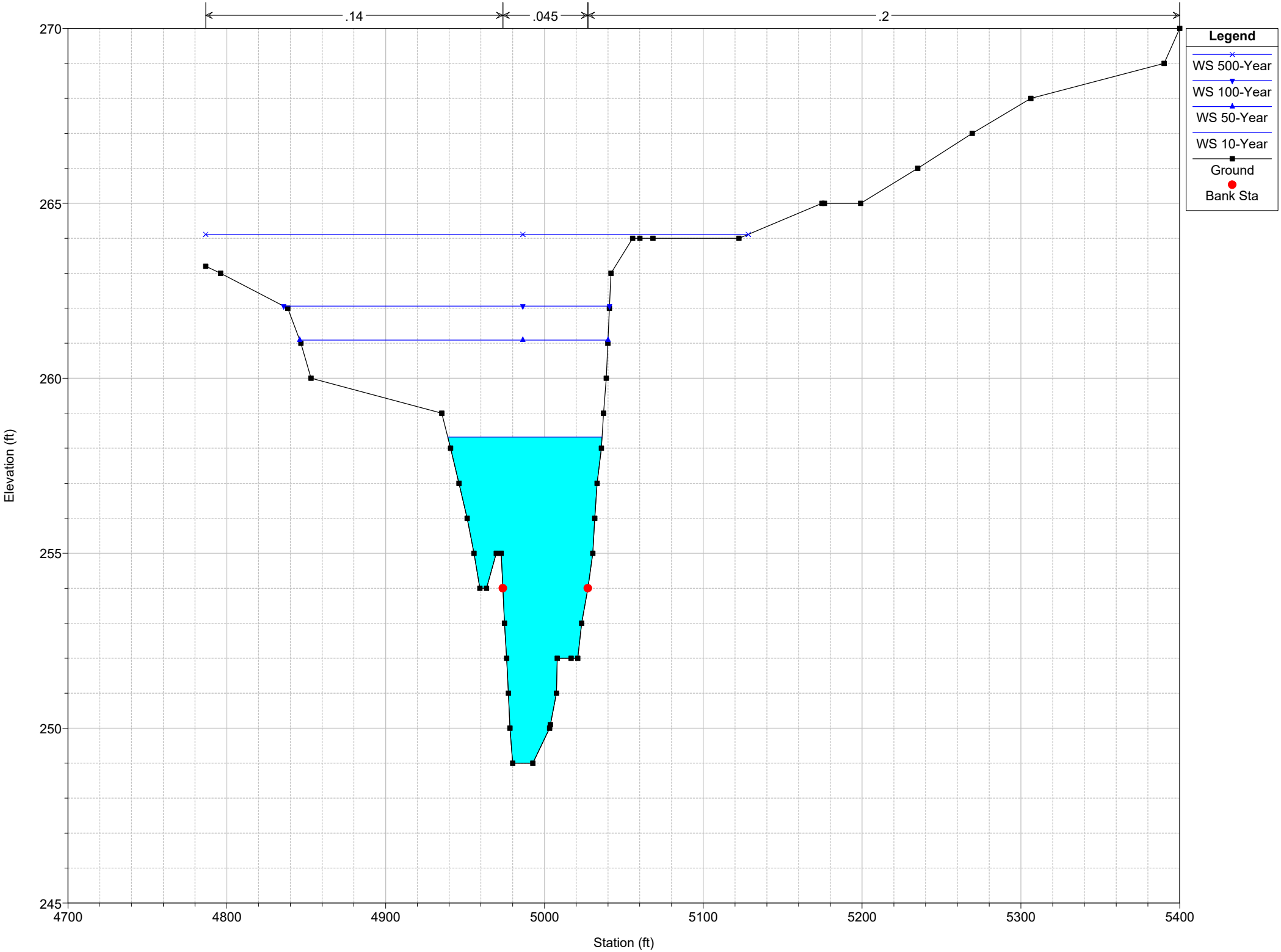
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 4888.4 Cross Section Booker Creek 9.0



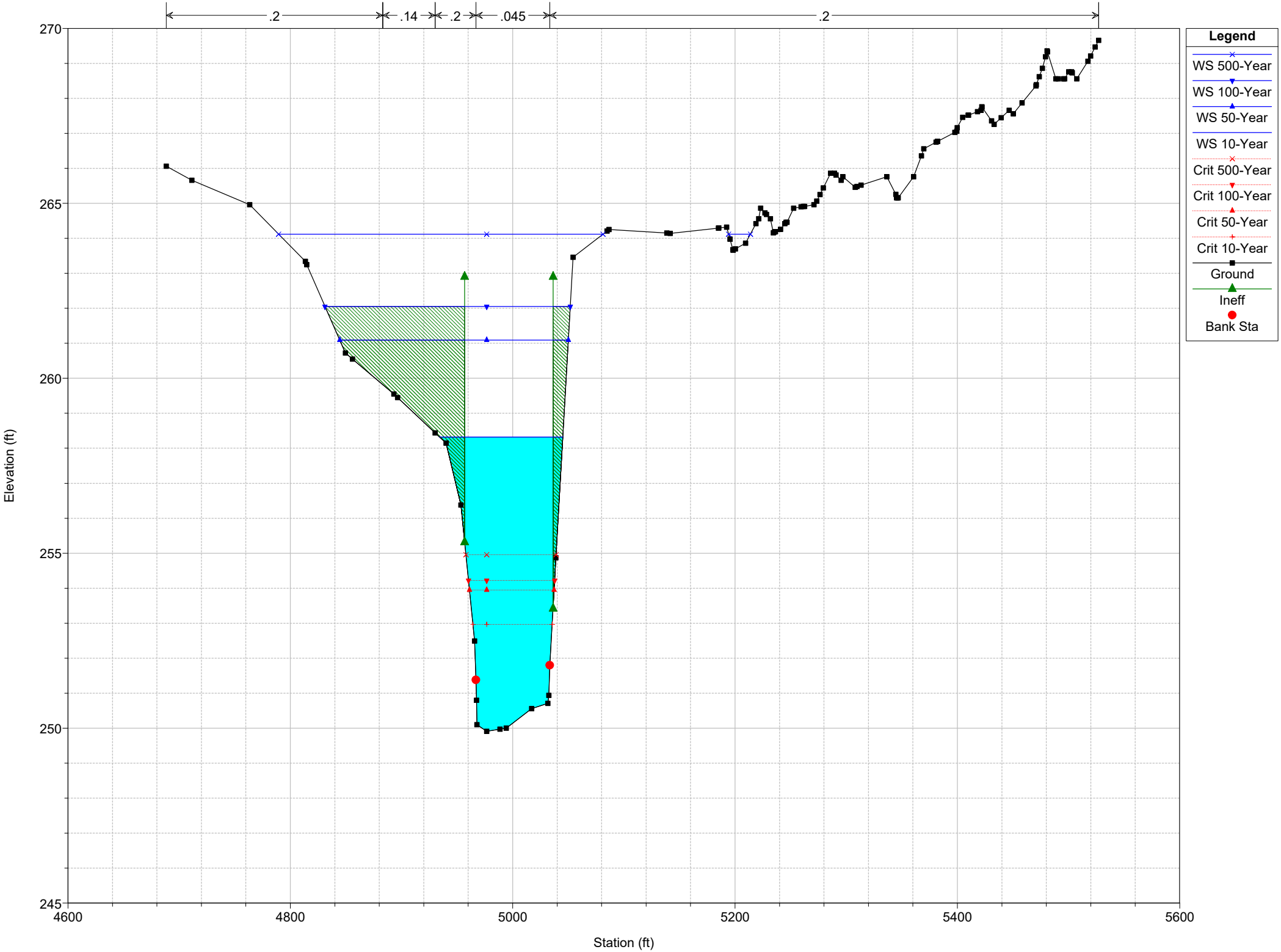
EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 4744.2 Cross Section Booker Creek 9.0



EX CONDS W/EASTGATE BLDG D + NEW SECTS Plan: Multiple 1/26/2017

RS = 4696.5 Upstream Section of Bridge/Culvert/Weir



Appendix D

Proposed Conditions Model

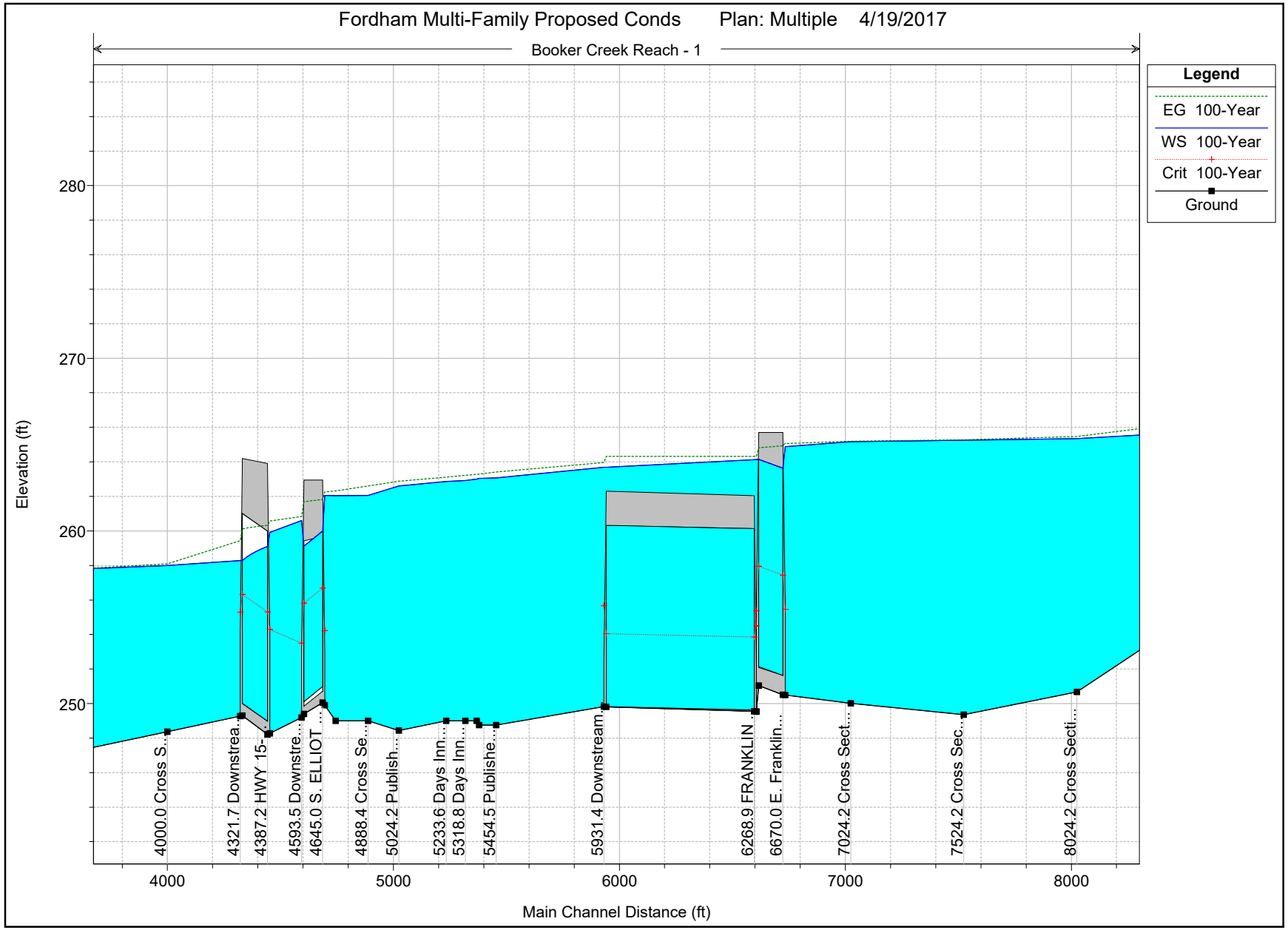
Proposed Conditions

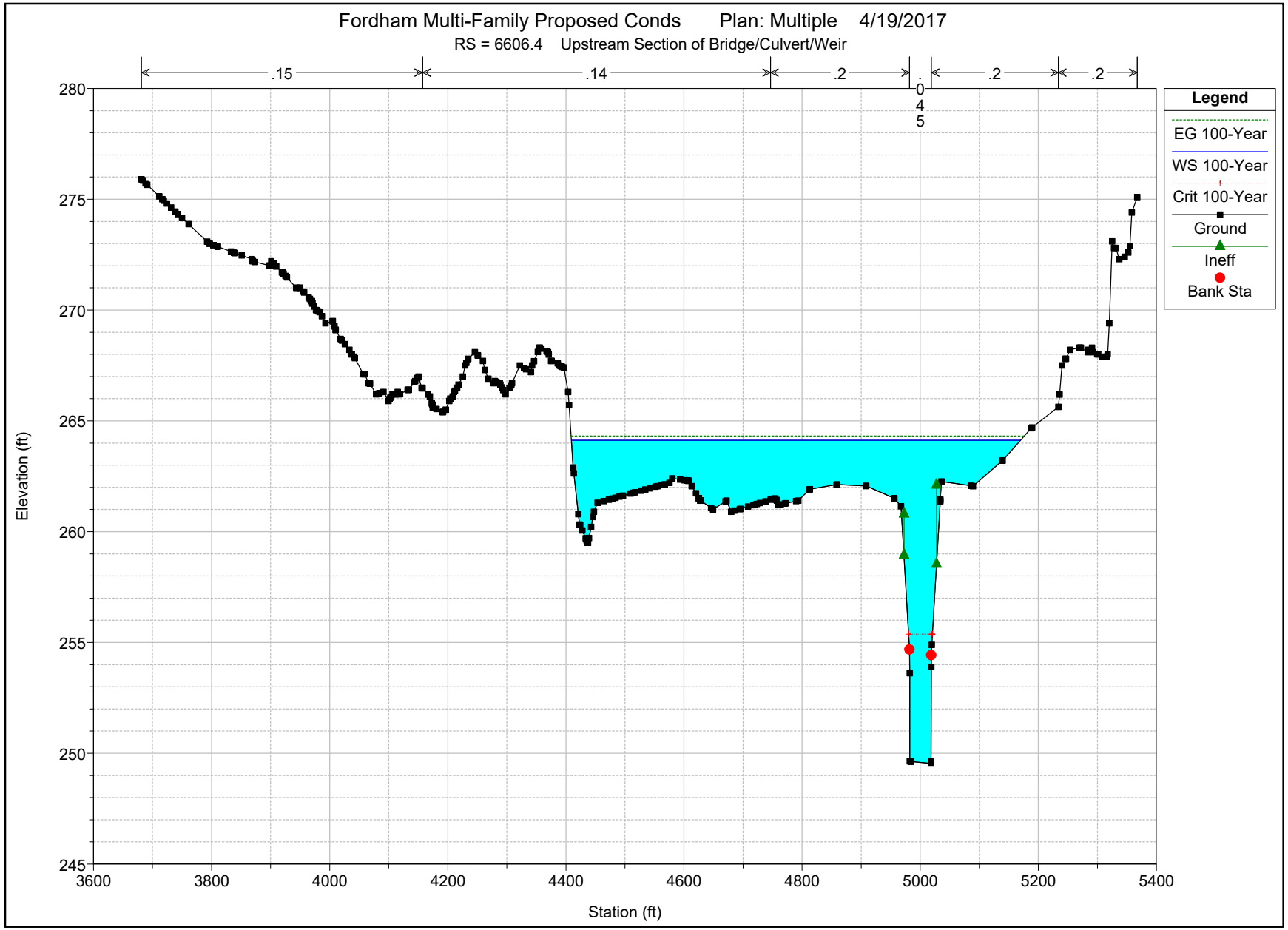
HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year

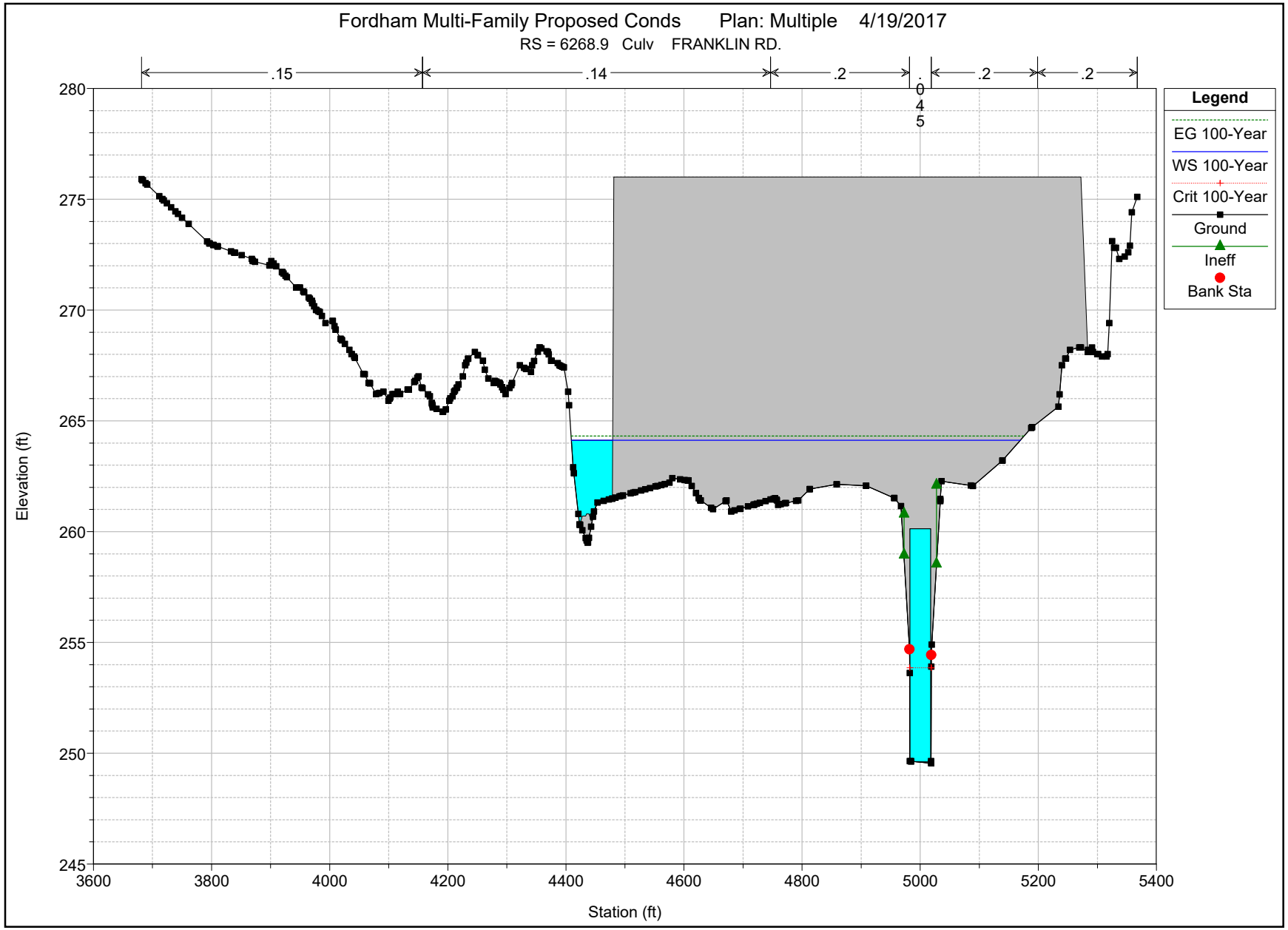
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	26670.3	100-Year	1010.00	470.17	479.17		479.36	0.001016	4.03	571.84	164.95	0.25
Reach - 1	26133.4	100-Year	1010.00	467.03	478.93	470.98	479.04	0.000316	2.98	682.79	170.84	0.15
Reach - 1	26050.4		Culvert									
Reach - 1	25967.4	100-Year	1010.00	463.47	468.18	467.42	469.32	0.010015	8.85	141.83	48.58	0.74
Reach - 1	25524.2	100-Year	1010.00	456.43	461.26	461.26	463.09	0.019561	10.91	101.80	37.54	0.97
Reach - 1	24962.5	100-Year	1010.00	444.33	449.41	449.13	451.04	0.016017	10.29	104.46	31.11	0.89
Reach - 1	24504.7	100-Year	1210.00	437.03	442.36	442.36	444.01	0.014848	10.69	164.19	67.86	0.89
Reach - 1	23991.1	100-Year	1210.00	426.45	434.78		434.93	0.001153	4.05	885.31	259.96	0.26
Reach - 1	23524.2	100-Year	1210.00	425.63	434.39		434.48	0.000745	3.38	1017.91	222.58	0.21
Reach - 1	23024.2	100-Year	1210.00	425.63	434.18		434.21	0.000359	2.30	1694.21	345.71	0.15
Reach - 1	22524.2	100-Year	1210.00	419.97	433.94		434.04	0.000293	2.98	876.82	133.60	0.15
Reach - 1	22396.4	100-Year	1210.00	420.03	434.01	422.35	434.01	0.000001	0.17	7437.51	788.44	0.01
Reach - 1	22383.4		Inl Struct									
Reach - 1	22370.4	100-Year	1210.00	425.91	431.84		432.28	0.004363	5.30	228.09	58.39	0.47
Reach - 1	22255.4	100-Year	1210.00	422.25	430.72	428.22	431.64	0.004285	7.82	190.60	35.56	0.51
Reach - 1	22230.4		Bridge									
Reach - 1	22205.4	100-Year	1210.00	421.56	427.53	427.53	429.79	0.018270	12.18	111.23	28.45	0.98
Reach - 1	22061.4	100-Year	1210.00	400.80	406.08	406.08	408.26	0.029823	11.85	103.30	24.75	1.00
Reach - 1	21577.4	100-Year	1610.00	383.59	390.01	390.01	391.38	0.016562	10.30	283.21	124.92	0.77
Reach - 1	21024.2	100-Year	1610.00	375.87	387.52		387.61	0.000581	3.31	1626.03	396.04	0.18
Reach - 1	20582.7	100-Year	1610.00	372.04	387.39		387.44	0.000240	2.59	1897.52	309.67	0.12
Reach - 1	20391.6	100-Year	1610.00	371.31	387.34	381.11	387.38	0.000335	3.13	2159.38	366.02	0.14
Reach - 1	20349.6		Bridge									
Reach - 1	20307.6	100-Year	1610.00	371.56	381.49	381.49	383.37	0.011994	13.35	335.44	137.15	0.78
Reach - 1	20024.2	100-Year	1610.00	366.75	372.95	372.95	375.10	0.020081	12.15	172.79	53.49	0.93
Reach - 1	19524.2	100-Year	1610.00	356.87	363.07	363.07	365.10	0.019404	11.94	190.49	60.38	0.91
Reach - 1	19024.2	100-Year	1610.00	343.08	349.35	349.35	351.90	0.022002	12.82	131.88	35.47	0.98
Reach - 1	18524.2	100-Year	1610.00	333.12	341.54	339.33	342.75	0.006820	8.94	214.81	47.68	0.57
Reach - 1	18024.2	100-Year	1610.00	328.79	335.31	335.06	337.44	0.017889	11.91	162.38	46.57	0.89
Reach - 1	17524.2	100-Year	1610.00	322.82	331.54		332.53	0.005531	8.26	281.37	80.20	0.52
Reach - 1	17020.0	100-Year	1610.00	321.41	327.86		328.79	0.010355	8.99	368.52	127.18	0.67
Reach - 1	16524.2	100-Year	1840.00	313.59	321.01	321.01	322.87	0.013242	11.32	251.85	110.80	0.78
Reach - 1	16024.2	100-Year	1840.00	304.23	310.96	310.96	313.67	0.021241	13.31	153.62	34.63	0.97
Reach - 1	15524.2	100-Year	1840.00	293.18	303.24		303.85	0.002577	6.96	635.59	218.69	0.41
Reach - 1	15183.4	100-Year	1840.00	292.43	302.35	299.08	302.96	0.002648	6.74	615.86	335.96	0.41
Reach - 1	15150.4		Bridge									
Reach - 1	15117.4	100-Year	1840.00	292.69	299.32	299.32	301.72	0.017666	12.58	169.01	46.70	0.97
Reach - 1	15024.2	100-Year	1840.00	291.44	299.02		299.97	0.005133	8.95	504.39	182.29	0.61
Reach - 1	14524.2	100-Year	1840.00	290.48	297.84		298.10	0.002321	5.89	1215.64	480.05	0.41
Reach - 1	14034.8	100-Year	1840.00	287.46	297.74		297.77	0.000228	2.37	2813.22	483.41	0.14
Reach - 1	13555.6	100-Year	1840.00	287.38	297.64		297.66	0.000227	2.36	2747.94	446.25	0.14
Reach - 1	13024.2	100-Year	1840.00	287.30	297.51		297.54	0.000242	2.43	2630.54	423.94	0.14
Reach - 1	12524.2	100-Year	1840.00	287.22	297.41		297.43	0.000190	2.14	3100.19	511.81	0.12
Reach - 1	12024.2	100-Year	1840.00	287.14	297.36		297.37	0.000068	1.29	5160.99	740.68	0.07
Reach - 1	11747.1	100-Year	1840.00	284.16	297.36		297.36	0.000022	0.91	8347.54	1138.46	0.05
Reach - 1	11352.3	100-Year	2280.00	273.46	297.35	279.99	297.35	0.000010	0.52	4580.90	601.53	0.03
Reach - 1	11341.3		Inl Struct									
Reach - 1	11330.3	100-Year	2280.00	277.80	285.16	285.16	287.48	0.011160	13.86	357.02	96.42	0.93
Reach - 1	11228.2	100-Year	2280.00	274.45	282.59	282.59	284.47	0.010668	12.50	401.31	125.42	0.80
Reach - 1	10952.4	100-Year	2280.00	270.52	276.78	276.78	279.23	0.014977	13.31	267.36	82.88	1.03
Reach - 1	10524.2	100-Year	2280.00	263.63	270.76	270.72	272.32	0.011104	11.22	450.92	206.29	0.85
Reach - 1	10024.2	100-Year	2280.00	262.00	270.65		270.71	0.000969	3.39	2450.93	742.96	0.23
Reach - 1	9691.7	100-Year	2670.00	260.63	270.10	268.50	270.26	0.001741	5.20	1980.54	560.12	0.33
Reach - 1	9676.2		Bridge									
Reach - 1	9660.7	100-Year	2670.00	260.97	270.00	268.18	270.21	0.002373	5.84	1740.64	535.20	0.38
Reach - 1	9524.2	100-Year	2670.00	259.17	269.53		269.83	0.002663	5.86	1473.62	491.54	0.35
Reach - 1	9024.2	100-Year	2670.00	256.05	267.49		268.21	0.003796	7.57	687.50	165.26	0.43
Reach - 1	8588.6	100-Year	2670.00	255.57	265.78		266.39	0.004456	7.50	951.55	336.53	0.45
Reach - 1	8024.2	100-Year	2670.00	250.67	265.34		265.47	0.000661	3.83	2184.66	594.27	0.19
Reach - 1	7524.2	100-Year	2860.00	249.35	265.26		265.28	0.000186	2.16	4368.60	784.87	0.10
Reach - 1	7024.2	100-Year	2860.00	250.01	265.17		265.19	0.000181	2.05	3922.82	607.39	0.10
Reach - 1	6733.5	100-Year	2860.00	250.49	264.88	255.45	265.06	0.000388	3.50	831.24	457.52	0.17
Reach - 1	6670.0		Culvert									
Reach - 1	6606.5	100-Year	2860.00	249.54	264.13	254.50	264.32	0.000368	3.44	844.21	473.19	0.16
Reach - 1	6606.4	100-Year	2860.00	249.54	264.12	255.37	264.31	0.000570	4.03	2321.21	760.41	0.19
Reach - 1	6268.9		Culvert									
Reach - 1	5931.4	100-Year	2860.00	249.82	263.68	255.66	263.96	0.000818	4.67	1781.30	734.61	0.22
Reach - 1	5454.5	100-Year	2860.00	248.76	263.07		263.41	0.001642	6.17	2171.99	939.05	0.32
Reach - 1	5378.8	100-Year	2860.00	248.76	263.04		263.29	0.000953	5.08	2376.96	1023.76	0.25
Reach - 1	5368.8	100-Year	2860.00	249.00	263.00		263.28	0.001001	5.23	2041.38	773.72	0.26
Reach - 1	5318.8	100-Year	2860.00	249.00	262.92		263.22	0.001238	5.51	1678.06	633.13	0.27
Reach - 1	5233.6	100-Year	2860.00	249.00	262.86		263.11	0.000980	4.99	1702.47	625.58	0.25
Reach - 1	5024.2	100-Year	2860.00	248.44	262.60		262.87	0.001352	5.68	1307.85	214.84	0.29
Reach - 1	4888.4	100-Year	2860.00	249.00	262.06		262.60	0.001458	6.11	715.35	159.79	0.31
Reach - 1	4744.2	100-Year	2860.00	249.00	262.05		262.32	0.000747	4.37	875.57	111.14	0.23

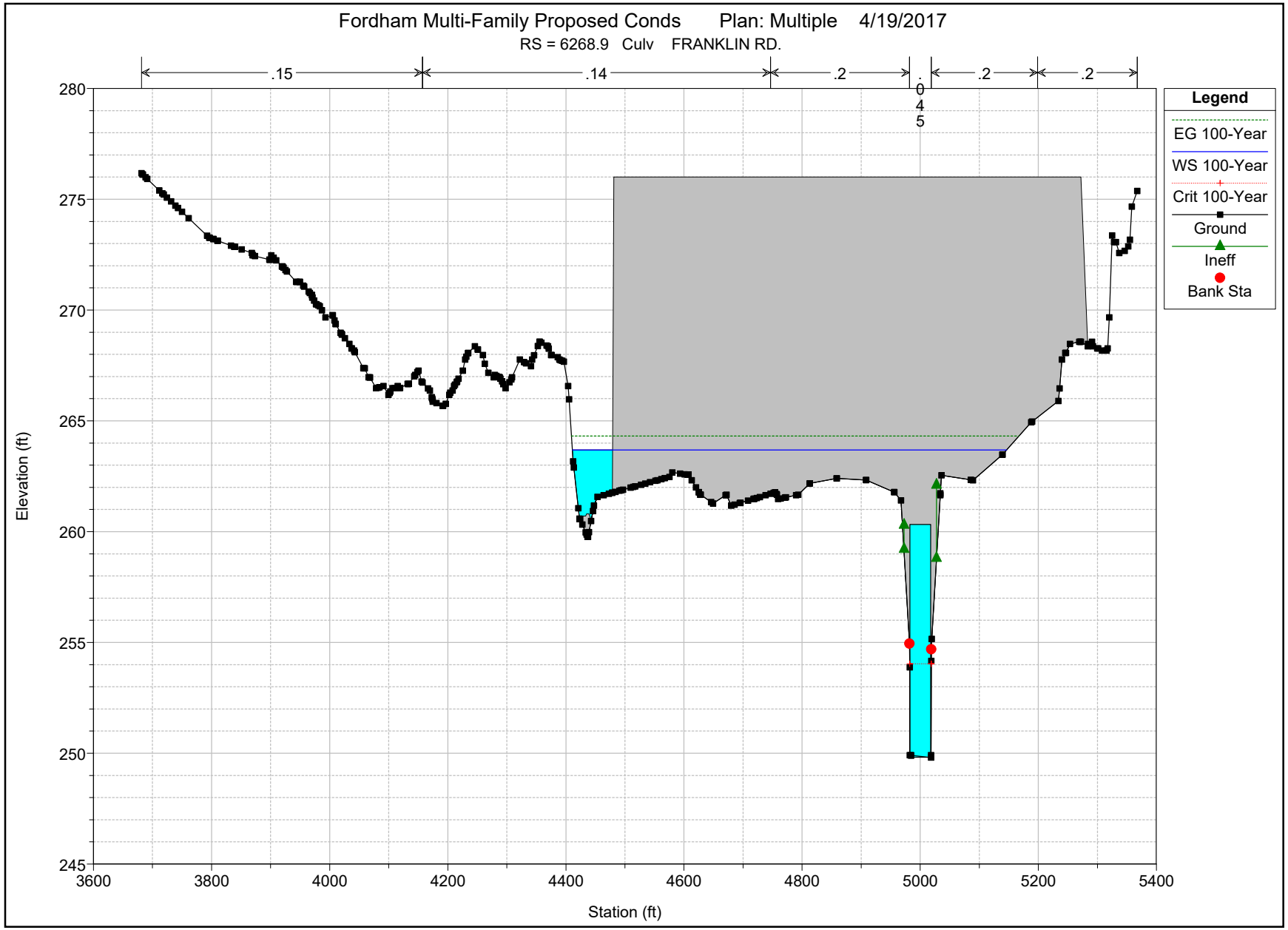
HEC-RAS Plan: MULTIPLE_BA River: Booker Creek Reach: Reach - 1 Profile: 100-Year (Continued)

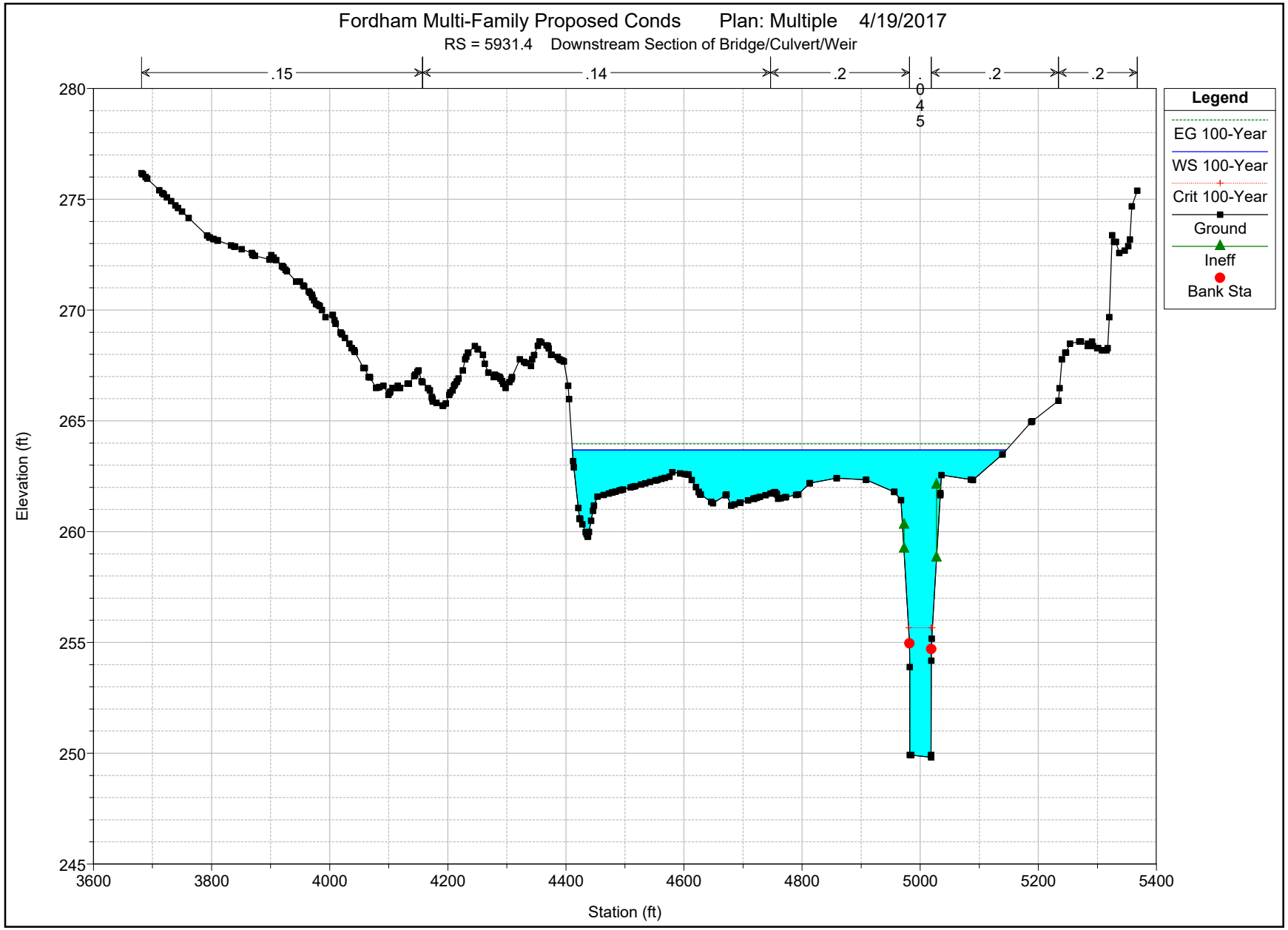
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	4696.5	100-Year	2970.00	249.91	262.05	254.22	262.26	0.000477	3.70	895.77	220.60	0.19
Reach - 1	4645.0		Culvert									
Reach - 1	4593.5	100-Year	2970.00	249.19	260.60	253.50	260.83	0.000593	3.95	836.46	209.15	0.21
Reach - 1	4452.7	100-Year	2970.00	248.28	259.92	254.30	260.57	0.001782	6.63	538.92	631.41	0.34
Reach - 1	4387.2		Culvert									
Reach - 1	4321.7	100-Year	2970.00	249.27	258.28	255.30	259.44	0.004391	8.76	391.36	413.53	0.52
Reach - 1	4000.0	100-Year	2970.00	248.37	258.00		258.09	0.001650	4.44	2313.37	557.32	0.29
Reach - 1	3500.0	100-Year	2970.00	246.98	257.72		257.74	0.000351	2.25	4839.51	946.43	0.14
Reach - 1	3185.2	100-Year	2970.00	246.10	256.40	253.20	257.24	0.003284	7.52	500.06	908.83	0.46
Reach - 1	3157.2		Bridge									
Reach - 1	3129.2	100-Year	2970.00	245.86	254.86	252.96	256.11	0.006022	9.10	385.91	879.17	0.60
Reach - 1	2957.4	100-Year	2970.00	243.96	255.32		255.34	0.000331	2.34	4403.90	879.86	0.14
Reach - 1	2362.9	100-Year	2970.00	243.50	255.03		255.07	0.000640	3.30	3515.45	770.54	0.19
Reach - 1	1661.6	100-Year	2970.00	242.95	254.76		254.77	0.000293	2.23	4739.86	1039.66	0.13
Reach - 1	920.6	100-Year	2970.00	242.61	254.63	249.25	254.64	0.000123	1.54	6717.80	1040.82	0.09

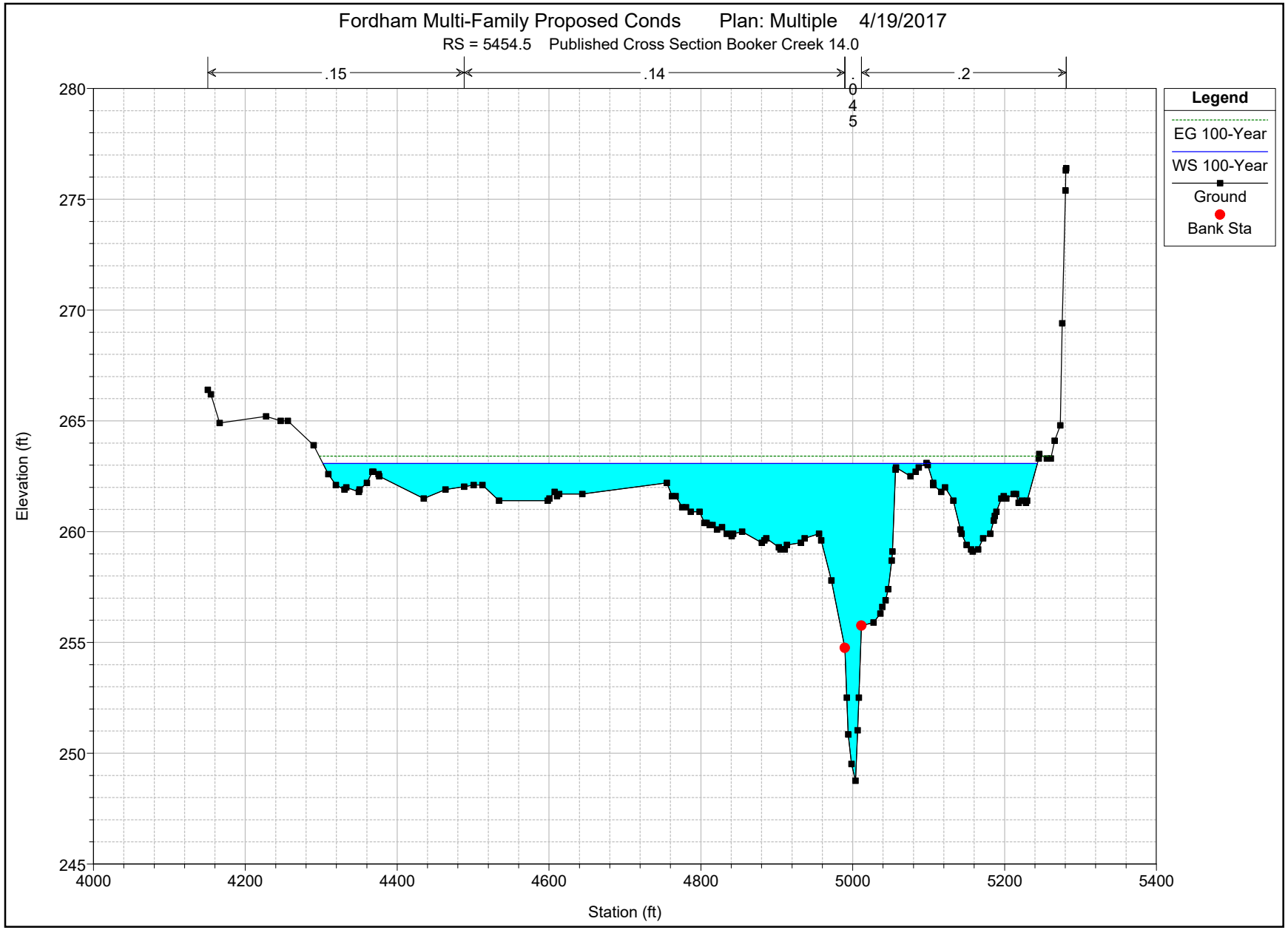

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
Booker Creek Reach - 1
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Elevation (ft)
280
270
260
250
4000.0 Cross S...
4321.7 Downstrea...
4387.2 HWY 15-...
4593.5 Downstre...
4645.0 S. ELLIOT ...
4888.4 Cross Se...
5024.2 Publish...
5233.6 Days Inn...
5318.8 Days Inn...
5454.5 Publishe...
5931.4 Downstream...
6268.9 FRANKLIN ...
6670.0 E. Franklin...
7024.2 Cross Sect...
7524.2 Cross Sec...
8024.2 Cross Secti...
4000
5000
6000
7000
8000
Main Channel Distance (ft)

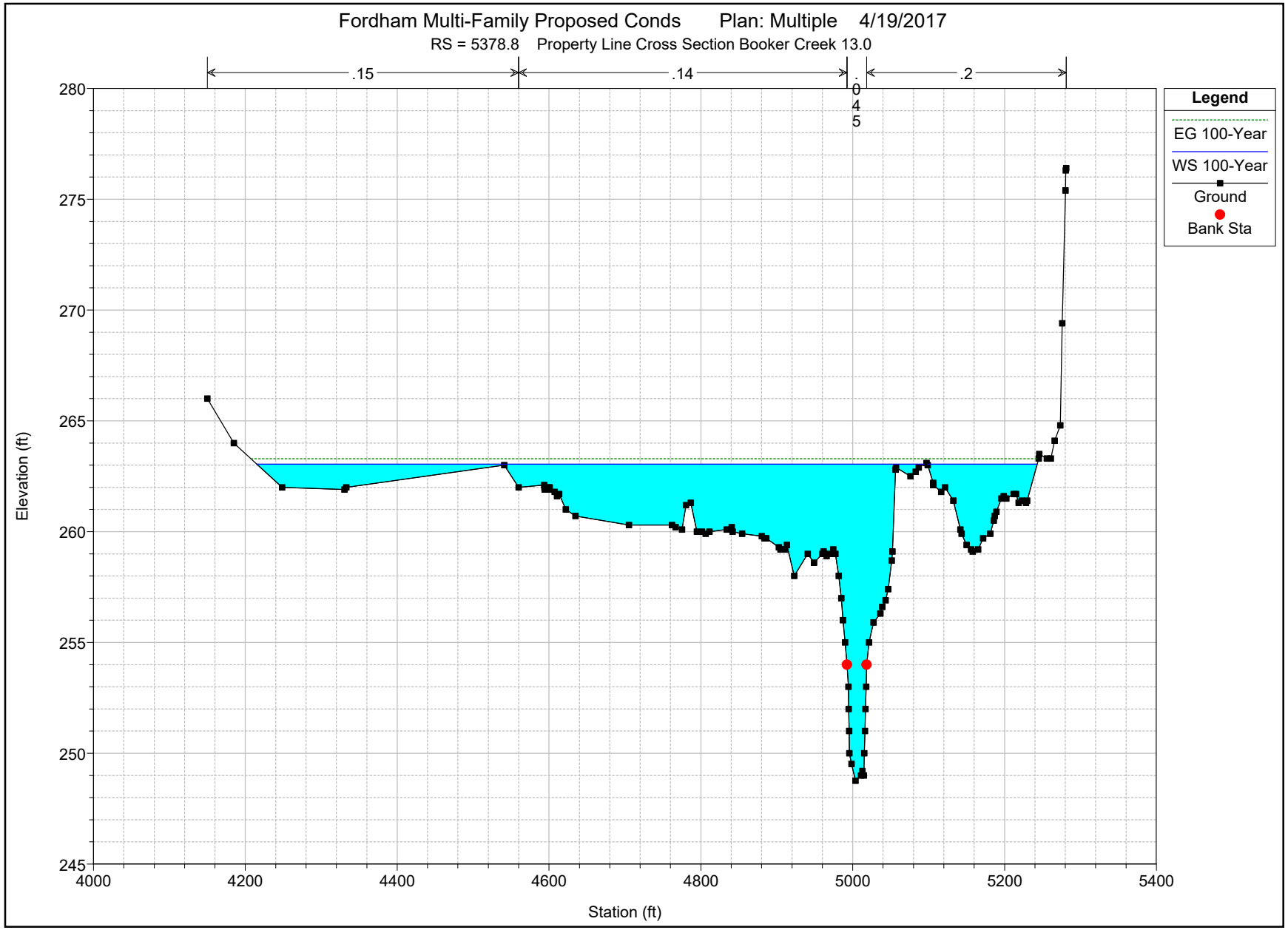

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 6606.4 Upstream Section of Bridge/Culvert/Weir
.15
.14
.2
.045
.2
.2
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400

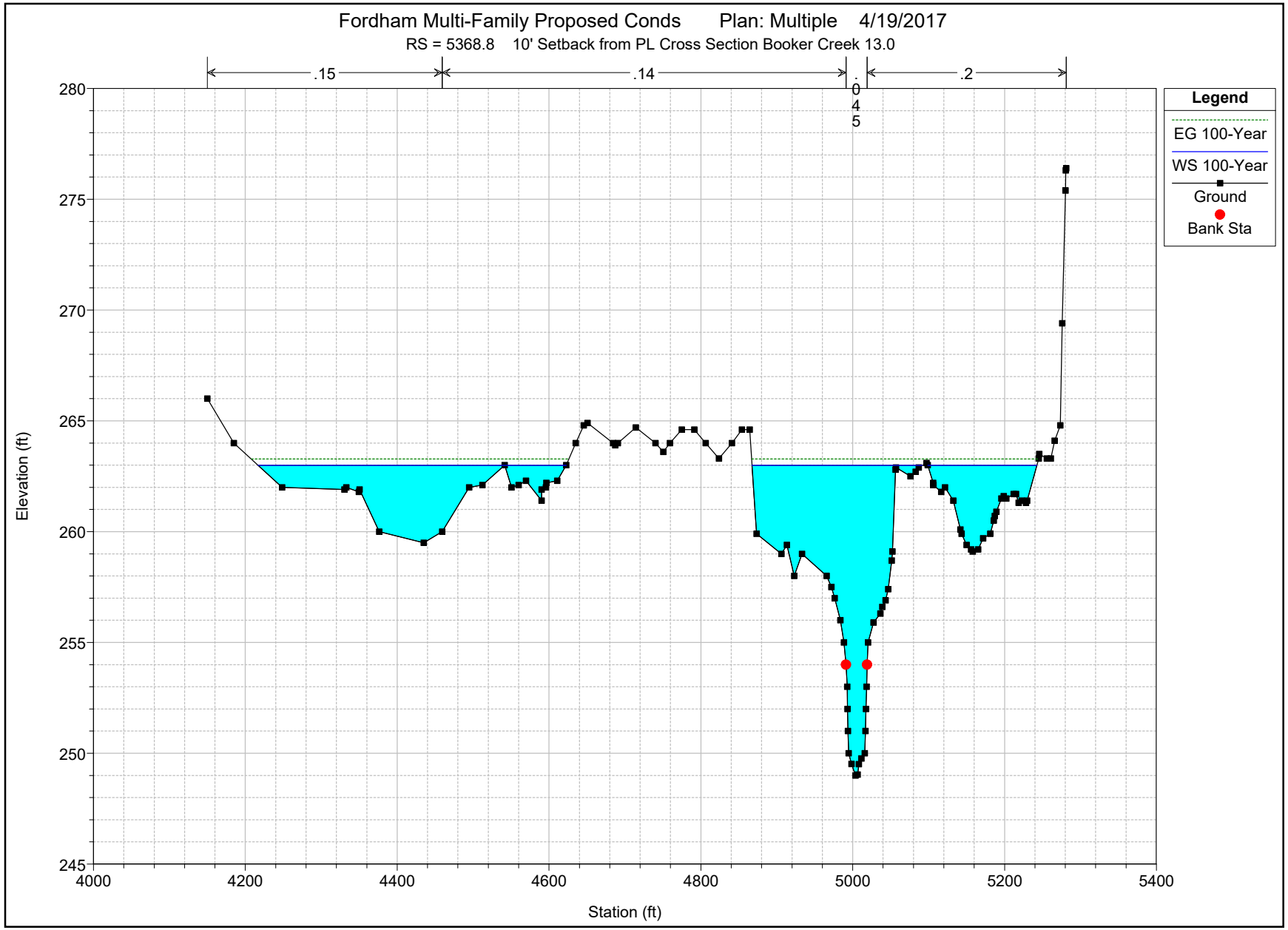

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 6268.9 Culv FRANKLIN RD.
.15
.14
.2
.045
.2
.2
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
Station (ft)

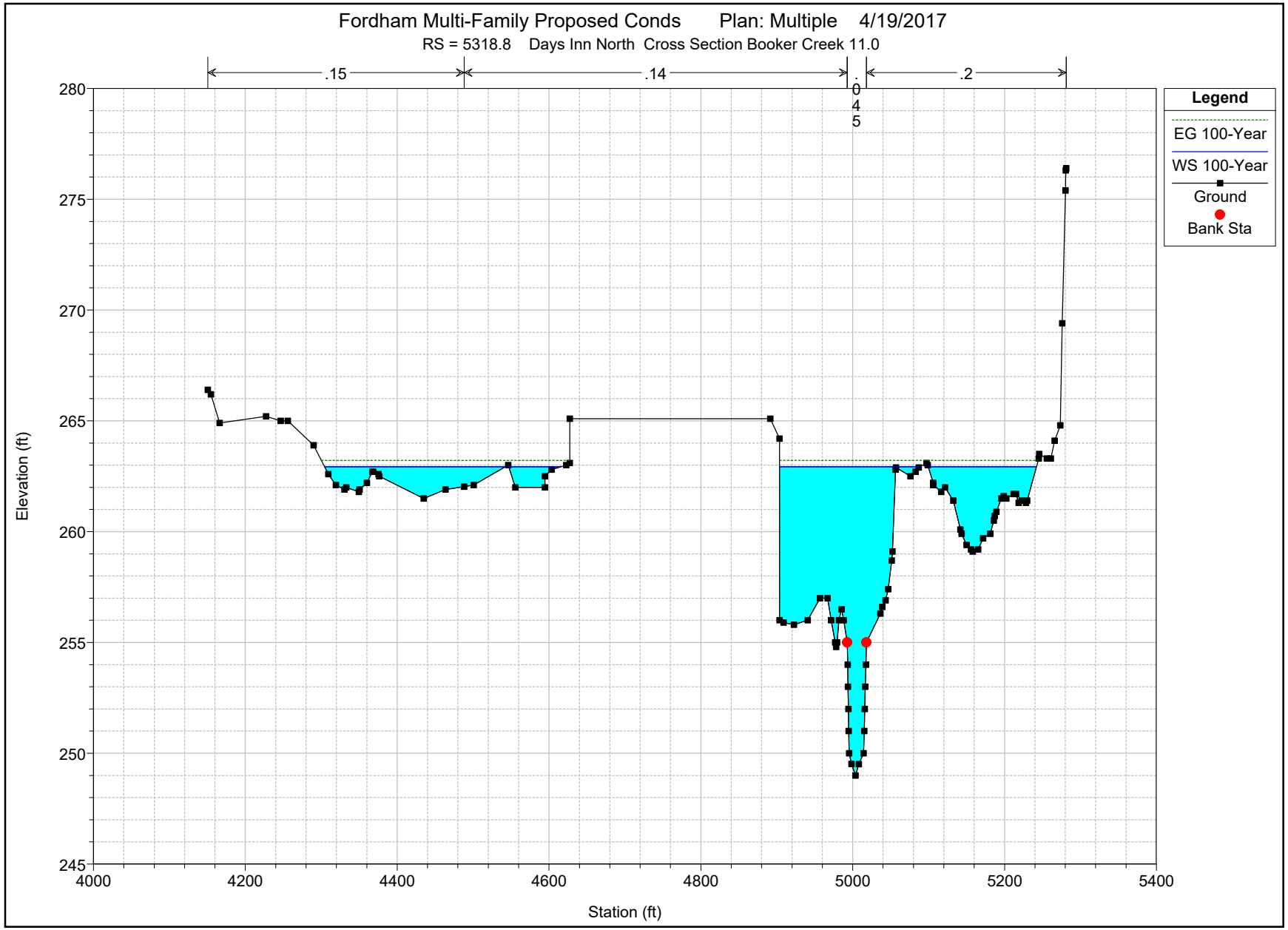

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 6268.9 Culv FRANKLIN RD.
.15
.14
.2
.045
.2
.2
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
Station (ft)

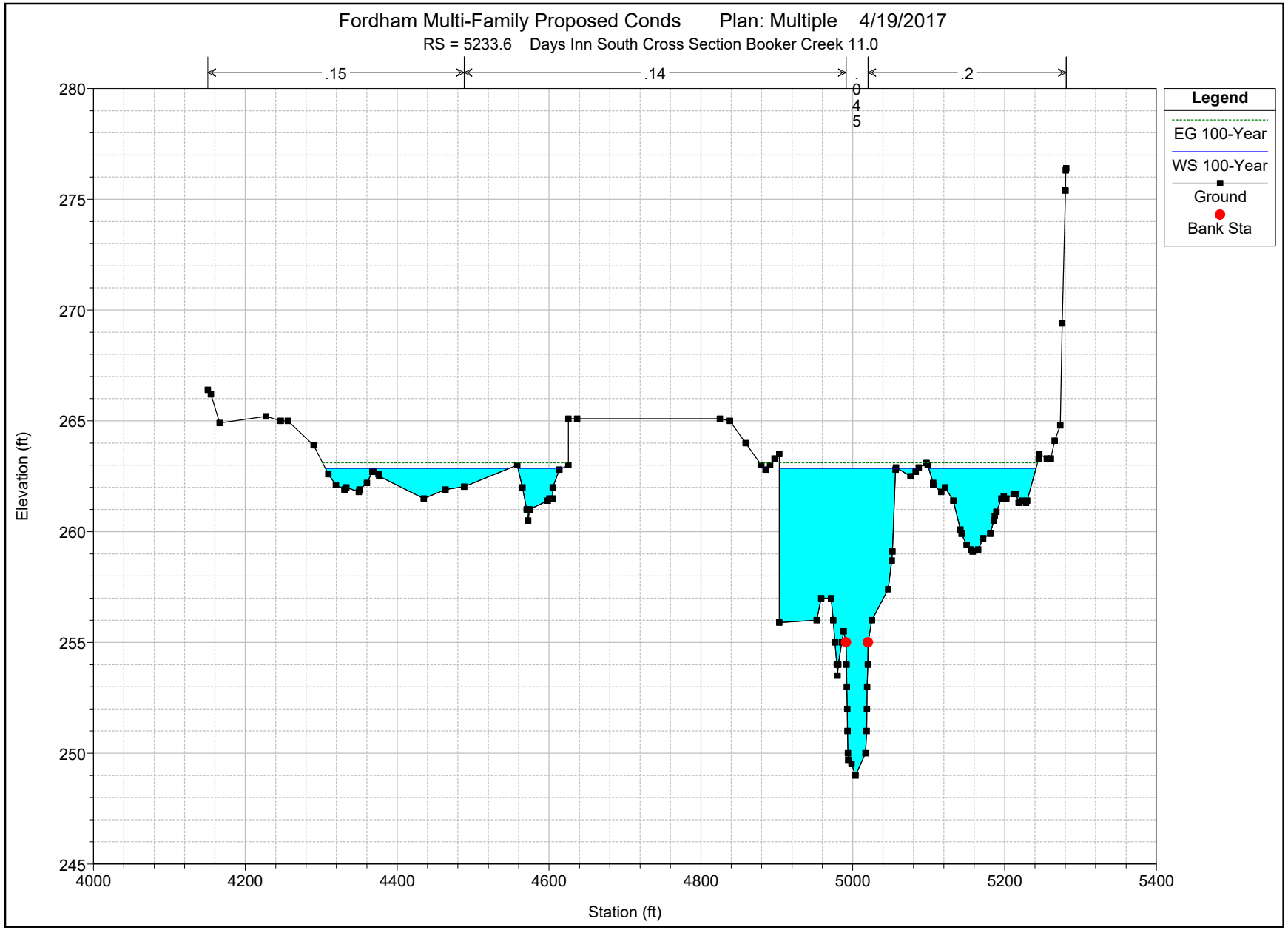

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5931.4 Downstream Section of Bridge/Culvert/Weir
.15
.14
.2
.045
.2
.2
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
280
275
270
265
260
255
250
245
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
Station (ft)

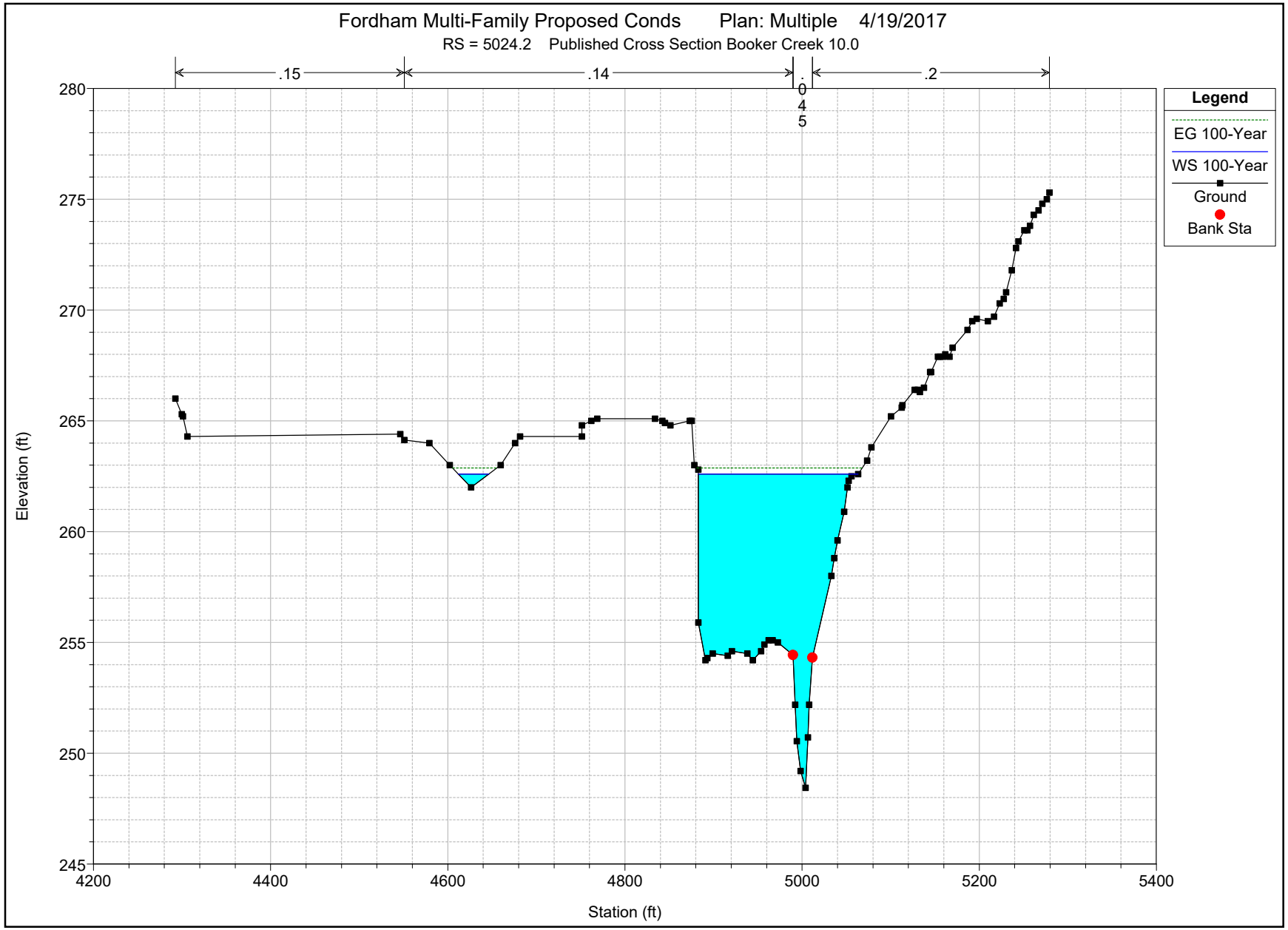

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5454.5 Published Cross Section Booker Creek 14.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4000
4200
4400
4600
4800
5000
5200
5400

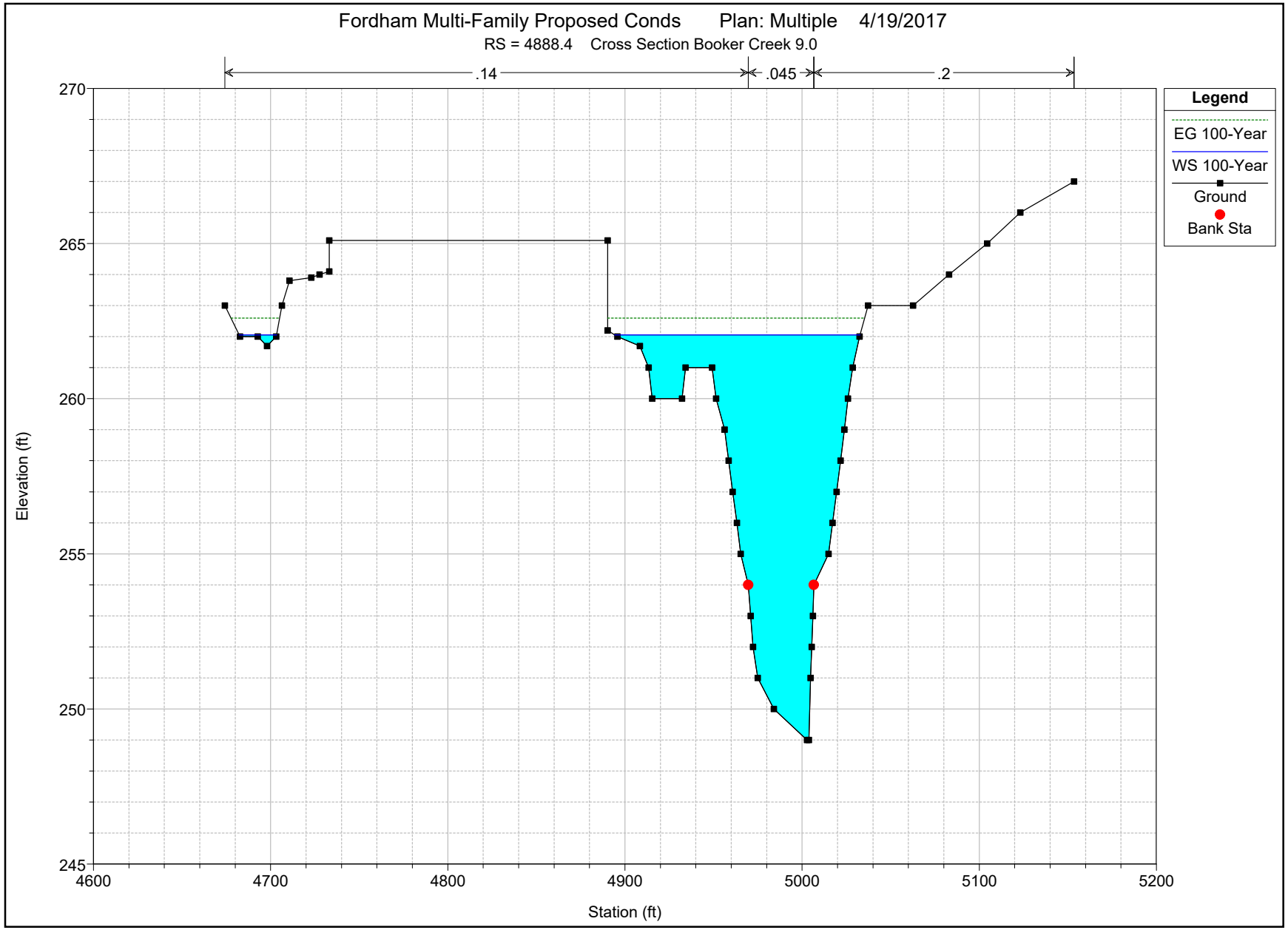

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5378.8 Property Line Cross Section Booker Creek 13.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4000
4200
4400
4600
4800
5000
5200
5400

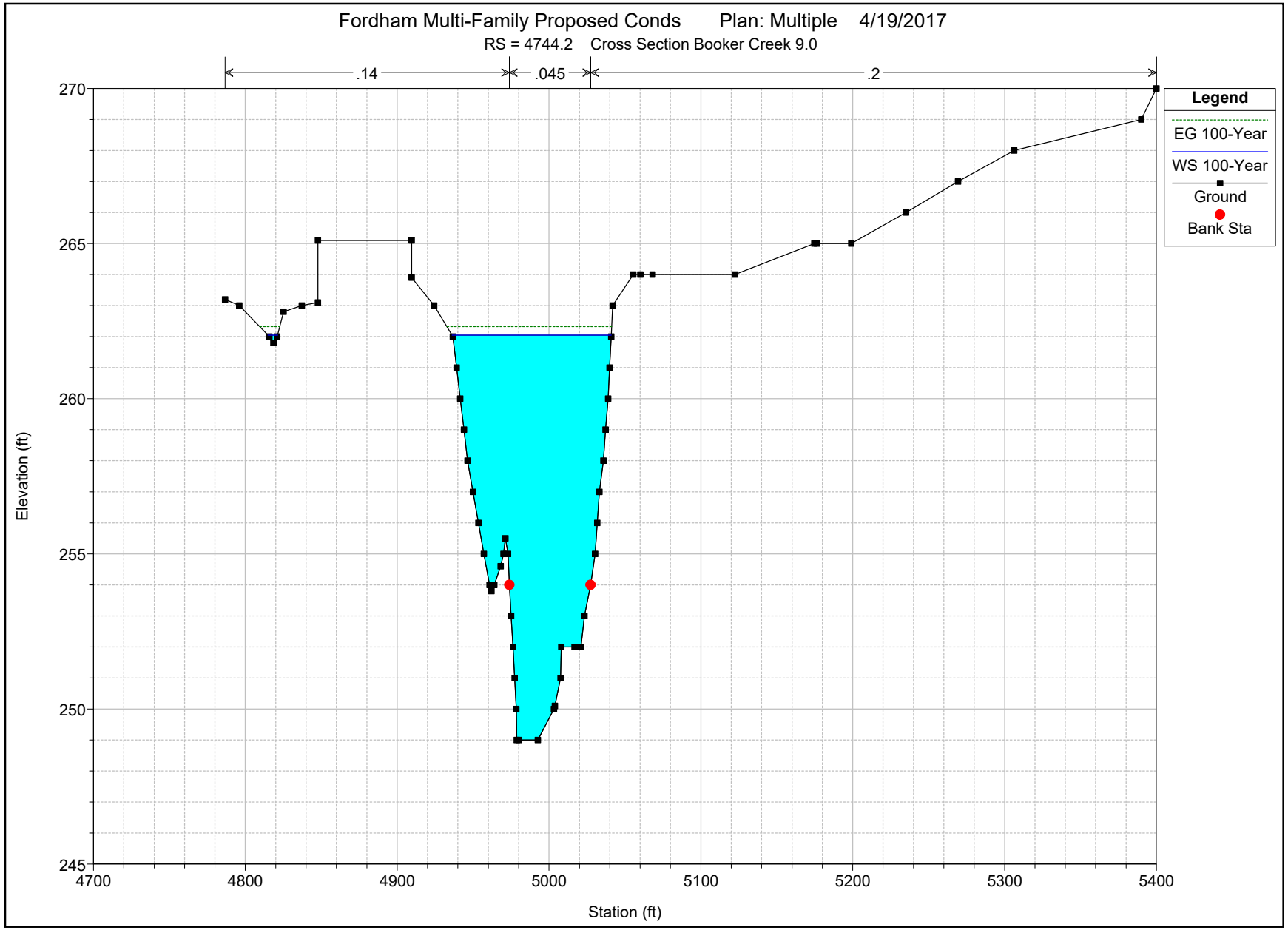

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5368.8 10' Setback from PL Cross Section Booker Creek 13.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4000
4200
4400
4600
4800
5000
5200
5400

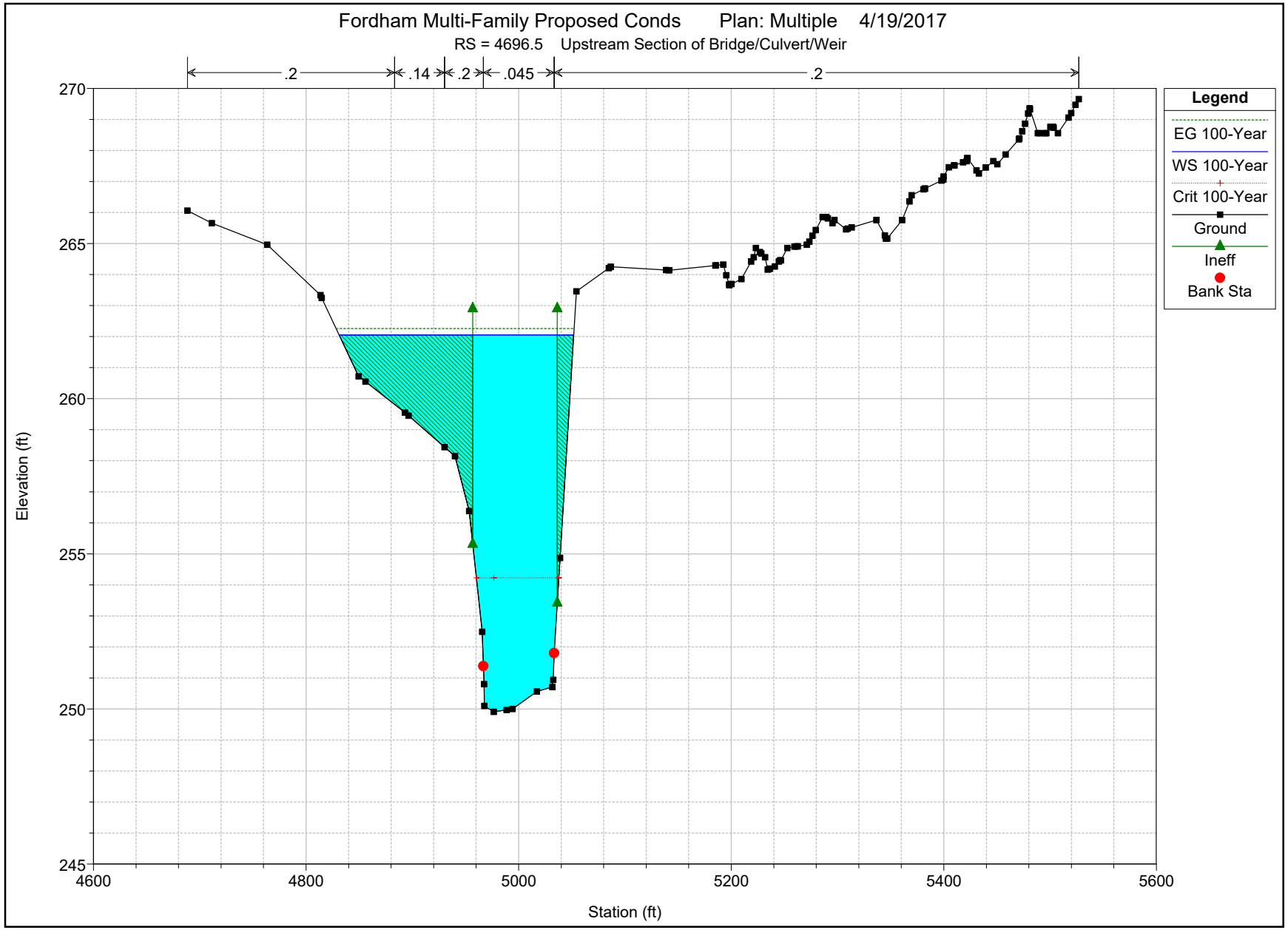

Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5318.8 Days Inn North Cross Section Booker Creek 11.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4000
4200
4400
4600
4800
5000
5200
5400


Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5233.6 Days Inn South Cross Section Booker Creek 11.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4000
4200
4400
4600
4800
5000
5200
5400


Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 5024.2 Published Cross Section Booker Creek 10.0
.15
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
280
275
270
265
260
255
250
245
4200
4400
4600
4800
5000
5200
5400


Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 4888.4 Cross Section Booker Creek 9.0
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
270
265
260
255
250
245
4600
4700
4800
4900
5000
5100
5200


Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 4744.2 Cross Section Booker Creek 9.0
.14
.045
.2
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
270
265
260
255
250
245
4700
4800
4900
5000
5100
5200
5300
5400


Fordham Multi-Family Proposed Conds Plan: Multiple 4/19/2017
RS = 4696.5 Upstream Section of Bridge/Culvert/Weir
.2
.14
.2
.045
.2
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
270
265
260
255
250
245
4600
4800
5000
5200
5400
5600