

Hydrology and Hydraulics Report

Fort Fairfield Puddle Dock Bridge #2691

WIN 025453.00

WIN:	25453.00
Town:	Ft Fairfield
Route No.	ME-161
Asset ID:	2691
Lat:	46.76550
Long:	-67.81664

Project Name:	Fort Fairfield, Puddle Dock Bridge #2691
Stream Name:	Pattie Brook
Bridge Name:	Puddle Dock Bridge
Analysis by:	csh
Date:	11/14/2021

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

Enter data in blue cells only!

	km ²	mi ²	ac
A	96.43	37.23	23827.2
W	12.19	4.7	3011.8
P _c	590181	5173988	
County	Aroostook N		

Enter data in [mi²]

Watershed Area *DRNAREA*

Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)

choose county from drop-down menu

ver. 2021 Jan 01

Worksheet prepared by:

Charles S. Hebson, PE

Environmental Office

Maine Dept. Transportation

Augusta, ME 04333-0016

207-557-1052

Charles.Hebson@maine.gov

Watershed Characteristics from StreamStats

STORNWI	12.64	NWI Wetlands %
STORAGE	13.06	% storage (lakes, ponds, reservoirs, wetlands)
SANDGRAVF	0.028	sand & gravel aquifer as decimal fraction of watershed A
ELEV	657	mean basin elevation (ft)
BSLDEM10M	6.41	mean basin slope (%)
COASTDIST	157.00	distance from the coast (mi)
ELEVMAX	1124	maximum basin elevation (ft)
LC06WATER	0.93	percent of drainage basin land cover as open water
PRECIP	38.4	mean annual precipitation
STATSGOA	0	mean basin percentage of hydrological soil group A

References:

Hodgkins, G.A., 1999.

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

Lombard, P.J. & G.A. Hodgkins, 2015.

Peak flow regression equations for small, ungaged streams:
in Maine: Comparing Map-Based to Field-Based Variables
SIR 2015-4059, USGS, Augusta, ME

Lombard, P.J. & G.A. Hodgkins, 2020.

Estimating Flood Magnitude and Frequency on Gaged and
Ungaged Streams in Maine
SIR 2020-5092, USGS, Augusta, ME.

Ret Pd	I24	Q _T (ft ³ /s)		Q _T (ft ³ /s)
T (yr)		1999 / 2015	2020	Design
1.1		441	393	395
2	2.32	842	725	725
5	2.88	1262	1064	1065
10	3.33	1566	1303	1305
25	3.95	1966	1608	1610
50	4.42	2276	1841	1840
100	4.90	2605	2079	2080
200	5.48	2941	2350	2350
500	6.21	3405	2715	2715

Instructions:

Enter values in blue cells only, watershed data from StreamStats

Generate "I24" DDF table from NOAA Atlas 14

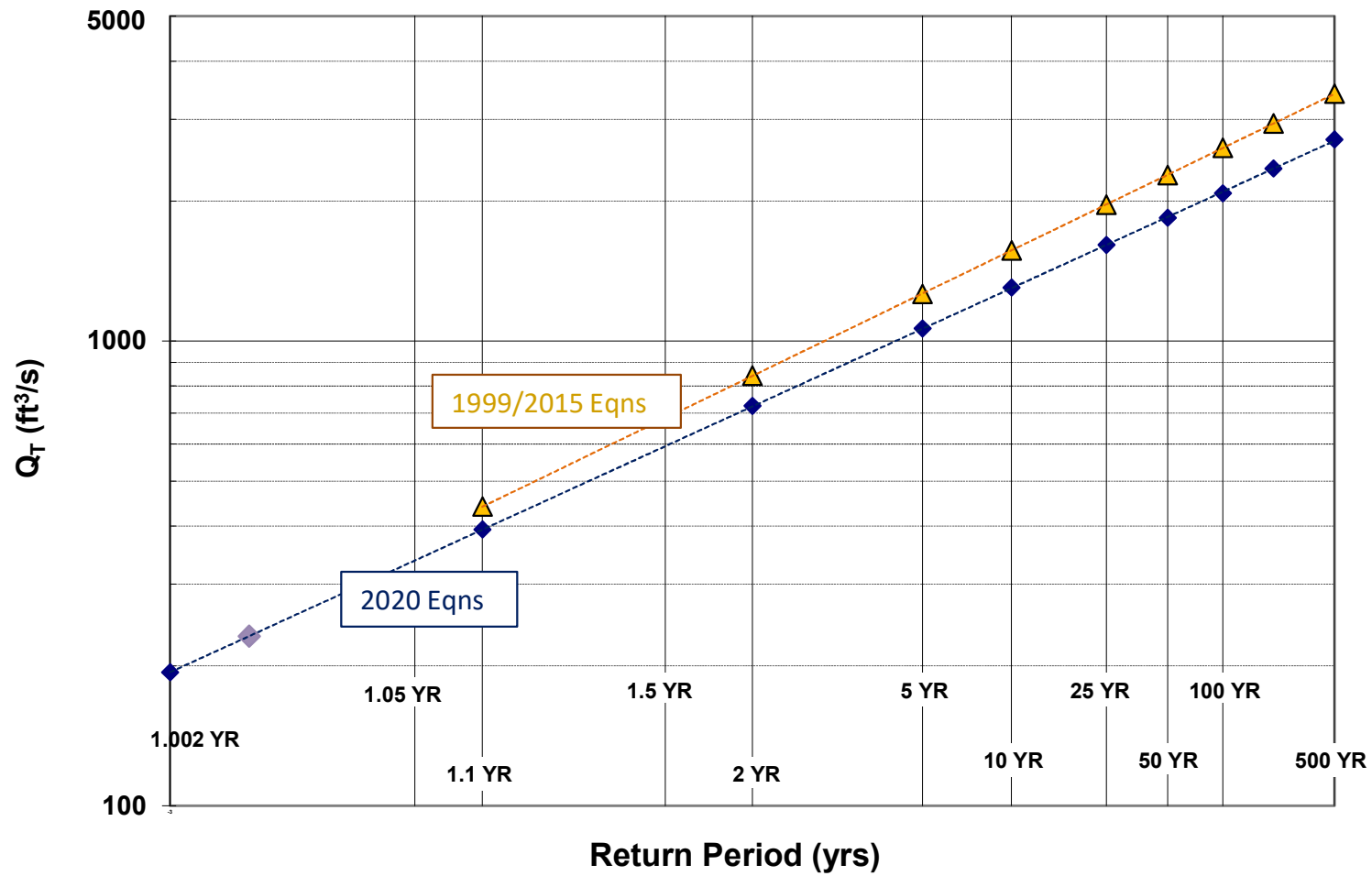
Copy CSV file into "I24" page

Use results under "Design"

Check against gage data and FEMA studies if available

Questions? Check with ENV / Hydrology Section

Log-Normal Probability Plot



WIN: 25453.00
 Town: Ft Fairfield
 Route No. ME-161
 Asset ID: 2691
 Lat: 46.76550 Long: -67.81664

Project Name: Fort Fairfield, Puddle Dock Bridge #2691
 Stream Name: Pattie Brook
 Bridge Name: Puddle Dock Bridge
 Analysis by: csh
 Date: 11/14/2021

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

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

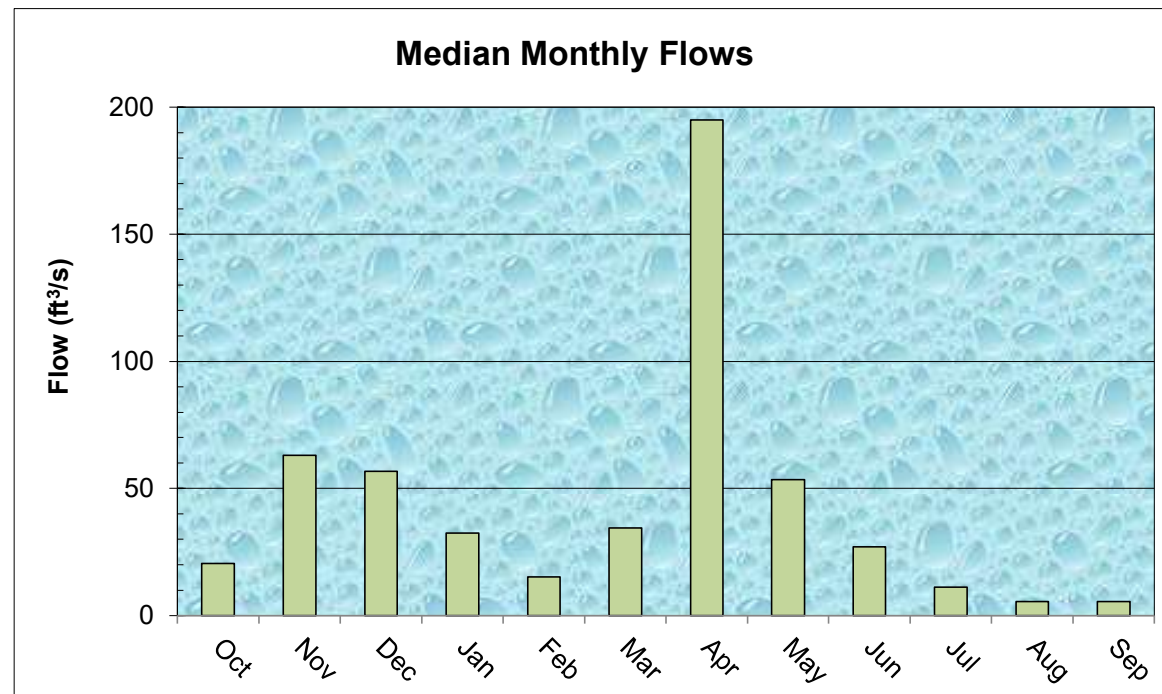
Value	Variable	Explanation
37.23	A	Area (mi ²)
590181	P _c	Watershed centroid (E,N; UTM; Zone 19; meters)
156.26	DIST	Distance from Coastal reference line (mi)
38.4	pptA	Mean Annual Precipitation (inches)
0.00	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q _{median} (ft ³ /s)	(m ³ /s)
Jan	32.46	0.9199
Feb	15.25	0.4323
Mar	34.47	0.9767
Apr	194.94	5.5244
May	53.49	1.5158
Jun	26.95	0.7637
Jul	11.10	0.3147
Aug	5.55	0.1572
Sep	5.46	0.1548
Oct	20.58	0.5832
Nov	63.07	1.7872
Dec	56.71	1.6071

Q _{bf}	231.5
ann avg	79.6
ann med	36.1
Q _{1.002}	242.3
Q _{1.01}	308.8
Q _{1.05}	412.3
Q _{bf}	407.3

assume v = 4ft/s

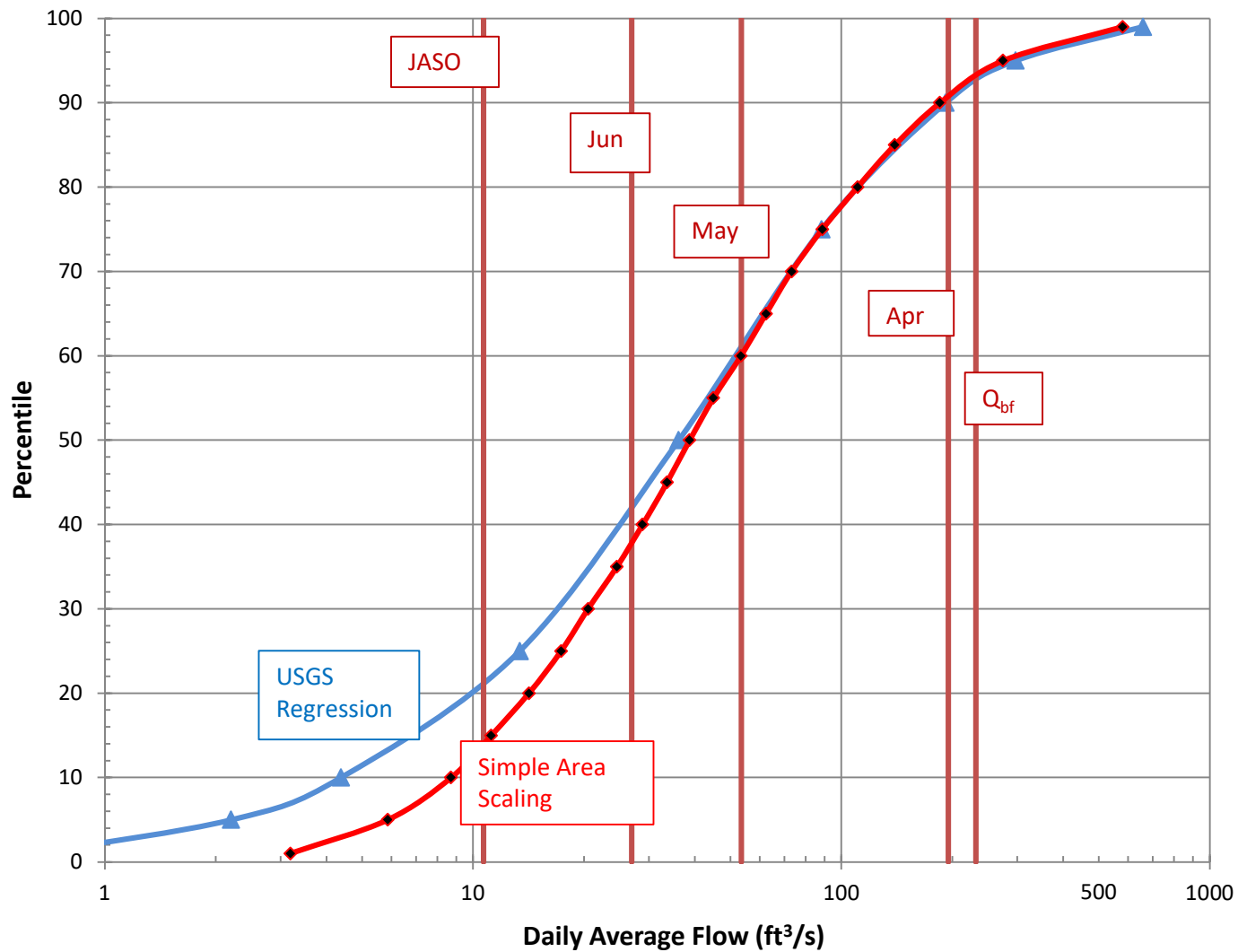
W _{bf}	50.1	estimated bankfull width (ft)
d _{bf}	2.0	estimated bankfull depth (ft)
A _{bf}	102.1	estimated bankfull flow area (ft ²)



References

Dudley, 2013. FY2013 Progress Report - Phase 1 ..., USFWS QRP Project
 Dudley, 2004. Estimating Monthly Streamflows ..., SIR 2004-5026
 Dudley, 2015. Regression Equations for Monthly & Annual Mean..., USGS SIR 2015-5151

Daily Average Flow Distribution



Daily Avg Flow Dist

$A_{ws} = (\text{mi}^2)$ 37.2
 $Q (\text{ft}^3/\text{s})$

Pctl	Median	84 th pctl
1	3.19	5.65
5	5.86	9.43
10	8.70	13.09
15	11.19	16.34
20	14.17	19.82
25	17.33	23.23
30	20.51	26.46
35	24.57	30.24
40	28.82	34.78
45	33.59	39.32
50	38.67	46.42
55	44.91	54.03
60	53.34	63.43
65	62.40	73.89
70	73.19	86.21
75	88.73	103.67
80	110.66	123.78
85	139.62	158.62
90	184.95	212.99
95	274.49	331.22
99	580.44	764.17

Q_{bf} 231.5

$Q_{1.002}$ 193.6

$Q_{1.1}$ 393.0

Q_2 725.1

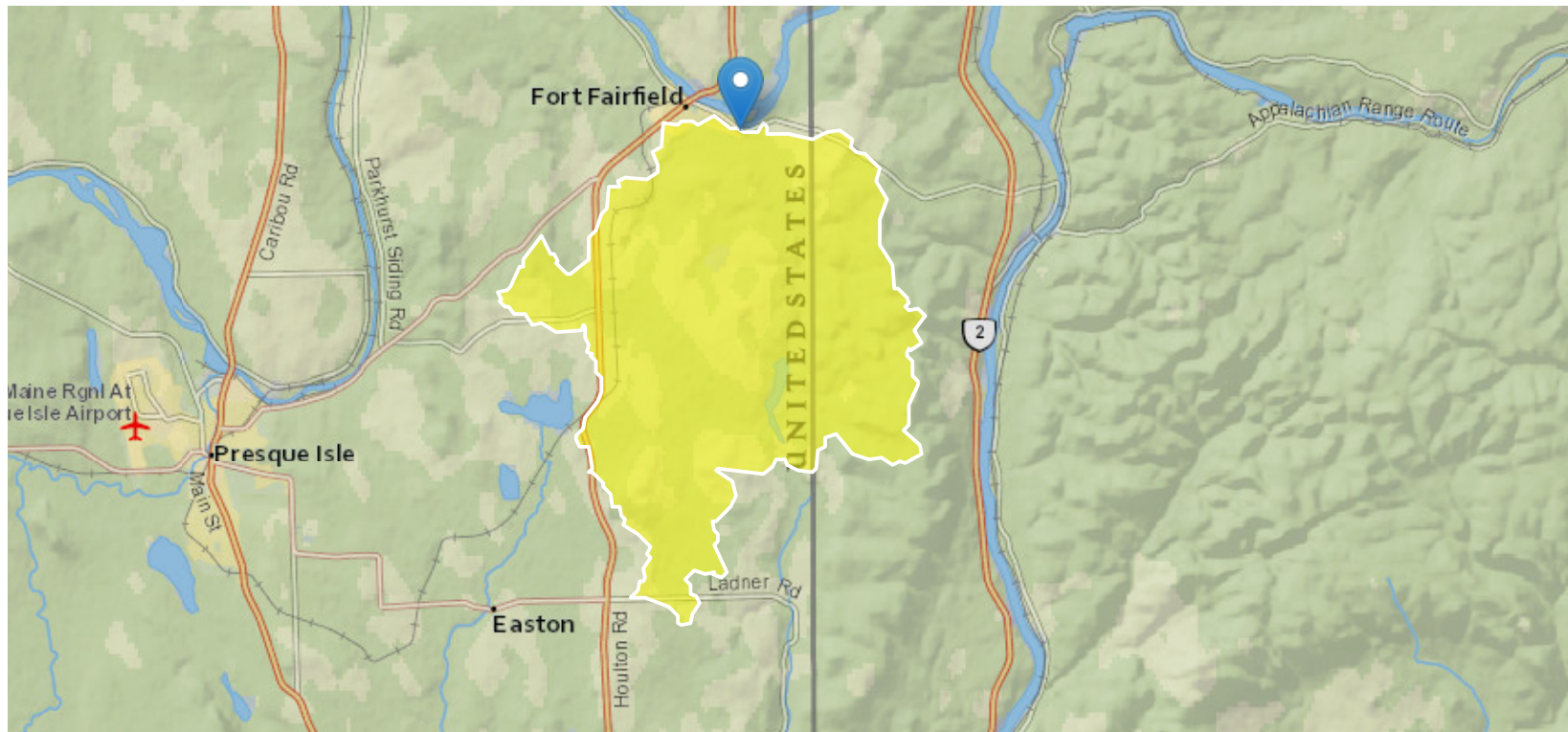
Ft Fairfield 25453 Puddle Dock Br #2691 ME161

Region ID: ME

Workspace ID: ME20211004181019981000

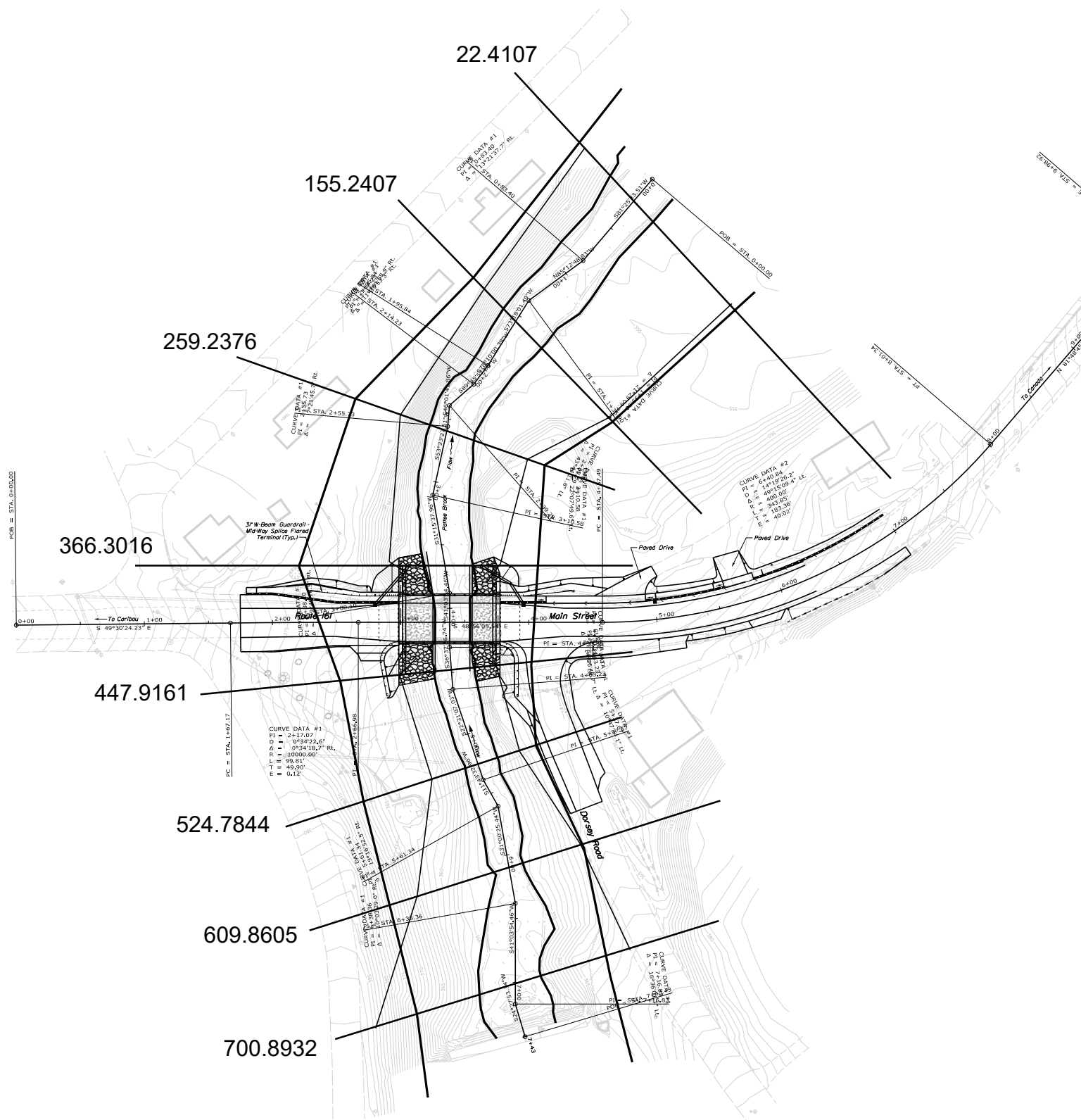
Clicked Point (Latitude, Longitude): 46.76550, -67.81661

Time: 2021-10-04 14:10:43 -0400



Basin Characteristics

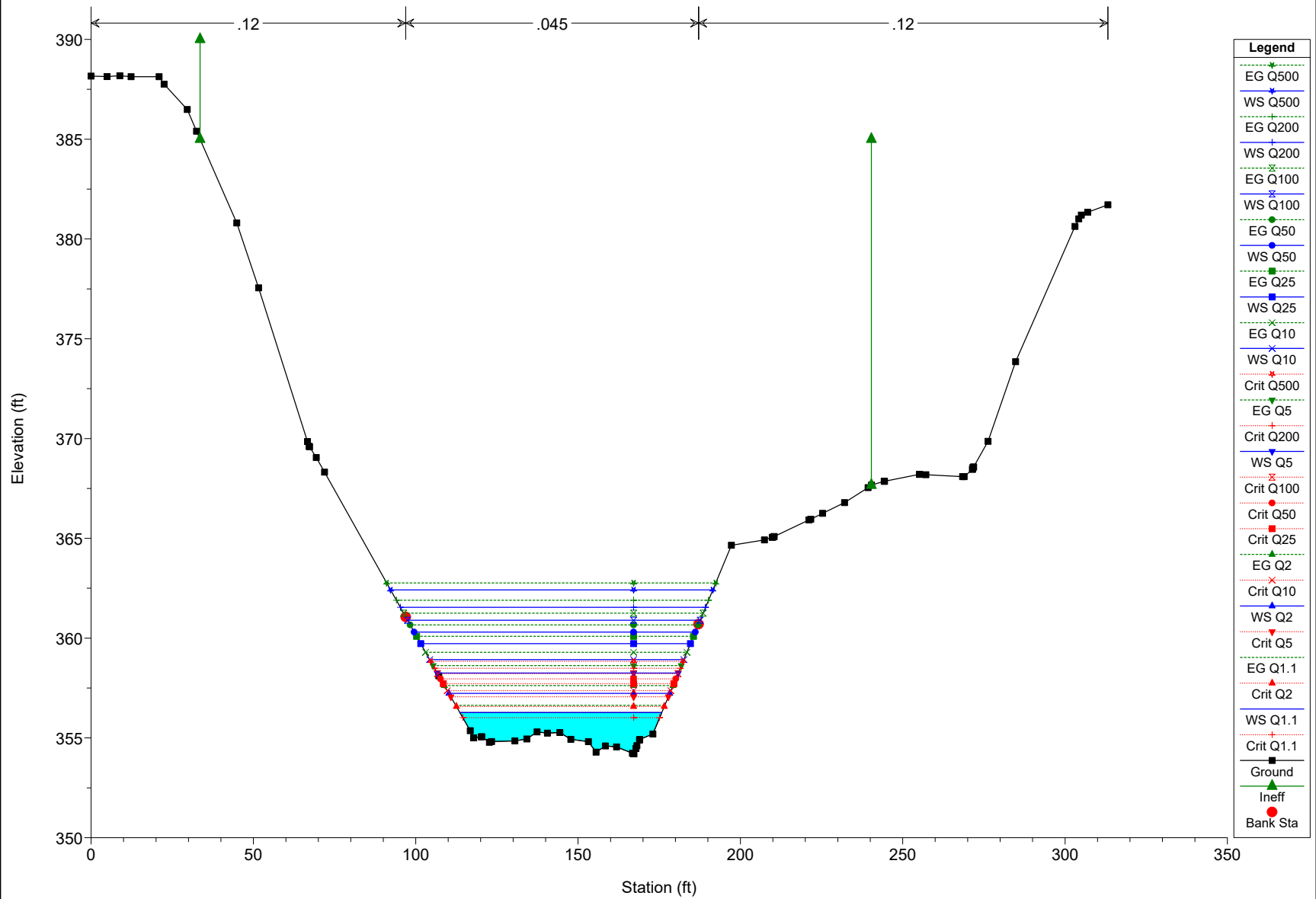
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	37.23	square miles



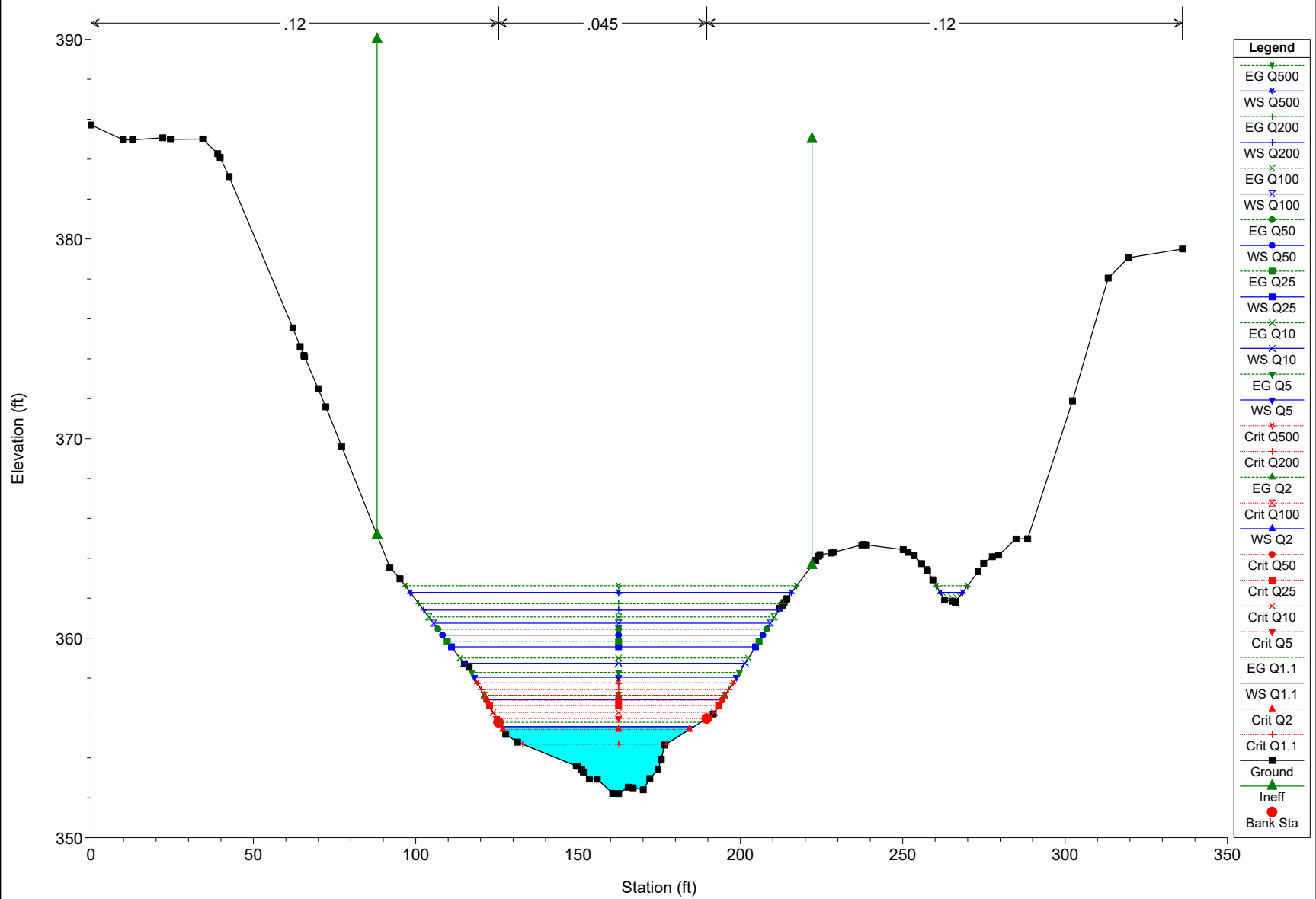
Existing Bridge

Non-Backwater Condition (Normal Depth)

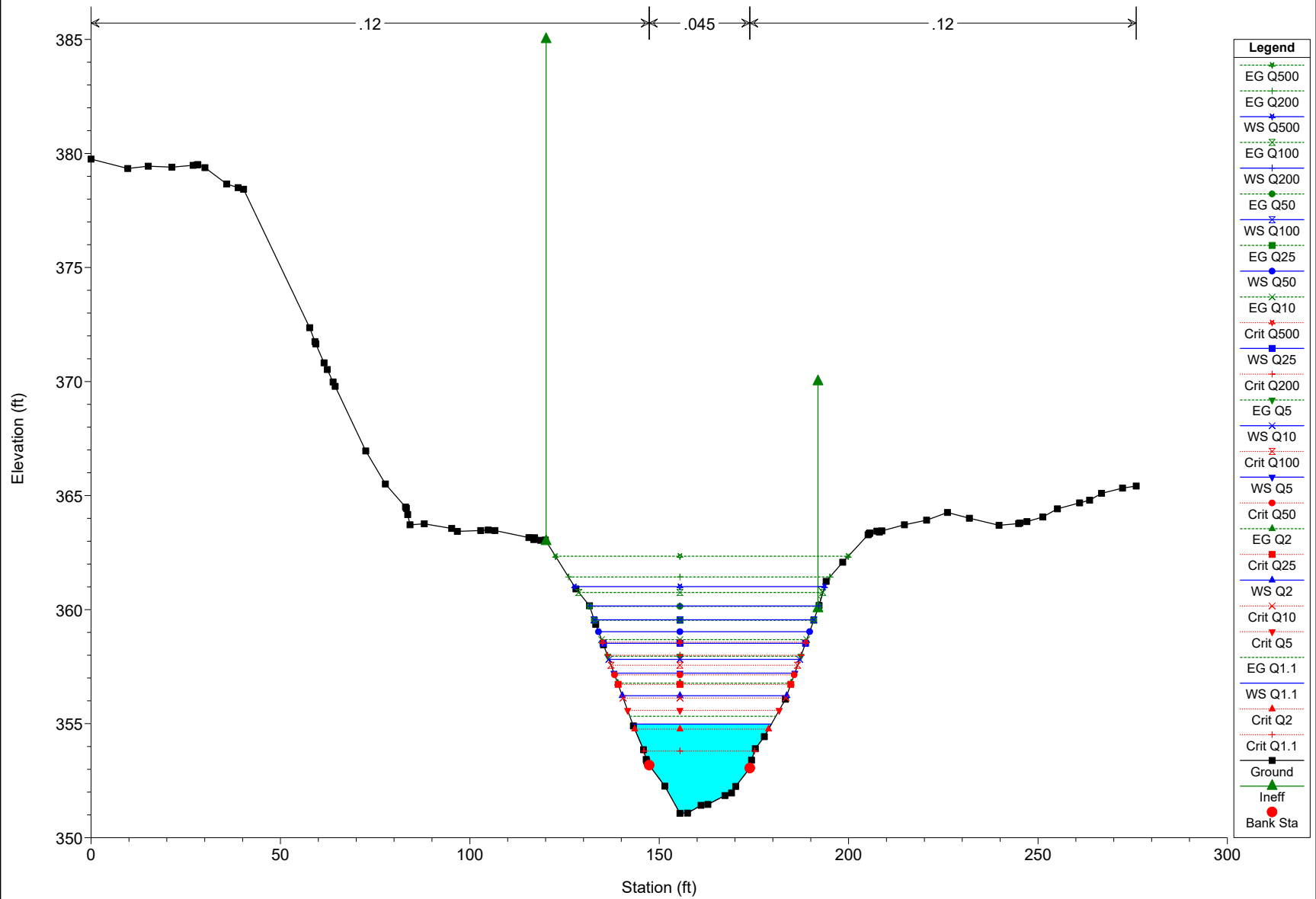
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 700.8932



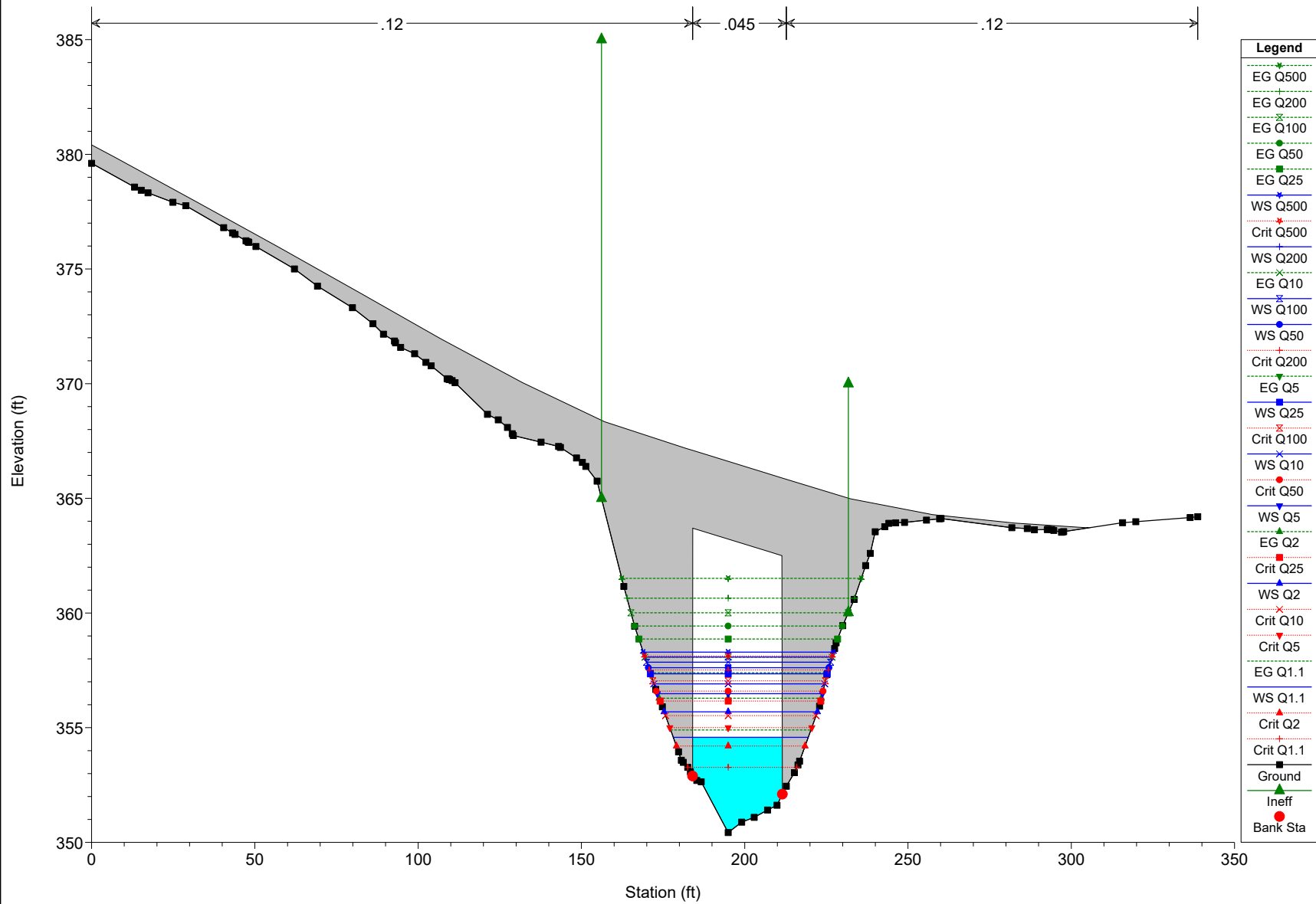
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 609.8605



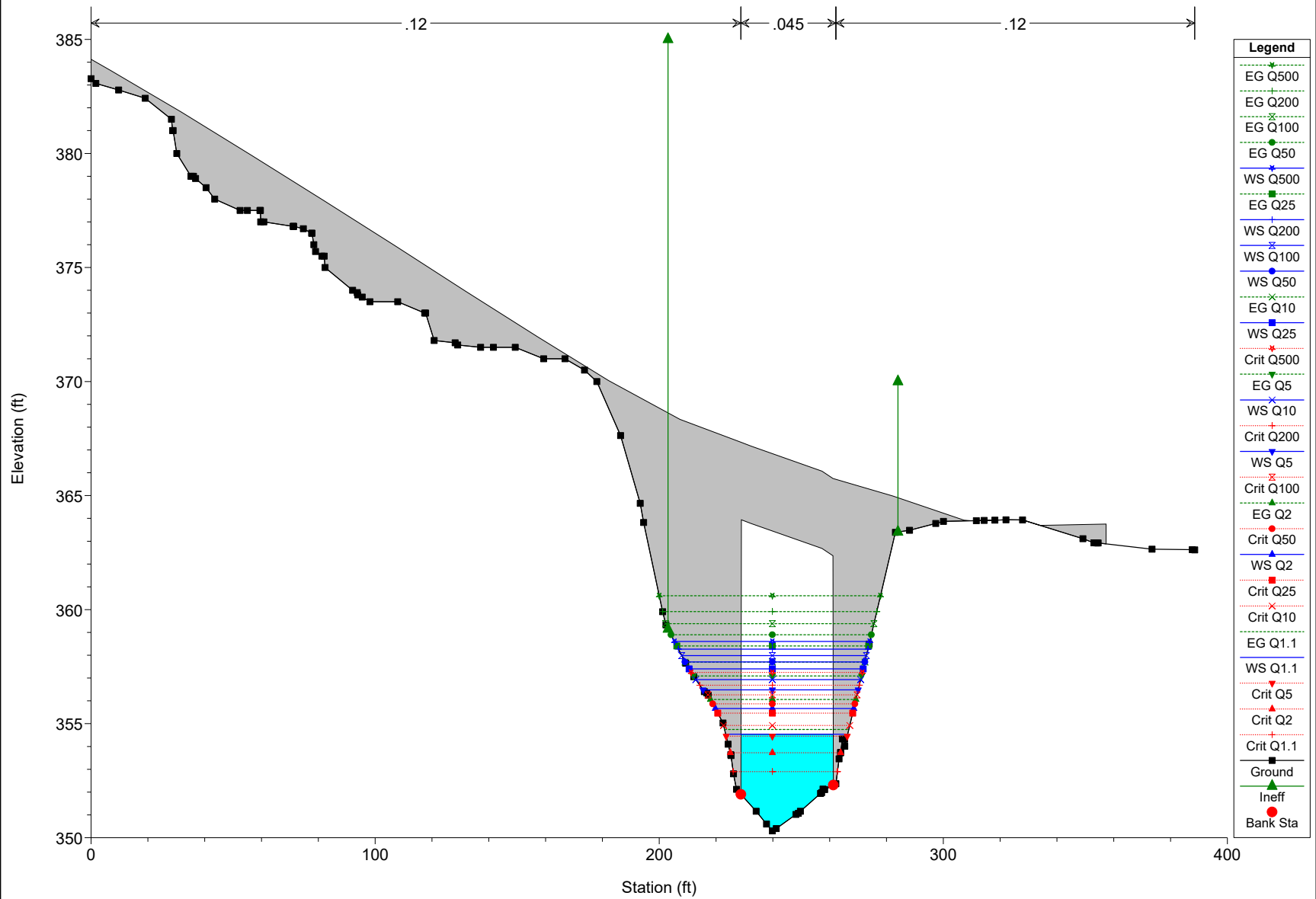
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 524.7844



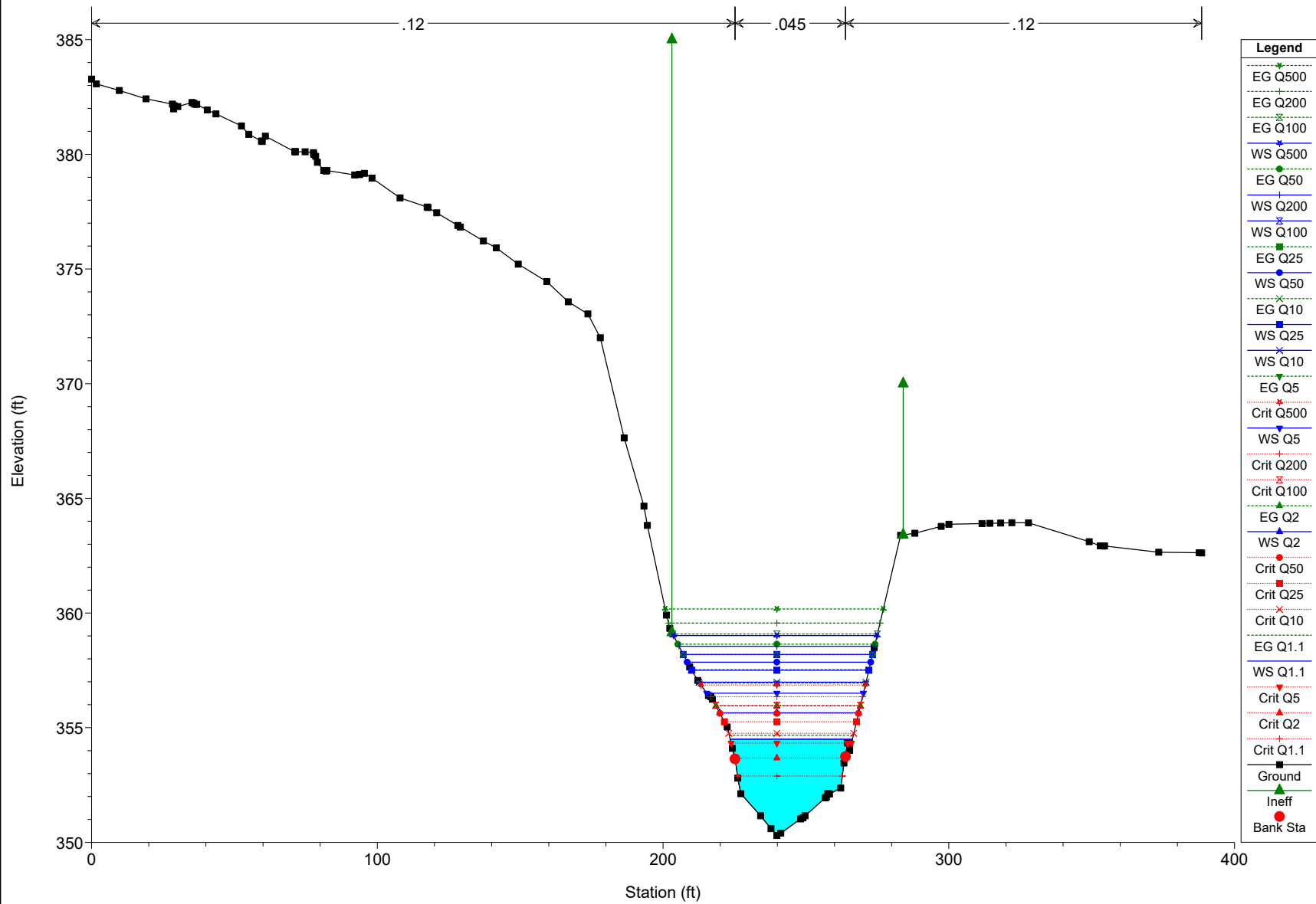
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 410.92 BR



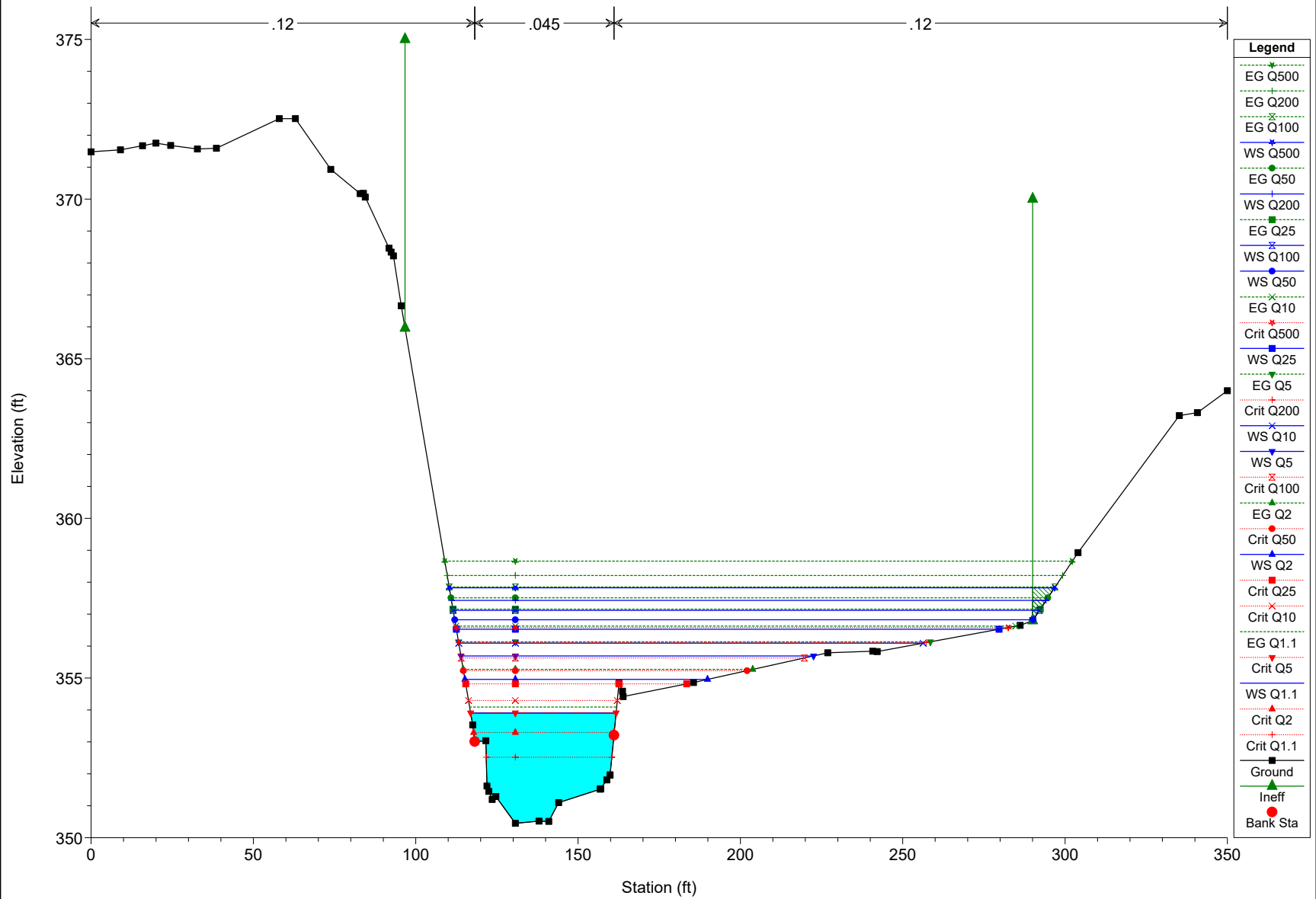
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 410.92 BR



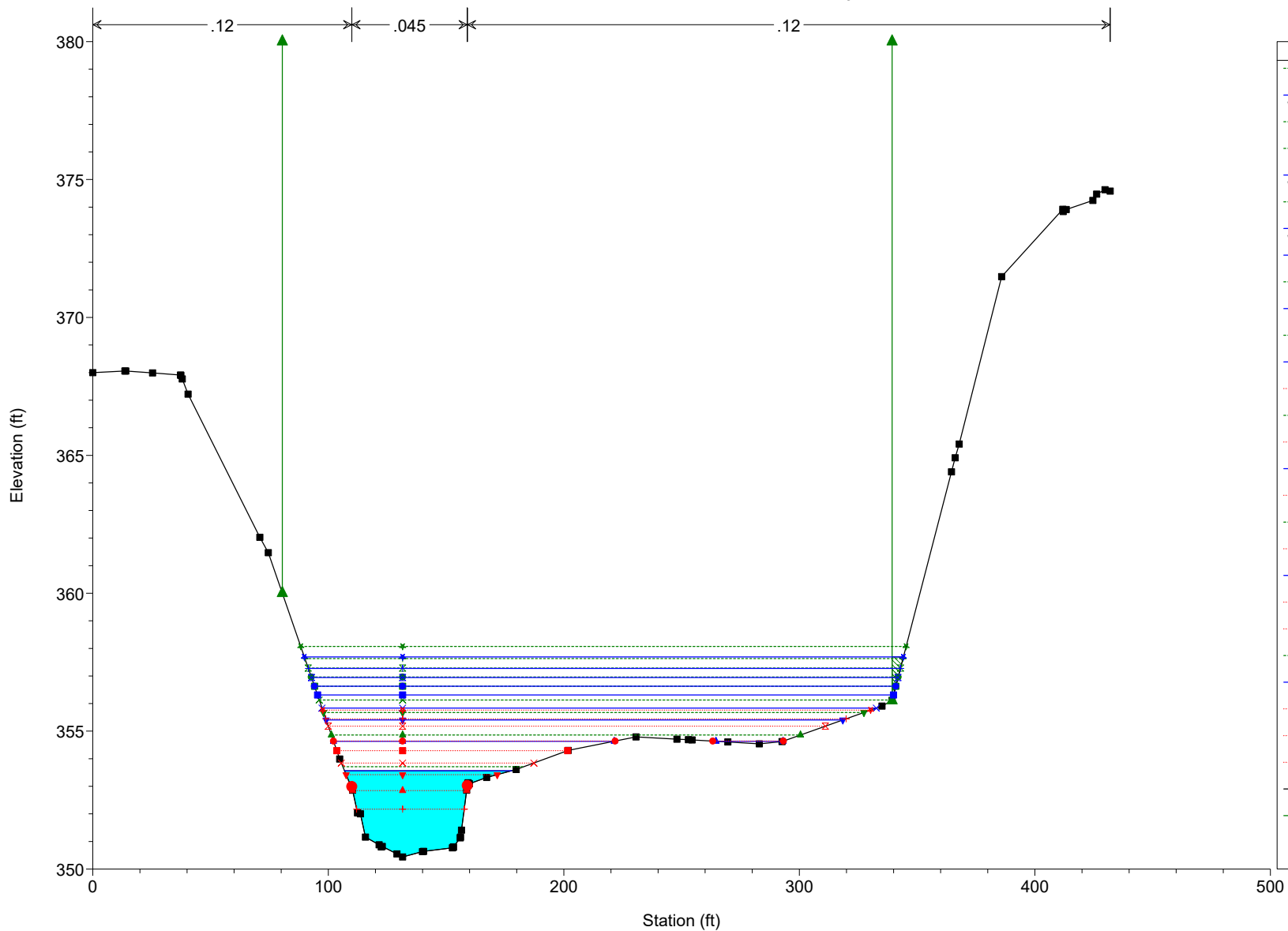
Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 366.3016



Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 155.2407

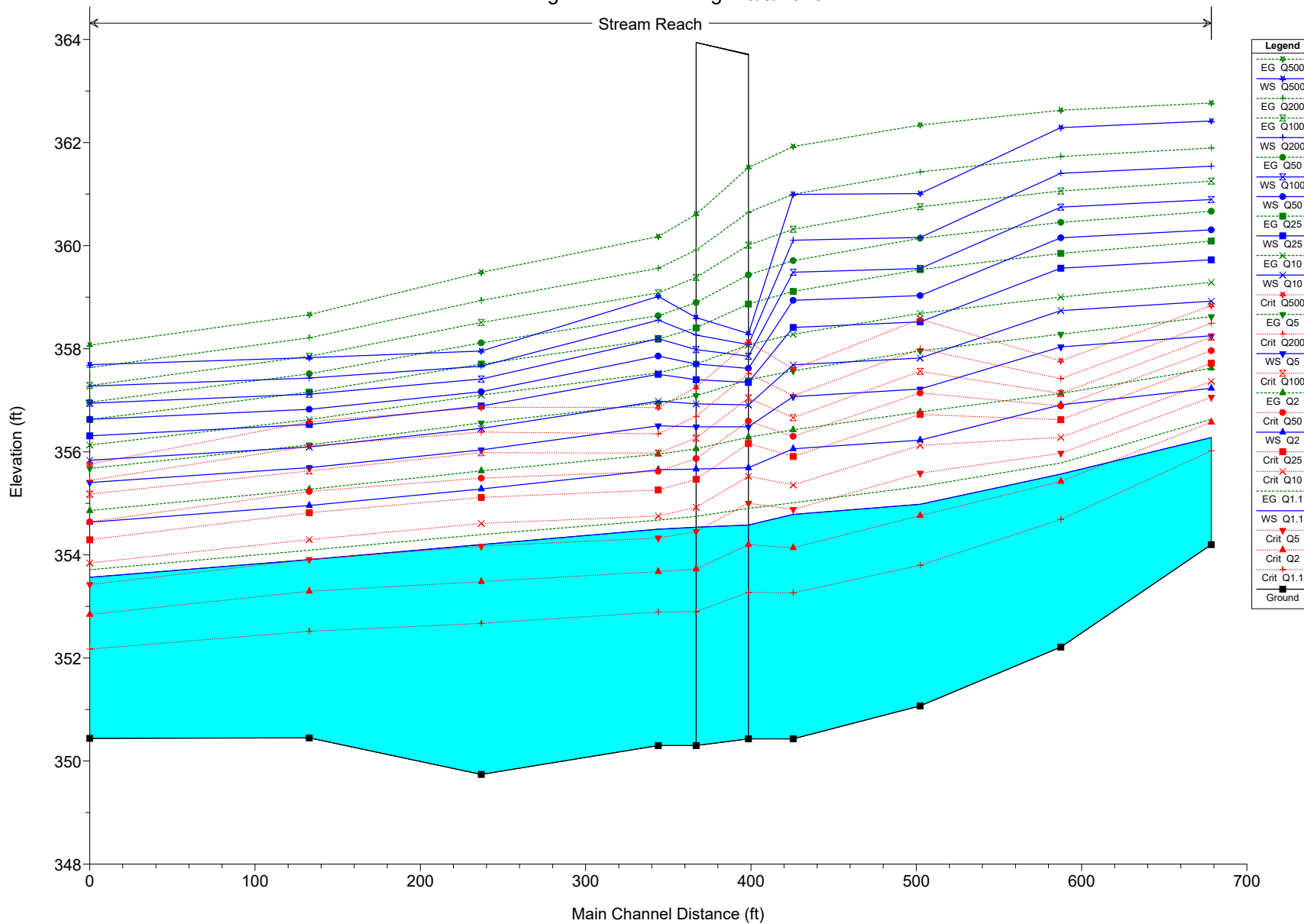


Existing Plan: Existing 6/9/2023
River = Stream Reach = Reach RS = 22.4107



Existing Plan: Existing 6/9/2023

Stream Reach



HEC-RAS Plan: Ex_Normal River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach	700.8932	Q1.1	395.00	354.20	356.28	356.02	356.63	0.014718	4.79	82.38	62.22	0.73
Reach	700.8932	Q2	725.00	354.20	357.23	356.57	357.62	0.008582	5.01	144.71	68.04	0.61
Reach	700.8932	Q5	1065.00	354.20	358.25	357.06	358.62	0.005401	4.91	217.12	74.22	0.51
Reach	700.8932	Q10	1305.00	354.20	358.92	357.37	359.29	0.004304	4.86	268.39	78.26	0.46
Reach	700.8932	Q25	1610.00	354.20	359.73	357.72	360.09	0.003460	4.83	333.19	83.09	0.43
Reach	700.8932	Q50	1840.00	354.20	360.31	357.96	360.67	0.003020	4.81	382.48	86.58	0.40
Reach	700.8932	Q100	2080.00	354.20	360.90	358.22	361.25	0.002645	4.79	434.50	90.12	0.38
Reach	700.8932	Q200	2350.00	354.20	361.54	358.49	361.90	0.002238	4.77	494.07	94.01	0.36
Reach	700.8932	Q500	2715.00	354.20	362.42	358.84	362.77	0.001816	4.74	578.67	99.27	0.33
Reach	609.8605	Q1.1	395.00	352.21	355.57	354.69	355.78	0.005955	3.72	106.16	59.42	0.49
Reach	609.8605	Q2	725.00	352.21	356.91	355.43	357.13	0.003088	3.77	196.26	72.61	0.39
Reach	609.8605	Q5	1065.00	352.21	358.04	355.97	358.28	0.002259	3.99	282.46	80.65	0.35
Reach	609.8605	Q10	1305.00	352.21	358.74	356.28	359.00	0.001981	4.16	340.95	86.62	0.33
Reach	609.8605	Q25	1610.00	352.21	359.56	356.62	359.85	0.001751	4.34	415.20	93.64	0.32
Reach	609.8605	Q50	1840.00	352.21	360.15	356.89	360.45	0.001620	4.46	471.93	98.67	0.32
Reach	609.8605	Q100	2080.00	352.21	360.75	357.13	361.06	0.001506	4.57	532.18	103.74	0.31
Reach	609.8605	Q200	2350.00	352.21	361.40	357.42	361.73	0.001393	4.67	602.11	109.33	0.30
Reach	609.8605	Q500	2715.00	352.21	362.29	357.76	362.63	0.001252	4.78	702.78	124.38	0.29
Reach	524.7844	Q1.1	395.00	351.07	354.98	353.80	355.32	0.004633	4.73	90.82	36.63	0.47
Reach	524.7844	Q2	725.00	351.07	356.23	354.76	356.77	0.004838	6.05	140.72	43.41	0.51
Reach	524.7844	Q5	1065.00	351.07	357.22	355.59	357.96	0.005059	7.09	185.85	47.74	0.54
Reach	524.7844	Q10	1305.00	351.07	357.82	356.12	358.68	0.005196	7.72	215.37	50.37	0.56
Reach	524.7844	Q25	1610.00	351.07	358.52	356.72	359.53	0.005303	8.40	251.86	53.46	0.57
Reach	524.7844	Q50	1840.00	351.07	359.03	357.14	360.14	0.005312	8.83	279.71	55.74	0.58
Reach	524.7844	Q100	2080.00	351.07	359.56	357.56	360.75	0.005256	9.21	309.65	58.03	0.59
Reach	524.7844	Q200	2350.00	351.07	360.16	358.00	361.43	0.005100	9.54	345.27	60.52	0.58
Reach	524.7844	Q500	2715.00	351.07	361.01	358.57	362.34	0.004763	9.84	398.25	66.03	0.57
Reach	447.9161	Q1.1	395.00	350.43	354.79	353.26	355.01	0.002908	3.85	112.05	42.37	0.38
Reach	447.9161	Q2	725.00	350.43	356.06	354.14	356.43	0.003109	4.96	170.05	48.75	0.41
Reach	447.9161	Q5	1065.00	350.43	357.07	354.88	357.57	0.003296	5.85	221.62	52.98	0.44
Reach	447.9161	Q10	1305.00	350.43	357.69	355.36	358.28	0.003408	6.38	255.10	55.60	0.45
Reach	447.9161	Q25	1610.00	350.43	358.41	355.91	359.11	0.003497	6.97	296.50	58.80	0.47
Reach	447.9161	Q50	1840.00	350.43	358.94	356.30	359.71	0.003511	7.33	328.13	61.20	0.48
Reach	447.9161	Q100	2080.00	350.43	359.48	356.66	360.32	0.003485	7.66	362.20	63.93	0.48
Reach	447.9161	Q200	2350.00	350.43	360.11	357.09	361.00	0.003392	7.95	402.95	67.03	0.48
Reach	447.9161	Q500	2715.00	350.43	360.99	357.61	361.92	0.003153	8.18	462.94	71.16	0.47
Reach	410.92	Bridge										
Reach	366.3016	Q1.1	395.00	350.30	354.50	352.89	354.67	0.002445	3.35	119.03	42.76	0.34
Reach	366.3016	Q2	725.00	350.30	355.65	353.67	355.95	0.002788	4.44	171.35	48.67	0.38
Reach	366.3016	Q5	1065.00	350.30	356.50	354.33	356.95	0.003198	5.38	215.26	54.81	0.42
Reach	366.3016	Q10	1305.00	350.30	356.98	354.76	357.53	0.003513	5.99	242.37	58.45	0.45
Reach	366.3016	Q25	1610.00	350.30	357.51	355.26	358.19	0.003904	6.70	273.86	62.03	0.48
Reach	366.3016	Q50	1840.00	350.30	357.86	355.62	358.64	0.004183	7.20	296.08	64.25	0.50
Reach	366.3016	Q100	2080.00	350.30	358.19	355.97	359.08	0.004461	7.70	318.10	66.29	0.52
Reach	366.3016	Q200	2350.00	350.30	358.55	356.35	359.56	0.004740	8.22	342.28	68.46	0.54
Reach	366.3016	Q500	2715.00	350.30	359.01	356.86	360.18	0.005061	8.85	374.45	71.23	0.57
Reach	259.2376	Q1.1	395.00	349.74	354.20	352.67	354.39	0.002715	3.56	114.63	42.52	0.36
Reach	259.2376	Q2	725.00	349.74	355.28	353.48	355.63	0.003261	4.78	162.97	48.79	0.42
Reach	259.2376	Q5	1065.00	349.74	356.04	354.17	356.56	0.003926	5.87	207.86	65.53	0.47
Reach	259.2376	Q10	1305.00	349.74	356.45	354.61	357.10	0.004389	6.55	235.48	67.00	0.50
Reach	259.2376	Q25	1610.00	349.74	356.89	355.11	357.70	0.005027	7.39	264.83	68.52	0.54
Reach	259.2376	Q50	1840.00	349.74	357.16	355.49	358.11	0.005534	8.00	283.92	69.49	0.58
Reach	259.2376	Q100	2080.00	349.74	357.41	355.98	358.51	0.006107	8.64	301.23	84.34	0.61
Reach	259.2376	Q200	2350.00	349.74	357.66	356.38	358.94	0.006763	9.33	318.89	87.00	0.65
Reach	259.2376	Q500	2715.00	349.74	357.95	356.86	359.48	0.007689	10.25	339.91	88.79	0.69
Reach	155.2407	Q1.1	395.00	350.45	353.91	352.52	354.09	0.003084	3.44	115.56	44.79	0.37
Reach	155.2407	Q2	725.00	350.45	354.96	353.29	355.27	0.003409	4.51	171.49	74.71	0.41
Reach	155.2407	Q5	1065.00	350.45	355.69	353.91	356.14	0.003867	5.41	238.86	108.63	0.45
Reach	155.2407	Q10	1305.00	350.45	356.09	354.30	356.63	0.004216	5.98	290.11	143.01	0.48
Reach	155.2407	Q25	1610.00	350.45	356.53	354.82	357.16	0.004562	6.59	357.74	167.13	0.50
Reach	155.2407	Q50	1840.00	350.45	356.82	355.23	357.51	0.004754	6.98	409.05	178.14	0.52
Reach	155.2407	Q100	2080.00	350.45	357.12	355.63	357.85	0.004854	7.29	461.44	180.56	0.53
Reach	155.2407	Q200	2350.00	350.45	357.43	356.11	358.21	0.004935	7.61	517.32	183.14	0.54
Reach	155.2407	Q500	2715.00	350.45	357.83	356.58	358.66	0.005017	8.00	588.18	186.39	0.55
Reach	22.4107	Q1.1	395.00	350.44	353.56	352.17	353.71	0.002500	3.08	132.93	70.93	0.34
Reach	22.4107	Q2	725.00	350.44	354.63	352.84	354.86	0.002502	3.88	232.99	147.65	0.36
Reach	22.4107	Q5	1065.00	350.44	355.40	353.42	355.68	0.002501	4.41	387.67	219.35	0.37
Reach	22.4107	Q10	1305.00	350.44	355.84	353.84	356.13	0.002500	4.69	486.01	235.34	0.37
Reach	22.4107	Q25	1610.00	350.44	356.31	354.29	356.63	0.002501	4.99	600.35	244.56	0.38
Reach	22.4107	Q50	1840.00	350.44	356.63	354.64	356.96	0.002501	5.18	678.66	246.83	0.38
Reach	22.4107	Q100	2080.00	350.44	356.94	355.18	357.29	0.002501	5.37	755.44	249.05	0.39

HEC-RAS Plan: Ex_Normal River: Stream Reach: Reach (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	22.4107	Q200	2350.00	350.44	357.27	355.45	357.63	0.002500	5.57	837.21	251.39	0.39
Reach	22.4107	Q500	2715.00	350.44	357.69	355.76	358.07	0.002504	5.82	940.76	254.35	0.40

HEC-RAS Plan: Ex_Normal River: Stream Reach: Reach

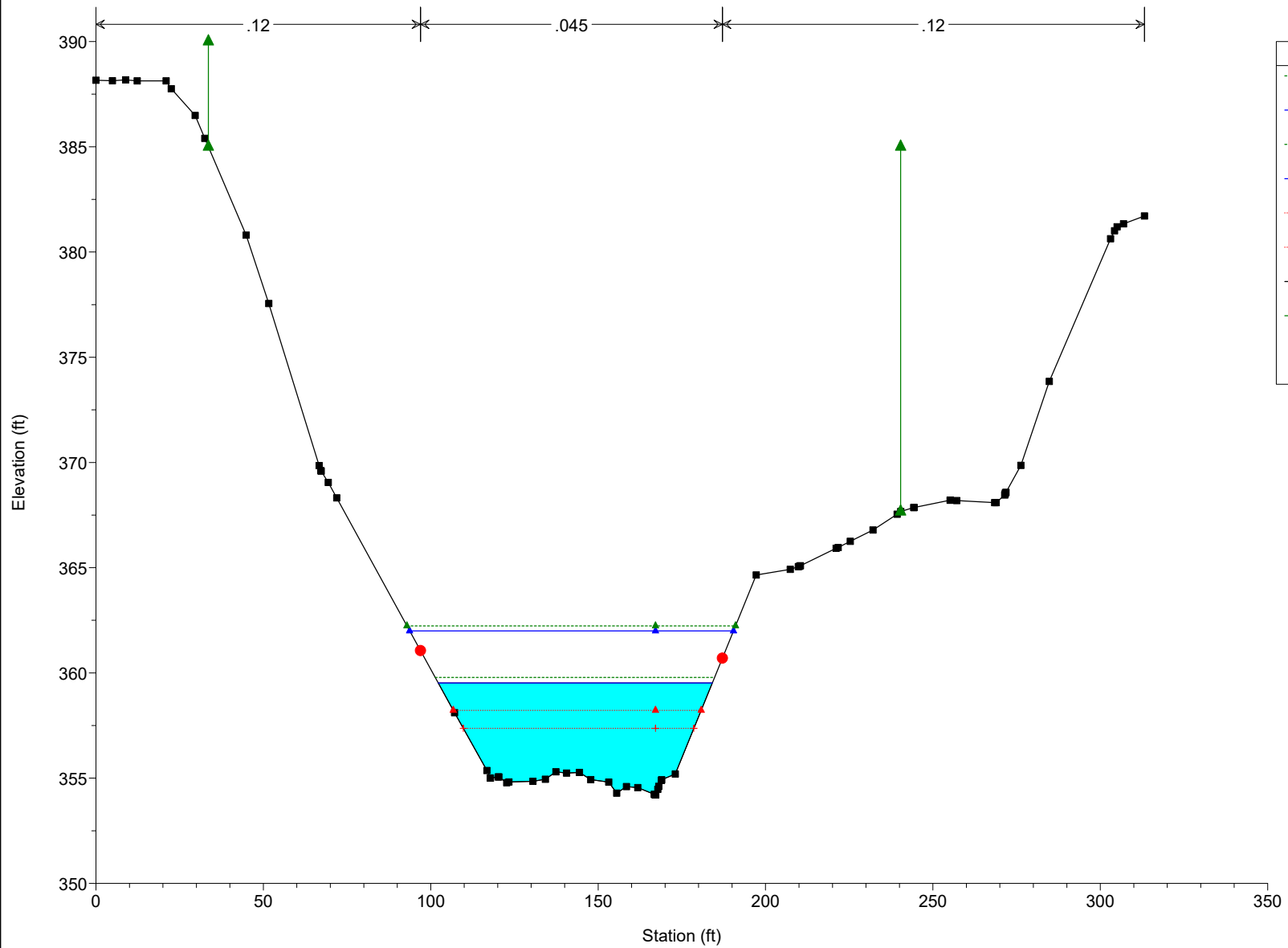
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Q Total	Min El Weir Flow	Delta EG	BR Open Vel	W.S. Elev
			(ft)	(ft)	(sq ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)
Reach	410.92	Q1.1	355.01	363.70	319.99	395.00	365.02	0.34	4.55	354.79
Reach	410.92	Q2	356.43	363.70	319.99	725.00	365.02	0.47	6.18	356.06
Reach	410.92	Q5	357.57	363.70	319.99	1065.00	365.02	0.63	7.65	357.07
Reach	410.92	Q10	358.28	363.70	319.99	1305.00	365.02	0.75	8.66	357.69
Reach	410.92	Q25	359.11	363.70	319.99	1610.00	365.02	0.93	9.90	358.41
Reach	410.92	Q50	359.71	363.70	319.99	1840.00	365.02	1.07	10.82	358.94
Reach	410.92	Q100	360.32	363.70	319.99	2080.00	365.02	1.23	11.78	359.48
Reach	410.92	Q200	361.00	363.70	319.99	2350.00	365.02	1.44	12.86	360.11
Reach	410.92	Q500	361.92	363.70	319.99	2715.00	365.02	1.75	14.39	360.99

Existing Bridge

Backwater Condition (Known WS)

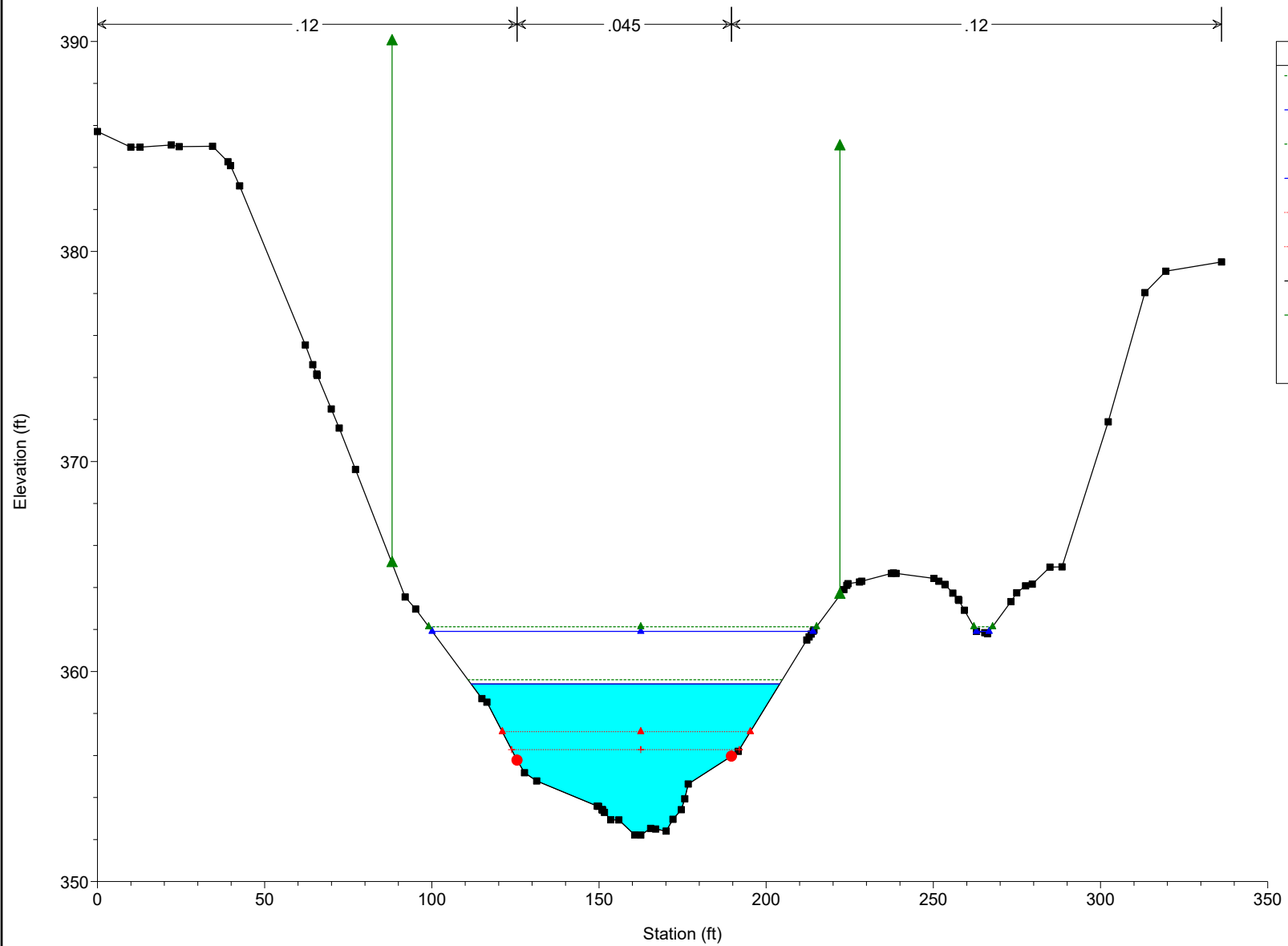
Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 700.8932



Existing Plan: Existing_Known 6/9/2023

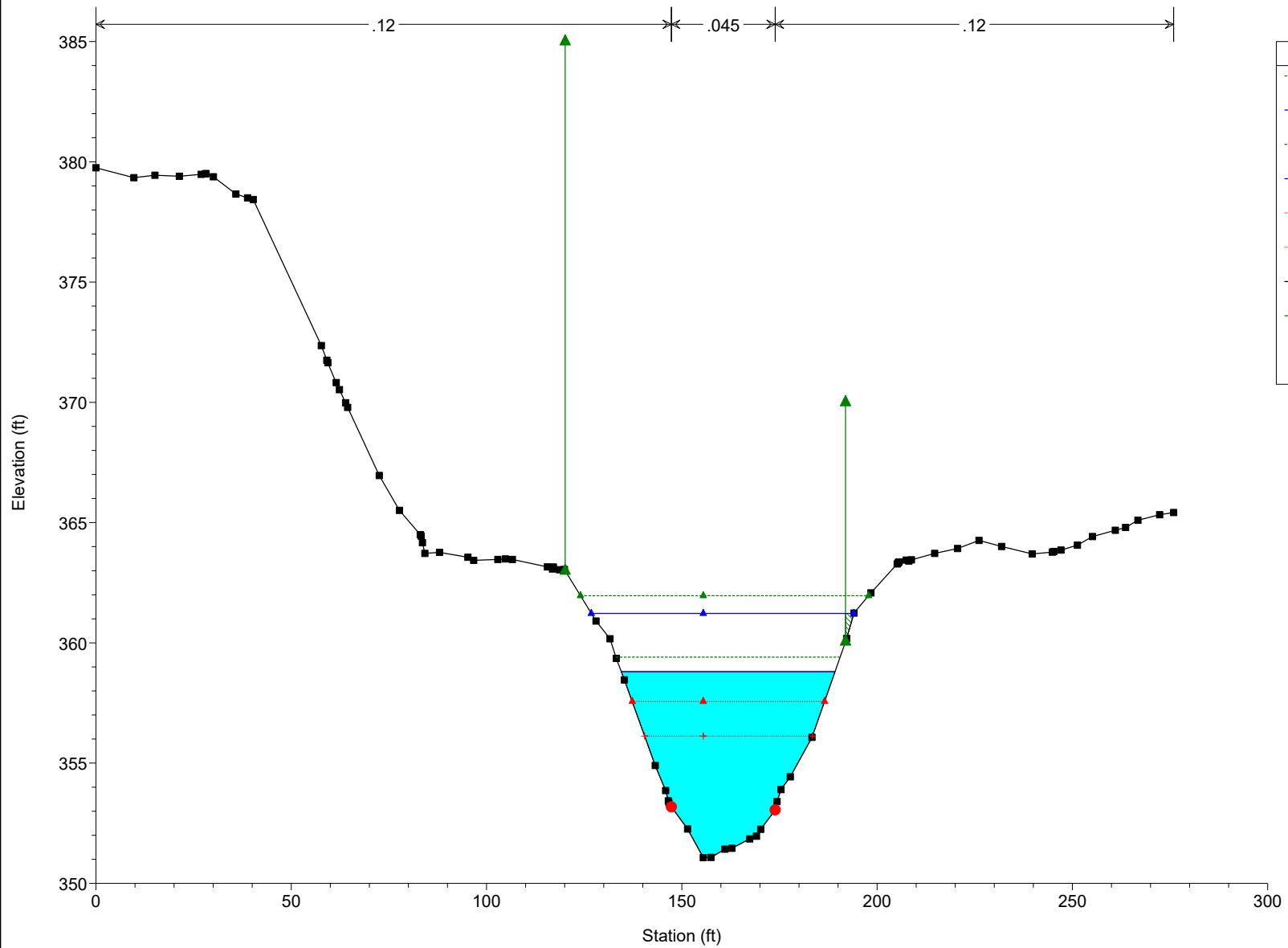
River = Stream Reach = Reach RS = 609.8605



Legend	
EG Q100	▲
WS Q100	▲
EG Q10	▲
WS Q10	▲
Crit Q100	▲
Crit Q10	+
Ground	■
Ineff	▲
Bank Sta	●

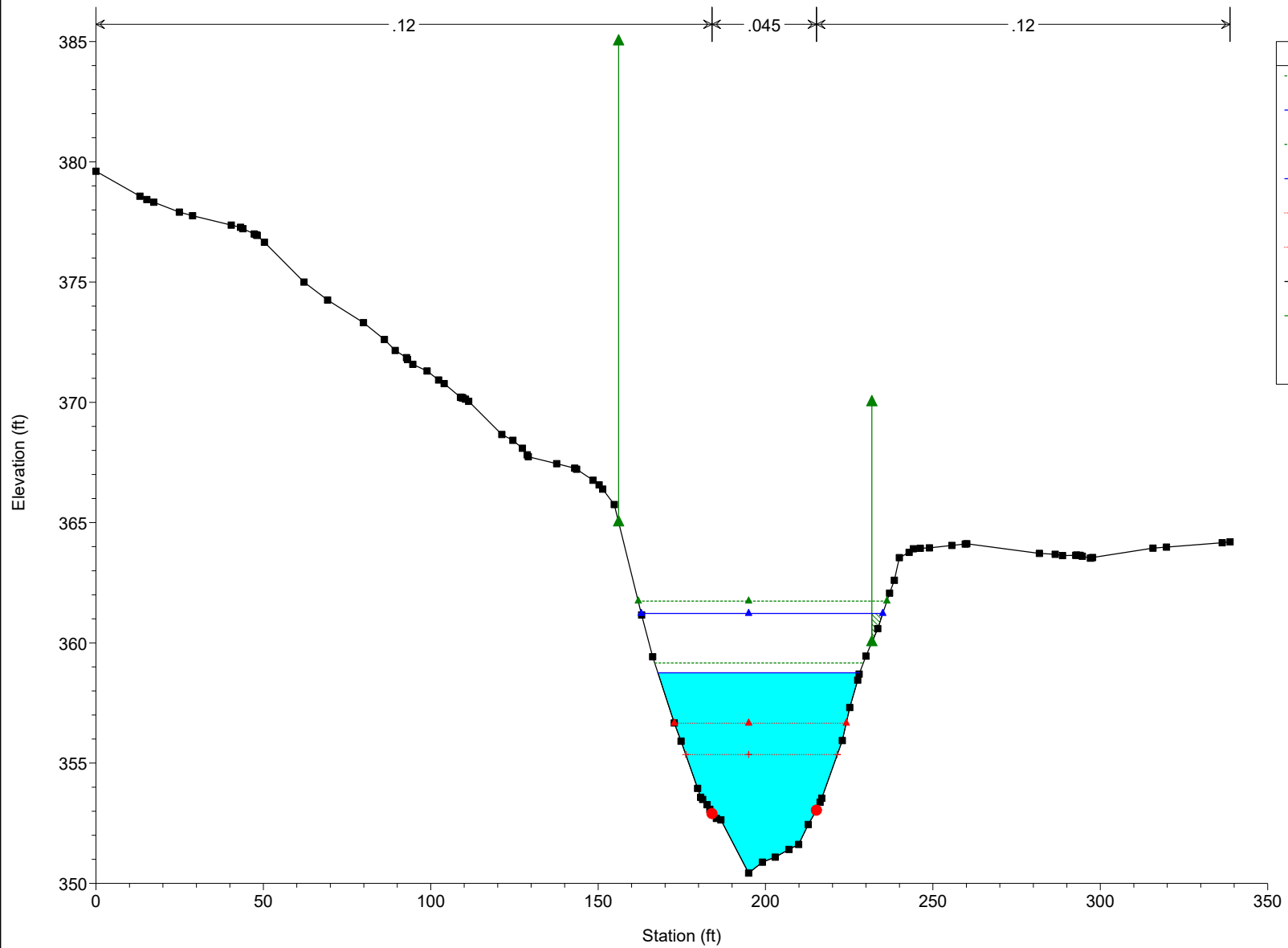
Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 524.7844



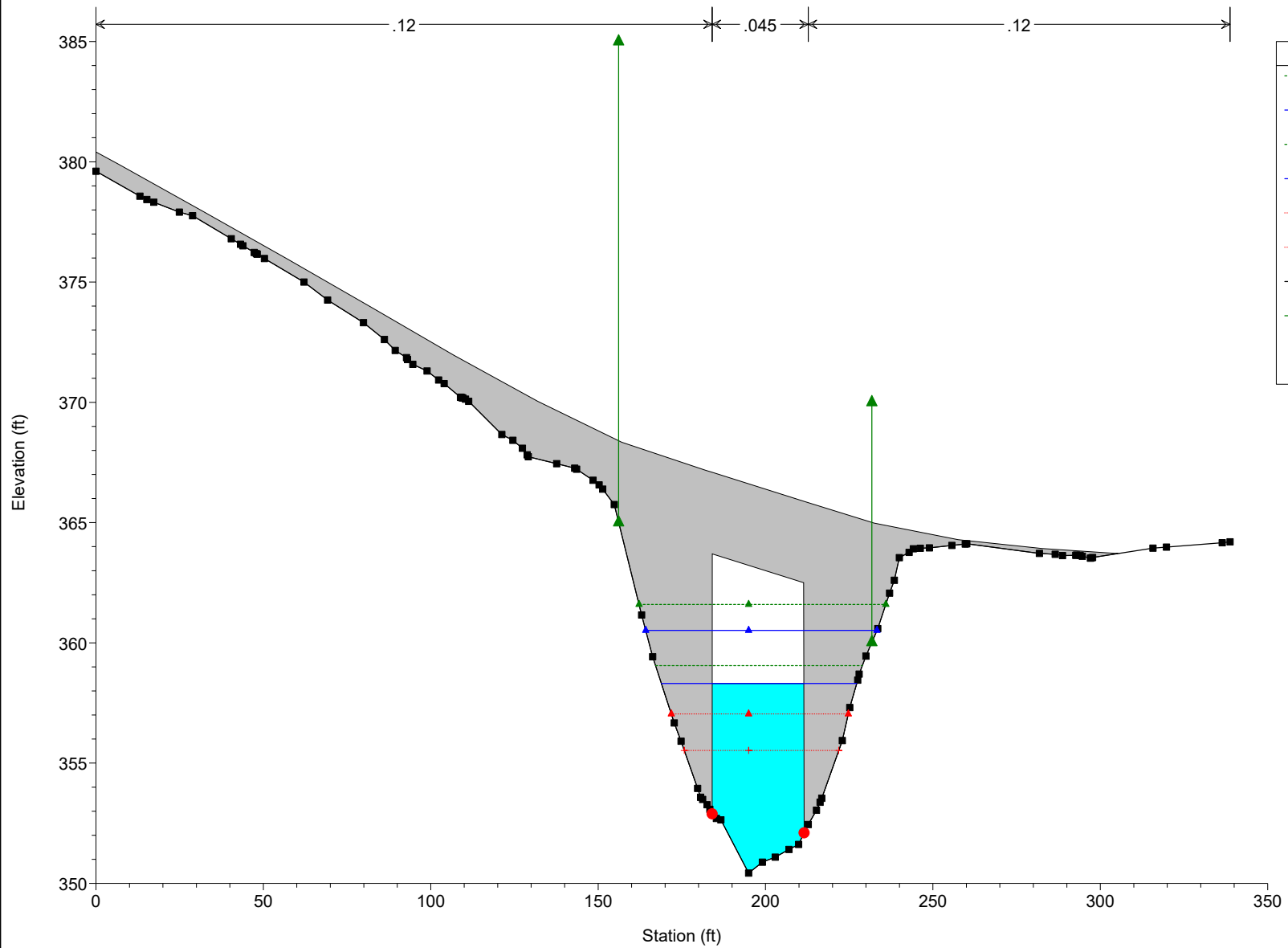
Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 447.9161



Existing Plan: Existing_Known 6/9/2023

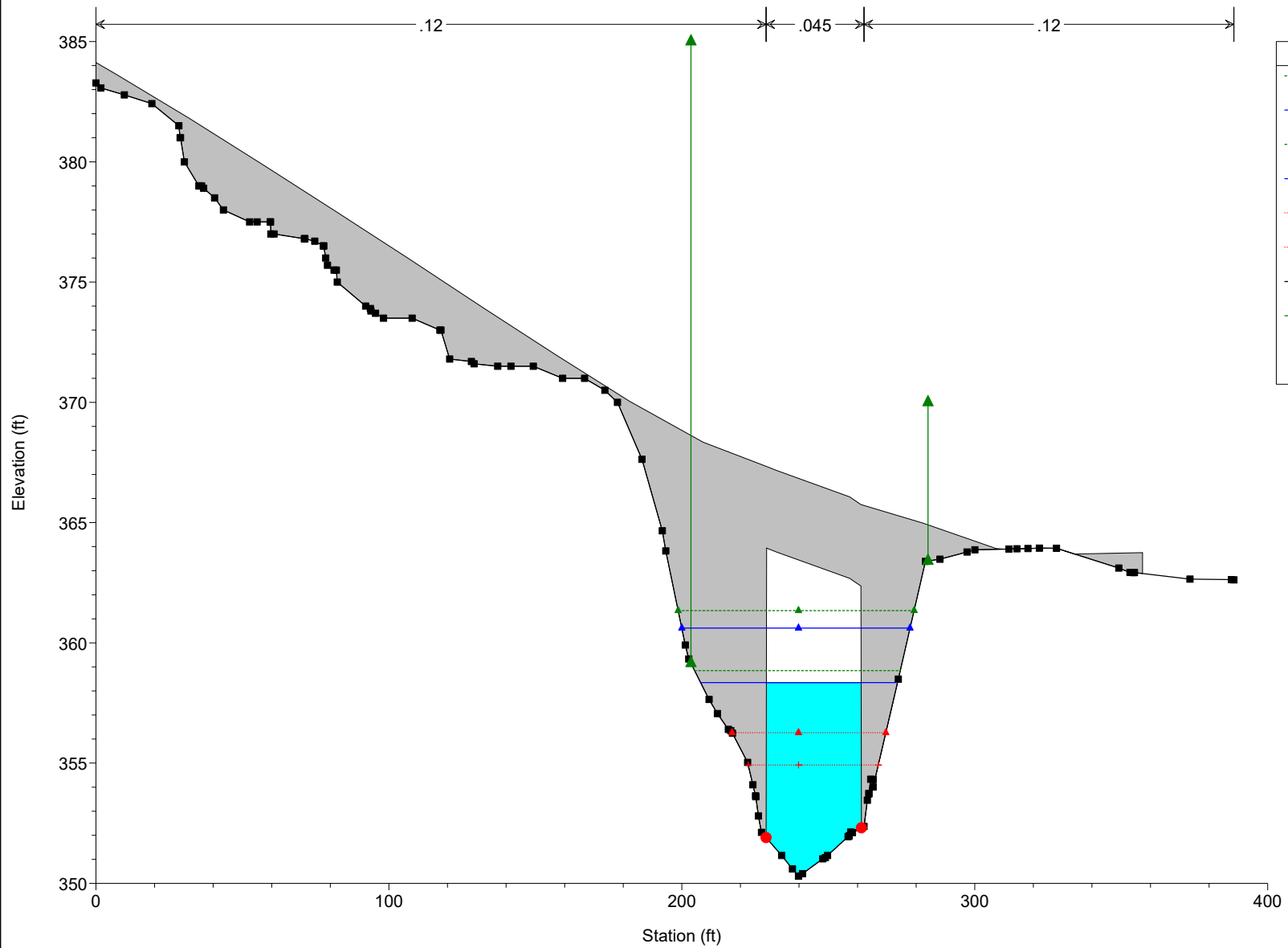
River = Stream Reach = Reach RS = 410.92 BR



Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	
Ineff	
Bank Sta	

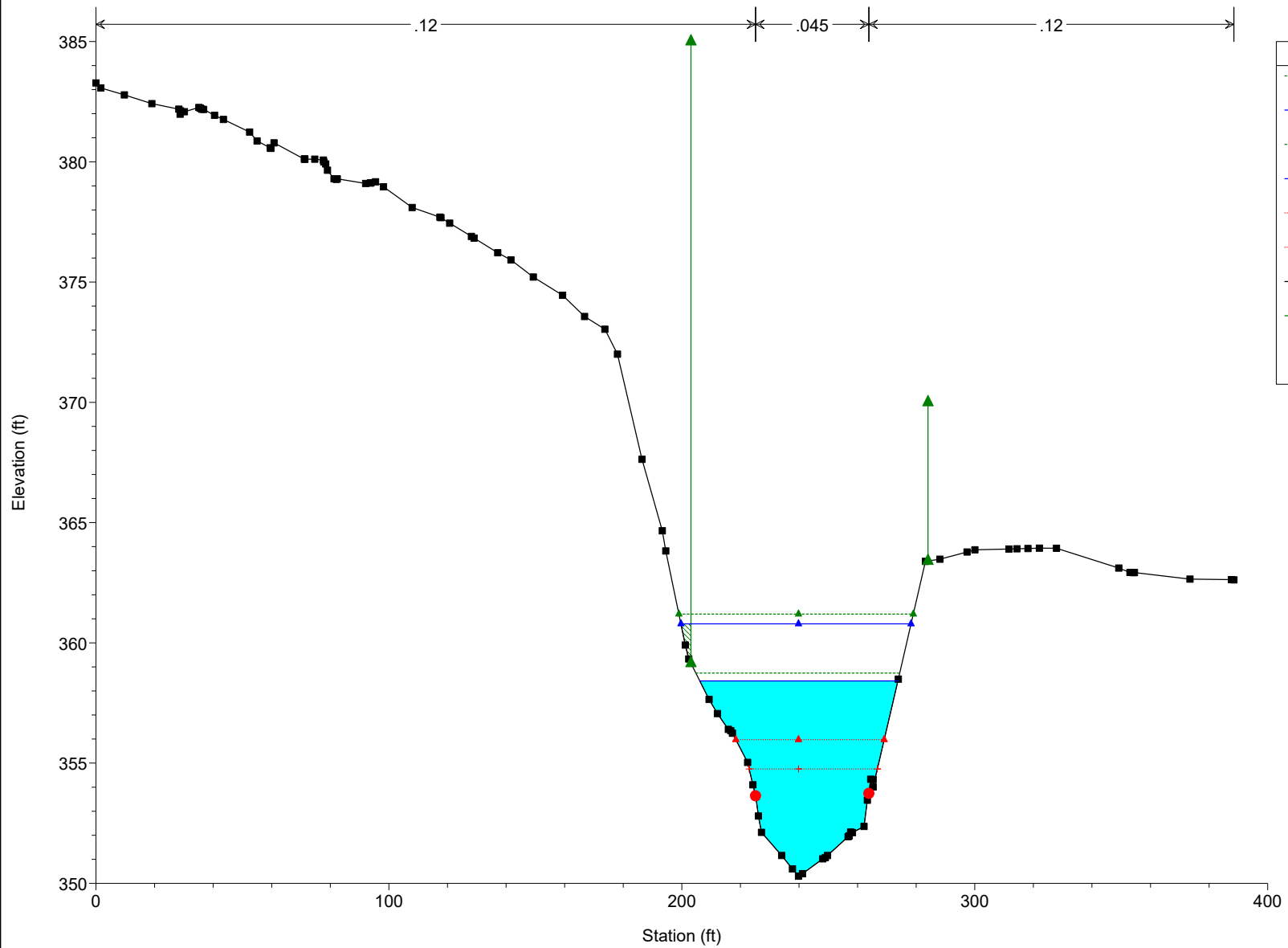
Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 410.92 BR

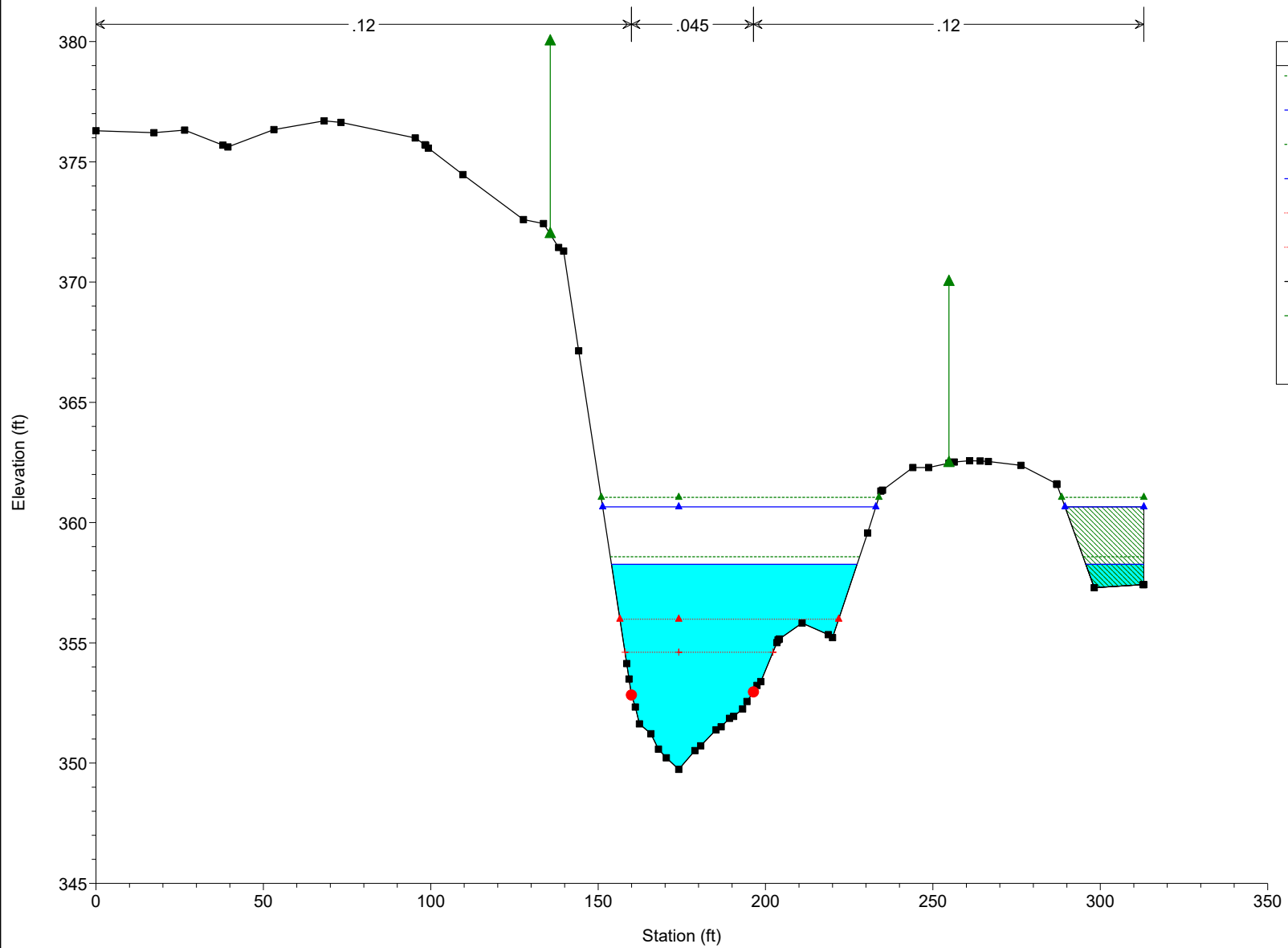


Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 366.3016

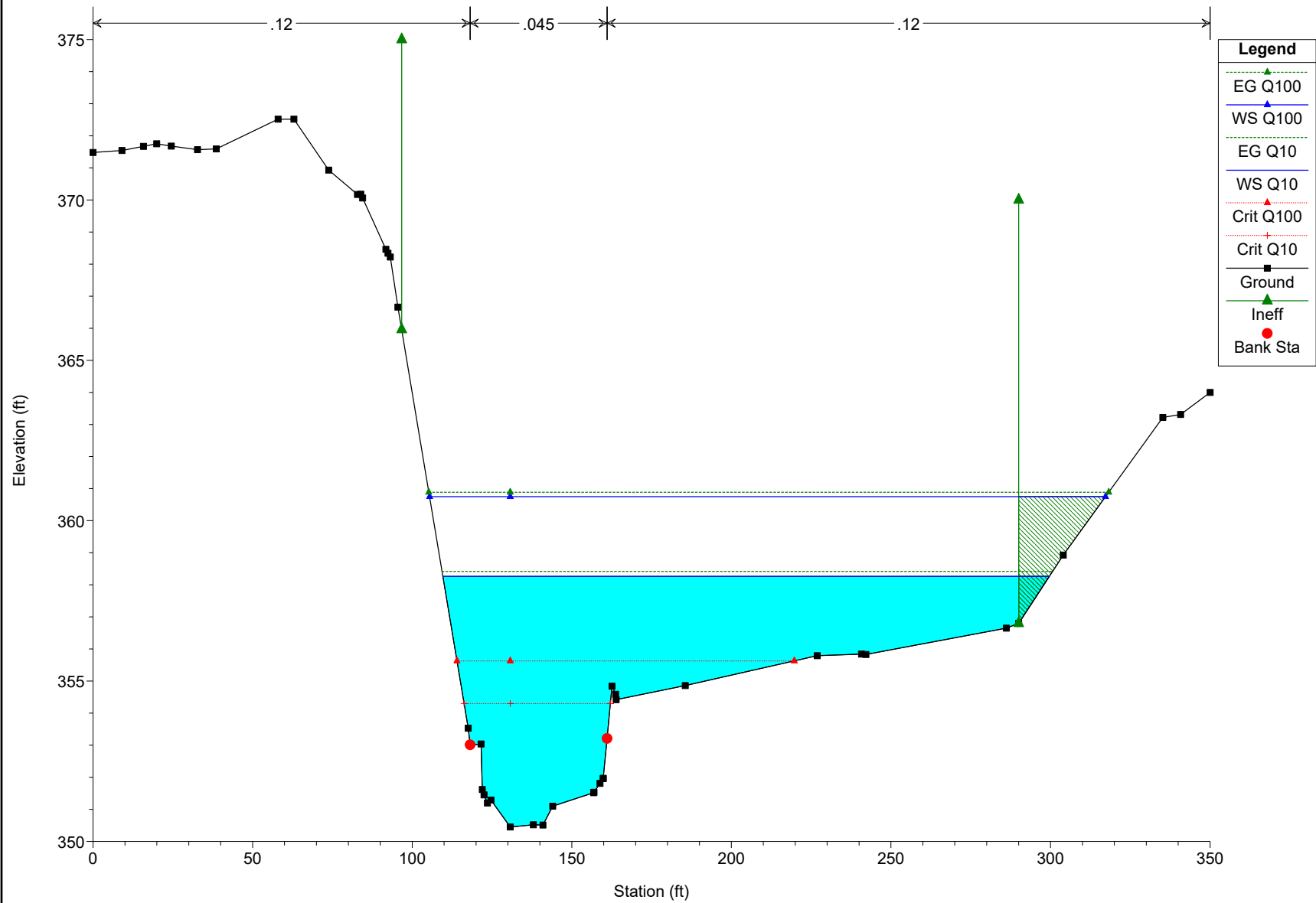


Existing Plan: Existing_Known 6/9/2023
River = Stream Reach = Reach RS = 259.2376



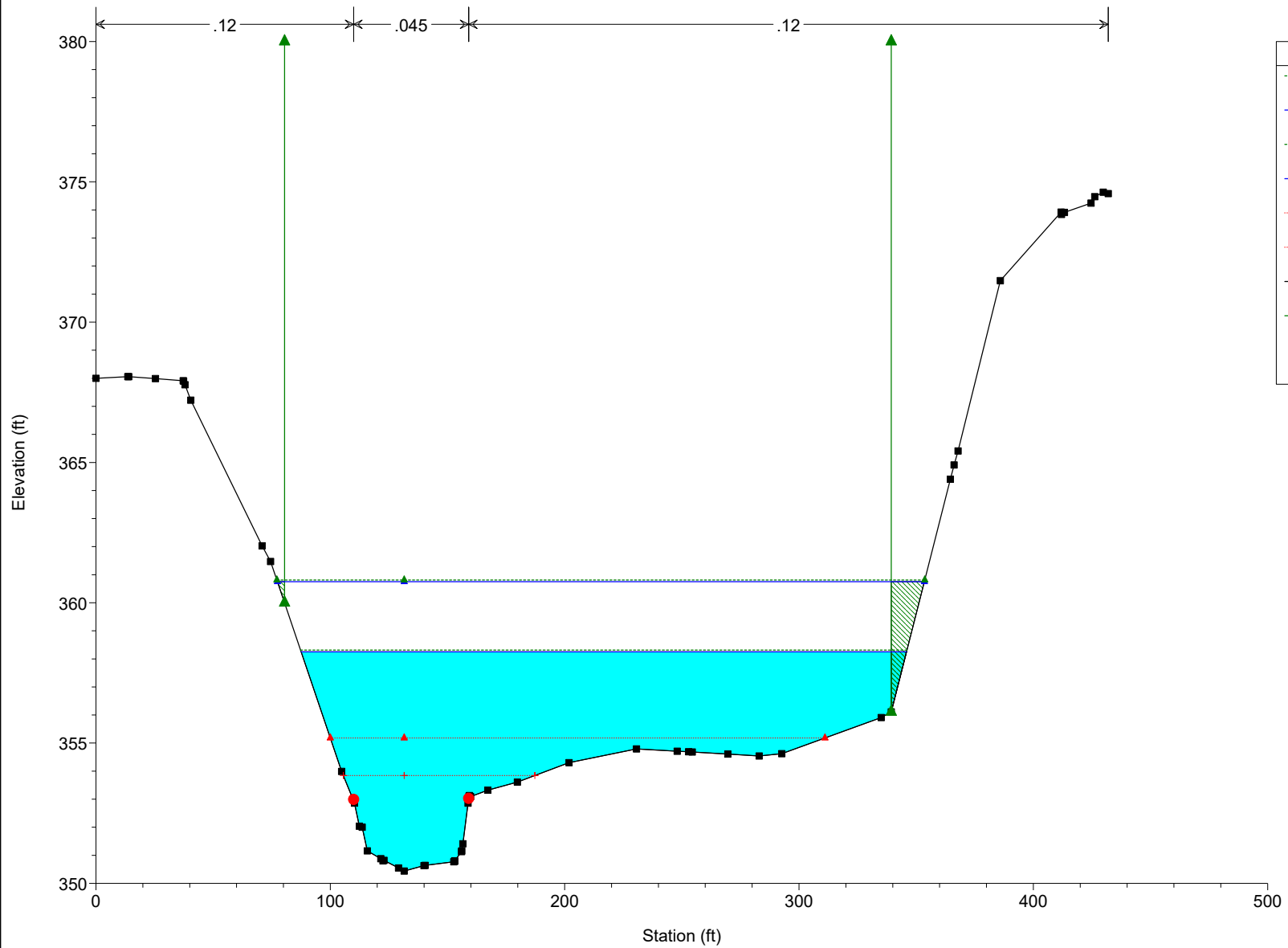
Existing Plan: Existing_Known 6/9/2023

River = Stream Reach = Reach RS = 155.2407



Existing Plan: Existing_Known 6/9/2023

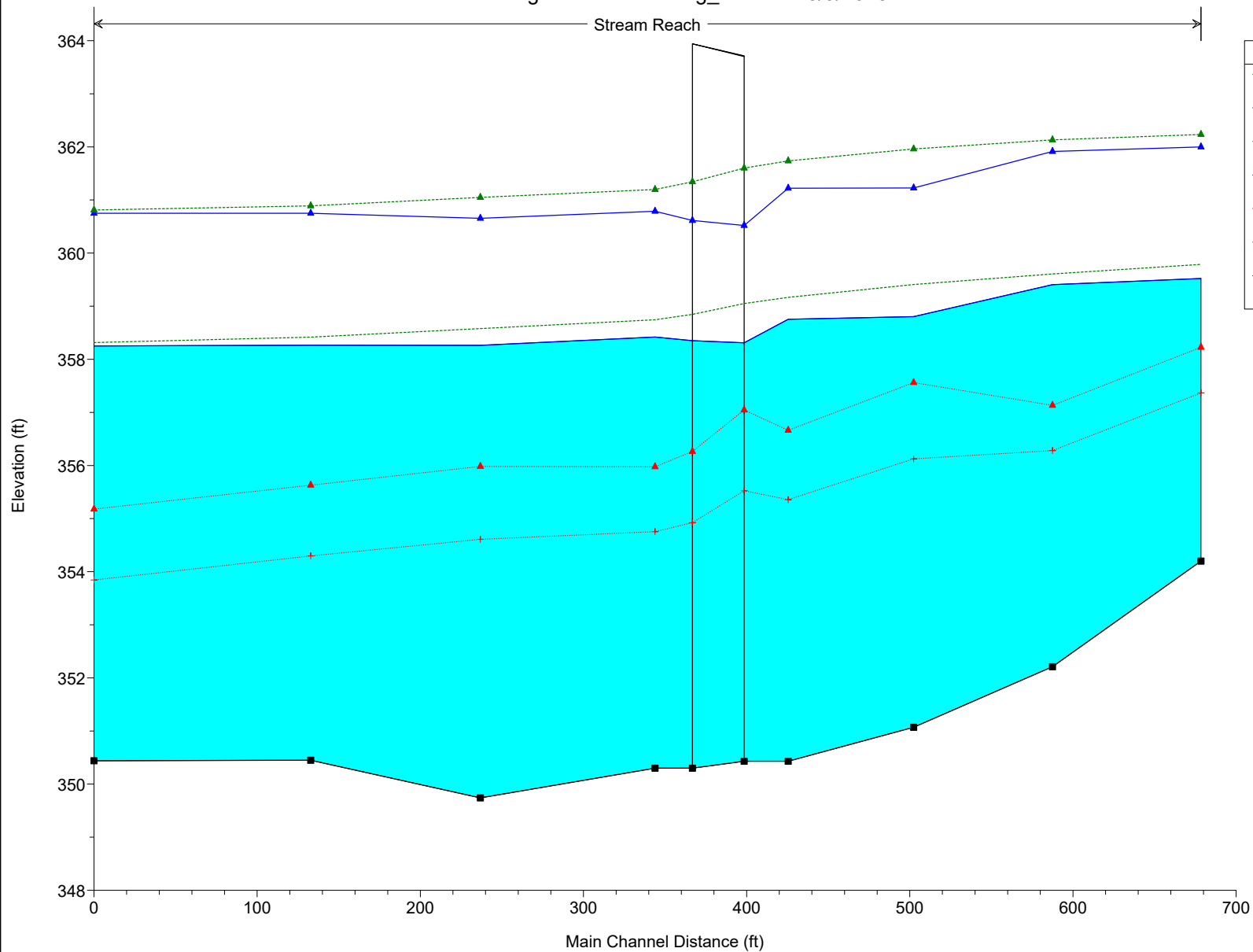
River = Stream Reach = Reach RS = 22.4107



Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	
Ineff	
Bank Sta	

Existing Plan: Existing_Known 6/9/2023

Stream Reach



Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	

HEC-RAS Plan: Ex_Known River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach	700.8932	Q10	1305.00	354.20	359.52	357.37	359.79	0.002645	4.12	316.43	81.87	0.37
Reach	700.8932	Q100	2080.00	354.20	362.00	358.22	362.23	0.001341	3.89	537.53	96.75	0.28
Reach	609.8605	Q10	1305.00	352.21	359.41	356.28	359.61	0.001267	3.62	400.73	92.32	0.27
Reach	609.8605	Q100	2080.00	352.21	361.91	357.13	362.13	0.000865	3.85	658.93	117.77	0.24
Reach	524.7844	Q10	1305.00	351.07	358.80	356.12	359.41	0.003002	6.50	267.12	54.72	0.44
Reach	524.7844	Q100	2080.00	351.07	361.23	357.56	361.96	0.002563	7.34	412.22	67.23	0.42
Reach	447.9161	Q10	1305.00	350.43	358.75	355.36	359.17	0.001931	5.35	316.95	60.27	0.35
Reach	447.9161	Q100	2080.00	350.43	361.22	356.66	361.74	0.001695	6.10	478.61	72.13	0.35
Reach	410.92		Bridge									
Reach	366.3016	Q10	1305.00	350.30	358.42	354.76	358.74	0.001563	4.66	333.19	67.66	0.31
Reach	366.3016	Q100	2080.00	350.30	360.79	355.97	361.20	0.001384	5.33	504.72	78.55	0.31
Reach	259.2376	Q10	1305.00	349.74	358.26	354.61	358.58	0.001512	4.68	362.31	90.67	0.31
Reach	259.2376	Q100	2080.00	349.74	360.65	355.98	361.05	0.001333	5.33	547.71	105.14	0.31
Reach	155.2407	Q10	1305.00	350.45	358.26	354.30	358.42	0.000874	3.48	667.12	190.00	0.23
Reach	155.2407	Q100	2080.00	350.45	360.75	355.63	360.89	0.000605	3.55	1120.49	211.77	0.20
Reach	22.4107	Q10	1305.00	350.44	358.25	353.84	358.32	0.000406	2.47	1081.15	258.32	0.16
Reach	22.4107	Q100	2080.00	350.44	360.75	355.18	360.81	0.000290	2.54	1722.18	276.05	0.14

HEC-RAS Plan: Ex_Known River: Stream Reach: Reach

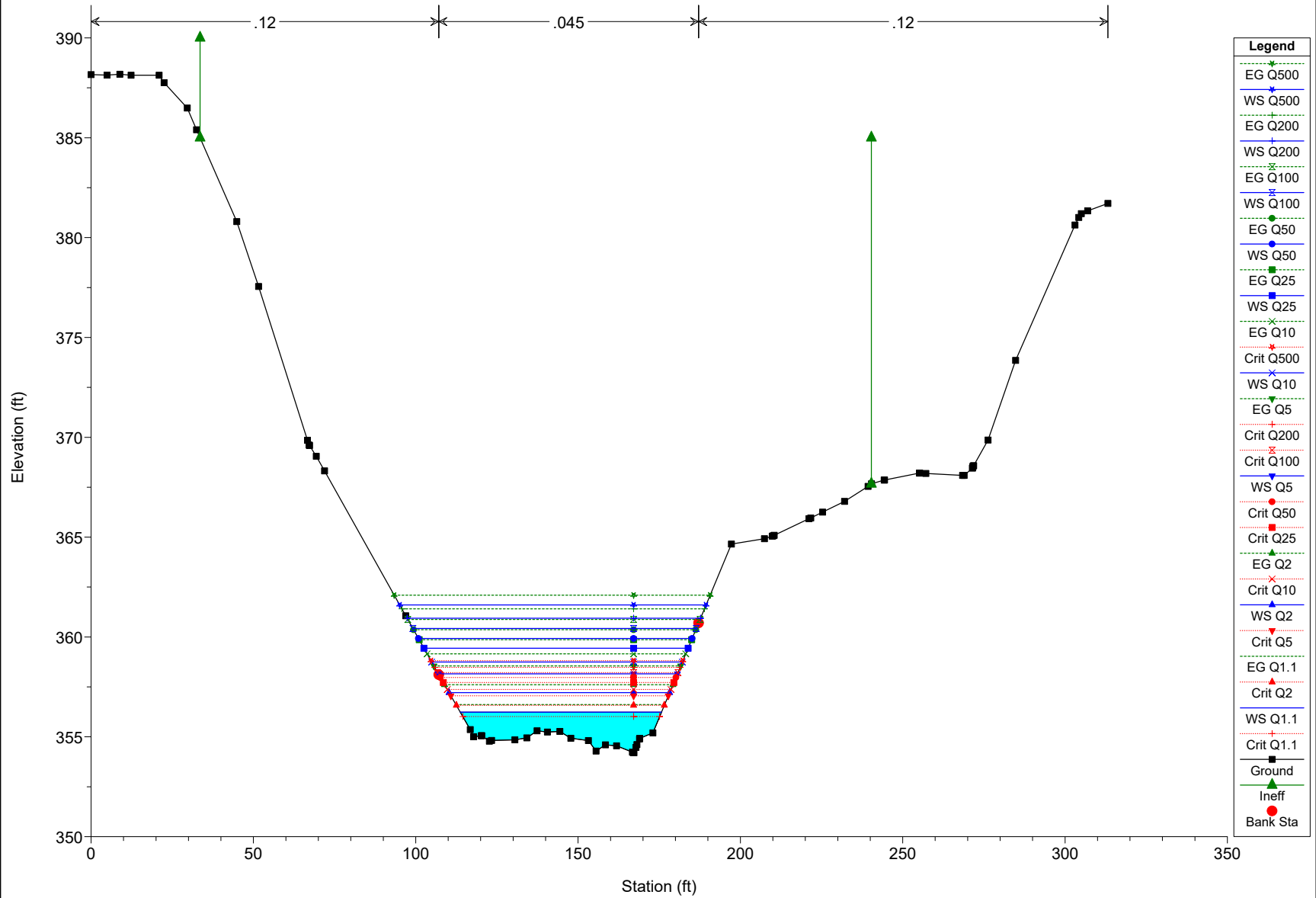
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Q Total	Min El Weir Flow	Delta EG	BR Open Vel	W.S. Elev
			(ft)	(ft)	(sq ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)
Reach	410.92	Q10	359.17	363.70	319.99	1305.00	365.02	0.42	6.90	358.75
Reach	410.92	Q100	361.74	363.70	319.99	2080.00	365.02	0.54	8.34	361.22

Proposed Bridge

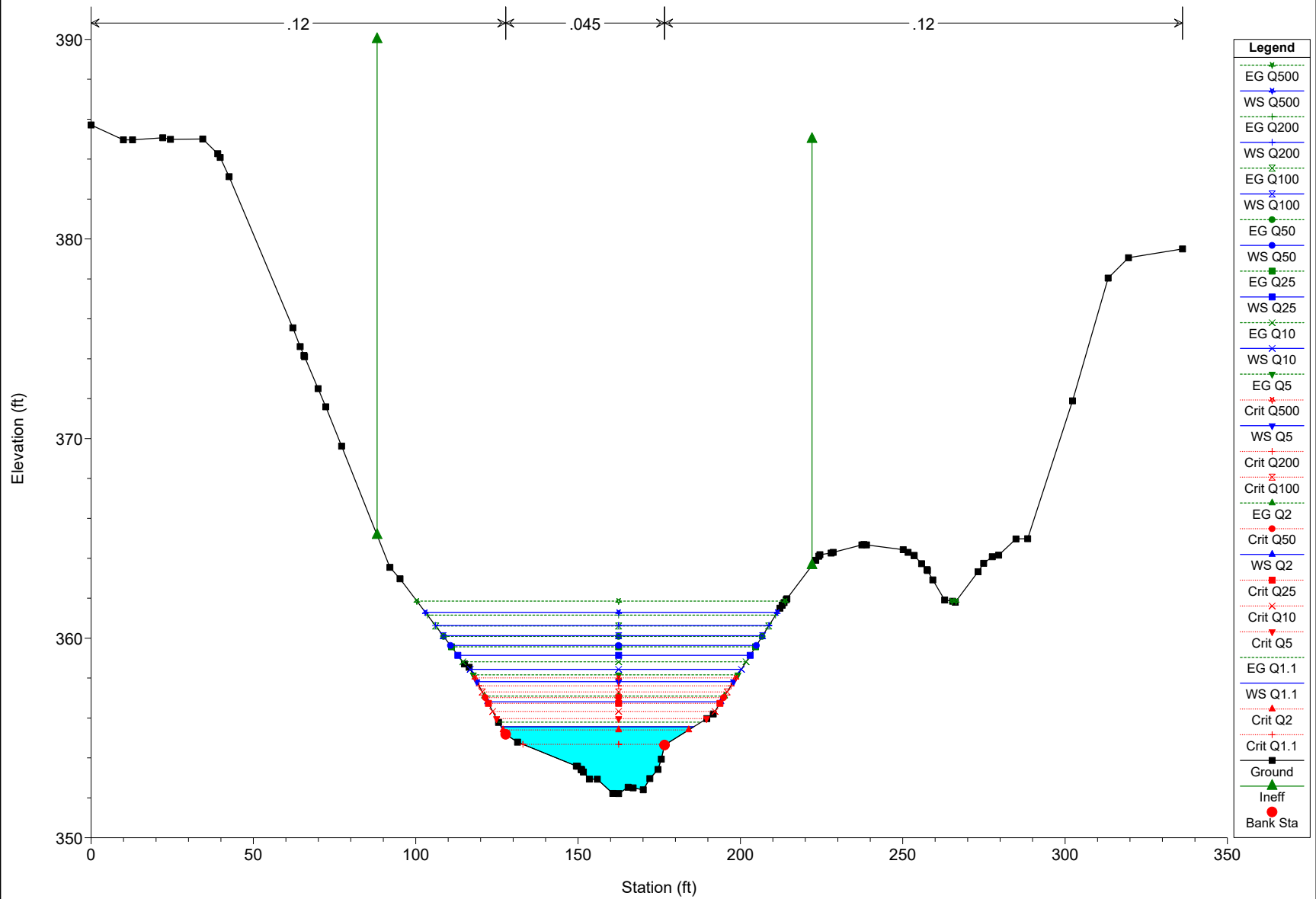
Non-Backwater Condition (Normal Depth)

Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 700.8932

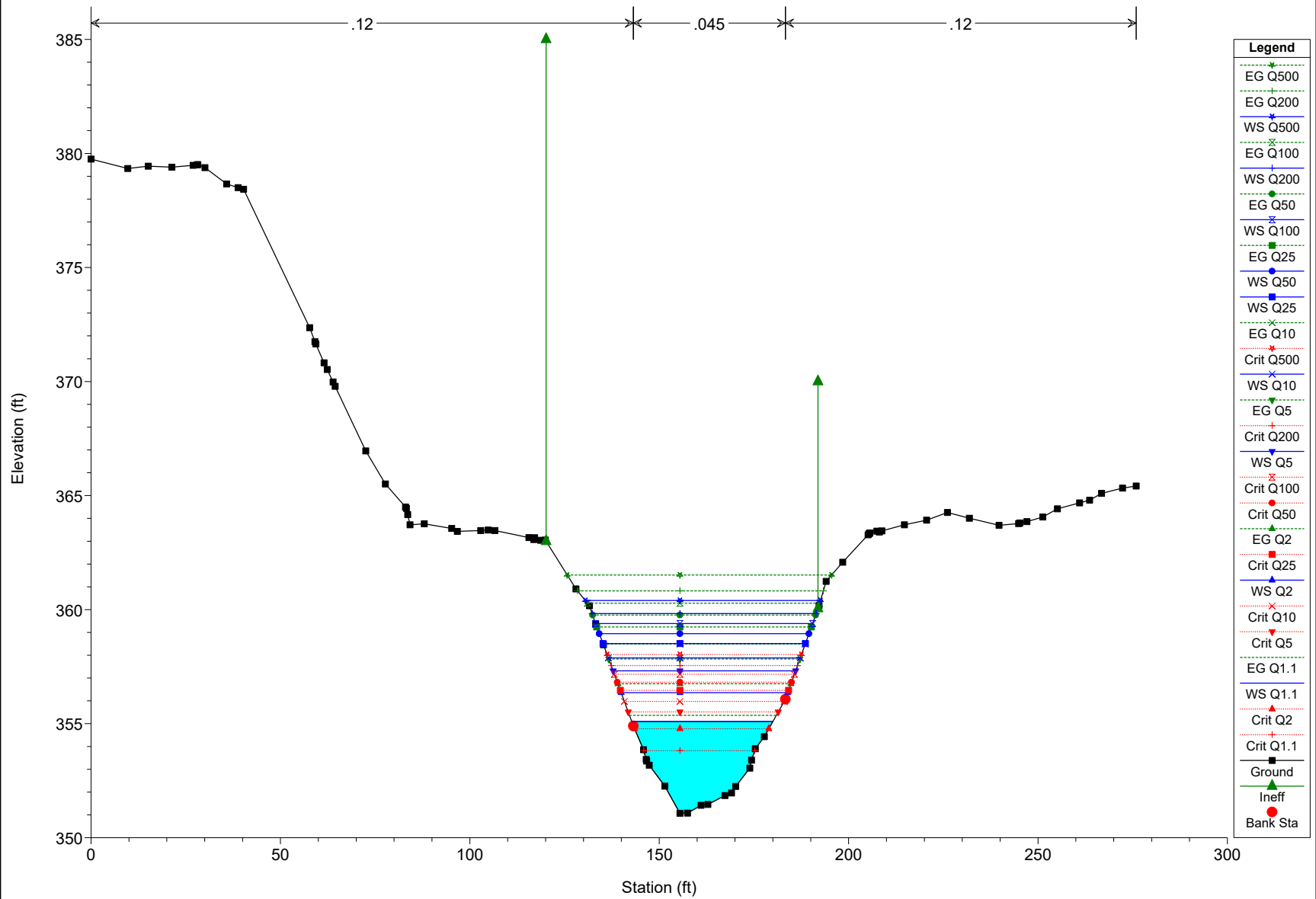


Proposed Plan: Proposed Normal 6/9/2023
River = Stream Reach = Reach RS = 609.8605



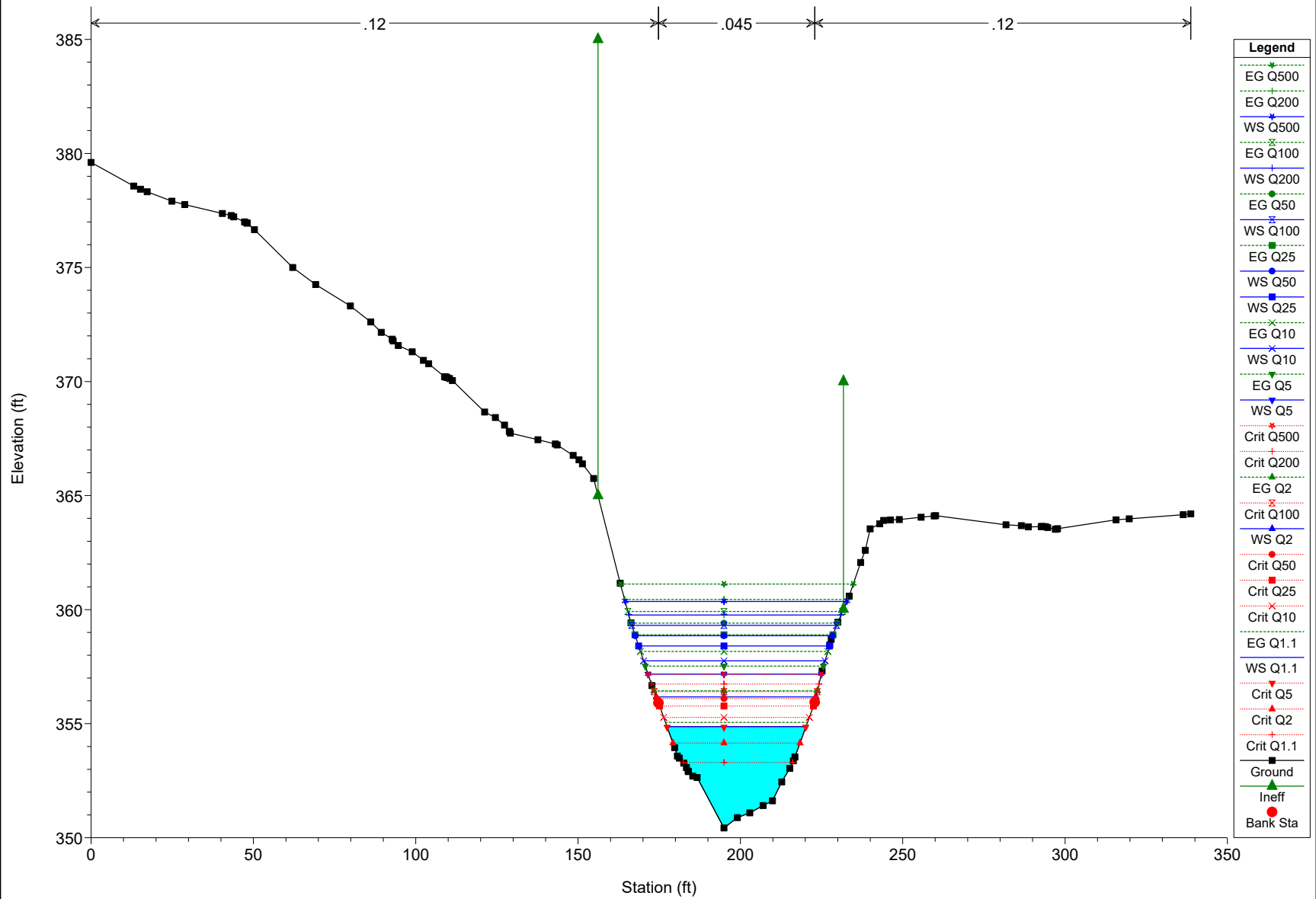
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 524.7844



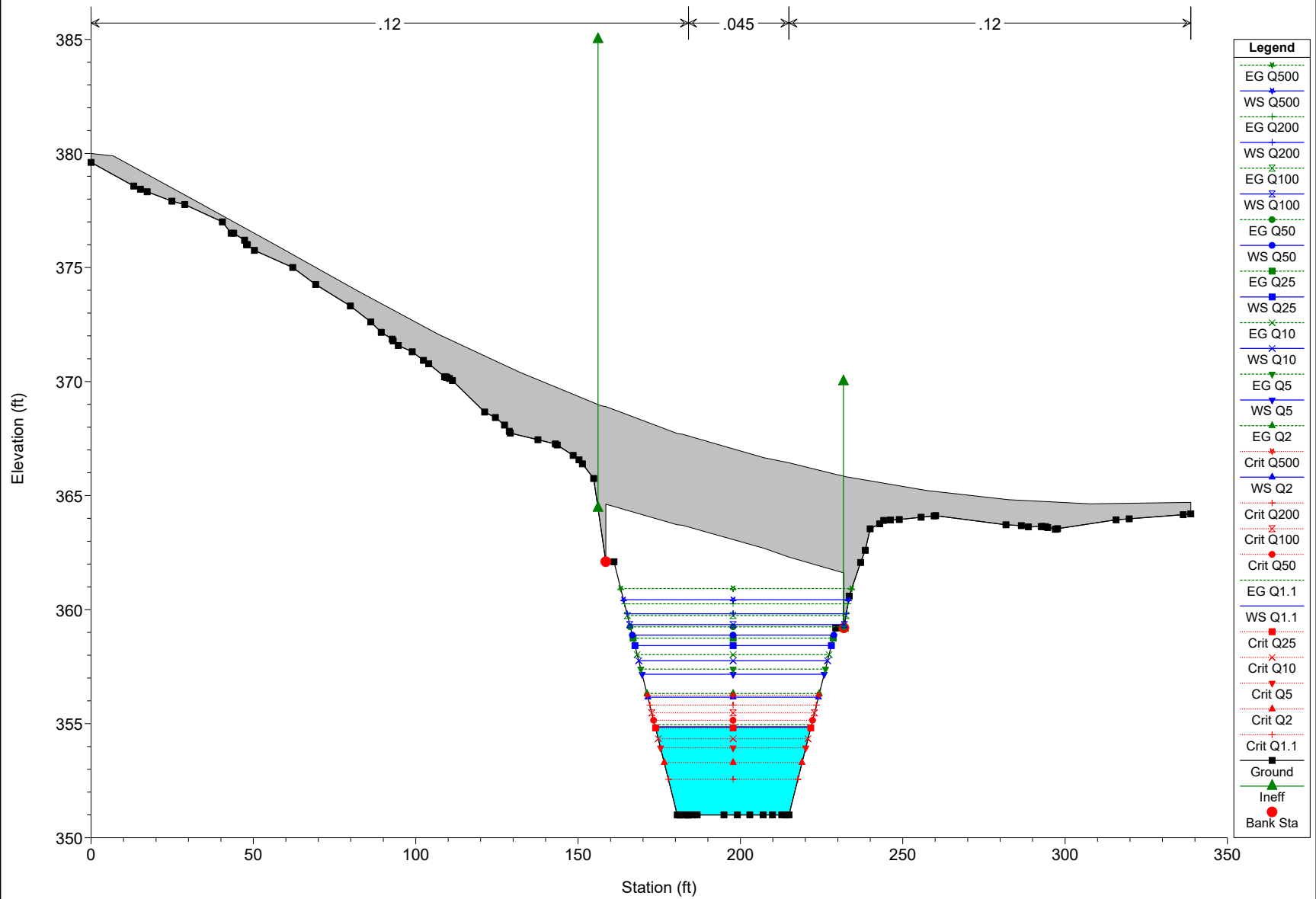
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 447.9161



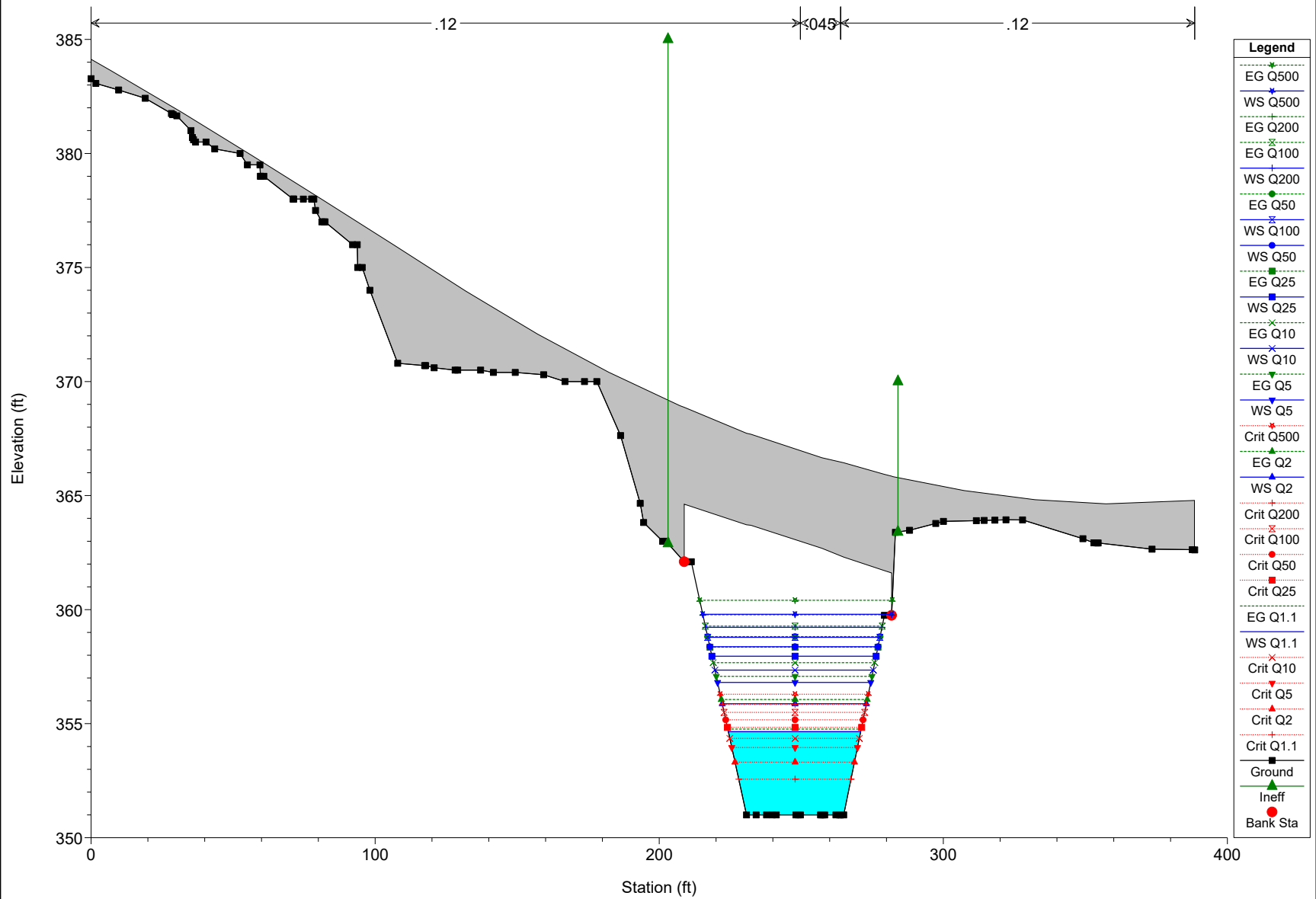
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 410.92 BR



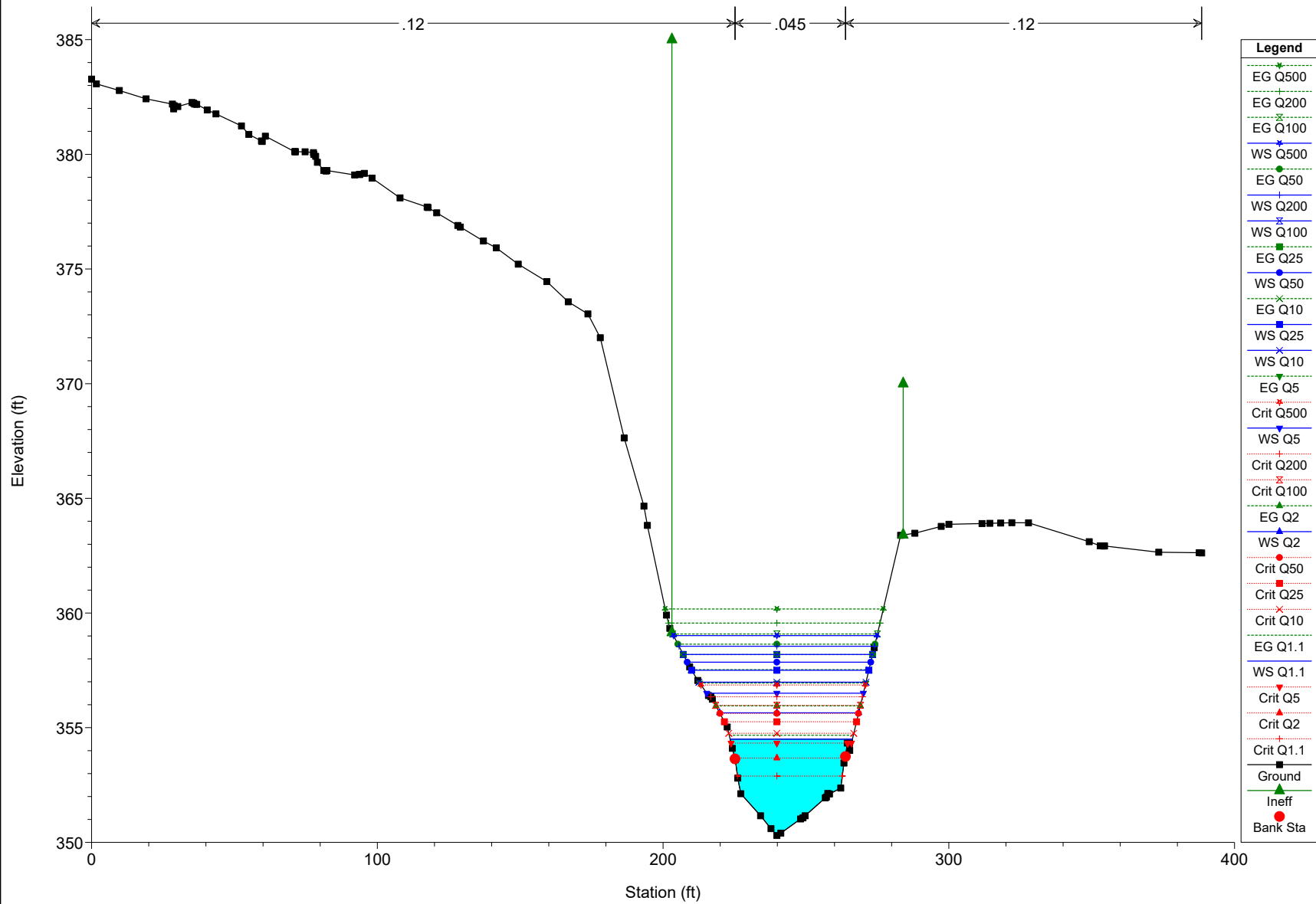
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 410.92 BR



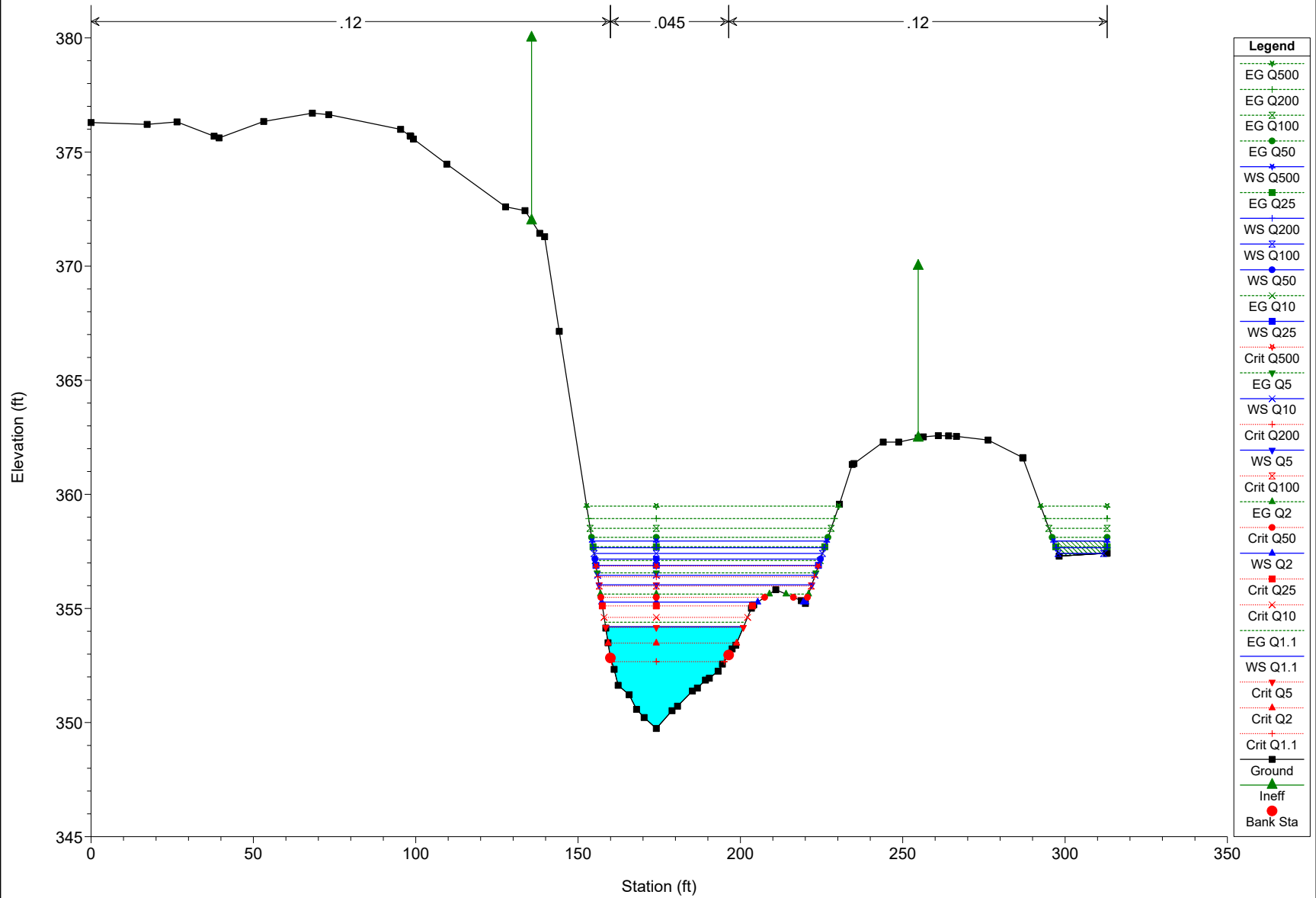
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 366.3016



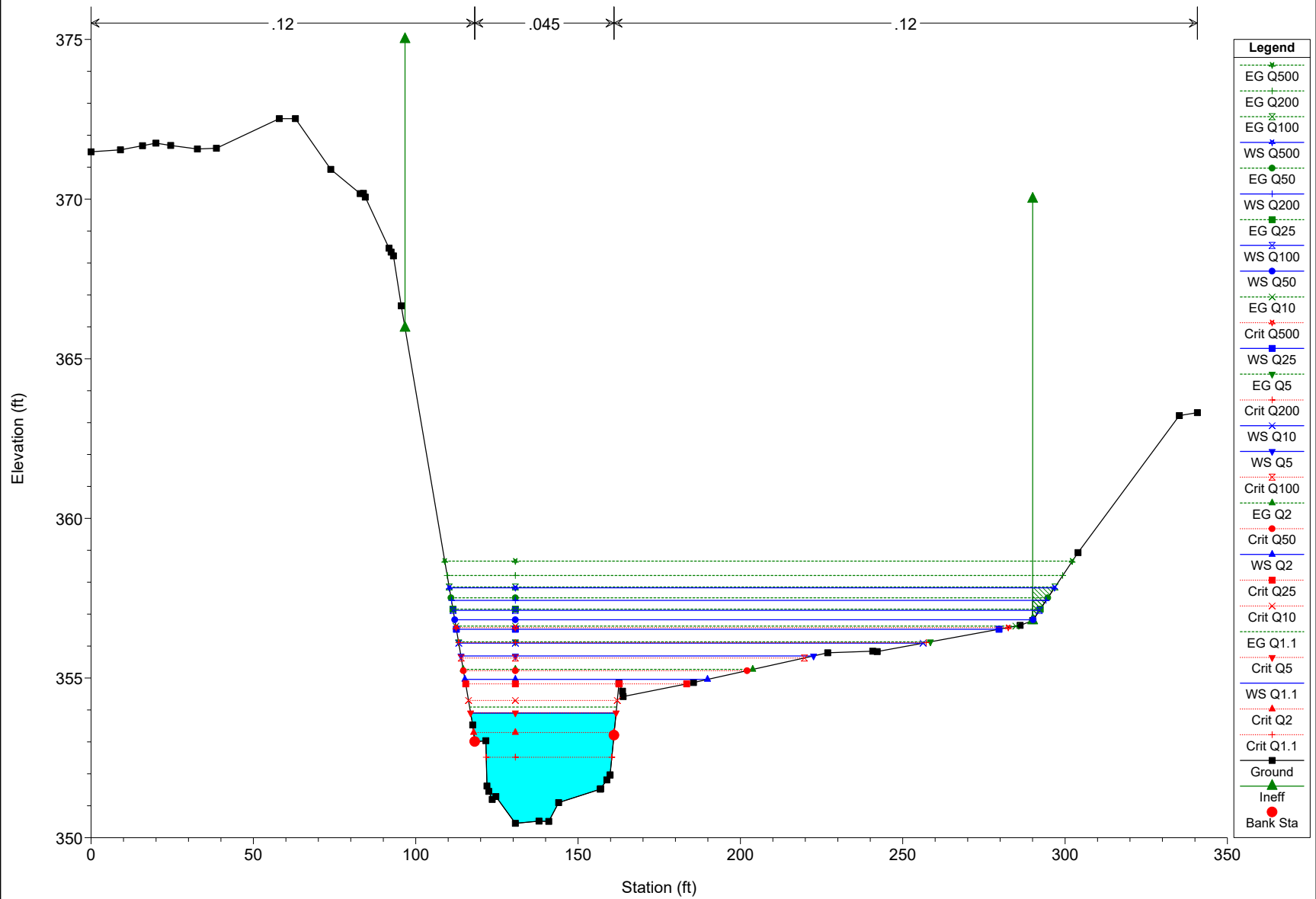
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 259.2376



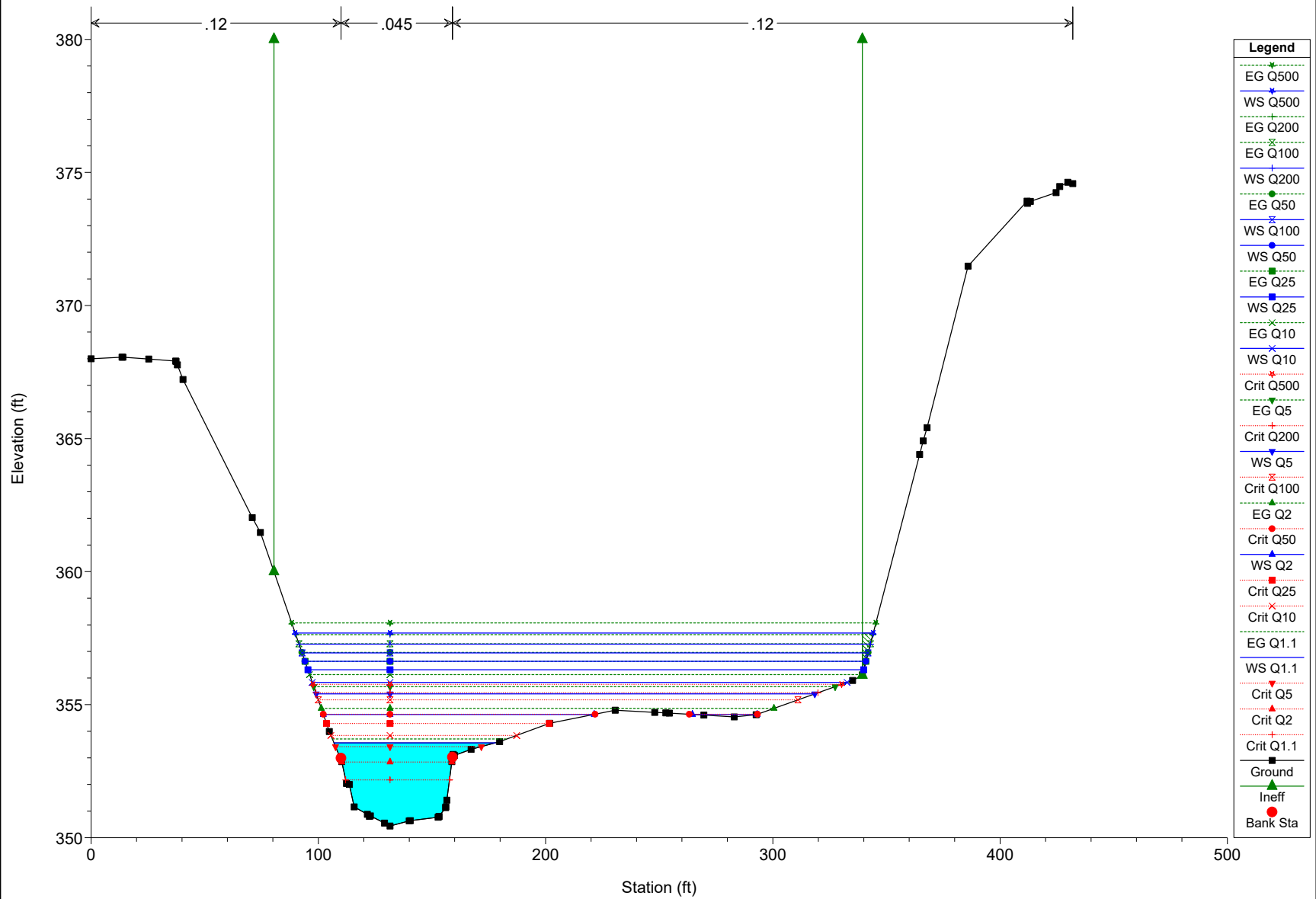
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 155.2407



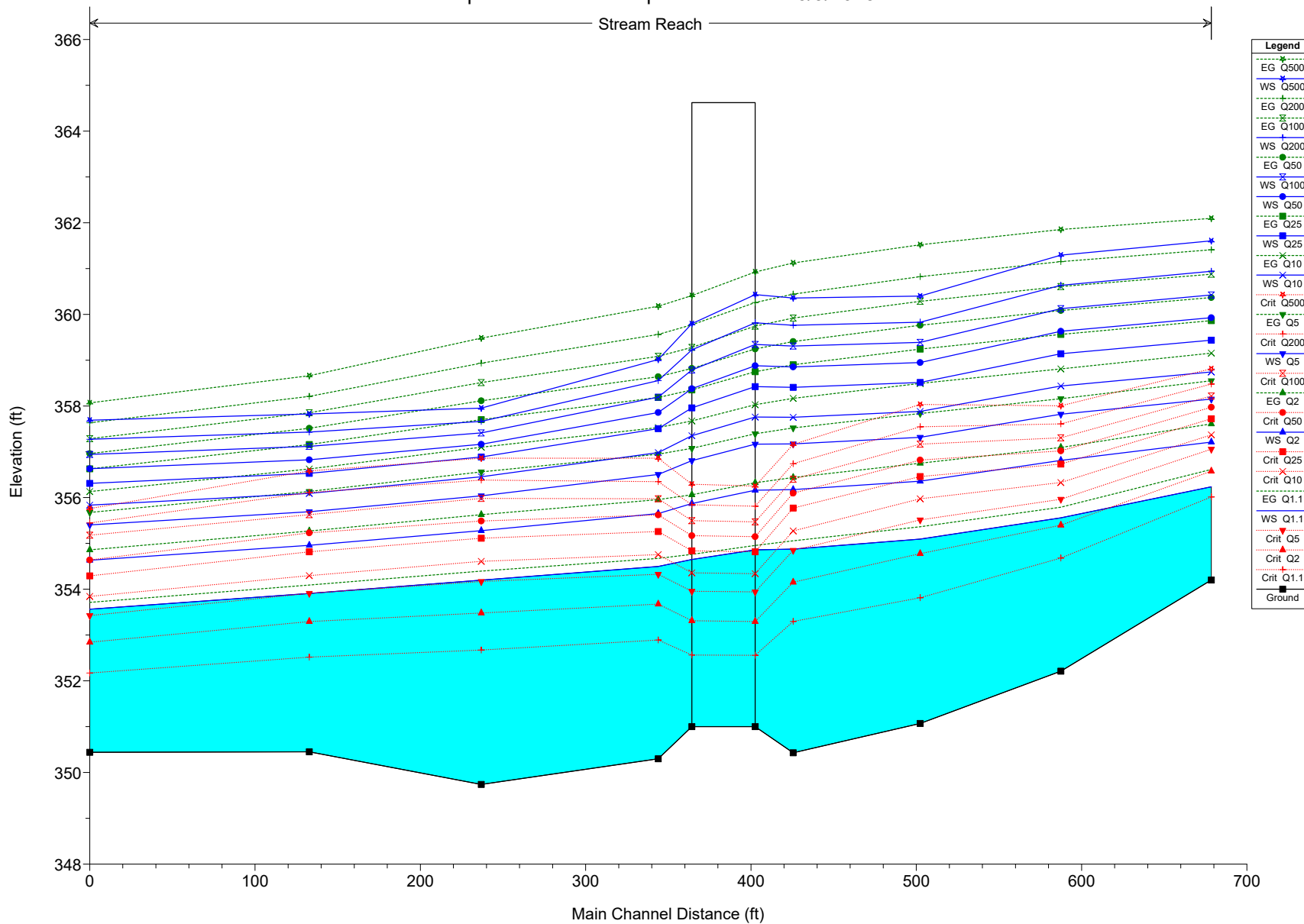
Proposed Plan: Proposed Normal 6/9/2023

River = Stream Reach = Reach RS = 22.4107



Proposed Plan: Proposed Normal 6/9/2023

Stream Reach



HEC-RAS Plan: Prop. Norm River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach	700.8932	Q1.1	395.00	354.20	356.24	356.01	356.62	0.016127	4.94	80.02	61.99	0.77
Reach	700.8932	Q2	725.00	354.20	357.21	356.58	357.61	0.008820	5.05	143.43	67.92	0.61
Reach	700.8932	Q5	1065.00	354.20	358.15	357.06	358.55	0.005973	5.08	209.80	73.63	0.53
Reach	700.8932	Q10	1305.00	354.20	358.74	357.37	359.15	0.004892	5.14	254.47	77.19	0.49
Reach	700.8932	Q25	1610.00	354.20	359.44	357.72	359.86	0.004103	5.25	309.31	81.35	0.46
Reach	700.8932	Q50	1840.00	354.20	359.93	357.97	360.37	0.003704	5.33	350.03	84.30	0.45
Reach	700.8932	Q100	2080.00	354.20	360.42	358.22	360.88	0.003373	5.41	392.70	87.29	0.43
Reach	700.8932	Q200	2350.00	354.20	360.94	358.48	361.41	0.003093	5.51	438.56	90.39	0.42
Reach	700.8932	Q500	2715.00	354.20	361.61	358.81	362.10	0.002772	5.64	500.02	94.39	0.41
Reach	609.8605	Q1.1	395.00	352.21	355.56	354.68	355.79	0.005311	3.87	105.74	59.33	0.47
Reach	609.8605	Q2	725.00	352.21	356.81	355.40	357.09	0.003521	4.33	189.10	71.90	0.42
Reach	609.8605	Q5	1065.00	352.21	357.82	355.96	358.16	0.003013	4.77	265.22	79.10	0.40
Reach	609.8605	Q10	1305.00	352.21	358.44	356.33	358.81	0.002837	5.06	315.25	83.50	0.40
Reach	609.8605	Q25	1610.00	352.21	359.14	356.73	359.56	0.002703	5.40	376.45	90.05	0.40
Reach	609.8605	Q50	1840.00	352.21	359.63	357.02	360.08	0.002628	5.63	421.62	94.23	0.40
Reach	609.8605	Q100	2080.00	352.21	360.12	357.31	360.61	0.002550	5.84	469.13	98.43	0.40
Reach	609.8605	Q200	2350.00	352.21	360.63	357.61	361.15	0.002497	6.07	520.36	102.77	0.40
Reach	609.8605	Q500	2715.00	352.21	361.29	358.00	361.85	0.002425	6.34	590.03	108.39	0.40
Reach	524.7844	Q1.1	395.00	351.07	355.09	353.82	355.36	0.004688	4.16	94.96	37.26	0.46
Reach	524.7844	Q2	725.00	351.07	356.36	354.78	356.75	0.004400	5.02	146.46	43.98	0.47
Reach	524.7844	Q5	1065.00	351.07	357.32	355.51	357.84	0.004279	5.80	190.60	48.17	0.48
Reach	524.7844	Q10	1305.00	351.07	357.88	355.97	358.49	0.004320	6.30	218.49	50.64	0.49
Reach	524.7844	Q25	1610.00	351.07	358.51	356.46	359.24	0.004415	6.89	251.47	53.42	0.51
Reach	524.7844	Q50	1840.00	351.07	358.95	356.82	359.76	0.004493	7.29	275.08	55.37	0.52
Reach	524.7844	Q100	2080.00	351.07	359.39	357.17	360.28	0.004535	7.67	299.82	57.32	0.53
Reach	524.7844	Q200	2350.00	351.07	359.83	357.54	360.82	0.004633	8.09	325.48	59.15	0.54
Reach	524.7844	Q500	2715.00	351.07	360.40	358.03	361.52	0.004721	8.61	359.94	62.10	0.55
Reach	447.9161	Q1.1	395.00	350.43	354.88	353.30	355.06	0.002930	3.41	115.91	42.83	0.37
Reach	447.9161	Q2	725.00	350.43	356.18	354.15	356.44	0.002904	4.13	175.84	49.26	0.38
Reach	447.9161	Q5	1065.00	350.43	357.17	354.85	357.52	0.002795	4.75	227.01	53.38	0.39
Reach	447.9161	Q10	1305.00	350.43	357.75	355.27	358.17	0.002821	5.17	258.79	55.89	0.40
Reach	447.9161	Q25	1610.00	350.43	358.41	355.77	358.90	0.002885	5.65	296.20	58.77	0.41
Reach	447.9161	Q50	1840.00	350.43	358.85	356.10	359.41	0.002938	5.99	322.93	60.77	0.42
Reach	447.9161	Q100	2080.00	350.43	359.31	356.40	359.92	0.002966	6.30	351.03	63.06	0.43
Reach	447.9161	Q200	2350.00	350.43	359.76	356.74	360.44	0.003032	6.65	380.24	65.32	0.44
Reach	447.9161	Q500	2715.00	350.43	360.36	357.16	361.12	0.003084	7.07	419.74	68.27	0.45
Reach	410.92	Bridge										
Reach	366.3016	Q1.1	395.00	350.30	354.50	352.89	354.67	0.002445	3.35	119.03	42.76	0.34
Reach	366.3016	Q2	725.00	350.30	355.65	353.67	355.95	0.002788	4.44	171.35	48.67	0.38
Reach	366.3016	Q5	1065.00	350.30	356.50	354.33	356.95	0.003198	5.38	215.26	54.81	0.42
Reach	366.3016	Q10	1305.00	350.30	356.98	354.76	357.53	0.003513	5.99	242.37	58.45	0.45
Reach	366.3016	Q25	1610.00	350.30	357.51	355.26	358.19	0.003904	6.70	273.86	62.03	0.48
Reach	366.3016	Q50	1840.00	350.30	357.86	355.62	358.64	0.004183	7.20	296.09	64.25	0.50
Reach	366.3016	Q100	2080.00	350.30	358.19	355.97	359.08	0.004461	7.70	318.11	66.29	0.52
Reach	366.3016	Q200	2350.00	350.30	358.55	356.35	359.56	0.004740	8.22	342.28	68.46	0.54
Reach	366.3016	Q500	2715.00	350.30	359.01	356.86	360.18	0.005061	8.85	374.45	71.23	0.57
Reach	259.2376	Q1.1	395.00	349.74	354.20	352.67	354.39	0.002715	3.56	114.63	42.52	0.36
Reach	259.2376	Q2	725.00	349.74	355.28	353.48	355.63	0.003261	4.78	162.97	48.79	0.42
Reach	259.2376	Q5	1065.00	349.74	356.04	354.17	356.56	0.003926	5.87	207.86	65.53	0.47
Reach	259.2376	Q10	1305.00	349.74	356.45	354.61	357.10	0.004389	6.55	235.48	67.00	0.50
Reach	259.2376	Q25	1610.00	349.74	356.89	355.11	357.70	0.005027	7.39	264.84	68.52	0.54
Reach	259.2376	Q50	1840.00	349.74	357.16	355.49	358.11	0.005534	8.00	283.92	69.49	0.58
Reach	259.2376	Q100	2080.00	349.74	357.41	355.98	358.51	0.006107	8.64	301.24	84.36	0.61
Reach	259.2376	Q200	2350.00	349.74	357.66	356.38	358.94	0.006762	9.33	318.90	87.00	0.65
Reach	259.2376	Q500	2715.00	349.74	357.95	356.86	359.48	0.007688	10.25	339.92	88.79	0.69
Reach	155.2407	Q1.1	395.00	350.45	353.91	352.52	354.09	0.003084	3.44	115.56	44.79	0.37
Reach	155.2407	Q2	725.00	350.45	354.96	353.29	355.27	0.003409	4.51	171.48	74.70	0.41
Reach	155.2407	Q5	1065.00	350.45	355.69	353.91	356.14	0.003867	5.41	238.86	108.63	0.45
Reach	155.2407	Q10	1305.00	350.45	356.09	354.30	356.63	0.004215	5.98	290.12	143.01	0.48
Reach	155.2407	Q25	1610.00	350.45	356.53	354.82	357.16	0.004562	6.59	357.75	167.14	0.50
Reach	155.2407	Q50	1840.00	350.45	356.82	355.23	357.51	0.004753	6.98	409.09	178.14	0.52
Reach	155.2407	Q100	2080.00	350.45	357.12	355.63	357.85	0.004853	7.29	461.50	180.57	0.53
Reach	155.2407	Q200	2350.00	350.45	357.43	356.11	358.21	0.004933	7.61	517.38	183.14	0.54
Reach	155.2407	Q500	2715.00	350.45	357.83	356.58	358.66	0.005016	8.00	588.25	186.40	0.55
Reach	22.4107	Q1.1	395.00	350.44	353.56	352.17	353.71	0.002500	3.08	132.93	70.93	0.34
Reach	22.4107	Q2	725.00	350.44	354.63	352.84	354.86	0.002502	3.88	232.99	147.65	0.36
Reach	22.4107	Q5	1065.00	350.44	355.40	353.42	355.68	0.002501	4.41	387.67	219.35	0.37
Reach	22.4107	Q10	1305.00	350.44	355.84	353.84	356.13	0.002500	4.69	486.01	235.34	0.37
Reach	22.4107	Q25	1610.00	350.44	356.31	354.29	356.63	0.002501	4.99	600.35	244.56	0.38
Reach	22.4107	Q50	1840.00	350.44	356.63	354.64	356.96	0.002501	5.18	678.66	246.83	0.38
Reach	22.4107	Q100	2080.00	350.44	356.94	355.18	357.29	0.002501	5.37	755.44	249.05	0.39

HEC-RAS Plan: Prop_Norm River: Stream Reach: Reach (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	22.4107	Q200	2350.00	350.44	357.27	355.45	357.63	0.002500	5.57	837.21	251.39	0.39
Reach	22.4107	Q500	2715.00	350.44	357.69	355.76	358.07	0.002504	5.82	940.76	254.35	0.40

HEC-RAS Plan: Prop_Norm River: Stream Reach: Reach

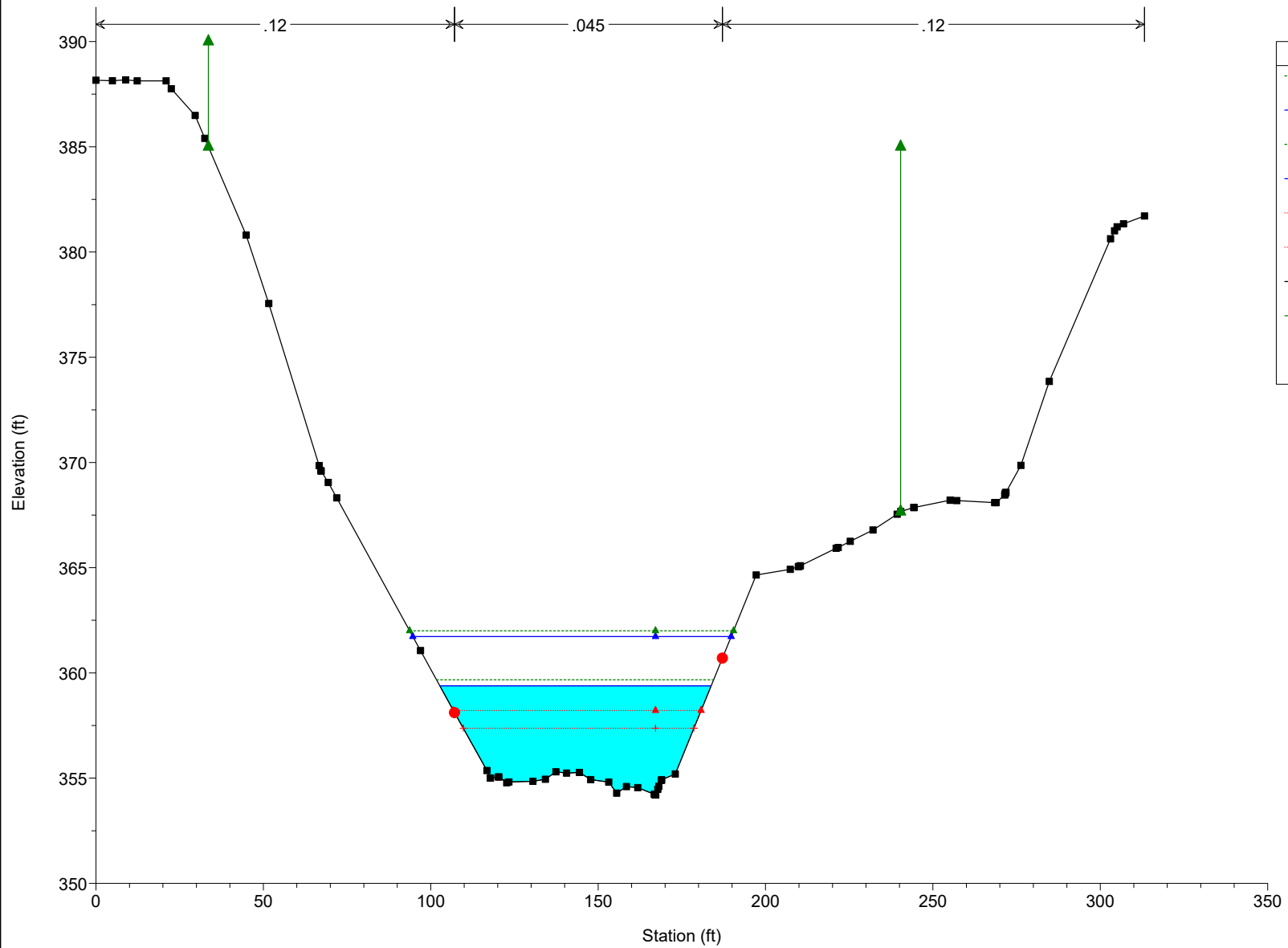
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Q Total	Min El Weir Flow	Delta EG	BR Open Vel	W.S. Elev
			(ft)	(ft)	(sq ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)
Reach	410.92	Q1.1	355.06	364.62	665.97	395.00	365.86	0.38	2.68	354.88
Reach	410.92	Q2	356.44	364.62	665.97	725.00	365.86	0.49	3.50	356.18
Reach	410.92	Q5	357.52	364.62	665.97	1065.00	365.86	0.57	4.16	357.17
Reach	410.92	Q10	358.17	364.62	665.97	1305.00	365.86	0.64	4.57	357.75
Reach	410.92	Q25	358.90	364.62	665.97	1610.00	365.86	0.71	5.03	358.41
Reach	410.92	Q50	359.41	364.62	665.97	1840.00	365.86	0.77	5.34	358.85
Reach	410.92	Q100	359.92	364.62	665.97	2080.00	365.86	0.83	5.63	359.31
Reach	410.92	Q200	360.44	364.62	665.97	2350.00	365.86	0.88	5.93	359.76
Reach	410.92	Q500	361.12	364.62	665.97	2715.00	365.86	0.94	6.28	360.36

Proposed Bridge

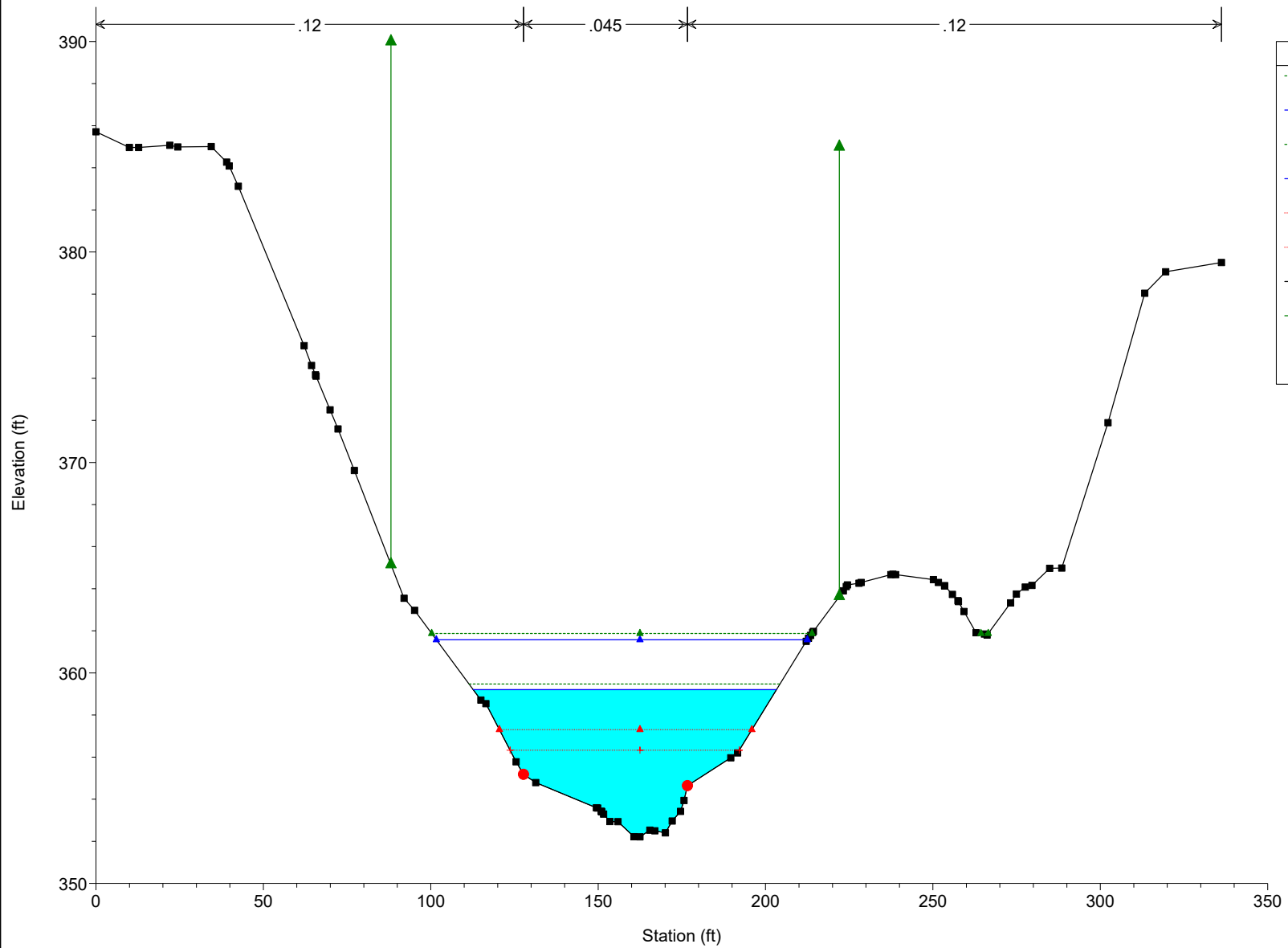
Backwater Condition (Known WS)

Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 700.8932

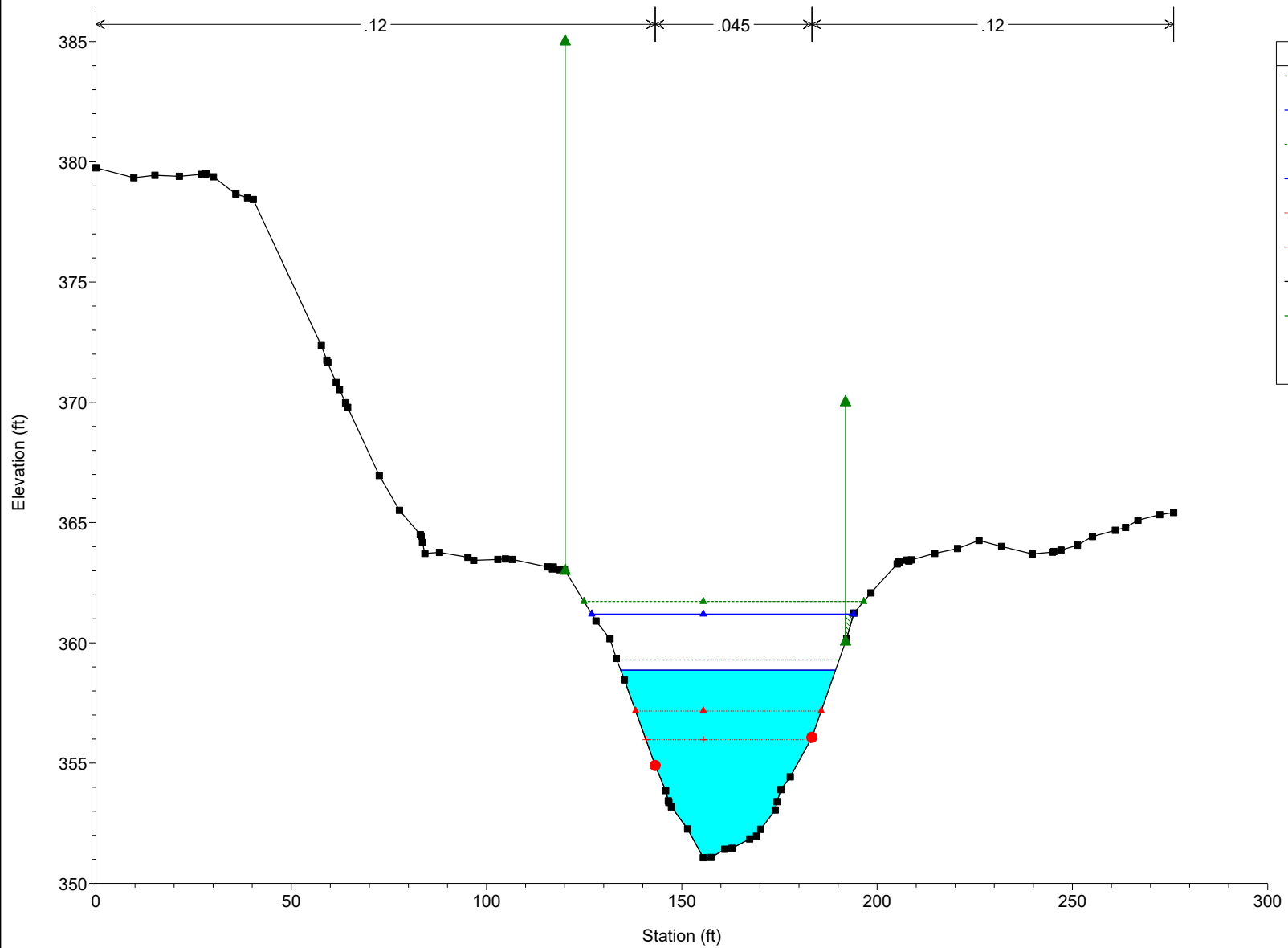


Proposed Plan: Proposed Known 6/9/2023
River = Stream Reach = Reach RS = 609.8605



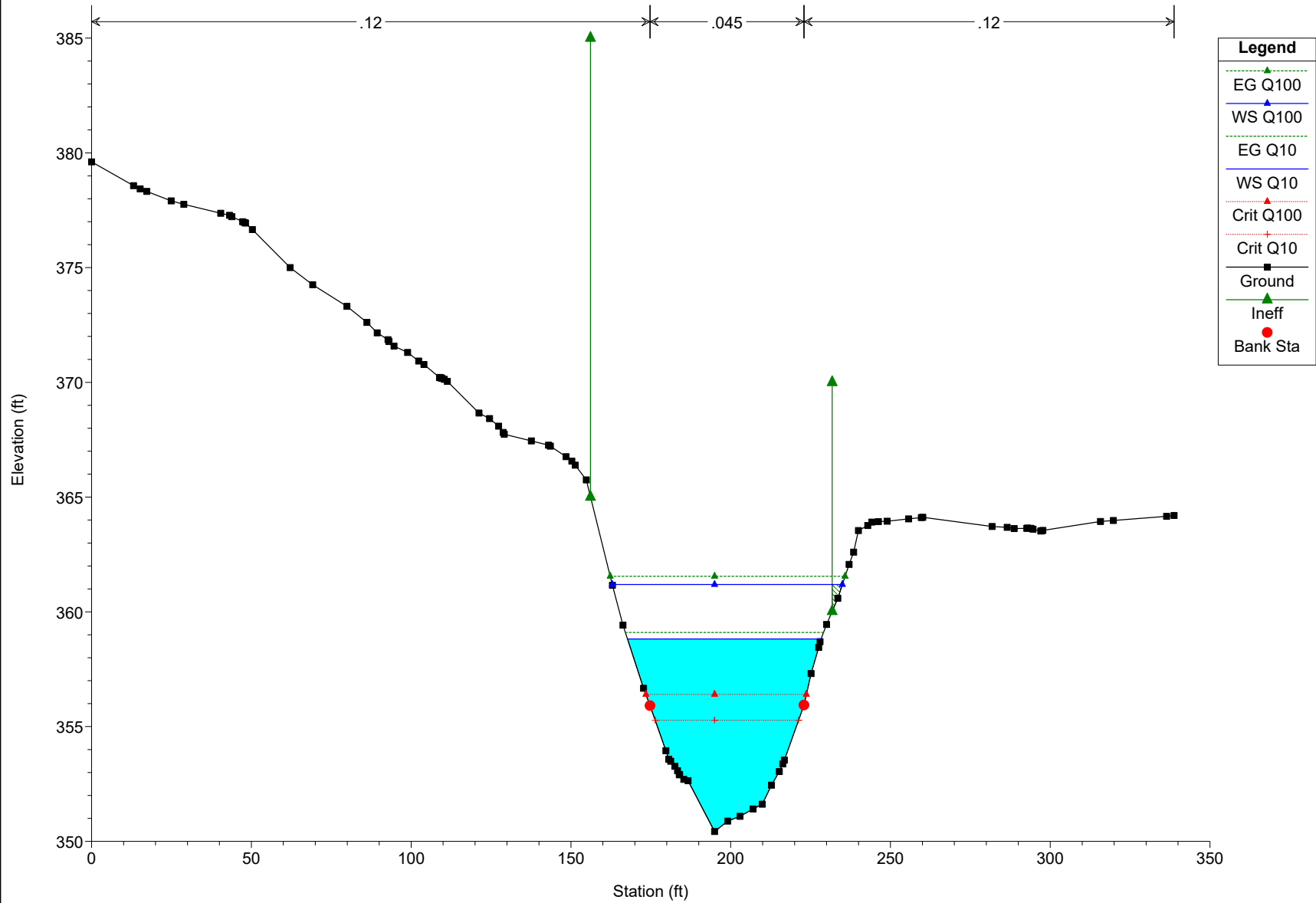
Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	
Ineff	
Bank Sta	

Proposed Plan: Proposed Known 6/9/2023
River = Stream Reach = Reach RS = 524.7844



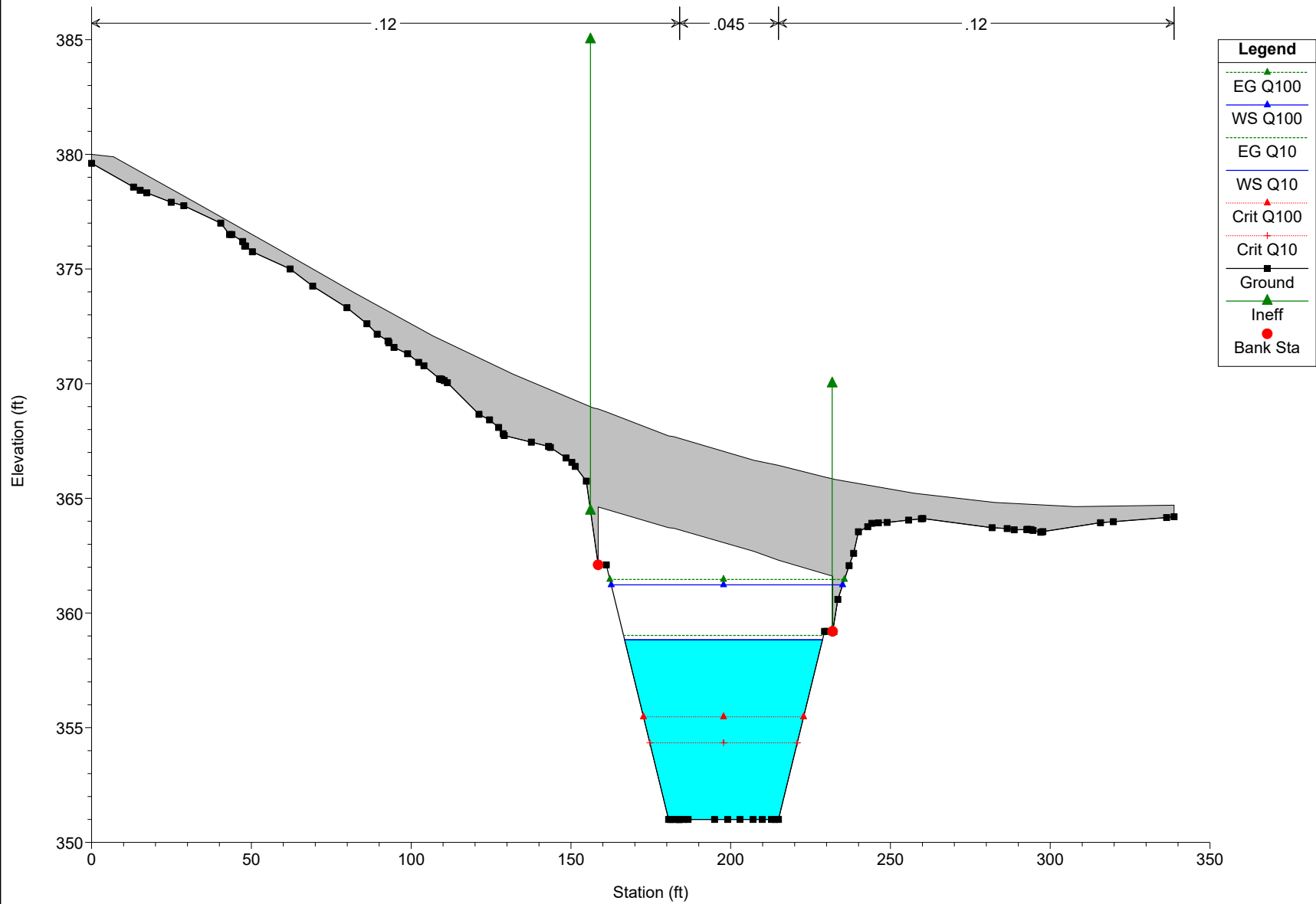
Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	
Ineff	
Bank Sta	

Proposed Plan: Proposed Known 6/9/2023
River = Stream Reach = Reach RS = 447.9161



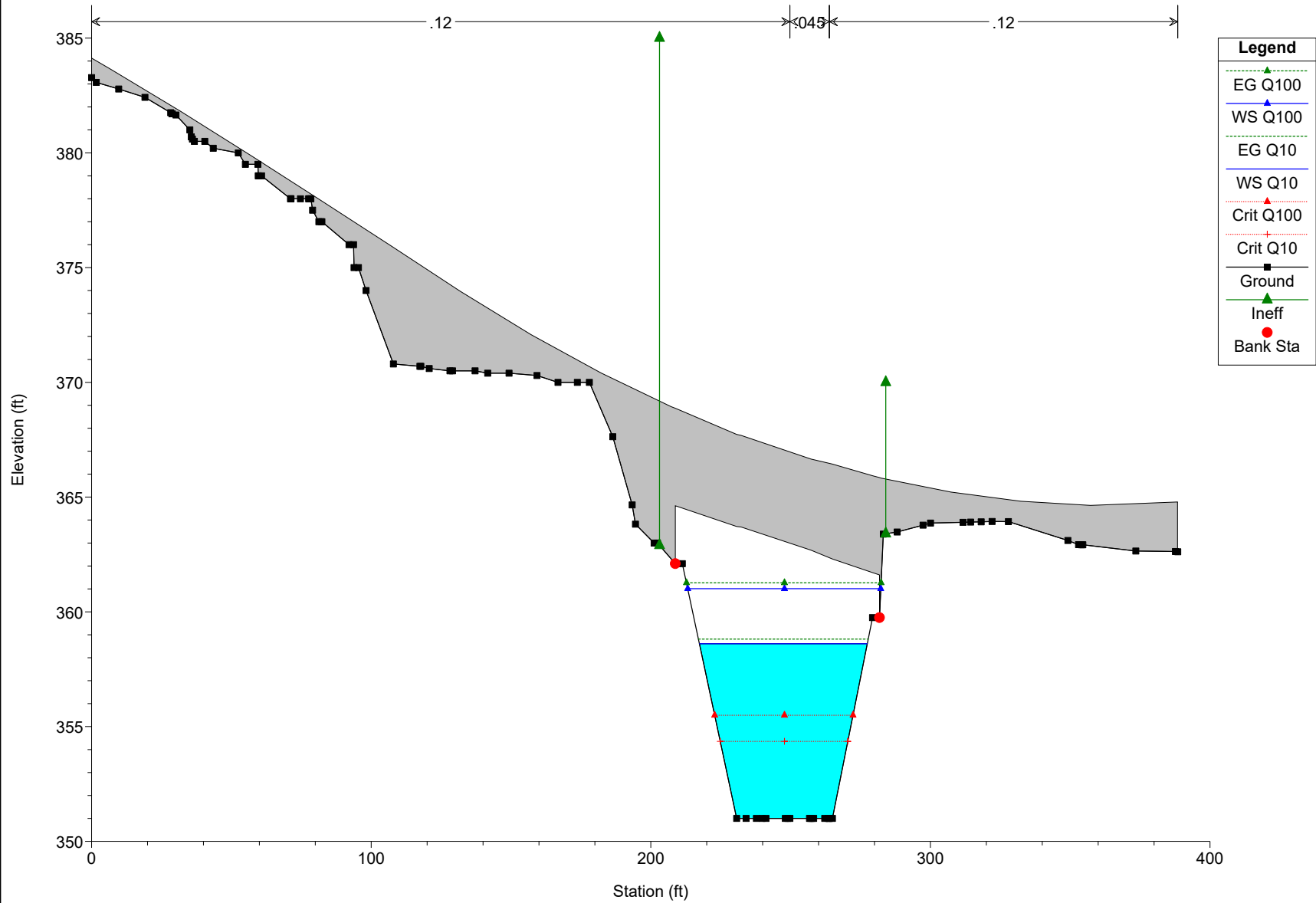
Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 410.92 BR



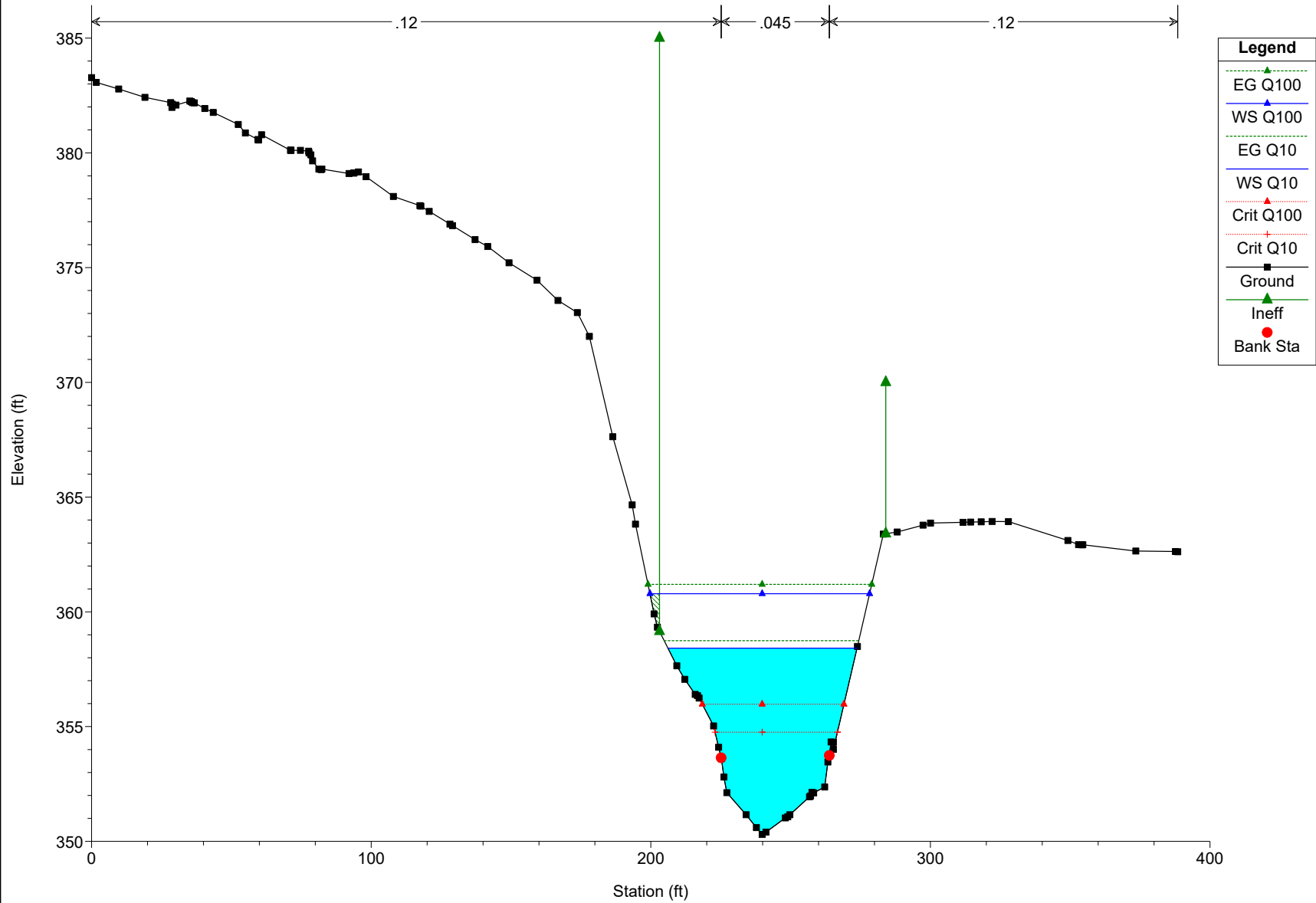
Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 410.92 BR



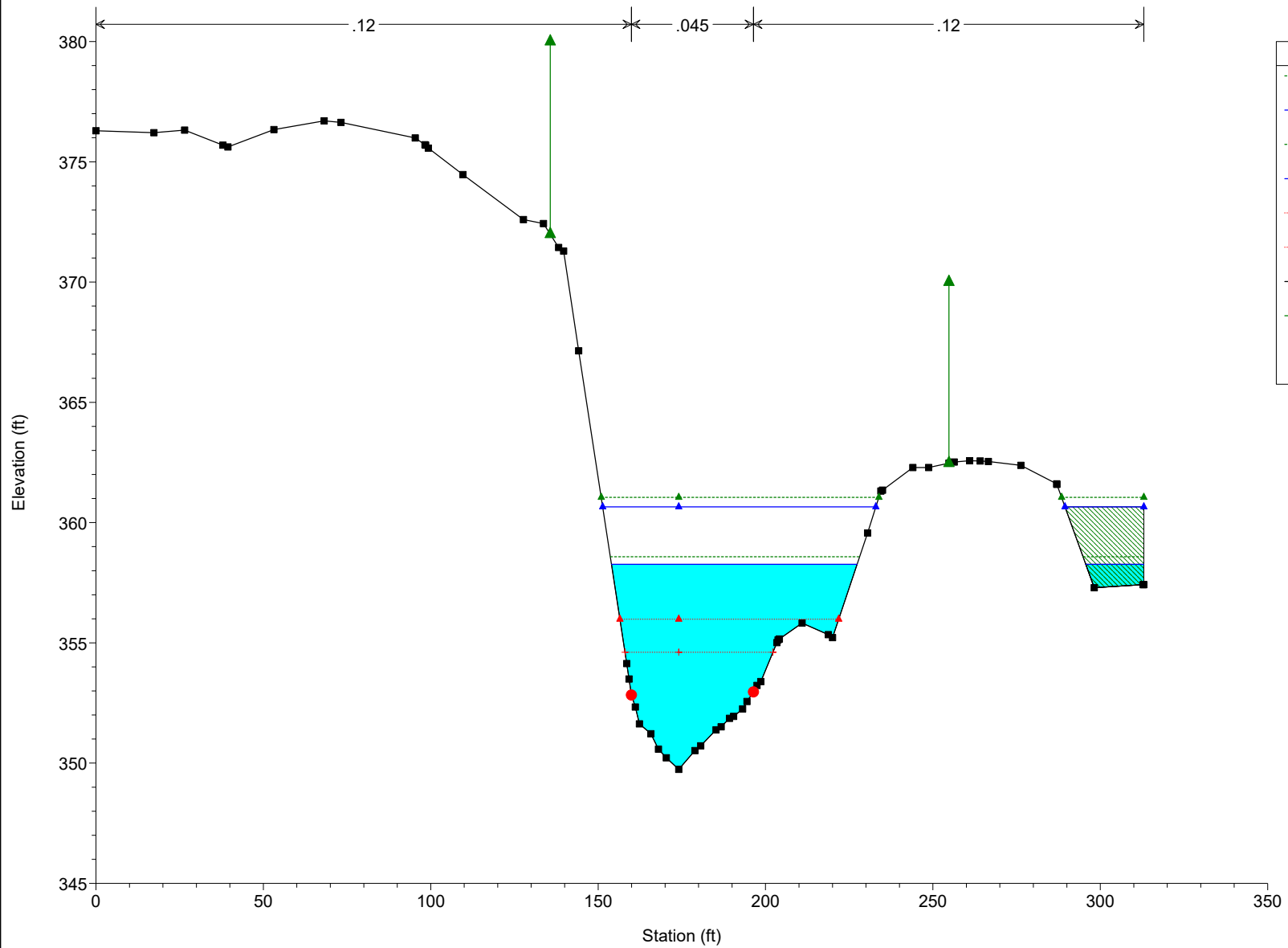
Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 366.3016



Proposed Plan: Proposed Known 6/9/2023

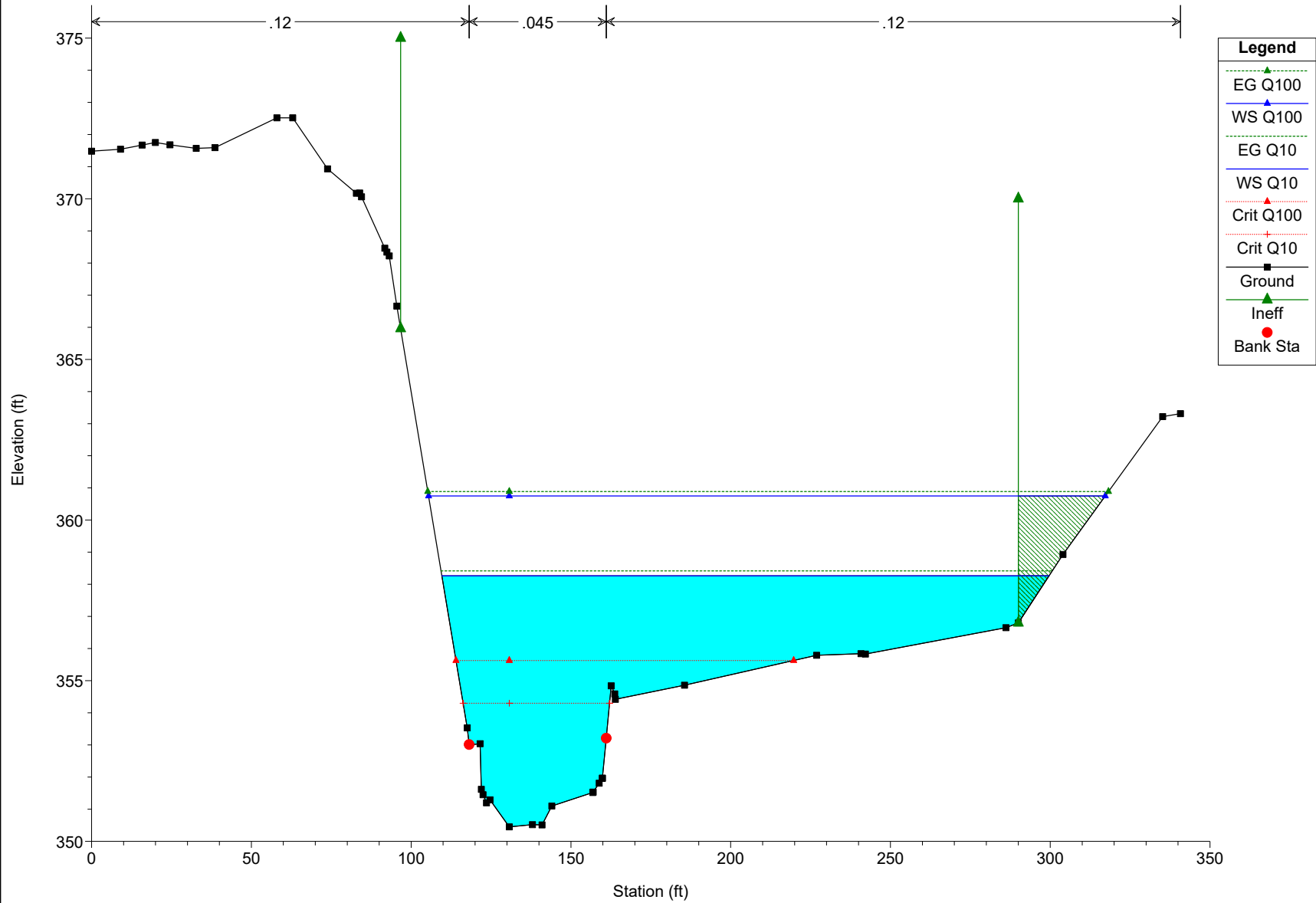
River = Stream Reach = Reach RS = 259.2376



Legend	
EG Q100	
WS Q100	
EG Q10	
WS Q10	
Crit Q100	
Crit Q10	
Ground	
Ineff	
Bank Sta	

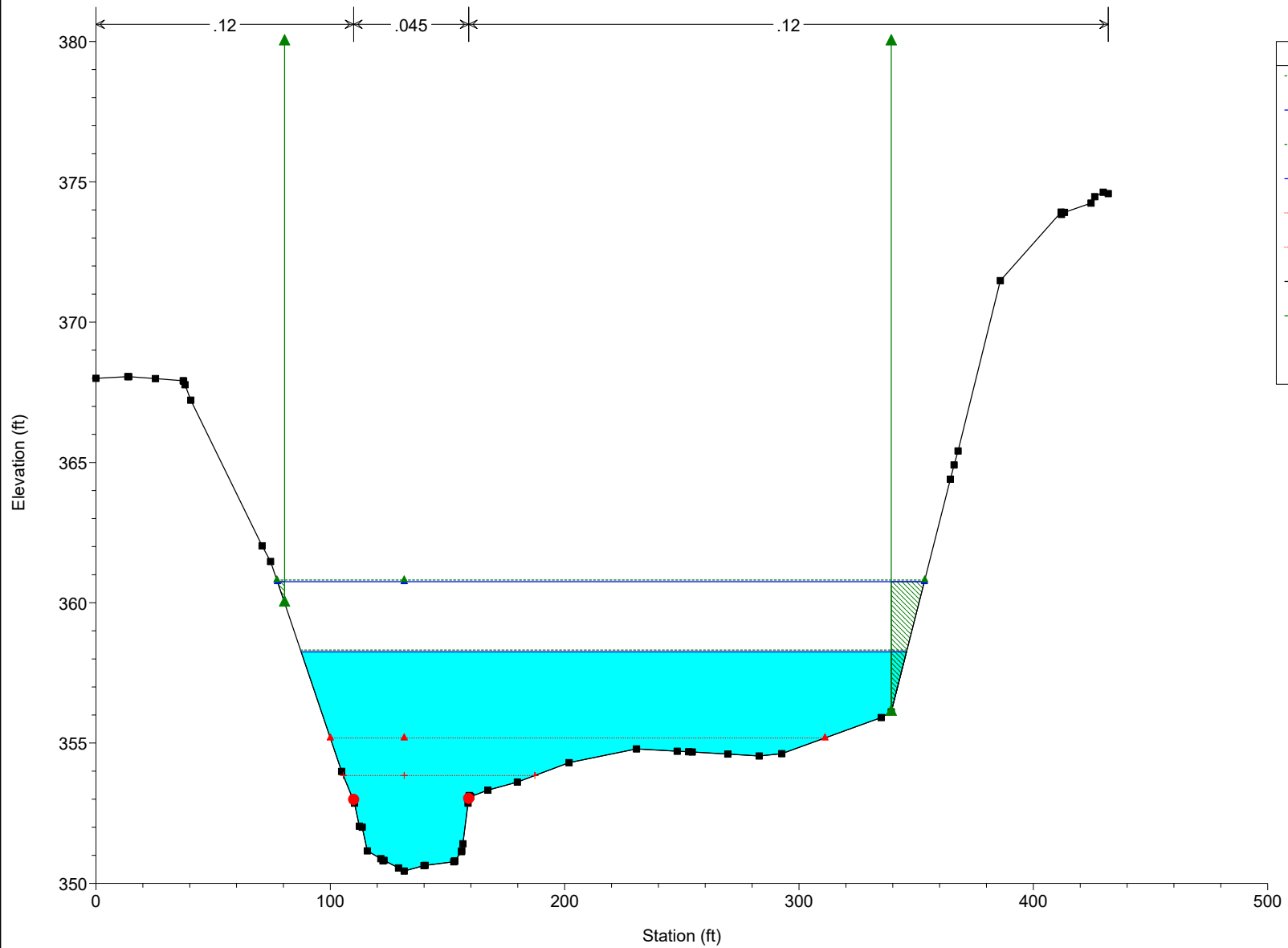
Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 155.2407



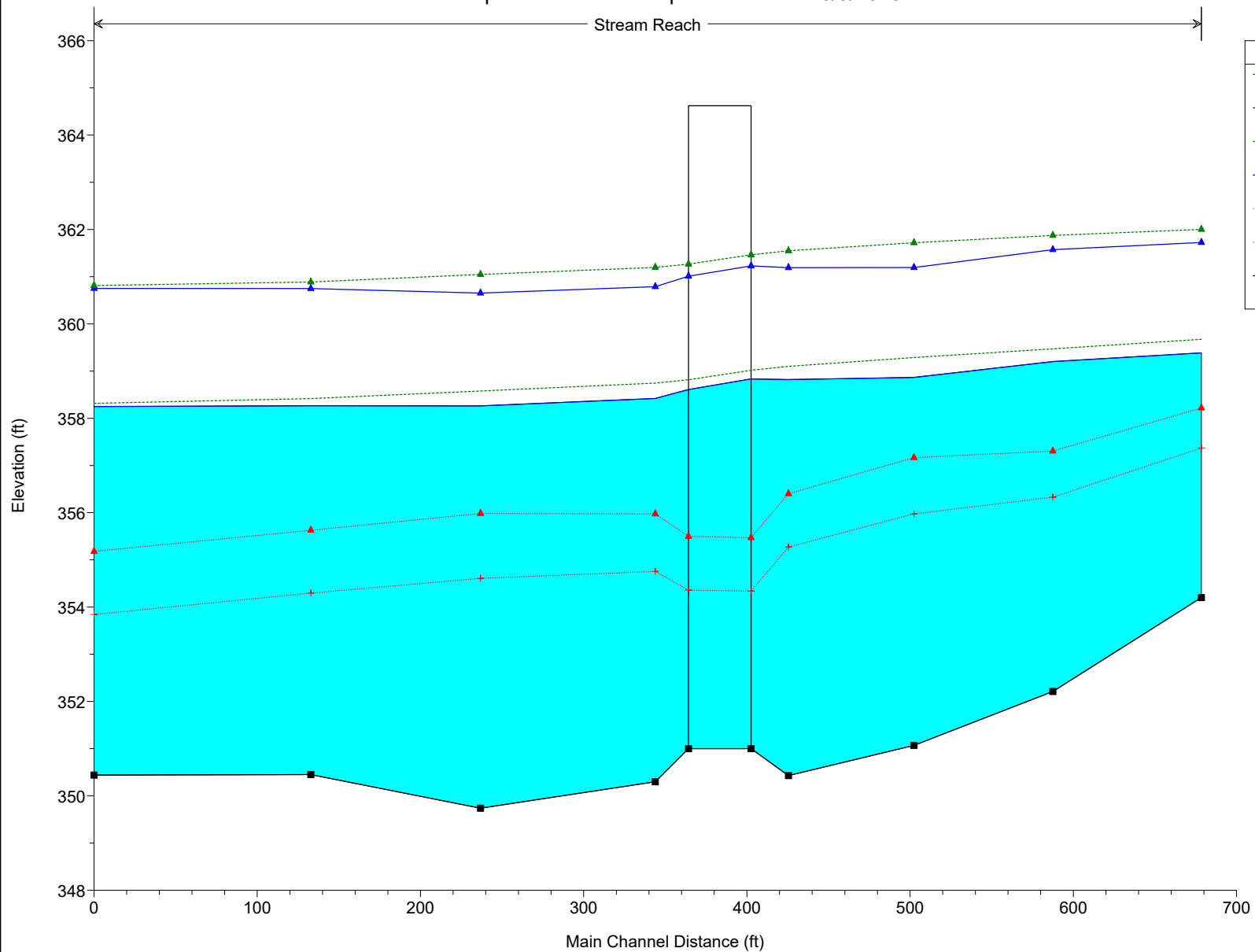
Proposed Plan: Proposed Known 6/9/2023

River = Stream Reach = Reach RS = 22.4107



Proposed Plan: Proposed Known 6/9/2023

Stream Reach



HEC-RAS Plan: Prop_Known River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach	700.8932	Q10	1305.00	354.20	359.39	357.37	359.67	0.002806	4.31	305.25	81.04	0.38
Reach	700.8932	Q100	2080.00	354.20	361.73	358.22	362.00	0.001521	4.23	511.42	95.11	0.30
Reach	609.8605	Q10	1305.00	352.21	359.20	356.33	359.47	0.001709	4.32	382.03	90.58	0.32
Reach	609.8605	Q100	2080.00	352.21	361.57	357.31	361.87	0.001254	4.67	620.62	110.82	0.29
Reach	524.7844	Q10	1305.00	351.07	358.87	355.97	359.29	0.002367	5.25	270.52	55.00	0.37
Reach	524.7844	Q100	2080.00	351.07	361.19	357.17	361.72	0.001963	5.93	410.15	67.05	0.36
Reach	447.9161	Q10	1305.00	350.43	358.82	355.27	359.10	0.001504	4.27	320.91	60.60	0.30
Reach	447.9161	Q100	2080.00	350.43	361.19	356.40	361.55	0.001275	4.87	476.46	72.00	0.29
Reach	410.92		Bridge									
Reach	366.3016	Q10	1305.00	350.30	358.42	354.76	358.74	0.001563	4.66	333.19	67.66	0.31
Reach	366.3016	Q100	2080.00	350.30	360.79	355.97	361.20	0.001384	5.33	504.72	78.55	0.31
Reach	259.2376	Q10	1305.00	349.74	358.26	354.61	358.58	0.001512	4.68	362.31	90.67	0.31
Reach	259.2376	Q100	2080.00	349.74	360.65	355.98	361.05	0.001333	5.33	547.71	105.14	0.31
Reach	155.2407	Q10	1305.00	350.45	358.26	354.30	358.42	0.000874	3.48	667.12	190.00	0.23
Reach	155.2407	Q100	2080.00	350.45	360.75	355.63	360.89	0.000605	3.55	1120.49	211.77	0.20
Reach	22.4107	Q10	1305.00	350.44	358.25	353.84	358.32	0.000406	2.47	1081.15	258.32	0.16
Reach	22.4107	Q100	2080.00	350.44	360.75	355.18	360.81	0.000290	2.54	1722.18	276.05	0.14

HEC-RAS Plan: Prop_Known River: Stream Reach: Reach

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Q Total	Min El Weir Flow	Delta EG	BR Open Vel	W.S. Elev
			(ft)	(ft)	(sq ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)
Reach	410.92	Q10	359.10	364.62	665.97	1305.00	365.86	0.36	3.64	358.82
Reach	410.92	Q100	361.55	364.62	665.97	2080.00	365.86	0.35	4.04	361.19