



**Report of
Hydraulic Analysis**

Scioto Greenways Project
City of Columbus
Franklin County, Ohio

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Table of Contents

1.0 INTRODUCTION	1
2.0 EXISTING SCIOTO RIVER HYDROLOGIC AND HYDRAULIC STUDIES	2
3.0 DATA COLLECTION.....	3
4.0 HYDROLOGY.....	4
5.0 HYDRAULIC ANALYSIS.....	5
5.1 DUPLICATE EFFECTIVE MODEL.....	5
5.2 CORRECTED EFFECTIVE / PRE-PROJECT CONDITIONS MODEL	8
5.2.1 Cross-Section Locations.....	8
5.2.1.1 Bridge Cross-section Locations.....	9
5.2.1.2 Dam Cross-section Locations.....	10
5.2.1.3 Added Cross-sections	12
5.2.2 Cross-Section Geometry	15
5.2.3 Bridge Modeling	16
5.2.4 Manning’s “n” Values.....	17
5.2.5 Boundary Conditions	20
5.2.6 Standard Project Flood.....	20
5.3 POST-PROJECT CONDITIONS MODEL.....	21
5.3.1 Standard Project Flood.....	21

6.0 MODELING RESULTS	23
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FIGURES

Figure 1-1 Project Area	1
Figure 5-1 Bridge Section Schematic from Hydraulic Reference Manual	9
Figure 5-2 Modifications to Bridge Cross-section Placement	10
Figure 5-3 Bridge Section Schematic from Hydraulics Reference Manual	11
Figure 5-4 Modifications to Dam Cross-section Placement.....	11
Figure 5-5 Expansion Ratios from HEC-RAS Hydraulic Reference Manual	17
Figure 5-6 Manning’s “n” Values for Natural Channels.....	18
Figure 5-7 Cowan (1959) (From HEC-RAS Hydraulic Reference Manual).....	18
Figure 5-8 Manning’s “n” Values for Floodplains	19

**REPORT OF
HYDRAULIC ANALYSIS****TABLES**

Table 5-1	Comparison of Duplicate Effective Model with Effective FEMA Model.....	6
Table 5-2	Summary of Cross-Section Location Changes.....	12
Table 5-3	Summary of Cross-Section Source Data	15
Table 5-4	Summary of Bridge Geometry Data	16
Table 5-5	Factors Used in Estimation of Manning’s “N” Value for Main Channel.....	19
Table 5-6	Boundary Conditions.....	20
Table 5-7	Post-project SPF Freeboard Summary	22
Table 6-1	Hydraulic Model Water Surface Elevation Results	23
Table 6-2	1-Percent-Annual-Chance Profile Summary	24

APPENDICES

Appendix A	Hydraulic Model Layout
Appendix B	Cross-Section Comparisons
Appendix C	Flood Profile Comparisons
Appendix D	QC Documentation
Appendix E	Digital Data

ACRONYMS

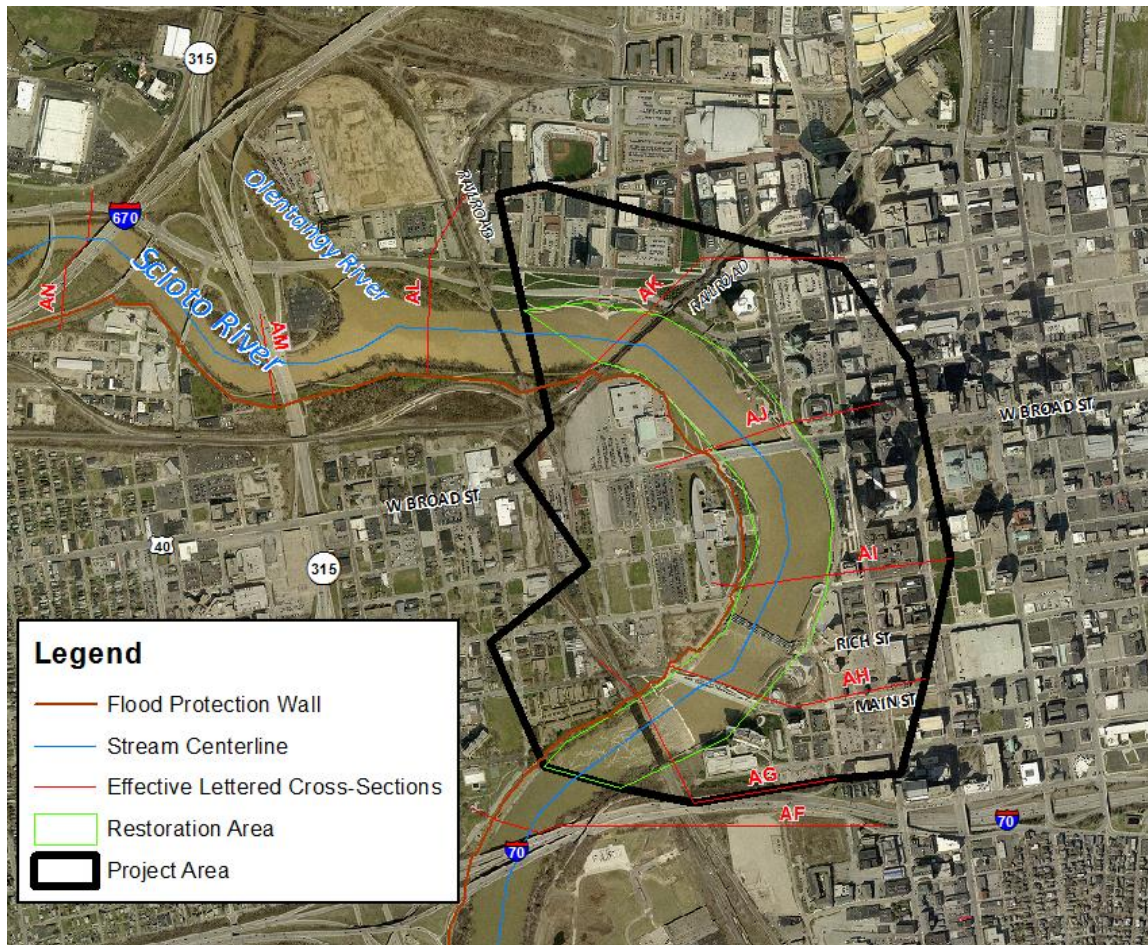
DHS	Department of Homeland Security
EMH&T	Evans, Mechwart, Hambleton and Tilton
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
Franklinton Floodwall	West Columbus Local Protection Project
FWDT	Floodway Data Table
GIS	Geographic Information Systems
HEC	Hydrologic Engineering Center
HEC-RAS	Hydrologic Engineering Center – River Analysis System
LiDAR	Light Detection and Ranging
LOMC	Letter of Map Change
LOMR	Letter of Map Revision
NAD	North American Datum
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NLCD	National Land Cover Dataset
PMF	Probable Maximum Flood
Rii	Resource International, Inc.
SPF	Standard Project Flood
Stantec	Stantec Consulting Services Inc.
USACE	United States Army Corps of Engineers

1.0 Introduction

In support of the Scioto Greenways Project, Stantec Consulting Services Inc. (Stantec) performed a detailed hydraulic analysis of an approximately 1.8 mile long portion of the Scioto River. The studied portion of the Scioto River extends from just downstream of the Dublin Road Dam to approximately 2,000 feet downstream of the Interstate 70 Bridge and includes approximately 1.2 miles of proposed stream restoration and urban park creation work. The proposed project area (Project Area) begins just downstream of the shared CSX/Norfolk Southern Railroad Bridge and continues north to just upstream of the Norfolk Southern Railroad Bridge located upstream of the Broad Street Bridge.

The goal of this study was to develop detailed hydraulic models to accurately determine existing flood hazards along the studied portion of the Scioto River and to model the impacts of the Main Street Dam removal, stream restoration and urban park creation to those flood hazards.

Figure 1-1 Project Area



2.0 Existing Scioto River Hydrologic and Hydraulic Studies

The United States Army Corps of Engineers (USACE) created the original effective hydrologic and hydraulic studies for the Scioto River in November 1980. This hydraulic study used the USACE's Hydrologic Engineering Center (HEC) HEC-2 computer program and was included in the Flood Insurance Rate Map dated July 5, 1983.

The current effective hydraulic analysis for the Scioto River was prepared by the USACE, Huntington District, in September 2001 and was published in the March 2004 *Flood Insurance Study (FIS) for Franklin County, Ohio and Incorporated Areas*. The model extends from approximately 1,500 feet downstream of Frank Road to just upstream of a pipe crossing bridge located approximately 3,000 feet upstream of Trabue Road, Model Sections 236.1-271. This study was done to convert the previous HEC-2 model to Hydrologic Engineering Center – River Analysis System (HEC-RAS) (Version 2.2) and to incorporate the newly constructed West Columbus Local Protection Project (Franklinton Floodwall).

As of the writing of this report, the Letter of Map Revision (LOMR) for the removal of the Town Street Bridge and the construction of the new Main Street and Rich Street Bridges (Letter of Map Change [LOMC] 12-05-3607P) completed by Evans, Mechwart, Hambleton and Tilton (EMH&T) is pending and will become effective on January 31, 2013. This model begins just upstream of the shared CSX/Norfolk Southern Bridge (lettered cross-section AG) and extends just upstream of the Norfolk Southern Railroad Bridge (lettered cross-section AK). When approved, this model will become the effective model for this portion of the Scioto River.

DLZ Ohio, Inc., under contract from the City of Columbus, completed a Scioto River study in 2010. The purpose of this study was to combine various smaller models into one model from the Franklin/Pickaway County line to the most upstream Interstate 670 Bridge. This model contains the following: Data from a 2003 LOMR completed by Malcolm Pirnie, which was not accepted by Federal Emergency Management Agency (FEMA) for the State Route 665 bridge replacement; Burgess & Niple's lateral flow model for the Olen area just upstream of the SR 665 Bridge to the Interstate 270 Bridge; EMH&T's Conditional Letter of Map Revision model for the removal of the Town Street Bridge and the construction of the new Main Street and Rich Street Bridges; and the effective model for all other areas.

For this study, portions of the Scioto River located outside of the Project Area were not changed from the effective USACE 2001 model.

3.0 Data Collection

Stantec obtained the following data for use in establishing the existing ground surface in the Project Area:

- Hydrographic survey of the Scioto River between the State Route 315 Bridge to the north and the Interstate 70 Bridge to the south, performed by Resource International, Inc. (Rii) in August 2011;
- Field survey of overbank areas outside of the hydrographic survey area, performed by Rii and delivered to Stantec in October 2012;
- Light Detection and Ranging (LiDAR) data flown in 2011, provided to Stantec by the City of Columbus in October 2012.

Sections outside of the Project Area were modeled using the effective model data. All survey data is based on the State Plane, Ohio South (SPOS Zone 3402) coordinate system, referenced to the North American Datum of 1983 (NAD83) with elevations referenced to the North American Vertical Datum of 1988 (NAVD 88).

Stantec obtained the following as-built drawings for the existing bridges in the Project Area:

- Norfolk Southern Railroad Bridge, provided by Norfolk Southern;
- Broad Street Bridge, provided by the Franklin County Engineer's Office;
- Rich Street Bridge, provided by the City of Columbus;
- Main Street Bridge, provided by the City of Columbus;
- Shared CSX/Norfolk Southern Bridge, provided by Norfolk Southern;

Bridges outside of the Project Area were modeled using the effective bridge model data.

Geographic Information Systems (GIS) data was also collected for use in this study. The following GIS data was obtained for project use:

- Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Map Database for Franklin County, Ohio, dated June 16, 2011.
- U.S. Geological Survey, National Land Cover Dataset (NLCD) 2006, downloaded on February 16, 2011.

4.0 Hydrology

No revisions to effective hydrology were made as part of this study. The discharges used in this study match those used in the effective HEC-RAS model prepared by the USACE, Huntington District, in September 2001.

A discrepancy does exist between the published flow data in the current effective FIS and the flow data used in the effective hydraulic model. The published flows were never included in a hydraulic analysis. Per guidance from FEMA Region V, if the effective FIRMs and Floodway Data Table (FWDT) are based on the effective hydraulic model, then subsequent models shall use the same flow data as used in the effective model. Due to this guidance, flows were taken directly from the effective hydraulic model.

Stream discharges used in the EMH&T 12-05-3607P LOMR model also matched the discharges used in the USACE 2001 model.

5.0 Hydraulic Analysis

New hydraulic analyses were performed to evaluate the effects of the removal of the Main Street Dam, stream restoration and urban park creation on Scioto River flood elevations during the 10-, 2-, 1-, 0.2-percent-annual-chance and Standard Project Flood (SPF) flood events. Hydraulic modeling was performed using the USACE's HEC-RAS computer program (Version 4.1.0).

5.1 DUPLICATE EFFECTIVE MODEL

A duplicate effective model was created using the effective HEC-RAS model prepared by the USACE, Huntington District, in September 2001 and published in the March 2004 FIS. This model was shortened to include only the area affected by the project. Water surface elevations at Cross-Section AE obtained from the effective 2001 USACE were used as the starting boundary conditions.

Model Sections 247.5 to 252.5 (lettered cross-section AG to lettered cross-section AK) from the 2001 USACE model were replaced with the EMH&T 12-05-3607P LOMR model geometry, which is the effective model for this portion of the Scioto River as of January 31, 2013.

Table 5-1 provides a summary of the results from the duplicate effective model and compares it to the effective FEMA model. FEMA requires that:

If data from the effective model is available and the same modeling program is used, the requester must generate models that duplicate the FIS profiles and the elevations shown in the FWDT in the FIS report within 0.1 foot. The appropriate Department of Homeland Security (DHS) DHS-FEMA Regional Office should be contacted if this model cannot be produced. See Appendix C for the addresses and telephone numbers of DHS-FEMA's Regional Offices. If the effective model is not available, the new model must be calibrated to reproduce the FIS profiles within 0.5 foot. (MT-2 Instruction Forms, Page 10).

As part of the EMH&T 12-05-3607P LOMR submittal, the effective 2001 USACE model, which was created in HEC-RAS Version 2.2, was re-ran, making no modifications, in HEC-RAS Version 4.0. According to the 12-05-3607P LOMR submittal, this change produced "increases to flood elevations within a range of approximately 0.20 – 0.25 feet (vertical) which propagate through the entire reach (Downstream Reach) of the Duplicate Effective model." After running the effective model in Version 4.0, the model was trimmed to include only the 12-05-3607P LOMR project area, with the starting boundary condition based on the new, increased water surface elevation. However, this approach does not allow for a seamless transition between the LOMR study area and the existing effective model downstream.

For the creation of the duplicate effective model for this study, it was necessary to use portions of the USACE 2001 model and the entire 12-05-3607P LOMR model. A known water surface

REPORT OF HYDRAULIC ANALYSIS

elevation taken from the USACE 2001 model was used as the starting boundary condition in compliance with FEMA guidelines, that state:

The downstream boundary condition in a one-dimensional, steady flow, step-backwater model should, whenever possible, be taken from a previously established water-surface elevation, such as a contiguous effective FIS immediately downstream. (FEMA Guidelines and Specifications, Appendix C.6.3, 2010.)

Due to the lack of a seamless transition between the USACE 2001 model and the 12-05-3607P LOMR model, it is not possible to duplicate effective water surface elevations to within 0.1 foot through, and upstream of, the area revised by the 12-05-3607P LOMR model when using the appropriate downstream boundary condition from the USACE 2001 model. The results of duplicate effective modeling for this study are summarized below in **Table 5-1**.

Table 5-1 Comparison of Duplicate Effective Model with Effective FEMA Model

HEC-RAS River Sta.*	Cross-Section Letter	Cross- Section Geometry Source	1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			
			Duplicate Effective Model	Effective Model	Difference	Effective Published Elevation***
253.6	AL	2001 USACE Model	721.29	720.96	0.33	721
253.5		2001 USACE Model	720.87	720.53	0.34	
253.4		2001 USACE Model	720.95	720.61	0.34	
253.3	C & O Railroad Bridge					
253.2		2001 USACE Model	720.90	720.56	0.34	
253.1		2001 USACE Model	720.89	720.55	0.34	
252.5	AK	12-05-3607P	720.48	720.60	-0.12	720.6
252.4		12-05-3607P	720.60	720.71	-0.11	
252.3	Penn Central Railroad Bridge					
252.2		12-05-3607P	720.57	720.68	-0.11	
252.1		12-05-3607P	720.57	720.69	-0.12	
251.5	AJ	12-05-3607P	720.33	720.45	-0.12	720.5
251.4		12-05-3607P	719.96	720.09	-0.13	
251.3	West Broad Street / US 40 Arch Bridge					
251.21		12-05-3607P	719.45	719.58	-0.13	
251.2		12-05-3607P	719.48	719.61	-0.13	
251.1		12-05-3607P	719.40	719.53	-0.13	
250.5	AI	12-05-3607P	718.96	719.10	-0.14	719.1
250.49		12-05-3607P	718.96	719.10	-0.14	

REPORT OF HYDRAULIC ANALYSIS

HEC-RAS River Sta.*	Cross-Section Letter	Cross- Section Geometry Source	1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			
			Duplicate Effective Model	Effective Model	Difference	Effective Published Elevation***
250.4		12-05-3607P	718.88	719.03	-0.15	
250.2		12-05-3607P	718.80	718.94	-0.14	
250.1		12-05-3607P	718.73	718.88	-0.15	
250		12-05-3607P	718.59	718.74	-0.15	
249.9		12-05-3607P	718.48	718.63	-0.15	
249.8		12-05-3607P	718.35	718.50	-0.15	
249.795	Rich Street Bridge					
249.79		12-05-3607P	718.12	718.28	-0.16	
249.78		12-05-3607P	718.06	718.23	-0.17	
249.76		12-05-3607P	718.01	718.18	-0.17	
249.74		12-05-3607P	717.98	718.15	-0.17	
249.73		12-05-3607P	717.99	718.15	-0.16	
249.5	AH	12-05-3607P	718.00	718.17	-0.17	718.2
249.4		12-05-3607P	717.81	717.98	-0.17	
249.3	West Main Street / Ohio State Route 3					
249.2		12-05-3607P	717.46	717.63	-0.17	
249.1		12-05-3607P	717.42	717.60	-0.18	
249.08		12-05-3607P	717.41	717.59	-0.18	
249.06		12-05-3607P	717.39	717.57	-0.18	
249.04		12-05-3607P	717.38	717.56	-0.18	
249.02		12-05-3607P	717.37	717.55	-0.18	
249		12-05-3607P	717.36	717.54	-0.18	
248.5		12-05-3607P	717.50	717.67	-0.17	
248.4		12-05-3607P	717.48	717.66	-0.18	
248.3	Main Street Dam					
248.2		12-05-3607P	716.93	717.13	-0.2	
248.1		12-05-3607P	716.93	717.13	-0.2	
247.5	AG	12-05-3607P	716.73	716.94	-0.21	716.9
247.4		2001 USACE Model	716.59	716.59	0	
247.3	Penn Central Railroad Bridge					
247.2		2001 USACE Model	716.41	716.42	-0.01	
247.1		2001 USACE Model	716.38	716.38	0	

HEC-RAS River Sta.*	Cross-Section Letter	Cross- Section Geometry Source	1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			
			Duplicate Effective Model	Effective Model	Difference	Effective Published Elevation***
246.5	AF	2001 USACE Model	716.16	716.16	0	716.2
246.4		2001 USACE Model	715.92	715.92	0	
246.3	Interstate 70/71 Bridge					
246.2		2001 USACE Model	715.63	715.63	0	
246.1		2001 USACE Model	715.65	715.65	0	
245	AE	2001 USACE Model	714.99	714.99	0	715

*This number is the HEC-RAS model cross-section reference number and does not reflect the actual mileage of the river.

**Effective profile discharge is 75,000 cfs.

***Elevations from June 16, 2011 FIS adjusted from NAVD 88 to NGVD 29 using 0.6 foot countywide conversion.

5.2 CORRECTED EFFECTIVE / PRE-PROJECT CONDITIONS MODEL

A Corrected Effective/Pre-project Conditions Model was created using the duplicate effective model as a basis. Within the Project Area, corrections were made to duplicate effective cross-section locations, cross-section geometry, bridge geometries and Manning’s ‘n’ Values. These corrections were made to better reflect the hydraulic conditions on the studied portion of the Scioto River. Model geometry was not revised outside of the Project Area.

The vertical datum of the Corrected effective / Pre-Project Conditions model was adjusted from the National Geodetic Vertical Datum (NGVD) 29 vertical datum to the NAVD 88 vertical datum using the countywide conversion of -0.6 feet (Elevation NAVD 88 = Elevation NGVD 29 – 0.6 feet) published in the effective FIS. The datum adjustment was made to facilitate the inclusion of new topography and survey data while maintaining a consistent vertical datum in the model.

Georeferencing was also added to the model to allow for seamless data transfer between HEC-RAS and GIS. A graphical illustration of the Corrected Effective/Pre-Project Conditions hydraulic model layout is provided in **Appendix A**.

5.2.1 Cross-Section Locations

Within the Project Area, cross-section locations were modified to more appropriately model existing bridges and dams within the HEC-RAS model and provide additional resolution to the model at critical locations within the Project Area. Cross-section locations were not altered

outside of the Project Area. A summary of the cross-section location modifications is provided in **Table 5-2**.

5.2.1.1 Bridge Cross-section Locations

The *HEC-RAS River Analysis Hydraulics Reference Manual* describes the four cross-section method used by HEC-RAS to model bridges and how bridge modeling cross-sections should be located in *Chapter 5, Modeling Bridges*, Pages 5-2 through 5-5.

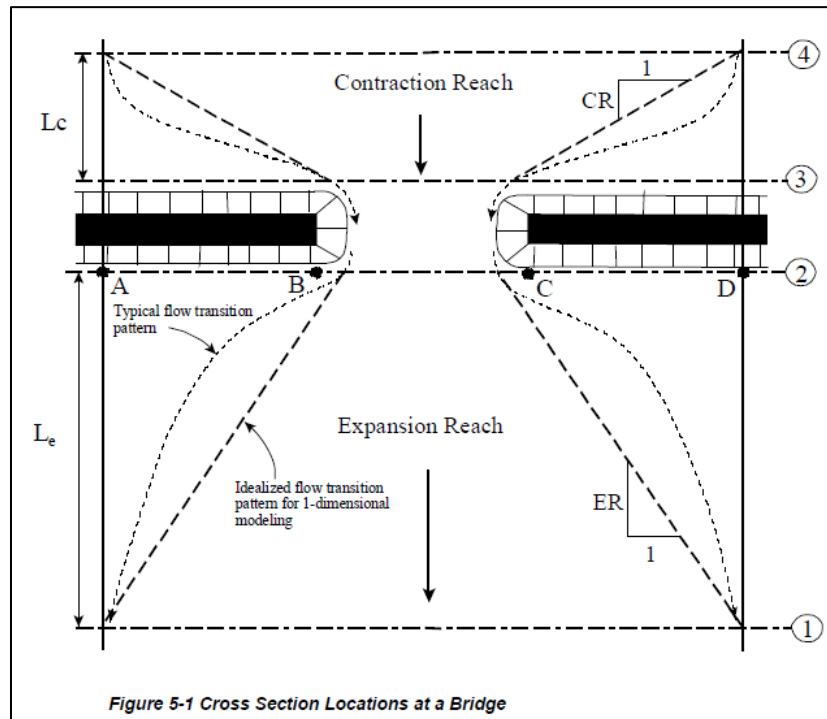


Figure 5-1 Bridge Section Schematic from Hydraulic Reference Manual

The guidance outlined in the *HEC-RAS River Analysis Hydraulics Reference Manual* states that bridge modeling sections 2 and 3 should not be placed immediately at the faces of the bridge deck, or within 1 or 2 feet of the bridge deck, and that modeling sections 1 and 4 should be placed at sufficient distance from the structure not to be influenced by the structure. Duplicate effective model cross-sections were placed based on the original HEC-2 bridge modeling routines used in the 1980 USACE model, with modeling sections 2 and 3 placed within 1 or 2 feet of the deck opening.

To better model the existing bridges within the Project Area in HEC-RAS, effective cross-sections were removed or relocated to obtain the appropriate cross-section spacing described in the *HEC-RAS River Analysis Hydraulics Reference Manual*.

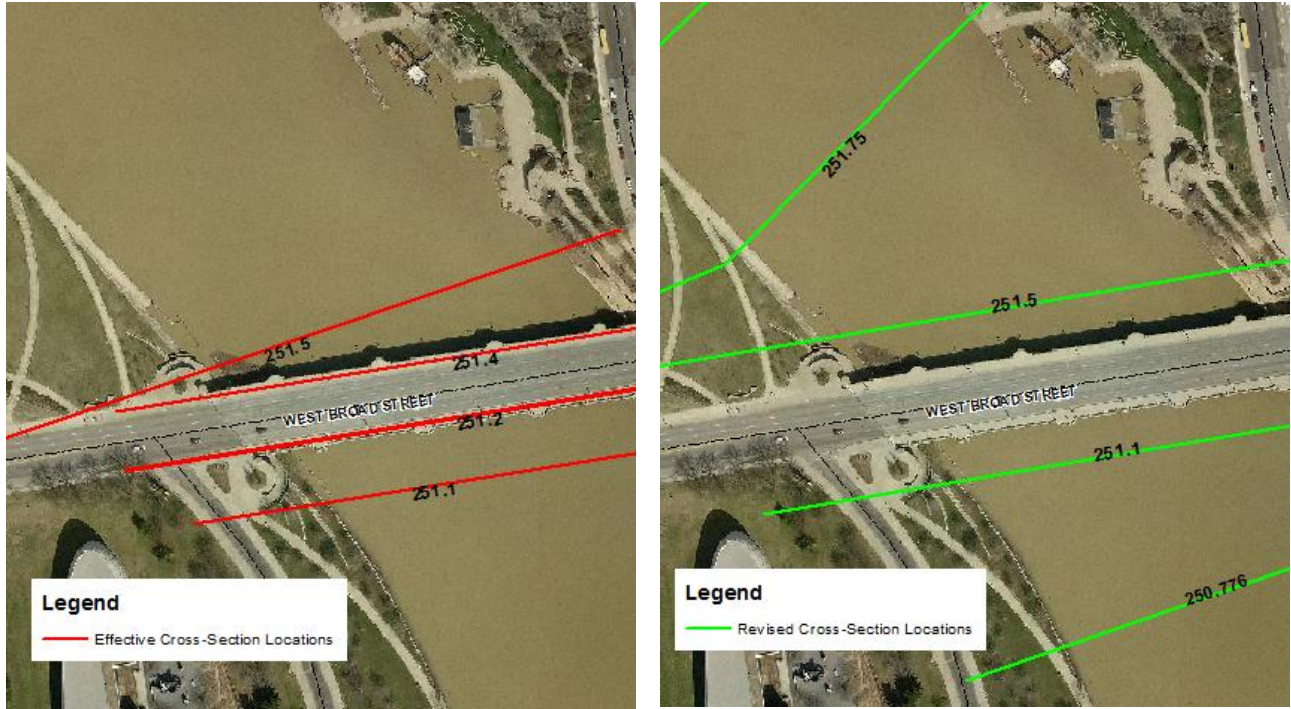


Figure 5-2 Modifications to Bridge Cross-section Placement

5.2.1.2 Dam Cross-section Locations

HEC-RAS also uses a four section method to model dams and inline structures. The appropriate placement of cross-sections to best model dams in HEC-RAS are described in *Chapter 8 Modeling Gated Spillways, Weirs and Drop Structures*, Pages 8-3 through 8-6, of *HEC-RAS River Analysis Hydraulics Reference Manual*.

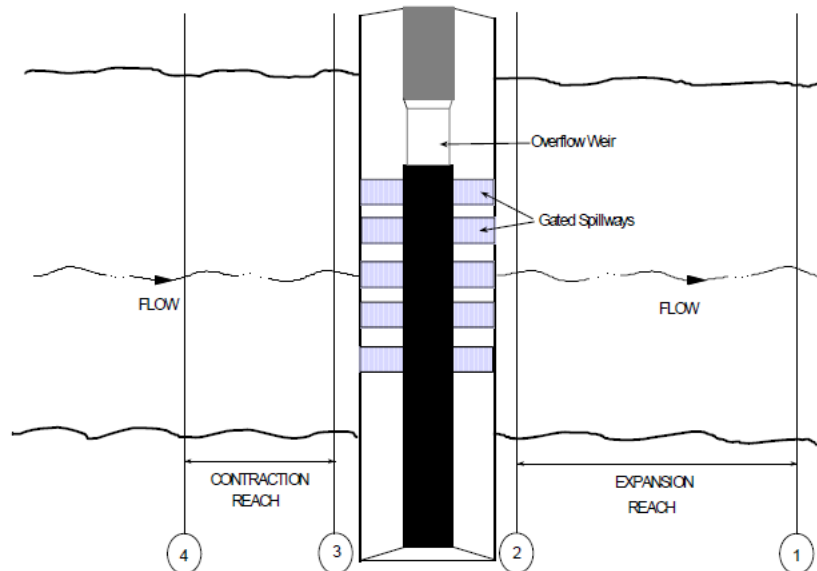


Figure 8-3 Cross Section Layout for Inline Gated Spillways and Weirs

Figure 5-3 Bridge Section Schematic from Hydraulics Reference Manual

Duplicate effective model cross-sections used to model inline structures were placed based on the original HEC-2 inline structure modeling routines. The duplicate effective model cross-section locations and spacing did not represent the actual location and curvature of the existing Main Street Dam, see **Figure 5-4**.

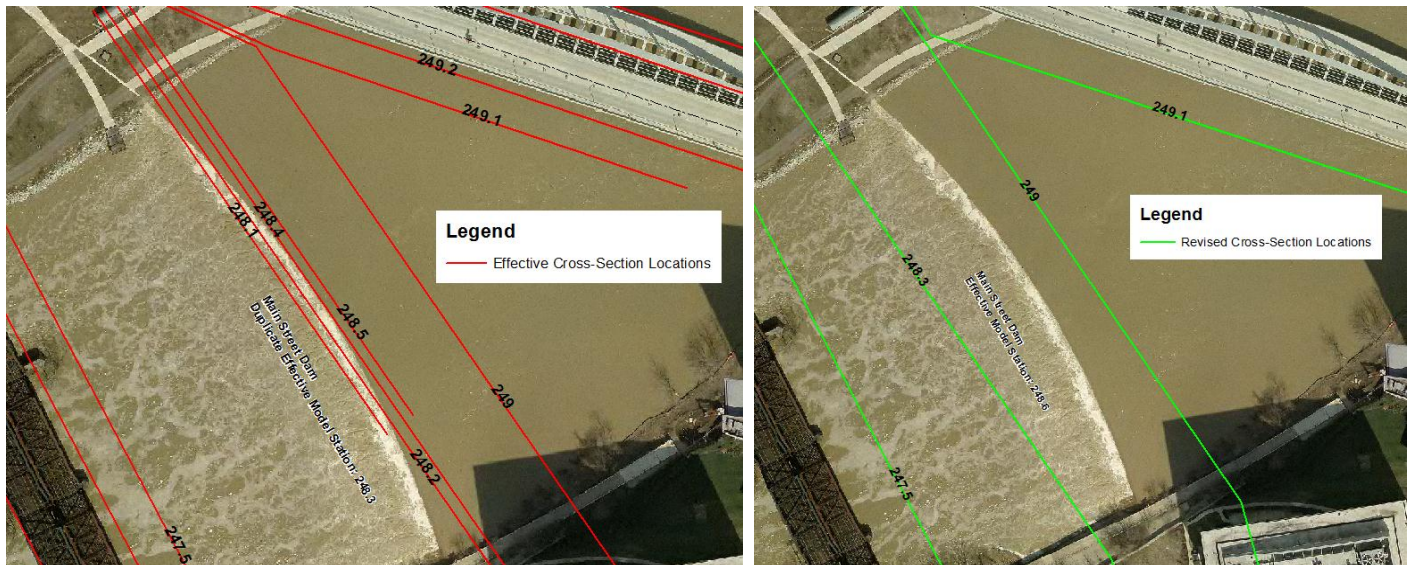


Figure 5-4 Modifications to Dam Cross-section Placement

To better model the existing Main Street dam within HEC-RAS, effective cross-sections were removed or relocated to obtain the appropriate cross-section spacing described in the *HEC-RAS River Analysis Hydraulics Reference Manual*.

5.2.1.3 Added Cross-sections

Additional cross-sections were added within the Project Area to add additional resolution to the Corrected Effective / Pre-Project Conditions model at critical areas that will be impacted by the proposed channel modifications shown in the Post-Project Conditions model.

Table 5-2 Summary of Cross-Section Location Changes

HEC-RAS River Sta. All Models*	Duplicate Effective Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Model Changes Summary
253.6	AL	AL	Location unchanged
253.5			Location unchanged Railroad bridge modeling section 4
253.4			Location unchanged Railroad bridge modeling section 3
253.3	C & O Railroad Bridge	CSX Railroad Bridge	Location unchanged
253.2			Location unchanged Railroad bridge modeling section 2
253.1			Location unchanged Railroad bridge modeling section 1
252.8			Added to improve bridge modeling and capture proposed changes Norfolk Southern Railroad Bridge modeling section 4
252.5 ^{††}	AK	AK	Relocated to improve bridge modeling Norfolk Southern Railroad Bridge modeling section 3
252.4 [†]			Removed
252.3	Penn Central Railroad Bridge	Norfolk Southern Railroad Bridge	Location unchanged
252.2 [†]			Removed
252.1 ^{††}			Relocated to improve bridge modeling Norfolk Southern Railroad Bridge modeling section 2
252.06			Added to improve bridge modeling and capture proposed changes Norfolk Southern Railroad Bridge modeling section 1
251.8			Added to capture proposed changes
251.75			Added to improve bridge modeling and capture proposed changes Broad Street Bridge modeling section 4
251.5 ^{††}	AJ	AJ	Relocated to improve bridge modeling Broad Street Bridge modeling section 3
251.4 [†]			Removed
251.3	West Broad Street / US 40 Arch Bridge	Broad Street Bridge	Location unchanged

HEC-RAS River Sta. All Models*	Duplicate Effective Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Model Changes Summary
251.21 [†]			Removed
251.2 [†]			Removed
251.1 ^{††}			Relocated to improve bridge modeling Broad Street Bridge modeling section 2
250.776			Added to improve bridge modeling and capture proposed changes Broad Street Bridge modeling section 1
250.6268			Added to capture proposed changes
250.5503		AI	Formerly 250.5, relocated to reflect removal of West Town St. Bridge and improve new bridge modeling Rich Street bridge modeling section 4
250.5 ^{†††}	AI		Relocated to 250.5503 due to removal of West Town St. Bridge
250.49 [†]			Removed to reflect removal of West Town St. Bridge
250.4728			Formerly 250, relocated to improve bridge modeling, Rich Street Bridge modeling section 3
250.4469		Rich Street Bridge	Station change only Formerly at station 249.795
250.4 [†]			Removed to reflect removal of West Town St. Bridge
250.2 [†]			Removed to reflect removal of West Town St. Bridge
250.1 [†]			Removed to reflect removal of West Town St. Bridge
250 ^{†††}			Relocated to Station 250.4728
249.9 [†]			Removed
249.8 [†]			Removed
249.795	Rich Street Bridge		Station change only Modeled as Station 250.4469
249.79			Added for modeling of Rich St. Bridge Rich Street Bridge modeling section 2
249.76 ^{††}			Relocated to improve modeling of Rich Street and Main Street Bridges Rich Street Bridge modeling Section 1 Main Street Bridge modeling Section 4
249.74 [†]			Removed
249.73 [†]			Removed
249.5 ^{††}	AH	AH	Relocated to improve bridge modeling Main Street Bridge modeling section 3
249.4 [†]			Removed

REPORT OF HYDRAULIC ANALYSIS

HEC-RAS River Sta. All Models*	Duplicate Effective Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Model Changes Summary
249.3	West Main Street / Ohio State Route 3	Main Street Bridge	Location unchanged
249.2 [†]			Removed
249.1			Location unchanged Main Street Bridge modeling section 2 Main Street Dam modeling section 4
249.08 [†]			Removed with remodeling of Main Street Dam
249.06 [†]			Removed with remodeling of Main Street Dam
249.04 [†]			Removed with remodeling of Main Street Dam
249.02 [†]			Removed with remodeling of Main Street Dam
249 ^{††}			Relocated to improve Main Street Bridge and Main Street Dam modeling Main Street Bridge modeling section 1 Main Street Dam modeling section 3
248.6		Main Street Dam	Station change only Formerly at station 248.3
248.5 [†]			Removed
248.4 ^{†††}			Relocated to 248.3 to improve Main Street Dam modeling
248.3	Main Street Dam		Main Street Dam station changed to 248.6 Formerly 248.4, relocated improve dam modeling Main Street Dam modeling section 2, Shared CSX/Norfolk Southern Railroad Bridge modeling section 4
248.2 [†]			Removed
248.1 [†]			Removed
247.5	AG	AG	Location unchanged Main Street Dam modeling section 1 Shared CSX/Norfolk Southern Railroad Bridge modeling section 3
247.4 [†]			Removed
247.3	Penn Central Railroad Bridge	Shared CSX/Norfolk Southern Railroad Bridge	Location unchanged
247.2 [†]			Removed
247.1 ^{††}			Relocated to improve bridge modeling Shared CSX/Norfolk Southern Railroad Bridge modeling section 2

HEC-RAS River Sta. All Models*	Duplicate Effective Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Cross-section Letter or Bridge Location	Corrected Effective / Pre-Project Model Changes Summary
† Duplicate Effective Cross-section removed from Corrected Effective/Pre-Project model			
†† Duplicate Effective Cross-section relocated in Corrected Effective/Pre-Project model, station number unchanged			
††† Duplicate Effective Cross-section relocated in Corrected Effective/Pre-Project model with new station number			
*This number is the HEC-RAS model cross-section reference number and does not reflect the actual mileage of the river.			

5.2.2 Cross-Section Geometry

Cross-section geometry within the Project Area was updated using 2011 hydrographic survey, 2012 field survey and 2011 LiDAR data. Levee points were also added to cross-sections within the Project Area to reflect the Franklinton Floodwall location. The effective model used blocked obstruction features to model the Franklinton Floodwall). Elevations of cross-sections outside of the Project Area were not modified beyond the vertical datum shift from NGVD 29 to NAVD 88. A summary of the geometric source data for each cross-section is provided in **Table 5-3**.

Table 5-3 Summary of Cross-Section Source Data

Cross-Section Letter	River Station	Cross-Section Geometry Data Source	
		Overbank Geometry	Channel Geometry
AL	253.6	Effective 2001 USACE Model	Effective 2001 USACE Model
	253.5	Effective 2001 USACE Model	Effective 2001 USACE Model
	253.3	CSX Railroad Bridge	
	253.1	Effective 2001 USACE Model	Effective 2001 USACE Model
	252.8	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AK	252.5	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	252.3	Norfolk Southern Railroad Bridge	
	252.1	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	252.06	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	251.8	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AJ	251.75	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	251.5	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	251.3	Broad Street Bridge	
	251.1	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	250.776	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AI	250.6268	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	250.5503	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	250.4728	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	250.4469	Rich Street Bridge	

Cross-Section Letter	River Station	Cross-Section Geometry Data Source	
		Overbank Geometry	Channel Geometry
	249.79	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	249.76	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AH	249.5	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	249.3	Main Street Bridge	
	249.1	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	249	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	248.6	Main Street Dam	
	248.3	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AG	247.5	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	247.3	Shared CSX/Norfolk Southern Railroad Bridge	
	247.1	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
	246.8	Rii Field Survey / 2011 LiDAR	Rii Hydrographic Survey
AF	246.5	Effective 2001 USACE Model	Effective 2001 USACE Model
	246.3	Interstate 70 Bridge	
	246.1	Effective 2001 USACE Model	Effective 2001 USACE Model
AE	245	Effective 2001 USACE Model	Effective 2001 USACE Model

5.2.3 Bridge Modeling

Bridge geometries within the Project Area were updated to reflect the current condition of the bridges as shown on the construction “As Built” plans. A summary of the bridge construction plans used to update the bridges in the Corrected Effective / Pre-project Conditions model is provided in **Table 5-4**. Bridges outside of the Project Area were modeled using the effective 2001 USACE model geometry.

Table 5-4 Summary of Bridge Geometry Data

Model Station	Bridge Name	Plan Number	Source	Date
252.3	Norfolk Southern Railroad Bridge	CJ-138.48	Norfolk Southern	1901 - 1973
251.3	Broad Street Bridge	FRA-40-12.26	Franklin County Engineer	1990
250.4469	Rich Street Bridge	FRA-62D-1.21	City of Columbus	2009
249.3	Main Street Bridge	FRA-62-14.11	City of Columbus	2005
247.3	CSX/Norfolk Southern Shared Railroad Bridge	AM-132.52	Norfolk Southern	1919

Ineffective flow areas at bridges were modeled assuming a 1:1 contraction ratio upstream of the bridge and a downstream expansion ratio selected based on *Table 5-1* of the January 2010 *HEC-RAS River Analysis Hydraulics Reference Manual*.

Table 5-1
Ranges of Expansion Ratios

		nob / nc = 1	nob / nc = 2	nob / nc = 4
b/B = 0.10	S = 1 ft/mile	1.4 – 3.6	1.3 – 3.0	1.2 – 2.1
	5 ft/mile	1.0 – 2.5	0.8 – 2.0	0.8 – 2.0
	10 ft/mile	1.0 – 2.2	0.8 – 2.0	0.8 – 2.0
b/B = 0.25	S = 1 ft/mile	1.6 – 3.0	1.4 – 2.5	1.2 – 2.0
	5 ft/mile	1.5 – 2.5	1.3 – 2.0	1.3 – 2.0
	10 ft/mile	1.5 – 2.0	1.3 – 2.0	1.3 – 2.0
b/B = 0.50	S = 1 ft/mile	1.4 – 2.6	1.3 – 1.9	1.2 – 1.4
	5 ft/mile	1.3 – 2.1	1.2 – 1.6	1.0 – 1.4
	10 ft/mile	1.3 – 2.0	1.2 – 1.5	1.0 – 1.4

Figure 5-5 Expansion Ratios from HEC-RAS Hydraulic Reference Manual

Due to high embankments and long spans, ineffective flow areas placed at the Broad Street and Main Street bridges do not influence water surface elevations on the Scioto River.

Expansion and contraction coefficients were adjusted to 0.3 and 0.5, respectively, at sections adjacent to structures. The adjustments of these coefficients were made based on *Table 5-2* of the bridge modeling guidelines outlined in *Chapter 5* of the *HEC-RAS River Analysis Hydraulics Reference Manual*.

5.2.4 Manning’s “n” Values

Manning’s “n” Values were revised to better model existing conditions within the Project Area. No revisions were made to Manning’s “n” Values of cross-sections located outside of the Project Area. Manning’s “n” Values used in the hydraulic computations for the main channel of the Scioto River were obtained from “Open Channel Hydraulics” (Chow, 1959), and were selected based on field observations of the channel, an analysis of the river bed material and engineering judgment. Manning’s “n” Values from “Open Channel Hydraulics” for natural channels are summarized in the HEC-RAS River Analysis Hydraulics Reference Manual as follows:

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
<i>A. Natural Streams</i>			
1. Main Channels			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150

Figure 5-6 Manning's "n" Values for Natural Channels

The Scioto River has a clean, full channel with gradual meanders and some deep pools. The main channel is clear of vegetation. From the descriptions listed in **Figure 5-6**, the Scioto River has a description falling between items "a" and "c" with a normal "n" value ranging between 0.03 and 0.04.

A Manning's "n" value of 0.032 was selected for the main channel using the Cowan (1959) method described on pages 3-16 and 3-17 of the *HEC-RAS River Analysis Hydraulics Reference Manual*.

$$n = (n_b + n_1 + n_2 + n_3 + n_4)m \tag{3-1}$$

Where: n_b = Base value for n for a straight uniform, smooth channel in natural materials

n_1 = Value added to correct for surface irregularities

n_2 = Value for variations in shape and size of the channel

n_3 = Value for obstructions

n_4 = Value for vegetation and flow conditions

m = Correction factor to account for meandering of the channel

Figure 5-7 Cowan (1959) (From HEC-RAS Hydraulic Reference Manual)

Factors associated with the use of the Cowan (1959) method were obtained from the *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, USGS Water-supply Paper 2339 (WSP 2339)*. River bed material samples indicate that the predominant bed material consists of small to medium gravel with median bed material sizes

ranging from 3 to 7 millimeters. A base “n_b” value of 0.025 was selected based on the Chow (1959) material roughness values for gravel found in “Table 1- Base Values of Manning’s n” of WSP 2339. Values of adjustment factors n₁, n₂, n₃ and n₄ were obtained from WSP 2339 Table 2, “Adjustment Values for Factors that Affect the Roughness of a Channel.” Adjustment factors and their associated descriptions are provided in **Table 5-5**.

Table 5-5 Factors Used in Estimation of Manning’s “N” Value for Main Channel

Factor	Value	Factor Description	Selected Value Description
n _b	0.025	Base “n” Value	Medium sized Gravel
n ₁	0	Irregularity of Bed Material	Smooth
n ₂	0	Variation in Channel Cross-section	Gradual Variation
n ₃	0.003	Obstructions	Negligible (bridge piers and other obstructions blocking less than 5% of cross-section area)
n ₄	0	Vegetation	None / Negligible
m	1.15	Meander	Appreciable Channel – Channel to Valley Length Ratio of 1.2-1.5
n	0.032	Manning’s “n” Value for Main Channel	$n = (n_b+n_1+n_2+n_3+n_4)m$

In overbank areas, Manning’s ‘n’ Values ranged from 0.04 to 0.08 and were selected based on land cover data from the USGS’ NLCD dataset and overbank “n” values from “Open Channel Hydraulics” Chow (1959). Field observations and imagery were used to verify land cover descriptions obtained from the NLCD.

Type of Channel and Description		Minimum	Normal	Maximum
2. Flood Plains				
a.	Pasture no brush			
1.	Short grass	0.025	0.030	0.035
2.	High grass	0.030	0.035	0.050
b.	Cultivated areas			
1.	No crop	0.020	0.030	0.040
2.	Mature row crops	0.025	0.035	0.045
3.	Mature field crops	0.030	0.040	0.050
c.	Brush			
1.	Scattered brush, heavy weeds	0.035	0.050	0.070
2.	Light brush and trees, in winter	0.035	0.050	0.060
3.	Light brush and trees, in summer	0.040	0.060	0.080
4.	Medium to dense brush, in winter	0.045	0.070	0.110
5.	Medium to dense brush, in summer	0.070	0.100	0.160
d.	Trees			
1.	Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2.	Same as above, but heavy sprouts	0.050	0.060	0.080
3.	Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4.	Same as above, but with flow into branches	0.100	0.120	0.160
5.	Dense willows, summer, straight	0.110	0.150	0.200

Figure 5-8 Manning’s “n” Values for Floodplains

5.2.5 Boundary Conditions

Known water surface elevations were used as the starting boundary condition for the Corrected Effective / Pre-project Conditions model for all recurrence intervals. Starting water surface elevations were obtained from the effective 2001 USACE HEC-RAS (version 2.2) model output and adjusted to the NAVD 88 vertical datum. Starting water surface elevations used in the model are summarized in **Table 5-6**.

Table 5-6 Boundary Conditions

Percent Annual Chance Profile	Known Water Surface Elevation	
	NGVD 29	NAVD 88
10%	714.9933	714.3933
2%	707.6744	707.0744
1%	712.8988	712.2988
0.20%	719.4723	718.8723
SPF	719.31	718.71

5.2.6 Standard Project Flood

The Franklinton Floodwall was constructed by the USACE, Huntington District, to provide a seven mile long barrier around the historic Franklinton area south and west of Downtown Columbus. The Franklinton area has a long history of flooding problems, with major floods hitting the area in 1913, 1937 and 1959.

The floodwall was designed to withstand the SPF. The SPF is a design criterion used by the USACE to study structures. In general, the magnitude of the SPF is about half of the probable maximum flood (PMF) and is based on the most likely combination of severe meteorological and hydrologic conditions for the region. The SPF is less theoretical than the PMF in that it results from storm characteristics that can reasonably be expected based on existing observations.

For this study, the SPF profile starting water surface elevation and stream flows were taken directly from the USACE's HEC-2 model. The location of the wall and top of wall elevations were taken from a 2005 survey performed by Woolpert, Inc. for the USACE and provided to Stantec by the City of Columbus. In the original Franklinton Floodwall design, the wall above the parking lot for the Franklin County Veterans Memorial facility was designed to be the initial overtopping point in a high flood event. This designed overflow point was modeled at station 252.06 with a minimum elevation of 727 feet (NAVD 88).

5.3 POST-PROJECT CONDITIONS MODEL

A post-project conditions model was created using the Corrected Effective / Pre-Project Conditions model as a basis. The Main Street Dam inline structure was removed to represent post-project conditions and channel geometry from lettered cross-section AF to lettered cross-section AK and was modified to include the proposed stream restoration of the Scioto River and urban park creation. Revisions to bridge ineffective flow areas and changes to the reach boundary conditions that were applied to the Corrected Effective / Pre-project Conditions model were also applied to the post-project conditions model. Manning's "n" Values were updated in channel areas to reflect changes resulting from the proposed stream restoration and urban park creation. A comparison between the Corrected Effective / Pre-project Conditions model and the Post-project model cross-sections has been provided in **Appendix B**.

5.3.1 Standard Project Flood

When compared to the field surveyed top of wall elevations of the Franklinton Flood Wall, water surface elevations of the post-project condition SPF do not overtop the floodwall at any location. Compared to the Pre-project conditions model, Post-project SPF water surface elevations decrease upstream of the existing Main Street Dam by as much as 0.48 feet (see profile in **Appendix C**). **Table 6-1** contains the hydraulic modeling results for the Pre- and Post-project SPF water surface elevations.

In the original Franklinton Floodwall design, the wall at Franklin County Veterans Memorial, model station 252.06, was designed to be the initial overtopping point in a high flood event. The proposed project does not change this initial overtopping location. A Post-project conditions SPF freeboard summary for the Franklinton Floodwall has been provided in **Table 5-7**.

Table 5-7 Post-project SPF Freeboard Summary

Model Station	Top of Floodwall Elevation Feet NAVD 88	SPF Water Surface Elevation Feet NAVD 88	Freeboard
252.8	729.9	726.77	3.13
252.5	728.6	726.72	1.88
252.3	Norfolk Southern Railroad Bridge		
252.1	728.3	726.06	2.24
252.06	727	725.98	1.02
251.8	729.55	725.58	3.97
251.75	731.4	725.53	5.87
251.5	730.08	725.49	4.59
251.3	Broad Street Bridge		
251.1	729.04	724.44	4.60
250.776	728.31	724.01	4.30
250.6268	728.71	723.82	4.89
250.5503	728	723.74	4.26
250.4728	727.2	723.37	3.83
250.4469	Rich Street Bridge		
249.79	726.13	722.97	3.16
249.76	726	722.7	3.30
249.5	726.08	722.81	3.27
249.3	Main Street Bridge		
249.1	725.84	721.86	3.98
249	725.82	721.24	4.58
248.3	724.68	721.38	3.30
247.5	724.2	721.41	2.79
247.3	Norfolk Southern / CSX Shared Railroad Bridge		
247.1	723.55	720.45	3.10
246.8	723.02	720.42	2.60

6.0 Modeling Results

Results of the hydraulic analyses indicate that the proposed dam removal and stream restoration project would not cause rises in the regulatory 1-percent-annual-chance flood event on the Scioto River. A comparison of pre- and post-project condition water surface elevations has been provided in **Table 6-1** below. Duplicate effective, Pre-project and Post-project condition 1-percent-annual-chance water surface elevations are provided in **Table 6-2**. A graphical profile comparing Pre-project and Post-project condition 1-percent-annual-chance water surface elevations has been provided in **Appendix C**. Documentation of quality control has been provided in **Appendix D**. Copies of all hydraulic models are provided in **Appendix E**.

Table 6-1 Hydraulic Model Water Surface Elevation Results

Cross-Section Letter	HEC-RAS River Sta.*	Post-Project Elevations (NGVD 88) (feet)					Pre-Project Elevations (NGVD 88) (feet)				
		10%	2%	1%	0.2%	SPF	10%	2%	1%	0.2%	SPF
AL	253.6	711.68	717.68	720.34	728.16	727.37	713.42	718.06	720.43	727.71	727.13
	253.5	711.33	717.28	719.90	727.74	726.94	713.16	717.68	720.00	727.28	726.68
	253.4	711.37	717.35	719.99	727.94	727.12	713.20	717.75	720.09	727.47	726.86
	253.3	CSX Railroad Bridge									
	253.2	711.34	717.31	719.94	727.77	726.91	713.17	717.71	720.04	727.27	726.62
	253.1	711.32	717.30	719.93	727.71	726.85	713.16	717.70	720.03	727.20	726.57
	252.8	711.22	717.17	719.78	727.61	726.77	713.09	717.58	719.89	727.12	726.50
AK	252.5	711.16	717.12	719.75	727.58	726.72	713.02	717.51	719.83	727.05	726.43
	252.3	Norfolk Southern Railroad Bridge									
	252.1	710.76	716.72	719.34	726.91	726.14	712.94	717.37	719.67	726.65	726.08
	252.06	710.7	716.59	719.19	727.03	726.07	712.86	717.24	719.52	726.57	725.98
	251.8	710.37	716.24	718.82	726.23	725.63	712.74	717.07	719.34	726.37	725.79
	251.75	710.28	716.18	718.76	726.20	725.61	712.68	717.01	719.28	726.32	725.74
AJ	251.5	710.13	716.07	718.67	726.12	725.53	712.58	716.87	719.13	726.13	725.55
	251.3	Broad Street Bridge									
	251.1	709.93	715.71	718.19	725.02	724.51	712.32	716.41	718.56	724.98	724.48
	250.776	709.67	715.37	717.80	724.53	724.02	712.29	716.37	718.52	724.94	724.45
	250.6268	709.27	715.04	717.51	724.39	723.88	712.21	716.28	718.44	724.89	724.39
AI	250.5503	709.20	714.96	717.42	724.26	723.77	712.11	716.16	718.32	724.78	724.28
	250.4728	708.86	714.65	717.13	724.00	723.49	711.92	715.88	718.02	724.45	723.96
	250.4469	Rich Street Bridge									
	249.79	708.65	714.40	716.85	723.55	723.08	711.77	715.63	717.73	724.05	723.58
	249.76	708.45	714.08	716.51	723.22	722.75	711.49	715.19	717.26	723.57	723.11
AH	249.5	708.46	714.16	716.61	723.36	722.88	711.46	715.19	717.27	723.64	723.17

REPORT OF HYDRAULIC ANALYSIS

Cross-Section Letter	HEC-RAS River Sta.*	Post-Project Elevations (NGVD 88) (feet)					Pre-Project Elevations (NGVD 88) (feet)				
		10%	2%	1%	0.2%	SPF	10%	2%	1%	0.2%	SPF
	249.3	Main Street Bridge									
	249.1	708.34	714.01	716.38	722.33	721.96	711.31	714.96	716.96	722.35	722.00
	249	708.06	713.57	715.86	721.56	721.21	711.03	714.51	716.46	721.75	721.42
	248.6	Main Street Dam									
	248.3	708.06	713.55	715.85	721.70	721.35	708.08	713.66	715.95	721.52	721.19
AG	247.5	708.10	713.62	715.93	721.77	721.42	708.07	713.64	715.94	721.51	721.18
	247.3	Shared CSX/Norfolk Southern Railroad Bridge									
	247.1	707.98	713.49	715.73	720.71	720.45	707.98	713.51	715.76	720.74	720.48
	246.8	707.95	713.46	715.71	720.67	720.41	707.96	713.49	715.74	720.71	720.46
	246.5	707.84	713.33	715.56	720.49	720.24	707.84	713.33	715.56	720.49	720.24
	246.4	707.73	713.14	715.32	720.16	719.93	707.73	713.14	715.32	720.16	719.93
	246.3	Interstate 70 Bridge									
	246.2	707.56	712.89	715.03	719.73	719.52	707.56	712.89	715.03	719.73	719.52
	246.1	707.55	712.89	715.05	719.76	719.55	707.55	712.89	715.05	719.76	719.55
AE	245	707.07	712.30	714.39	718.87	718.71	707.07	712.30	714.39	718.87	718.71

Table 6-2 1-Percent-Annual-Chance Profile Summary

HEC-RAS River Sta. All Models*	Effective / Duplicate Effective Models 1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			Pre-Project / Post-Project Models 1-Percent-Annual-Chance Profiles (NAVD 88) (feet)**		
	FIS Cross- Section Letter	Duplicate Effective Model	Effective Model	Cross-Section Letter	Pre-Project Model	Post-Project Model
256.066					724.87	724.86
256					724.84	724.83
255.96					724.77	724.76
255.95					723.70	723.69
255.94					724.07	724.06
255.93	Interstate 670 Ramp			Interstate 670 Ramp		
255.92					723.42	723.41
255.91					723.43	723.42
255.9	AN			AN	723.25	723.24
255.8					723.54	723.52
255.75	Interstate 670 Bridge			Interstate 670 Bridge		
255.7					722.80	722.78

REPORT OF HYDRAULIC ANALYSIS

HEC-RAS River Sta. All Models*	Effective / Duplicate Effective Models 1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			Pre-Project / Post-Project Models 1-Percent-Annual-Chance Profiles (NAVD 88) (feet)**		
	FIS Cross- Section Letter	Duplicate Effective Model	Effective Model	Cross-Section Letter	Pre-Project Model	Post-Project Model
255.6					722.76	722.75
255.5					722.61	722.6
255.4					722.96	722.94
255.3	Interstate 670 Ramp			Interstate 670 Ramp		
255.2					722.01	722
255.1					721.81	721.79
254.95					721.91	721.9
254.94					721.79	721.77
254.93	North Souder Avenue Bridge			North Souder Avenue Bridge		
254.92					721.68	721.67
254.91					721.18	721.16
254.5	AM			AM	720.81	720.8
254.4					720.80	720.78
254.3	State Route 315 Bridge			State Route 315 Bridge		
254.2					720.47	720.45
254.1					720.40	720.38
253.6	AL	721.29	720.96	AL	720.39	720.37
253.5		720.87	720.53		719.96	719.94
253.4		720.95	720.61		720.04	720.02
253.3	C & O Railroad Bridge			C & O Railroad Bridge		
253.2		720.90	720.56		719.99	719.98
253.1		720.89	720.55		719.98	719.96
252.8	***				719.89	719.78
252.5	AK	720.48	720.60	AK	719.79	719.79
252.4		720.60	720.71	***		
252.3	Penn Central Railroad Bridge			Norfolk Southern Railroad Bridge		
252.2		720.57	720.68	***		
252.1		720.57	720.69		719.63	719.33
252.06	***				719.52	719.19
251.8	***				719.34	718.82
251.75	***				719.28	718.76
251.5	AJ	720.33	720.45	AJ	719.11	718.69
251.4		719.96	720.09	***		
251.3	West Broad Street / US 40 Arch Bridge			Broad Street Bridge		

HEC-RAS River Sta. All Models*	Effective / Duplicate Effective Models 1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			Pre-Project / Post-Project Models 1-Percent-Annual-Chance Profiles (NAVD 88) (feet)**		
	FIS Cross- Section Letter	Duplicate Effective Model	Effective Model	Cross-Section Letter	Pre-Project Model	Post-Project Model
251.21		719.45	719.58	***		
251.2		719.48	719.61	***		
251.1		719.40	719.53		718.54	718.17
250.776	***				718.52	717.8
250.6268	***				718.44	717.51
250.5503	***			AI	718.32	717.42
250.5	AI	718.96	719.10	***		
250.49		718.96	719.10	***		
250.4728	***				718.02	717.13
250.4469	***			Rich Street Bridge		
250.4		718.88	719.03	***		
250.2		718.80	718.94	***		
250.1		718.73	718.88	***		
250		718.59	718.74	***		
249.9		718.48	718.63	***		
249.8		718.35	718.50	***		
249.795	Rich Street Bridge			***		
249.79		718.12	718.28		717.72	716.79
249.78		718.06	718.23	***		
249.76		718.01	718.18		717.25	716.51
249.74		717.98	718.15	***		
249.73		717.99	718.15	***		
249.5	AH	718.00	718.17	AH	717.27	716.57
249.4		717.81	717.98	***		
249.3	West Main Street / Ohio State Route 3			Main Street Bridge		
249.2		717.46	717.63	***		
249.1		717.42	717.60		716.93	716.35
249.08		717.41	717.59	***		
249.06		717.39	717.57	***		
249.04		717.38	717.56	***		
249.02		717.37	717.55	***		
249		717.36	717.54		716.46	715.84
248.5		717.50	717.67	Main Street Dam (Removed-Post Project)		
248.4		717.48	717.66	***		

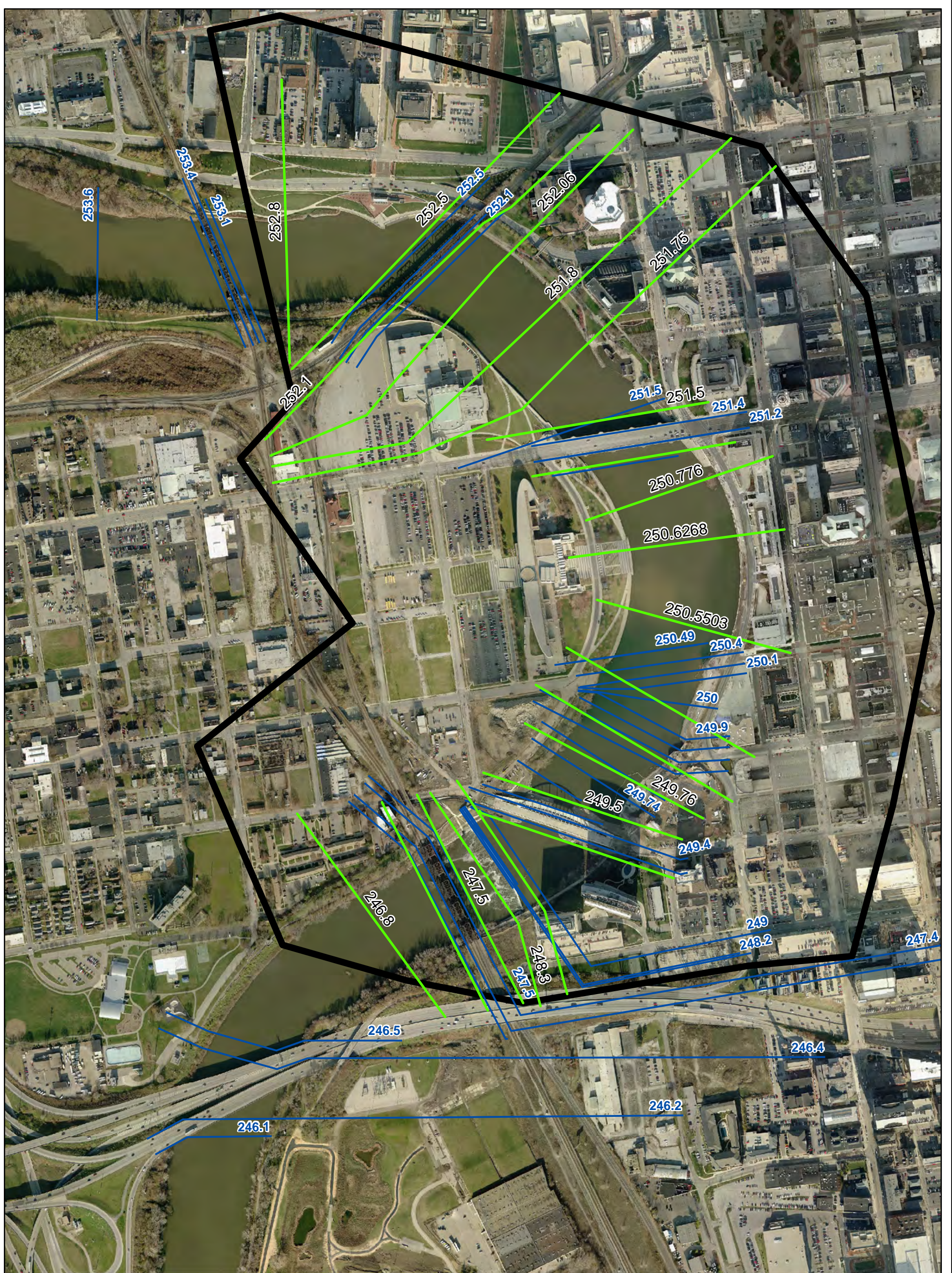
HEC-RAS River Sta. All Models*	Effective / Duplicate Effective Models 1-Percent-Annual-Chance Profiles (NGVD 29) (feet)**			Pre-Project / Post-Project Models 1-Percent-Annual-Chance Profiles (NAVD 88) (feet)**		
	FIS Cross- Section Letter	Duplicate Effective Model	Effective Model	Cross-Section Letter	Pre-Project Model	Post-Project Model
248.3	Main Street Dam				715.95	715.85
248.2		716.93	717.13	***		
248.1		716.93	717.13	***		
247.5	AG	716.73	716.94	AG	715.95	715.93
247.4		716.59	716.59	***		
247.3	Penn Central Railroad Bridge			Shared CSX/Norfolk Southern Railroad Bridge		
247.2		716.41	716.42	***		
247.1		716.38	716.38		715.76	715.74
246.8	***				715.74	715.71
246.5	AF	716.16	716.16		715.56	715.56
246.4		715.92	715.92		715.32	715.32
246.3	Interstate 70/71 Bridge			Interstate 70 Bridge		
246.2		715.63	715.63		715.03	715.03
246.1		715.65	715.65		715.05	715.05
245	AE	714.99	714.99	AE	714.39	714.39

*This number is the HEC-RAS model cross-section reference number and does not reflect the actual mileage of the river.

**Effective profile discharge is 75,000 cfs.

***Cross-Section Location/Spacing changed to better model pre-project and post-project flood conditions

Appendix A
Hydraulic Model Layout



Legend

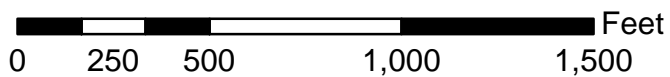
— Corrected Effective/Pre-Project Cross Sections

— Effective Cross Sections

Project Area



SCALE:
1 in = 500 feet



SCALE:

1 in = 0 miles

1 OF 2

PROJECT NO. 173408853

Date: 1/24/2013

Drawn By: KAS

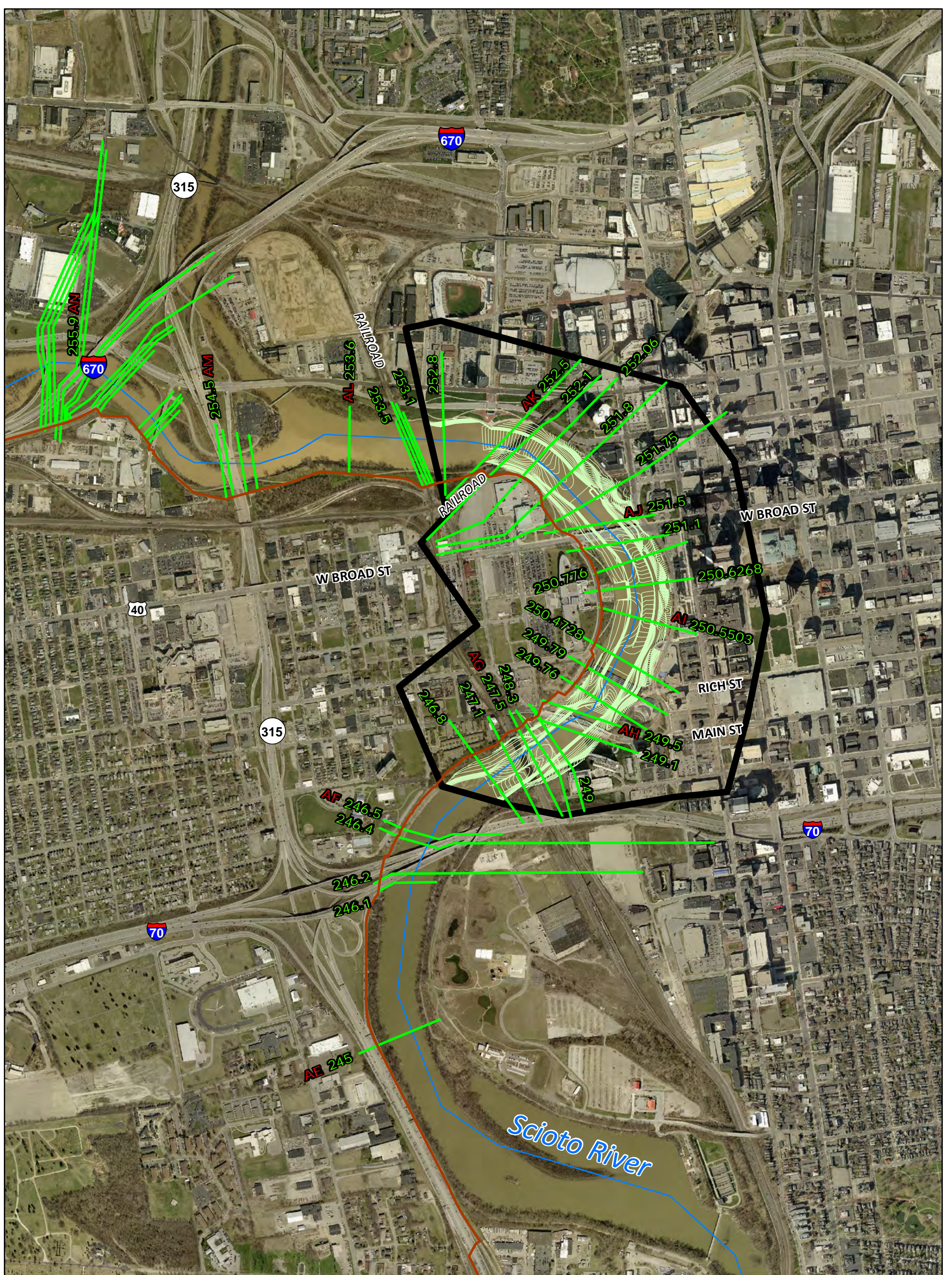
Checked By: TW

Checked By:






Revised

1.

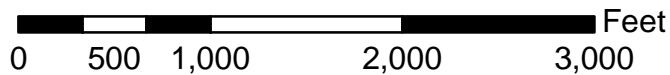
2.



Legend

-  Flood Protection Wall
-  Model Cross-sections
-  Project Area
-  Stream Centerline
-  Proposed Grading

SCALE:
1 in = 1,000 feet



PAGE
2 OF 2

PROJECT NO. 173408853

Date:	1/24/2013
Drawn By:	KAS
Checked By:	TW
Checked By:	
Revised	
1.	
2.	

Appendix B
Cross-Section Comparisons

B1 – Hydraulic Summary Tables

Post-Project																										
Reach	River Sta	Profile	W.S. Elev (ft)	Min Ch El (ft)	Top Width (ft)	Top Width Act (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Sta W.S. Lft (ft)	Sta W.S. Rgt (ft)	Left Sta Eff (ft)	Right Sta Eff (ft)	Ineff El Left (ft)	Ineff El Right (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Area Left (sq ft)	Flow Area L (sq ft)	Area Channel (sq ft)	Flow Area Ch (sq ft)	Area Right (sq ft)	Flow Area R (sq ft)
SciotoRiver	253.6	100-Year	720.34	693	680.88	680.88	73.9	674.1	40.35	721.23	40.35	721.23			365.05	74007.34	627.61	1.38	5.14	1.59	264.01	264.01	14400.12	14400.12	394.54	394.54
SciotoRiver	253.5	100-Year	719.9	693.1	555.32	555.32	3126.2	3603.2	3087.85	3643.17	3087.85	3643.17			823.05	73492.88	684.07	2.11	6.53	2.03	390.81	390.81	11255.46	11255.46	337.8	337.8
SciotoRiver	253.4	100-Year	719.99	691.4	603.13	603.13	2467.1	3176.4	2491.28	3094.41	2491.28	3094.41				75000							13065.7	13065.7		
SciotoRiver	253.3																									
SciotoRiver	253.2	100-Year	719.94	691.4	602.94	602.94	2467.1	3176.4	2491.46	3094.41	2491.46	3094.41				75000							13037.21	13037.21		
SciotoRiver	253.1	100-Year	719.93	691.4	606.13	606.13	2346.2	2971.7	2367.92	2974.05	2367.92	2974.05				74999.93	0.07		5.71	0.18			13126.6	13126.6	0.39	0.39
SciotoRiver	252.8	100-Year	719.78	692.84	940.58	921.74	759.86	1232.68	236.99	1305.88	346.92	1305.88	729.5		1559.79	72721.7	718.5	1.19	6.14	1.76	1315.04	1311.28	11853.03	11853.03	409.08	409.08
SciotoRiver	252.5 AK	100-Year	719.75	687	1226.83	740.54	1006.02	1494.98	105.36	1569.18	828.64	1569.18	731.85	728.08	4830.86	69323.15	845.99	2.34	5.26	1.44	3163.68	2065.01	13173.06	13173.06	587	587
SciotoRiver	252.3																									
SciotoRiver	252.1	100-Year	719.34	691.49	1006.06	674.81	991.32	1410.85	236.37	1495.61	814.32	1489.13	731.43	728.47	6189.53	66809.68	2000.8	3.15	6.65	2.74	3188.75	1965.95	10044.77	10044.77	735.59	729.28
SciotoRiver	252.06	100-Year	719.19	687	687.8	596.85	1025.13	1400.05	745.8	1472.36	875.51	1472.36	723.79		3728.68	68963.04	2308.29	2.79	6.9	3.02	1663.11	1335.86	9993.7	9993.7	765.09	765.09
SciotoRiver	251.8	100-Year	718.82	691.95	553.67	553.67	1359.95	1702.95	1259.92	1841	1259.92	1841	727.9	724.69	2985.51	67951.41	4063.09	3.27	7.99	3.8	912.11	912.11	8501.07	8501.07	1069.71	1069.71
SciotoRiver	251.75	100-Year	718.76	682	620.37	620.37	1635.84	1966.67	1487.99	2108.36	1487.99	2108.36			3933.49	66135.38	4931.13	3	7.53	3.32	1311.49	1311.49	8788.1	8788.1	1486.94	1486.94
SciotoRiver	251.5 AJ	100-Year	718.67	691.94	634.31	634.31	351.18	688.28	213.21	847.52	213.21	847.52	731.57	728	3563.45	63805.26	7631.29	2.97	7.53	3.73	1200.82	1200.82	8474.66	8474.66	2046.34	2046.34
SciotoRiver	251.3																									
SciotoRiver	251.1	100-Year	718.19	688.4	594.82	594.82	332.54	651.91	205.76	800.58	205.76	800.58	731.34	727.86	3316.37	63401.8	8281.83	3.27	7.57	4.24	1013.52	1013.52	8375.69	8375.69	1952.31	1952.31
SciotoRiver	250.776	100-Year	717.8	685	553.5	553.5	489.43	760.89	427.69	981.19	427.69	981.19	732.45		1125.3	63335.75	10538.95	2.77	8.63	4.14	406.08	406.08	7339.81	7339.81	2546.73	2546.73
SciotoRiver	250.6268	100-Year	717.51	691.02	593.61	593.61	433.43	702.98	350.81	944.41	350.81	944.41		728.71	1630.25	63467.05	9902.69	3.06	9.19	4.09	532.25	532.25	6902.35	6902.35	2421.96	2421.96
SciotoRiver	250.5503 AI	100-Year	717.42	685	589.02	589.02	481.34	759.75	386.75	975.76	386.75	975.76			1144.65	63391.04	10464.32	2.38	8.61	4.14	481.56	481.56	7364.37	7364.37	2525.78	2525.78
SciotoRiver	250.4728	100-Year	717.13	691.05	543.68	543.68	528.98	819.98	427.63	971.31	427.63	971.31	731.25	727.2	2827.84	63748.26	8423.9	3.35	8.76	4.55	843.59	843.59	7279.1	7279.1	1852.02	1852.02
SciotoRiver	250.4469																									
SciotoRiver	249.79	100-Year	716.85	690.25	564.81	563.96	532.3	829.35	404.15	968.96	405	968.96	729.05	728.74	4571.19	64067.87	6360.94	3.64	8.53	3.93	1256.04	1255.96	7511.01	7511.01	1620.1	1620.1
SciotoRiver	249.76	100-Year	716.51	684	528.62	528.62	427.35	699.27	346.34	874.96	346.34	874.96	724.73	726	1280.77	65027.76	8691.47	2.7	9.15	4.41	474.21	474.21	7104.47	7104.47	1969.18	1969.18
SciotoRiver	249.5 AH	100-Year	716.61	690.05	652.4	652.4	434.84	787.23	279.79	932.19	279.79	932.19	725.01	723.66	3629.29	66240.86	5129.86	2.92	7.5	3.46	1244.22	1244.22	8828.2	8828.2	1483.69	1483.69
SciotoRiver	249.3																									
SciotoRiver	249.1	716.38	689.91	716.37	716.37	594.64	931.2	372.48	1088.85	372.48	1088.85	723.28	720.62	8595.22	61233.2	5171.55	1281.78	3.47	7.18	3.15	2476.98	2476.98	8529.88	8529.88	1640.74	1640.74
SciotoRiver	249	715.86	689.44	826.15	564.77	668.51	962.57	88.65	1106.42	541.65	1106.42	724.51	720.58	5895.22	64166.1	4938.73	526.95	4.06	8.63	3.15	2339.66	1451.3	7433.31	7433.31	1567.62	1567.62
SciotoRiver	248.3	715.85	687.79	944.4	625.68	623.91	933.71	140.6	1103.69	478.01	1103.69	723.6	723.6	2988.05	66719.3	5292.66	525.98	2.79	8.19	3.72	2123.29	1070.25	8149.03	8149.03	1423.27	1423.27
SciotoRiver	247.5 AG	715.93	685.23	918.93	647.76	521.82	879.96	91.78	1010.71	362.95	1010.71	719.22	722.94	3454.4	68287.6	3258.01	1062.62	2.1	7	2.2	2322.34	1644.94	9760.67	9760.67	1481.36	1481.36
SciotoRiver	247.3																									
SciotoRiver	247.1	100-Year	715.73	682	591.02	591.02	440.85	835.49	347.55	938.58	347.55	938.58	721.42	722.83	2538.72	68732.6	3728.68	2.83	6.58	3.1	897.98	897.98	10444.94	10444.94	1201.99	1201.99
SciotoRiver	246.8	100-Year	715.71	686.53	591.07	591.07	324.91	758.34	283.9	874.97	283.9	874.97		723.04	871.01	70625.23	3503.76	1.77	6.14	2.57	492.46	492.46	11498.71	11498.71	1365.16	1365.16
SciotoRiver	246.5	100-Year	715.56	684	599.51	599.51	3103.3	3604.9	3056.16	3655.66	3056.16	3655.66			659.15	73521.21	819.64	1.4	5.4	1.52	470.92	470.92	13603.31	13603.31	540.07	540.07
SciotoRiver	246.4	100-Year	715.32	685.1	651	423.4	4004.3	4427.7	3828.86	4479.85	4004.3	4427.7	724	717		75000			6.42		1561.24		11676.63	11676.63	768.36	
SciotoRiver	246.3																									
SciotoRiver	246.2	100-Year	715.03	685.1	649.37	423.4	4004.3	4427.7	3830.38	4479.75	4004.3	4427.7	724	717		75000			6.49		1509.62		11551.53	11551.53	752.97	
SciotoRiver	246.1	100-Year	715.05	685.1	658.74	658.74	4057.8	4456	3879.7	4538.43	3879.7	4538.43	688.8	688.7	2329.62	68935.46	3734.92	1.49	6.32	2.49	1560.38	1560.38	10905.6	10905.6	1501.71	1501.71
SciotoRiver	245	100-Year	714.39	684.9	600.85	600.85	3645	4103	3564.53	4165.38	3564.53	4165.38	699.4	699.4	826.03	73188.59	985.39	1.42	5.78	1.71	579.91	579.91	12665.48	12665.48	576.48	576.48

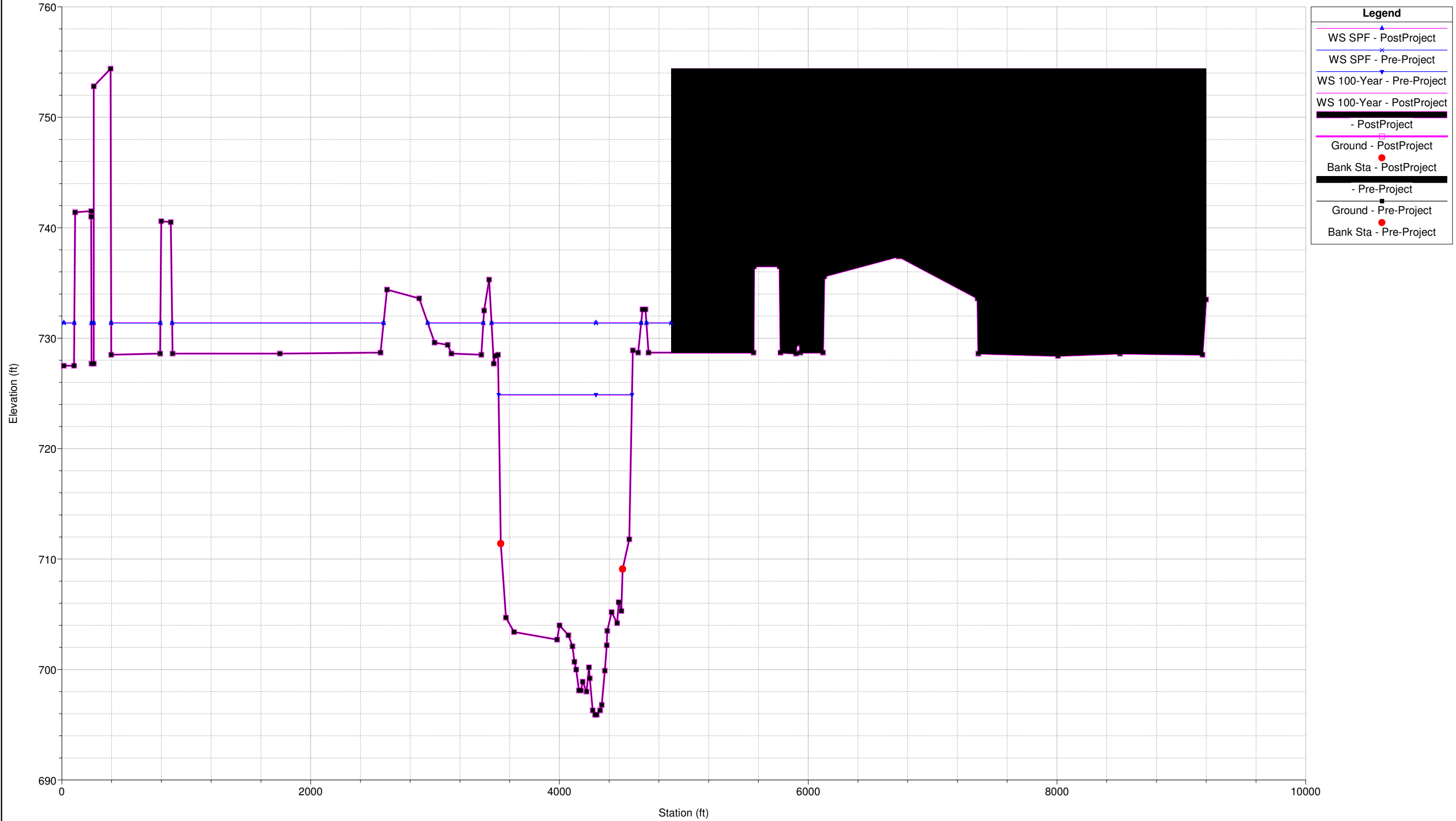
*Pre-Project elevations are referenced to NAVD88.

Heading	Unit	Description
W.S. Elev	(ft)	Calculated water surface
Min Ch El	(ft)	Minimum channel elevation
Top Width	(ft)	Top width of the wetted cross section
Top Width Act	(ft)	Top width of the wetted cross section, not including ineffective flow
Ch Sta L	(ft)	Left station of channel
Ch Sta R	(ft)	Right station of channel
Sta W.S. Lft	(ft)	Left station where water intersects the ground
Sta W.S. Rgt	(ft)	Right station where water intersects the ground
Left Station Eff	(ft)	Furthest left station where there is effective flow
Rght Sta Eff	(ft)	Furthest right station that still has effective flow
Ineff El Left	(ft)	The elevation of the left ineffective area
Ineff El Right	(ft)	The elevation of the right ineffective area
Q Left	(cfs)	Flow in left overbank
Q Channel	(cfs)	Flow in main channel
Q Right	(cfs)	Flow in right overbank
Vel Left	(ft/s)	Average velocity of flow in left overbank
Vel Chnl	(ft/s)	Average velocity of flow in main channel
Vel Right	(ft/s)	Average velocity of flow in right overbank
Area Left	(sq ft)	Flow area of the left overbank, including ineffective flow
Flow Area L	(sq ft)	Area of left overbank active flow
Area Channel	(sq ft)	Flow area of the main channel, including ineffective flow
Flow Area Ch	(sq ft)	Area of main channel active flow
Area Right	(sq ft)	Flow area of the right overbank, including ineffective flow
Flow Area R	(sq ft)	Area of right overbank active flow

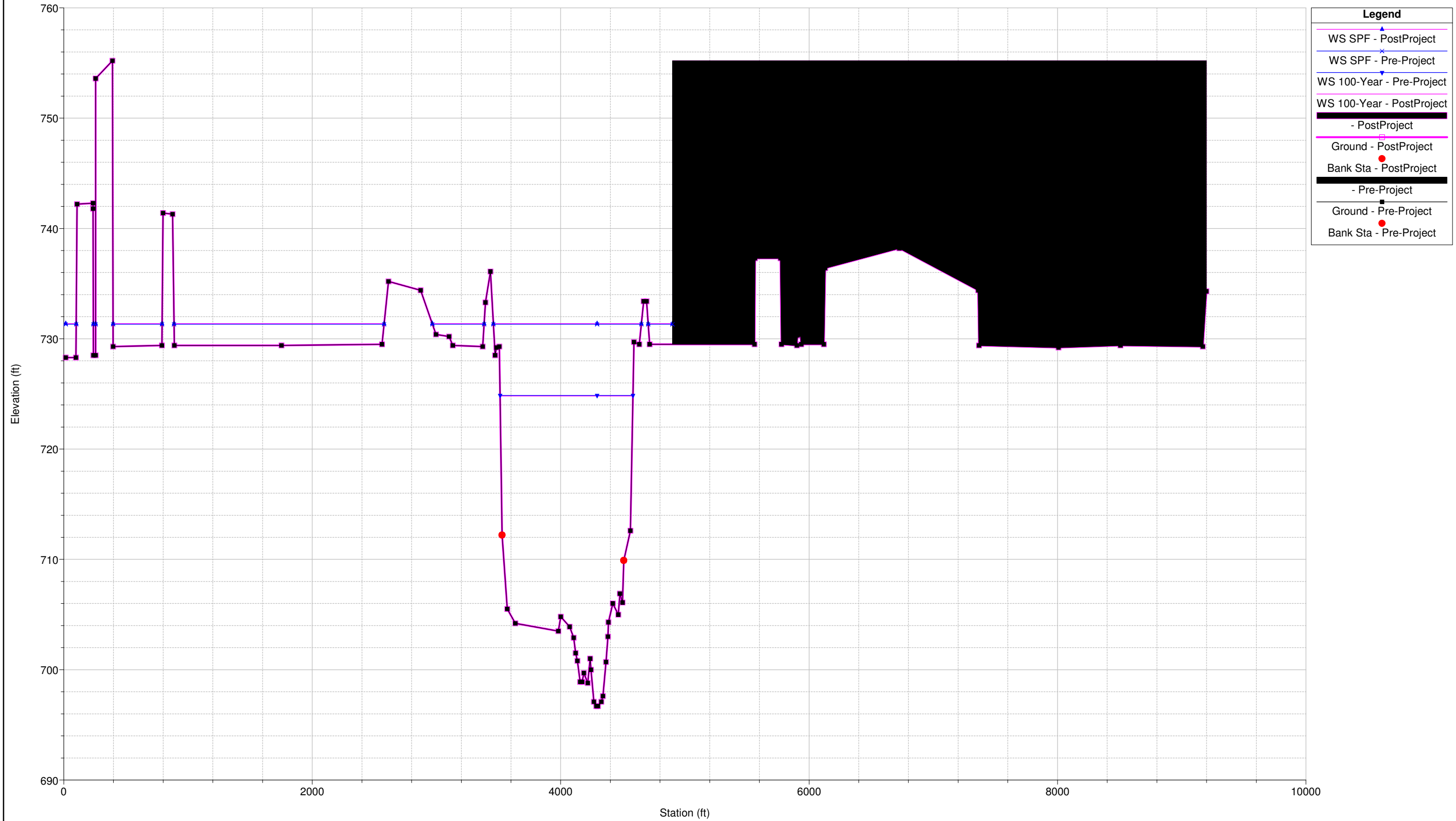
Scioto Greenways Hydraulics Summary								
Station	1% Annual Chance Flood			Standard Project Flood (SPF)				
	Pre-Project	Post Project	Difference	Pre-Project	Post Project	Difference	Levee Top	Post Freeboard
256.066	724.89	724.84	-0.05	731.36	731.41	0.05		
256	724.86	724.81	-0.05	731.32	731.38	0.06		
255.96	724.80	724.75	-0.05	731.22	731.27	0.05		
255.95	723.73	723.67	-0.06	730.46	730.53	0.07		
255.94	724.10	724.04	-0.06	730.74	730.80	0.06		
255.93	I-670 Ramp Bridge							
255.92	723.45	723.39	-0.06	730.31	730.39	0.08		
255.91	723.46	723.40	-0.06	730.40	730.47	0.07		
255.9	723.28	723.22	-0.06	730.19	730.27	0.08		
255.8	723.56	723.50	-0.06	730.38	730.45	0.07		
255.75	I-670 Bridge							
255.7	722.83	722.76	-0.07	729.71	729.80	0.09		
255.6	722.79	722.73	-0.06	729.76	729.86	0.10		
255.5	722.64	722.58	-0.06	729.59	729.69	0.10		
255.4	722.99	722.92	-0.07	729.86	729.95	0.09		
255.3	I-670 Ramp Bridge							
255.2	722.05	721.97	-0.08	728.92	729.13	0.21		
255.1	721.84	721.77	-0.07	728.91	729.12	0.21		
254.95	721.94	721.87	-0.07	728.90	729.10	0.20		
254.94	721.82	721.75	-0.07	728.81	729.01	0.20		
254.93	North Souder Avenue Bridge							
254.92	721.72	721.64	-0.08	728.66	728.87	0.21		
254.91	721.21	721.13	-0.08	728.13	728.35	0.22		
254.5	720.86	720.77	-0.09	727.75	727.97	0.22		
254.4	720.84	720.75	-0.09	727.76	727.99	0.23		
254.3	St. Rt. 315 Bridge							
254.2	720.51	720.42	-0.09	727.15	727.39	0.24		
254.1	720.44	720.35	-0.09	727.04	727.28	0.24		
253.6	720.43	720.34	-0.09	727.13	727.37	0.24		
253.5	720.00	719.90	-0.10	726.68	726.94	0.26		
253.4	720.09	719.99	-0.10	726.86	727.12	0.26		
253.3	C&O Railroad Bridge							
253.2	720.04	719.94	-0.10	726.62	726.91	0.29		
253.1	720.03	719.93	-0.10	726.57	726.85	0.28		
252.8	719.89	719.78	-0.11	726.50	726.77	0.27	729.90	3.13
252.5	719.83	719.75	-0.08	726.43	726.72	0.29	728.60	1.88
252.3	Norfolk Southern Railroad Bridge							
252.1	719.67	719.34	-0.33	726.08	726.14	0.06	728.30	2.16
252.06	719.52	719.19	-0.33	725.98	726.07	0.09	727.00	0.93
251.8	719.34	718.82	-0.52	725.79	725.63	-0.16	729.55	3.92
251.75	719.28	718.76	-0.52	725.74	725.61	-0.13	731.40	5.79
251.5	719.13	718.67	-0.46	725.55	725.53	-0.02	730.08	4.55
251.3	Broad Street Bridge							
251.1	718.56	718.19	-0.37	724.48	724.51	0.03	729.04	4.53
250.776	718.52	717.80	-0.72	724.45	724.02	-0.43	728.31	4.29
250.6268	718.44	717.51	-0.93	724.39	723.88	-0.51	728.71	4.83
250.5503	718.32	717.42	-0.90	724.28	723.77	-0.51	728.00	4.23
250.4728	718.02	717.13	-0.89	723.96	723.49	-0.47	727.20	3.71
250.4469	Rich Street Bridge							
249.79	717.73	716.85	-0.88	723.58	723.08	-0.50	726.13	3.05
249.76	717.26	716.51	-0.75	723.11	722.75	-0.36	726.00	3.25
249.5	717.27	716.61	-0.66	723.17	722.88	-0.29	726.08	3.20
249.3	Main Street Bridge							
249.1	716.96	716.38	-0.58	722.00	721.96	-0.04	725.84	3.88
249	716.46	715.86	-0.60	721.42	721.21	-0.21	725.82	4.61
248.6	Main Street Dam							
248.3	715.95	715.85	-0.10	721.19	721.35	0.16	724.68	3.33
247.5	715.94	715.93	-0.01	721.18	721.42	0.24	724.20	2.78
247.3	CSX / Norfolk Southern Shared Railroad Bridge							
247.1	715.76	715.73	-0.03	720.48	720.45	-0.03	723.55	3.10
246.8	715.74	715.71	-0.03	720.46	720.41	-0.05	723.02	2.61
246.5	715.56	715.56	0.00	720.24	720.24	0.00		
246.4	715.32	715.32	0.00	719.93	719.93	0.00		
246.3	I-70/71 Bridge							
246.2	715.03	715.03	0.00	719.52	719.52	0.00		
246.1	715.05	715.05	0.00	719.55	719.55	0.00		
245	714.39	714.39	0.00	718.71	718.71	0.00		

B2 – Cross-section Comparisons

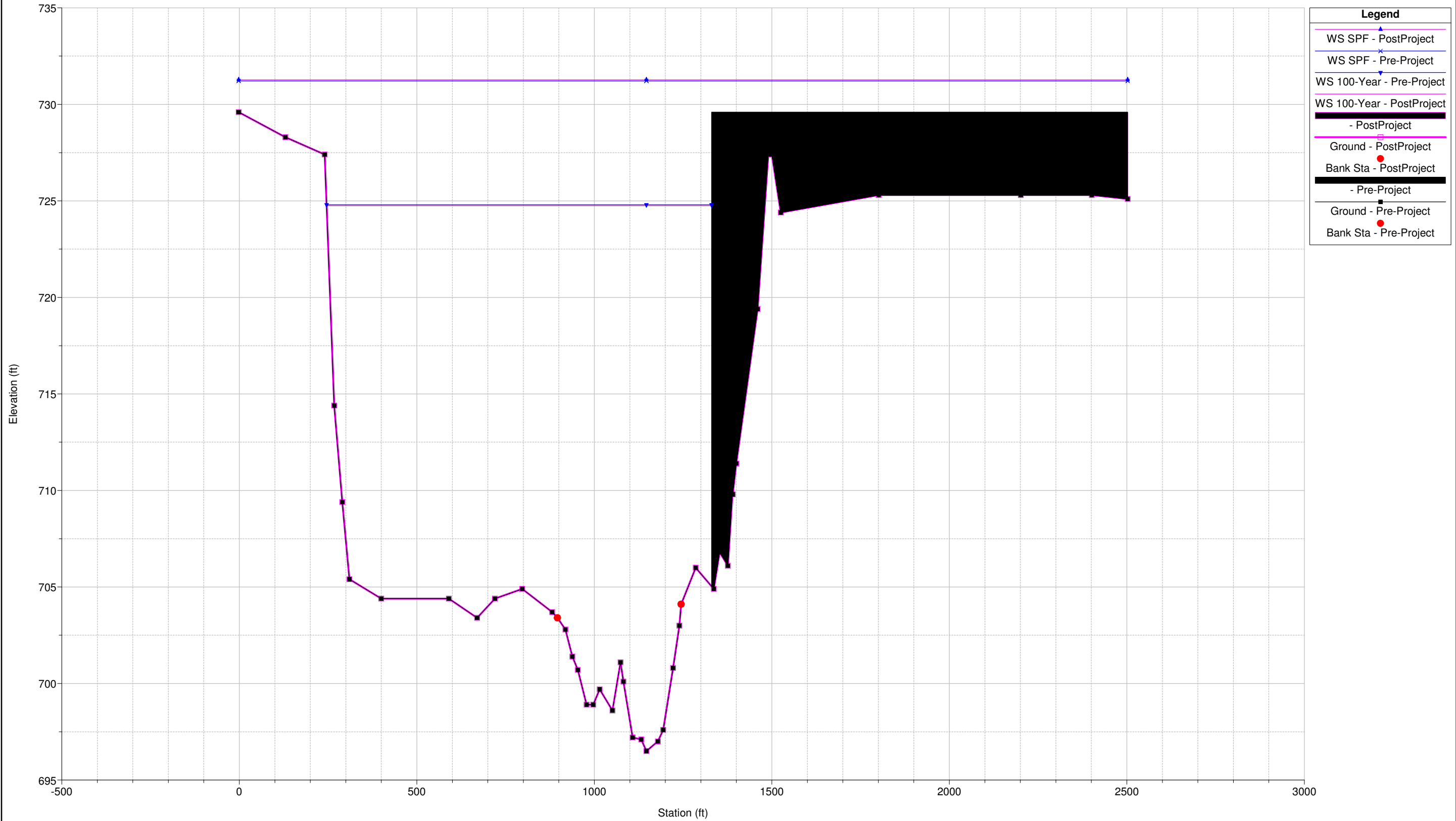
Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 256.066



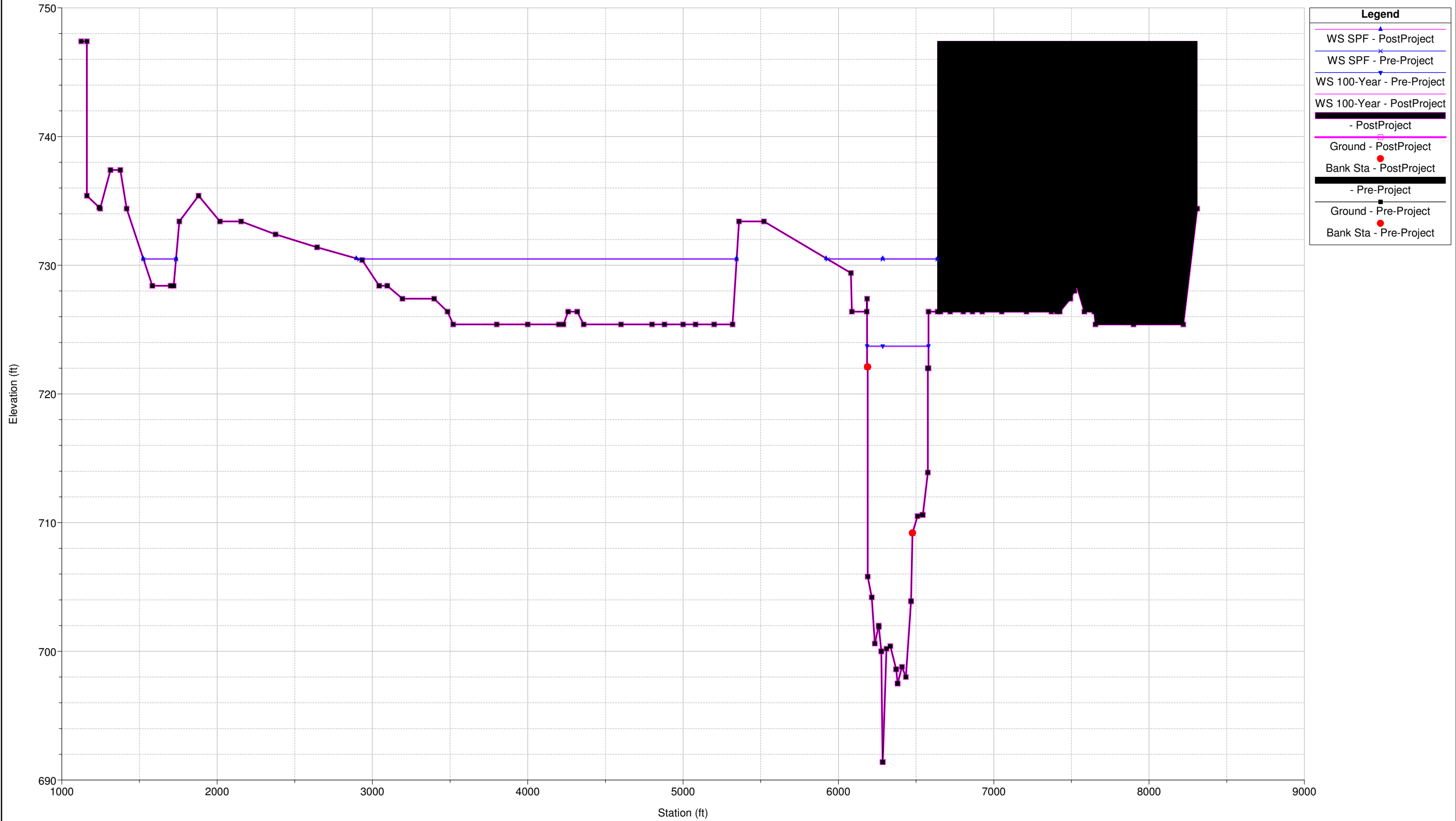
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 256



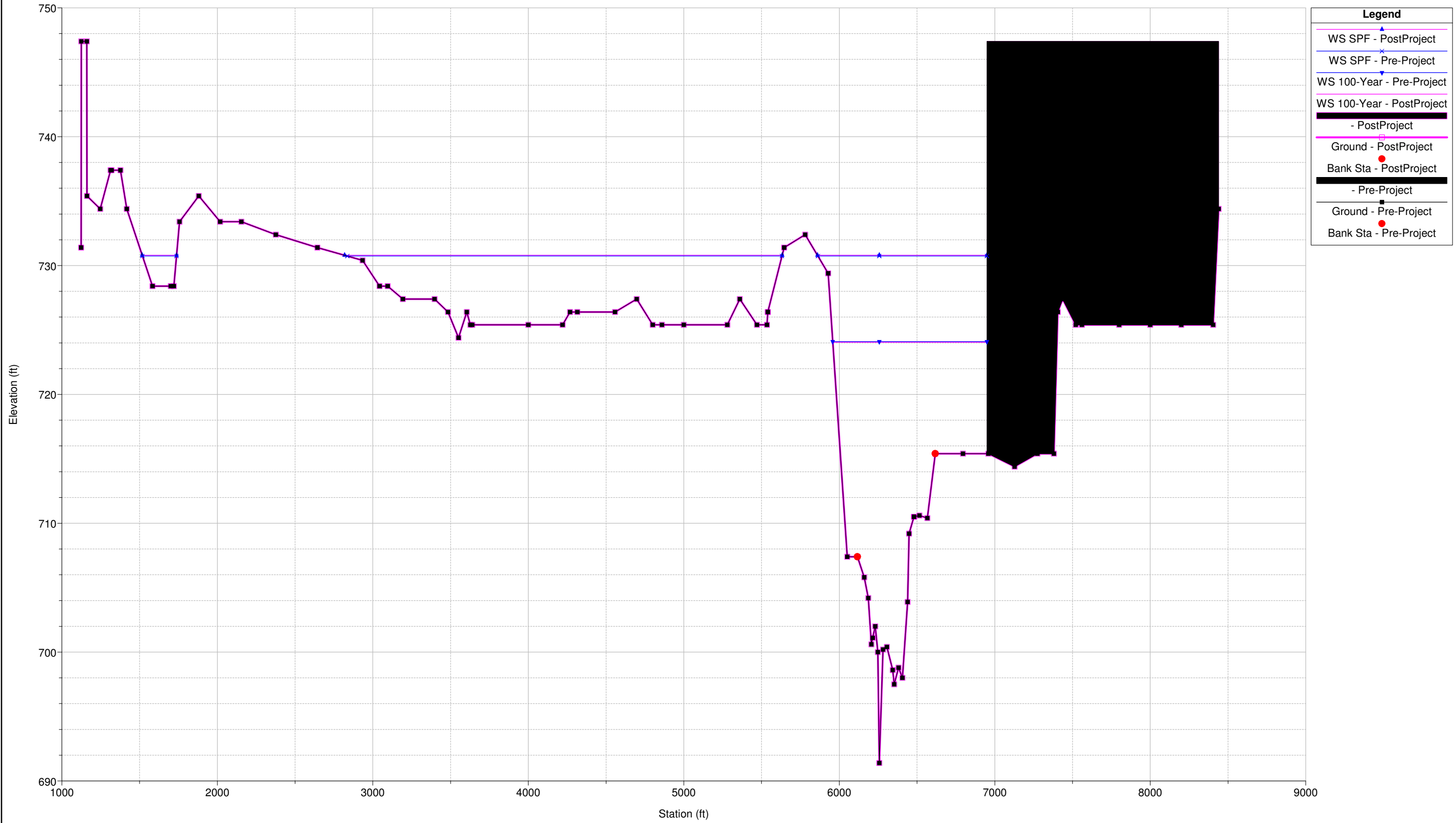
Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.96



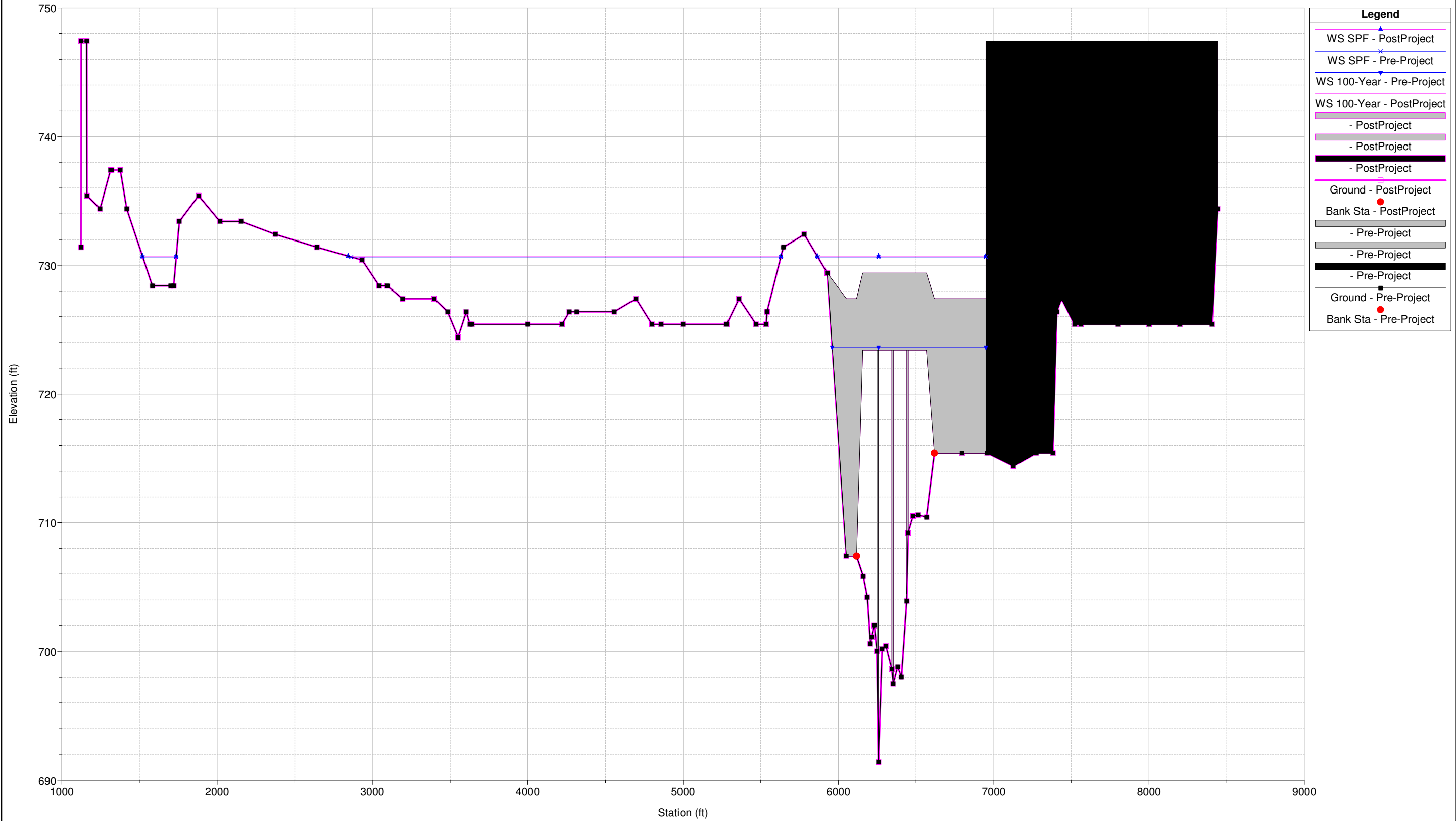
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.95



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.94

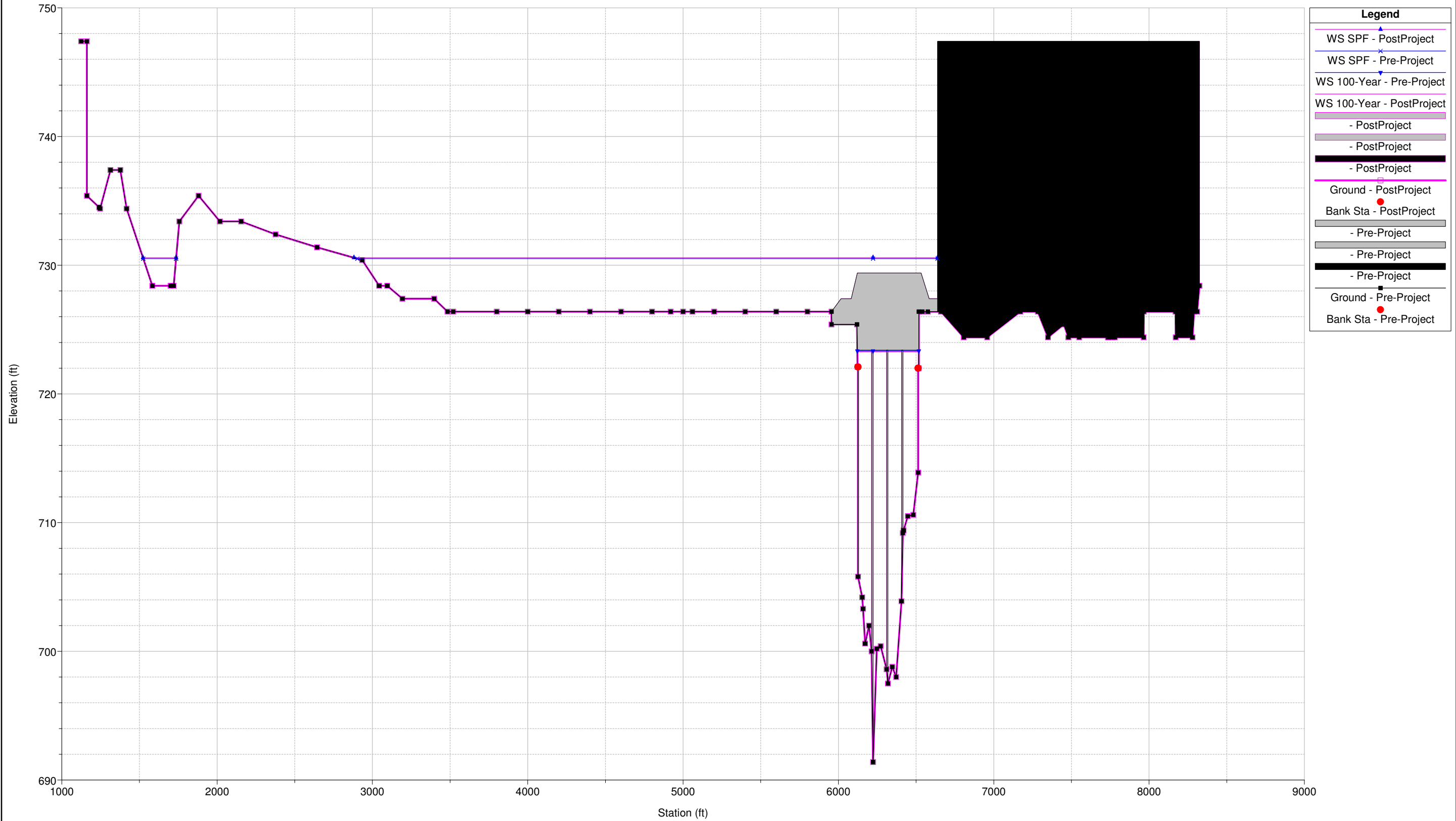


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.93 BR

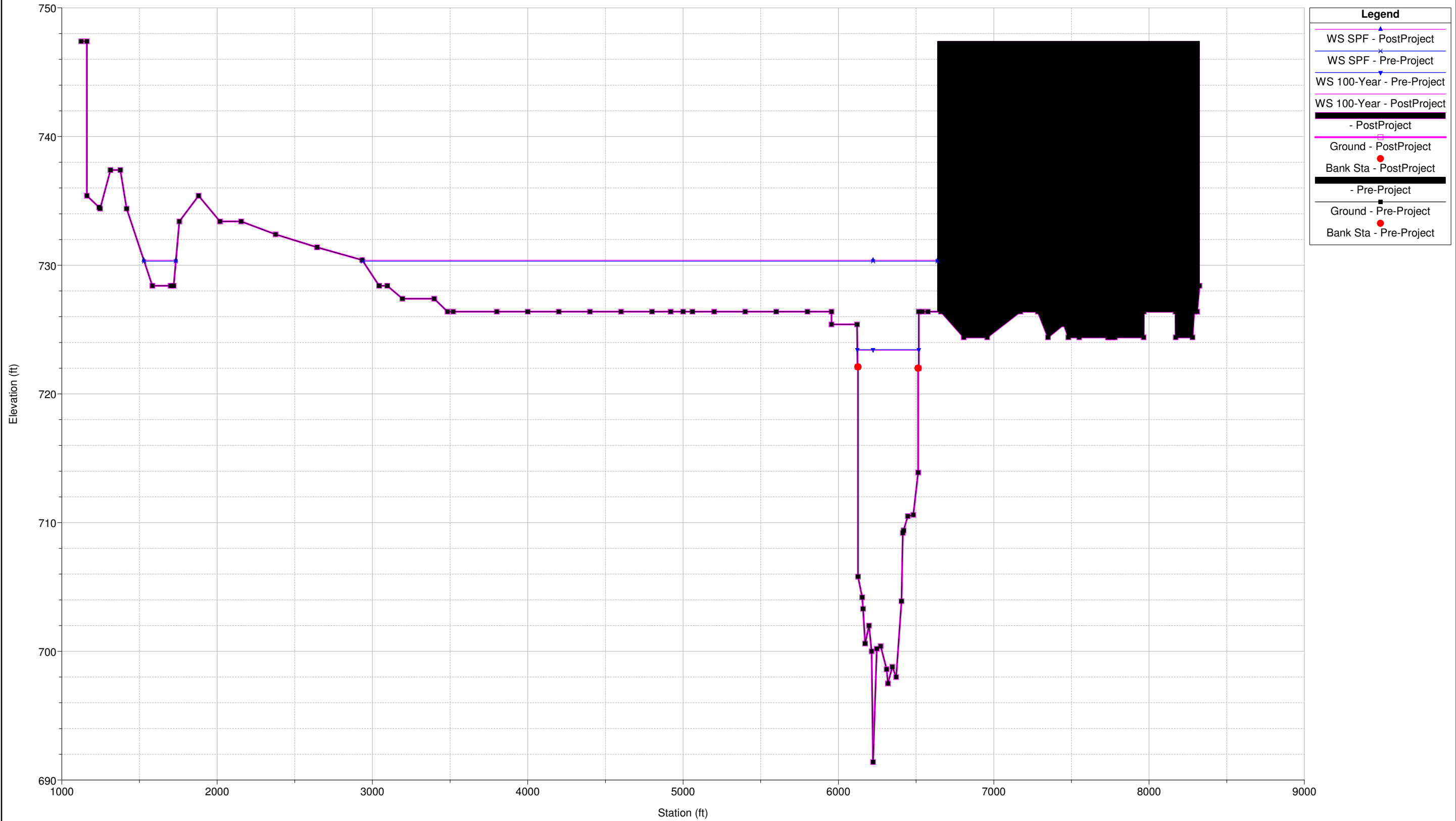


Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▲
WS 100-Year - PostProject	▲
- PostProject	■
- PostProject	■
- PostProject	■
- PostProject	■
Ground - PostProject	■
Bank Sta - PostProject	●
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
Ground - Pre-Project	■
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.93 BR



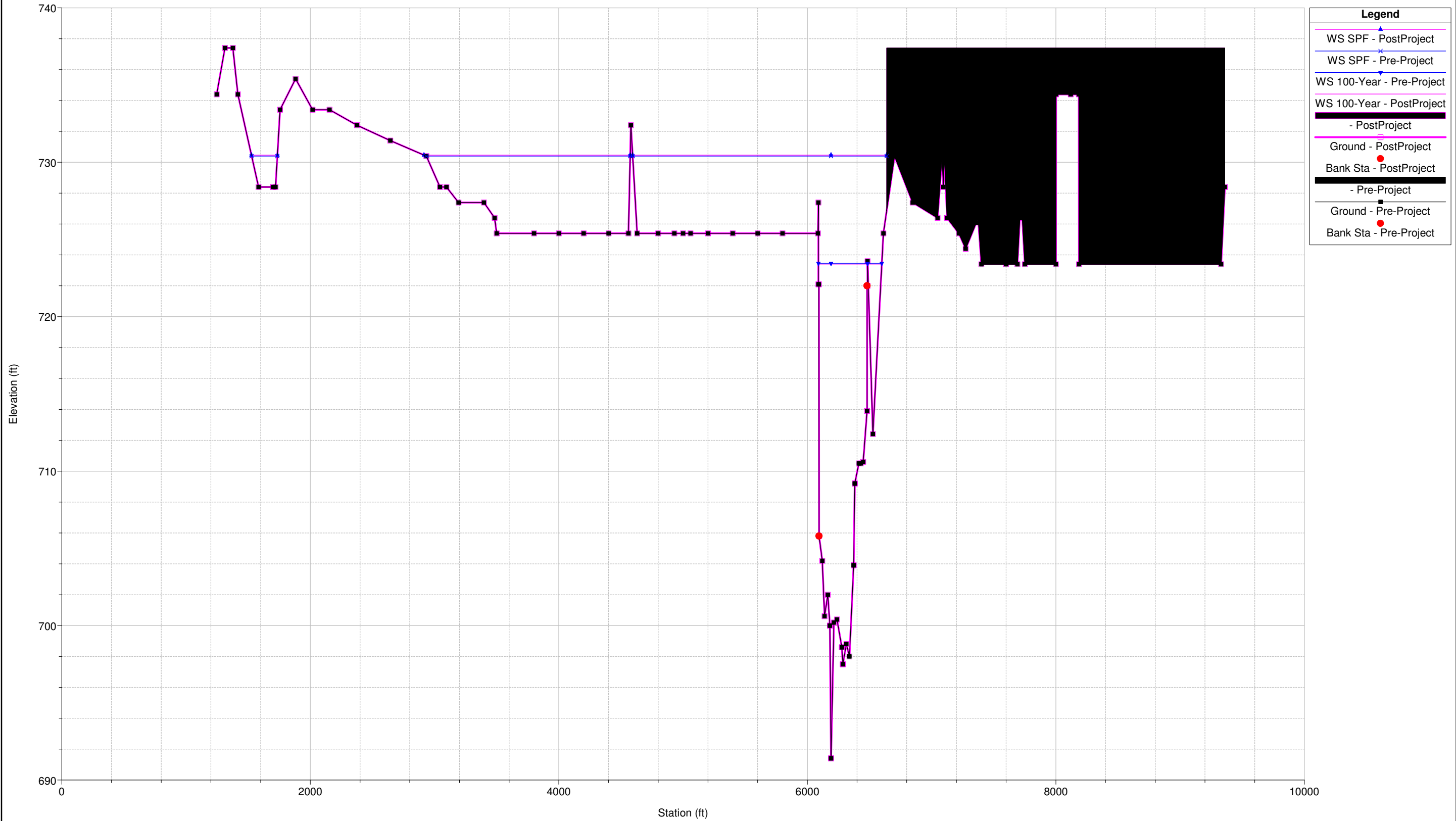
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.92



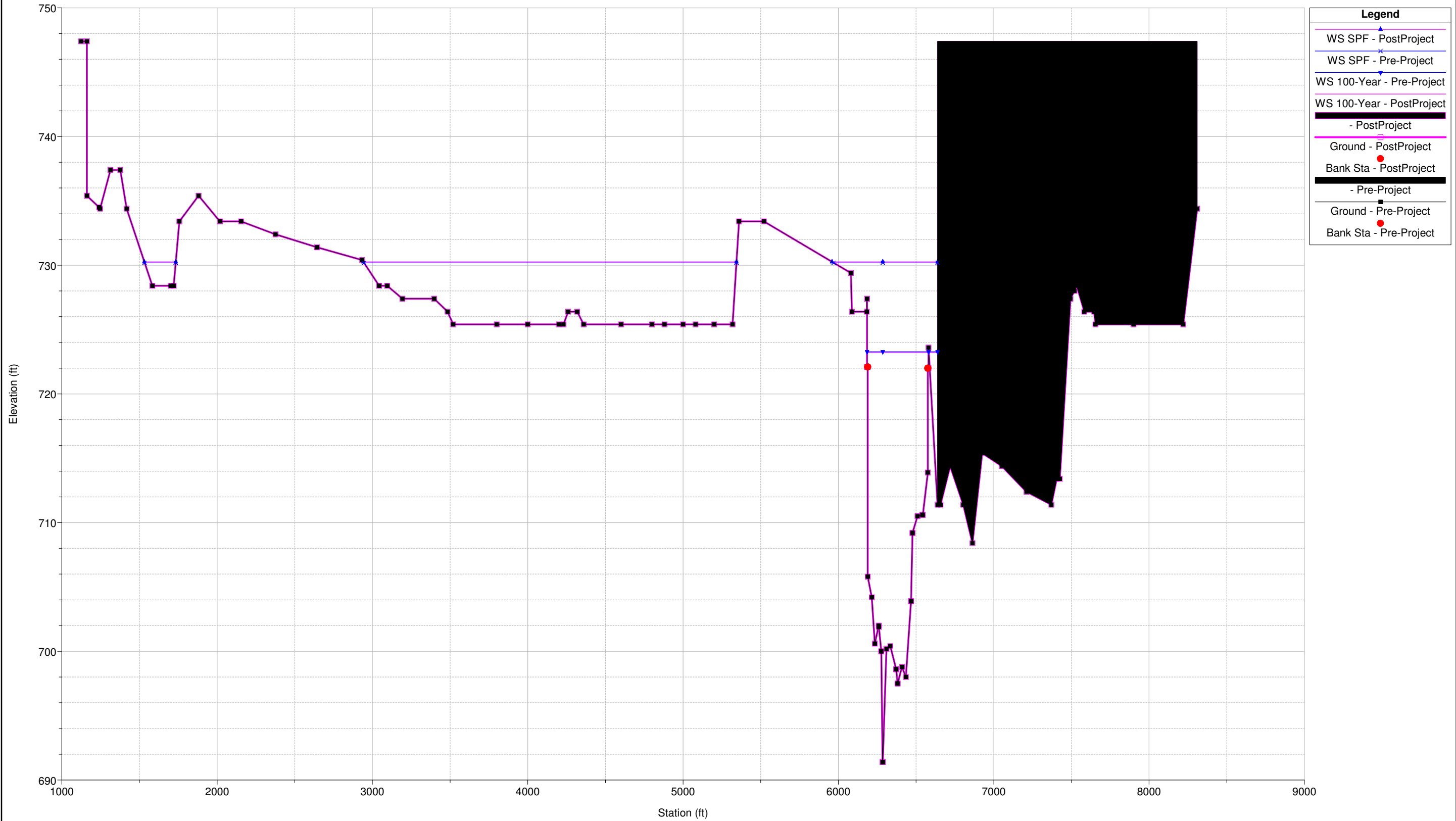
Legend

- WS SPF - PostProject (Blue line with triangles)
- WS SPF - Pre-Project (Blue line with triangles)
- WS 100-Year - Pre-Project (Blue line with triangles)
- WS 100-Year - PostProject (Blue line with triangles)
- PostProject (Black line with squares)
- Ground - PostProject (Black line with squares)
- Bank Sta - PostProject (Red circle)
- Pre-Project (Black line with squares)
- Ground - Pre-Project (Black line with squares)
- Bank Sta - Pre-Project (Red circle)

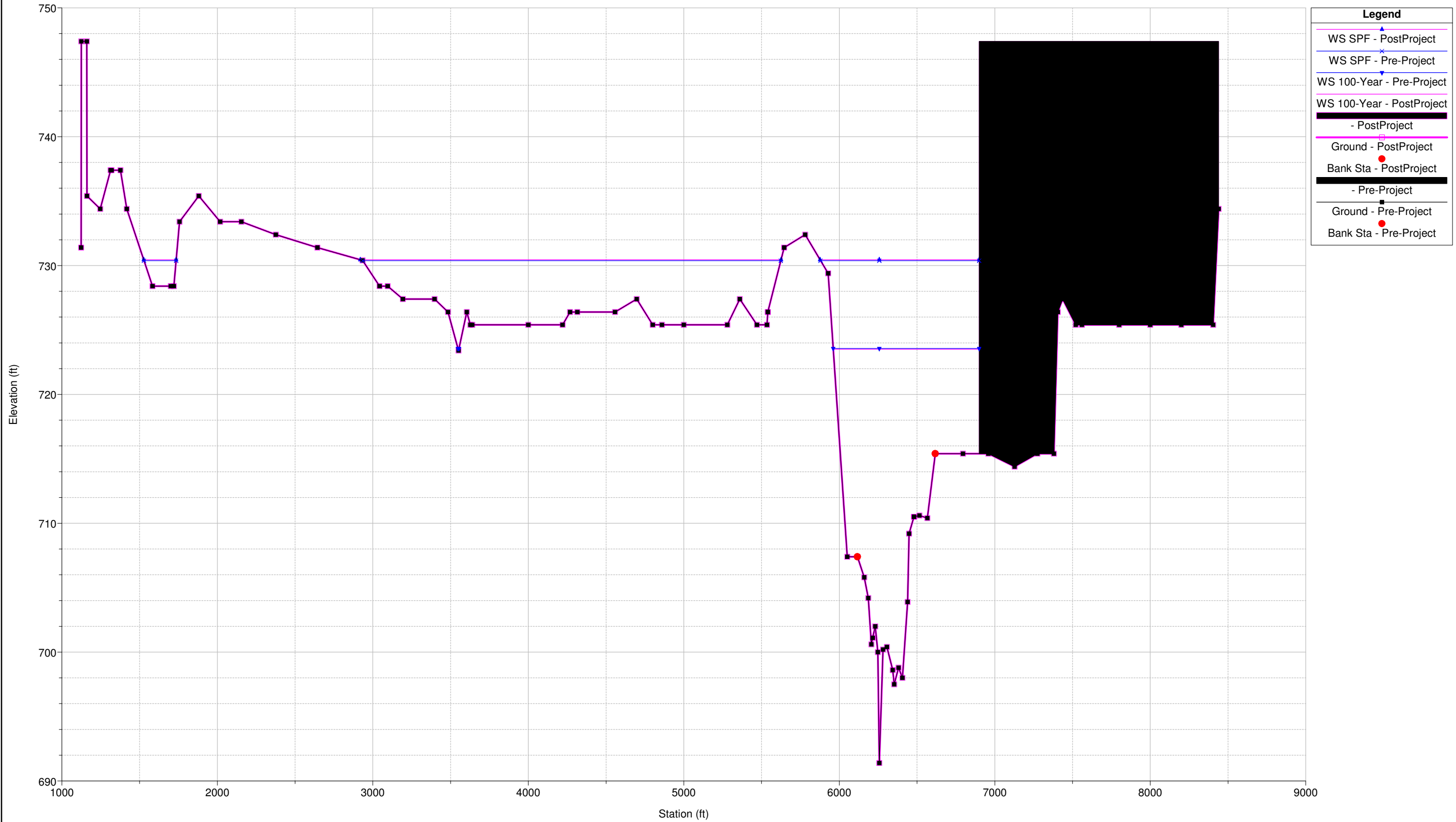
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.91



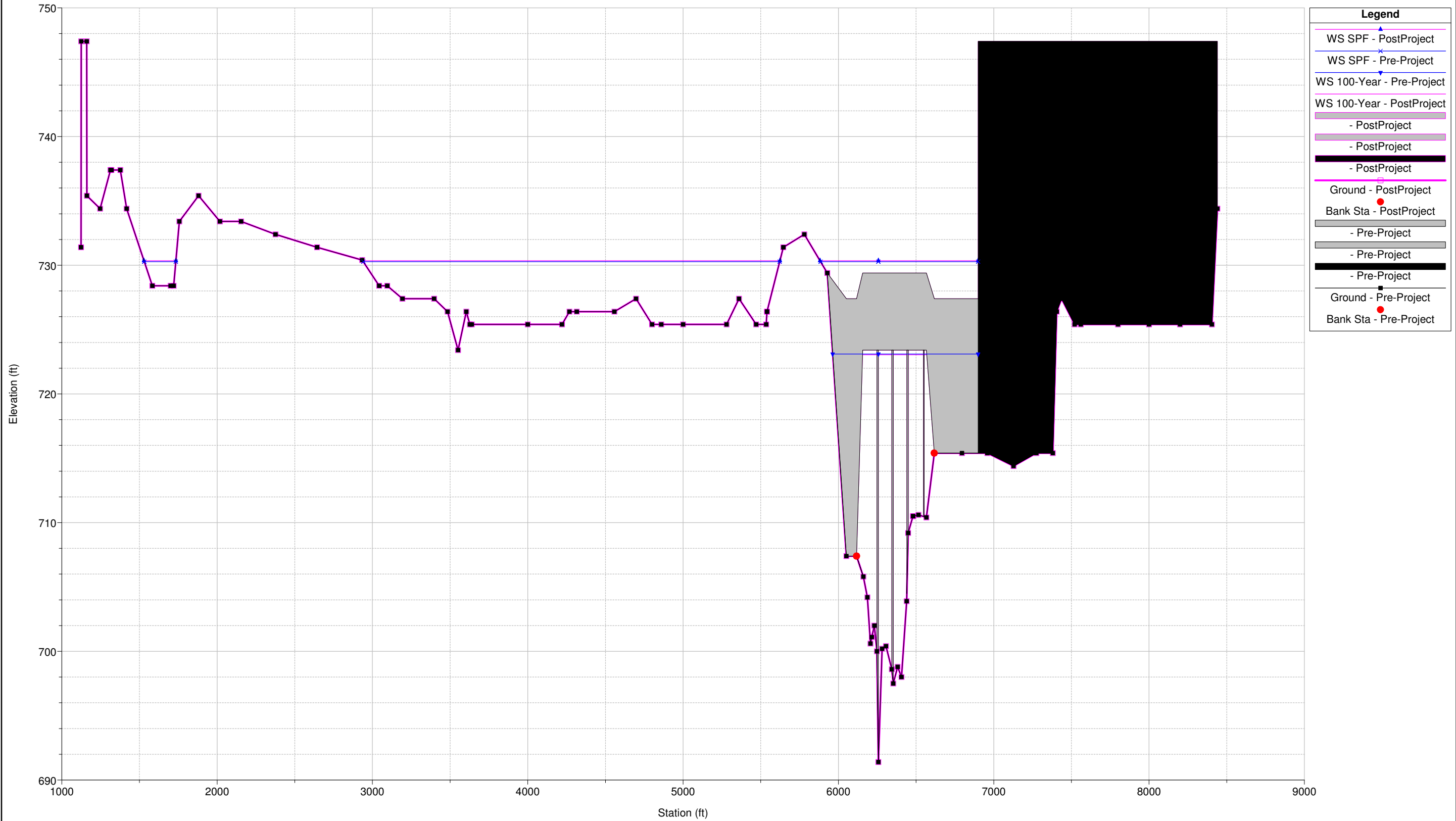
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.9



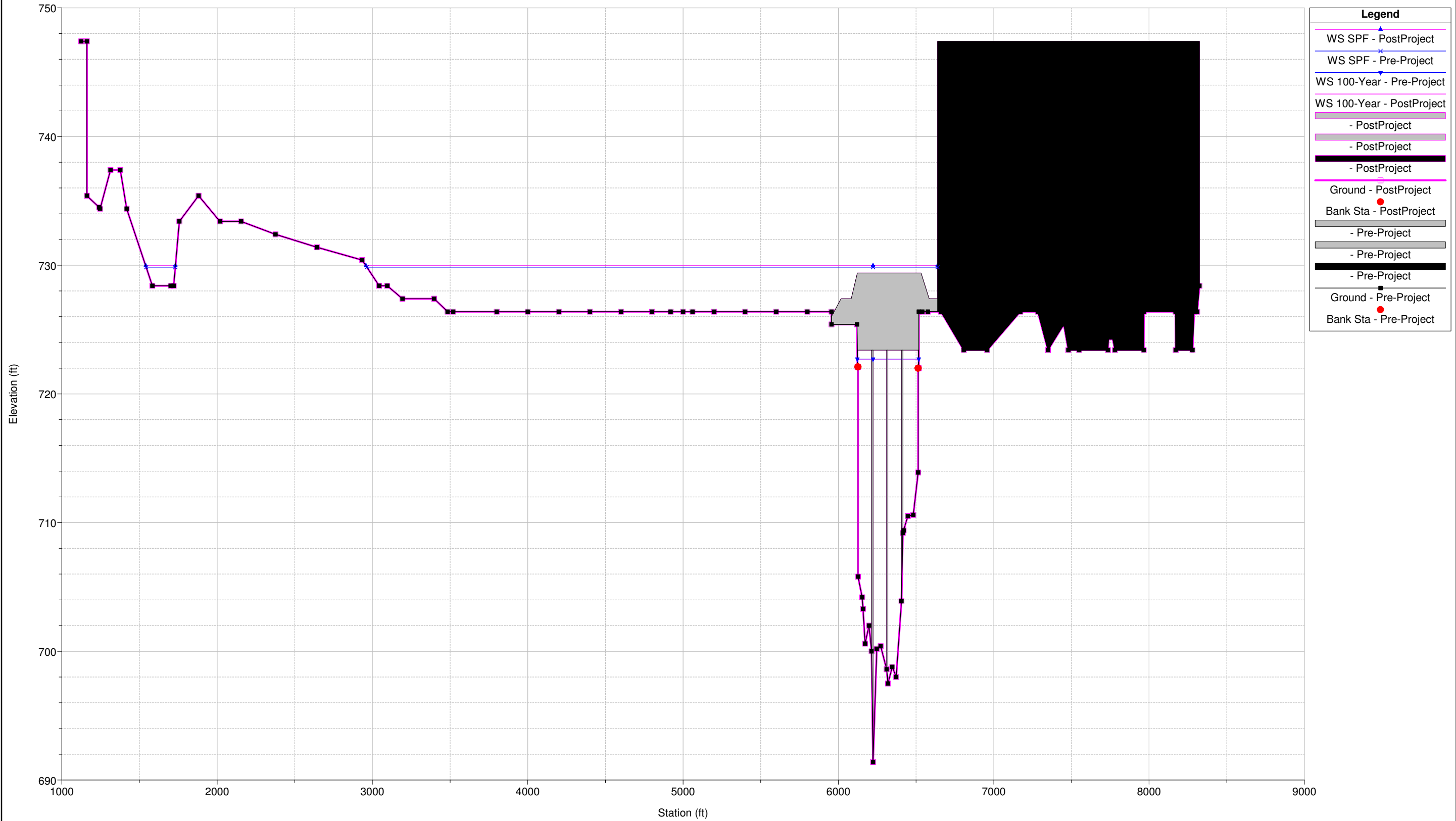
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.8



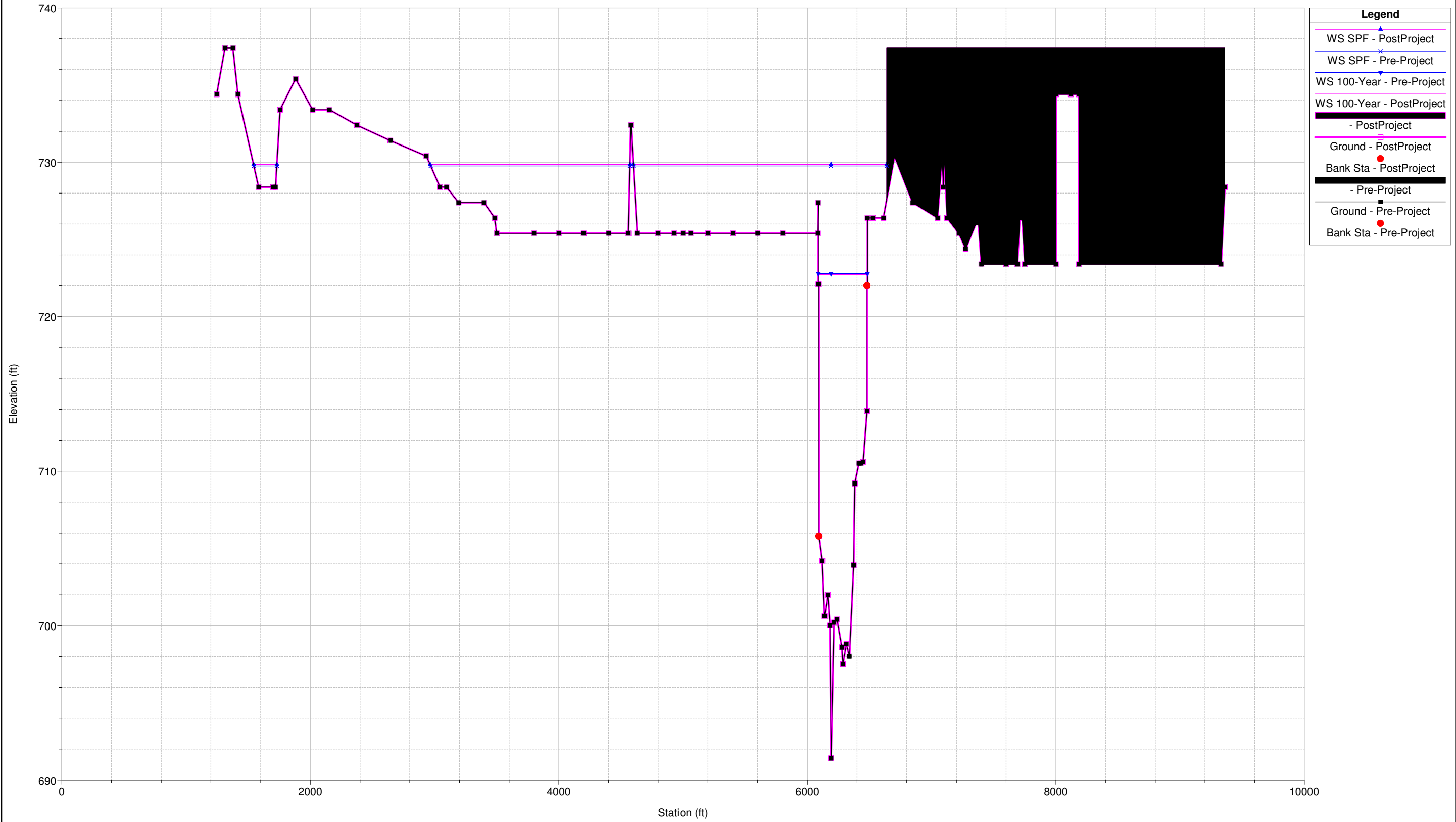
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.75 BR



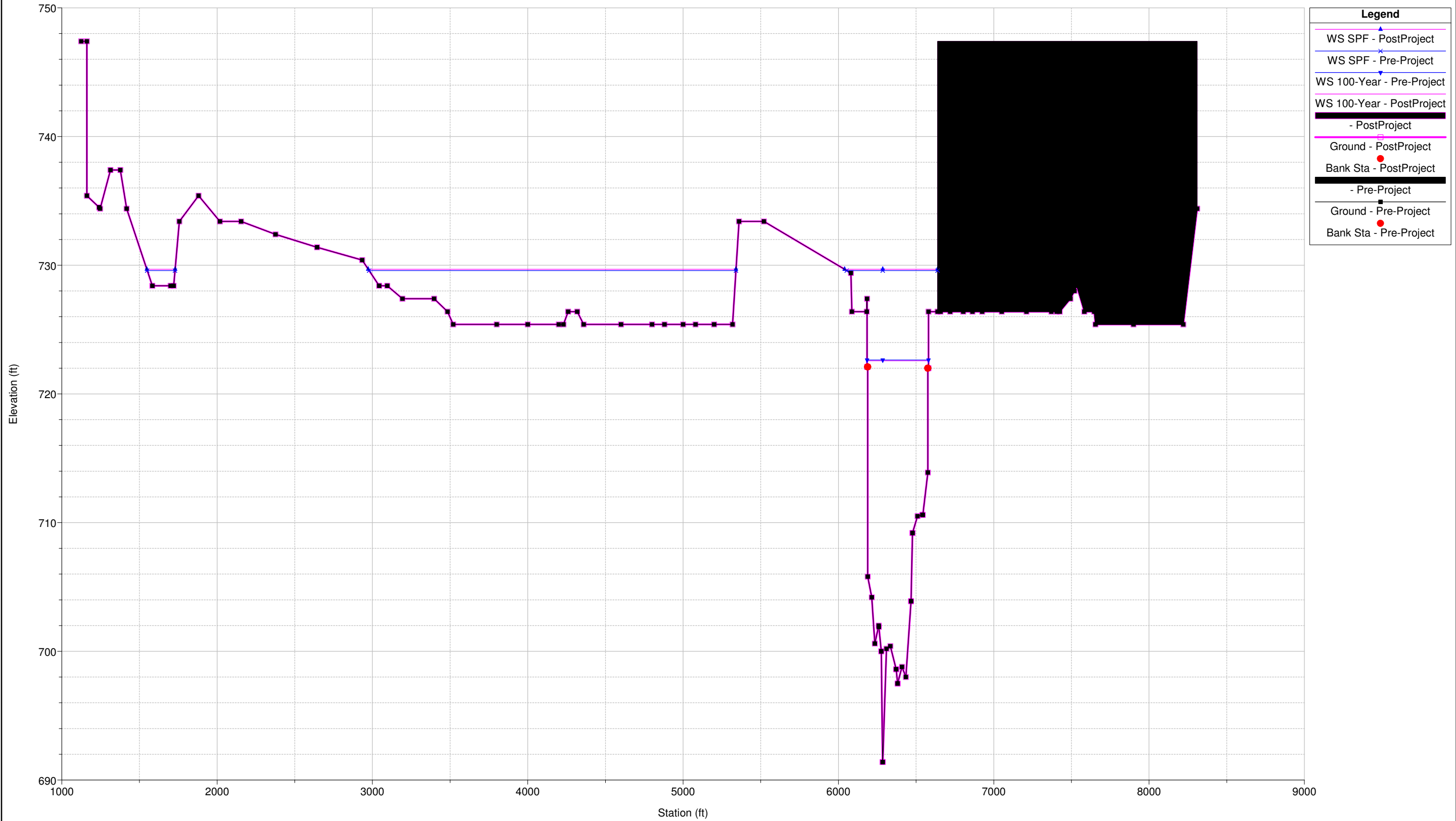
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.75 BR



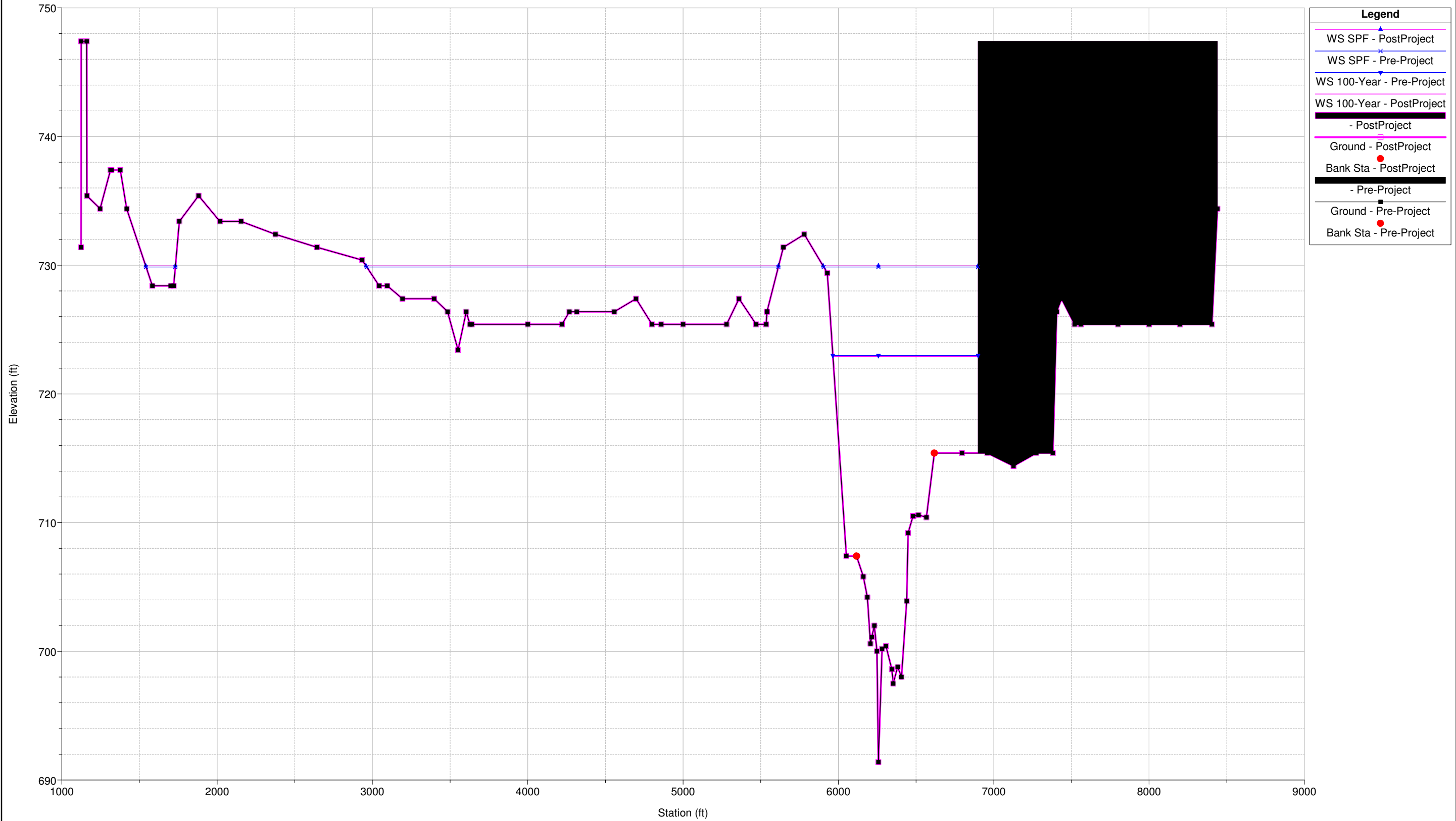
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.6



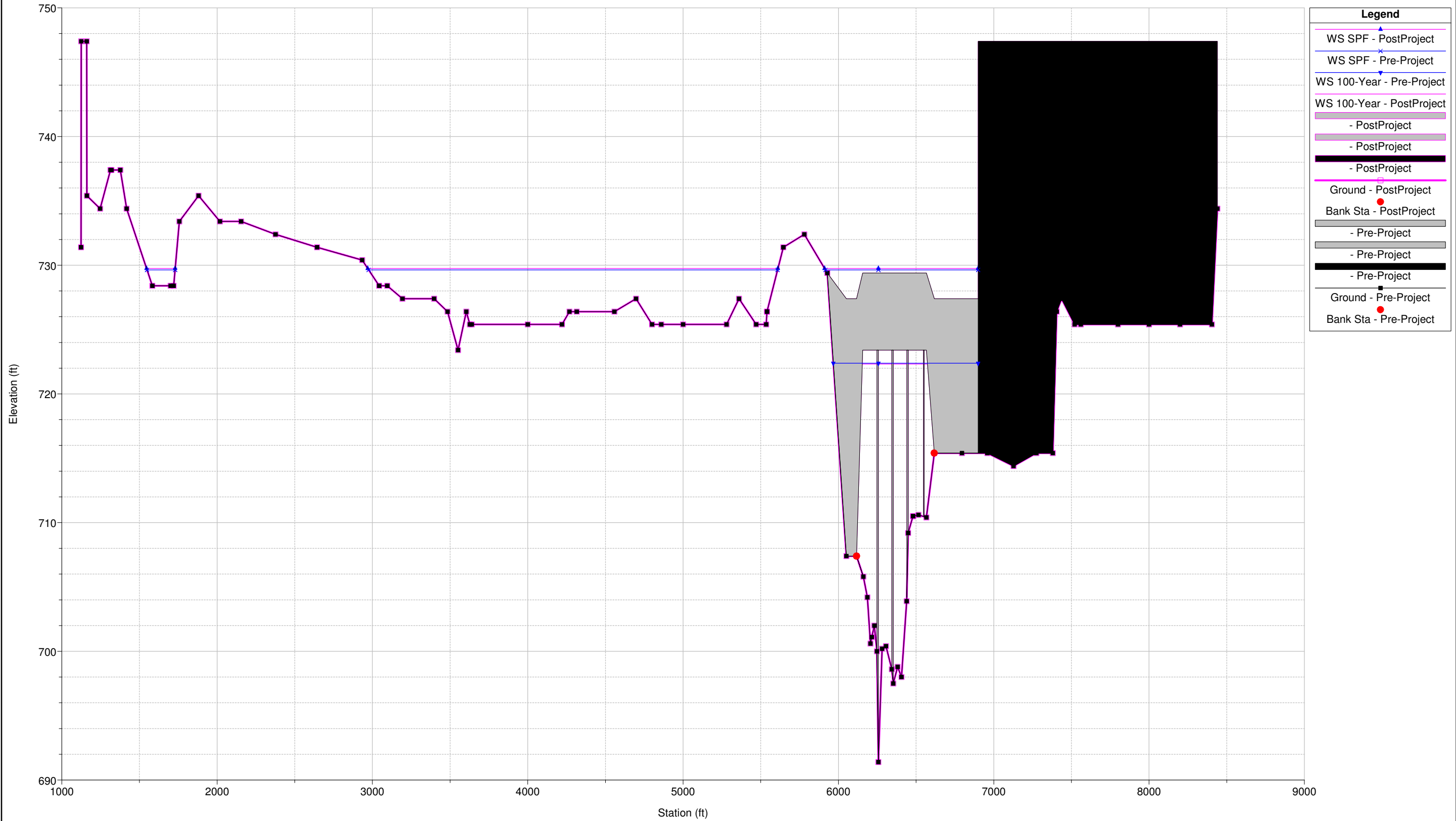
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.5



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.4



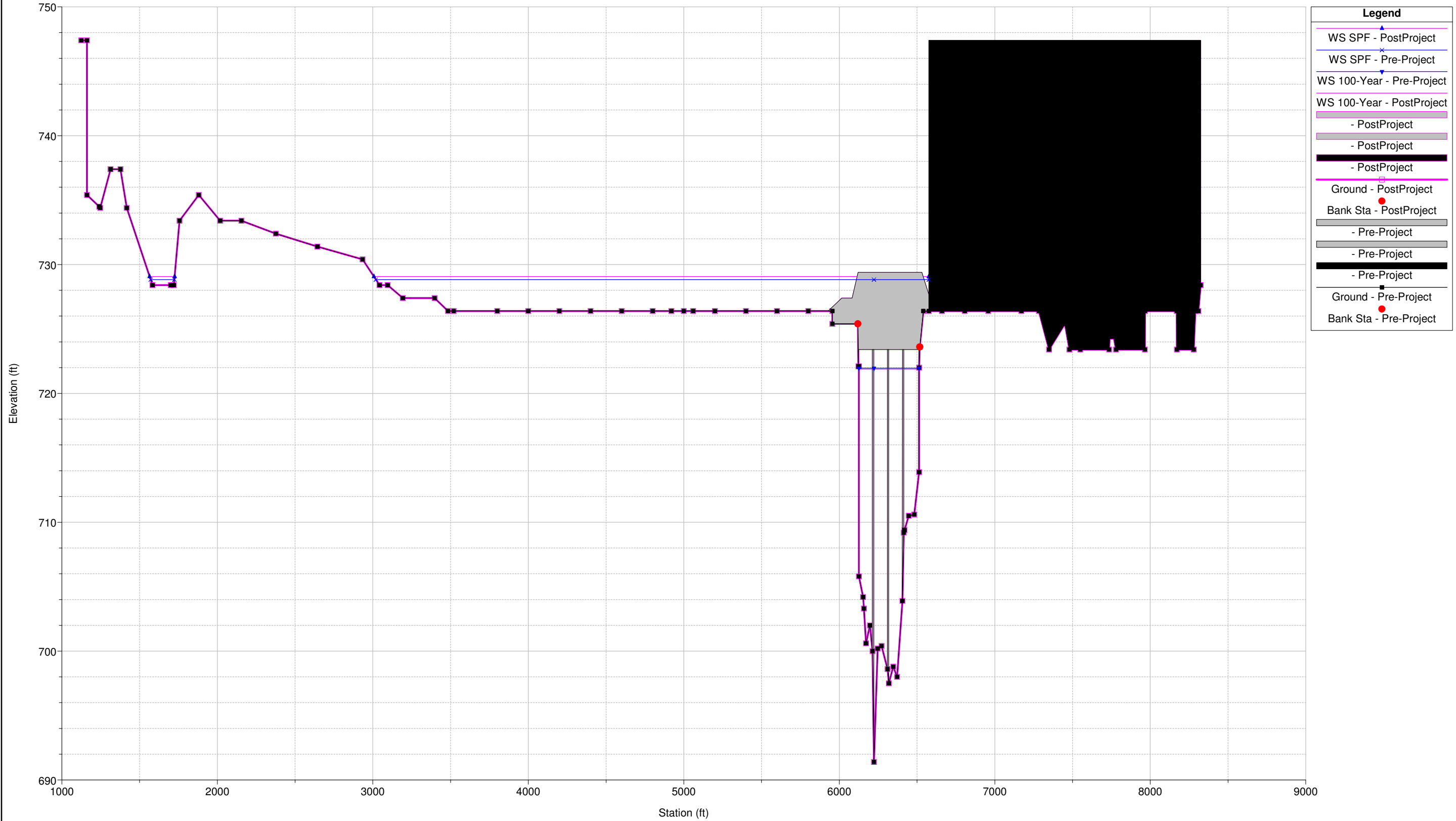
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.3 BR



Legend

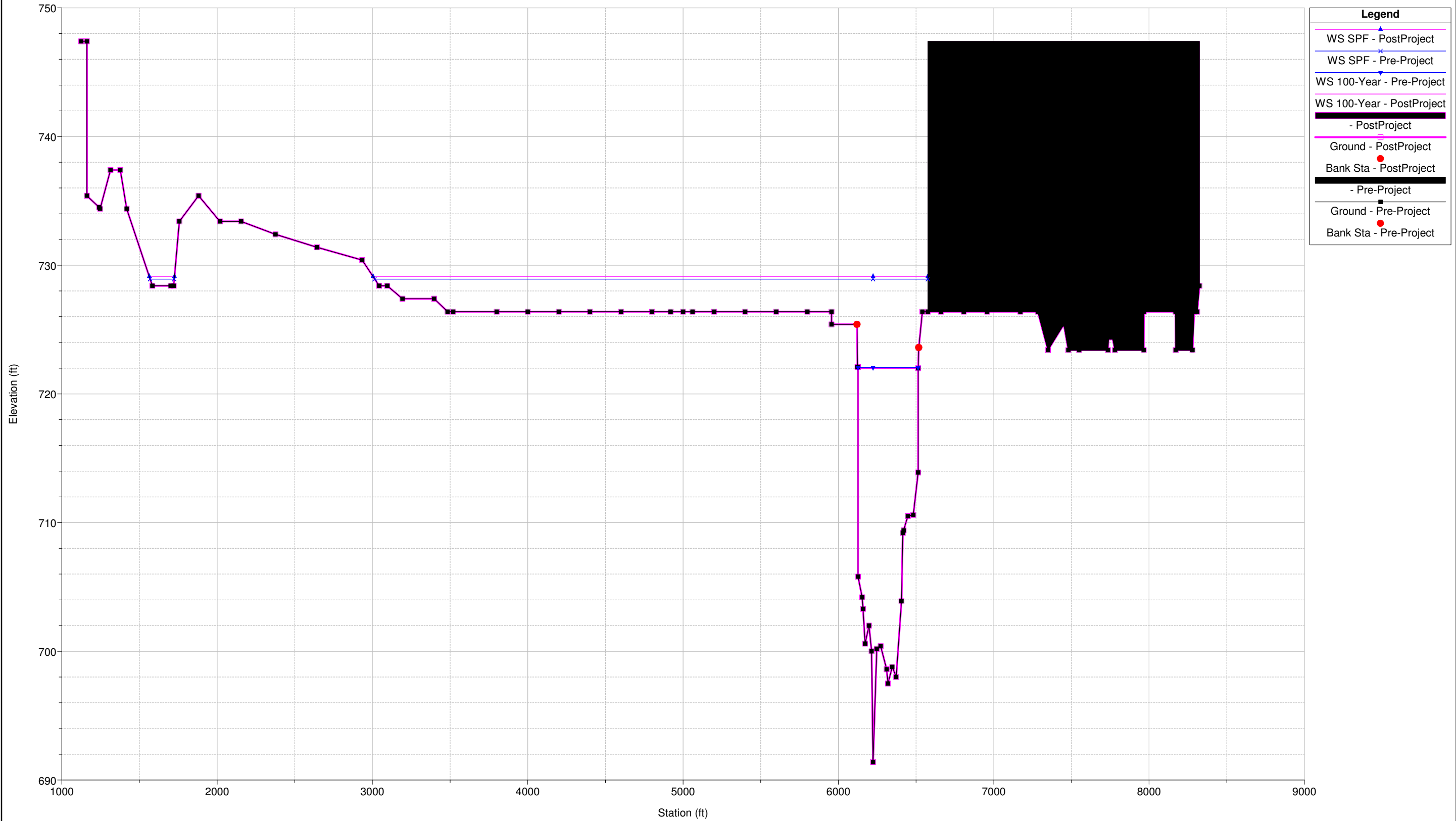
- WS SPF - PostProject
- WS SPF - Pre-Project
- WS 100-Year - Pre-Project
- WS 100-Year - PostProject
- PostProject
- PostProject
- PostProject
- PostProject
- Ground - PostProject
- Bank Sta - PostProject
- Pre-Project
- Pre-Project
- Pre-Project
- Pre-Project
- Ground - Pre-Project
- Bank Sta - Pre-Project

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.3 BR



Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▲
WS 100-Year - PostProject	▲
- PostProject	■
- PostProject	■
- PostProject	■
- PostProject	■
Ground - PostProject	■
Bank Sta - PostProject	●
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
Ground - Pre-Project	■
Bank Sta - Pre-Project	●

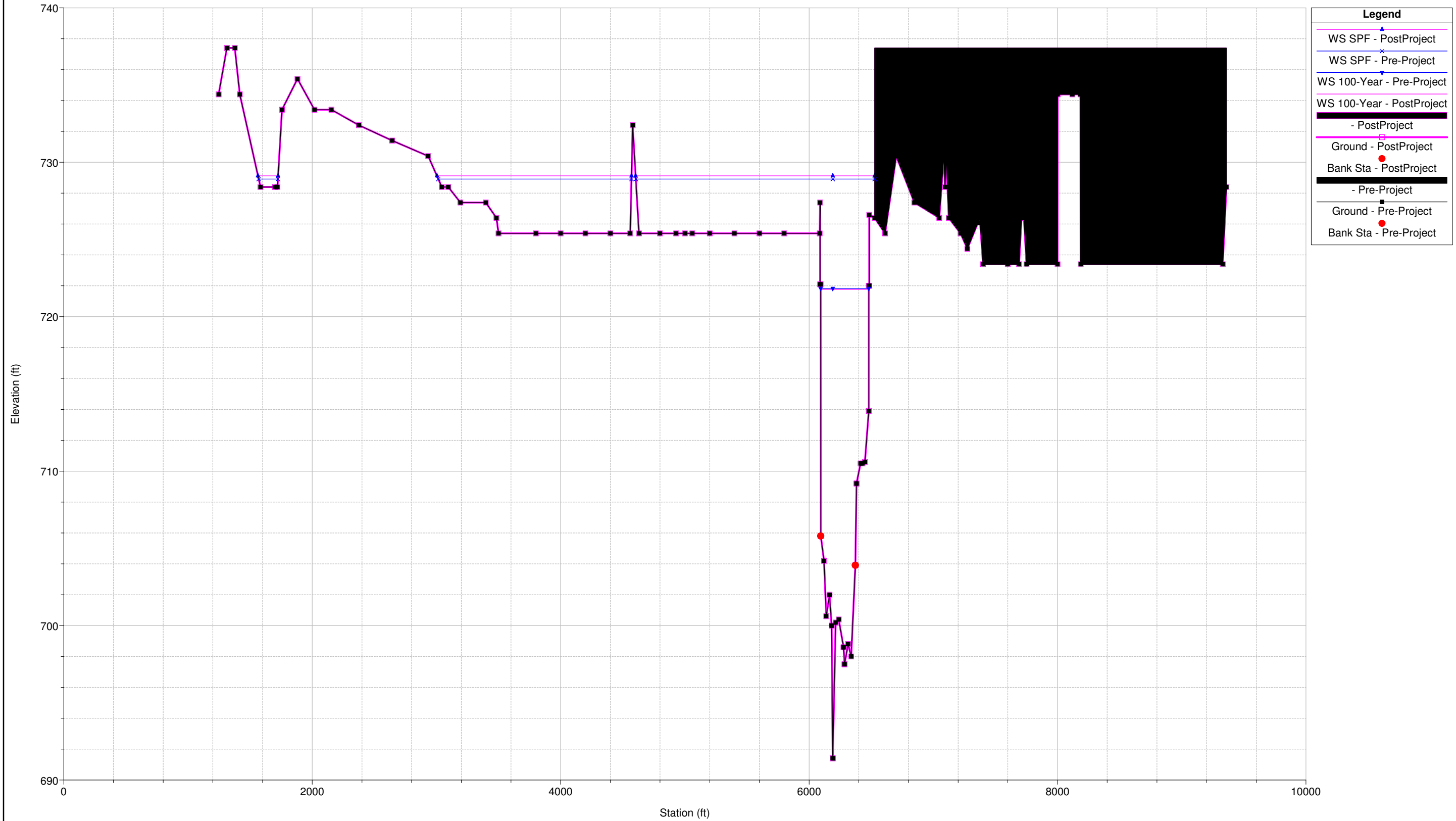
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.2



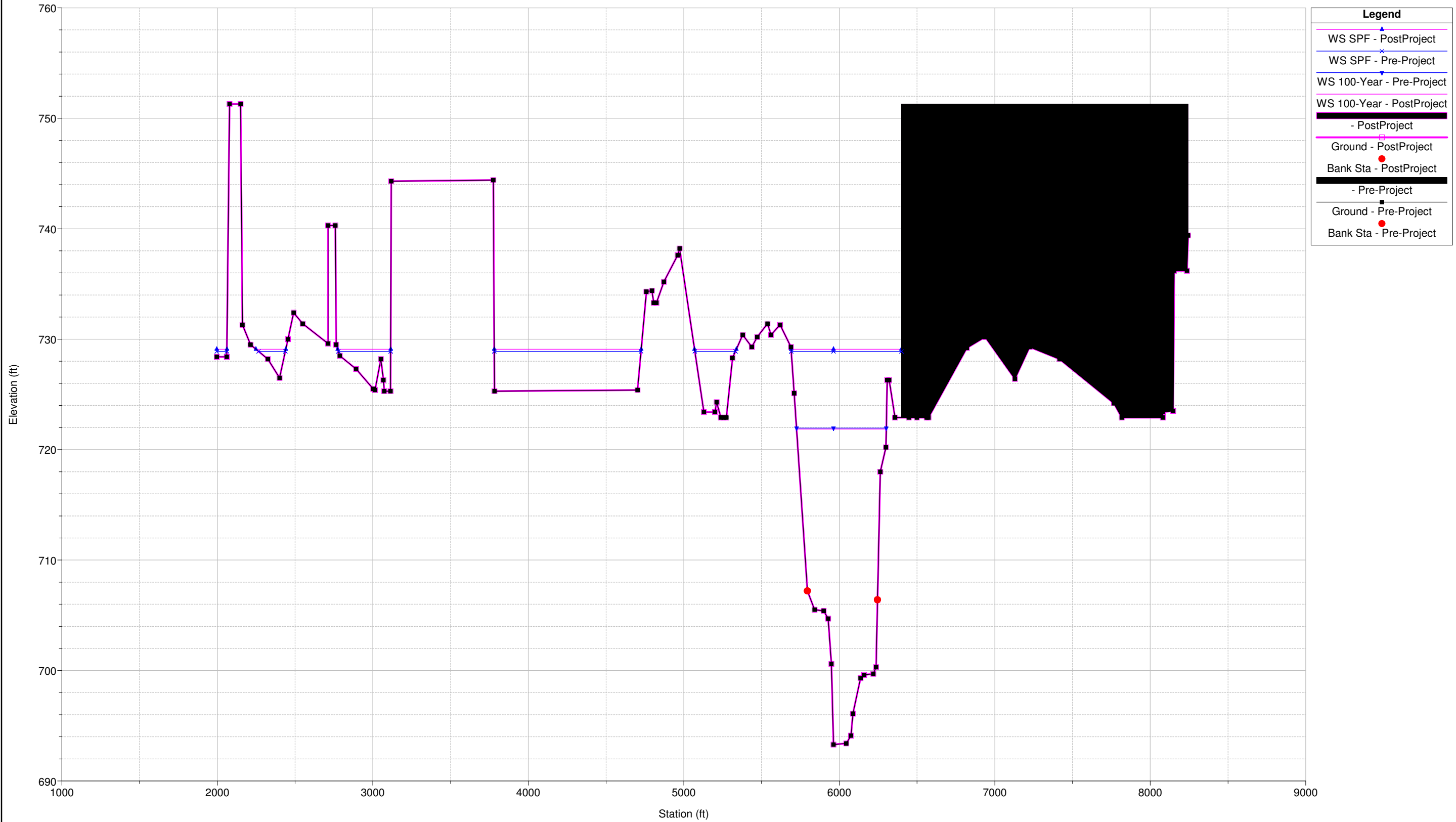
Legend

- WS SPF - PostProject (magenta line with 'x' marker)
- WS SPF - Pre-Project (blue line with 'x' marker)
- WS 100-Year - Pre-Project (blue line with triangle marker)
- WS 100-Year - PostProject (magenta line with triangle marker)
- PostProject (thick black line)
- Ground - PostProject (magenta line with square marker)
- Bank Sta - PostProject (red circle marker)
- Pre-Project (thick black line)
- Ground - Pre-Project (black line with square marker)
- Bank Sta - Pre-Project (red circle marker)

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 255.1

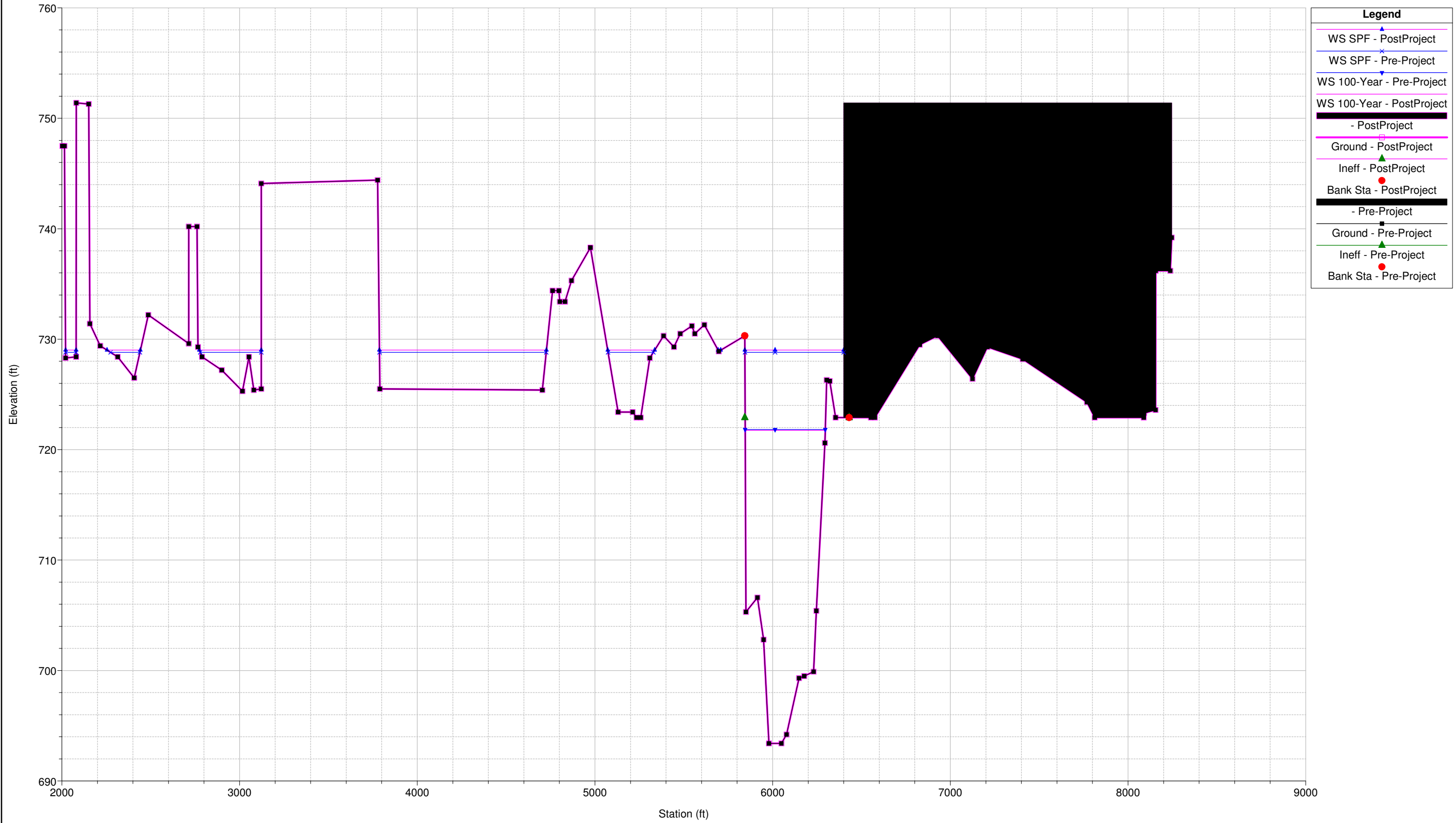


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.95

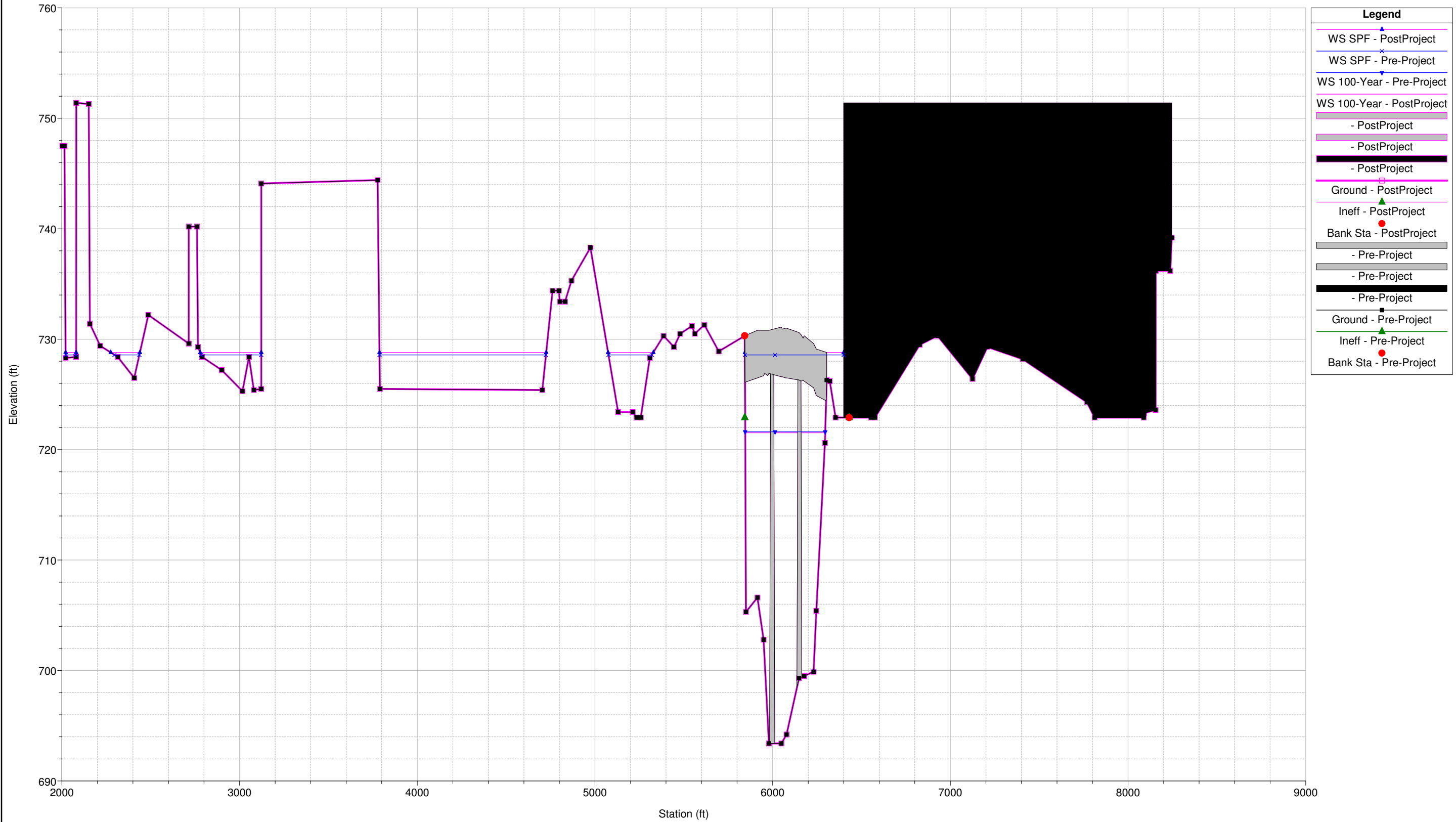


Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▲
WS 100-Year - PostProject	▲
- PostProject	■
Ground - PostProject	■
Bank Sta - PostProject	●
- Pre-Project	■
Ground - Pre-Project	■
Bank Sta - Pre-Project	●

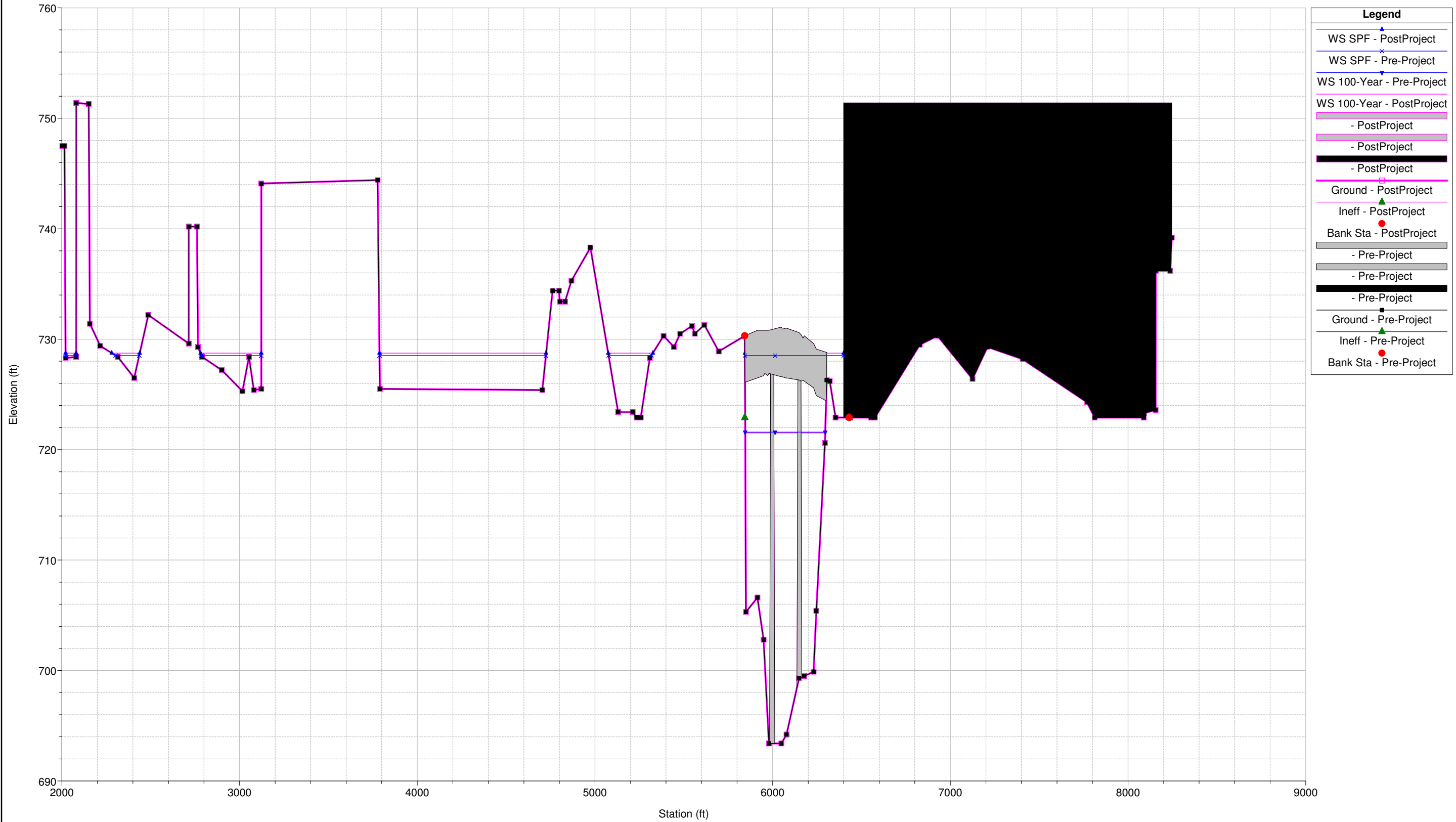
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.94



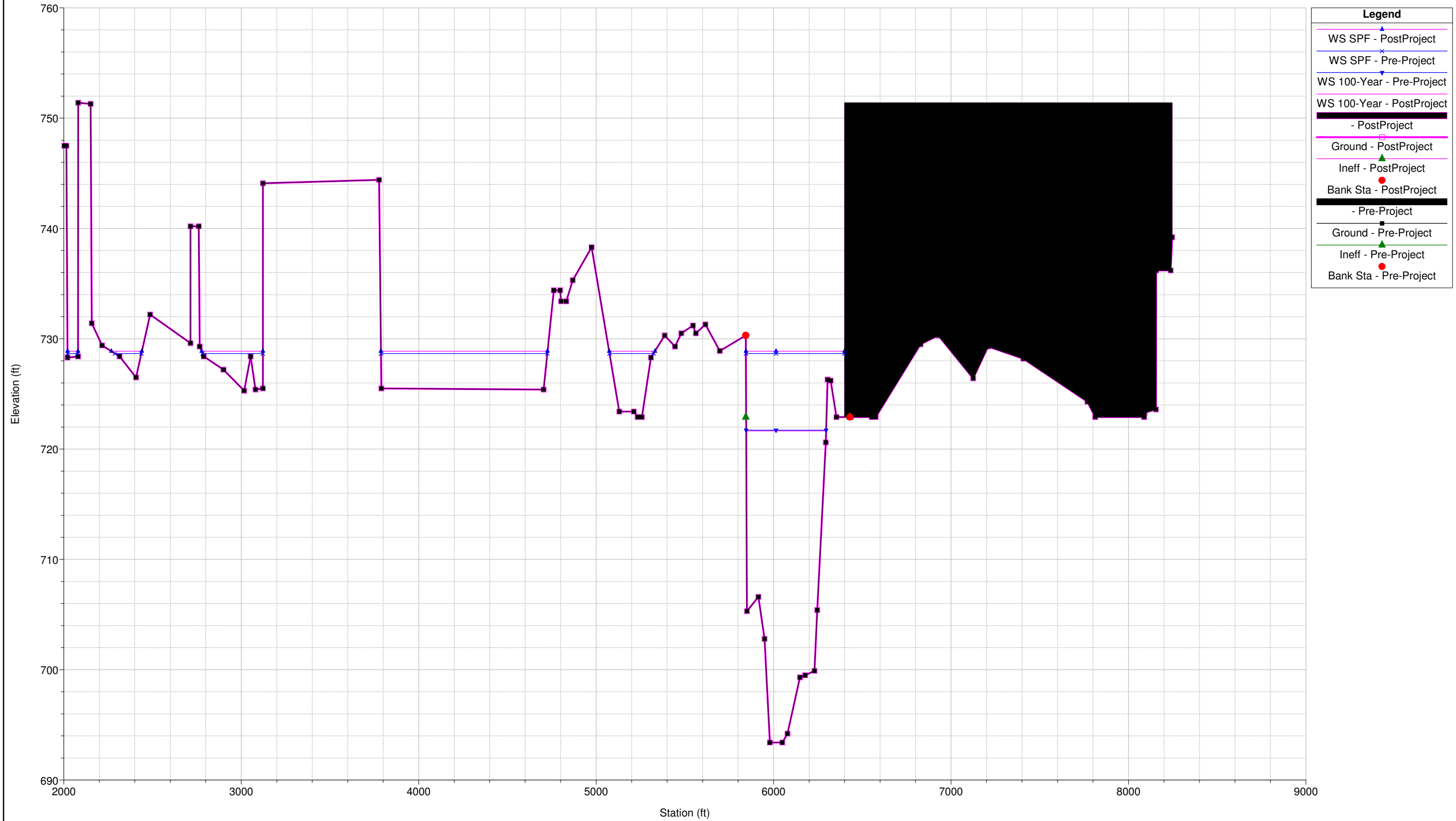
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.93 BR



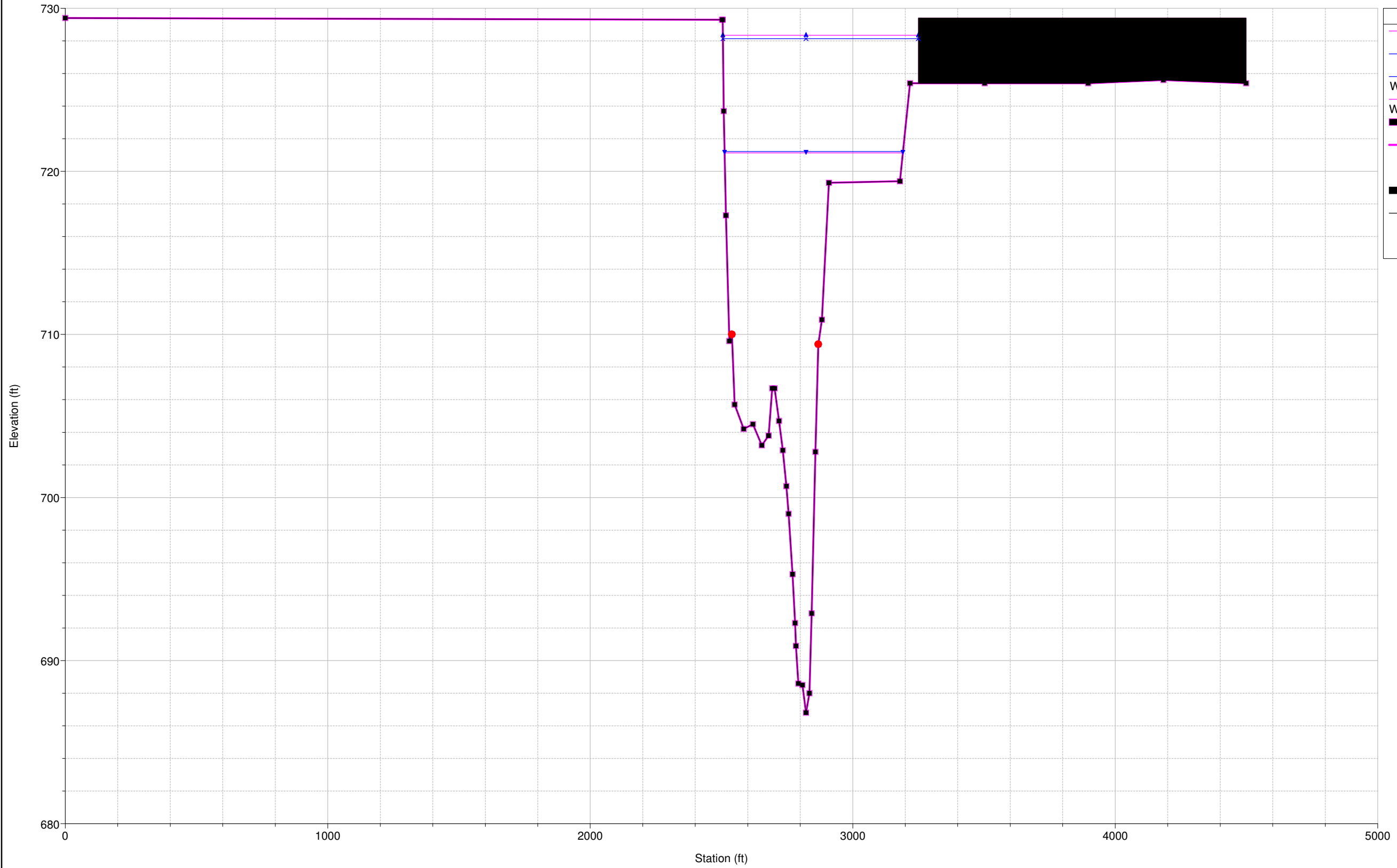
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.93 BR



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.92



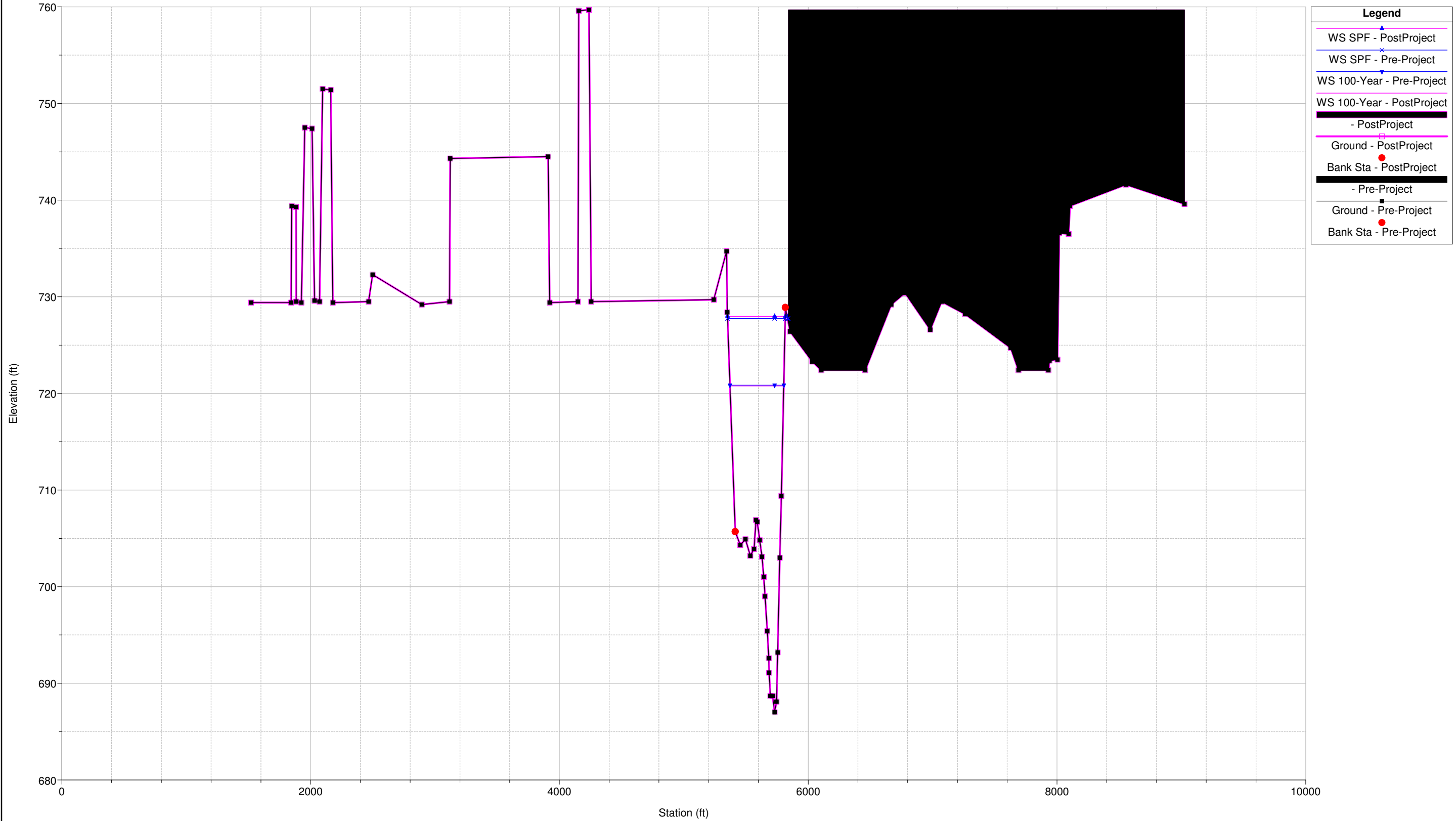
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.91



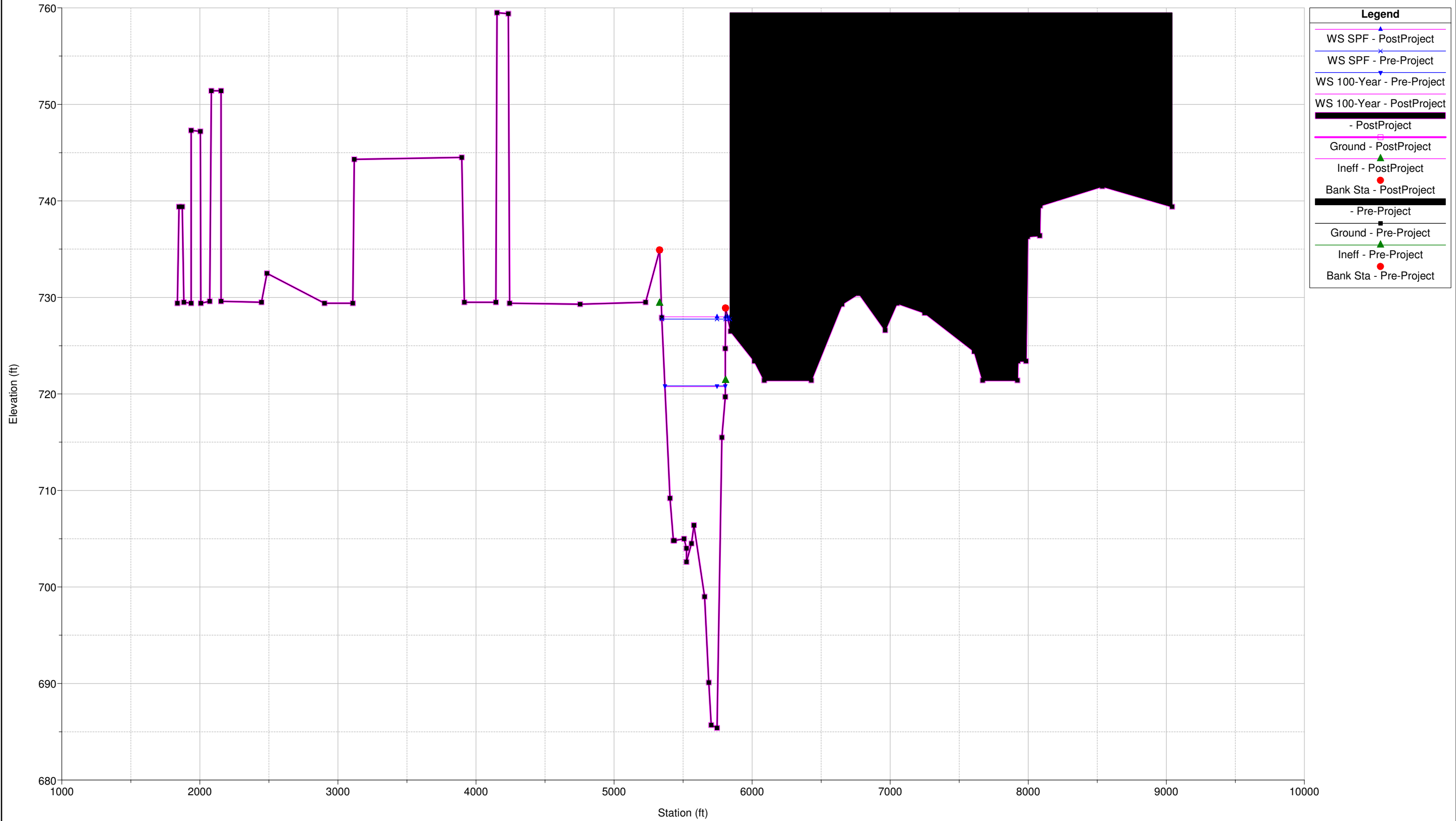
Legend

- WS SPF - PostProject (Blue line with upward triangle)
- WS SPF - Pre-Project (Blue line with downward triangle)
- WS 100-Year - Pre-Project (Magenta line with downward triangle)
- WS 100-Year - PostProject (Magenta line with upward triangle)
- PostProject (Thick black line)
- Ground - PostProject (Thin black line)
- Bank Sta - PostProject (Red circle)
- Pre-Project (Thick black line)
- Ground - Pre-Project (Thin black line)
- Bank Sta - Pre-Project (Red circle)

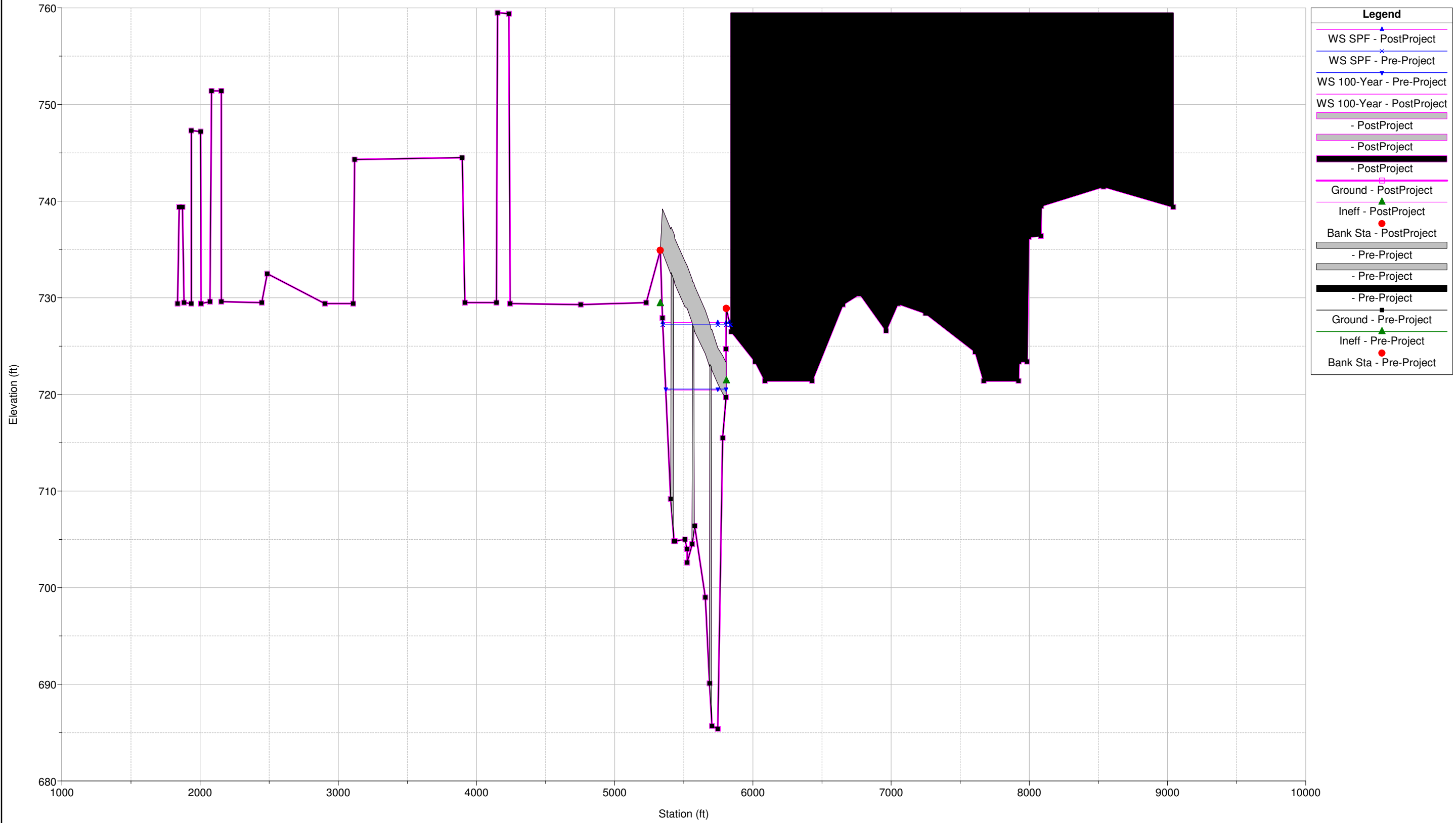
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.5



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.4

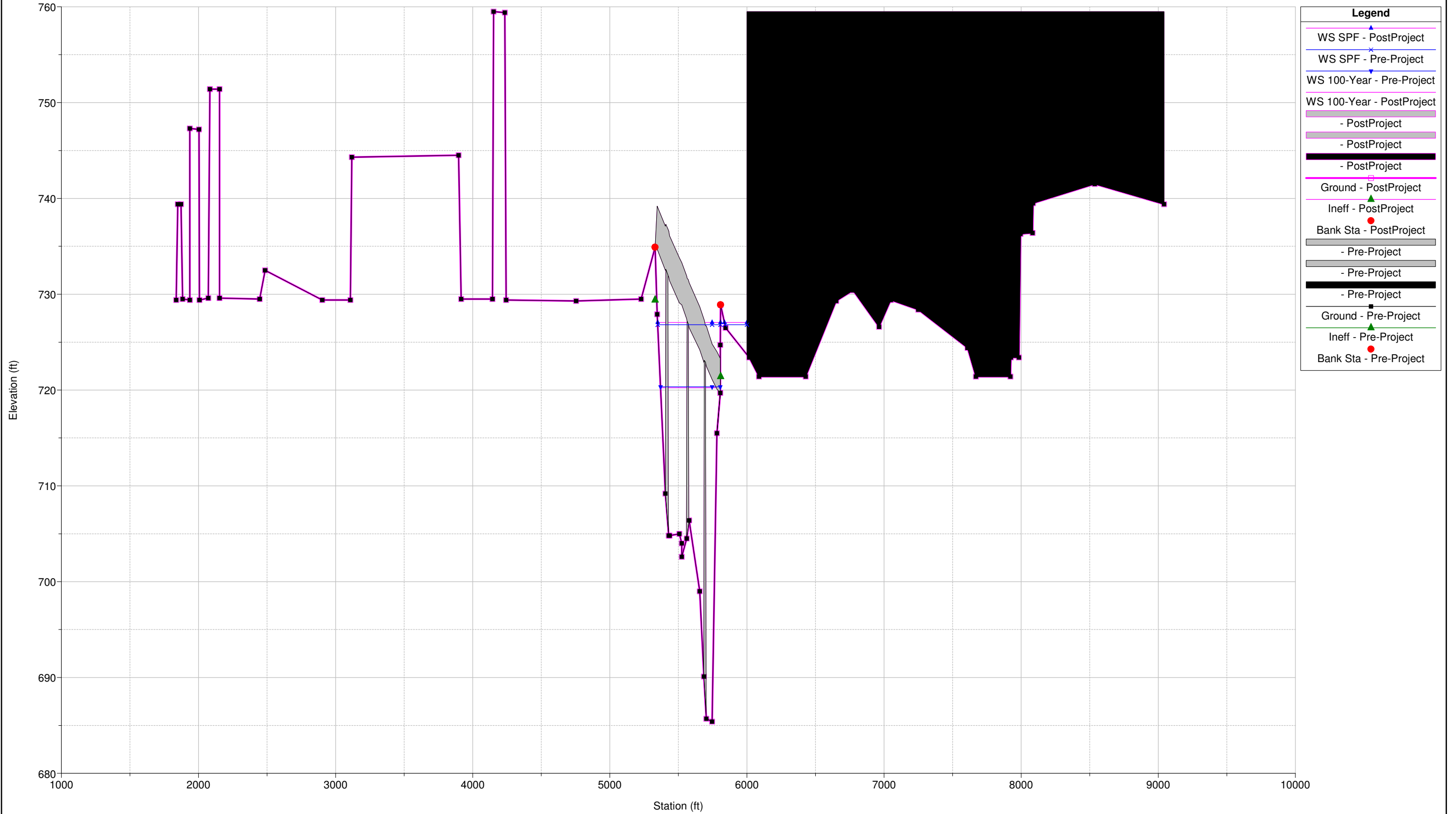


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.3 BR

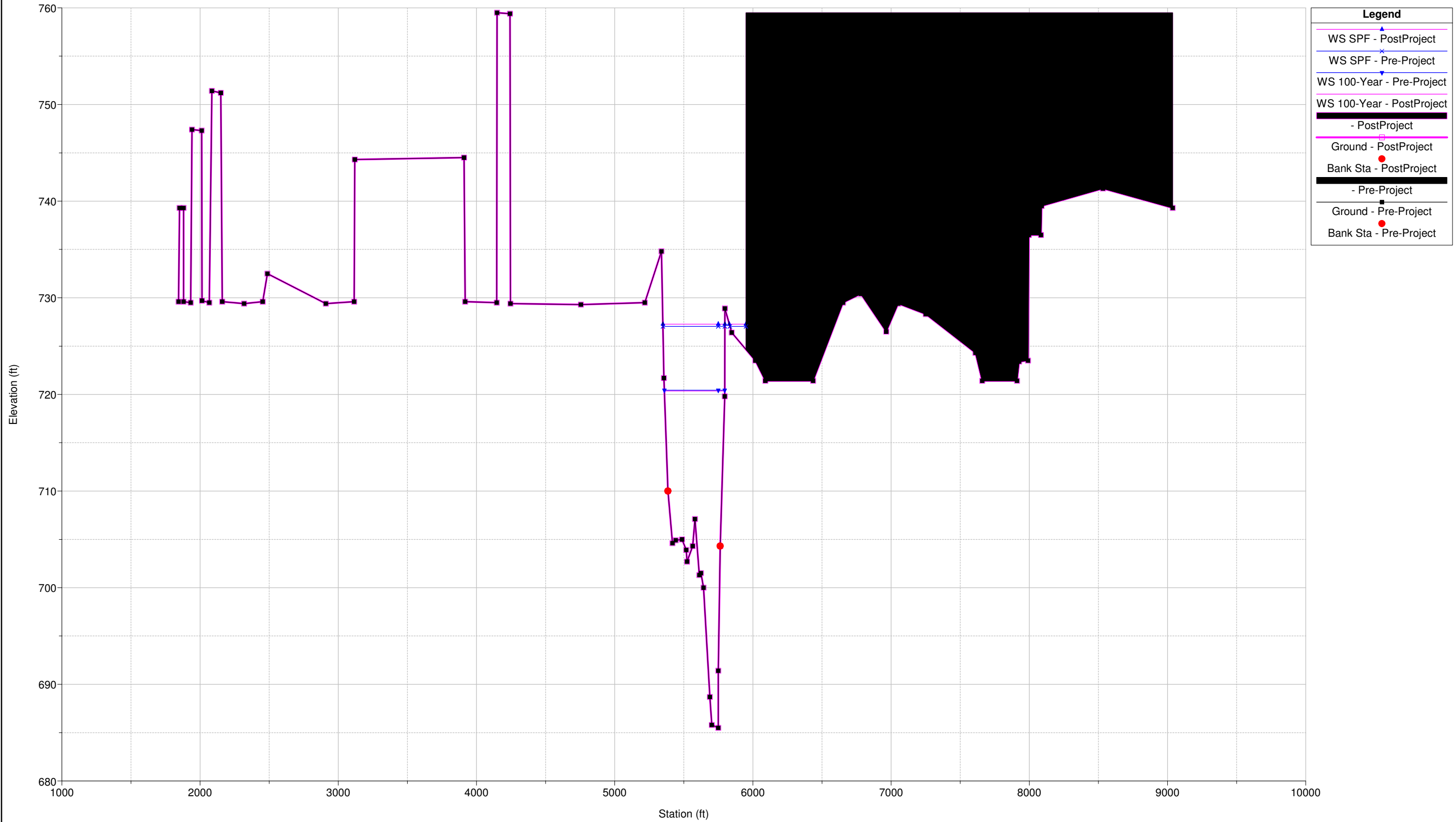


Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
- PostProject	■
- PostProject	■
- PostProject	■
- PostProject	■
Ground - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
- Pre-Project	■
Ground - Pre-Project	■
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

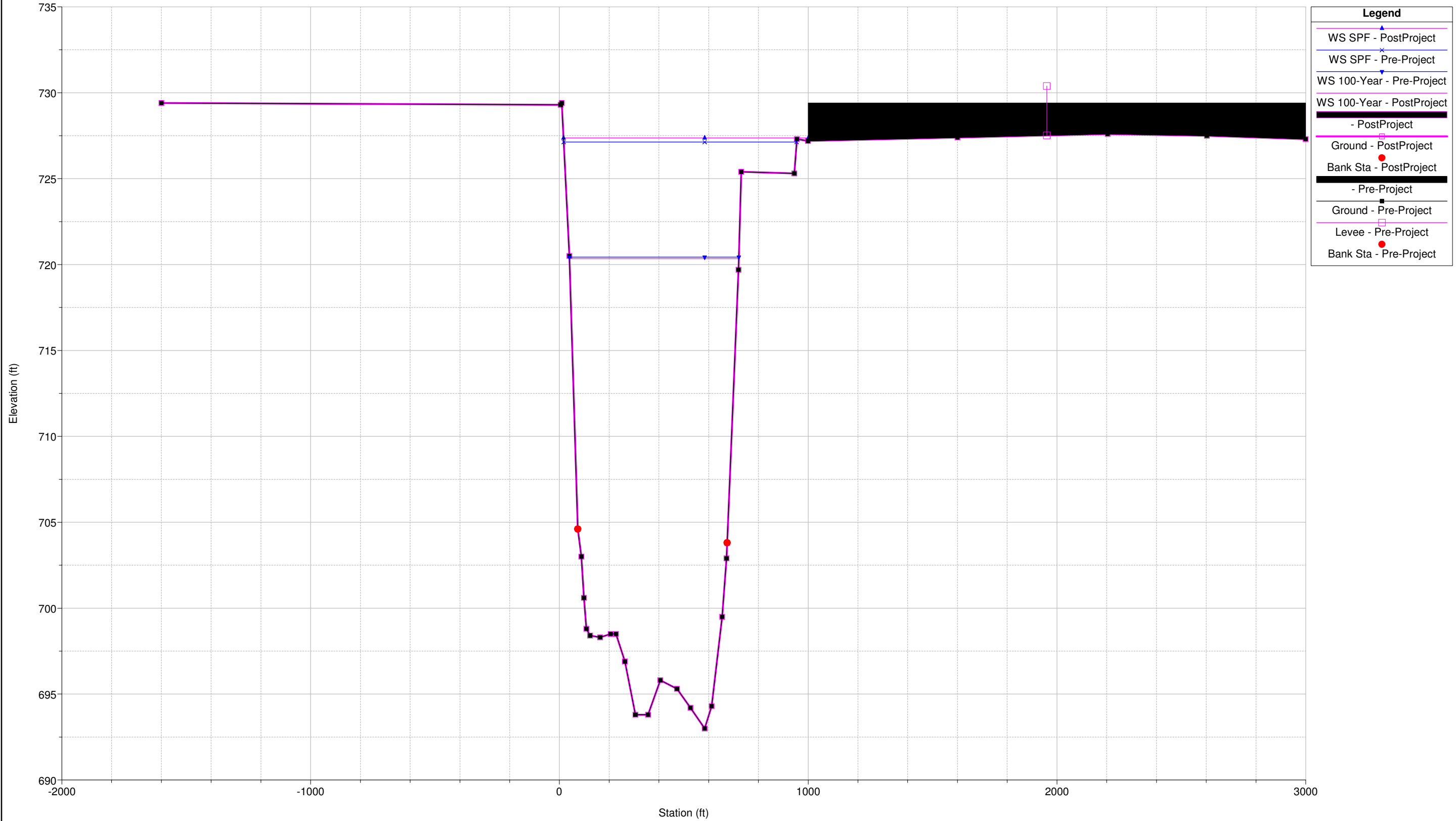
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.3 BR



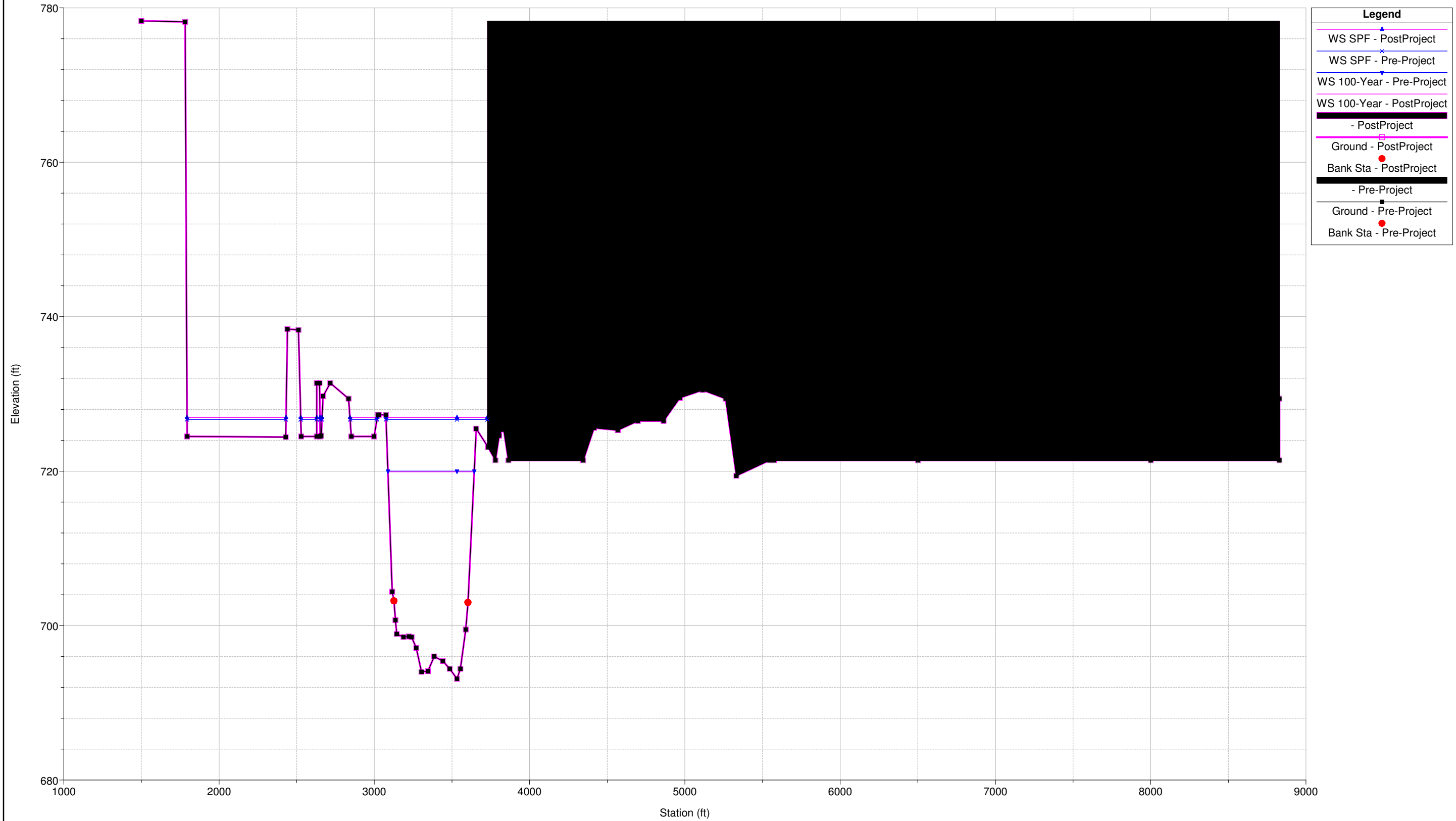
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 254.1



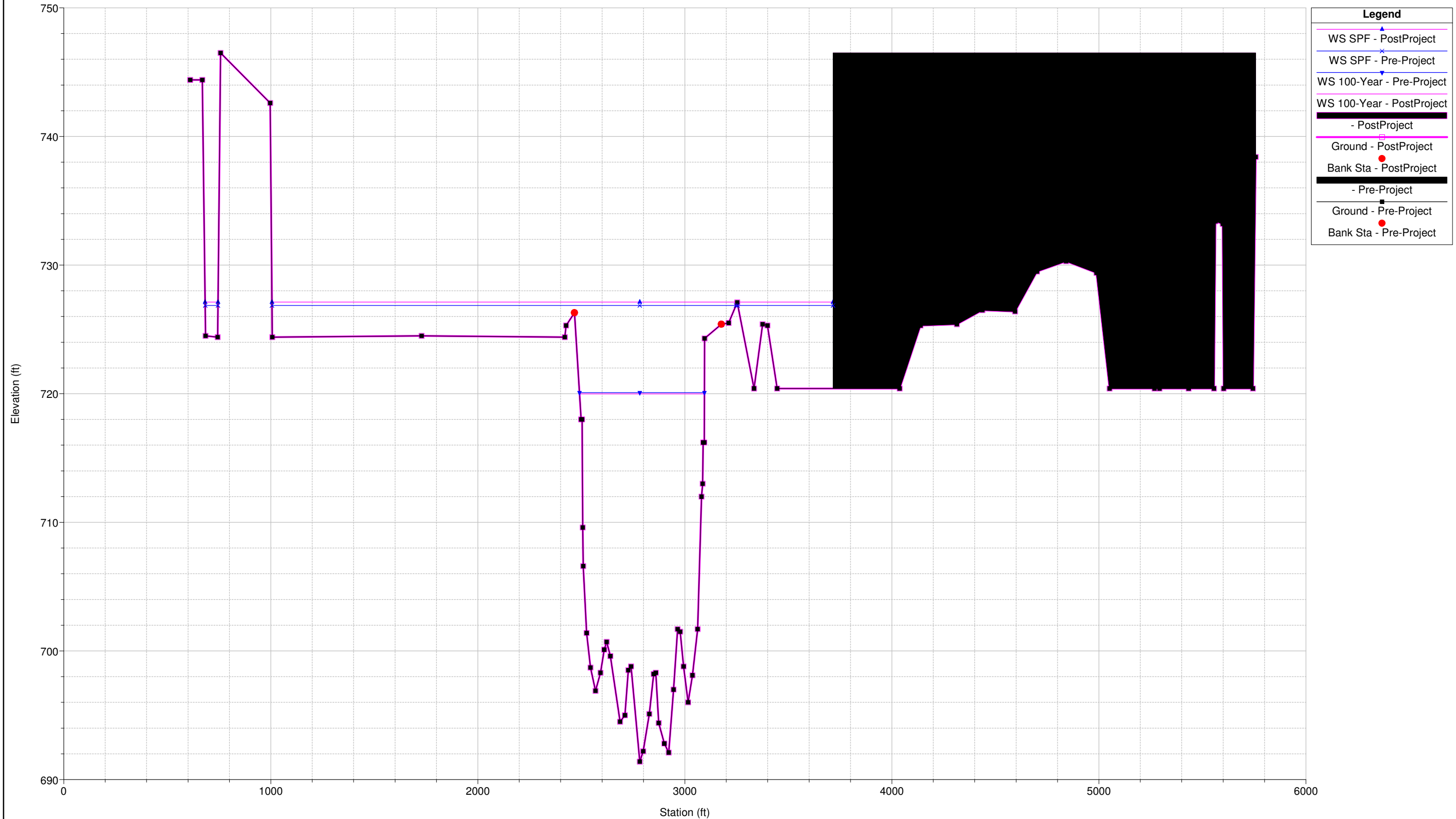
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.6



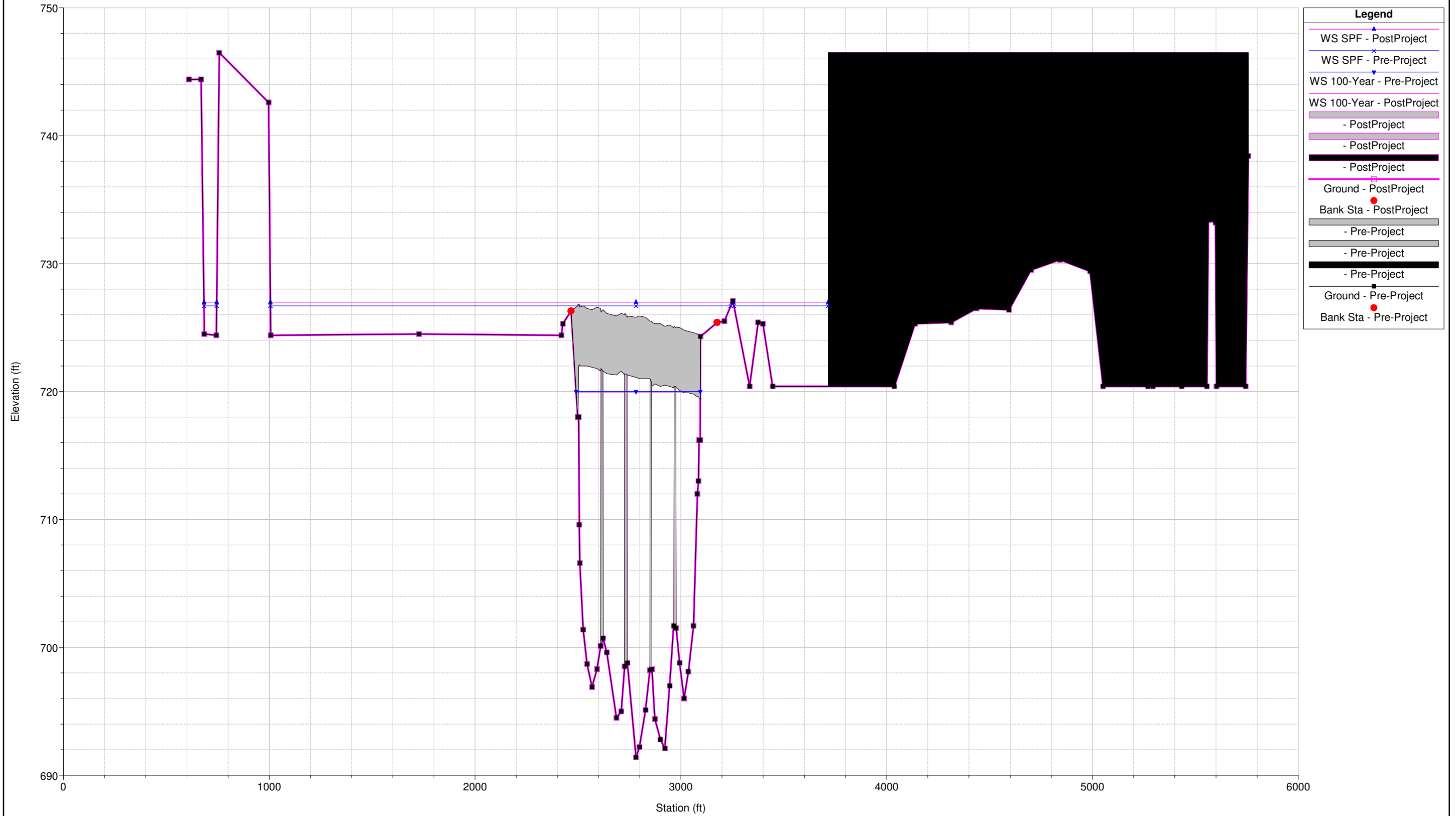
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.5



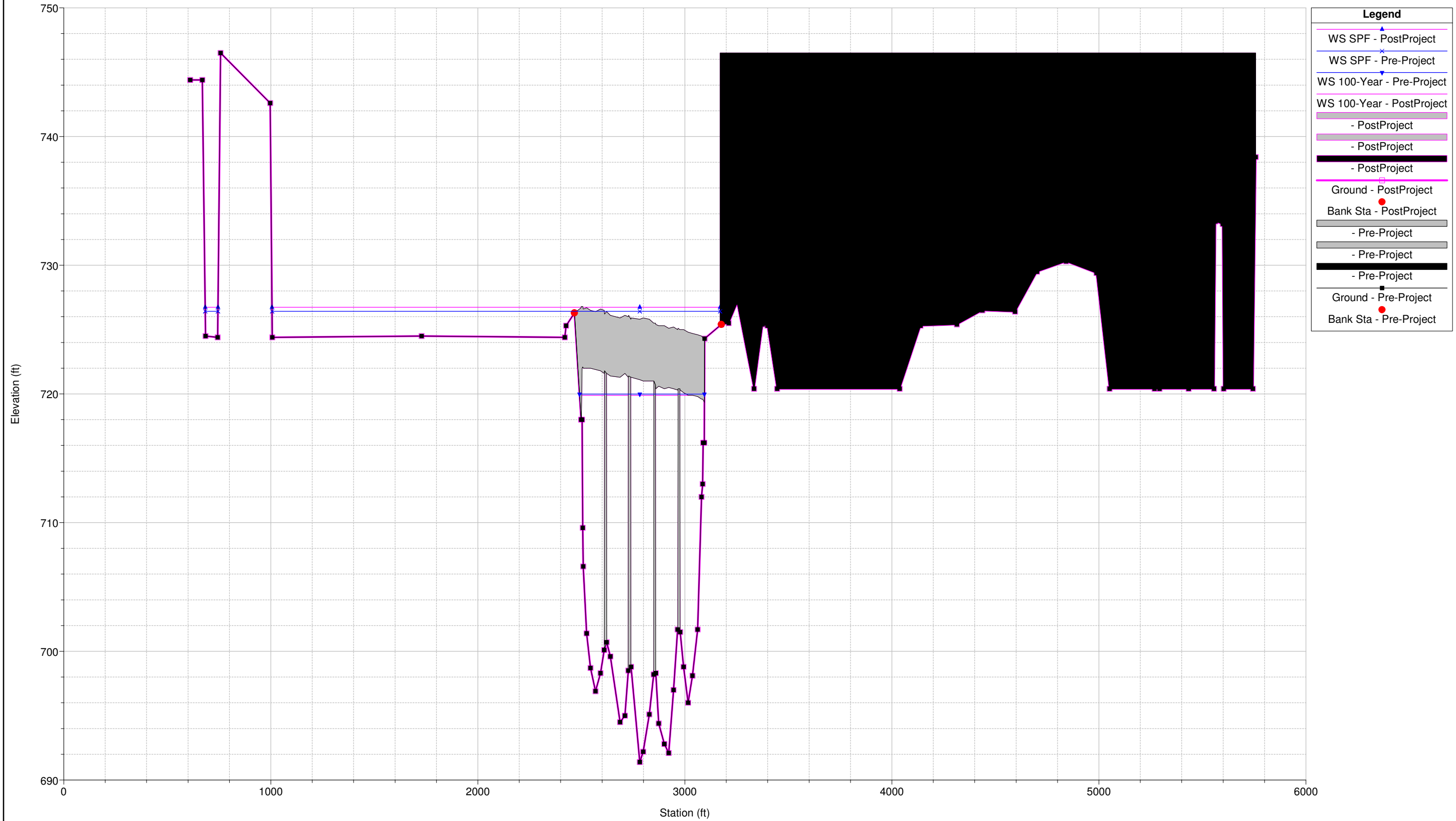
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.4



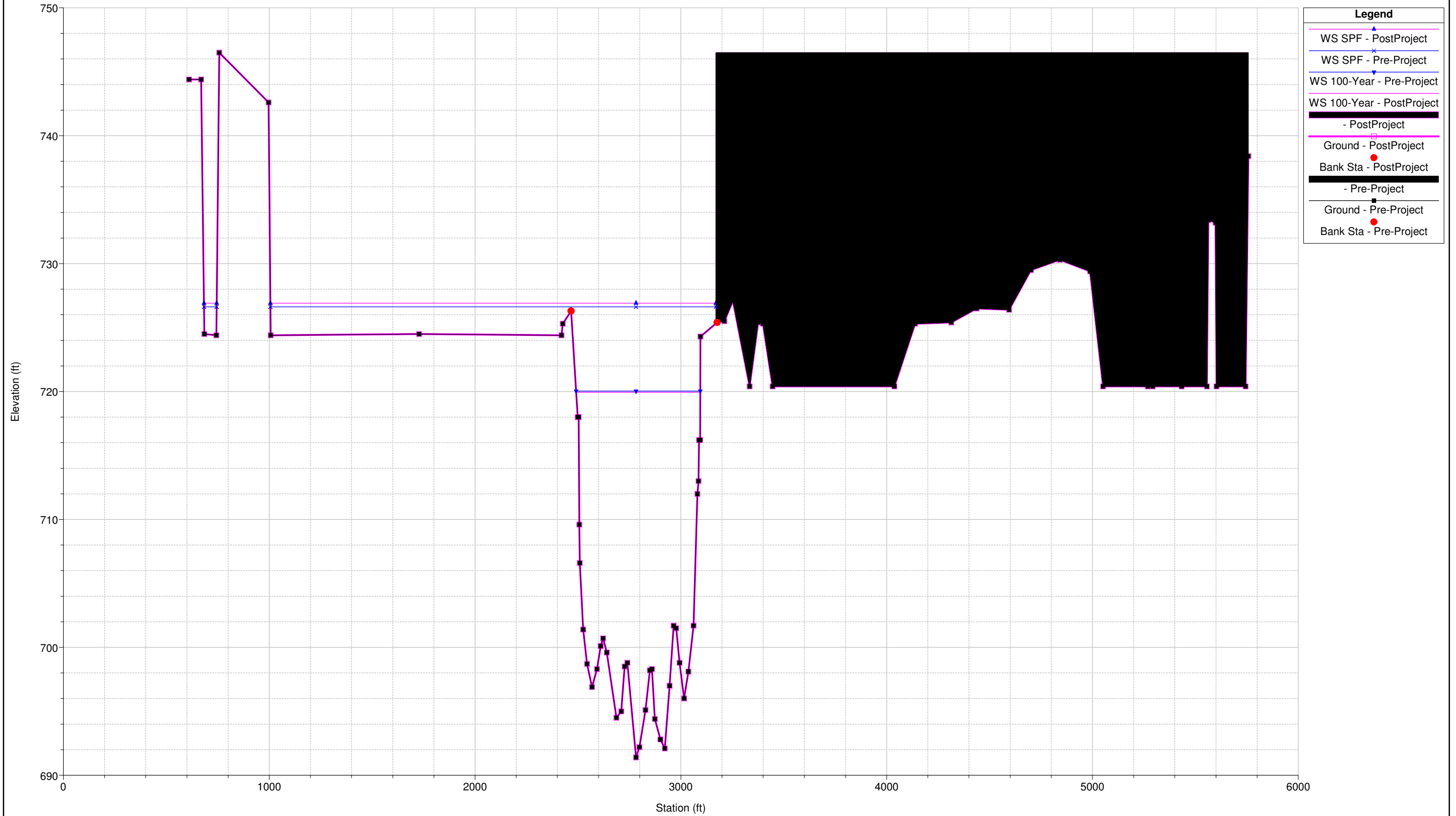
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.3 BR



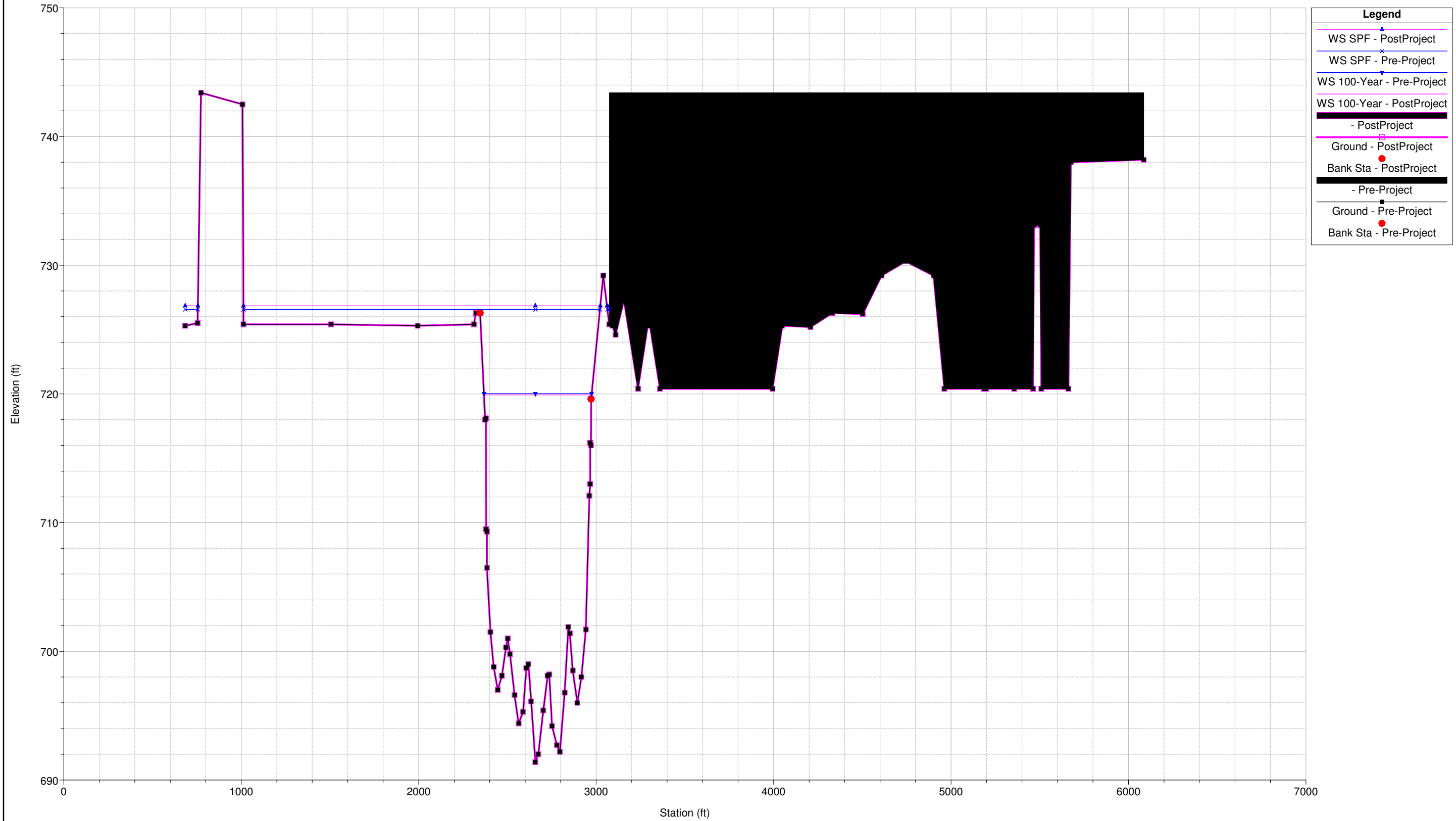
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.3 BR



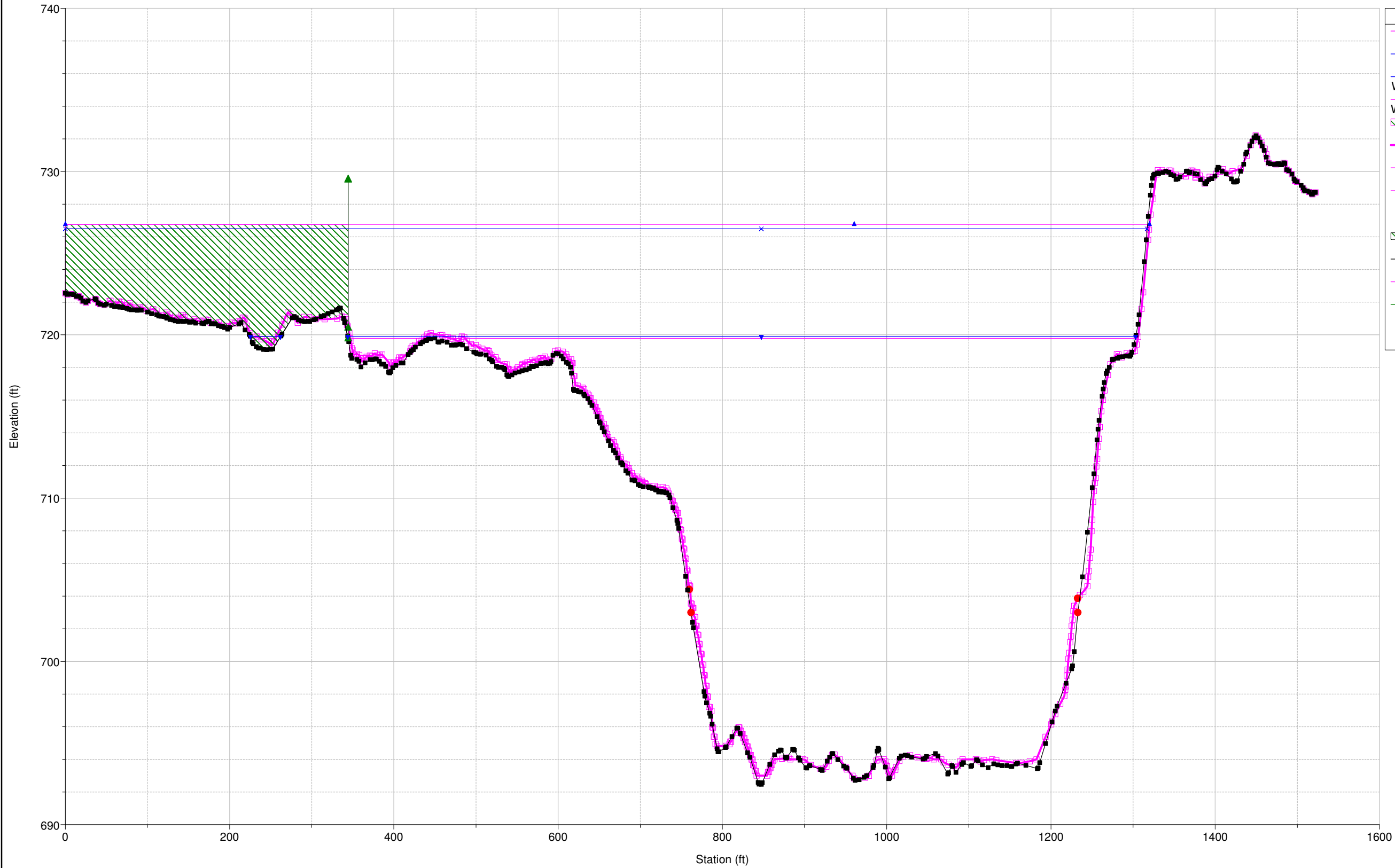
Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.2



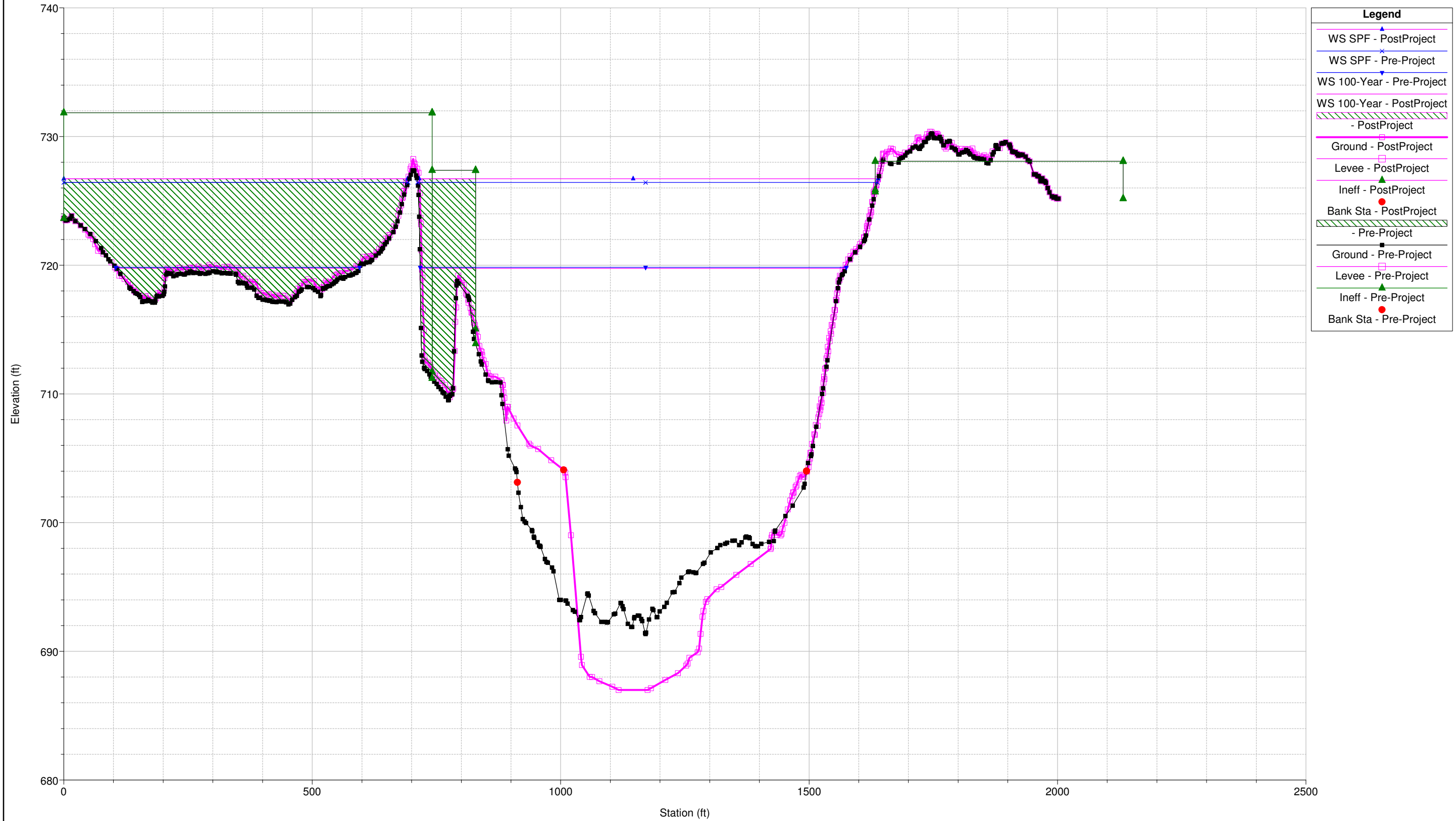
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 253.1



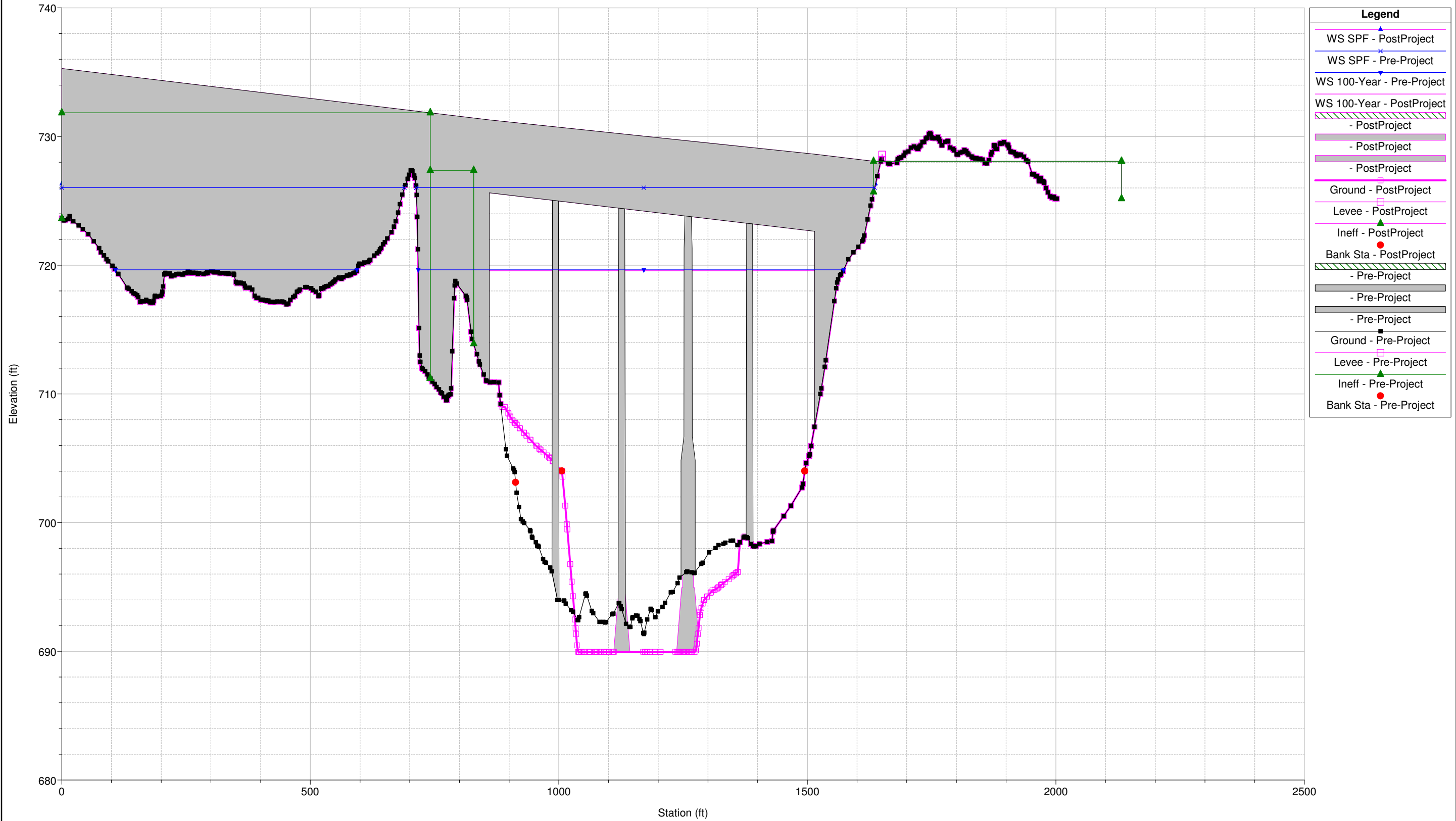
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.8



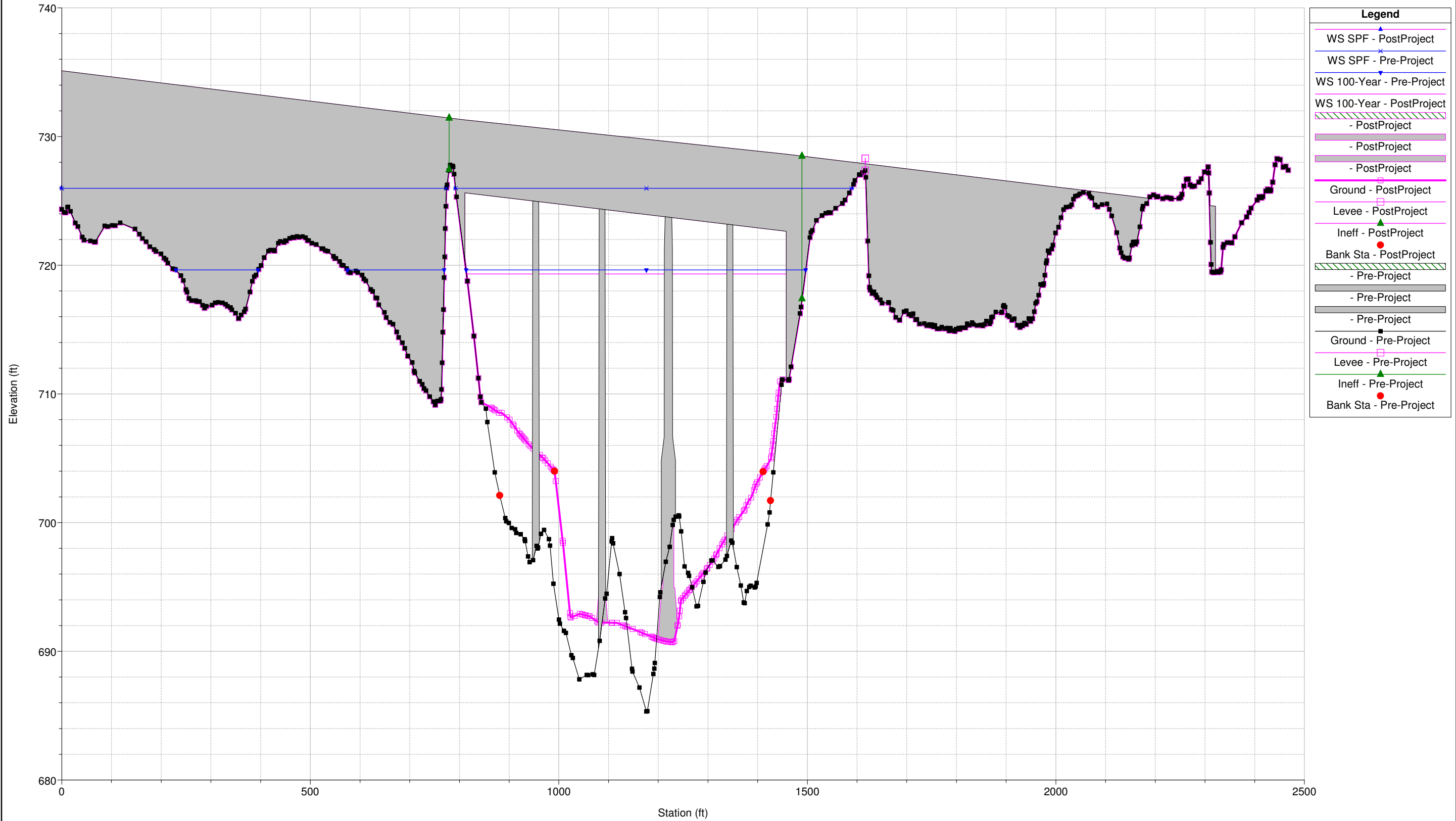
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.5



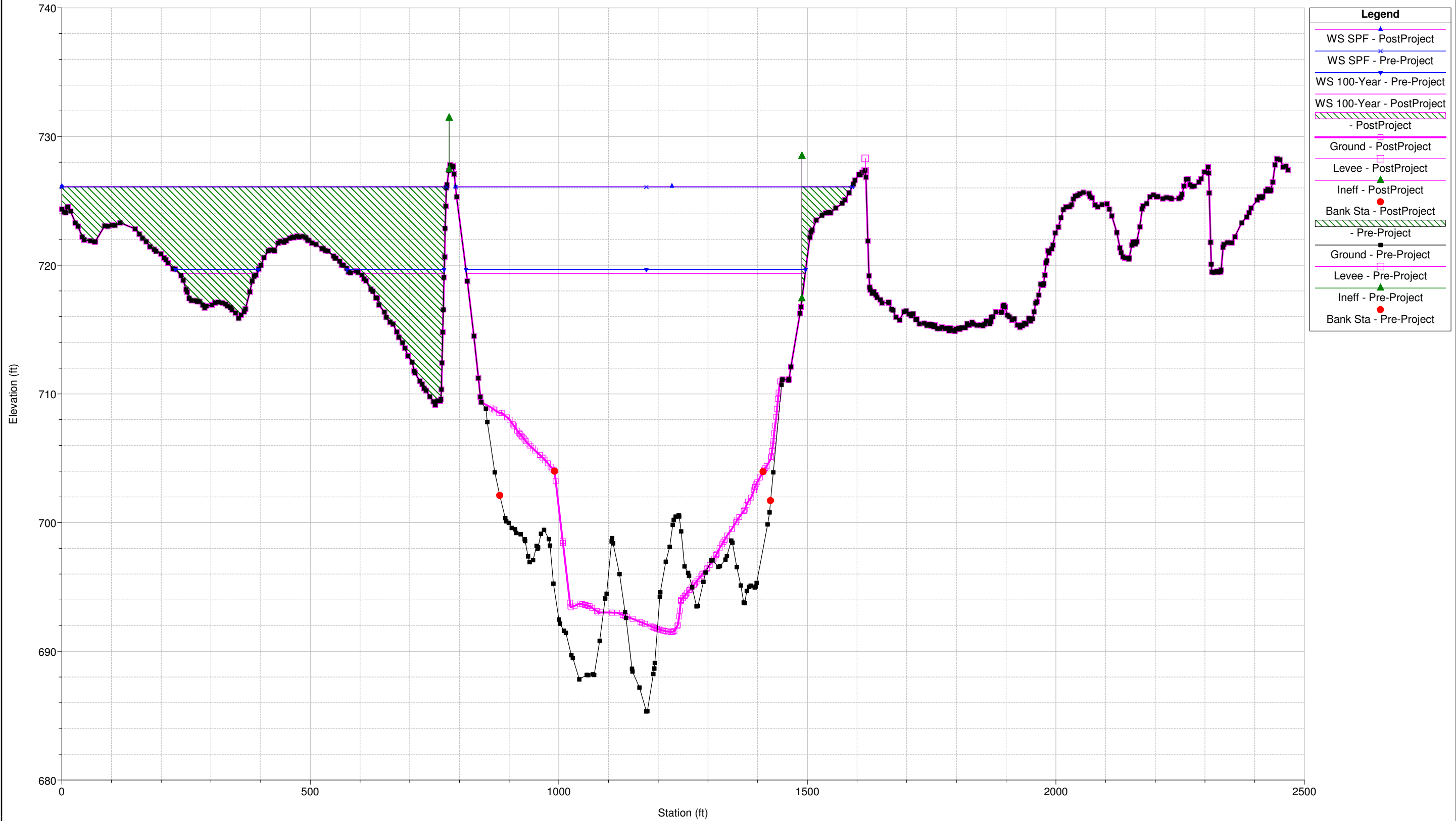
Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.3 BR



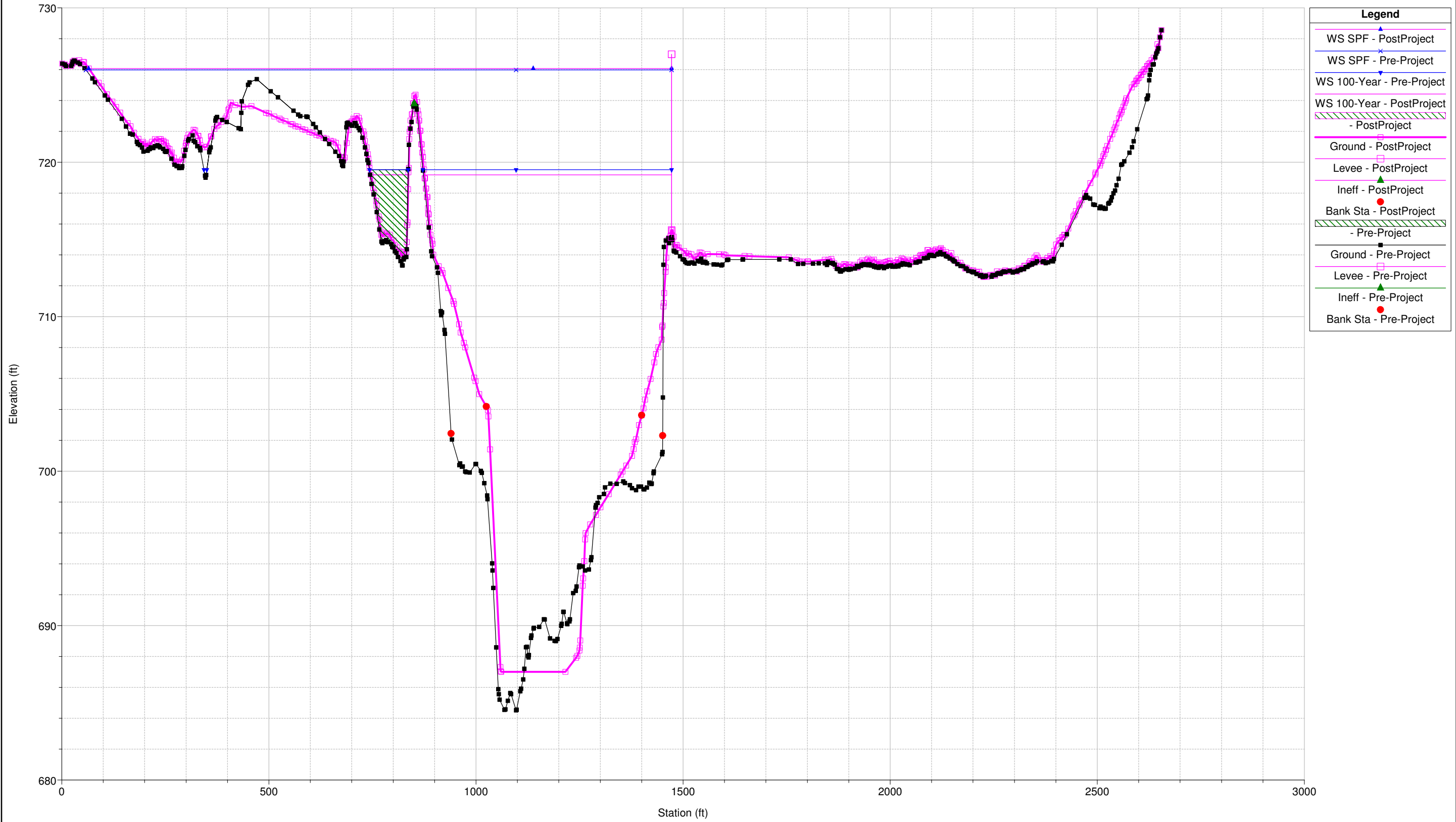
Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.3 BR



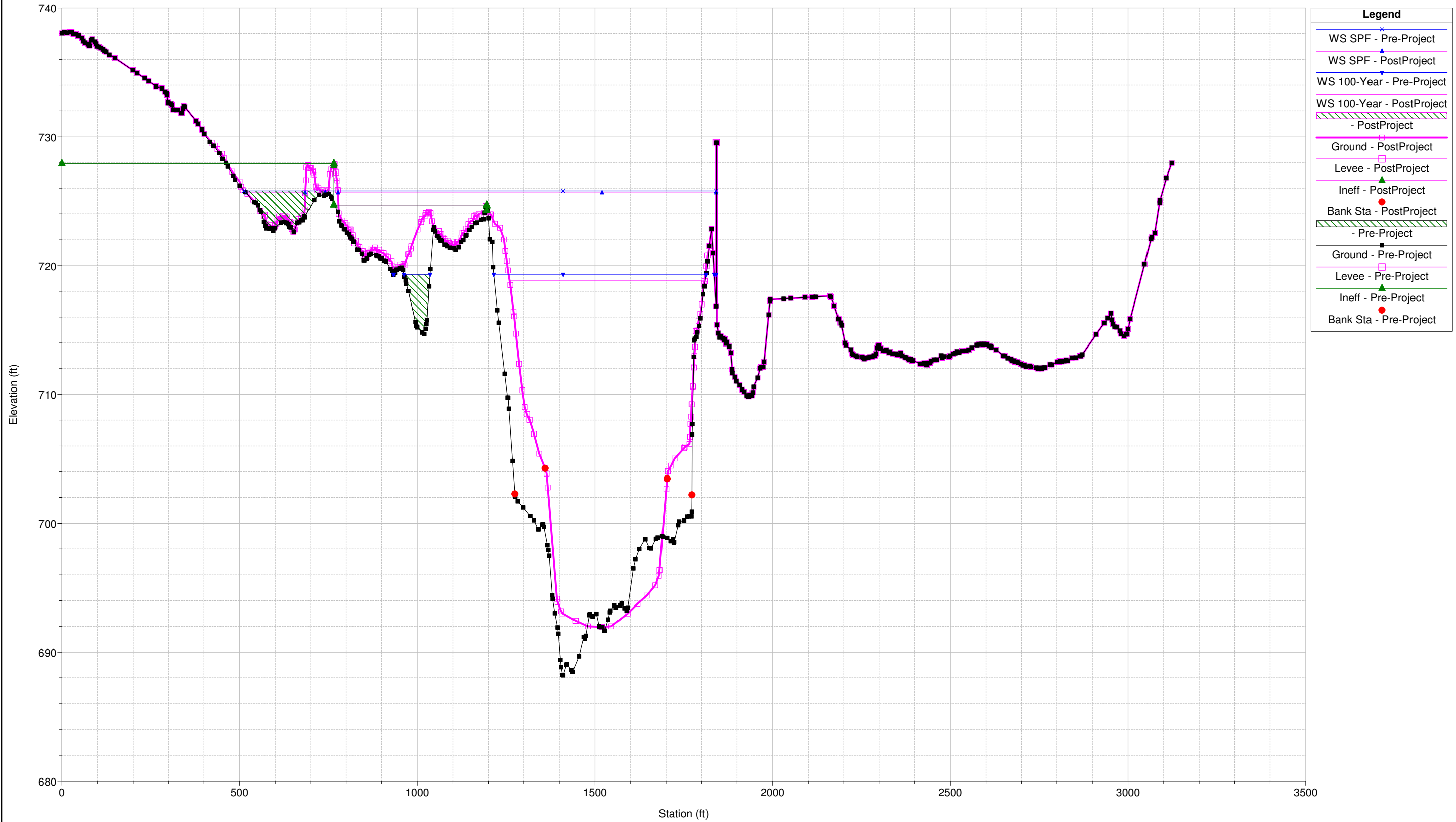
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.1



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 252.06

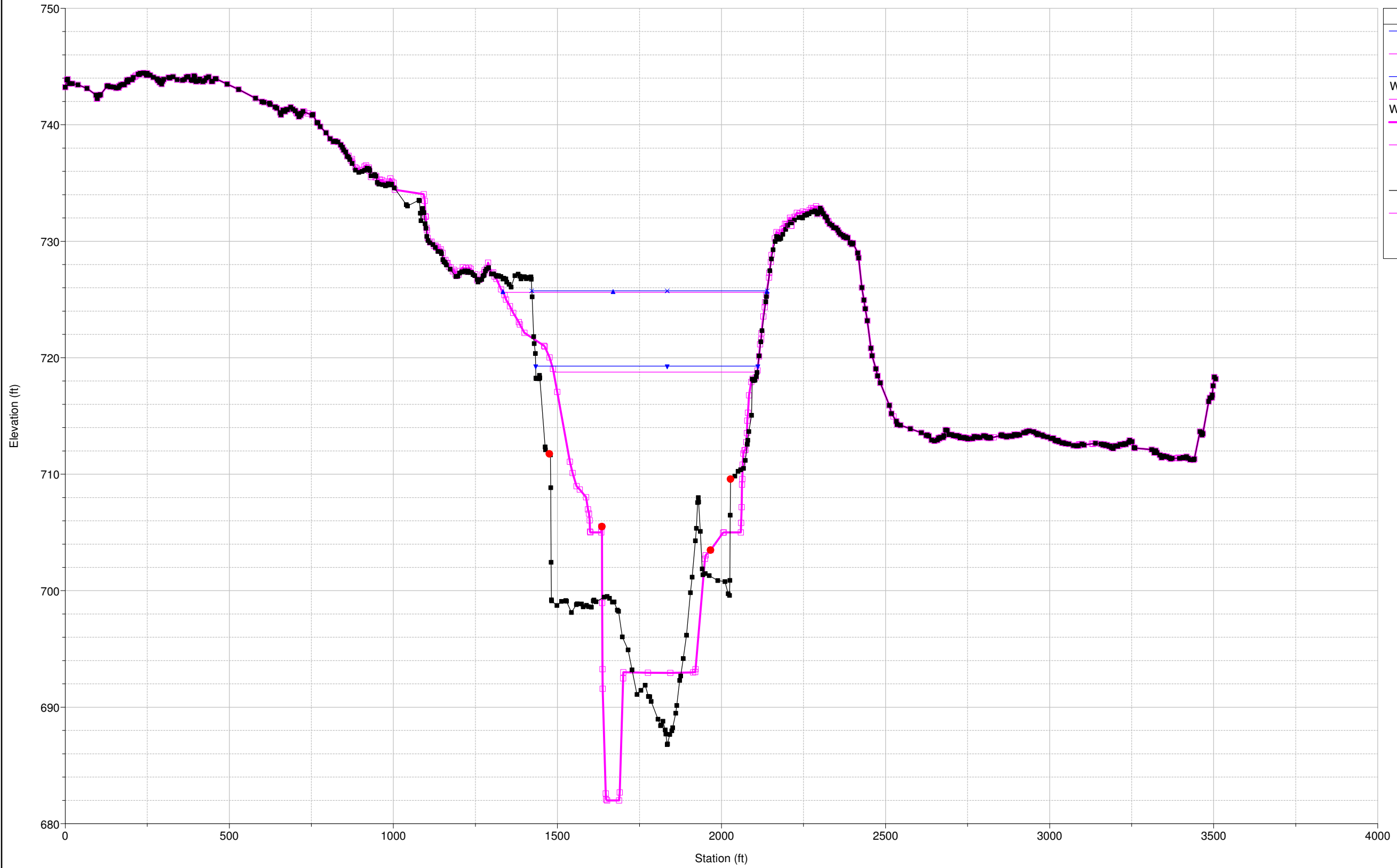


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.8



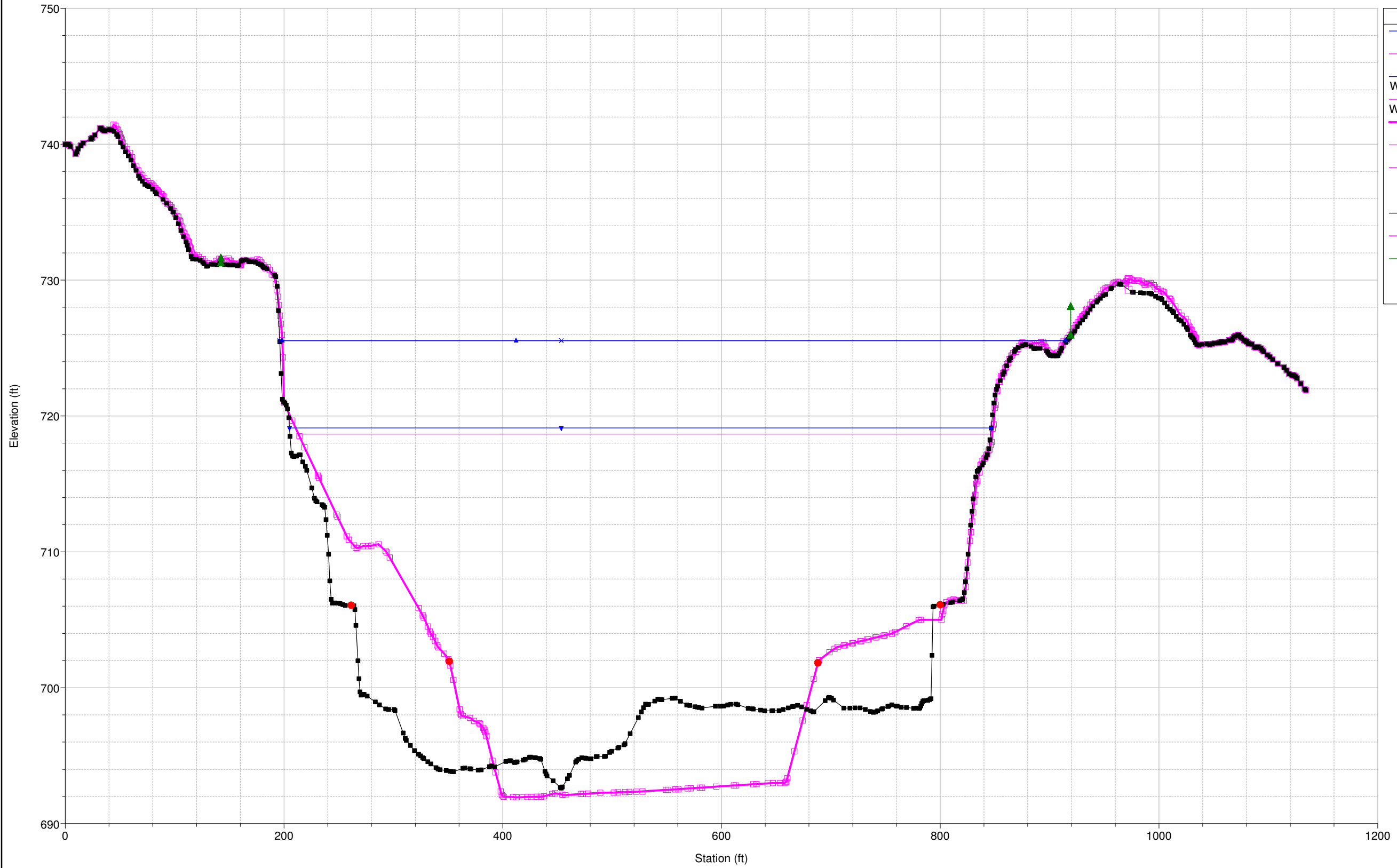
Legend	
WS SPF - Pre-Project	✕
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
- PostProject	▨
Ground - PostProject	□
Levee - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▨
Ground - Pre-Project	■
Levee - Pre-Project	□
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.75



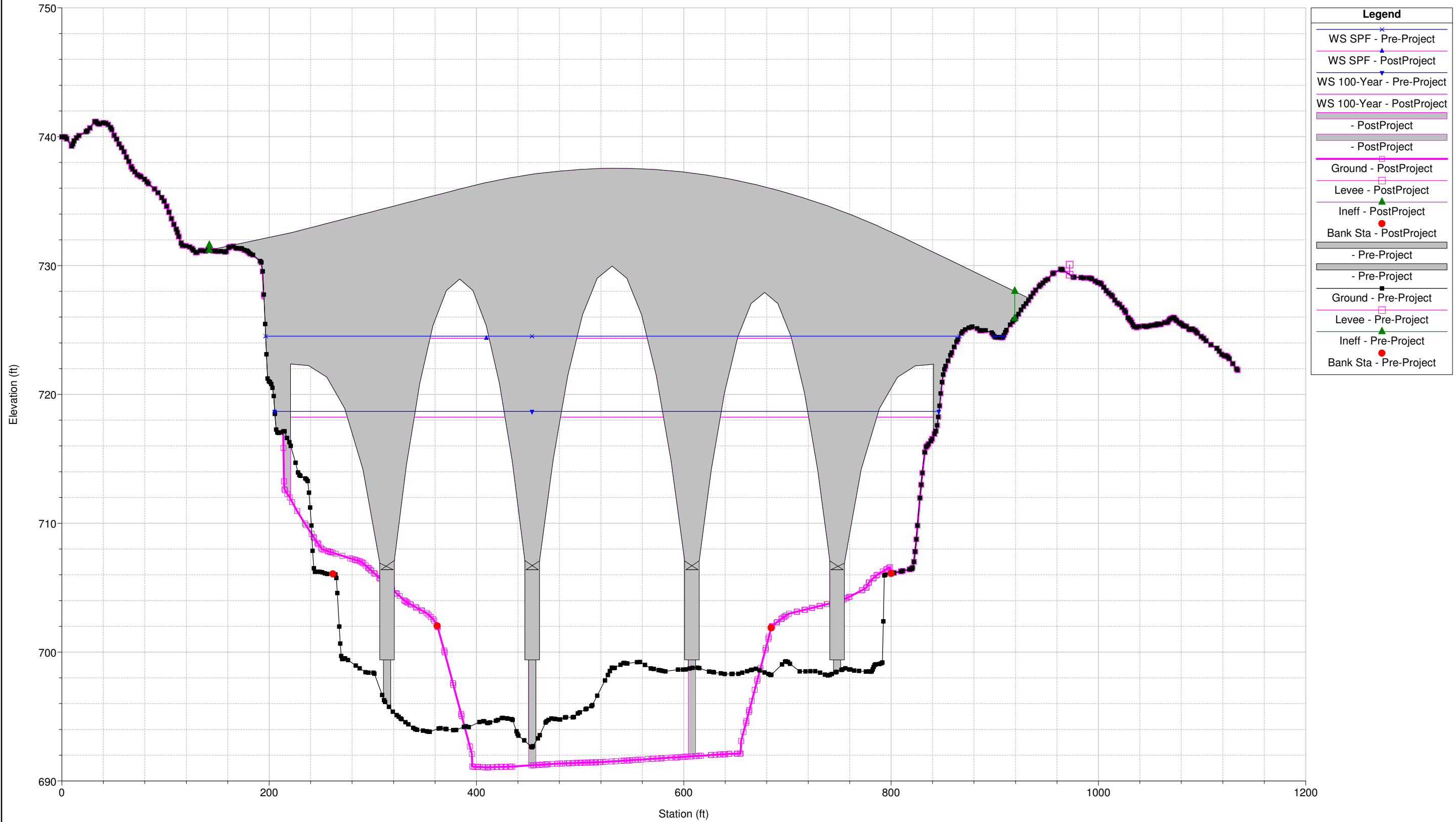
Legend	
WS SPF - Pre-Project	✕
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	✕
Ground - PostProject	—
Levee - PostProject	□
Bank Sta - PostProject	●
Ground - Pre-Project	—
Levee - Pre-Project	□
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.5

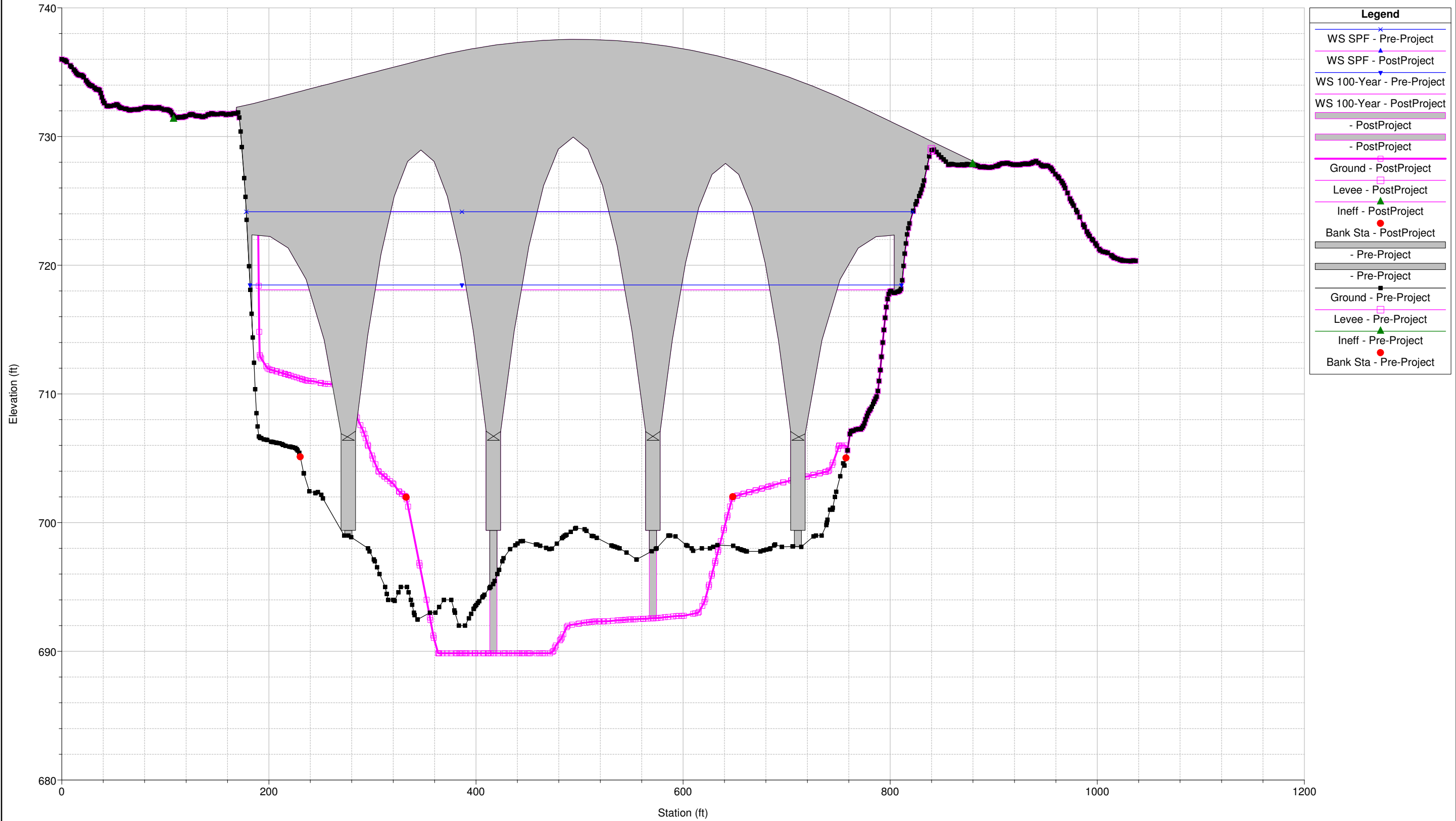


Legend	
WS SPF - Pre-Project	▲
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▼
Ground - PostProject	■
Levee - PostProject	■
Ineff - PostProject	▲
Bank Sta - PostProject	●
Ground - Pre-Project	■
Levee - Pre-Project	■
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.3 BR

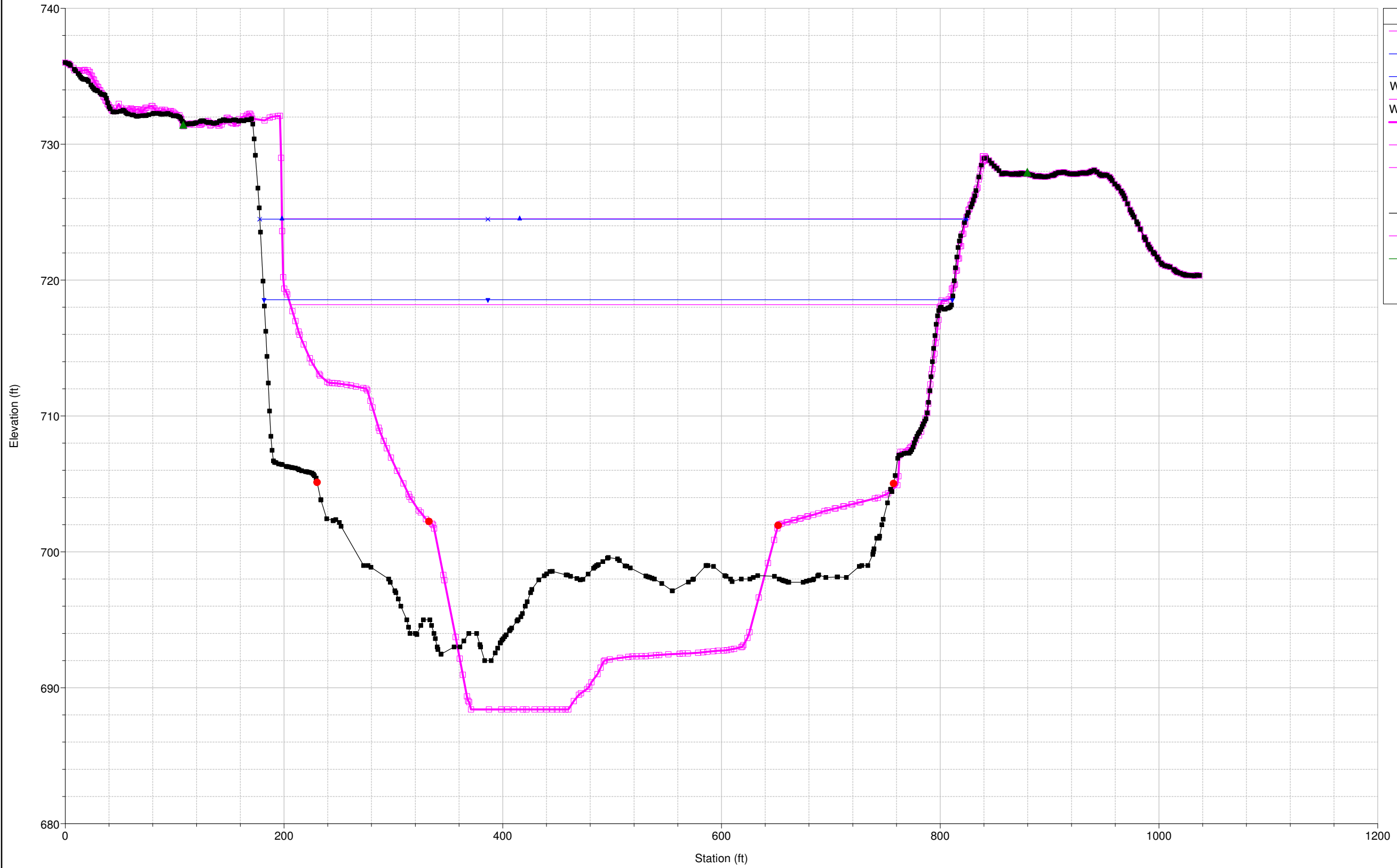


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.3 BR



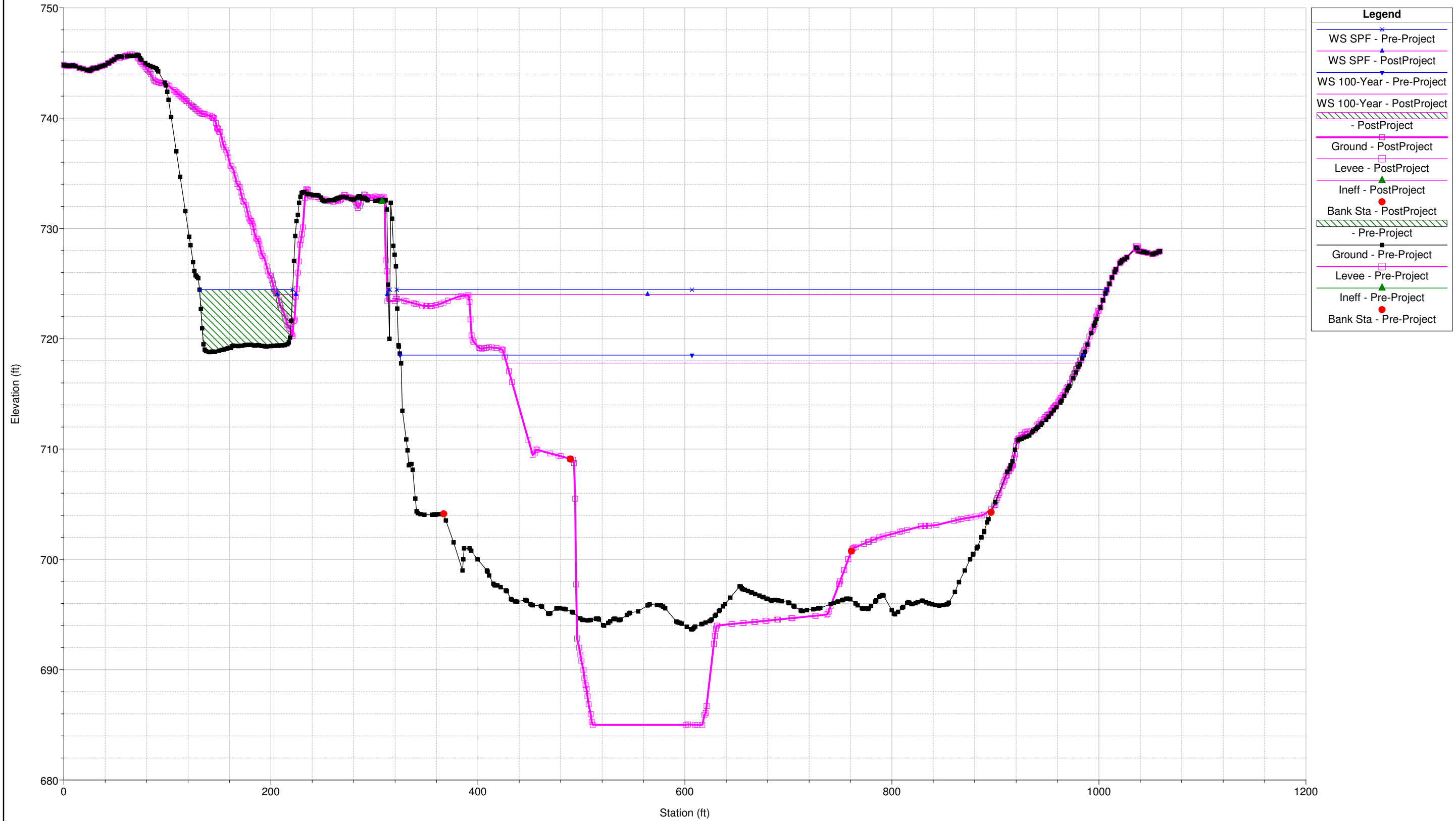
Legend	
WS SPF - Pre-Project	Blue line with 'x' marker
WS SPF - PostProject	Magenta line with triangle marker
WS 100-Year - Pre-Project	Blue line with inverted triangle marker
WS 100-Year - PostProject	Magenta line with square marker
- PostProject	Grey shaded area
- PostProject	Grey shaded area
Ground - PostProject	Magenta line with square marker
Levee - PostProject	Grey shaded area
Ineff - PostProject	Magenta line with triangle marker
Bank Sta - PostProject	Red dot
- Pre-Project	Grey shaded area
- Pre-Project	Grey shaded area
Ground - Pre-Project	Black line with square marker
Levee - Pre-Project	Grey shaded area
Ineff - Pre-Project	Green line with triangle marker
Bank Sta - Pre-Project	Green dot

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 251.1

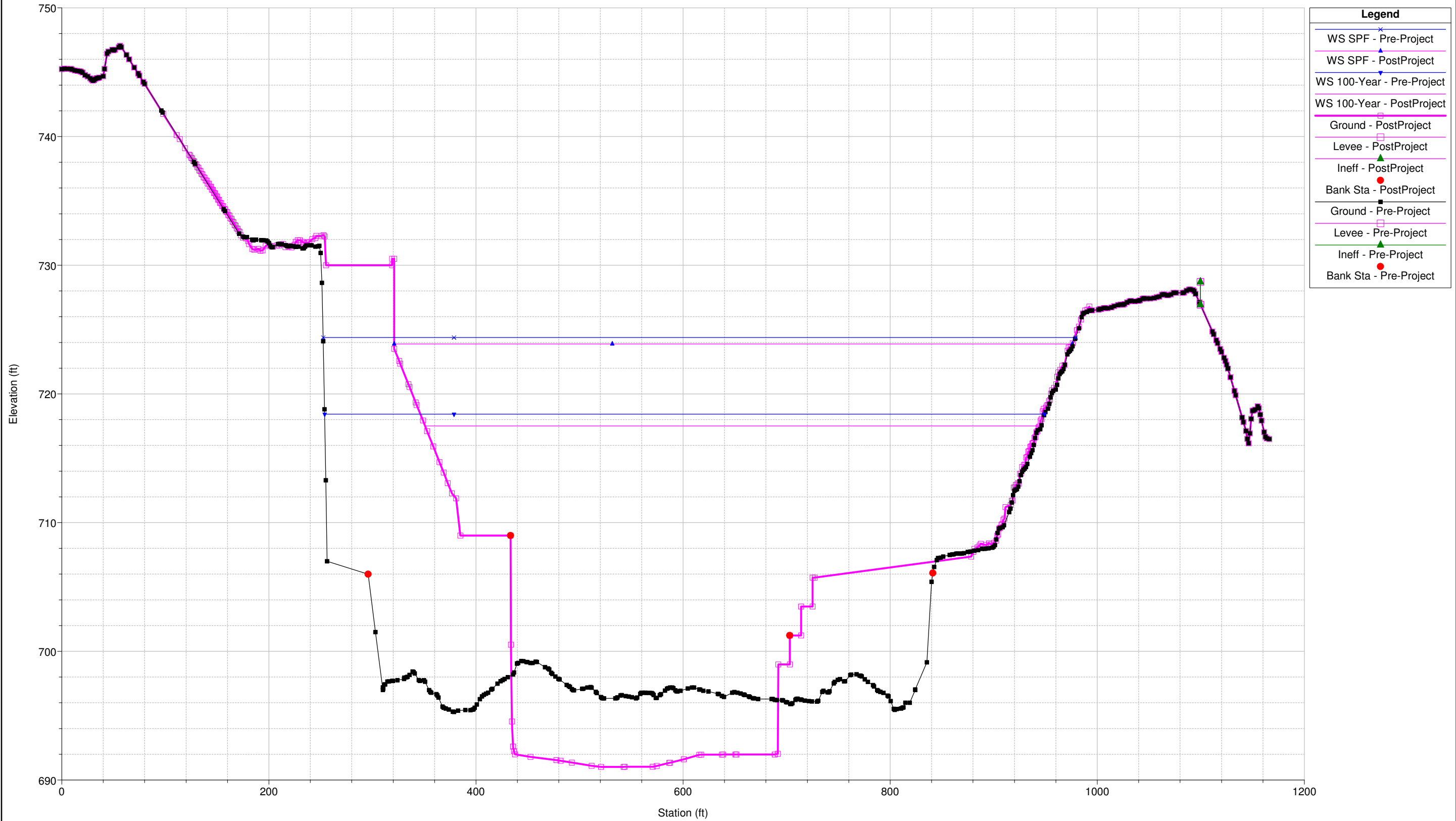


Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
Ground - PostProject	■
Levee - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
Ground - Pre-Project	■
Levee - Pre-Project	□
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

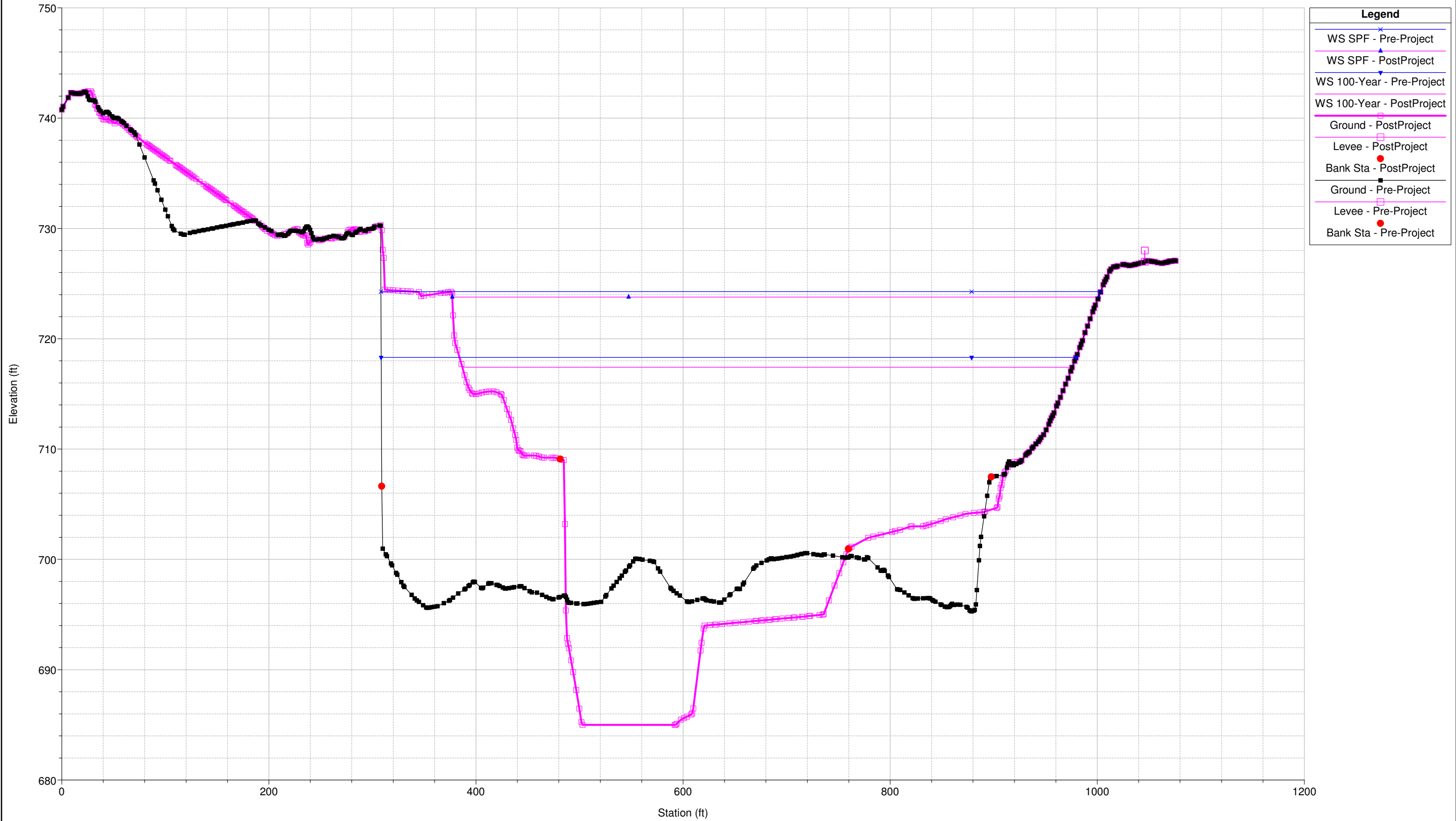
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 250.776



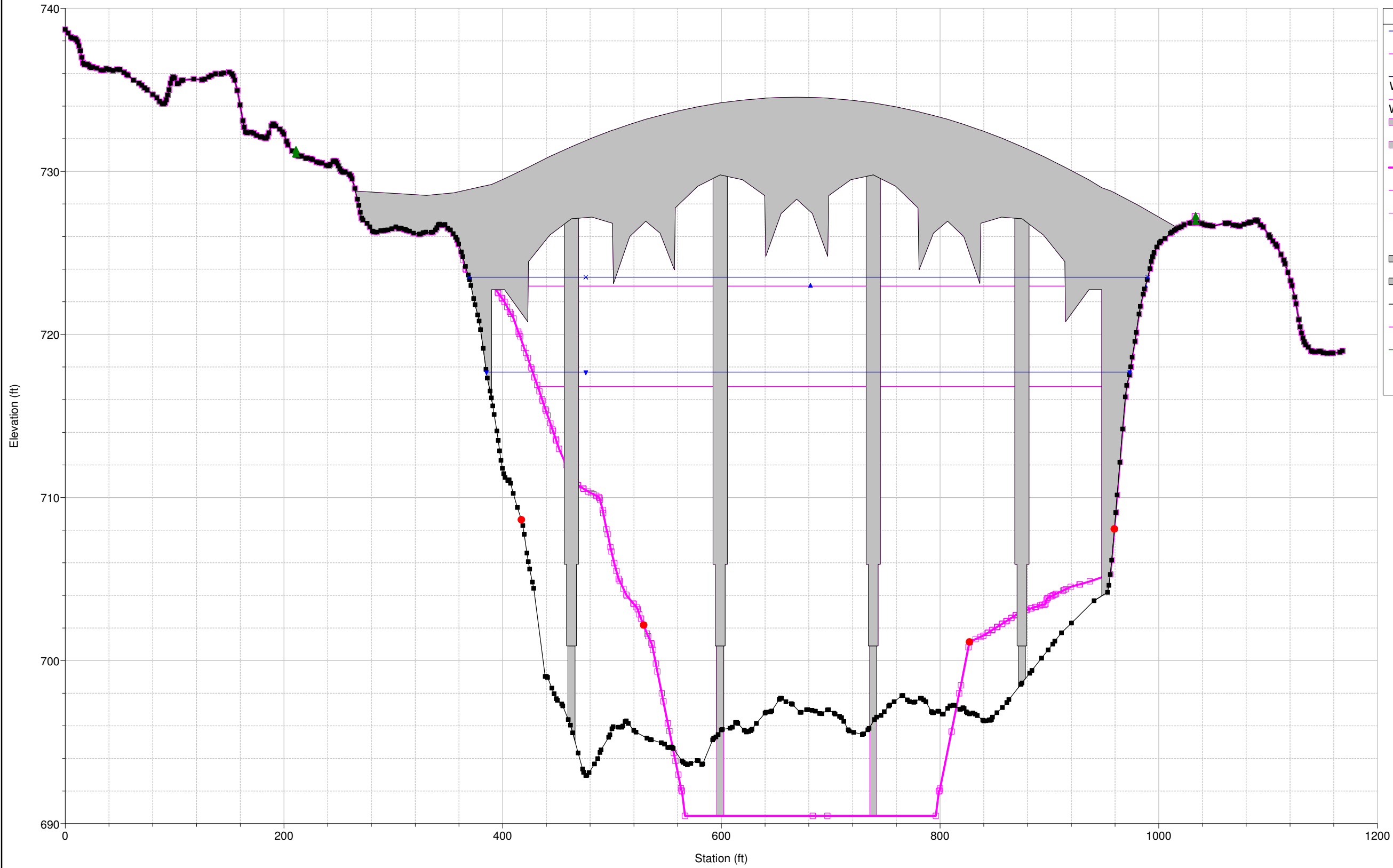
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 250.6268



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 250.5503

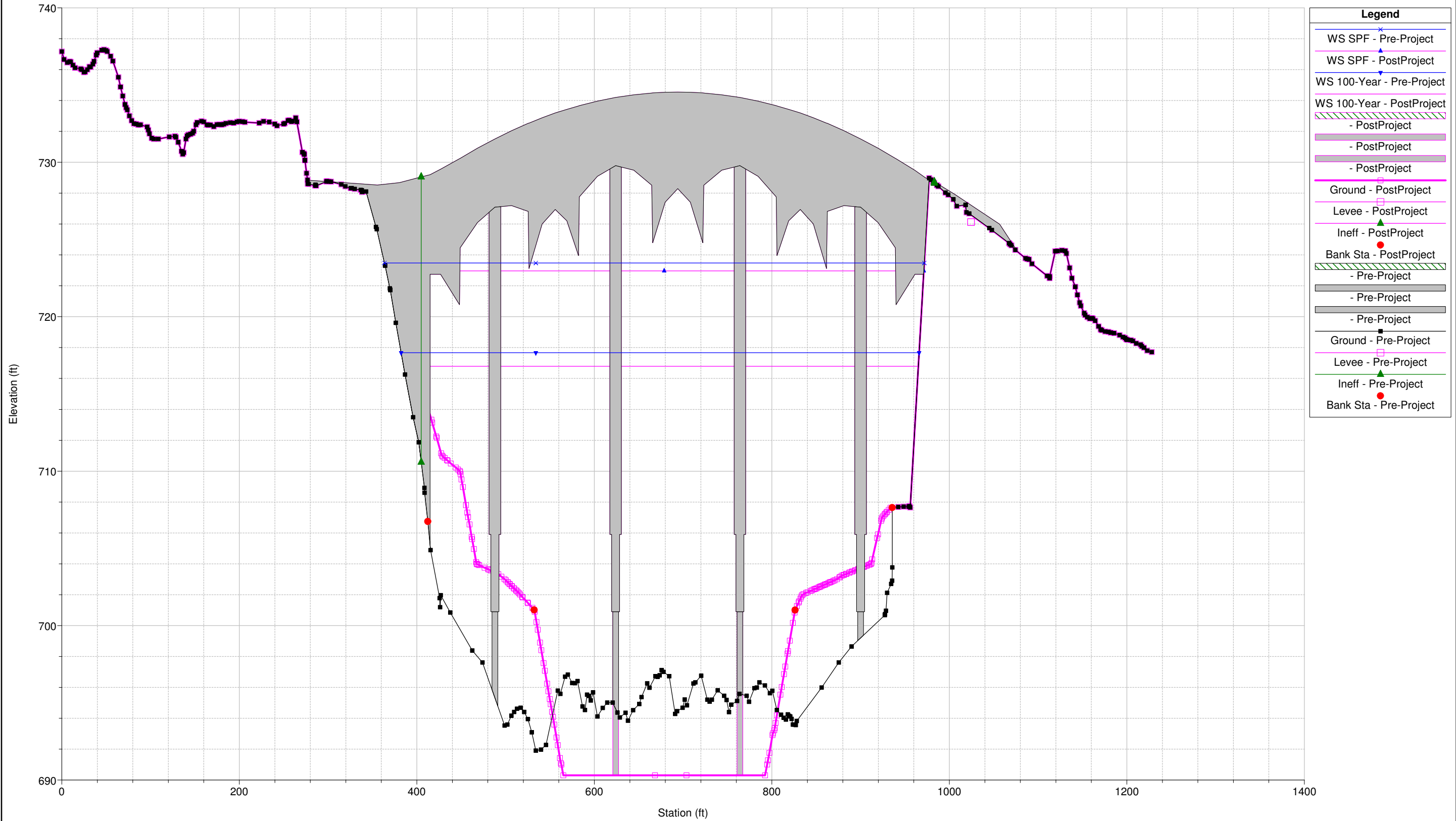


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 250.4469 BR



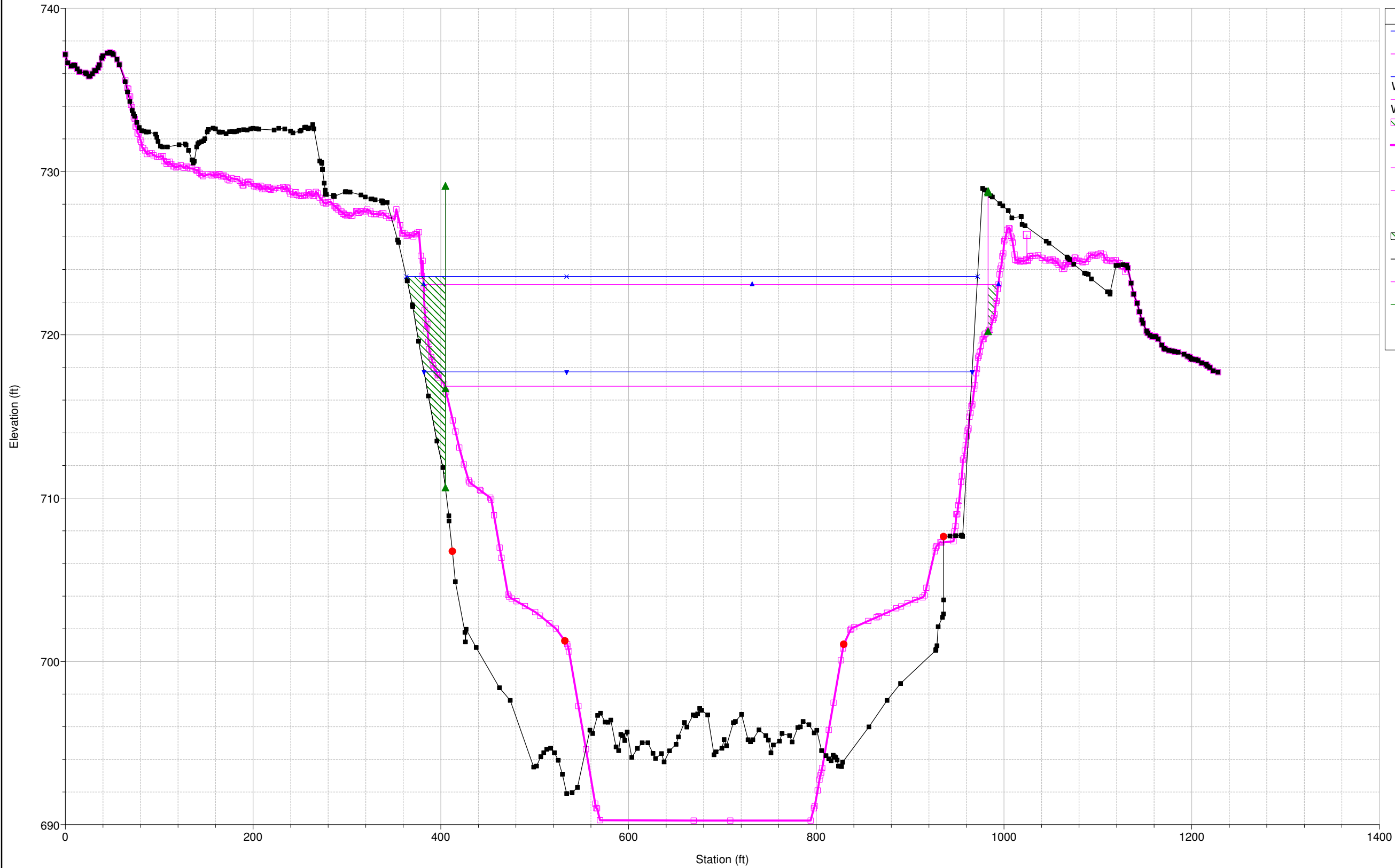
Legend	
WS SPF - Pre-Project	✕
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	◆
- PostProject	■
- PostProject	■
Ground - PostProject	□
Levee - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	■
- Pre-Project	■
Ground - Pre-Project	■
Levee - Pre-Project	□
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 250.4469 BR



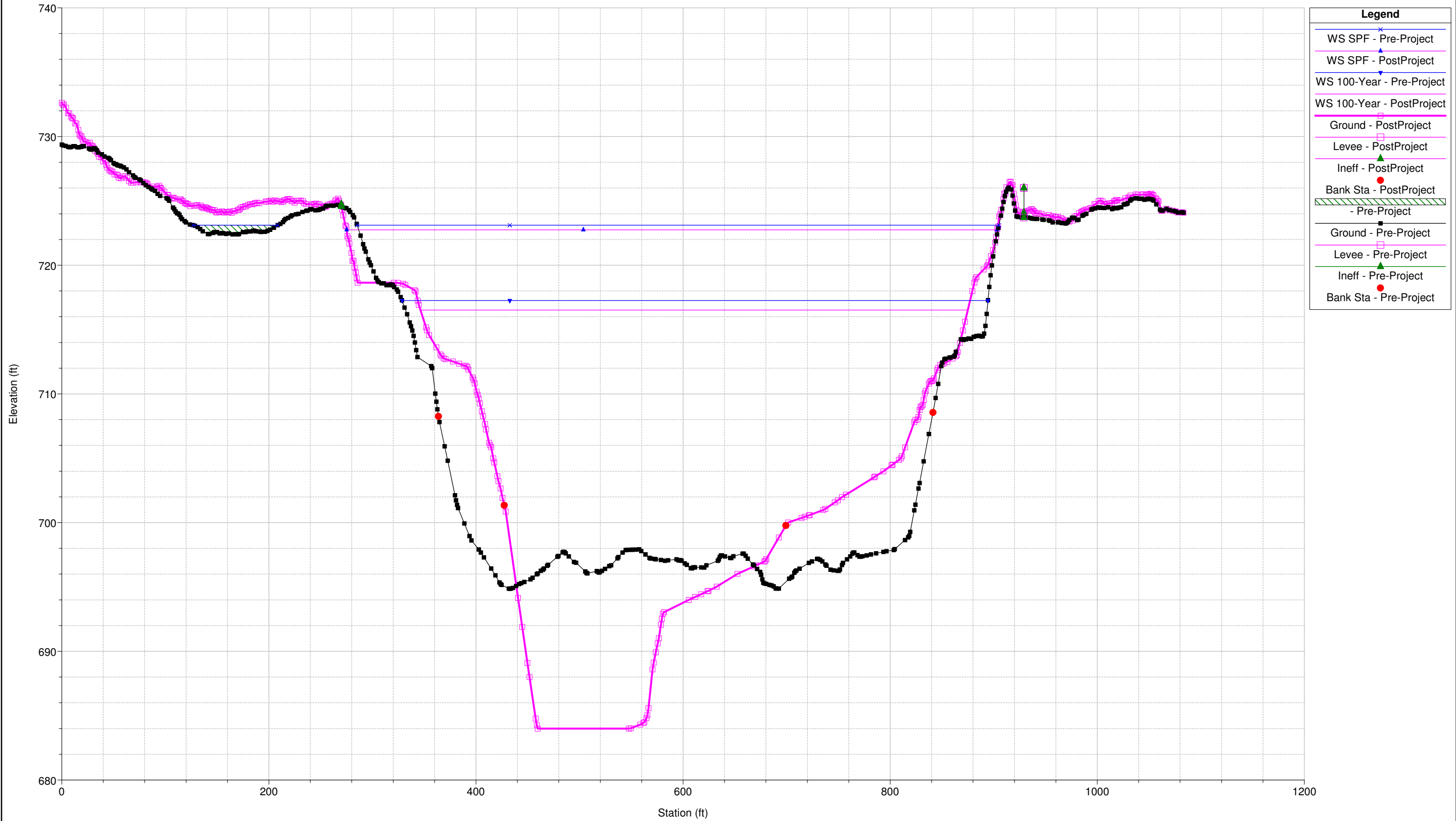
Legend	
WS SPF - Pre-Project	Black line with 'x' markers
WS SPF - PostProject	Magenta line with triangle markers
WS 100-Year - Pre-Project	Black line with triangle markers
WS 100-Year - PostProject	Magenta line with triangle markers
- PostProject	Hatched pattern
- PostProject	Solid grey bar
- PostProject	Solid grey bar
- PostProject	Solid grey bar
Ground - PostProject	Magenta line with square markers
Levee - PostProject	Magenta line with square markers
Ineff - PostProject	Green line with triangle markers
Bank Sta - PostProject	Red circle marker
- Pre-Project	Hatched pattern
- Pre-Project	Solid grey bar
- Pre-Project	Solid grey bar
Ground - Pre-Project	Black line with square markers
Levee - Pre-Project	Black line with square markers
Ineff - Pre-Project	Green line with triangle markers
Bank Sta - Pre-Project	Red circle marker

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.79

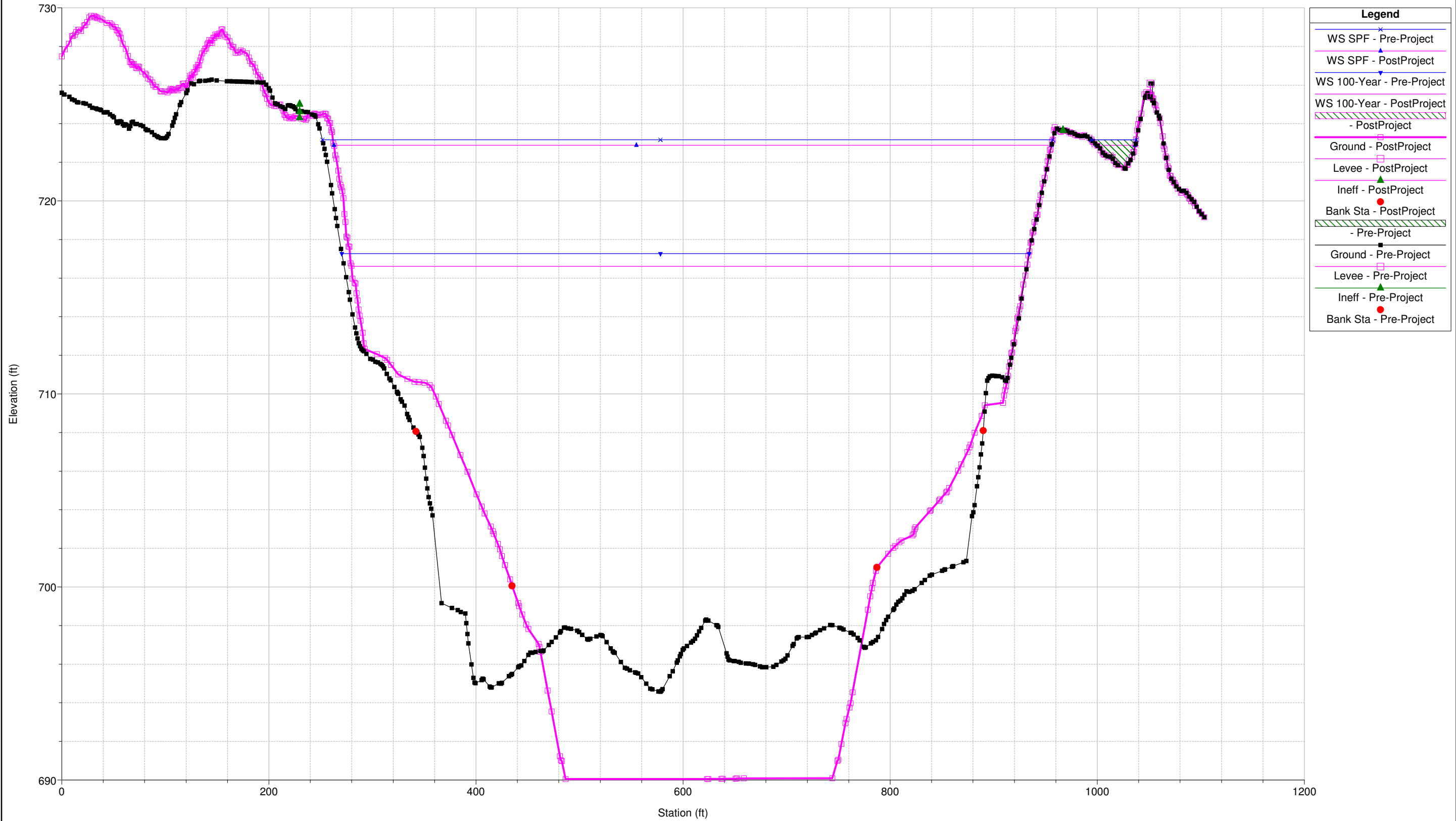


Legend	
WS SPF - Pre-Project	✕
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
- PostProject	▨
Ground - PostProject	□
Levee - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▨
Ground - Pre-Project	■
Levee - Pre-Project	□
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

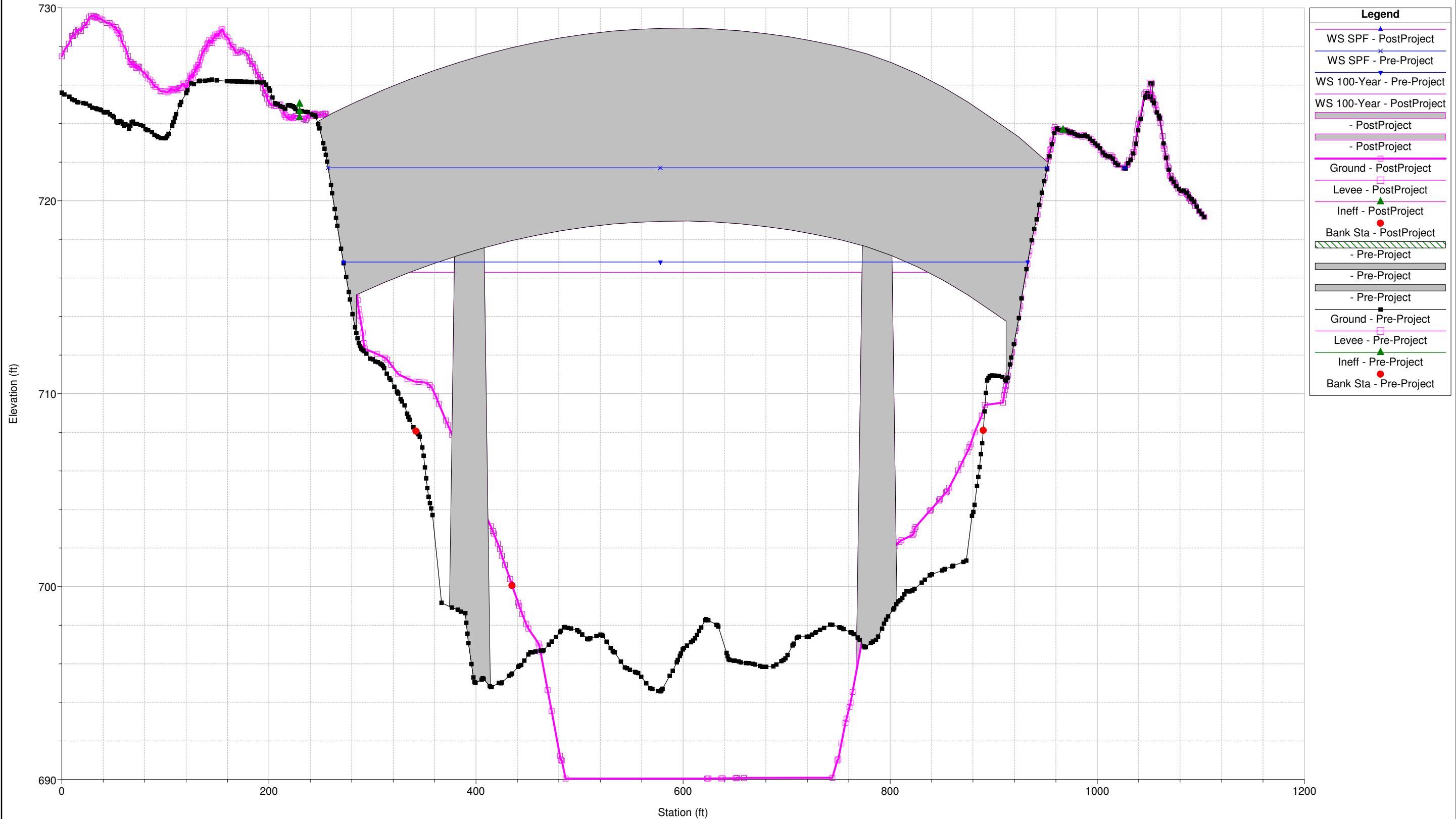
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.76



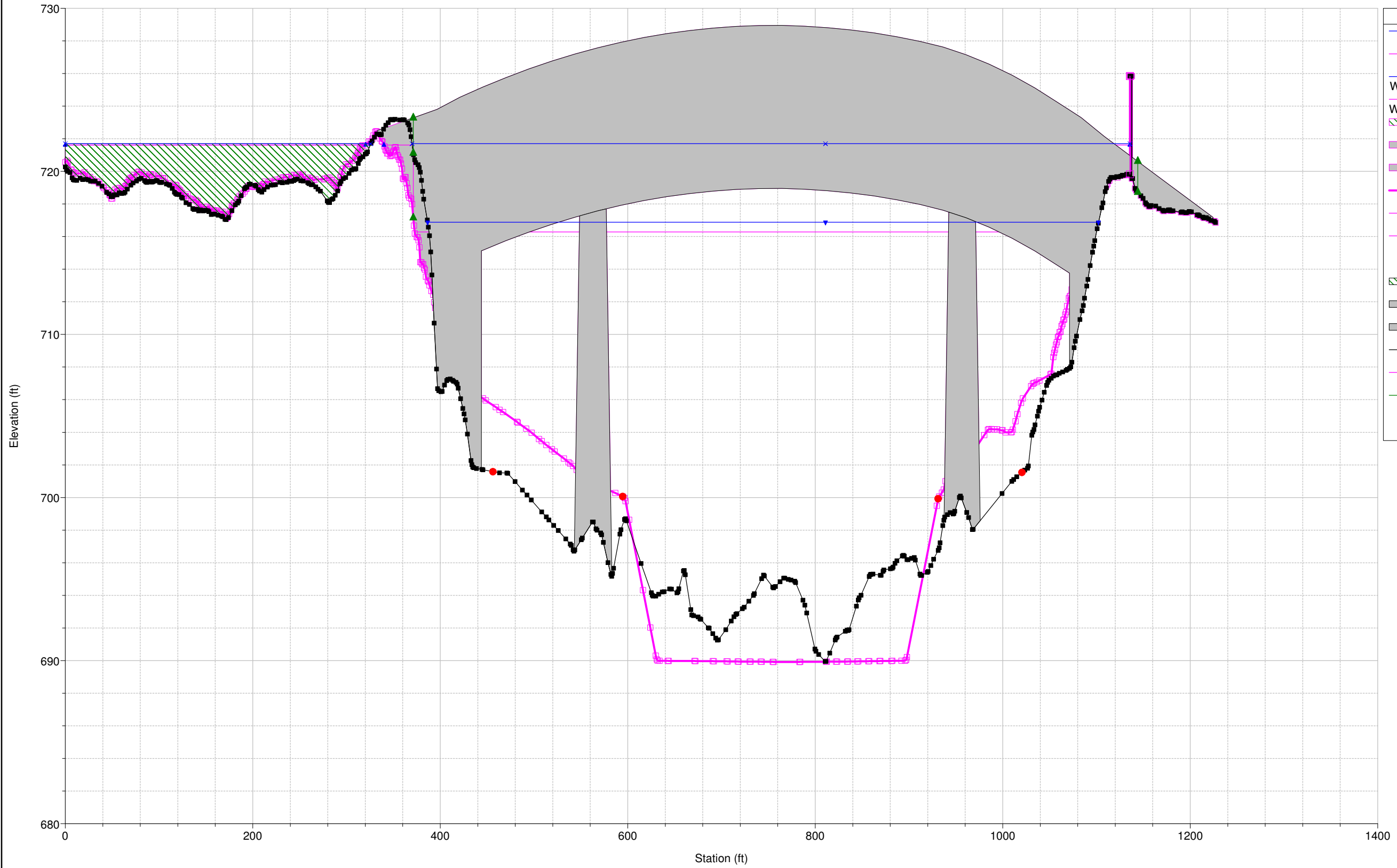
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.5



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.3 BR

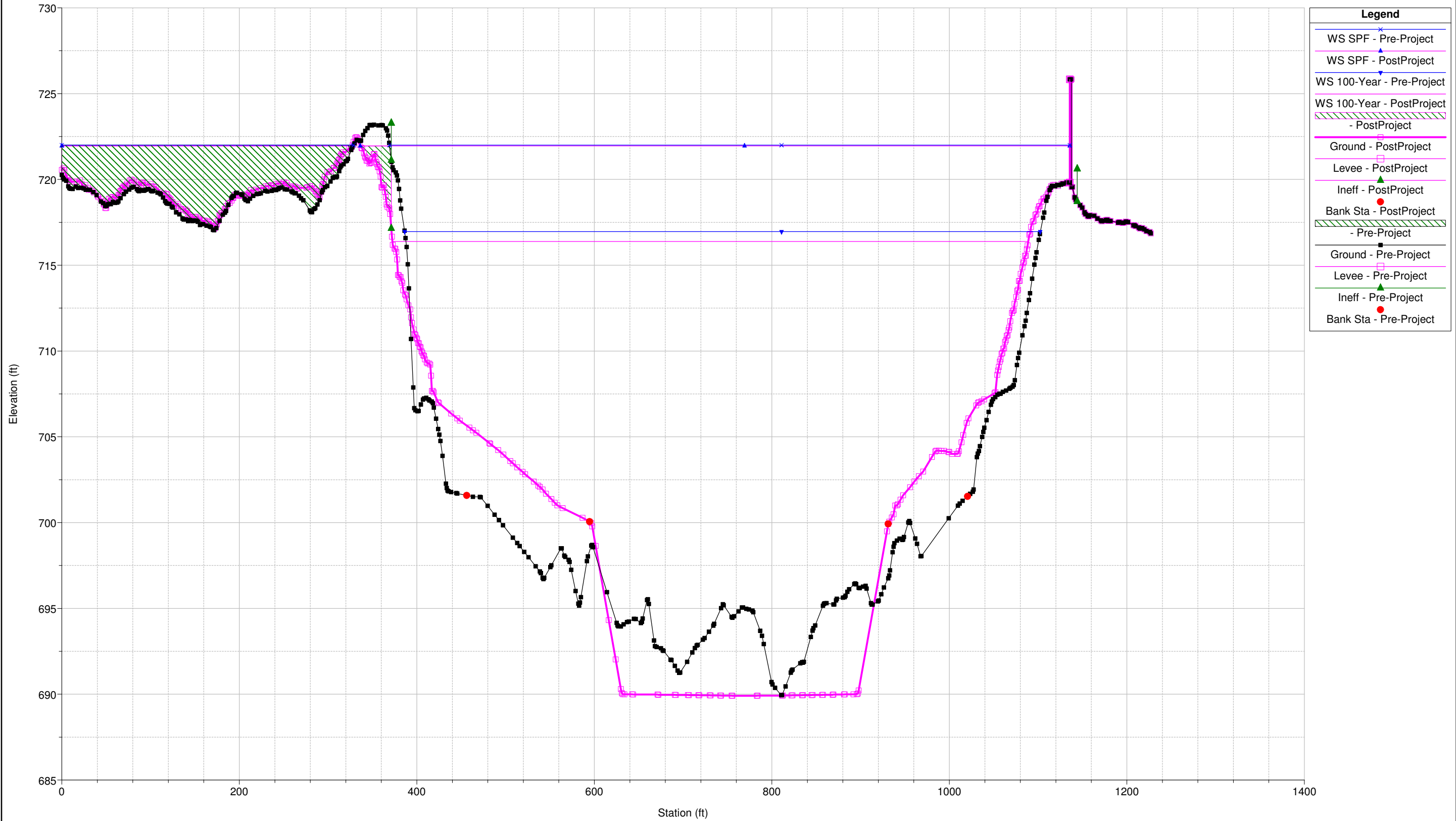


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.3 BR

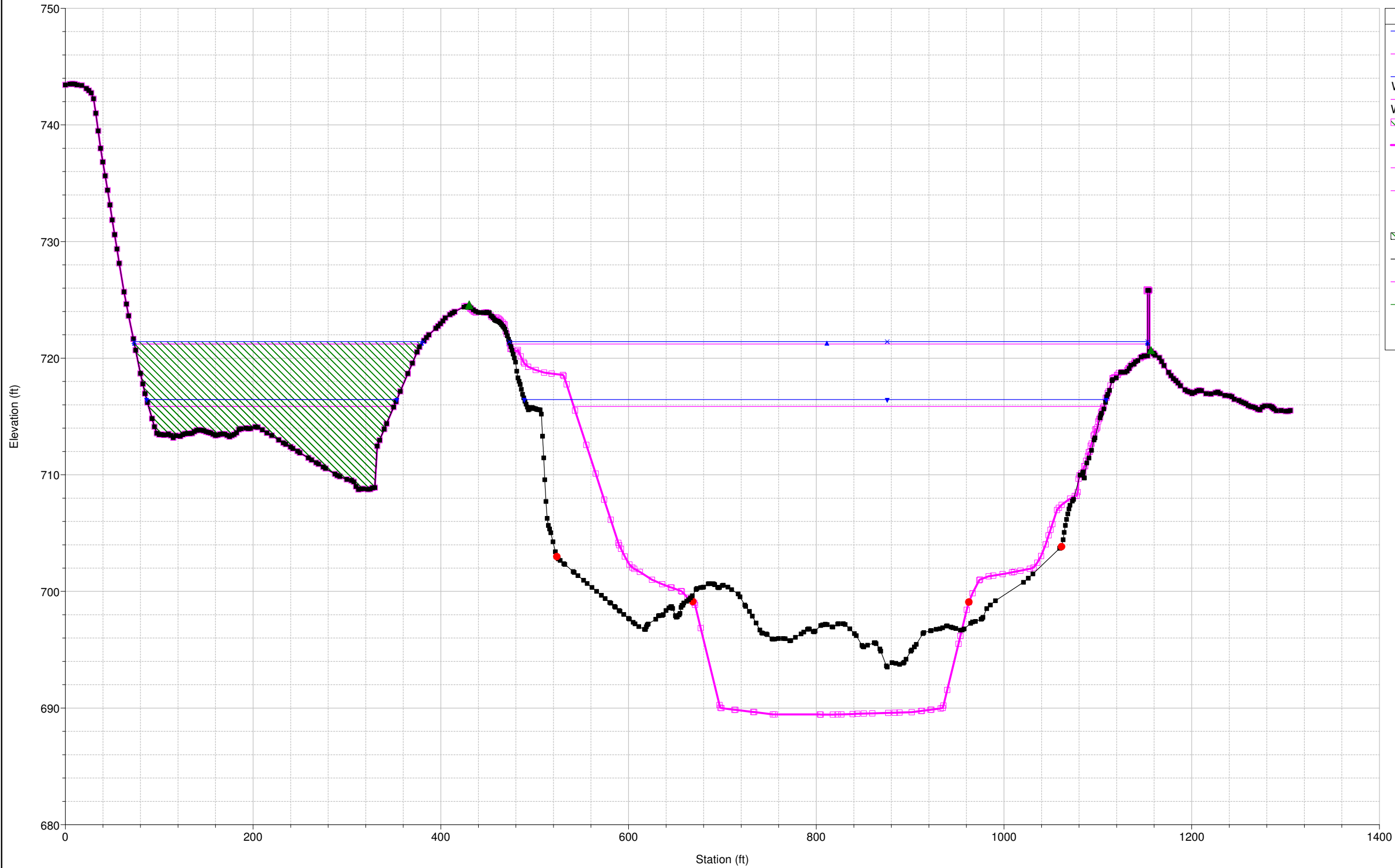


Legend	
WS SPF - Pre-Project	Blue line with 'x' marker
WS SPF - PostProject	Magenta line with triangle marker
WS 100-Year - Pre-Project	Solid blue line
WS 100-Year - PostProject	Solid magenta line
- PostProject	Diagonal hatched pattern
- PostProject	Solid grey fill
- PostProject	Solid magenta fill
Ground - PostProject	Magenta line with square marker
Levee - PostProject	Magenta line with square marker
Ineff - PostProject	Magenta line with triangle marker
Bank Sta - PostProject	Red circular marker
- Pre-Project	Diagonal hatched pattern
- Pre-Project	Solid grey fill
- Pre-Project	Solid magenta fill
Ground - Pre-Project	Black line with square marker
Levee - Pre-Project	Black line with square marker
Ineff - Pre-Project	Black line with triangle marker
Bank Sta - Pre-Project	Red circular marker

Sciotgreenways Plan: 1) Pre-Project 2) PostProject
RS = 249.1

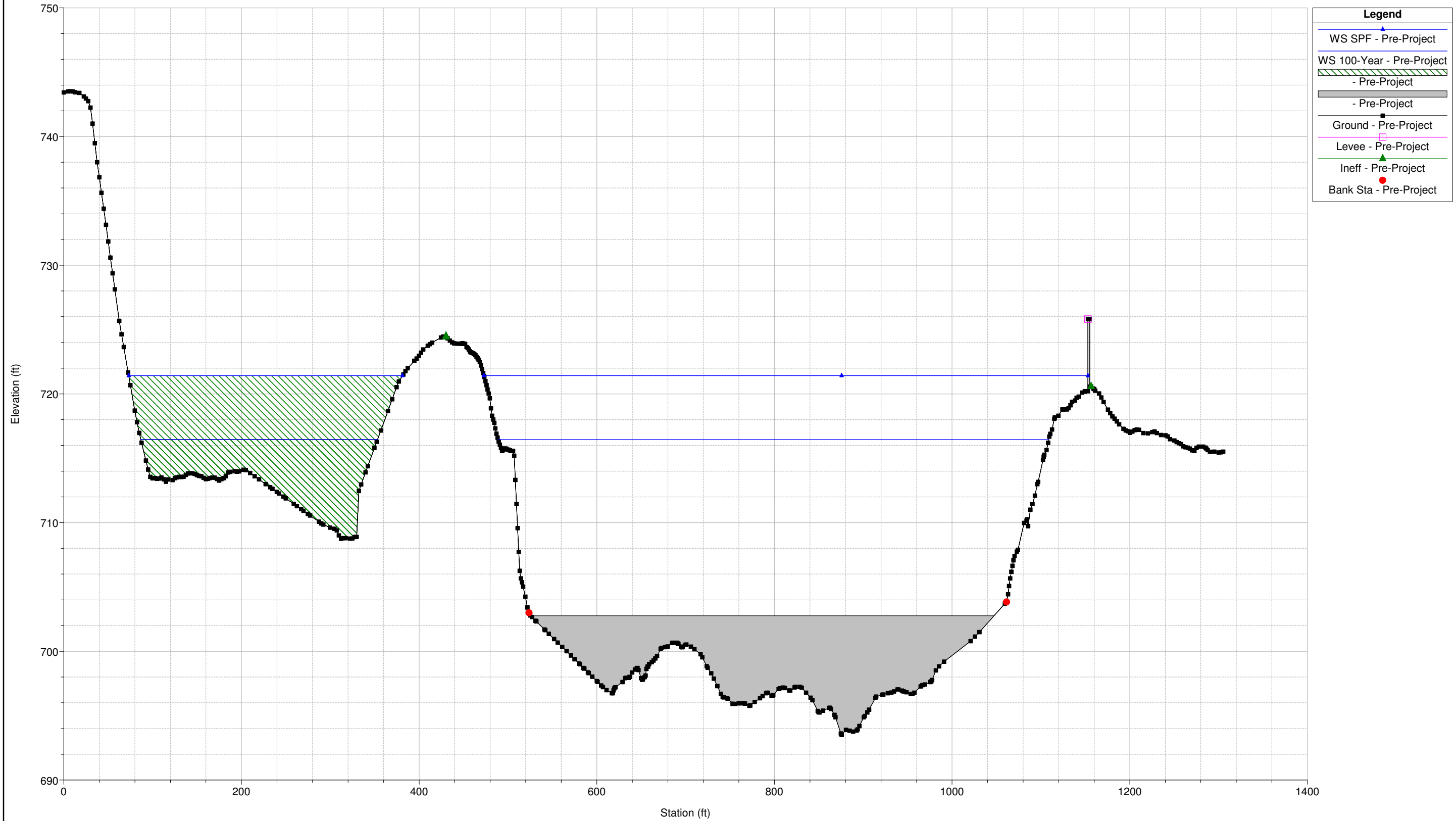


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 249

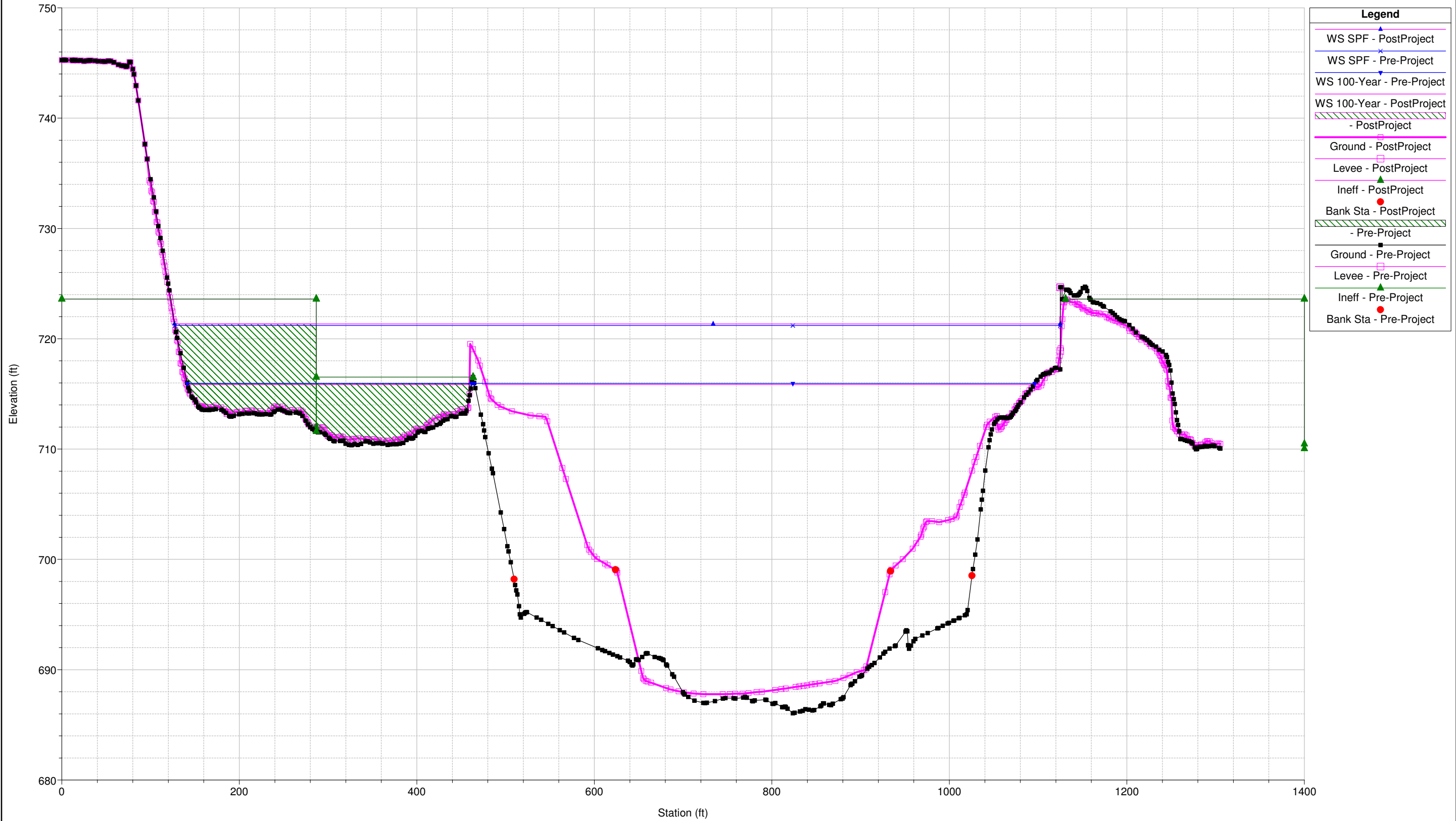


Legend	
WS SPF - Pre-Project	✕
WS SPF - PostProject	▲
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
- PostProject	▨
Ground - PostProject	■
Levee - PostProject	□
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▨
Ground - Pre-Project	■
Levee - Pre-Project	□
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

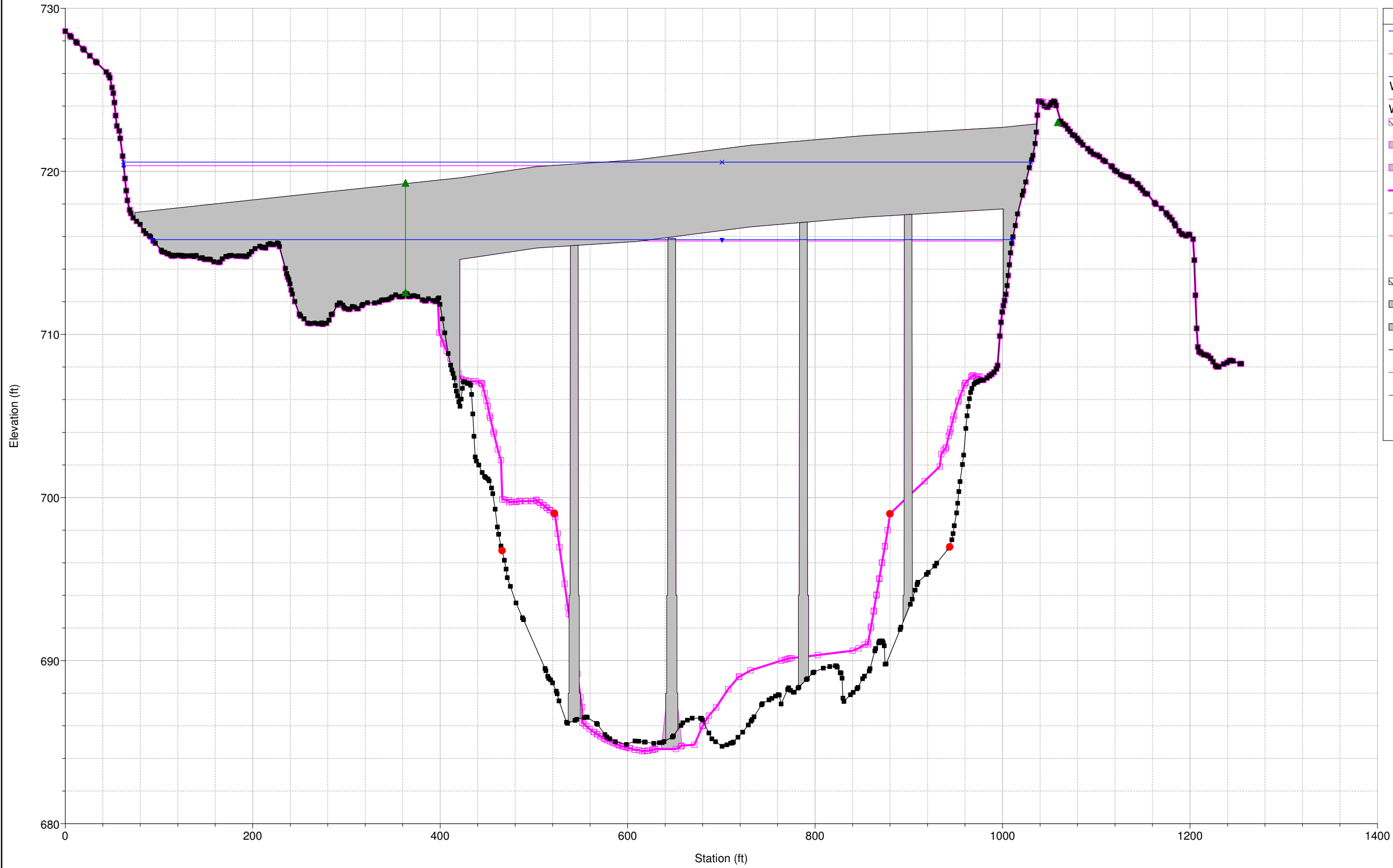
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 248.6 IS



Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 248.3

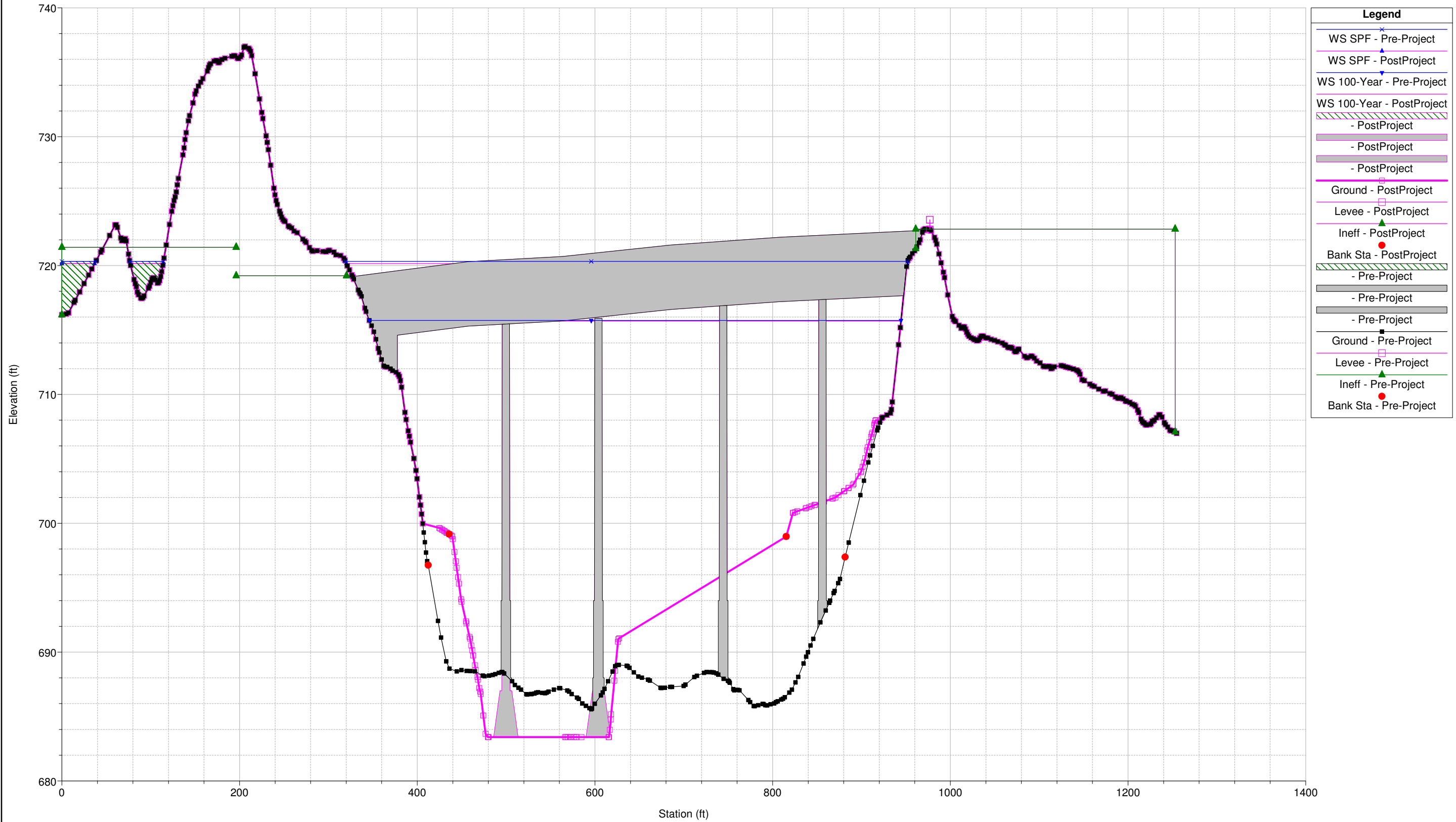


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 247.3 BR



Legend	
WS SPF - Pre-Project	Blue line with 'x' marker
WS SPF - PostProject	Magenta line with 'x' marker
WS 100-Year - Pre-Project	Blue line with downward triangle marker
WS 100-Year - PostProject	Magenta line with downward triangle marker
- PostProject	Diagonal hatched pattern
- PostProject	Solid grey bar
- PostProject	Solid grey bar
Ground - PostProject	Magenta line with square marker
Levee - PostProject	Magenta line with square marker
Ineff - PostProject	Green line with upward triangle marker
Bank Sta - PostProject	Red line with circle marker
- Pre-Project	Diagonal hatched pattern
- Pre-Project	Solid grey bar
- Pre-Project	Solid grey bar
Ground - Pre-Project	Black line with square marker
Levee - Pre-Project	Black line with square marker
Ineff - Pre-Project	Green line with upward triangle marker
Bank Sta - Pre-Project	Red line with circle marker

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 247.3 BR

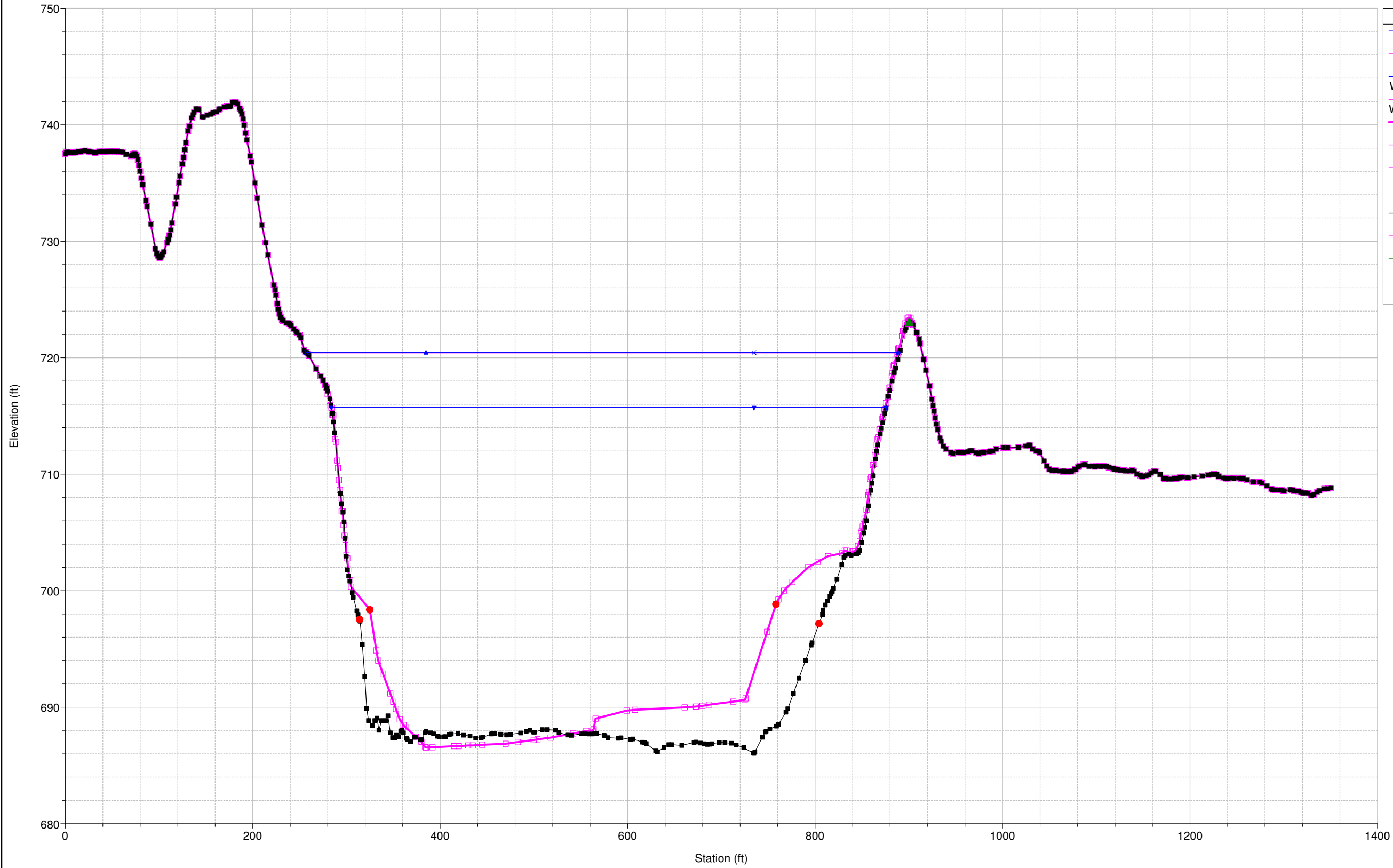


Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 247.1



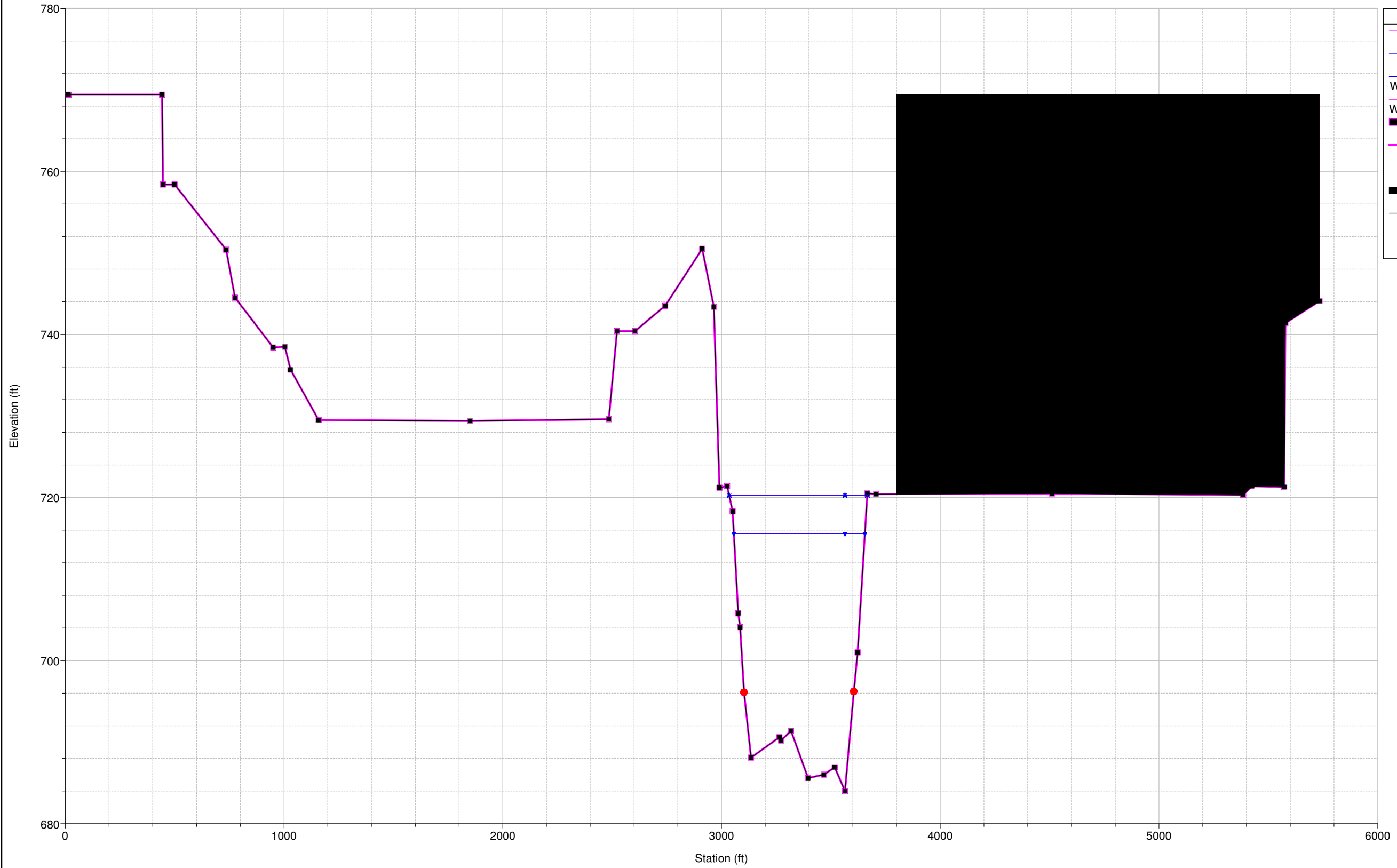
Legend	
WS SPF - Pre-Project	Blue line with 'x' markers
WS SPF - PostProject	Magenta line with triangle markers
WS 100-Year - Pre-Project	Blue line with triangle markers
WS 100-Year - PostProject	Magenta line with triangle markers
- PostProject	Diagonal hatched area
Ground - PostProject	Black line with square markers
Levee - PostProject	Magenta line with square markers
Ineff - PostProject	Green triangle marker
Bank Sta - PostProject	Red circle marker
- Pre-Project	Diagonal hatched area
Ground - Pre-Project	Black line with square markers
Levee - Pre-Project	Magenta line with square markers
Ineff - Pre-Project	Green triangle marker
Bank Sta - Pre-Project	Red circle marker

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.8



Legend	
WS SPF - Pre-Project	Blue line with 'x' markers
WS SPF - PostProject	Magenta line with upward triangle markers
WS 100-Year - Pre-Project	Blue line with downward triangle markers
WS 100-Year - PostProject	Magenta line with downward triangle markers
Ground - PostProject	Black line with square markers
Levee - PostProject	Magenta line with square markers
Ineff - PostProject	Green line with upward triangle markers
Bank Sta - PostProject	Red circle markers
Ground - Pre-Project	Black line with square markers
Levee - Pre-Project	Magenta line with square markers
Ineff - Pre-Project	Green line with upward triangle markers
Bank Sta - Pre-Project	Red circle markers

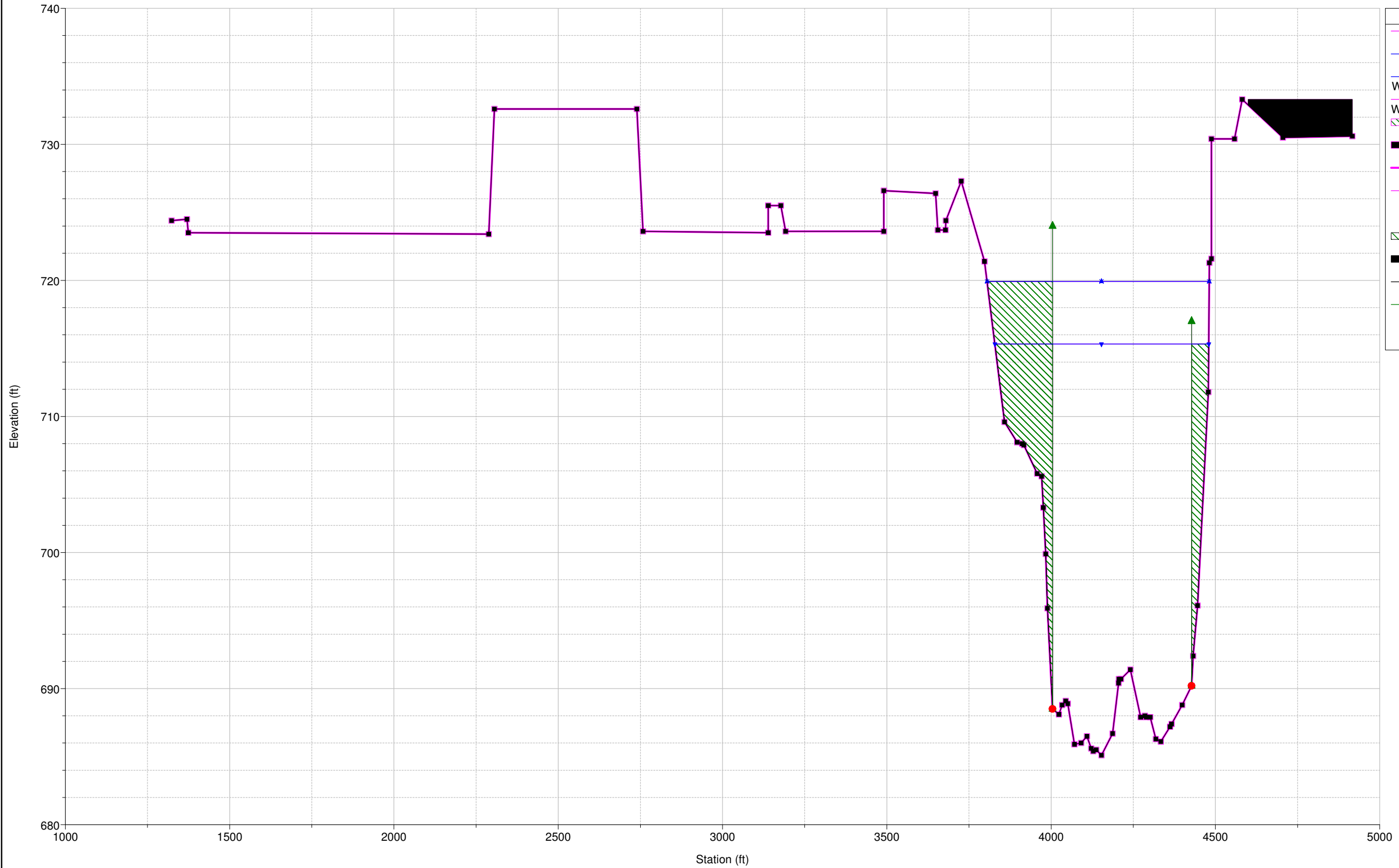
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.5



Legend

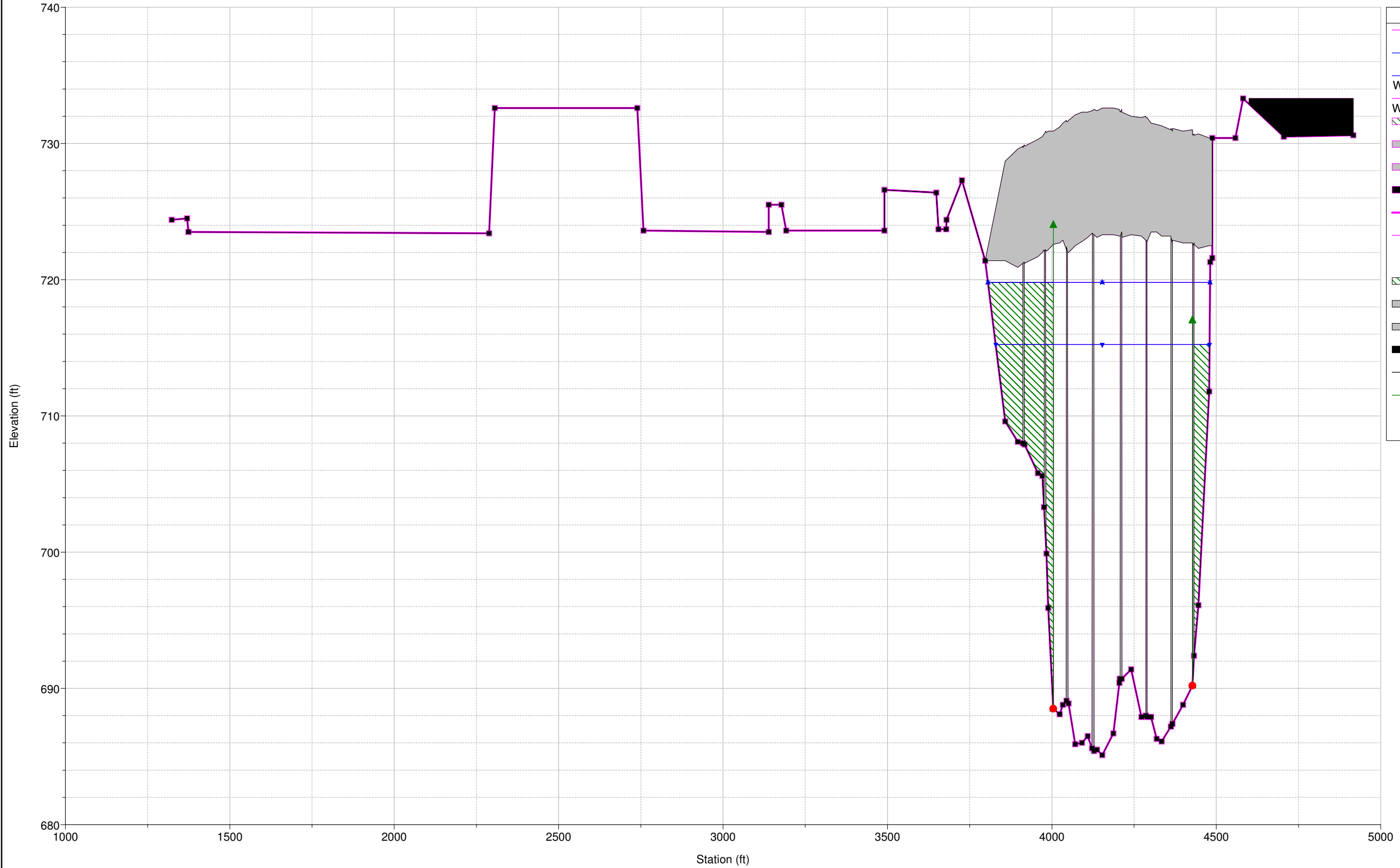
- WS SPF - PostProject (magenta line with upward triangle)
- WS SPF - Pre-Project (blue line with 'x')
- WS 100-Year - Pre-Project (blue line with downward triangle)
- WS 100-Year - PostProject (magenta line with square)
- PostProject (thick black line)
- Ground - PostProject (black line with square)
- Bank Sta - PostProject (red circle)
- Pre-Project (thick black line)
- Ground - Pre-Project (black line with square)
- Bank Sta - Pre-Project (red circle)

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.4



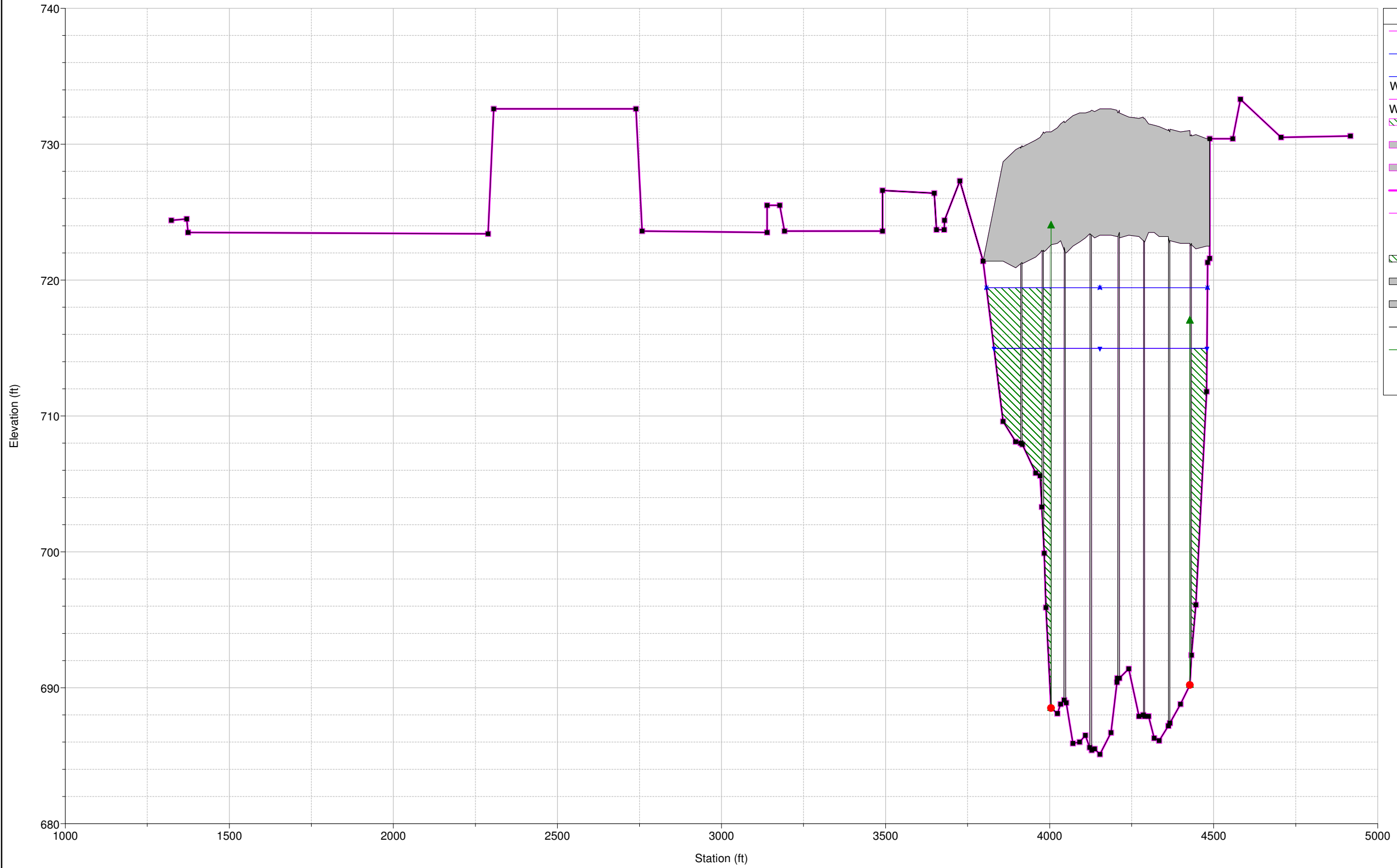
Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	▲
WS 100-Year - Pre-Project	▲
WS 100-Year - PostProject	▲
- PostProject	▲
- PostProject	▲
Ground - PostProject	▲
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▲
- Pre-Project	▲
Ground - Pre-Project	▲
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.3 BR



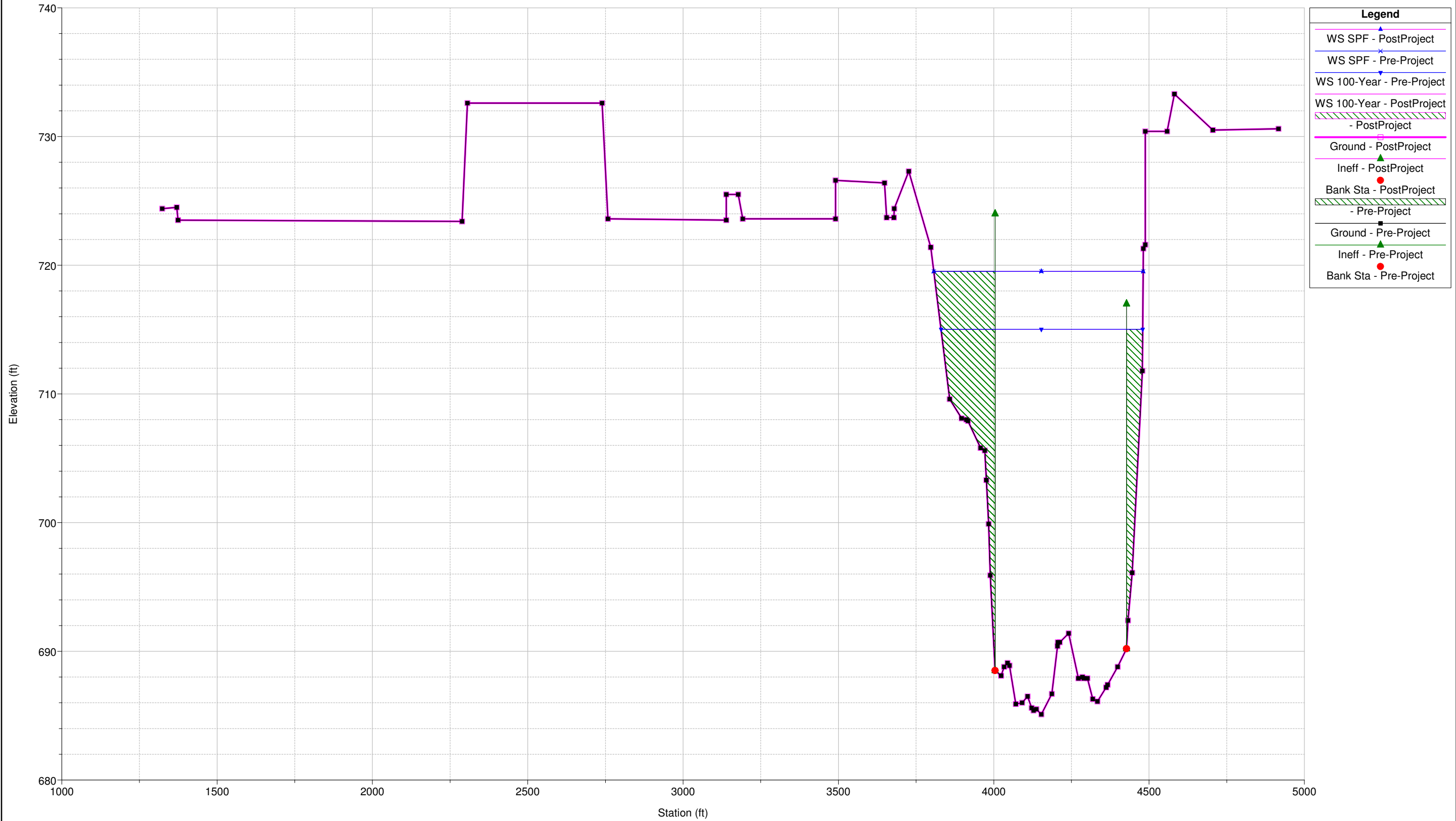
Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	×
WS 100-Year - Pre-Project	▼
WS 100-Year - PostProject	▲
- PostProject	▨
- PostProject	▨
- PostProject	▨
- PostProject	▨
- PostProject	▨
- PostProject	▨
Ground - PostProject	▬
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▨
- Pre-Project	▨
- Pre-Project	▨
- Pre-Project	▨
- Pre-Project	▨
Ground - Pre-Project	▬
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.3 BR

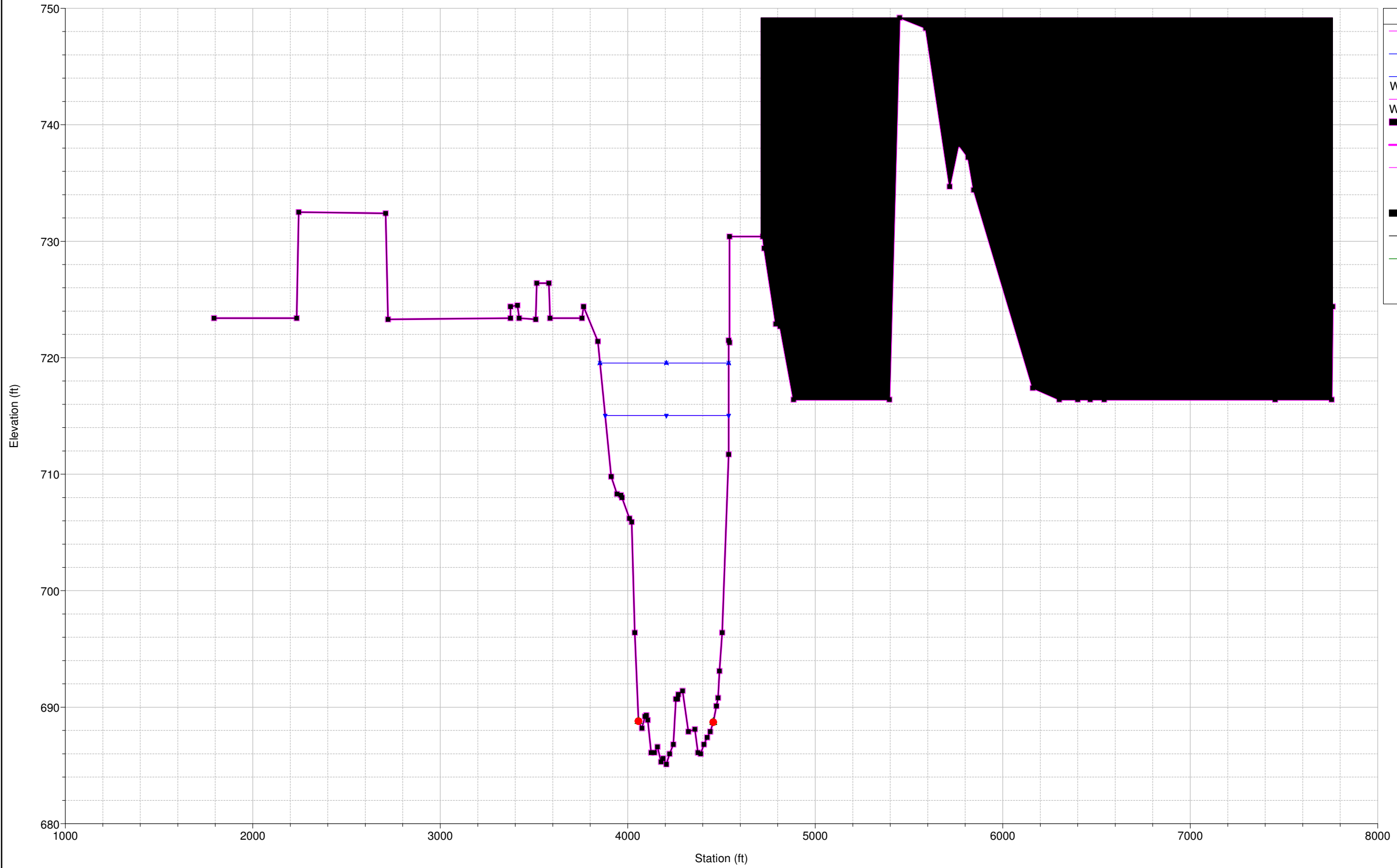


Legend	
WS SPF - PostProject	▲
WS SPF - Pre-Project	▲
WS 100-Year - Pre-Project	▲
WS 100-Year - PostProject	▲
- PostProject	▨
- PostProject	▨
- PostProject	▨
Ground - PostProject	■
Ineff - PostProject	▲
Bank Sta - PostProject	●
- Pre-Project	▨
- Pre-Project	▨
- Pre-Project	▨
Ground - Pre-Project	■
Ineff - Pre-Project	▲
Bank Sta - Pre-Project	●

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.2



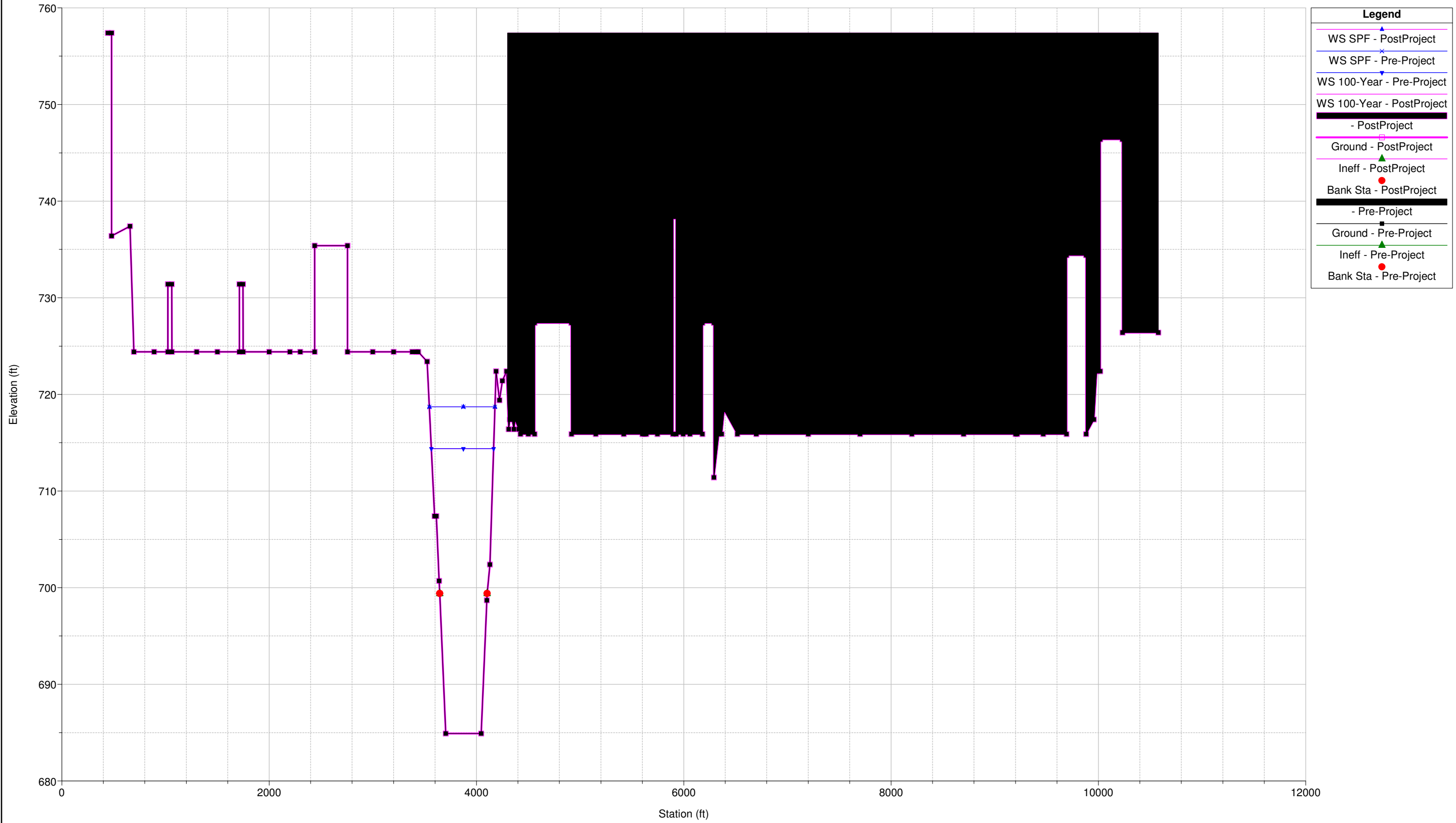
Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 246.1



Legend

- WS SPF - PostProject (blue line with triangle markers)
- WS SPF - Pre-Project (blue line with 'x' markers)
- WS 100-Year - Pre-Project (blue line with triangle markers)
- WS 100-Year - PostProject (blue line with circle markers)
- PostProject (black filled area)
- Pre-Project (black filled area)
- Ground - PostProject (purple line with square markers)
- Ground - Pre-Project (purple line with square markers)
- Ineff - PostProject (purple line with triangle markers)
- Ineff - Pre-Project (purple line with triangle markers)
- Bank Sta - PostProject (red circle markers)
- Bank Sta - Pre-Project (red circle markers)

Sciotogreenways Plan: 1) Pre-Project 2) PostProject
RS = 245

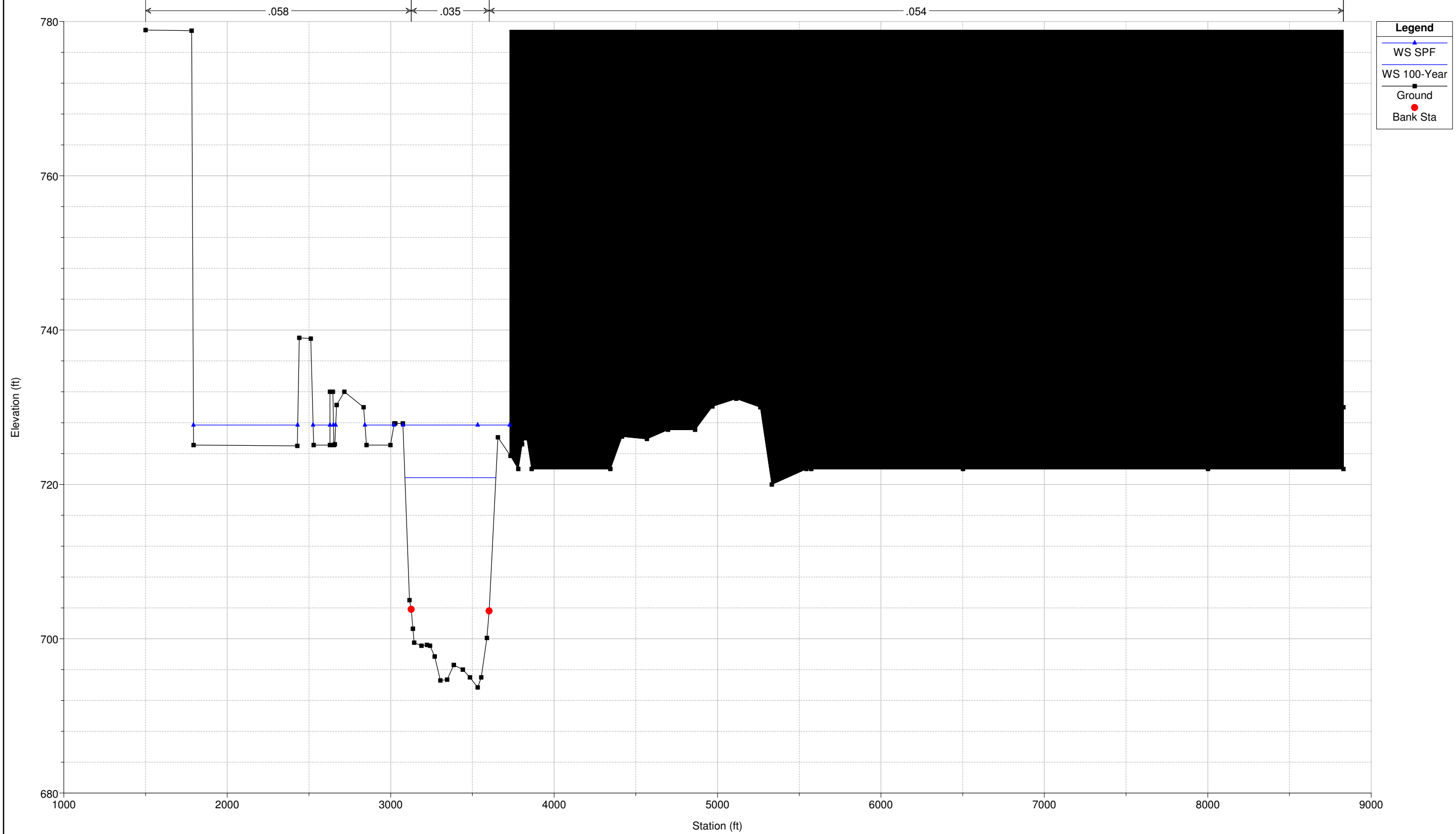


B3 – Duplicate Effective Cross-sections

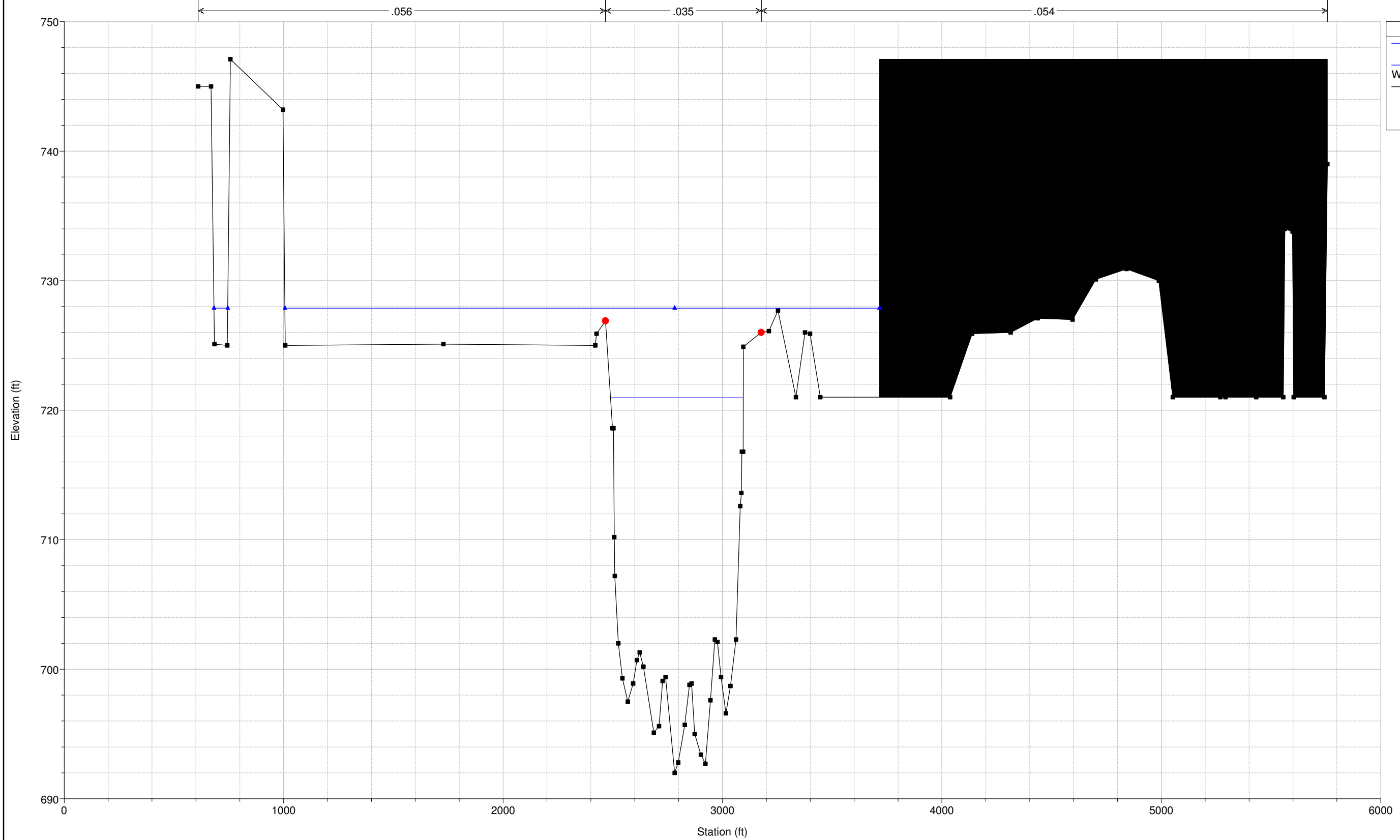
Sciotogreenways Plan: Duplicate_Effective
RS = 253.6



SciotoGreenways Plan: Duplicate_Effective
RS = 253.5



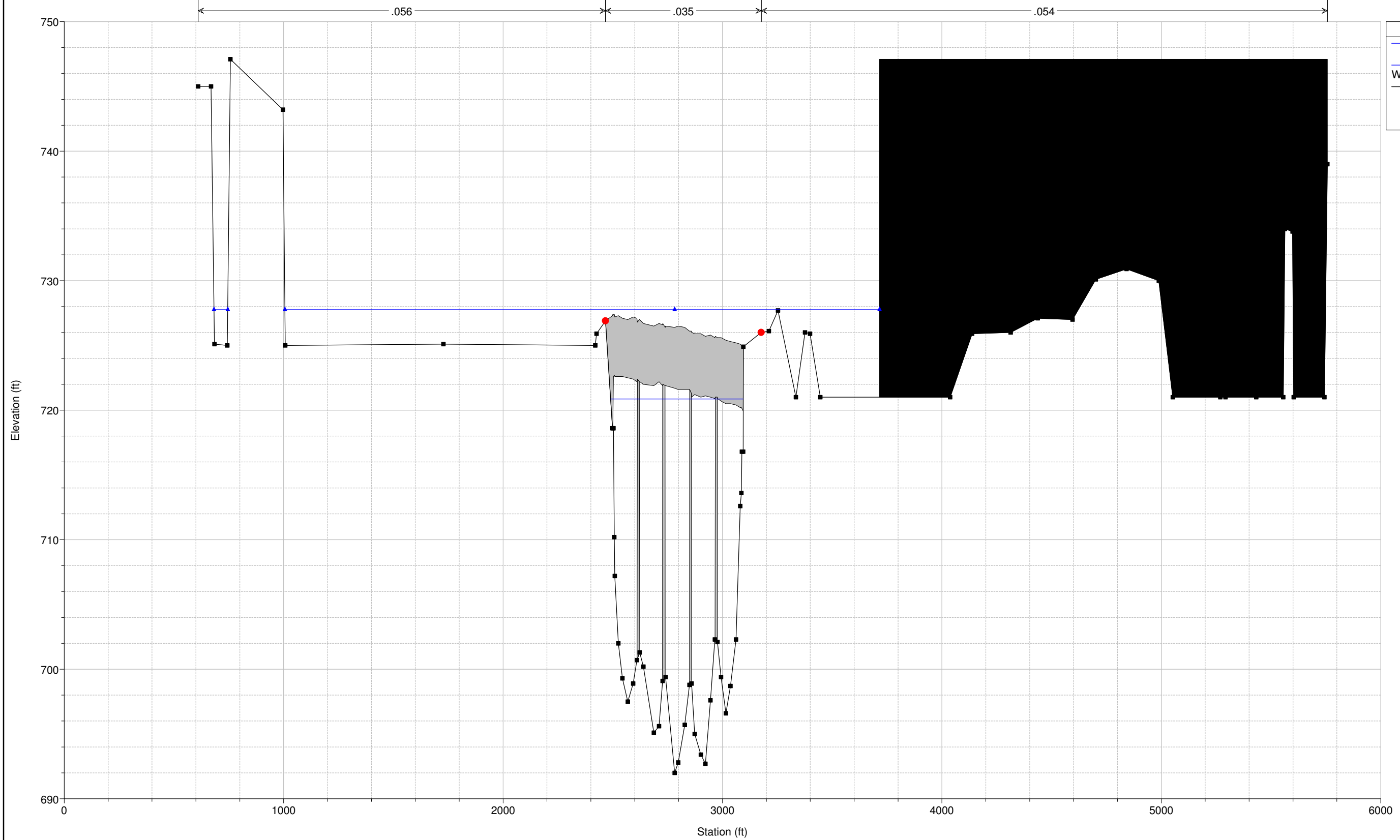
SciotoGreenways Plan: Duplicate_Effective
RS = 253.4



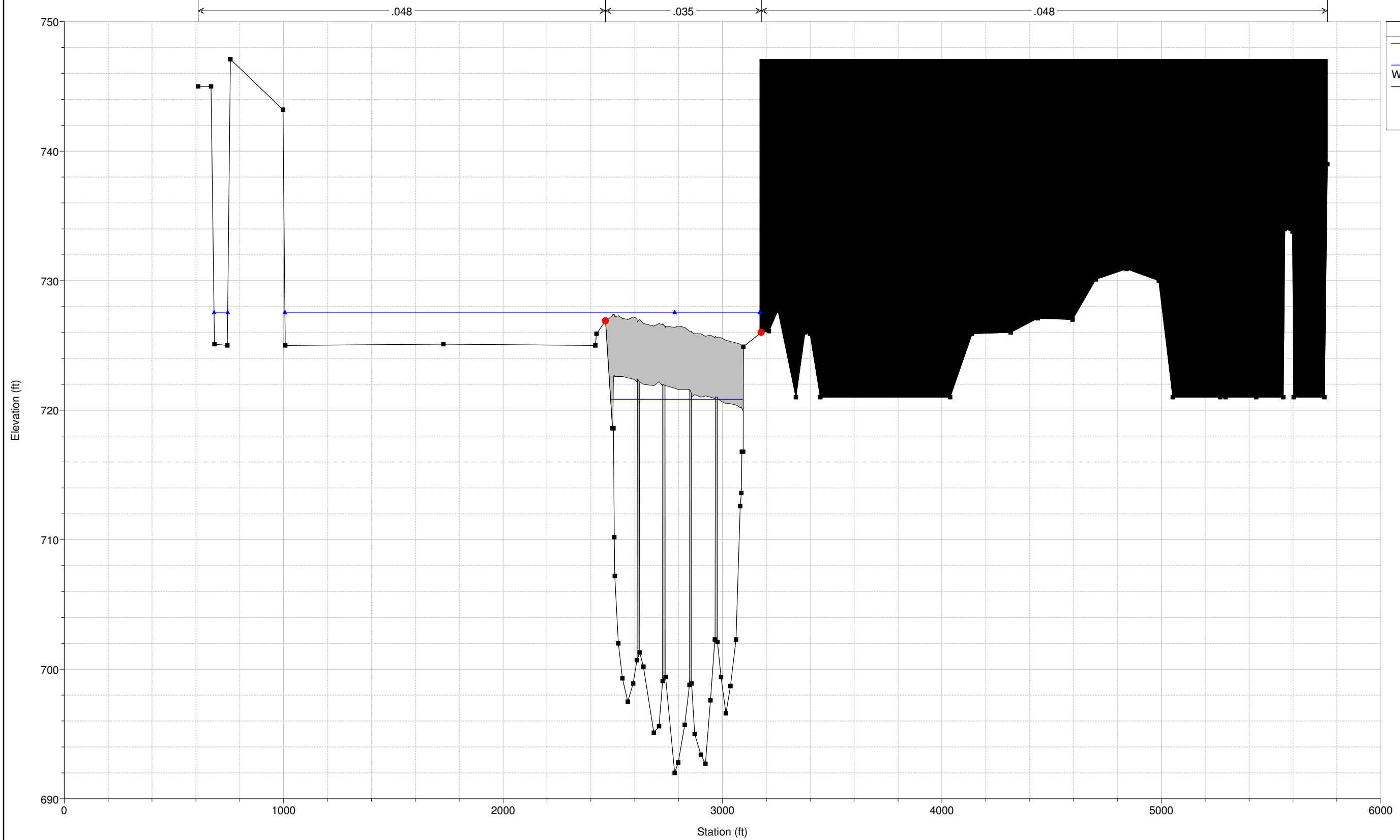
Legend

- WS 50-Year (Blue line with upward triangle)
- WS 100-Year (Blue line with downward triangle)
- Ground (Black line with square)
- Bank Sta (Red dot)

SciotoGreenways Plan: Duplicate_Effective
RS = 253.3 BR



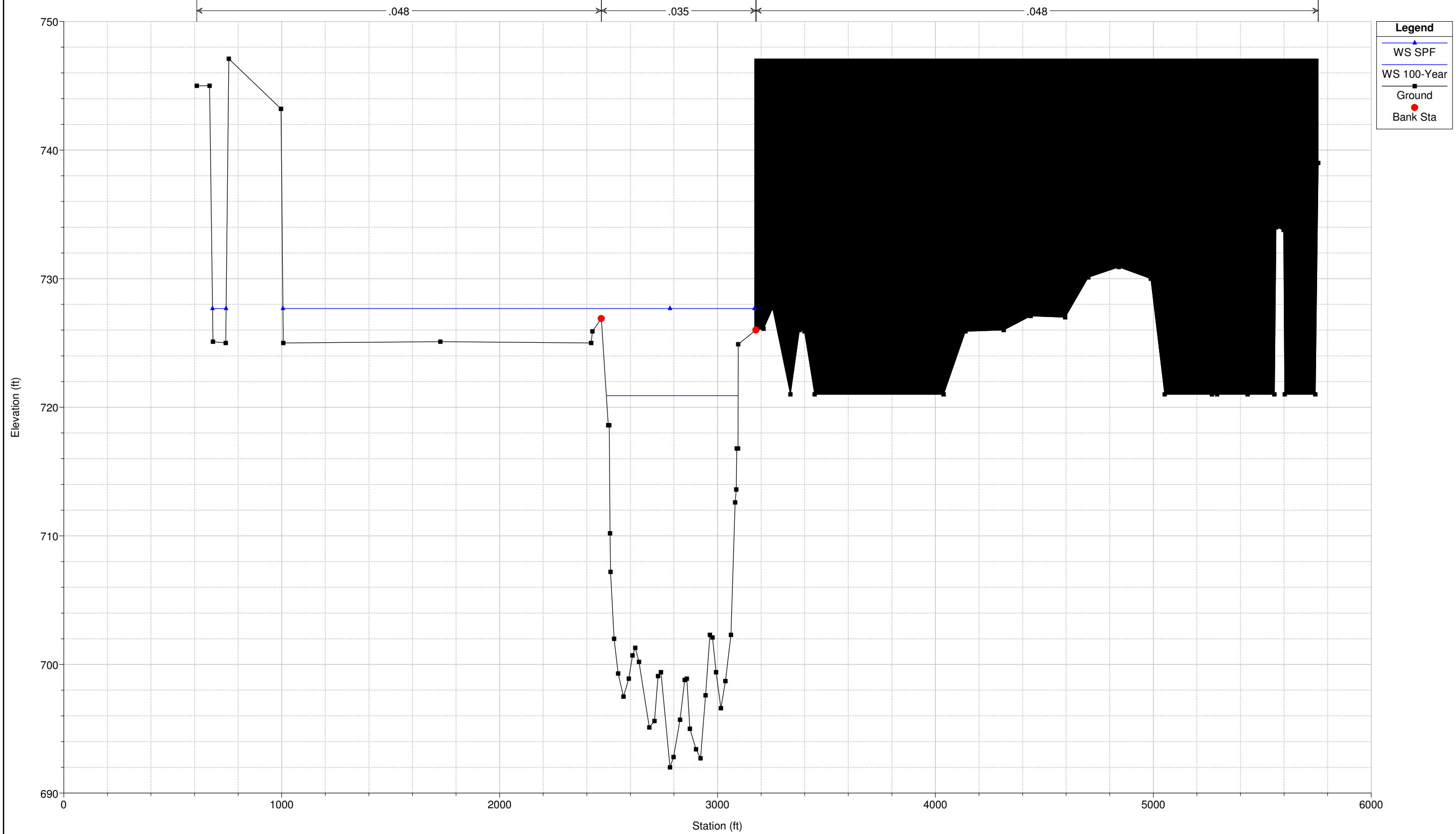
Sciotogreenways Plan: Duplicate_Effective
RS = 253.3 BR



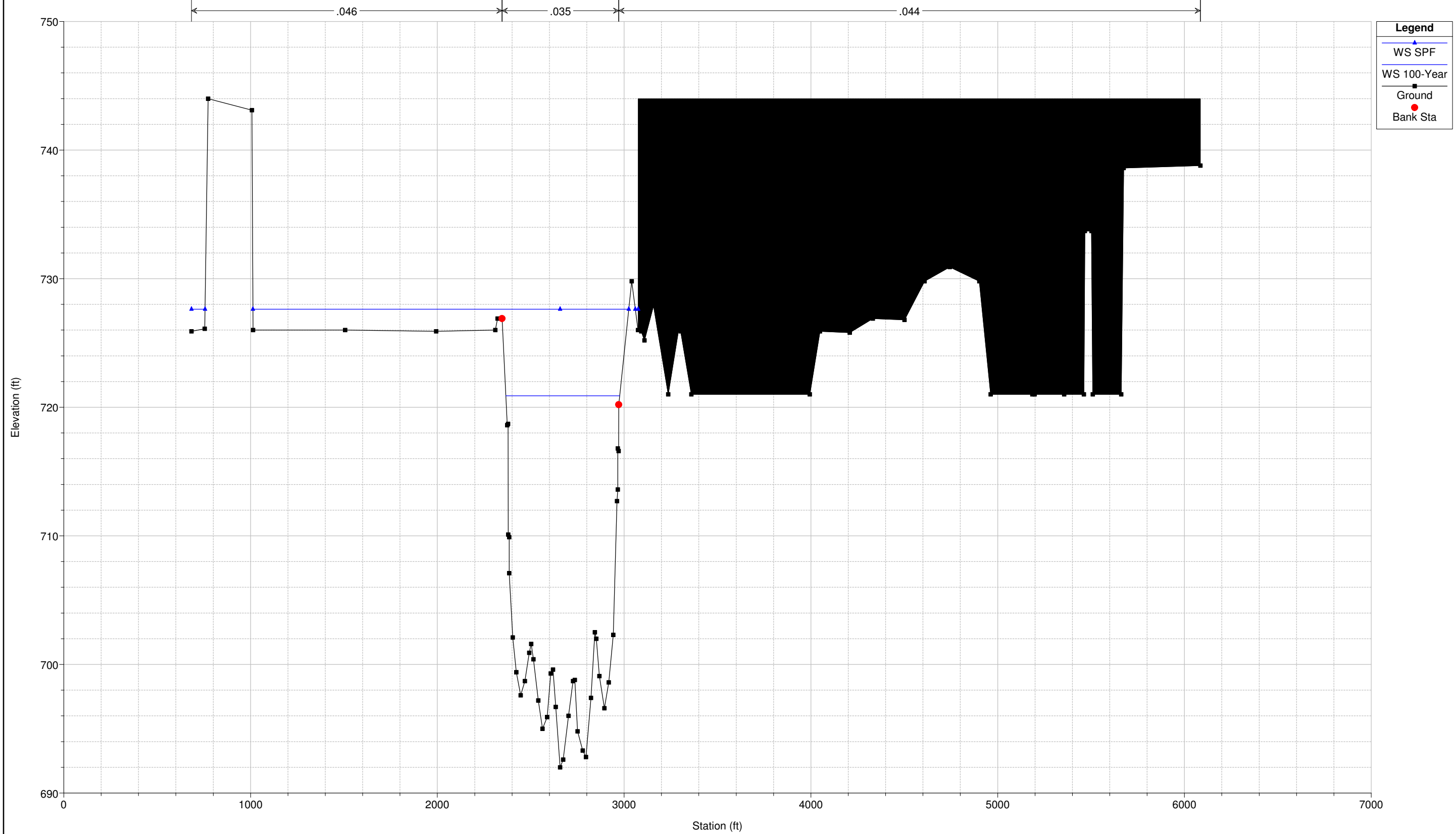
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

SciotoGreenways Plan: Duplicate_Effective
RS = 253.2

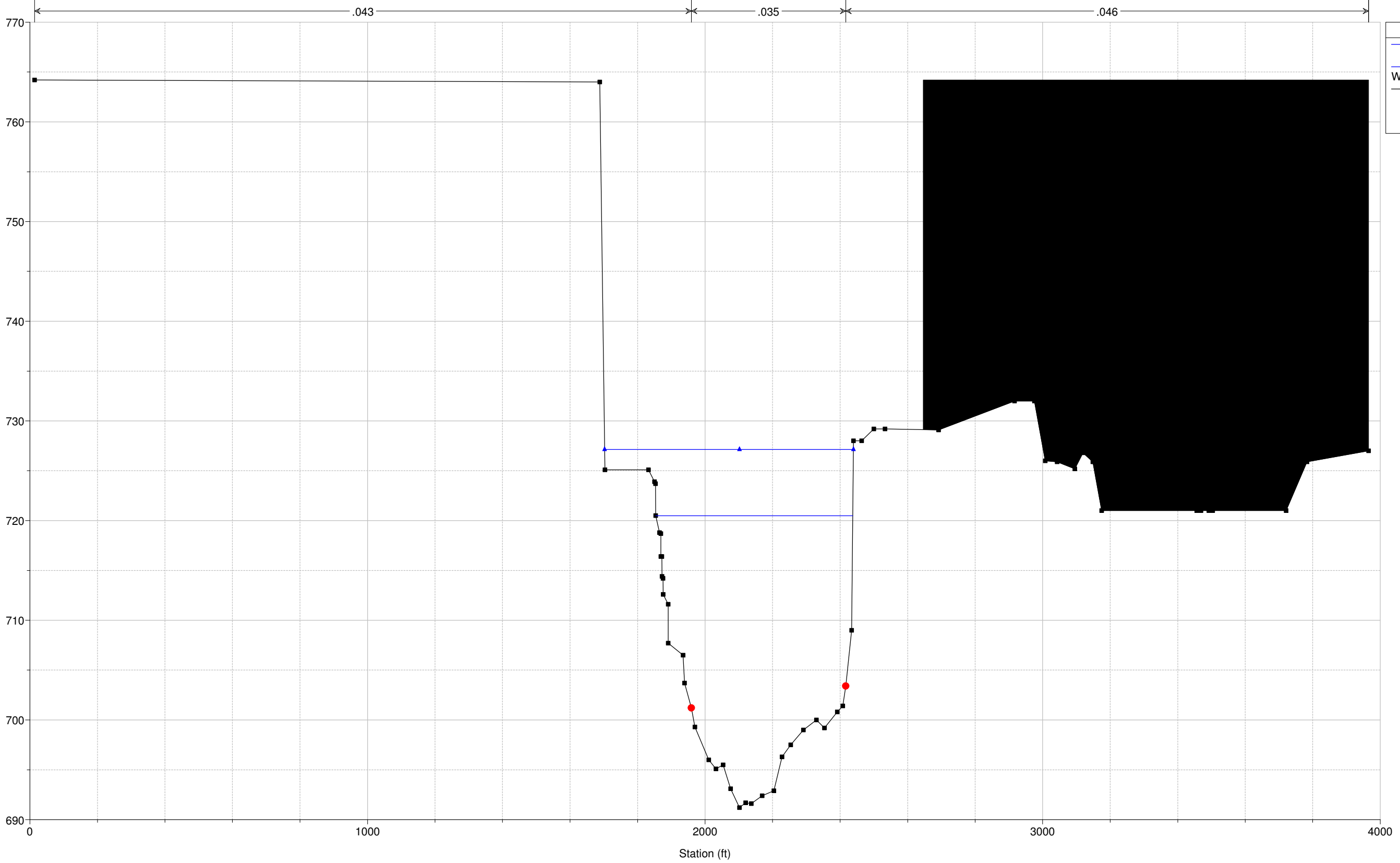


Sciotogreenways Plan: Duplicate_Effective
RS = 253.1



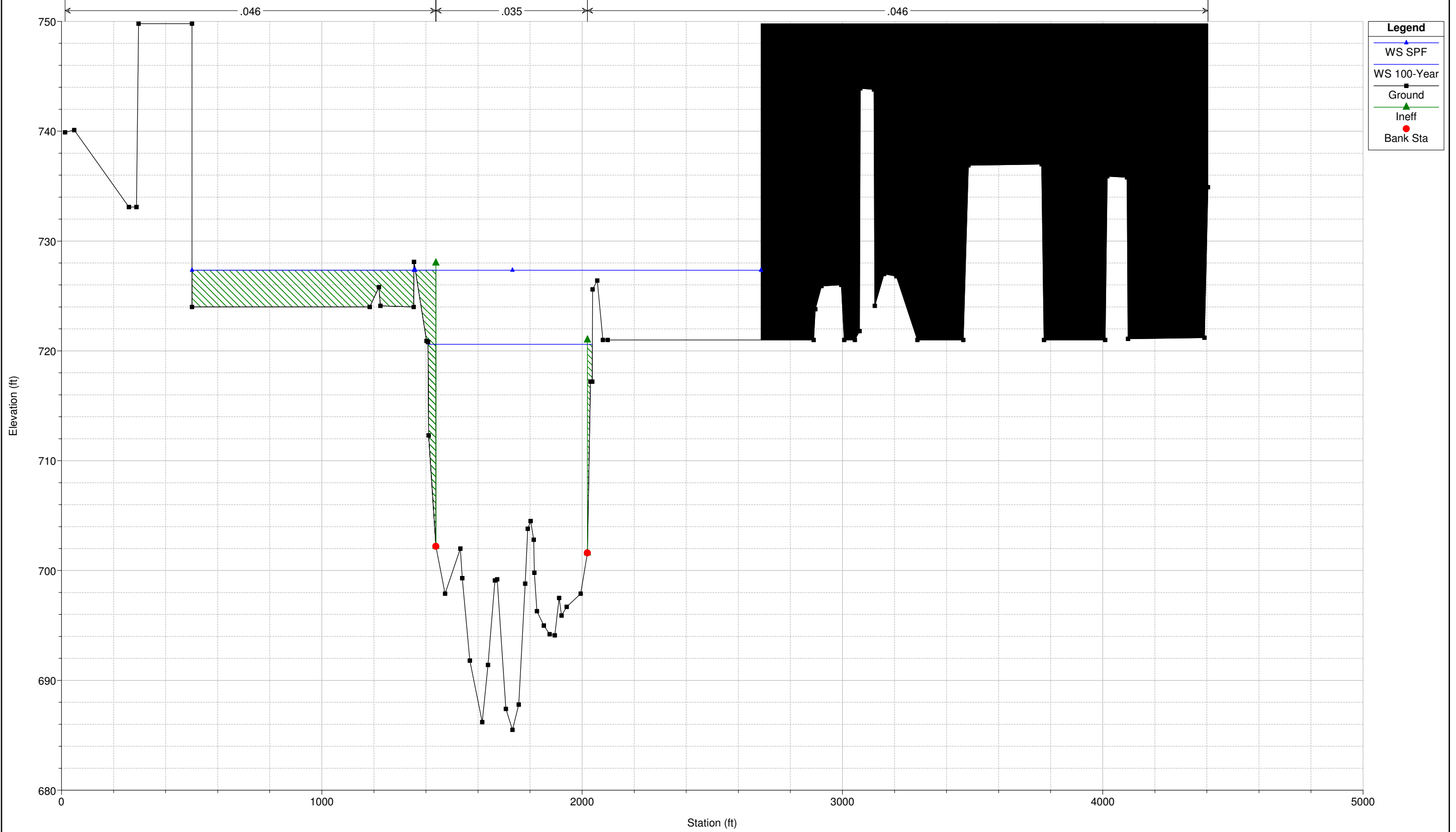
SciotoGreenways Plan: Duplicate_Effective

RS = 252.5

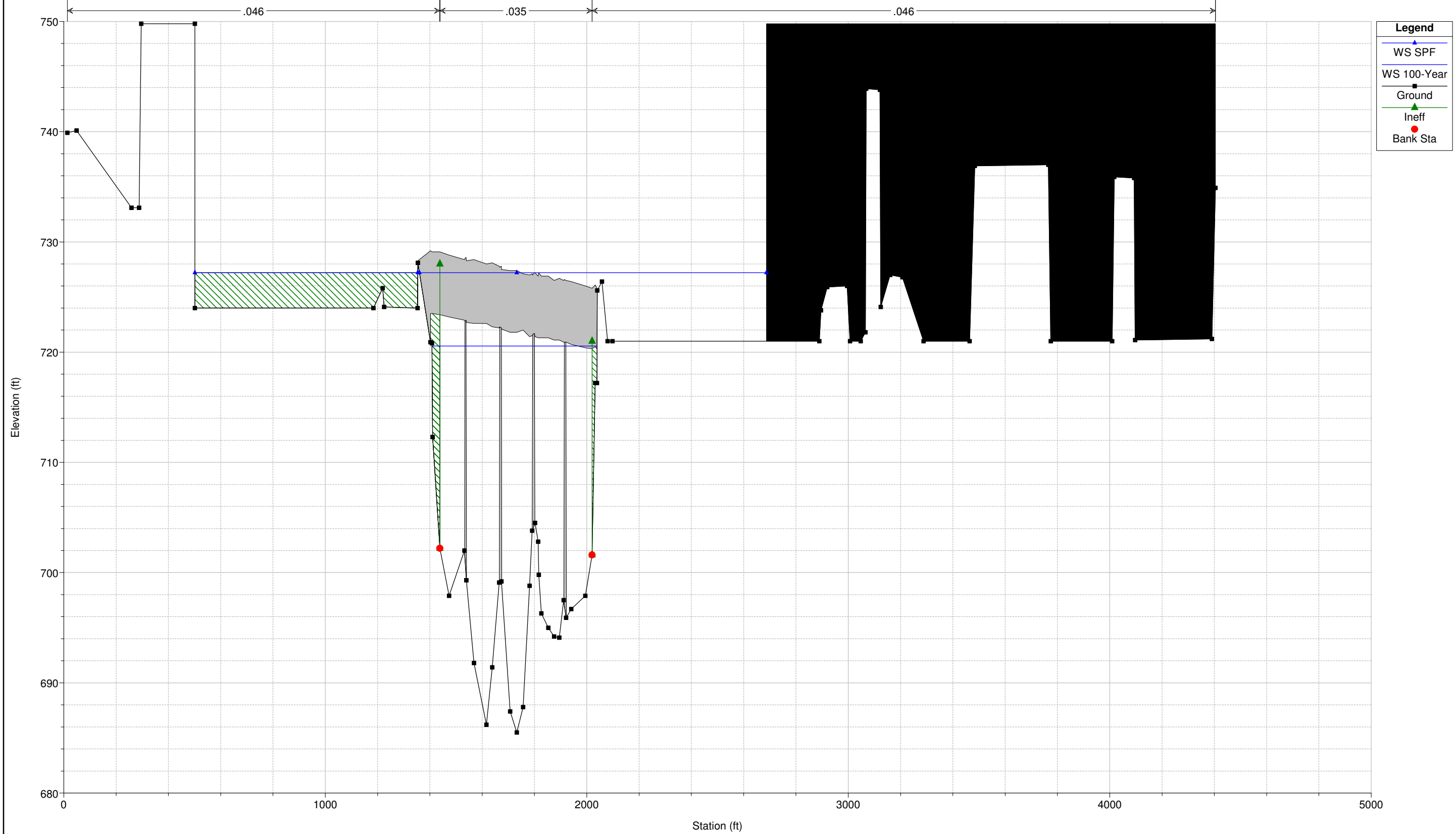


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Bank Sta

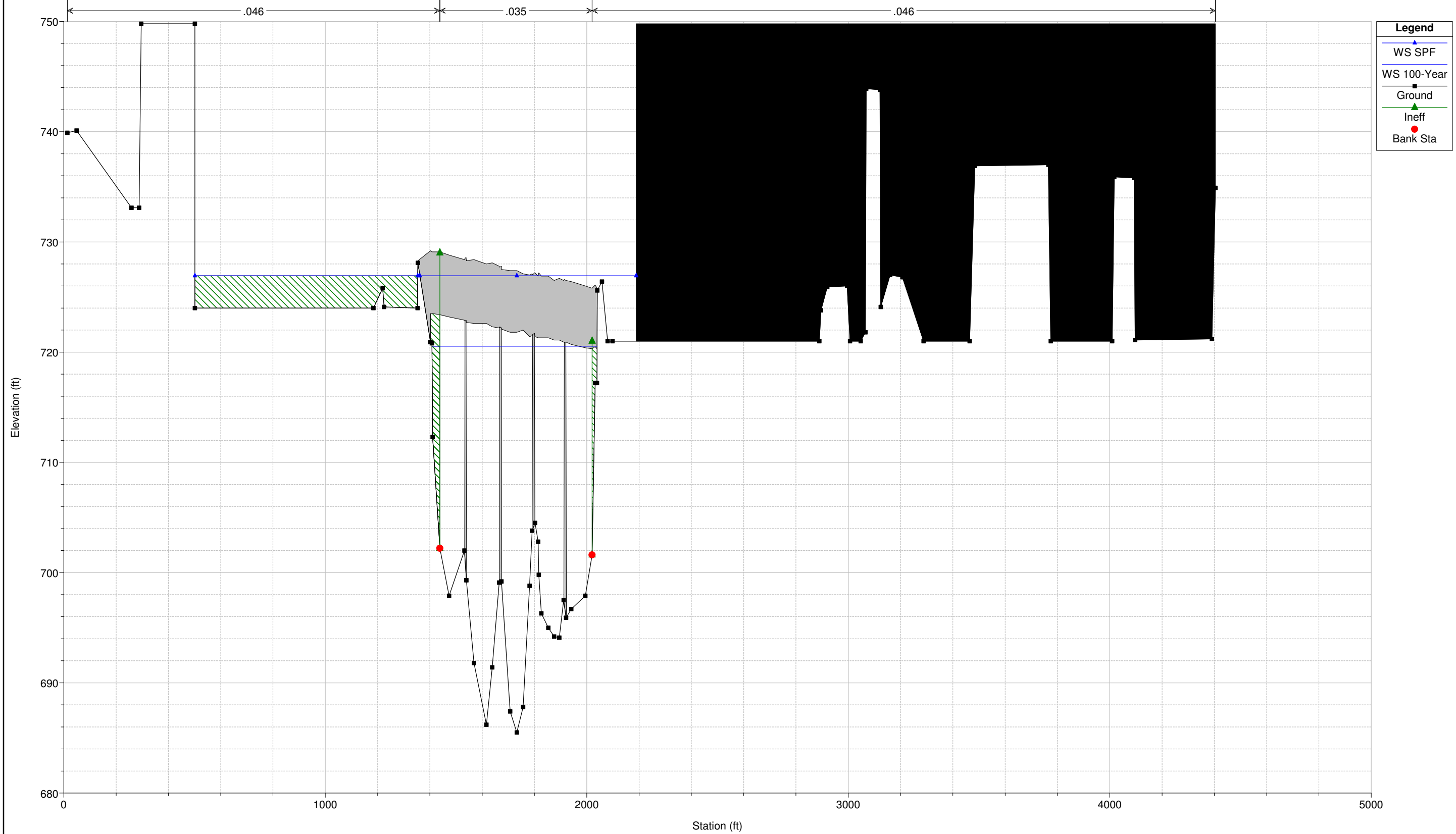
SciotoGreenways Plan: Duplicate_Effective
RS = 252.4



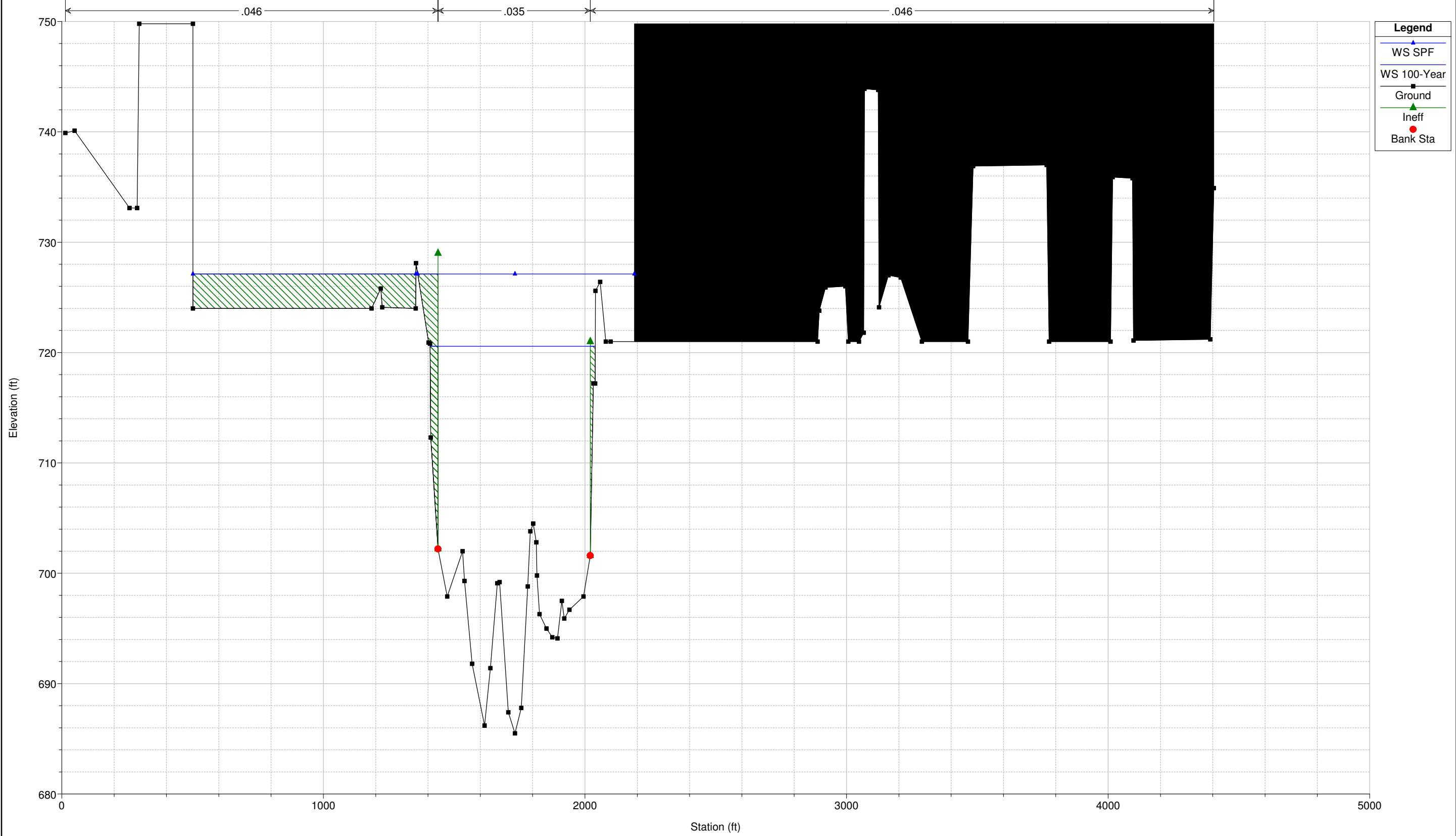
Sciotogreenways Plan: Duplicate_Effective
RS = 252.3 BR



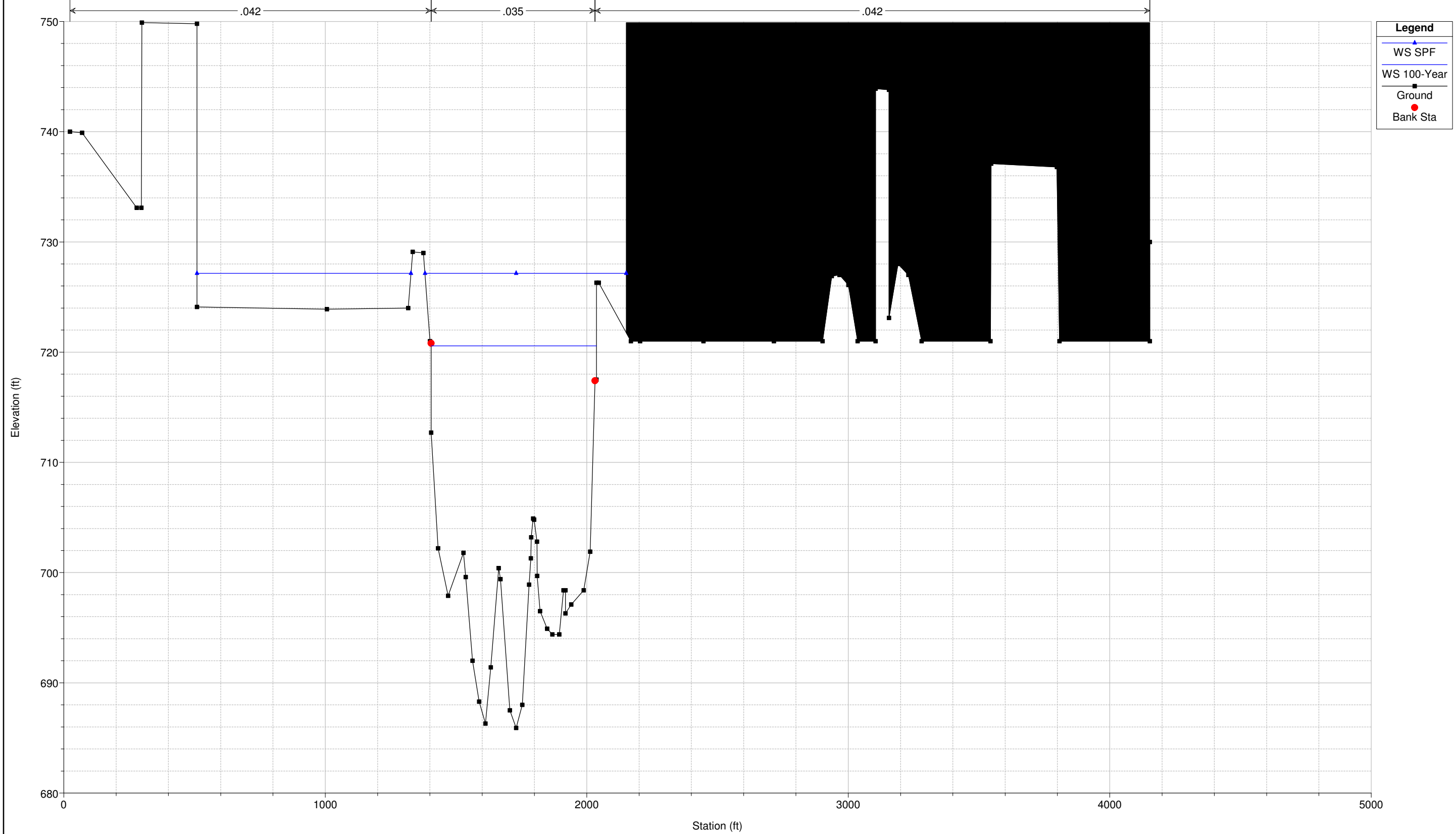
Sciotogreenways Plan: Duplicate_Effective
RS = 252.3 BR



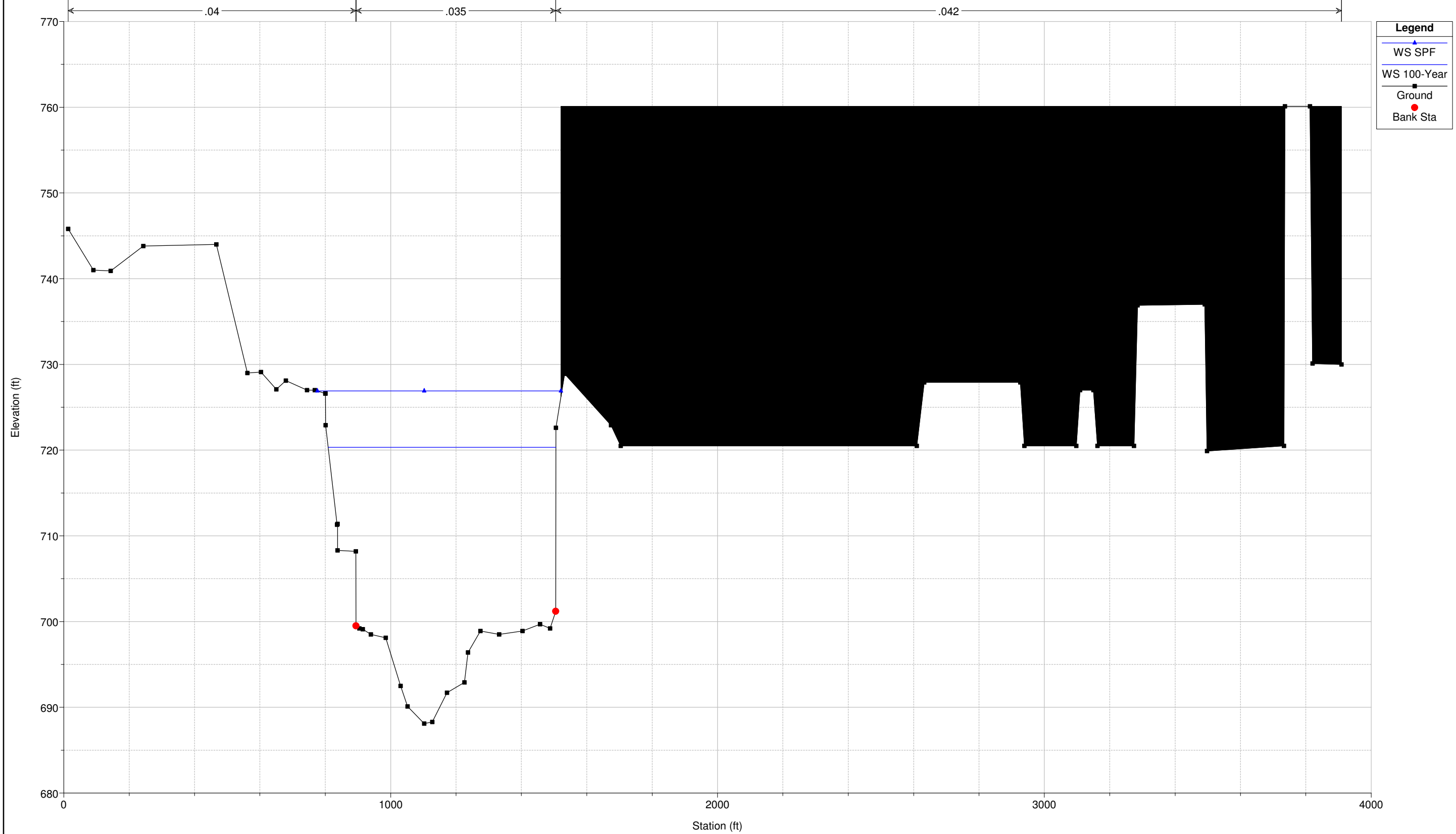
Sciotogreenways Plan: Duplicate_Effective
RS = 252.2



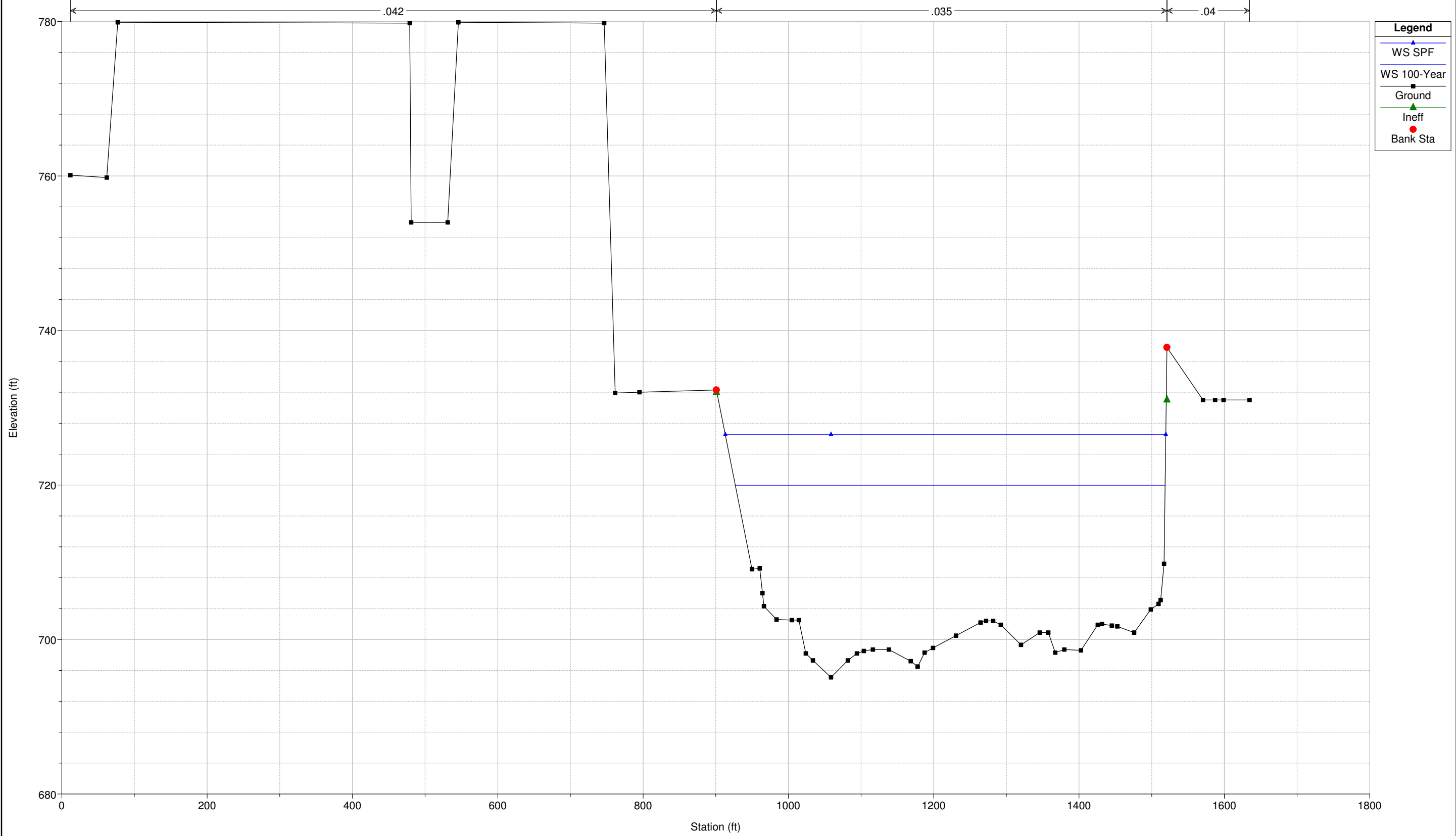
Sciotogreenways Plan: Duplicate_Effective
RS = 252.1



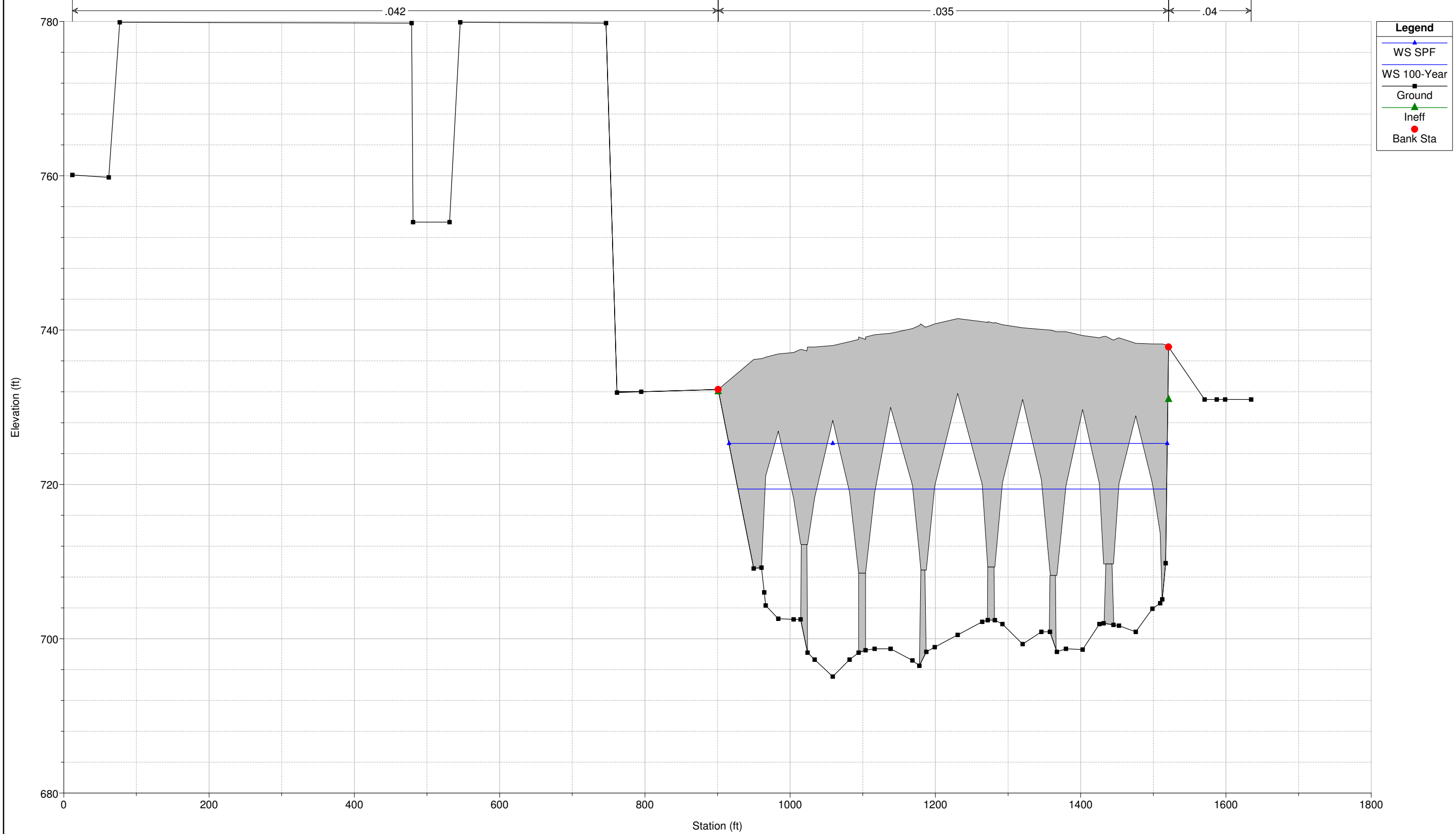
Sciotogreenways Plan: Duplicate_Effective
RS = 251.5



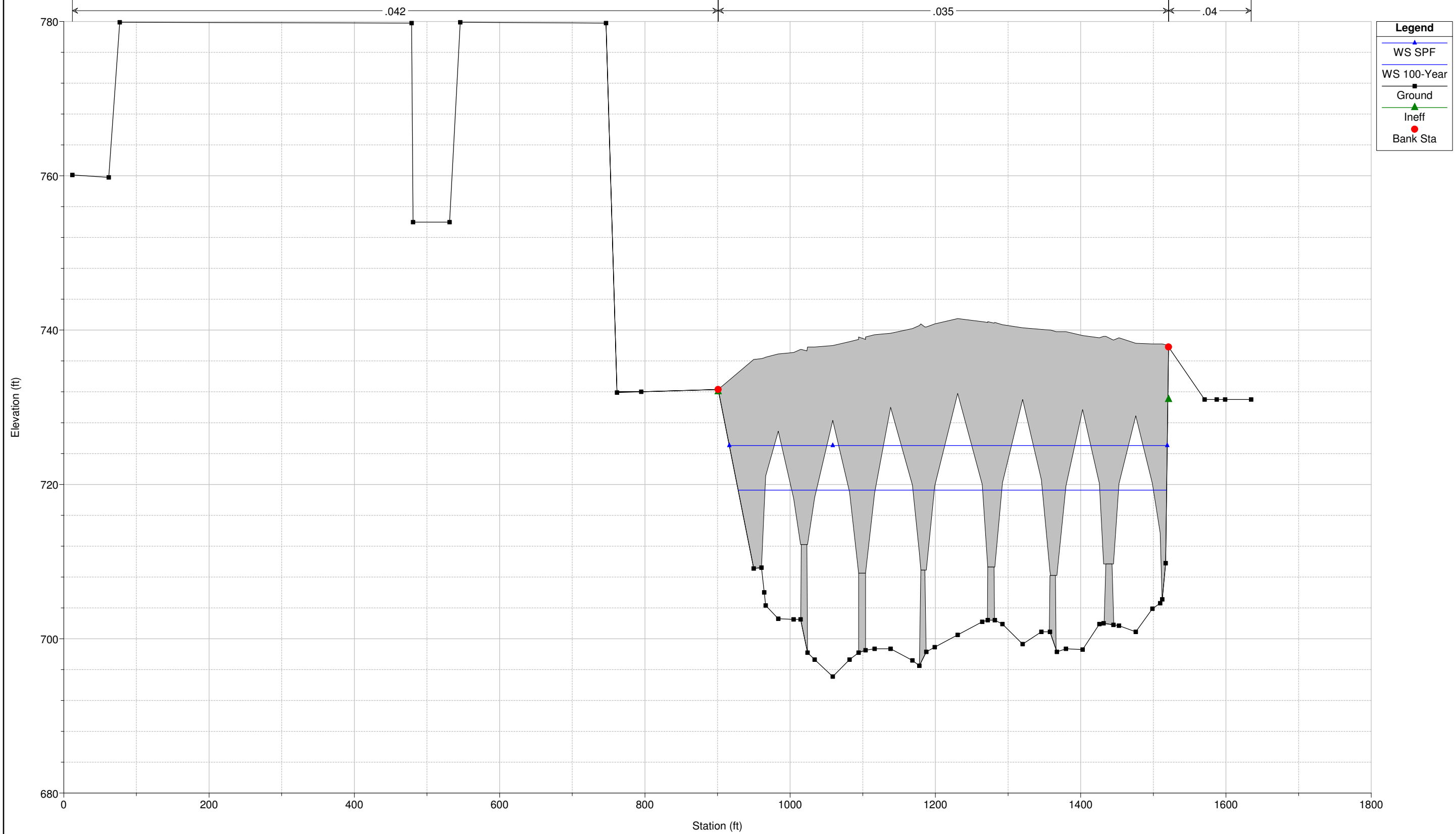
Sciotogreenways Plan: Duplicate_Effective
RS = 251.4



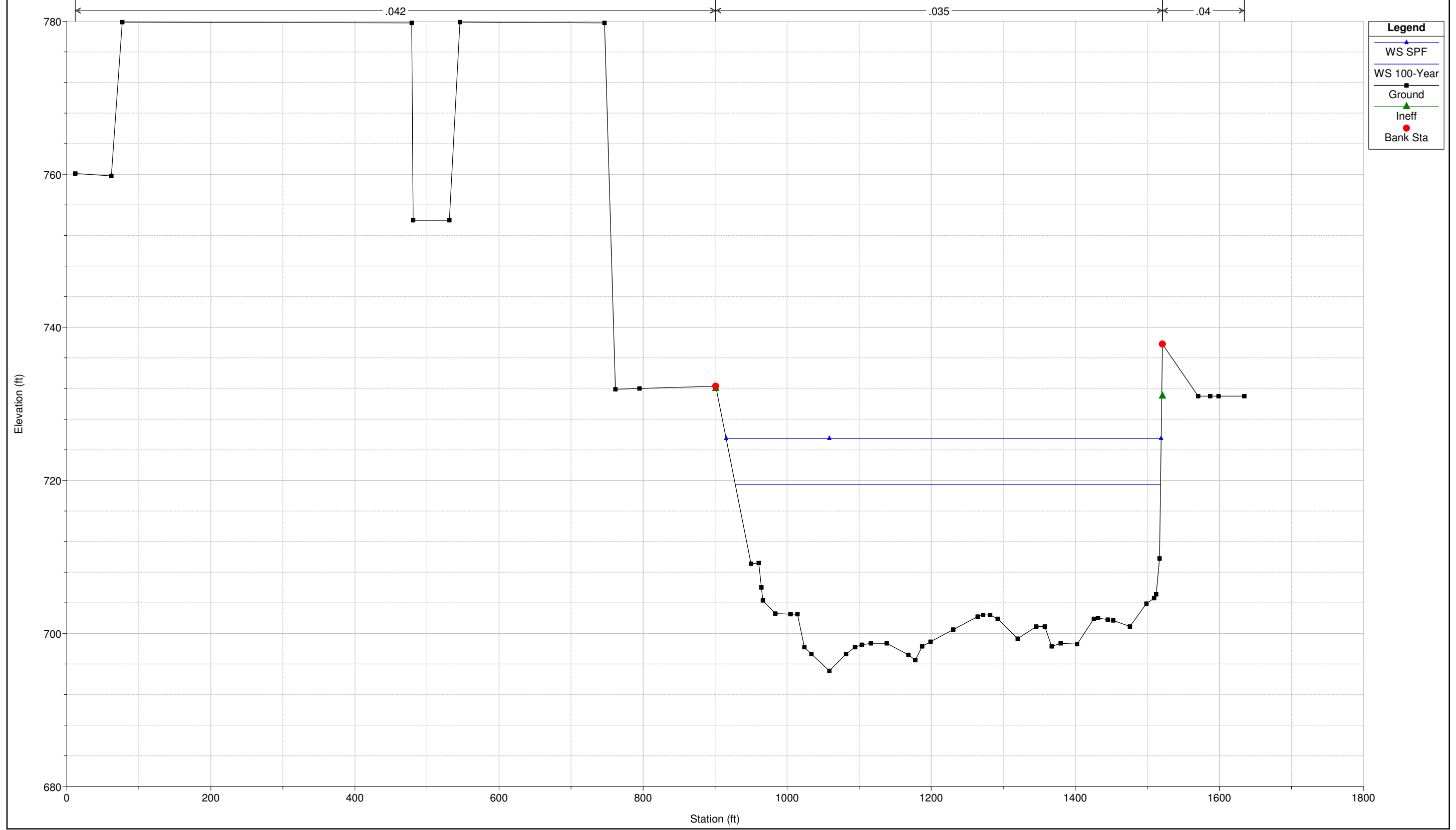
SciotoGreenways Plan: Duplicate_Effective
RS = 251.3 BR



SciotoGreenways Plan: Duplicate_Effective
RS = 251.3 BR



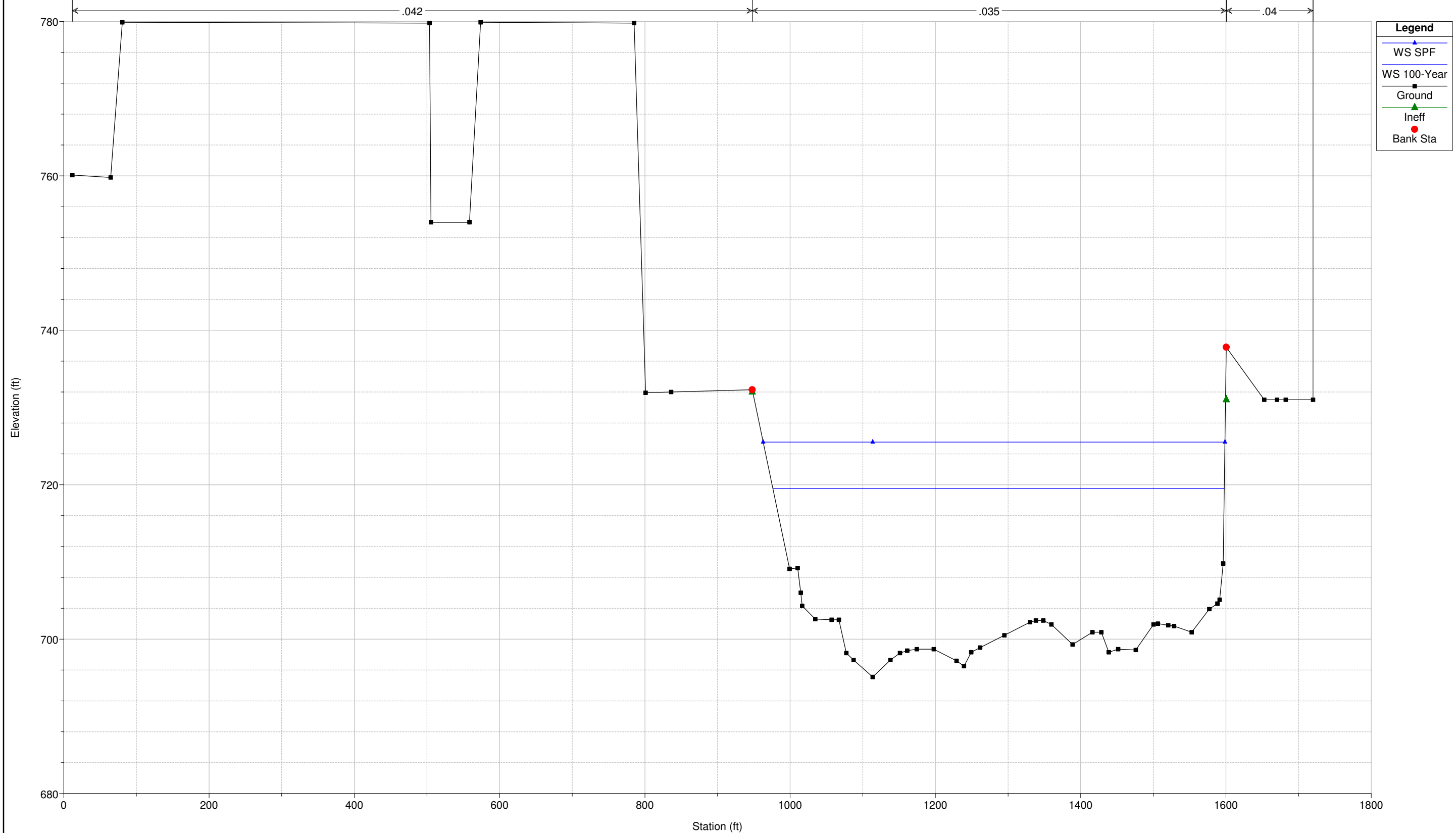
SciotoGreenways Plan: Duplicate_Effective
RS = 251.21



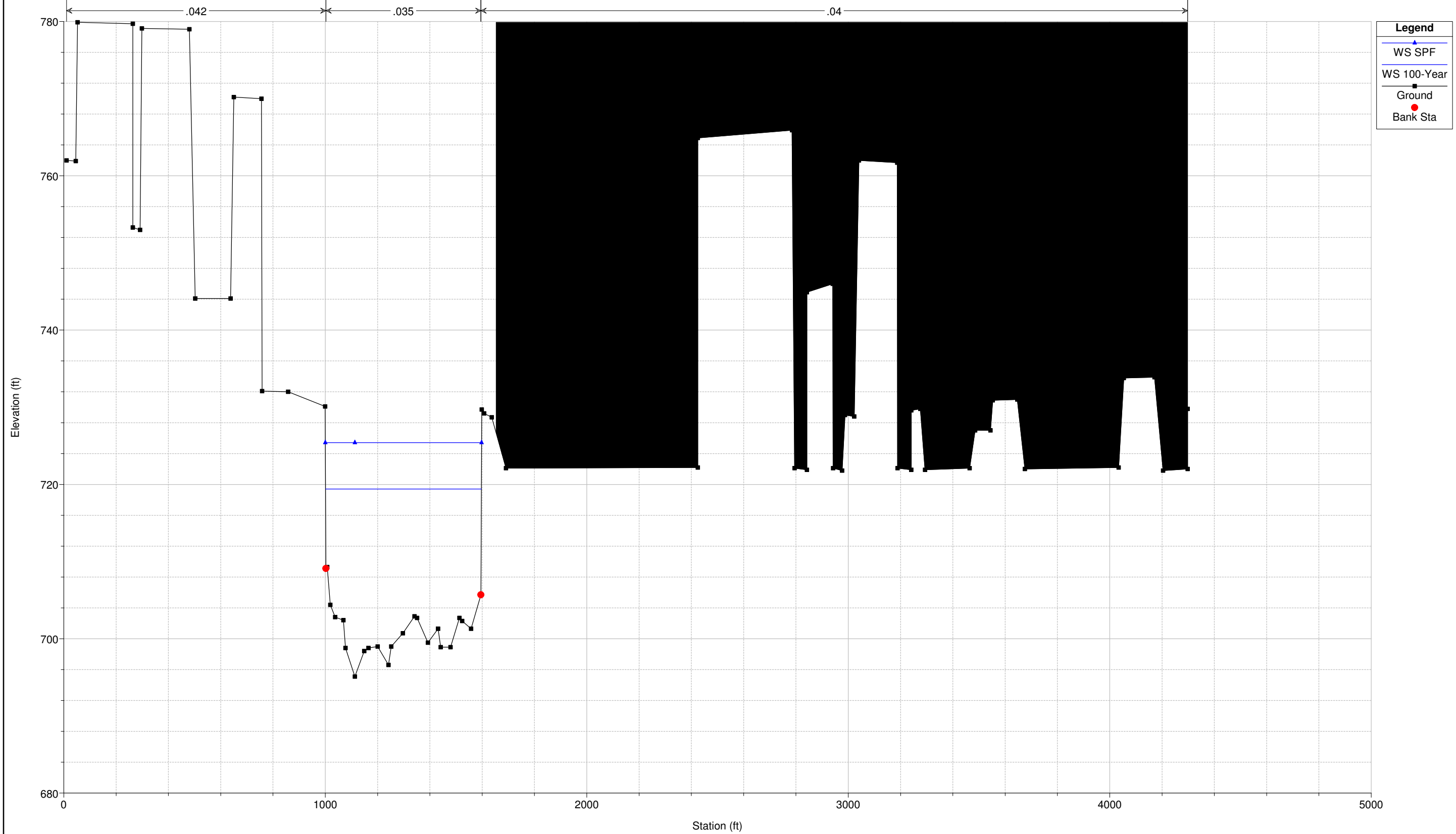
Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line)
- Ground (Black line with square)
- Ineff (Green line with triangle)
- Bank Sta (Red dot)

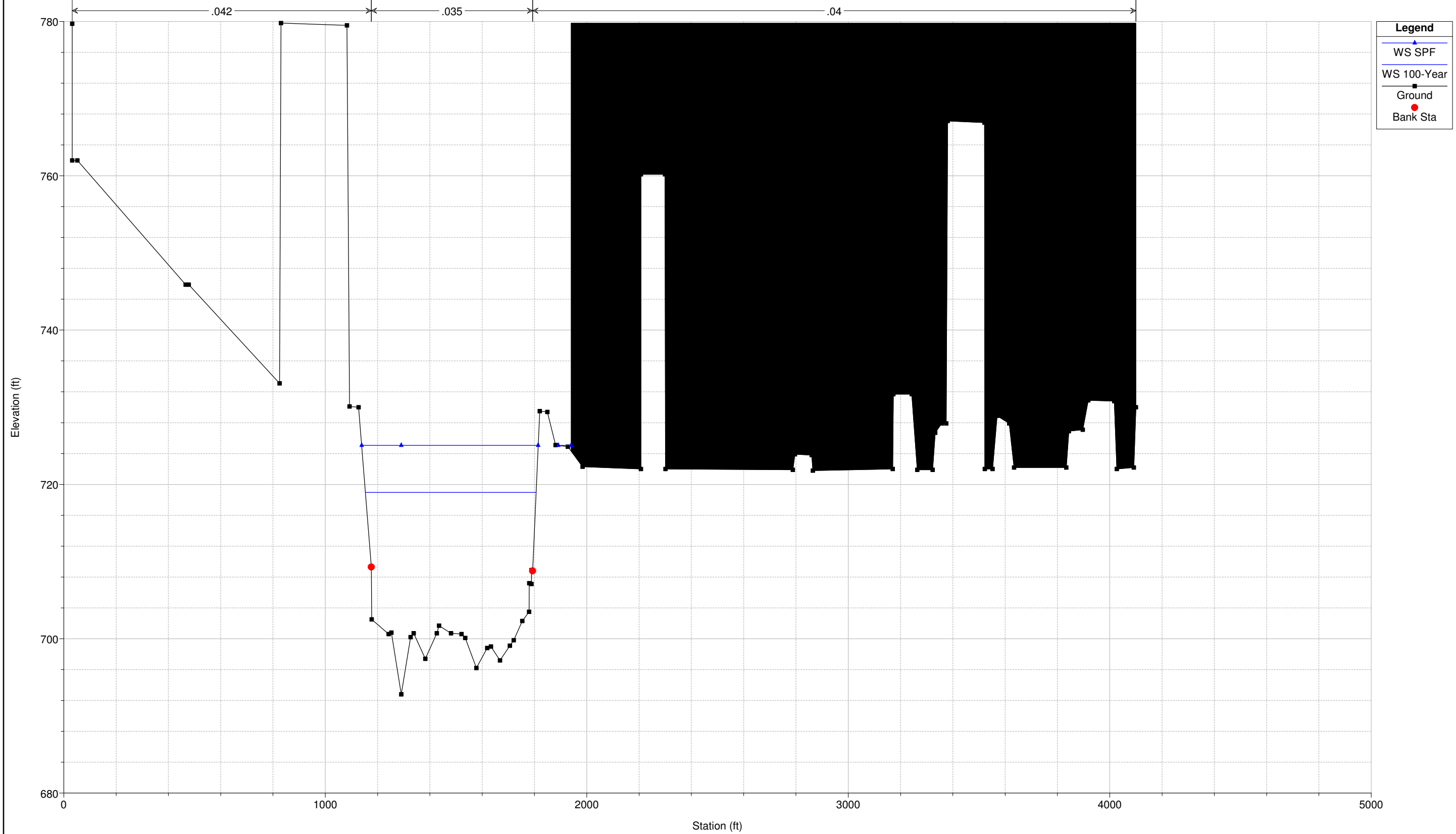
Sciotogreenways Plan: Duplicate_Effective
RS = 251.2



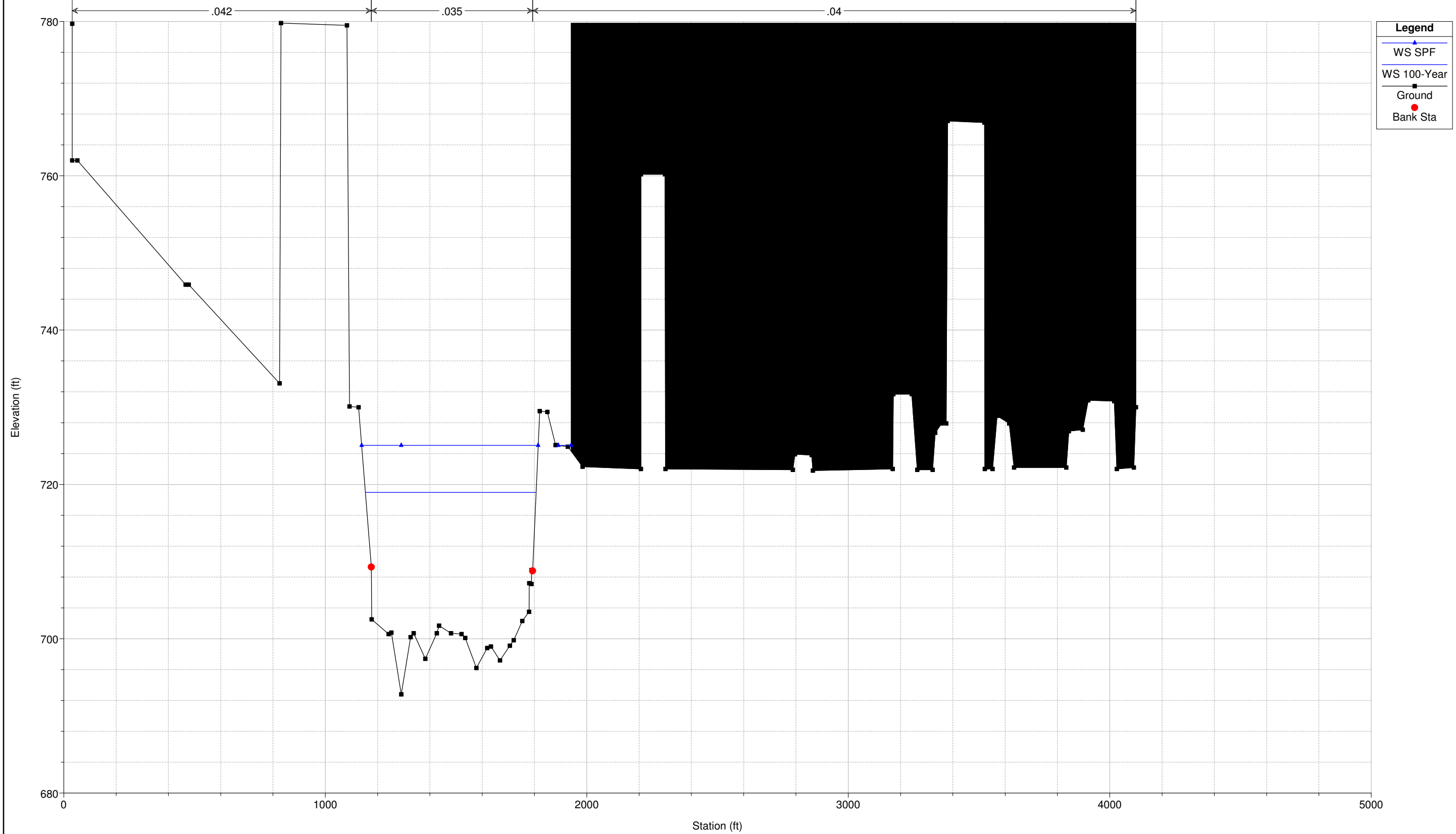
Sciotogreenways Plan: Duplicate_Effective
RS = 251.1



Sciotogreenways Plan: Duplicate_Effective
RS = 250.5



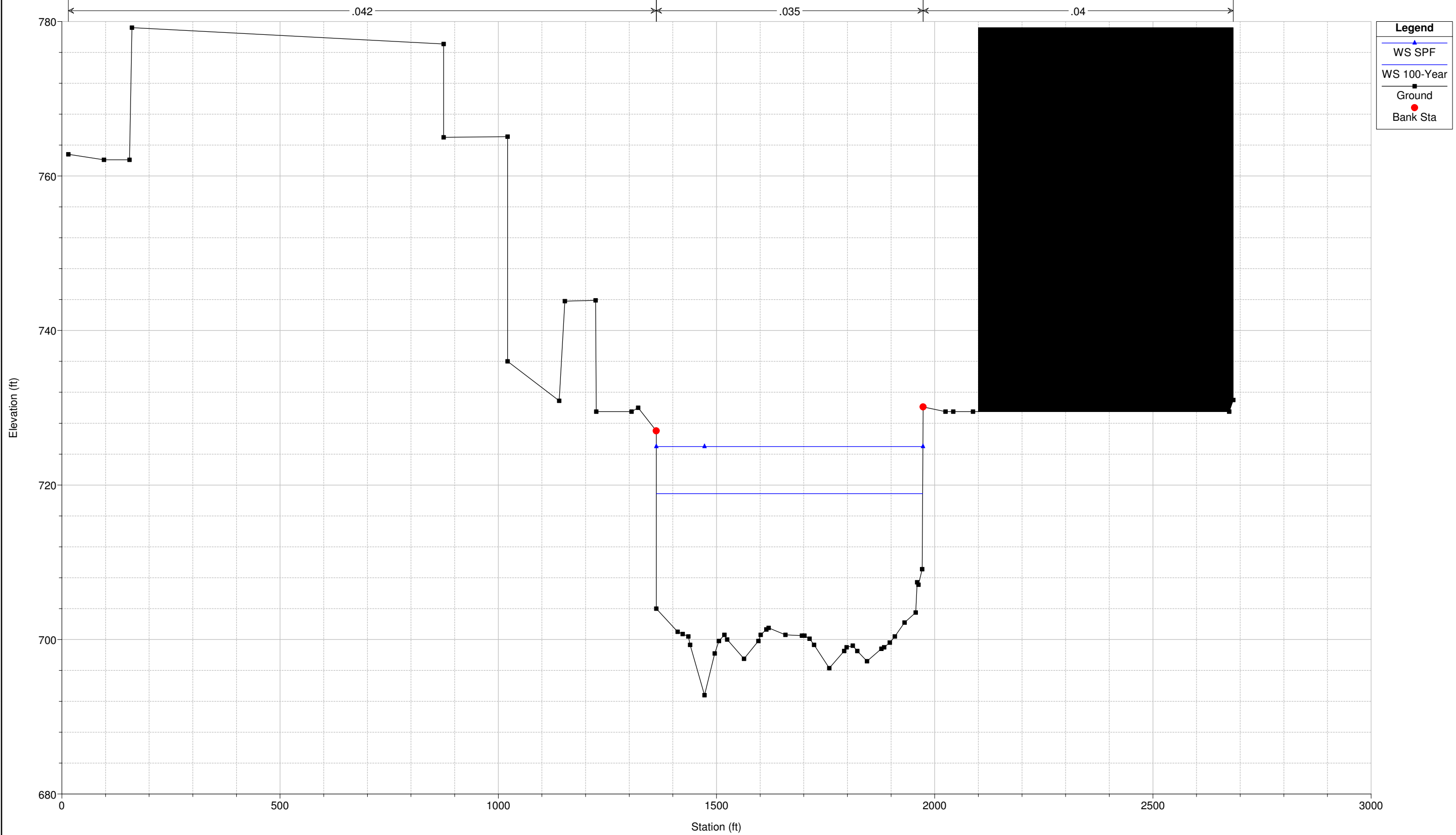
Sciotogreenways Plan: Duplicate_Effective
RS = 250.49



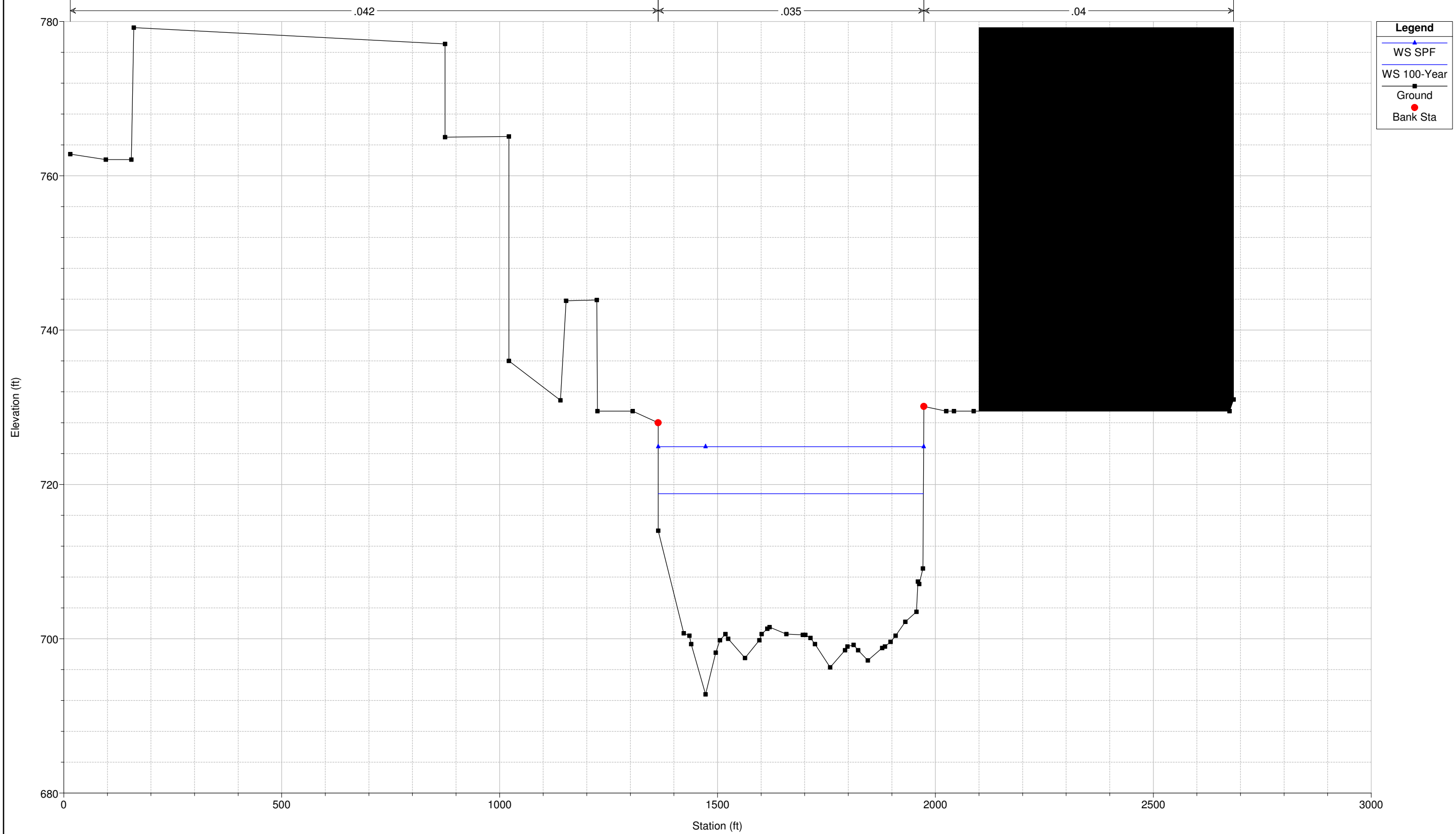
Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line with triangle)
- Ground (Black line with square)
- Bank Sta (Red circle)

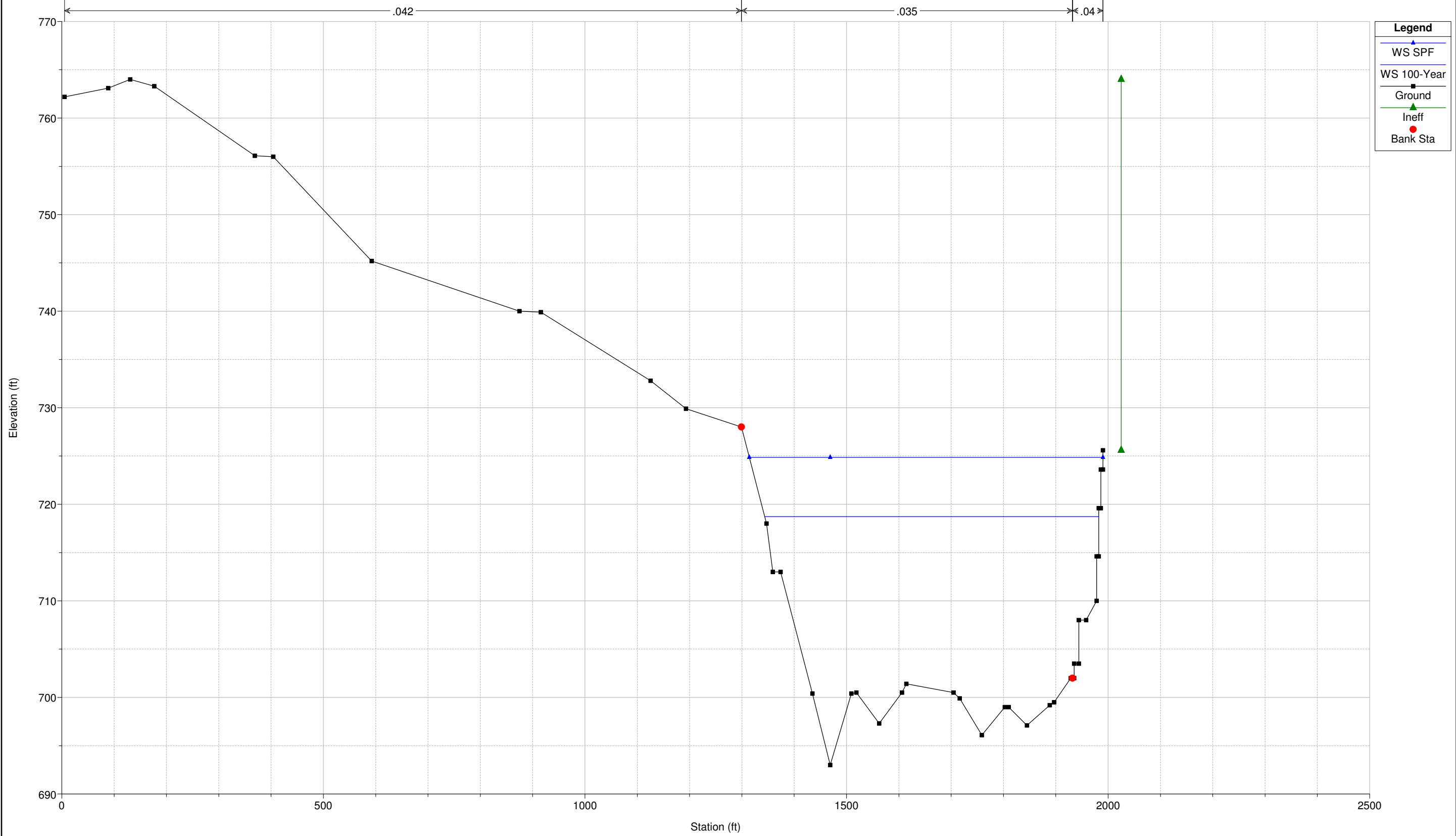
SciotoGreenways Plan: Duplicate_Effective
RS = 250.4



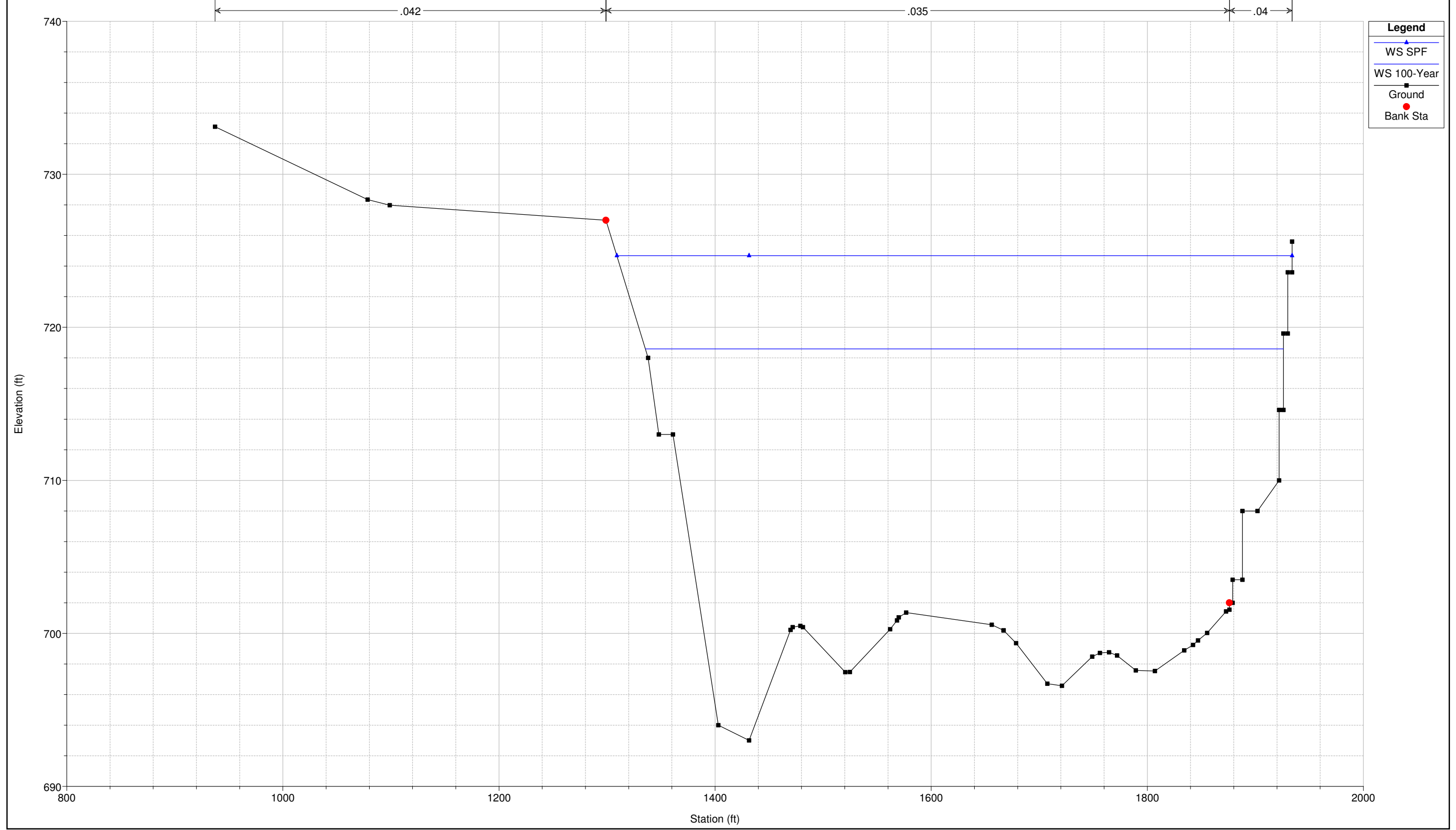
SciotoGreenways Plan: Duplicate_Effective
RS = 250.2



SciotoGreenways Plan: Duplicate_Effective
RS = 250.1



Sciotogreenways Plan: Duplicate_Effective
RS = 250

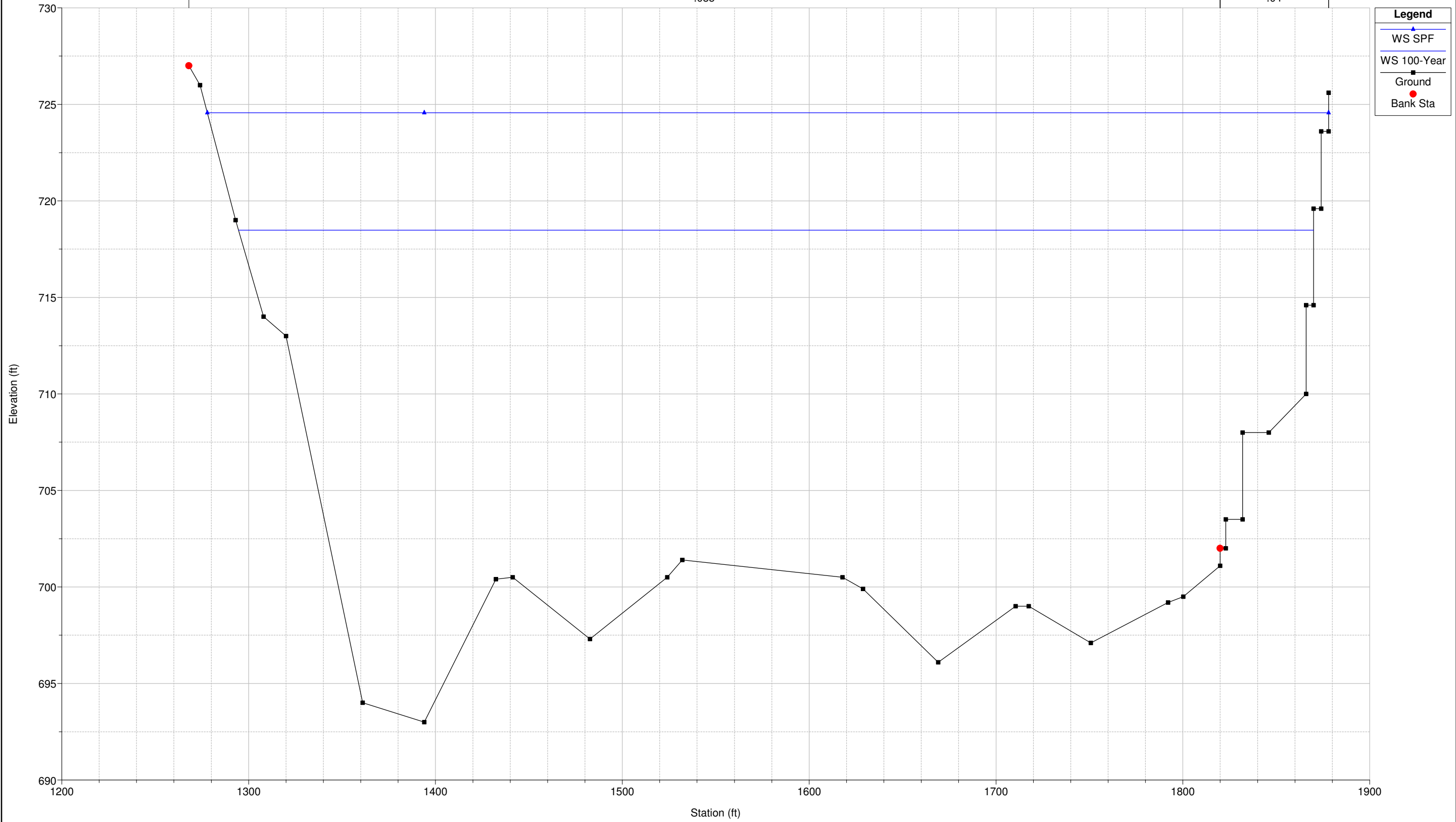


Sciotogreenways Plan: Duplicate_Effective

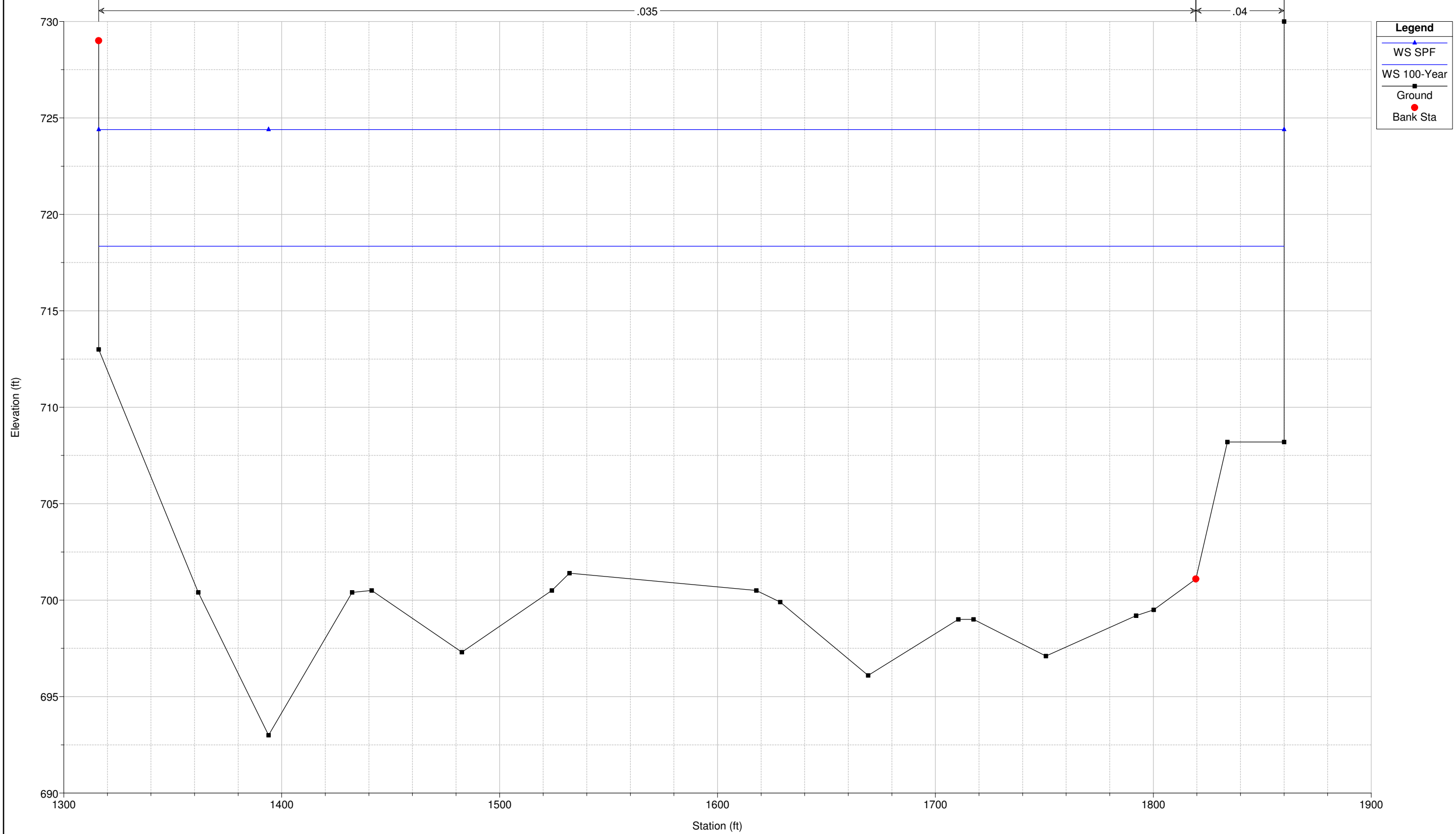
RS = 249.9

.035

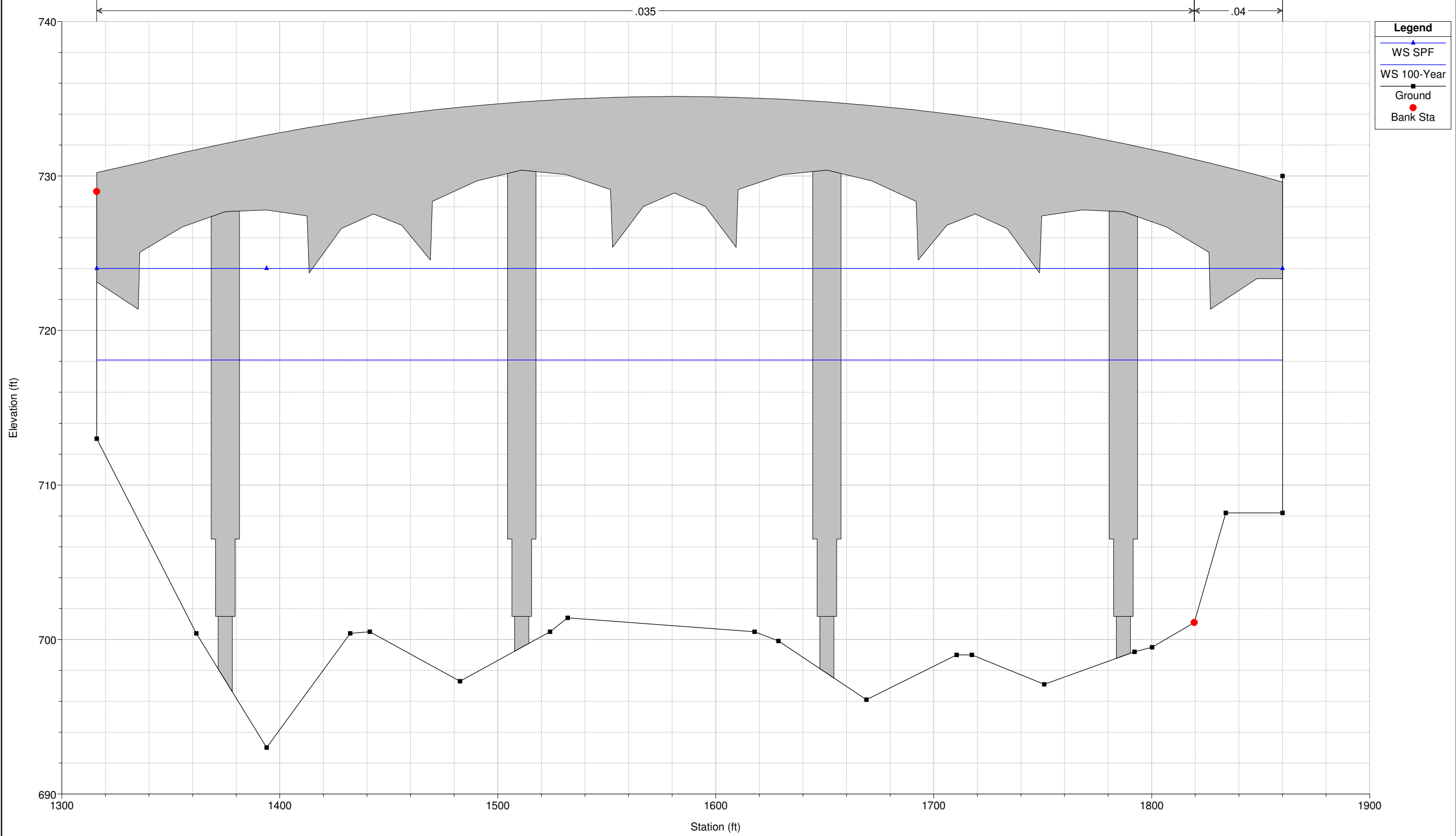
.04



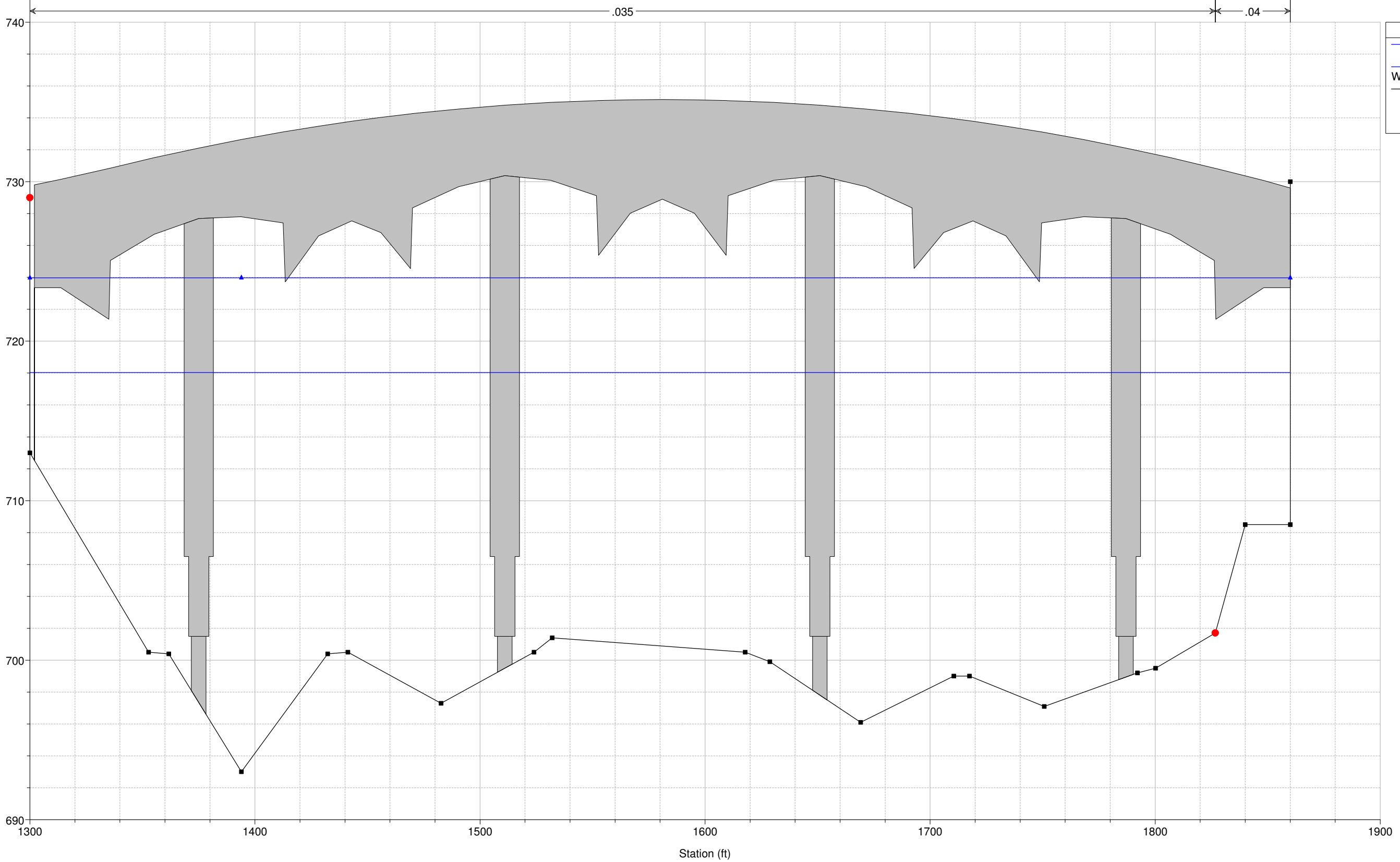
SciotoGreenways Plan: Duplicate_Effective
RS = 249.8



Sciotogreenways Plan: Duplicate_Effective
RS = 249.795 BR



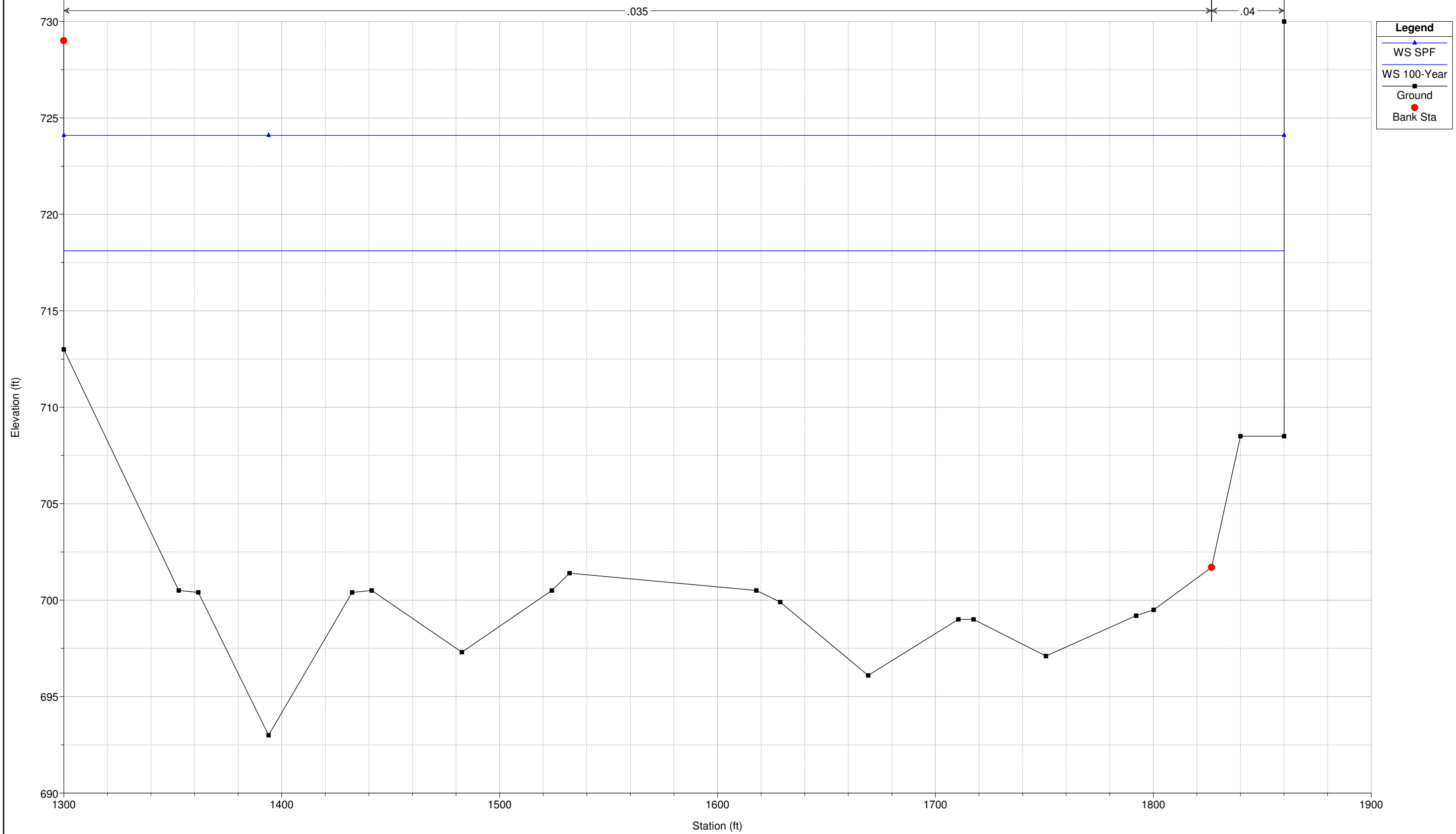
Sciotogreenways Plan: Duplicate_Effective
RS = 249.795 BR



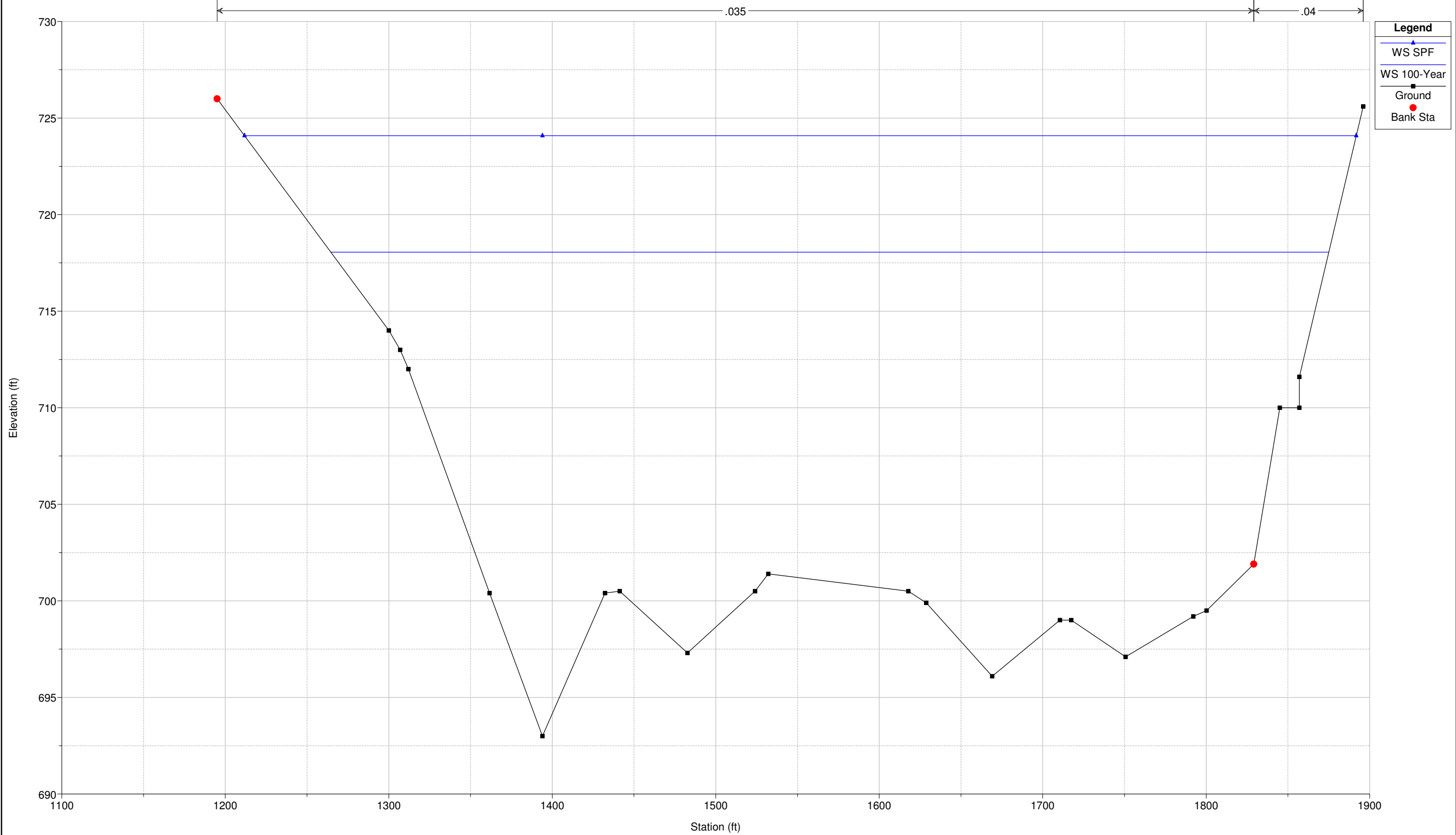
Legend

- WS 50-Year
- WS 100-Year
- Ground
- Bank Sta

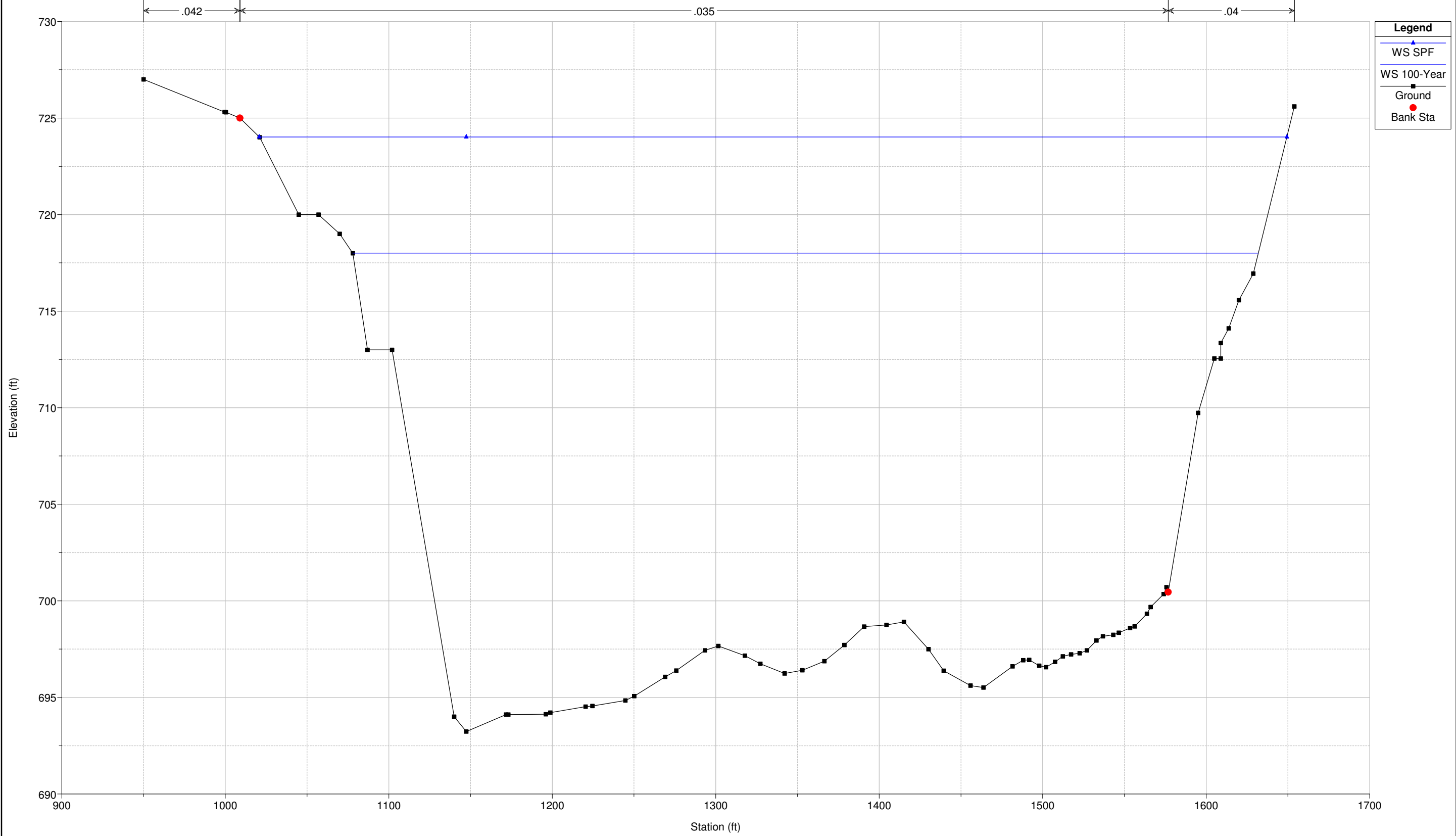
Sciotogreenways Plan: Duplicate_Effective
RS = 249.79



Sciotogreenways Plan: Duplicate_Effective
RS = 249.78



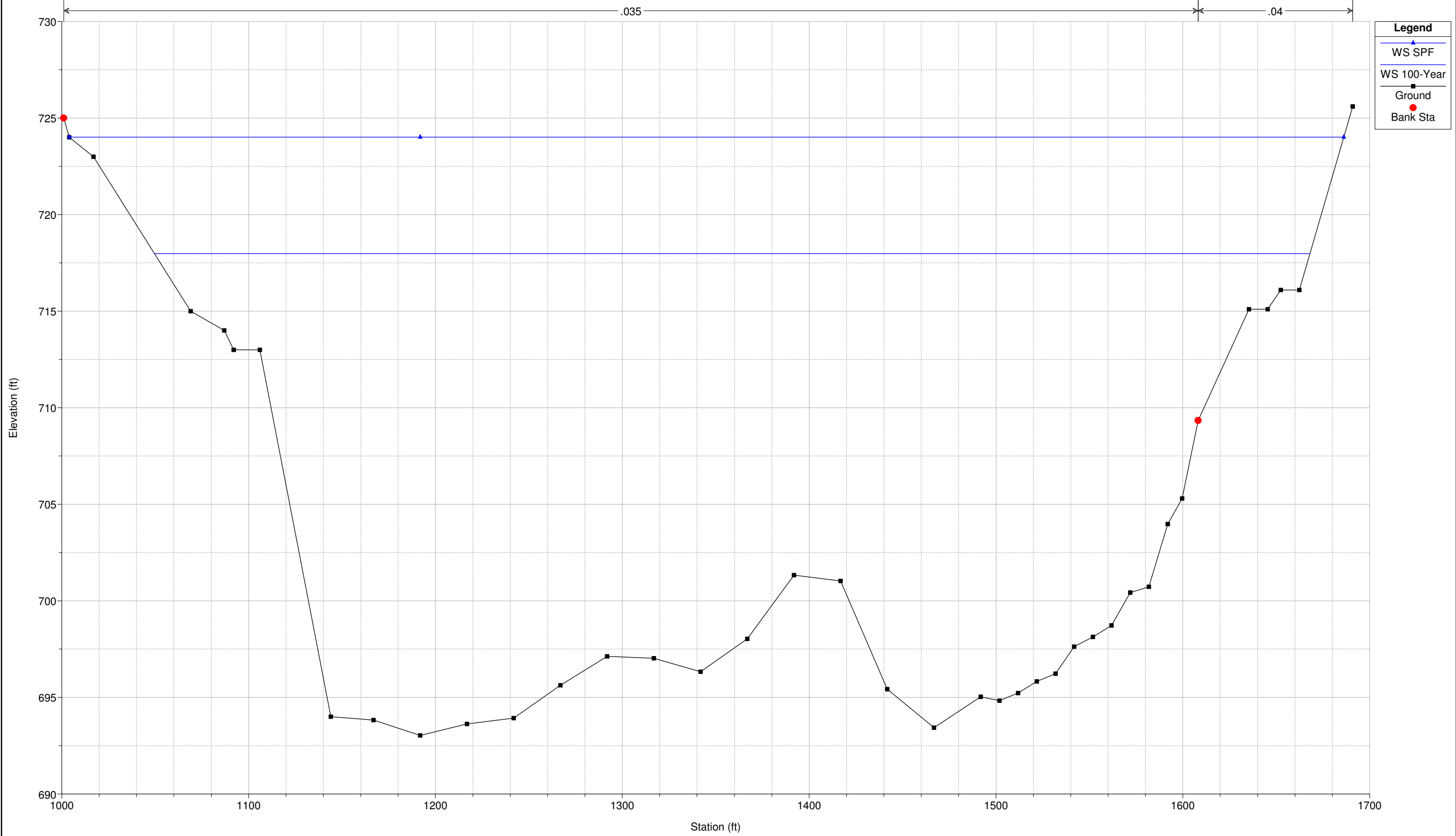
Sciotogreenways Plan: Duplicate_Effective
RS = 249.76



Legend

- WS SPF (blue line with triangle)
- WS 100-Year (blue line with square)
- Ground (black line with square)
- Bank Sta (red dot)

Sciotogreenways Plan: Duplicate_Effective
RS = 249.74



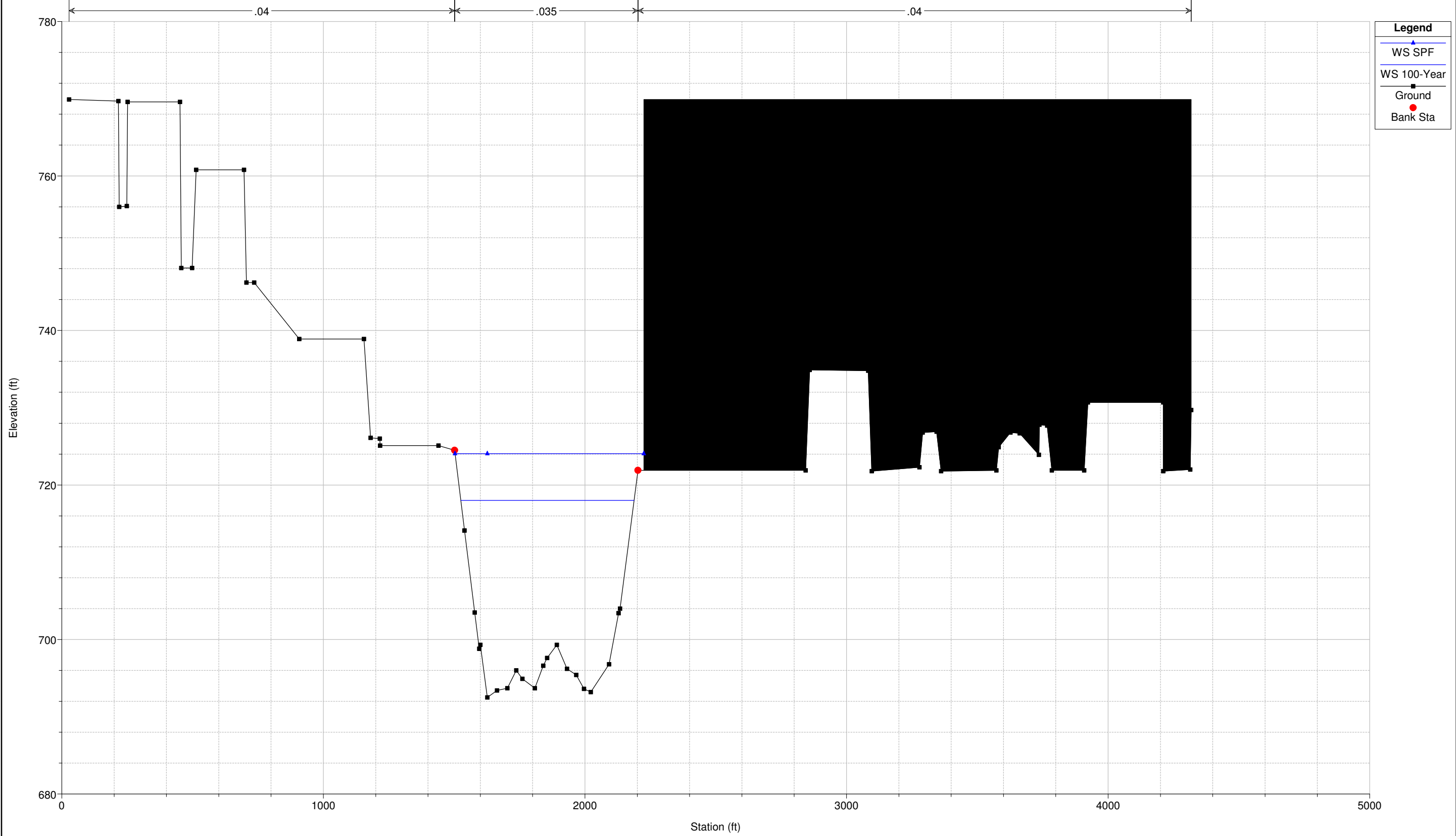
Sciotogreenways Plan: Duplicate_Effective
RS = 249.73



Legend

- WS SPF (Blue line with triangle marker)
- WS 100-Year (Blue line with square marker)
- Ground (Black line with square marker)
- Bank Sta (Red dot)

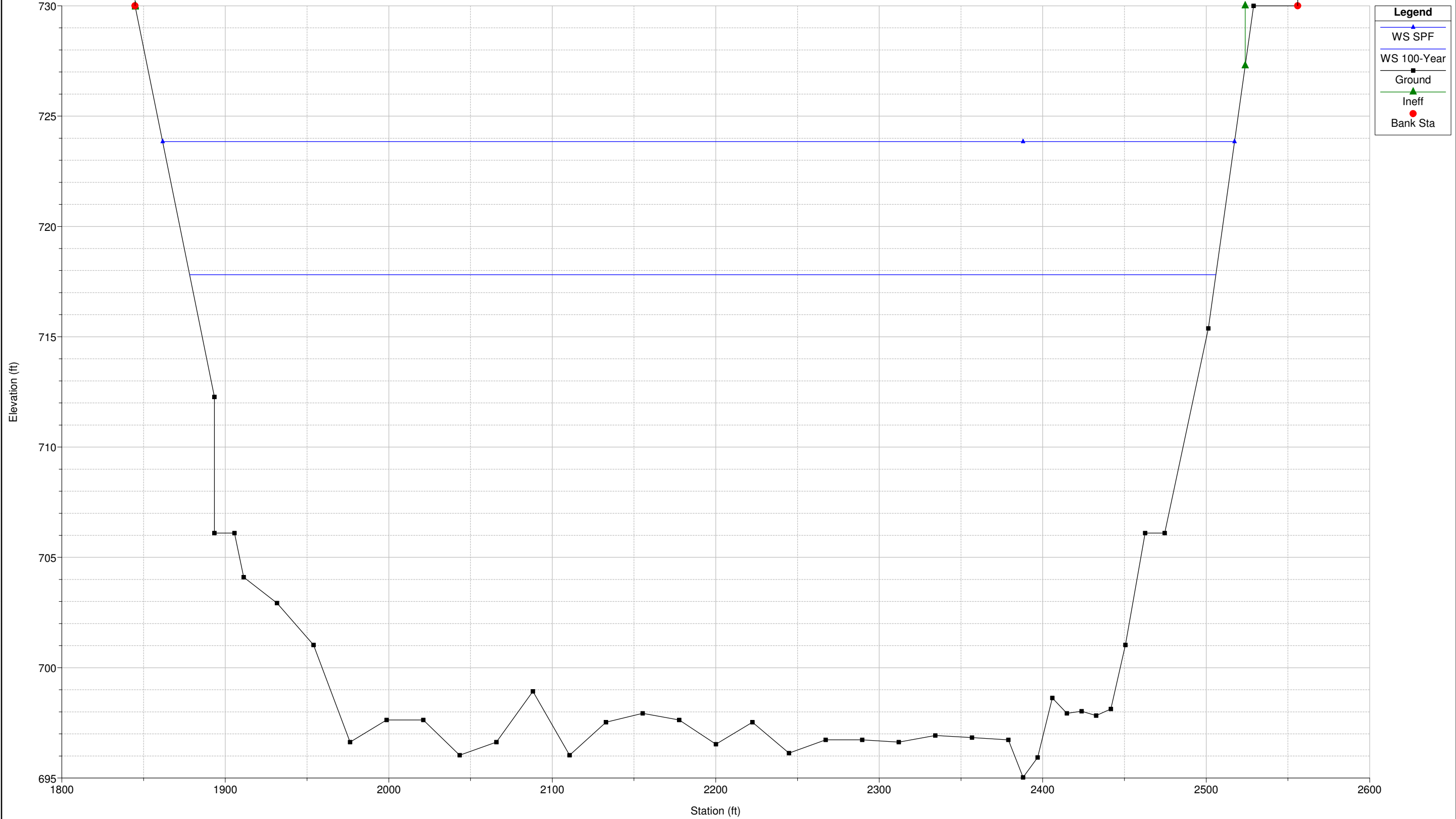
SciotoGreenways Plan: Duplicate_Effective
RS = 249.5



SciotoGreenways Plan: Duplicate_Effective

RS = 249.4

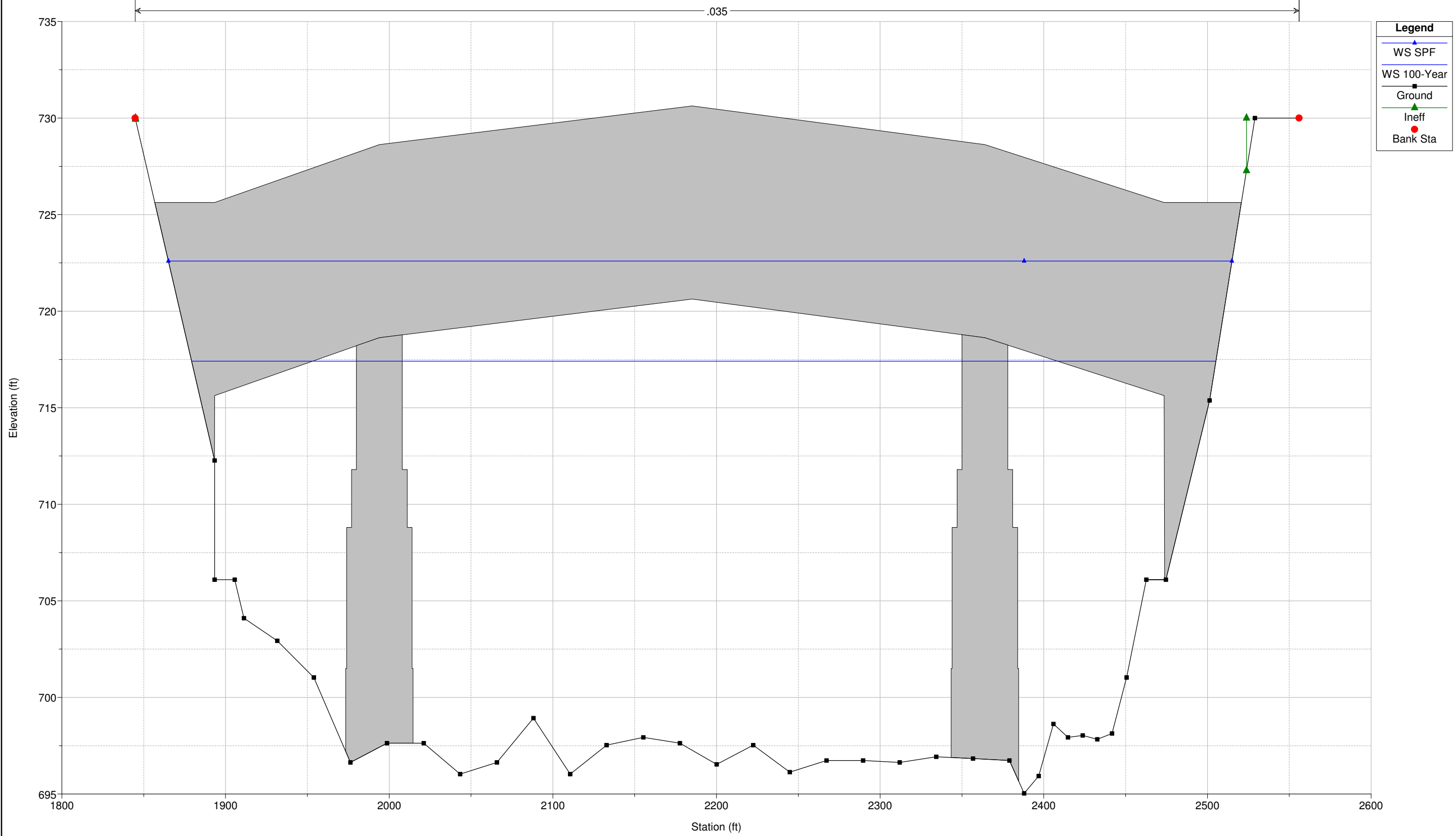
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SciotoGreenways Plan: Duplicate_Effective

RS = 249.3 BR

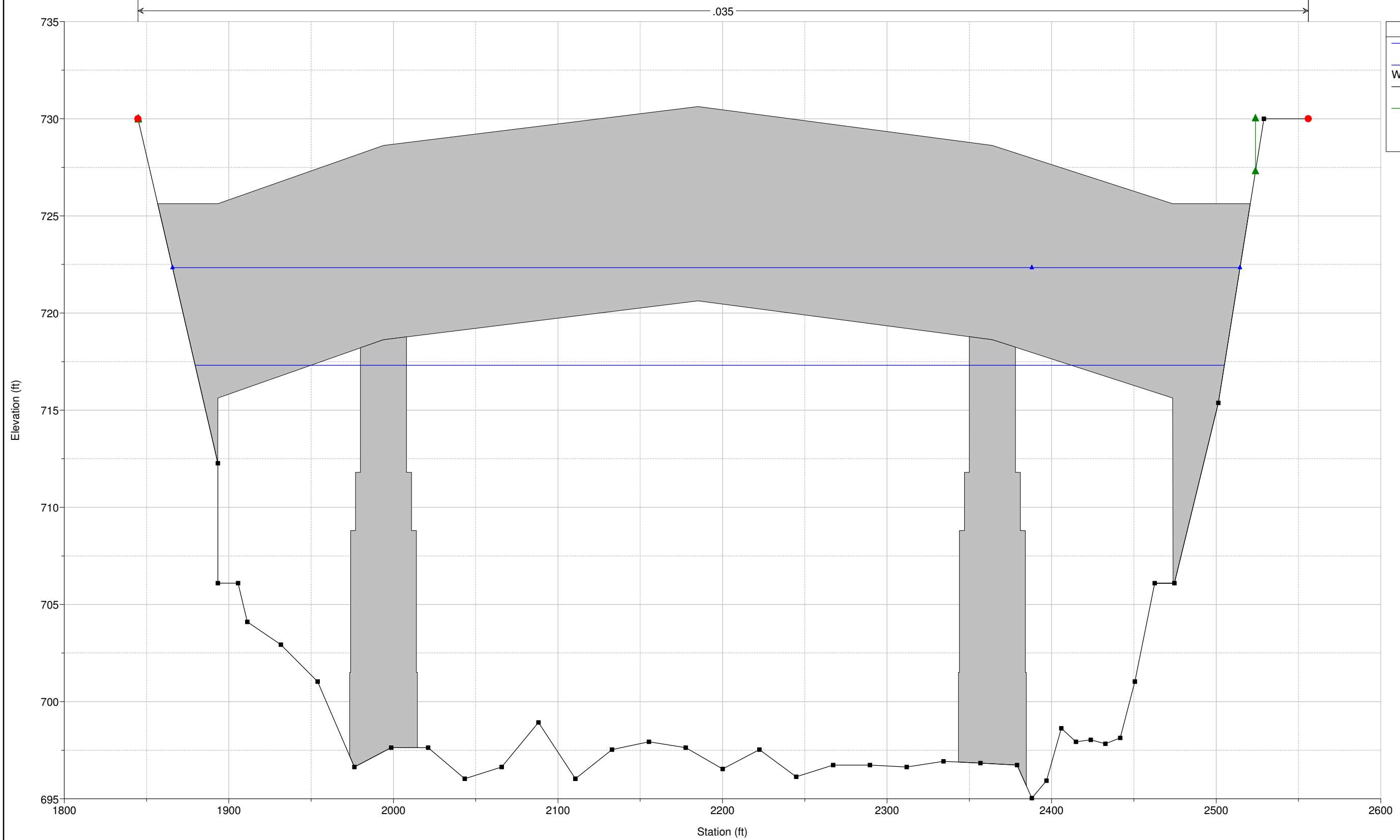
.035



SciotoGreenways Plan: Duplicate_Effective

RS = 249.3 BR

.035



Legend

WS SPF

WS 100-Year

Ground

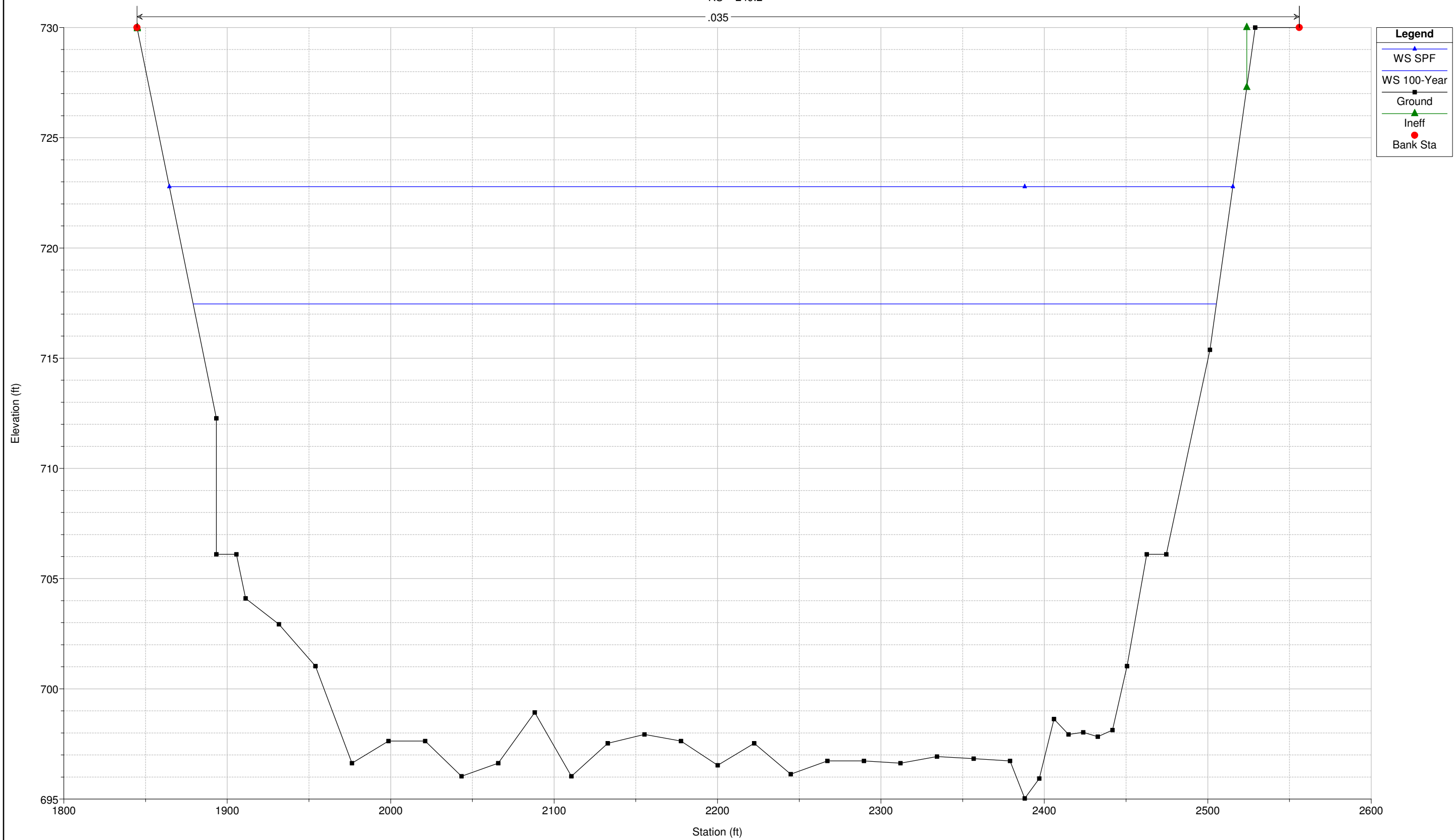
Ineff

Bank Sta

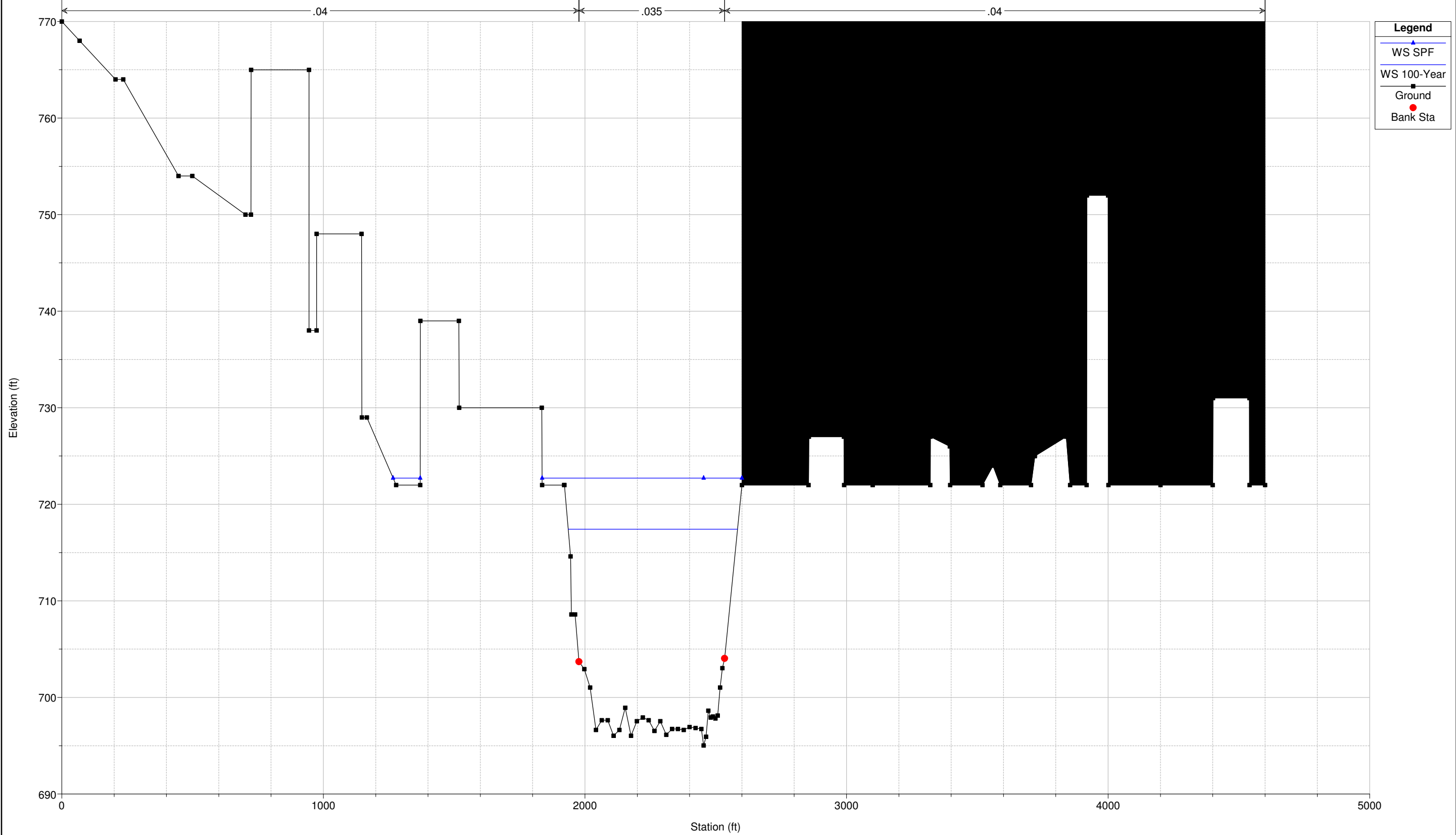
Sciotogreenways Plan: Duplicate_Effective

RS = 249.2

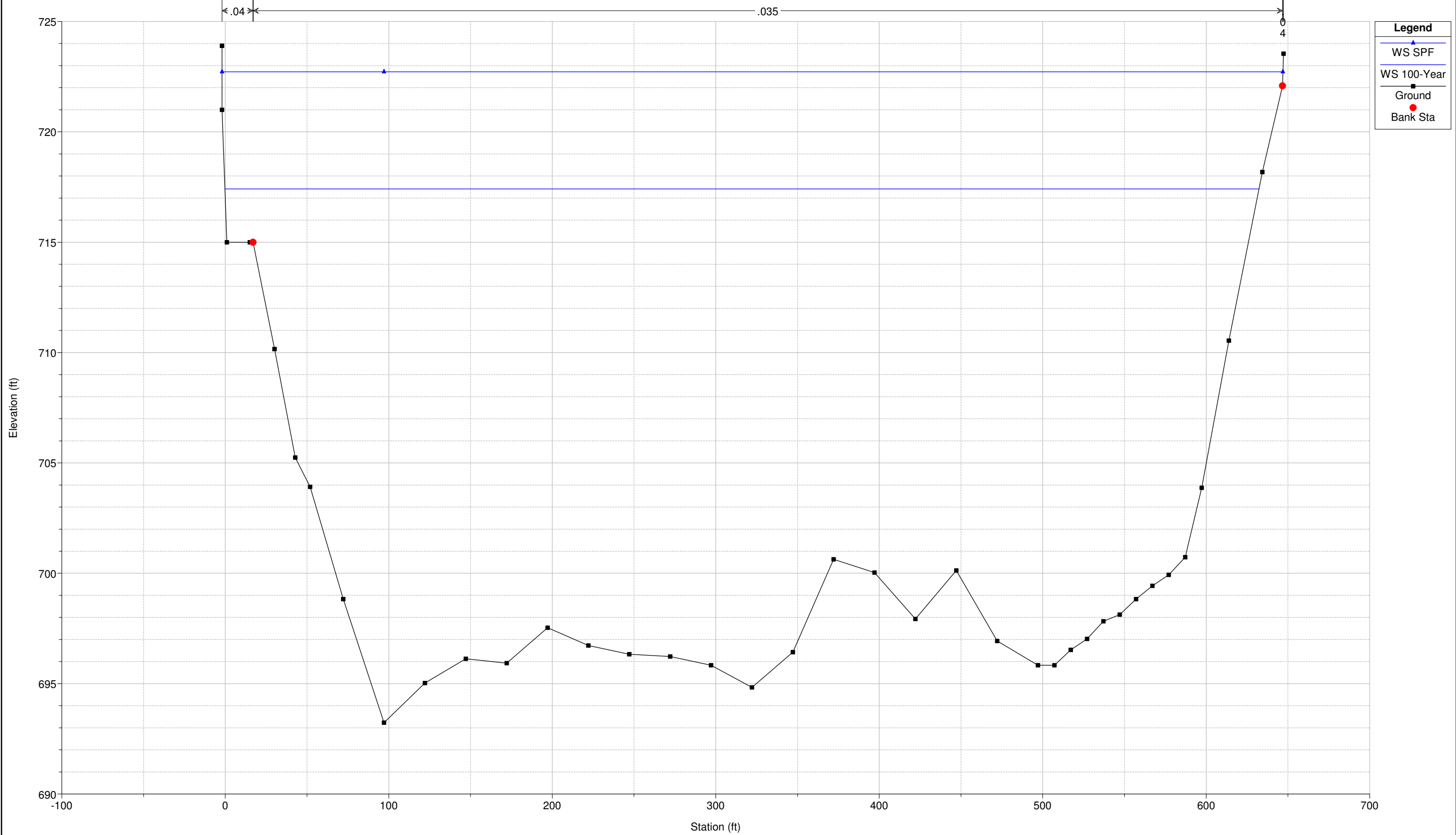
.035



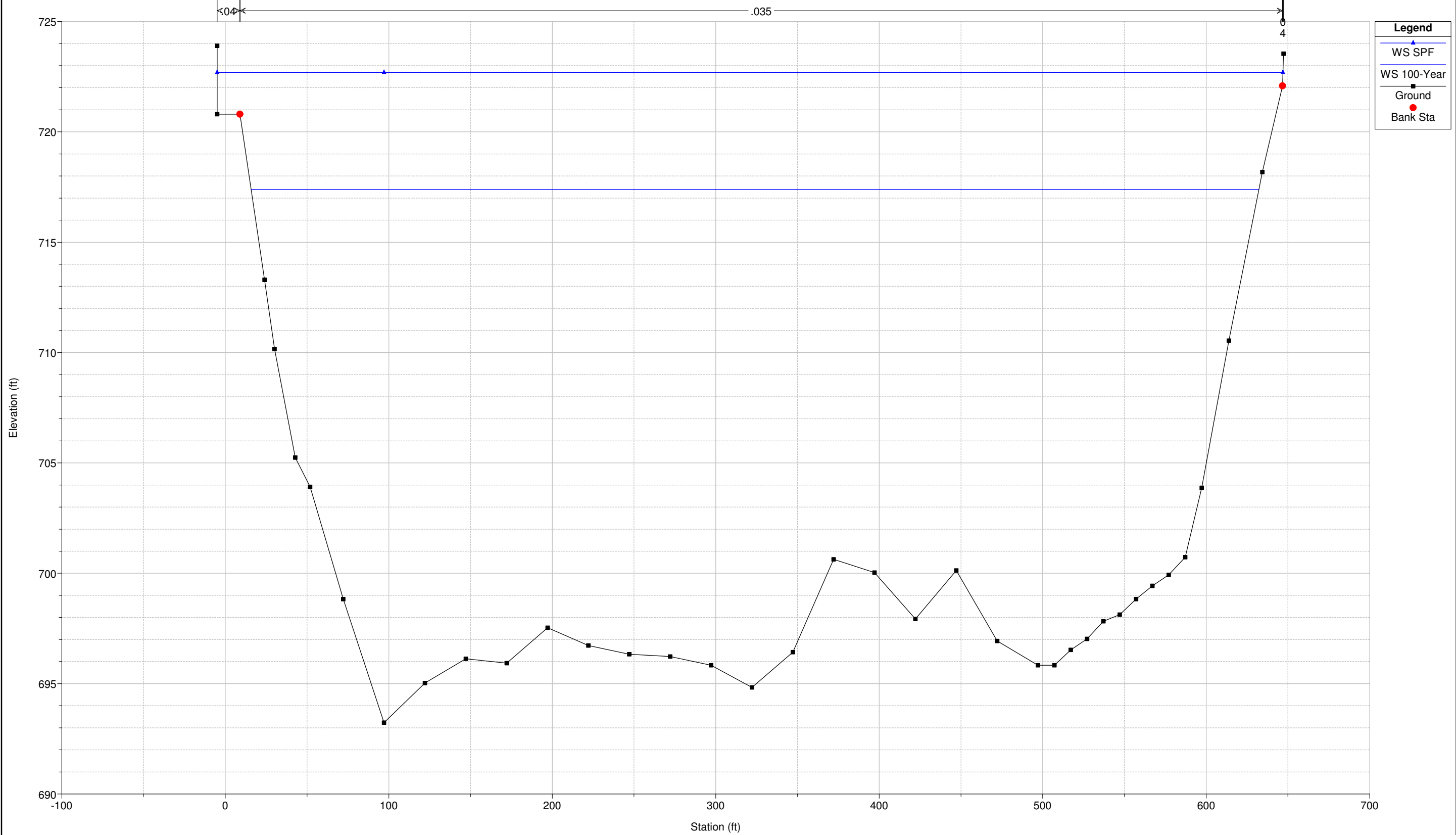
SciotoGreenways Plan: Duplicate_Effective
RS = 249.1



Sciotogreenways Plan: Duplicate_Effective
RS = 249.08

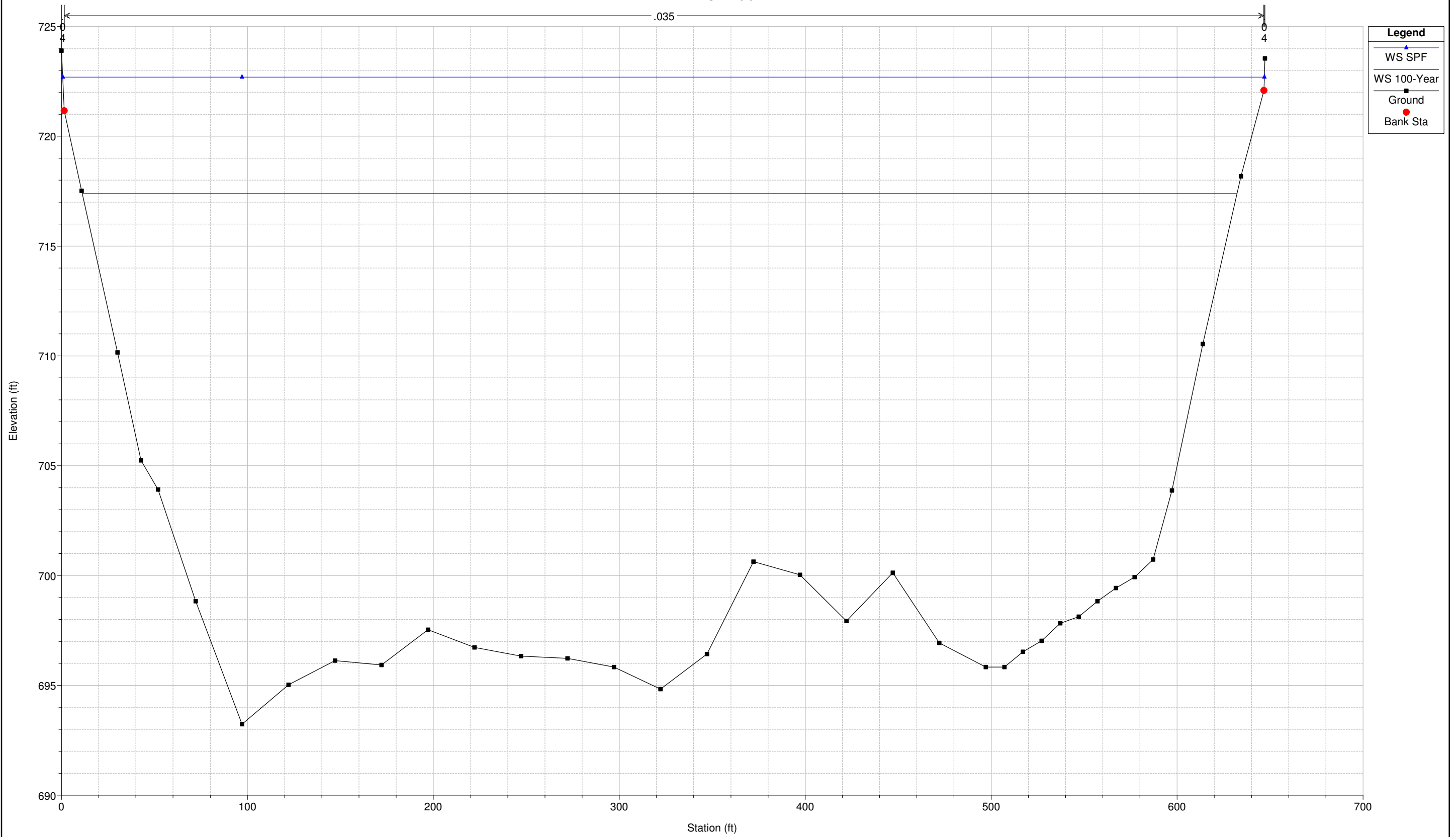


SciotoGreenways Plan: Duplicate_Effective
RS = 249.06



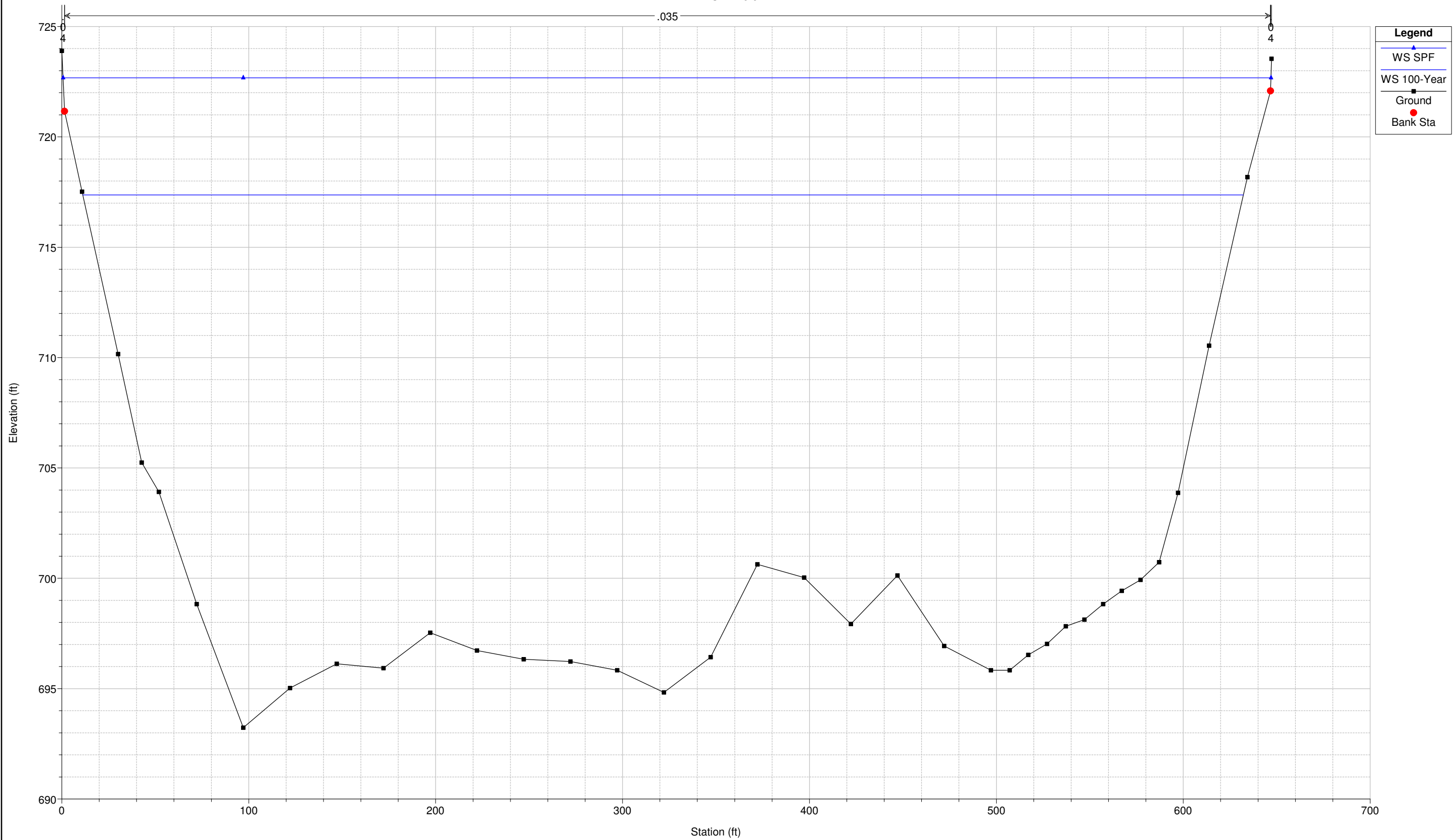
SciotoGreenways Plan: Duplicate_Effective
RS = 249.04

.035



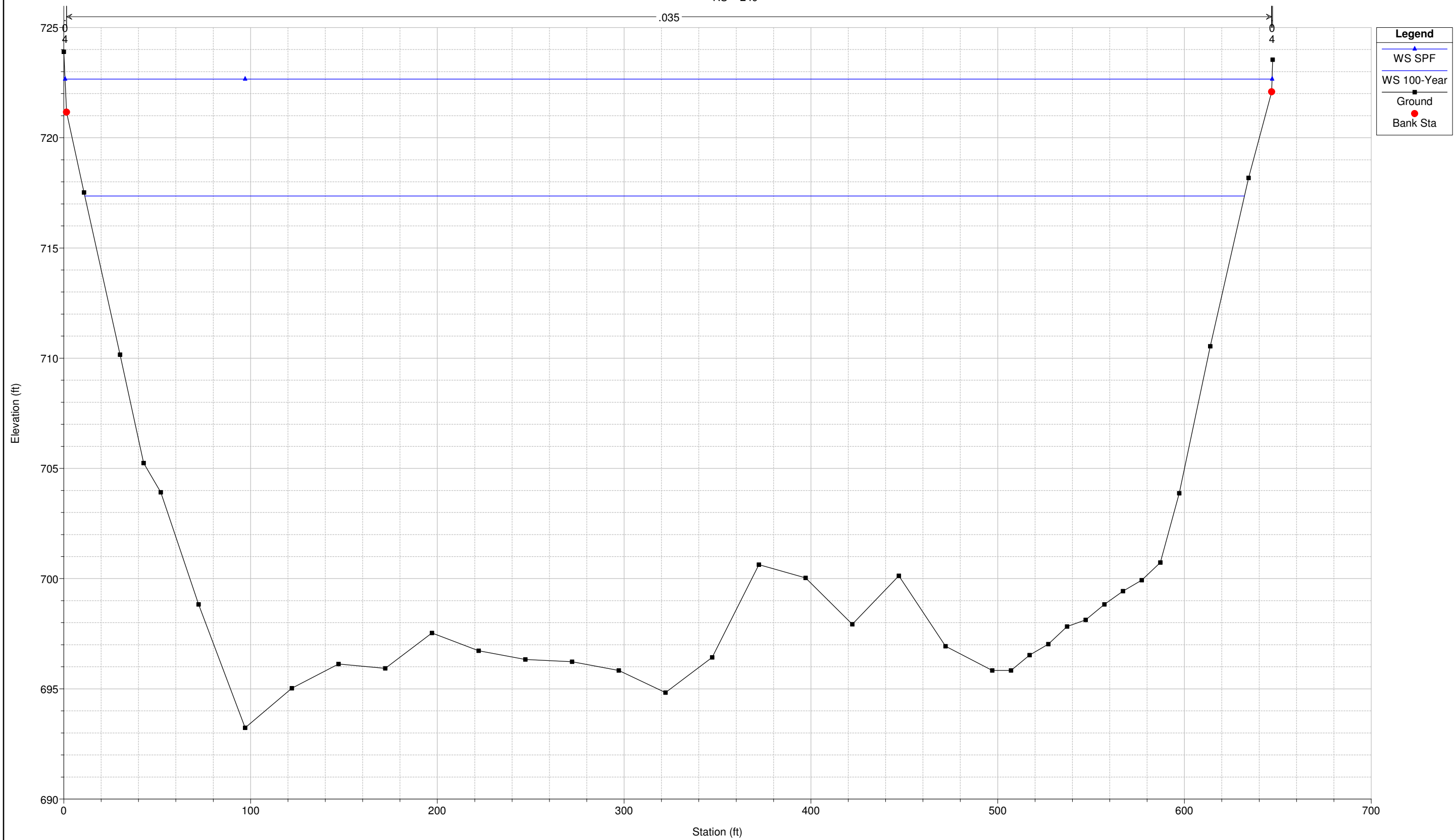
Sciotogreenways Plan: Duplicate_Effective
RS = 249.02

.035

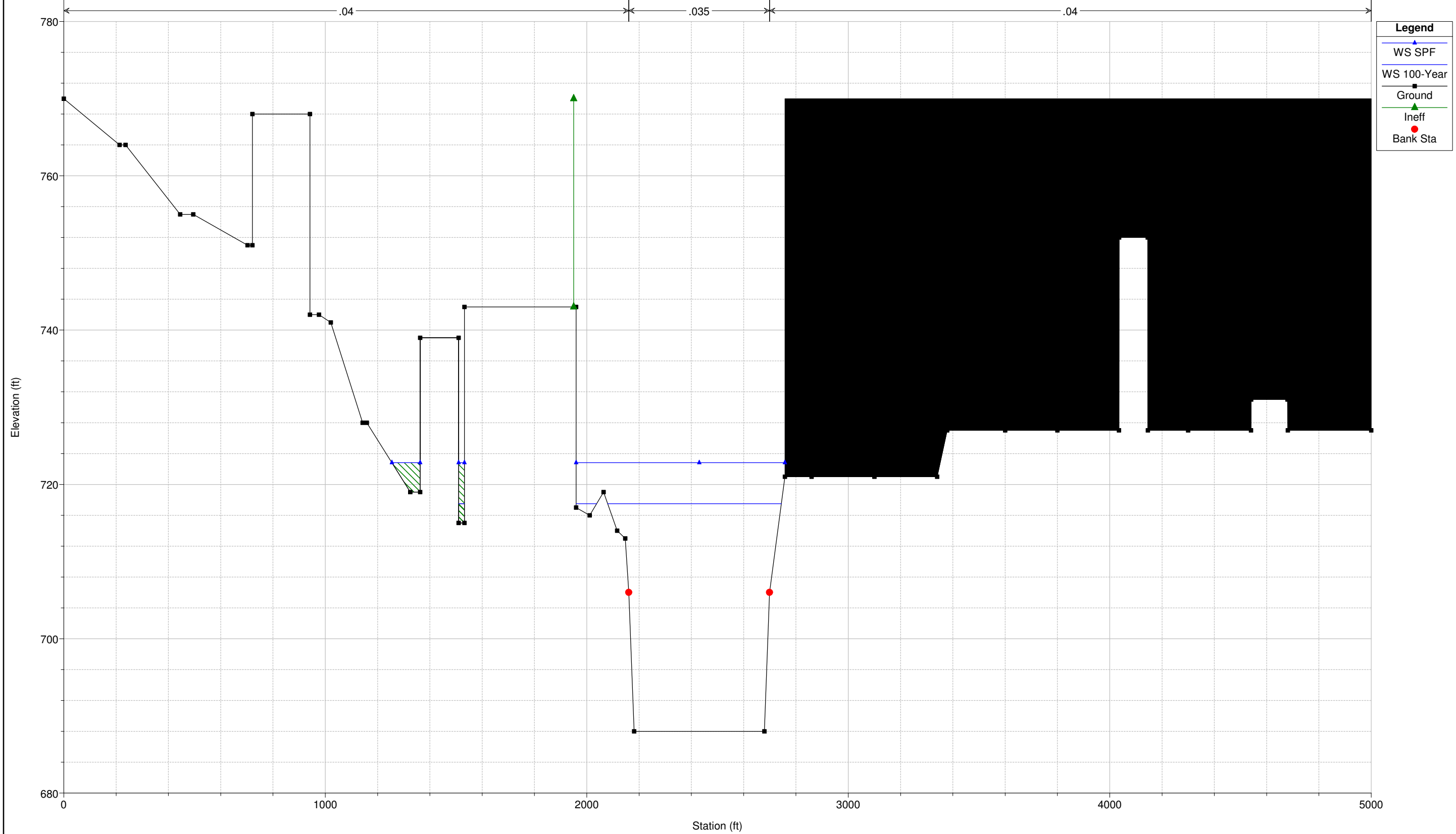


Sciotogreenways Plan: Duplicate_Effective
RS = 249

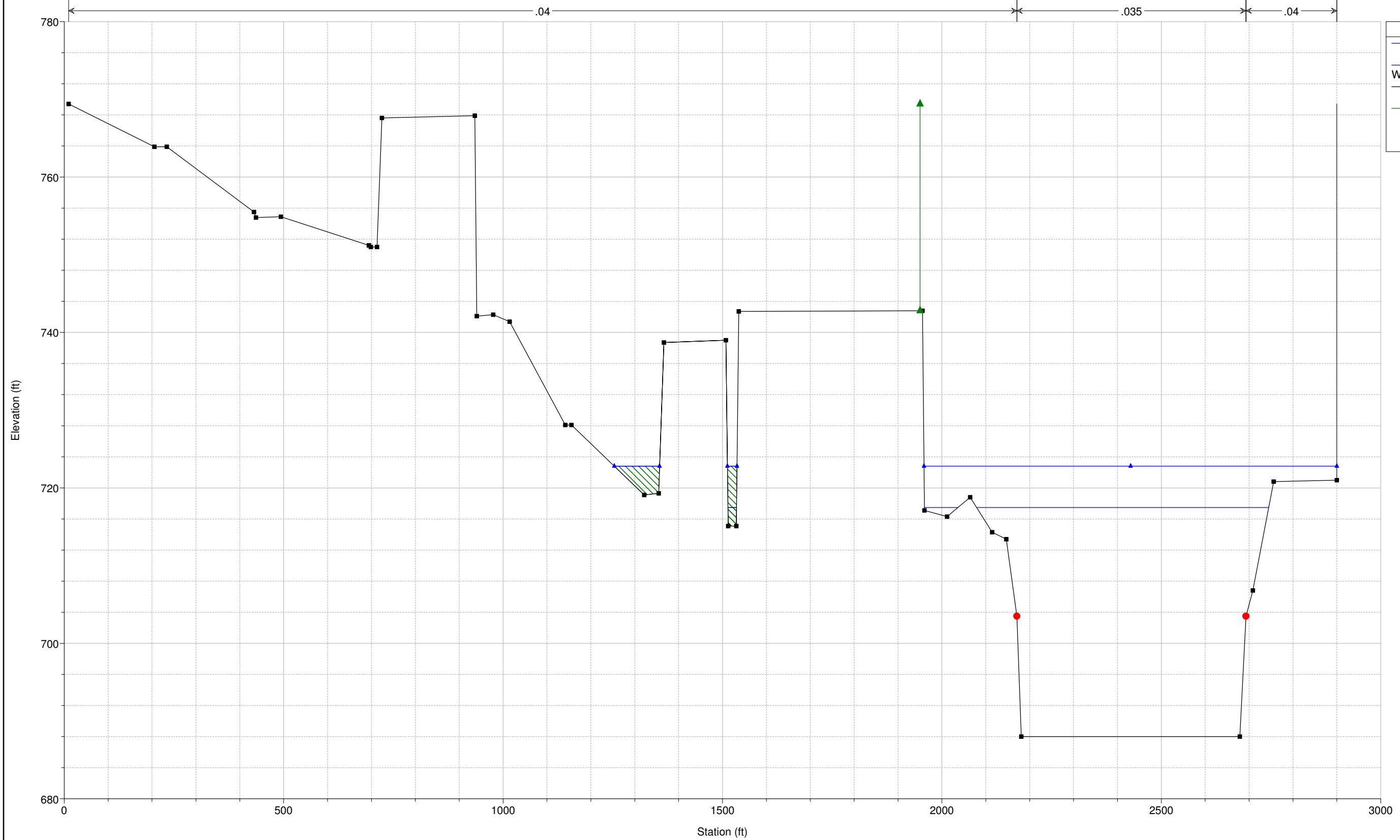
.035



Sciotogreenways Plan: Duplicate_Effective
RS = 248.5



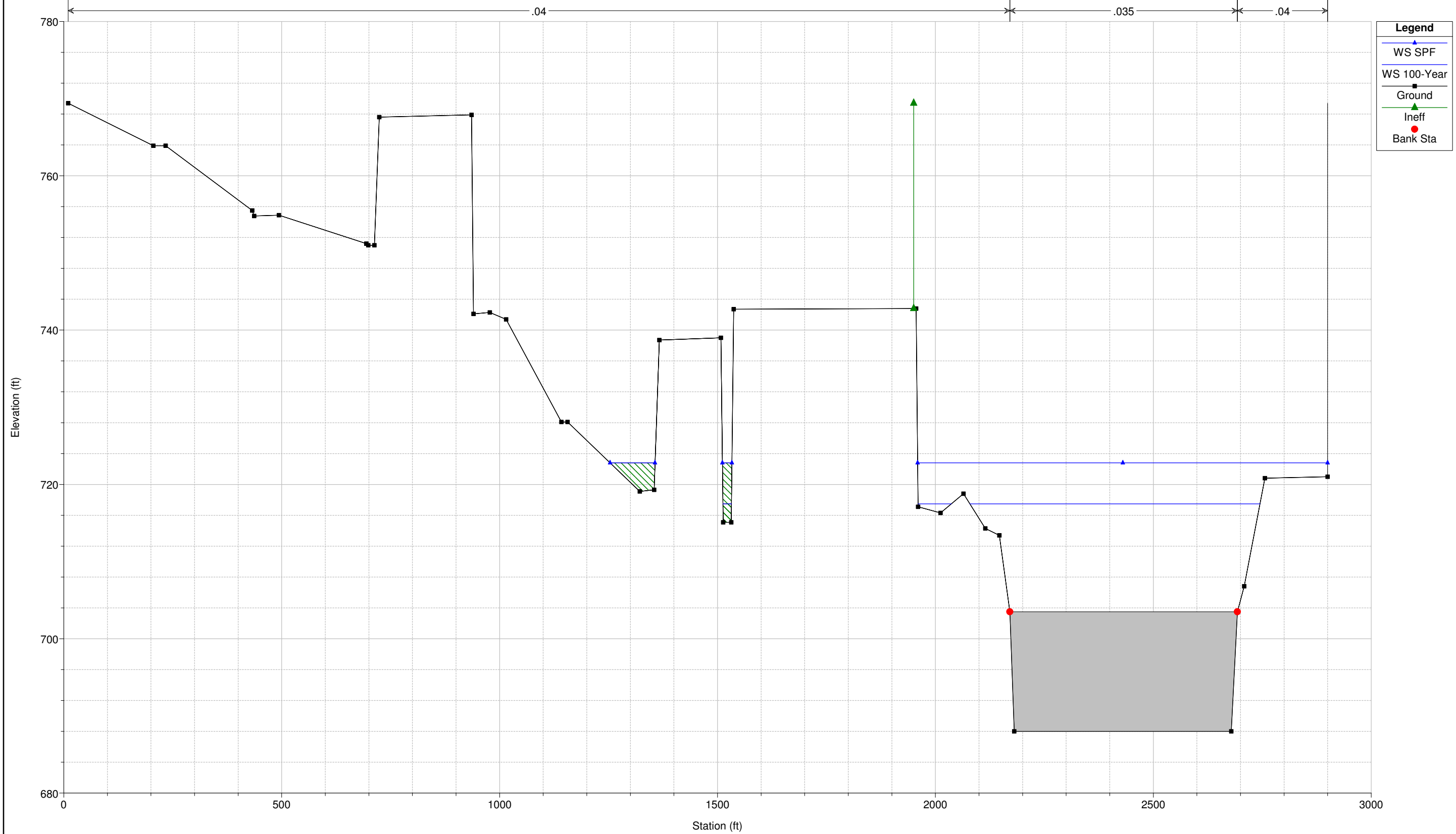
Sciotogreenways Plan: Duplicate_Effective
RS = 248.4



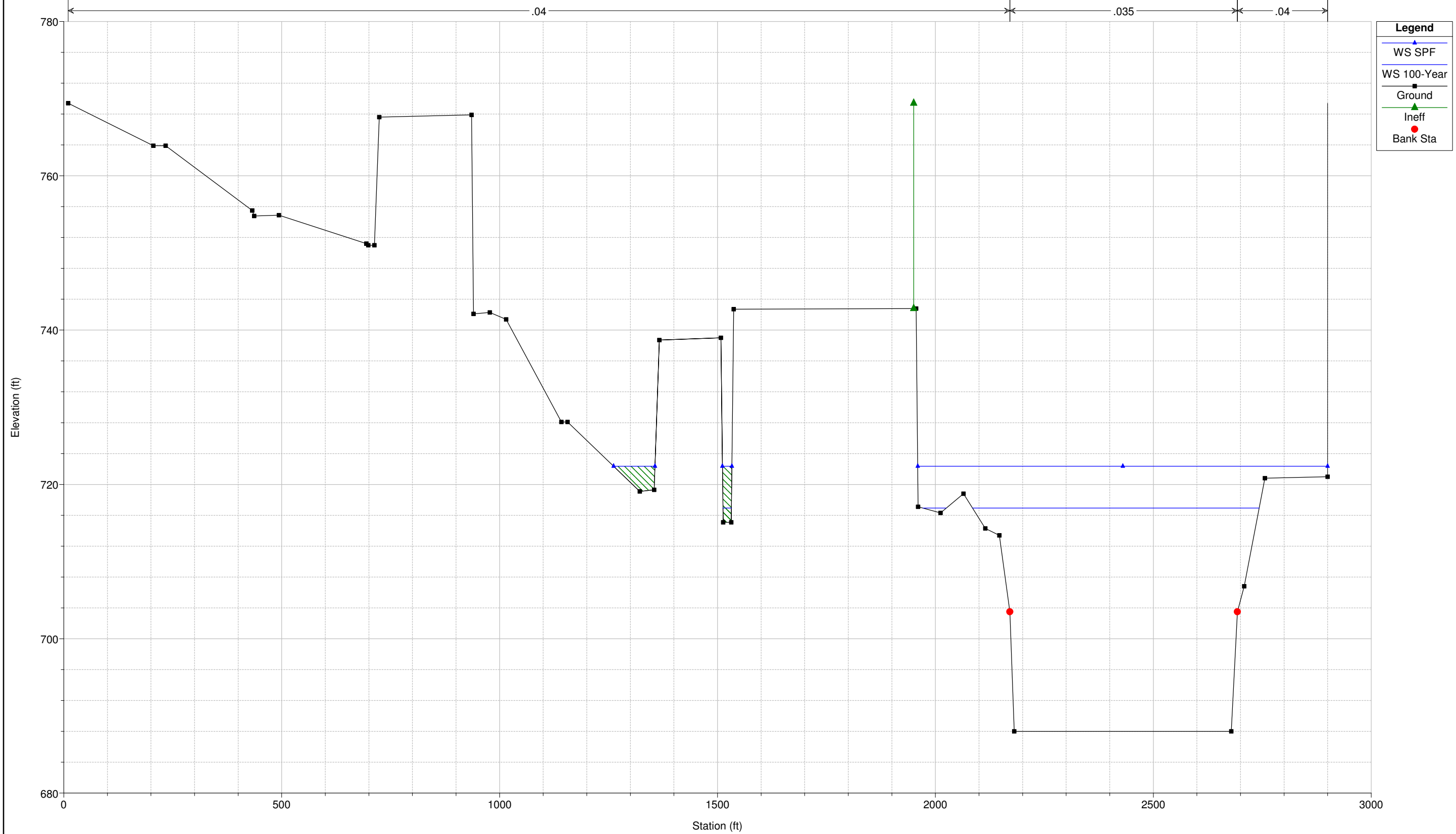
Legend

- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

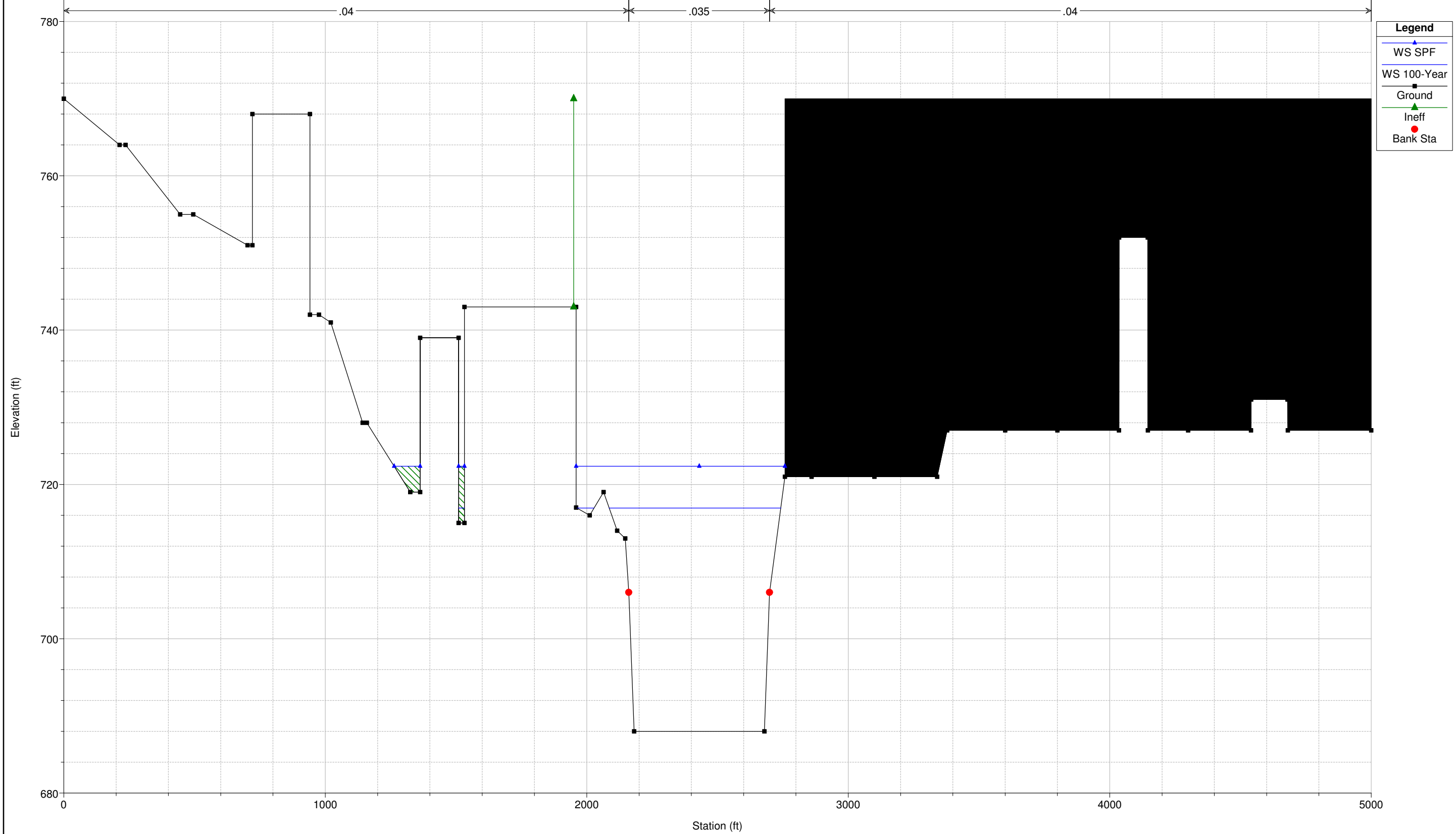
Sciotogreenways Plan: Duplicate_Effective
RS = 248.3 IS



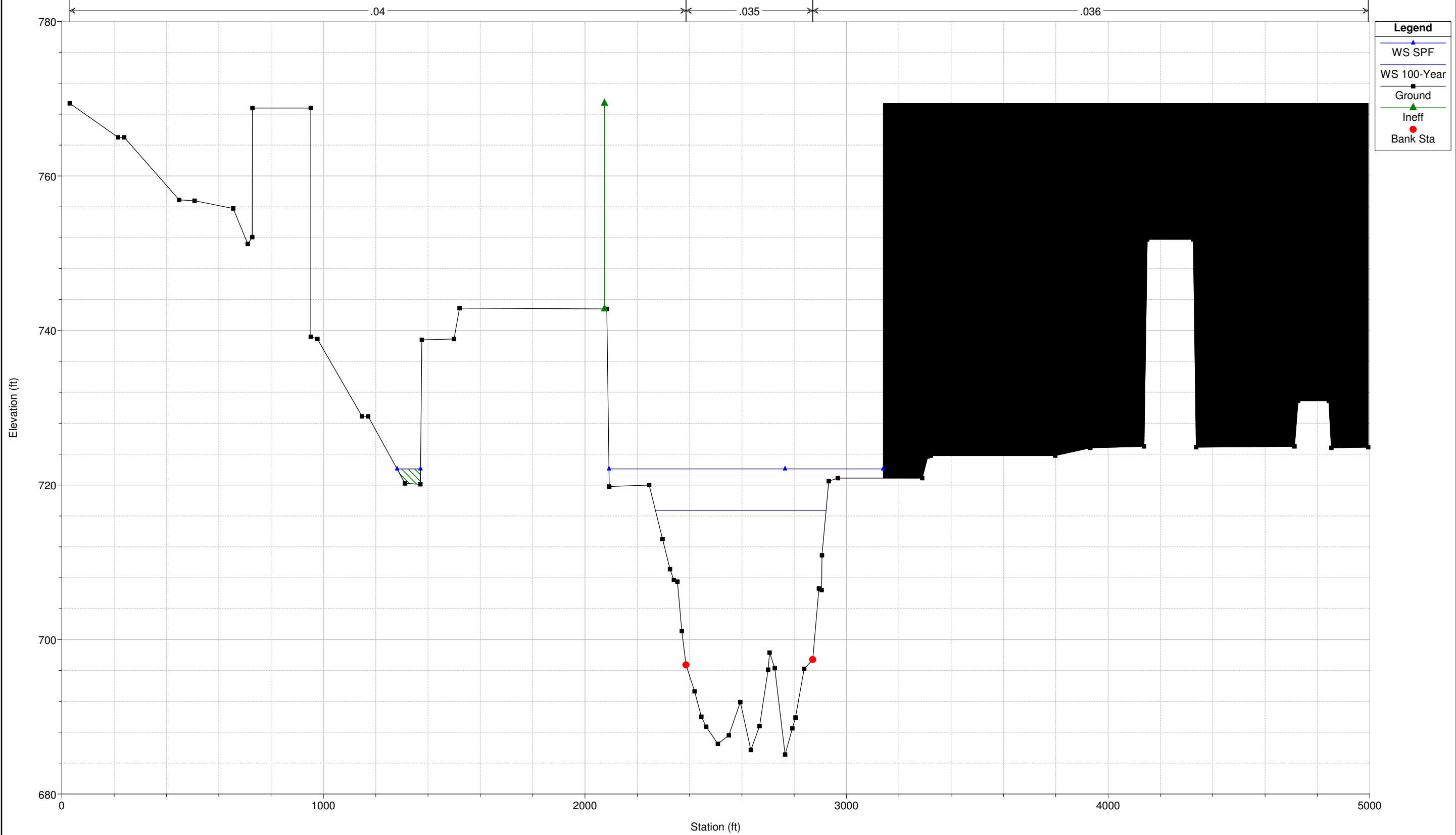
Sciotogreenways Plan: Duplicate_Effective
RS = 248.2



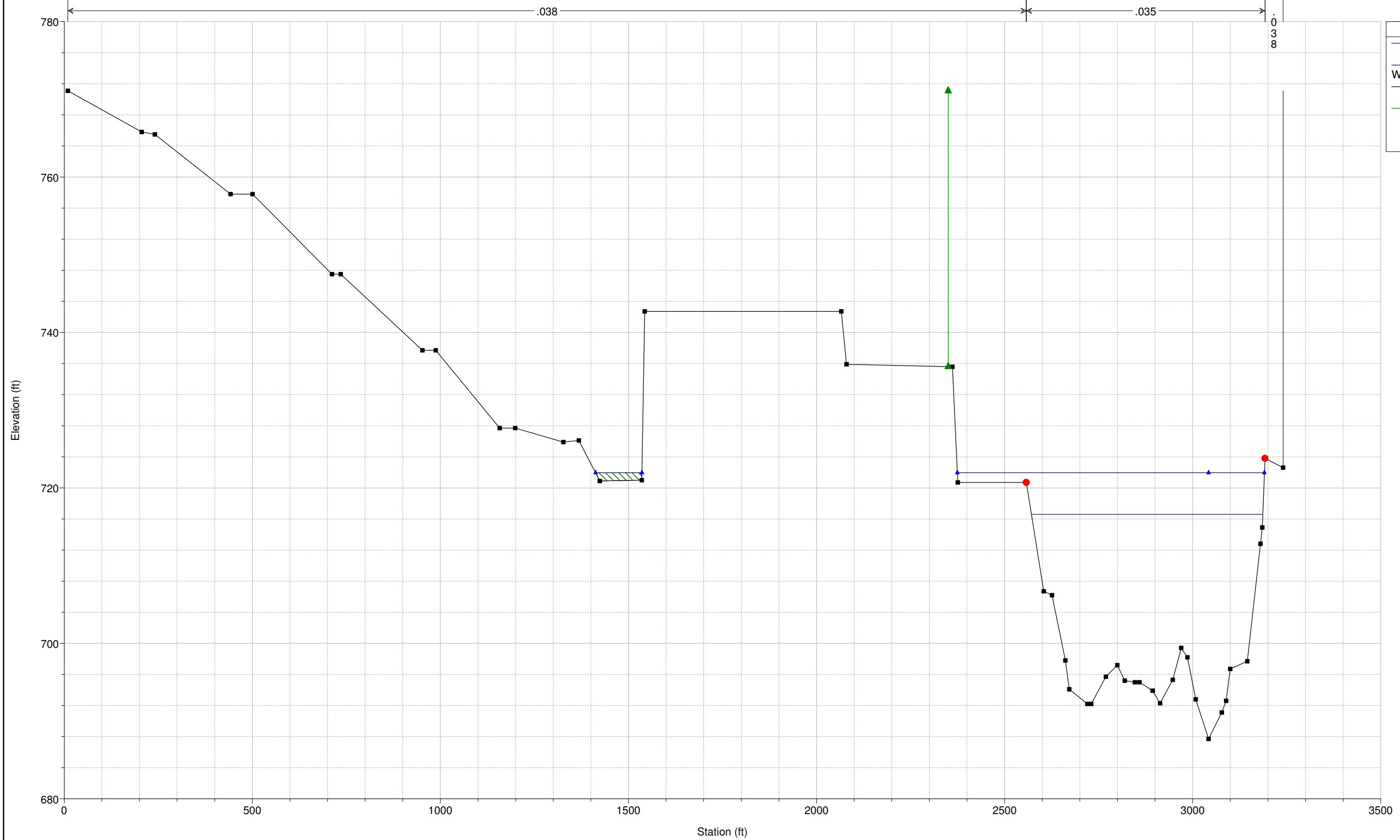
Sciotogreenways Plan: Duplicate_Effective
RS = 248.1



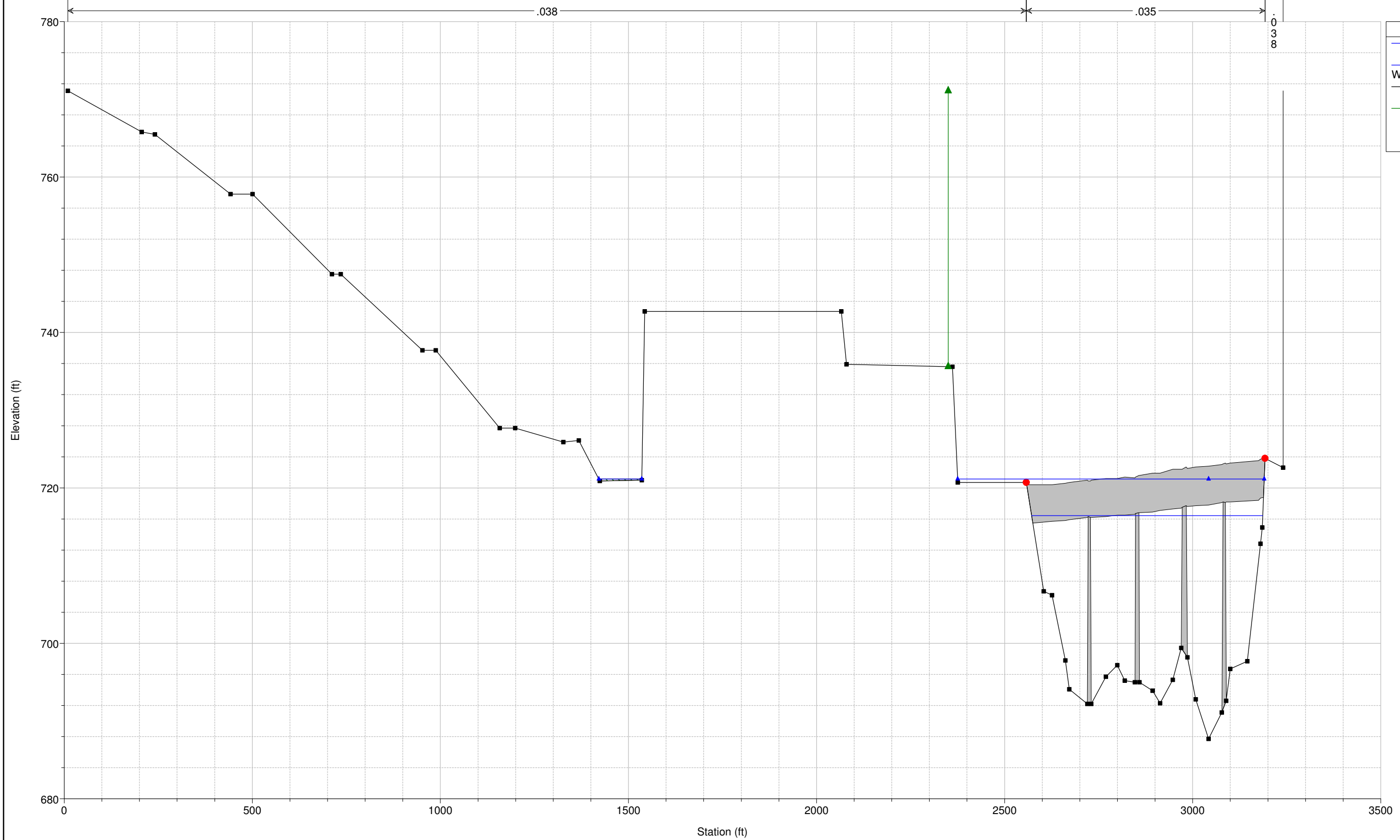
Sciotogreenways Plan: Duplicate_Effective
RS = 247.5



Sciotogreenways Plan: Duplicate_Effective
RS = 247.4



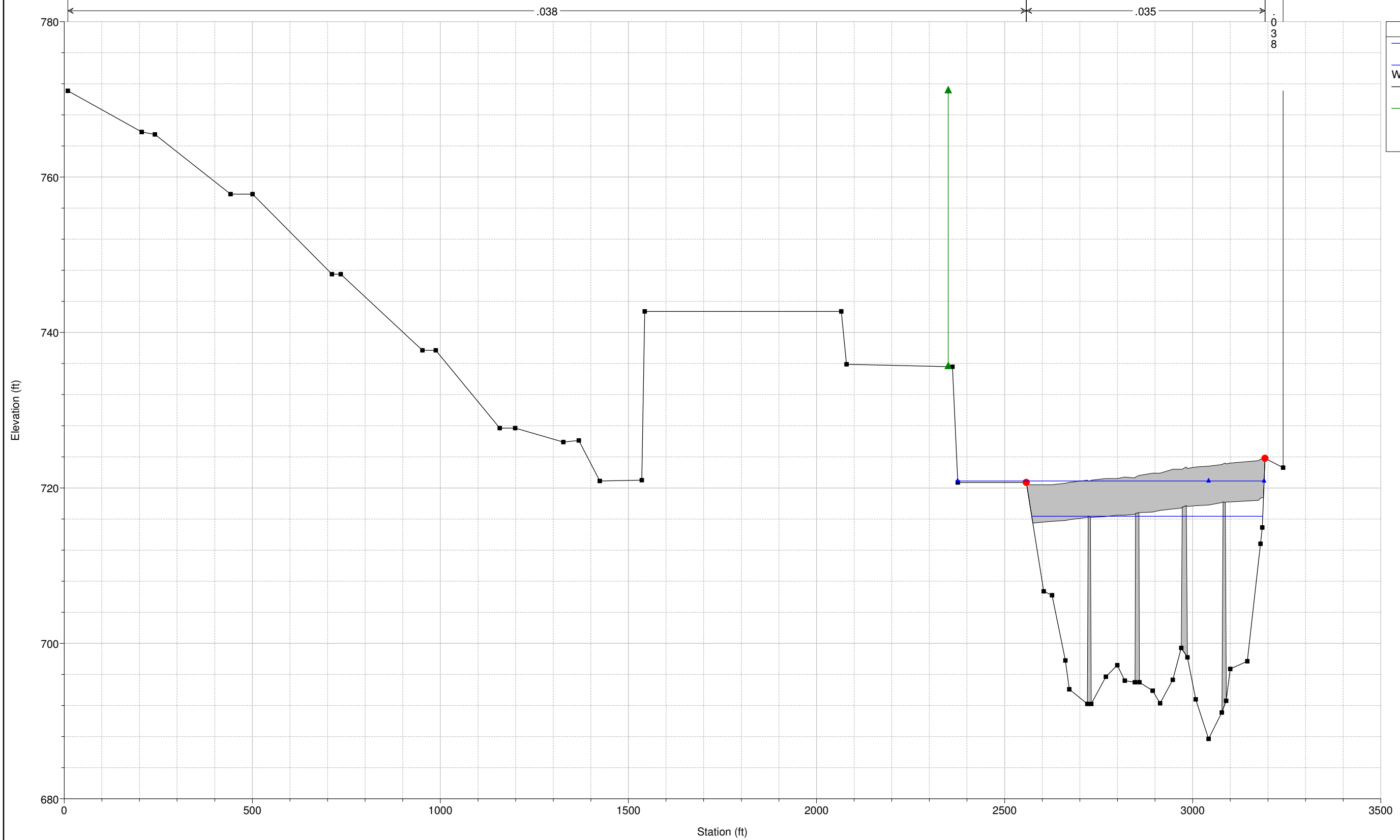
Sciotogreenways Plan: Duplicate_Effective
RS = 247.3 BR



Legend

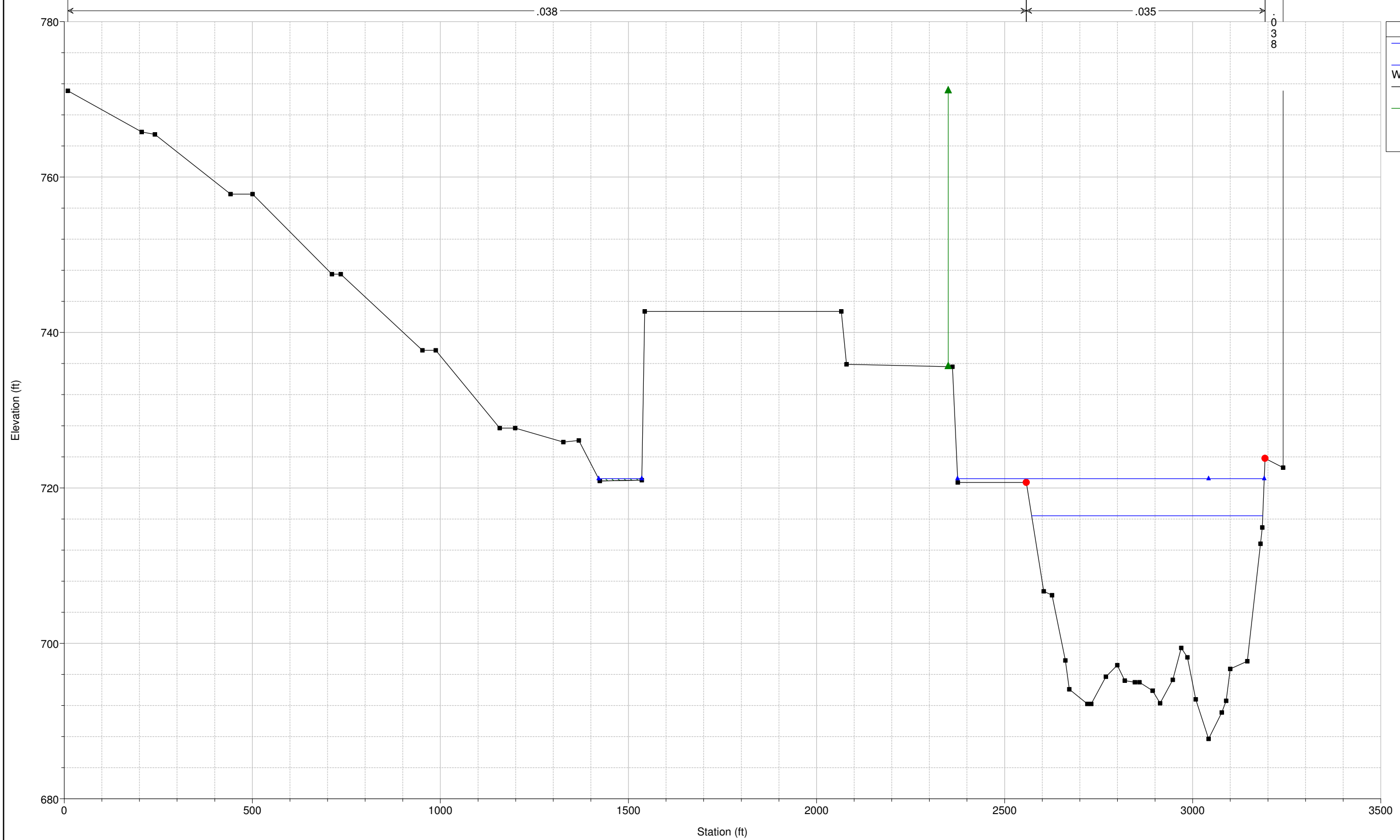
- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

Sciotogreenways Plan: Duplicate_Effective
RS = 247.3 BR



- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Duplicate_Effective
RS = 247.2

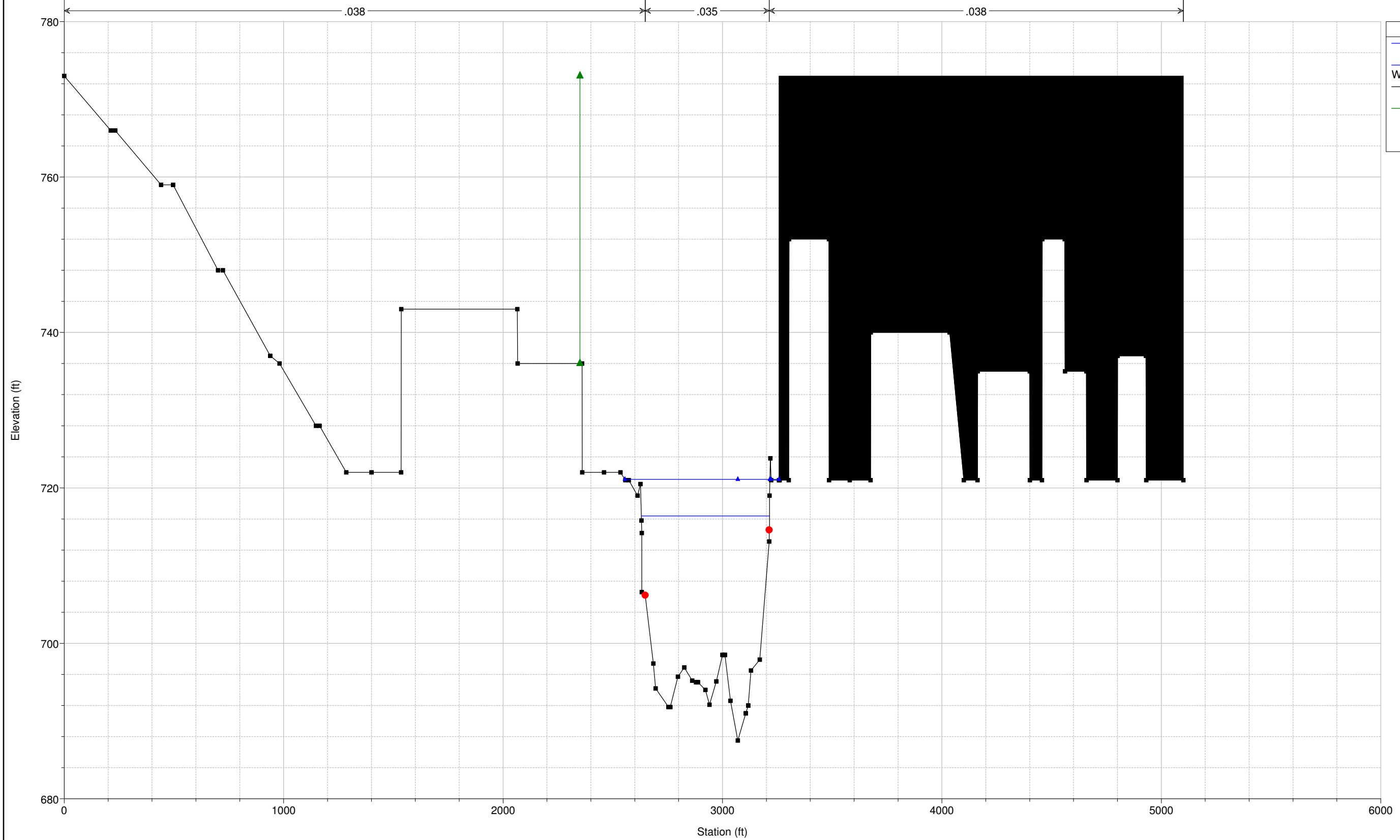


Legend

- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

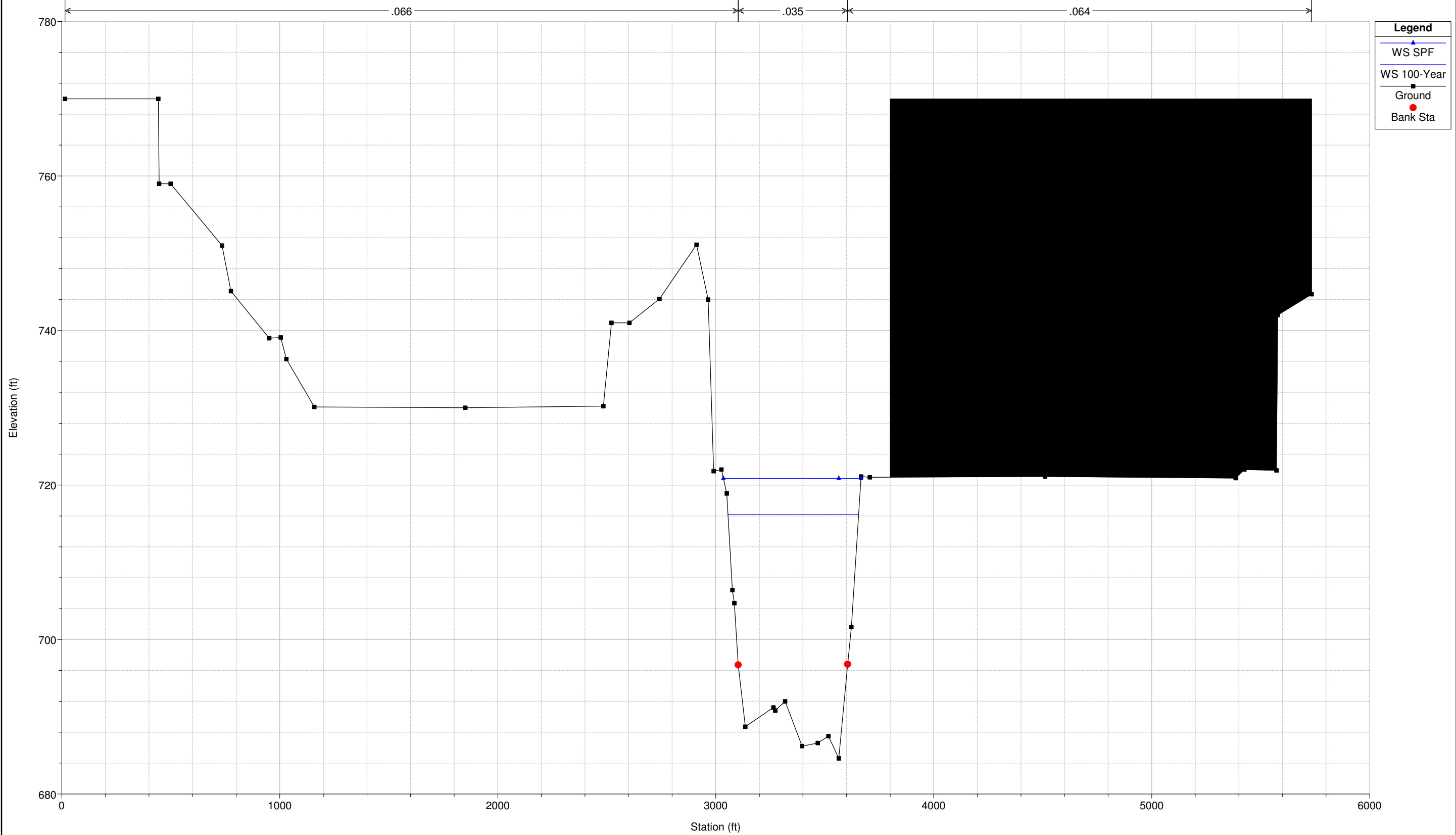
Sciotogreenways Plan: Duplicate_Effective

RS = 247.1

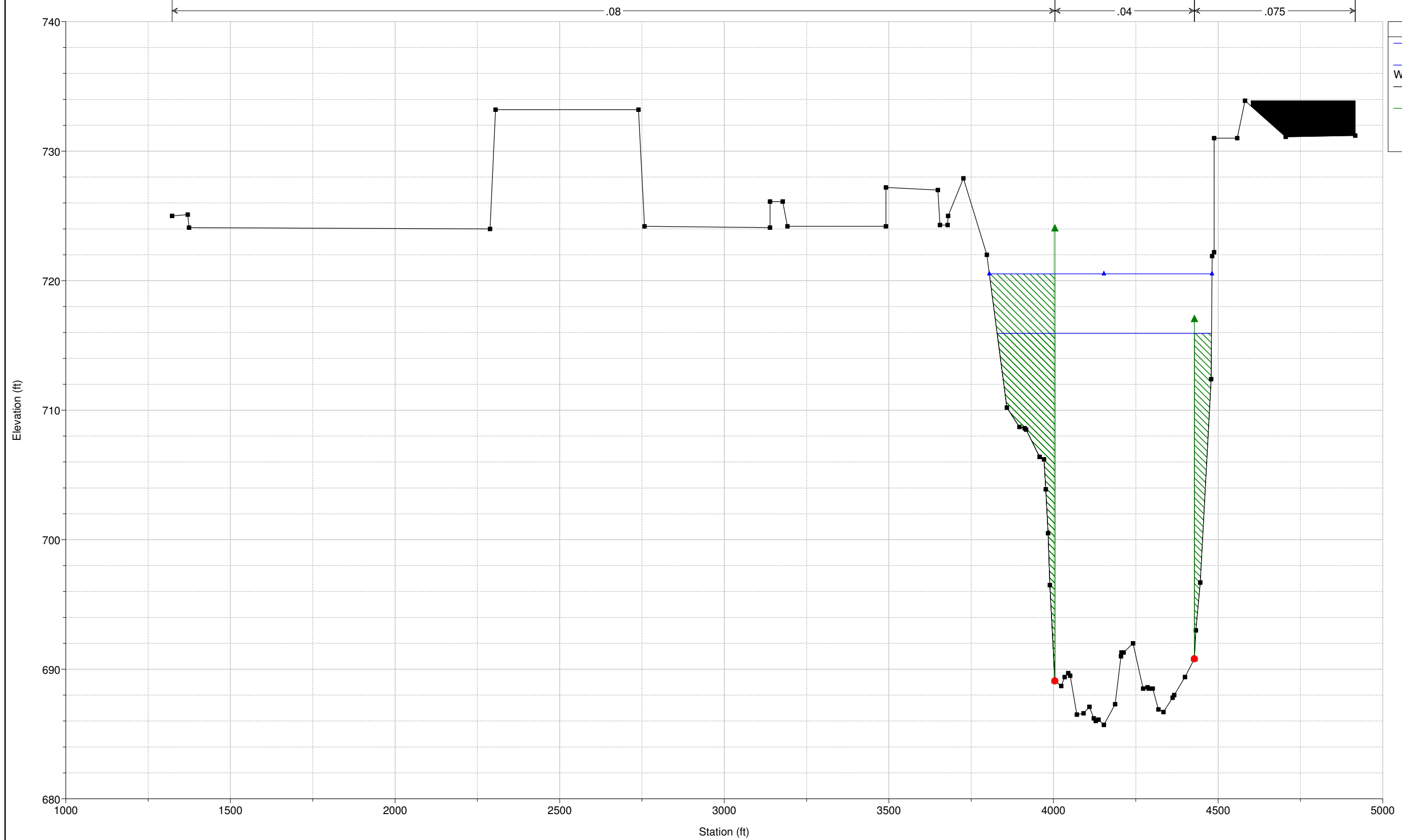


- Legend
- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

Sciotogreenways Plan: Duplicate_Effective
RS = 246.5



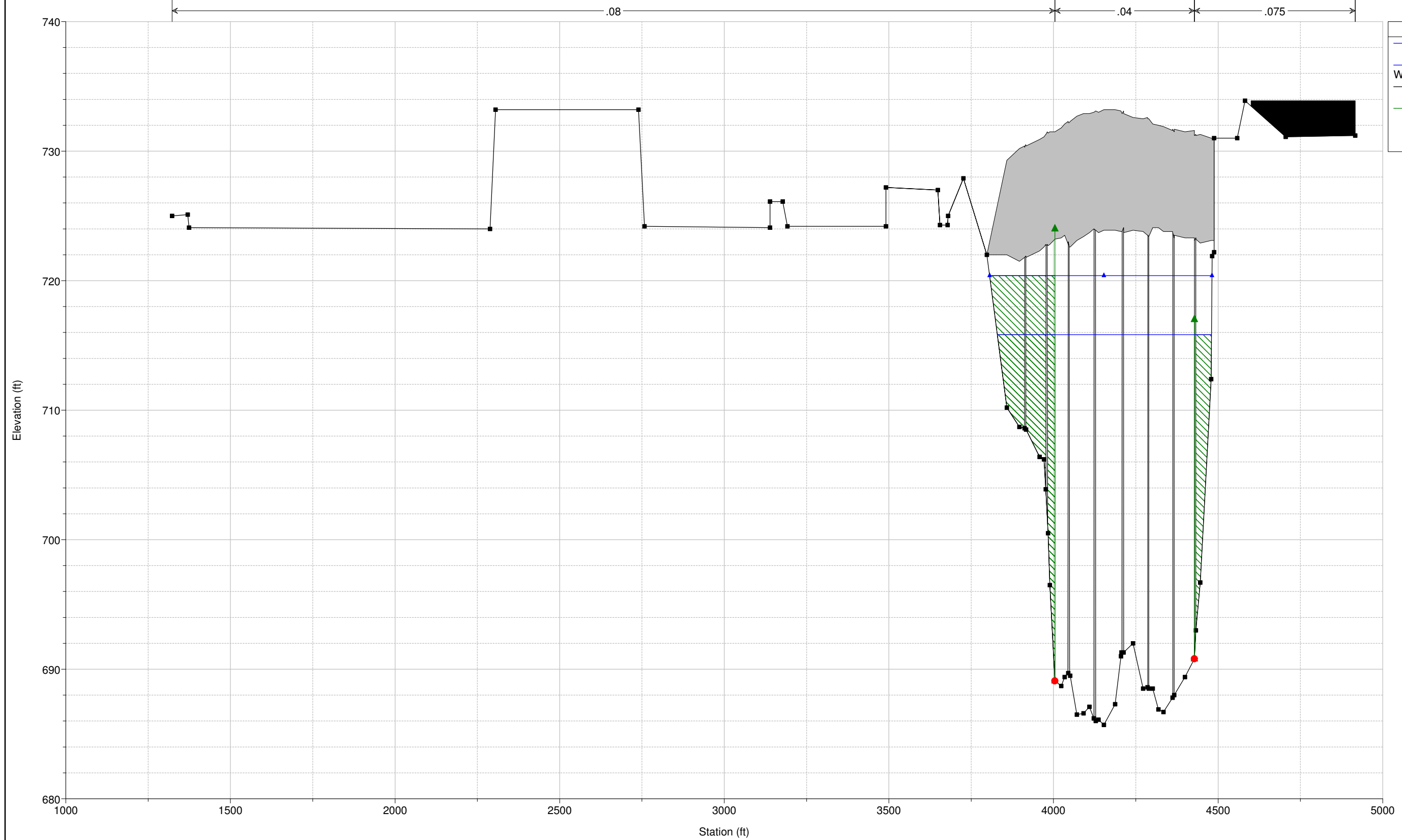
Sciotogreenways Plan: Duplicate_Effective
RS = 246.4



Legend

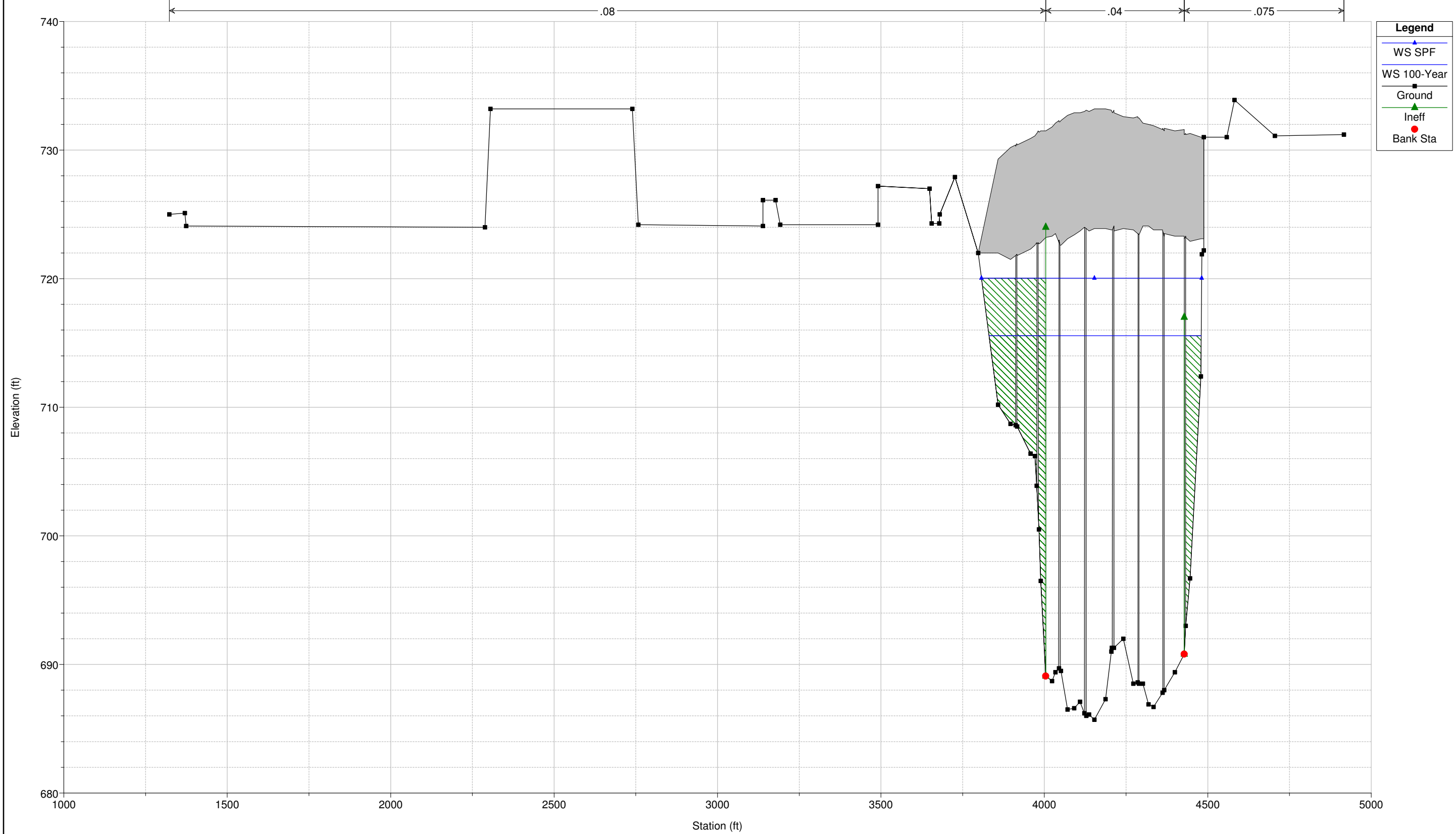
- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

Sciotogreenways Plan: Duplicate_Effective
RS = 246.3 BR

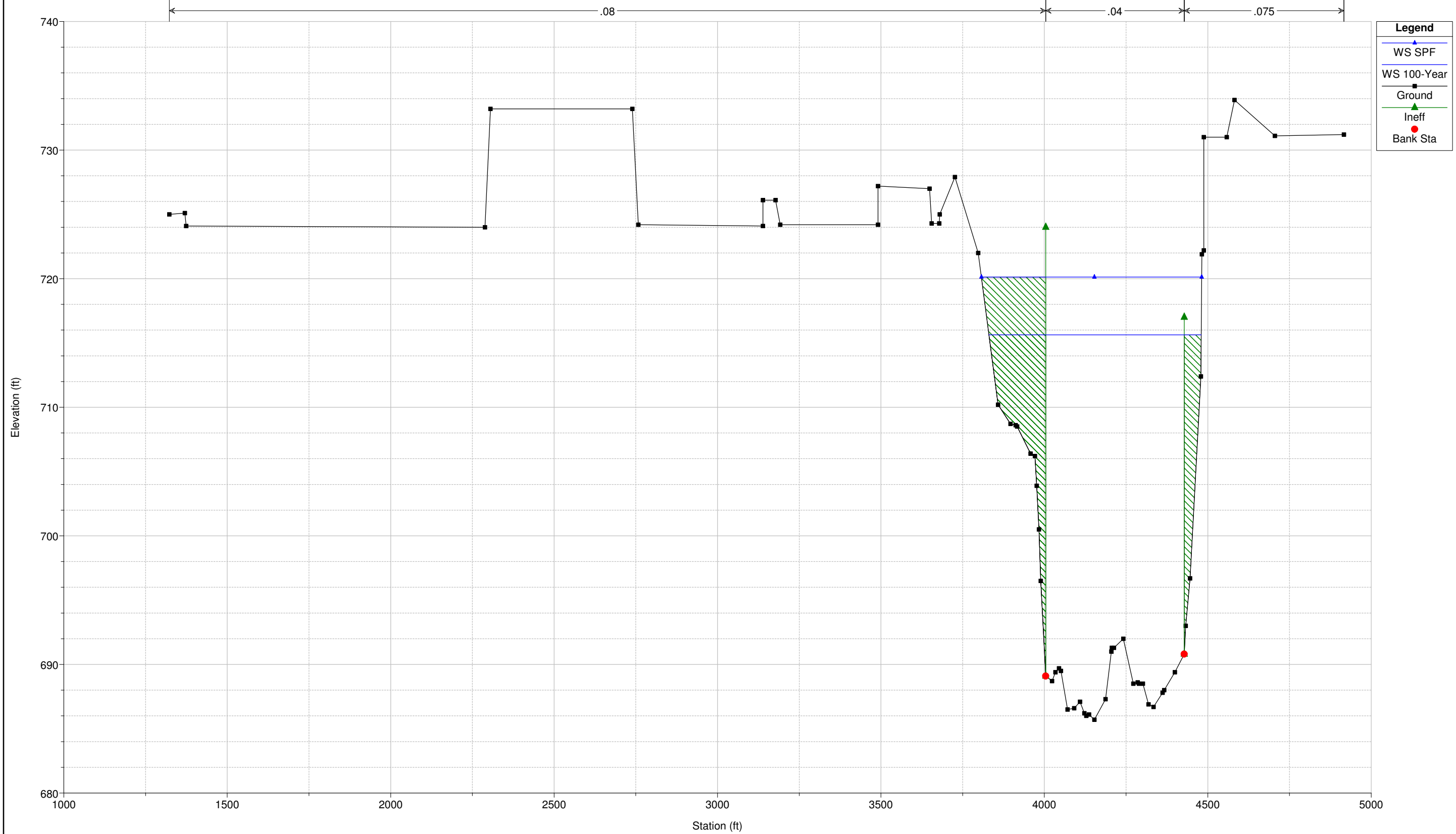


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

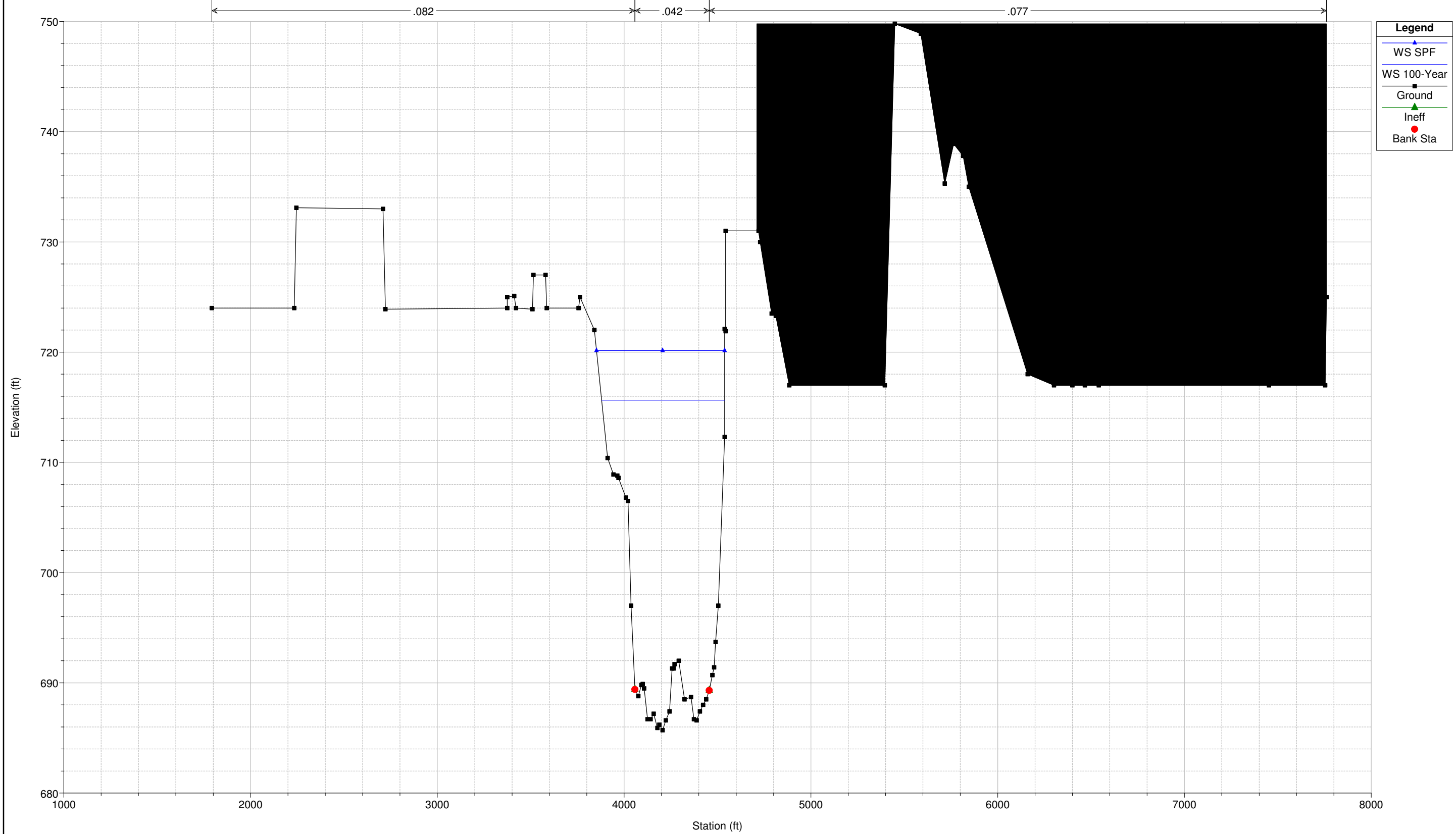
Sciotogreenways Plan: Duplicate_Effective
RS = 246.3 BR



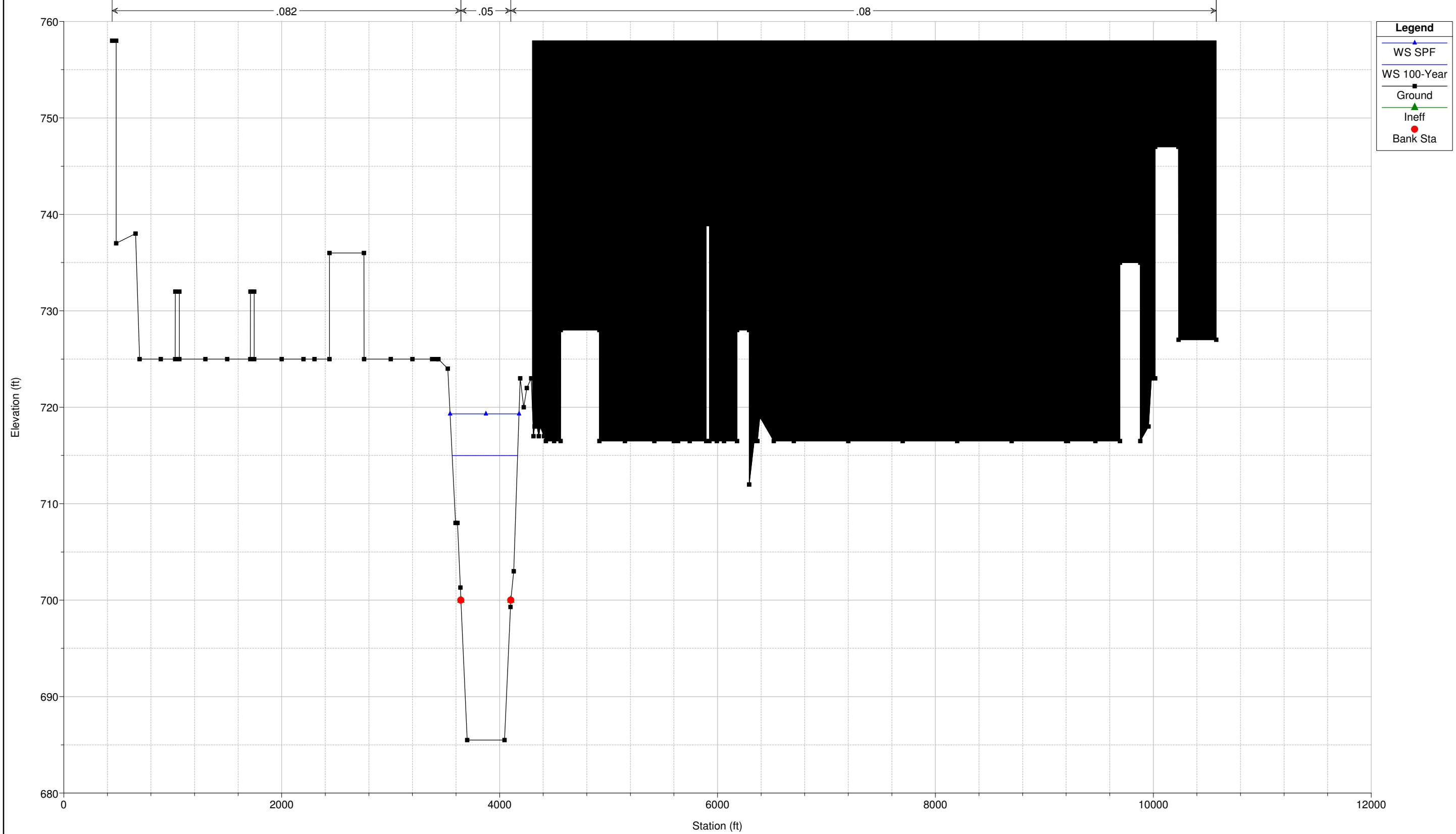
Sciotogreenways Plan: Duplicate_Effective
RS = 246.2



Sciotogreenways Plan: Duplicate_Effective
RS = 246.1

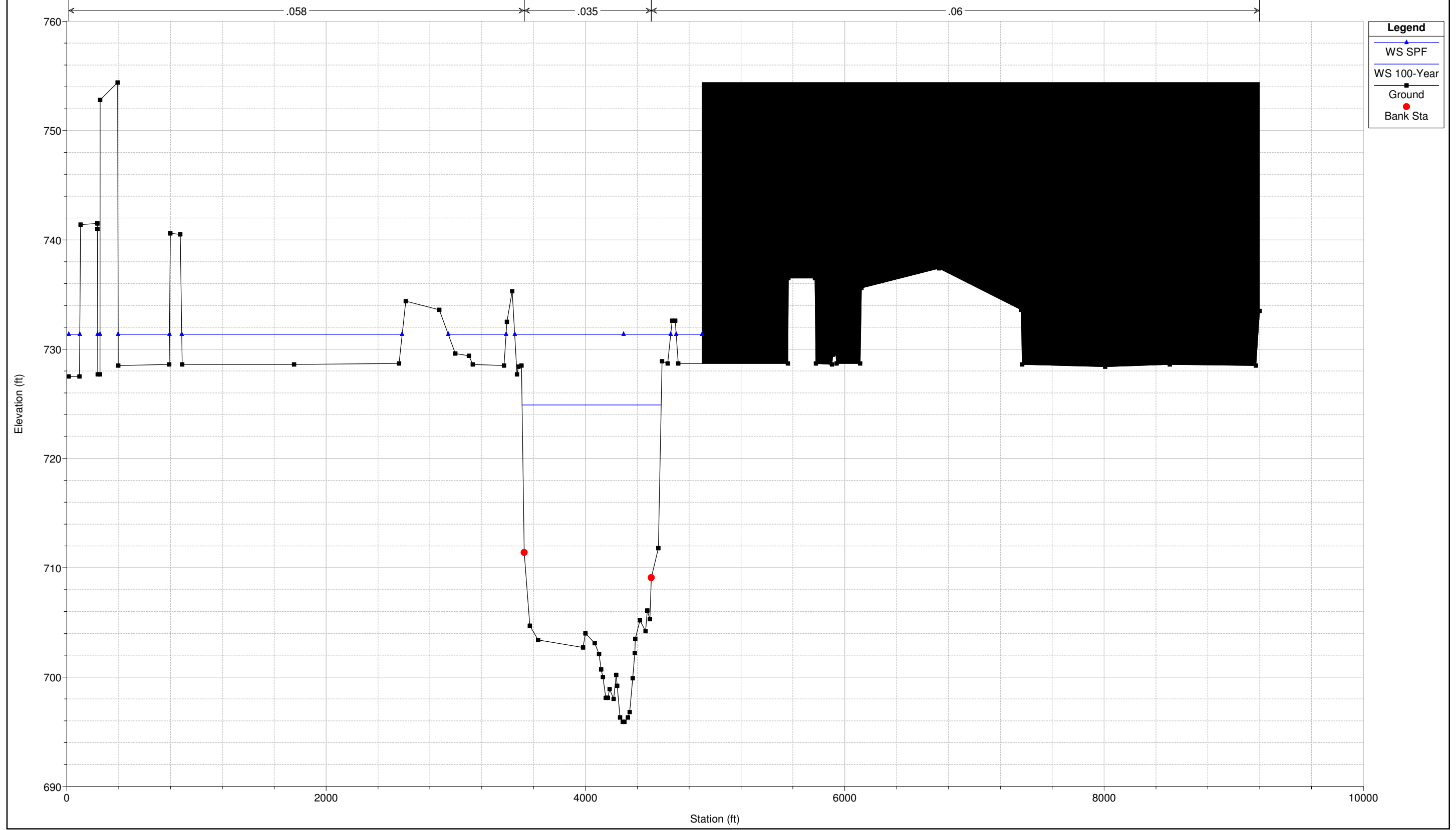


SciotoGreenways Plan: Duplicate_Effective
RS = 245



B4 – Corrected Effective / Pre-project Cross-sections

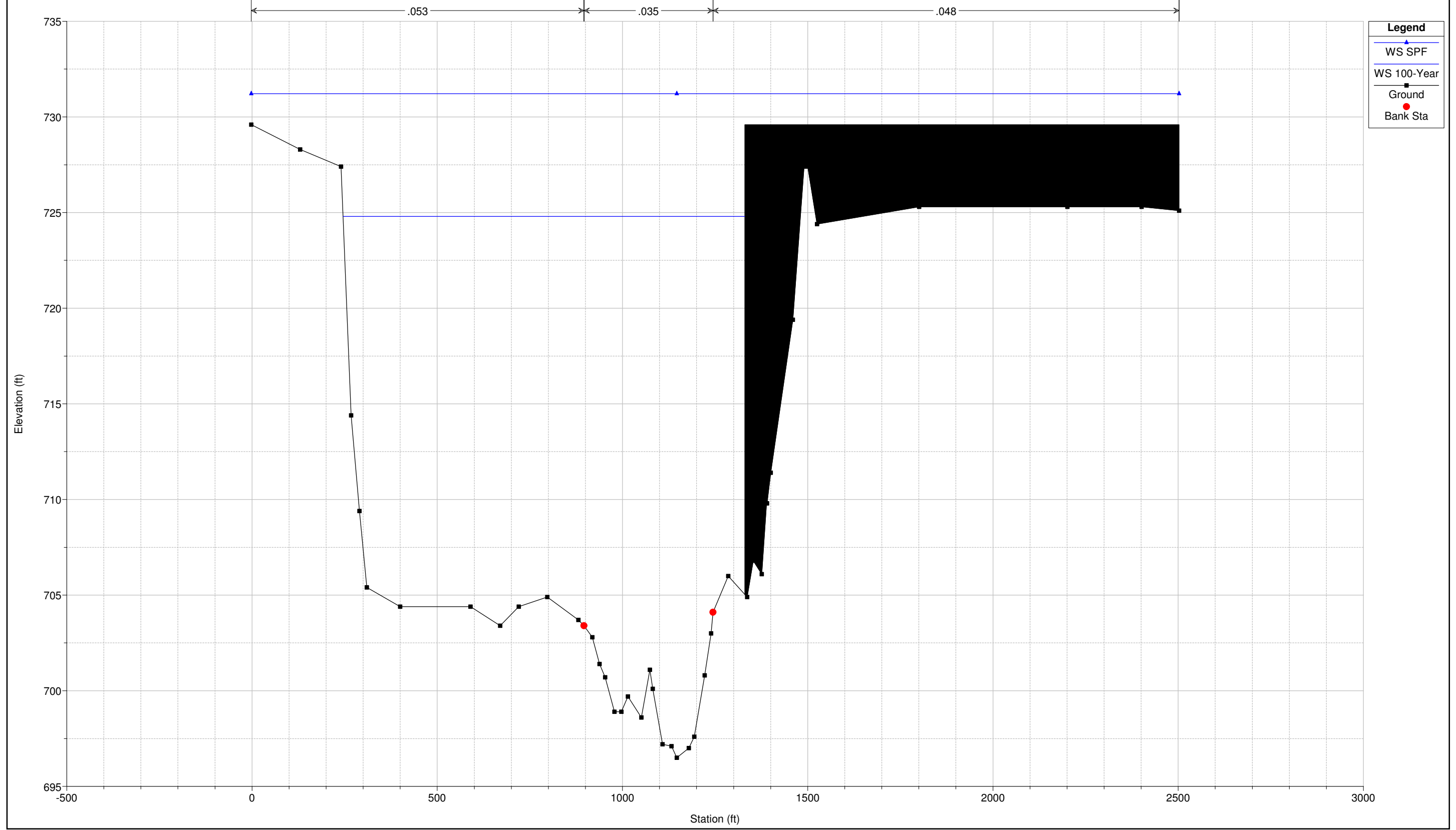
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 256.066



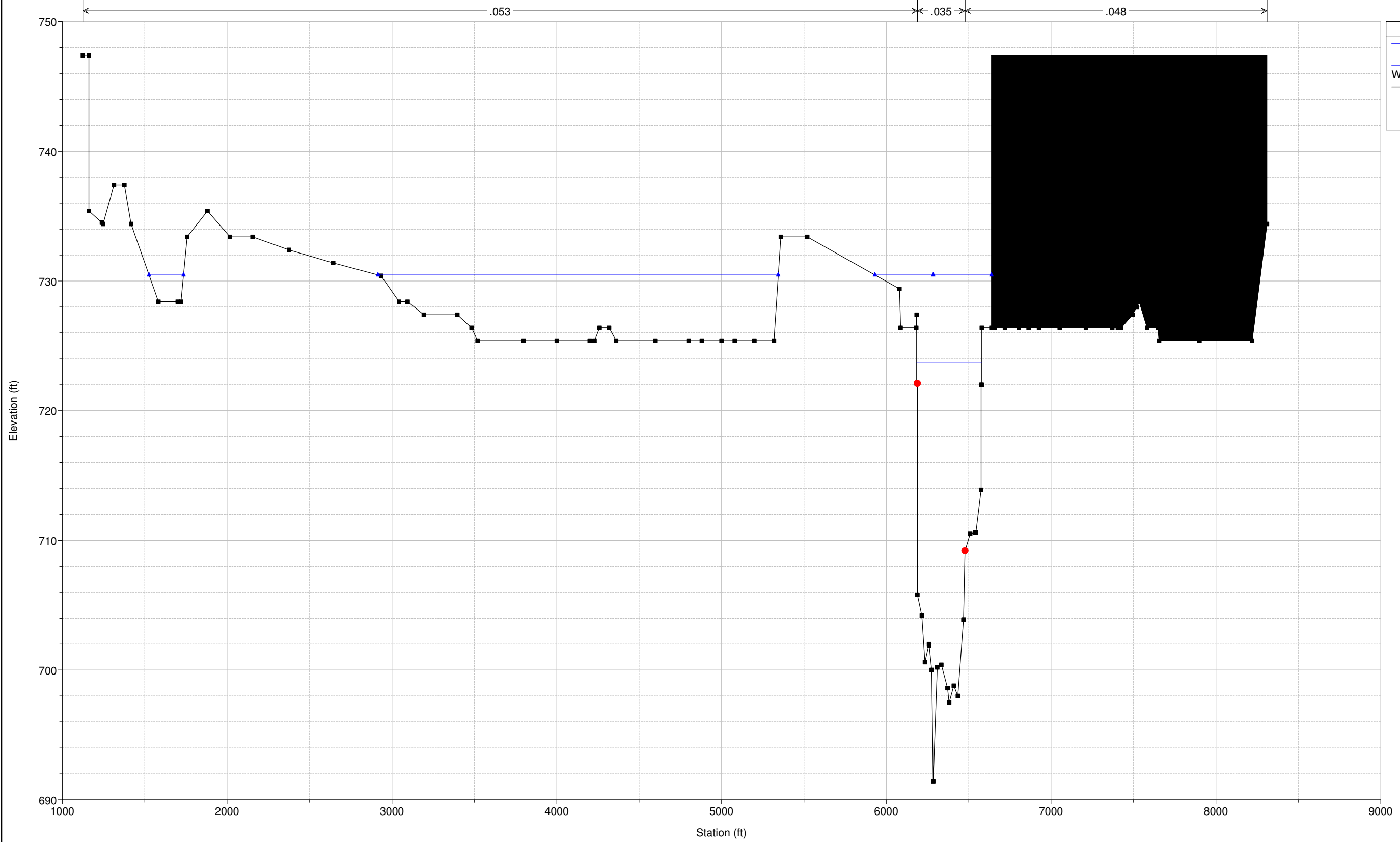
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 256



Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.96



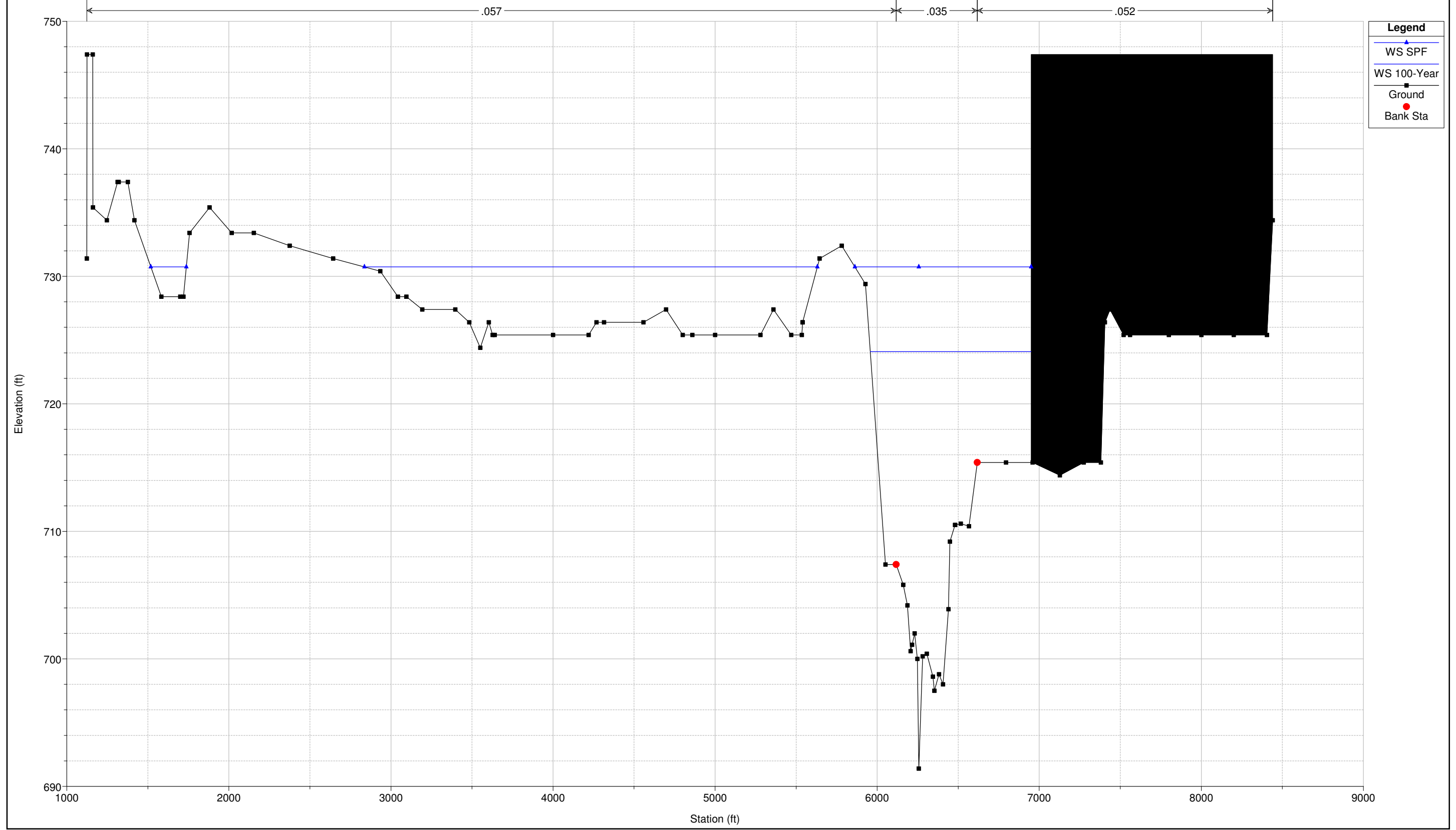
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.95



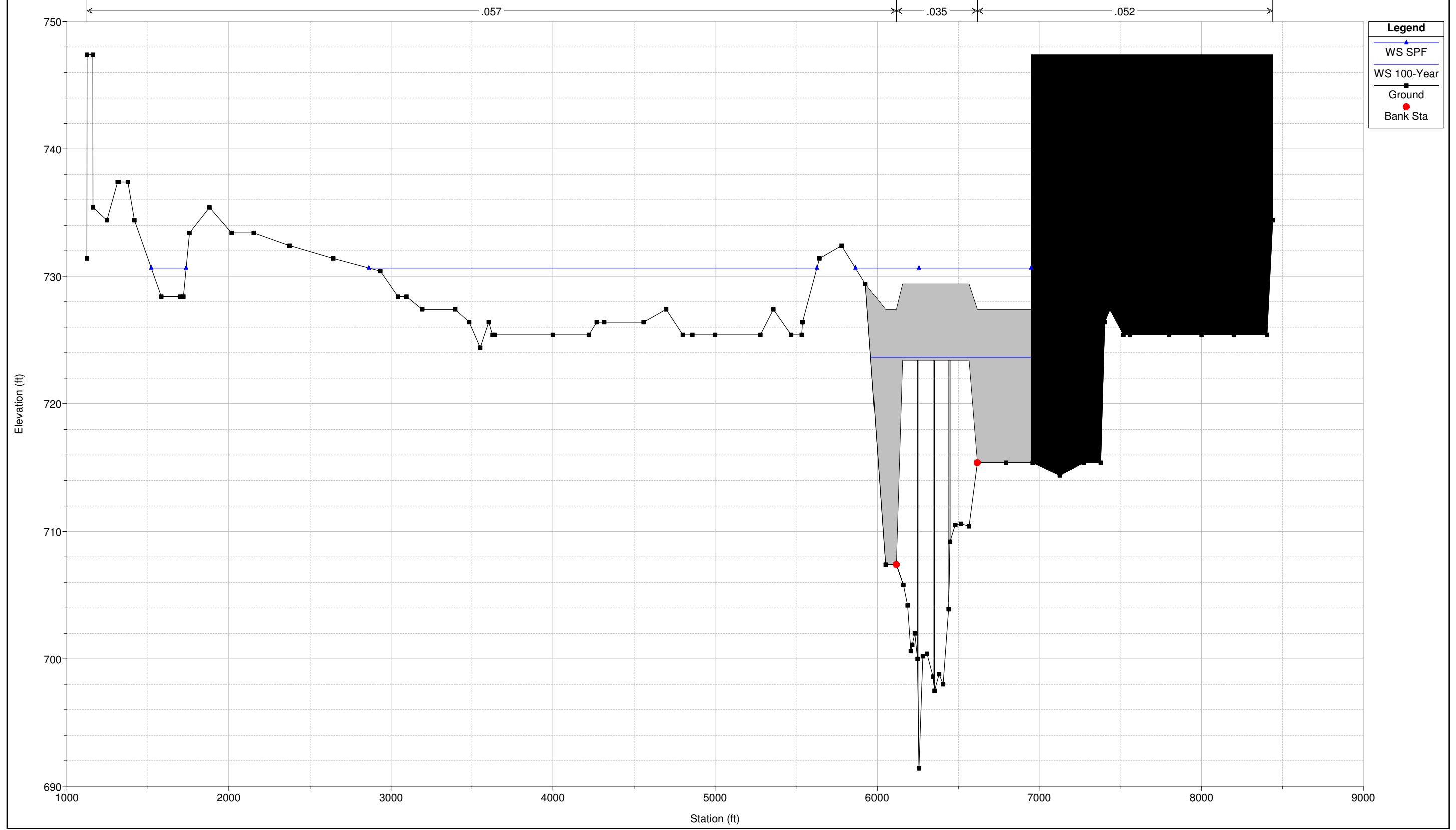
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

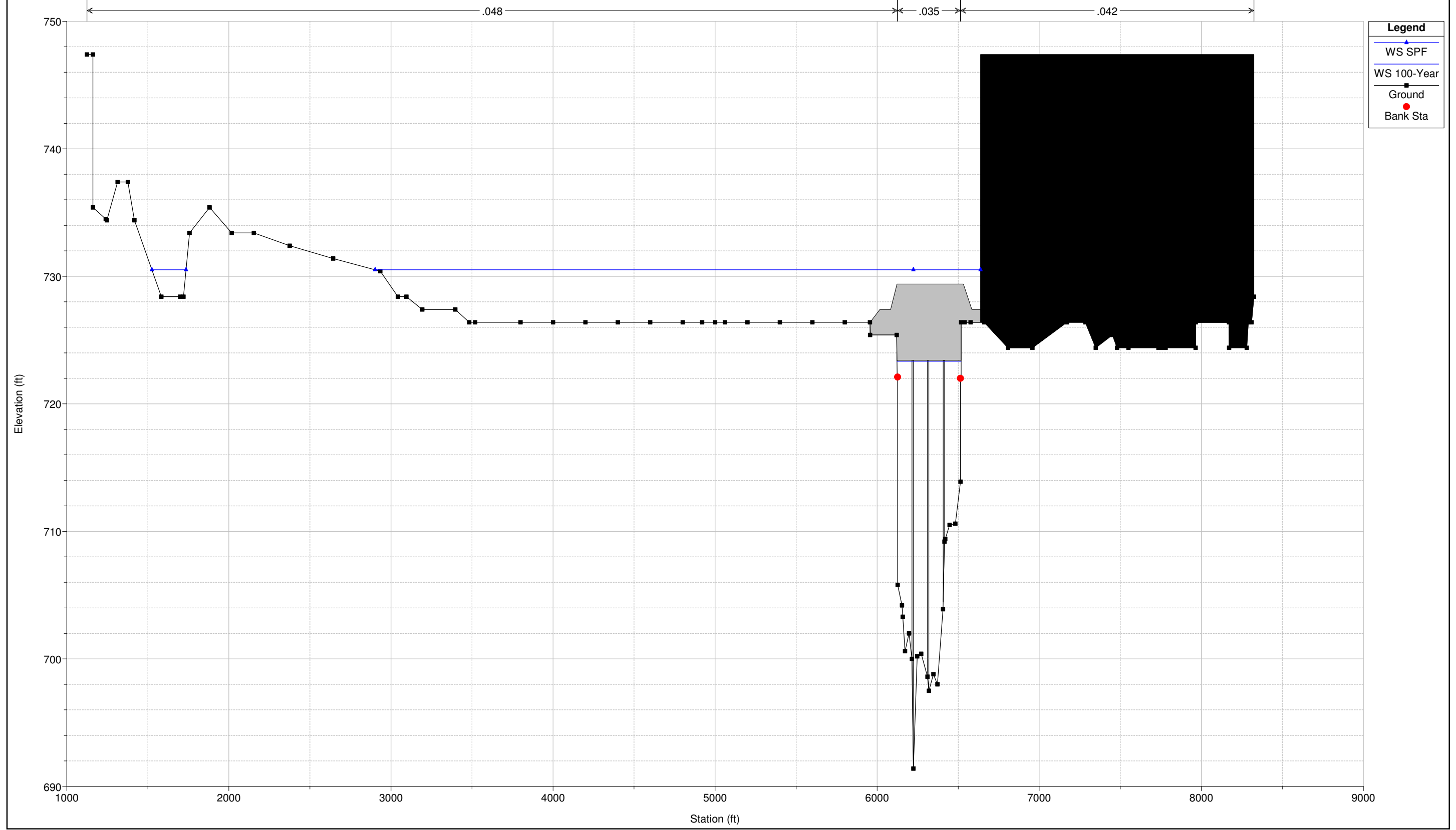
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.94



SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 255.93 BR



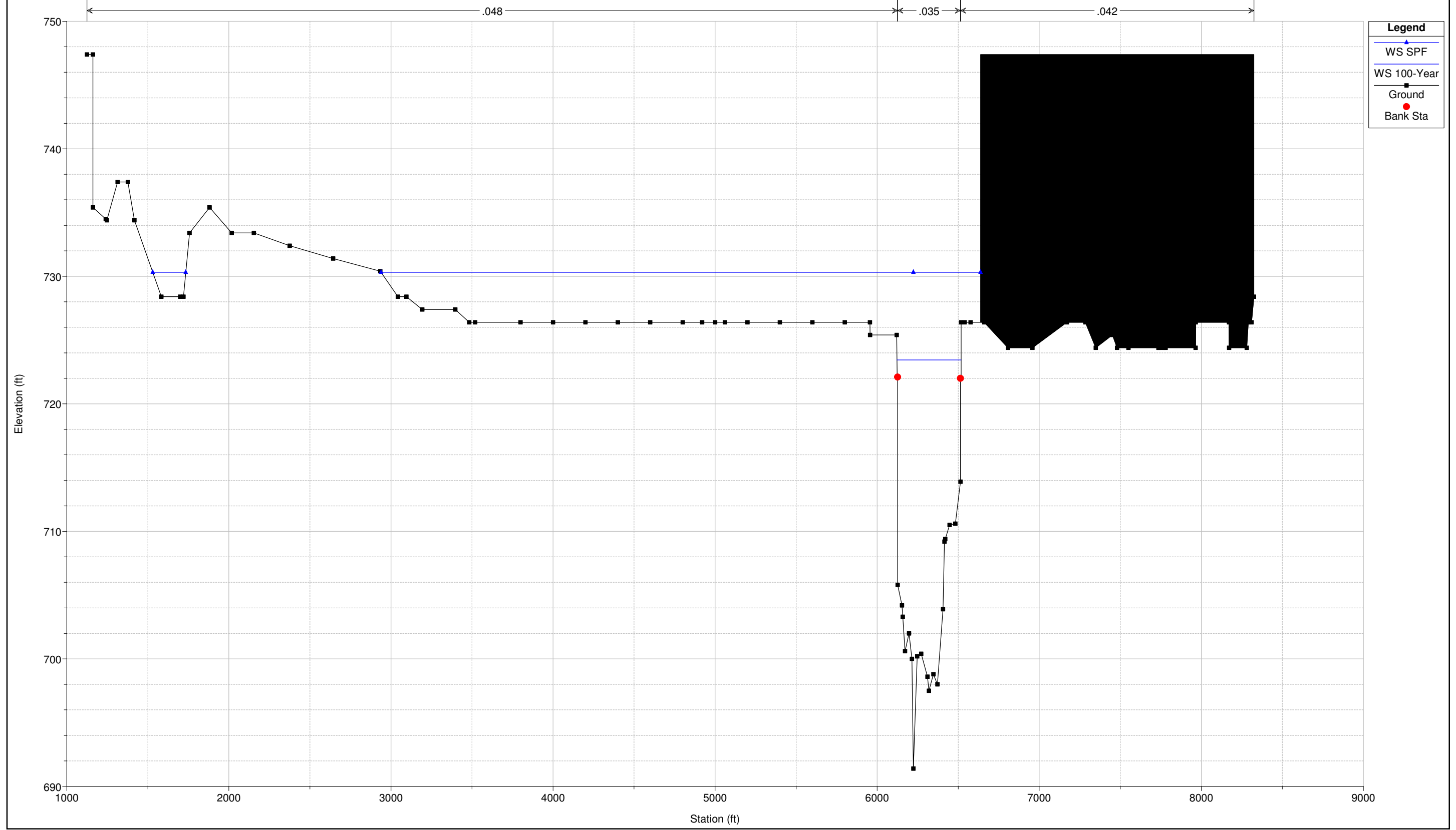
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.93 BR



Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line with triangle)
- Ground (Black line with square)
- Bank Sta (Red circle)

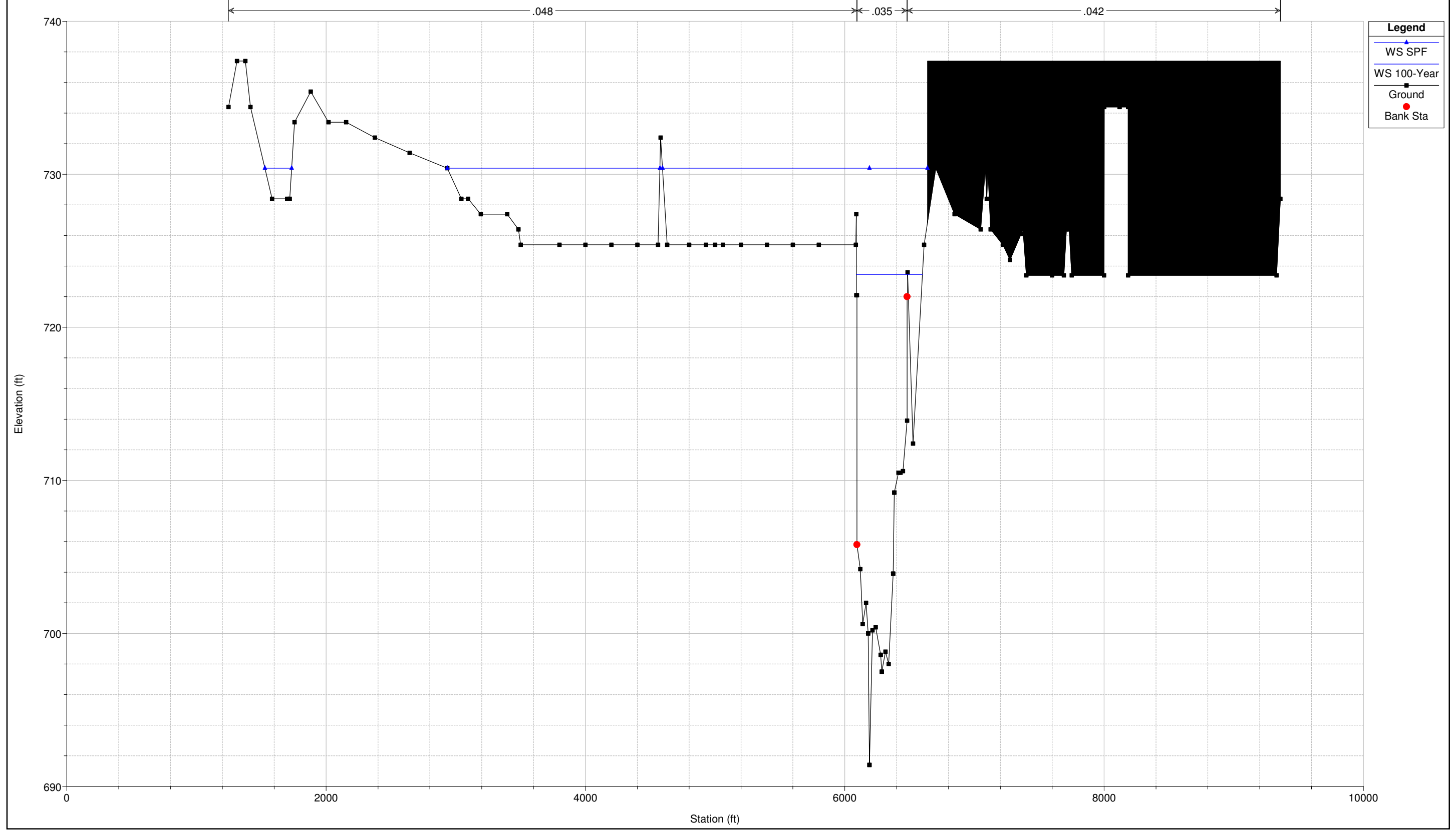
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.92



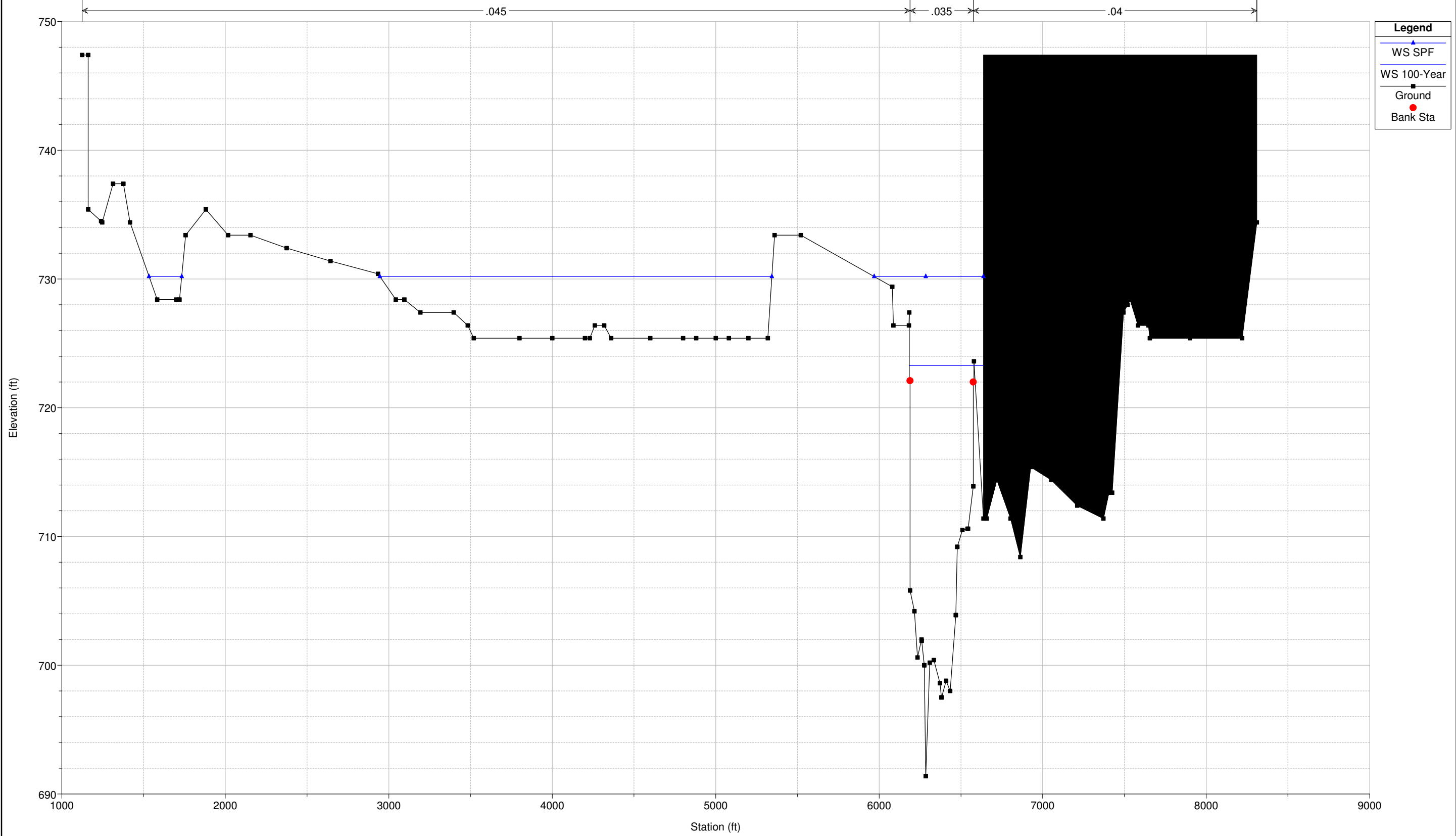
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

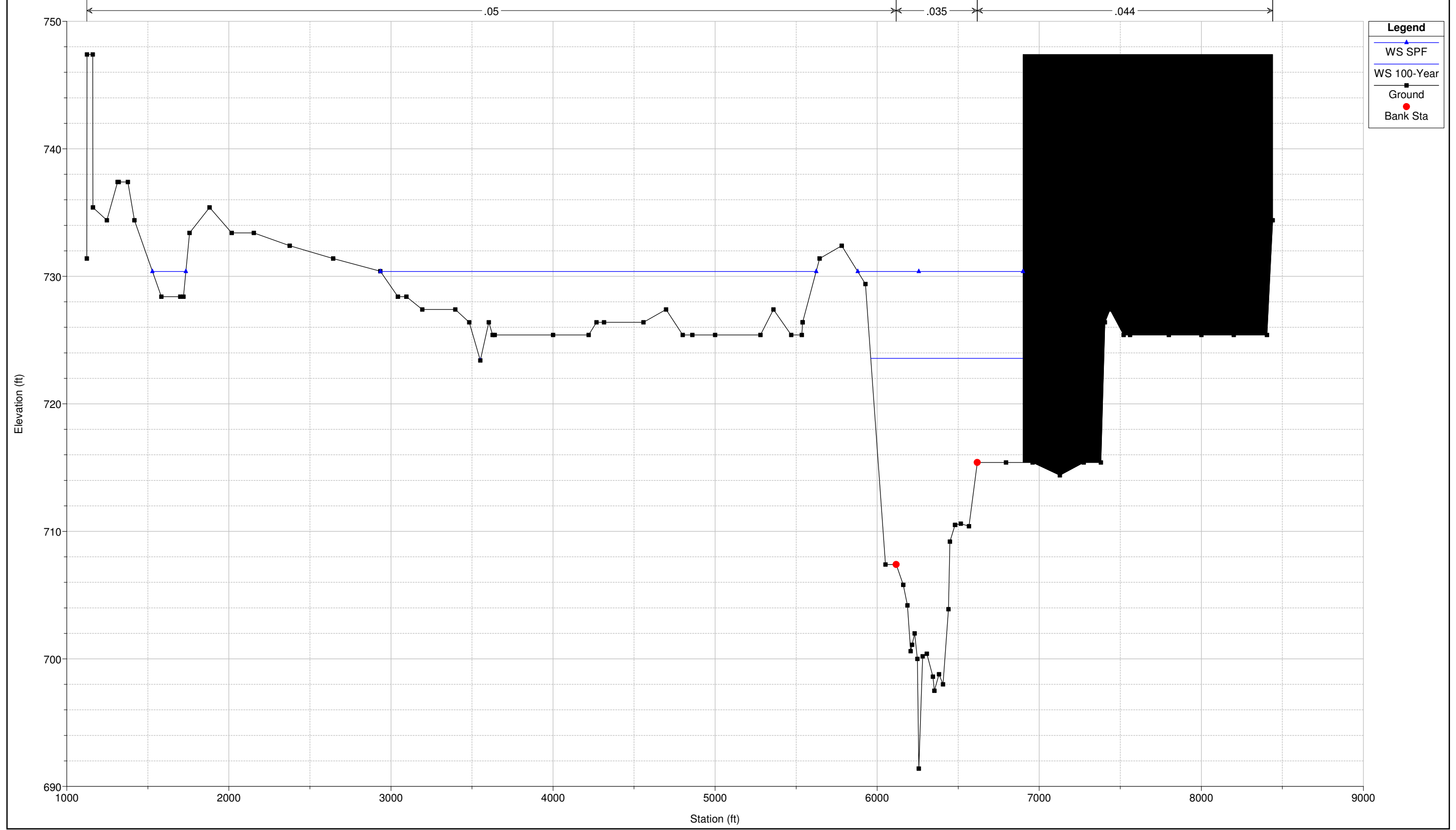
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.91



SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 255.9



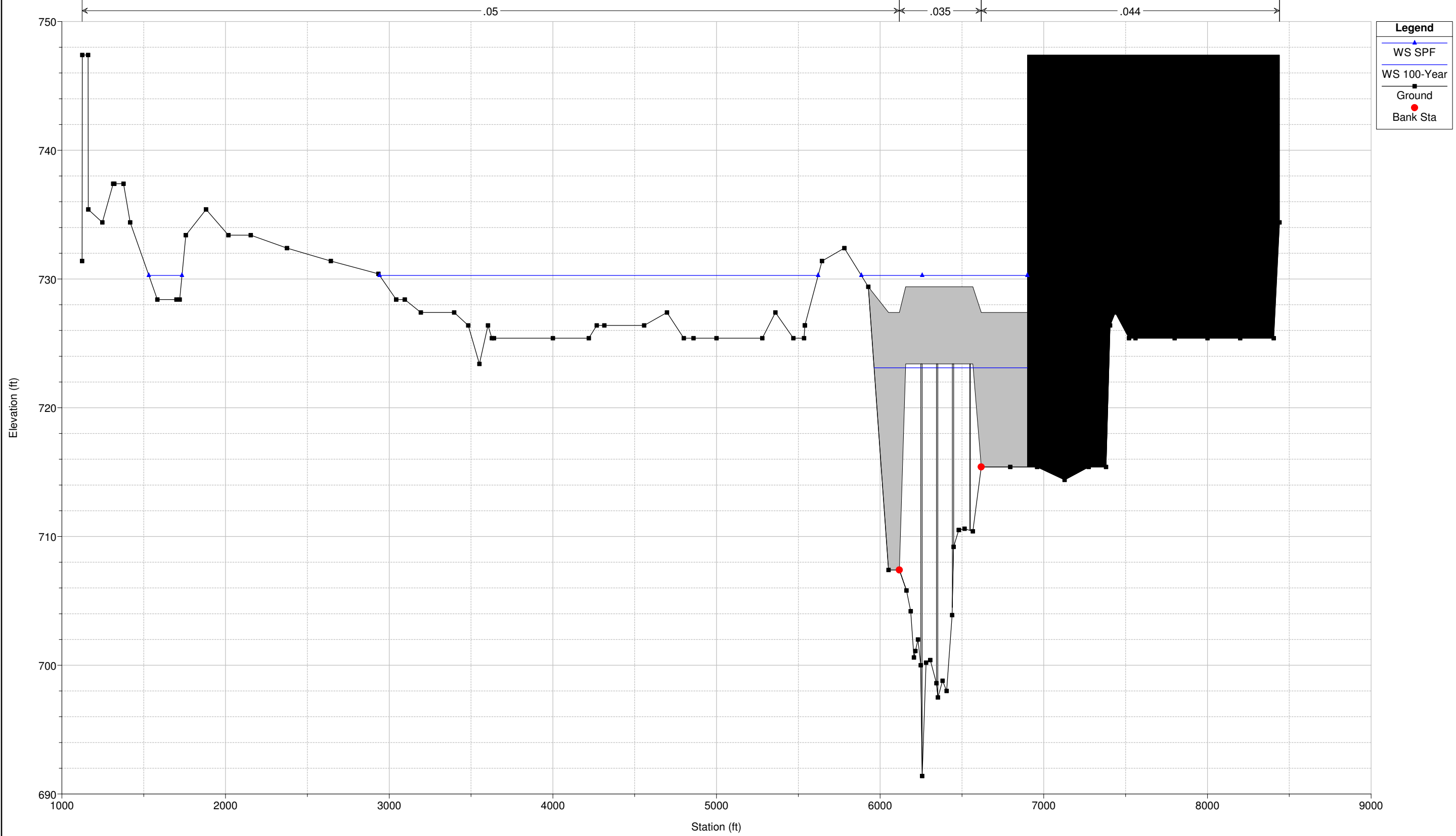
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 255.8



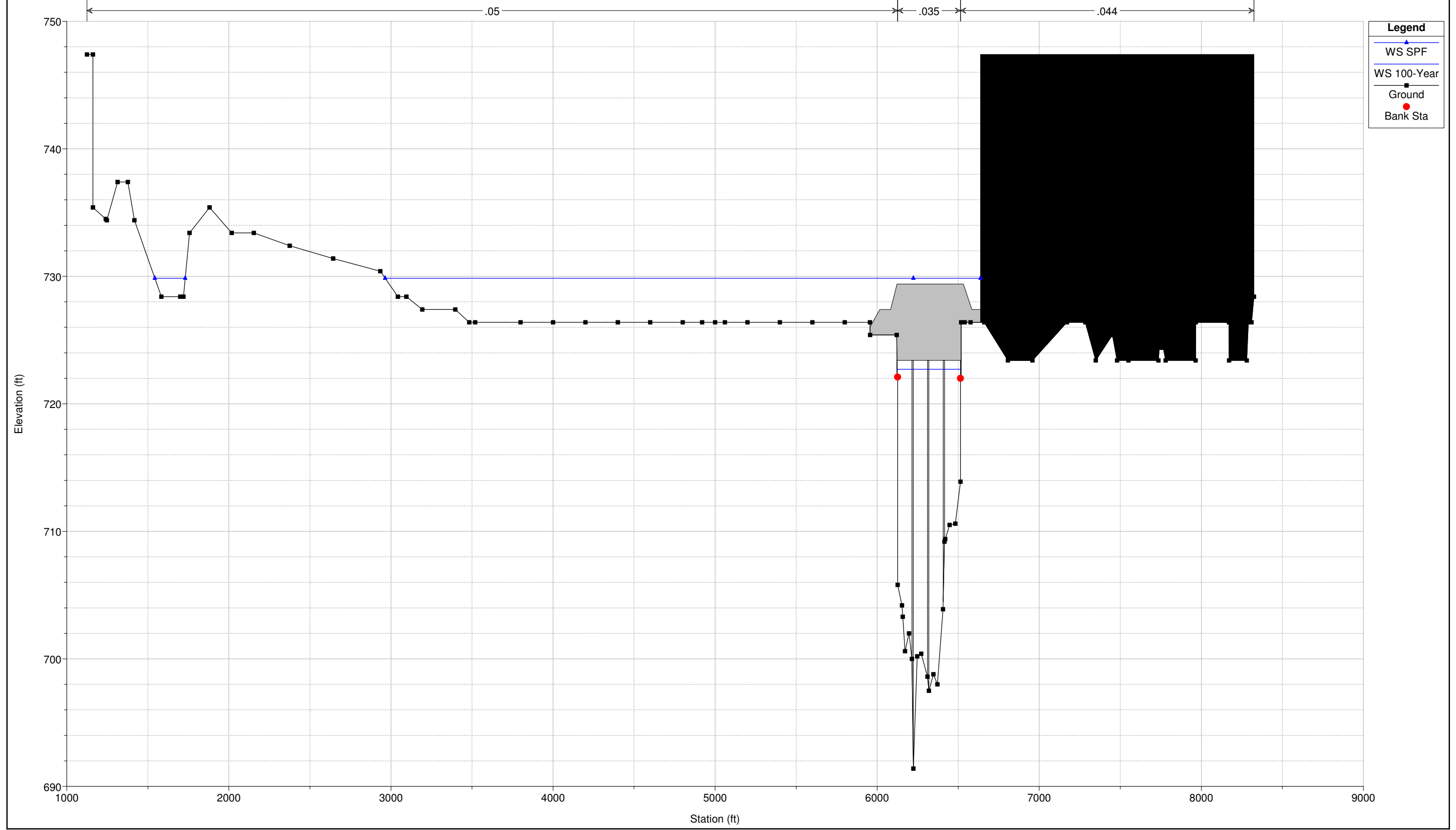
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.75 BR



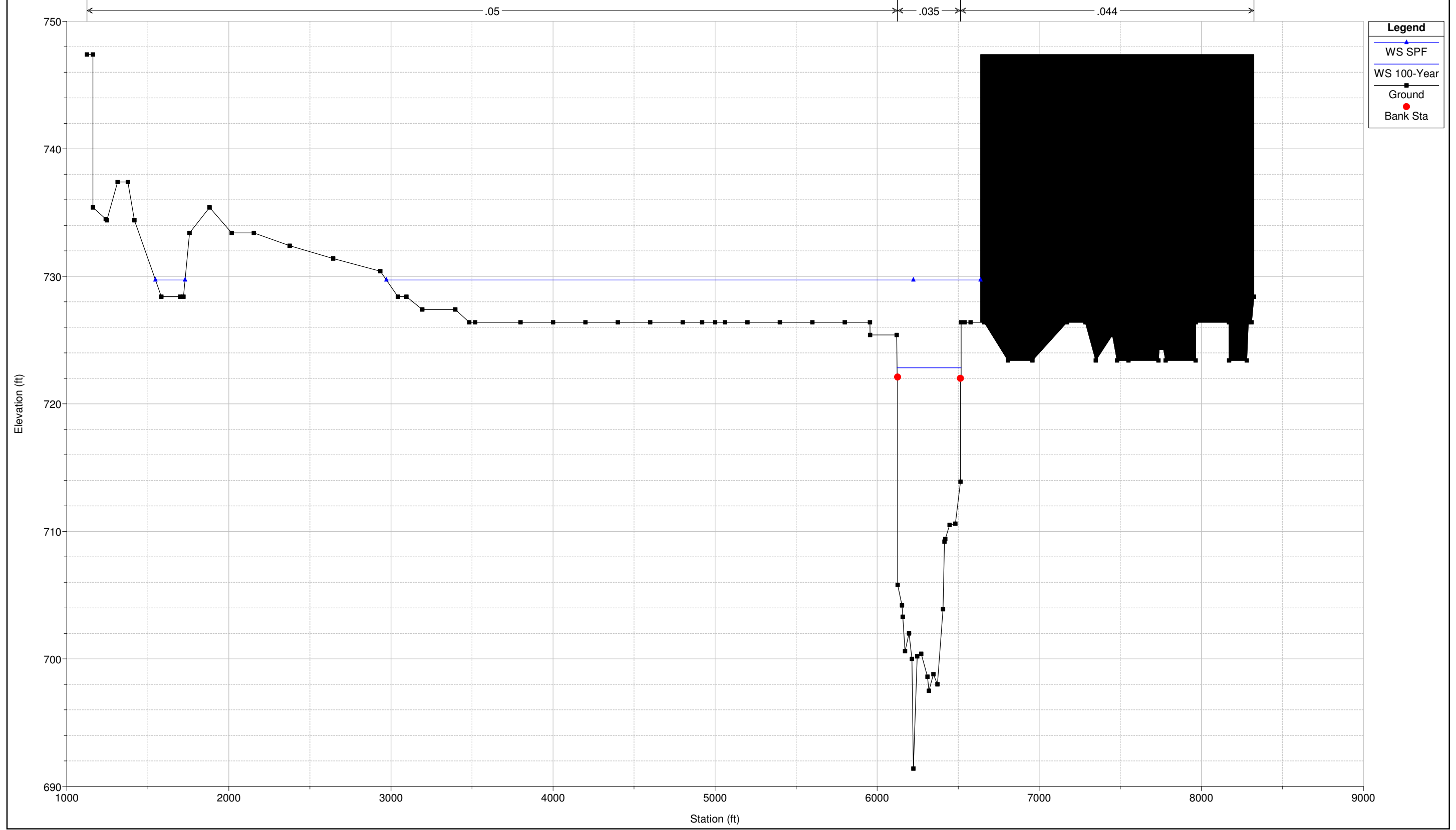
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.75 BR



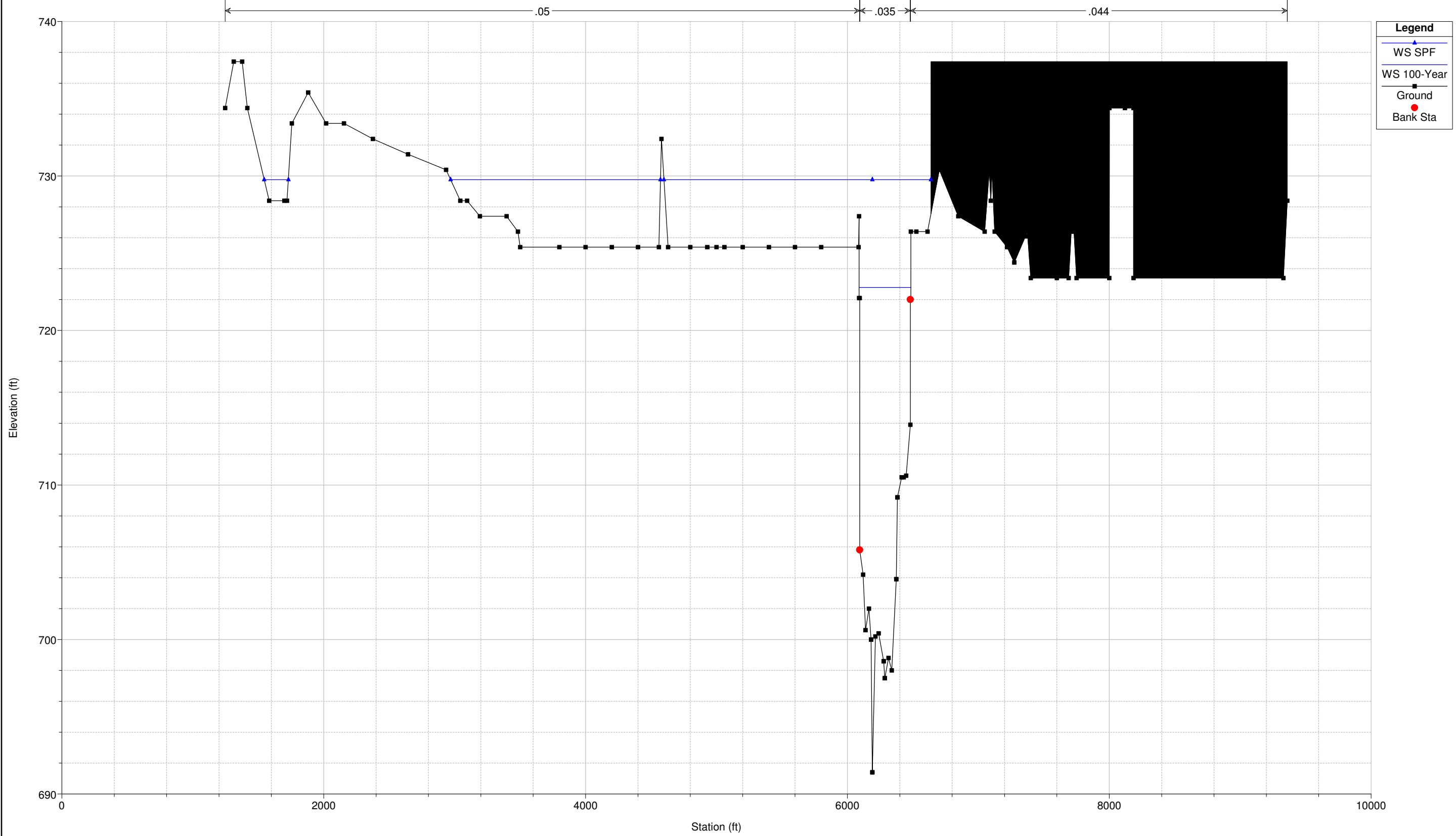
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

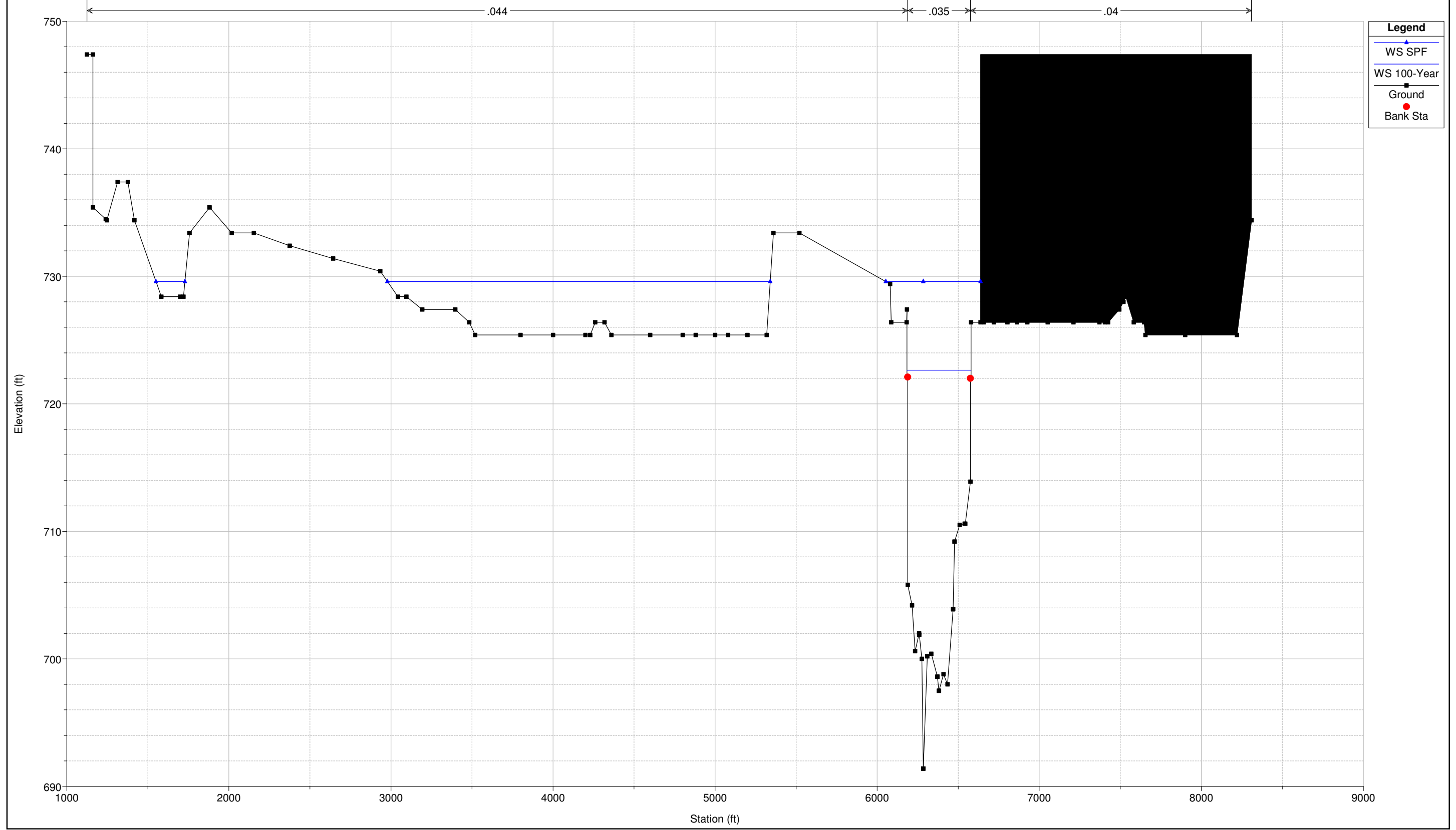
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.7



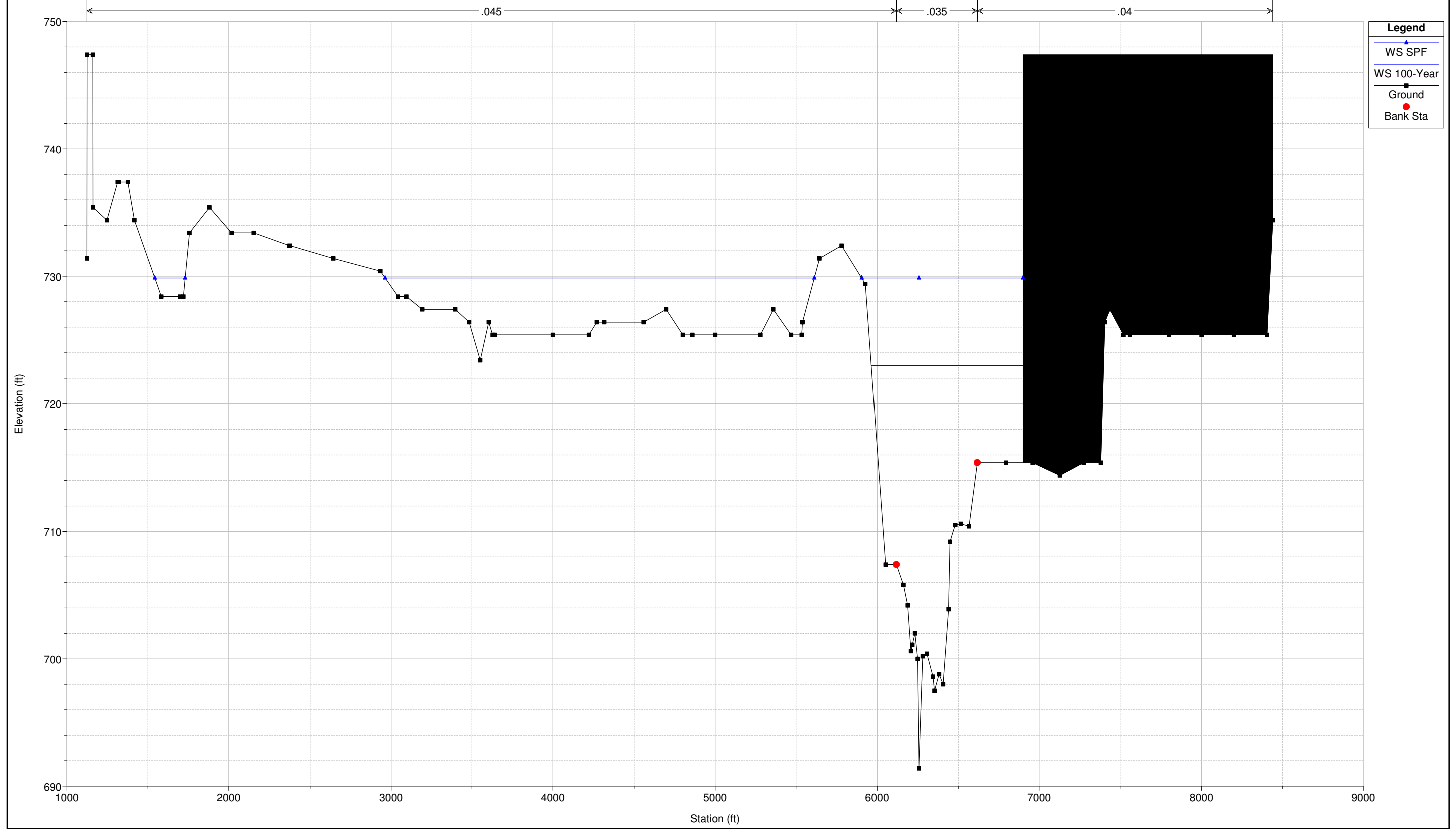
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.6



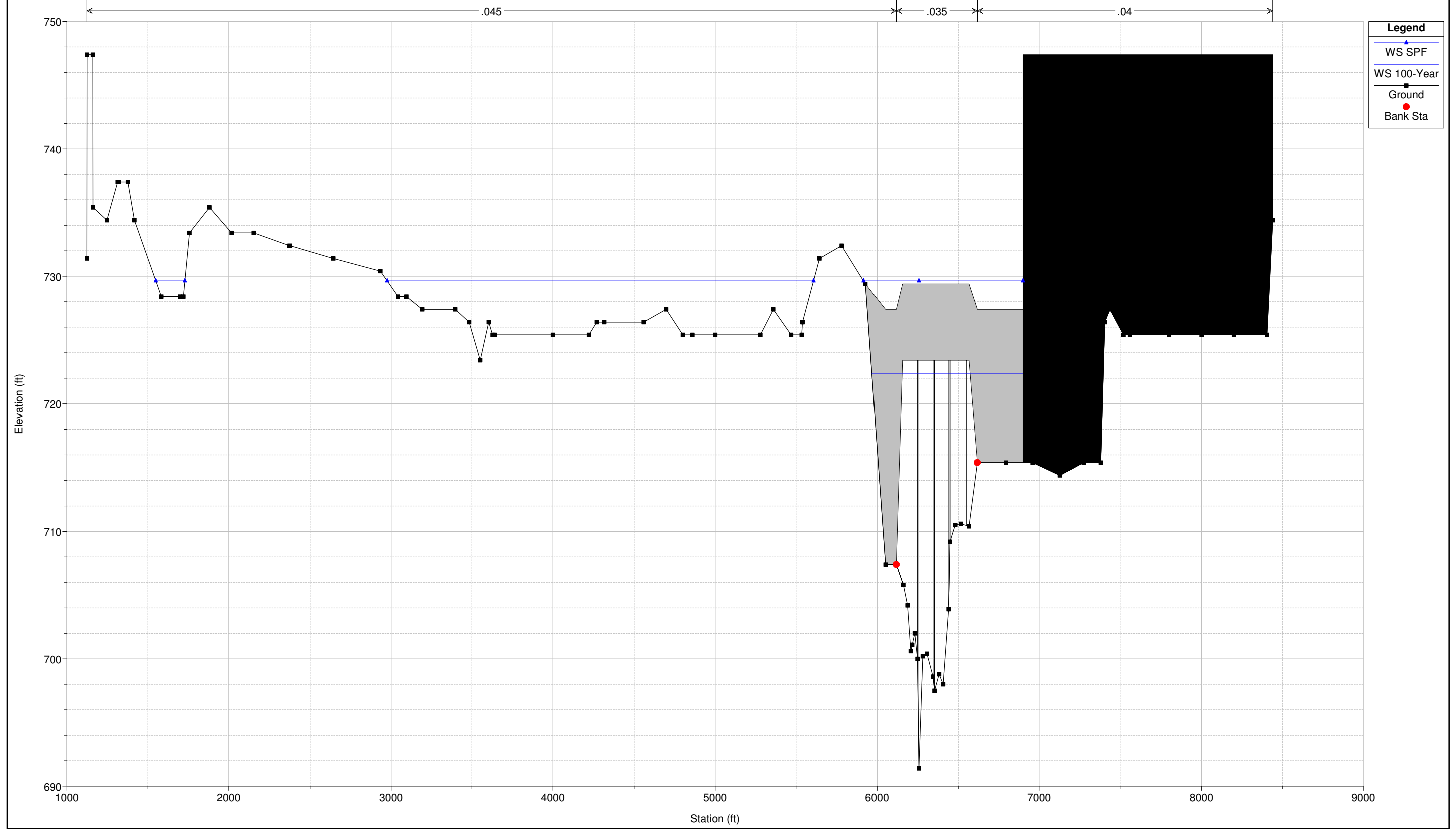
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 255.5



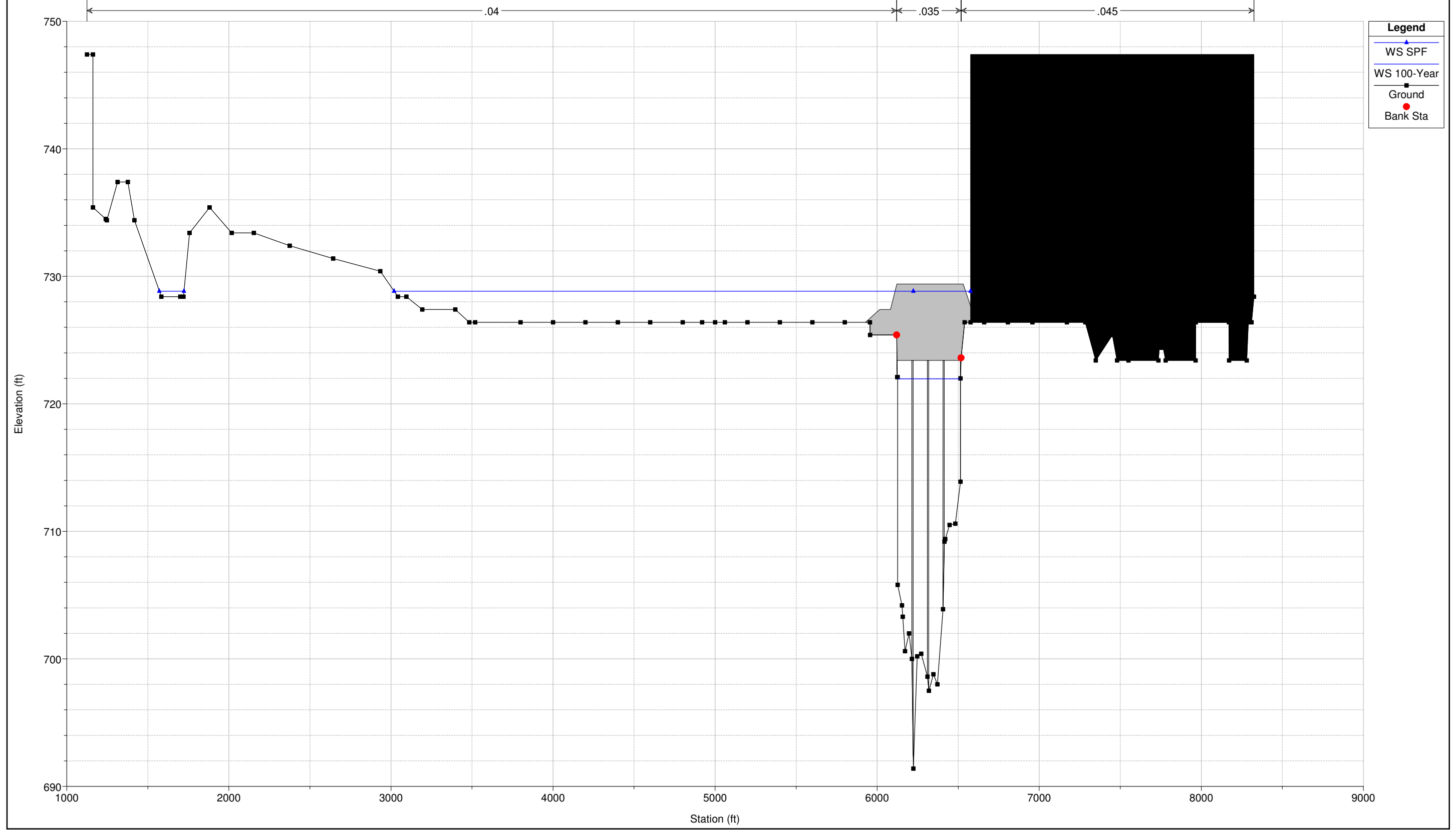
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.4



Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.3 BR



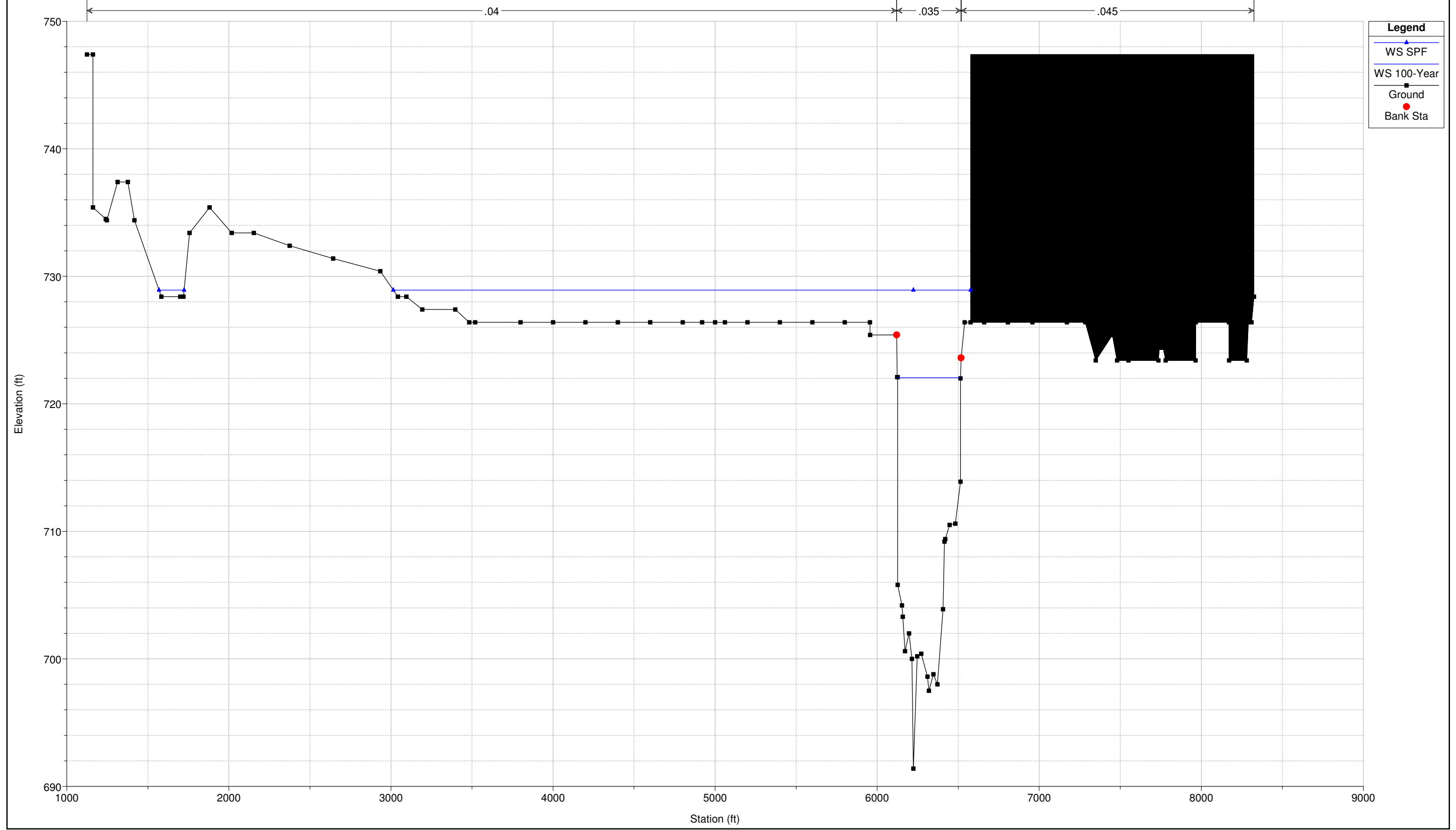
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.3 BR



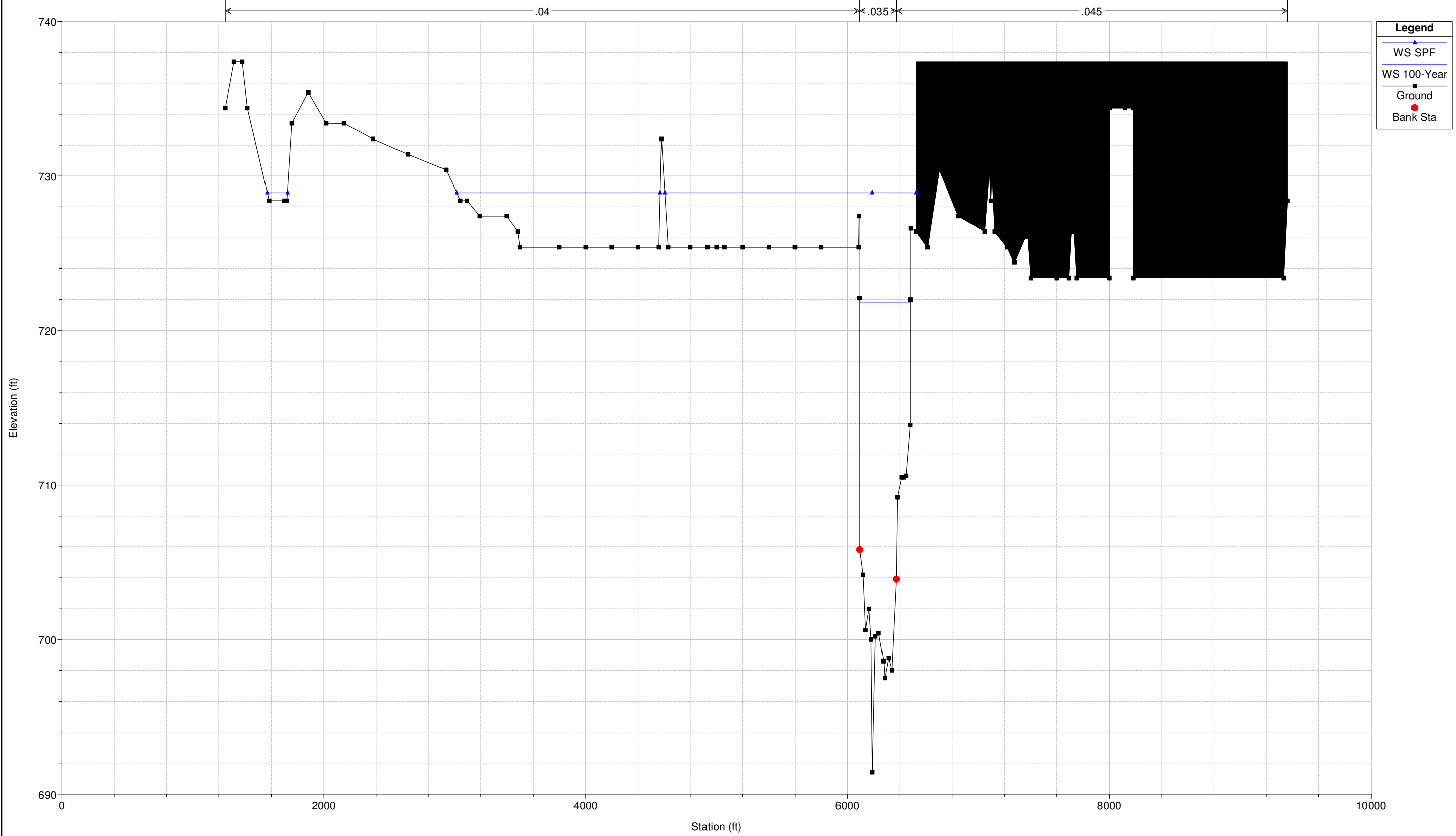
Legend

- WS SPF (Blue triangle)
- WS 100-Year (Blue line)
- Ground (Black square)
- Bank Sta (Red circle)

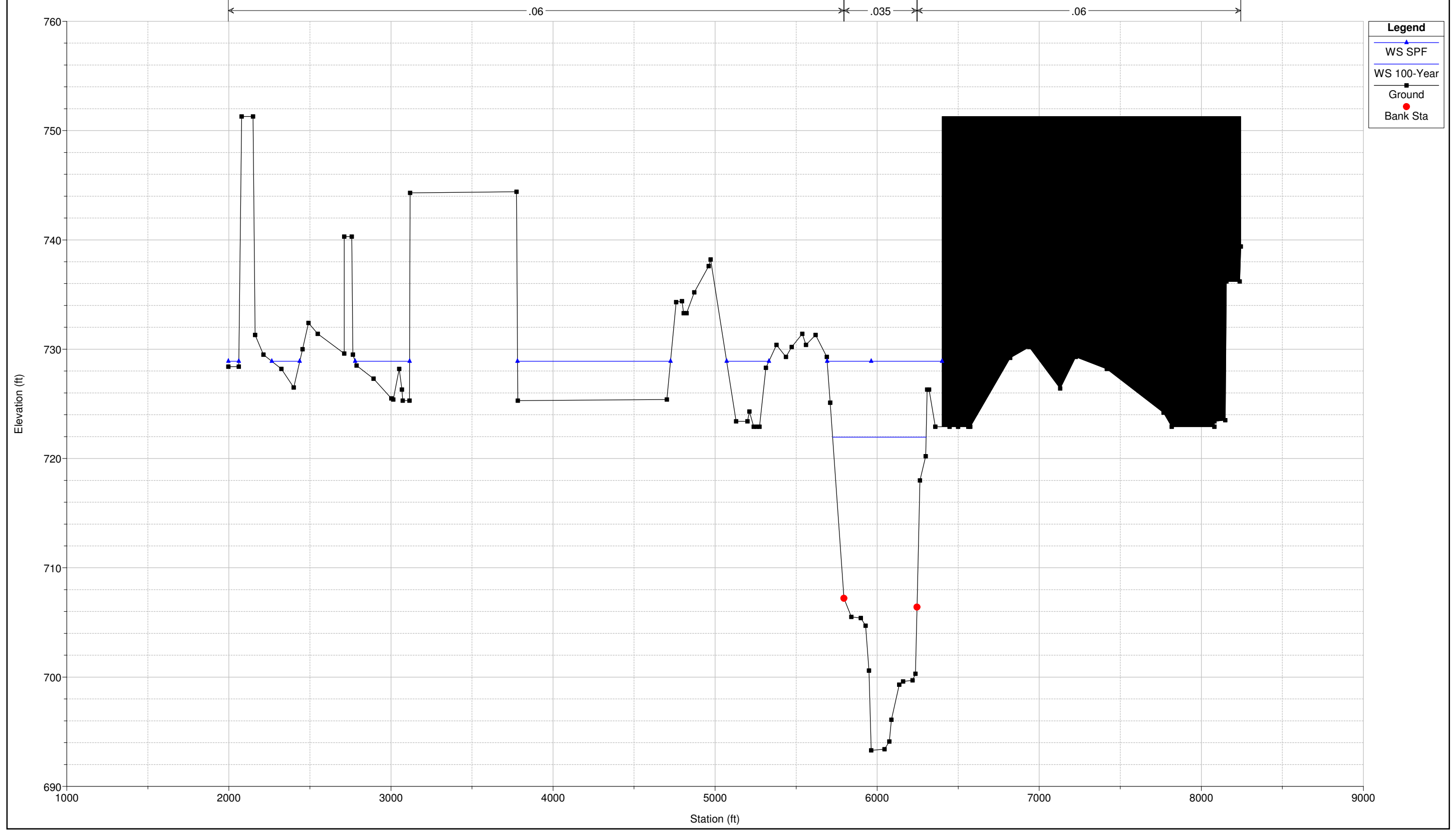
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.2



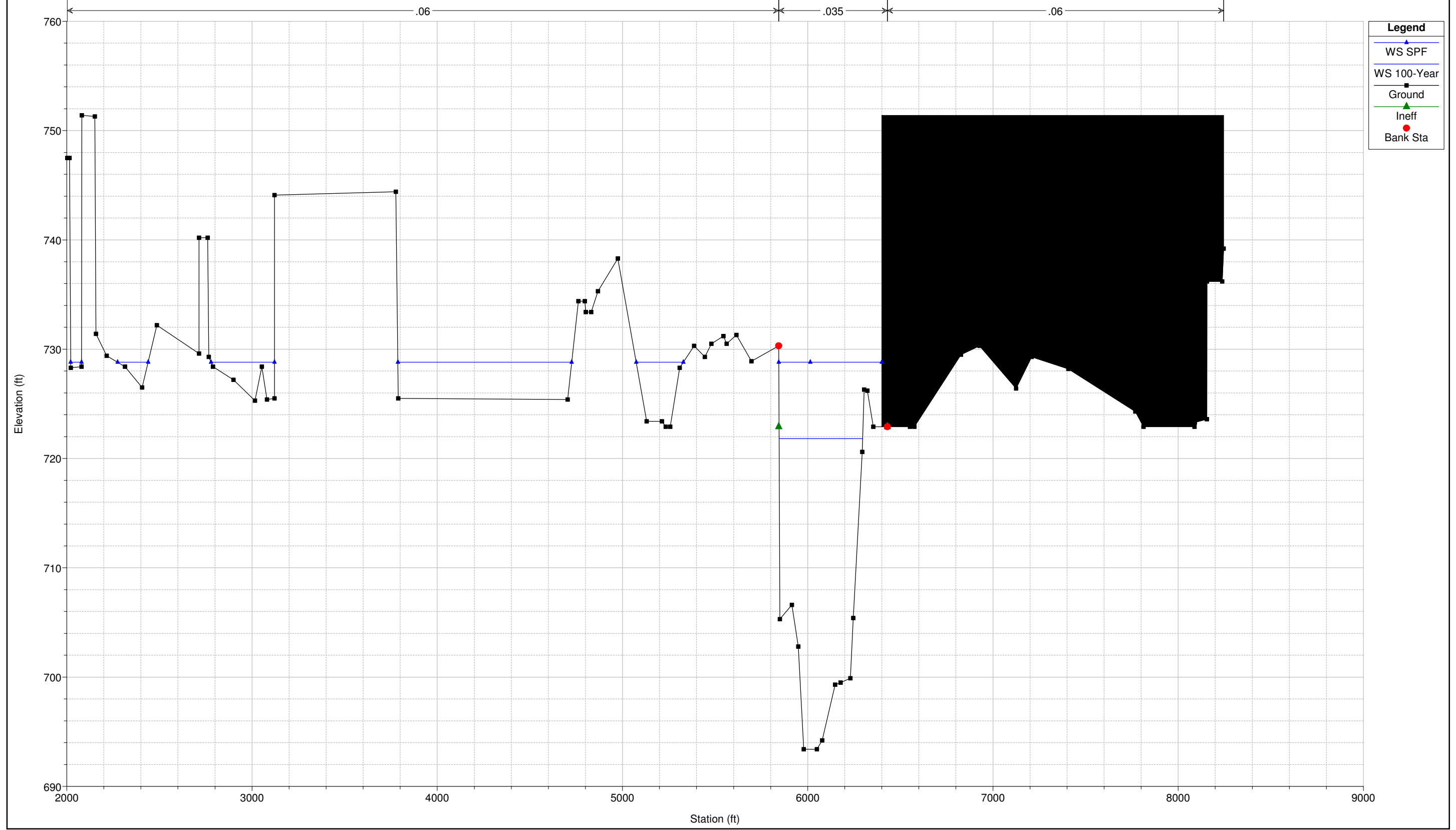
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 255.1



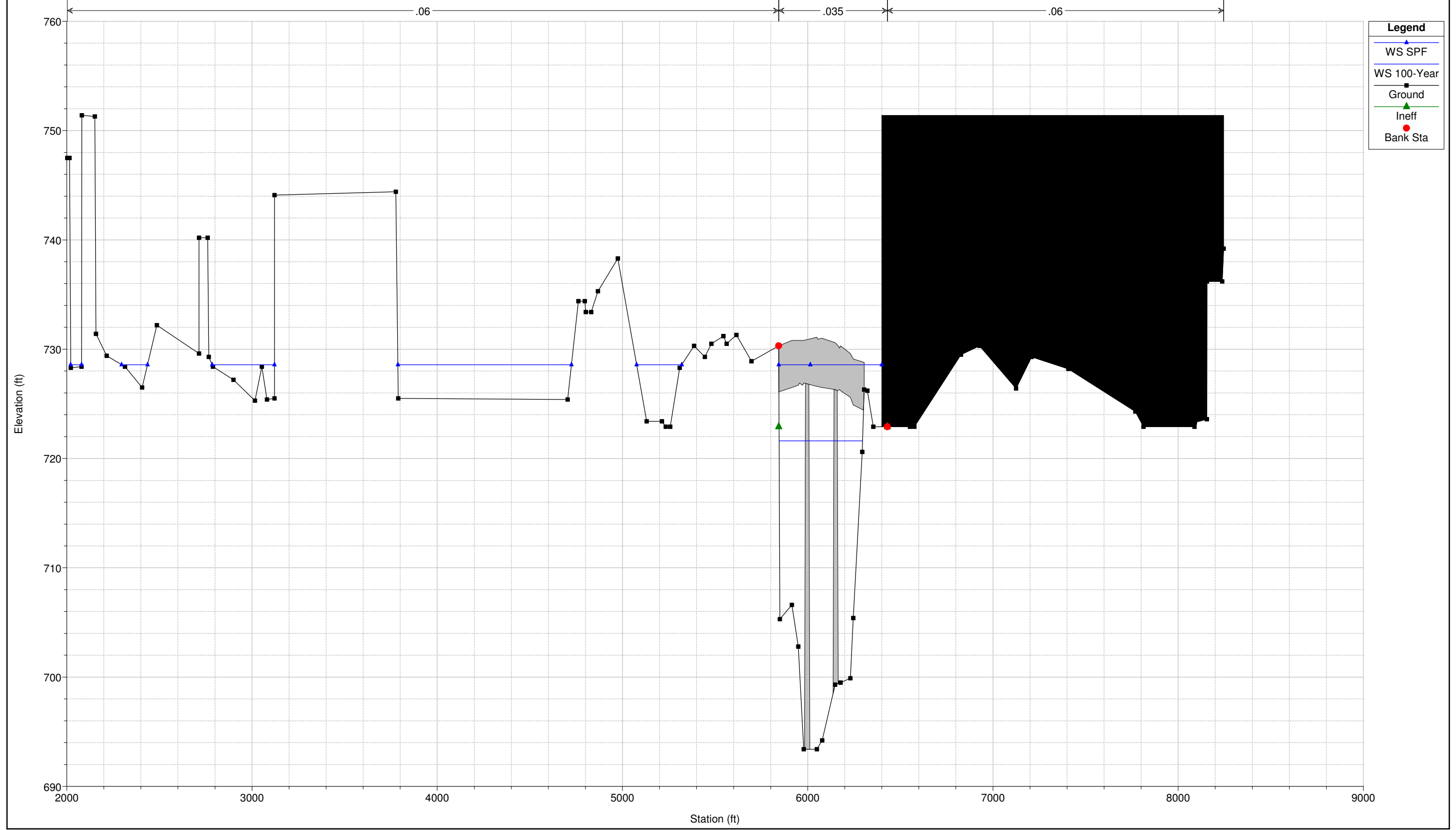
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.95



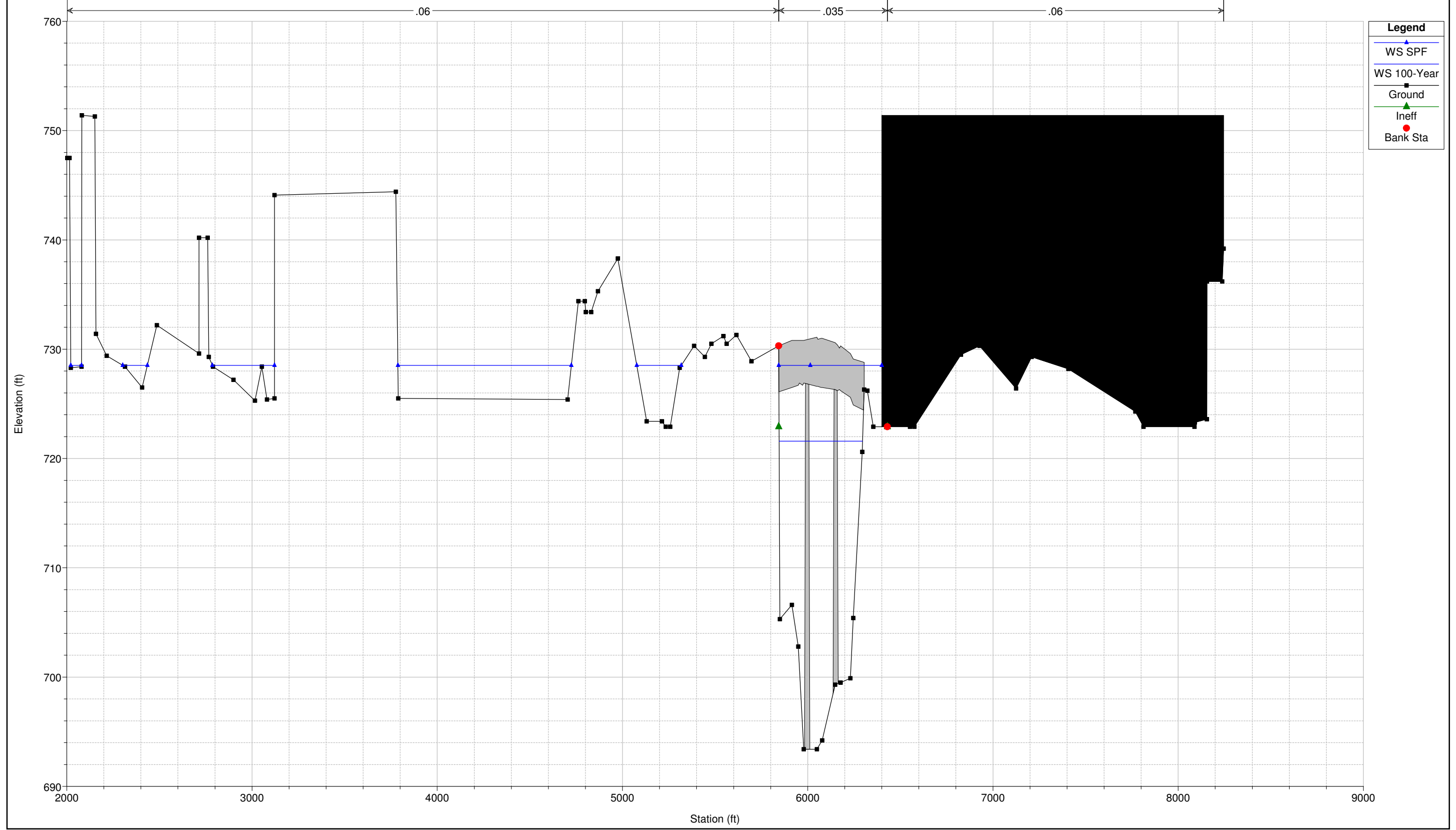
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.94



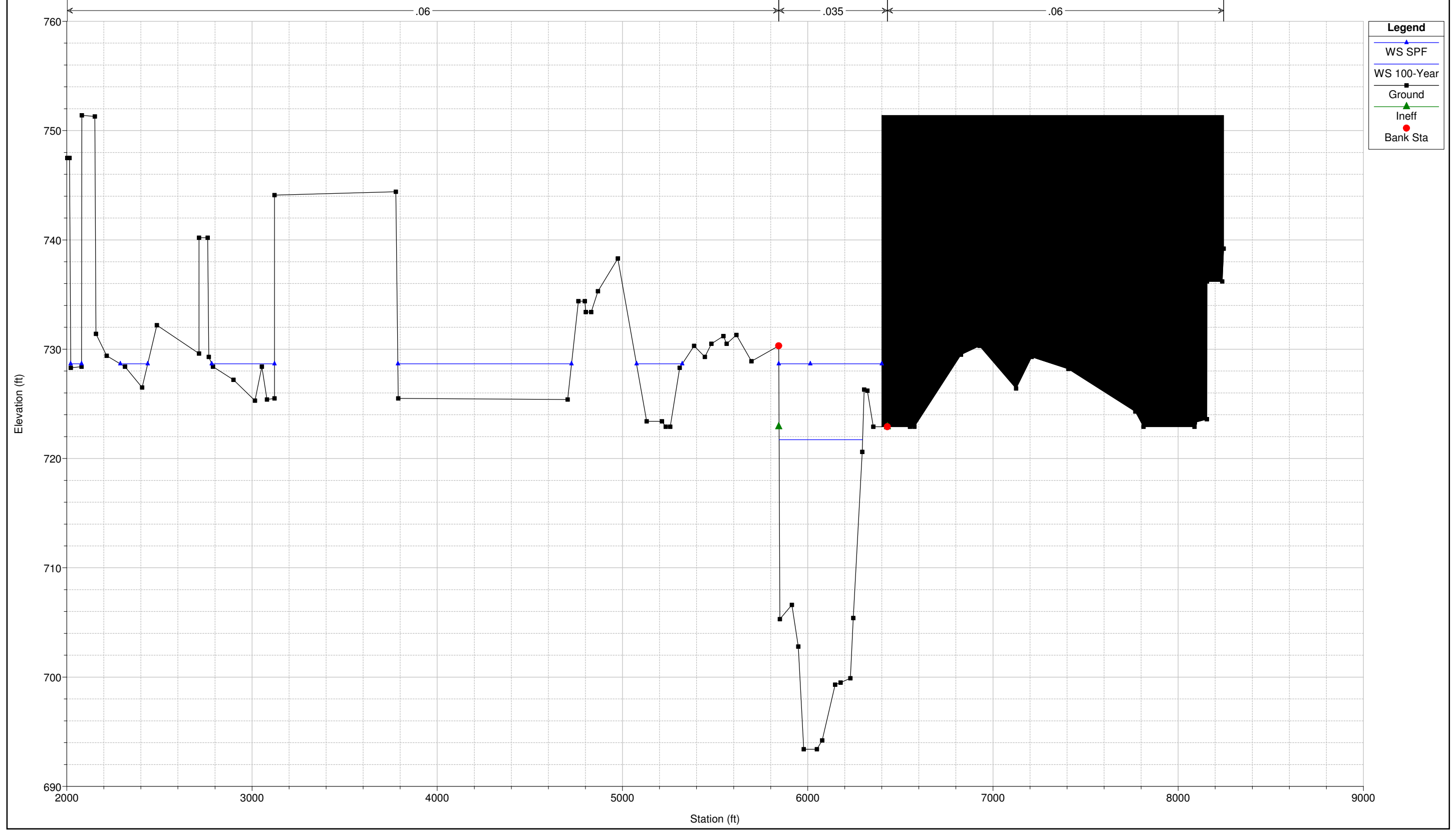
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.93 BR



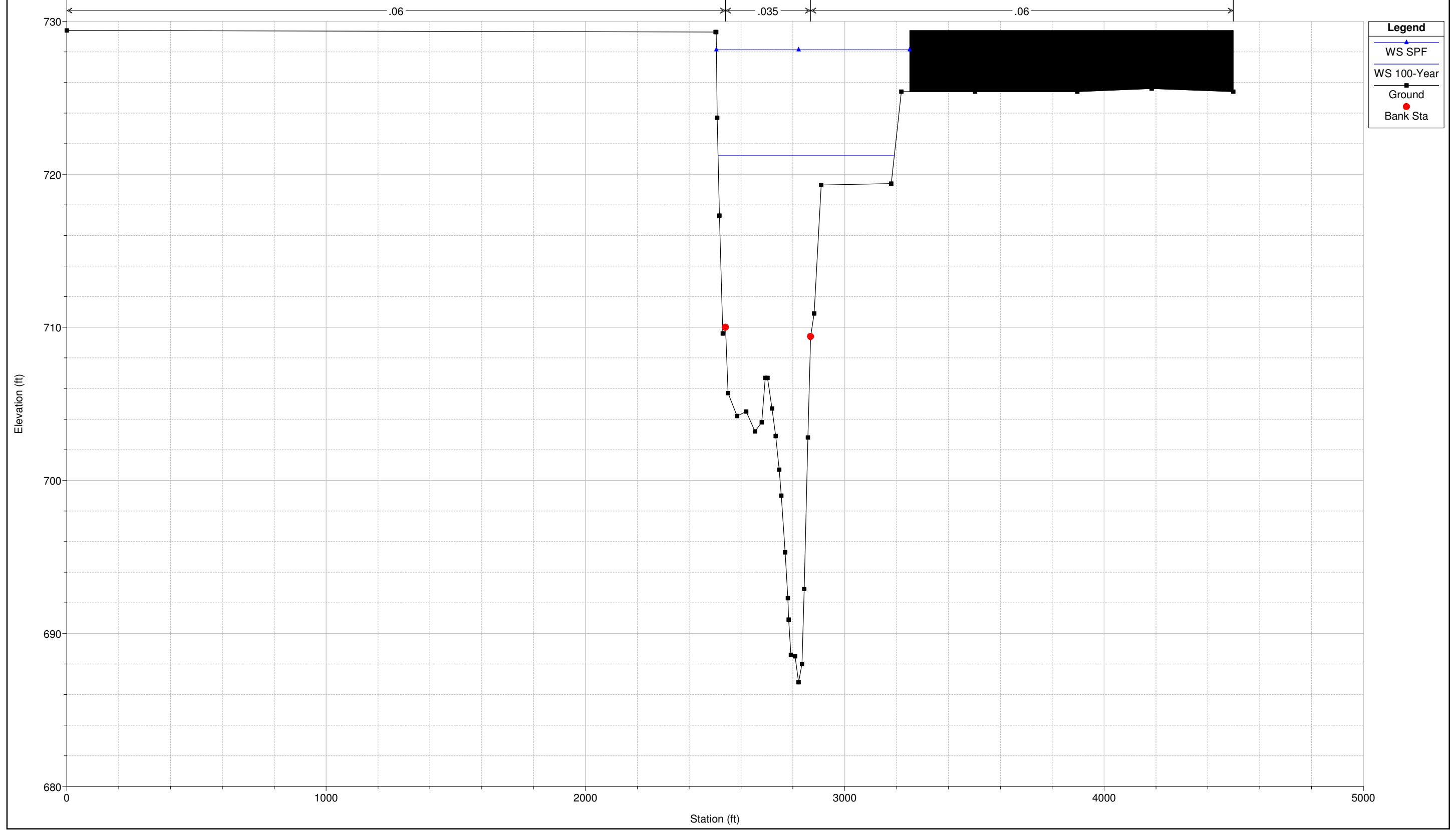
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.93 BR



Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.92



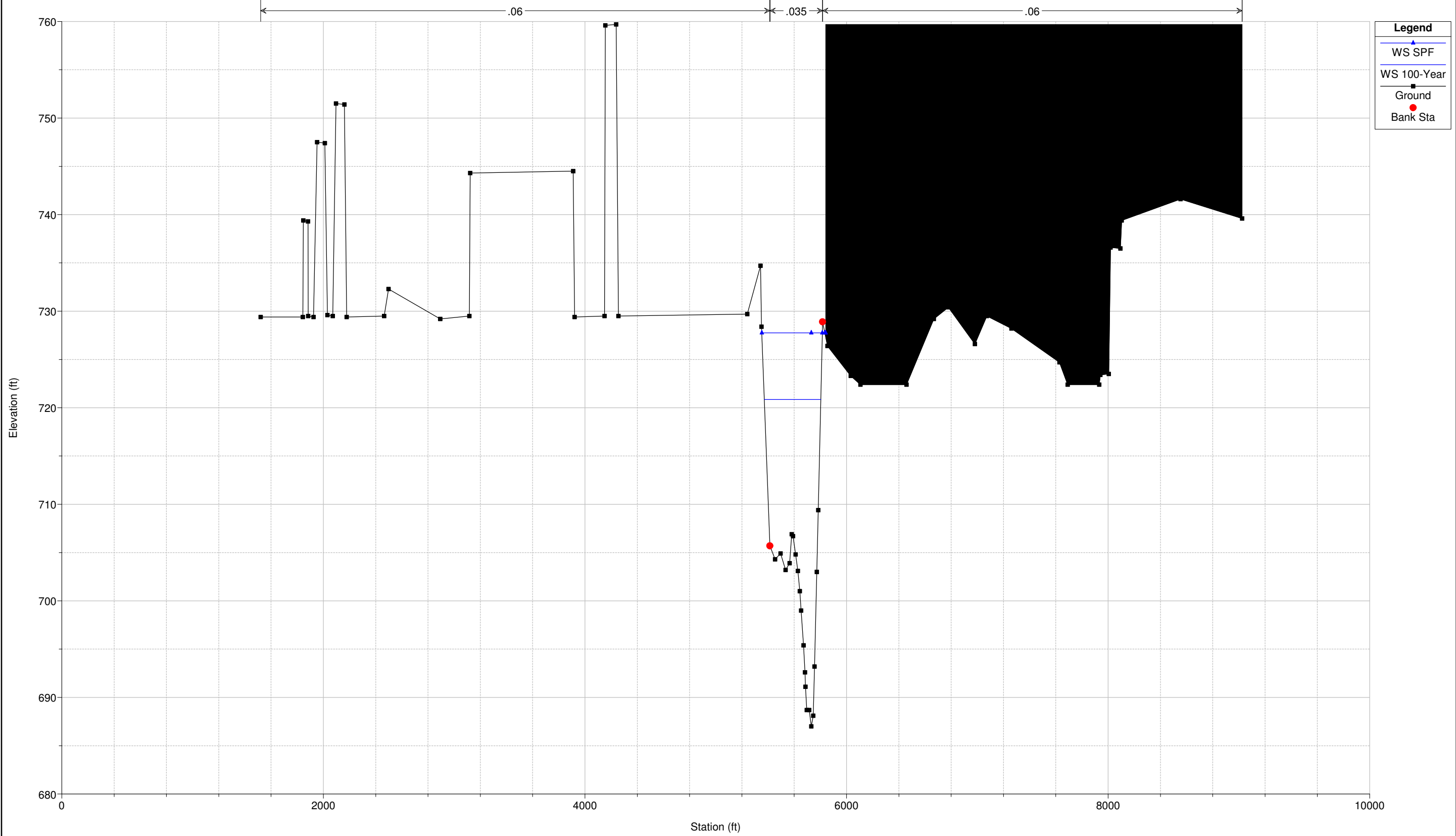
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.91



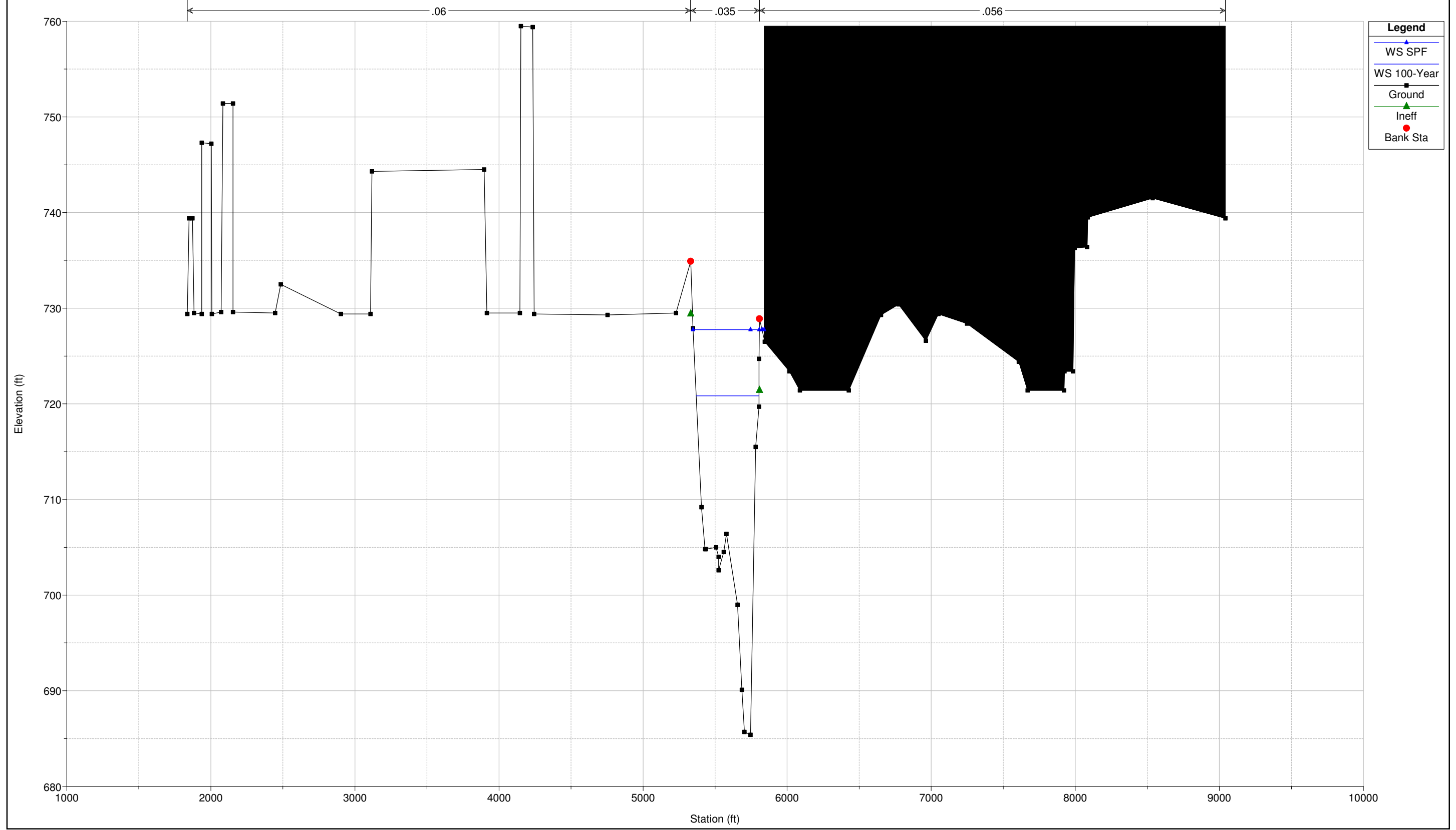
Legend

- WS SPF (Blue line with triangle marker)
- WS 100-Year (Blue line with square marker)
- Ground (Black line with square marker)
- Bank Sta (Red circle marker)

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.5

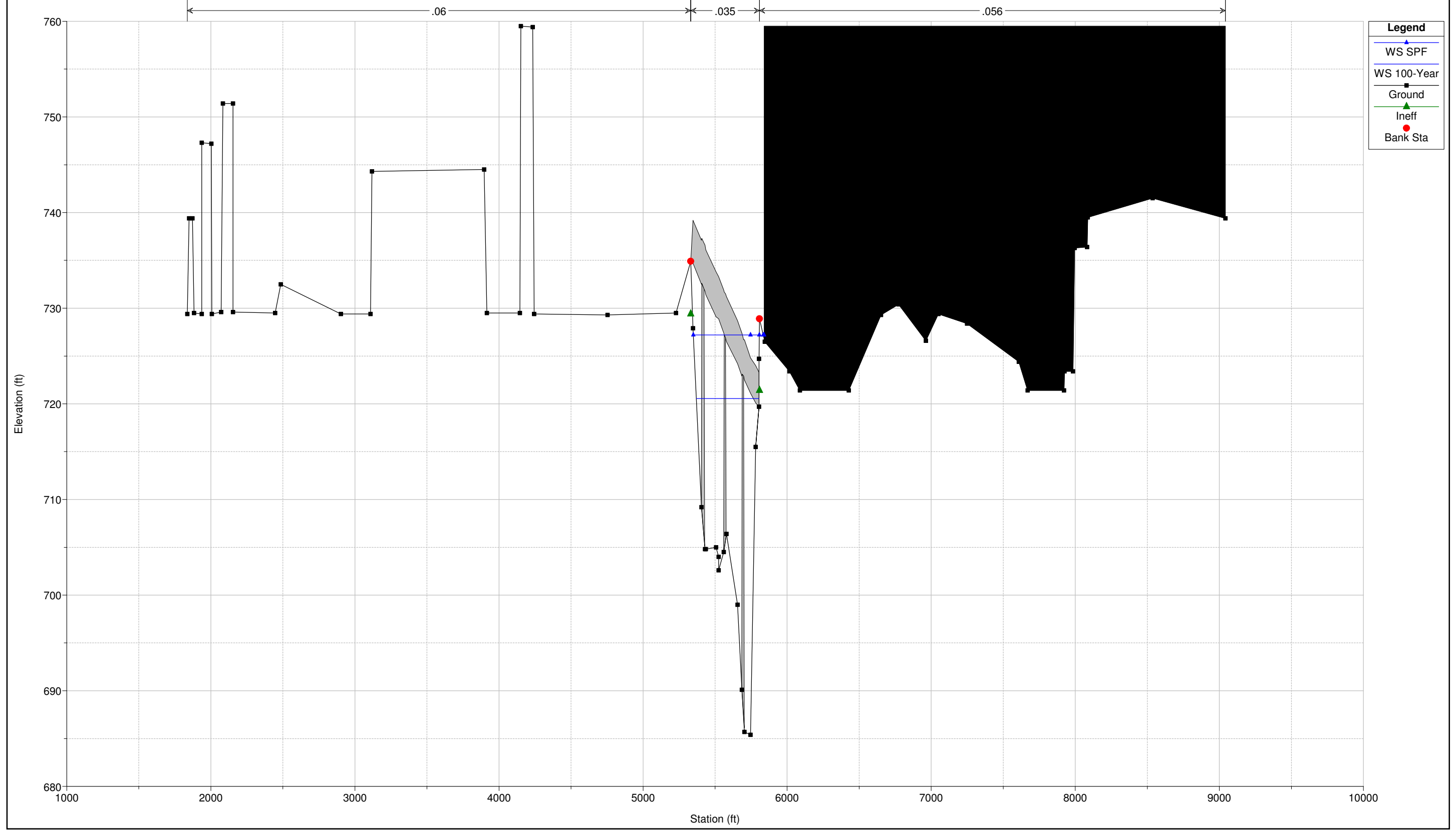


Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.4



- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.3 BR

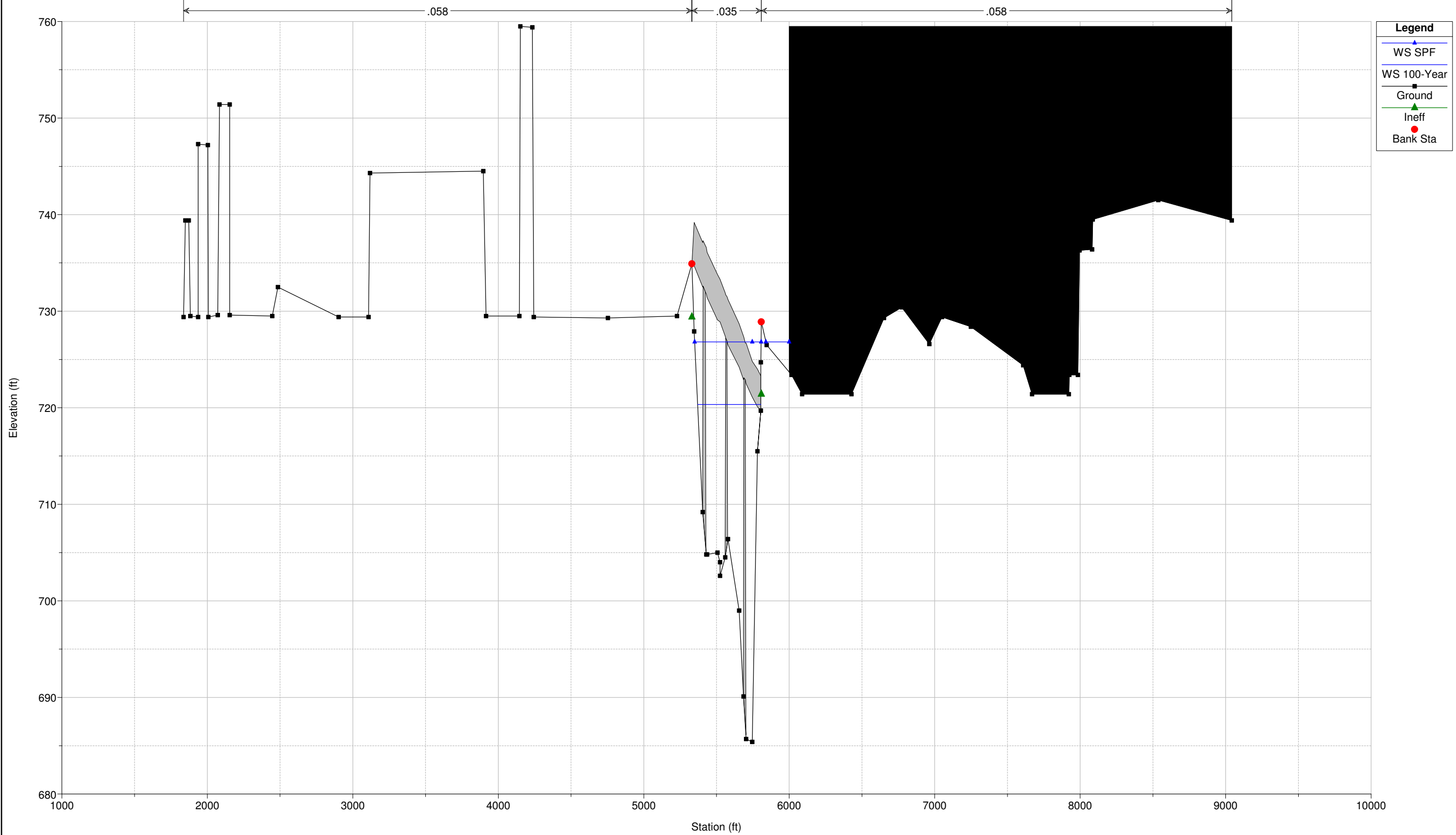


Legend

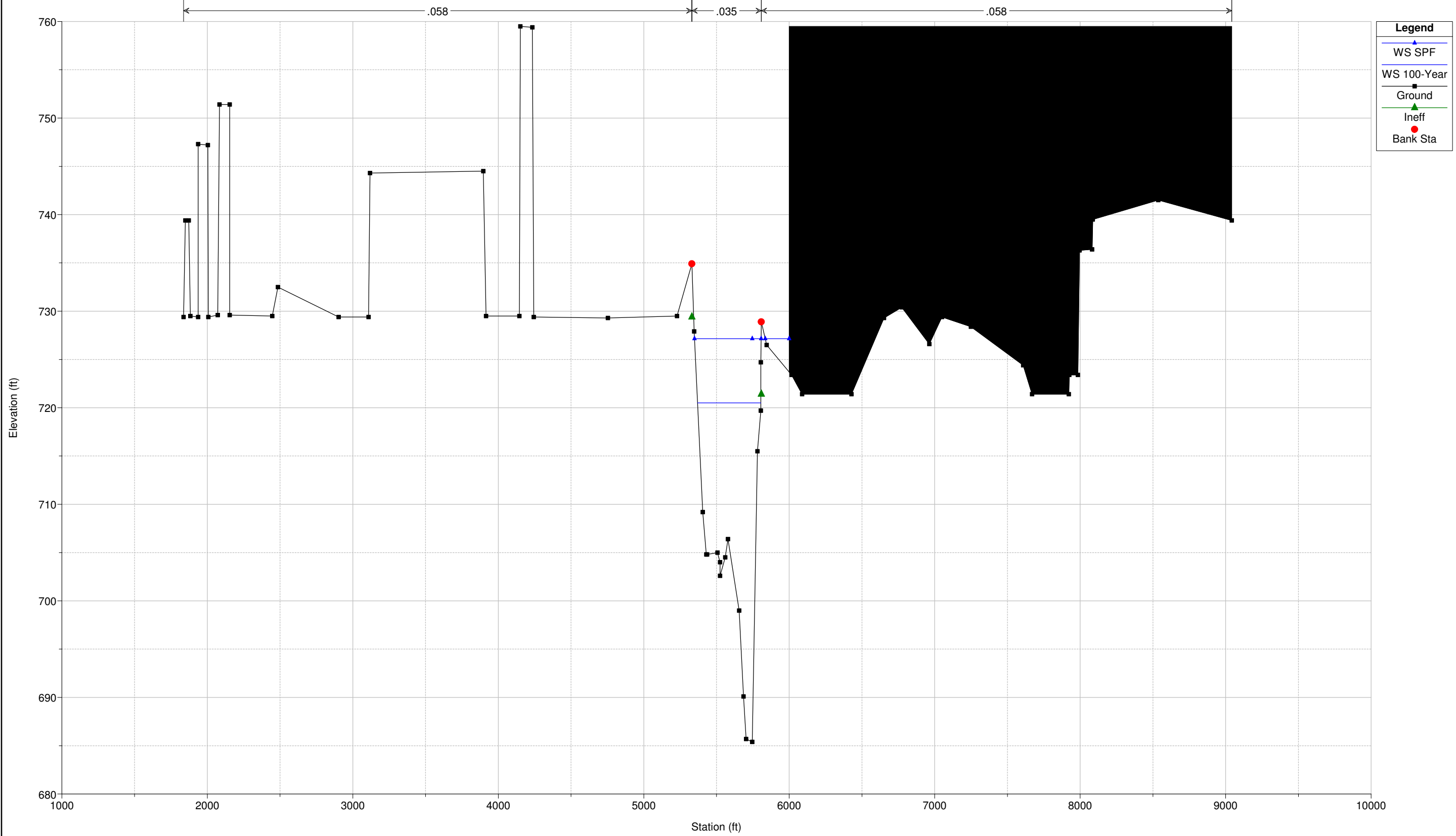
- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project

RS = 254.3 BR

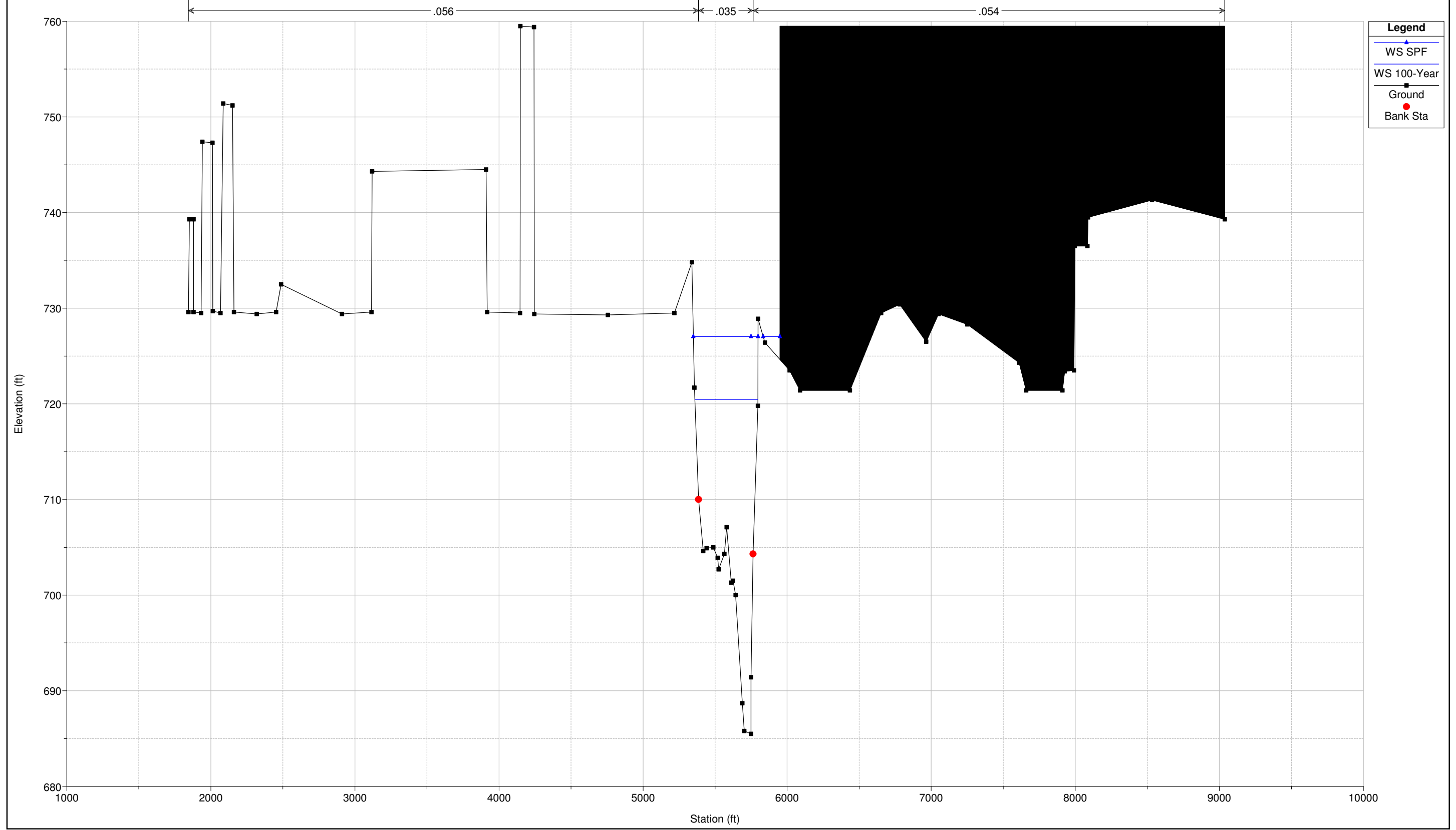


Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.2

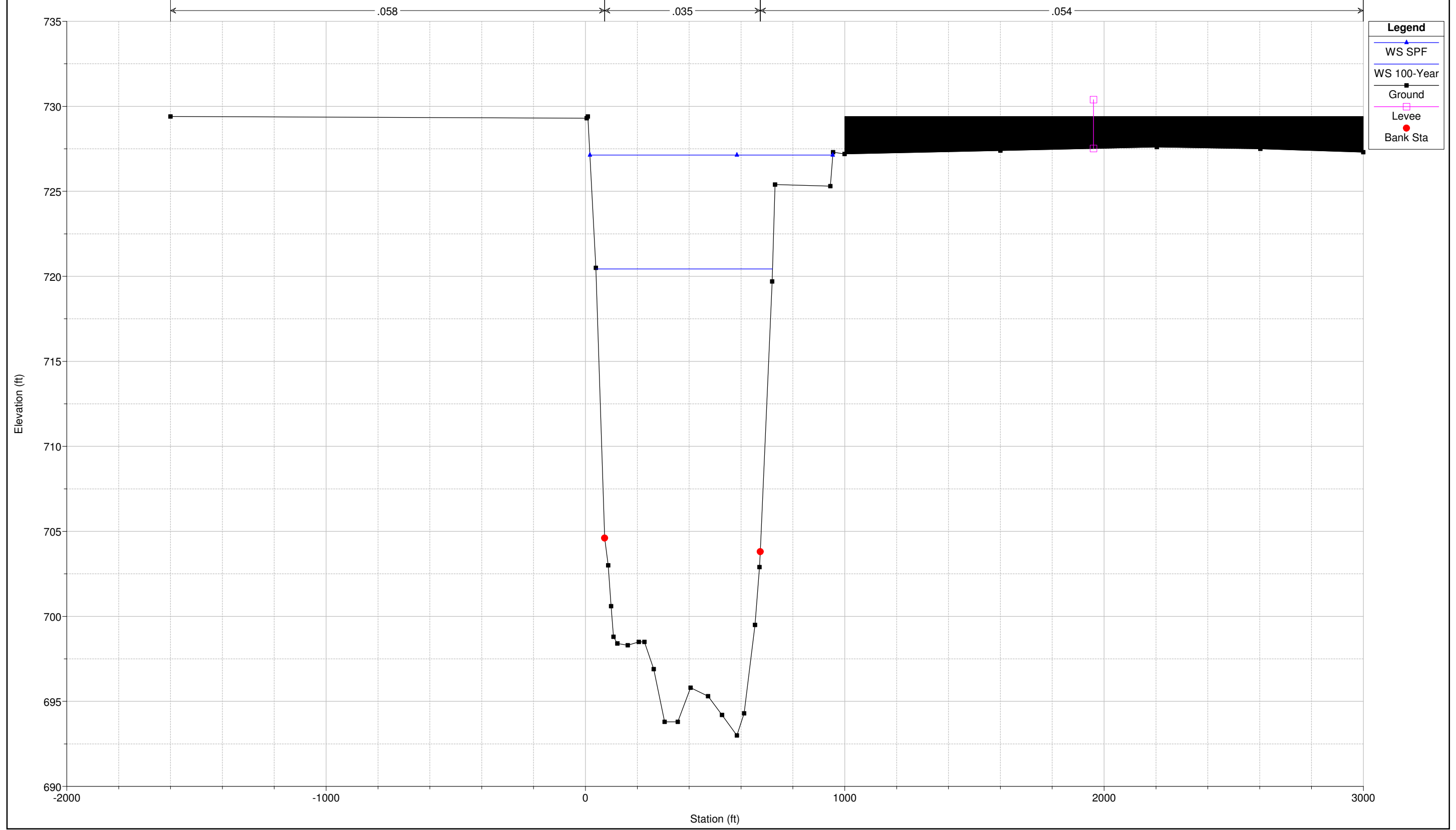


Legend	
WS SPF	▲
WS 100-Year	■
Ground	■
Ineff	▲
Bank Sta	●

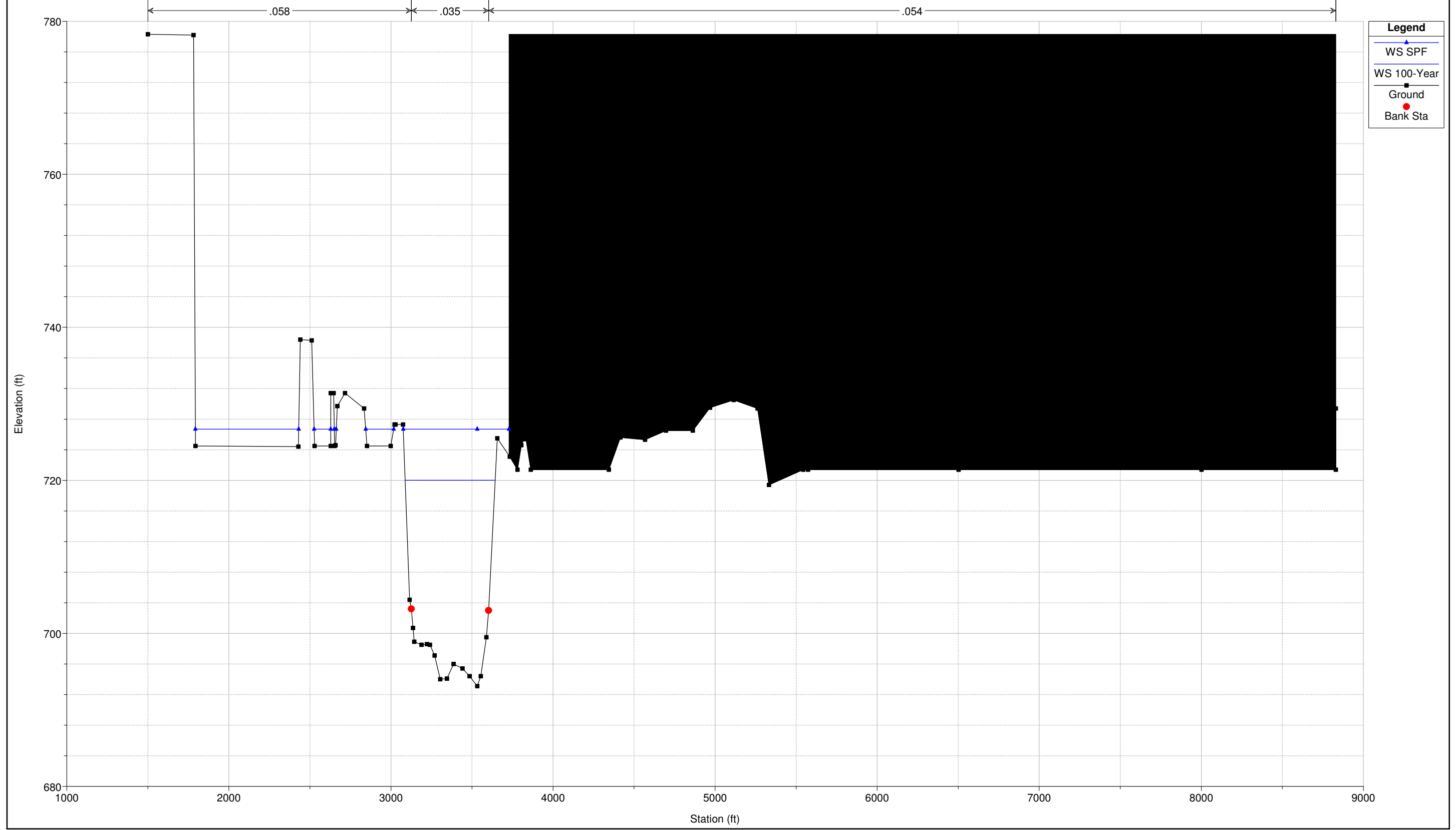
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 254.1



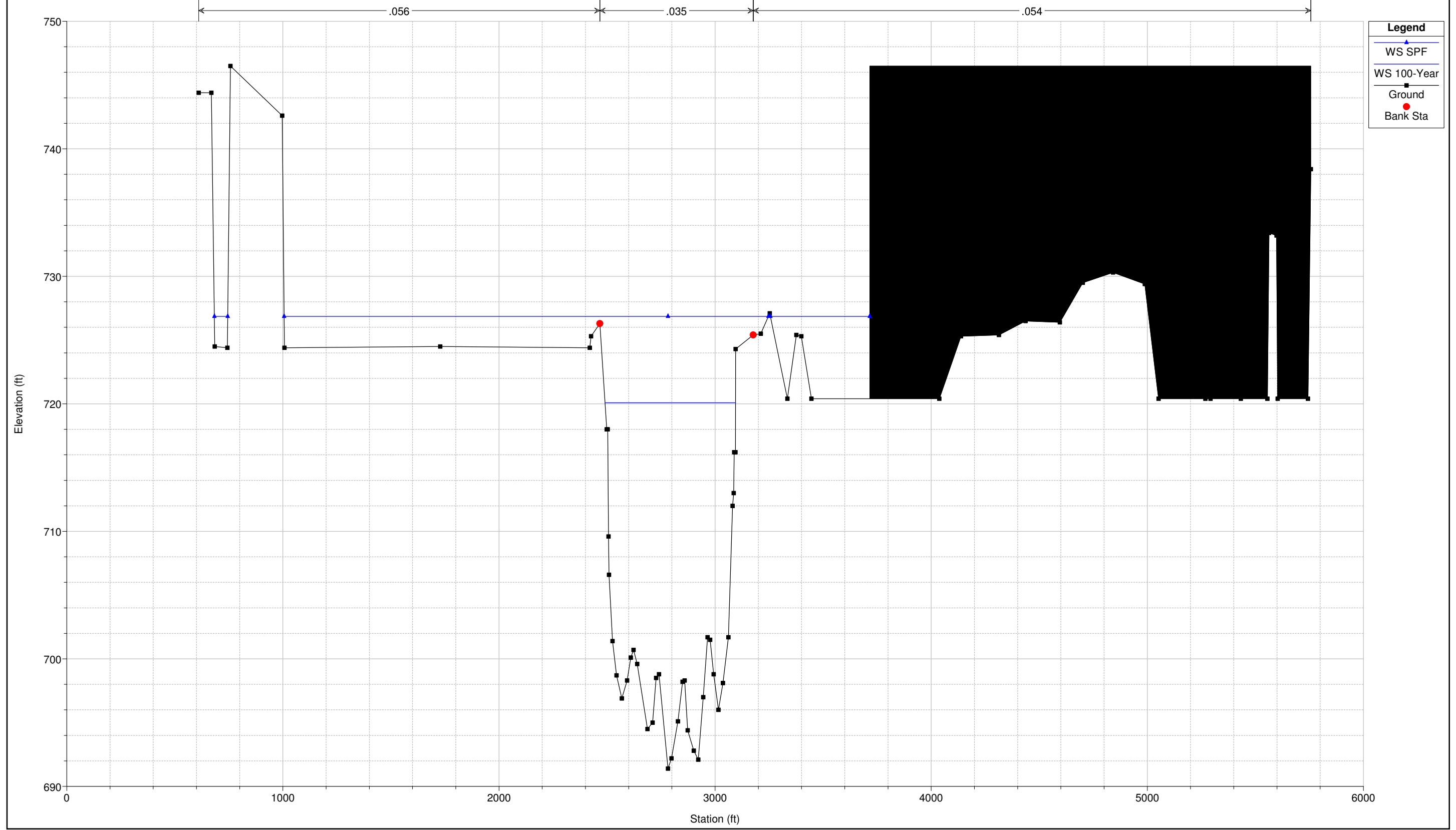
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.6



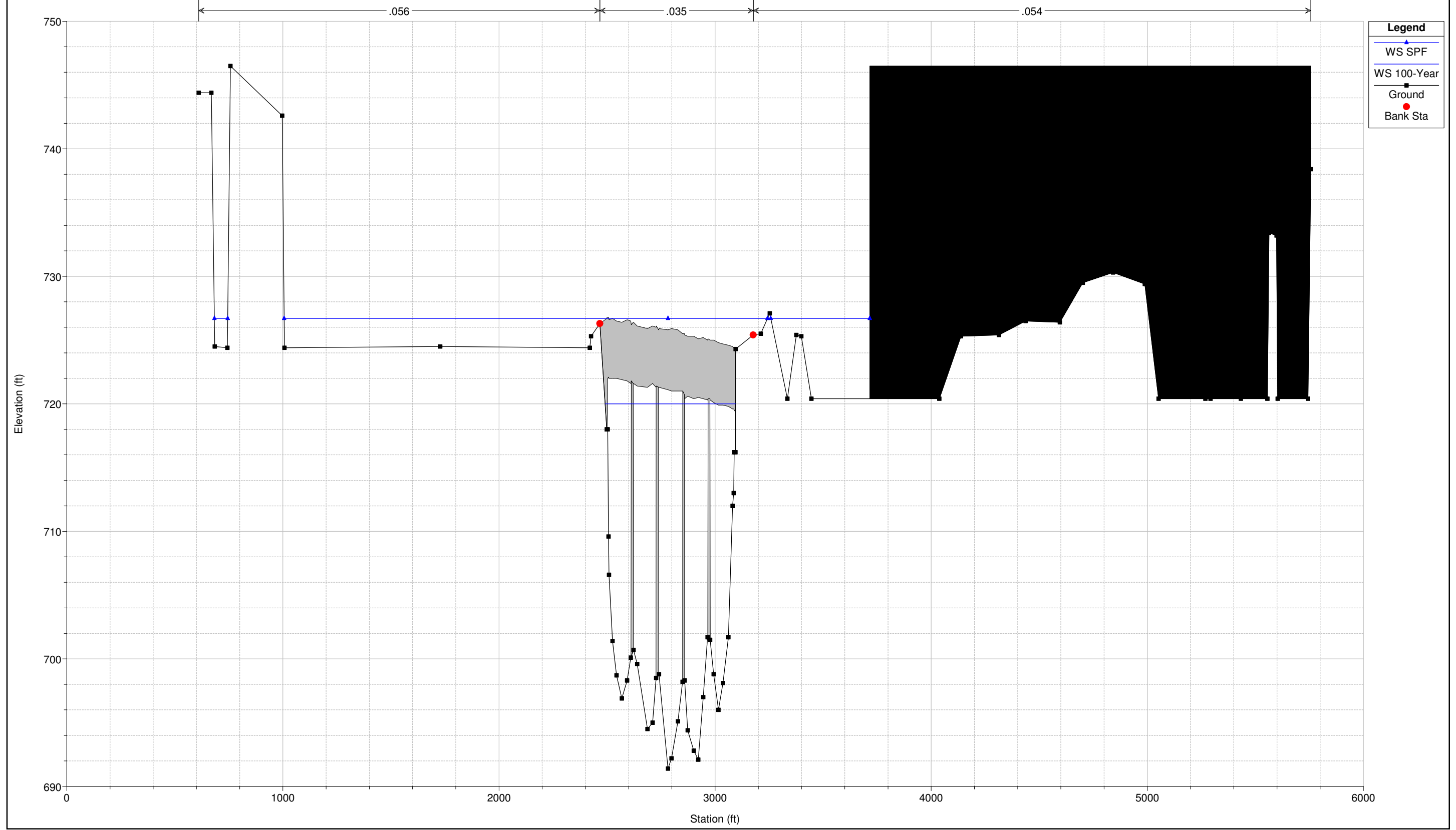
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.5



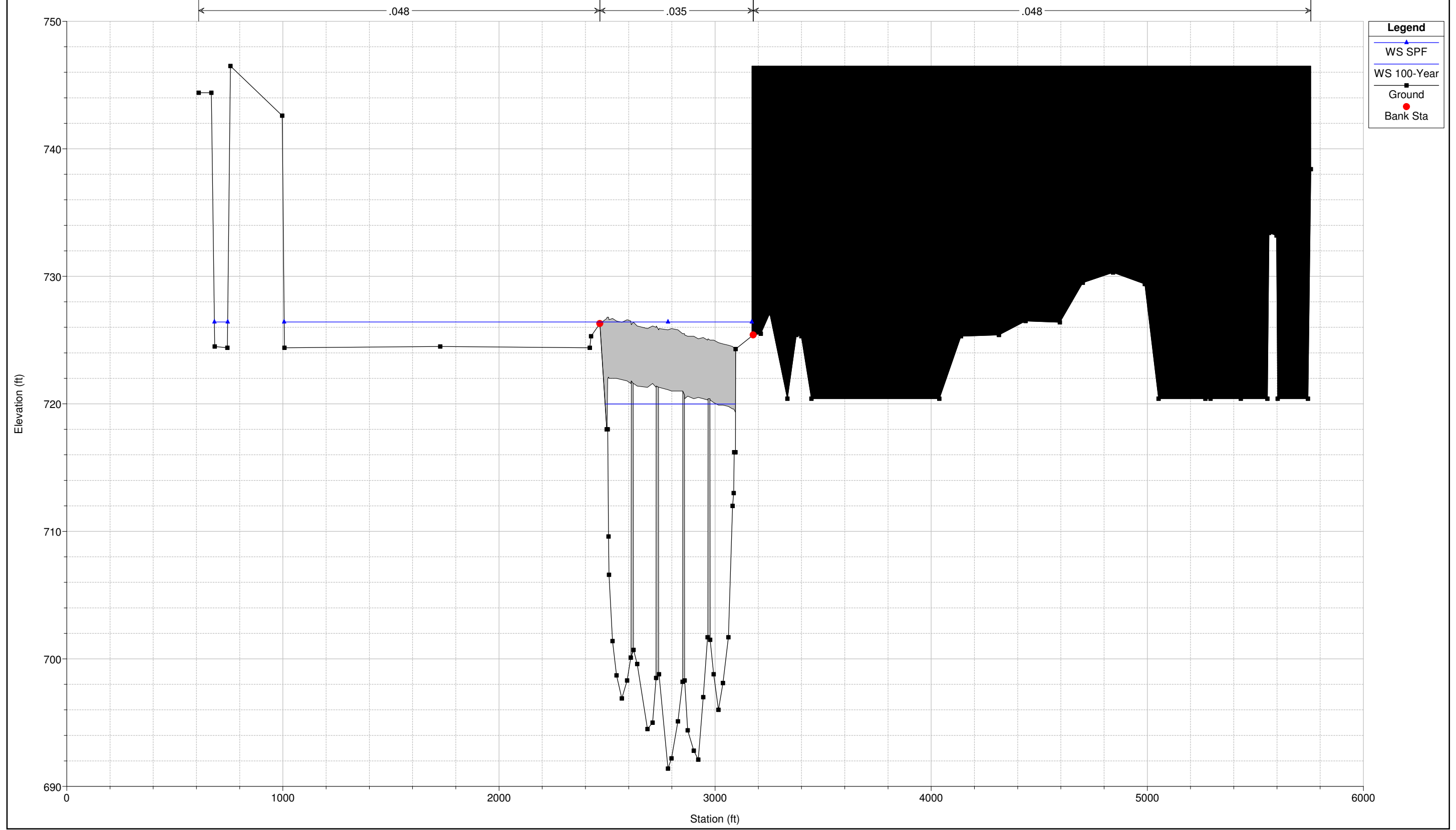
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 253.4



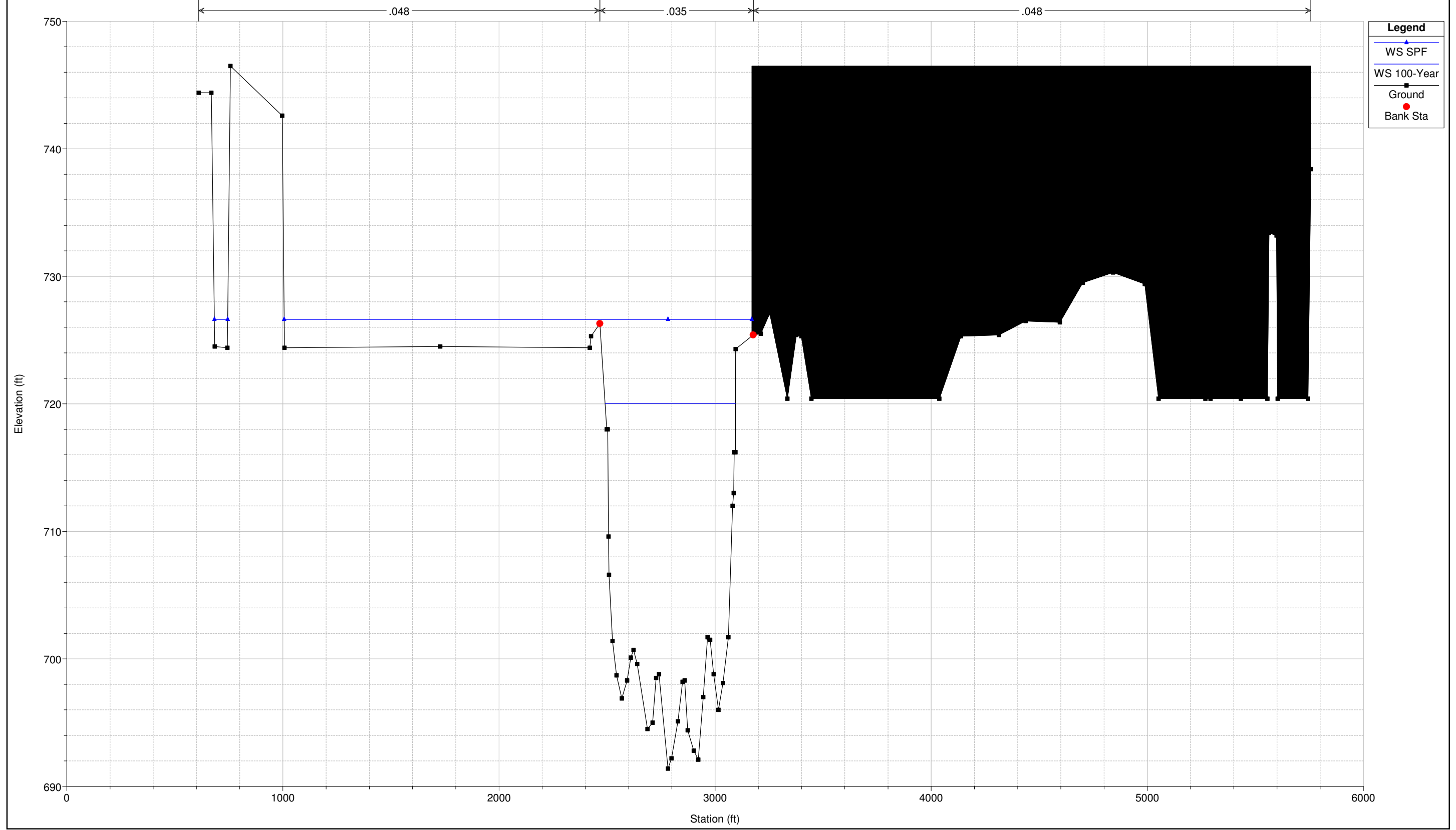
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.3 BR



Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.3 BR



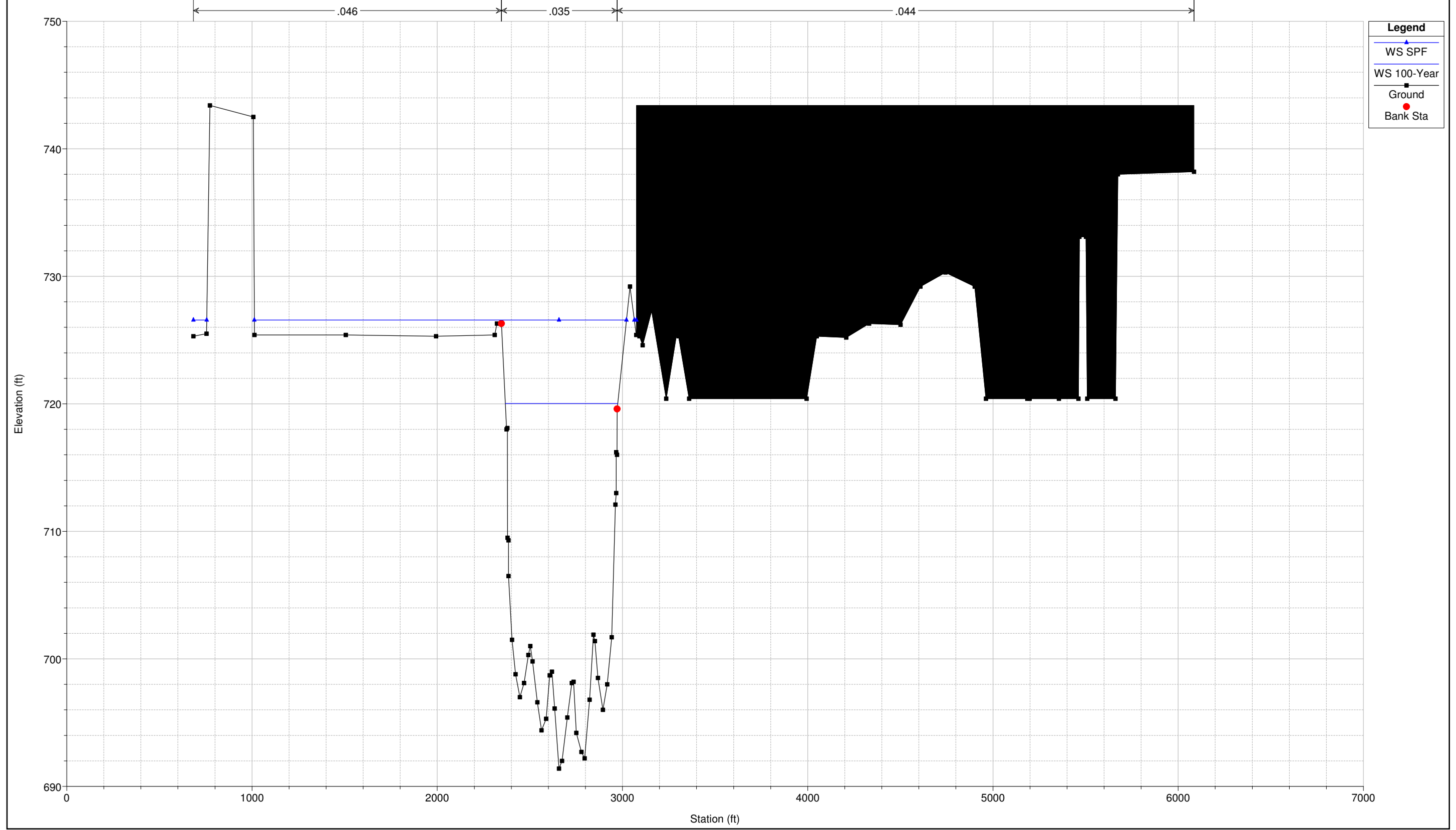
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.2



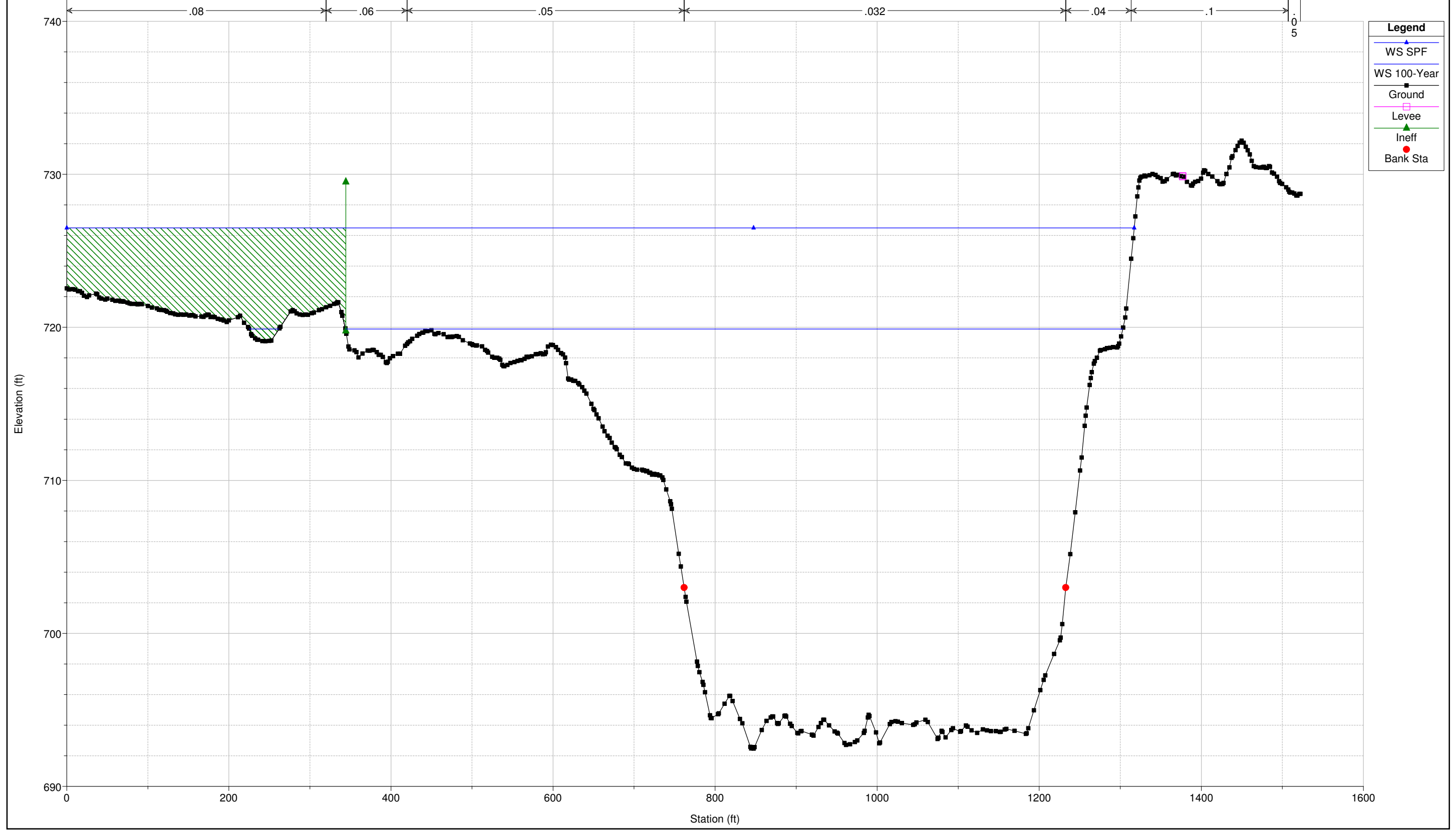
Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Black line with square)
- Ground (Black area)
- Bank Sta (Red dot)

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 253.1

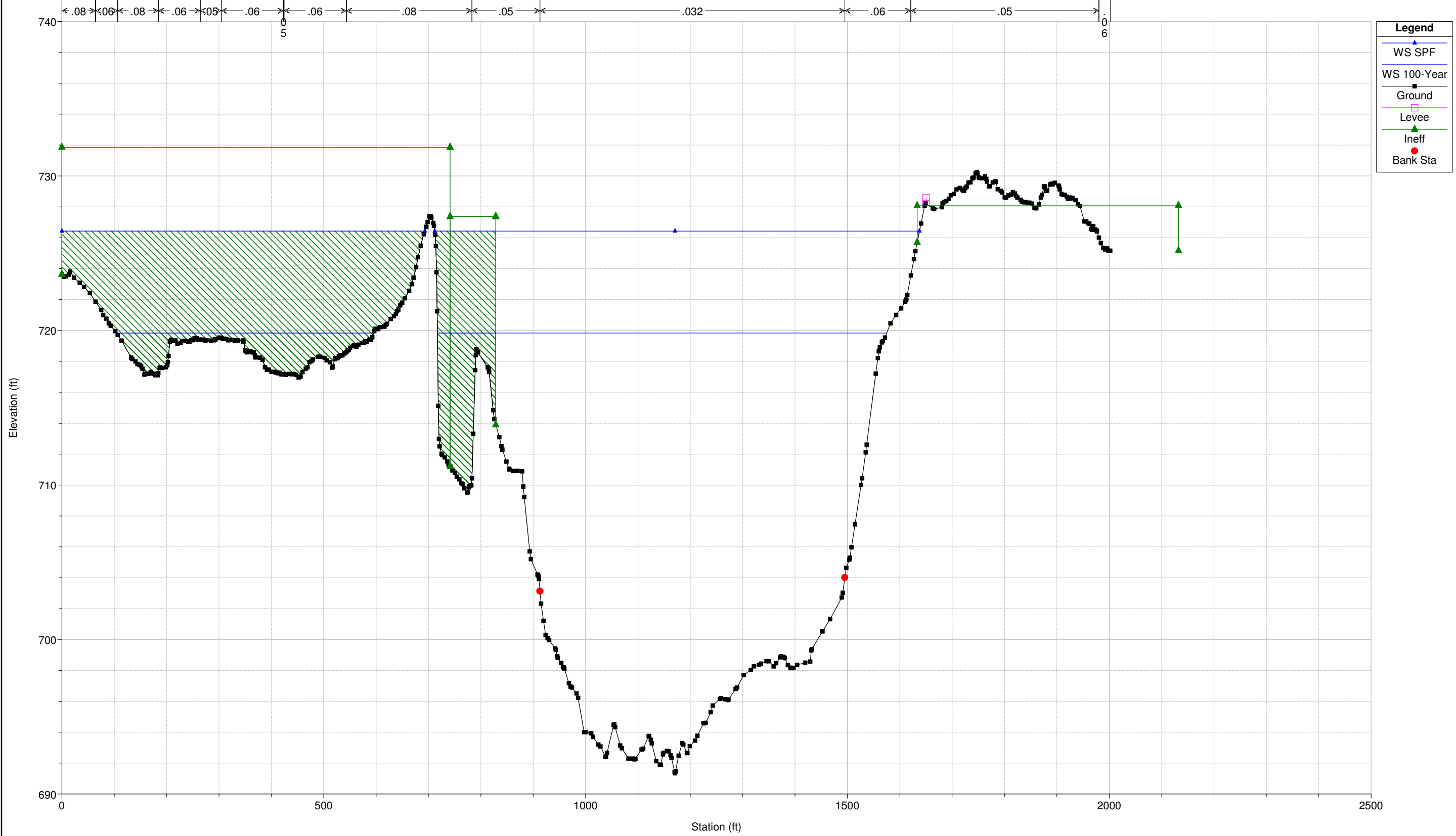


SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 252.8

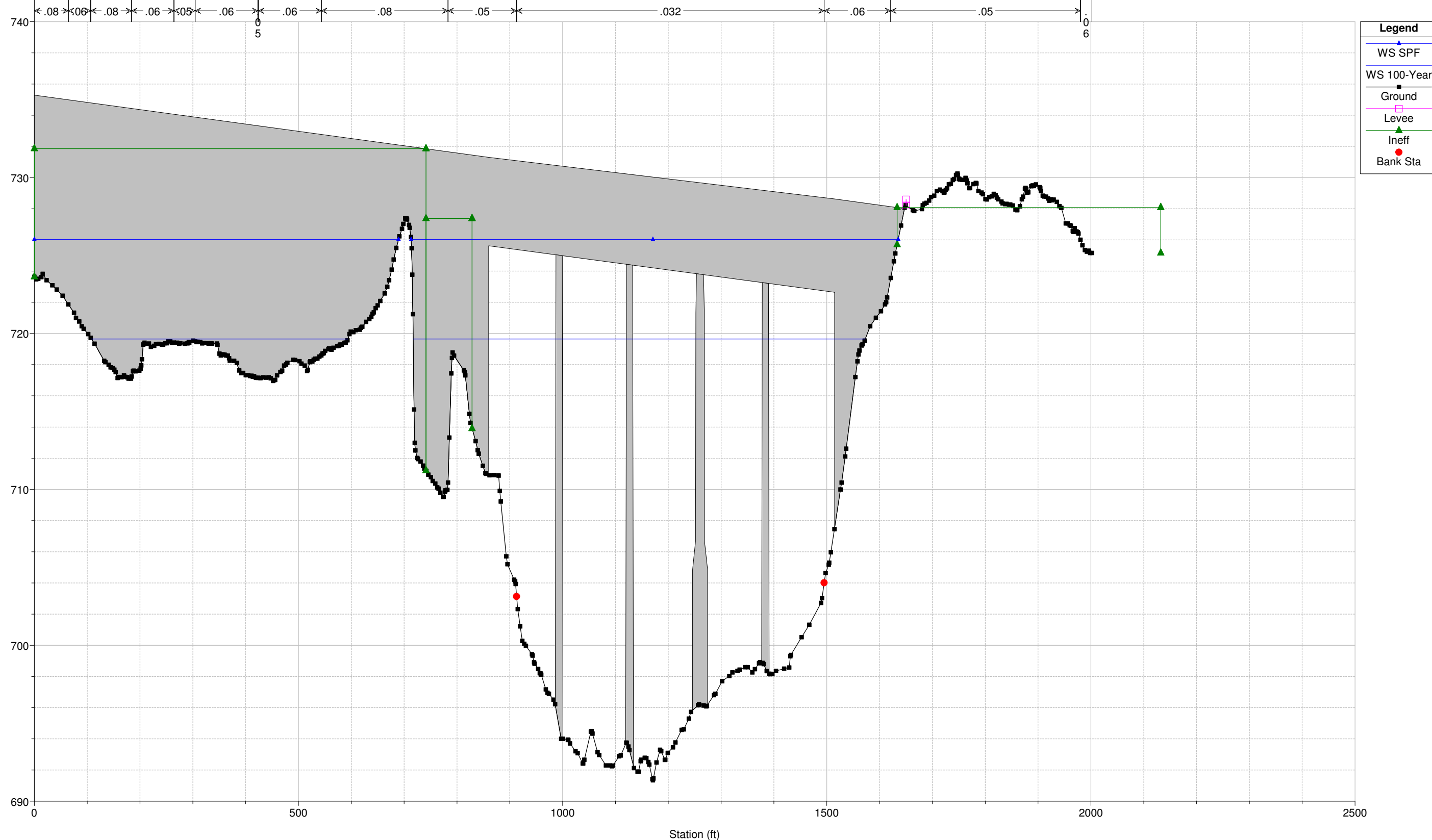


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 252.5

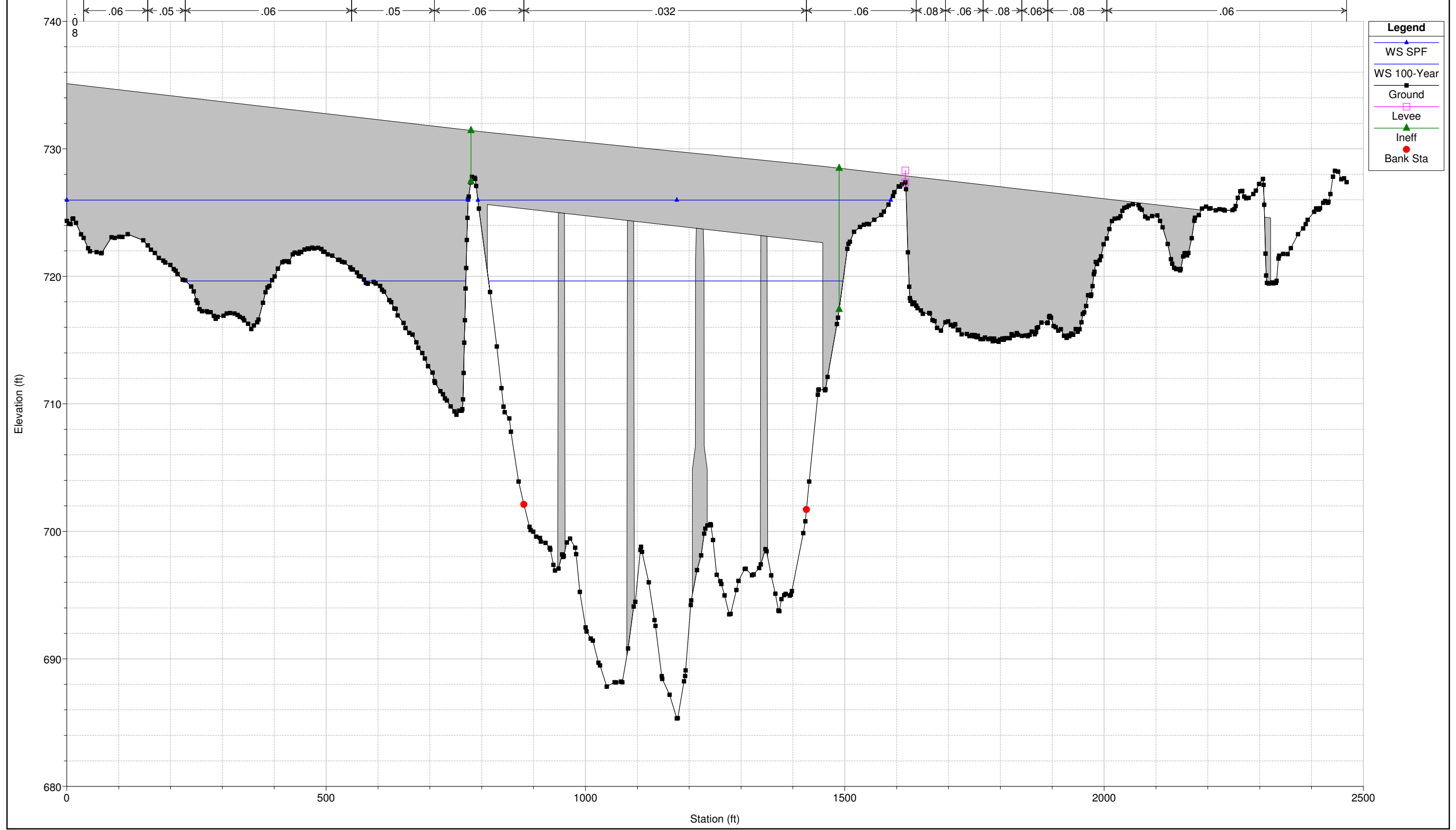


Sciotgreenways Plan: Corrected Effective / Pre-project
RS = 252.3 BR



- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

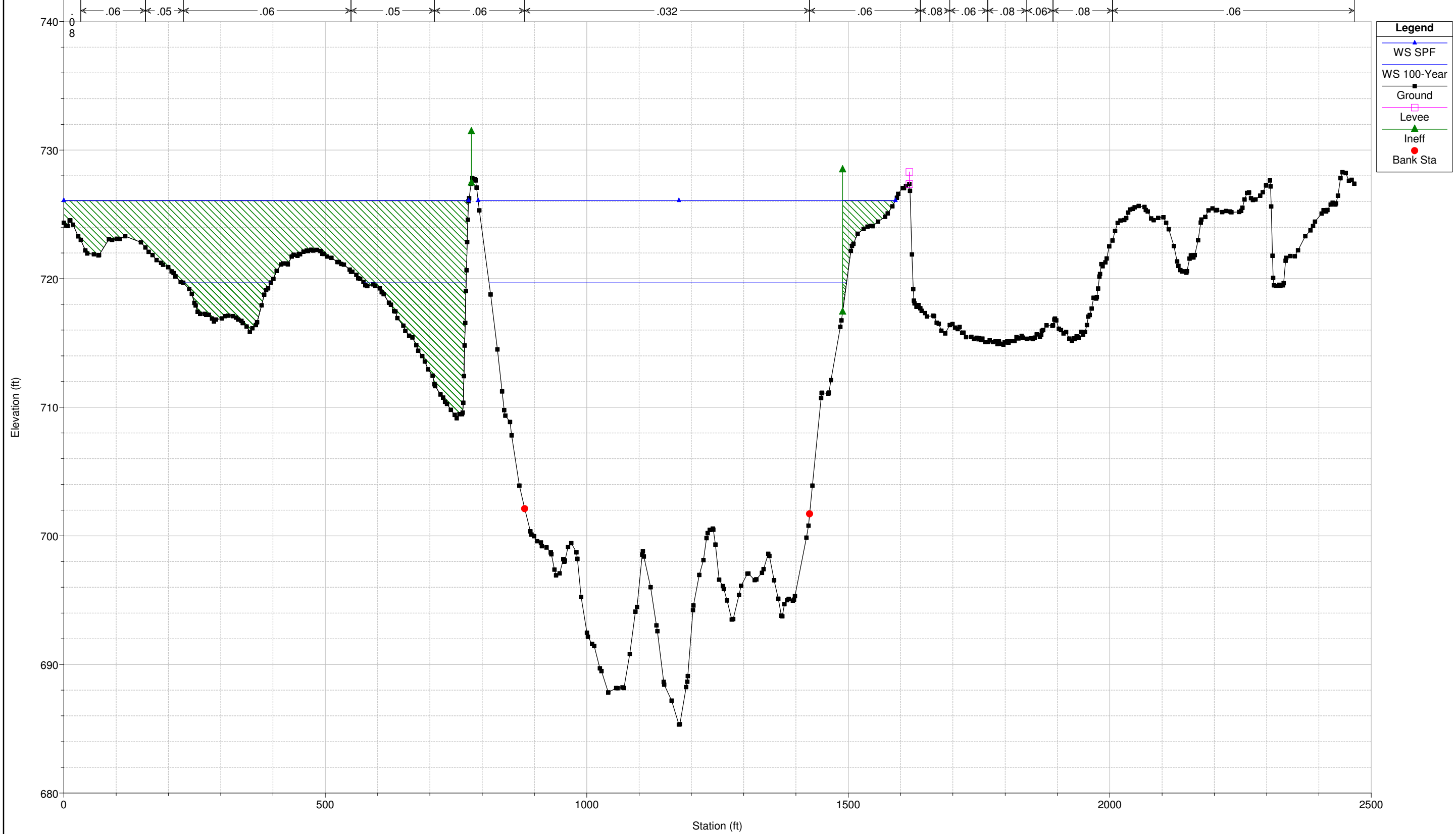
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 252.3 BR



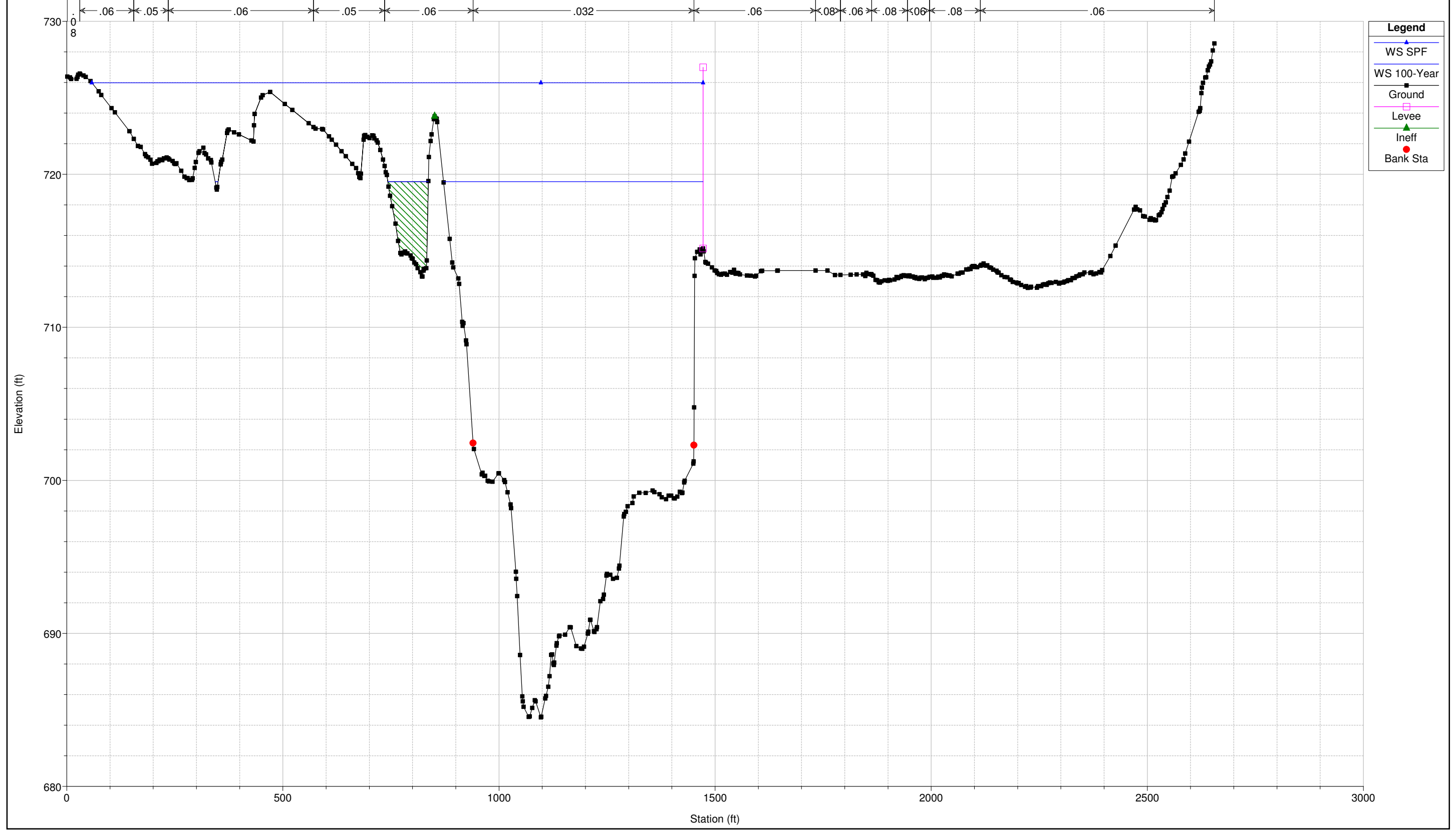
Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line with square)
- Ground (Black line with square)
- Levee (Pink square)
- Ineff (Green line with triangle)
- Bank Sta (Red circle)

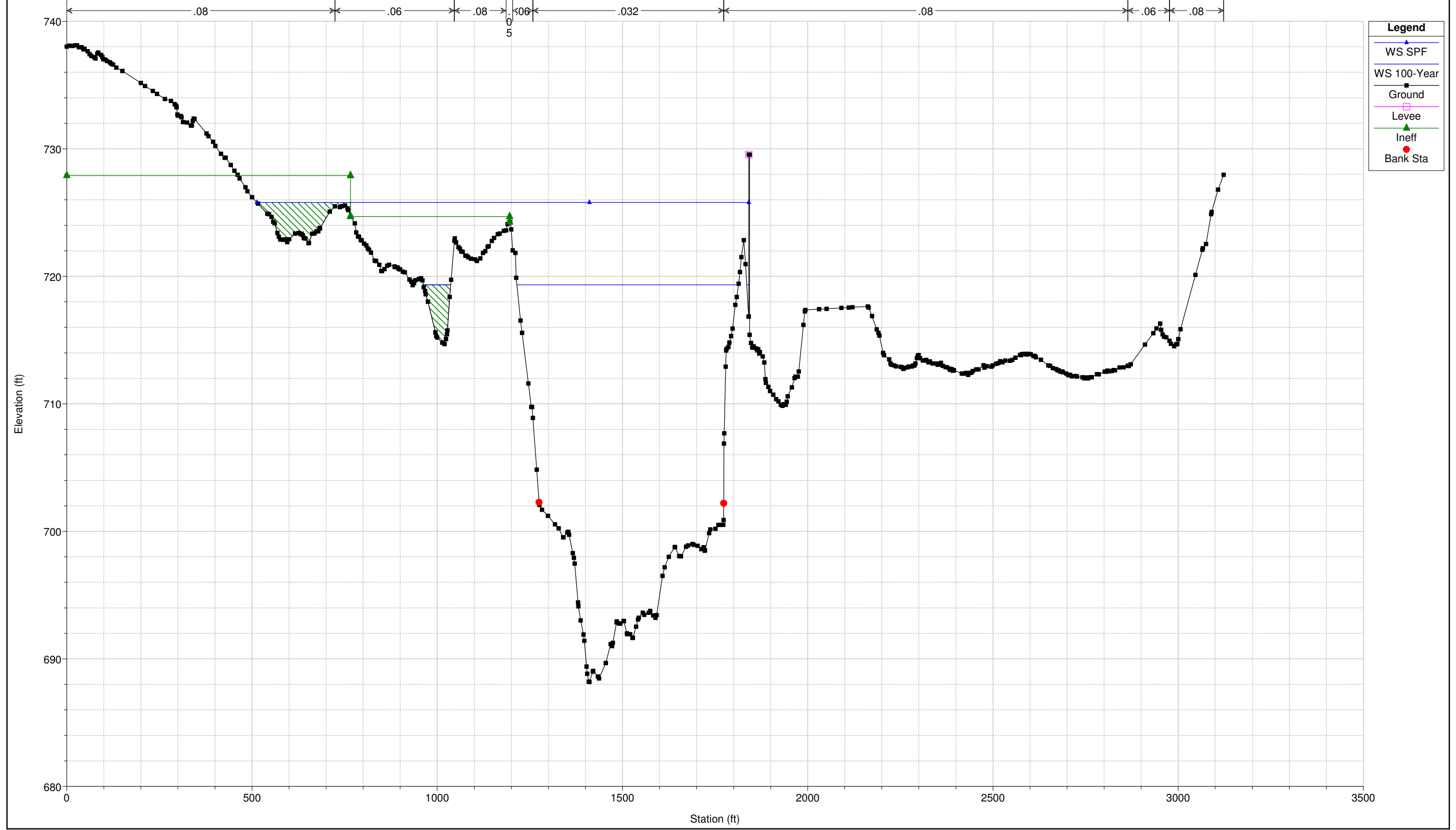
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 252.1



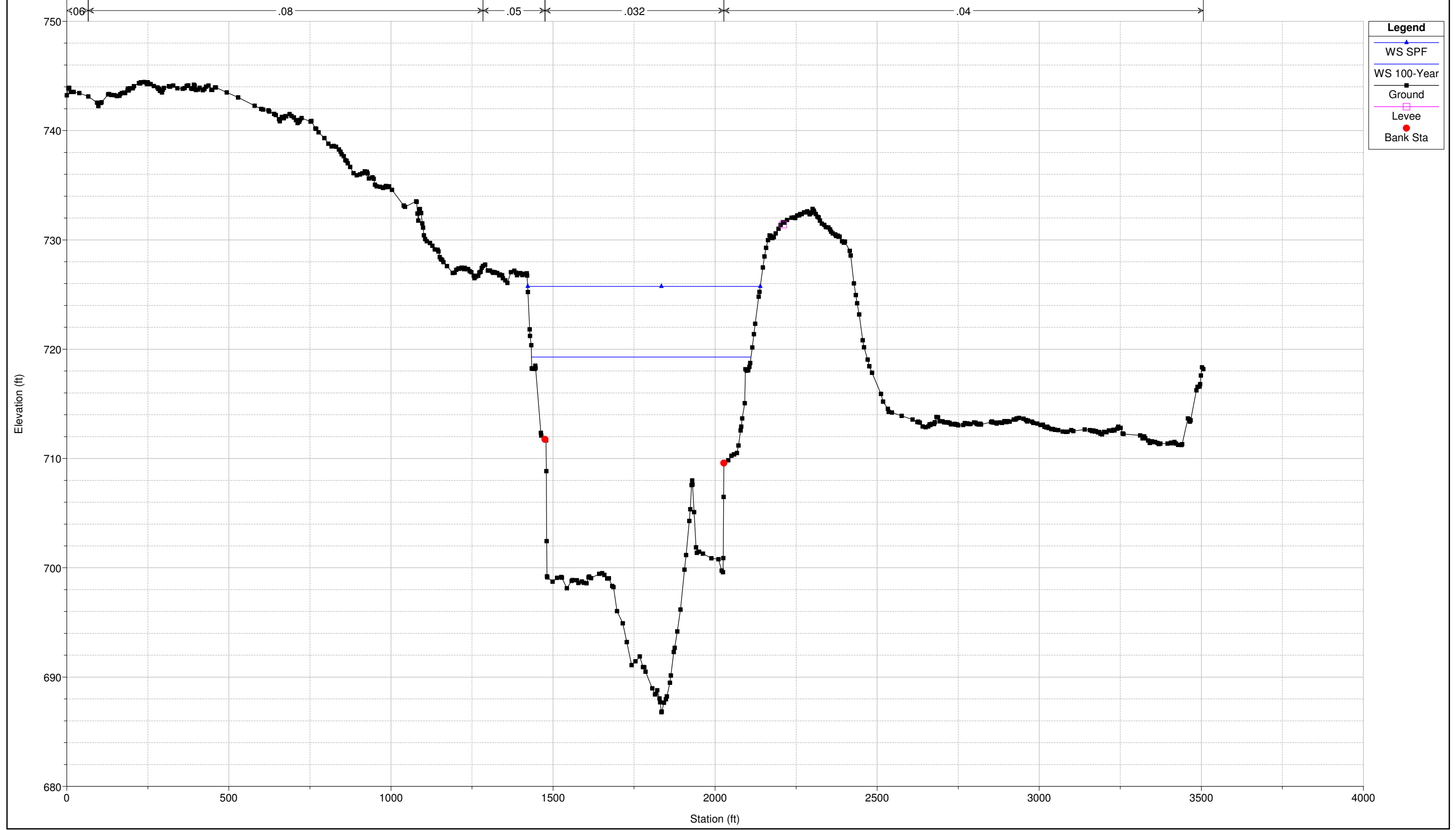
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 252.06



SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 251.8

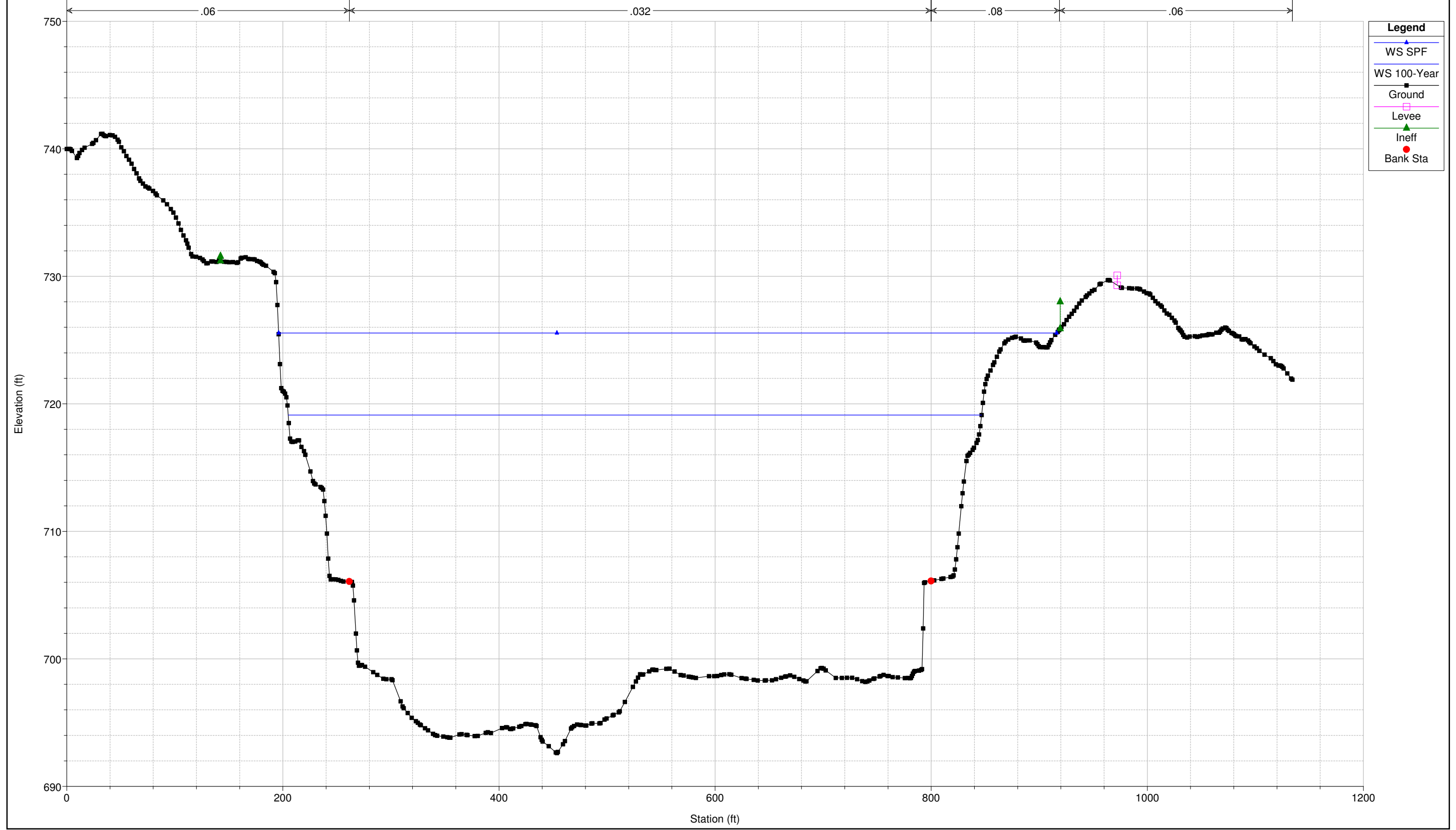


Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 251.75



- Legend
- WS SPF
- WS 100-Year
- Ground
- Levee
- Bank Sta

SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 251.5

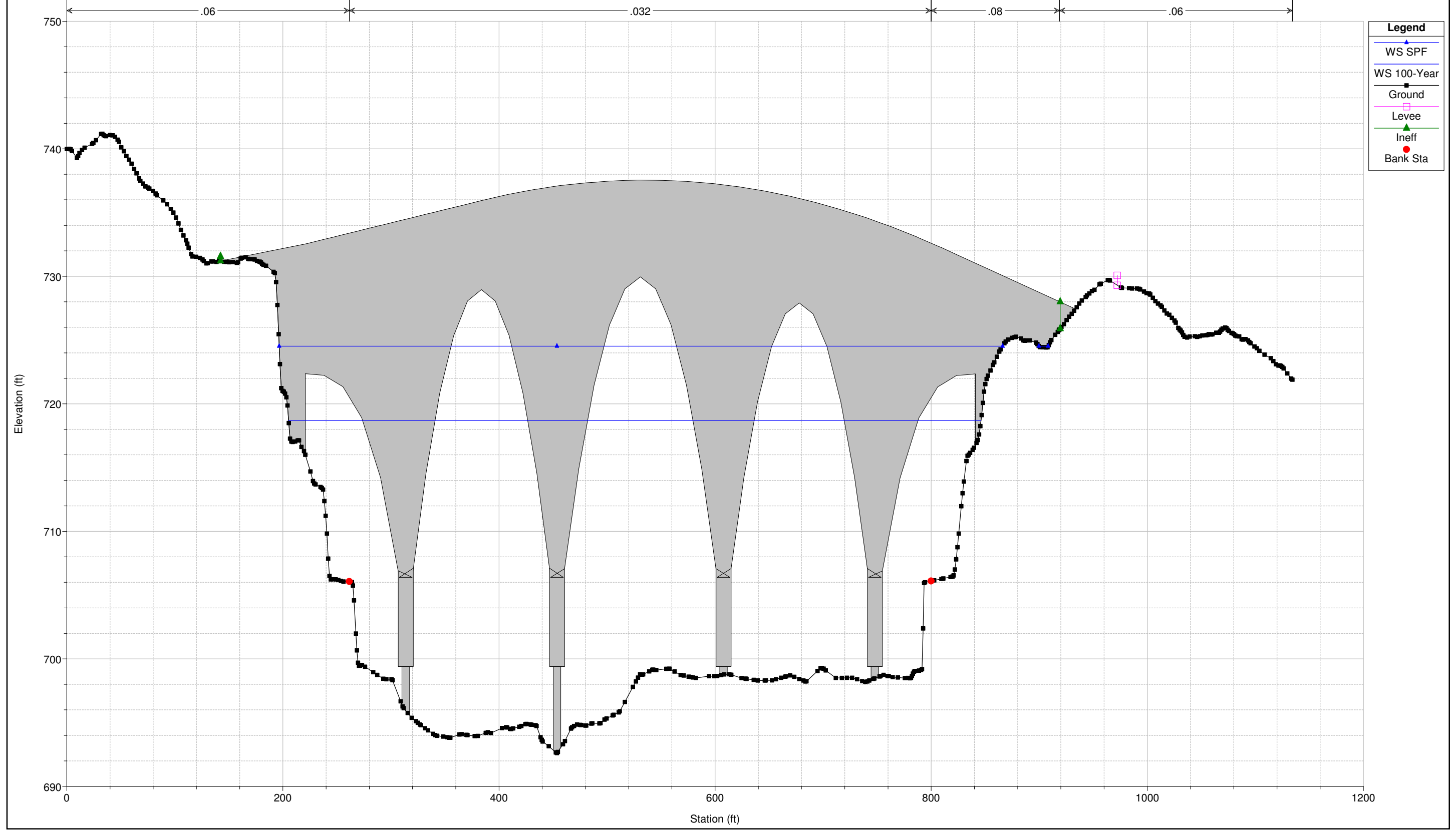


Legend

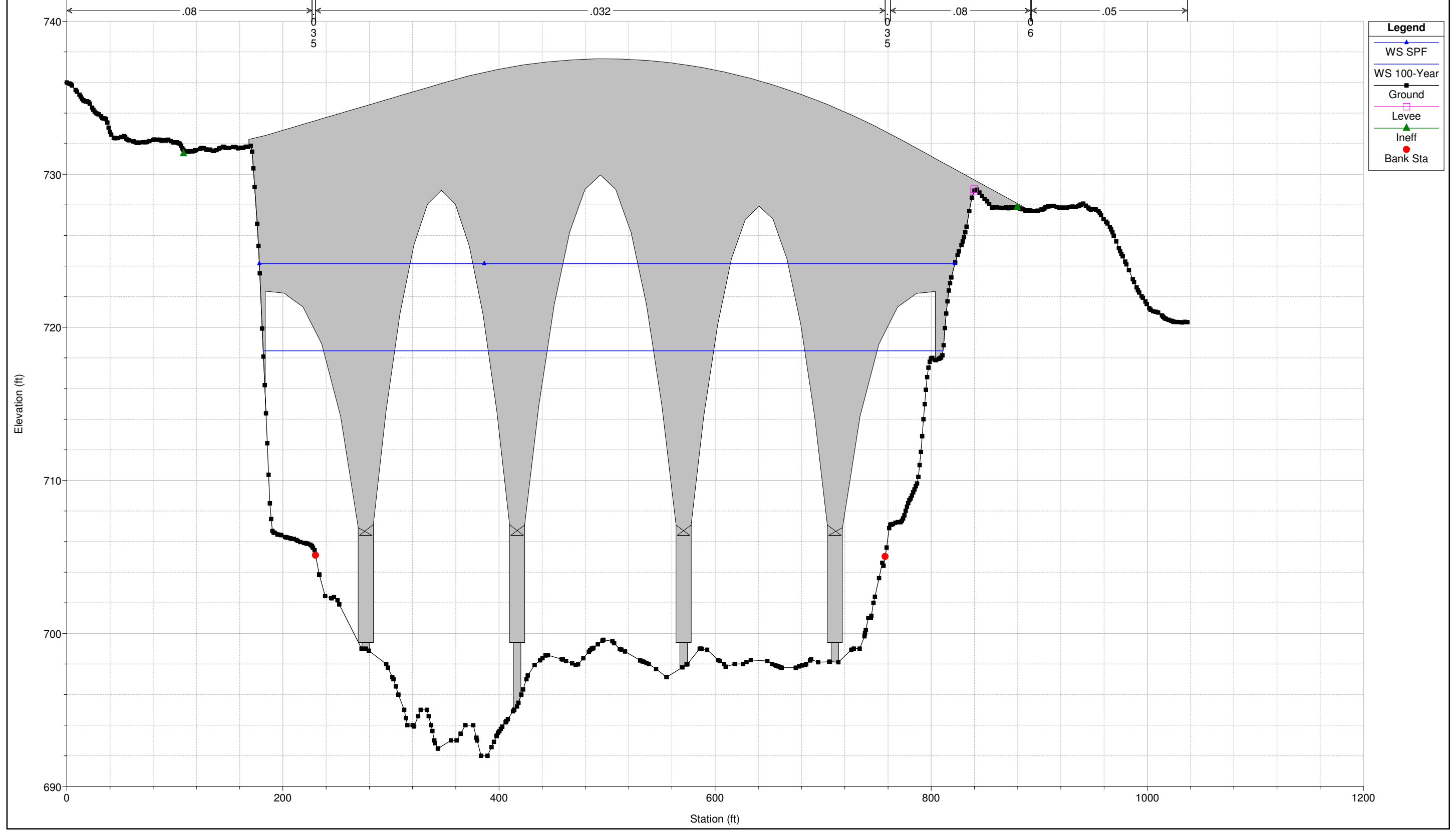
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

← .06 * .032 * .08 * .06 →

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 251.3 BR

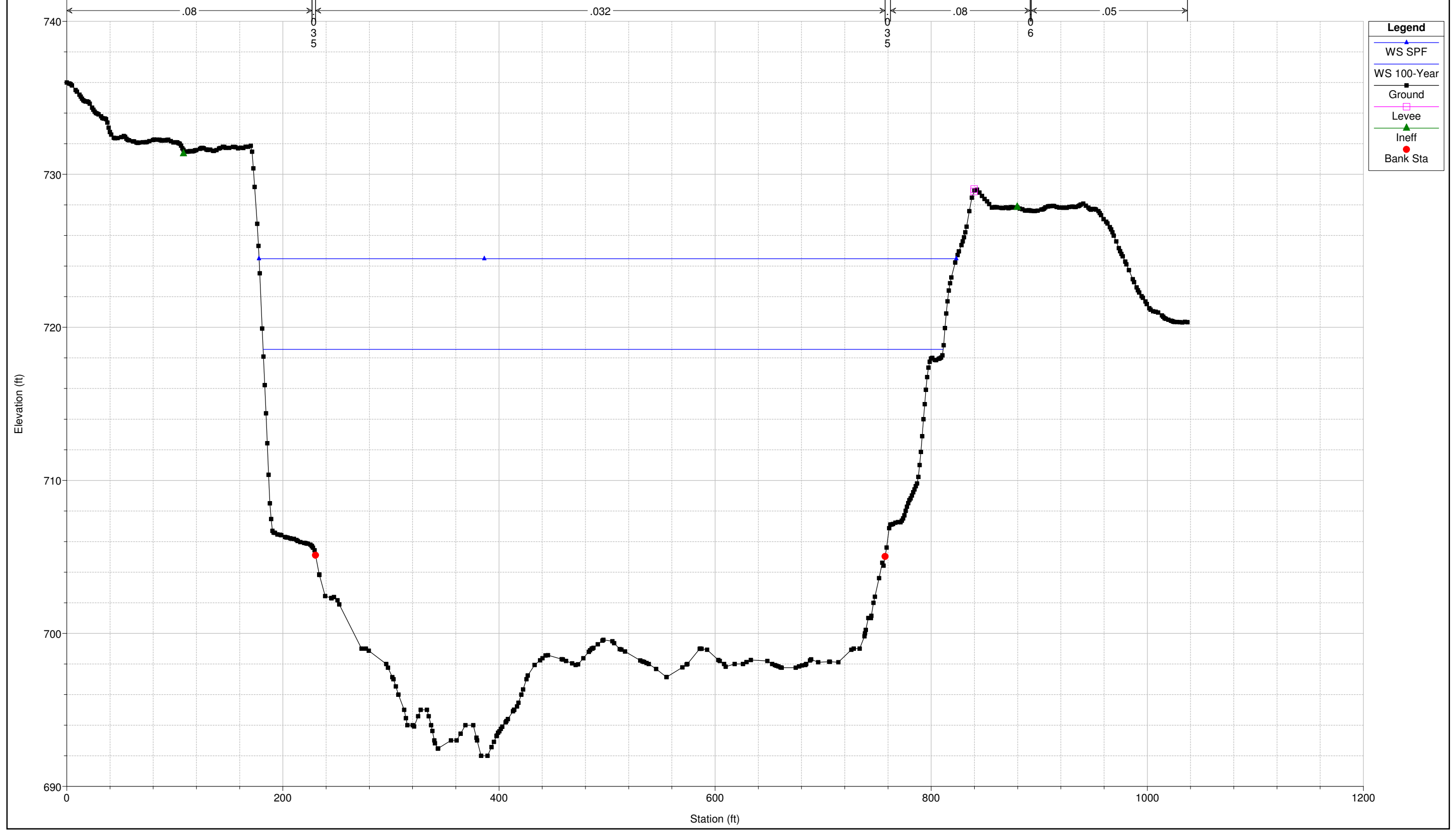


Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 251.3 BR



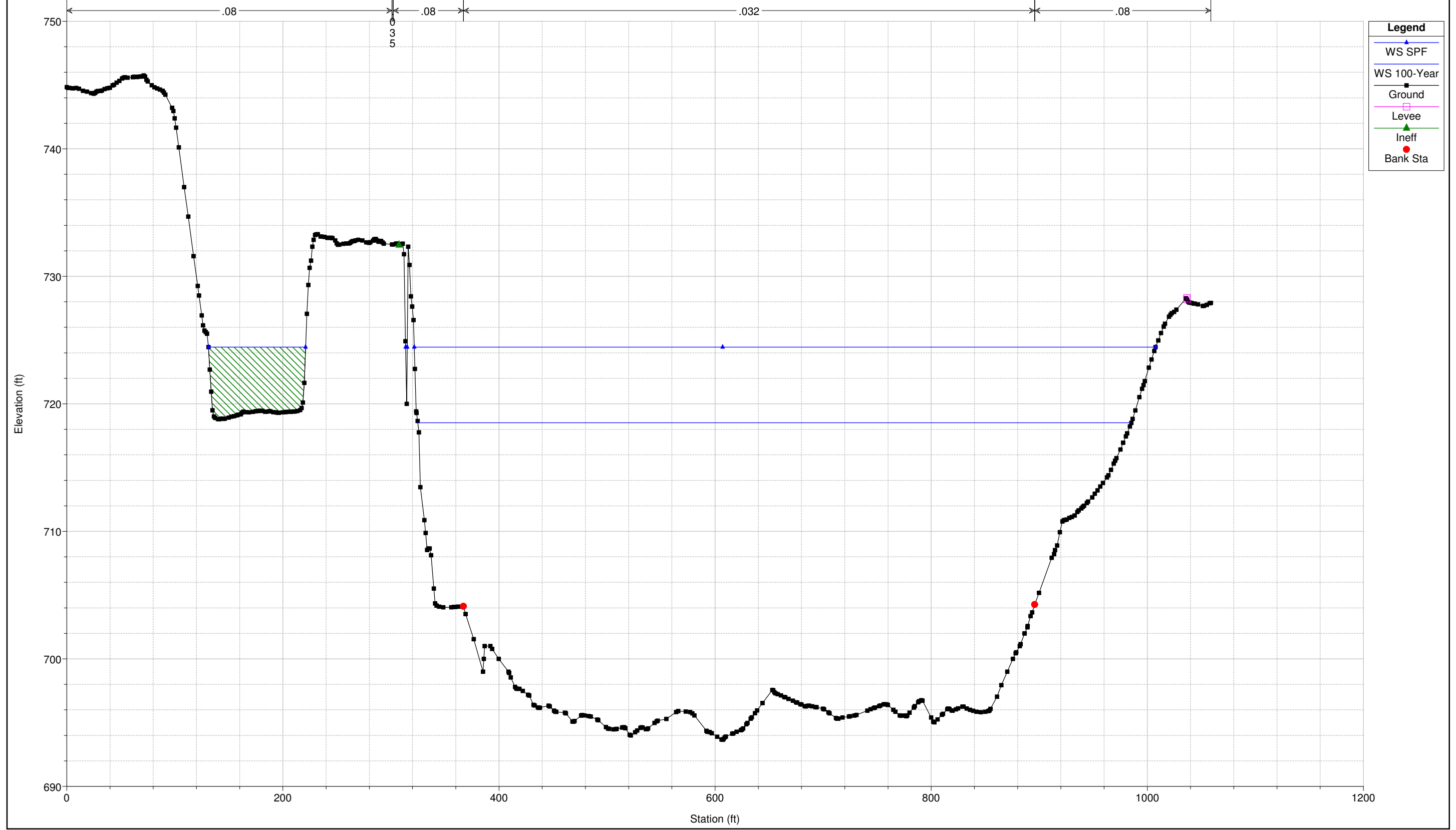
- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 251.1

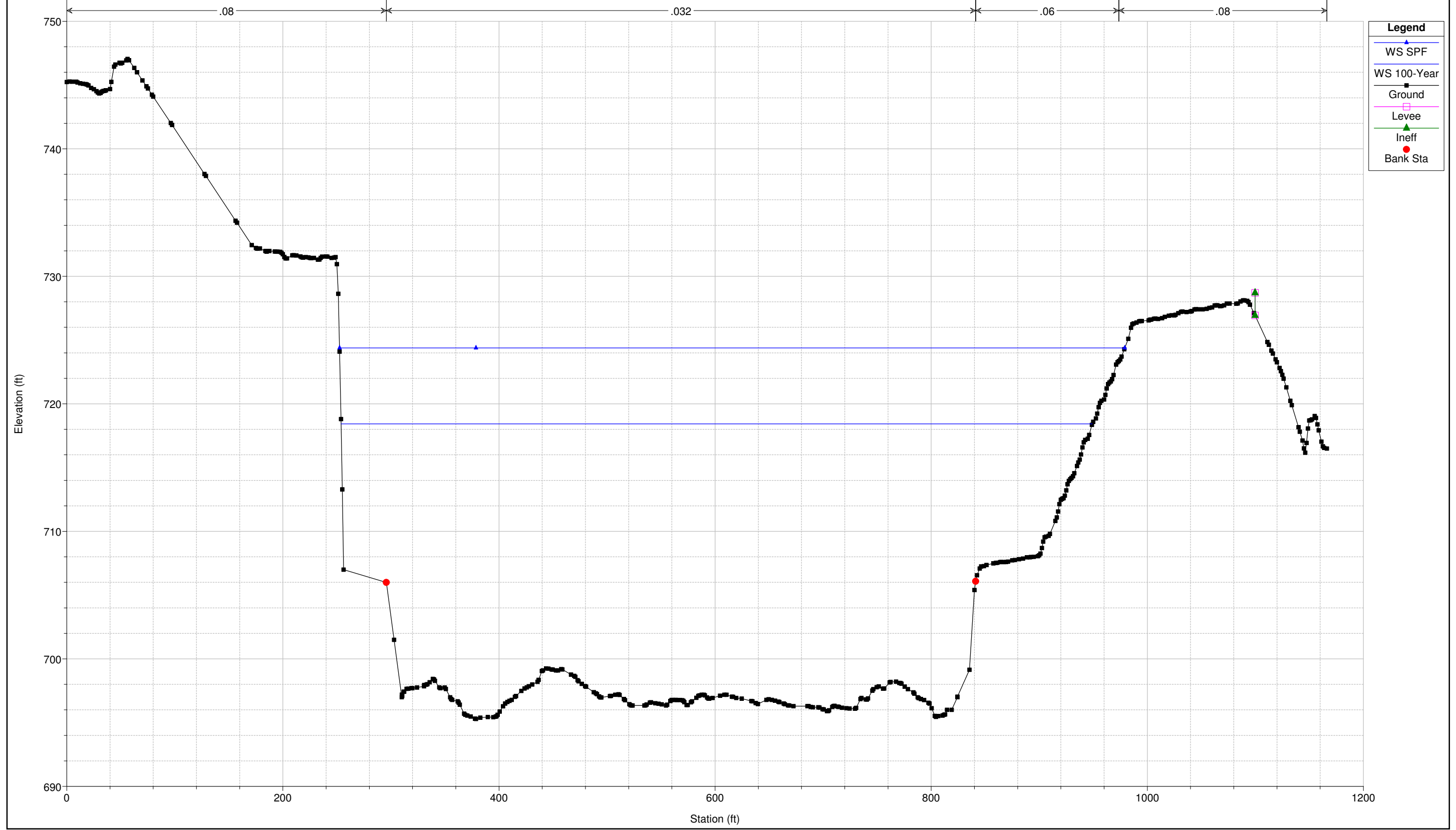


- Legend
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

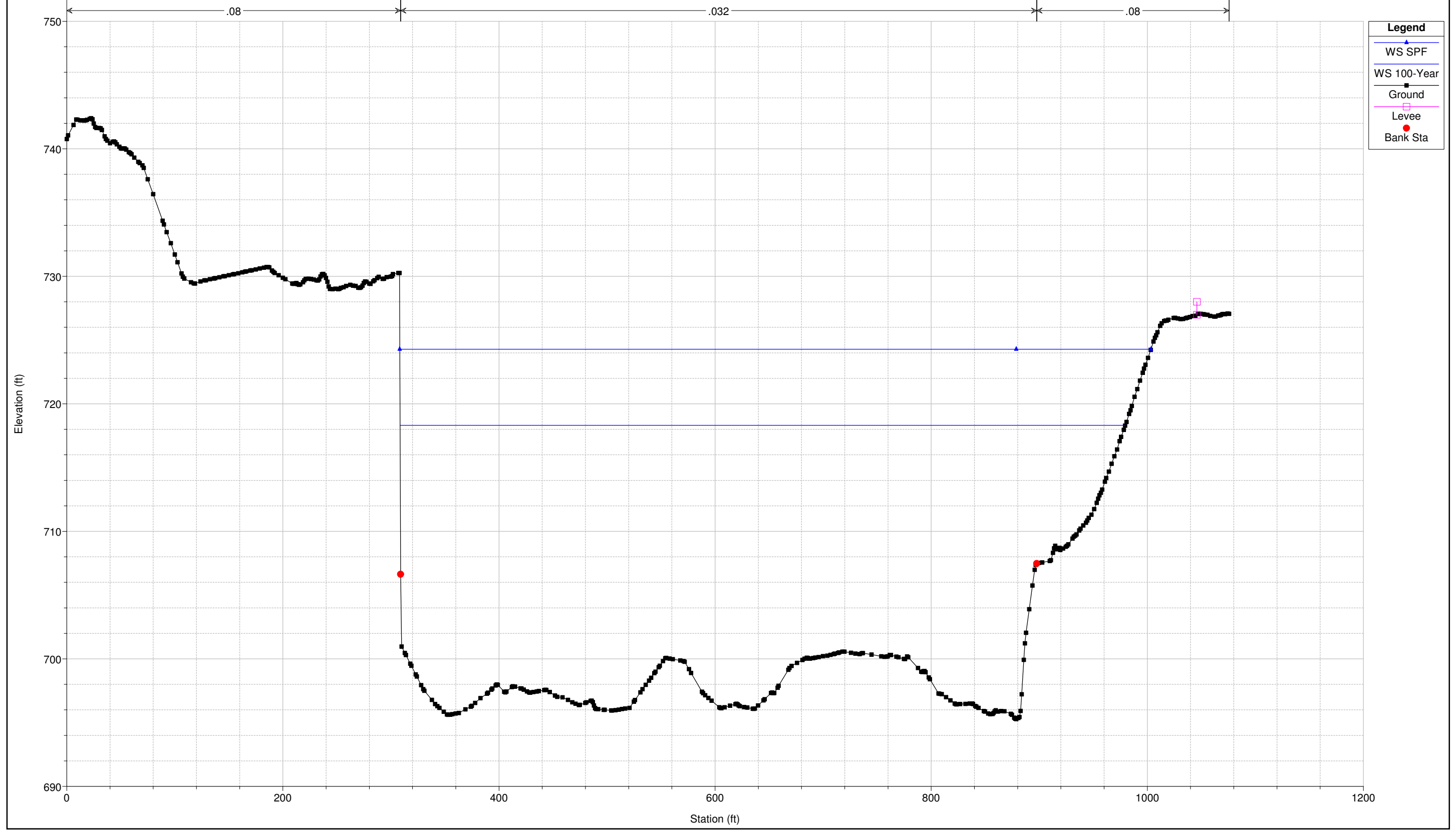
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 250.776



SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 250.6268



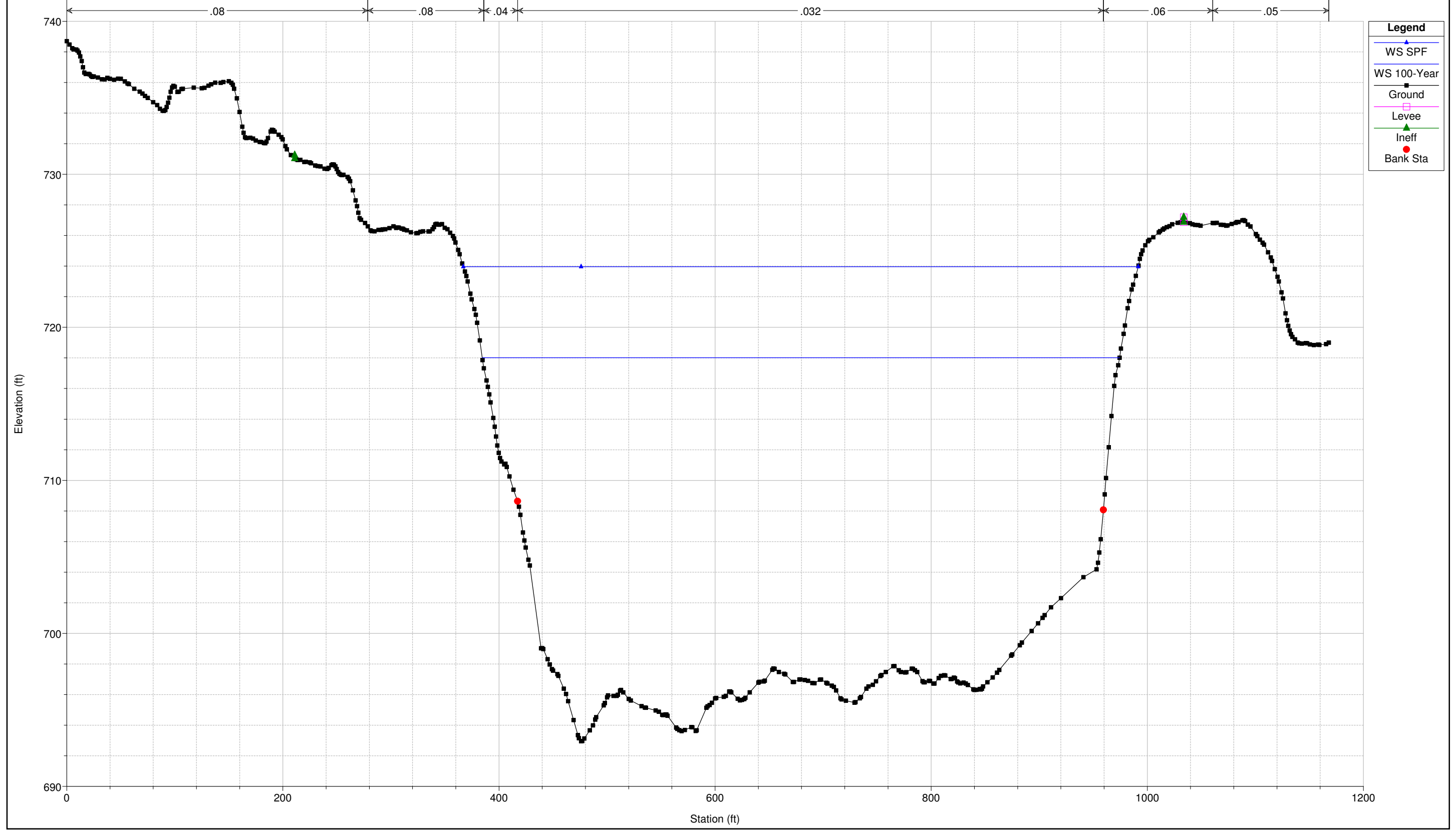
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 250.5503



Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Bank Sta

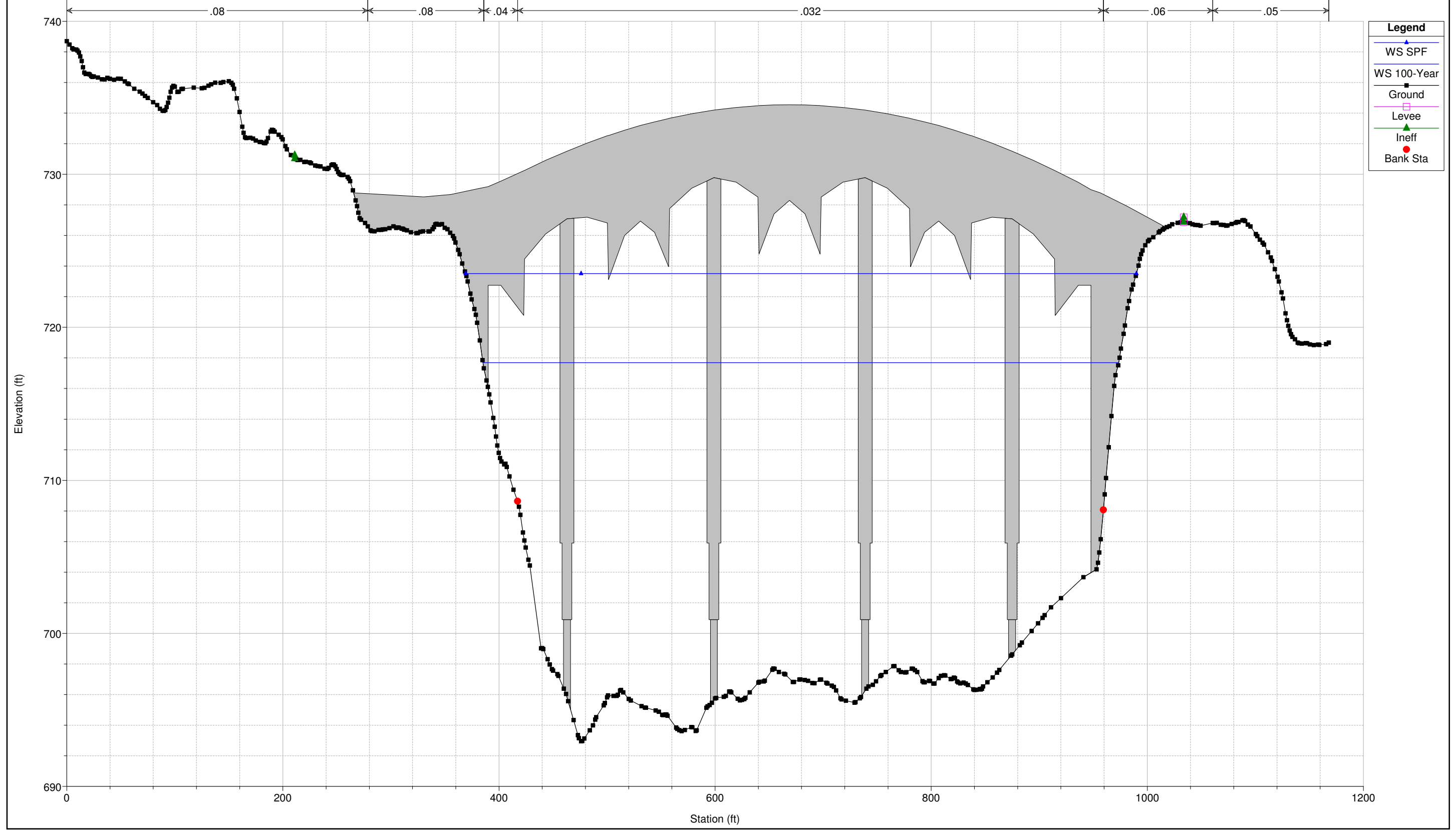
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 250.4728



Legend

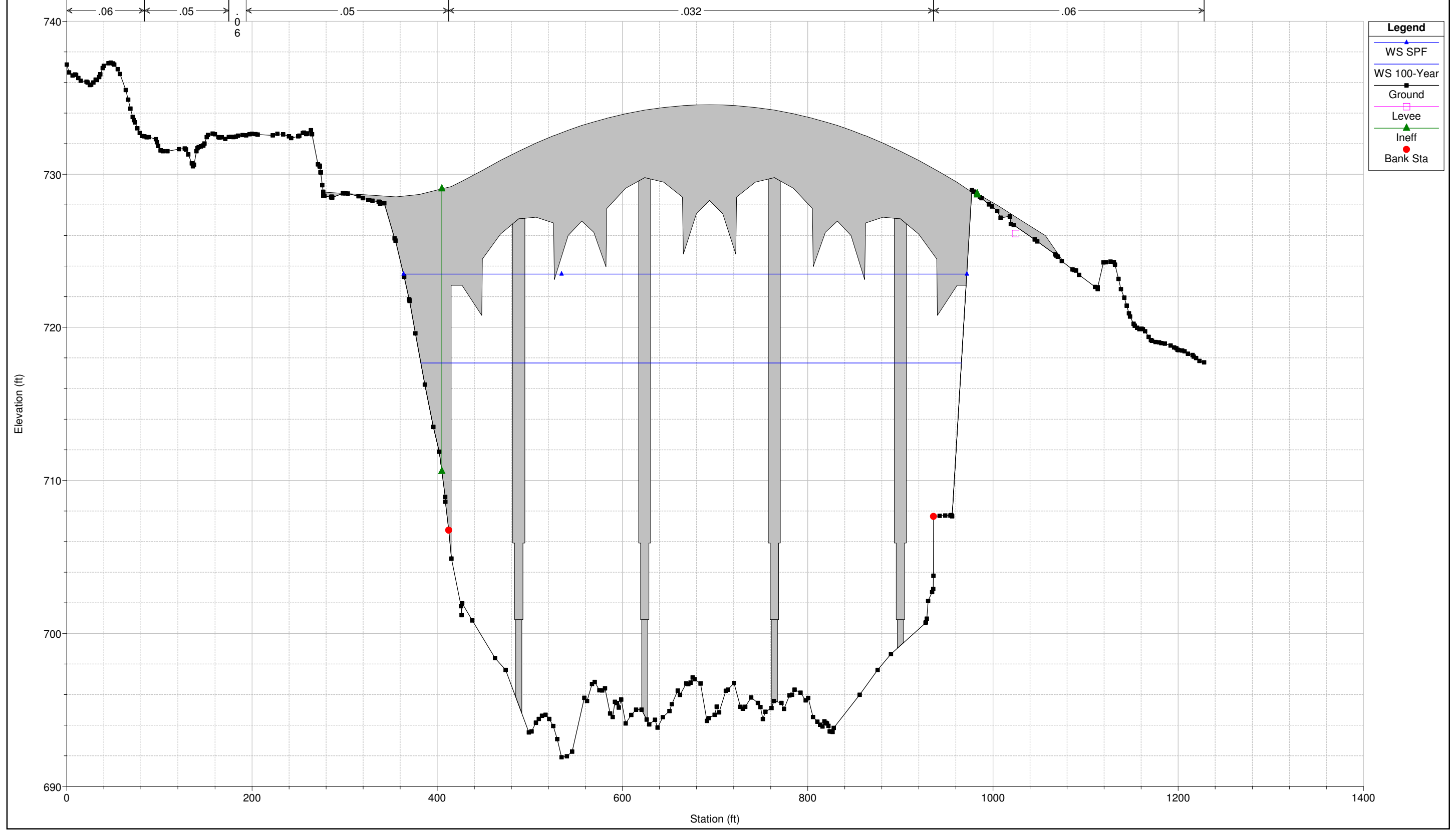
- WS SPF (Blue line with triangle marker)
- WS 100-Year (Blue line with square marker)
- Ground (Black line with square marker)
- Levee (Magenta line with square marker)
- Ineff (Green line with triangle marker)
- Bank Sta (Red circle marker)

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 250.4469 BR



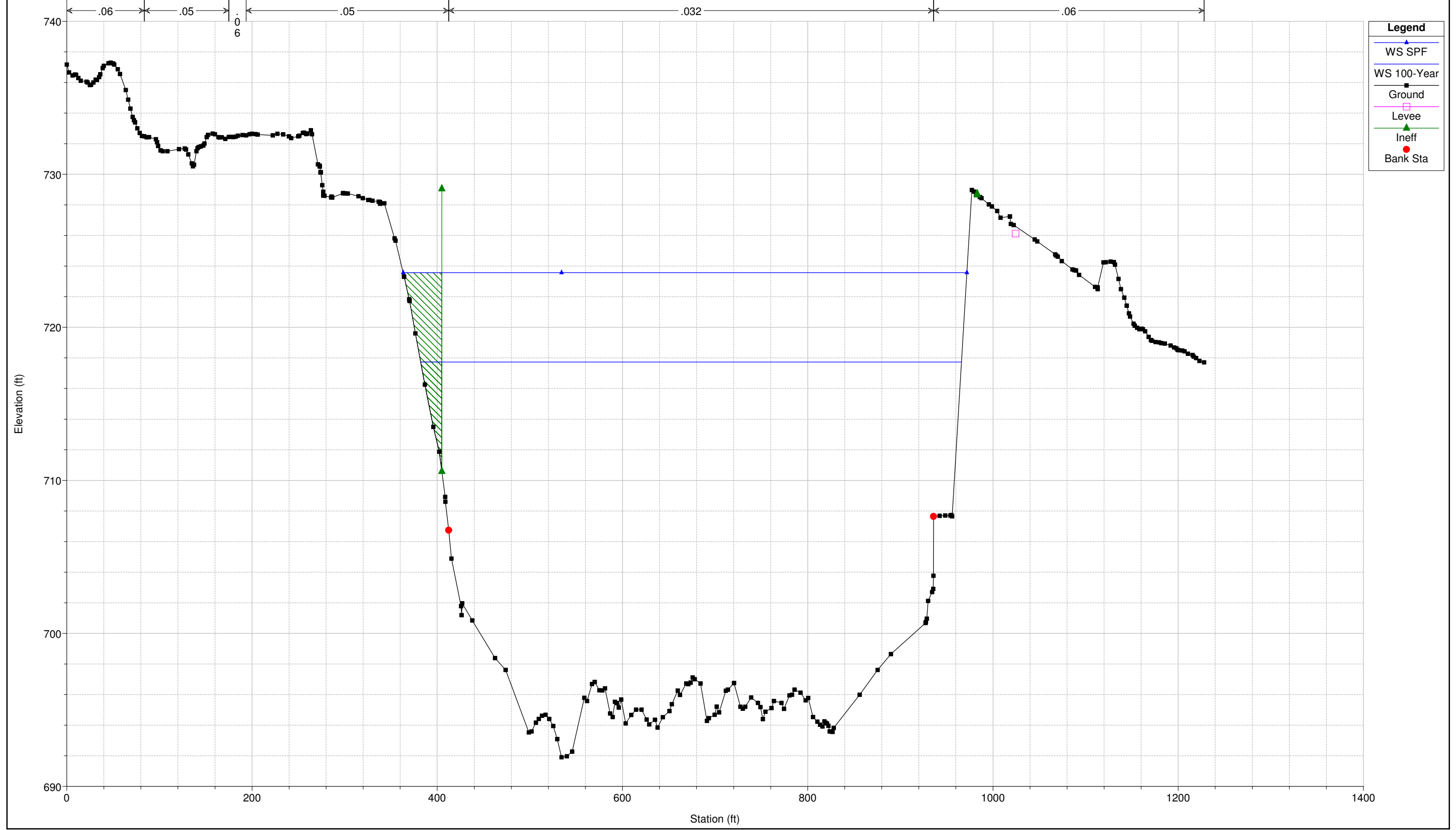
- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 250.4469 BR



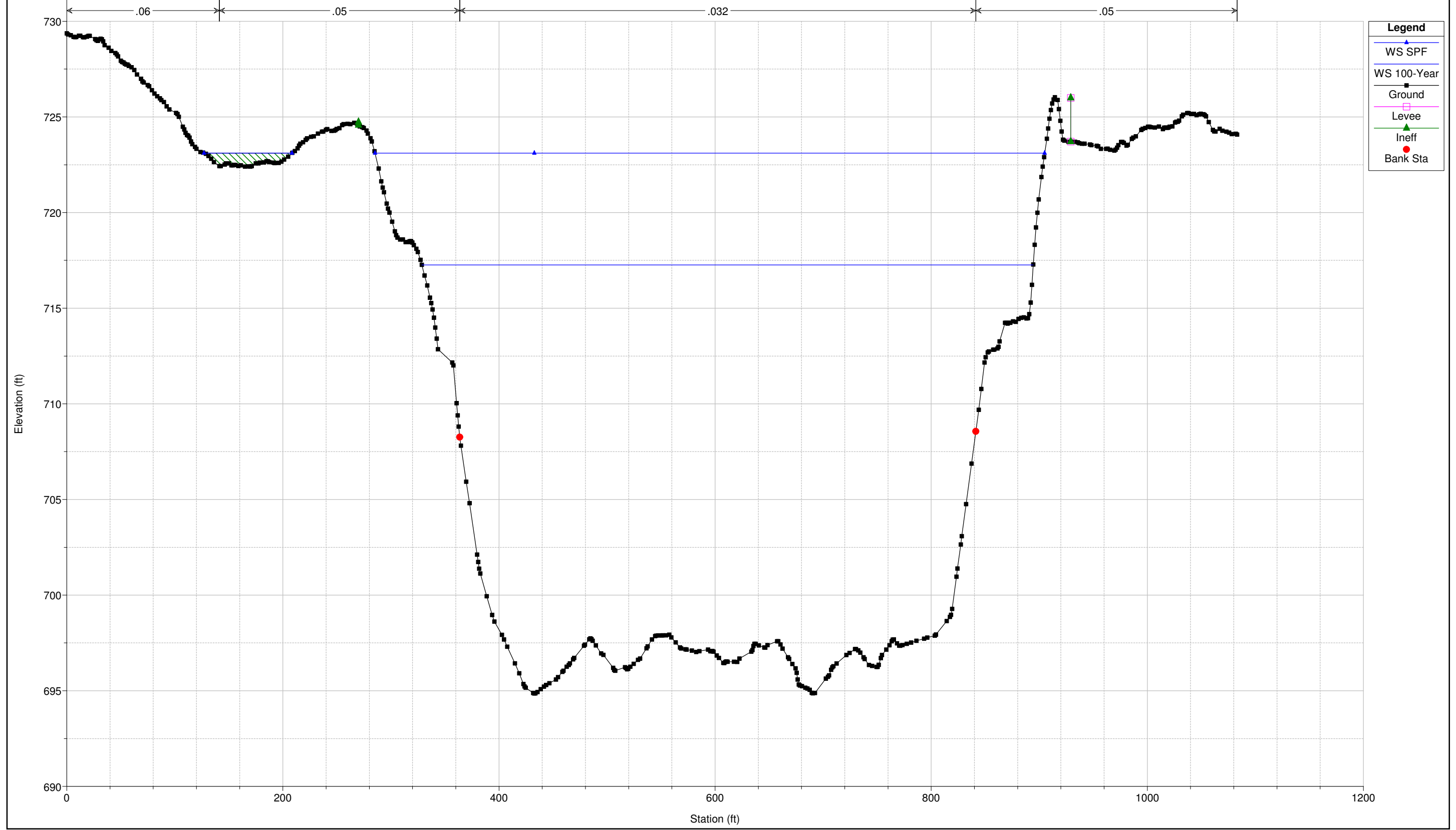
- Legend
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 249.79



- Legend
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

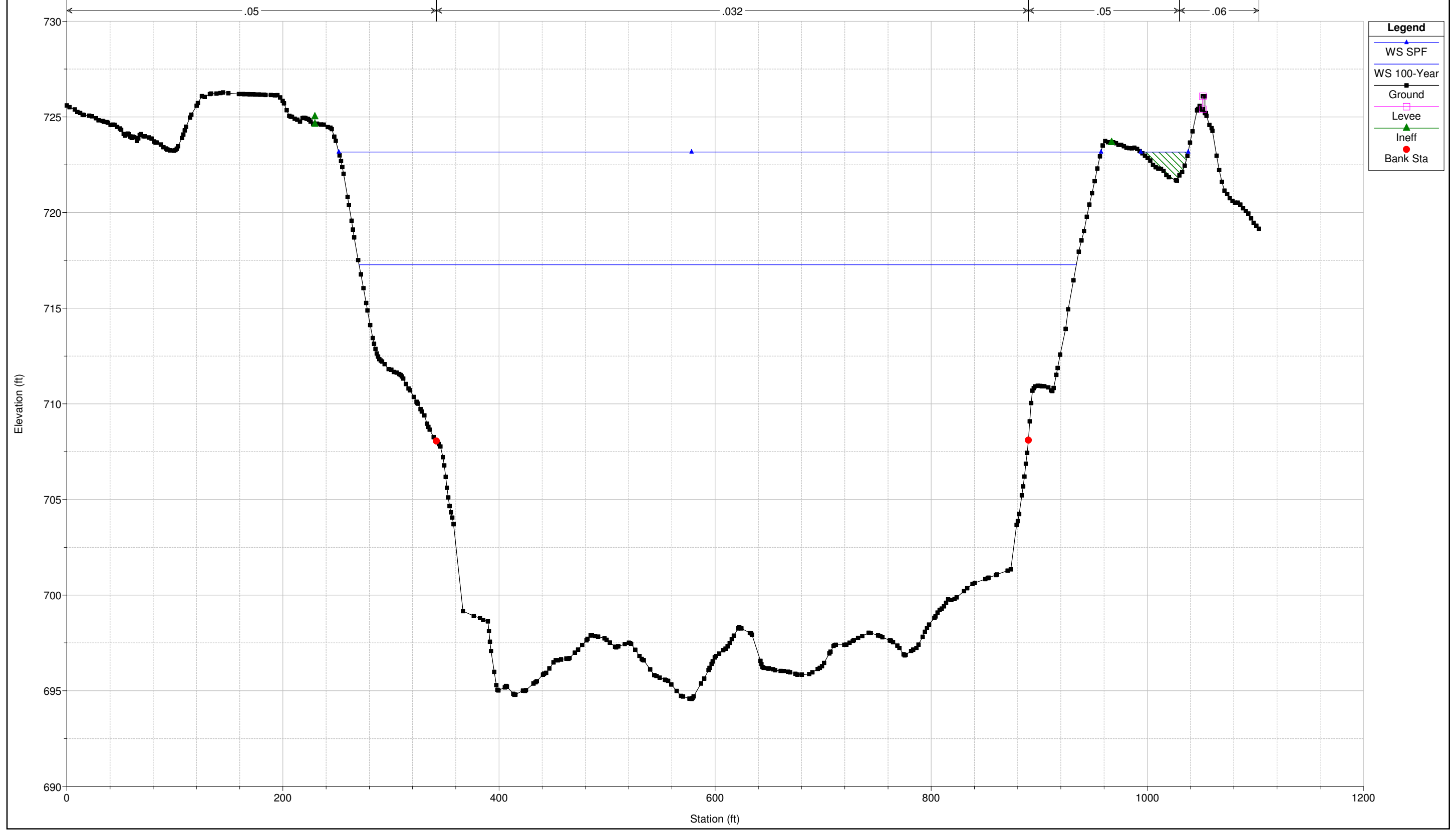
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 249.76



Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

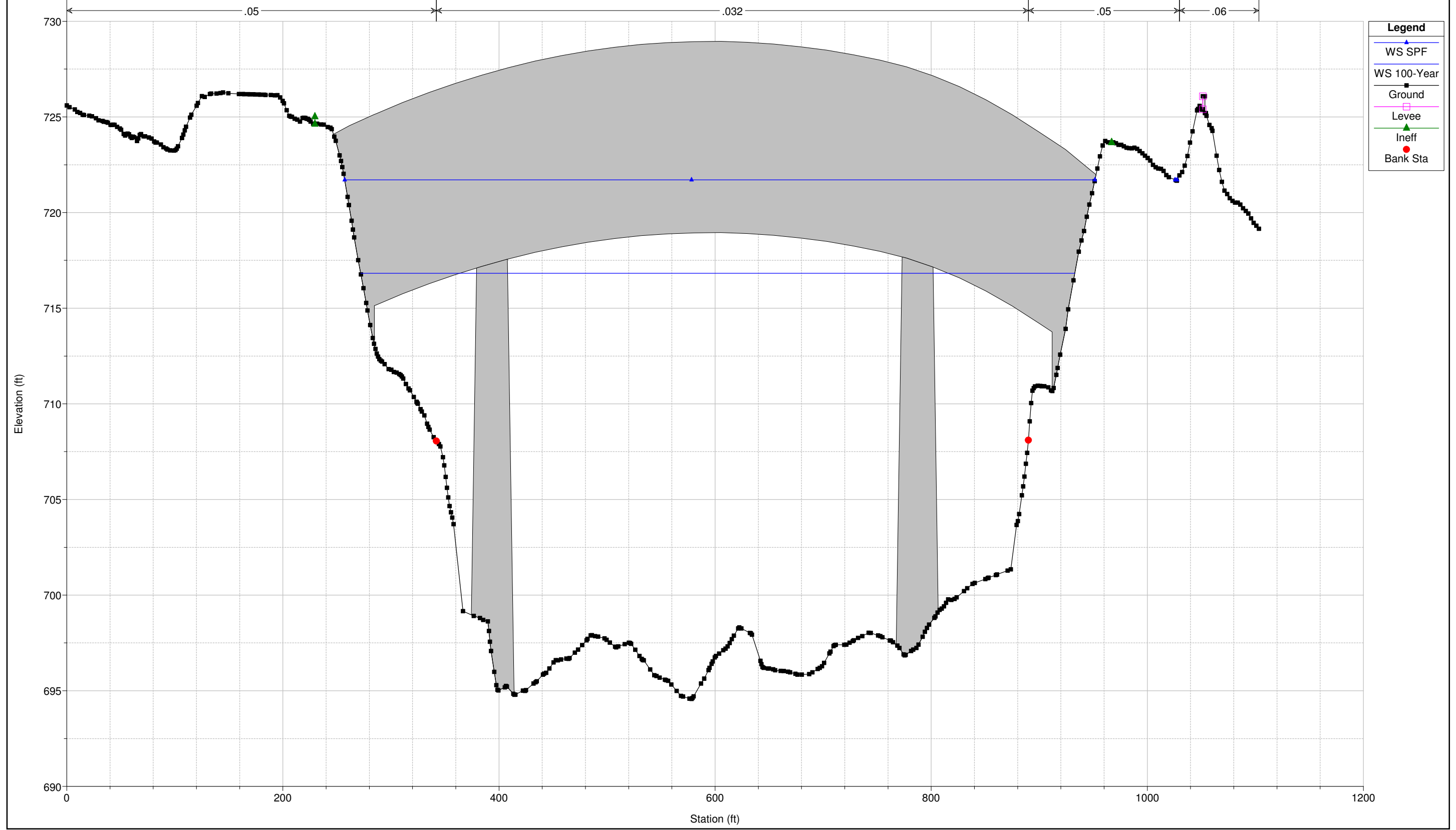
SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 249.5



Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

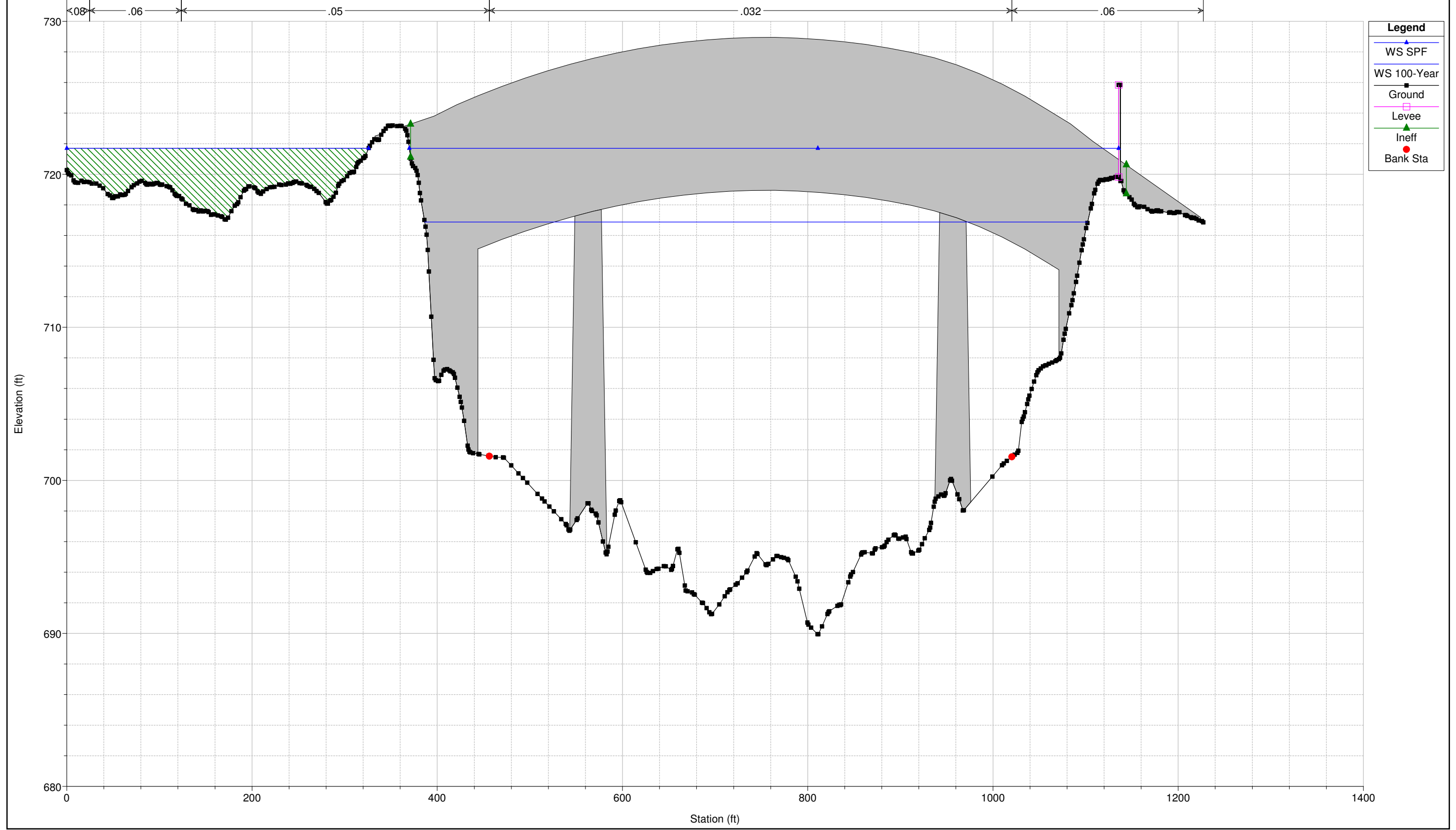
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 249.3 BR



Legend

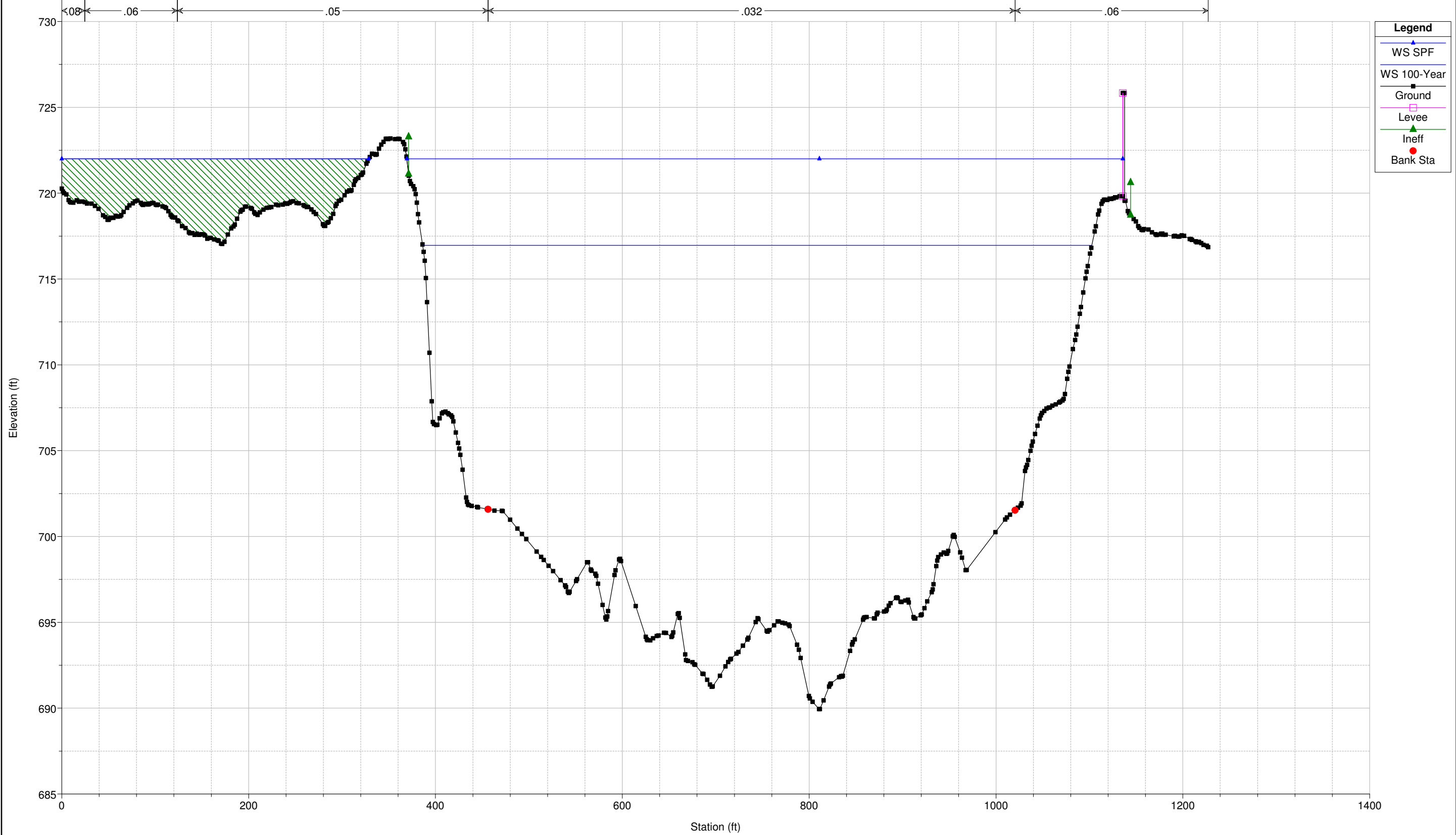
- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line with square)
- Ground (Black line with square)
- Levee (Grey shaded area)
- Ineff (Green line with triangle)
- Bank Sta (Red dot)

SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 249.3 BR



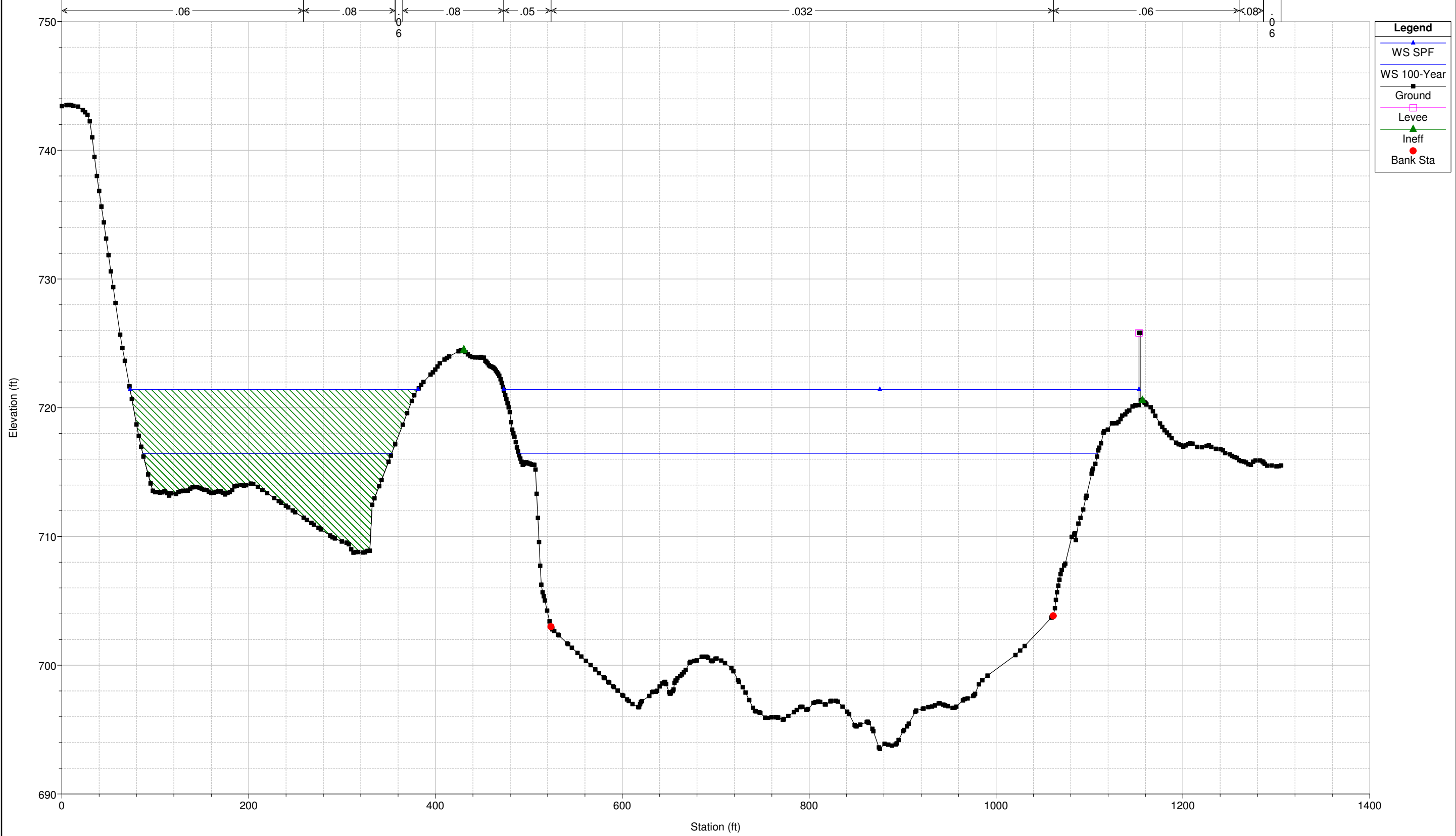
- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 249.1

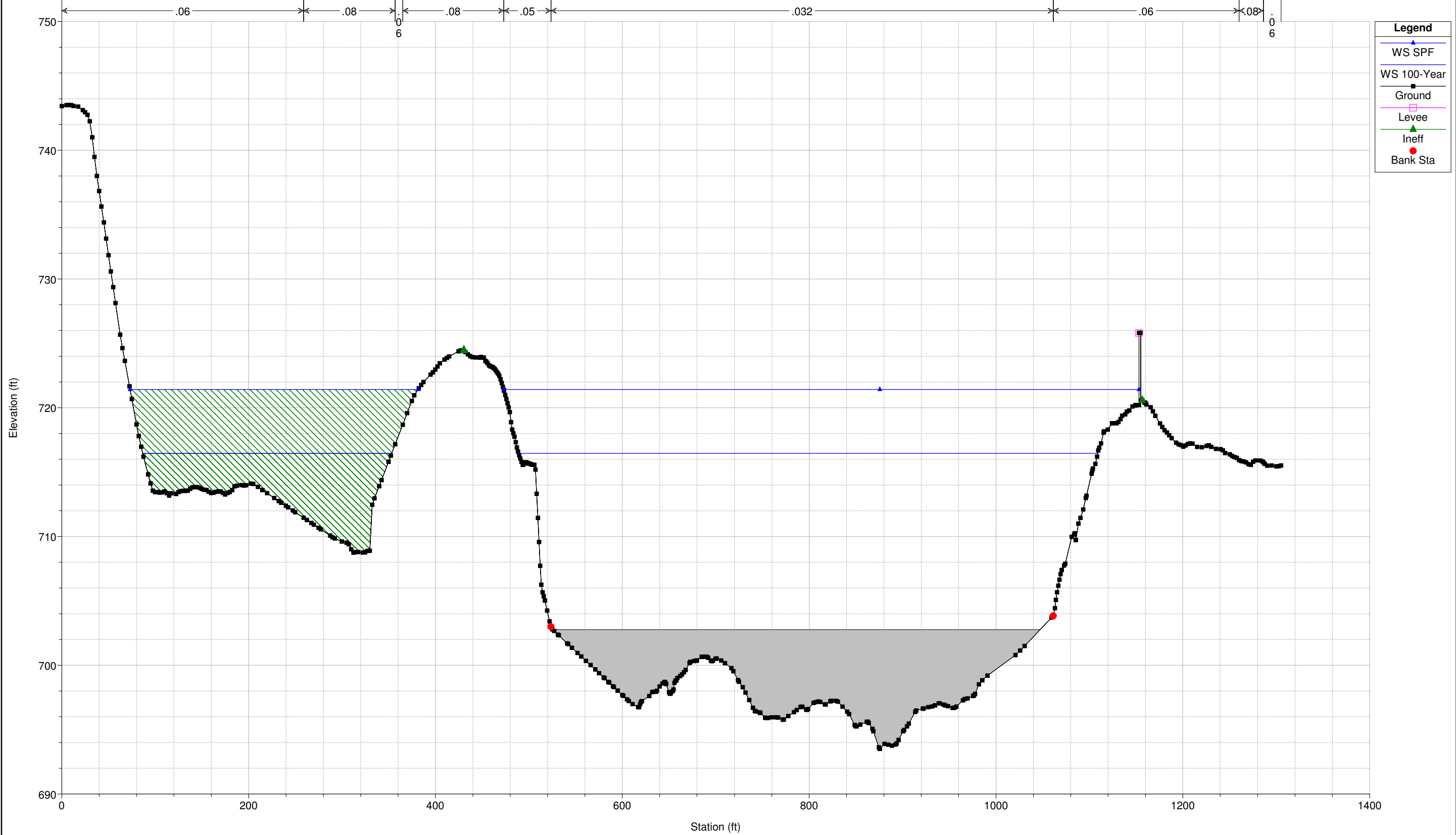


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

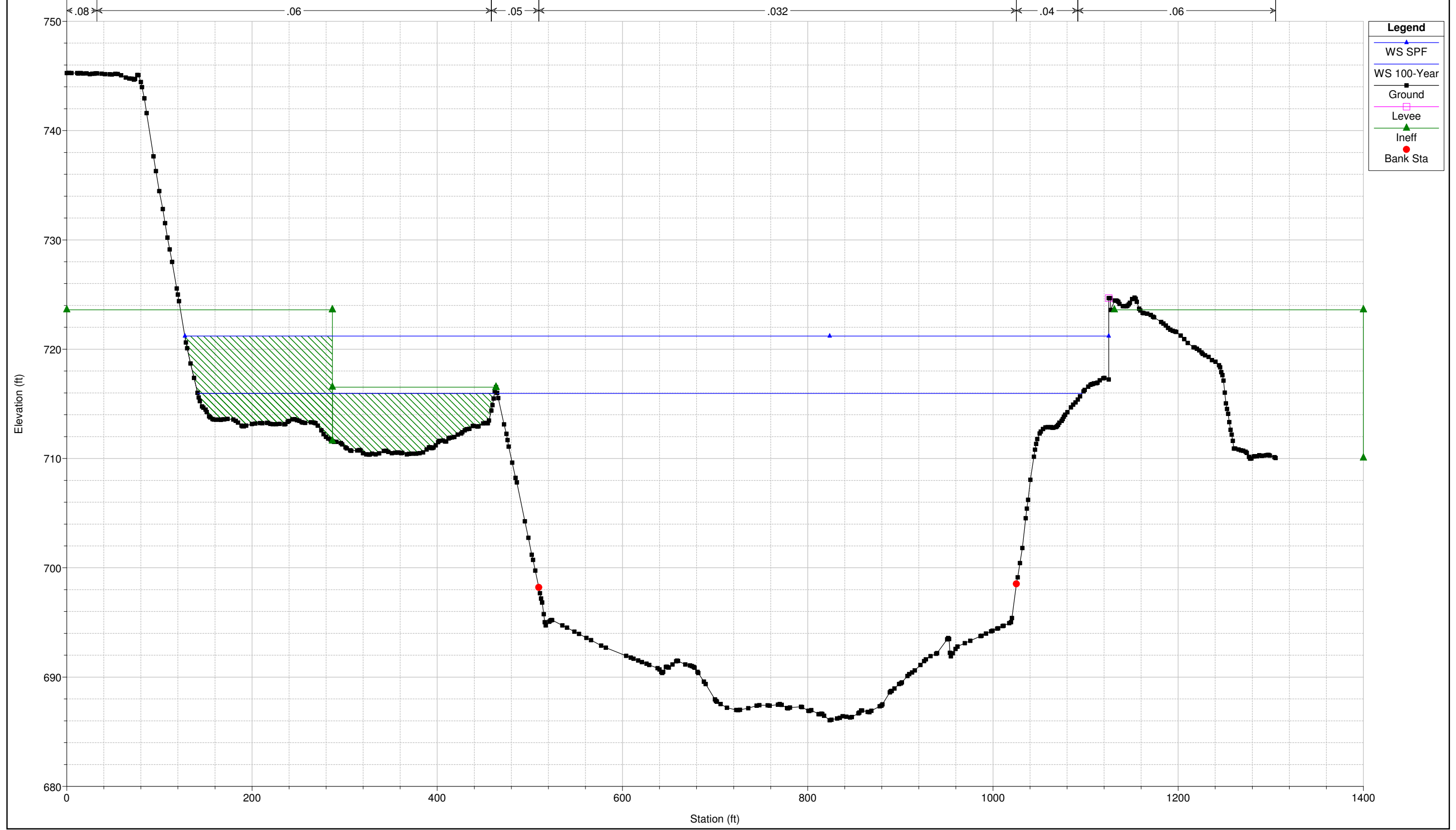
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 249



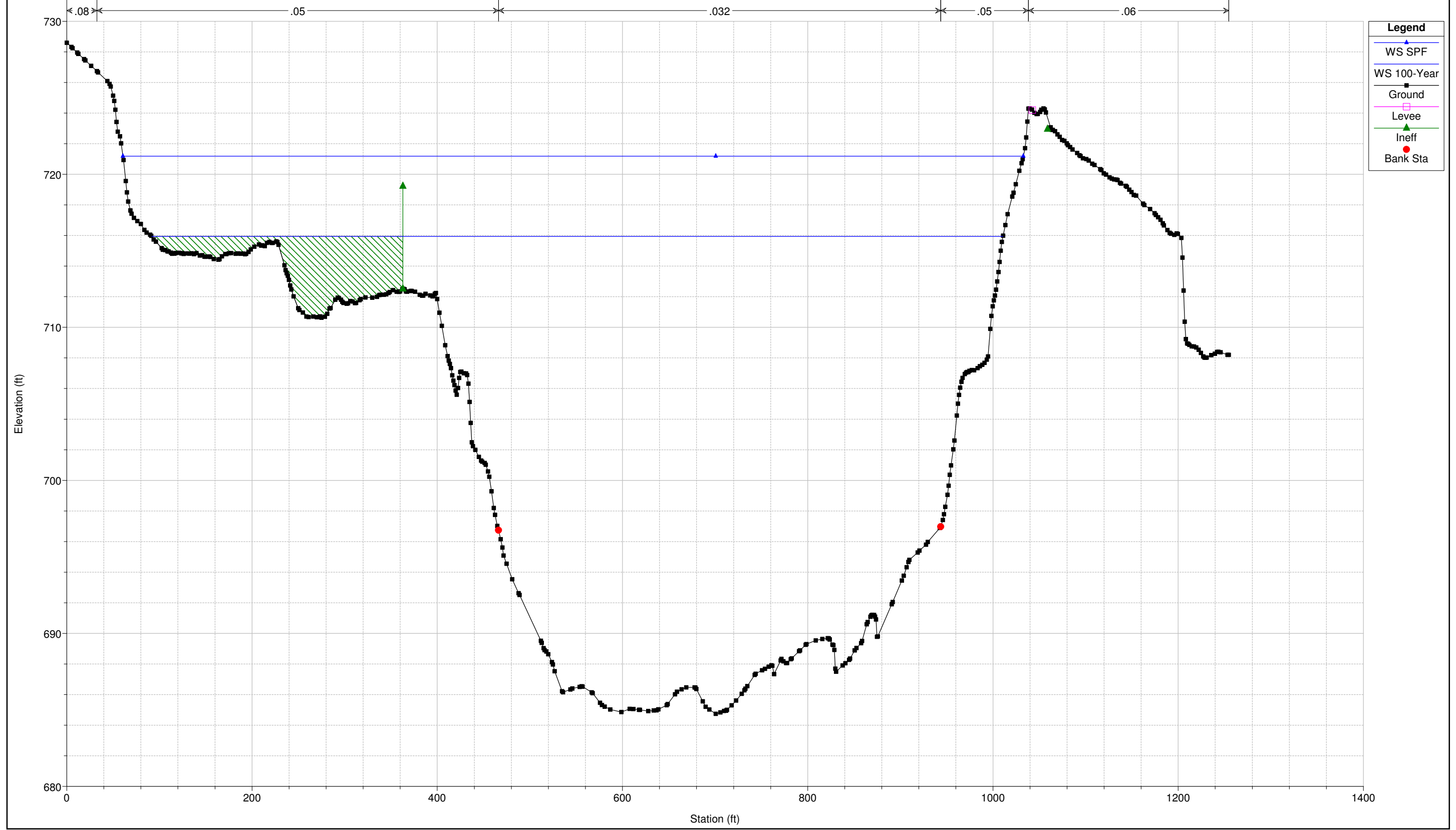
Sciotogreenways Plan: Corrected Effective / Pre-project
 RS = 248.6 IS



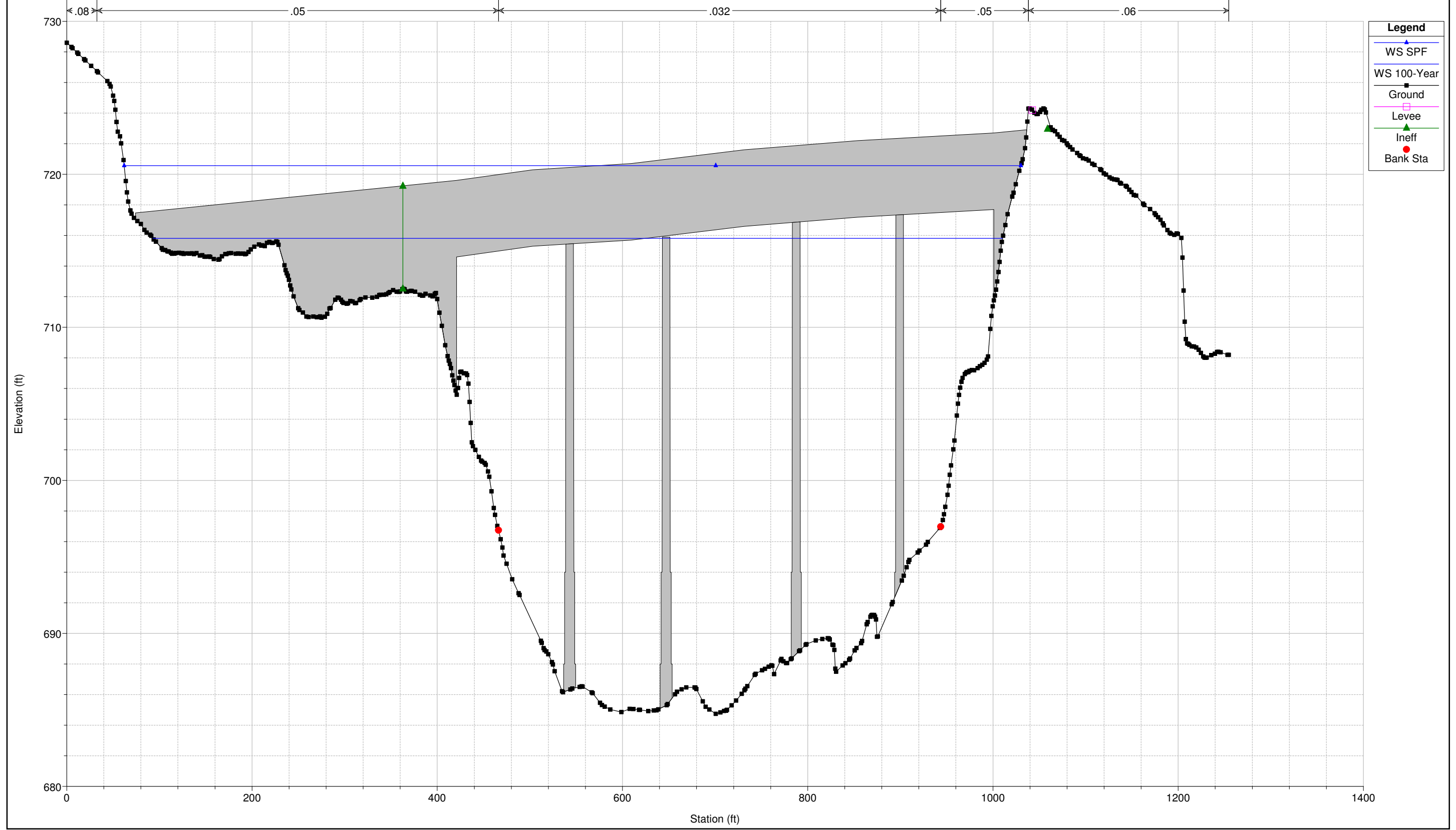
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 248.3



SciotoGreenways Plan: Corrected Effective / Pre-project
RS = 247.5



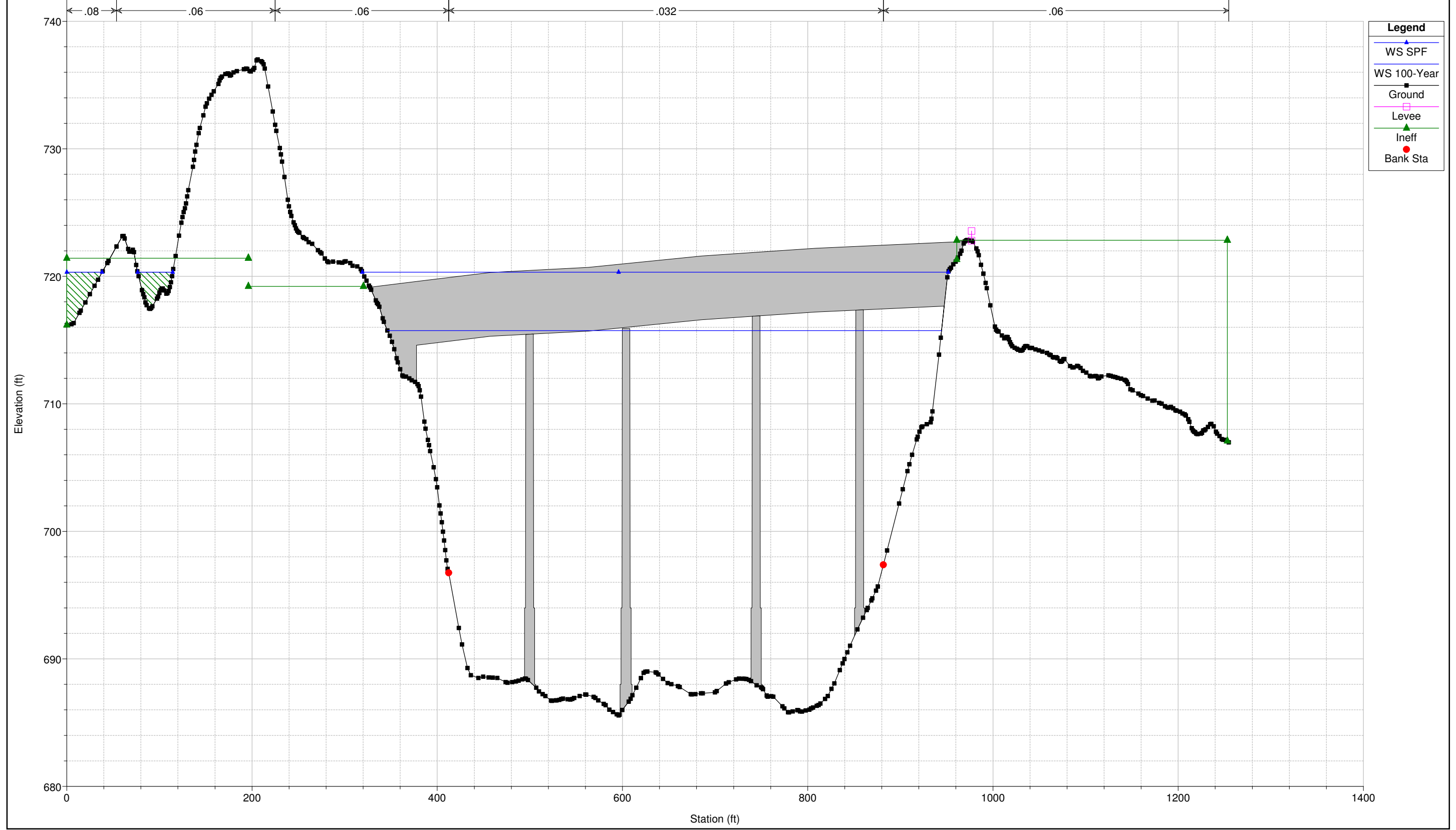
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 247.3 BR



Legend

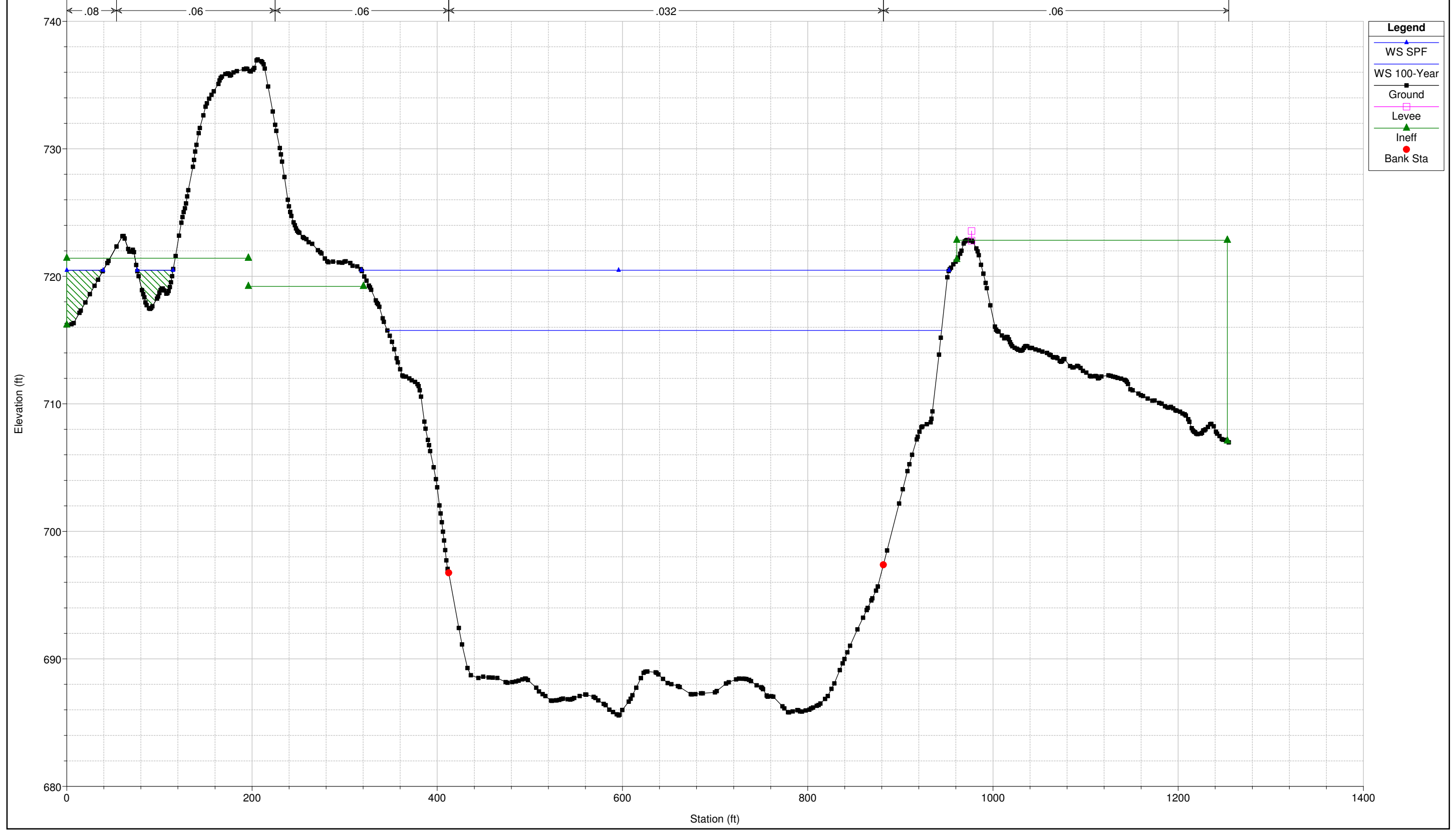
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 247.3 BR



- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Levee
 - Ineff
 - Bank Sta

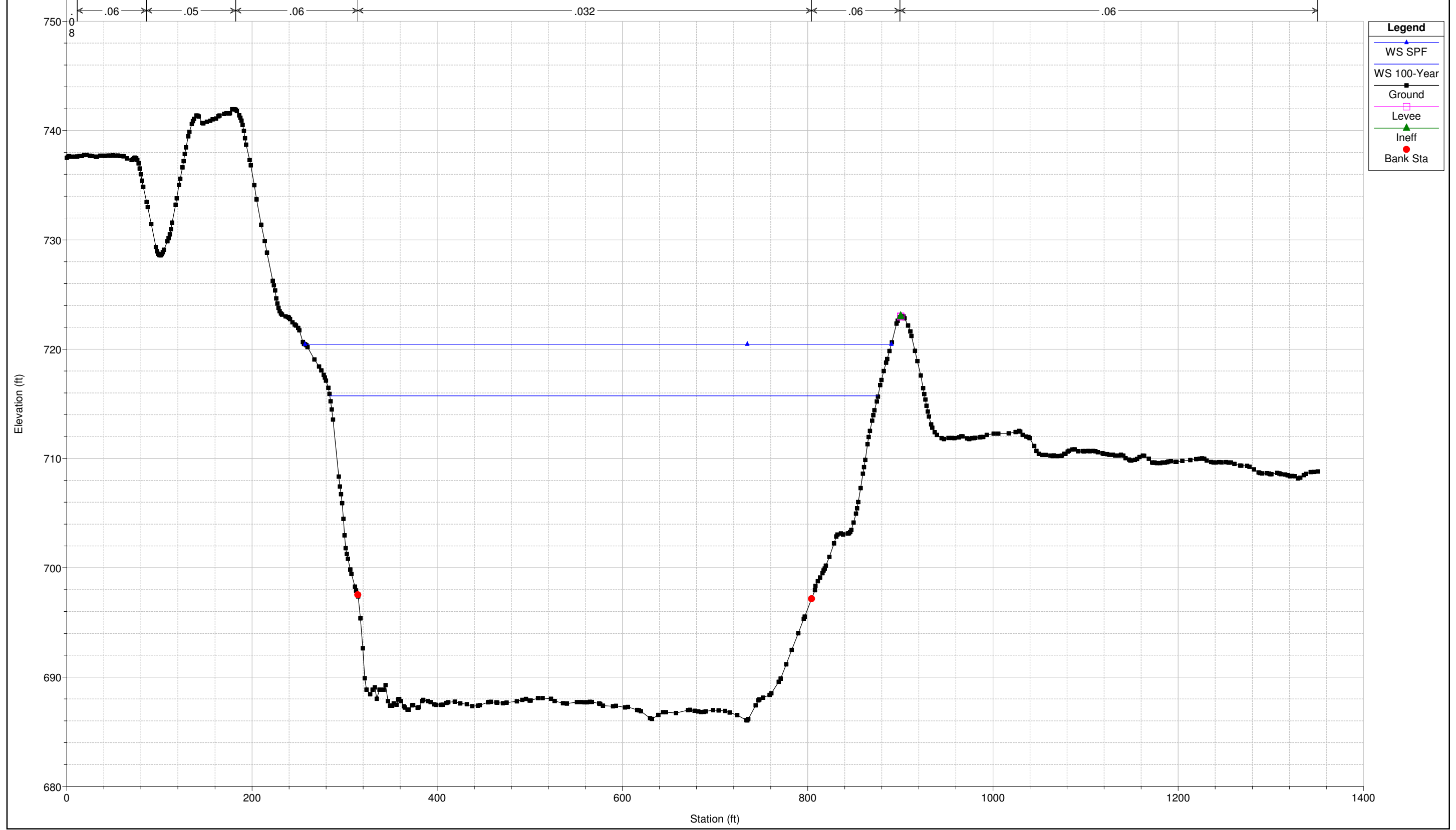
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 247.1



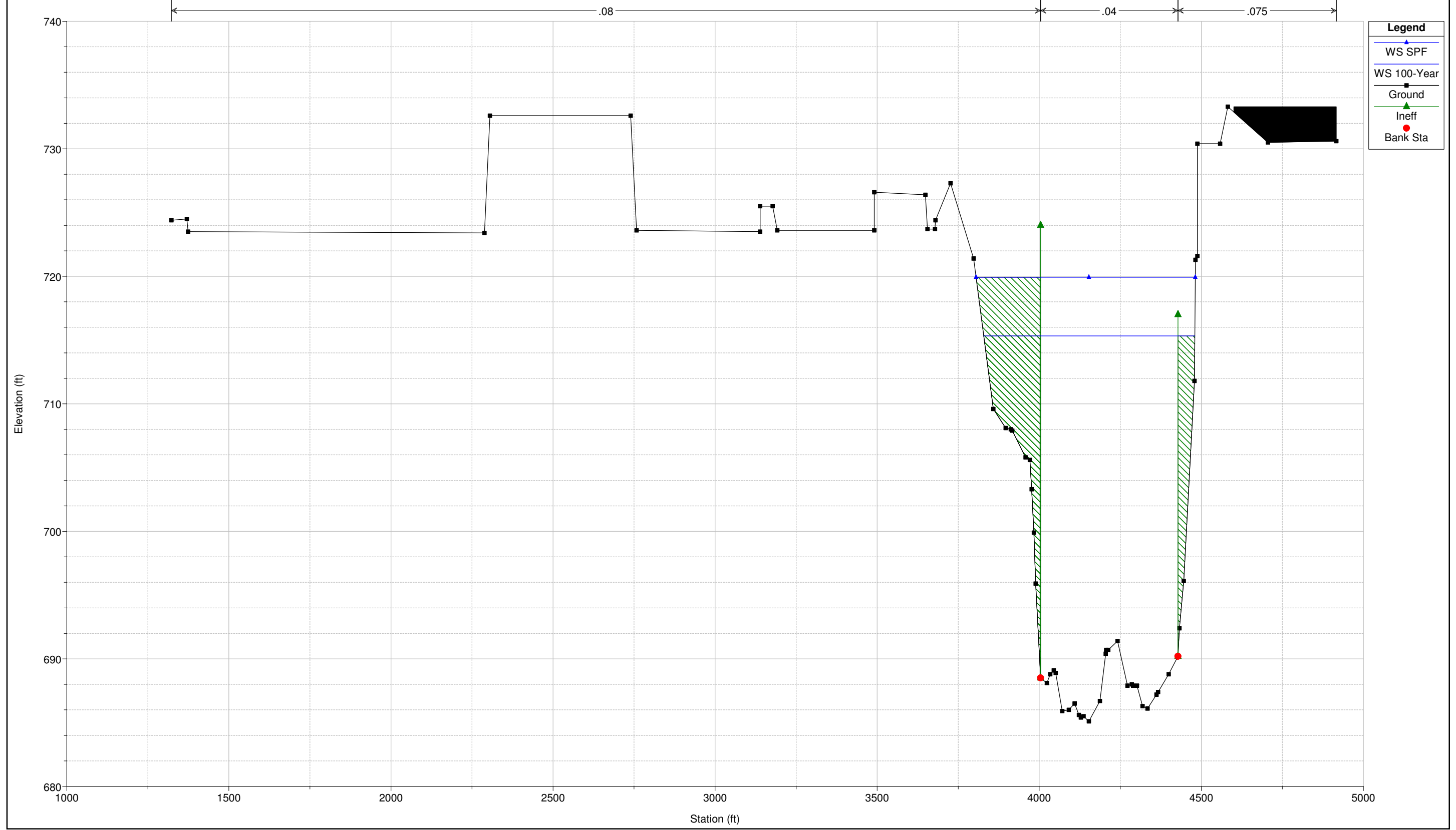
Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.8



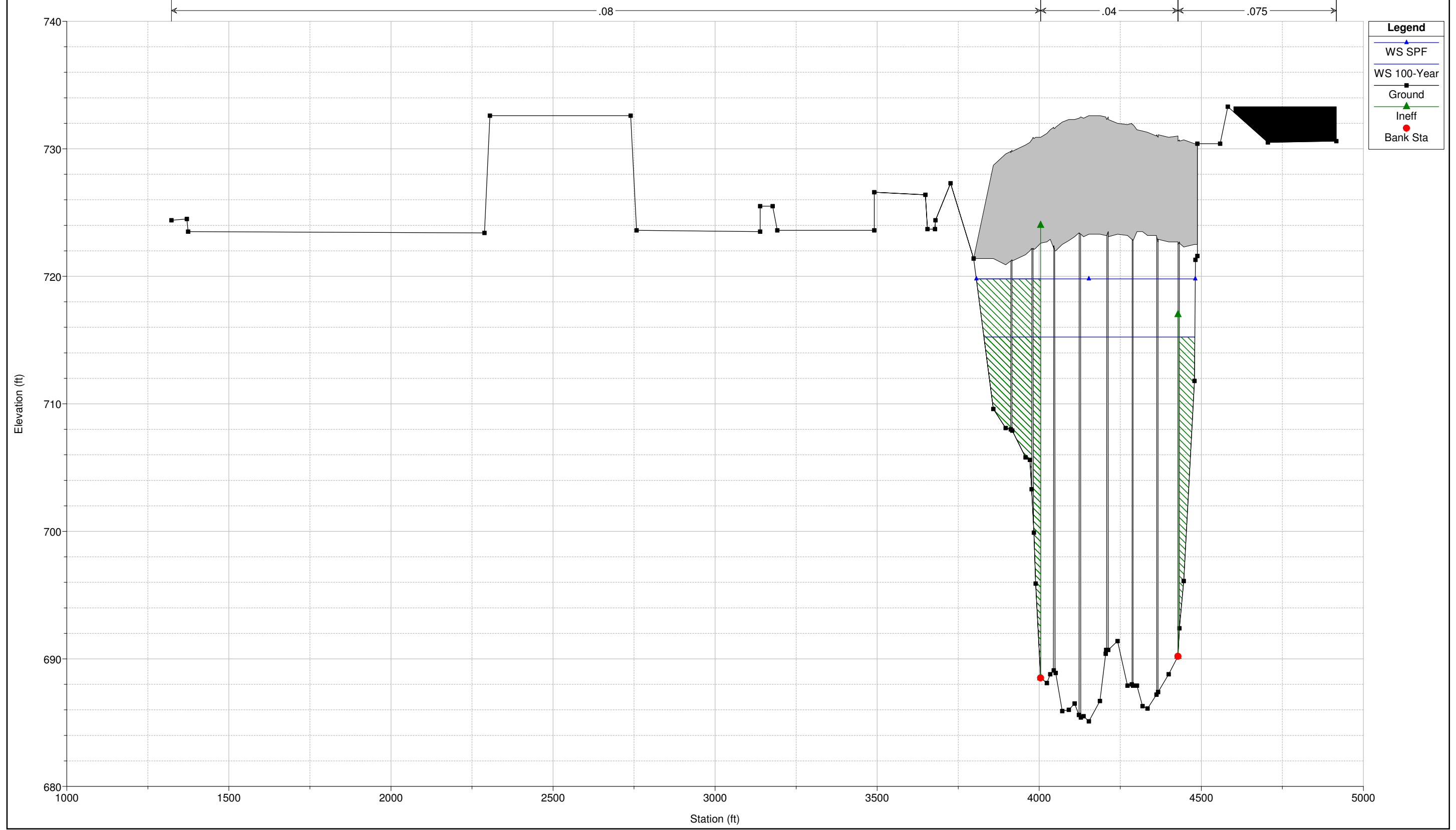
Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.4



Legend

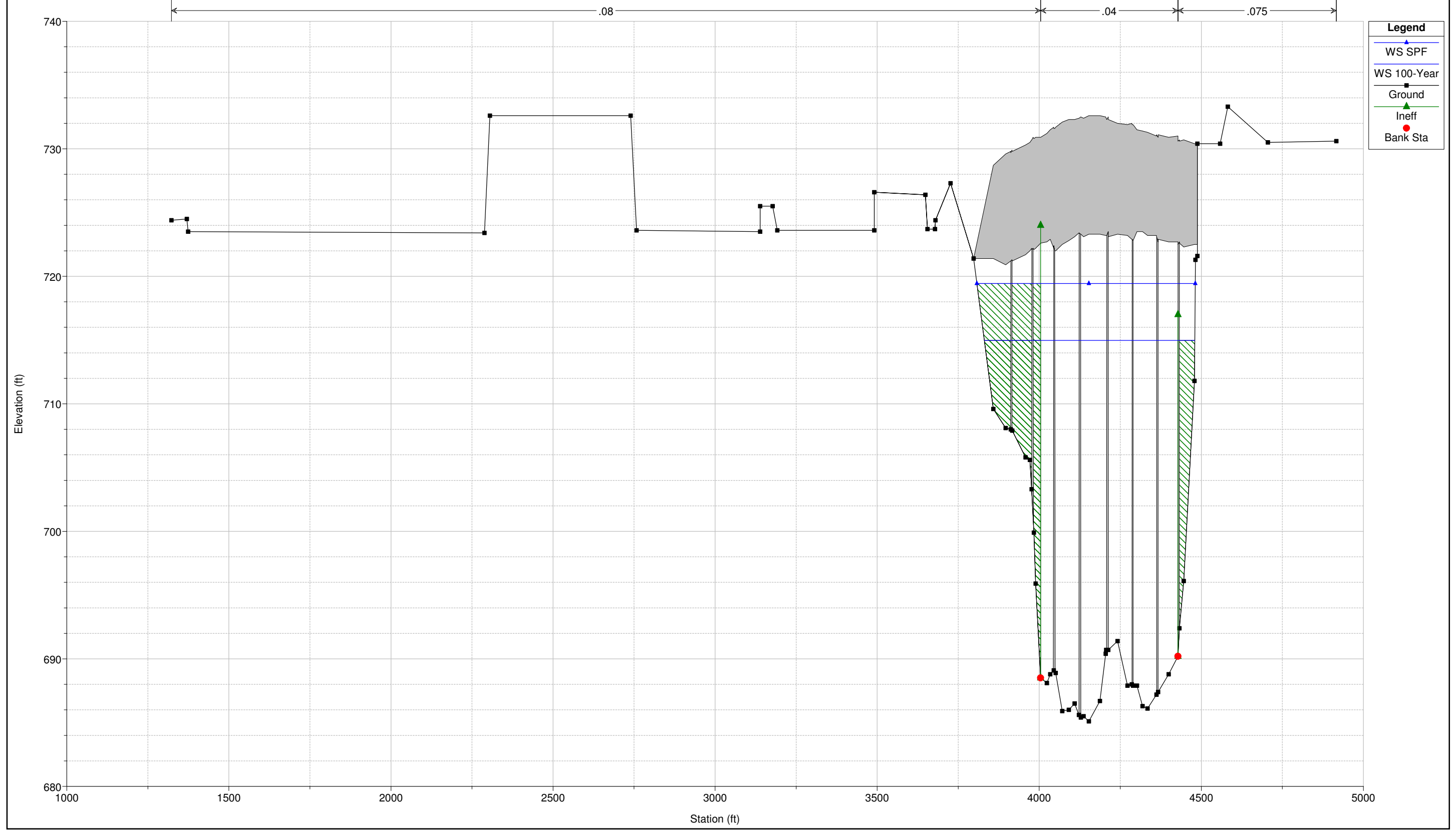
- WS SPF
- WS 100-Year
- Ground
- Ineff
- Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.3 BR



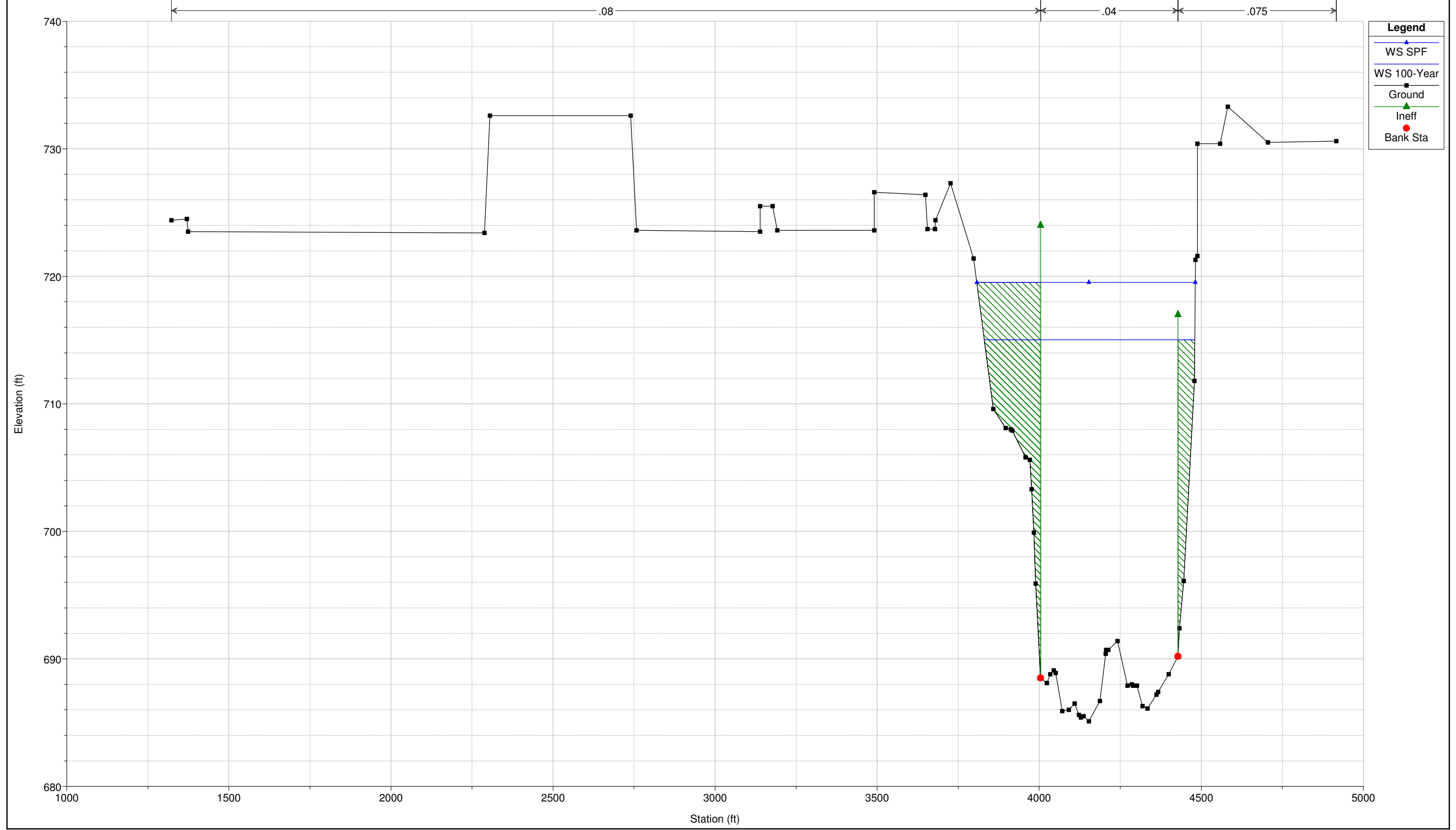
- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.3 BR



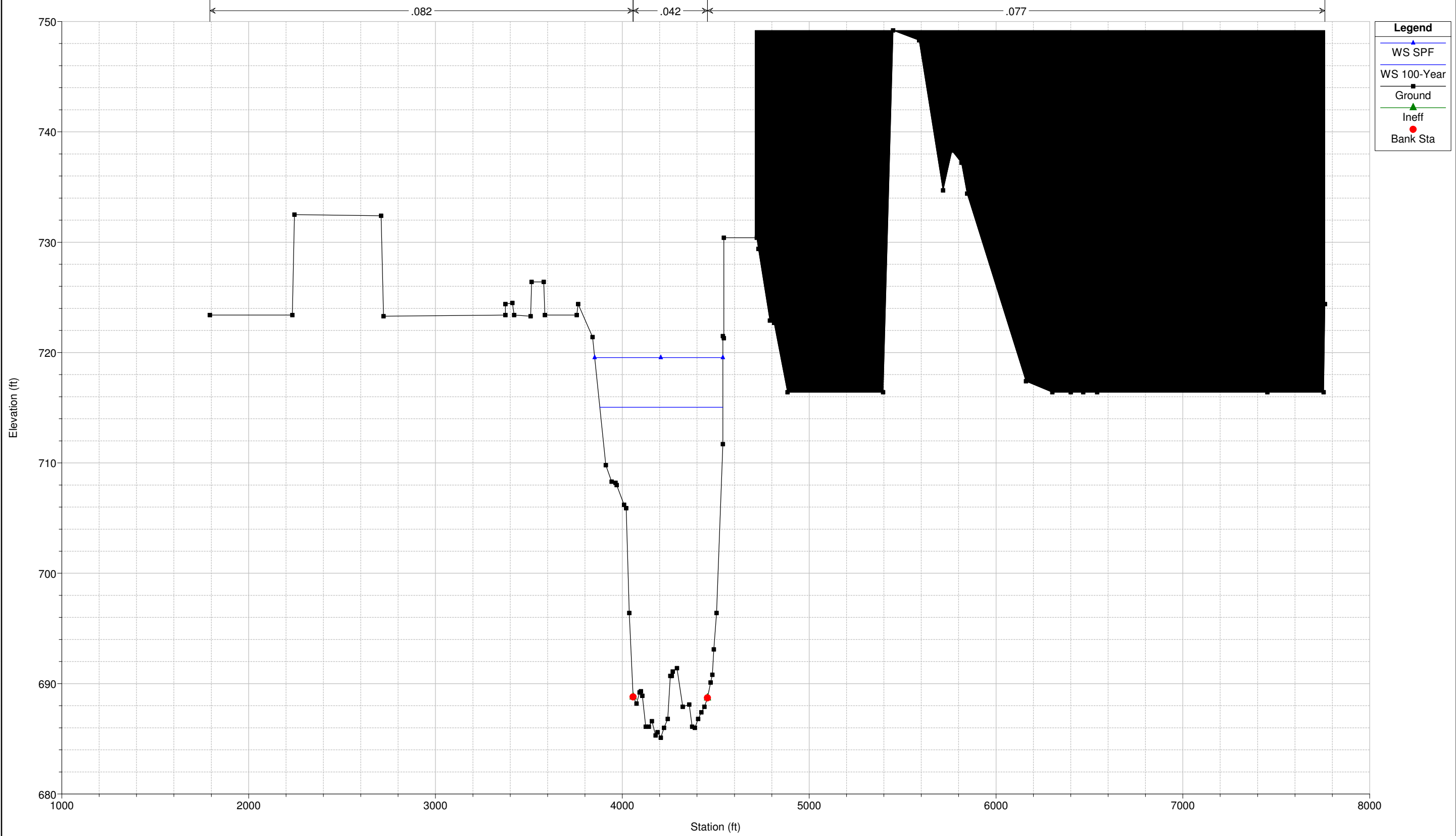
- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.2

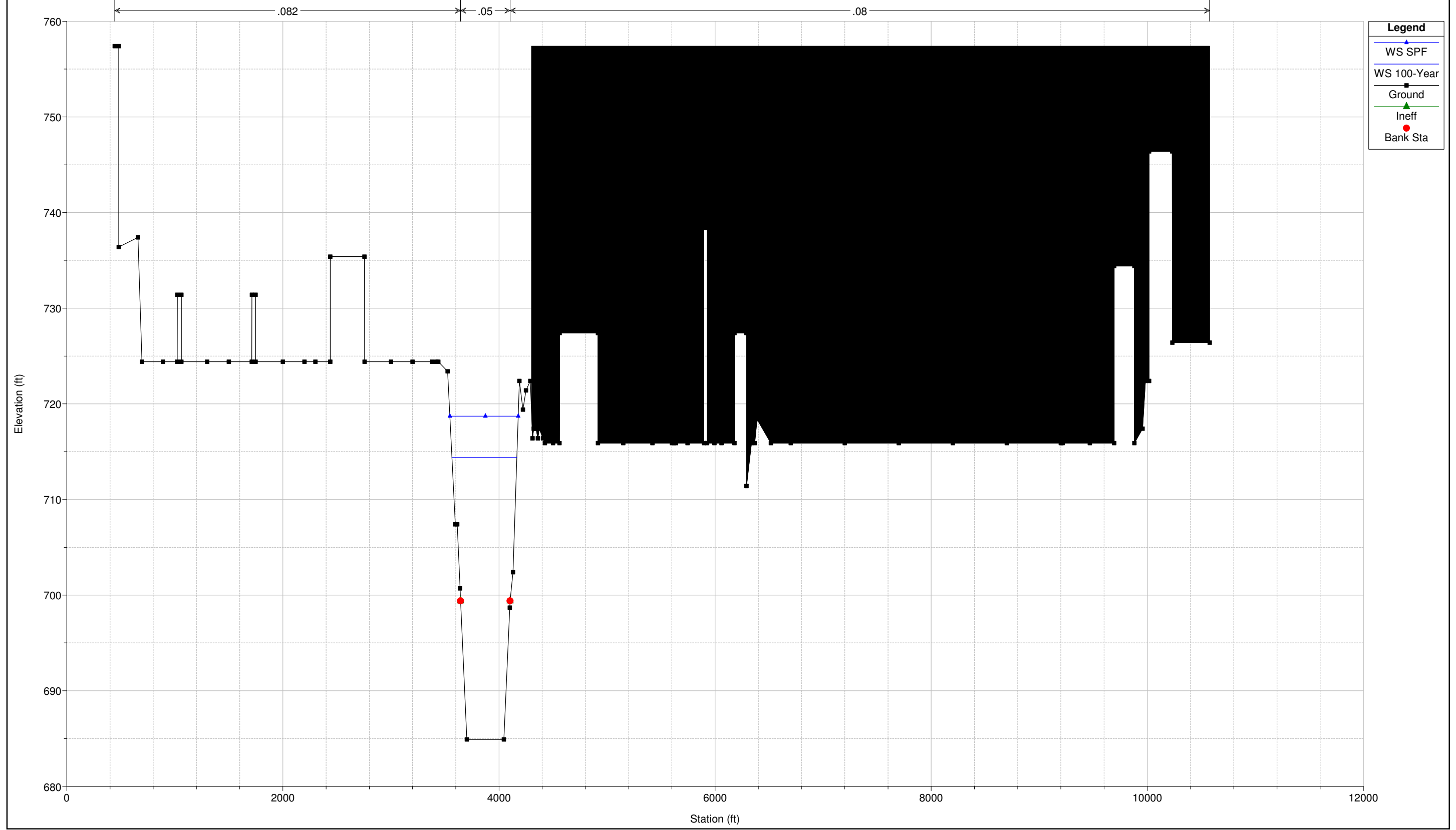


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 246.1

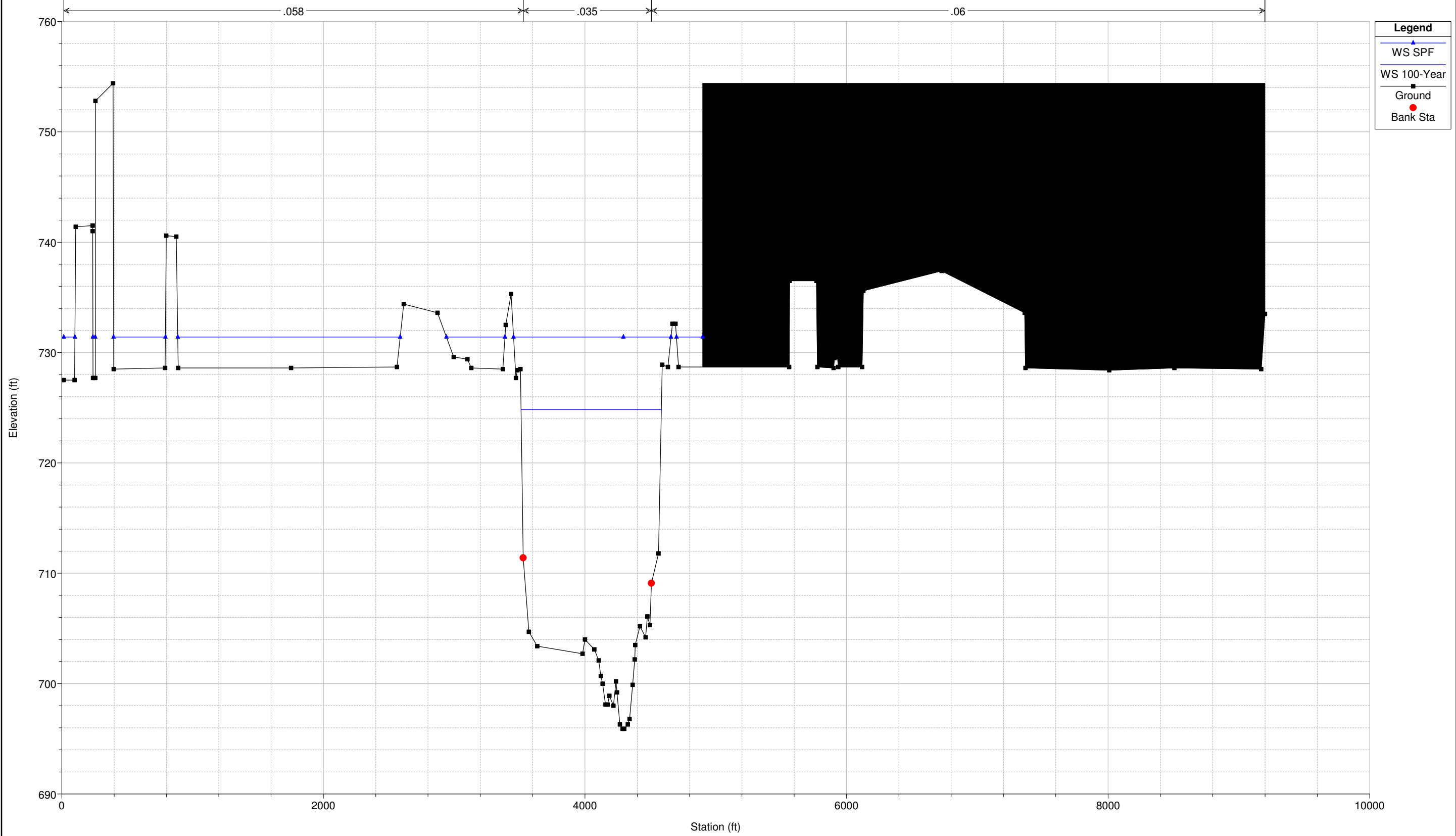


Sciotogreenways Plan: Corrected Effective / Pre-project
RS = 245

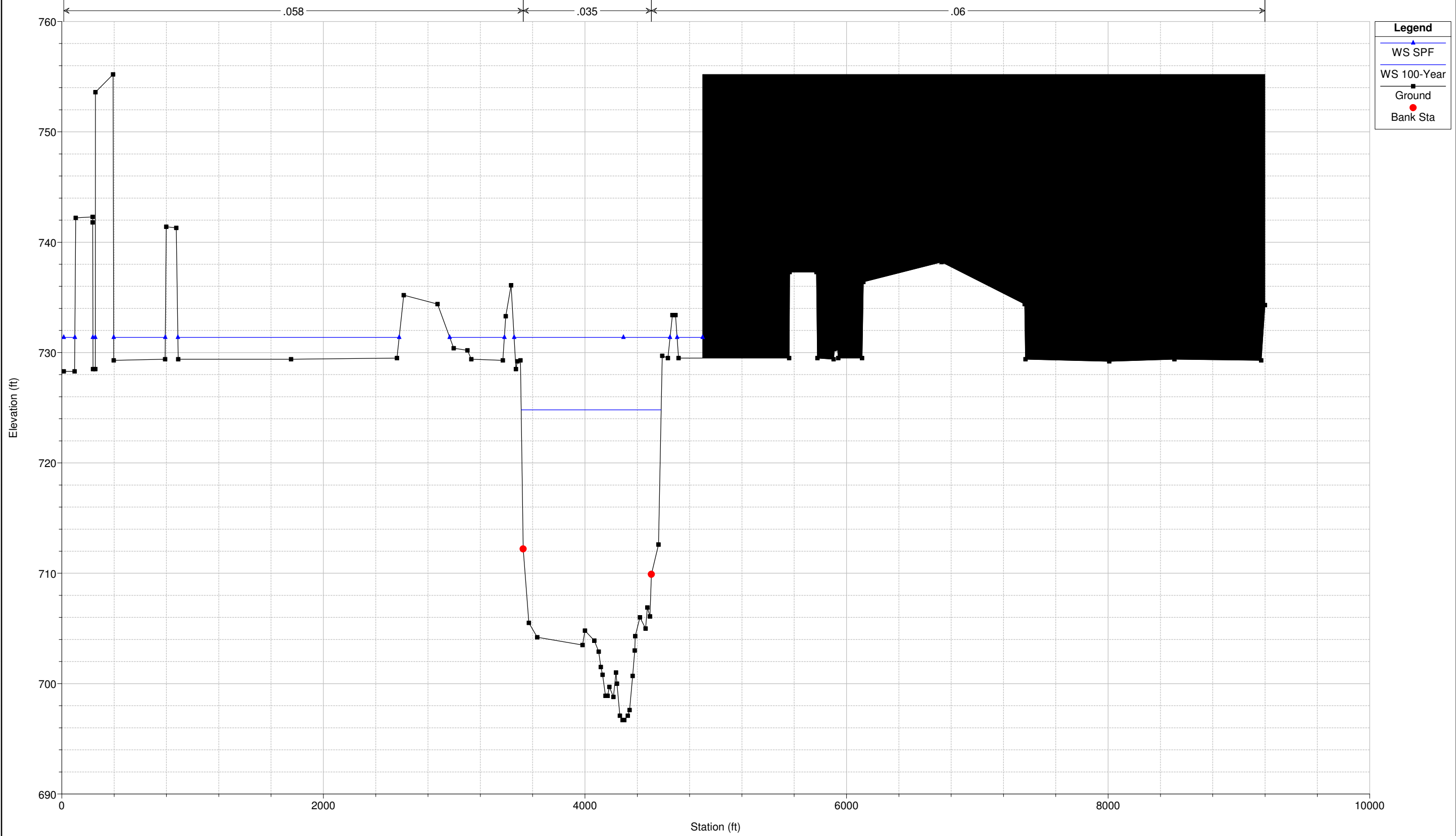


B5 – Post-project Cross-sections

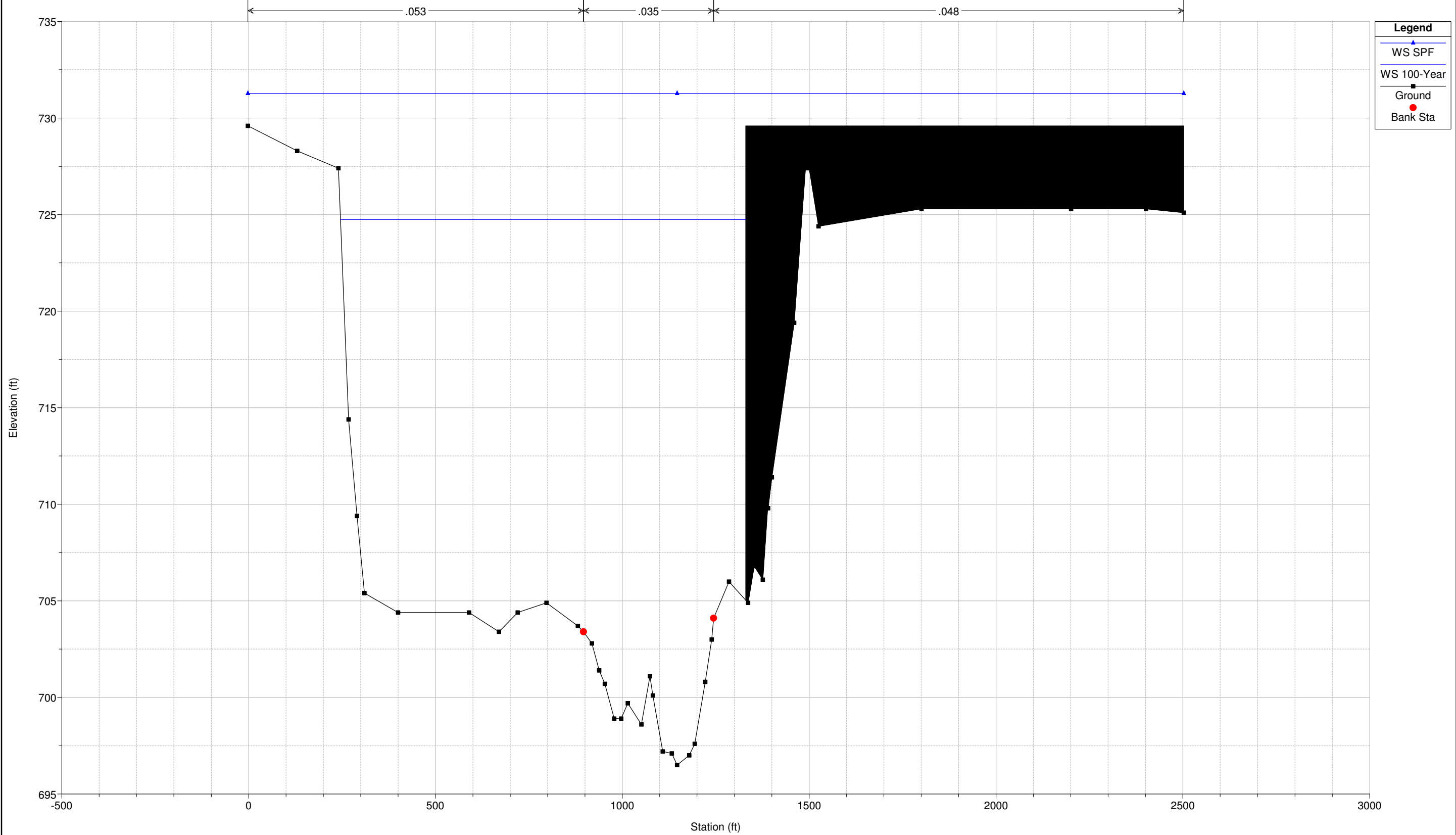
Sciotogreenways Plan: Post-project
RS = 256.066



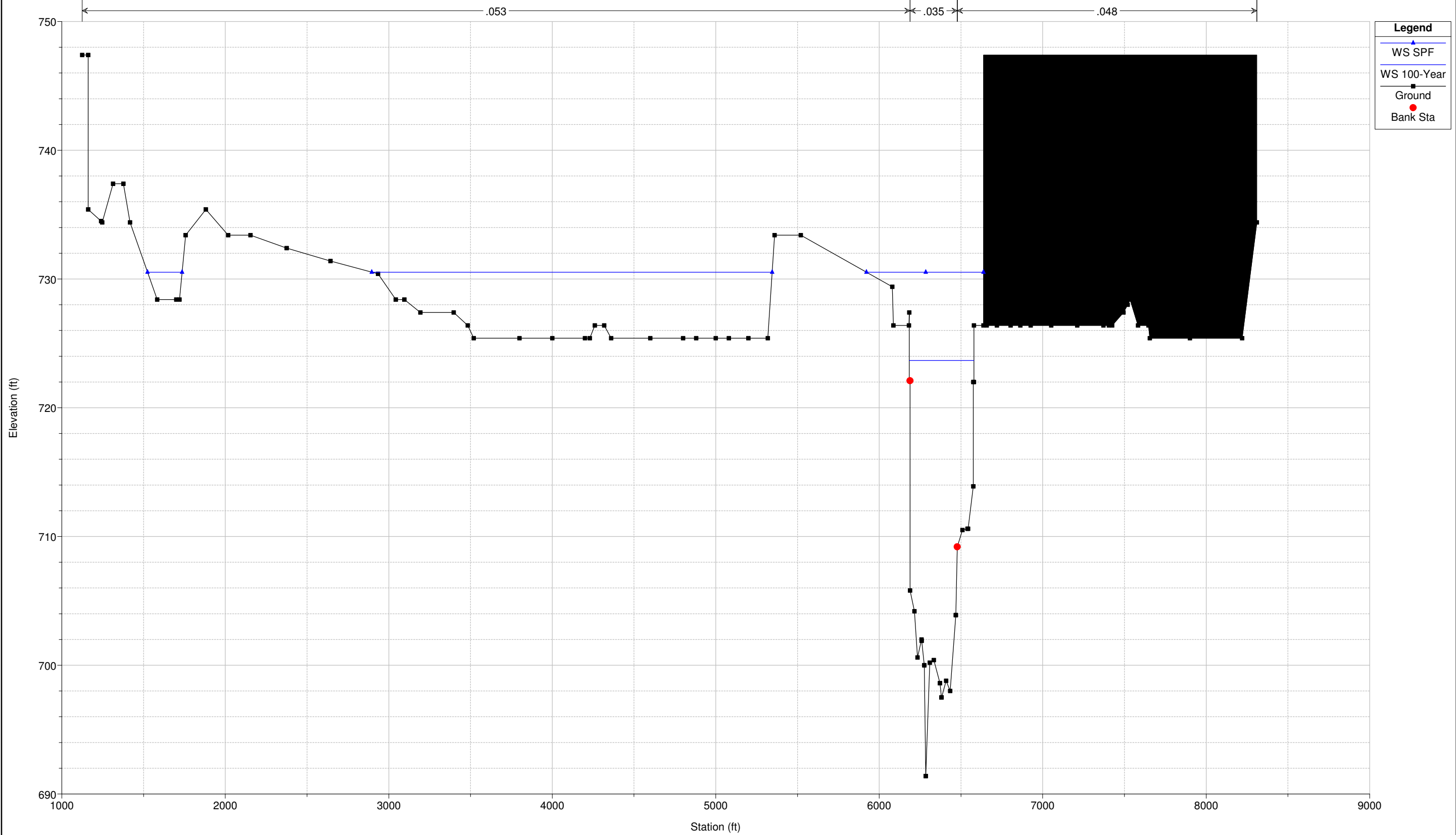
SciotoGreenways Plan: Post-project
RS = 256



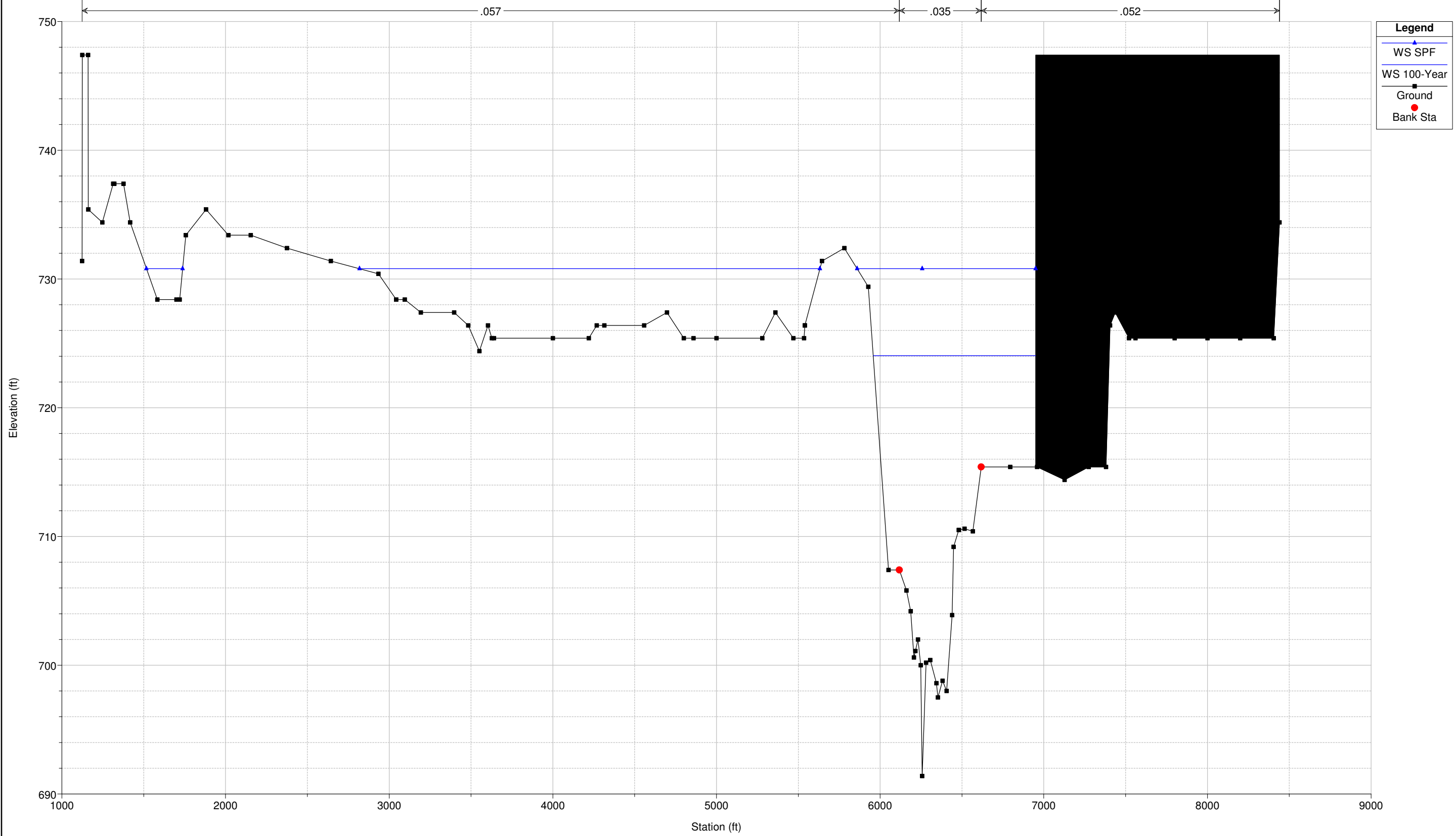
Sciotogreenways Plan: Post-project
RS = 255.96



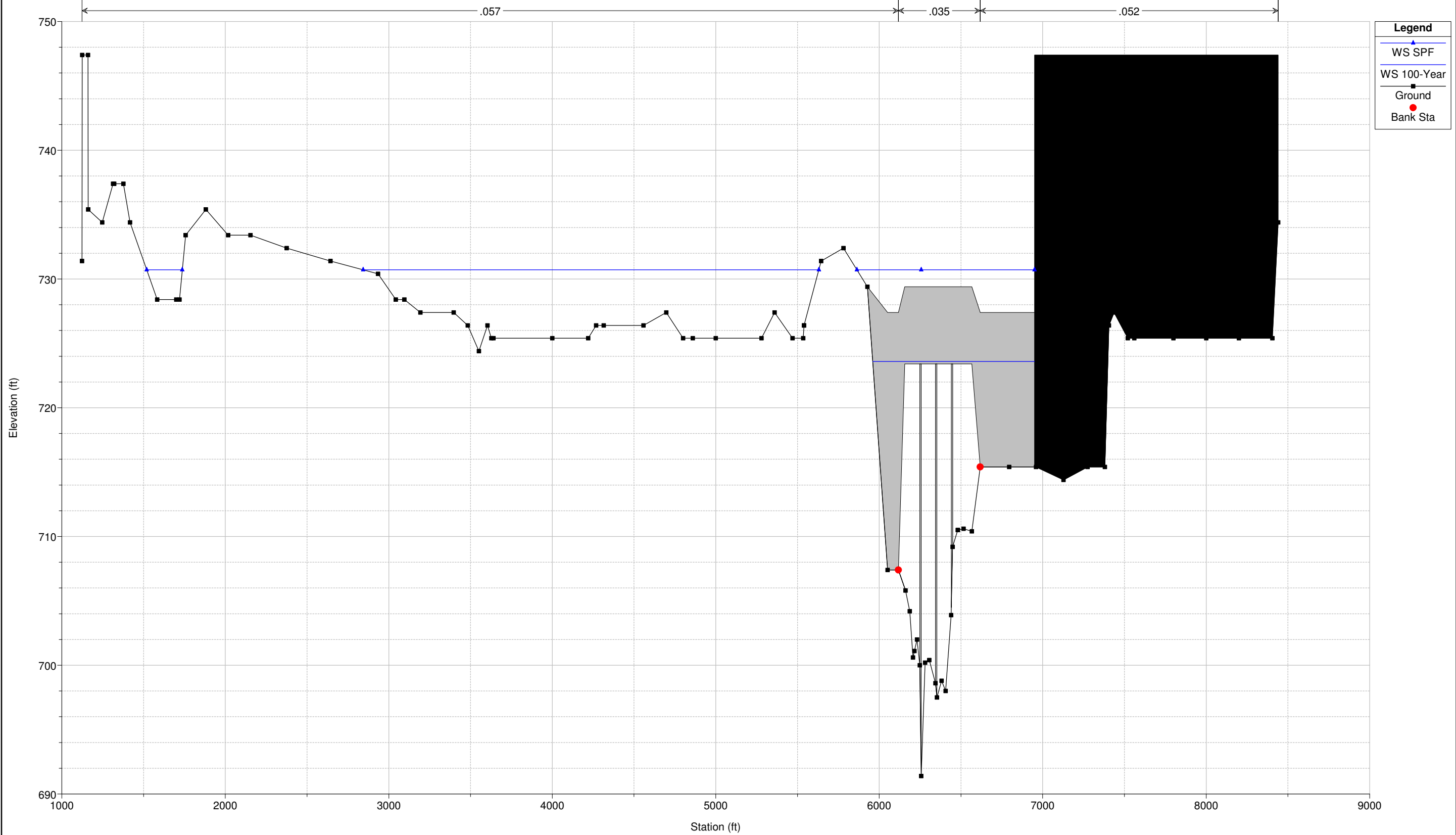
Sciotogreenways Plan: Post-project
RS = 255.95



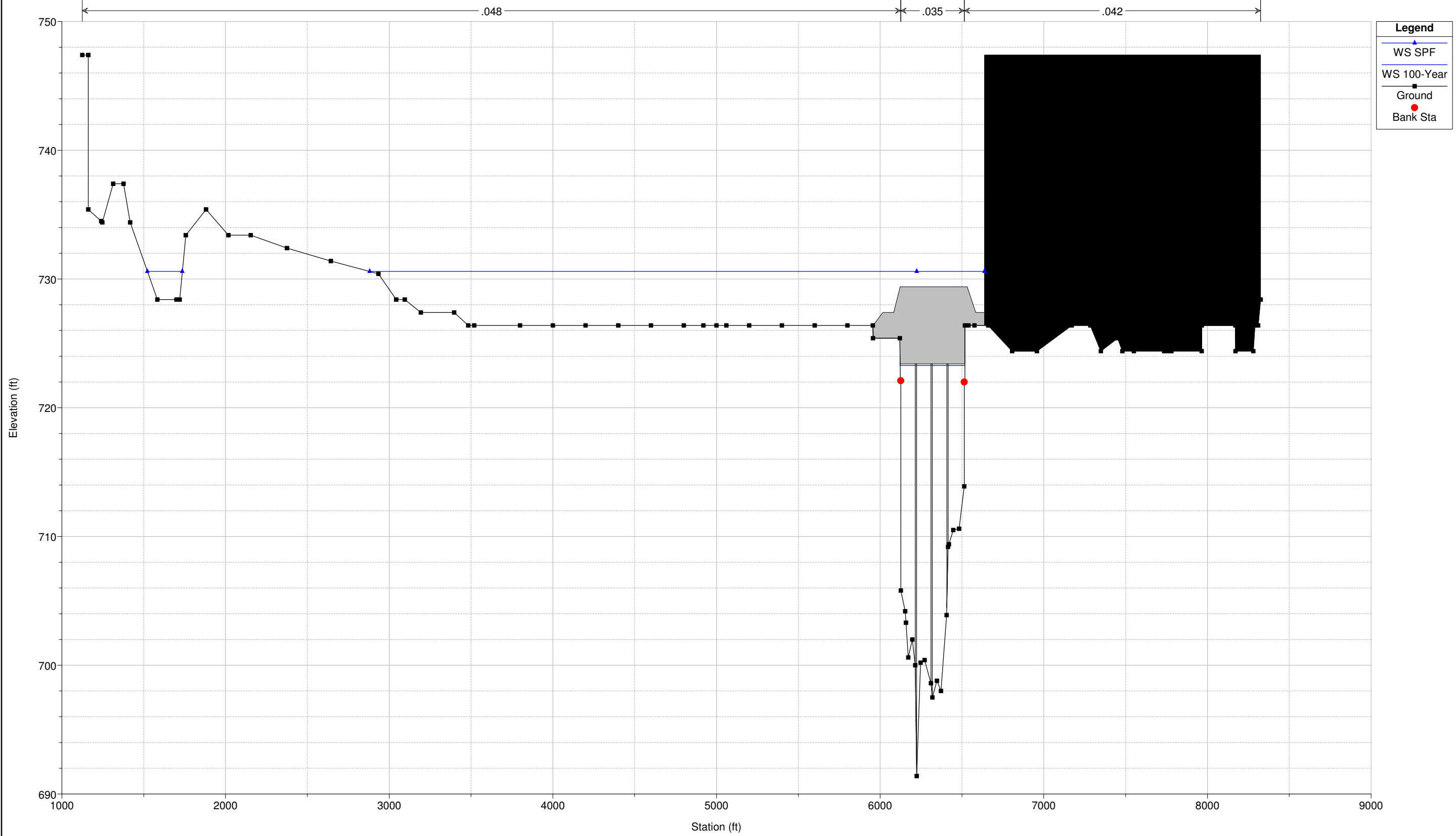
SciotoGreenways Plan: Post-project
RS = 255.94



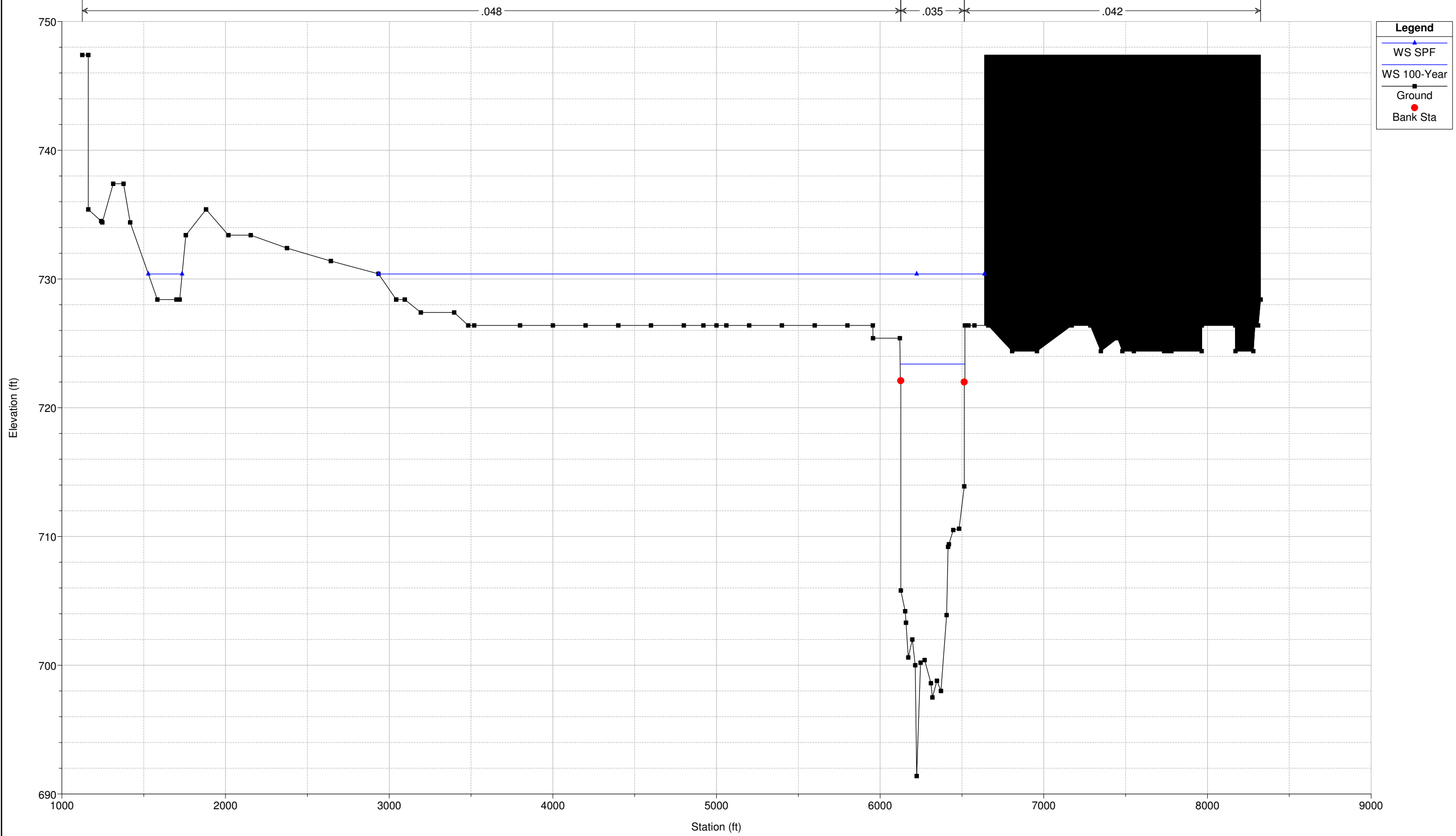
Sciotgreenways Plan: Post-project
RS = 255.93 BR



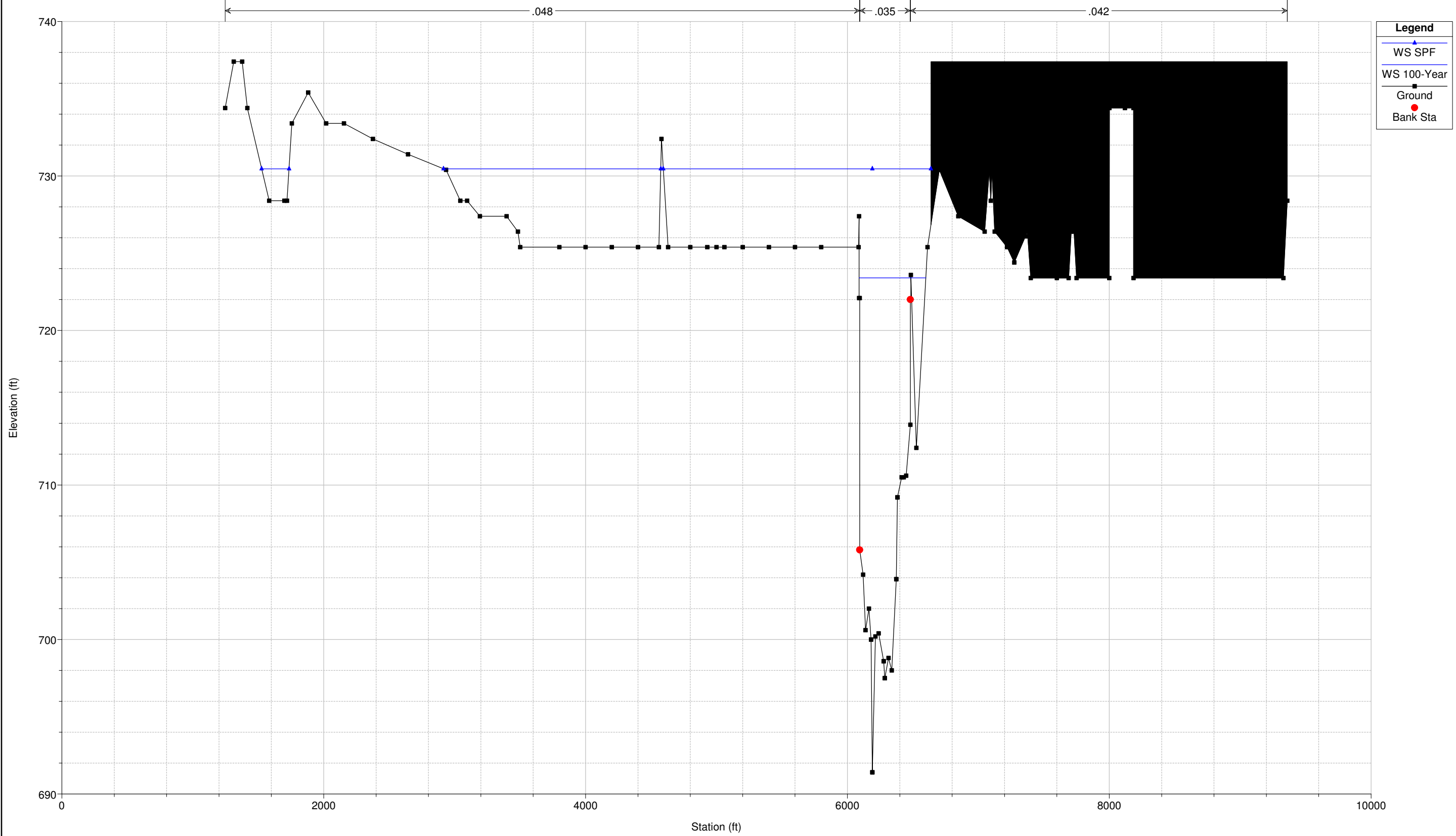
Sciotgreenways Plan: Post-project
RS = 255.93 BR



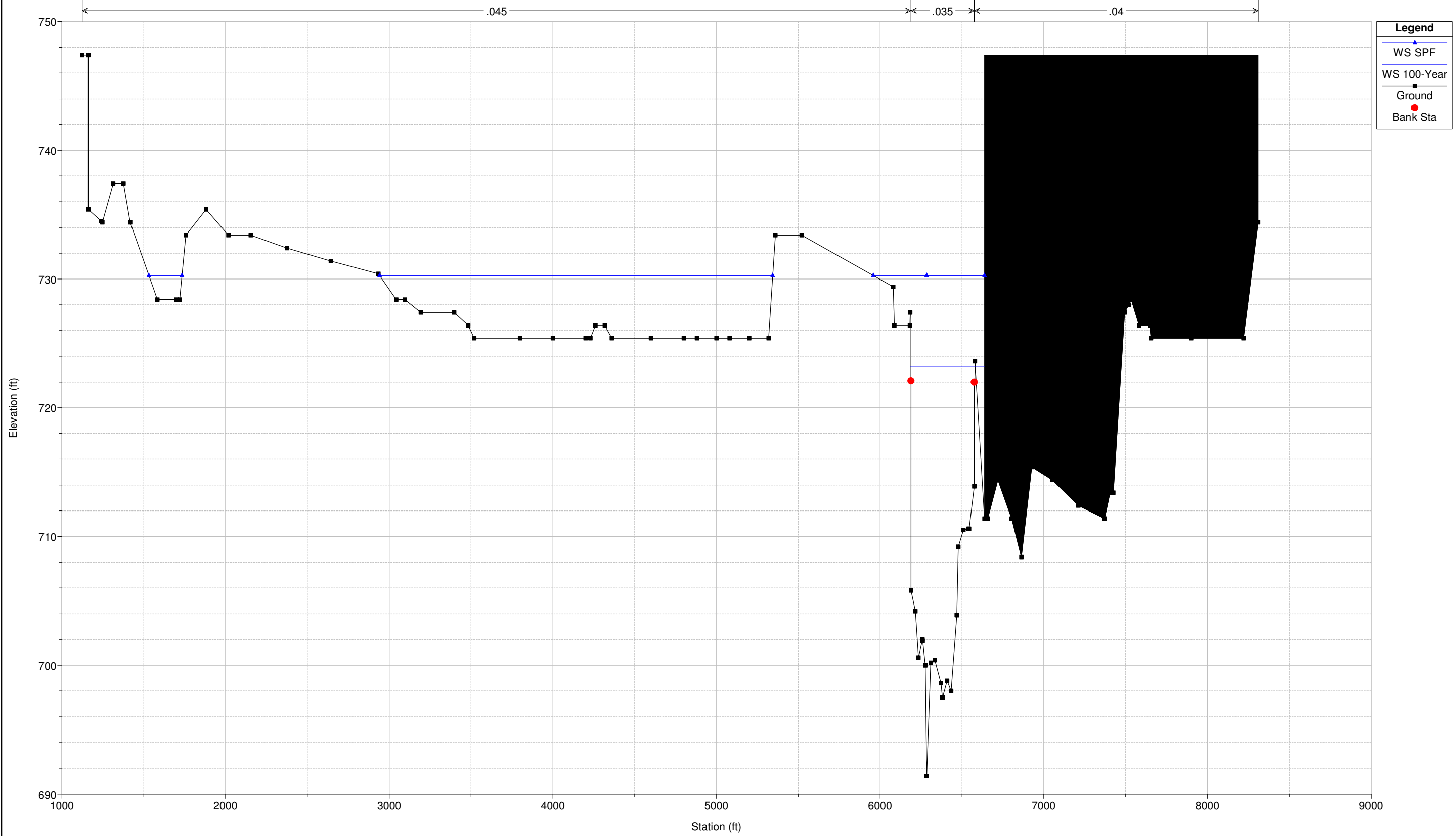
Sciotgreenways Plan: Post-project
RS = 255.92



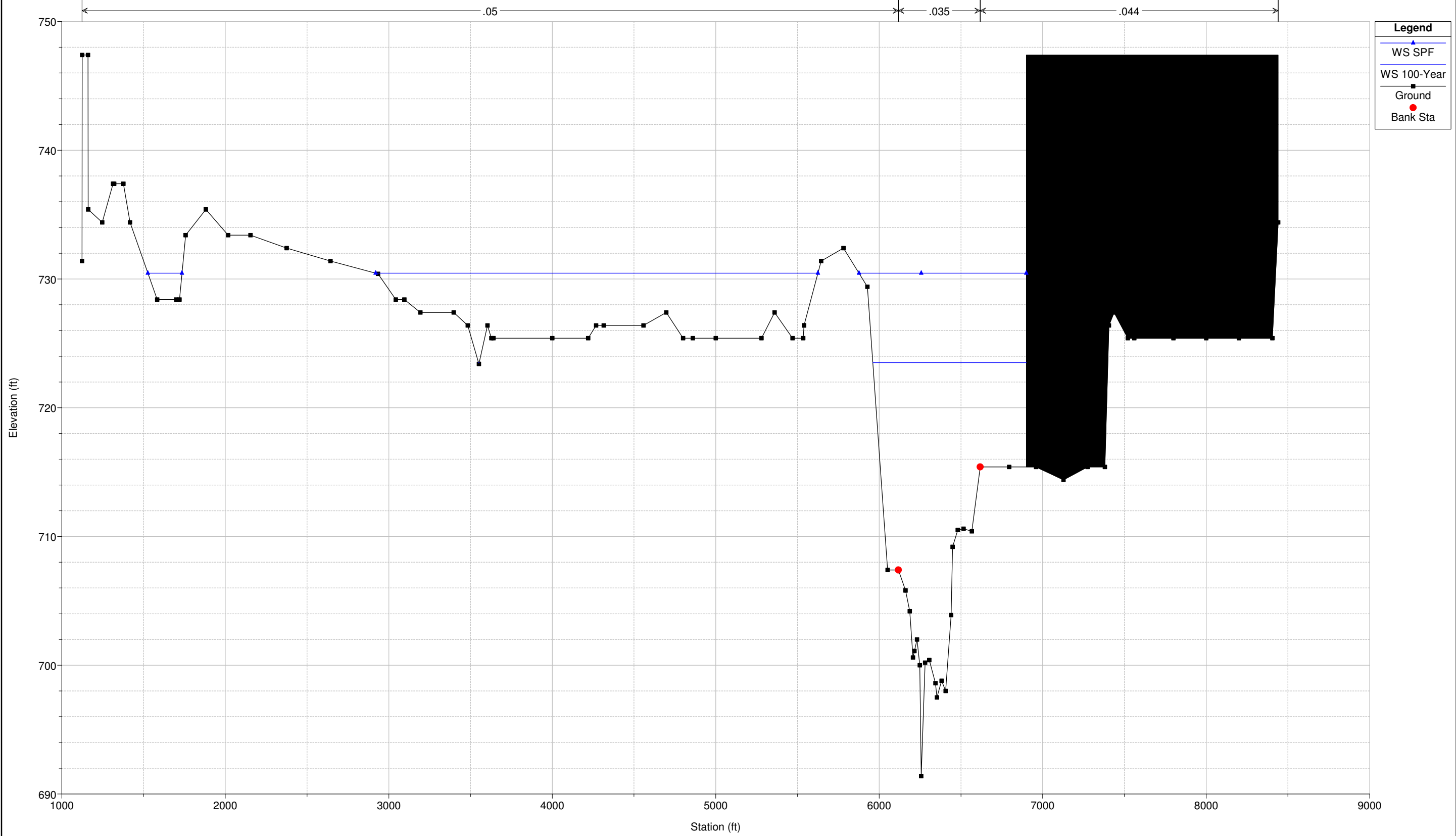
Sciotgreenways Plan: Post-project
RS = 255.91



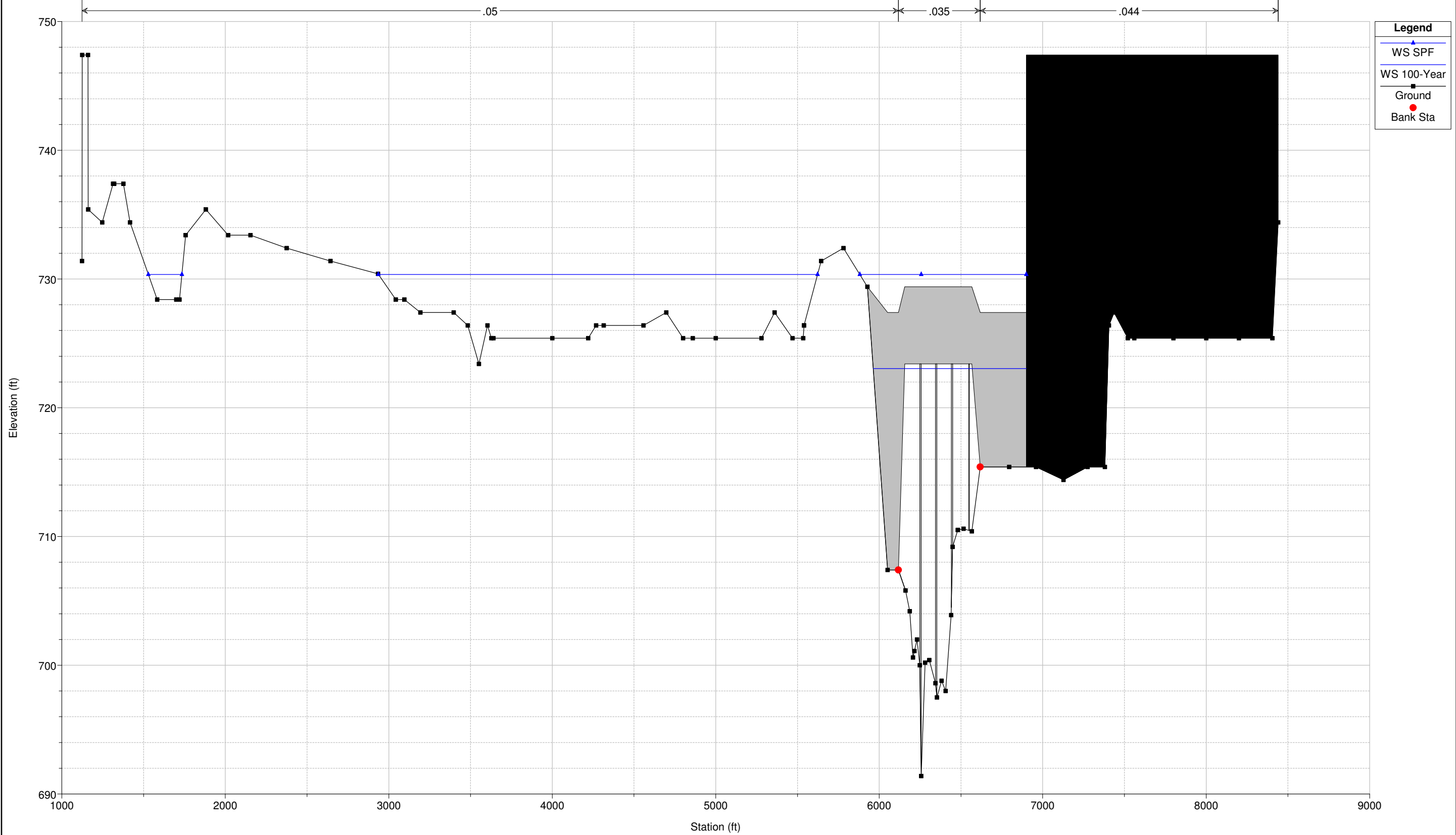
Sciotgreenways Plan: Post-project
RS = 255.9



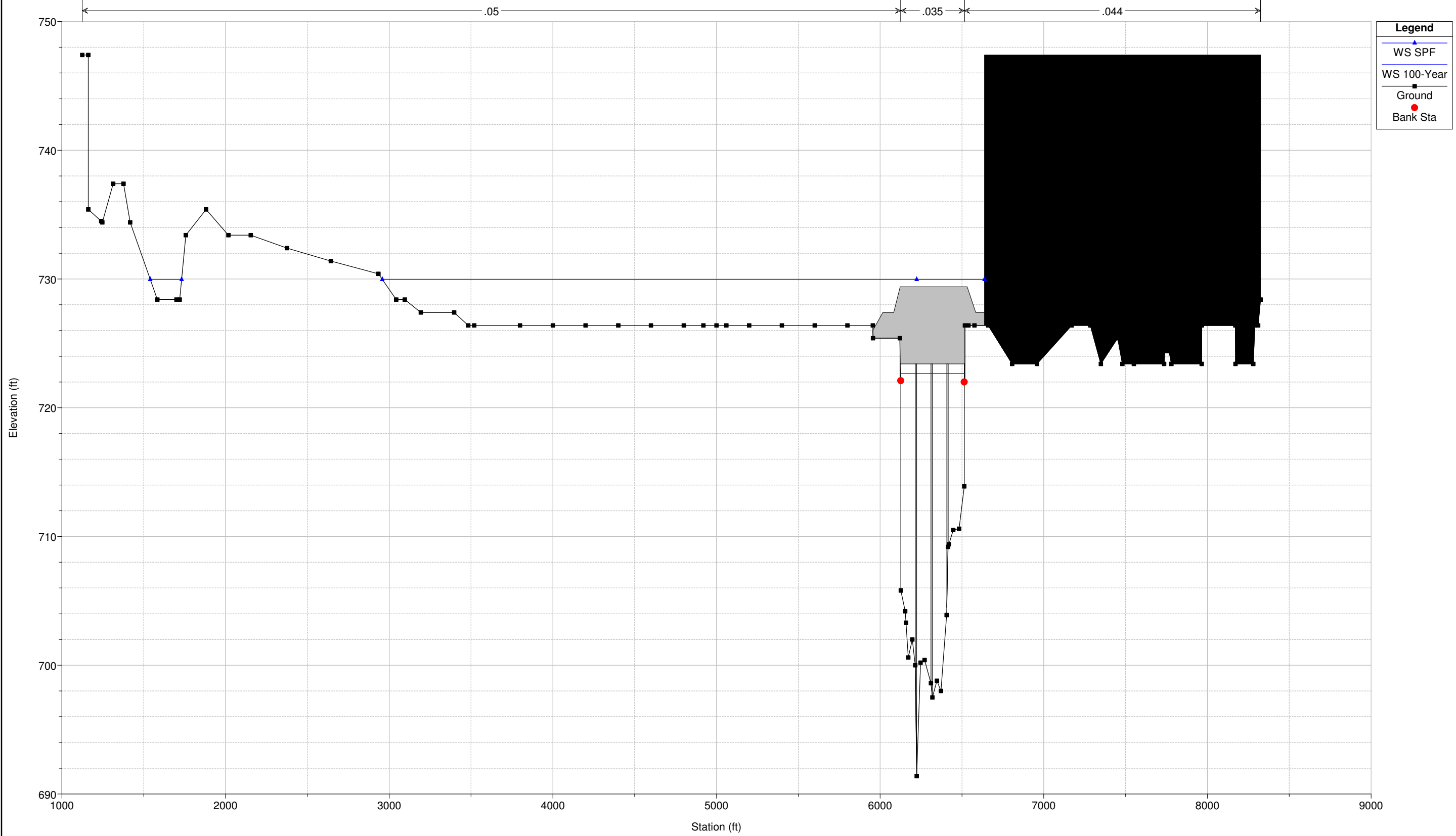
Sciotgreenways Plan: Post-project
RS = 255.8



Sciotgreenways Plan: Post-project
RS = 255.75 BR



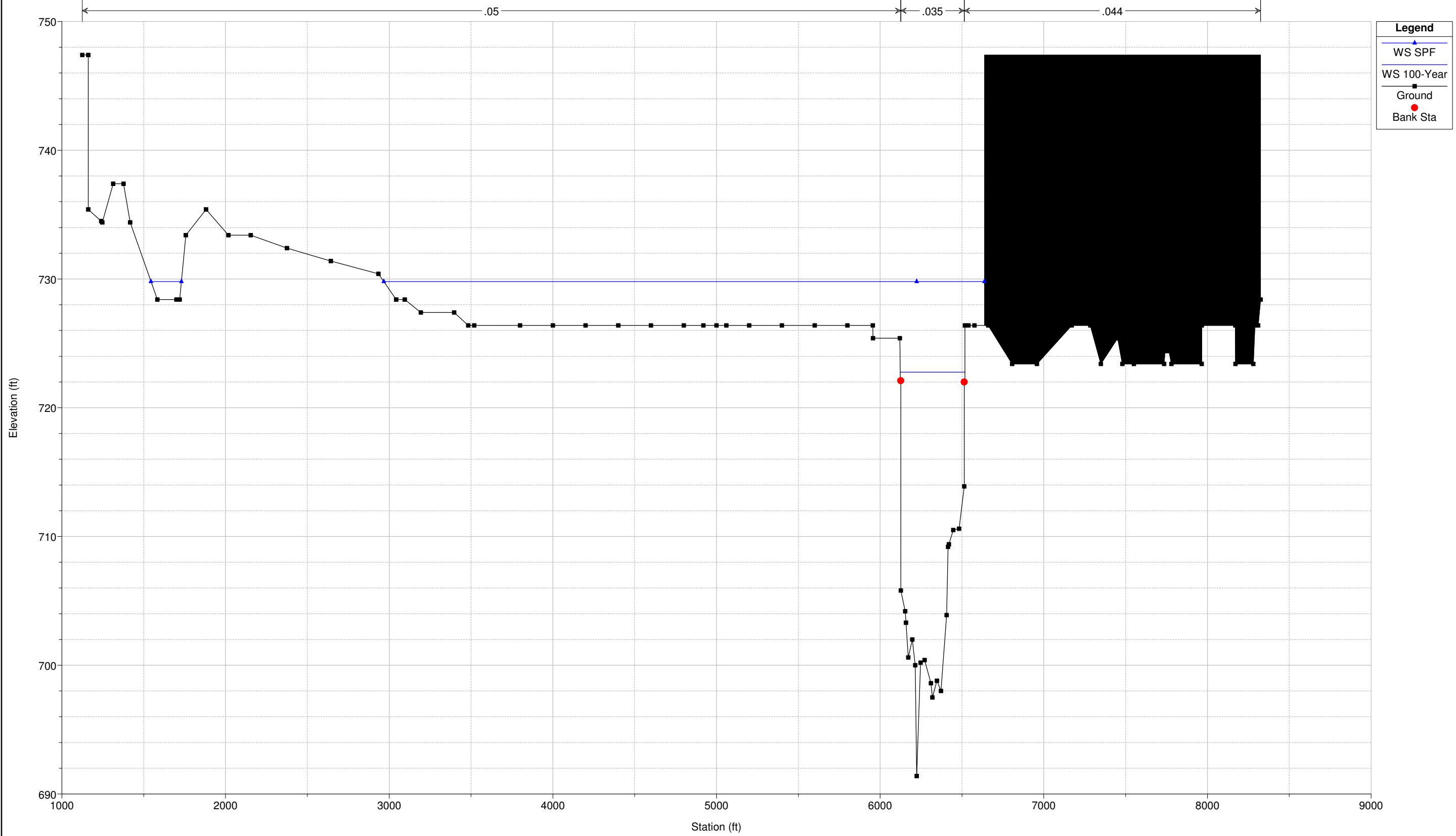
Sciotgreenways Plan: Post-project
RS = 255.75 BR



Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Black line with square)
- Ground (Black line with square)
- Bank Sta (Red dot)

Sciotogreenways Plan: Post-project
RS = 255.7

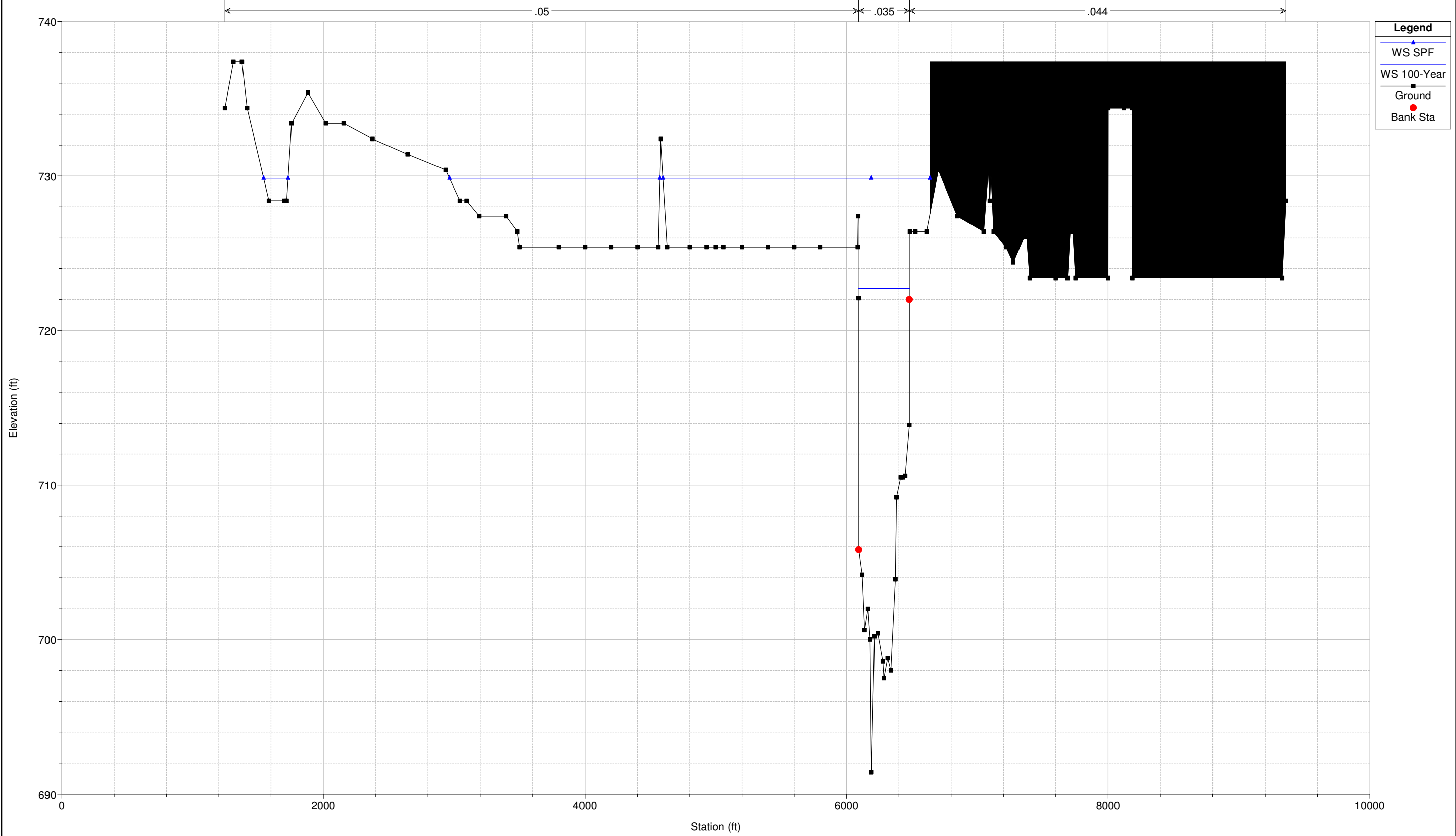


Legend

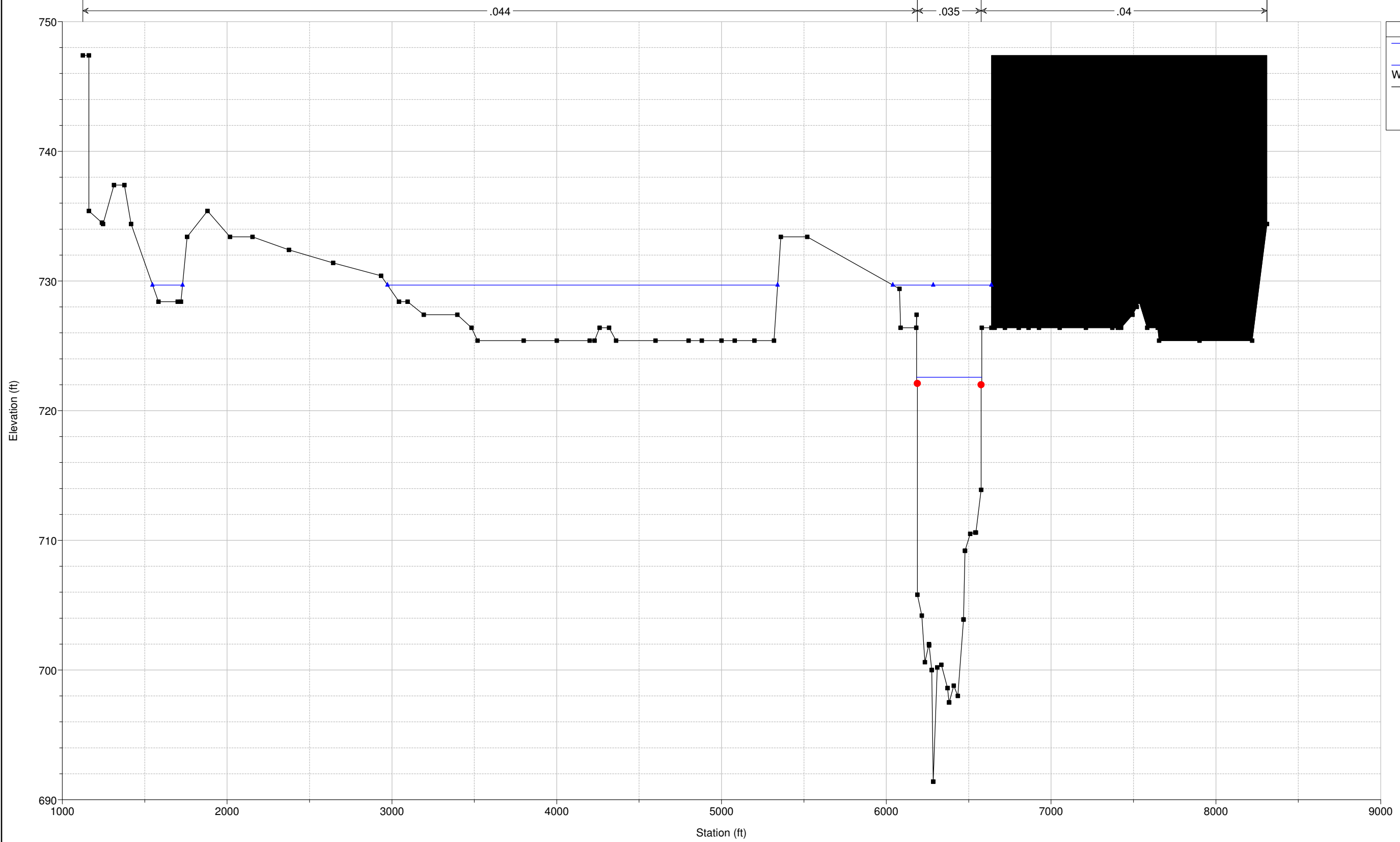
- WS SPF
- WS 100-Year
- Ground
- Bank Sta

← .05 → .035 → .044 →

Sciotogreenways Plan: Post-project
RS = 255.6



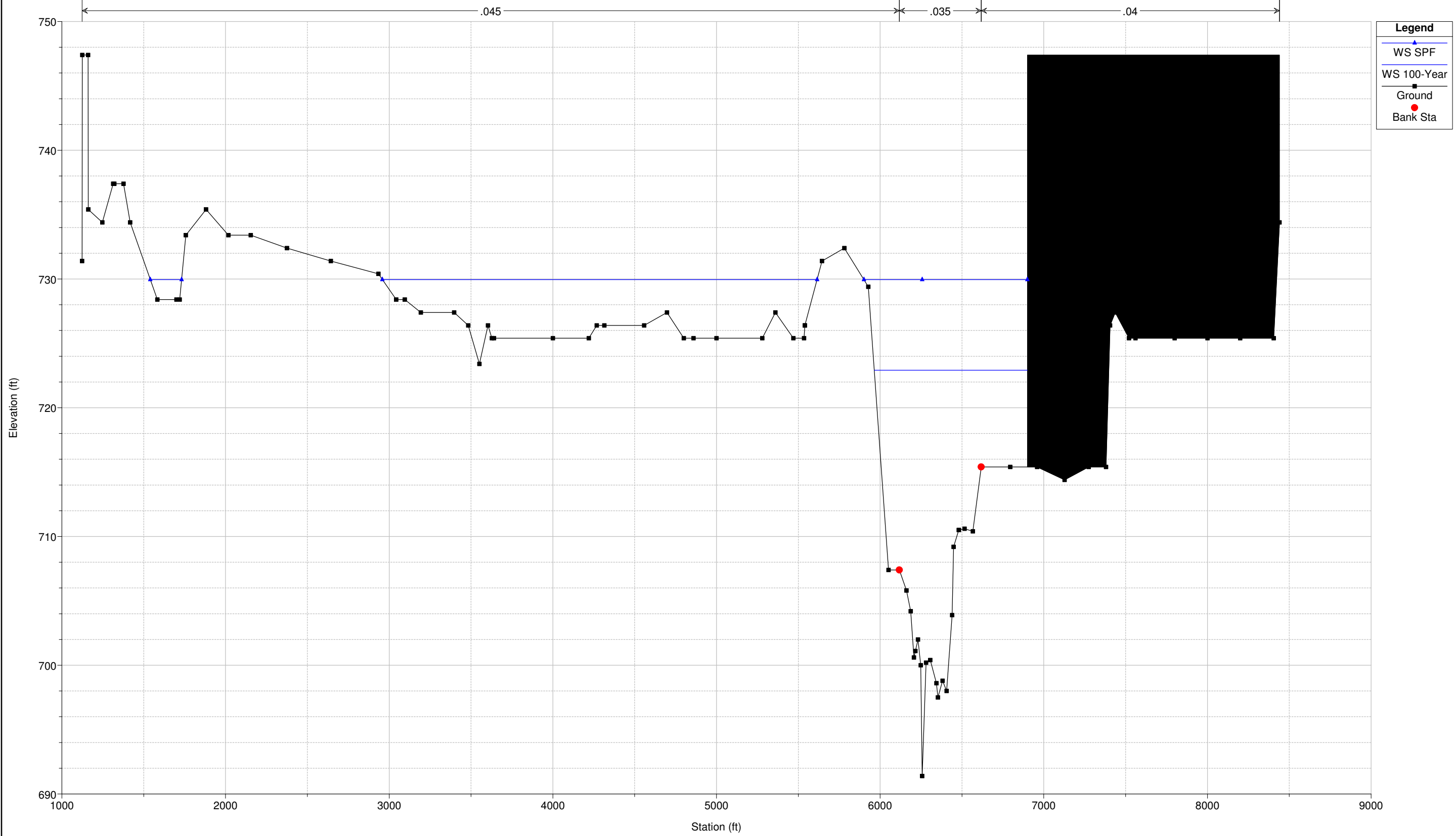
Sciotgreenways Plan: Post-project
RS = 255.5



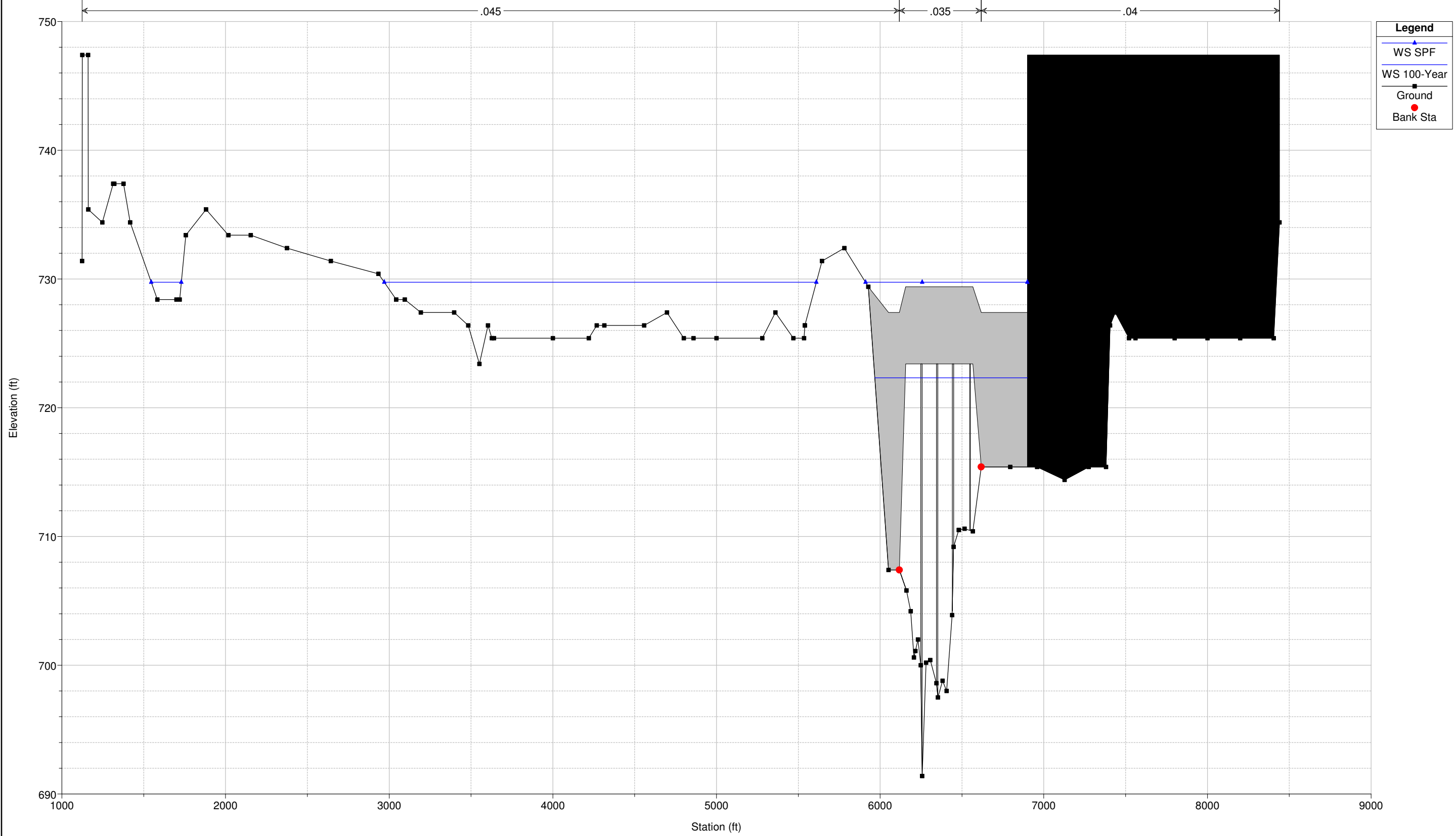
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

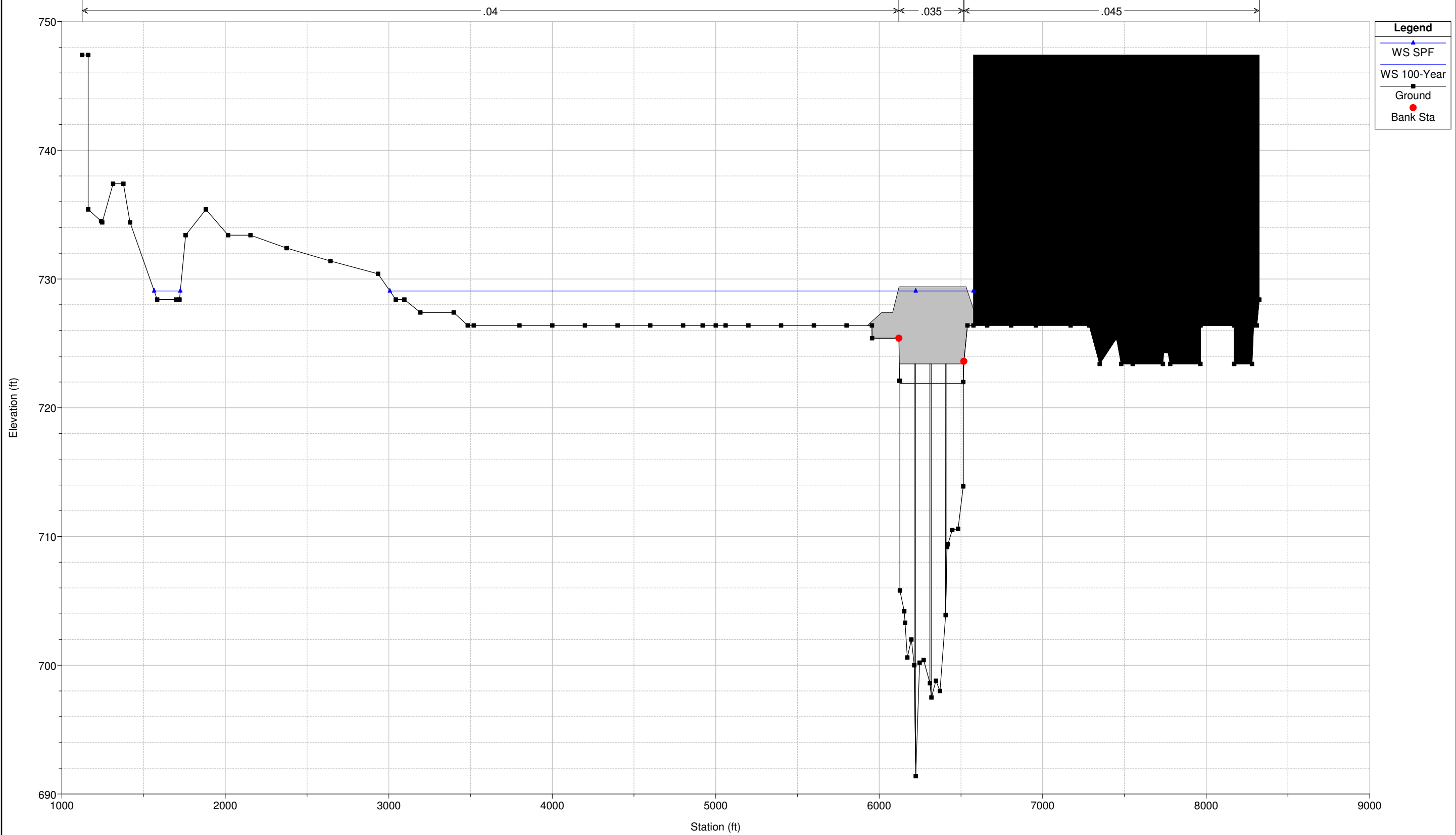
Sciotgreenways Plan: Post-project
RS = 255.4



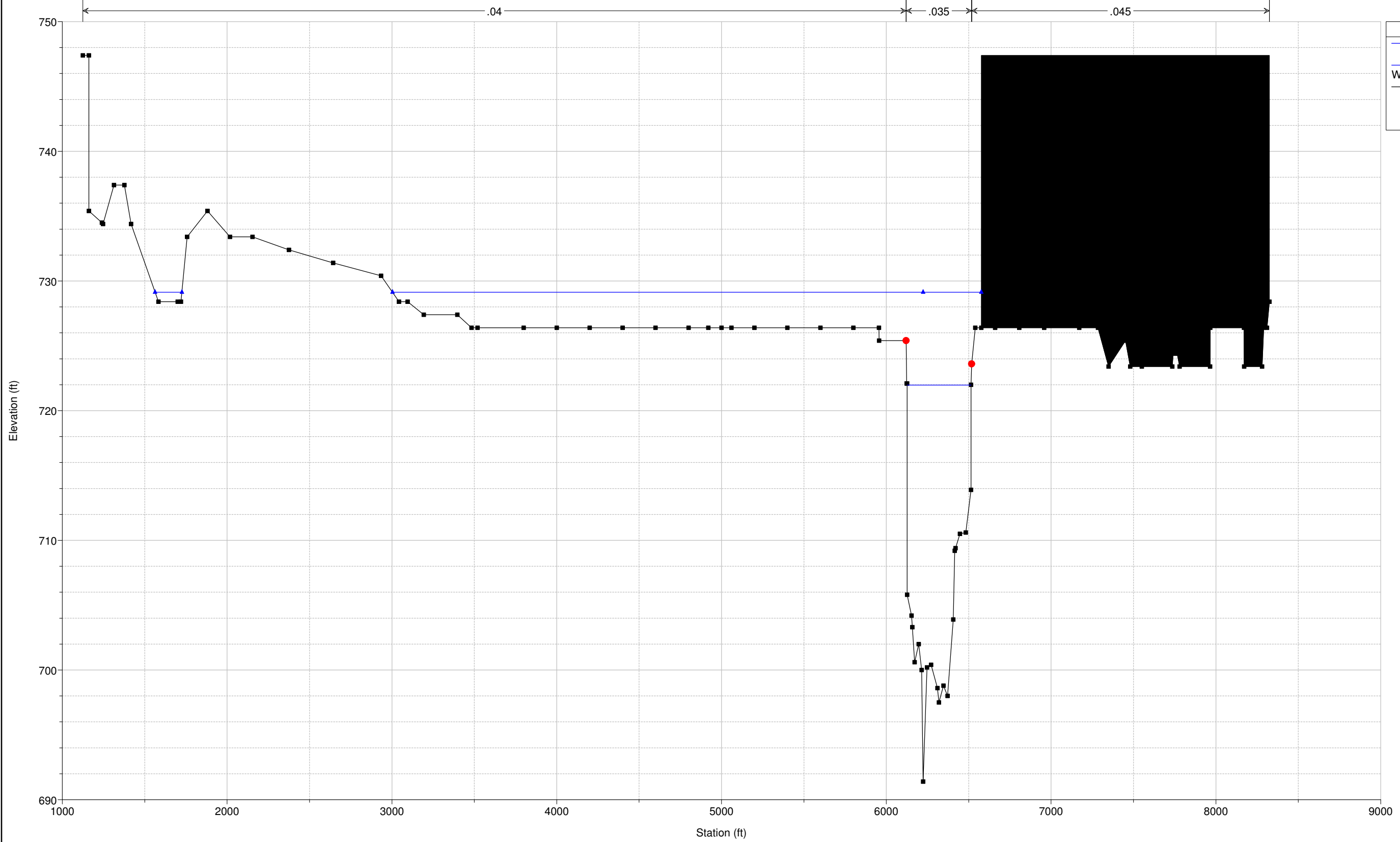
Sciotgreenways Plan: Post-project
RS = 255.3 BR



Sciotgreenways Plan: Post-project
RS = 255.3 BR



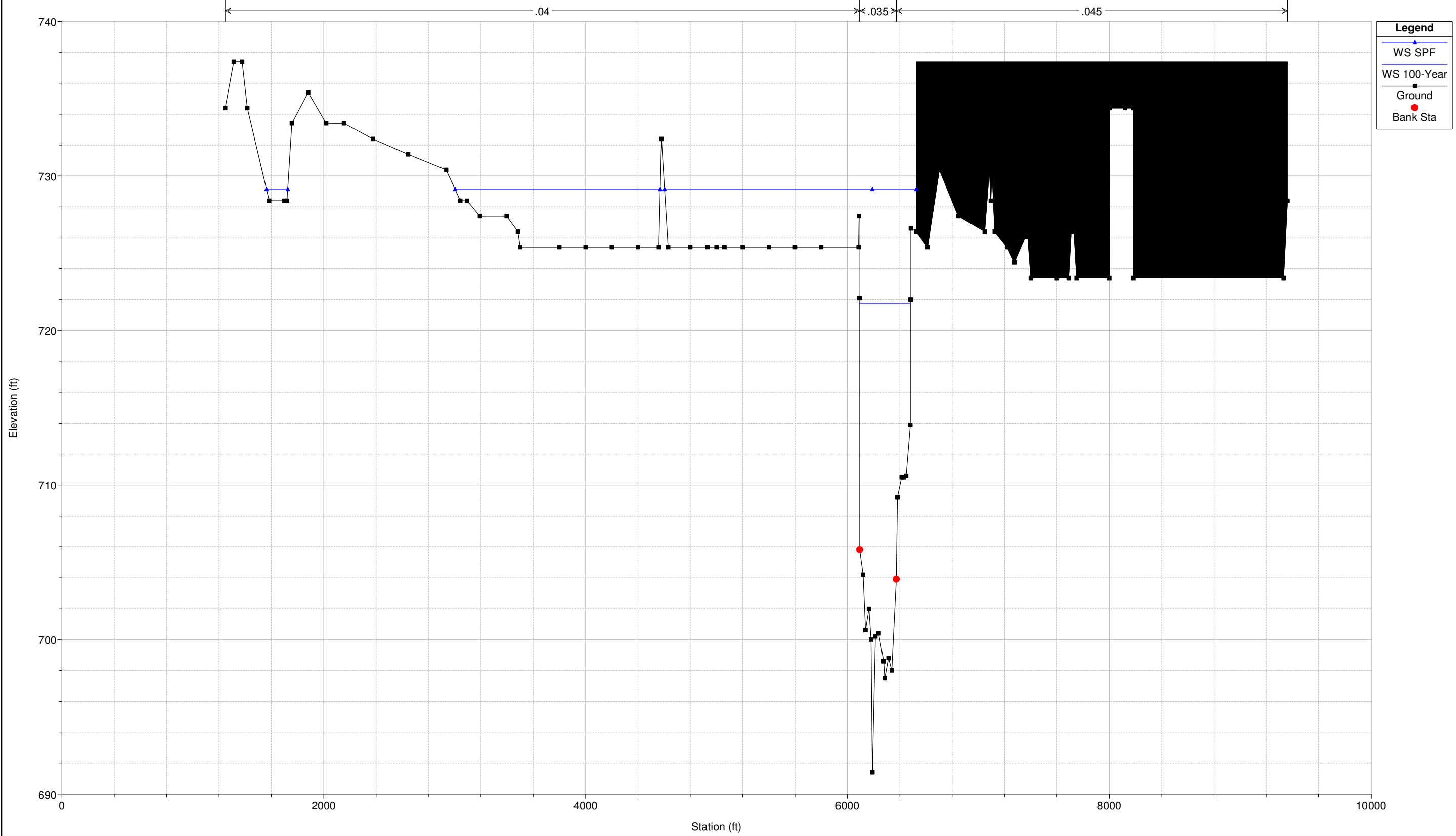
Sciotgreenways Plan: Post-project
RS = 255.2



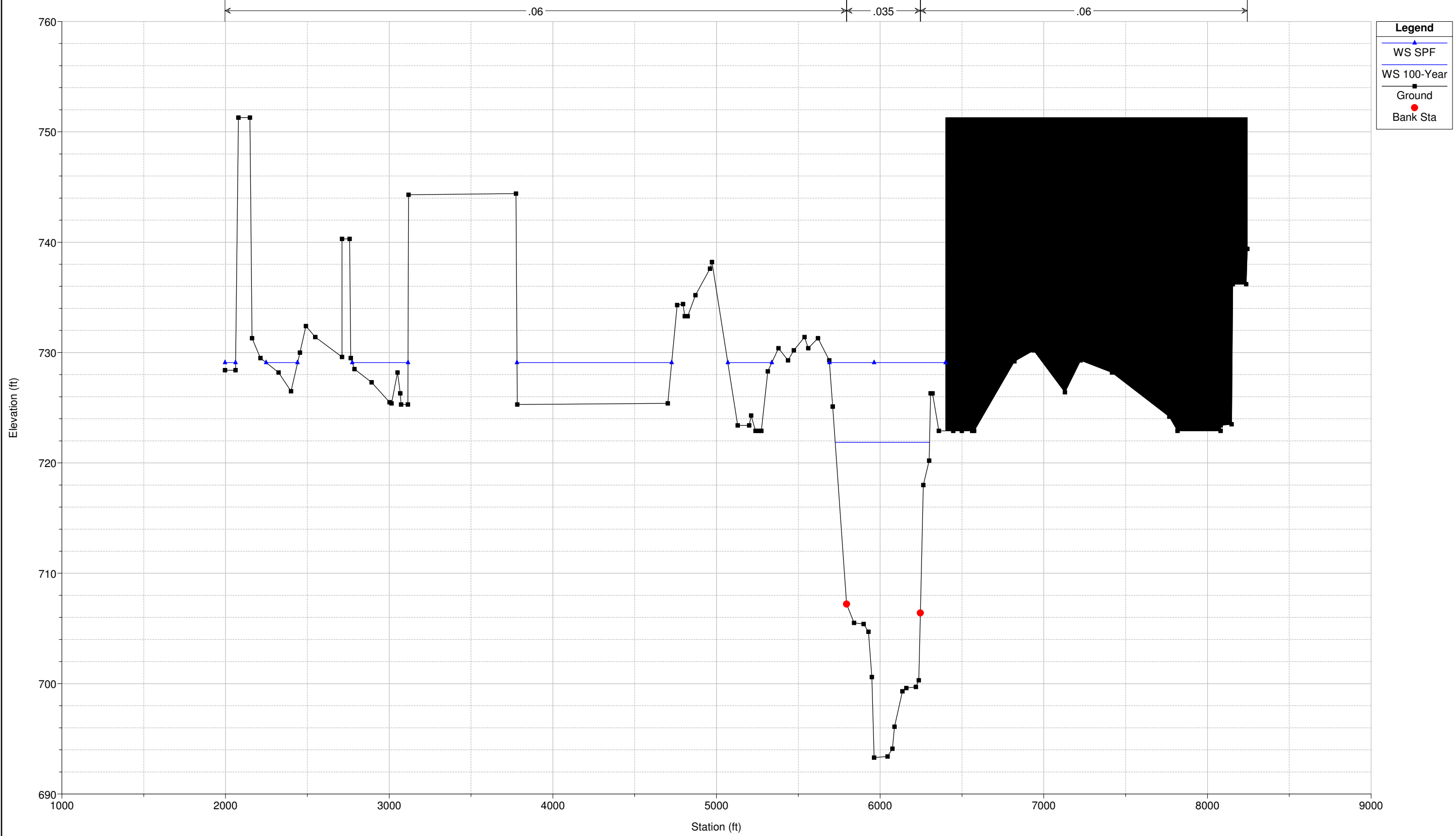
Legend

- WS SPF
- WS 100-Year
- Ground
- Bank Sta

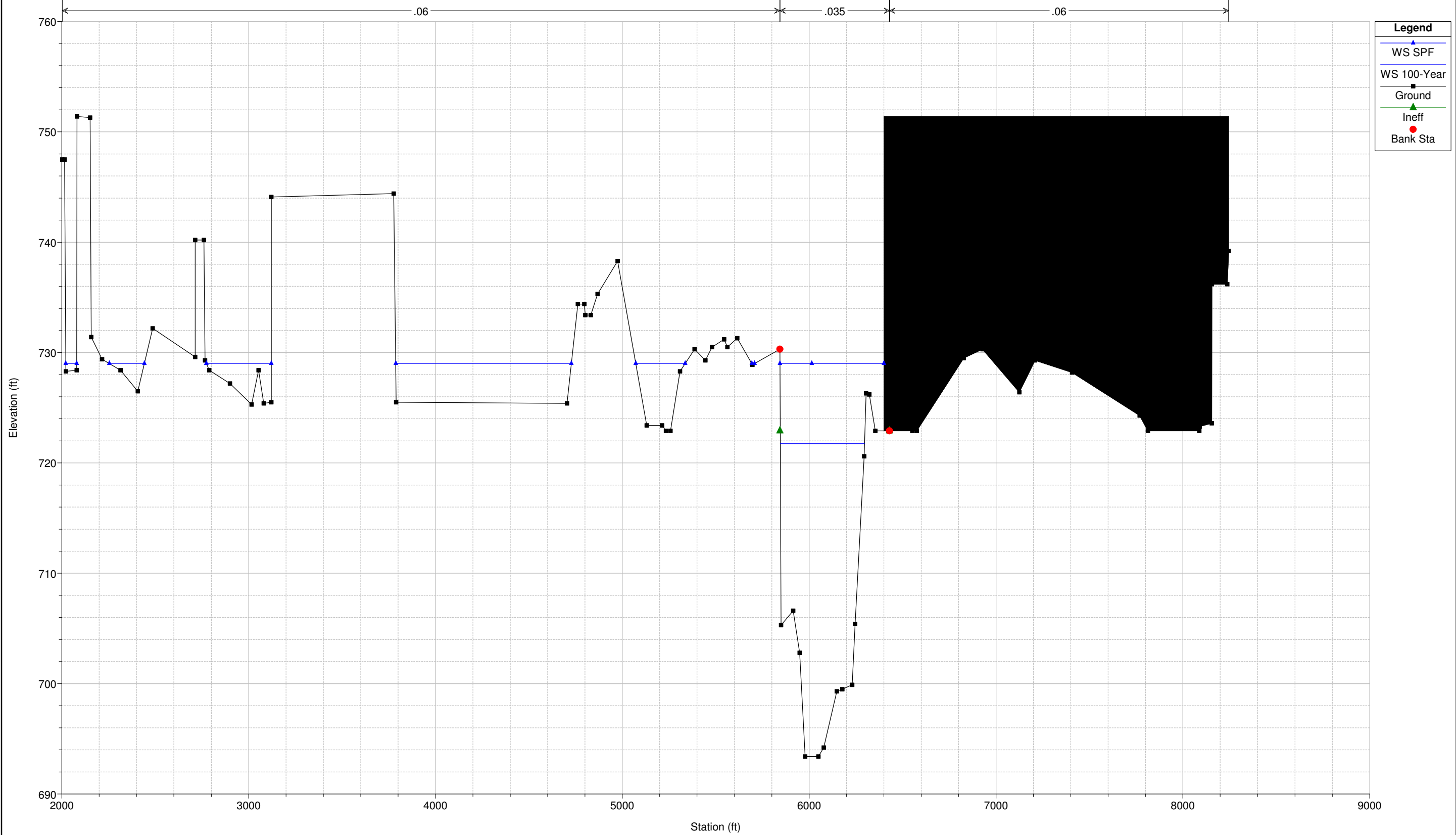
Sciotogreenways Plan: Post-project
RS = 255.1



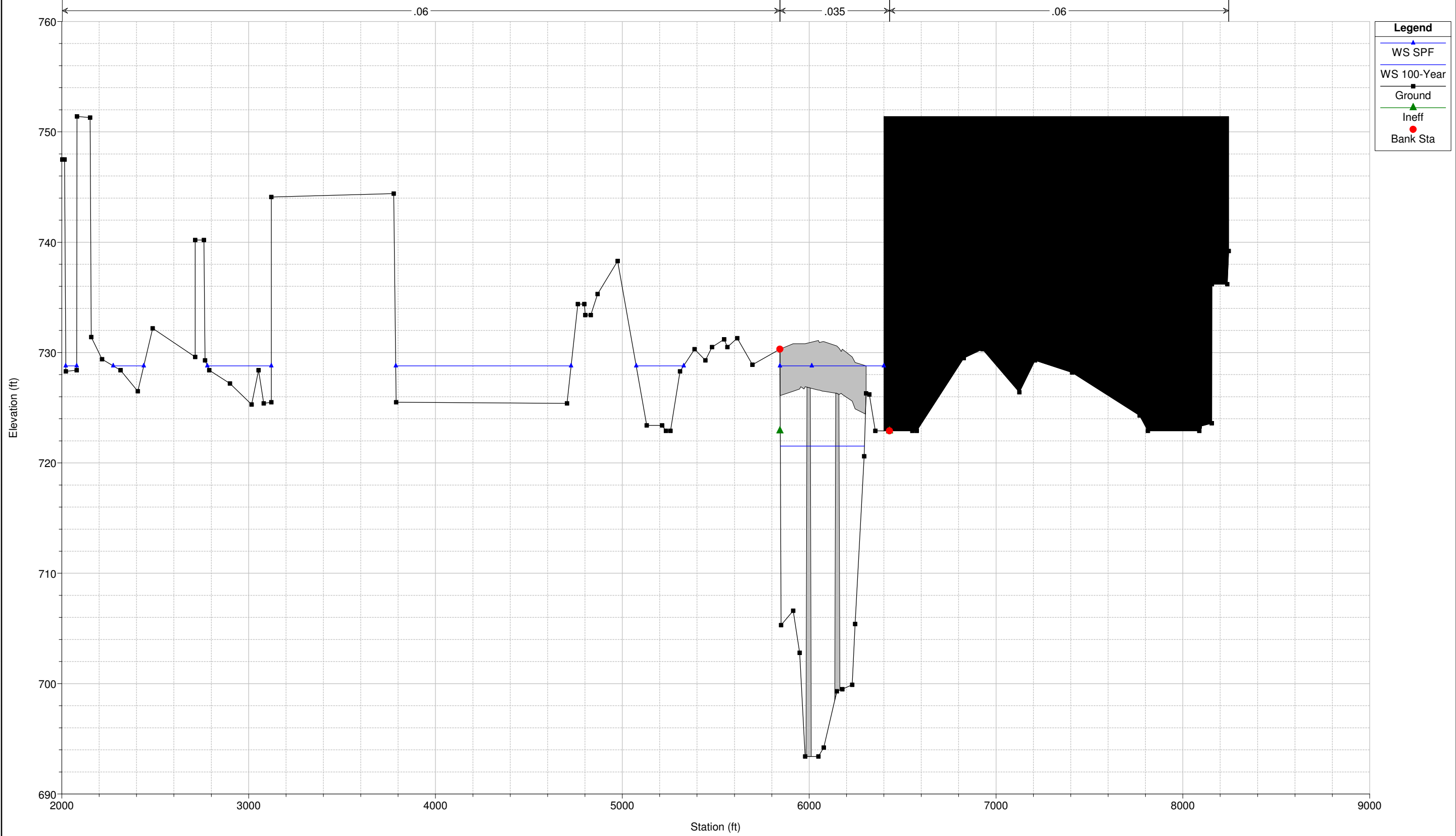
Sciotgreenways Plan: Post-project
RS = 254.95



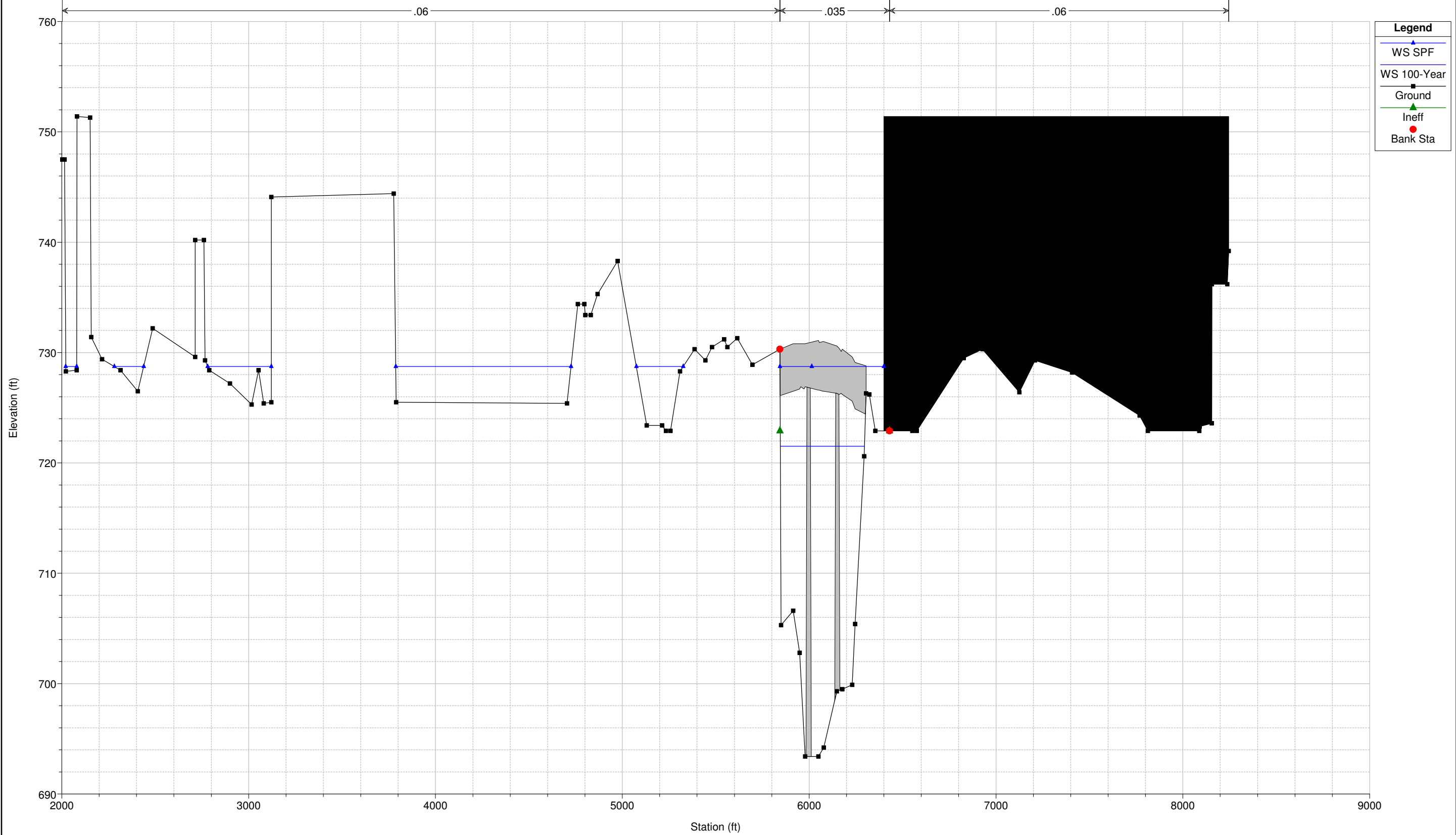
Sciotogreenways Plan: Post-project
RS = 254.94



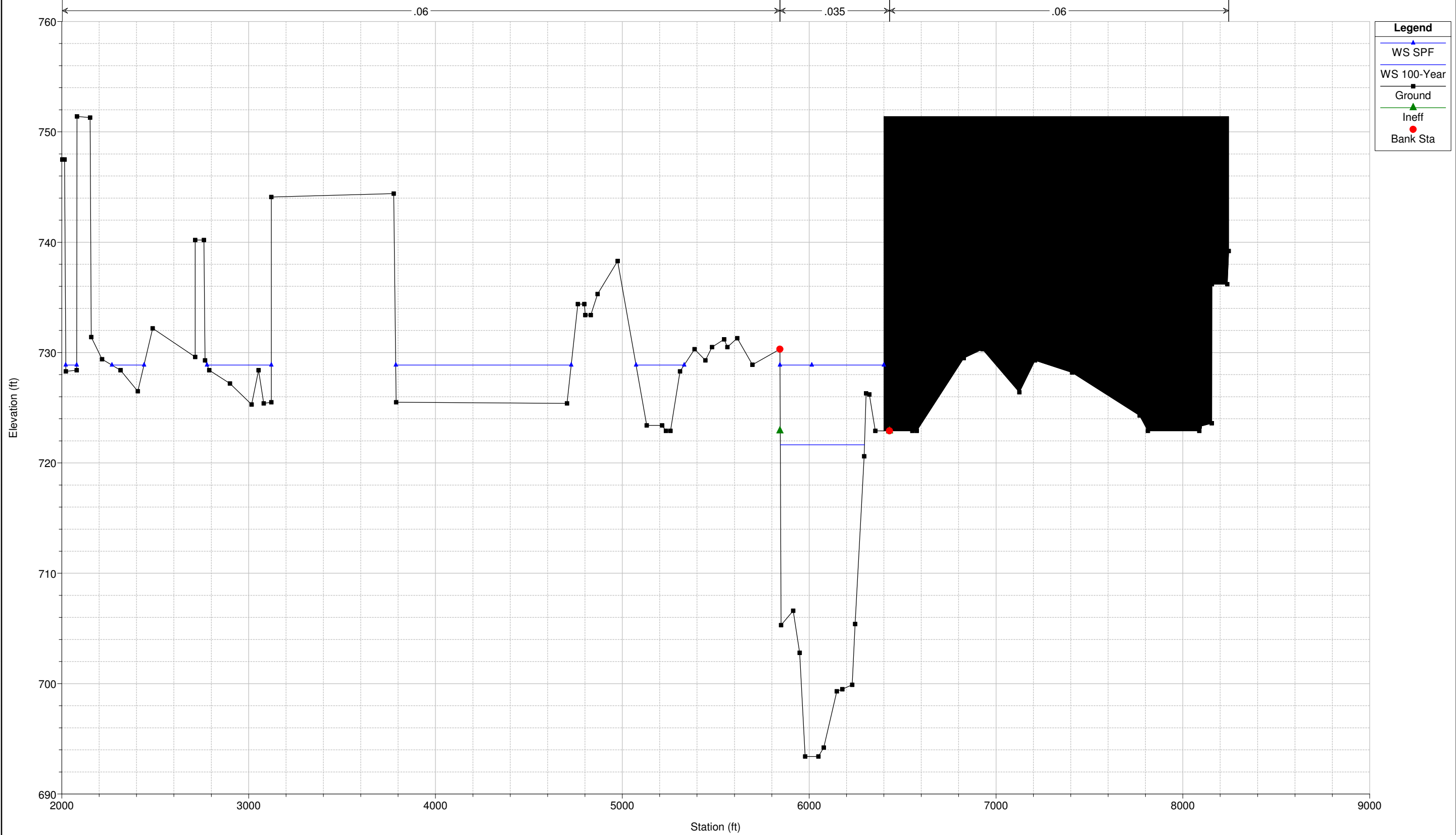
Sciotogreenways Plan: Post-project
RS = 254.93 BR



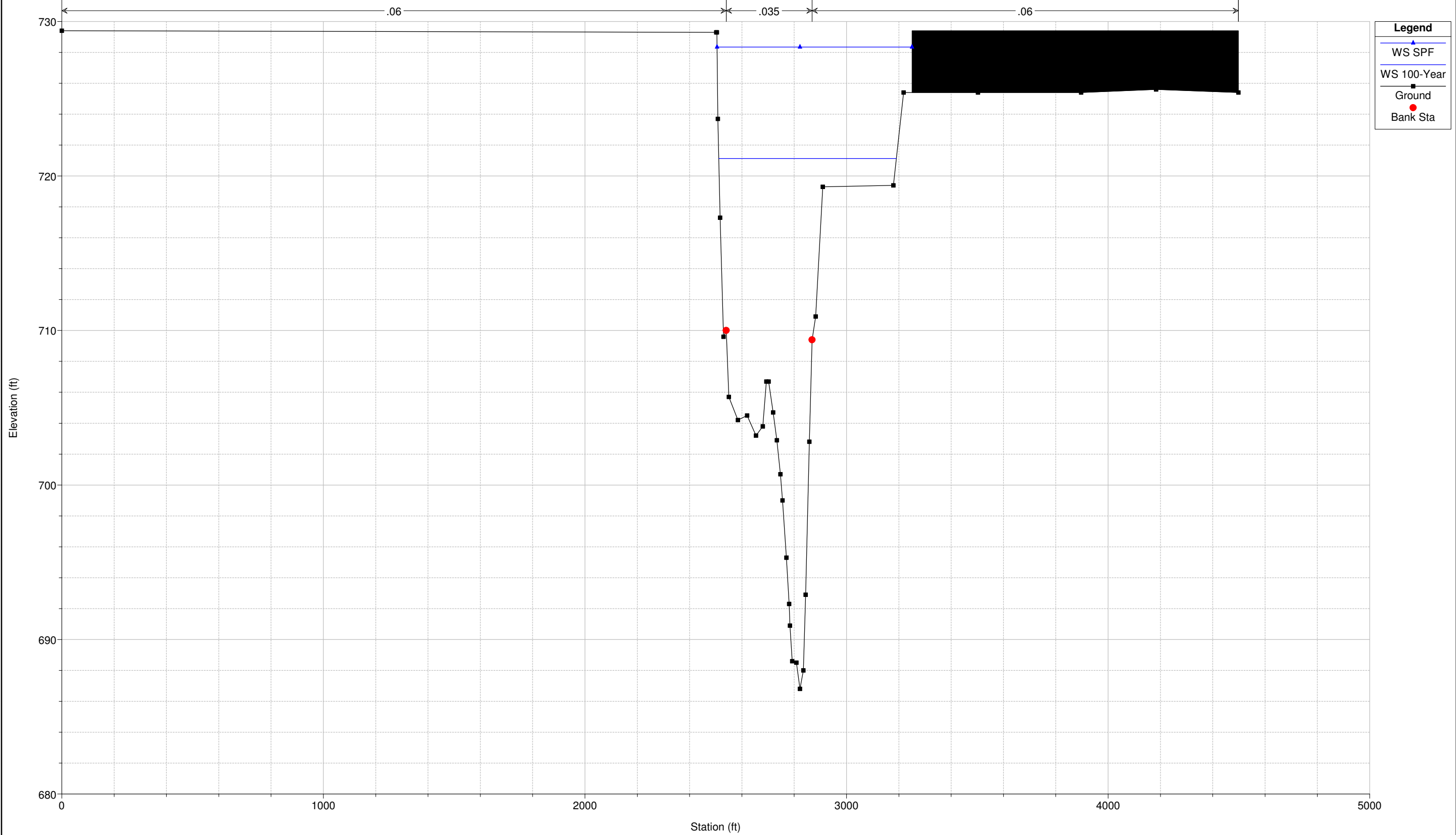
Sciotgreenways Plan: Post-project
RS = 254.93 BR



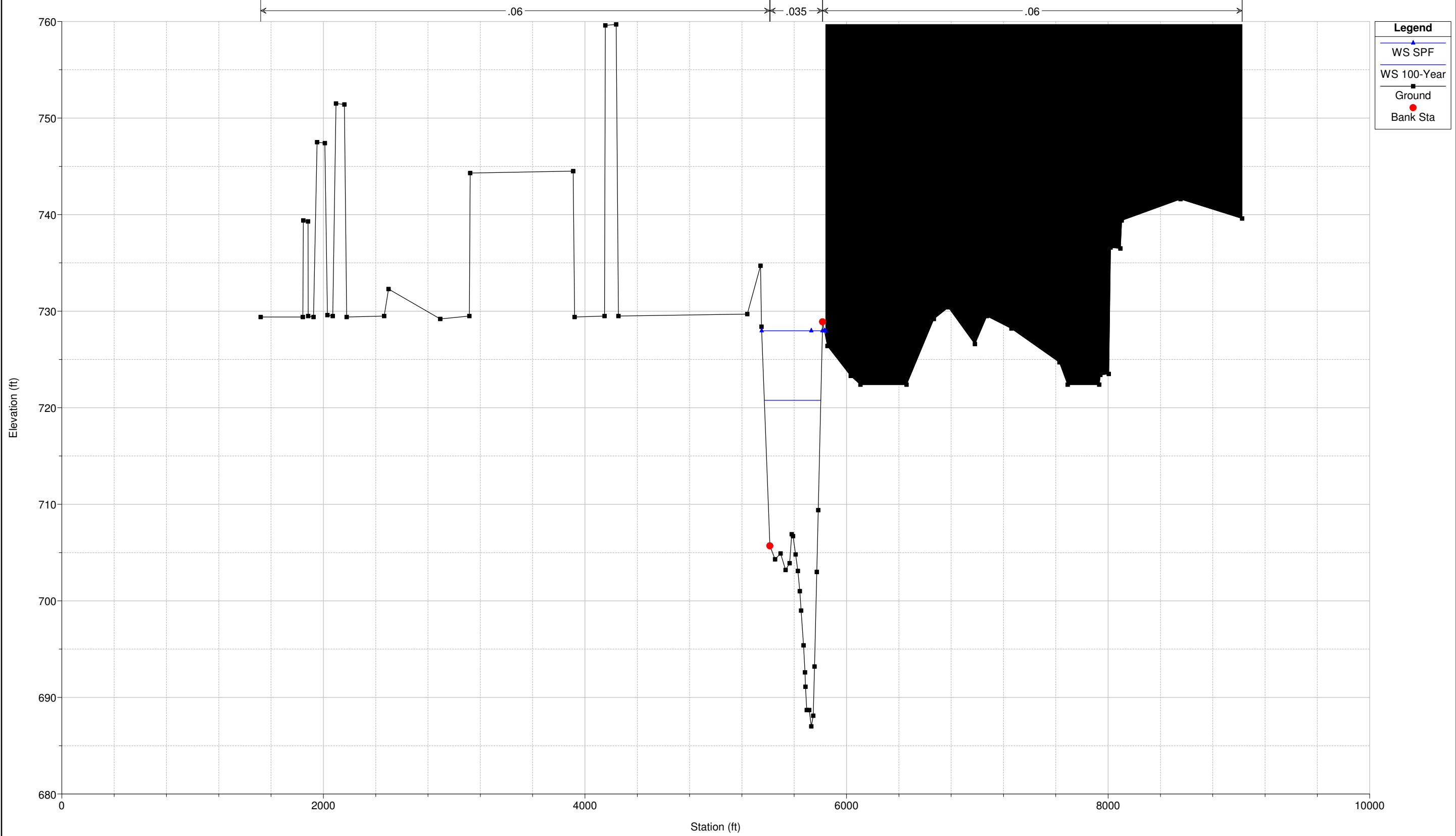
Sciotogreenways Plan: Post-project
RS = 254.92



Sciotogreenways Plan: Post-project
RS = 254.91

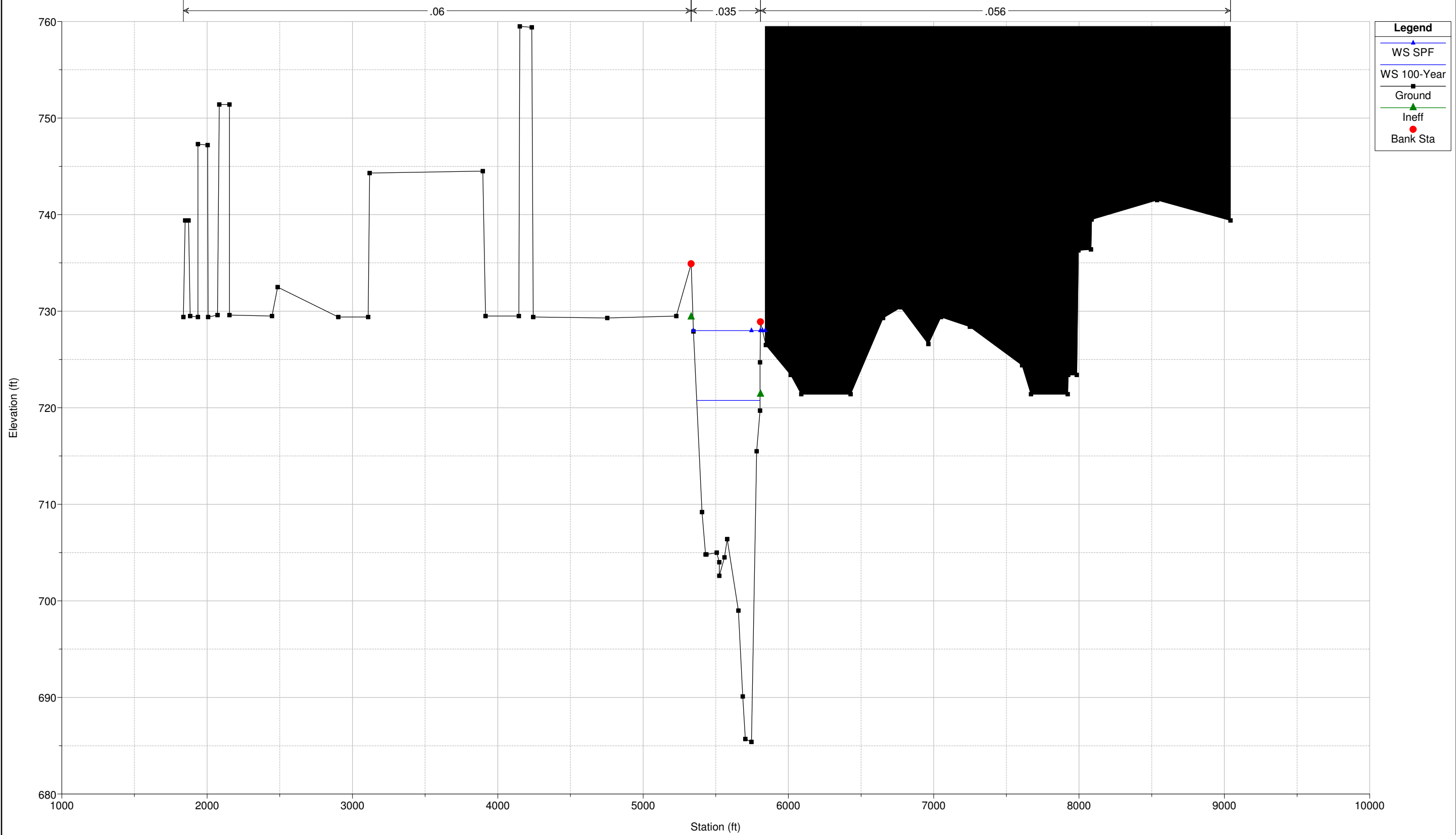


Sciotogreenways Plan: Post-project
RS = 254.5



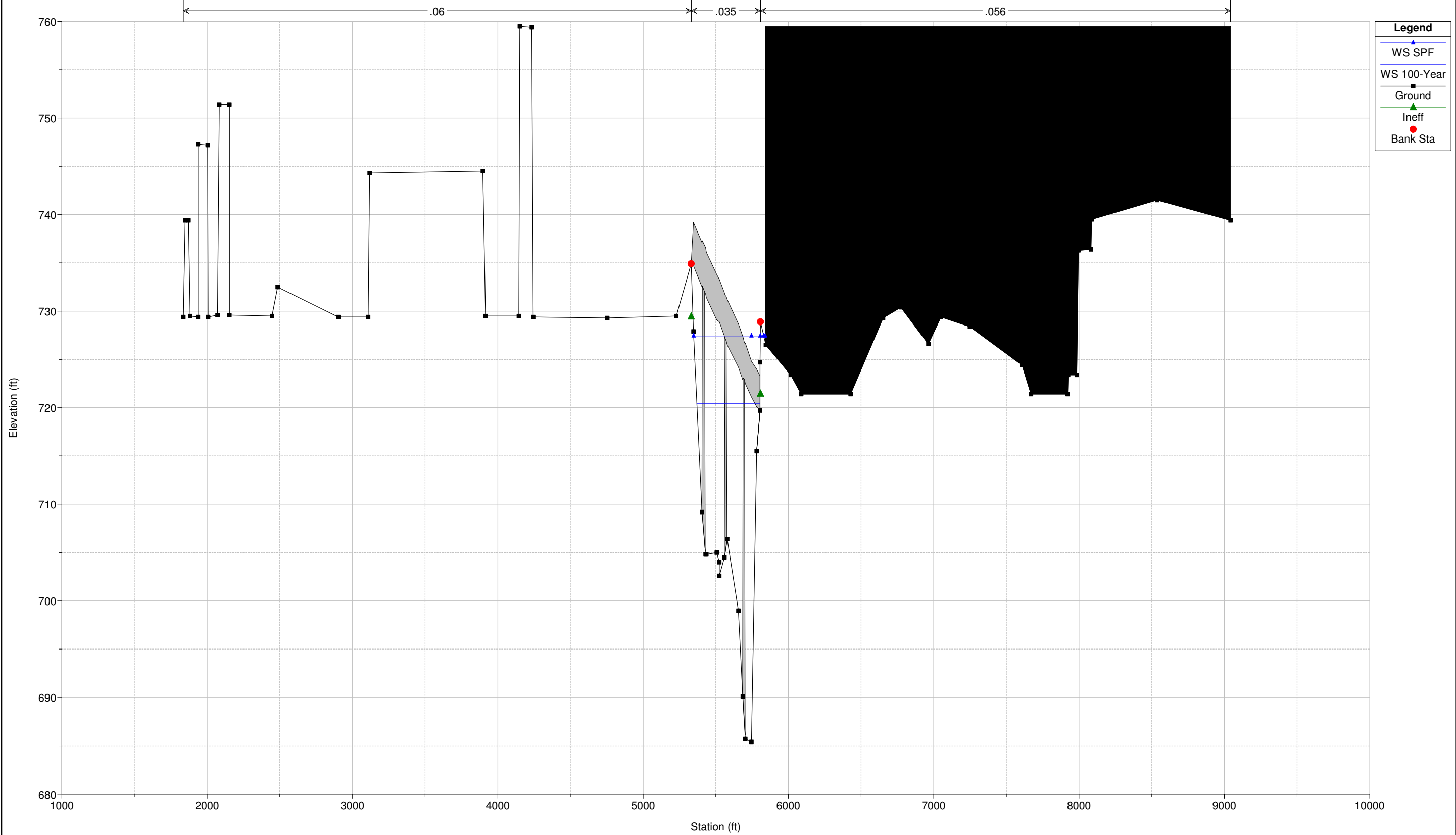
Sciotogreenways Plan: Post-project

RS = 254.4



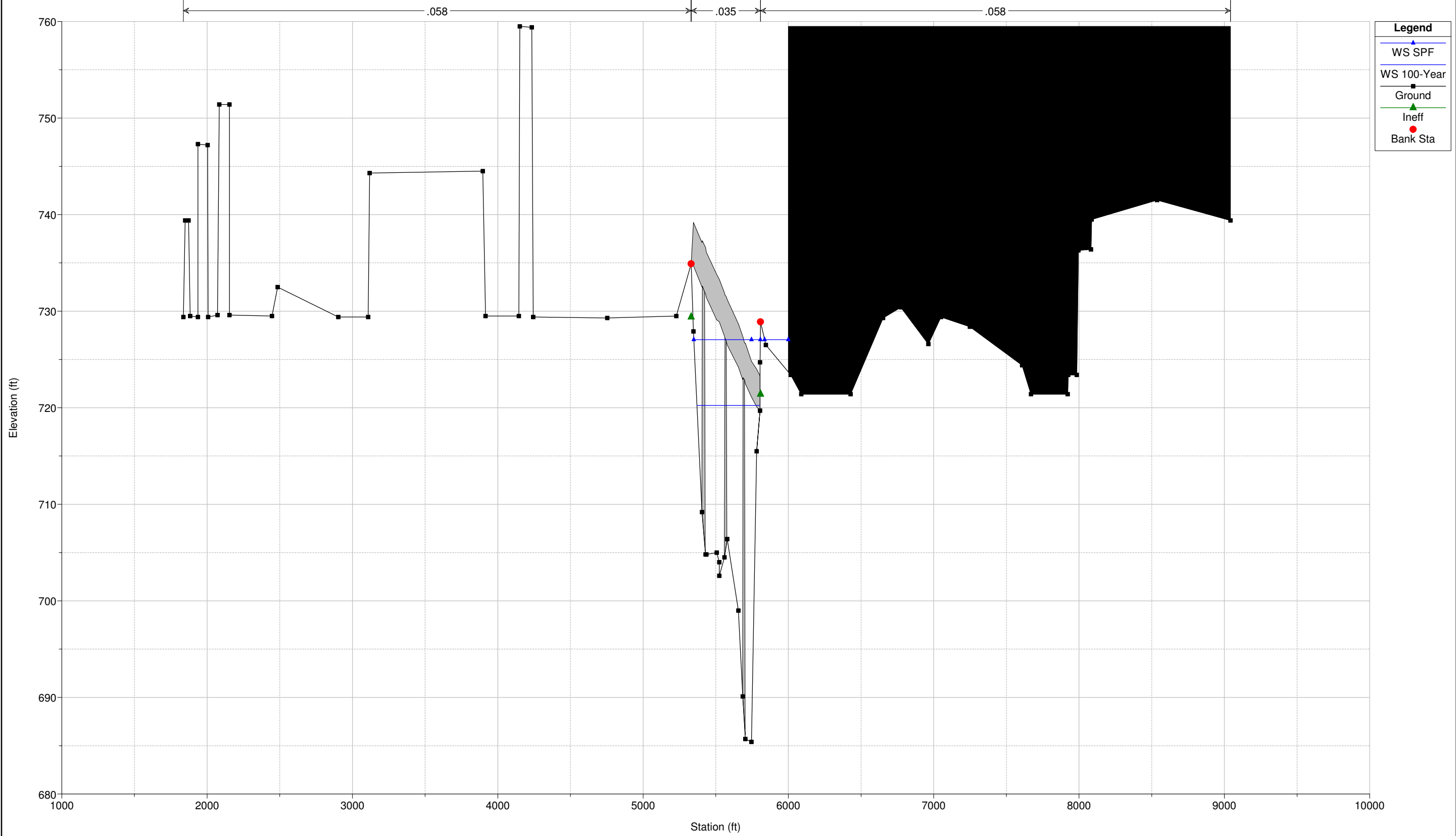
Sciotogreenways Plan: Post-project

RS = 254.3 BR



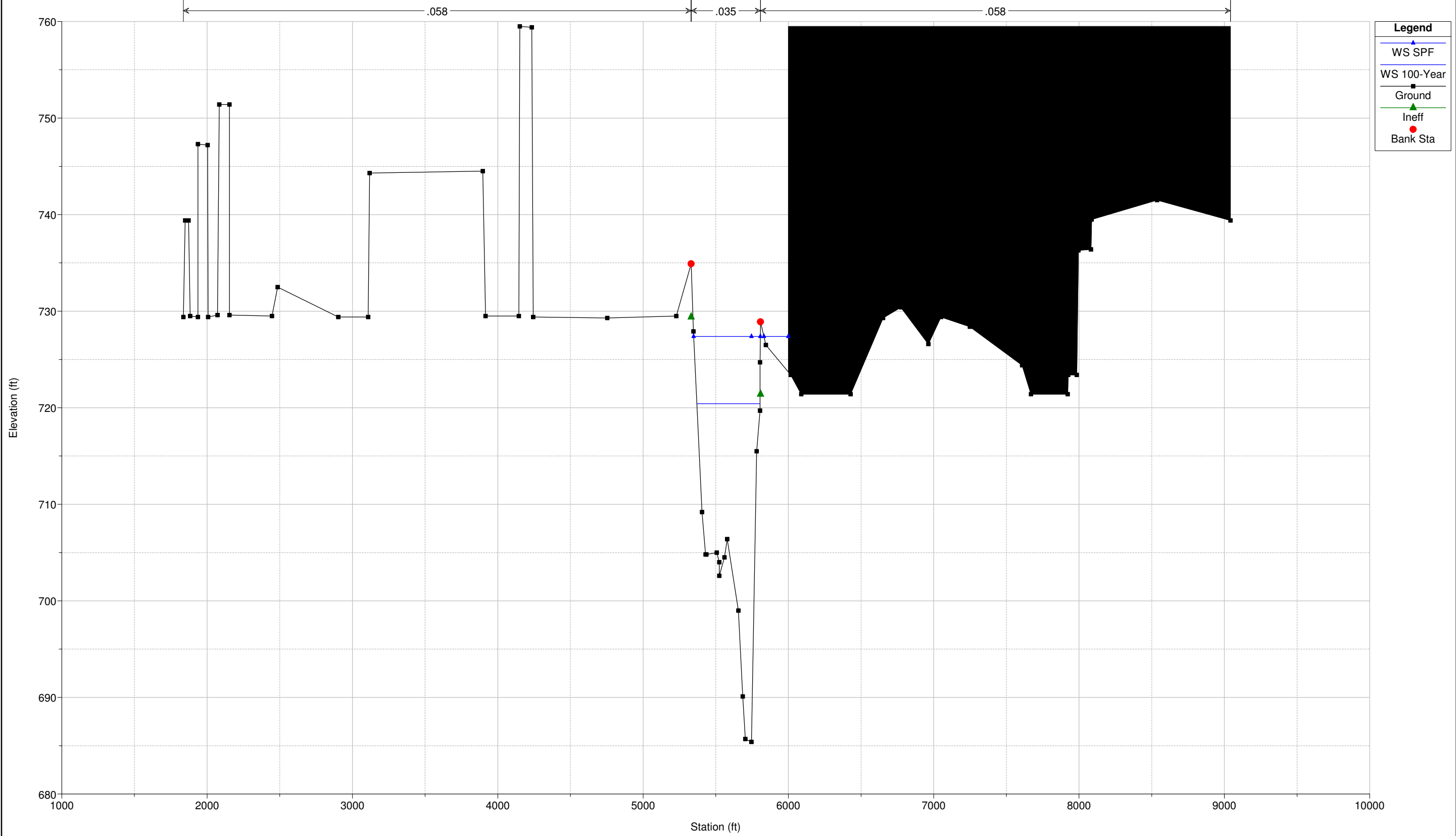
Sciotogreenways Plan: Post-project

RS = 254.3 BR



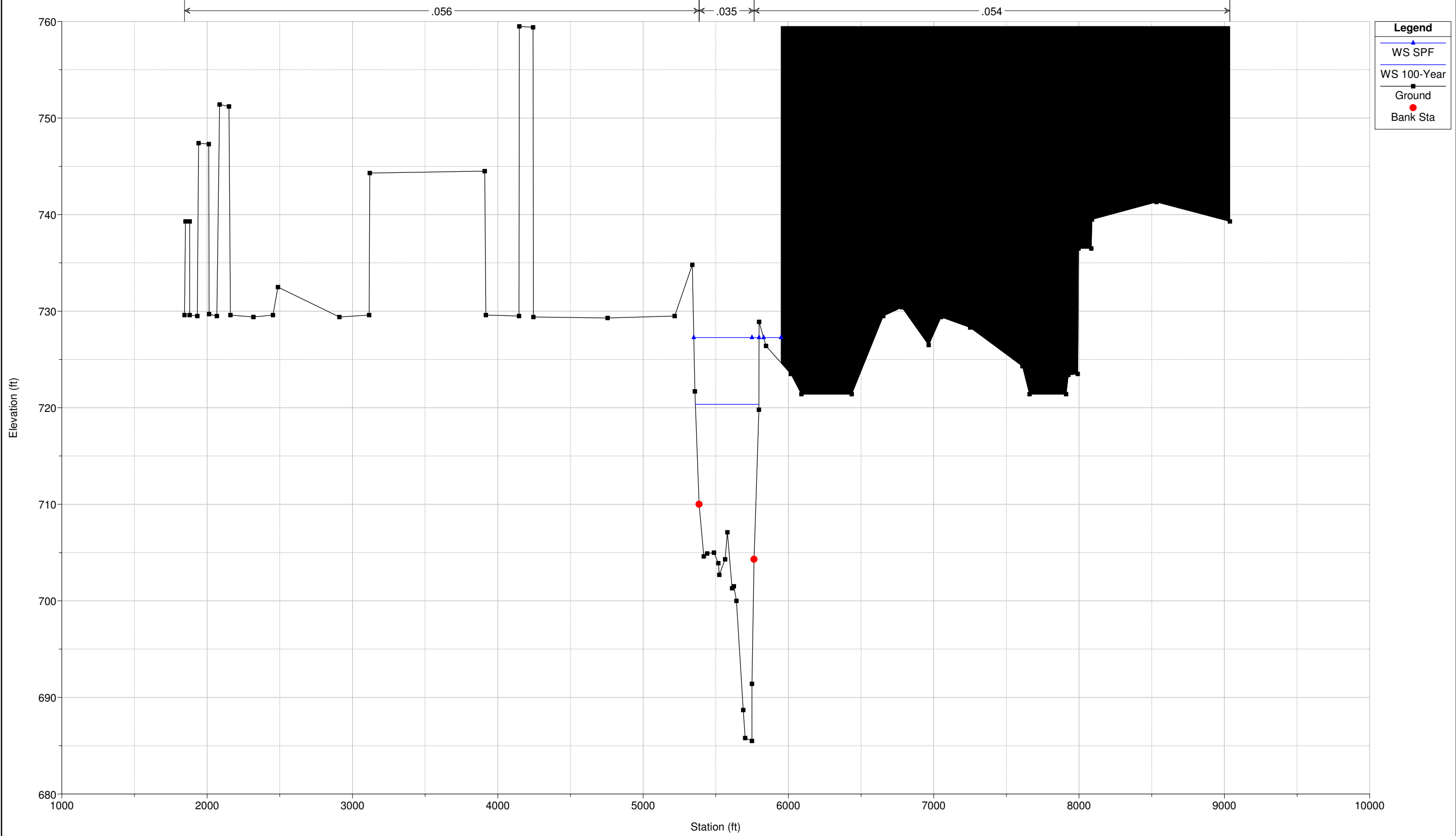
Sciotogreenways Plan: Post-project

RS = 254.2

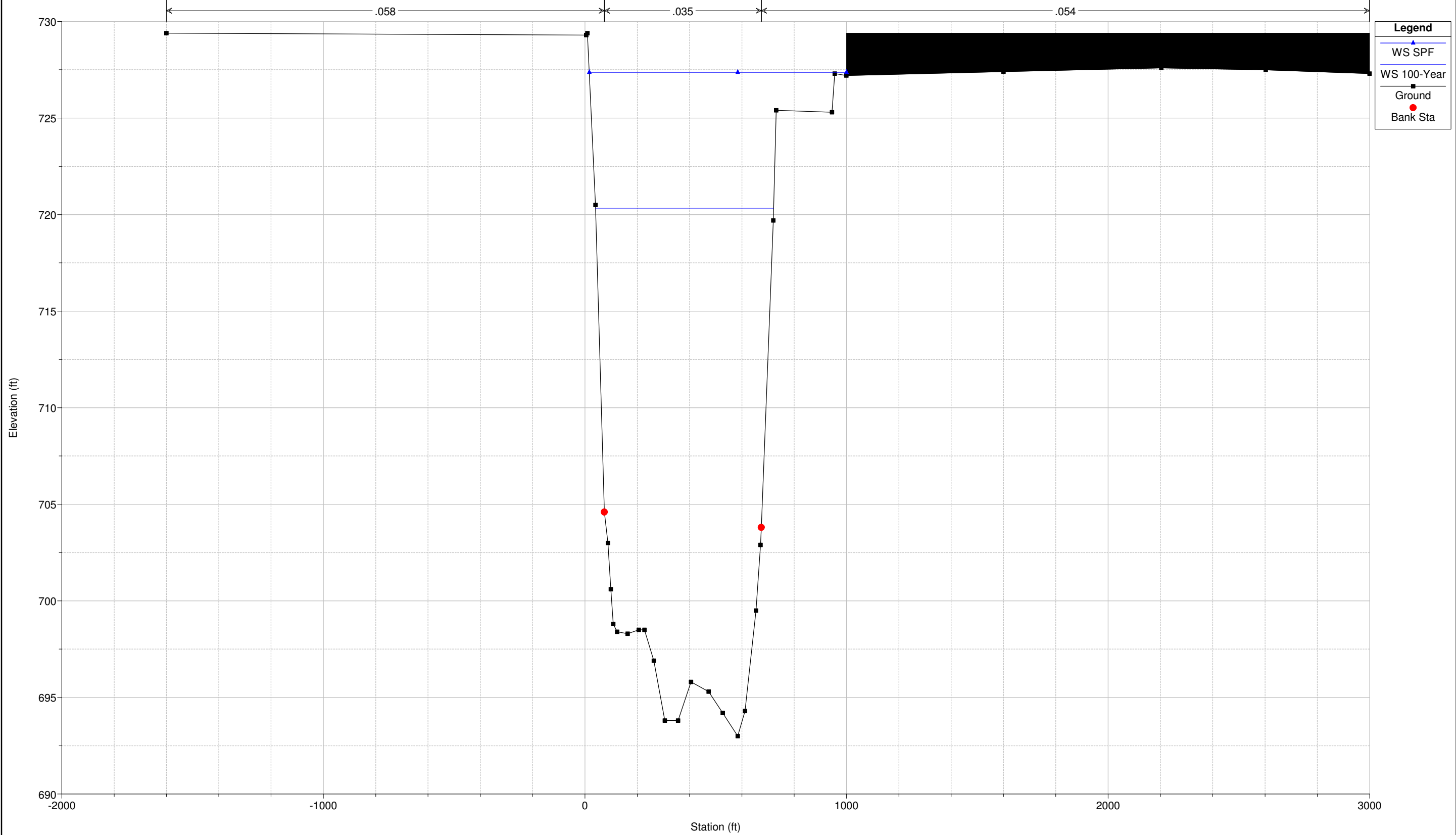


Sciotogreenways Plan: Post-project

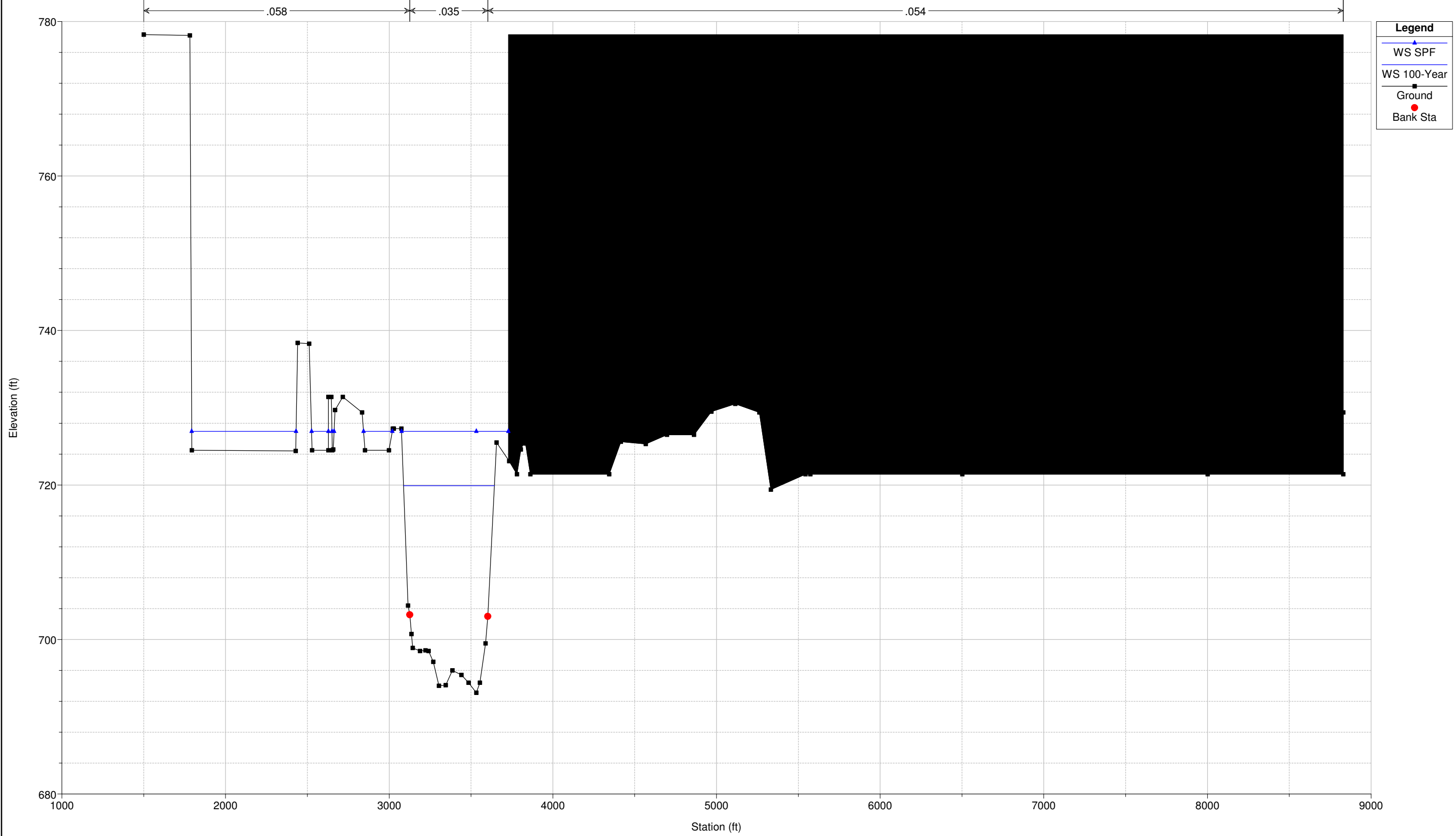
RS = 254.1



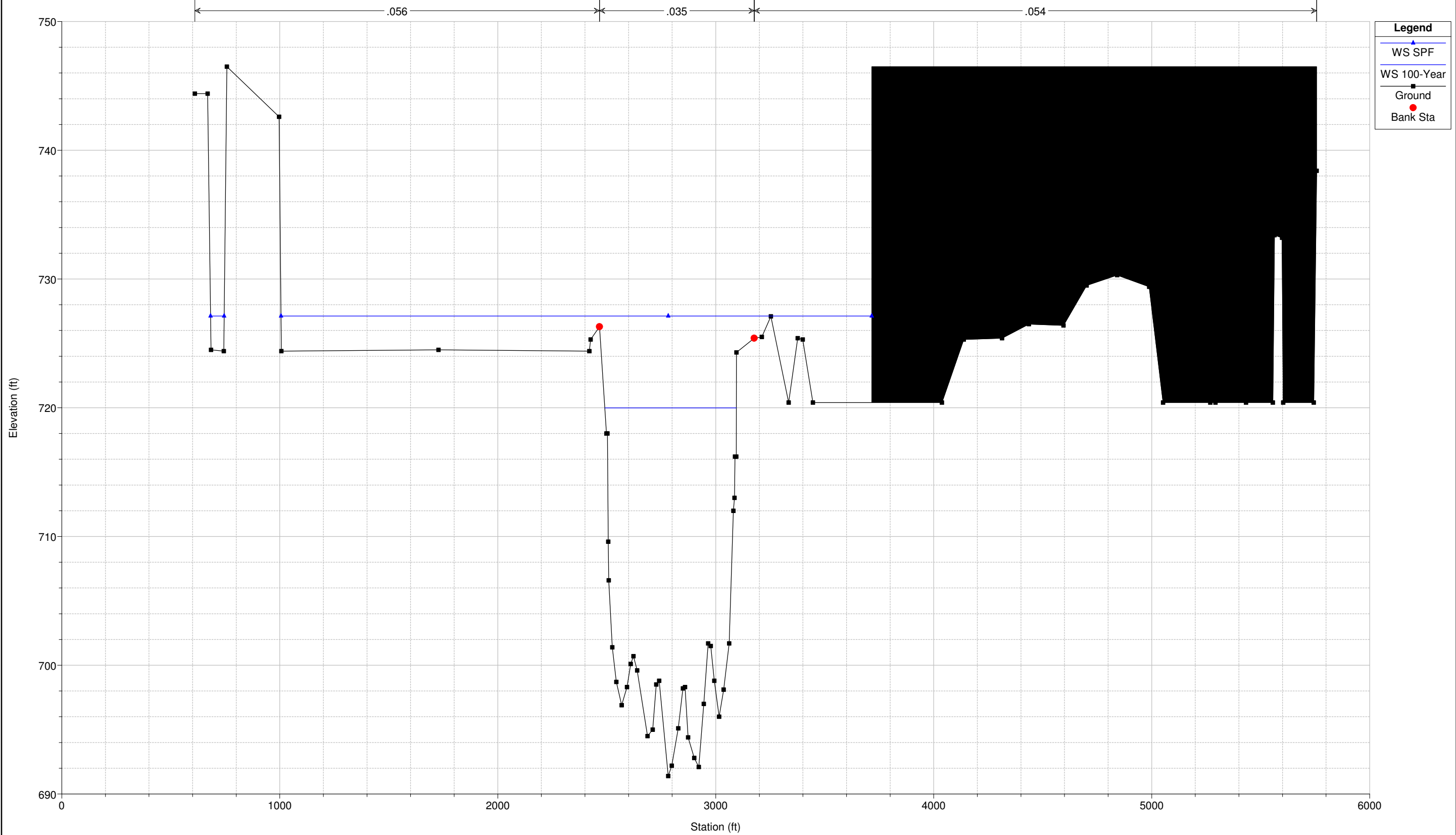
Sciotogreenways Plan: Post-project
RS = 253.6



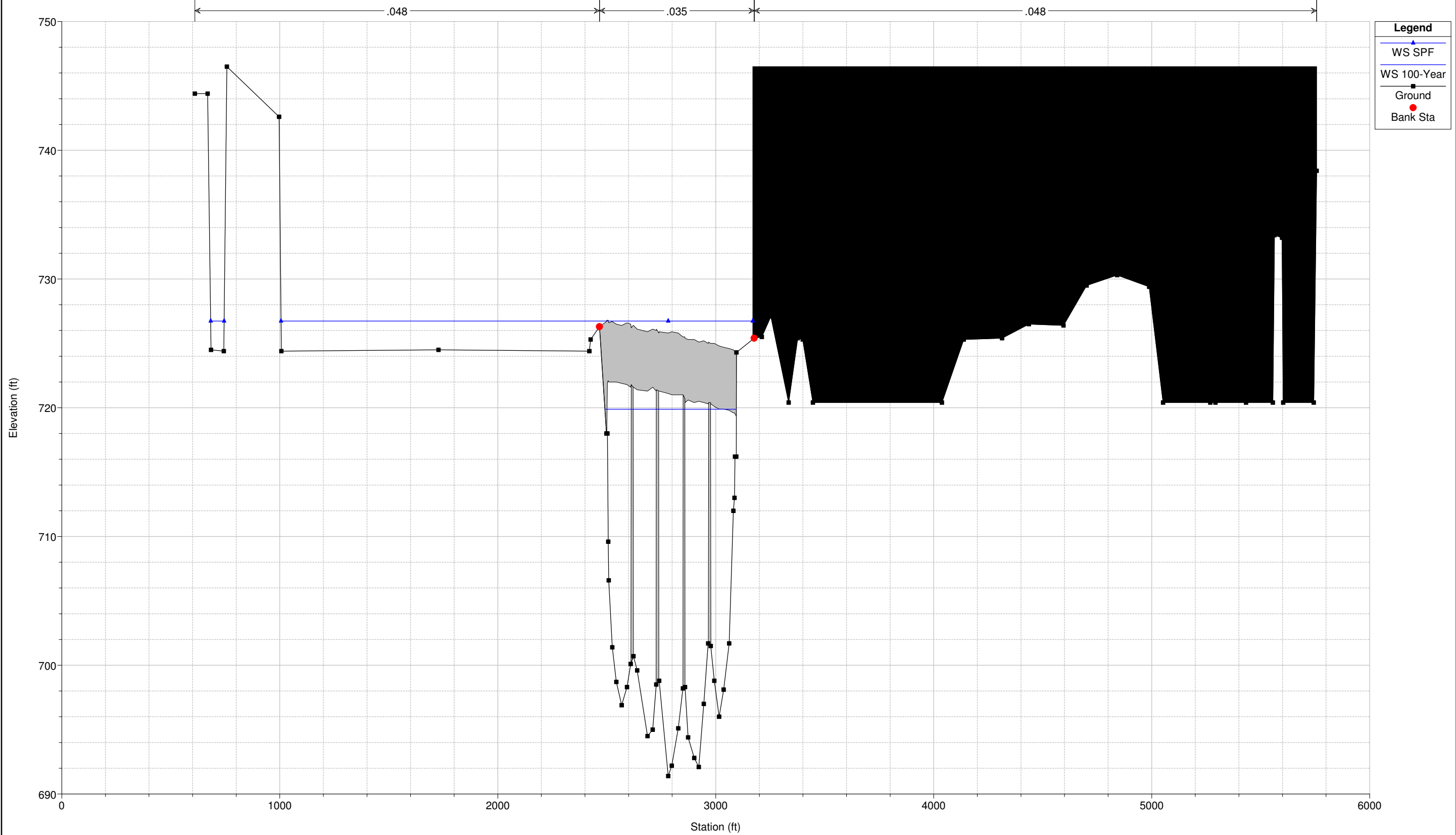
Sciotogreenways Plan: Post-project
RS = 253.5



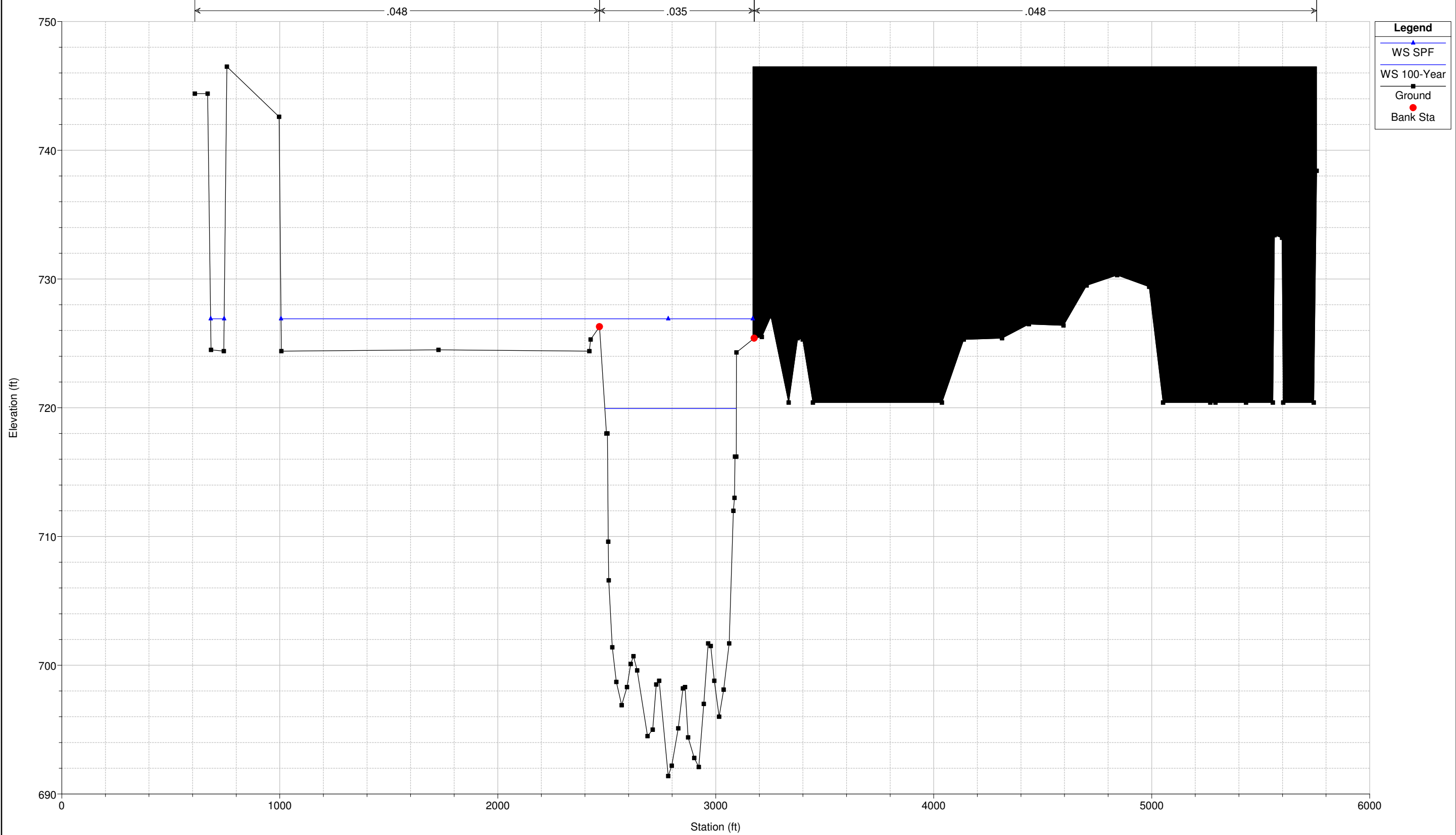
Sciotgreenways Plan: Post-project
RS = 253.4



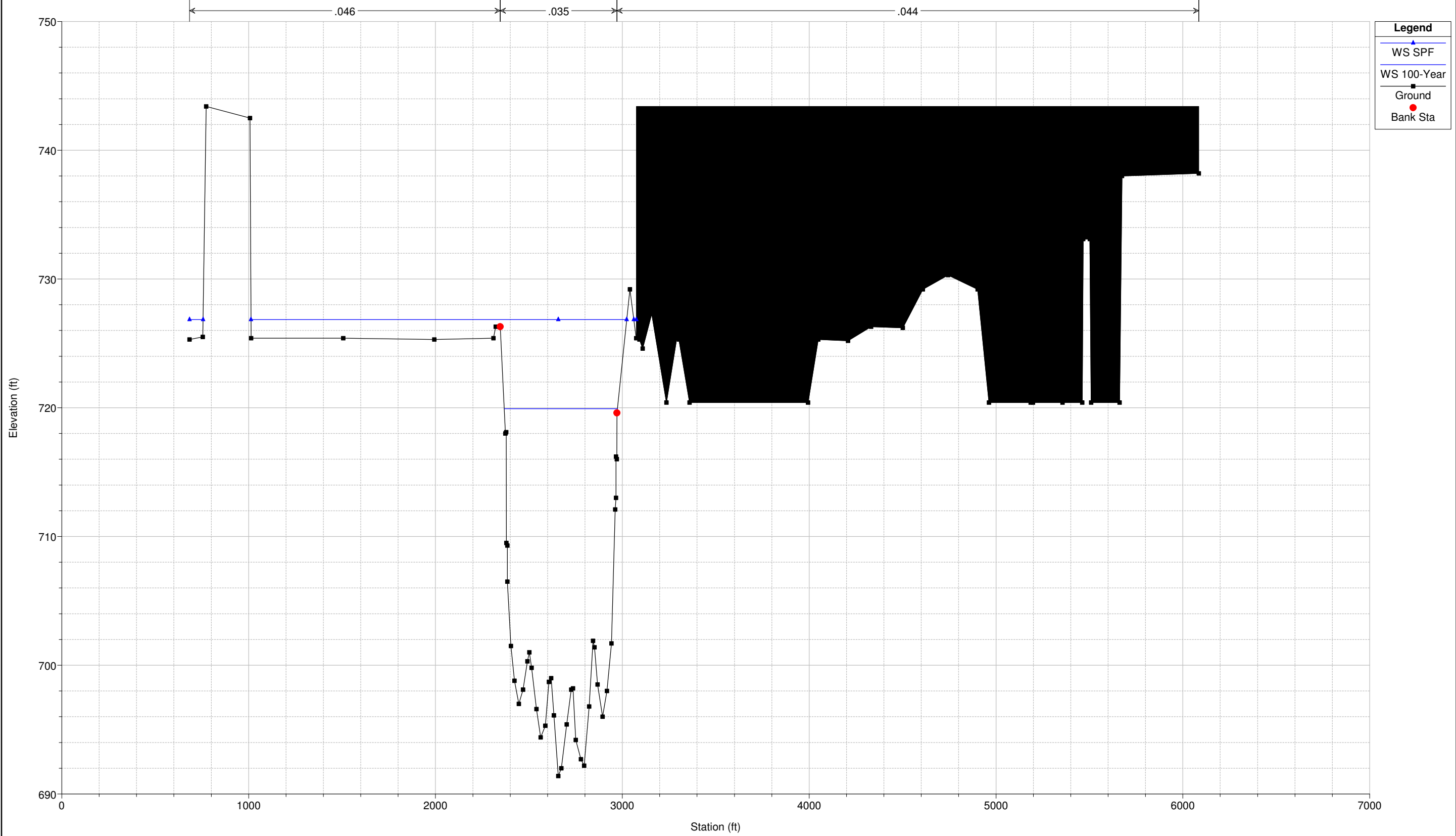
Sciotogreenways Plan: Post-project
RS = 253.3 BR



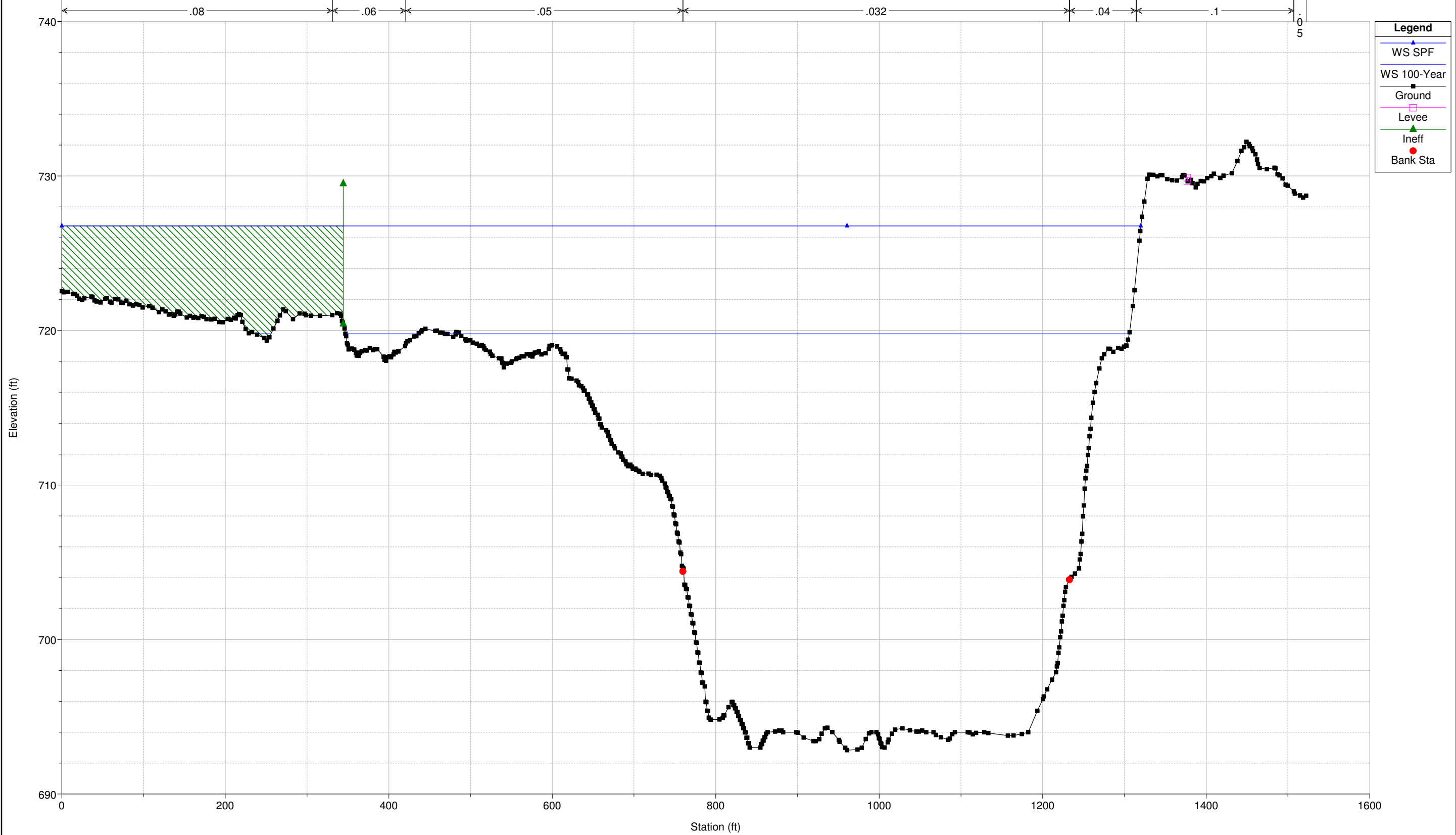
Sciotgreenways Plan: Post-project
RS = 253.2



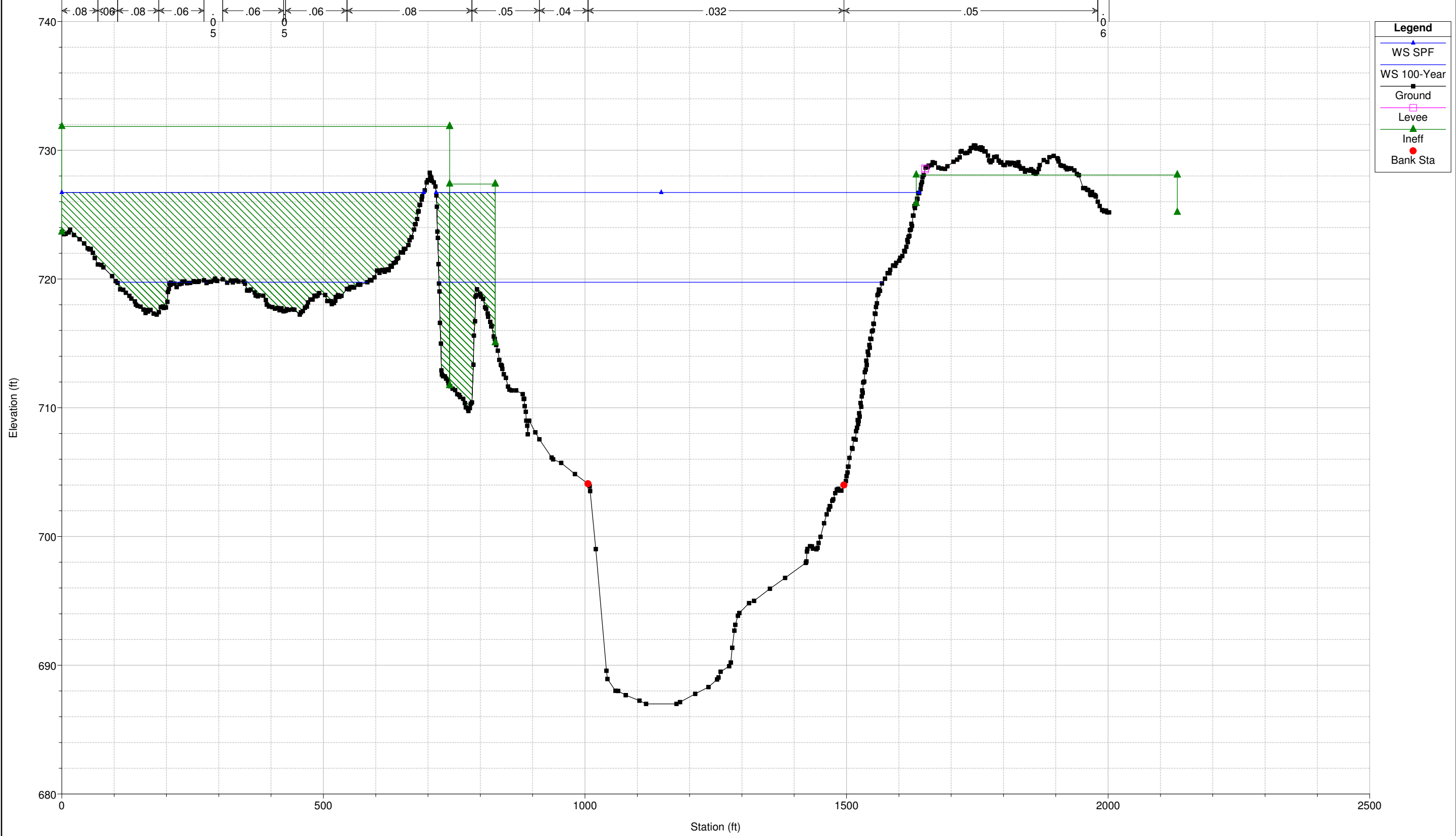
SciotoGreenways Plan: Post-project
RS = 253.1



Sciotogreenways Plan: Post-project
RS = 252.8

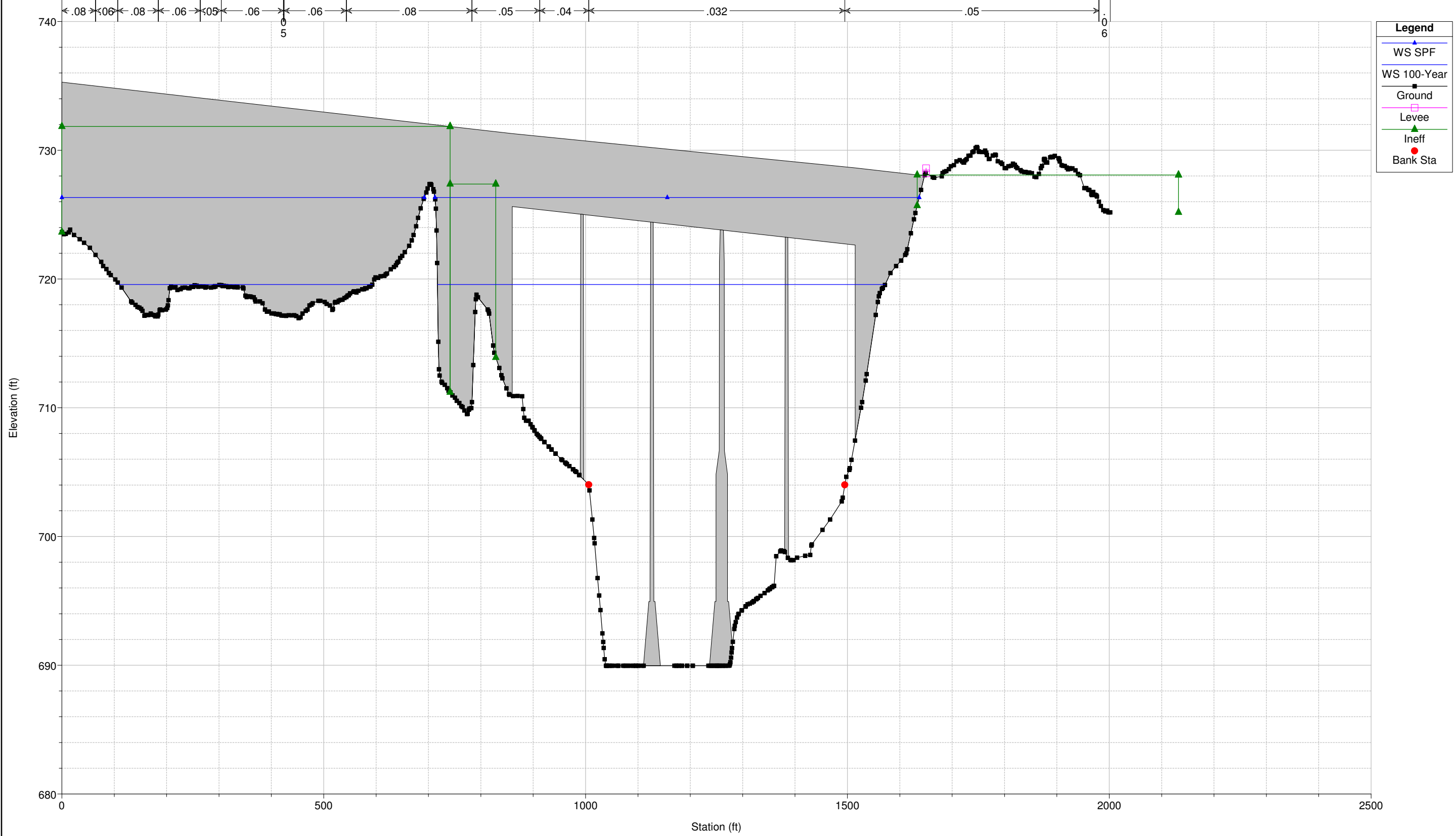


Sciotgreenways Plan: Post-project
RS = 252.5



Sciotgreenways Plan: Post-project

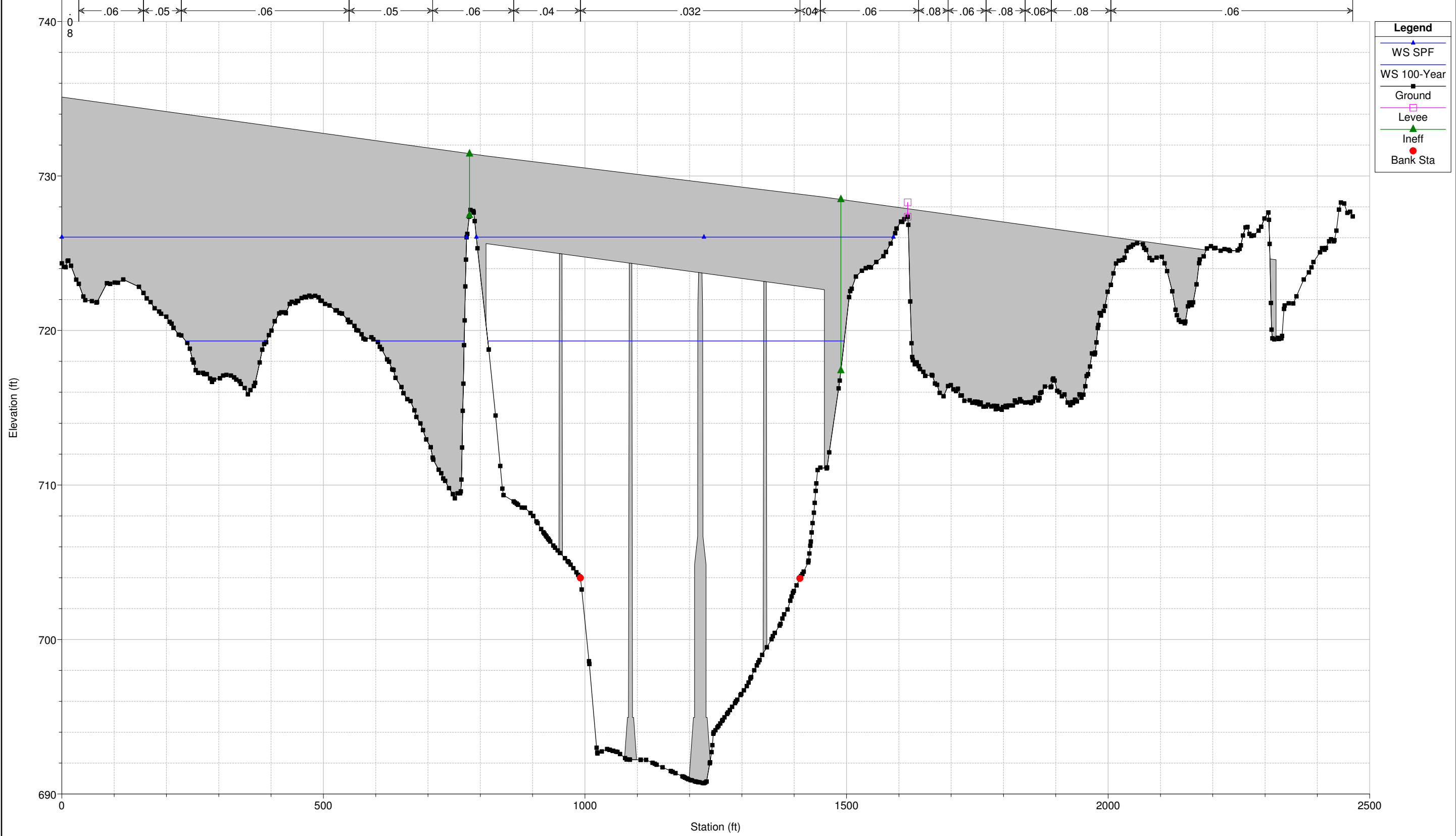
RS = 252.3 BR



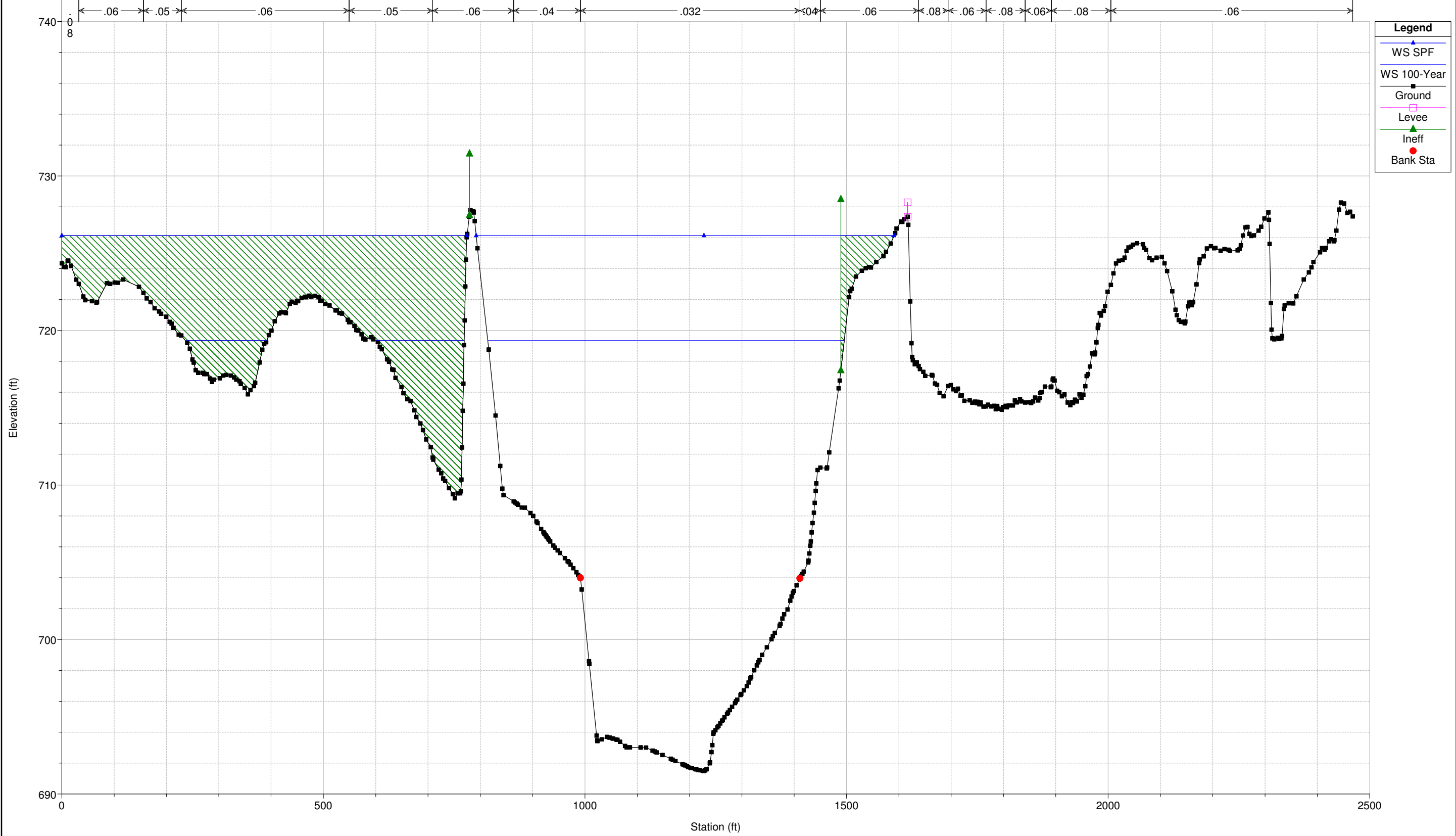
Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

Sciotgreenways Plan: Post-project
RS = 252.3 BR

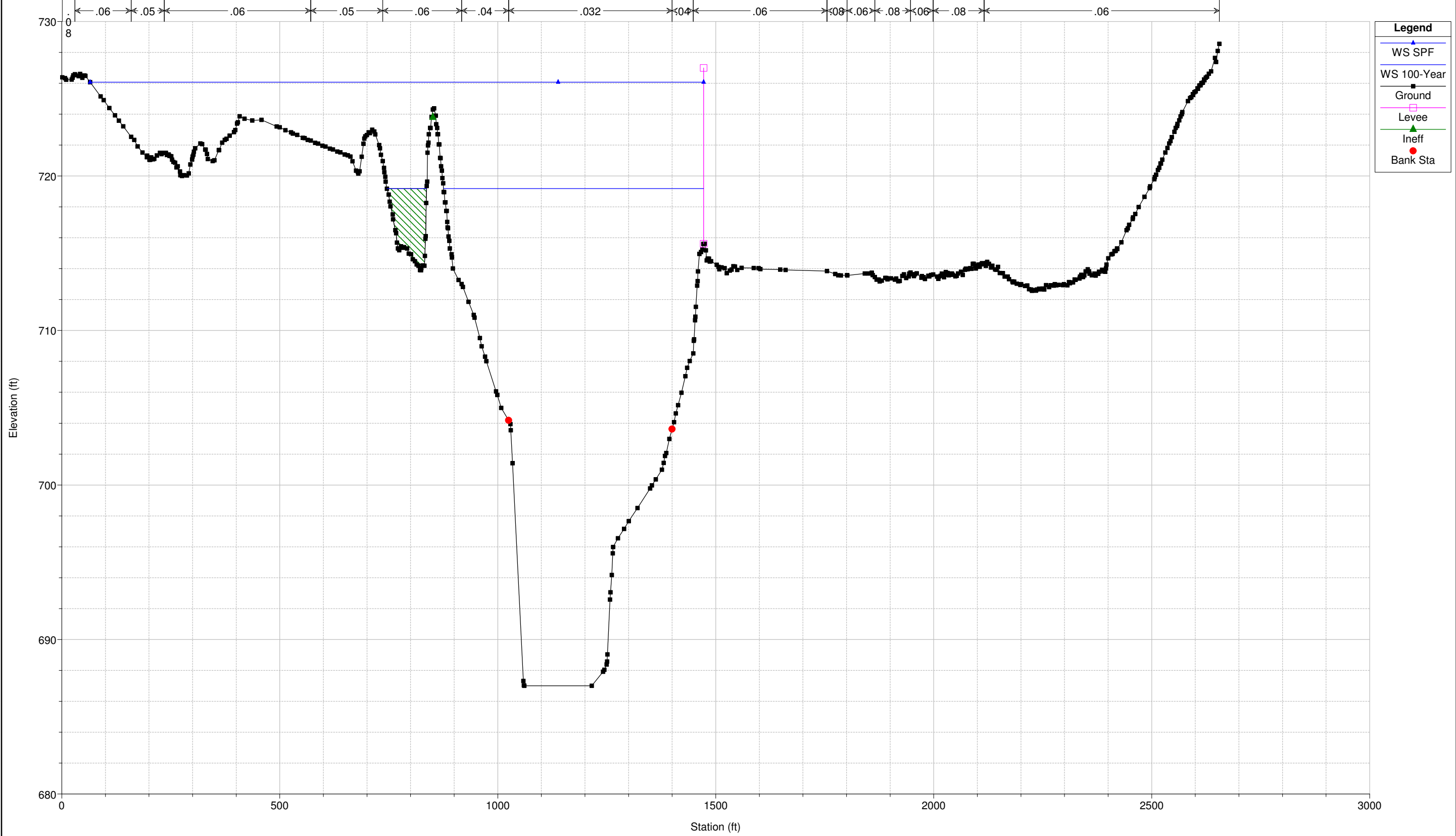


Sciotogreenways Plan: Post-project
RS = 252.1



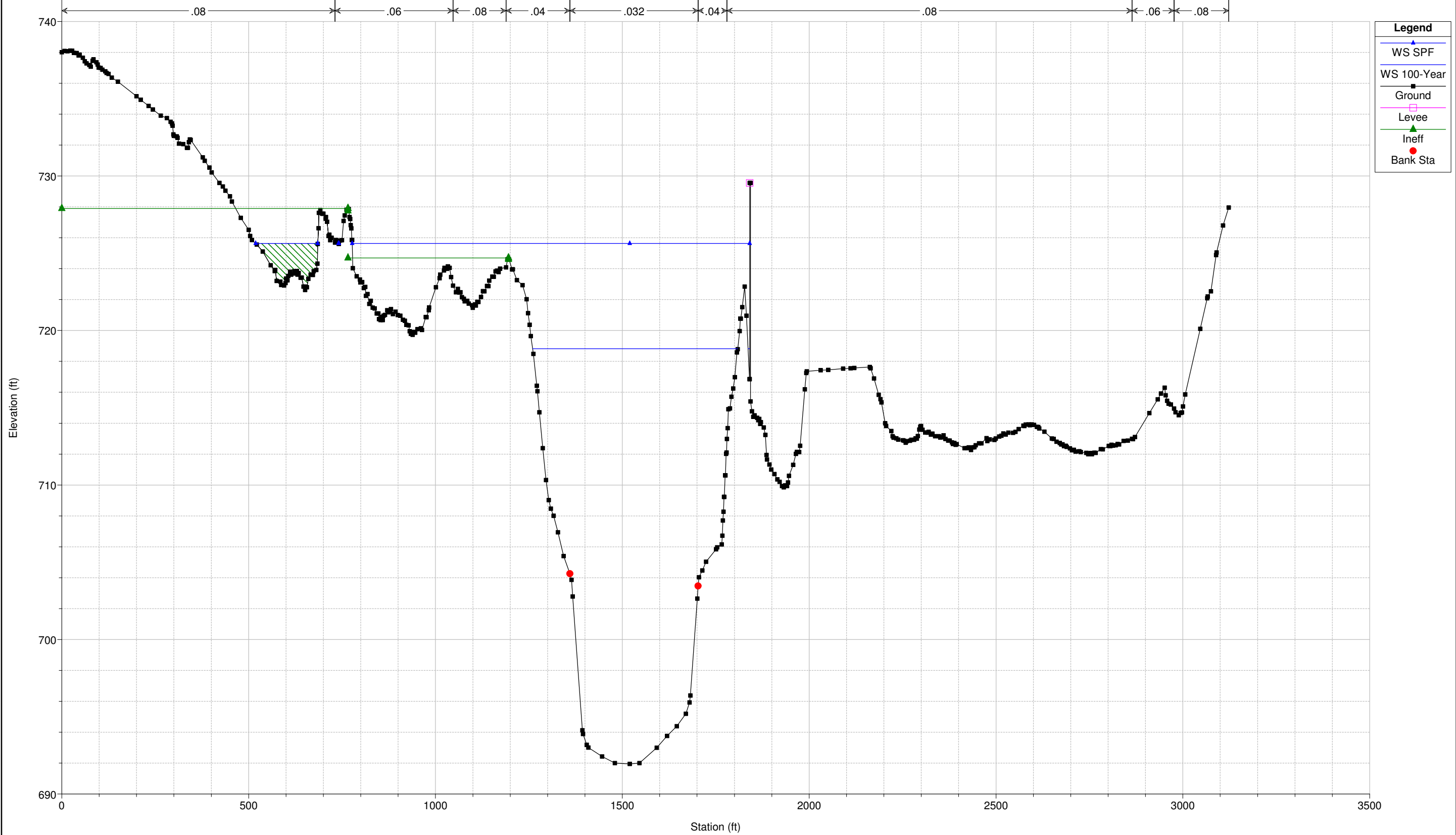
- Legend
- WS SPF
- WS 100-Year
- Ground
- Levee
- Ineff
- Bank Sta

Sciotgreenways Plan: Post-project
RS = 252.06

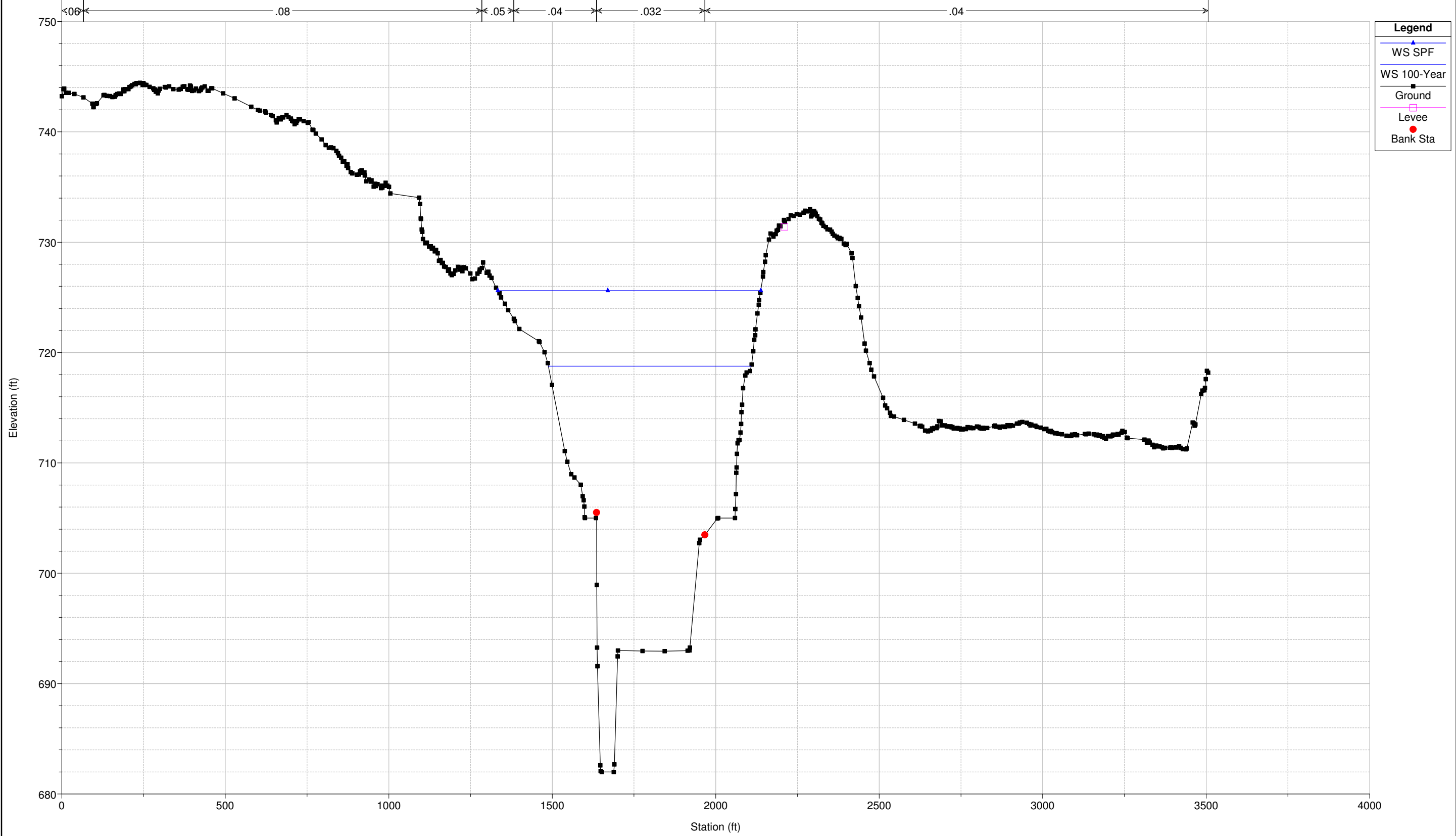


Sciotogreenways Plan: Post-project

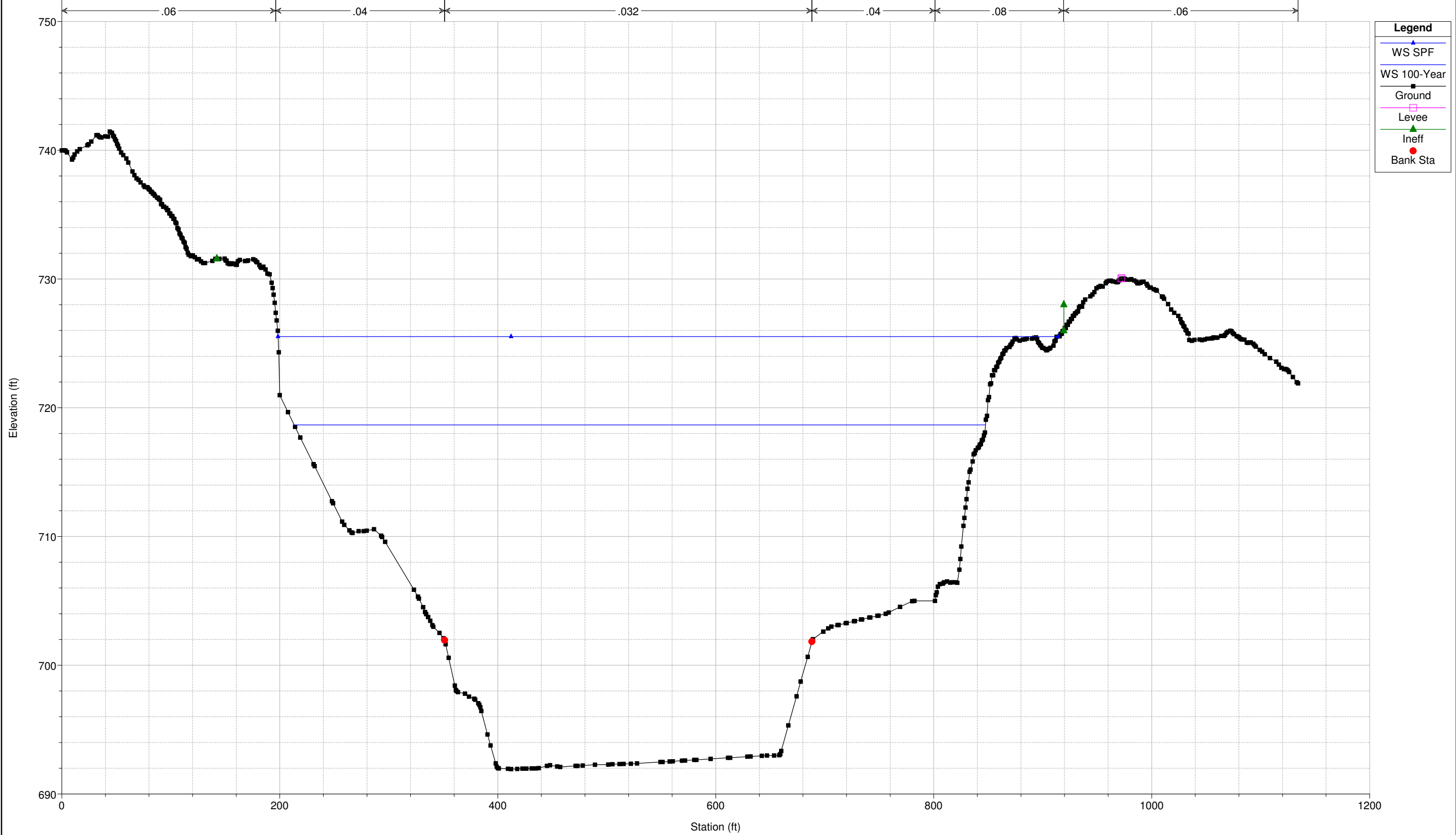
RS = 251.8



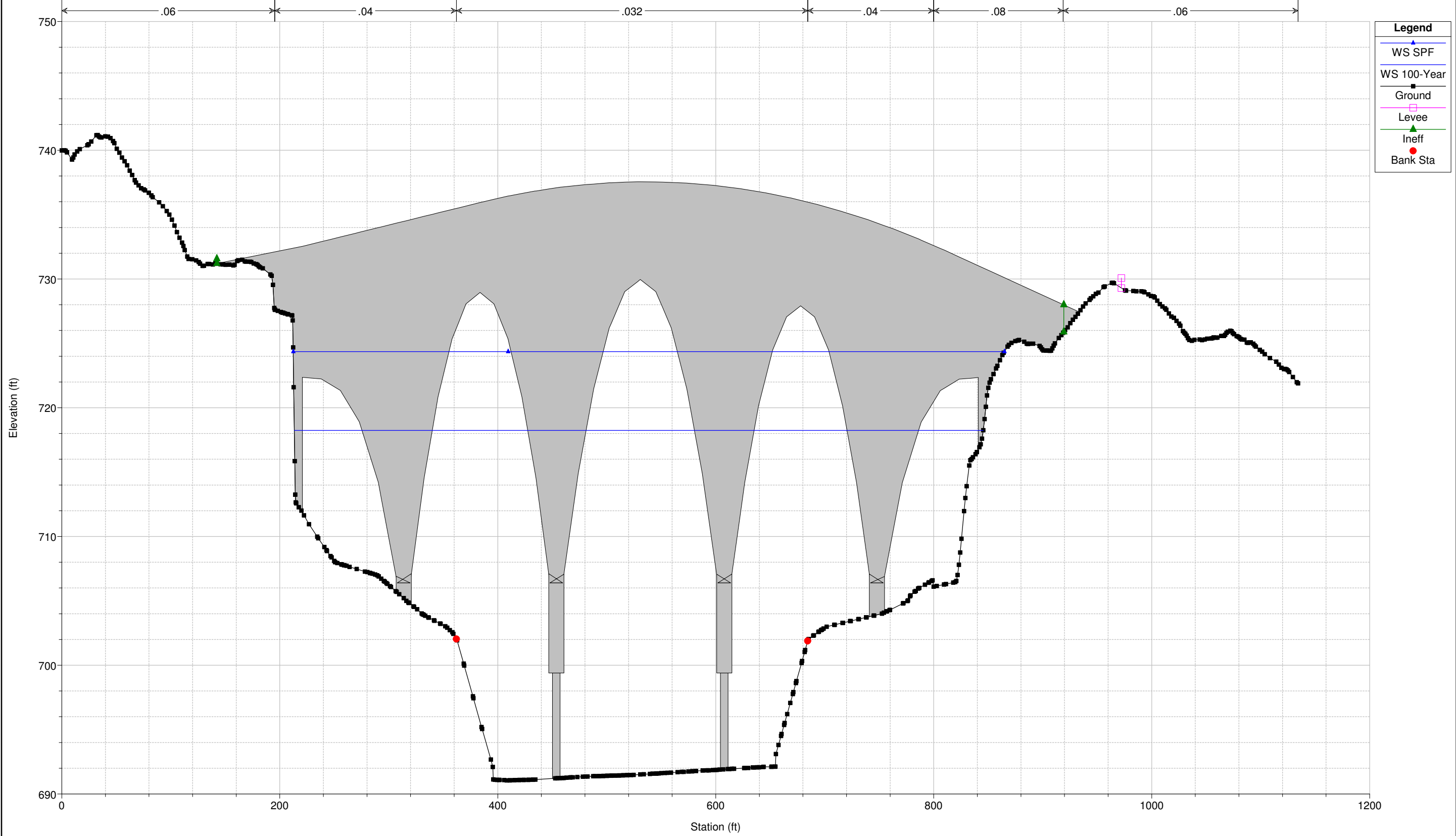
Sciotgreenways Plan: Post-project
RS = 251.75



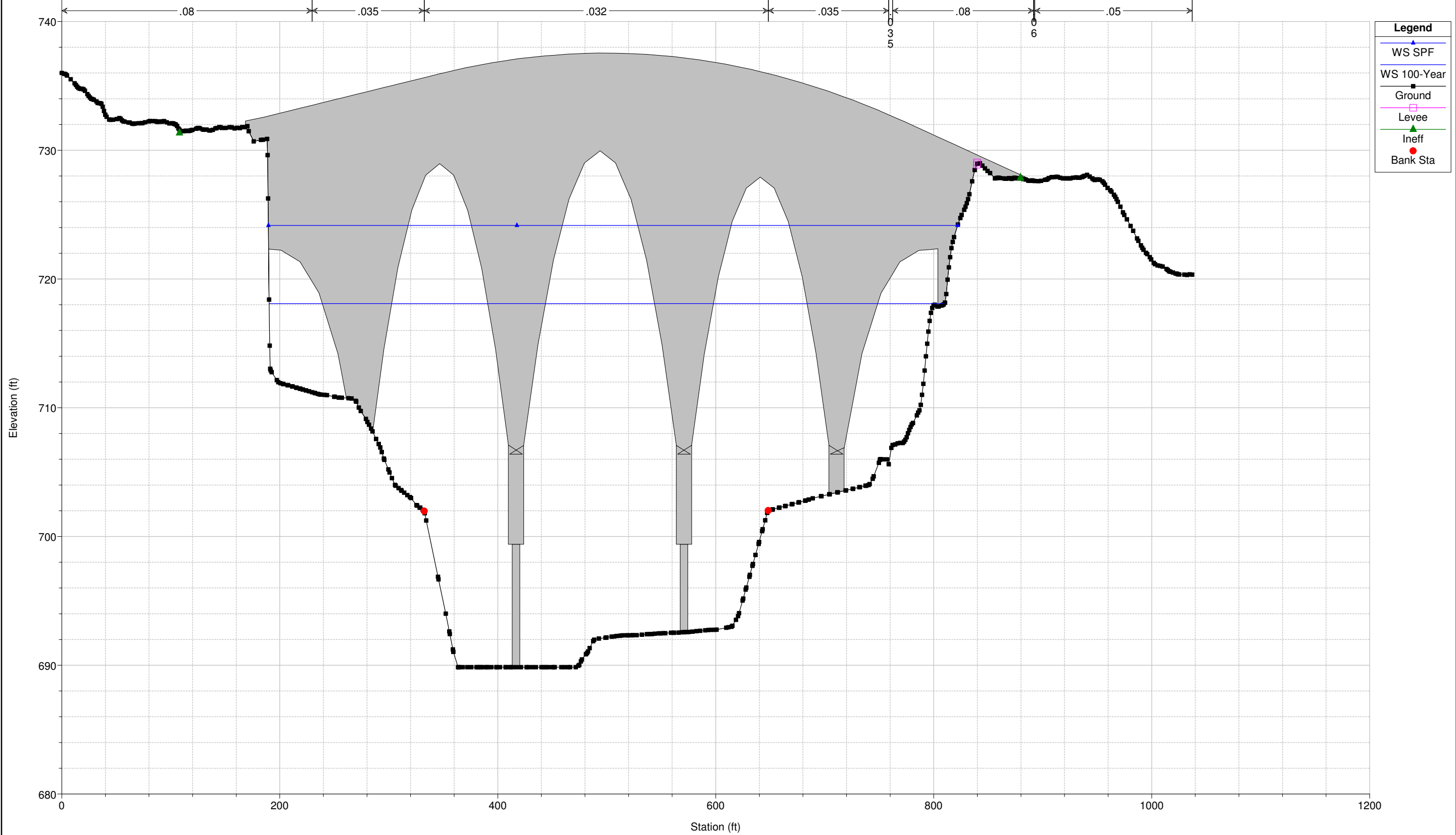
Sciotogreenways Plan: Post-project
RS = 251.5



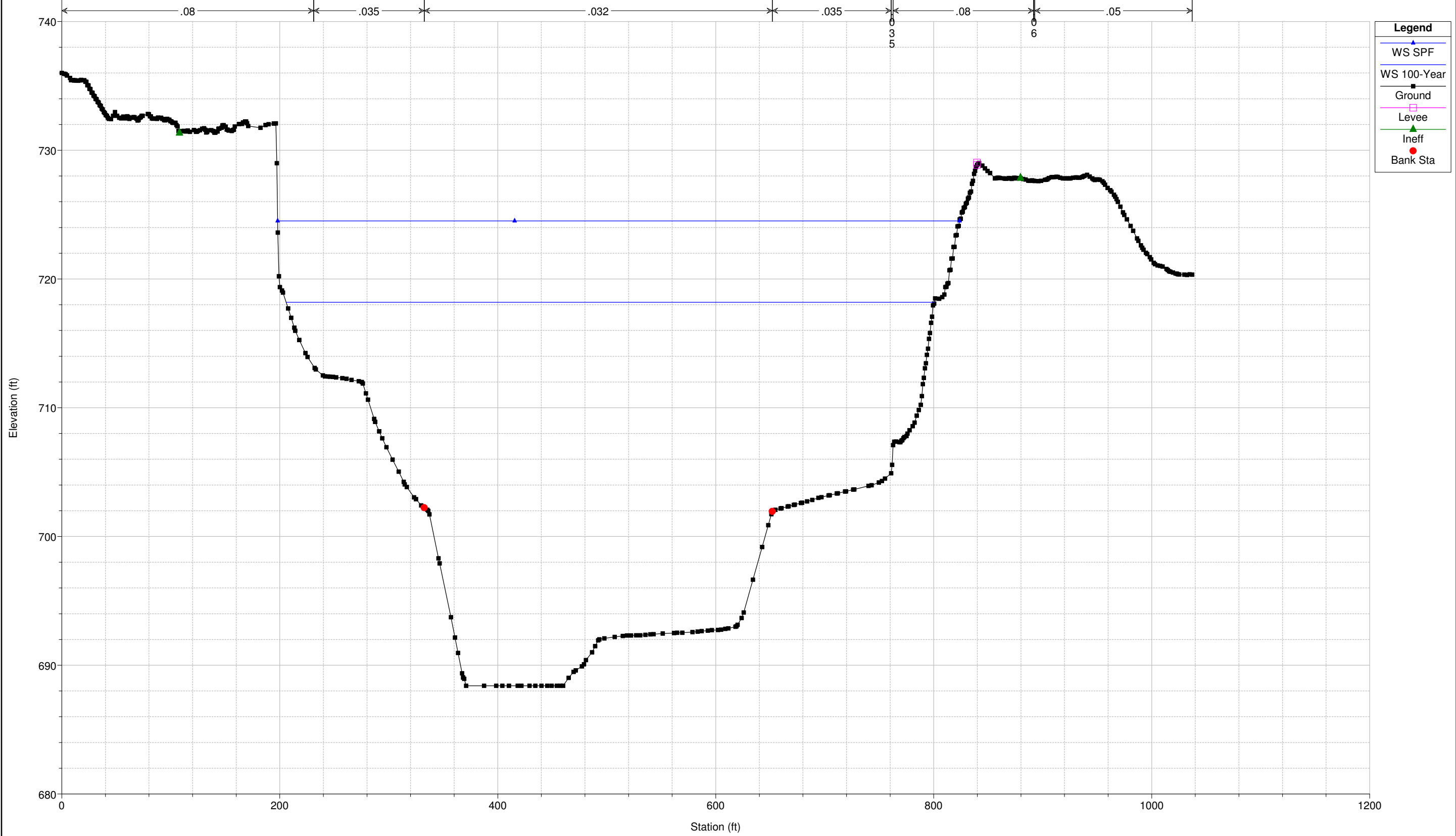
Sciotgreenways Plan: Post-project
RS = 251.3 BR



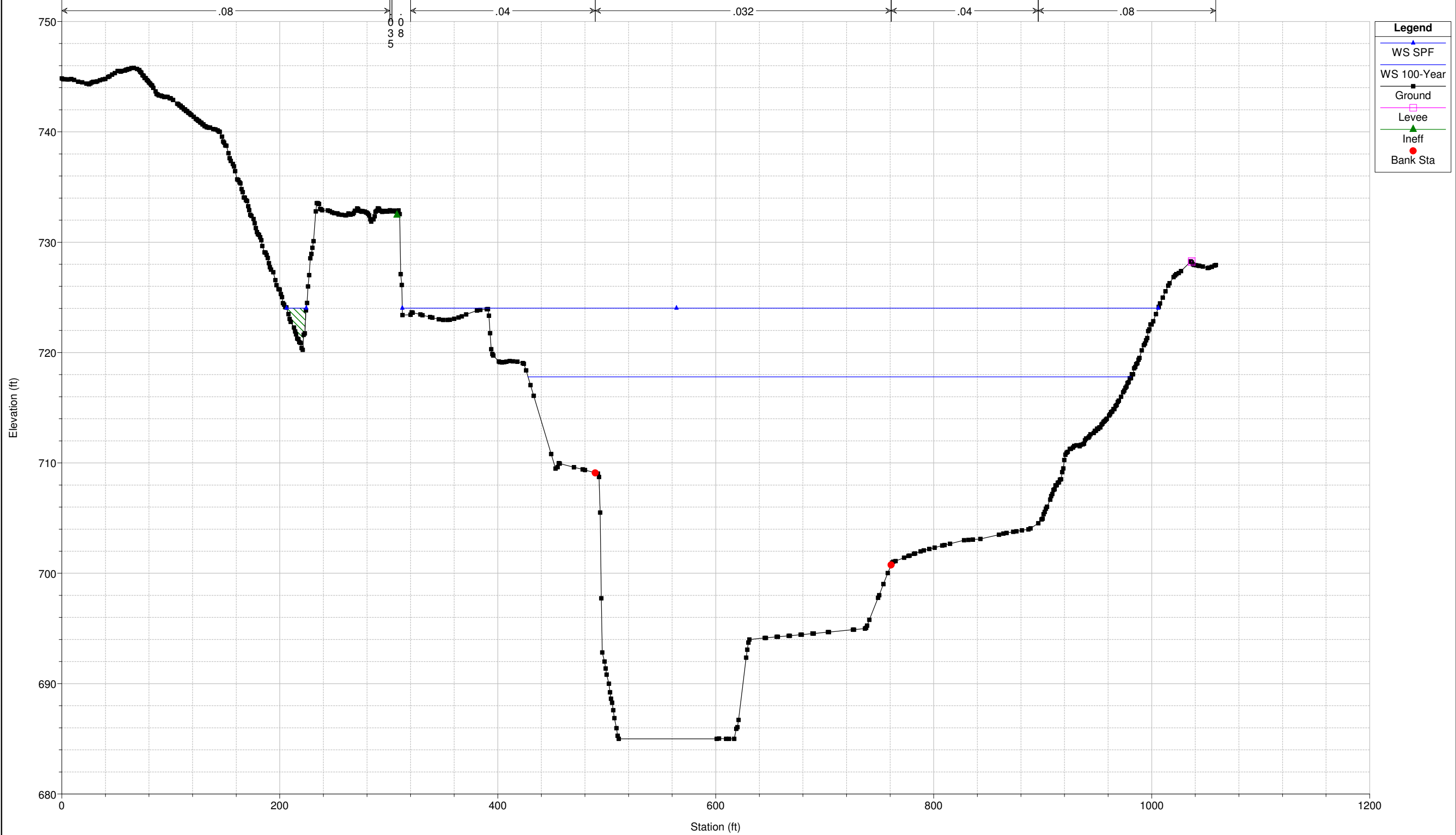
Sciotgreenways Plan: Post-project
RS = 251.3 BR



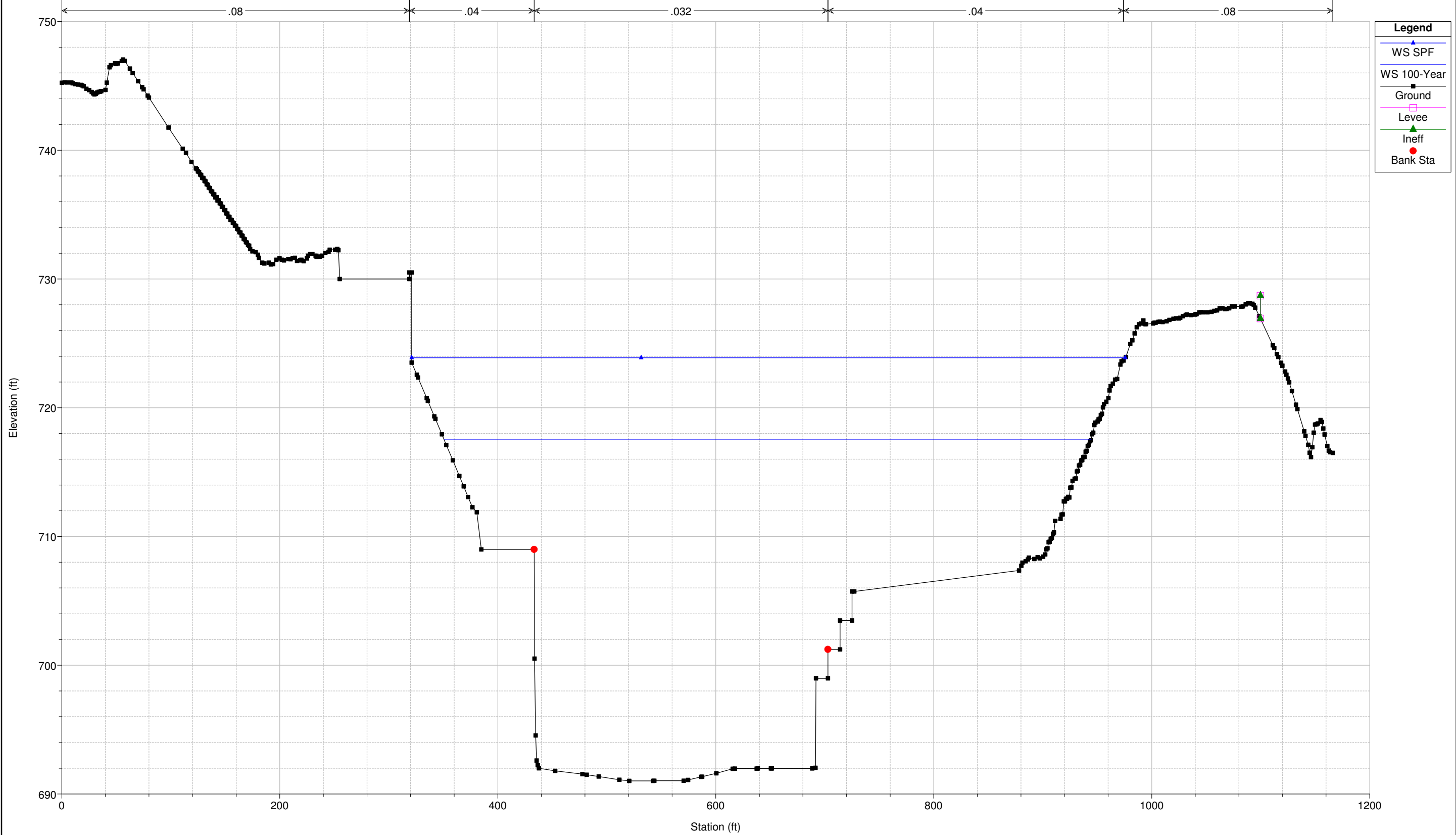
Sciotgreenways Plan: Post-project
RS = 251.1



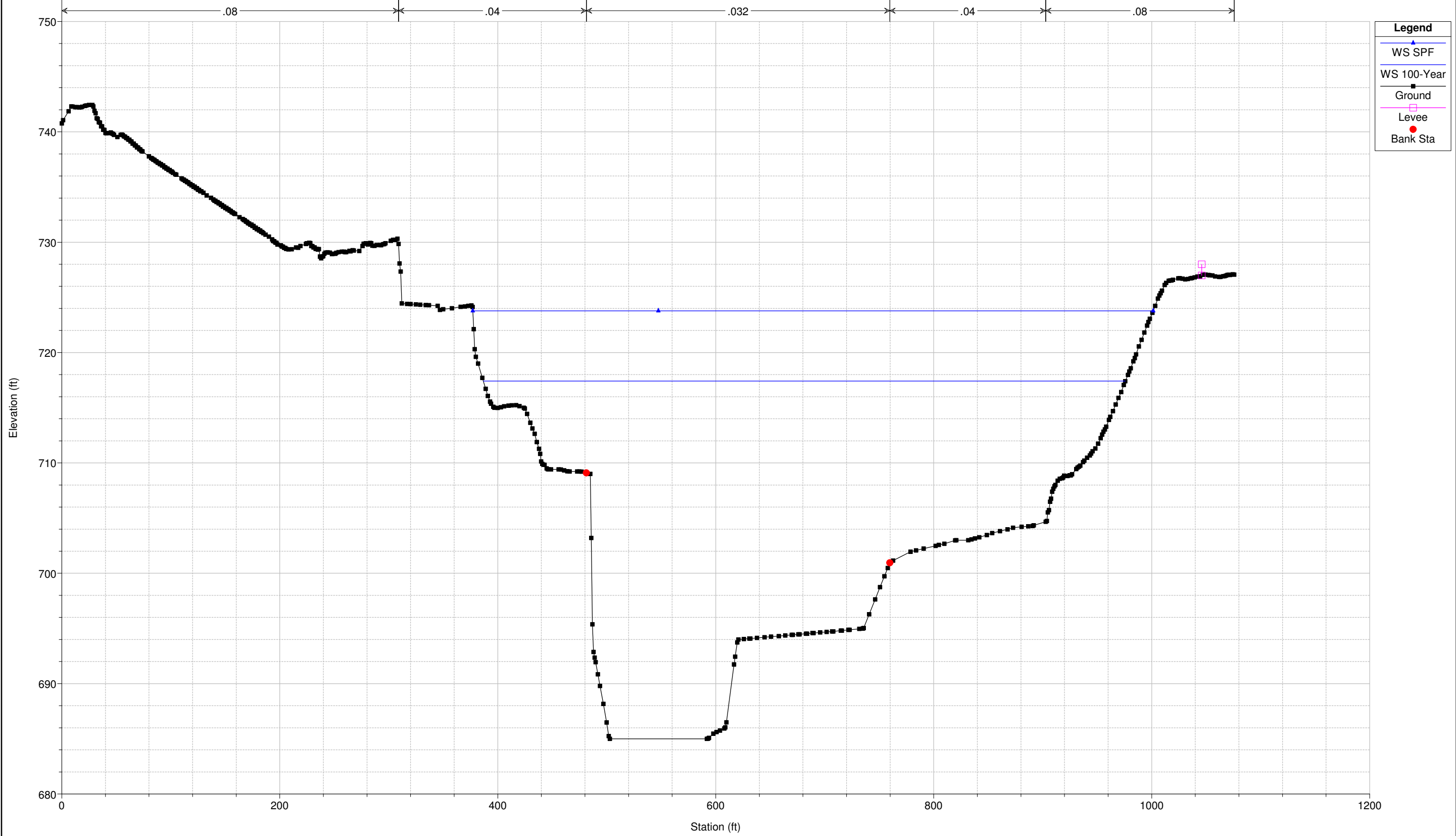
Sciotgreenways Plan: Post-project
RS = 250.776



Sciotogreenways Plan: Post-project
RS = 250.6268



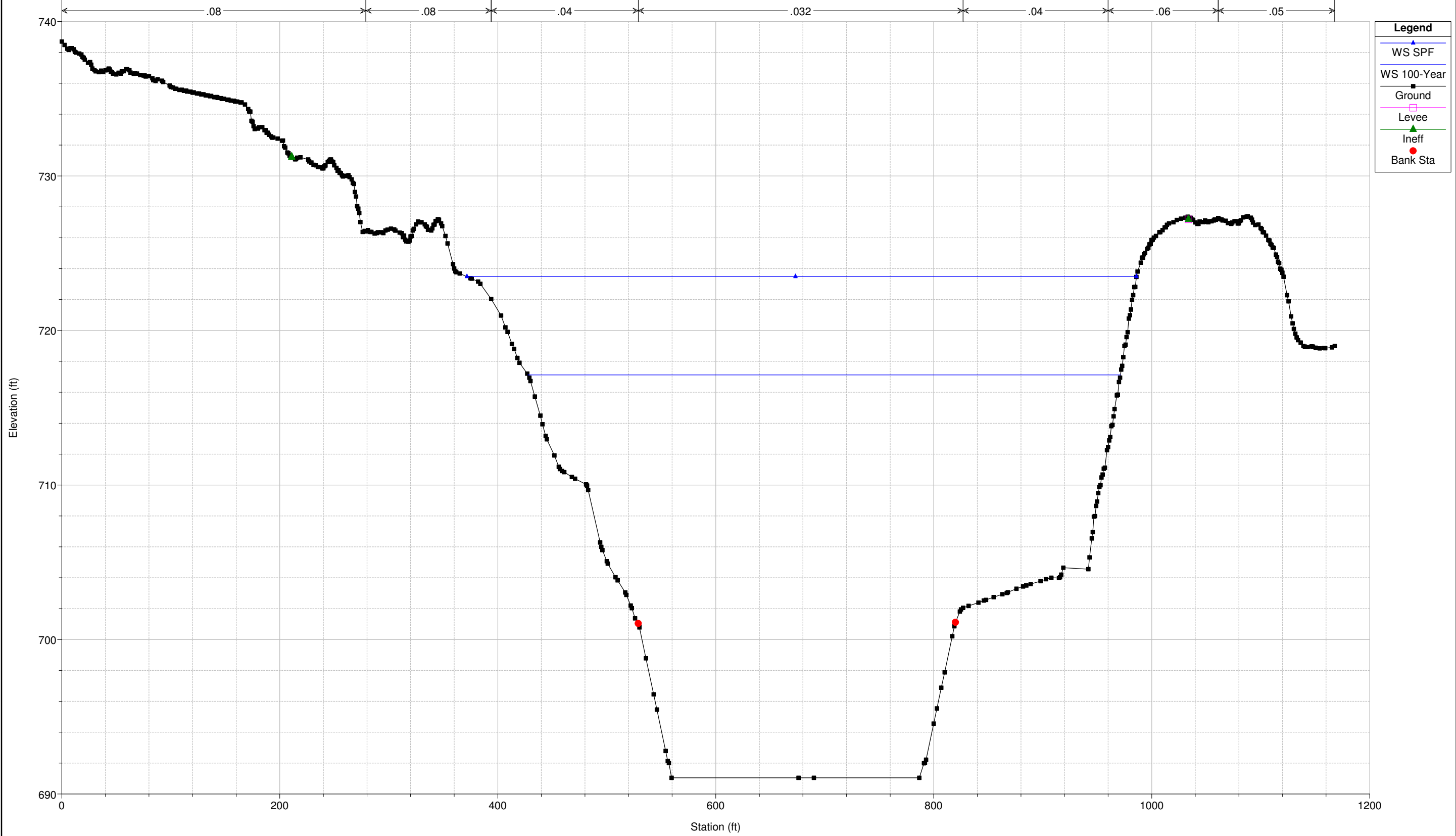
Sciotogreenways Plan: Post-project
RS = 250.5503



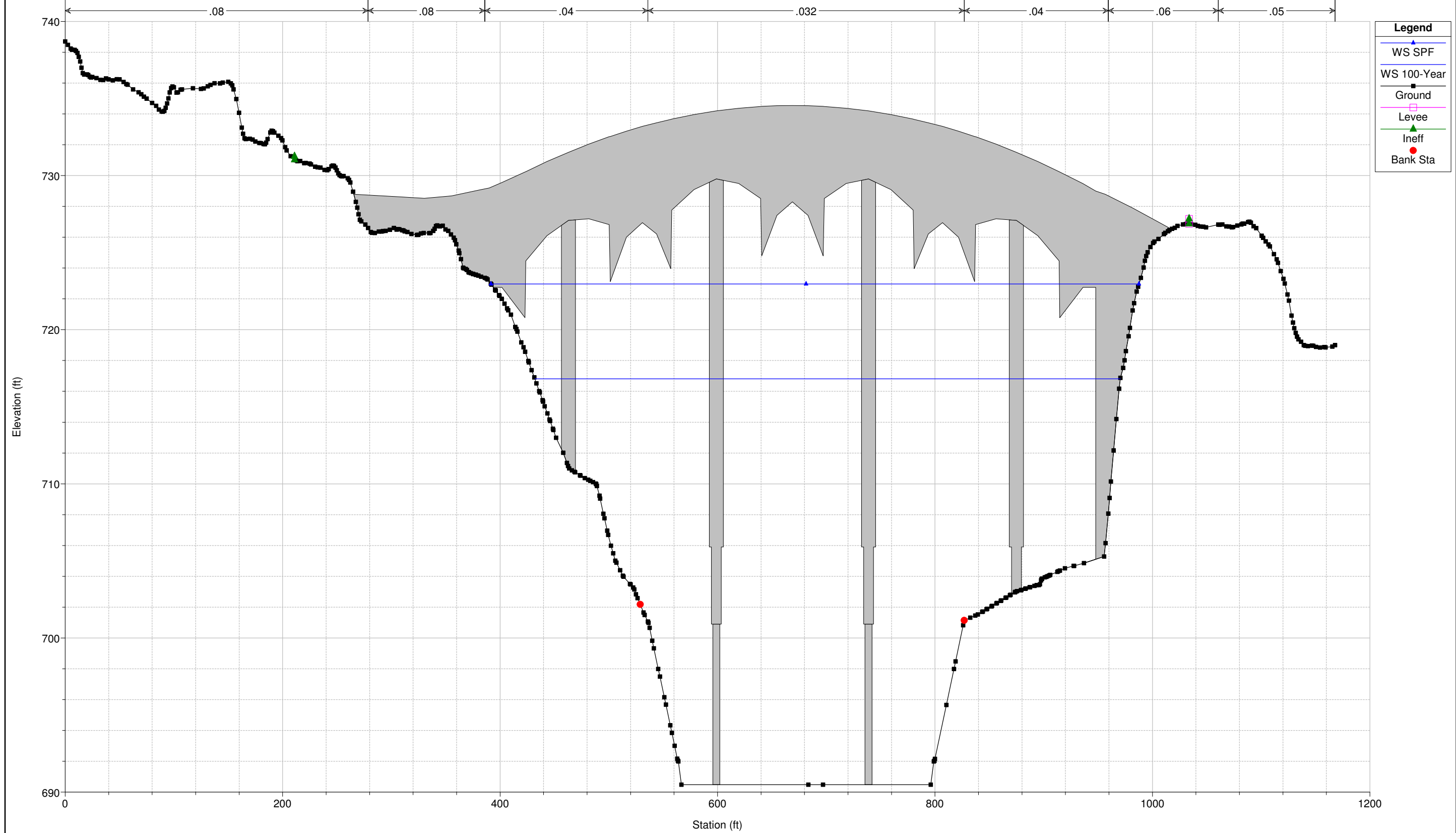
Legend

- WS SPF
- WS 100-Year
- Ground
- Levee
- Bank Sta

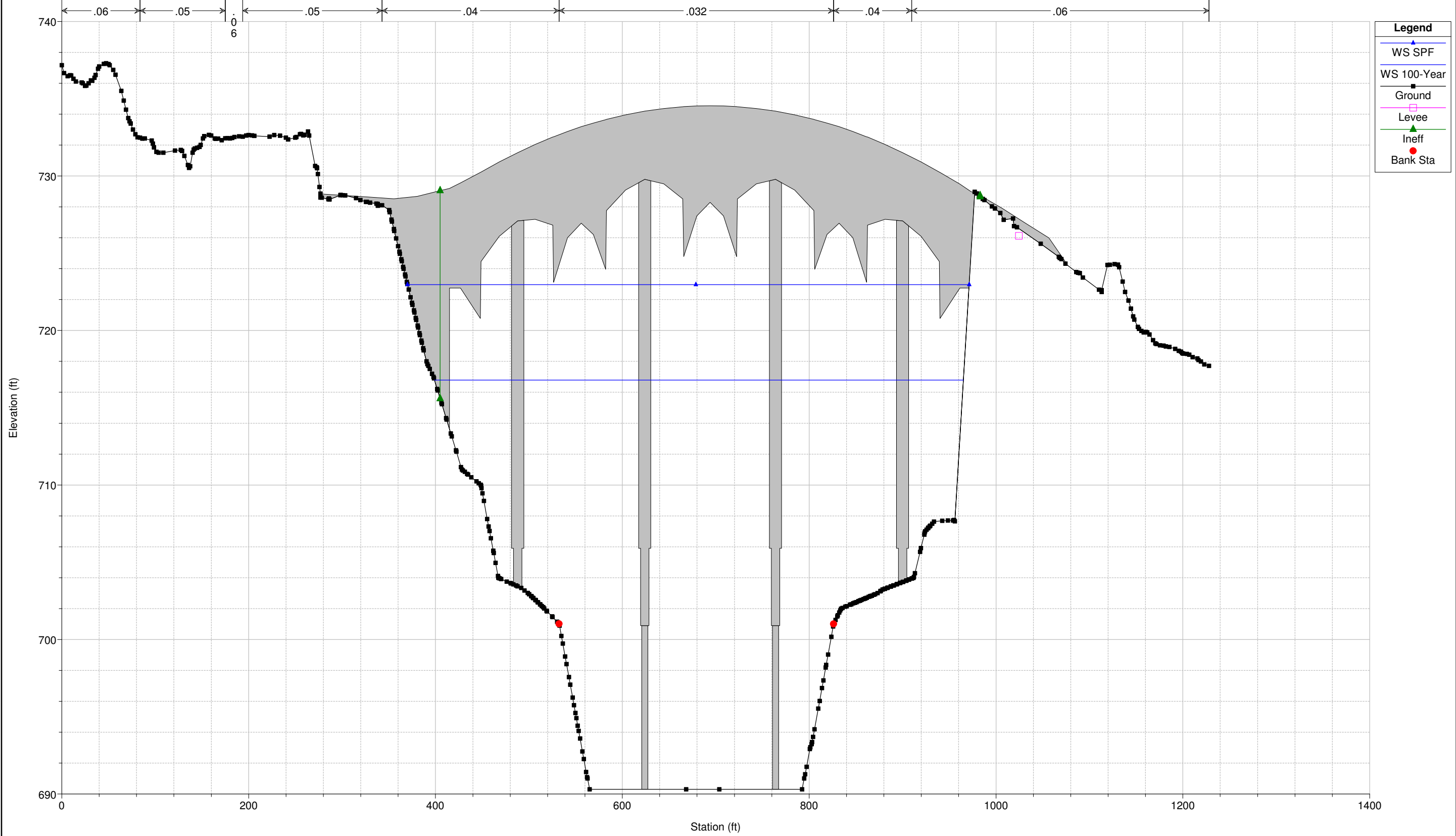
Sciotgreenways Plan: Post-project
RS = 250.4728



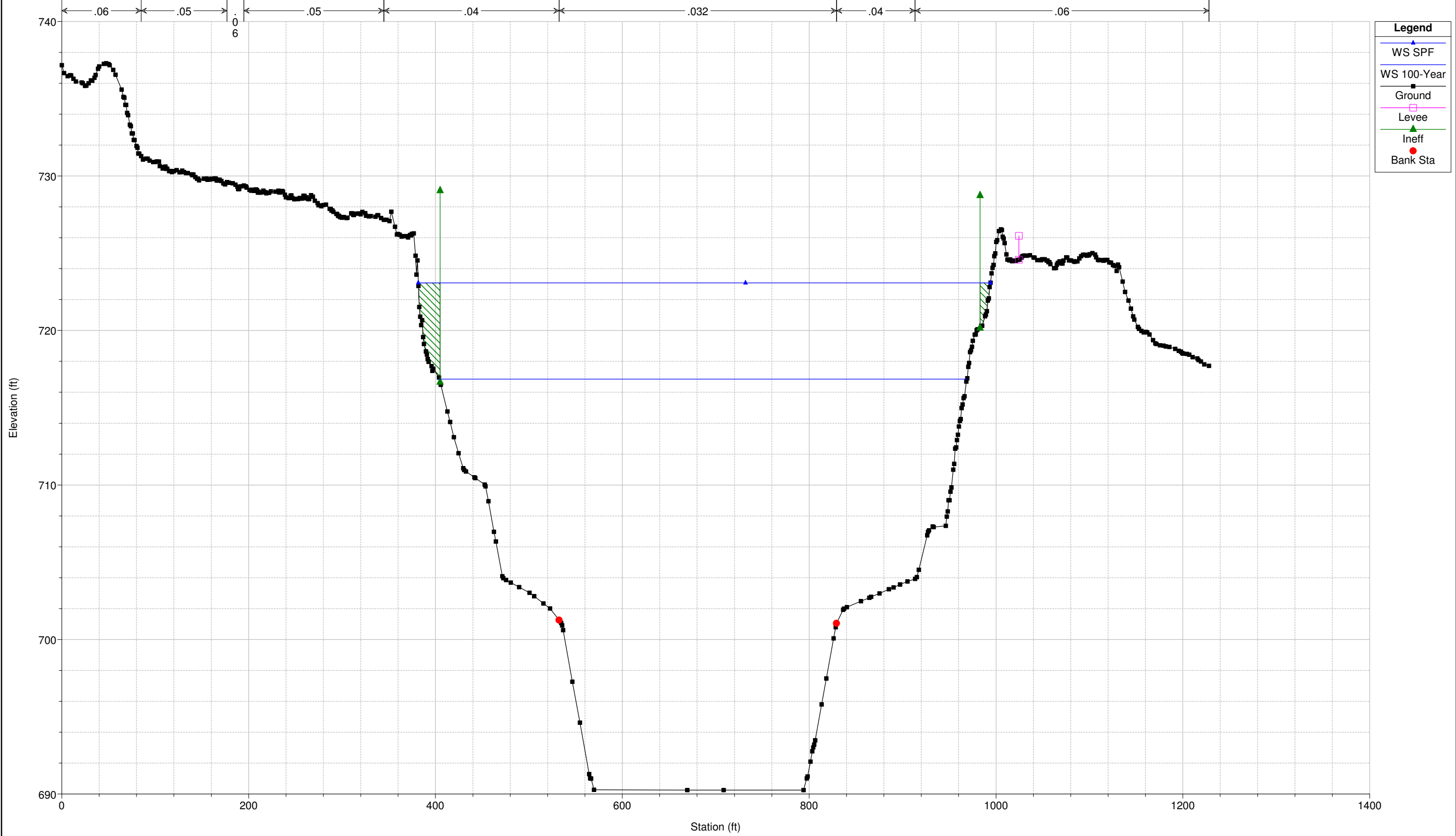
Sciotogreenways Plan: Post-project
RS = 250.4469 BR



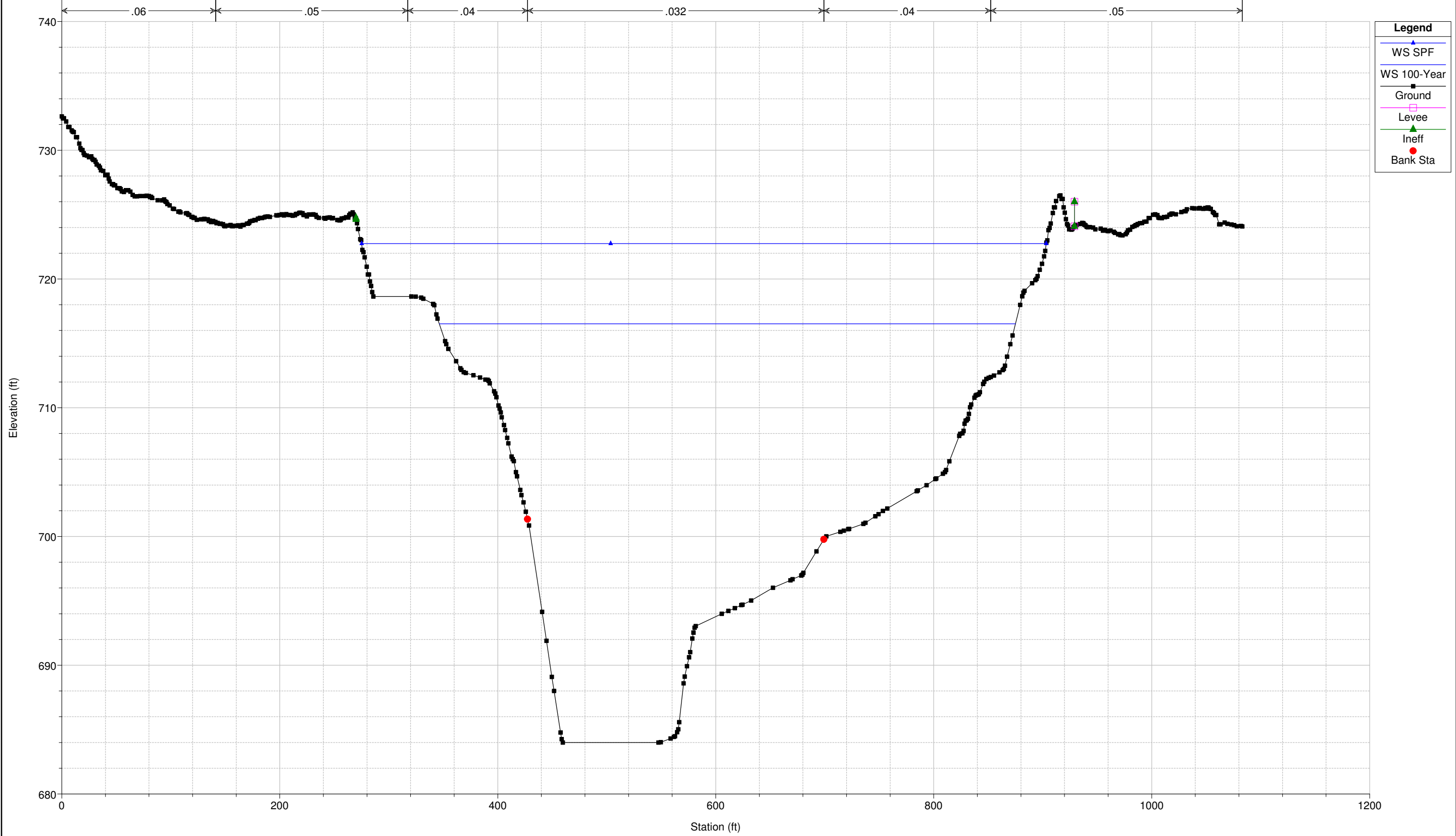
Sciotogreenways Plan: Post-project
RS = 250.4469 BR



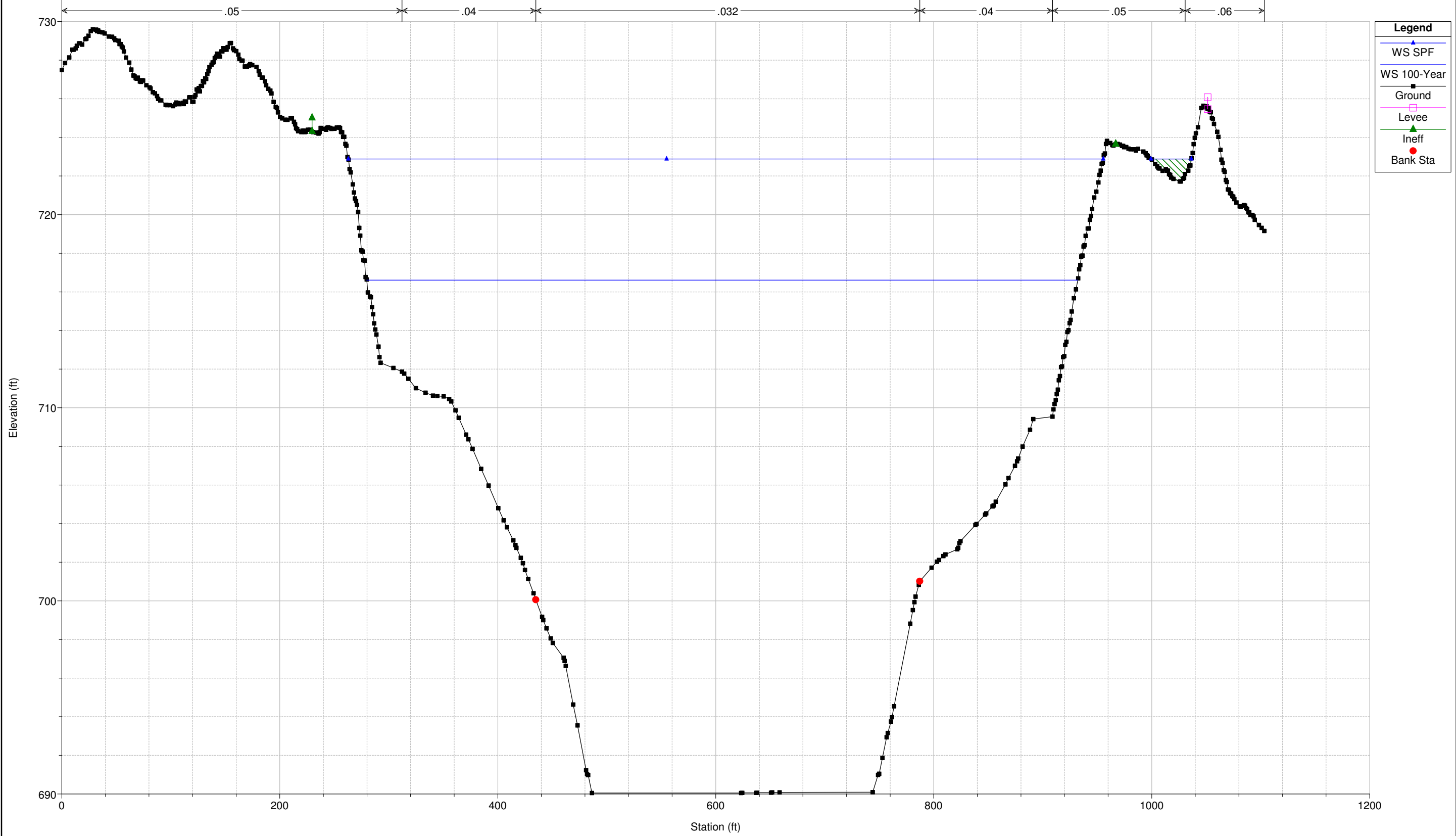
Sciotogreenways Plan: Post-project
RS = 249.79



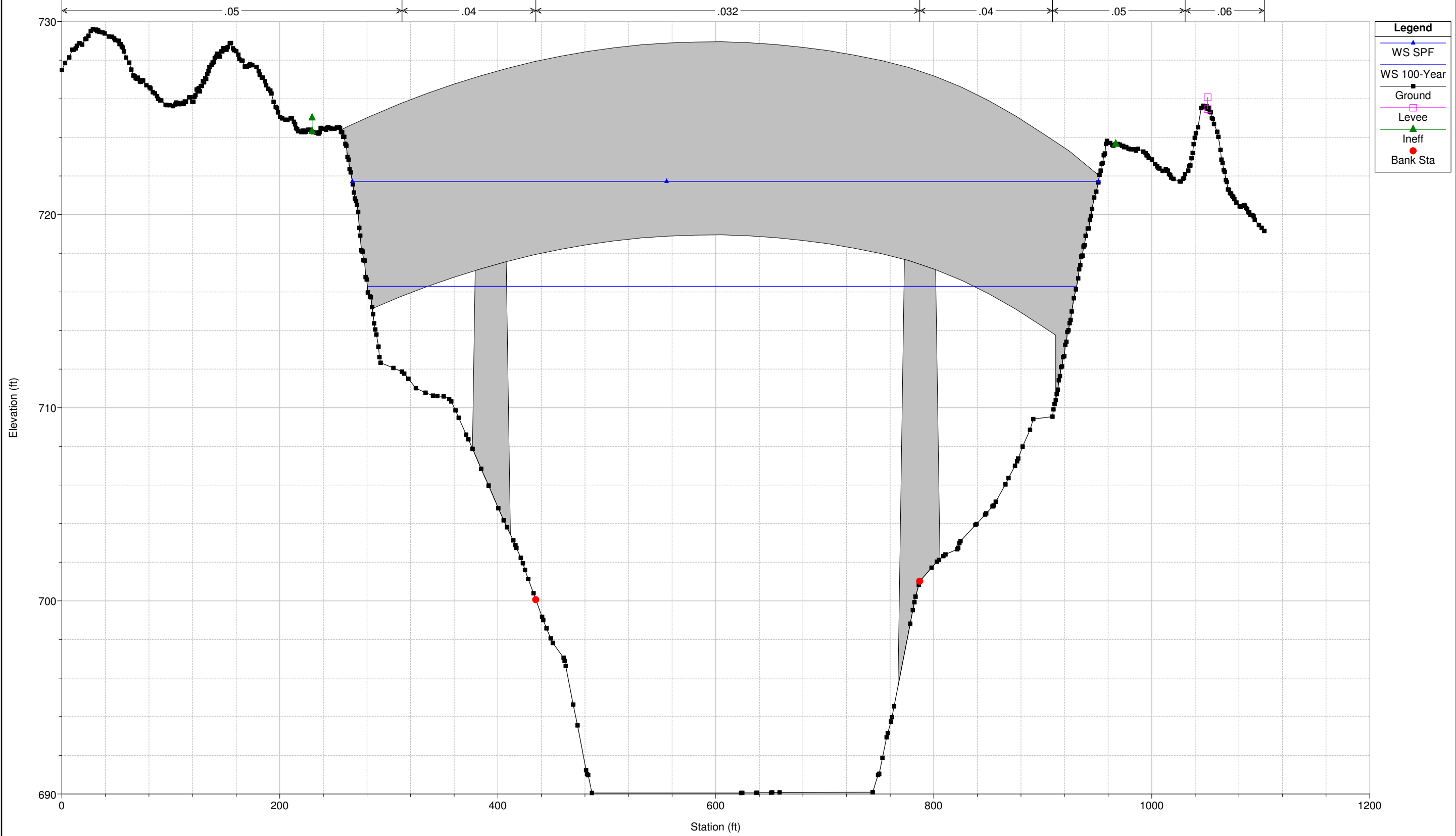
Sciotogreenways Plan: Post-project
RS = 249.76



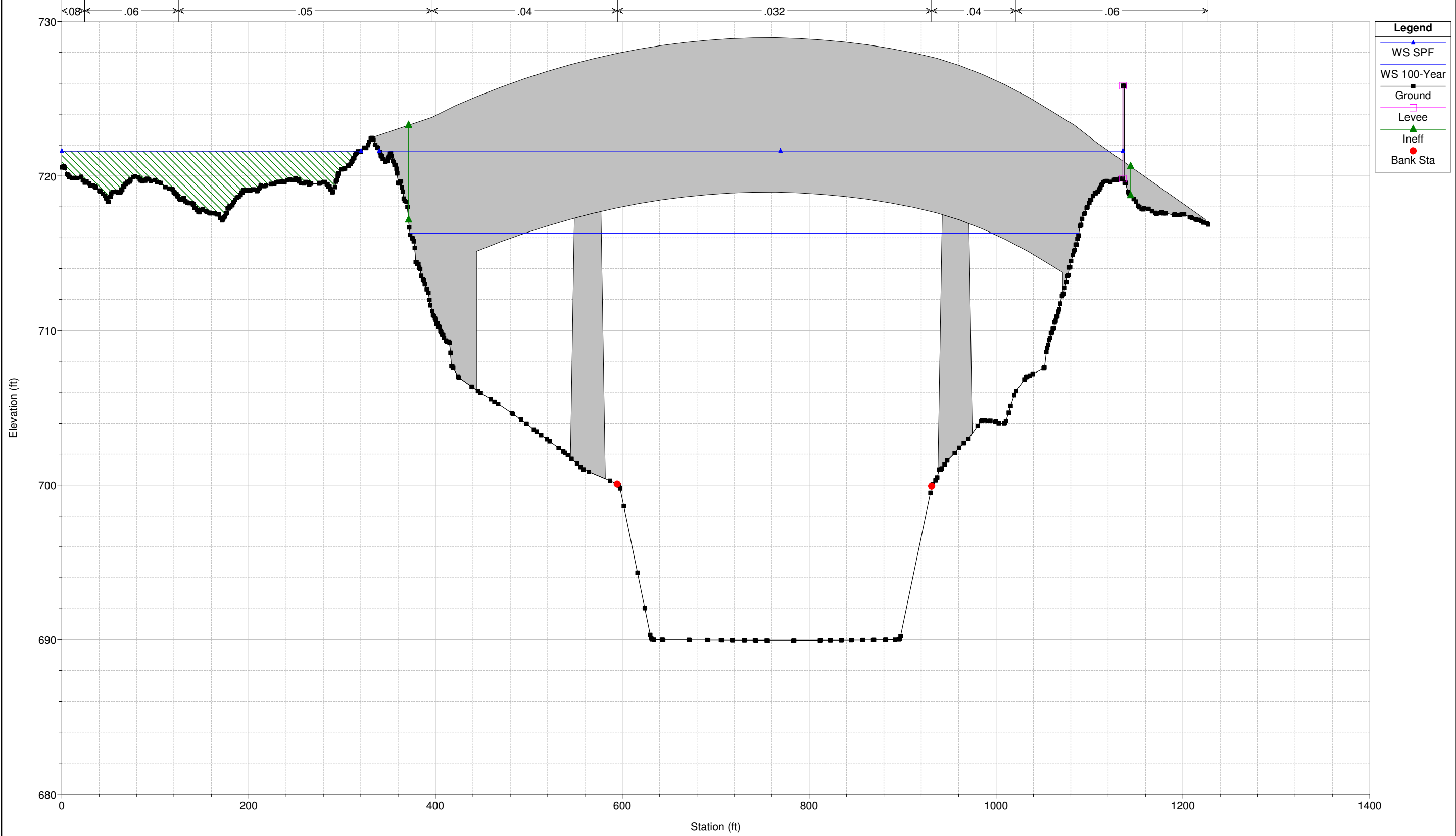
Sciotogreenways Plan: Post-project
RS = 249.5



Sciotogreenways Plan: Post-project
RS = 249.3 BR



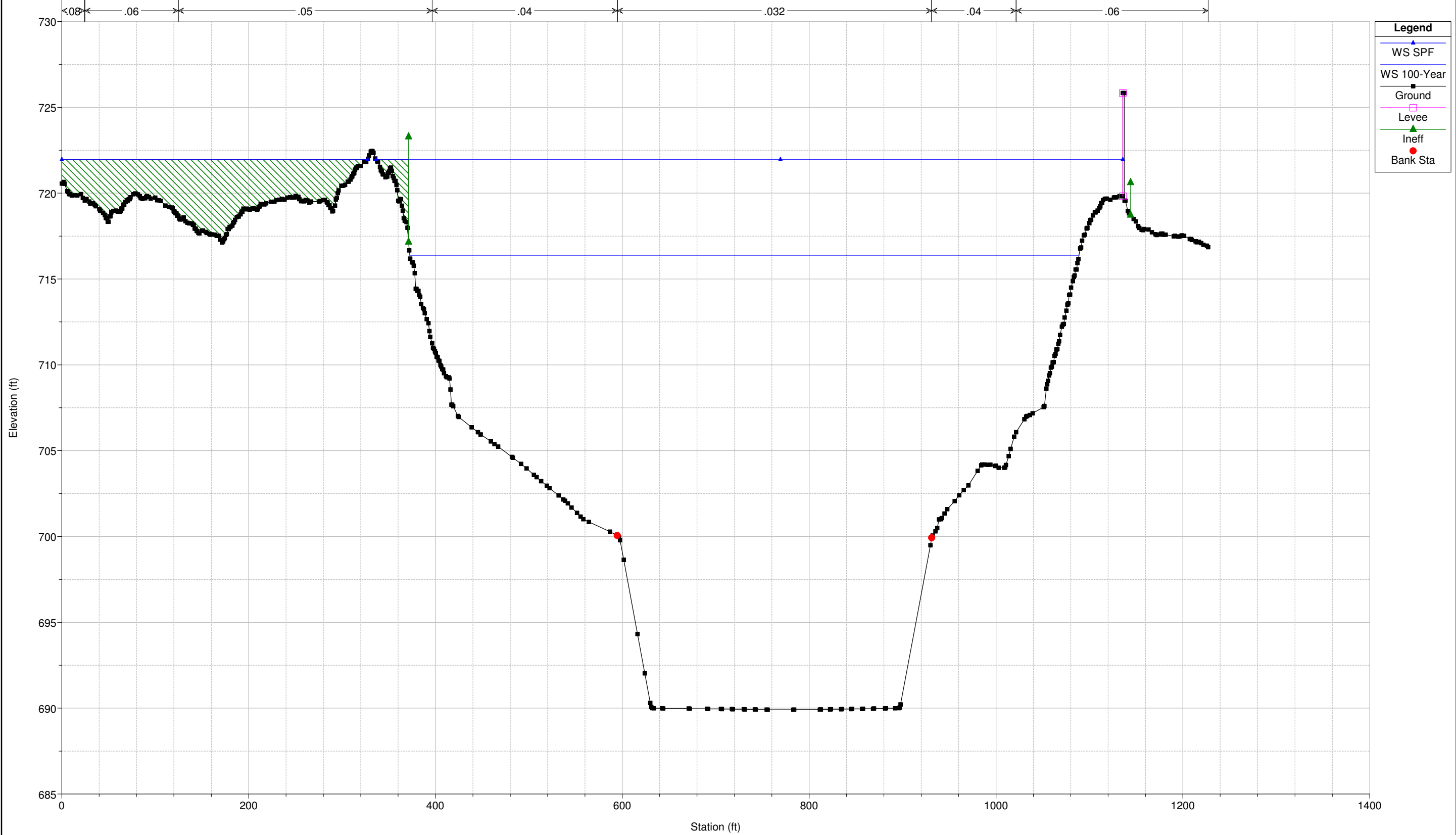
Sciotogreenways Plan: Post-project
RS = 249.3 BR



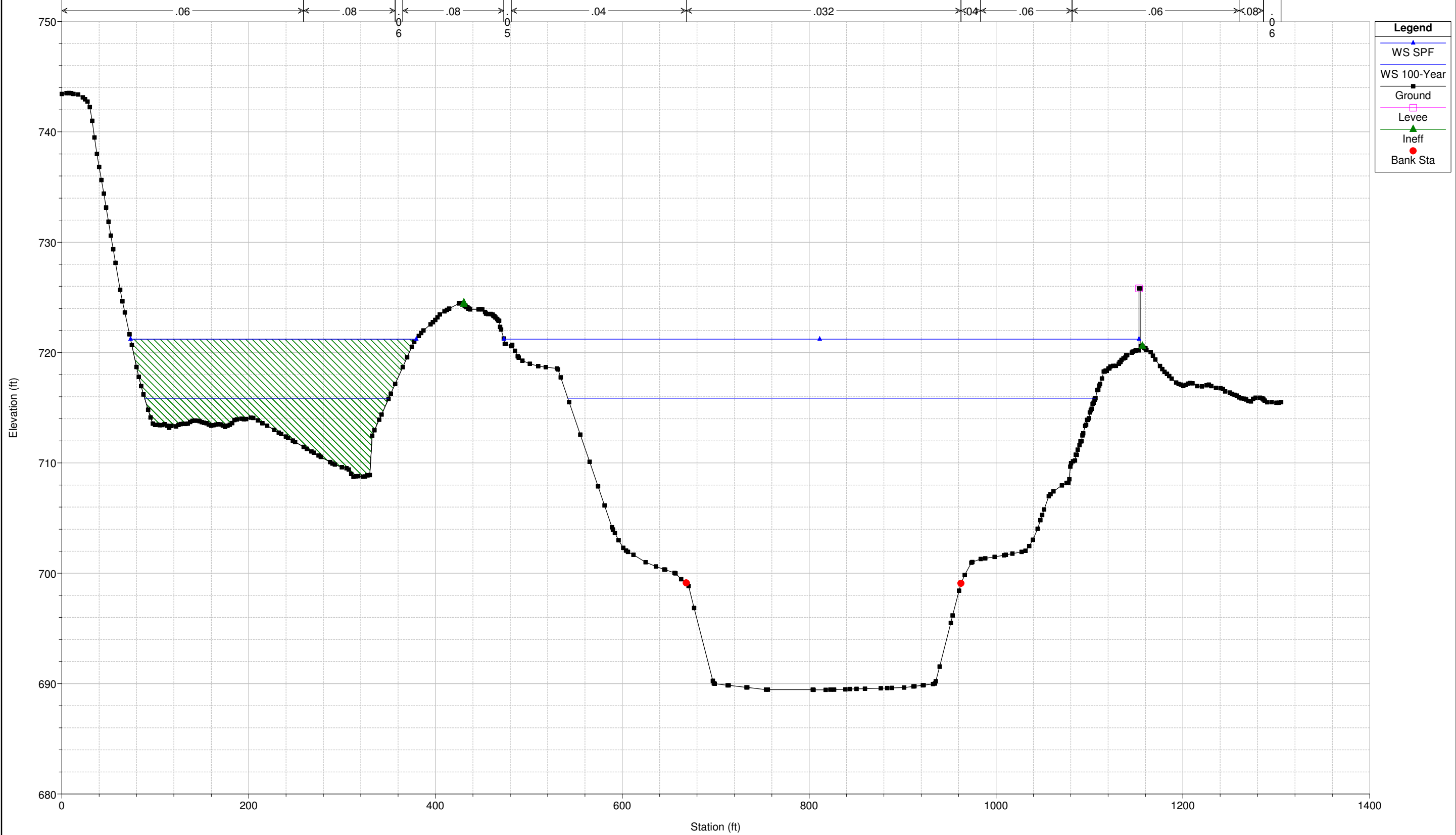
Legend

- WS SPF (Blue line with triangle)
- WS 100-Year (Blue line with triangle)
- Ground (Black line with square)
- Levee (Pink square)
- Ineff (Green triangle)
- Bank Sta (Red circle)

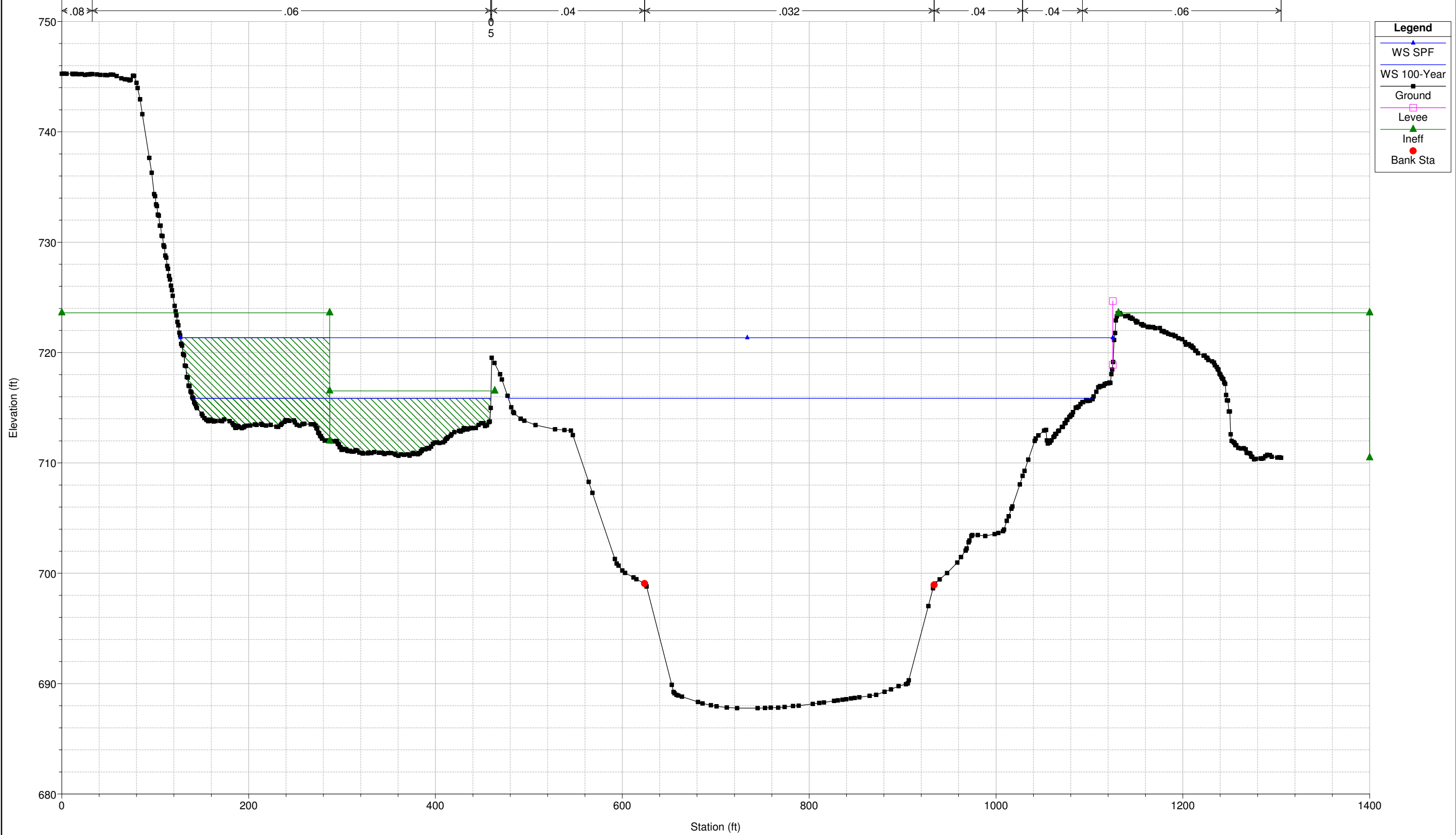
SciotoGreenways Plan: Post-project
RS = 249.1



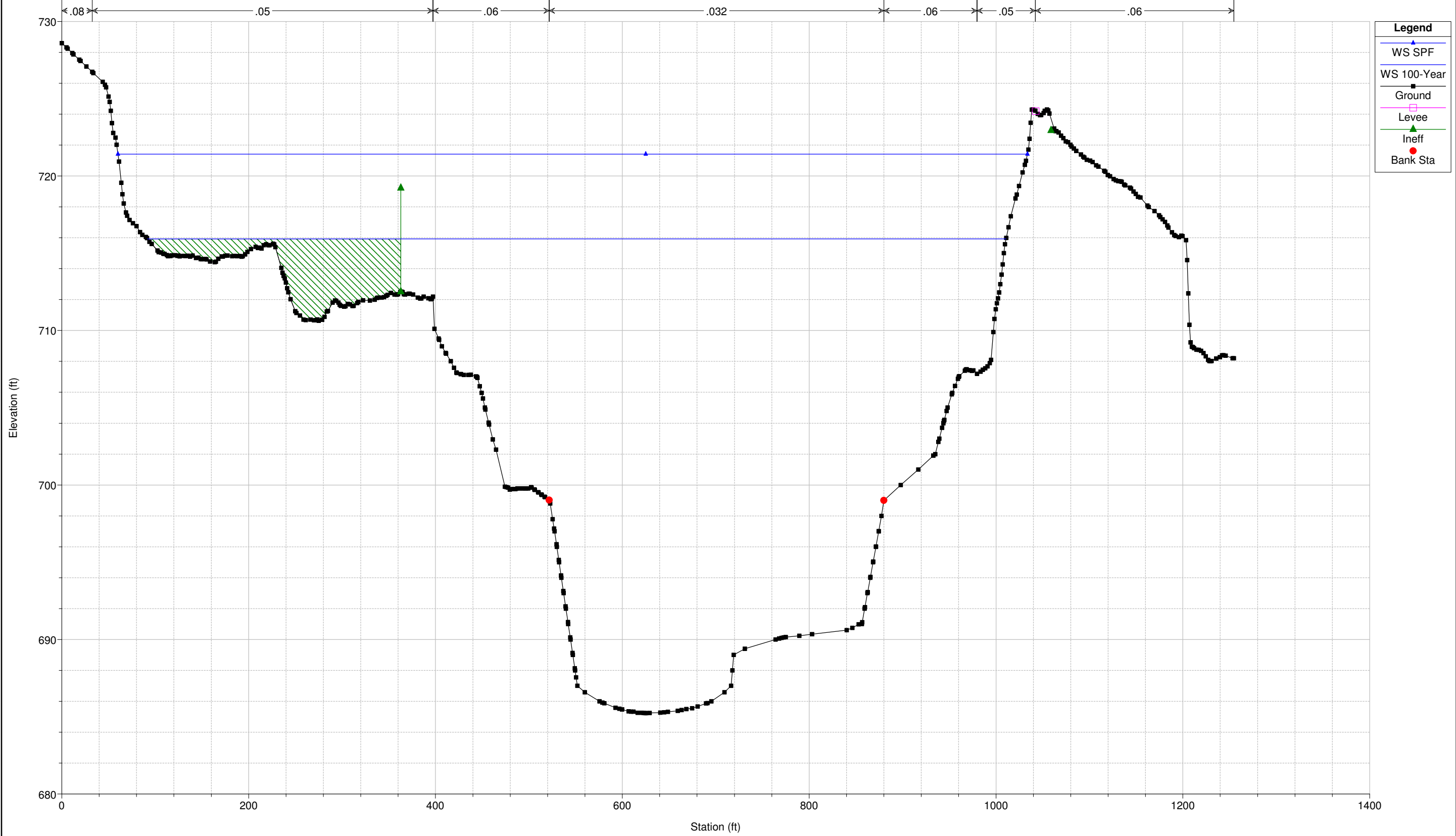
Sciotgreenways Plan: Post-project
RS = 249



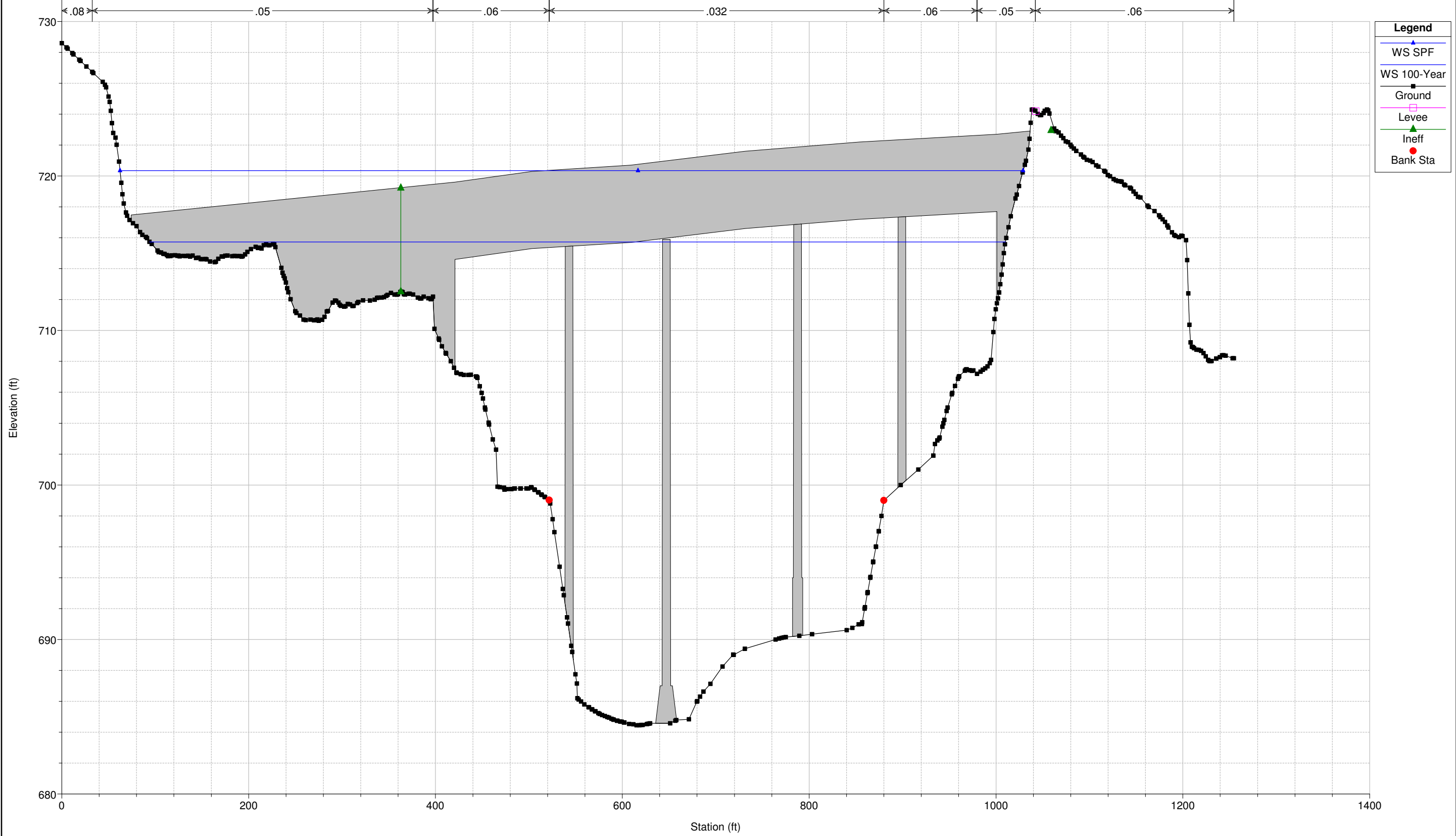
Sciotogreenways Plan: Post-project
RS = 248.3



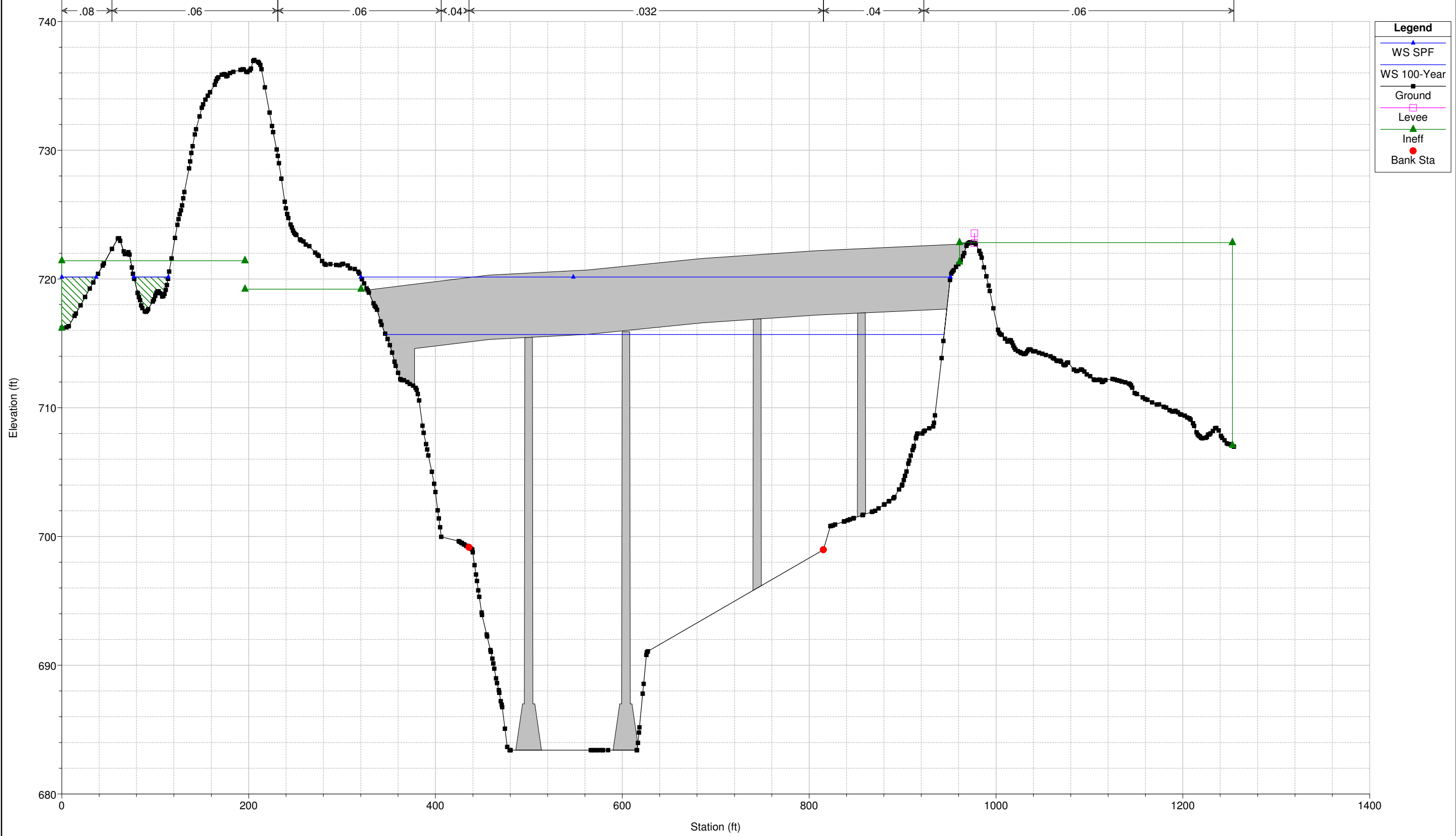
Sciotgreenways Plan: Post-project
RS = 247.5



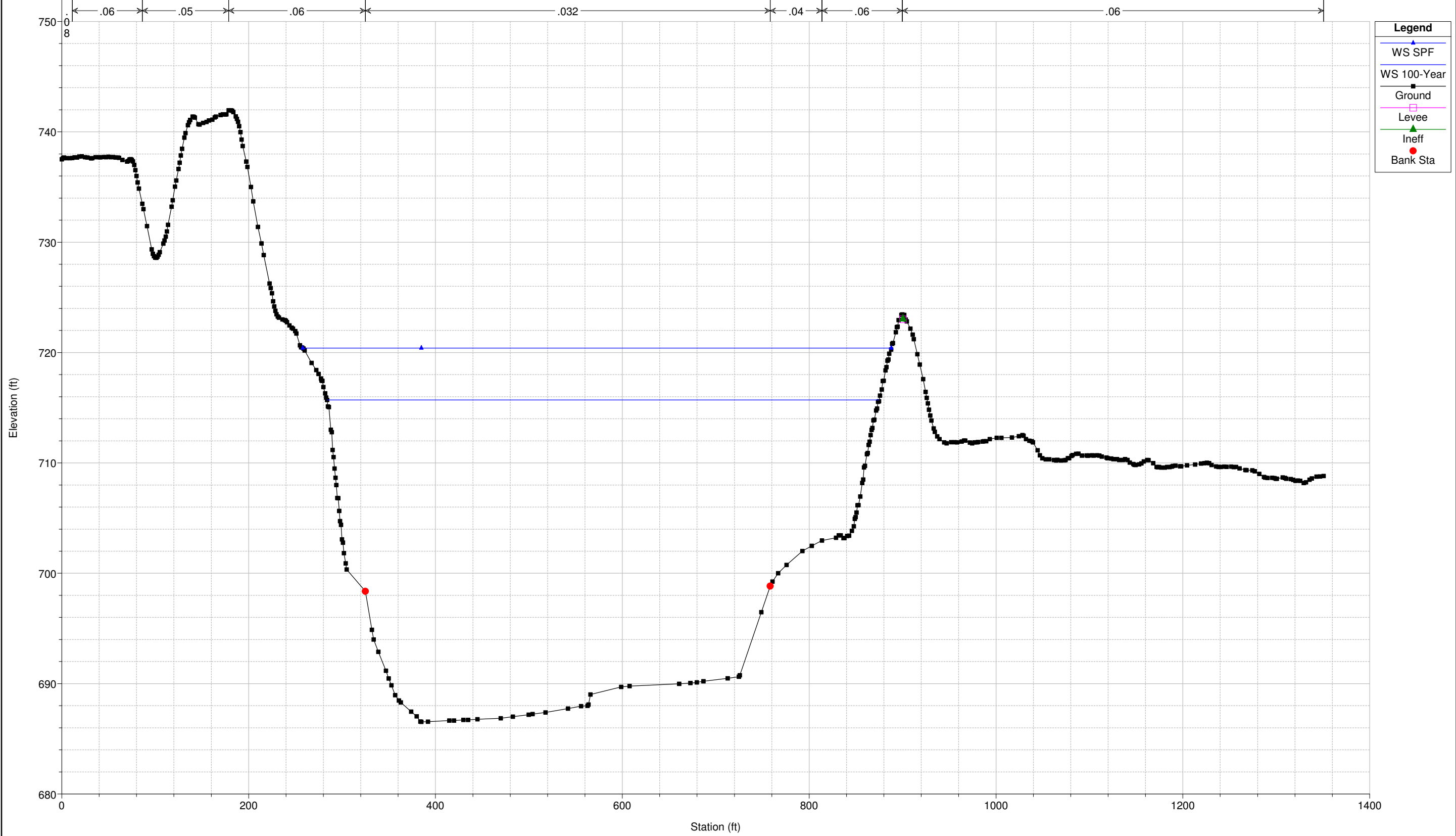
Sciotgreenways Plan: Post-project
RS = 247.3 BR



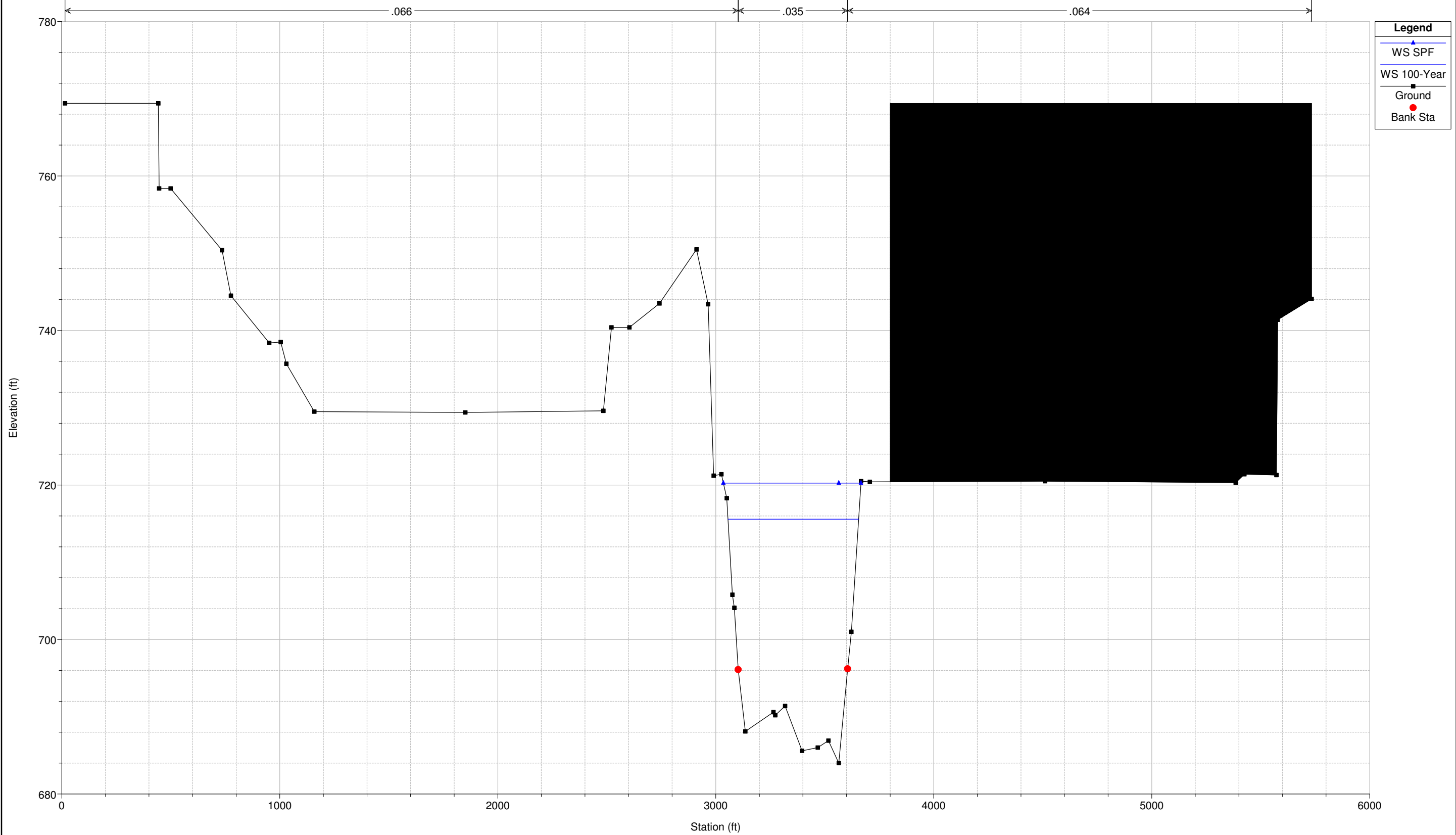
SciotoGreenways Plan: Post-project
RS = 247.3 BR



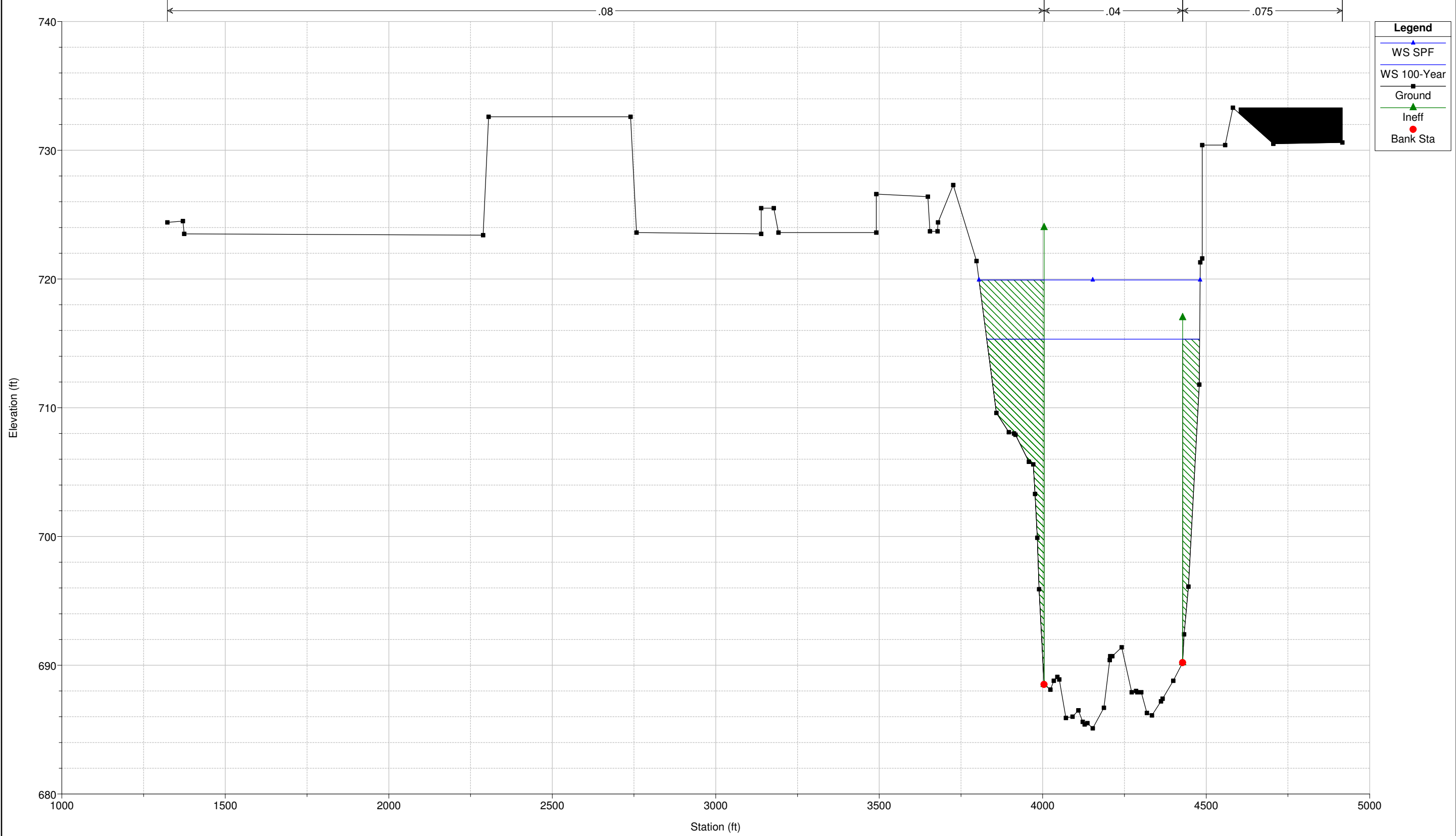
Sciotgreenways Plan: Post-project
RS = 246.8



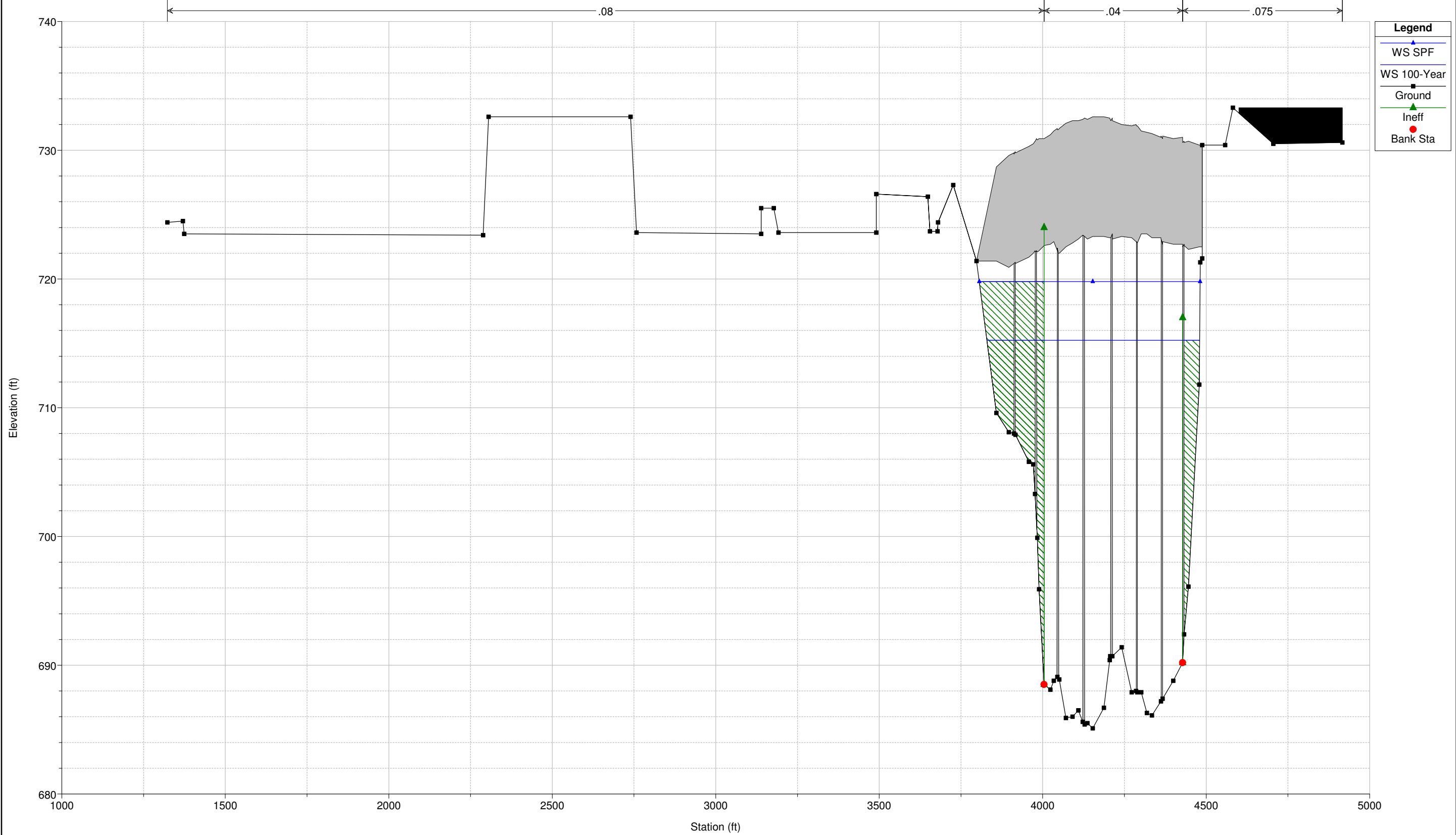
Sciotogreenways Plan: Post-project
RS = 246.5



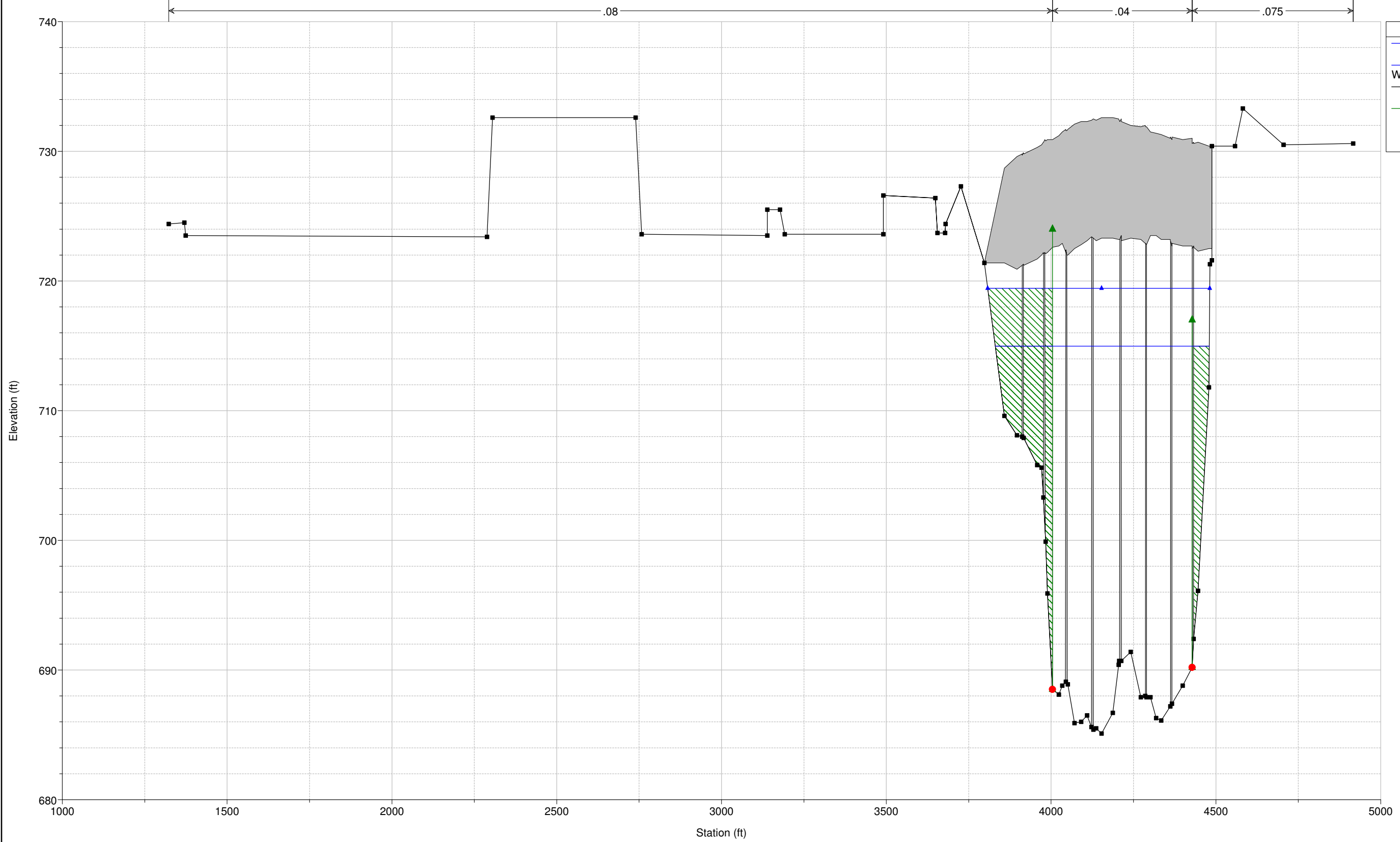
Sciotogreenways Plan: Post-project
RS = 246.4



Sciotogreenways Plan: Post-project
RS = 246.3 BR

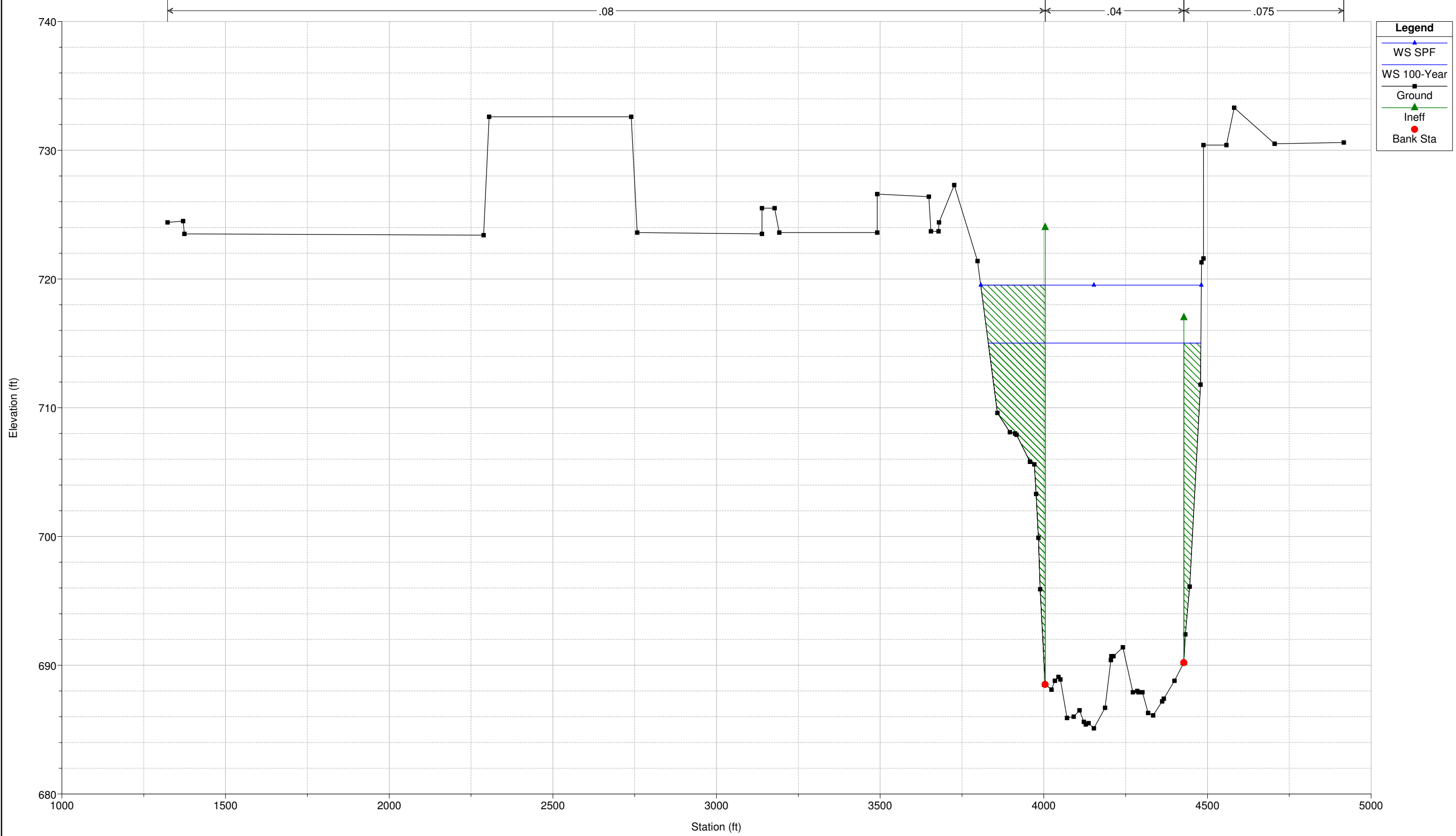


Sciotogreenways Plan: Post-project
RS = 246.3 BR

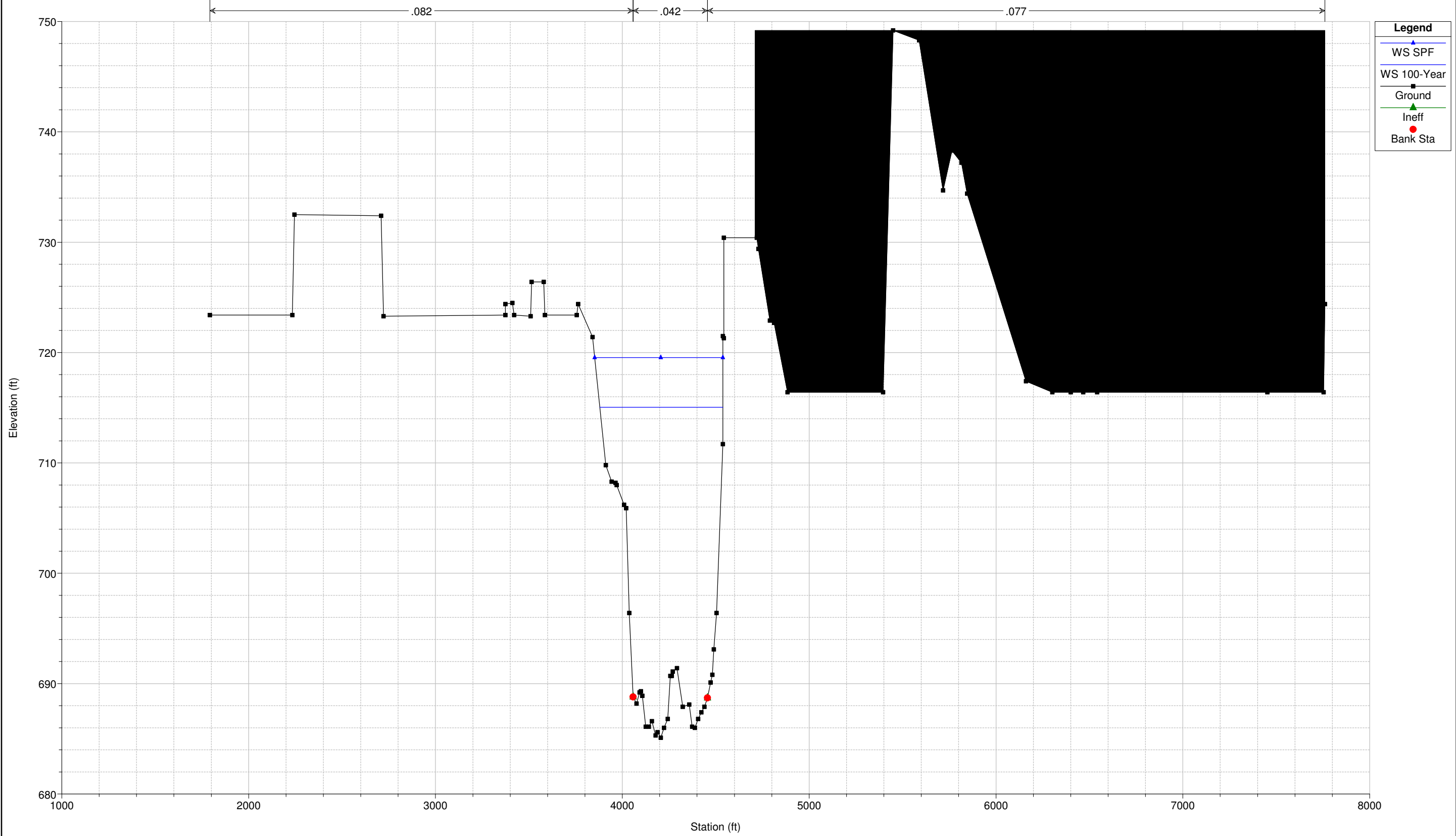


- Legend**
- WS SPF
 - WS 100-Year
 - Ground
 - Ineff
 - Bank Sta

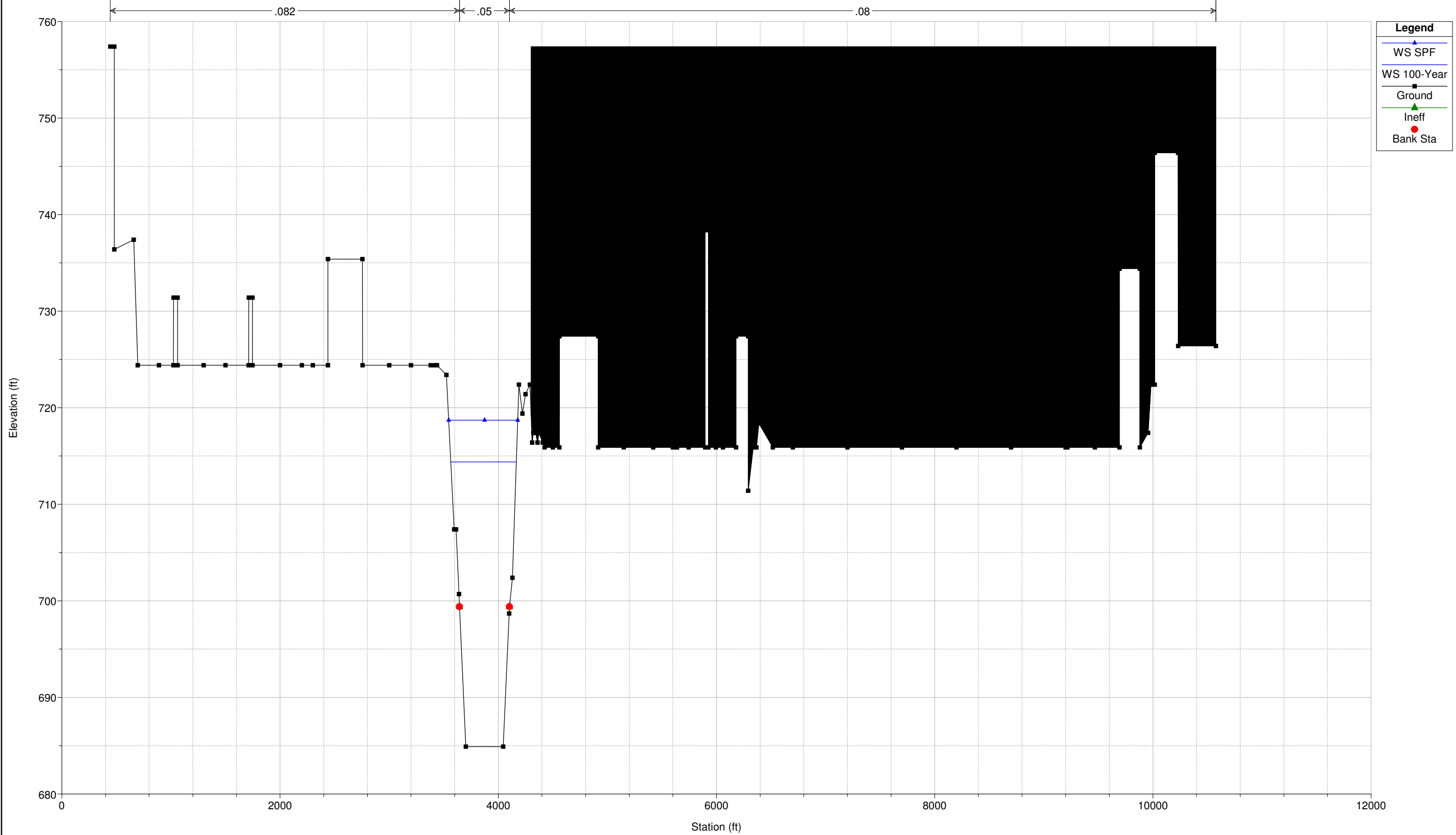
Sciotogreenways Plan: Post-project
RS = 246.2



SciotoGreenways Plan: Post-project
RS = 246.1

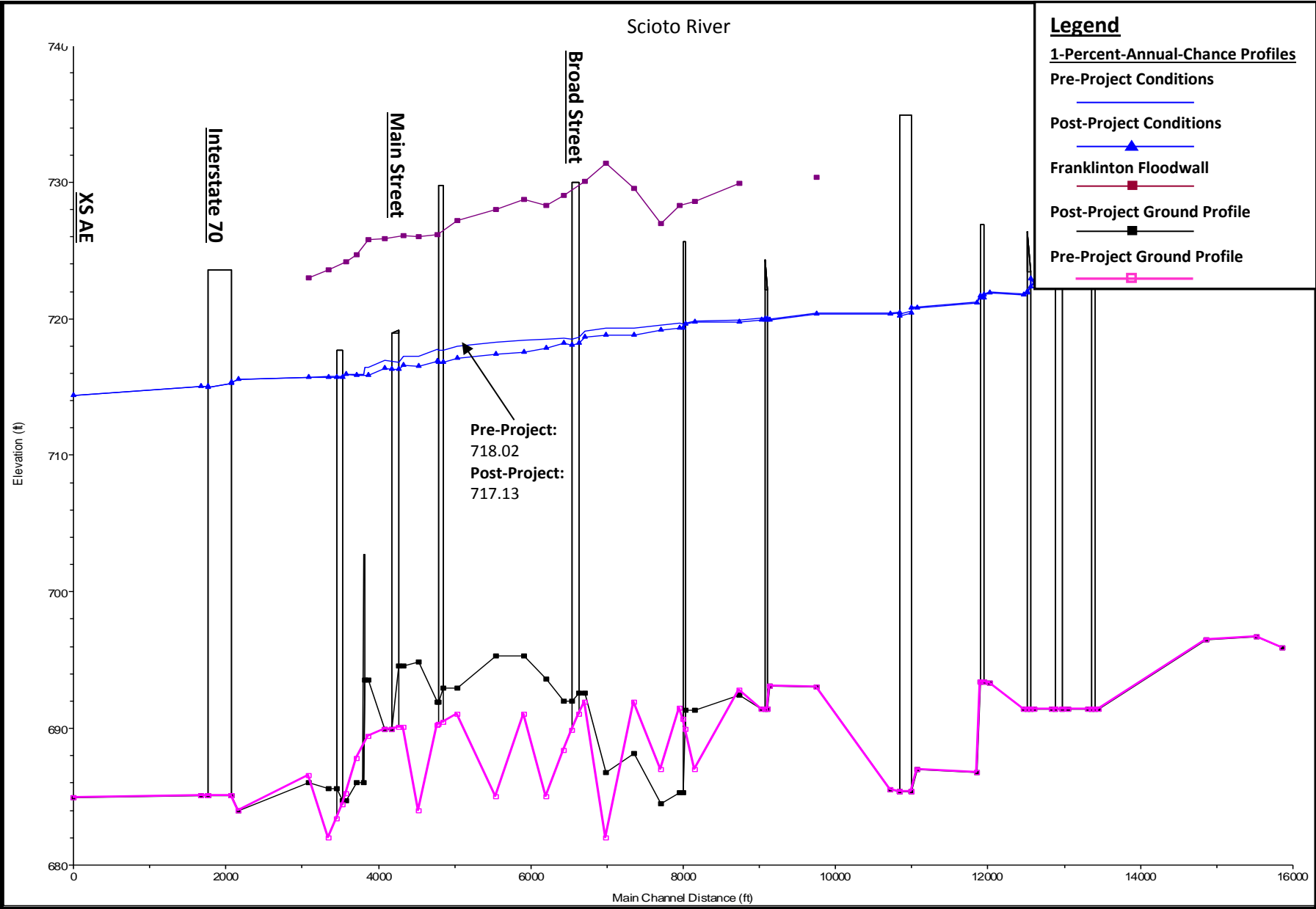


Sciotogreenways Plan: Post-project
RS = 245

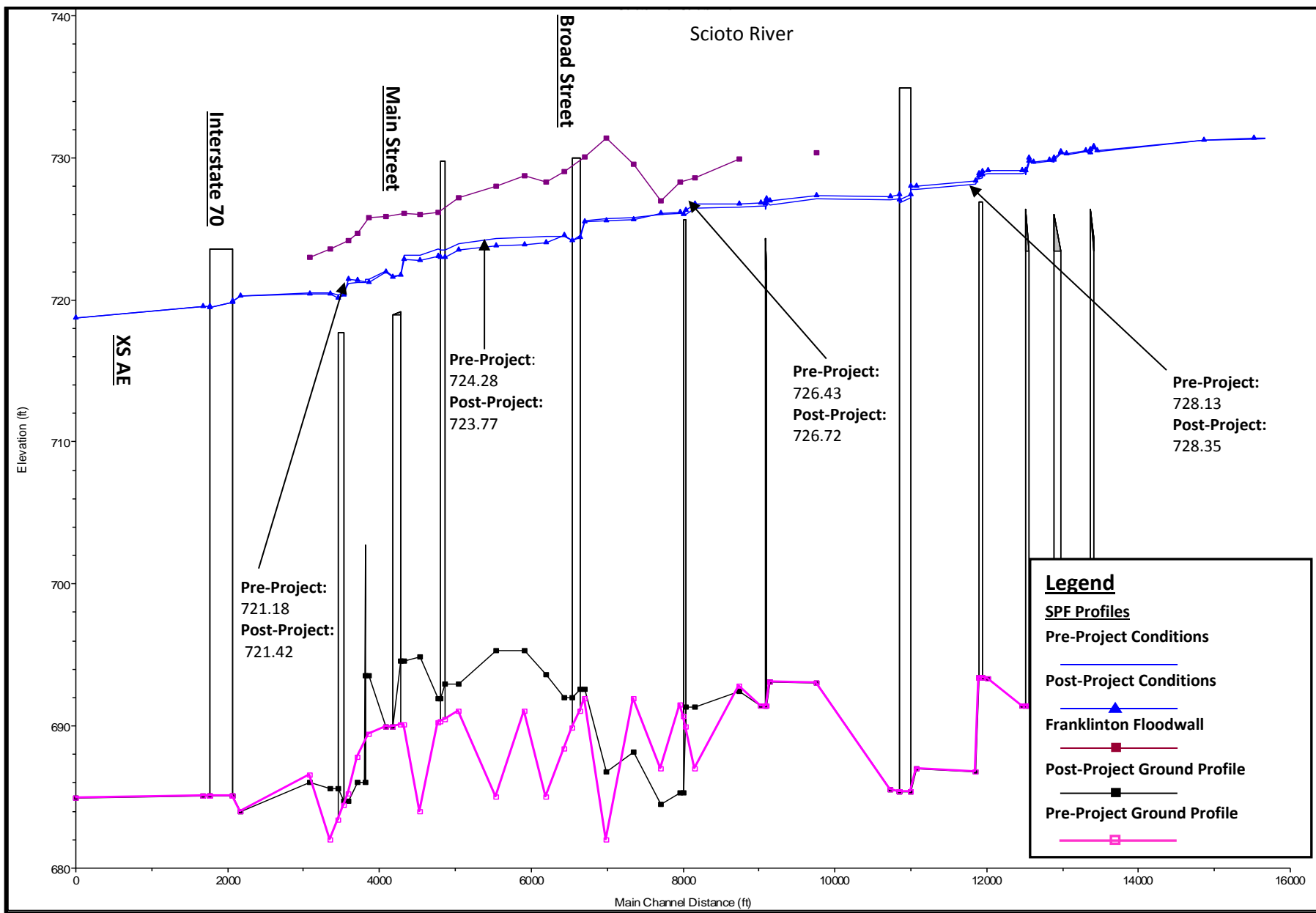


Appendix C
Flood Profile Comparisons

Appendix C – Flood Profile Comparisons



Appendix C – Flood Profile Comparisons



Appendix D
QC Documentation



ENGINEERING QUALITY REVIEW CHECKLIST SIGN OFF FORM

STUDY NAME: Scioto Greenways

Document Name: Eng_QC.20091102

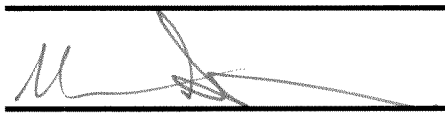
ORIGINATOR(S) Zach Whitten
Kurt Shellhause

INITIALS: ZNW
KAS

SIGNATURE/DATE:  11/29/12
SIGNATURE/DATE:  11/29/2012
SIGNATURE/DATE: _____
SIGNATURE/DATE: _____


REVIEWER: Mark Seidelmann

INITIALS: MES

SIGNATURE/DATE:  11/29/2012
SIGNATURE/DATE: _____
SIGNATURE/DATE: _____

QA APPROVAL: Travis White

INITIALS: TW

SIGNATURE/DATE:  11/30/12

Appendix E
Digital Data