FINAL DRAINAGE REPORT

BENT GRASS RESIDENTIAL SUBDIVISION
FILING NO. 2

El Paso County, Colorado

SF-19-014

PREPARED FOR:
Challenger Homes
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

PREPARED BY:
Galloway & Company, Inc.
1755 Telstar Drive, Suite 107
Colorado Springs, CO 80920

DATE:
July 2019

Cursory redlines Steve Kuehster 9/25/2019

ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____ _____

Scott Brown, PE 45900 Date
For and on behalf of Galloway & Company, Inc.

DEVELOPER'S CERTIFICATION

I, The developer, have read and will comply with all of the requirements specified in this drainage report and plan.

By:_____ _____

Date

Address: Challenger Homes
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

DEVELOPER'S CERTIFICATION

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

_____ _____

For El Paso County Engineer/Director Date

Conditions:

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

TABLE OF CONTENTS

Provide a section in the Table of contents labeled "4 step process"
Discuss the 4 steps in the report. used for the drainage design.

I. Purpose

The intent of the developer is to develop the residential portion of the Bent Grass Subdivision. The purpose of this Final Drainage Report is to identify on and offsite drainage patterns, locate and identify tributary or downstream drainage features and facilities that impact the site, and to identify which types of drainage facilities will be needed and where they will be located. This report will remain in general compliance with the previously approved MDDP for the site prepared by Galloway & Company.

II. General Description

The project is a single-family residential development located in the Falcon area of El Paso County, Colorado. The site is located in the Northwest ¼ and Southwest ¼ of Section 1, Township 13S, Range 65W, of the Sixth Principal Meridian, County of El Paso, State of Colorado. The subject property is located to the south of The Meadows Filing No. 3; west of Bent Grass Residential Filing No. 1; north of Latigo Business Center Filing No 1, undeveloped property, and the Mountain View Electric Association; and east of The Meadows Filing No. 2. A Vicinity Map is included in Appendix A.

A Planned Unit Development Plan Amendment has already been approved for the site, PUD-14-002. This Development Plan is the basis for the drainage facility design contained within this MDDP. The site consists of approximately 103.4 acres and includes 309 dwelling units.

The existing soil types within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consist of Columbine gravelly sandy loam, Blakeland-Fluvaquentic Haplaquolls, and Blakeland loamy sand. All soils are defined as having a hydrologic soil group of A. See the soils map included in Appendix A.

III. Previous Reports

The proposed site has been included in multiple drainage studies in the past. The following is a composite list of the existing reports pertaining to this site analysis.

1. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
2. *Master Development Drainage Plan – Bent Grass Residential Subdivison*, by Galloway & Company, May 2019.
3. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
4. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
5. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.
6. *Master Development Drainage Plan for The Ranch*, by Classic Consulting Engineers & Surveyors, LLC, November 2018.
7. *Falcon Highlands Master Development Drainage Plan & Preliminary Drainage Report & Final Drainage Report for Filing 1*, by URS, January 2005.
8. *Final Drainage Report and Erosion Control Plan – Latigo Business Center Filing No. 1 A Re-subdivision of a Portion of Latigo Business and Research Center Filing No. 1*, by Kiowa Engineering Corporation, November 2004.

9. *Final Drainage Letter Report for Lot 1, Latigo Business Center Filing No. 1*, by Colorado Design Concepts, April 2005.
10. *Final Drainage and Erosion Control for The Meadows Filing Three Subdivision* , by LADD Engineering, July 2000.

IV. Drainage Criteria

Hydrology calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

The drainage calculations were based on the criteria manual Figure 6-5 and IDF equations to determine the intensity, and are listed in Table 1 below.

Table 1 - Precipitation Data

Return Period	One Hour Depth (in).	Intensity (in/hr)
5-year	1.50	5.17
100-year	2.52	8.68

The rational method was used to calculate peak flows as the tributary areas are less than 100 acres. The rational method has been proven to be accurate for basins of this size and is based on the following formula:

$Q = CIA$

Where:

Q = Peak Discharge (cfs)
C = Runoff Coefficient
I = Runoff intensity (inches/hour)
A = Drainage area (acres)

The runoff coefficients are calculated based on land use, percent imperviousness, and design storm for each basin, as shown in the drainage criteria manual (Table 6-6). Composite percent impervious and C values were calculated using the residential, streets, roofs, and lawns coefficients found in Table 6-6 of the manual.

The 100-year event was used as the major storm event for pipes and inlets. The 5-year event was used as the minor event.

For the preliminary design of the channels HEC-RAS version 5.0.3 was utilized. The model was prepared to evaluate velocity, Froude number, and channel depth. Additionally, the model was utilized to size the culverts under Bent Grass Meadows Parkway. A Manning's n value of 0.045 was utilized for the channel which is appropriate for a bunch type native grass that is anticipated within the full channel section. The channels were designed to have a maximum depth of 5' per the criteria manual and have a maximum velocity of 5 ft/s with a maximum Froude number of 0.6.

The UD-Detention spreadsheet was utilized for sizing the water quality orifices on the proposed water quality portion of the regional detention pond.

HEC-HMS will be utilized to analyze the hydrology of the overall basin and verify that no changes in release rates have occurred to the regional detention pond with it's addition of water quality.

UD-Inlet was utilized to calculate both the street capacities and the inlet capacities.

StormCAD was utilized to size the storm sewer systems. It was also utilized to analyze the culvert for RWT204 due to the minor losses caused by the inlets on the culvert. HEC-RAS will no model minor losses through a culvert well. Therefore, the HEC-RAS model for that reach is broken at the culvert. StormCAD was utilized to identify the headwater on the culvert which was then subsequently used as a downstream boundary condition on the model upstream of Bent Grass Meadows Parkway.

V. Existing Drainage Conditions

The site is contained fully within one major drainage basin; the West Falcon Tributary. The site does border the Middle Falcon Tributary along the eastern edge of the property. The site generally drains from north to south with an average slope of 2% outside of the channel. The rational method was used to analyze the individual basins within the site because their size permits it. Excerpts from the DBPS are included in the appendix.

In addition to the DBPS The Ranch MDDP to the north and west of the site has revisited their existing conditions as well as existing conditions from the site directly to the north of them. Several detention ponds have been created within the Paint Brush Hills Subdivision and which revise the offsite flow entering the site within the major drainageway. This is taken into account with The Ranch MDDP. While The Ranch is still in design stage they are proposing detention ponds within their site to release at historic rates. This will revise the flow rates in their designed section of the channel to below the rates that are identified within the DBPS. A HEC-HMS model will be prepared with subsequent submittals updating the existing flow rates within the channel (as well as the proposed flow rates).

Per the DBPS the site lies within the basins, WT200, WT210, and WT220. These basins connect to channel reaches RWT202, RWT204, and RWT210. Both the RWT204 and RWT210 sections of channel currently exist and appear as a drainageway when visiting the site. Reach RWT202 appears to be a shallow overland flow through the project site. It is nearly unrecognizable through the site from a visual standpoint.

The existing channels have been visually inspected via a site walk and all appear in really good condition. There are no signs of scour within the bottoms of the channel. There are small areas that are incised or sloughing at the top of bank of the channel. These areas are less than 12" in height.

There is a small depression at the north end of the site, it appears to be the remnants of an old stock pond. It provides no detention or water quality for the upstream area. It will be removed with the development of this site.

All the existing condition basins need to be discussed in this report.

VI. Proposed Drainage Conditions

There has been very minor change to the overall Falcon Area Basin delineation with the proposed condition. A small portion of the site that previously went to the Middle Tributary has been revised to

The basin directly to the East of this site needs to be discussed. Including recent modifications made with the construction of the Bentgrass ResidentiallFiling Number 1.

come into the site and a small portion of the site that was previously within the West Tributary has been designed to drain into the Middle Tributary. This will be discussed with the individual basins. All necessary calculations can be found within the appendices of the report.

There are two channels that run through the site. As was discussed within the Existing Conditions portion of the report both the RWT202 and RWT204 run through the site. The proposed development will will drain to the RWT204 channel. The two channels come together near the southern end of the site and become RWT210. Because Bent Grass Meadows Parkway is being constructed the culvert for both the RWT202 and RWT204 will be installed with this project. They will be installed at their ultimate locations.

The DBPS alternative that was approved shows a small sub regional pond (SR3) to provide EURV for a portion of the tributary area. The basin analysis provided in the DBPS shows no decrease in either the 2-year or the 100-year events through this point. It has been discussed with El Paso County to not construct this pond, but in lieu of that revise the existing detention pond WU South to provide water quality for the entire tributary area. This modification will be discussed later in the report.

Requires Deviations to the Engineering Criteria Manual. Submittal

The site will release undetained directly into the West Tributary channel RWT204.

As has been mentioned previously the site is proposed to be single family residential. The site has been designed to provide a large lot buffer between the existing large lots to the north and west of the site and the proposed site. Beyond this buffer the majority of the site is smaller approximately 1/8 acre lots.

Basin OS-1 (10.35 AC, Q5 = 4.5 cfs, Q100 = 21.8 cfs): a basin that is associated with The Meadows Filing No. 3 lots 14, 15, 16, and 17. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin A-1 to **DP-1**. It is anticipated that with the plot plans for the lots adjacent to the northern property line they will provide swales around the proposed house directing runoff from Basin OS-1 into the proposed streets of Basin A-1.

Call out these swales on the DR and GEC plans.

Basin A-1 (2.96 AC, Q5 = 3.6 cfs, Q100 = 9.5 cfs): a basin that is in the northeast corner of the site. It encompasses single-family residential lots (Type A and B) along Ansley Court. Runoff will flow from each lot onto Ansley Court where proposed mountable curb and gutter will convey flows to **DP-1**. Flows will then be conveyed West by mountable curb and gutter to DP-2.

Basin OS-2 (1.60 AC, Q5 = 1.2 cfs, Q100 = 2.1 cfs): a basin that is associated with The Meadows Filing No. 3 lot 14. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin A-2 to **DP-2**. It is anticipated that with the plot plans for the lots adjacent to the northern property line they will provide swales around the proposed house directing run off from Basin OS-2 into the proposed streets of Basin A-2.

Basin A-2 (1.37 AC, Q5 = 1.7 cfs, Q100 = 4.7 cfs): a basin that is in the northeast area of the site. It encompasses single-family residential lots (Type A) along Berwyn Court. Runoff will flow from each lot onto Berwyn Court where proposed mountable curb and gutter will convey flows to **DP- 2**. Flows will then be conveyed South by mountable curb and gutter to DP-3.

Basin A-3 (1.57 AC, Q5 = 2.0 cfs, Q100 = 5.0 cfs): a basin that is in the northeast area of the site. It encompasses single-family residential lots (Type A and B) along Niebrara Drive and Berwyn Court. Runoff will flow from each lot onto Niebrara Drive and Berwyn Court where proposed mountable curb and gutter will convey flows to **DP-3**. Flows will then be conveyed West by a proposed cross pan to DP-4.

Basin OS-3 (1.08 AC, Q5 = 0.4 cfs, Q100 = 2.4 cfs): a basin that is associated with The Meadows Filing No. 3 lot 14. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin A-4 to **DP-4.** It is anticipated that with the plot plans for the lots adjacent to the northern property line they will provide swales around the proposed house directing run off from Basin OS-3 into Berwyn Court of Basin A-4.

Basin A-4 (2.43 AC, Q5 = 3.0 cfs, Q100 = 7.9 cfs): a basin that is in the northeast area of the site. It encompasses single-family residential lots (Type A and B) along Berwyn Court and a small portion of Willmore Drive. Runoff will flow from each lot onto Berwyn Court where proposed mountable curb and gutter will convey flows to **DP-4**. Flows will then be conveyed West along Bent Grass Meadows Drive by curb and gutter to DP-8.

Basin E-1 (1.69 AC, Q5 = 3.5 cfs, Q100 = 7.4 cfs): a basin that is in the center of the site and encompasses a portion of Bent Grass Meadows Drive. A high point on the far East of the basin forces water to flow to a low point at **DP-8**, which represents a 20' CDOT Type R sump inlet, which conveys stormwater via proposed 54" RCP storm sewer to DP-9. Emergency overflow will spill over the crown of the road and enter into a proposed 20' CDOT Type R sump inlet represented by DP-9.

Basin OS-7 (2.25 AC, Q5 = 0.8 cfs, Q100 = 4.8 cfs): a basin that is associated with The Meadows Filing No. 3 lots 4 and 5. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin D-2 to **DP-5**.

Basin D-2 (3.52 AC, Q5 = 4.2 cfs, Q100 = 10.7 cfs): a basin that is in the northwest area of the site. It is undeveloped and covered in native grasses, weeds, rock, and shrubs. Runoff from this basin sheet flows from North to South along grades between 2.5 and 6.5 percent. Small portions of the basin will flow directly into RWT202. Most of this basin sheet flows from north to south and collects at **DP-5**. Flows will then be conveyed East by a proposed cross pan to DP-6.

Tabulate the areas that do not get treated. No more than 20 % or one acre.

Basin OS-6 (7.52 AC, Q5 = 4.6 cfs, Q100 = 18.5 cfs): a basin that is associated with The Meadows Filing No. 3 lots 4 and 5. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin D-1 to **DP-6**.

Basin D-1 (14.44 AC, Q5 = 15.3 cfs, Q100 = 41.1 cfs): a basin that is in the northwest area of the site. It is undeveloped and covered in native grasses, weeds, rock, and shrubs. Runoff from this basin sheet flows from North to South along grades between 2.5 and 6.5 percent. Small portions of the basin will flow directly into RWT204. Most of this basin sheet flows from north to south and collects at **DP-6**. Flows will then be conveyed East along Bent Grass Meadows Drive by curb and gutter to DP-8.

Basin E-2 (0.63 AC, Q5 = 2.2 cfs, Q100 = 4.2 cfs): a basin that is in the center of the site and encompasses a portion of Bent Grass Meadows Drive. A high point on the far West of the basin forces water to flow to a low point at **DP-8**, which represents a 20' CDOT Type R sump inlet, which conveys stormwater via a proposed 54" RCP storm sewer to DP-9. Emergency overflow will spill over the crown of the road and enter into a proposed 20' CDOT Type R sump inlet represented by DP-9.

Basin E-3 (0.78 AC, Q5 = 2.9 cfs, Q100 = 5.3 cfs): a basin that is in the center of the site and encompasses a portion of Bent Grass Meadows Drive. A high point on the far West of the basin forces water to flow to a low point at **DP-9**, which represents a 20' CDOT Type R sump inlet, which conveys

stormwater via a proposed 54" storm sewer to outfall into RWT204. This inlet receives emergency overflow from DP-8.

Basin B-3 (0.46 AC, Q5 = 1.1 cfs, Q100 = 2.3 cfs): a basin that is in the North-central area of the site. It encompasses the fronts of two single family Type A lots, and a large portion of Silky Thread Road. Runoff will flow form each lot onto Silky Thread Road where proposed mountable curb and gutter will convey flows west into a proposed temporary swale. Flows will continue West to **DP-10** where it will enter RWT204.

Basin B-4 (2.12 AC, Q5 = 0.7 cfs, Q100 = 4.4 cfs): a basin that is in the North-central area of the site, and a portion of The Meadows Filing No. 3 lot 13. Runoff from this basin sheet flows until it is intercepted by a proposed temporary swale just West of Silky Thread Road. Once intercepted, flows will be routed West to **DP-10** into RWT204.

Basin OS-4 (6.05 AC, Q5 = 3.8 cfs, Q100 = 14.8 cfs): a basin that is associated with The Meadows Filing No. 3 lot 7, 10, 11, 12, and 13. Runoff from this basin sheet flows south to the northern property line of the site. This runoff from the basin will be routed through Basin B-1 to **DP-11** It is anticipated that with the plot plans for the lots adjacent to the northern property line they will provide swales around the proposed house directing run off from Basin OS-4 into Thedford Court of Basin B-1.

Basin B-1 (4.83 AC, Q5 = 5.8 cfs, Q100 = 14.9 cfs): a basin that is in the northeast area of the site. It encompasses single-family residential Type A lots along Thedford Court and Willmore Drive. Runoff will flow from each lot onto the street where proposed mountable curb and gutter will convey flows South and then West to **DP-11**.

Basin B-2 (1.17 AC, Q5 = 2.0 cfs, Q100 = 4.3 cfs): a basin that is in the northeast area of the site. It encompasses the fronts of single-family residential Type B lots along Willmore Drive. Runoff will flow from each lot onto the street where proposed mountable curb and gutter will convey flows West to **DP-12**.

Basin B-5 (1.22 AC, Q5 = 0.4 cfs, Q100 = 2.9 cfs): a basin that is in the northeast area of the site. It is undeveloped and covered in native grasses, weeds, rock, and shrubs. Runoff from this basin sheet flows from North to South along grades around 2 percent. Runoff will be intercepted by a proposed temporary swale that will convey flows West to **DP-14** into RWT204.

Basin OS-5 (13.28 AC, Q5 = 5.8 cfs, Q100 = 26.1 cfs): a basin that is associated with The Meadows Filing No. 3 lot 7, 10, 11, 12, and 13. Runoff from this basin sheet flows south crossing the northern property line of the site, flows then spill directly into RWT204.

Basin C-5 (7.86 AC, Q5 = 10.9 cfs, Q100 = 24.9 cfs): a basin that is in the southeast area of the site. It encompasses single-family residential lots, Type A lots along Feather Reed Drive and Avena Road. Runoff will flow from each lot onto the street where proposed mountable curb and gutter will convey flows West and then South to a proposed on-grade 15' CDOT Type R inlet, **DP-15**. Captured flow will convey stormwater via a proposed 24" RCP storm sewer to DP-16. By-pass flow will continue down Feather Reed Drive to DP-17 where 5 yr. and 100 yr. flows will be completely captured by a 20' CDOT Type R sump inlet.

Basin C-6 (4.82 AC, Q5 = 6.0 cfs, Q100 = 14.7 cfs): a basin that is in the southeast area of the site. It encompasses single-family residential lots, Type A lots along the North portion of Feather Reed Drive and

Type A lots along the South portion of Feather Reed Drive. Runoff will flow from each lot onto Feather Reed Drive where proposed mountable curb and gutter will convey flows West and then South to a proposed on-grade 10' CDOT Type R inlet, **DP-16**. Captured flow will convey stormwater via a proposed 30" RCP storm sewer to DP-18. By-pass flow will continue down Feather Reed Drive to DP-18 where 5 yr. and 100 yr. flows will be completely captured by a 20' CDOT Type R sump inlet.

Basin C-3 (2.38 AC, Q5 = 3.4 cfs, Q100 = 7.9 cfs): a basin that is in the southeast area of the site. It encompasses single-family residential lots, Type A lots along Berwyn Drive. Runoff will flow from each lot onto the street where proposed mountable curb and gutter will convey flows West to a proposed 20' CDOT Type R sump inlet, **DP-17**. 5 yr. and 100 yr. flows will be completely captured and then conveyed via a proposed 30" RCP storm sewer to DP-18.

Basin C-4 (3.61 AC, Q5 = 5.2 cfs, Q100 = 12.0 cfs): a basin that is in the southeast area of the site. It encompasses single-family residential lots, Type A lots along Bossett Drive. Runoff will flow from each lot onto the street where proposed mountable curb and gutter will convey flows West to a proposed 20' CDOT Type R sump inlet, **DP-17**. 5 yr. and 100 yr. flows will be completely captured and then conveyed via a proposed 30" RCP storm sewer to DP-18

Basin C-1 (1.35 AC, Q5 = 2.6 cfs, Q100 = 5.8 cfs): a basin that is associated with Bent Grass Residential Filing No. 1 lots 58, 59, 60, 61, 62, 63, 64, 65, and 66. It encompasses the rears of single-family residential lots. Runoff will flow West from each lot into a proposed swale which will convey flows South to Avena Road. Then, proposed mountable curb and gutter will convey flows West and will be routed through basin C-2 along Berwyn Drive to **DP-18**.

Basin C-2 (5.96 AC, Q5 = 6.2 cfs, Q100 = 15.9 cfs): a basin that is in the Southeast corner of the site. It encompasses fronts of single-family residential Type B lots. Runoff will flow from each lot onto Berwyn Drive where proposed mountable curb and gutter will convey flows South and then West to a proposed 20' CDOT Type R sump inlet, **DP-18**, where 5 yr. and 100 yr. flows will be completely captured and then conveyed via a proposed 42" RCP storm sewer pipe to outfall into RWT210.

Basin C-7 (2.00 AC, Q5 = 2.0 cfs, Q100 = 6.2 cfs): a basin that is in the South-central area of the site adjacent to RWT204 and RWT 210. It encompasses the rears of single-family residential Type B lots. Runoff will sheet flow West directly into RWT204 and RWT210.

Basin OS-8 (20.08 AC, Q5 = 9.1 cfs, Q100 = 43.5 cfs): a basin that is associated with The Meadows Filing No. 2 lots 1, 2, 3, 4, 5, and 6. Runoff from this basin sheet flows from the Northwest to the Southeast until crossing the West property line of the site. The runoff will continue to sheet flow in the same manner through basins D-4 and D-3 until intercepted by a proposed swale on the southern property line of the site. Collected flows will then be routed East to **DP-21** where 5 yr. and 100 yr. flows will be captured by a CDOT Type D area inlet. Flows will then be conveyed by a 36" RCP storm drain piped underneath Bent Grass Meadows Drive out falling into a proposed swale that will route flows South to DP-24 and then East ultimately into RWT210.

Basin OS-9 (10.62 AC, Q5 = 4.7 cfs, Q100 = 22.6 cfs): a basin that is associated with The Meadows Filing No. 1 lot 11 and The Meadows Filing No. 2 lots 1 and 2. Runoff from this basin sheet flows from the Northwest to the Southeast until crossing the West property line of the site. The runoff will continue to sheet flow in the same manner through basin D-4 until intercepted by a proposed swale on the southern property line of the site. Collected flows will then be routed East to **DP-21** where 5 yr. and 100 yr. flows

will be captured by a CDOT Type D area inlet. Flows will then be conveyed by a 36" RCP storm drain piped underneath Bent Grass Meadows Drive out-falling into a proposed swale that will route flows South to DP-24 and then ultimately East into RWT210.

Basin D-4 (9.65 AC, Q5 = 7.2 cfs, Q100 = 23.5 cfs): a basin that is in the West area of the site. Runoff from this basin sheet flows from the Northwest to the Southeast. The runoff be intercepted by a proposed swale on the southern property line of the site. Collected flows will then be routed East to **DP-21** where 5 yr. and 100 yr. flows will be captured by a CDOT Type D area inlet. Flows will then be conveyed by a 36" RCP storm drain piped underneath Bent Grass Meadows Drive out-falling into a proposed swale that will route flows South to DP-24 and then ultimately East into RWT210.

Basin D-3 (9.16 AC, Q5 = 9.4 cfs, Q100 = 26.2 cfs): a basin that is in the West area of the site. Runoff from this basin sheet flows from the Northwest to the Southeast. A large portion of the runoff will be intercepted by a proposed swale on the southern property line of the site. Collected flows in the swale will then be routed East to **DP-21** where 5 yr. and 100 yr. flows will be captured by a CDOT Type D area inlet. Flows will then be conveyed by a 36" RCP storm drain piped underneath Bent Grass Meadows Drive out-falling into a proposed swale that will route flows South to DP-24 and then ultimately East into RWT210. The rest of flow from the basin sheet flow onto Bent Grass Meadows Drive where proposed curb and gutter will convey flows South where the 5 yr. and 100 yr. flows will be captured by a proposed 25' CDOT Type R on-grade inlet, **DP-22**. Captured flow will be routed by a 24" RCP storm drain piped to DP-23.

Basin E-4 (0.91 AC, Q5 = 3.0 cfs, Q100 = 5.7 cfs): a basin that is in the Southwest area of the site and encompasses a portion of Bent Grass Meadows Drive. Runoff from this basin is almost immediately captured by proposed curb and gutter and then routed South where the 5 yr. and 100 yr. flows will be captured by a proposed 25' CDOT Type R on-grade inlet, **DP-22**. Captured flow will be routed by a 24" RCP storm drain piped to DP-23.

Basin E-5 (0.89 AC, Q5 = 3.3 cfs, Q100 = 6.1 cfs): a basin that is in the Southwest area of the site and encompasses a portion of Bent Grass Meadows Drive. Runoff from this basin is almost immediately captured by proposed curb and gutter and then routed South where the 5 yr. and 100 yr. flows will be captured by a proposed 25' CDOT Type R on-grade inlet, **DP-23**. Captured flow will be routed by a 24" RCP storm drain piped to an outfall at DP-24. Flows will then be routed East by a proposed swale until out-falling into RWT210.

Basin F-1 (0.46 AC, Q5 = 0.6 cfs, Q100 = 1.7 cfs): a basin that is in the Northeast corner of the site. It encompasses the rears of single-family residential Type B lots. Runoff from the basin will follow historical patterns East onto a future school site.

Basin F-2 (0.62 AC, Q5 = 1.8 cfs, Q100 = 3.7 cfs): a basin that is in the east side of the site. It encompasses a portion of Bent Grass Meadows Parkway. There is a high point in the road causing a portion of the road to drain east into the existing roadway. Bent Grass Residential Filing No. 1 had two basins accounting for this condition (Basins A and B with a total area of 0.38 acres). The anticipated flow rate from these two basins was 1.3 cfs in the 5-year event and 2.6 cfs in the 100-year event. The proposed runoff from the proposed slightly exceeds the anticipated runoff in the Filing No. 1 Report.

Basin G-1 (3.01 AC, Q5 = 3.1 cfs, Q100 = 9.5 cfs): a basin that is in the South-east corner of the site. It encompasses the rears of single-family residential Type B lots. Runoff will follow historical patterns and sheet flow South off-site.

Tabulate the areas that do not get treated. No more than 20 % or one acre.

Basin H-1 (0.31 AC, Q5 = 1.1 cfs, Q100 = 2.1 cfs): a basin that is associated with Latigo Business Center Filing No. 1 lot 1. It encompasses a portion of Bent Grass Meadows Parkway South of the proposed (2) 25' CDOT Type R Inlets on site.

VII. Proposed Channel Improvements

As can be seen in the drainage maps the proposed Filing No. 2 does not encroach into the existing channel for the RWT204 reach. It is desired to leave the channel in its existing condition if the channel can be proven to be stable. In the future when the remainder of the site is developed the RWT204 channel will be consolidated into a smaller designed cross section and will be relocated to within a tract. It will be realigned off of it's current alignment. The low point of Bent Grass Meadows Parkway has been designed such that it aligns with the proposed channel alignment. The culvert for RWT204 will double as a storm sewer system at this crossing. Because of this it was modeled with StormCAD.

The future channel and the existing channel do not align at this location. Therefore, a small amount of grading is proposed to direct runoff from the existing channel to the proposed culvert location. After outfalling to the south of Bent Grass Meadows Parkway there is another small section of grading to direct flows back to the existing channel. The radii of these bends were designed such that super elevation/increased velocities are not expected.

The future channel design is anticipated to have a series of Grouted Sloping Boulder Drops within it. One of these drops was placed specifically at the outfall of the proposed culvert. This was done so that the drop could be utilized as energy dissipation from the culvert.

Reviewing the HEC-RAS model prepared for the conditions proposed by this report it can be seen that the existing and proposed conditions have similar velocities and Froude numbers. Given that the channel is stable in its current state it is proposed to not provide improvements to the channel at this time.

Riprap protection will be provided at the individual outfalls from the site into the channel to prevent scouring from the point discharges.

Future filings will need to review the channel for necessary improvements if the ultimate channel is not constructed at such time.

At this time no development other than Bent Grass Meadows Parkway is being constructed west of the RWT204. There is no need to improve or construct the RWT202 reach. However, because the roadway is being constructed the crossing will need to be installed. It is proposed to install the box culverts under the road along with the future drops on the up and downstream ends of the culverts. From the top of the upstream drop the grading will be daylighted at 4:1. From the toe of the downstream drop the grading has been designed to allow the culverts to drain if water were to enter them. It is not anticipated that the culverts would be utilized in a large storm event.

The MDDP identifies the use of check structures for the RWT210 channel downstream of the site. Again due to the existing stability of the channel and the minor increase in flows velocities and Froude numbers have only slightly changed. For the purposes of this Filing it is proposed to leave the channel as is and install the proposed improvements with subsequent filings.

Address whether the added base flow due to residential development will cause erosion of the existing channels.
Also address a plan for channel improvements that is more definite than "wait and see".

The channel design flow rates have previously been established using HEC-HMS in the DBPS. The site has been analyzed using the Rational method. The HEC-HMS model for the basin has been obtained from El Paso County and has been revised accordingly for the developed site. It was necessary to break apart the basin into a couple of smaller basins in order to accurately design the crossings of Bent Grass Meadows Parkway. The DBPS also shows the pond SR3 which has been removed with this project, so it was necessary to remove it from the model.

In addition to the changes made with this project several changes have been made upstream of the Bent Grass Subdivision. The Ranch MDDP has added detention ponds for their project and has corrected several of the other offline ponds near the northern end of their site. In addition to the ponds the DBPS had identified a flow diversion from the Falcon Watershed into the Sand Creek Watershed. This diversion has been corrected with The Ranch MDDP. The updated HEC-HMS model is necessary because the DBPS hydrology has now been superseded by The Ranch design.

The Ranch MDDP has also investigated the connection from The Ranch site through the Meadows Filing No. 3 to the Bent Grass site. It has been identified that the existing homes within the Meadows do not have the adequate drainage improvements to convey storm water through the subdivision. The drainage path through the Meadows is incorrectly identified and allowed homes built closer to the flow path than should have been allowed. In addition, several culverts were erroneously constructed restricting the flow path through the subdivision.

The conclusion of The Ranch MDDP is that major channel improvements are necessary through the Meadows subdivision. They state that multiple meetings have taken place with El Paso County regarding this issue and funding for the improvements is being discussed.

VIII. Proposed Regional Pond Improvements

As has been previously mentioned the DBPS identified a pond named SR3 at the junction of RWT202 and RWT204 near the south end of the Bent Grass Residential Subdivision. The purpose of this pond was to provide EURV for a portion of the tributary area, it was identified to have a volume of 1 acre-foot. It has been discussed with El Paso County to not construct this pond. In its place Pond WU will be modified to provide water quality for the entire tributary area.

Utilizing the areas and percent impervious values from the future models in the DBPS it was determined that pond WU has a tributary area of 3.58 square miles and a 7.33% impervious. Utilizing the WQCV equations contained with the Criteria it has been determined that a volume of 9.764 ac-ft is required for the entire tributary area. This volume exceeds the volume for the 5-year event per the DBPS.

The stage storage data for the pond was taken from the DBPS and it was found that the required volume exceeds the front edge of the existing outlet structure on the pond. It is proposed to raise the front edge of the existing outlet to provide the required water quality capture volume. The existing orifices on the fact of the outlet structure will be covered to prevent release through them and a new rectangular hole will be cut through the existing wall. An orifice plate with square orifices will be installed to release the WQCV. A well screen will be installed on the face of the outlet structure. A small micro pool will be proposed directly in front of the orifice plate in an effort to reduce clogging of the well screen. The revised HEC-HMS model prepared for the channel flow rates will review the pond function and release rates when prepared.

In reviewing the pond and in discussions with El Paso County the inlet to Pond WU has washed out and is in need of repair. As part of the proposed improvements to the pond the washed out embankment will be repaired. Not much discussion or design can be located regarding the original embankment. In discussions with the County it is understood that there are multiple areas of wetlands in the area. While the majority of the West Tributary should be directed through Pond WU there are two 18" pipes to the east of the embankment that allow flows to pass from the West Tributary into the existing wetlands to maintain them. The embankment is designed such that flows will back up prior to entering Pond WU and will pass through the existing pipes to the east.

Site investigations have identified that a large reason the embankment failed was improper erosion protection. It is apparent that as the embankment was overtopped it began scourging under the riprap placed on the downhill side of the embankment. Given enough time or a large enough storm it was able to dislodge a section of the protection and the embankment washed out.

It is proposed to fill the washed out area of the embankment back to match the existing grades around it. The 18" pipe through the embankment will be replaced. The purpose of this pipe is to drain the area just upstream of the embankment since the dual pipes to the east are higher than that point. Riprap will be re-established on the downstream side of the embankment. In addition it is proposed to riprap the top of the embankment to protect it from scour. A cutoff wall will also be installed through the full length of the embankment from the top of the embankment to just below the toe of slope on the downstream side. The cutoff wall should be installed on downstream side of the top of the embankment. It is proposed to install a portion of the cutoff wall as sheet pipes. This will be through the area of the embankment that is still existing to avoid reconstructing the entire embankment. In the are where the washout occurred and where the pipe will be passing through the cutoff wall it is proposed to do a concrete cutoff wall. The concrete wall should be cast around the sheet pipe wall on both ends to prevent flows cutting between the walls and creating a failure.

IX. Maintenance

The proposed channels are to be public facilities. After completion of construction and upon the Board of County Commissioners acceptance the channels will be owned and maintained by El Paso County along with all drainage facilities within the public Right-of-Way.

X. Wetlands Mitigation

No wetlands are located on site.

XI. Floodplain Statement

A portion of the project site lies within Zone AE Special Flood Hazard Area as defined by the FIRM Map number 08041C0553G effective December 7, 2018. A copy of the FIRM Panel is included in the appendix.

The portion of channel that has a floodplain designation is only the RWT210 and RWT204 portions of the channel. It is unknown why the western channel, RWT202 is unmapped since it is the larger contributor regarding flow rates. The proposed improvements to RWT204 will likely require a CLOMR and LOMR. At this time it is unknown exactly what was mapped through this section as the FIS does not have detailed enough information contained within it. HEC-RAS models have been requested from FEMA for

the channel. The effective models will help identify what flow rates were utilized in establishing the floodplain. More information will be provided as the project progresses and more information can be obtained.

XII. Drainage/Bridge Fees and Credits/Reimbursements

The site lies within the Falcon Drainage Basin. The DBPS was approved in 2013 and has drainage and bridge fees associated with the basin.

The subdivision has a total area of 50.795 acres.

The percent impervious for the subdivision has been calculated with this report to be approximately 39 percent.

50.795 acres x 39% = 19.81 Impervious Acres

The following calculations are based on the 2019 Falcon Basin drainage/bridge fees:

Drainage Fees

$29,622 x 19.81 Imp. Acres = $586,811.82

Bridge Fees

$4,069 x 19.81 Imp. Acres = $80,606.89

Per discussions with El Paso County the fees may be offset by the cost of regional improvements. The regional improvements would include channel, culvert, detention pond modification, and pond inlet repair costs. Below is a cost estimate for the improvements proposed with this filing.

Item	Quantity	Unit	Unit Cost	Cost
Storm Drain Improvements (Public)				
10' CDOT Type R Inlet (Public)	11	EA	$ 8,000.00	$ 88,000.00
15' CDOT Type R Inlet (Public)	3	EA	$ 9,800.00	$ 29,400.00
CDOT Type D Area Inlet (Public)	1	EA	$ 7,900.00	$ 7,900.00
5' Manhole - Type II (Public)	1	EA	$ 4,700.00	$ 4,700.00
24" RCP Storm Drain (Public)	137	LF	$ 70.00	$ 9,590.00
30" RCP Storm Drain (Public)	166	LF	$ 95.00	$ 15,770.00
36" RCP Storm Drain (Public)	156	LF	$ 110.00	$ 17,160.00
42" RCP Storm Drain (Public)	438	LF	$ 140.00	$ 61,320.00
24" FES	1	EA	$ 970.00	$ 970.00
36" FES	1	EA	$ 1,610.00	$ 1,610.00
42" FES	1	EA	$ 1,700.00	$ 1,700.00
Soil Rip Rap - Type L	16	CY	$ 60.00	$ 960.00
Soil Rip Rap - Type M	17	CY	$ 70.00	$ 1,190.00

Soil Rip Rap - Type VH	18	CY	$	90.00	$	1,620.00
Cutoff Walls - Concrete	3.9	CY	$	600.00	$	2,340.00
Cutoff Walls - Steel Reinforcement	160	LBS	$	0.90	$	144.00
Subtotal					$	244,374.00
Culvert 1 (Circular Pipe) (Public)						
54" RCP Storm Drain (Public)	117	LF	$	210.00	$	24,570.00
24" Grouted Boulders	46	SY	$	170.00	$	7,820.00
Rip Rap - Type M Soil	9	CY	$	70.00	$	630.00
Headwalls - Concrete	3	CY	$	600.00	$	1,800.00
Wingwalls - Concrete	35	CY	$	600.00	$	21,000.00
Headwalls - Steel Reinforcement	209	LBS	$	0.90	$	188.10
Wingwalls - Steel Reinforcement	1300	LBS	$	0.90	$	1,170.00
Subtotal					$	57,178.10
Culvert 2 (Concrete Box Culvert) (Public)						
5' x 12' Concrete Box Culvert	266	LF	$	1,600.00	$	425,600.00
30" Grouted Boulders	164	SY	$	190.00	$	31,160.00
Soil Rip Rap - Type M	52.44	CY	$	70.00	$	3,670.80
Headwalls - Concrete	35	CY	$	600.00	$	21,000.00
Wingwalls - Concrete	60	CY	$	600.00	$	36,000.00
Headwalls - Steel Reinforcement	1300	LBS	$	0.90	$	1,170.00
Wingwalls - Steel Reinforcement	4430	LBS	$	0.90	$	3,987.00
Subtotal					$	522,587.80
Regional Pond Improvements (Public)						
18" RCP Storm Drain (Public)	126	LF	$	54.00	$	6,804.00
18" FES	2	EA	$	920.00	$	1,840.00
3' Concrete Headwall	2	CY	$	600.00	$	1,200.00
13' Cutoff Wall - Concrete	60	CY	$	600.00	$	36,000.00
13' Cutoff Wall - Steel Reinforcement	6380	LBS	$	0.90	$	5,742.00
13' Sheet Pile Cutoff Wall	155	LF	$	620.00	$	96,100.00
Rip Rap - Type VH	2260	CY	$	85.00	$	192,100.00
Pond Modification to Full Spectrum	1	LS	$	60,000.00	$	60,000.00
Subtotal					$	399,786.00
Total (Public)					**$**	**1,223,925.90**
Contingency				10%	$	122,392.59
Grand Total (Public)					**$**	**1,346,318.49**

Channel improvements need to be identified. There are impacts to the channels to the east caused by this development.

Reimbursable costs are limited to those shown in the DBPS. Provide a separate table for those (the pond above and the channel improvements).

XIII. Conclusion

The Bent Grass Residential Subdivision lies within the West Tributary of the Falcon Area Watershed. Recommendations are made within this report to establish and stabilize multiple drainageways through the project site. Detention for the site is provided in a regional pond that will be modified to provide water quality for the entire tributary area. Recommendations are also given for re-establishing the inlet to the regional pond. All drainage facilities within this report were sized according to the Drainage Criteria Manuals. All of the channel corridors will be publicly owned and maintained and shall be the responsibility of El Paso County. Upon development of the individual parcels within the Bent Grass Residential Subdivision, separate Final Drainage Reports will be required to be submitted and approved by El Paso County.

XIV. References

1. *City of Colorado Springs/County of El Paso Drainage Criteria Manual*, October 1991.
2. *Drainage Criteria Manual, Volume 2*, City of Colorado Springs, November 2002.
3. *Urban Storm Drainage Criteria Manual*, Urban Drainage and Flood Control District, January 2016 (with current revisions).
4. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
5. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
6. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
7. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.
8. *Master Development Drainage Plan for The Ranch*, by Classic Consulting Engineers & Surveyors, LLC, November 2018.
9. *Falcon Highlands Master Development Drainage Plan & Preliminary Drainage Report & Final Drainage Report for Filing 1*, by URS, January 2005.
10. *Final Drainage Report and Erosion Control Plan – Latigo Business Center Filing No. 1 A Re-subdivision of a Portion of Latigo Business and Research Center Filing No. 1*, by Kiowa Engineering Corporation, November 2004.

APPENDIX A

Exhibits and Figures

BENT GRASS

-

BENT GRASS MEADOWS DRIVE
SCALE: 1" = 2,000'

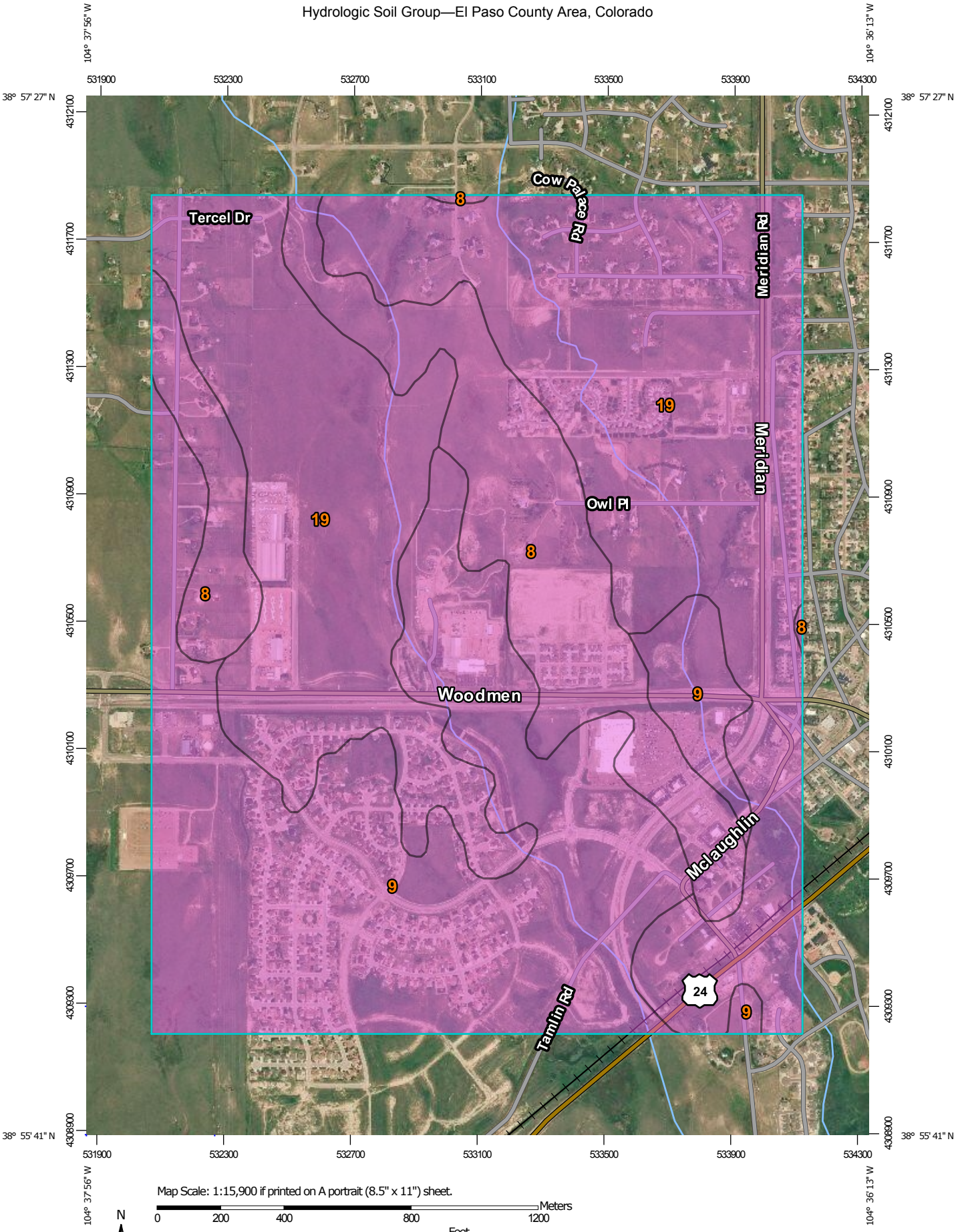
VICINITY MAP

Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	RGD
Date:	04/02/2019

Galloway

1755 Telstar Drive, Suite 107
Colorado Springs, CO 80920
719.900.7220 • GallowayUS.com

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:15,900 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	214.3	16.0%
9	Blakeland-Fluvaquentic Haplaquolls	A	465.8	34.7%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	662.6	49.3%
Totals for Area of Interest			**1,342.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

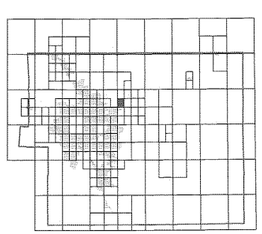
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

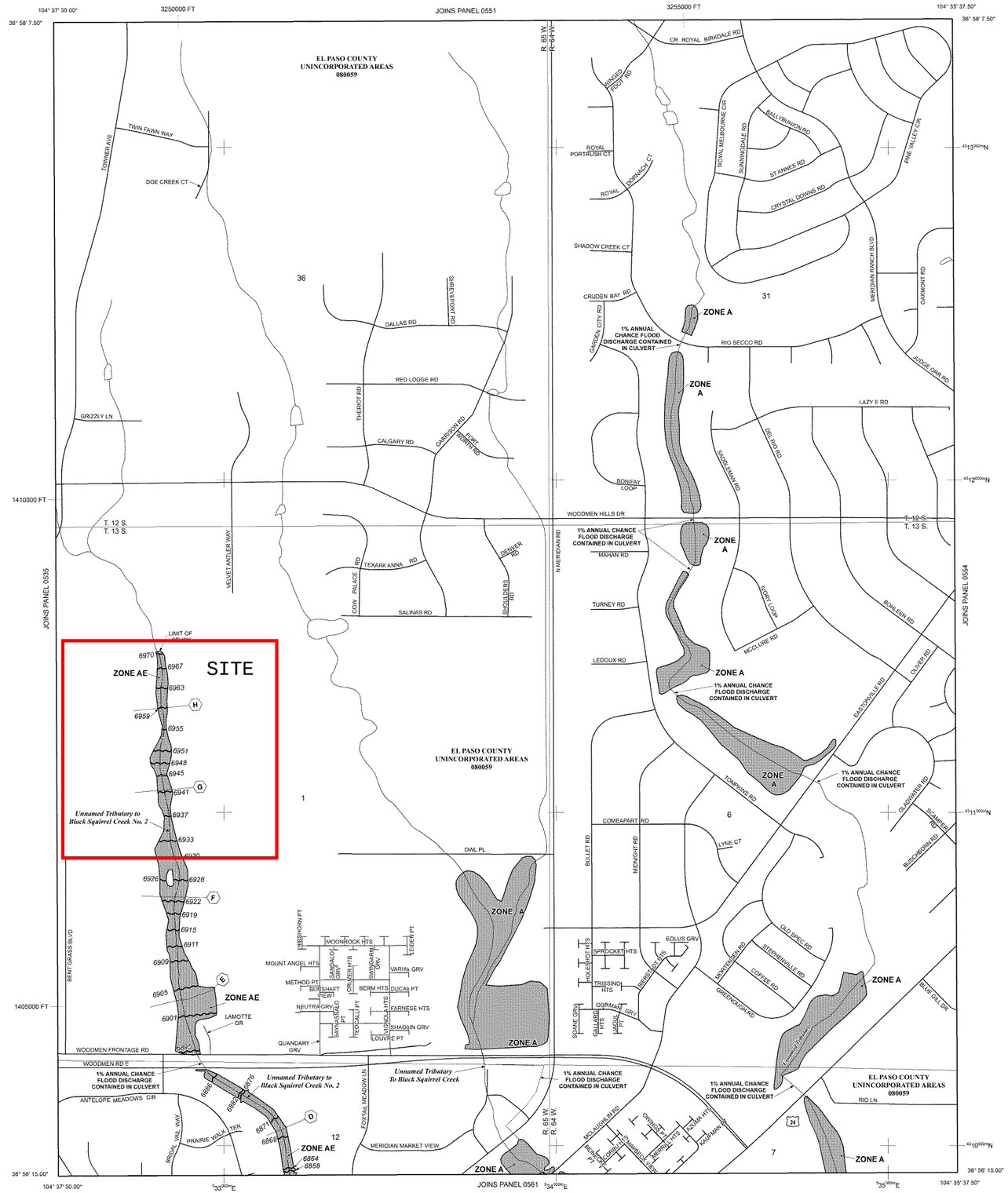
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0553G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 553 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0553	G

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

MAP NUMBER
08041C0553G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

FALCON DRAINAGE BASIN PLANNING STUDY

SELECTED PLAN REPORT

FINAL - SEPTEMBER 2015

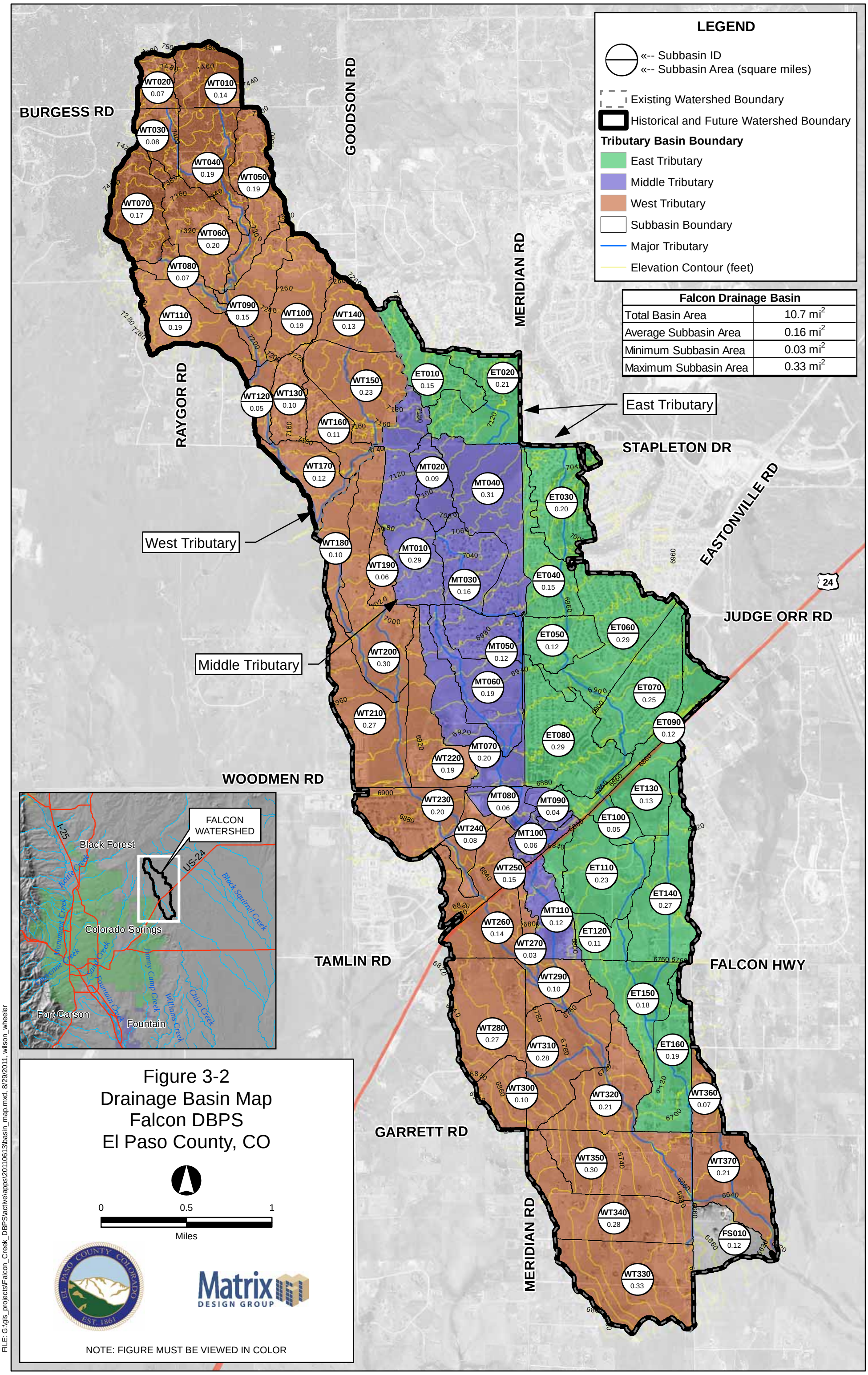
Prepared for:

El Paso County Public Services Department
3275 Akers Drive
Colorado Springs, CO 80922

Prepared By:

Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920

Matrix Project No. 10.122.003


LEGEND
«-- Subbasin ID
«-- Subbasin Area (square miles)
Existing Watershed Boundary
Historical and Future Watershed Boundary
Tributary Basin Boundary
East Tributary
Middle Tributary
West Tributary
Subbasin Boundary
Major Tributary
Elevation Contour (feet)
Falcon Drainage Basin
Total Basin Area 10.7 mi²
Average Subbasin Area 0.16 mi²
Minimum Subbasin Area 0.03 mi²
Maximum Subbasin Area 0.33 mi²
BURGESS RD
GOODSON RD
MERIDIAN RD
RAYGOR RD
STAPLETON DR
EASTONVILLE RD
JUDGE ORR RD
WOODMEN RD
TAMLIN RD
FALCON HWY
GARRETT RD
East Tributary
West Tributary
Middle Tributary
FALCON WATERSHED
Black Forest
Colorado Springs
Fort Carson
Fountain
I-25
US-24
Kettle Creek
Monument Creek
Black Squirrel Creek
Jimmy Camp Creek
Williams Creek
Chico Creek
Sand Creek
Fountain Creek
Figure 3-2
Drainage Basin Map
Falcon DBPS
El Paso County, CO
0
0.5
1
Miles
Matrix DESIGN GROUP
NOTE: FIGURE MUST BE VIEWED IN COLOR
FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20110613\basin_map.mxd, 8/29/2011, wilson_wheeler

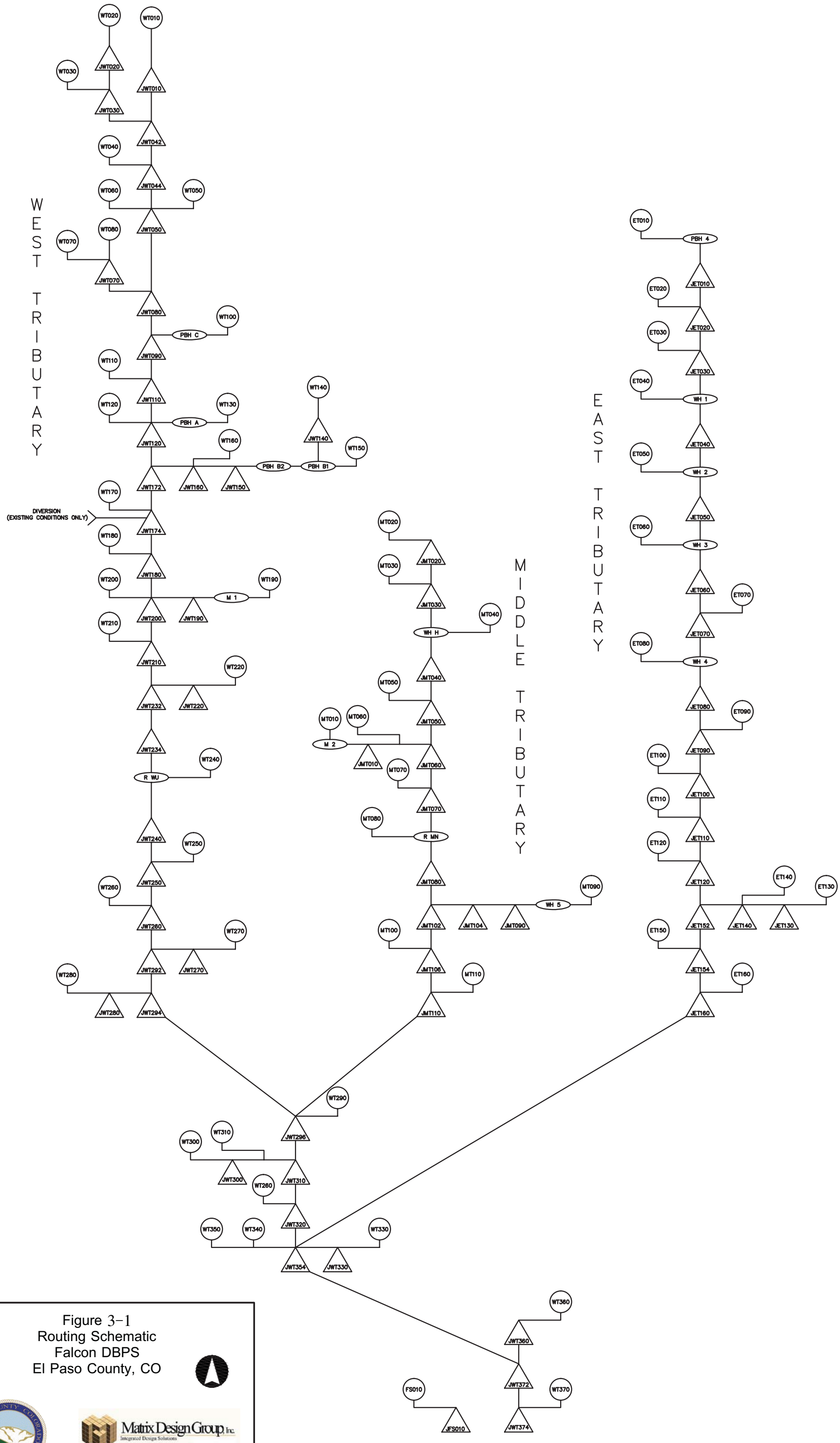


Figure 3-1
Routing Schematic
Falcon DBPS
El Paso County, CO

Matrix Design Group Inc.
Integrated Design Solutions

DRAWING NOT TO SCALE

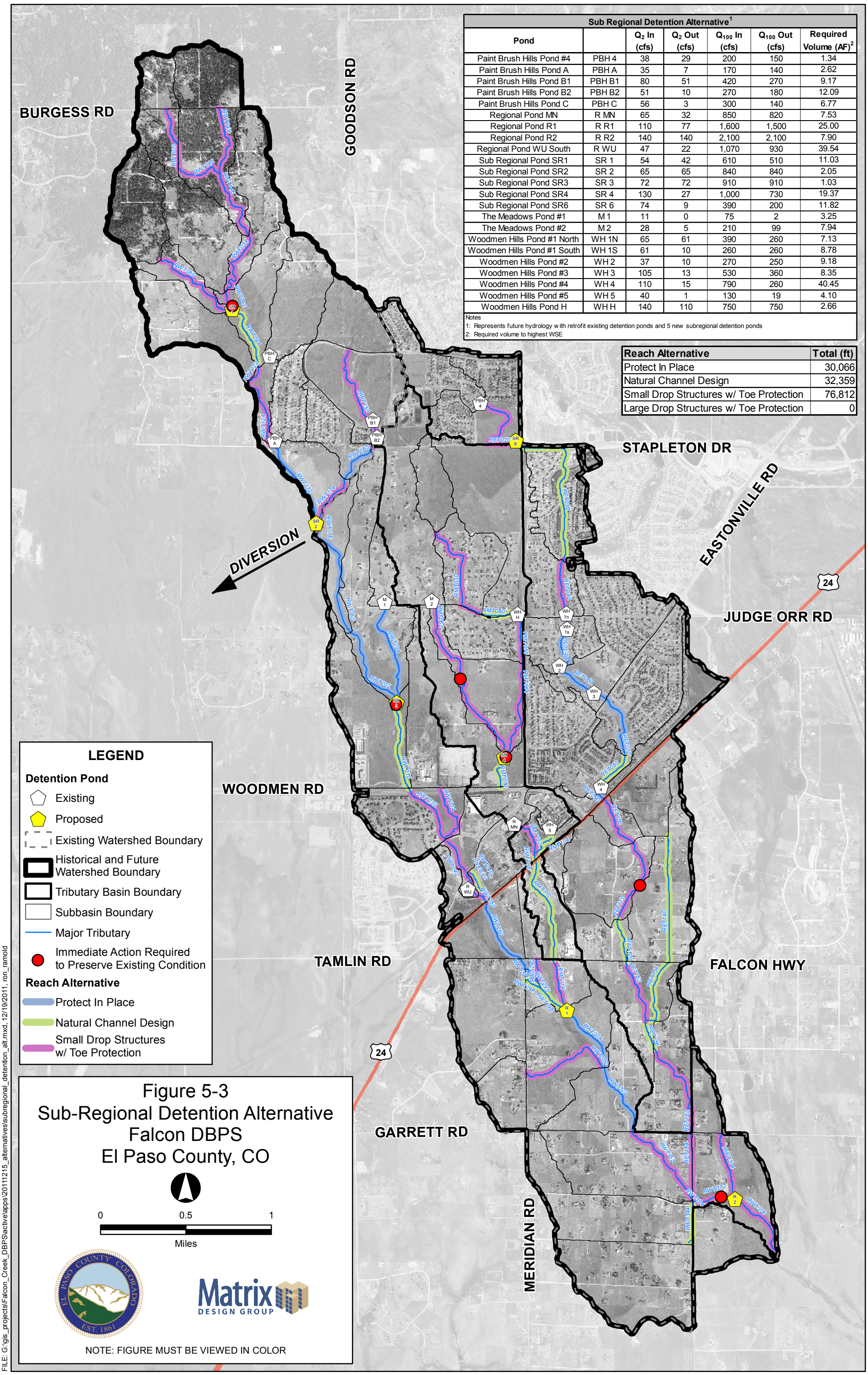
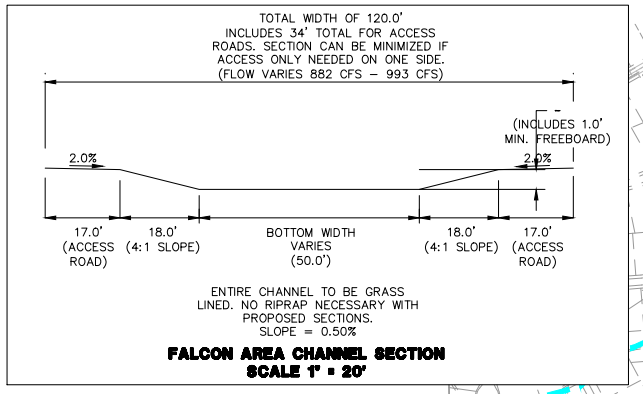


Figure 5-3
Sub-Regional Detention Alternative
Falcon DBPS
El Paso County, CO

Sub Regional Detention Alternative[1]						
Pond		Q_2 In (cfs)	Q_2 Out (cfs)	Q_{100} In (cfs)	Q_{100} Out (cfs)	Required Volume (AF)[2]
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,100	2,100	7.90
Regional Pond WU South	R WU	47	22	1,070	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	75	2	3.25
The Meadows Pond #2	M 2	28	5	210	99	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	105	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	19	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes
1: Represents future hydrology with retrofit existing detention ponds and 5 new subregional detention ponds
2: Required volume to highest WSE

Reach Alternative	Total (ft)
Protect In Place	30,066
Natural Channel Design	32,359
Small Drop Structures w/ Toe Protection	76,812
Large Drop Structures w/ Toe Protection	0



FALCON AREA CHANNEL SECTION
SCALE 1" = 20'

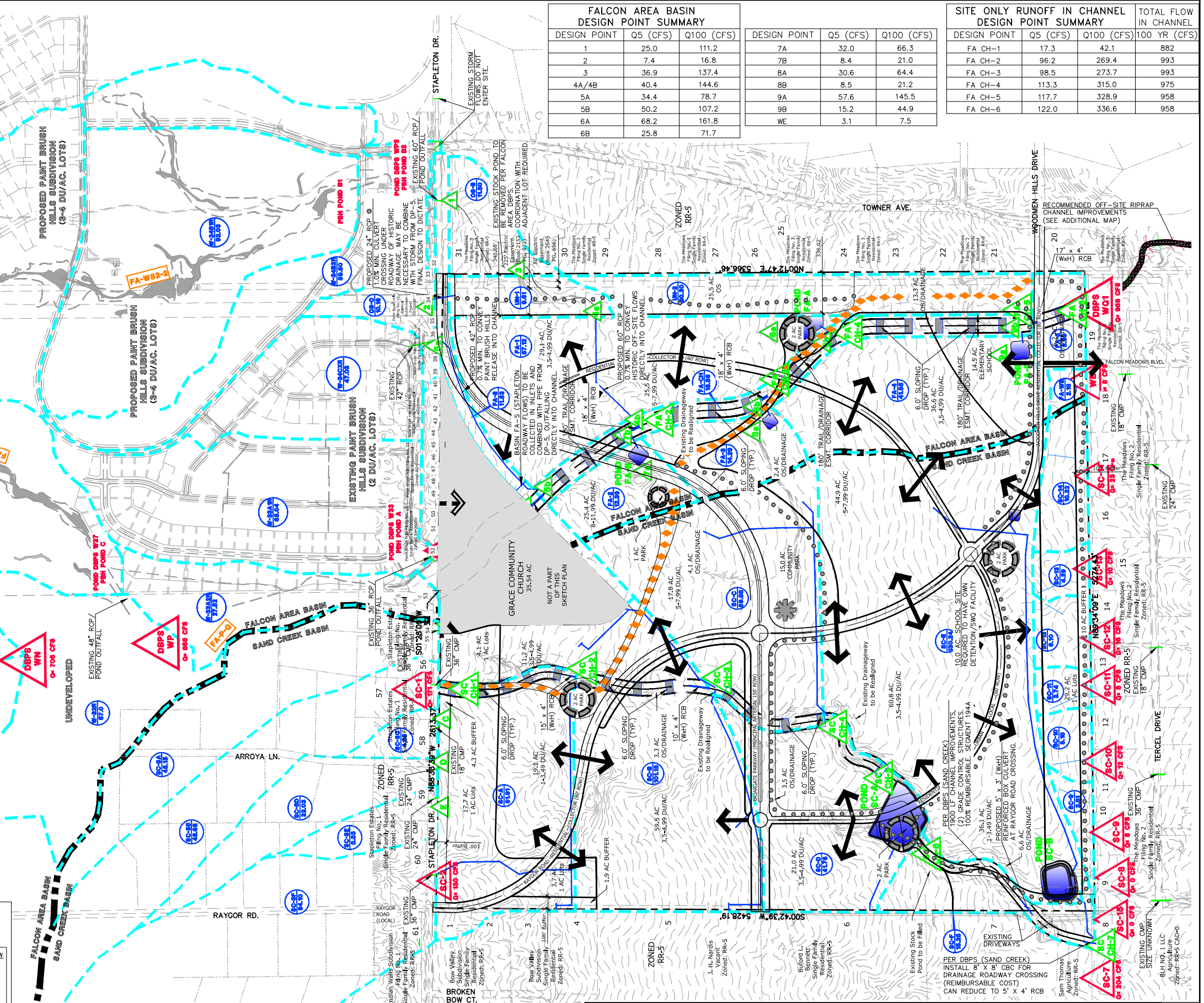
400 200 0 400 800

SCALE: 1" = 400'

FALCON AREA BASIN DESIGN POINT SUMMARY		
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	25.0	111.2
2	7.4	16.8
3	36.9	137.4
4A/4B	40.4	144.6
5A	34.4	78.7
5B	50.2	107.2
6A	68.2	161.8
6B	25.8	71.7

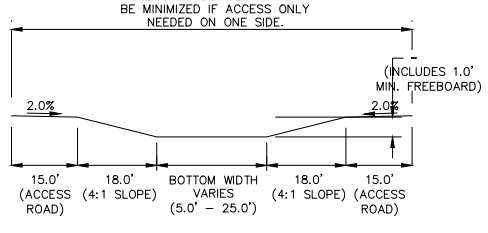
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
7A	32.0	66.3
7B	8.4	21.0
8A	30.6	64.4
8B	8.5	21.2
9A	57.6	145.5
9B	15.2	44.9
WE	3.1	7.5

SITE ONLY RUNOFF IN CHANNEL DESIGN POINT SUMMARY			TOTAL FLOW IN CHANNEL
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	100 YR (CFS)
FA CH–1	17.3	42.1	882
FA CH–2	96.2	269.4	993
FA CH–3	98.5	273.7	993
FA CH–4	113.3	315.0	975
FA CH–5	117.7	328.9	958
FA CH–6	122.0	336.6	958



SAND CREEK BASIN DESIGN POINT SUMMARY		
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
SC–1/SC CH–1	27.2	171.4
SC–2	23.3	129.8
SC CH–2	62.2	370.8
SC CH–3	88.8	480.8
SC CH–4	105.4	576.6
SC CH–5	109.5	616.5
SC CH–6	8.2	125.9
SC–7/SC CH–7	16.6	203.8
SC–8	0.0	0.0
SC–9	3.4	8.1
SC–10	5.0	12.0
SC–11	3.3	8.0
SC–12	6.5	15.7
SC–13	4.1	9.9
SC–14	9.6	23.2
SC–15	0.0	0.0

TOTAL WIDTH VARIES (71.0' – 91.0')
INCLUDES 30' TOTAL FOR ACCESS ROADS. SECTION CAN BE MINIMIZED IF ACCESS ONLY NEEDED ON ONE SIDE.



SECTION	BOTTOM W	TOTAL W
CH–1 TO CH–2	5.0'	71.0'
CH–2 TO CH–3	15.0	81.0'
CH–3 TO CH–4	20.0'	86.0'
CH–4 TO CH–5	25.0'	91.0'
CH–5 TO CH–6	15.0'	81.0'

ENTIRE CHANNEL TO BE GRASS LINED. NO RIPRAP NECESSARY WITH PROPOSED SECTIONS.
SLOPE = 0.50%

SAND CREEK CHANNEL SECTIONS
SCALE 1" = 20'

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

CLASSIC CONSULTING
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799(Fax)

THE RANCH

MDDP DRAINAGE MAP
DEVELOPED CONDITIONS

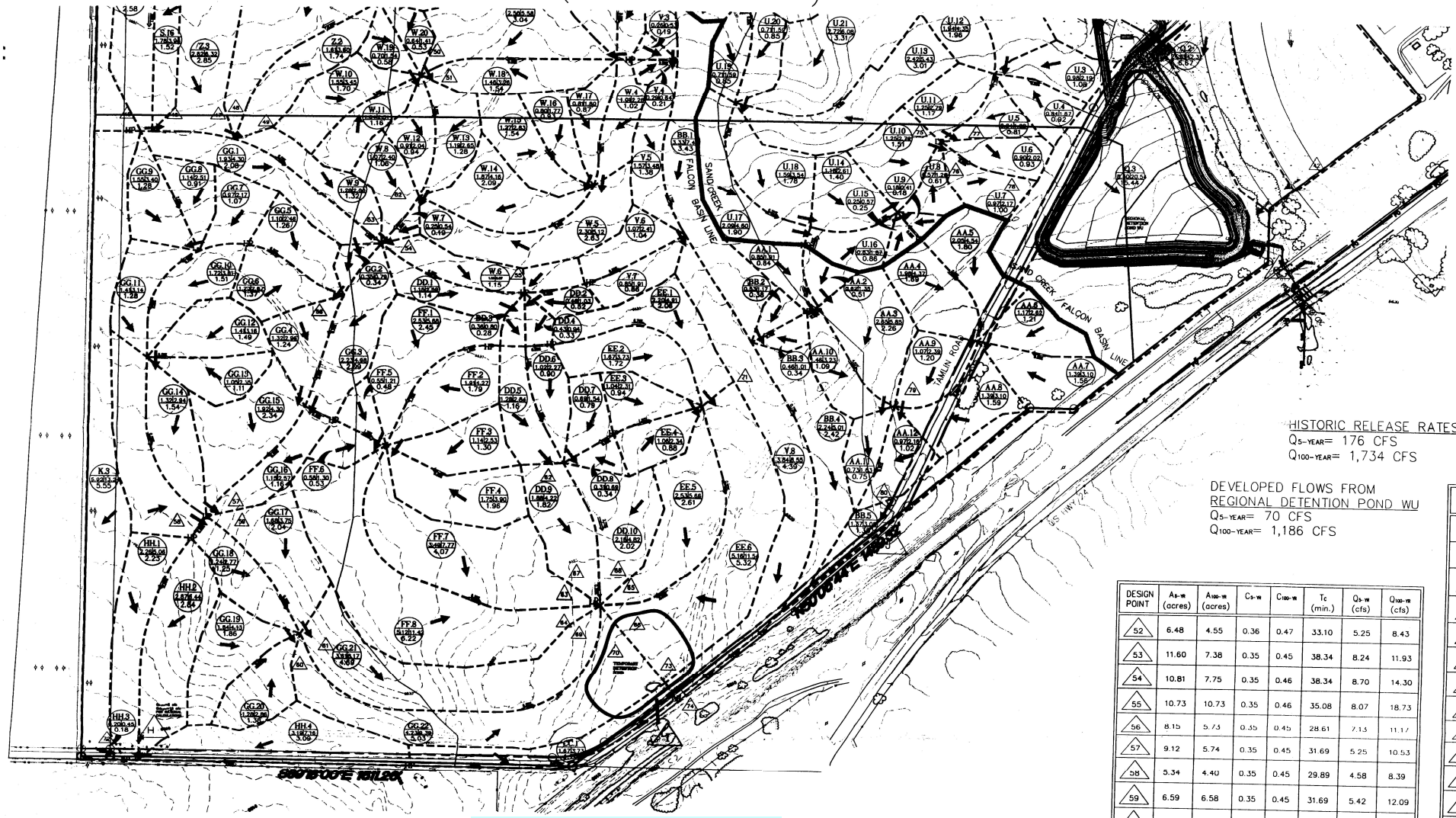
DESIGNED BY	MAL	SCALE	DATE	11/11/18
DRAWN BY	BB	(H) 1"= 400'	SHEET 2	OF 2
CHECKED BY		(V) 1"= N/A	JOB NO.	1182.10

N:\118210\DRAWINGS\DEVELOPMENT\118210-MDDP-DEVELOPED.dwg, 11/12/2018 10:35:18 AM, 1:1

FINAL DRAINAGE
FALCON HIGHL

SHEET 4 OF 4

(SEE SHEET 3)



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HISTORIC RELEASE RATES
$Q_{5\text{-YEAR}}$= 176 CFS
$Q_{100\text{-YEAR}}$= 1,734 CFS

DEVELOPED FLOWS FROM REGIONAL DETENTION POND WU
$Q_{5\text{-YEAR}}$= 70 CFS
$Q_{100\text{-YEAR}}$= 1,186 CFS

DEVELOPED FLOWS FROM TEMP. DETENTION POND
$Q_{5\text{-YEAR}}$= 49.70 CFS
$Q_{100\text{-YEAR}}$= 126.74 CFS

HISTORIC RELEASE RATES
$Q_{5\text{-YEAR}}$= 64.50 CFS
$Q_{100\text{-YEAR}}$= 159.70 CFS

DESIGN POINT	$A_{5\text{-YR}}$ (acres)	$A_{100\text{-YR}}$ (acres)	$C_{5\text{-YR}}$	$C_{100\text{-YR}}$	Tc (min.)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
52	6.48	4.55	0.36	0.47	33.10	5.25	8.43
53	11.60	7.38	0.35	0.45	38.34	8.24	11.93
54	10.81	7.75	0.35	0.46	38.34	8.70	14.30
55	10.73	10.73	0.35	0.46	35.08	8.07	18.73
56	8.15	5.73	0.35	0.45	28.61	7.13	11.17
57	9.12	5.74	0.35	0.45	31.69	5.25	10.53
58	5.34	4.40	0.35	0.45	29.89	4.58	8.39
59	6.59	6.58	0.35	0.45	31.69	5.42	12.09
60	6.67	6.57	0.35	0.45	33.52	5.25	11.64
61	6.46	6.37	0.35	0.45	33.52	5.09	11.64
62	6.14	3.97	0.35	0.46	28.11	6.08	9.01
63	6.58	6.58	0.35	0.45	32.94	5.30	11.87
64	6.58	6.58	0.35	0.45	32.94	5.30	11.87
65	4.91	3.11	0.35	0.45	24.03	4.66	6.59
66	4.80	3.07	0.35	0.45	24.03	4.53	6.51

DESIGN POINT	$A_{5\text{-YR}}$ (acres)	$A_{100\text{-YR}}$ (acres)
67	5.30	5.24
68	5.24	5.24
69	16.51	16.51
70	16.51	16.51
71	7.99	5.79
72	8.34	8.34
73	21.57	21.57
74	21.57	21.57
75	17.68	17.63
76	6.11	6.19
77	6.11	6.19
78	7.39	7.39
79	7.30	7.30
80	8.23	8.23

URS
9960 FE
COLORAD
(719) 53

FIGURE

APPENDIX B

Hydrologic Computations

COMPOSITE % IMPERVIOUS CALCULATIONS: PROPOSED

Subdivision: Bent Grass
Location: CO, Colorado Springs

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
		Paved/Gravel Roads			Lawns/Undeveloped			Roofs			Residential - 1/8 Acre			Residential - 1/4 Acre			Residential - 1/3 Acre			Residential - 1/2 Acre			Residential - 1 Acre			Basins Total
Basin ID	Total Area (ac)	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	Weighted % Imp.
A-1	2.96	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	1.22	26.8	40	0.68	9.2	30	0.00	0.0	25	0.00	0.0	20	1.06	7.2	43.2
A-2	1.37	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.39	18.6	40	0.56	16.4	30	0.00	0.0	25	0.00	0.0	20	0.42	6.1	41.1
A-3	1.57	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.59	24.4	40	0.98	25.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	49.4
A-4	2.43	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.93	25.0	40	0.88	14.5	30	0.00	0.0	25	0.00	0.0	20	0.62	5.1	44.6
B-1	4.83	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	2.28	30.7	40	1.49	12.3	30	0.00	0.0	25	0.00	0.0	20	1.07	4.4	47.4
B-2	1.16	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	1.16	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-3	0.46	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.46	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-4	2.12	100	0.00	0.0	2	2.12	2.0	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
B-5	1.22	100	0.00	0.0	2	1.22	2.0	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-1	1.35	100	0.03	2.1	2	0.16	0.2	90	0.00	0.0	65.0	1.16	55.9	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	58.2
C-2	5.96	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	2.08	22.7	40	2.39	16.0	30	0.99	5.0	25	0.50	2.1	20	0.00	0.0	45.8
C-3	2.38	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	1.61	44.0	40	0.77	12.9	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	56.9
C-4	3.61	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	2.86	51.4	40	0.75	8.4	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	59.8
C-5	7.86	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	6.53	54.0	40	1.33	6.8	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	60.8
C-6	4.82	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	2.63	35.5	40	1.66	13.8	30	0.53	3.3	25	0.00	0.0	20	0.00	0.0	52.6
C-7	2.00	100	0.00	0.0	2	0.38	0.4	90	0.00	0.0	65.0	0.26	8.5	40	0.50	10.0	30	0.55	8.3	25	0.31	3.9	20	0.00	0.0	31.1
D-1	14.44	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	3.65	16.4	40	7.48	20.7	30	0.75	1.6	25	0.00	0.0	20	2.56	3.5	42.2
D-2	3.52	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	1.63	30.1	40	1.24	14.1	30	0.00	0.0	25	0.00	0.0	20	0.65	3.7	47.9
D-3	9.16	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.82	5.8	40	5.88	25.7	30	1.86	6.1	25	0.60	1.6	20	0.00	0.0	39.2
D-4	9.65	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.00	0.0	40	1.00	4.1	30	5.94	18.5	25	1.63	4.2	20	1.08	2.2	29.0
E-1	1.64	100	0.71	43.3	2	0.23	0.3	90	0.00	0.0	65.0	0.00	0.0	40	0.70	17.1	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	60.7
E-2	0.63	100	0.51	81.0	2	0.12	0.4	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	81.4
E-3	0.78	100	0.69	88.5	2	0.09	0.2	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	88.7
E-4	0.91	100	0.73	80.2	2	0.18	0.4	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	80.6
E-5	0.89	100	0.79	88.8	2	0.10	0.2	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	89.0
F-1	0.46	100	0.00	0.0	2	0.00	0.0	90	0.00	0.0	65.0	0.00	0.0	40	0.43	37.4	30	0.00	0.0	25	0.00	0.0	20	0.03	1.3	38.7
F-2	0.62	100	0.28	45.2	2	0.11	0.4	90	0.00	0.0	65.0	0.23	24.1	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	69.7
G-1	3.01	100	0.00	0.0	2	0.63	0.4	90	0.00	0.0	65.0	0.60	13.0	40	0.60	7.9	30	0.36	3.6	25	0.82	6.8	20	0.00	0.0	31.7
H-1	0.31	100	0.22	71.0	2	0.09	0.6	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	71.6
OS-1	10.35	100	0.43	4.1	2	9.60	1.9	90	0.32	2.8	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	8.8
OS-2	1.60	100	0.31	19.3	2	0.00	0.0	90	0.08	4.6	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	23.9
OS-3	1.08	100	0.00	0.0	2	1.08	2.0	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
OS-4	6.05	100	0.71	11.7	2	5.25	1.7	90	0.10	1.5	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	14.9
OS-5	13.28	100	0.70	5.3	2	12.20	1.8	90	0.38	2.6	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	9.7
OS-6	7.52	80	0.69	7.3	2	6.61	1.8	90	0.22	2.6	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	11.7
OS-7	2.25	80	0.00	0.0	2	2.21	2.0	90	0.04	1.6	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	3.6
OS-8	20.08	80	0.90	3.6	2	18.62	1.9	90	0.56	2.5	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	8.0
OS-9	10.62	80	0.48	3.6	2	9.84	1.9	90	0.30	2.5	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	8.0
OS-10	2.64	100	0.00	0.0	2	2.64	2.0	90	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0

Lot Type Identification:

Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
% Impervious values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS: PROPOSED

Subdivision: Bent Grass
Location: CO, Colorado Springs

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Basin ID	Total Area (ac)	Paved/Gravel Roads			Lawns/Undeveloped			Roofs			Residential - 1/8 Acre			Residential - 1/4 Acre			Residential - 1/3 Acre			Residential - 1/2 Acre			Residential - 1 Acre			Composite C_5	Composite C_{100}
		C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)		
A-1	2.96	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.22	0.30	0.50	0.68	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	1.06	0.33	0.52
A-2	1.37	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.39	0.30	0.50	0.56	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.42	0.31	0.51
A-3	1.57	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.59	0.30	0.50	0.98	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.36	0.53
A-4	2.43	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.93	0.30	0.50	0.88	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.62	0.33	0.52
B-1	4.83	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.28	0.30	0.50	1.49	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	1.07	0.35	0.53
B-2	1.16	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.16	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-3	0.46	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.46	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-4	2.12	0.90	0.96	0.00	0.09	0.36	2.12	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
B-5	1.22	0.90	0.96	0.00	0.09	0.36	1.22	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-1	1.35	0.90	0.96	0.03	0.09	0.36	0.16	0.73	0.81	0.00	0.45	0.59	1.16	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.42	0.57
C-2	5.96	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.08	0.30	0.50	2.39	0.25	0.47	0.99	0.22	0.46	0.50	0.20	0.44	0.00	0.34	0.52
C-3	2.38	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.61	0.30	0.50	0.77	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.40	0.56
C-4	3.61	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.86	0.30	0.50	0.75	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.42	0.57
C-5	7.86	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	6.53	0.30	0.50	1.33	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.42	0.57
C-6	4.82	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.63	0.30	0.50	1.66	0.25	0.47	0.53	0.22	0.46	0.00	0.20	0.44	0.00	0.38	0.55
C-7	2.00	0.90	0.96	0.00	0.09	0.36	0.38	0.73	0.81	0.00	0.45	0.59	0.26	0.30	0.50	0.50	0.25	0.47	0.55	0.22	0.46	0.31	0.20	0.44	0.00	0.25	0.47
D-1	14.44	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.65	0.30	0.50	7.48	0.25	0.47	0.75	0.22	0.46	0.00	0.20	0.44	2.56	0.32	0.51
D-2	3.52	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.63	0.30	0.50	1.24	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.65	0.35	0.53
D-3	9.16	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.82	0.30	0.50	5.88	0.25	0.47	1.86	0.22	0.46	0.60	0.20	0.44	0.00	0.30	0.50
D-4	9.65	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	1.00	0.25	0.47	5.94	0.22	0.46	1.63	0.20	0.44	1.08	0.24	0.47
E-1	1.64	0.90	0.96	0.71	0.09	0.36	0.23	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.70	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.53	0.68
E-2	0.63	0.90	0.96	0.51	0.09	0.36	0.12	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.75	0.85
E-3	0.78	0.90	0.96	0.69	0.09	0.36	0.09	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.81	0.89
E-4	0.91	0.90	0.96	0.73	0.09	0.36	0.18	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.74	0.84
E-5	0.89	0.90	0.96	0.79	0.09	0.36	0.10	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.81	0.89
F-1	0.46	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.43	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.03	0.29	0.50
F-2	0.62	0.90	0.96	0.28	0.09	0.36	0.11	0.73	0.81	0.00	0.45	0.59	0.23	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.59	0.72
G-1	3.01	0.90	0.96	0.00	0.09	0.36	0.63	0.73	0.81	0.00	0.45	0.59	0.60	0.30	0.50	0.60	0.25	0.47	0.36	0.22	0.46	0.82	0.20	0.44	0.00	0.26	0.47
H-1	0.31	0.90	0.96	0.22	0.09	0.36	0.09	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.66	0.79
OS-1	10.35	0.90	0.96	0.43	0.09	0.36	9.60	0.73	0.81	0.32	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.40
OS-2	1.60	0.90	0.96	0.31	0.09	0.36	0.00	0.73	0.81	0.08	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.21	0.23
OS-3	1.08	0.90	0.96	0.00	0.09	0.36	1.08	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
OS-4	6.05	0.90	0.96	0.71	0.09	0.36	5.25	0.73	0.81	0.10	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.19	0.44
OS-5	13.28	0.90	0.96	0.70	0.09	0.36	12.20	0.73	0.81	0.38	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.15	0.40
OS-6	7.52	0.90	0.96	0.69	0.09	0.36	6.61	0.73	0.81	0.22	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.18	0.43
OS-7	2.25	0.90	0.96	0.00	0.09	0.36	2.21	0.73	0.81	0.04	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.10	0.37
OS-8	20.08	0.90	0.96	0.90	0.09	0.36	18.62	0.73	0.81	0.56	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.40
OS-9	10.62	0.90	0.96	0.48	0.09	0.36	9.84	0.73	0.81	0.30	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.40
OS-10	2.64	0.90	0.96	0.00	0.09	0.36	2.64	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	<= 1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
C values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)
Coeffficients use HSG A&B soils - Refer to "Appendix A: Exhibits and Figures" for soil map

STANDARD FORM SF-2: PROPOSED
TIME OF CONCENTRATION

Subdivision: Bent Grass
Location: CO, Colorado Springs

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					Tc CHECK			
DATA						(T_i)			(T_t)					(URBANIZED BASINS)			FINAL
BASIN ID	D.A. (AC)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	Cv	VEL. (FPS)	T_t (MIN)	COMP. T_c (MIN)	TOTAL LENGTH(FT)	Urbanized T_c (MIN)	T_c (MIN)
A-1	2.96	A	43.2	0.33	0.52	100	1.3	12.8	550	1.3	20	2.3	4.0	16.8	650.0	13.6	13.6
A-2	1.37	A	41.1	0.31	0.51	100	4.3	8.9	310	2.3	20	3.0	1.7	10.6	410.0	12.3	10.6
A-3	1.57	A	49.4	0.36	0.53	70	1.0	11.3	680	1.2	20	2.2	5.2	16.5	750.0	14.2	14.2
A-4	2.43	A	44.6	0.33	0.52	100	4.2	8.7	650	1.7	20	2.6	4.2	12.9	750.0	14.2	12.9
B-1	4.83	A	47.4	0.35	0.53	100	2.0	10.9	910	1.2	20	2.2	6.9	17.8	1010.0	15.6	15.6
B-2	1.17	A	65.0	0.45	0.59	85	0.2	18.7	430	0.9	20	1.9	3.9	22.6	515.0	12.9	12.9
B-3	0.46	A	65.0	0.45	0.59	15	2.0	3.7	190	1.0	20	2.0	1.6	5.2	205.0	11.1	5.2
B-4	2.12	A	2.0	0.09	0.36	300	2.7	22.9	690	2.7	15	2.5	4.6	27.6	990.0	15.5	15.5
B-5	1.22	A	2.0	0.09	0.36	200	2.7	18.8	100	2.7	15	2.5	0.7	19.5	300.0	11.7	11.7
C-1	1.35	A	58.2	0.42	0.57	35	2.4	5.5	400	2.4	20	3.1	2.2	7.7	435.0	12.4	7.7
C-2	5.96	A	45.8	0.34	0.52	100	2.0	11.0	1770	1.5	20	2.4	12.0	23.1	1870.0	20.4	20.4
C-3	2.38	A	56.9	0.40	0.56	100	1.6	11.0	810	1.0	20	2.0	6.8	17.7	910.0	15.1	15.1
C-4	3.61	A	59.8	0.42	0.57	100	2.0	9.9	973	2.0	20	2.8	5.7	15.6	1073.0	16.0	15.6
C-5	7.86	A	60.8	0.42	0.57	100	2.0	9.9	1200	1.3	20	2.2	8.9	18.8	1300.0	17.2	17.2
C-6	4.82	A	52.6	0.38	0.55	100	3.0	9.1	1230	1.5	20	2.4	8.4	17.5	1330.0	17.4	17.4
C-7	2.00	A	31.1	0.25	0.47	100	2.5	11.5	170	2.5	15	2.4	1.2	12.7	270.0	11.5	11.5
D-1	14.44	A	42.2	0.32	0.51	100	1.0	14.3	1180	2.0	20	2.8	7.0	21.2	1280.0	17.1	17.1
D-2	3.52	A	47.9	0.35	0.53	100	1.0	13.7	1000	2.0	20	2.8	5.9	19.6	1100.0	16.1	16.1
D-3	9.16	A	39.2	0.30	0.50	90	1.5	12.1	1020	1.5	20	2.4	6.9	19.1	1110.0	16.2	16.2
D-4	9.65	A	29.0	0.24	0.47	100	1.5	13.8	1700	1.5	20	2.4	11.6	25.3	1800.0	20.0	20.0
E-1	1.69	A	60.7	0.53	0.68	25	2.0	4.1	940	1.0	20	2.0	7.8	12.0	965.0	15.4	12.0
E-2	0.63	A	81.4	0.75	0.85	25	2.0	2.5	665	1.6	20	2.5	4.4	6.9	690.0	13.8	6.9
E-3	0.78	A	88.7	0.81	0.89	25	2.0	2.1	632	1.0	20	2.0	5.3	7.4	657.0	13.7	7.4
E-4	0.91	A	80.6	0.74	0.84	25	2.0	2.6	913	2.0	20	2.8	5.4	8.0	938.0	15.2	8.0
E-5	0.89	A	89.0	0.81	0.89	25	2.0	2.1	903	2.1	20	2.9	5.2	7.3	928.0	15.2	7.3
F-1	0.46	A	38.7	0.29	0.50	66	2.5	8.9	-	-	15	10.4	0.1	9.0	66.0	10.4	9.0
F-2	0.62	A	69.7	0.59	0.72	25	2.0	3.7	464	4.0	20	4.0	1.9	5.6	489.0	12.7	5.6
G-1	3.01	A	31.7	0.26	0.47	100	3.5	10.1	109	3.5	15	2.8	0.6	10.8	209.0	11.2	10.8
H-1	0.31	A	71.6	0.66	0.79	25	2.0	3.2	135	2.0	20	2.8	0.8	4.0	160.0	10.9	5.0
OS-1	10.35	A	8.8	0.14	0.40	100	2.4	13.2	1600	2.4	15	2.3	11.5	24.7	1700.0	19.4	19.4
OS-2	1.60	A	23.9	0.21	0.23	100	2.2	12.5	950	2.2	15	2.2	7.1	19.6	1050.0	15.8	15.8
OS-3	1.08	A	2.0	0.09	0.36	100	2.2	14.2	450	2.2	15	2.2	3.4	17.6	550.0	13.1	13.1
OS-4	6.05	A	14.9	0.19	0.44	100	2.2	12.8	1200	2.2	15	2.2	9.0	21.8	1300.0	17.2	17.2
OS-5	13.28	A	9.7	0.15	0.40	100	2.2	13.4	2100	2.2	15	2.2	15.7	29.1	2200.0	22.2	22.2
OS-6	7.52	A	11.7	0.18	0.43	100	2.1	13.2	1000	2.3	15	2.3	7.3	20.5	1100.0	16.1	16.1
OS-7	2.25	A	3.6	0.10	0.37	100	2.2	14.1	900	2.2	15	2.2	6.7	20.8	1000.0	15.6	15.6
OS-8	20.08	A	8.0	0.14	0.40	100	2.3	13.3	1400	2.3	15	2.3	10.3	23.6	1500.0	18.3	18.3
OS-9	10.62	A	8.0	0.14	0.40	100	2.0	14.0	1500	2.0	15	2.1	11.8	25.7	1600.0	18.9	18.9
OS-10	2.64	A	2.0	0.09	0.36	100	2.0	14.7	400	2.0	15	2.1	3.1	17.8	500.0	12.8	12.8

NOTES:

T_i = (0.395*(1.1 - C_5)*(L)^0.5)/((S)^0.33), S in ft/ft

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

Tc Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 5-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	1	OS-1	10.35	0.14	19.4	1.45	3.13	4.5					1.3	4.5				650	2.3	4.7	
	1	A-1	2.96	0.33	13.6	0.98	3.67	3.6													
	1								24.2	2.43	2.81	6.8	1	6.8				160	2.0	1.3	Total flow on North side of Niebrara Drive
	2	OS-2	1.60	0.21	15.8	0.34	3.44	1.2					2.3	1.2				700	3.0	3.8	
	2	A-2	1.37	0.31	10.6	0.42	4.04	1.7													
	2								19.7	0.76	3.11	2.4									Total flow at NE corner of Niebrara Dr. & Berwyn Ct.
	2								25.5	3.19	2.73	8.7	1.5	8.7				300	2.4	2.0	Total flow at DP-2
	3	A-3	1.57	0.36	14.2	0.57	3.61	2.1													
	3								27.5	3.76	2.61	9.8	1.4	9.8				60	2.4	0.4	Total flow at NE corner of Bent Grass M.D. & Berwyn Ct.
	4	OS-3	1.08	0.09	13.1	0.10	3.73	0.4					1.8	0.4				680	2.7	4.2	
	4	A-4	2.43	0.33	12.9	0.80	3.75	3.0													
	4								17.3	0.90	3.31	3.0									Total flow at NW corner of Bent Grass M.D. & Berwyn Ct.
	4								28.0	4.66	2.59	12.1	1.0	12.1				840	2.0	7.0	Total flow entering Bent Grass M.D. from Berwyn Ct.
	5	D-2	3.52	0.35	16.1	1.23	3.41	4.2							4.2						Future total flow captured by inlet = 4.2 cfs
	6	D-1	14.44	0.32	17.1	4.62	3.32	15.3					1.1	1.0	14.3						Future total flow by-passing inlet = 1 cfs Future total flow captured by inlet = 14.3 cfs
	6								17.1	0.31	3.32	1.0	1.0	1.0				430	2.0	3.6	Future total flow entering Bent Grass M.D. = 1 cfs // Routed to inlet at DP-8
	7							4.0							4.0						Total flow entering FES from RWT204 then piped to DP-8
	8	E-2	0.63	0.75	6.9	0.47	4.68	2.2													
	8-W								20.7	0.78	3.04	2.4									Total flow approaching DP-8 from the West
	8	E-1	1.69	0.53	12.0	0.90	3.86	3.5													
	8-E								35.0	5.56	2.25	12.5									Total flow approaching DP-8 from the East
	8								35.0	6.34	2.25	14.3			14.3						Total flow captured by inlet = 14.3 cfs
	8														18.3						Total flow at DP-8 = 18.3 cfs // Piped to inlet at DP-9
	9	E-3	0.78	0.81	7.4	0.63	4.59	2.9							2.9						Total flow captured by inlet = 2.9 cfs
	9														21.2						Total flow at DP-9 = 21.2 cfs // Piped to outfall into RWT204

STANDARD FORM SF-3: PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 5-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	10	B-3	0.46	0.45	5.2	0.21	5.10	1.1					2.5	1.1				350	3.2	1.8	Total flow at the west point of Silky Thread Rd.
	10	B-4	2.12	0.09	15.5	0.19	3.47	0.7													
	10								15.5	0.40	3.47	1.4									Total flow entering existing channel (RWT204) from temp. swale
	11	OS-4	6.05	0.19	17.2	1.15	3.31	3.8					1.2	3.8				910	2.2	6.9	
	11	B-1	4.83	0.35	15.6	1.69	3.46	5.8													
	11								24.1	2.84	2.81	8.0									Total flow on North side of Willmore Dr.
	12	B-2	1.17	0.45	12.9	0.53	3.75	2.0													Total flow on South side of Willmore Dr.
	13								24.1	3.37	2.81	9.5	2.5	9.5				200	3.2	1.1	Total flow going West off of Willmore Dr. into temporary swale
	14	B-5	1.22	0.09	11.7	0.11	3.90	0.4													Total flow sheet flowing from Basin B-4 to temporary swale
	14								25.2	3.48	2.74	9.5									Total flow entering existing channel (RWT204) from temp. swale
	15	C-5	7.86	0.42	17.2	3.30	3.31	10.9					1.0	1.1	9.8			150	2.0	1.3	Total flow by-passing inlet = 1.1 cfs Total flow at DP-15 = 9.8 cfs // Piped to inlet at DP-16
	16	C-6	4.82	0.38	17.4	1.83	3.30	6.0					1	0.7	5.3			150	2.0	1.3	Total flow by-passing inlet = 0.7 cfs Total flow captured by inlet = 5.3 cfs
	16								17.4	4.57	3.30	15.1			15.1						Total flow at DP-16 = 15.1 cfs // Piped to inlet at DP-18
	17	C-4	3.61	0.42	15.6	1.52	3.46	5.3													
	17								18.5	1.86	3.21	6.0									Total flow approaching DP-17 from the NW
	17	C-3	2.38	0.40	15.1	0.95	3.52	3.3													Total flow approaching DP-17 from the SE
	17								18.5	2.81	3.21	9.0			9.0						Total flow at DP-17 = 9 cfs // Piped to inlet at DP-18
	18	C-1	1.35	0.42	7.7	0.57	4.52	2.6					1.5	2.6				1400	2.4	9.5	
	18	C-2	5.96	0.34	20.4	2.03	3.06	6.2													
	18								20.4	2.60	3.06	8.0									Total flow approaching DP-18 from the SE
	18								20.4	2.82	3.06	8.6			8.6						Total flow captured by inlet = 8.6 cfs
	18								20.4	10.20	3.06	31.2			31.2						Total flow at DP-18 = 31.2 cfs // Piped to outfall into RWT210

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 5-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	19	D-3	9.16	0.30	16.2	2.75	3.41	9.4							9.4						Total flow at DP-19 = 9.4 cfs // Piped to inlet at DP-20
	20	OS-8	20.08	0.14	18.3	2.81	3.22	9.0					1.5	9.0				1800	2.4	12.2	
	20	D-4	9.65	0.24	20.0	2.32	3.09	7.2													
	20								30.6	5.13	2.45	12.6		0.3	12.3						Total flow by-passing inlet = 0.3 cfs Total flow captured by inlet = 12.3 cfs
	20								30.6	7.77	2.45	19.0			19.0						Total flow at DP-20 = 19 cfs // Piped to inlet at DP-21
	20								30.6	0.11	2.45	0.3	2.5	0.3				550	3.2	2.9	Total flow entering Bent Grass M.D. from DP-19&20
	21	OS-9	10.62	0.14	18.9	1.49	3.18	4.7					2	4.7				470	2.8	2.8	
	21								21.7	1.49	2.97	4.4			4.4						Total flow captured by area inlet = 4.4 cfs
	21								30.6	9.26	2.45	22.7			22.7	2.0		600	2.8	3.5	Total flow at DP-21 = 22.7 cfs // Piped under Bent Grass M.D. into swale
	22	E-4	0.91	0.74	8.0	0.67	4.46	3.0													
	22	OS-10	2.64	0.09	12.8	0.24	3.76	0.9					2.8	0.9				150	3.3	0.7	
	22								33.5	1.02	2.32	2.4			2.4						Total flow at DP-22 = 2.4 cfs // Piped to inlet at DP-23
	23	E-5	0.89	0.81	7.3	0.72	4.60	3.3							3.3						Total flow captured by inlet = 3.3 cfs
	23								33.5	1.74	2.32	4.0			4.0						Total flow at DP-23 = 4 cfs // Piped to outfall at DP-24
	24								33.5	11.00	2.32	25.5			25.5						Total flow at DP-24 = 25.5 cfs // Routed to RWT204

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 100-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	1	OS-1	10.35	0.40	19.4	4.14	5.26	21.8					1.3	21.8				650	2.3	4.7	
	1	A-1	2.96	0.52	13.6	1.54	6.16	9.5													
	1								24.2	5.68	4.71	26.8	1	26.8				160	2.0	1.3	Total flow on North side of Niebrara Drive
	2	OS-2	1.60	0.23	15.8	0.37	5.77	2.1					2.3	2.1				700	3.0	3.8	
	2	A-2	1.37	0.51	10.6	0.70	6.79	4.8													
	2								19.7	1.07	5.23	5.6									Total flow at NE corner of Niebrara Dr. & Berwyn Ct.
	2								25.5	6.75	4.57	30.8	1.5	30.8				300	2.4	2.0	Total flow at DP-2
	3	A-3	1.57	0.53	14.2	0.83	6.05	5.0													
	3								27.5	7.58	4.38	33.2	1.4	33.2				60	2.4	0.4	Total flow at NE corner of Bent Grass M.D. & Berwyn Ct.
	4	OS-3	1.08	0.36	13.1	0.39	6.26	2.4					1.8	2.4				680	2.7	4.2	
	4	A-4	2.43	0.52	12.9	1.26	6.29	7.9													
	4								17.3	1.65	5.55	9.2									Total flow at NW corner of Bent Grass M.D. & Berwyn Ct.
	4								28.0	9.23	4.34	40.1	1.0	40.1				840	2.0	7.0	Total flow entering Bent Grass M.D. from Berwyn Ct.
	5	D-2	3.52	0.53	16.1	1.87	5.73	10.7													Total flow at DP-5
	6	D-1	14.44	0.51	17.1	7.36	5.58	41.1					1.1	21.9	19.2						Total flow at DP-6
	5&6								17.1	9.23	5.58	51.5 25.8									Q at each inlet = 25.8 cfs
	5								17.1	4.62	5.58	25.8	1.1	10.1	15.7			60	2.1	0.5	Future total flow by-passing inlet = 10.1 cfs Future total flow captured by inlet = 15.7 cfs
	6								17.1	4.62	5.58	25.8	1.0	6.0	19.8						Future total flow by-passing inlet = 6 cfs Future total flow captured by inlet = 19.8 cfs
	6								17.6	2.87	5.51	15.8	1	15.8				430	2.0	3.6	Future total flow entering Bent Grass M.D. = 15.8 cfs // Routed to inlet at DP-8
	7							43.0							43.0						Total flow entering FES from RWT204 then piped to DP 8
	8	E-2	0.63	0.85	6.9	0.54	7.86	4.2													
	8-W								21.2	3.41	5.04	17.2									Total flow approaching DP-8 from the West
	8	E-1	1.69	0.68	12.0	1.15	6.48	7.5													
	8-E								35.0	10.38	3.78	39.2									Total flow approaching DP-8 from the East
	8								35.0	13.79	3.78	52.1									Total flow at DP-8 along North side of Bent Grass M.D
	9	E-3	0.78	0.89	7.4	0.69	7.70	5.3													Total flow at DP-9 along South side of Bent Grass M.D.
	8&9								35.0	14.48	3.78	54.7 27.4									Total flow at DP-8&9 Q at each inlet = 27.4 cfs
	8														27.4						Total flow captured by inlet = 27.4 cfs
	8														70.4						Total flow at DP-8 = 70.4 cfs // Piped to inlet at DP-9

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 100-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	9														27.4						Total flow captured by inlet = 27.4 cfs
	9														97.7						Total flow at DP-9 = 97.7 cfs // Piped to outfall into RWT204
	10	B-3	0.46	0.59	5.2	0.27	8.56	2.3					2.5	2.3				350	3.2	1.8	Total flow at the west point of Silky Thread Rd.
	10	B-4	2.12	0.36	15.5	0.76	5.83	4.4													
	10								15.5	1.03	5.83	6.0									Total flow entering existing channel (RWT204) from temp. swale
	11	OS-4	6.05	0.44	17.2	2.66	5.56	14.8					1.2	14.8				910	2.2	6.9	
	11	B-1	4.83	0.53	15.6	2.56	5.81	14.9													
	11								24.1	5.22	4.71	24.6									Total flow on North side of Willmore Dr.
	12	B-2	1.17	0.59	12.9	0.69	6.30	4.3													Total flow on South side of Willmore Dr.
	13								24.1	5.91	4.71	27.8	2.5	27.8				200	3.2	1.1	Total flow going West off of Willmore Dr. into temporary swale
	14	B-5	1.22	0.36	11.7	0.44	6.54	2.9													Total flow sheet flowing from Basin B-4 to temporary swale
	14								25.2	6.35	4.60	29.2									Total flow entering existing channel (RWT204) from temp. swale
	15	C-5	7.86	0.57	17.2	4.48	5.56	24.9					1.0	9.4	15.5			150	2.0	1.3	Total flow by-passing inlet = 9.4 cfs Total flow at DP-15 = 15.5 cfs // Piped to inlet at DP-16
	16	C-6	4.82	0.55	17.4	2.65	5.54	14.7					1	6.1	8.6			150	2.0	1.3	Total flow by-passing inlet = 6.1 cfs Total flow captured by inlet = 8.6 cfs
	16								17.4	4.34	5.54	24.0			24.0						Total flow at DP-16 = 24 cfs // Piped to inlet at DP-18
	17	C-4	3.61	0.57	15.6	2.06	5.81	12.0													
	17								18.5	3.75	5.39	20.2									Total flow approaching DP-17 from the NW
	17	C-3	2.38	0.56	15.1	1.33	5.90	7.8													Total flow approaching DP-17 from the SE
	17								18.5	5.08	5.39	27.4			27.4						Total flow at DP-17 = 27.4 cfs // Piped to inlet at DP-18
	18	C-1	1.35	0.57	7.7	0.77	7.59	5.8					1.5	5.8				1400	2.4	9.5	
	18	C-2	5.96	0.52	20.4	3.10	5.14	15.9													
	18								20.4	3.87	5.14	19.9									Total flow approaching DP-18 from the SE
	18								20.4	4.97	5.14	25.5			25.5						Total flow captured by inlet = 25.5 cfs
	18								20.4	14.39	5.14	74.0			74.0						Total flow at DP-18 = 74 cfs // Piped to outfall into RWT210

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Bent Grass
Location: CO, Colorado Springs
Design Storm: 100-Year

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	19	D-3	9.16	0.50	16.2	4.58	5.72	26.2													Total flow at DP-19
	20	OS-8	20.08	0.40	18.3	8.03	5.41	43.4					1.5	43.4				1800	2.4	12.2	
	20	D-4	9.65	0.47	20.0	4.54	5.19	23.6													
	20								30.6	12.57	4.12	51.8									Total flow at DP-20
	19&20								30.6	17.15	4.12	70.7 35.3									Total flow at DP-19&20 Q at each inlet = 35.3 cfs
	19								30.6	8.58	4.12	35.3	1.25	12.1	23.2			60	2.2	0.4	Total flow by-passing inlet = 12.1 cfs Total flow at DP-19 = 23.2 cfs // Piped to inlet at DP-20
	20								30.6	8.58	4.12	35.3		12.1	23.2						Total flow by-passing inlet = 12.1 cfs Total flow captured by inlet = 23.2 cfs
	20								31.0	5.89	4.08	24.0	2.5	24.0				550	3.2	2.9	Total flow entering Bent Grass M.D. from DP-19&20
	20								30.6	11.26	4.12	46.4			46.4						Total flow at DP-20 = 46.4 cfs // Piped to inlet at DP-21
	21	OS-9	10.62	0.40	18.9	4.25	5.33	22.7					2	22.7				470	2.8	2.8	
	21								21.7	4.25	4.99	21.2			21.2						Total flow captured by area inlet = 21.2 cfs
	21								30.6	15.51	4.12	63.9			63.9	2.0		600	2.8	3.5	Total flow at DP-21 = 63.9 cfs // Piped under Bent Grass M.D. into swale
	22	E-4	0.91	0.84	8.0	0.76	7.50	5.7													
	22	OS-10	2.64	0.36	12.8	0.95	6.31	6.0													
	22								31.0	7.60	4.08	31.0									Total flow at DP-22
	23	E-5	0.89	0.89	7.3	0.79	7.73	6.1													Total flow at DP-23
	22&23								31.0	8.39	4.08	34.2 17.1		0.1	17.0						Total flow at DP-22&23 Q at each inlet = 17.1 cfs
	22								31.0	4.19	4.08	17.1		0.1	17.0						Total flow by-passing inlet = 0.1 cfs Total flow at DP-22 = 17 cfs // Piped to inlet at DP-23
	23								31.0	4.19	4.08	17.1		0.1	17.0						Total flow by-passing inlet = 0.1 cfs Total flow captured by inlet = 17 cfs
	23								31.0	8.33	4.08	34.0			34.0						Total flow at DP-23 = 34 cfs // Piped to outfall at DP-24
	24								34.1	23.85	3.84	91.6			91.6						Total flow at DP-24 = 91.6 cfs // Routed to RWT204

APPENDIX C

Hydraulic Computations

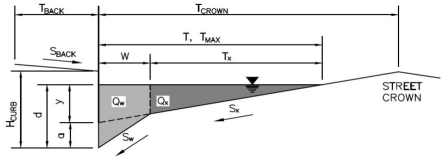
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.9**	**113.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

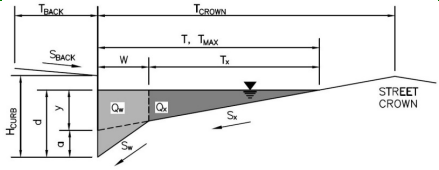
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-2 (North Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.023	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.5**	**127.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

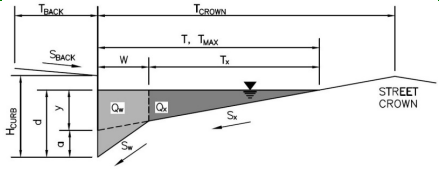
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-2**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

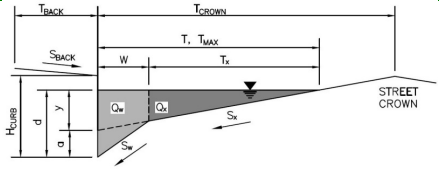
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-3**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.4**	**128.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

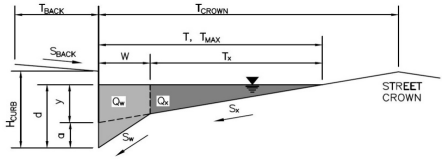
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-4 @ Bent Grass M.D.**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.8**	**143.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

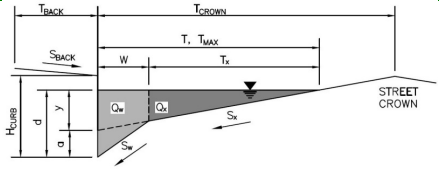
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-4**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

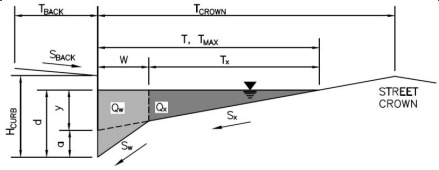
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-5**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

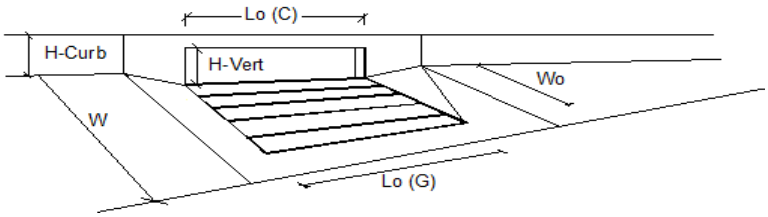
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.2**	**15.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**10.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**61**	**%**

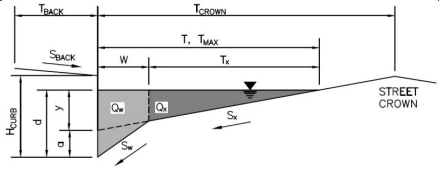
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-6 @ Bent Grass M.D.**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**15.4**	**133.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

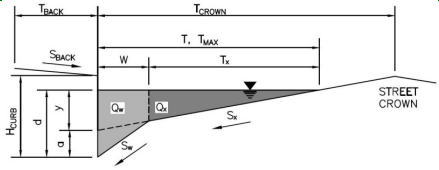
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-6**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

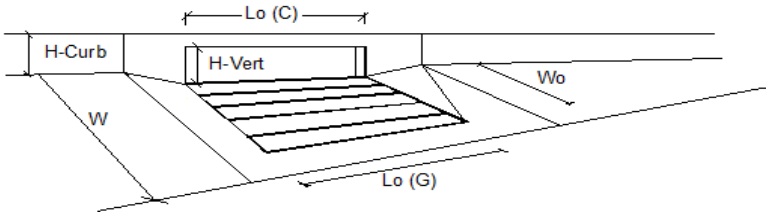
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**15.4**	**133.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**14.3**	**19.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**6.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**77**	**%**

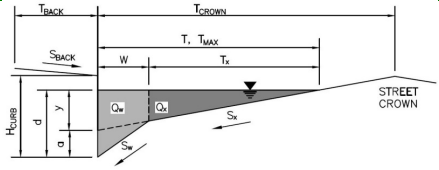
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-8 (East Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**19.0**	**171.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

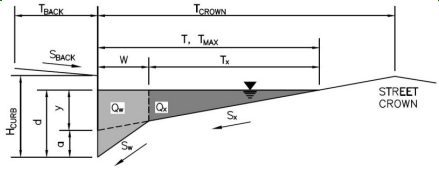
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-8 (West Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.5**	**150.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

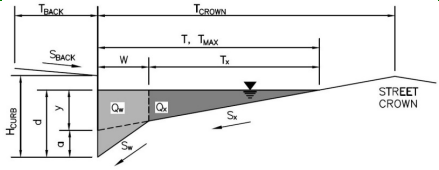
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-8**



Gutter Geometry (Enter data in the blue cells)

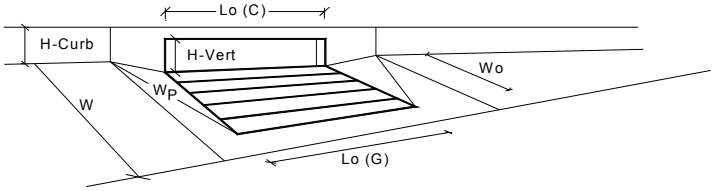
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.4**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	14.3	27.4	cfs

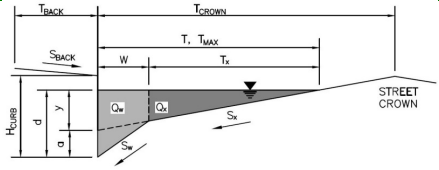
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-9**



Gutter Geometry (Enter data in the blue cells)

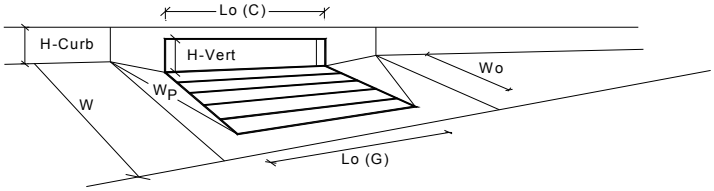
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.4**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.9	27.4	cfs

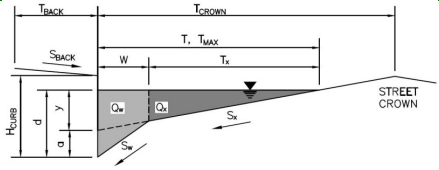
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-11**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

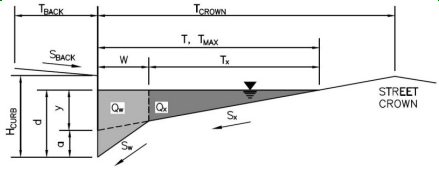
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-12**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

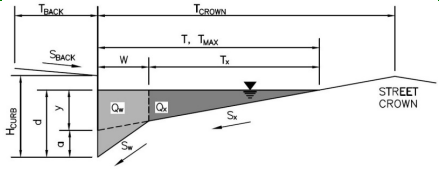
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-15**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

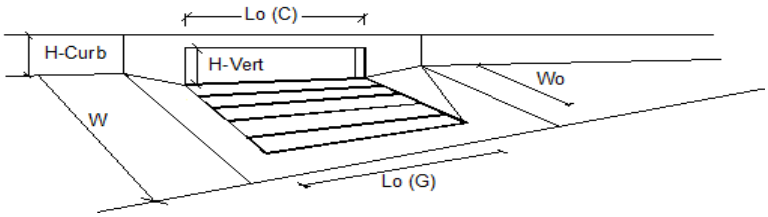
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.1**	**136.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.8**	**15.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.1**	**9.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**62**	**%**

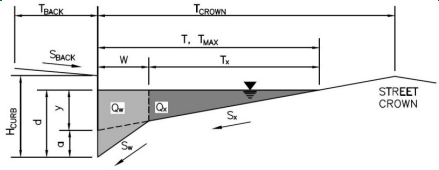
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-16**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

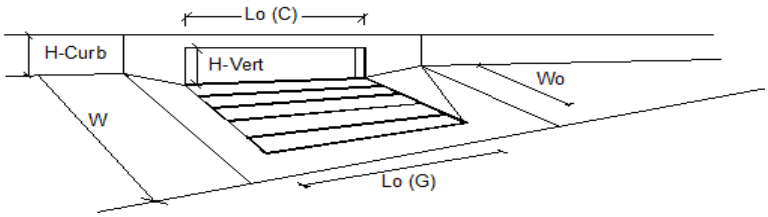
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.1**	**136.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.3**	**8.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.7**	**6.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**58**	**%**

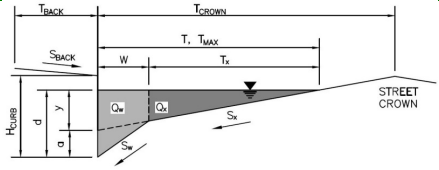
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-17 (NW Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

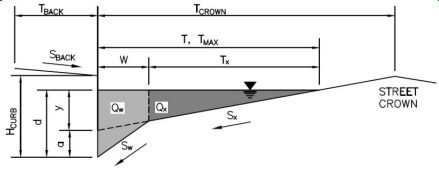
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-17 (SE Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

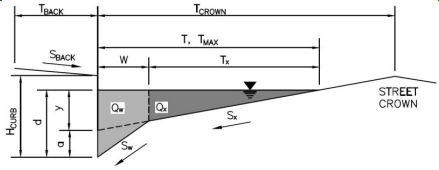
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-17**



Gutter Geometry (Enter data in the blue cells)

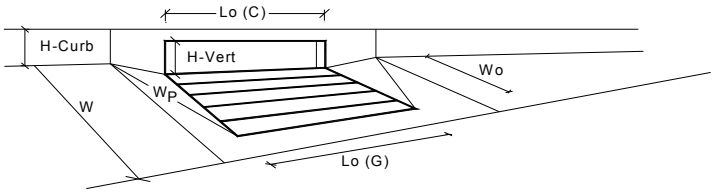
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.30	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**11.8**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	9.0	27.4	cfs

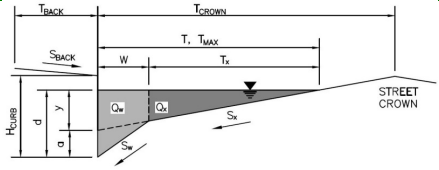
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-18 (SE Approach)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.9**	**113.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

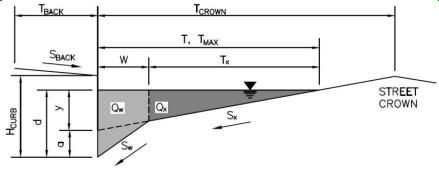
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-18**



Gutter Geometry (Enter data in the blue cells)

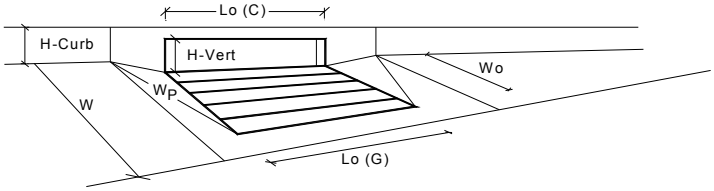
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**11.8**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.6	25.5	cfs

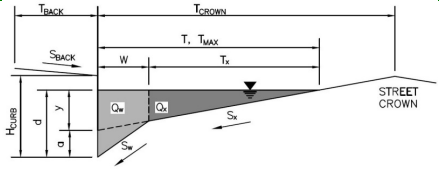
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-19**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

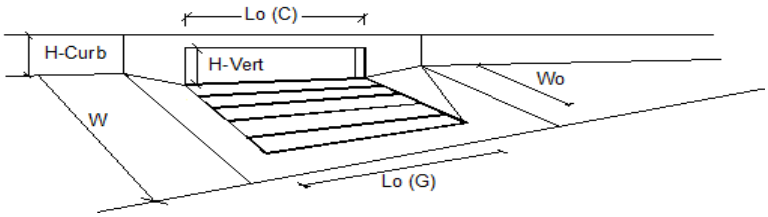
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.4**	**23.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**12.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**66**	**%**

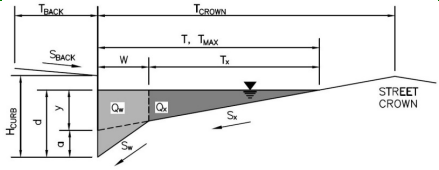
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-20 @ Bent Grass M.D.**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.9**	**175.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

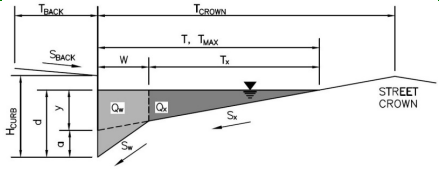
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-20**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

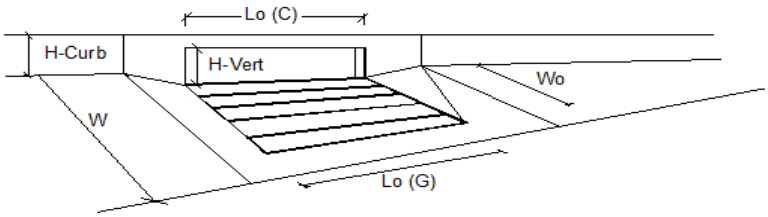
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**138.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



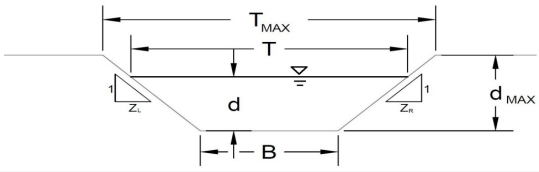
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**12.3**	**23.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**12.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**66**	**%**

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Bent Grass Residential Filing No. 2

DP-21



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0030	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	19.00	19.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.50	1.50	feet

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	19.00	19.00	ft
Water Depth	d =	2.00	2.00	ft
Flow Area	A =	22.00	22.00	sq ft
Wetted Perimeter	P =	19.49	19.49	ft
Hydraulic Radius	R =	1.13	1.13	ft
Manning's n	n =	0.030	0.030	
Flow Velocity	V =	2.95	2.95	fps
Velocity-Depth Product	VR =	3.33	3.33	ft^2/s
Hydraulic Depth	D =	1.16	1.16	ft
Froude Number	Fr =	0.48	0.48	
Max. Flow Based On Allowable Top Width	Q_T =	64.9	64.9	cfs

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	1.50	1.50	feet
Top Width	T =	15.00	15.00	feet
Flow Area	A =	13.50	13.50	square feet
Wetted Perimeter	P =	15.37	15.37	feet
Hydraulic Radius	R =	0.88	0.88	feet
Manning's n	n =	0.030	0.030	
Flow Velocity	V =	2.50	2.50	fps
Velocity-Depth Product	VR =	2.19	2.19	ft^2/s
Hydraulic Depth	D =	0.90	0.90	feet
Froude Number	Fr =	0.46	0.46	
Max. Flow Based On Allowable Water Depth	Q_d =	33.7	33.7	cfs

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	33.7	33.7	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	1.50	1.50	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	4.4	21.2	cfs
Water Depth	d =	0.57	1.22	feet
Top Width	T =	7.57	12.73	feet
Flow Area	A =	3.02	9.57	square feet
Wetted Perimeter	P =	7.71	13.03	feet
Hydraulic Radius	R =	0.39	0.73	feet
Manning's n	n =	0.030	0.030	
Flow Velocity	V =	1.46	2.21	fps
Velocity-Depth Product	VR =	0.57	1.63	ft^2/s
Hydraulic Depth	D =	0.40	0.75	feet
Froude Number	Fr =	0.41	0.45	

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

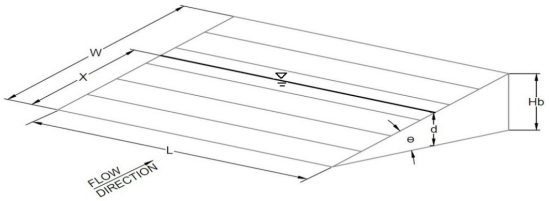
AREA INLET IN A SWALE

Bent Grass Residential Filing No. 2

DP-21

Inlet Design Information (Input)

Type of Inlet	CDOT TYPE D (Parallel & Depressed)	Inlet Type =	CDOT TYPE D (Parallel & Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.17	degrees
Width of Grate		W =	6.00	feet
Length of Grate		L =	3.00	feet
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.01	feet
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.67	
Orifice Coefficient		C_o =	0.45	
Weir Coefficient		C_w =	1.44	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.57	2.22	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	14.9	25.0	cfs
Base Weir Flow	Q_{wb} =	42.7	71.5	cfs
Interception without Clogging	Q_{wi} =	72.4	121.4	cfs
Interception with Clogging	Q_{wa} =	45.3	75.9	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	81.5	96.8	cfs
Interception with Clogging	Q_{oa} =	50.9	60.5	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**45.3**	**60.5**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

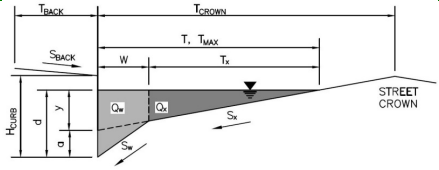
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-22 (10' Inlet)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

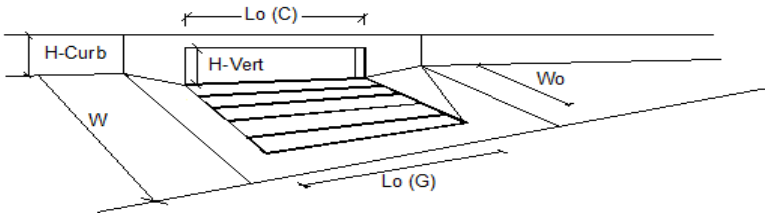
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.1**	**152.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.0**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**0**	**98**	**%**

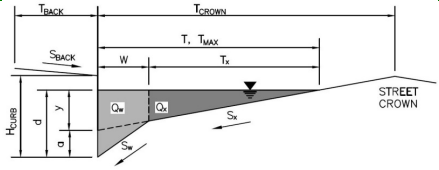
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-22 (15' Inlet)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

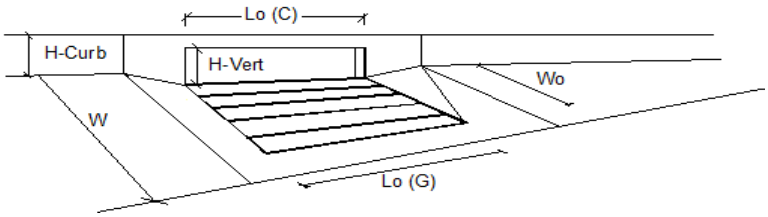
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.1**	**152.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**12.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**4.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**75**	**%**

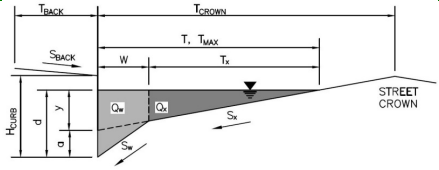
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-23 (10' Inlet)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

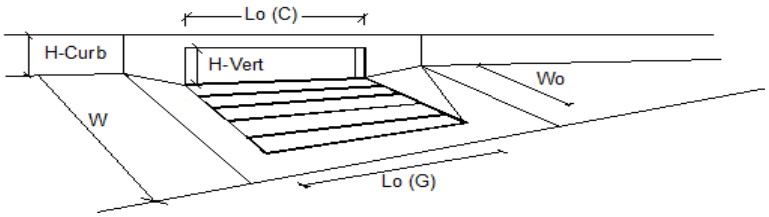
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.1**	**152.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.0**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**0**	**98**	**%**

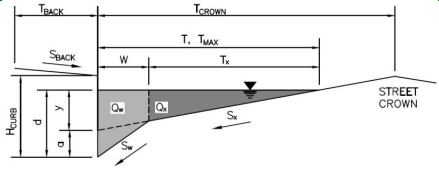
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Residential Filing No. 2**

Inlet ID: **DP-23 (15' Inlet)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

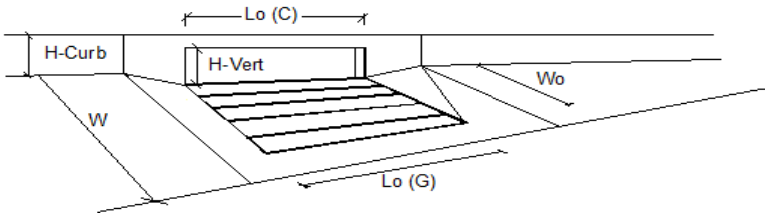
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.1**	**152.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

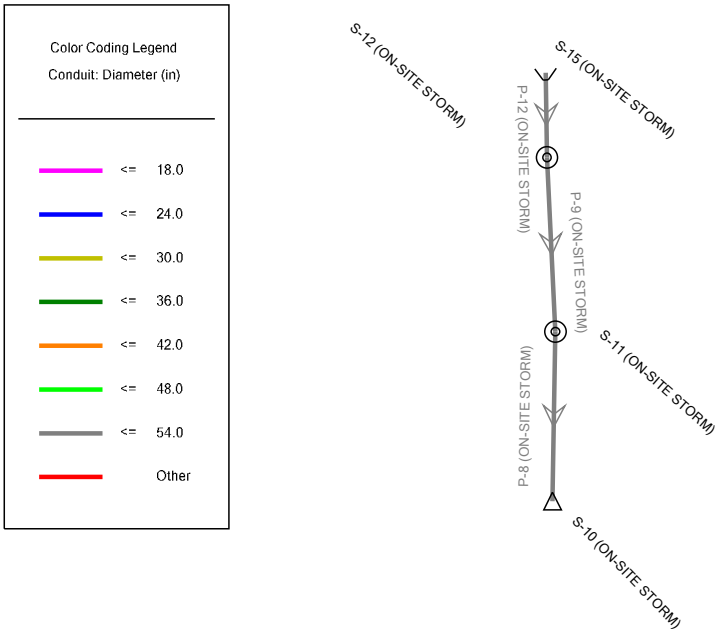
INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

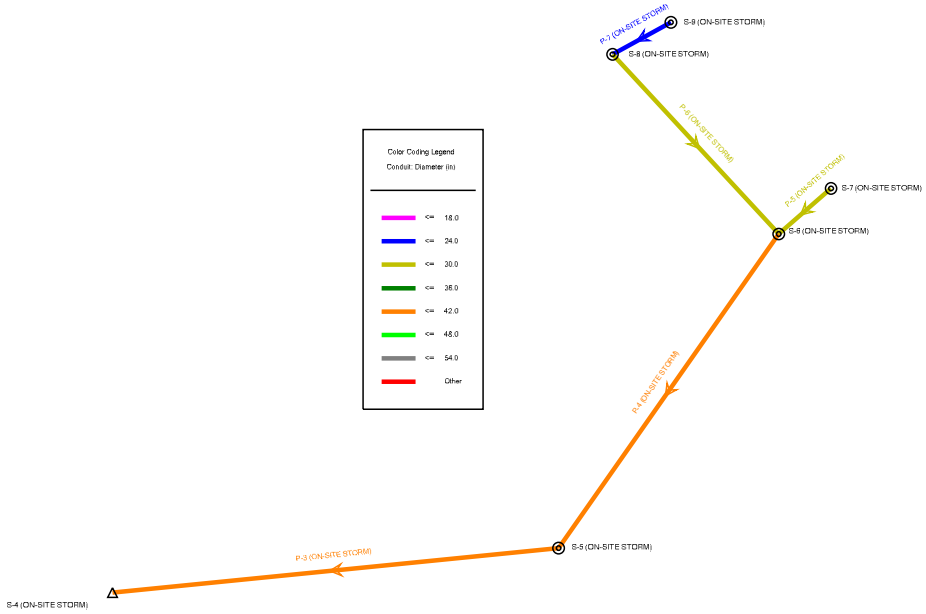


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**12.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**4.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**75**	**%**

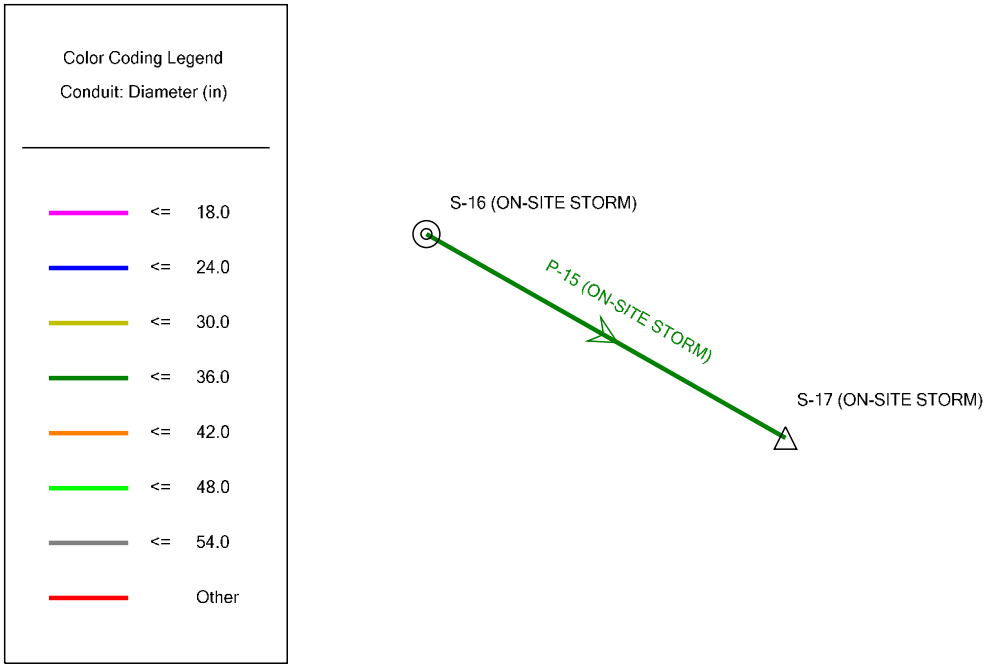
North


Color Coding Legend
Conduit: Diameter (in)
<= 18.0
<= 24.0
<= 30.0
<= 36.0
<= 42.0
<= 48.0
<= 54.0
Other
S-12 (ON-SITE STORM)
P-12 (ON-SITE STORM)
S-15 (ON-SITE STORM)
P-9 (ON-SITE STORM)
S-11 (ON-SITE STORM)
P-8 (ON-SITE STORM)
S-10 (ON-SITE STORM)

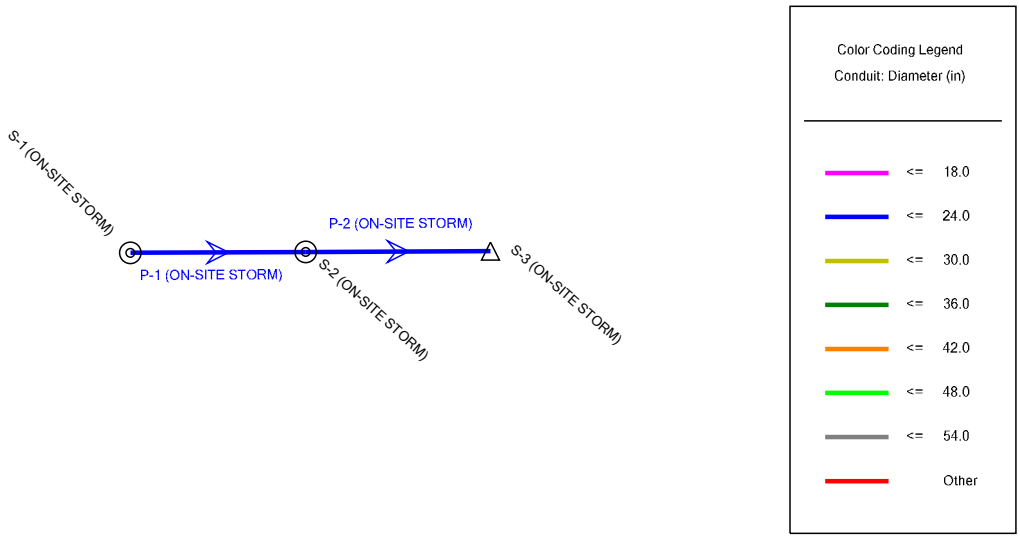
South East


P-7 (ON-SITE STORM)
S-9 (ON-SITE STORM)
S-8 (ON-SITE STORM)
P-6 (ON-SITE STORM)
P-5 (ON-SITE STORM)
S-7 (ON-SITE STORM)
S-6 (ON-SITE STORM)
Color Coding Legend
Conduit: Diameter (in)
<= 18.0
<= 24.0
<= 30.0
<= 36.0
<= 42.0
<= 48.0
<= 54.0
Other
P-4 (ON-SITE STORM)
S-5 (ON-SITE STORM)
P-3 (ON-SITE STORM)
S-4 (ON-SITE STORM)

West


Color Coding Legend
Conduit: Diameter (in)
<= 18.0
<= 24.0
<= 30.0
<= 36.0
<= 42.0
<= 48.0
<= 54.0
Other
S-16 (ON-SITE STORM)
P-15 (ON-SITE STORM)
S-17 (ON-SITE STORM)

South West


S-1 (ON-SITE STORM)
P-1 (ON-SITE STORM)
S-2 (ON-SITE STORM)
P-2 (ON-SITE STORM)
S-3 (ON-SITE STORM)
Color Coding Legend
Conduit: Diameter (in)
<= 18.0
<= 24.0
<= 30.0
<= 36.0
<= 42.0
<= 48.0
<= 54.0
Other

FlexTable: Conduit Table

Active Scenario: 5 YR

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Flow / Capacity (Design) (%)
P-9 (ON-SITE STORM)	S-12 (ON-SITE STORM)	S-11 (ON-SITE STORM)	6,937.05	6,936.68	49.0	0.008	54.0	0.013	18.30	7.01	170.80	6,938.27	6,938.23	6,938.70	6,938.45	10.7
P-8 (ON-SITE STORM)	S-11 (ON-SITE STORM)	S-10 (ON-SITE STORM)	6,936.68	6,936.41	35.4	0.008	54.0	0.013	21.20	7.34	171.80	6,937.99	6,937.52	6,938.46	6,938.27	12.3
P-1 (ON-SITE STORM)	S-1 (ON-SITE STORM)	S-2 (ON-SITE STORM)	6,931.91	6,931.67	49.0	0.005	24.0	0.013	2.40	3.64	15.83	6,933.43	6,933.42	6,933.44	6,933.43	15.2
P-2 (ON-SITE STORM)	S-2 (ON-SITE STORM)	S-3 (ON-SITE STORM)	6,931.67	6,931.41	51.6	0.005	24.0	0.013	4.00	4.24	16.06	6,933.42	6,933.41	6,933.45	6,933.44	24.9
P-7 (ON-SITE STORM)	S-9 (ON-SITE STORM)	S-8 (ON-SITE STORM)	6,925.45	6,925.27	36.2	0.005	24.0	0.013	9.80	5.33	15.94	6,926.81	6,926.77	6,927.10	6,927.00	61.5
P-6 (ON-SITE STORM)	S-8 (ON-SITE STORM)	S-6 (ON-SITE STORM)	6,924.77	6,924.13	128.6	0.005	30.0	0.013	15.10	5.96	28.93	6,926.08	6,925.75	6,926.60	6,926.06	52.2
P-5 (ON-SITE STORM)	S-7 (ON-SITE STORM)	S-6 (ON-SITE STORM)	6,924.31	6,924.13	36.5	0.005	30.0	0.013	9.00	5.18	28.79	6,925.75	6,925.75	6,925.90	6,925.86	31.3
P-4 (ON-SITE STORM)	S-6 (ON-SITE STORM)	S-5 (ON-SITE STORM)	6,923.13	6,922.12	201.7	0.005	42.0	0.013	31.20	7.16	71.19	6,924.86	6,924.43	6,925.53	6,924.77	43.8
P-3 (ON-SITE STORM)	S-5 (ON-SITE STORM)	S-4 (ON-SITE STORM)	6,921.82	6,920.64	235.5	0.005	42.0	0.013	31.20	7.16	71.21	6,924.24	6,924.14	6,924.54	6,924.30	43.8
P-12 (ON-SITE STORM)	S-15 (ON-SITE STORM)	S-12 (ON-SITE STORM)	6,937.29	6,937.05	32.1	0.007	54.0	0.013	4.00	4.44	169.98	6,938.48	6,938.48	6,938.50	6,938.50	2.4
P-15 (ON-SITE STORM)	S-16 (ON-SITE STORM)	S-17 (ON-SITE STORM)	6,934.42	6,933.64	155.0	0.005	36.0	0.013	22.70	6.62	47.31	6,935.95	6,935.10	6,936.56	6,935.79	48.0

FlexTable: Conduit Table

Active Scenario: 100 YR

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Flow / Capacity (Design) (%)
P-9 (ON-SITE STORM)	S-12 (ON-SITE STORM)	S-11 (ON-SITE STORM)	6,937.05	6,936.68	49.0	0.008	54.0	0.013	94.40	11.01	170.80	6,940.89	6,940.87	6,941.55	6,941.45	55.3
P-8 (ON-SITE STORM)	S-11 (ON-SITE STORM)	S-10 (ON-SITE STORM)	6,936.68	6,936.41	35.4	0.008	54.0	0.013	131.00	11.89	171.80	6,940.05	6,939.51	6,941.68	6,941.46	76.2
P-1 (ON-SITE STORM)	S-1 (ON-SITE STORM)	S-2 (ON-SITE STORM)	6,931.91	6,931.67	49.0	0.005	24.0	0.013	17.00	5.41	15.83	6,934.94	6,934.67	6,935.40	6,935.12	107.4
P-2 (ON-SITE STORM)	S-2 (ON-SITE STORM)	S-3 (ON-SITE STORM)	6,931.67	6,931.41	51.6	0.005	24.0	0.013	34.00	10.82	16.06	6,934.58	6,933.41	6,936.40	6,935.23	211.7
P-7 (ON-SITE STORM)	S-9 (ON-SITE STORM)	S-8 (ON-SITE STORM)	6,925.45	6,925.27	36.2	0.005	24.0	0.013	15.50	4.93	15.94	6,929.41	6,929.24	6,929.79	6,929.62	97.2
P-6 (ON-SITE STORM)	S-8 (ON-SITE STORM)	S-6 (ON-SITE STORM)	6,924.77	6,924.13	128.6	0.005	30.0	0.013	24.00	4.89	28.93	6,928.75	6,928.31	6,929.12	6,928.68	83.0
P-5 (ON-SITE STORM)	S-7 (ON-SITE STORM)	S-6 (ON-SITE STORM)	6,924.31	6,924.13	36.5	0.005	30.0	0.013	27.40	5.58	28.79	6,928.47	6,928.31	6,928.95	6,928.79	95.2
P-4 (ON-SITE STORM)	S-6 (ON-SITE STORM)	S-5 (ON-SITE STORM)	6,923.13	6,922.12	201.7	0.005	42.0	0.013	74.00	7.69	71.19	6,927.09	6,926.00	6,928.01	6,926.92	103.9
P-3 (ON-SITE STORM)	S-5 (ON-SITE STORM)	S-4 (ON-SITE STORM)	6,921.82	6,920.64	235.5	0.005	42.0	0.013	74.00	8.41	71.21	6,925.41	6,924.14	6,926.33	6,925.06	103.9
P-12 (ON-SITE STORM)	S-15 (ON-SITE STORM)	S-12 (ON-SITE STORM)	6,937.29	6,937.05	32.1	0.007	54.0	0.013	43.00	8.91	169.98	6,941.22	6,941.22	6,941.35	6,941.34	25.3
P-15 (ON-SITE STORM)	S-16 (ON-SITE STORM)	S-17 (ON-SITE STORM)	6,934.42	6,933.64	155.0	0.005	36.0	0.013	63.90	9.04	47.31	6,938.06	6,936.64	6,939.33	6,937.91	135.1

FlexTable: Manhole Table

Active Scenario: 5 YR

Label	Elevation (Rim) (ft)	Headloss Coefficient (Standard)	Headloss Method	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
S-11 (ON-SITE STORM)	6,945.59	0.500	Standard	0.24	6,938.23	6,937.99	6,938.45	6,938.46
S-12 (ON-SITE STORM)	6,945.58	0.500	Standard	0.22	6,938.48	6,938.27	6,938.50	6,938.70
S-2 (ON-SITE STORM)	6,937.01	0.050	Standard	0.00	6,933.42	6,933.42	6,933.43	6,933.45
S-1 (ON-SITE STORM)	6,937.01	1.320	Standard	0.02	6,933.44	6,933.43	6,933.46	6,933.44
S-8 (ON-SITE STORM)	6,932.39	1.320	Standard	0.69	6,926.77	6,926.08	6,927.00	6,926.60
S-9 (ON-SITE STORM)	6,932.52	0.000	Standard	0.00	6,926.81	6,926.81	6,927.10	6,927.10
S-7 (ON-SITE STORM)	6,931.23	0.000	Standard	0.00	6,925.75	6,925.75	6,925.90	6,925.90
S-6 (ON-SITE STORM)	6,931.21	1.320	Standard	0.89	6,925.75	6,924.86	6,926.06	6,925.53
S-5 (ON-SITE STORM)	6,927.82	0.640	Standard	0.19	6,924.43	6,924.24	6,924.77	6,924.54
S-16 (ON-SITE STORM)	6,945.20	0.000	Standard	0.00	6,935.95	6,935.95	6,936.56	6,936.56

FlexTable: Manhole Table

Active Scenario: 100 YR

Label	Elevation (Rim) (ft)	Headloss Coefficient (Standard)	Headloss Method	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
S-11 (ON-SITE STORM)	6,945.59	0.500	Standard	0.82	6,940.87	6,940.05	6,941.45	6,941.68
S-12 (ON-SITE STORM)	6,945.58	0.500	Standard	0.33	6,941.22	6,940.89	6,941.34	6,941.55
S-2 (ON-SITE STORM)	6,937.01	0.050	Standard	0.09	6,934.67	6,934.58	6,935.12	6,936.40
S-1 (ON-SITE STORM)	6,937.01	1.320	Standard	0.60	6,935.54	6,934.94	6,936.00	6,935.40
S-8 (ON-SITE STORM)	6,932.39	1.320	Standard	0.49	6,929.24	6,928.75	6,929.62	6,929.12
S-9 (ON-SITE STORM)	6,932.52	0.000	Standard	0.00	6,929.41	6,929.41	6,929.79	6,929.79
S-7 (ON-SITE STORM)	6,931.23	0.000	Standard	0.00	6,928.47	6,928.47	6,928.95	6,928.95
S-6 (ON-SITE STORM)	6,931.21	1.320	Standard	1.21	6,928.31	6,927.09	6,928.68	6,928.01
S-5 (ON-SITE STORM)	6,927.82	0.640	Standard	0.59	6,926.00	6,925.41	6,926.92	6,926.33
S-16 (ON-SITE STORM)	6,945.20	0.000	Standard	0.00	6,938.06	6,938.06	6,939.33	6,939.33

FlexTable: Outfall Table

Active Scenario: 5 YR

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Energy Grade Line (ft)	Flow (Total Out) (cfs)
S-10 (ON-SITE STORM)	6,942.43	6,936.41	User Defined Tailwater	6,937.52	6,937.52	21.20
S-3 (ON-SITE STORM)	6,934.16	6,931.41	Crown	6,933.41	6,933.41	4.00
S-4 (ON-SITE STORM)	6,925.02	6,919.81	Crown	6,924.14	6,924.14	31.20
S-17 (ON-SITE STORM)	6,937.47	6,933.64	Free Outfall	6,935.10	6,935.10	22.70

FlexTable: Outfall Table

Active Scenario: 100 YR

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Energy Grade Line (ft)	Flow (Total Out) (cfs)
S-10 (ON-SITE STORM)	6,942.43	6,936.41	User Defined Tailwater	6,939.51	6,939.51	131.00
S-3 (ON-SITE STORM)	6,934.16	6,931.41	Crown	6,933.41	6,933.41	34.00
S-4 (ON-SITE STORM)	6,925.02	6,919.81	Crown	6,924.14	6,924.14	74.00
S-17 (ON-SITE STORM)	6,937.47	6,933.64	Crown	6,936.64	6,936.64	63.90

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

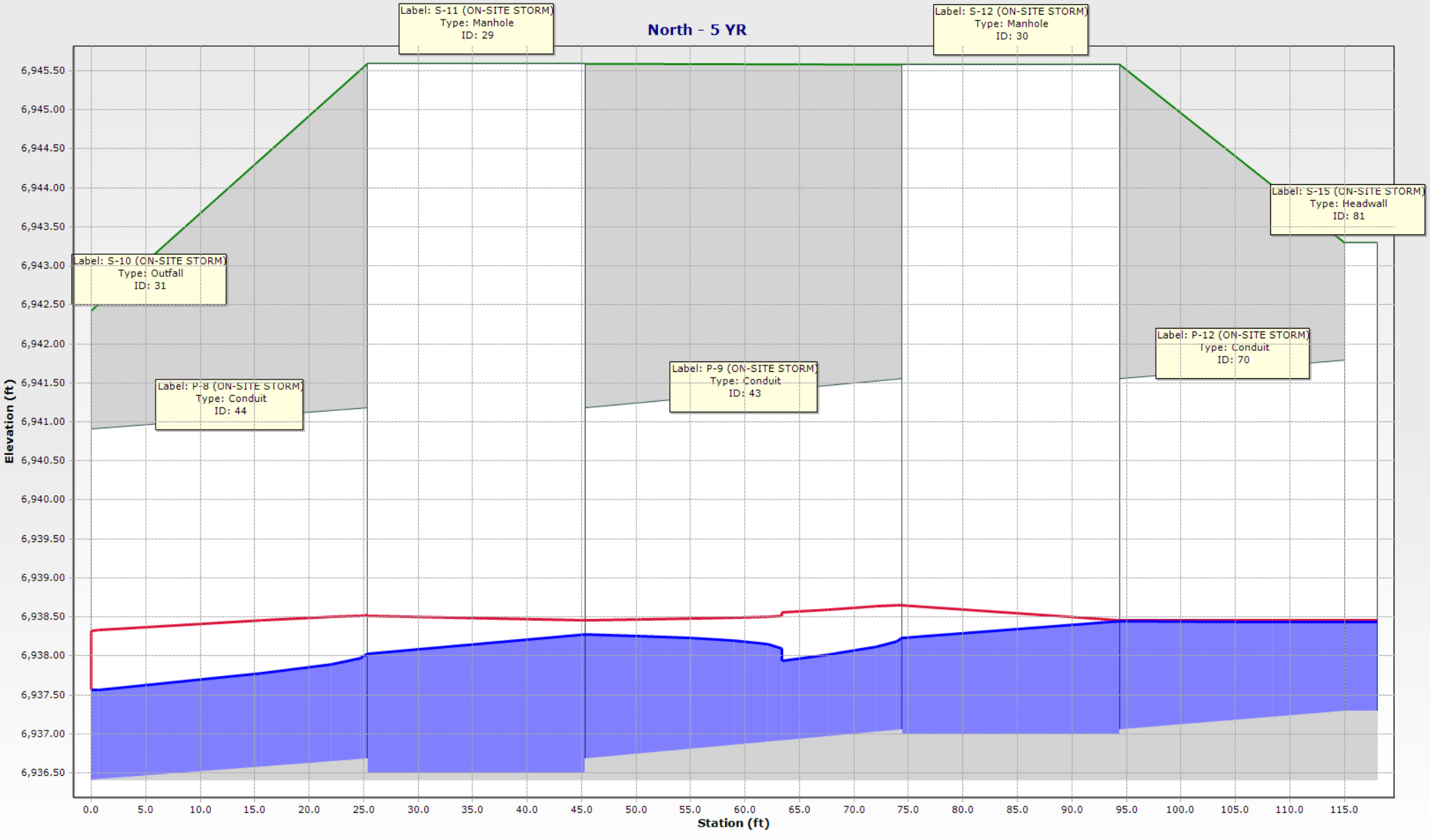
Subdivision: Bent Grass
Location: CO, Colorado Springs

Project Name: Bent Grass Residential Filing No. 2
Project No.: CLH000014.20
Calculated By: CMWJ
Checked By: SMB
Date: 7/25/19

	Storm Drain System			
	DP-18 Outfall	DP-21 Outfall	DP-24 Outfall	
Q_{100} (cfs)	74.0	63.9	91.6	
D or H (in)	42	36	24	
W (ft)				
Slope (%)	0.50	0.50	0.50	
Yn (in)	48.00	36.00	36.00	
Y_t (ft)	Unknown	Unknown	Unknown	*If "Unknown" Yt/D=0.4*
$Y_{t/D}$, Yt/H	0.40	0.40	0.40	
Supercritical	Yes	Yes	Yes	*Based on Froud Number >/< 1*
Q/D^2.5, Q/WH^1.5	3.23	4.10	16.19	
Q/D^1.5, Q/WH^0.5				
Da, Ha (in) *	45.00	36.00	30.00	*Da=0.5(D+Yn), Ha=0.5(H+Yn)*
Q/Da^1.5, Q/WHa^0.5 *	10.19	12.30	23.17	
d_{50} (in), Required	8.81	10.64	20.04	
Required Riprap Size	L	M	VH	
Use Riprap Size	**L**	**M**	**VH**	*Found using Figure 9-38 (USDCM)*
d_{50} (in)	9	12	24	
1/(2 tan θ)	4.10	3.60	6.80	*Found using Figure 9-35/9-36 (USDCM)*
Erosive Soils	Yes	Yes	Yes	
A_t	13.45	11.62	16.65	*A_t=Q/5.5*
L	25.1	24.1	128.0	*L=(1/(2 tan θ))(A_t/Yt - D)*
Min L	10.5	9.0	6.0	*Min L=3D or 3H*
Max L	35.0	30.0	20.0	*Max L=10D or 10H*
Length (ft)	26.0	25.0	20.0	
Bottom Width (ft)	10.5	9.0	6.0	*Width=3D (Minimum)*
Riprap Depth (in)	18	24	48	*Depth=2(d_{50})*
Type II Base Depth (in)	6	6	8	
Cutoff Wall	Yes	Yes	Yes	
Cutoff Wall Depth (ft)	3.0	3.0	4.7	*Depth of Riprap and Base*
Cutoff Wall Width (ft)	6.9	6.3	4.3	

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).
** This is a temporary minor storm culvert and the riprap has been sized for minor storm flows


North - 5 YR
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Type: Manhole
ID: 29
Label: S-12 (ON-SITE STORM)
Type: Manhole
ID: 30
Label: S-15 (ON-SITE STORM)
Type: Headwall
ID: 81
Label: S-10 (ON-SITE STORM)
Type: Outfall
ID: 31
Label: P-12 (ON-SITE STORM)
Type: Conduit
ID: 70
Label: P-9 (ON-SITE STORM)
Type: Conduit
ID: 43
Label: P-8 (ON-SITE STORM)
Type: Conduit
ID: 44
Elevation (ft)
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6,937.00
6,936.50
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15.0
20.0
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30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
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95.0
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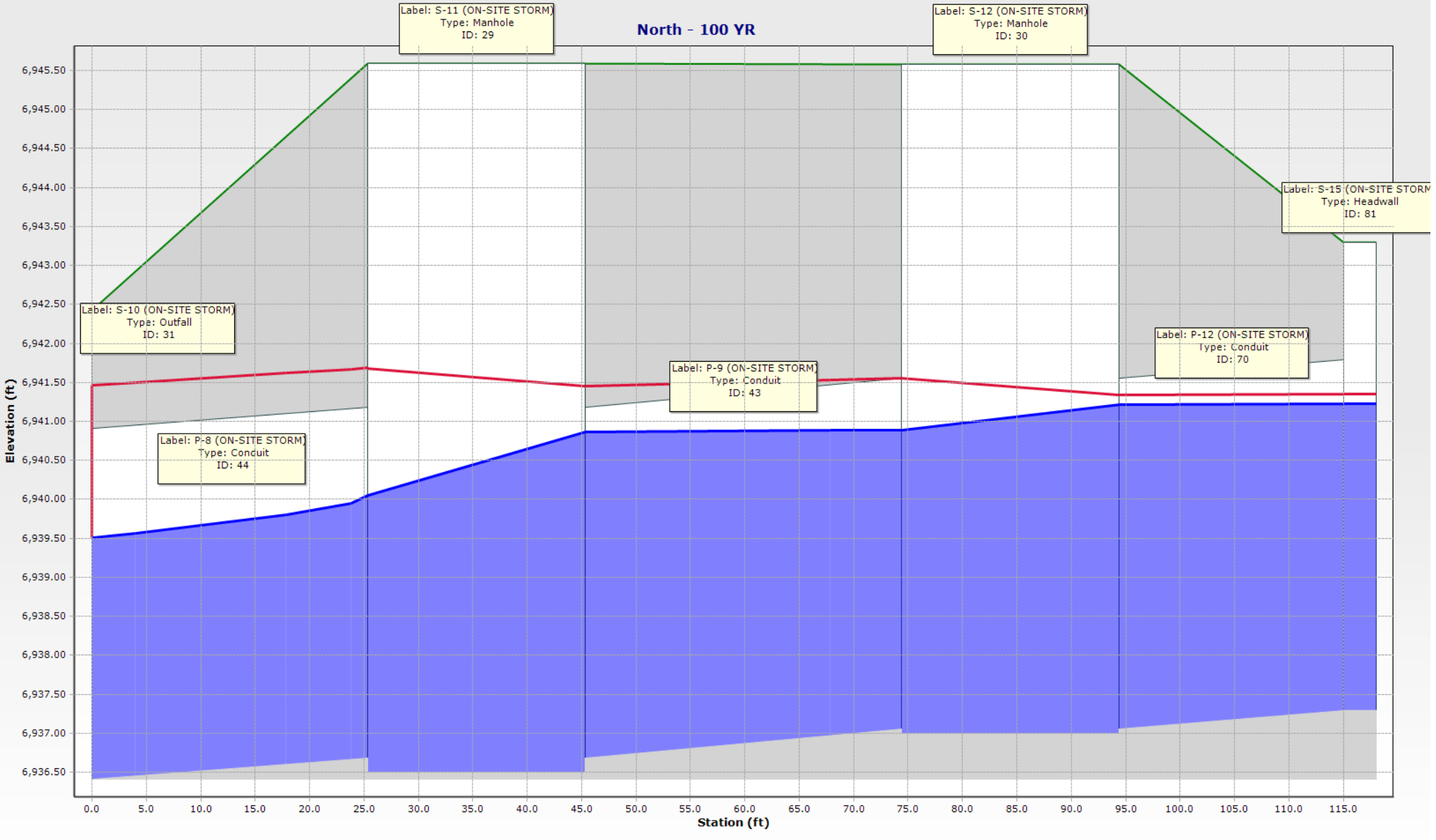
115.0
Station (ft)


North - 100 YR
Label: S-11 (ON-SITE STORM)
Type: Manhole
ID: 29
Label: S-12 (ON-SITE STORM)
Type: Manhole
ID: 30
Label: S-15 (ON-SITE STORM
Type: Headwall
ID: 81
Label: S-10 (ON-SITE STORM)
Type: Outfall
ID: 31
Label: P-12 (ON-SITE STORM)
Type: Conduit
ID: 70
Label: P-9 (ON-SITE STORM)
Type: Conduit
ID: 43
Label: P-8 (ON-SITE STORM)
Type: Conduit
ID: 44
Elevation (ft)
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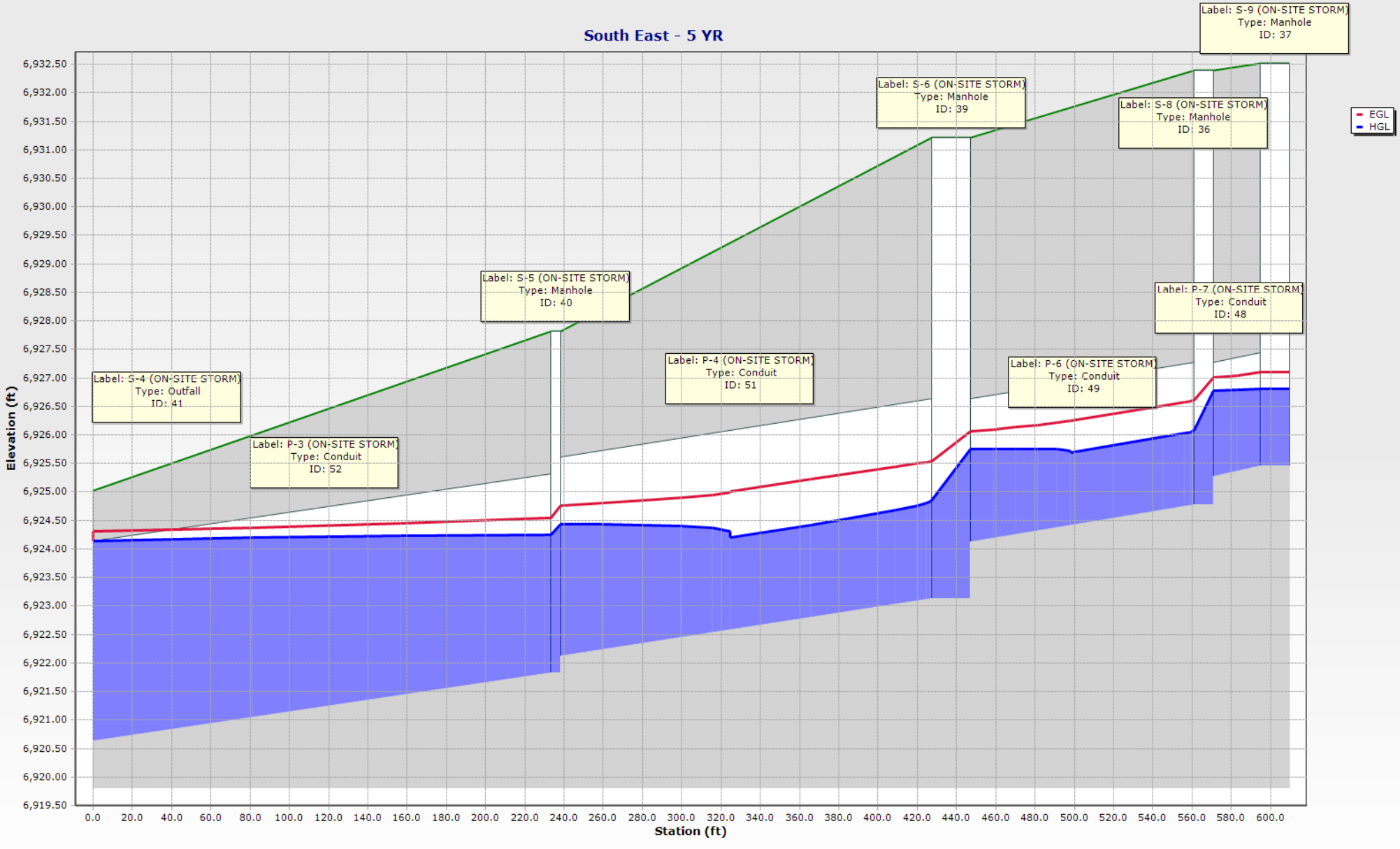
Station (ft)


South East - 5 YR
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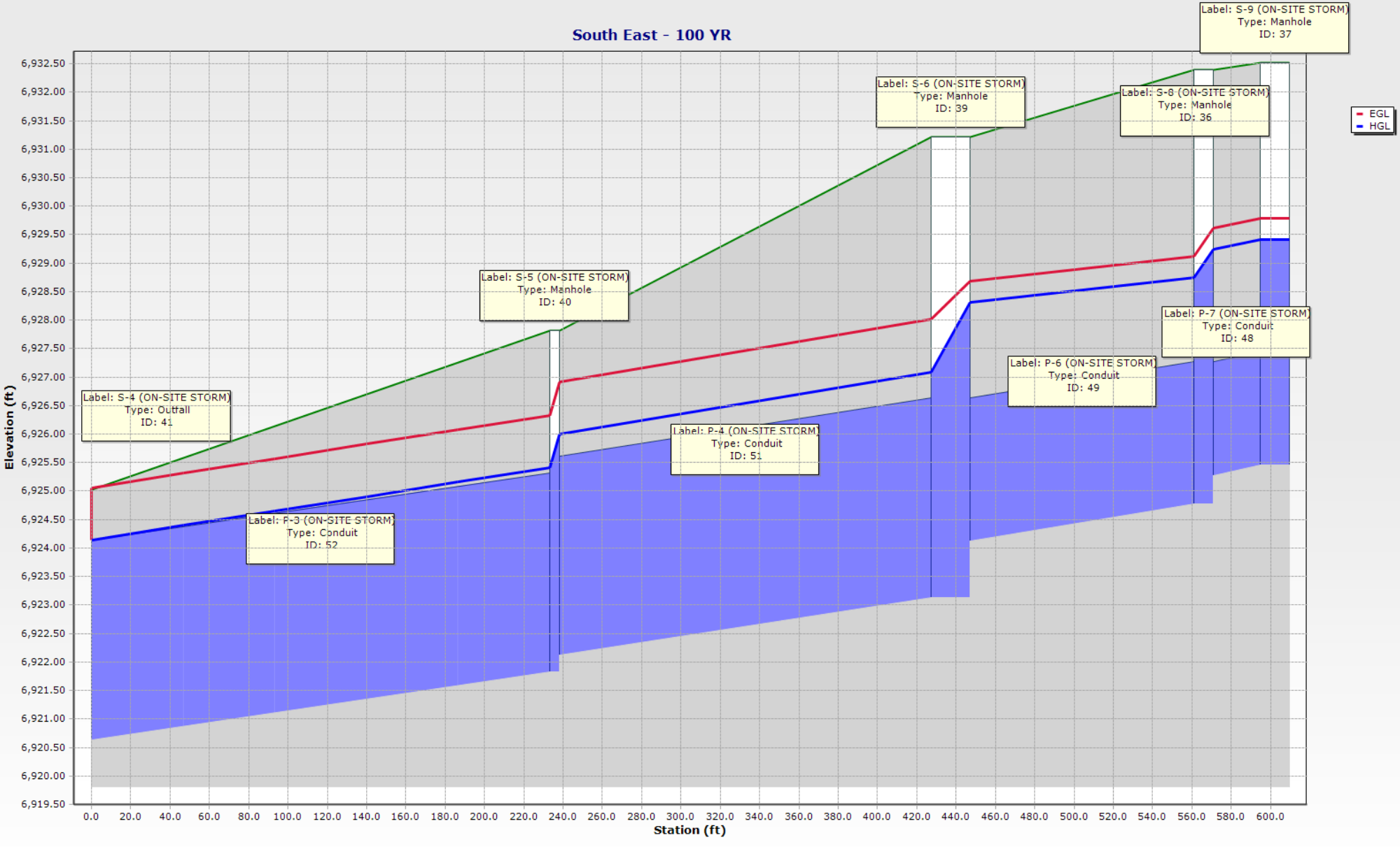
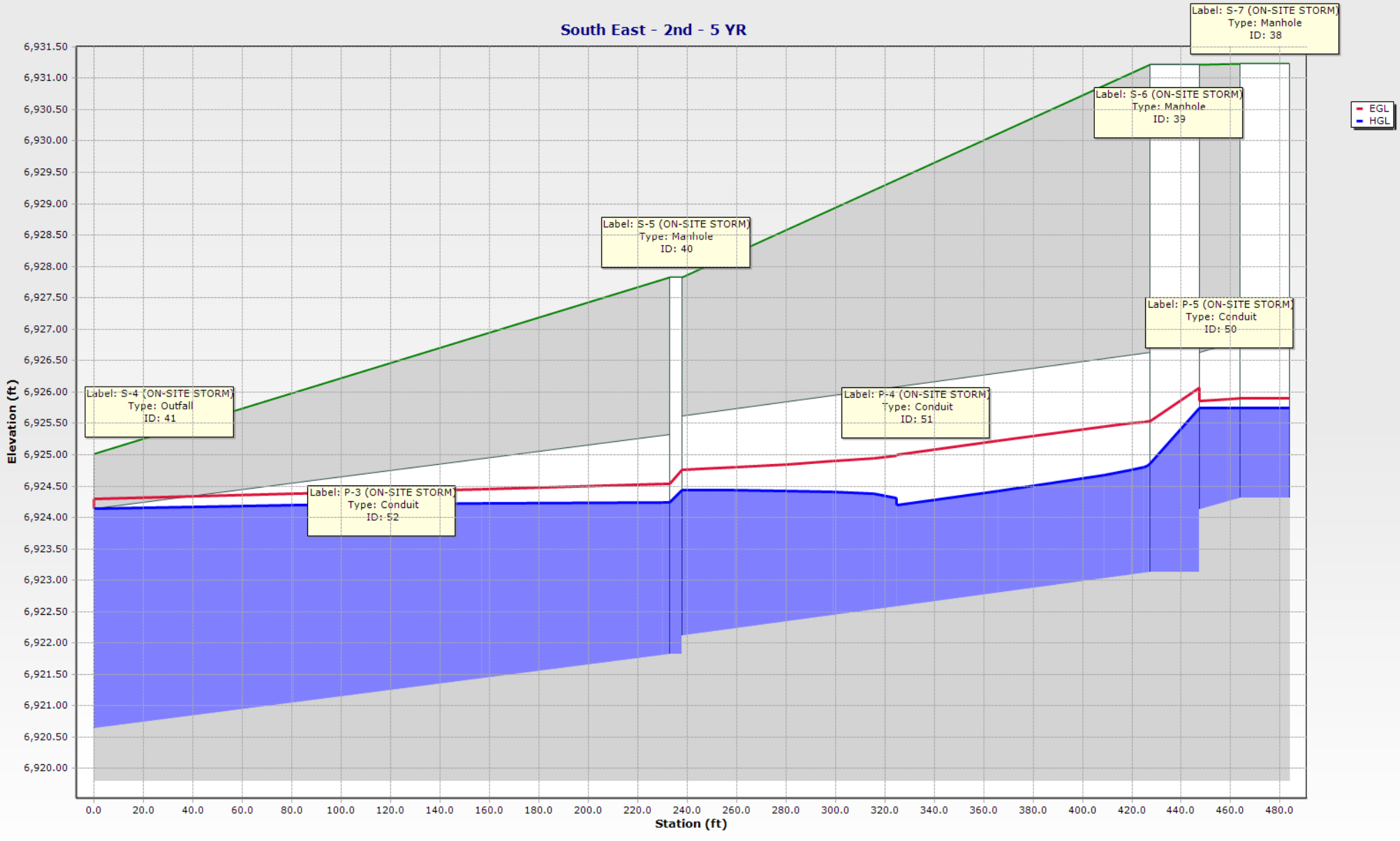
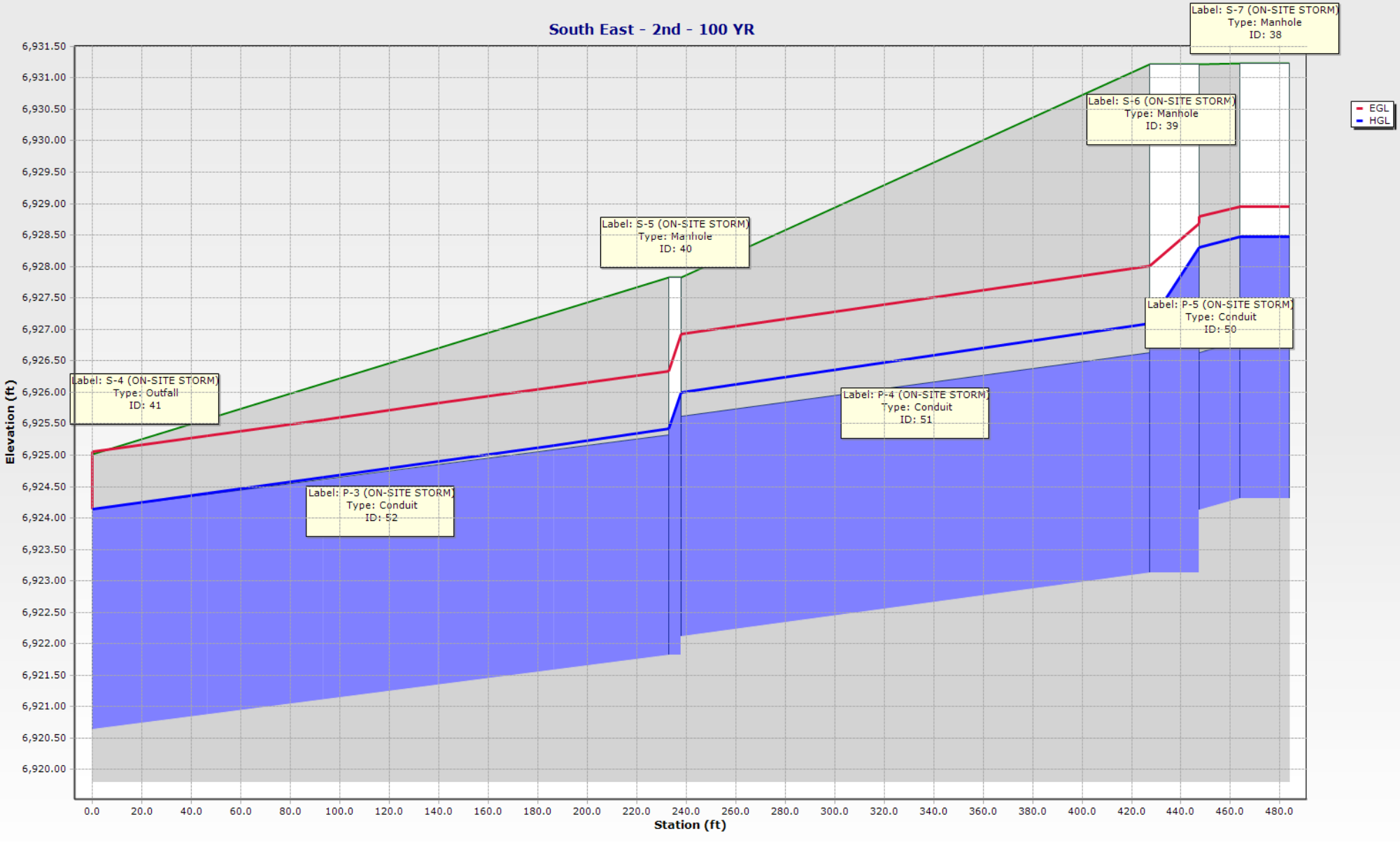
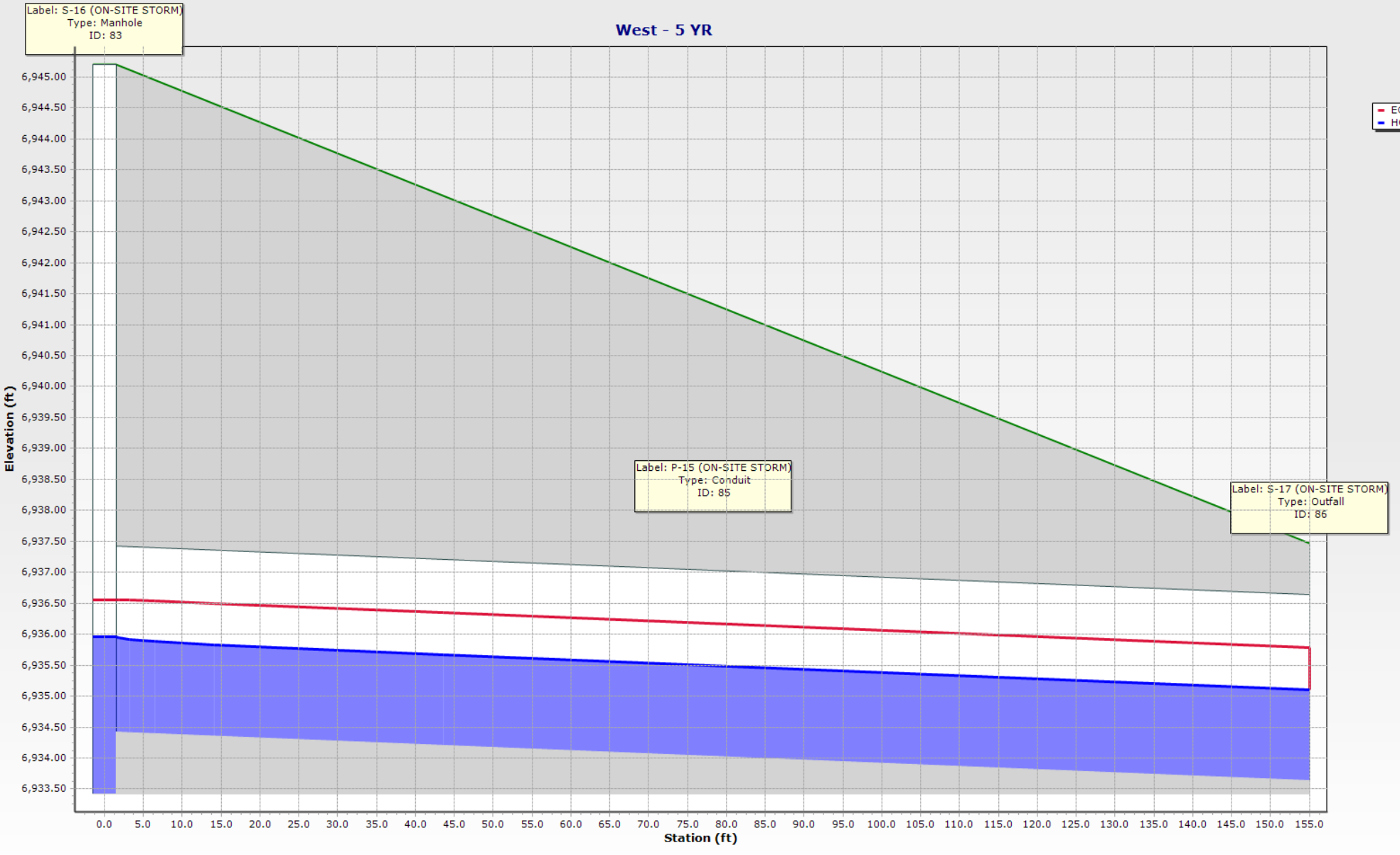
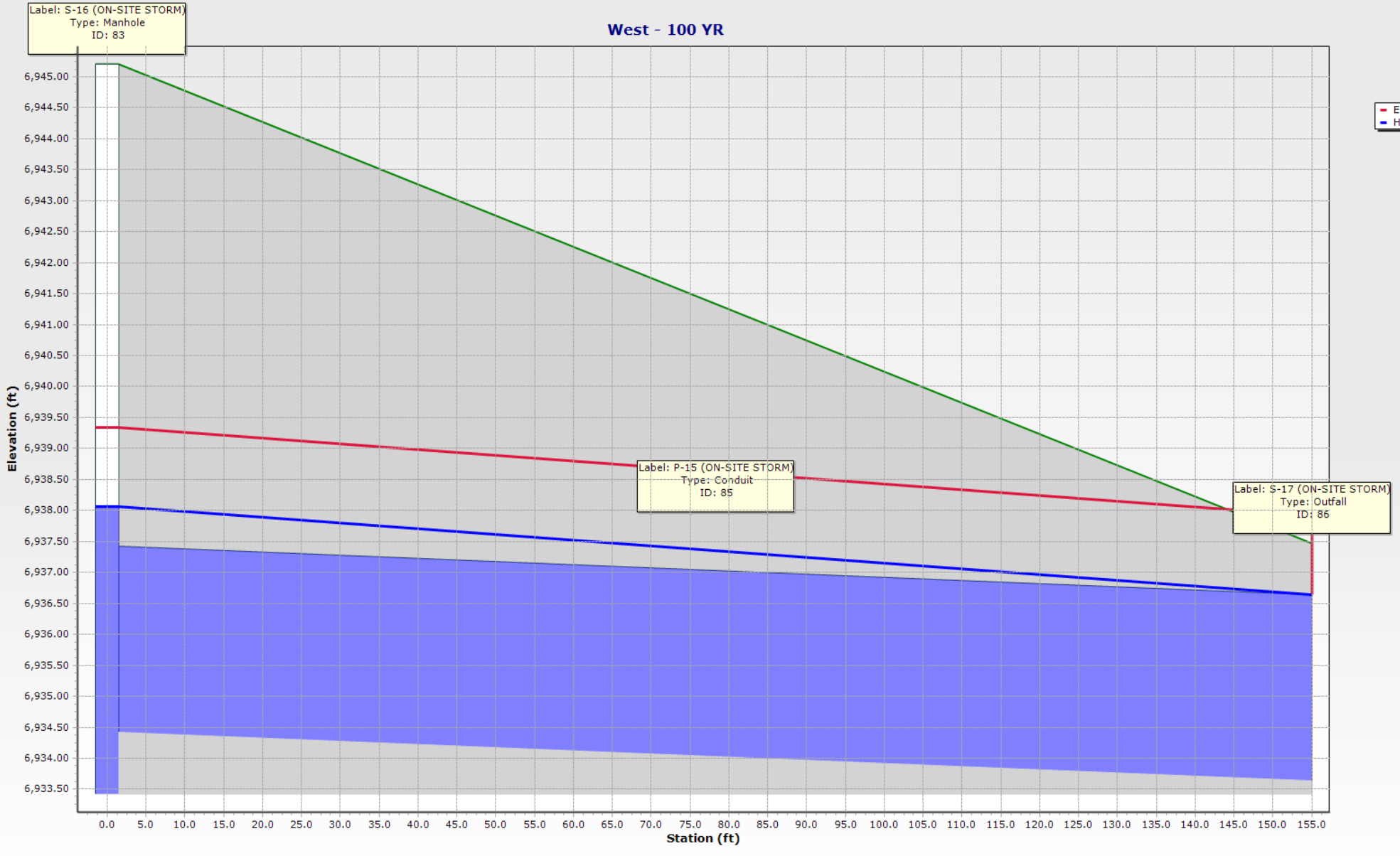
Type: Manhole
ID: 37
Label: S-6 (ON-SITE STORM)
Type: Manhole
ID: 39
Label: S-8 (ON-SITE STORM)
Type: Manhole
ID: 36
Label: S-5 (ON-SITE STORM)
Type: Manhole
ID: 40
Label: P-7 (ON-SITE STORM)
Type: Conduit
ID: 48
Label: P-4 (ON-SITE STORM)
Type: Conduit
ID: 51
Label: P-6 (ON-SITE STORM)
Type: Conduit
ID: 49
Label: S-4 (ON-SITE STORM)
Type: Outfall
ID: 41
Label: P-3 (ON-SITE STORM)
Type: Conduit
ID: 52
EGL
HGL
Elevation (ft)
Station (ft)

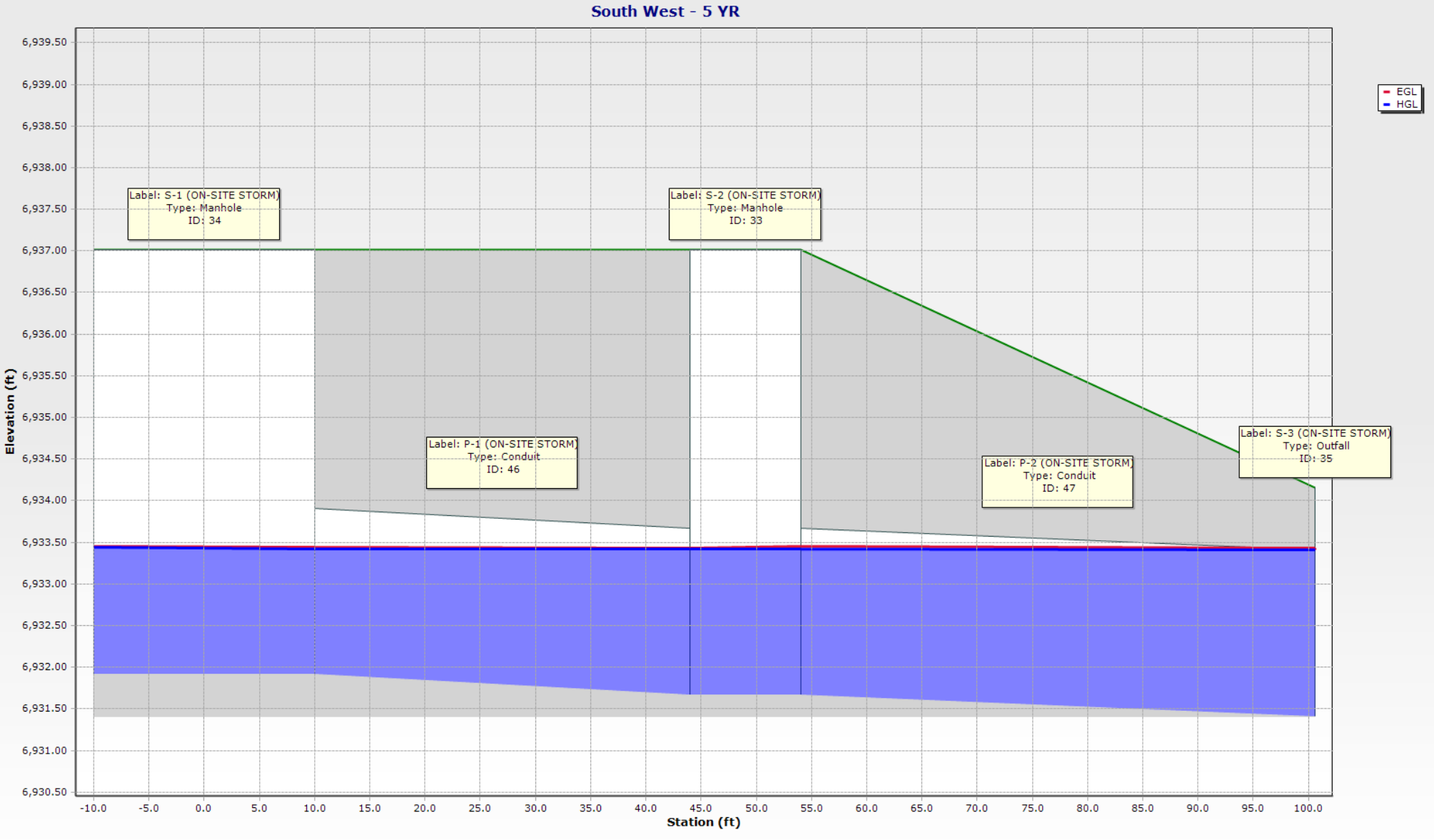

South East - 100 YR
Label: S-9 (ON-SITE STORM)
Type: Manhole
ID: 37
Label: S-6 (ON-SITE STORM)
Type: Manhole
ID: 39
Label: S-8 (ON-SITE STORM)
Type: Manhole
ID: 36
Label: S-5 (ON-SITE STORM)
Type: Manhole
ID: 40
Label: P-7 (ON-SITE STORM)
Type: Conduit
ID: 48
Label: P-6 (ON-SITE STORM)
Type: Conduit
ID: 49
Label: S-4 (ON-SITE STORM)
Type: Outfall
ID: 41
Label: P-4 (ON-SITE STORM)
Type: Conduit
ID: 51
Label: P-3 (ON-SITE STORM)
Type: Conduit
ID: 52
EGL
HGL
Elevation (ft)
Station (ft)
6,932.50
6,932.00
6,931.50
6,931.00
6,930.50
6,930.00
6,929.50
6,929.00
6,928.50
6,928.00
6,927.50
6,927.00
6,926.50
6,926.00
6,925.50
6,925.00
6,924.50
6,924.00
6,923.50
6,923.00
6,922.50
6,922.00
6,921.50
6,921.00
6,920.50
6,920.00
6,919.50
0.0 20.0 40.0 60.0 80.0 100.0 120.0 140.0 160.0 180.0 200.0 220.0 240.0 260.0 280.0 300.0 320.0 340.0 360.0 380.0 400.0 420.0 440.0 460.0 480.0 500.0 520.0 540.0 560.0 580.0 600.0

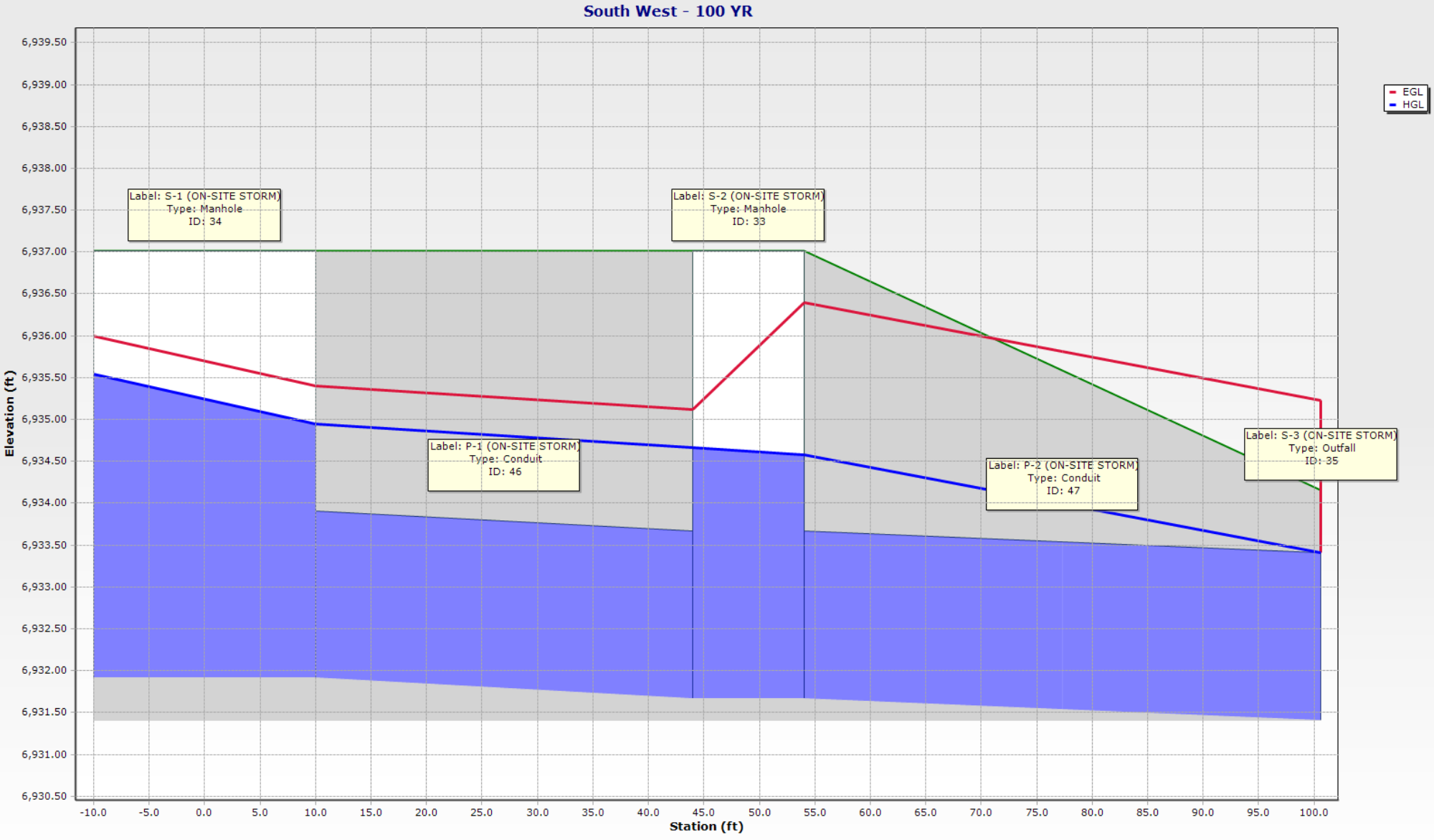

South East - 2nd - 5 YR
Label: S-7 (ON-SITE STORM)
Type: Manhole
ID: 38
Label: S-6 (ON-SITE STORM)
Type: Manhole
ID: 39
Label: S-5 (ON-SITE STORM)
Type: Manhole
ID: 40
Label: P-5 (ON-SITE STORM)
Type: Conduit
ID: 50
Label: S-4 (ON-SITE STORM)
Type: Outfall
ID: 41
Label: P-4 (ON-SITE STORM)
Type: Conduit
ID: 51
Label: P-3 (ON-SITE STORM)
Type: Conduit
ID: 52
EGL
HGL
Elevation (ft)
6,931.50
6,931.00
6,930.50
6,930.00
6,929.50
6,929.00
6,928.50
6,928.00
6,927.50
6,927.00
6,926.50
6,926.00
6,925.50
6,925.00
6,924.50
6,924.00
6,923.50
6,923.00
6,922.50
6,922.00
6,921.50
6,921.00
6,920.50
6,920.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
Station (ft)


South East - 2nd - 100 YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: S-7 (ON-SITE STORM)
Type: Manhole
ID: 38
Label: S-6 (ON-SITE STORM)
Type: Manhole
ID: 39
Label: S-5 (ON-SITE STORM)
Type: Manhole
ID: 40
Label: S-4 (ON-SITE STORM)
Type: Outfall
ID: 41
Label: P-5 (ON-SITE STORM)
Type: Conduit
ID: 50
Label: P-4 (ON-SITE STORM)
Type: Conduit
ID: 51
Label: P-3 (ON-SITE STORM)
Type: Conduit
ID: 52


West - 5 YR
Label: S-16 (ON-SITE STORM)
Type: Manhole
ID: 83
Label: P-15 (ON-SITE STORM)
Type: Conduit
ID: 85
Label: S-17 (ON-SITE STORM)
Type: Outfall
ID: 86
EGL
HGL
Elevation (ft)
6,945.00
6,944.50
6,944.00
6,943.50
6,943.00
6,942.50
6,942.00
6,941.50
6,941.00
6,940.50
6,940.00
6,939.50
6,939.00
6,938.50
6,938.00
6,937.50
6,937.00
6,936.50
6,936.00
6,935.50
6,935.00
6,934.50
6,934.00
6,933.50
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0 140.0 145.0 150.0 155.0
Station (ft)


West - 100 YR
Label: S-16 (ON-SITE STORM)
Type: Manhole
ID: 83
Label: P-15 (ON-SITE STORM)
Type: Conduit
ID: 85
Label: S-17 (ON-SITE STORM)
Type: Outfall
ID: 86
EGL
HGL
Elevation (ft)
6,945.00
6,944.50
6,944.00
6,943.50
6,943.00
6,942.50
6,942.00
6,941.50
6,941.00
6,940.50
6,940.00
6,939.50
6,939.00
6,938.50
6,938.00
6,937.50
6,937.00
6,936.50
6,936.00
6,935.50
6,935.00
6,934.50
6,934.00
6,933.50
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0 140.0 145.0 150.0 155.0
Station (ft)


South West - 5 YR
EGL
HGL
Label: S-1 (ON-SITE STORM)
Type: Manhole
ID: 34
Label: S-2 (ON-SITE STORM)
Type: Manhole
ID: 33
Label: P-1 (ON-SITE STORM)
Type: Conduit
ID: 46
Label: P-2 (ON-SITE STORM)
Type: Conduit
ID: 47
Label: S-3 (ON-SITE STORM)
Type: Outfall
ID: 35
Elevation (ft)
6,939.50
6,939.00
6,938.50
6,938.00
6,937.50
6,937.00
6,936.50
6,936.00
6,935.50
6,935.00
6,934.50
6,934.00
6,933.50
6,933.00
6,932.50
6,932.00
6,931.50
6,931.00
6,930.50
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
Station (ft)


South West - 100 YR
EGL
HGL
Label: S-1 (ON-SITE STORM)
Type: Manhole
ID: 34
Label: S-2 (ON-SITE STORM)
Type: Manhole
ID: 33
Label: P-1 (ON-SITE STORM)
Type: Conduit
ID: 46
Label: P-2 (ON-SITE STORM)
Type: Conduit
ID: 47
Label: S-3 (ON-SITE STORM)
Type: Outfall
ID: 35
Elevation (ft)
6,939.50
6,939.00
6,938.50
6,938.00
6,937.50
6,937.00
6,936.50
6,936.00
6,935.50
6,935.00
6,934.50
6,934.00
6,933.50
6,933.00
6,932.50
6,932.00
6,931.50
6,931.00
6,930.50
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
Station (ft)

APPENDIX D

Preliminary Channel HEC-RAS Models

Existing Conditions Model

```
                    HEC-RAS HEC-RAS 5.0.3 September 2016
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HEC-RAS Model
Project File : CLH14.20_Channel.prj
Run Date and Time: 5/21/2019 2:12:02 PM

Project in English units

Project Description:
CRS Info=<SpatialReference> <CoordinateSystem Code="3502" Unit="US_survey_Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0" ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: Existing
Plan File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.p01

Geometry Title: Existing
Geometry File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.g01

Flow Title : Existing
Flow File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.f01

Plan Summary Information:

Number of:	Cross Sections	= 81	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: Existing
Flow File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.f01

Flow Data (cfs)

River	Reach	RS	100-YR	5-YR
Existing Channel	East	5000	43	4
Existing Channel	East	3900	880	14

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Existing Channel	East	100-YR	Normal S = 0.0329	Normal S = 0.0247
Existing Channel	East	5-YR	Normal S = 0.0329	Normal S = 0.0247

GEOMETRY DATA

Geometry Title: Existing
Geometry File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.g01

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 5000

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6963.58	38.49	6963.58	42.67	6962.96	75	6959.7	89.7	6962.75
110.04	6963.46	118.77	6963.24	121.11	6963.48	125.8	6963.63	150	6963.63

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	38.49	.045	89.7	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
38.49	89.7	53.22	50	51.12	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 4950

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6964.91	4.49	6964.91	14.11	6964.28	28.72	6963.12	45.08	6961.83
66.68	6958.45	67.88	6958.26	72.91	6957.97	75	6957.85	81.59	6957.48
83.44	6957.78	105.7	6961.57	120.79	6962.71	134.68	6963.68	150	6963.68

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.08    .045   105.7     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.08   105.7             56.3      50   55.05             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4900

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6963.53   12.58 6963.53   20.95  6963.2   27.05 6962.33   36.46 6961.09
   59.75 6957.96   71.58 6956.48      75 6956.22   76.29 6956.13   77.28 6956.08
    80.6 6956.68   100.6 6959.86  126.33 6962.03     150 6963.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   20.95    .045  126.33     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         20.95  126.33             71.1      50   38.94             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4850

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6959.99   34.39 6959.99   54.42 6958.91    58.9 6957.85   72.94 6954.52
      75 6954.47   76.05 6954.44   77.22 6954.55   88.32 6956.31   97.52 6957.97
  111.09 6958.96  131.03 6960.59  146.87 6962.04     150 6962.04

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .05   54.42    .045  111.09     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         54.42  111.09            49.15      50   56.56             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4800

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6960.57     9.2 6960.57   44.01 6958.08   59.83 6954.92   68.81 6953.23
      75 6953.14   76.25 6953.12   79.12 6953.16   91.93 6955.91   95.94 6956.94
   100.1 6956.93     150 6956.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   44.01    .045   95.94     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         44.01   95.94            61.25      50   43.37             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4750

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6958.34   35.51 6958.34   38.45 6958.32   40.25 6958.17   43.73 6957.56
   73.46  6952.3      75 6952.25   75.36 6952.24   77.32 6952.32   89.26 6955.07
   96.38 6956.45  105.11  6956.9  123.28 6956.85  137.41 6956.83     150 6956.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.25    .045   96.38     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.25   96.38            62.73      50   41.17              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4700

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6958.93    6.21 6958.93   26.86 6957.79   46.91 6956.53   55.57 6954.93
    72.9 6951.61      75 6951.59    75.6 6951.58   77.45 6951.54   84.09 6952.97
   93.45 6955.07   97.28 6955.56   135.4 6956.48  143.04 6956.78  144.21 6956.78
  145.18 6956.78  147.21 6956.91     150 6957.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.91    .045   97.28     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.91   97.28            48.59      50   53.31              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4650

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.92      13 6955.92   15.98 6955.77   17.47 6955.75   19.19 6955.69
    39.7 6954.03   40.71 6953.88   59.63 6950.54   61.54 6950.65   62.99 6950.73
   63.73 6950.75   68.59 6951.79   81.56 6954.29  100.82 6955.21  110.87 6955.88
  117.25 6955.97  128.49 6956.29  136.54 6956.29

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    39.7    .045   81.56     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          39.7   81.56            31.33      50   63.68             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4600

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.98    3.42 6955.98   11.44 6955.16   22.53 6954.54   39.05 6953.33
   60.56  6950.2   67.66 6949.26   68.34 6949.29   69.24 6949.27   71.52 6949.23
   78.98 6950.86   88.89 6953.25   99.87 6954.11  104.06 6954.54  107.26 6954.49
  144.24 6954.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   39.05    .045   88.89     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         39.05   88.89            31.96      50   60.47             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4550

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6954.47    15.6 6953.37   18.05 6953.02   48.88 6948.55   52.45 6948.24
   55.27 6947.91   55.52 6947.88   59.39  6948.6   75.66 6952.81   89.66 6953.03
   91.58 6953.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    15.6    .045   75.66     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

```
          15.6   75.66            69.03      50   28.51              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4500

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.85    9.47 6955.85   42.52 6953.36   46.11 6953.07   52.65 6951.78
   69.08  6947.9      75 6947.95   75.53 6947.96   76.98 6947.94    83.7 6948.98
  107.55 6952.53  110.42 6952.62  126.61 6953.03  127.51 6953.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.11    .045  107.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.11  107.55            50.62      50   52.59              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4450

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6954.6   18.39  6954.6   39.23 6952.75   40.72 6952.62   44.07 6951.87
   69.43  6946.6      73 6946.49      75 6946.44   76.07  6946.4   95.73 6951.85
   96.83 6952.15  115.18 6952.51     150 6952.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.72    .045   96.83     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.72   96.83            46.56      50   51.87              .1       .3
```

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 4400

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6954.57	12.29	6954.57	24.56	6954.28	34.56	6953.13	39.34	6952.67
42.47	6951.97	70.43	6945.75	70.85	6945.66	70.89	6945.64	70.91	6945.64
75	6944.96	75.01	6944.96	96.91	6951.35	98.66	6951.94	121.74	6952.08
150	6952.08								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	39.34	.045	98.66	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
39.34	98.66	61.22	50	41.17	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 4350

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6951.38	40.69	6951.38	47.23	6951.34	70.53	6944.91	70.85	6944.84
70.91	6944.83	75	6944.47	75.21	6944.46	87.72	6947.7	104.7	6951.48
134.53	6952.12	141.79	6952.34	150	6952.34				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	47.23	.045	104.7	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
47.23	104.7	50.69	50	48.39	.1	.3

CROSS SECTION

```
RIVER: Existing Channel
REACH: East                RS: 4300

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6949.81   27.06 6949.81   45.38 6949.59   68.23 6944.71   72.38  6943.8
   72.71 6943.79      75 6943.87   78.16 6943.97   98.85 6948.57  107.94 6950.62
   120.3 6951.57  129.52 6951.73     150 6951.73

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.38    .045  107.94     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.38  107.94            39.47      50   60.56             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 4250

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6948.57    9.29 6948.57    42.5 6948.14   64.45  6944.4   72.35 6942.82
      75 6942.96   75.29 6942.98   79.17 6943.16   89.72  6945.8  103.42 6949.07
  109.38 6949.39  124.14 6949.31     150 6949.31

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    42.5    .045  103.42     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          42.5  103.42            47.28      50   53.35             .1       .3

CROSS SECTION
```

```
RIVER: Existing Channel
REACH: East                RS: 4200

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6947.06   16.62 6947.06   37.93 6946.33   57.15 6943.81   69.99 6941.92
   73.64 6941.77      75 6941.74    77.7 6941.68   85.94 6943.75  100.62 6947.59
  107.28 6947.97   118.1  6948.6  141.84 6948.75     150 6948.75

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   37.93    .045  100.62     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         37.93  100.62            34.12      50   59.42             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 4150

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6946.72   21.81 6946.72   33.75 6946.21   44.72 6944.88   62.77 6942.12
      71 6941.78      75 6941.68   75.99 6941.65   88.27 6943.68   99.02 6945.62
  133.28 6946.17   148.4 6946.47     150 6946.47

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   33.75    .045   99.02     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         33.75   99.02            54.56      50   47.87             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 4100
```

```
INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6946.92   12.52 6946.92    26.8 6946.38   41.81 6945.52   49.62 6943.85
   65.65 6940.64      75  6940.5   76.62 6940.48    80.6 6940.53   99.13 6942.25
  110.21 6943.95  122.91 6944.07  136.87 6945.44  138.58 6945.44

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   41.81    .045  110.21     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         41.81  110.21            78.87      50   30.41             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4050

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6944.33   26.04 6944.33   27.03 6944.25   27.69 6944.25   31.28 6943.83
   69.09 6939.89   69.24 6939.61      75 6939.61   78.24 6939.61   78.37  6939.6
   78.82 6939.73   95.65 6943.72  103.92 6943.86  115.58  6945.3  119.28  6945.5
   124.8 6945.27  136.11 6945.27

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   27.69    .045   95.65     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         27.69   95.65            48.52      50   51.38             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 4000
```

```
INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6944.13    6.34 6944.13    8.29 6943.89   23.16 6942.56   71.88 6938.59
      75 6938.53   76.88 6938.49   77.66 6938.51   79.85 6939.03   94.21 6943.12
  108.06 6943.52  148.53 6944.03     150 6944.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    6.34    .045   94.21     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          6.34   94.21             53.35      50    53.9              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3950

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6941.02   28.34 6941.02      73 6938.11   75.49 6938.03   75.83 6938.01
   77.39 6937.94    81.6 6939.05  111.91 6941.68  115.43  6941.7  136.93 6940.99
  138.53 6940.99

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   28.34    .045  111.91     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         28.34  111.91             66.9      50   63.88              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3900

INPUT
Description:
```

```
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6943.22    2.46 6943.22   33.41 6939.86   35.37 6939.67    36.6 6939.52
   40.25  6939.3   47.13 6939.08   82.19 6938.13   92.84 6937.57   93.35 6937.54
  108.61 6937.58  113.66 6937.66   129.2 6937.61  148.46  6937.5  151.59 6937.21
  153.38 6937.13  156.56 6937.91  171.58 6942.04  176.24 6942.19  190.37 6942.19

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    2.46    .045  171.58     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          2.46  171.58            29.56      50   67.78              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3850

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6941.79    3.34 6941.79   16.12  6941.2    44.4 6939.51   73.28 6937.89
    89.2 6936.79   89.45  6936.8  103.72 6937.45  123.96  6937.2  133.88 6935.31
  149.05 6939.25  156.89 6941.24  161.79 6941.24

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    3.34    .045  156.89     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          3.34  156.89            54.23      50   63.45              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3800

INPUT
Description:
Station Elevation Data    num=      14
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6938.59   23.83 6938.59   26.75  6938.1   64.69 6934.35      65 6934.41
   72.38 6935.95   78.29 6937.48   86.93 6938.68   87.76 6938.73   89.76 6938.23
  107.51 6934.66     127 6938.71   132.8 6939.83     140 6939.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   23.83    .045   132.8     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         23.83   132.8            51.02      50   49.21              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3750

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6938.4   22.93  6938.4   39.82 6937.64   64.36 6934.46   73.46 6933.22
   73.77 6933.18   76.31 6933.49   86.66 6934.62   92.06 6934.61   95.12 6934.69
  103.76 6934.62  132.38 6934.34  155.38 6938.15  162.61 6939.21   169.1 6939.38
  170.59 6939.38

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   22.93    .045  162.61     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         22.93  162.61            52.26      50   46.49              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3700

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
       0 6938.69   13.37 6938.69   28.67  6938.2   70.27  6932.3   72.77 6931.91
    72.8  6931.9   74.04  6932.1   88.79 6933.84   92.58 6934.15   96.39 6934.03
  121.74 6933.67   137.6 6933.46  148.44 6933.23   164.2 6936.02  181.52 6938.72
  185.99 6938.72

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   28.67    .045  181.52     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         28.67  181.52            60.14      50   33.53              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3650

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6937.92    15.4 6937.92   21.77 6937.78   43.82 6934.93   72.59 6931.21
   72.68  6931.2   76.28 6931.74   89.29 6933.63  104.89 6934.34  113.84 6934.54
  126.98 6934.36   154.1 6932.43  160.15 6933.47  184.83 6938.29   190.1 6938.29

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   21.77    .045  184.83     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         21.77  184.83            51.25      50   52.46              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3600

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6937.62     3.4 6937.62   12.79 6937.38   31.35 6936.43    41.1 6935.11
```

```
   72.31 6930.64   72.71 6930.58   85.12 6931.53   99.12 6932.37  109.14 6933.33
  125.17 6934.55  145.22 6931.88  153.89 6930.85  173.12 6935.35  181.06  6937.1
  185.24 6937.26  194.98 6937.26

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05       0    .045  181.06     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  181.06            62.01      50    47.9             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3550

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6935.73    5.33 6935.73   37.55 6934.96   49.84 6933.13   73.26 6929.49
   73.65 6929.51   95.34 6930.85  104.54  6931.6  109.72 6931.57  122.26 6931.76
  135.86 6930.75   147.9 6929.91  163.85 6933.22  175.35 6935.76  179.76 6935.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   37.55    .045  175.35     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         37.55  175.35            59.06      50   53.38             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3500

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6935.25   15.01 6935.25   28.58 6934.15   35.27  6933.7   49.03 6931.78
   74.87  6928.8      75 6928.81   88.97 6930.15   92.89 6930.24   97.98 6929.93
```

```
  111.92 6929.62  120.37 6928.86  136.63 6932.23  146.26 6934.93     150 6934.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.01    .045  146.26     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.01  146.26             39.9      50   66.73             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3450

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6933.2   12.09  6933.2   13.53 6932.95   41.86 6930.45    64.8 6928.71
      75 6928.49   78.25 6928.42   89.89 6928.01  109.29 6933.08  109.55 6933.15
     150 6933.15

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   12.09    .045  109.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         12.09  109.55             24.8      50  100.26             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3400

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6932.69   17.69 6932.69   60.53 6928.38   63.35 6928.09   63.87 6928.07
   72.82 6927.76   80.87 6927.47   86.02 6928.04  105.87 6929.71  122.83 6930.24
  177.44 6932.03  180.28 6932.03
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   17.69    .045  177.44     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         17.69  177.44             54.43      50   48.43              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3350

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6932.72     3.8 6932.72    5.77 6932.69    7.36  6932.6   35.04 6931.32
   58.71 6927.57   67.53 6926.42   69.95 6926.44   73.79 6926.56   81.57 6926.79
   98.39 6928.03  119.22 6929.56  143.64 6930.24  162.24 6930.68  169.23 6930.68

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   35.04    .045  162.24     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         35.04  162.24              60.4      50   46.98              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3300

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6931.16    1.46 6931.16   44.98 6930.18   48.76  6929.8   64.02 6925.77
   69.23 6924.78   72.69 6924.97   73.78 6925.03   84.98 6925.91  105.49 6927.36
   128.8 6929.31  141.49 6929.55  185.07 6931.08  185.49 6931.08     192 6931.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .05   44.98    .045   128.8     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         44.98   128.8             56.3      50   33.79             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3250

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6929.55    4.97 6929.53   22.77 6929.02   50.59 6928.45   55.37 6927.16
    70.4 6923.75   73.72 6924.03   77.53 6924.34   81.44 6924.74   88.07 6925.55
  122.82  6929.1  123.27 6929.11  155.02 6929.73  171.66 6930.38  173.05 6930.38

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   50.59    .045  122.82     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         50.59  122.82            48.03      50   52.79             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3200

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6928.61   16.79 6928.61   37.89 6927.96   47.88 6927.46   61.58  6925.2
   70.66 6923.44      75 6923.29   75.47 6923.28   79.54 6923.32  108.39 6927.73
  109.33 6927.91  114.48  6928.1  140.39 6929.05     150 6929.31

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   47.88    .045  109.33     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         47.88  109.33             50.1      50   50.13              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3150

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6926.88   22.24 6926.88   45.77 6926.19   52.94 6924.92   62.61 6923.15
      75 6923.39   82.58 6923.53    93.8 6923.61  101.67 6925.21  106.55 6926.24
  133.38 6928.12  144.02 6928.52     150 6928.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.77    .045  106.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.77  106.55            44.23      50   56.79              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 3100

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6925.44   41.21 6925.44   42.21 6925.41   42.95 6925.29   60.07 6921.98
   72.45  6922.5      75 6922.53   96.06 6922.78  107.62 6924.87  109.76 6925.31
  120.75 6926.15  136.34 6927.41  138.56 6927.55  141.06 6927.59     150 6927.59

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   42.21    .045  109.76     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         42.21  109.76             33.1      50   68.21              .1       .3
```

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 3050

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6927.04	20.4	6926.3	37.77	6925.36	47.85	6924.76	63.81	6921.9
64.86	6921.72	68.48	6921.7	75	6921.67	101.35	6921.56	109.5	6922.78
119.15	6924.48	139.32	6925.18	150	6925.18				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	47.85	.045	119.15	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
47.85	119.15	67.72	50	48.85	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 3000

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6926.75	12.07	6926.75	30.38	6924.81	46.17	6923.42	69.32	6920.99
70.32	6920.85	70.81	6920.84	75	6920.75	83.92	6920.57	92.87	6922.59
100.45	6924.17	134.8	6924.77	150	6924.77				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	12.07	.045	100.45	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.07	100.45	64.93	50	45.01	.1	.3

CROSS SECTION

```
RIVER: Existing Channel
REACH: East                RS: 2950

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6925.81   18.13 6925.81   19.68 6925.79   20.08 6925.76   21.08  6925.7
   40.93 6924.34   62.31 6920.25   64.23 6919.84    65.4 6919.86   73.12 6919.94
   79.78 6920.01    89.4 6921.77   95.22 6922.65  166.18 6924.46  175.43  6924.7
  179.51  6924.7

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.93    .045   95.22     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.93   95.22            50.79      50   51.25             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 2900

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6924.92    20.3 6924.92   22.17 6924.89   24.13 6924.76   41.82 6923.67
   59.09 6919.82   61.33 6919.34   64.69 6919.34   73.26 6919.33   82.61 6919.31
   94.28 6920.95      99 6921.46  183.37 6923.45  185.87 6923.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   41.82    .045      99     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         41.82      99            65.91      50   45.14             .1       .3

CROSS SECTION
```

```
RIVER: Existing Channel
REACH: East                RS: 2850

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6923.53   14.01 6923.53   32.65 6922.77   47.73 6922.24   62.37 6918.47
   64.37 6917.96   70.64 6918.05   72.59 6918.07   78.56 6918.13   84.89 6918.97
   98.45 6920.68  118.89 6921.29  188.61 6923.26  189.28 6923.26

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   14.01    .045  118.89     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         14.01  118.89            66.73      50   53.41              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 2800

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6922.35   10.49 6922.35   37.01 6921.12   54.97 6920.34   63.84 6917.94
   66.89 6917.16      75 6917.29   81.41 6917.39    81.5 6917.39   81.68 6917.42
    98.3 6920.39  144.82 6921.51     150 6921.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   54.97    .045    98.3     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         54.97    98.3            67.78      50   48.95              .1       .3

CROSS SECTION


RIVER: Existing Channel
```

```
REACH: East                RS: 2750

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6920.98    8.09 6920.98   32.07 6919.62   49.48 6918.77   61.26 6917.17
   64.88 6916.55      75 6915.94   75.38 6915.92   78.15 6915.84   83.39 6917.25
   92.71 6919.98     150 6919.98

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    8.09    .045   92.71     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.09   92.71             45.41      50   50.66              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 2700

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6919.86   10.07 6919.86   28.38 6918.78   49.99 6917.31   60.09 6916.05
   67.57 6915.26   70.91 6915.09      75 6914.88   77.09 6914.78   83.92 6917.05
   90.44 6919.08  131.67 6919.81     150 6919.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   10.07    .045   90.44     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         10.07   90.44             62.4      50   52.53              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East                RS: 2650
```

```
INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6919.1    8.33  6919.1   17.17 6918.81   23.07 6918.56   53.21 6917.64
   56.81 6916.91   68.79 6914.18   72.13 6913.94      75 6913.83   78.45 6913.71
   89.72 6916.51    95.1 6918.05  106.86 6918.14     150 6918.14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   53.21    .045    95.1     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         53.21    95.1             54.3      50   79.13             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2600

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6918.03   15.61 6918.03   18.34 6917.93   20.86 6917.82   26.37  6917.5
   46.83 6916.29   48.34 6915.95      62 6913.18   68.32 6912.98   71.23  6912.9
   73.59 6912.84   82.87 6915.73   87.16  6916.8  113.27 6916.84  164.93  6917.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.83    .045   87.16     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.83   87.16            60.01      50   72.05             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2550

INPUT
Description:
```

```
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6917.98   16.03 6917.98    30.3 6917.37   33.44 6916.28   39.01 6915.48
   47.77 6914.45   64.51 6912.49   71.43 6912.49   71.67 6912.49   75.28 6912.38
   89.77 6914.65   90.88 6914.77  108.35 6915.07  144.31 6915.68  157.36 6915.97
  178.95 6916.25  199.36 6916.51  211.51 6916.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   47.77    .045  108.35     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         47.77  108.35            65.45      50    93.8             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2500

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6917.34   21.33 6917.34   43.19 6915.76   50.05 6915.24   58.83 6913.21
   65.27  6911.7   72.35 6911.56   73.69 6911.54   75.82 6911.56   81.29 6912.14
    96.3 6913.77  116.43 6914.35  183.46 6915.89  185.27 6915.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   21.33    .045  183.46     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         21.33  183.46            69.23      50    85.3             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2450

INPUT
Description:
Station Elevation Data    num=      13
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6914.52     .64 6914.52   46.94 6913.89   51.13 6913.72   53.31 6913.16
   67.55 6910.62      75  6910.7   78.02 6910.73   79.98 6910.73   98.22 6913.34
   98.49 6913.37  134.64 6914.39     150 6914.39

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.94    .045   98.49     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.94   98.49            38.25      50   54.23              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2400

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6913.88     .43 6913.88    22.4 6913.14   42.22 6912.55   51.23 6911.52
   66.38 6909.67   72.38 6908.29      75 6907.83   75.12 6907.81   79.67 6909.31
   90.18 6912.93  130.62 6913.82     150 6913.82

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   42.22    .045   90.18     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         42.22   90.18            62.04      50   59.15              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2350

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6913.3   15.78  6913.3   61.91 6911.47   66.32 6911.31   76.86 6910.37
```

```
   95.48 6908.73  100.28 6908.56  101.17  6908.5  104.23 6908.31  110.73 6909.36
  126.12 6911.75   135.5 6912.03  171.12  6912.6  174.35  6912.6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.78    .045   135.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.78   135.5            50.75      50   50.85             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2300

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6911.72   22.76 6911.72   33.65 6911.34   69.33  6910.1   78.94 6909.72
    85.8 6908.79    90.2 6908.18  100.69 6908.29  102.97 6908.31   116.1 6908.44
  121.54 6909.11   135.6 6911.06  146.49 6911.35   179.8 6912.22  187.16 6912.38
  192.88 6912.56  216.57 6912.97     229 6912.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   78.94    .045   135.6     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         78.94   135.6            40.98      50   54.76             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2250

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6910.61    1.56 6910.61   23.77 6909.76   50.13 6908.84   60.48  6907.4
   61.16 6907.31    62.7  6907.3      75 6907.38      89 6907.46    92.6 6908.02
```

```
  107.95 6910.49  119.02 6910.41     150 6910.41

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    1.56    .045  107.95     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1.56  107.95            49.97      50   49.41             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2200

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6910.07    8.28 6910.07    13.9 6909.74   24.43 6909.15   45.28 6908.07
   57.94 6906.38   59.54 6906.18   61.87 6906.21      75  6906.3   88.29 6906.39
   94.06 6907.33   109.9 6910.46     150 6910.46

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    8.28    .045   109.9     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.28   109.9            53.67      50   48.88             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2150

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6909.25     5.2 6909.25   19.11  6908.3   32.48 6907.46   50.08 6905.59
   53.71 6905.09   59.94 6905.13      75 6905.29   92.37 6905.47  103.43 6907.89
  118.11 6910.41  137.07 6910.55  144.67 6910.76     150 6910.76
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05     5.2    .045  118.11     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           5.2  118.11             34.58      50   63.09              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2100

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6908.5    6.15  6908.5   10.02 6908.21   19.07 6907.14   26.74 6906.22
   32.27 6905.66   49.04 6903.79      75 6904.43   88.43 6904.77  103.66  6905.1
  122.34 6909.12   127.5 6909.92  143.26 6910.52     150 6910.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    6.15    .045   127.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          6.15   127.5             31.66      50    64.9              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2050

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6907.45    9.89 6907.45   17.07 6906.74   23.21 6905.85   42.66 6903.64
   45.68 6903.25      75 6903.71   98.82 6904.09  109.01 6904.25  110.23 6904.49
  132.05 6908.89     142 6909.17     150 6909.17

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .05    9.89    .045  132.05     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9.89  132.05            49.84      50   49.41             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 2000

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6906.54    9.47 6906.54   20.03 6905.52   29.79 6904.81   44.84 6903.15
   46.69 6902.93   50.42 6902.97      75 6903.16  111.98 6903.44  122.44 6905.66
  132.44 6907.76  144.92 6907.83     150 6907.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    9.47    .045  132.44     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9.47  132.44            47.64      50    56.5             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1950

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6906.83     2.6 6906.83   24.26 6906.52    57.8  6904.5   68.74 6903.96
    75.6 6903.31   86.59 6902.27   110.3 6902.52  134.76 6902.78  138.55  6902.8
  144.24 6903.49  165.28 6905.85  170.19 6906.05  182.84 6906.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   24.26    .045  170.19     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         24.26  170.19            52.36      50    54.3              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1900

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6906.08    5.45 6906.08    18.2 6905.94   28.51 6905.83   53.96 6904.57
    81.9 6902.98   82.53 6902.93   98.87 6901.84  114.34  6901.8  127.32 6901.77
  130.99  6901.8  137.41 6902.43  143.62 6903.03  173.17 6905.83  186.59 6905.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   28.51    .045  173.17     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         28.51  173.17            63.75      50   36.61              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1850

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6904.47   10.75 6904.47   13.78 6904.31   33.62 6903.13   51.09 6902.12
   52.48 6901.98   61.55 6901.26      75 6901.25   81.26 6901.25    88.3  6901.2
  104.78 6902.72  137.72 6905.89     150 6905.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   10.75    .045  137.72     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         10.75  137.72            61.98      50   38.16              .1       .3
```

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 1800

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6903.01	10.31	6903.01	20.44	6902.68	47.13	6901.17	48.74	6901.04
58.16	6900.25	69.18	6900.3	75	6900.32	93.92	6900.39	132.45	6905.6
133.42	6905.71	133.78	6905.72	148.41	6905.96	150	6905.96		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	10.31	.045	133.78	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
10.31	133.78	50.79	50	53.54	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 1750

INPUT
Description:
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6903.28	1.47	6903.28	3.64	6903.26	15.26	6902.98	16.04	6902.96
51.67	6902.08	60.78	6901.9	64.92	6901.8	92.65	6900.99	104.5	6900.66
106.01	6900.54	119.29	6899.84	139.25	6899.82	140.69	6899.82	159.99	6899.76
164.67	6899.75	195.04	6904.47	196.26	6904.65	197.05	6904.67	212.31	6904.88
212.46	6904.88								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	15.26	.045	196.26	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.26	196.26	61.55	50	50.72	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 1700

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6903	.45	6903	3.91	6902.88	31.82	6901.95	34.62	6901.88
36.89	6901.82	115.47	6900.28	119.22	6900.19	123.6	6899.98	140.07	6899.58
161.01	6899.71	163.07	6899.72	182.45	6899.75	186.05	6899.76	214.78	6903.01
215.32	6903.07	215.47	6903.08	234.71	6903.44	269.69	6904.2	276.85	6904.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	3.91	.045	215.47	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
3.91	215.47	28.94	50	59.09	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 1650

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6902.16	4.27	6902.16	6.93	6902.4	12.64	6902.49	15.67	6902.55
21.47	6902.35	25.2	6902.23	52.02	6901.33	103.14	6900.15	118.47	6899.75
142.92	6898.99	157.7	6899.12	160.56	6899.28	174.94	6899.63	175.17	6899.63
188.88	6899.92	189.58	6899.93	197.96	6899.52	201.38	6899.35	218.42	6901.04
224.9	6901.7	228.87	6901.79	281.79	6902.4	295.03	6902.4		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	15.67	.045	224.9	.05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

```
         15.67   224.9            50.13      50   73.62             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1600

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6901.59    2.06 6901.59    7.04 6901.57   15.57 6901.33   43.98 6900.34
   66.12 6899.74   74.32 6899.49  118.46 6899.89  145.39 6899.62  166.55  6899.4
  180.14 6898.93  185.57 6898.29  201.22 6899.59  206.55 6899.96  252.15 6900.82
  254.18 6900.88  255.31 6900.91  259.84 6900.91

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    7.04    .045  254.18     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          7.04  254.18             77.3      50   30.02             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1550

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6900.06    4.45 6900.06    9.08 6900.11   32.59 6899.49   43.11 6899.21
   85.62 6898.17  136.71 6897.97  148.44 6897.92  152.79 6897.91  154.06 6897.87
  157.25 6897.99  202.23 6899.17  208.34 6899.21  236.29 6900.05  262.22 6900.88
  275.94 6900.88

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    9.08    .045  262.22     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

```
          9.08  262.22            50.69      50   49.44              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1500

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6899.23   10.45 6898.71   16.94 6898.13   54.66 6897.28   72.38 6897.55
   92.11 6897.48  108.73 6897.41  135.95 6897.51  142.61 6897.58  144.79  6897.6
  172.75 6898.08  172.79 6898.08  180.01 6898.25  214.74  6899.1  227.93  6899.3
  259.53 6900.29  259.56 6900.29  266.11 6900.29

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05       0    .045  259.53     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  259.53            65.39      50   50.26              .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1450

INPUT
Description:
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6897.19     2.4 6897.19     7.1 6897.19    9.98 6897.11   13.15 6897.51
   28.03 6897.92   30.39 6897.92   33.72 6897.79    64.2 6896.43   97.65    6897
  111.18 6897.22  136.14 6897.73  136.58 6897.73  136.63 6897.73  137.26 6897.73
   179.1 6896.36  180.44 6896.37   183.9 6896.41  185.63 6896.94  208.58 6897.29
  258.32 6899.12  259.97 6899.22  265.98 6899.49  280.35 6899.49   302.4 6899.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   30.39    .045  265.98     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         30.39  265.98           109.19      50   50.75             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1400

INPUT
Description:
Station Elevation Data    num=      23
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6895.61     .12 6895.61   36.32 6896.21   53.71 6896.47   75.26 6897.27
   76.03 6897.29   76.07 6897.29   91.24 6896.72   97.25 6896.52  100.08 6895.77
  125.33 6894.94  129.54 6894.98  135.84 6895.04  139.62 6896.21  153.34 6896.42
  183.07 6897.51  193.08 6898.17  218.95 6899.32  220.94 6899.32  222.25 6899.32
  229.54 6899.61  237.52 6899.45  241.42 6899.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   76.07    .045  218.95     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         76.07  218.95            51.77      50   59.74             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1350

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6897.05     .01 6897.05    6.43 6895.86   11.05 6895.69   23.15  6895.3
   28.83 6893.78   36.57 6893.53   43.63  6893.6   52.76 6893.68   58.59 6895.48
    63.1 6895.55   72.88 6895.91   91.22 6897.11   100.4 6897.52  111.21 6897.52
  118.27  6897.5  140.44  6898.4  156.39  6898.4

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05       0    .045   100.4     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   100.4            44.72      50   60.04             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1300

INPUT
Description:
Station Elevation Data    num=      23
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6895.69    2.98 6895.69    11.3 6896.14   21.38 6895.92   37.79 6893.21
   45.21 6891.73   57.32 6891.49   62.54 6889.74   62.55 6889.74   66.21 6889.28
   69.25 6889.35      75 6889.28    85.9 6889.13   91.38 6892.02   96.92 6892.54
  127.41 6893.56  129.81 6893.59  137.69 6895.62  140.07 6895.68  144.43 6895.79
  146.08  6895.8  147.85 6896.16     150 6896.16

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   21.38    .045  137.69     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         21.38  137.69            53.12      50   50.07             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1250

INPUT
Description:
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6894.47    2.29 6894.47    7.64 6894.85    25.6 6893.42   34.28 6893.23
   42.32  6891.9   45.96 6891.17   51.88 6891.06   54.44  6890.2   54.45  6890.2
   65.86 6888.78      75 6888.97   75.36 6888.98    85.1 6888.85   88.31 6890.54
  104.84  6892.1  123.12 6892.71  129.88  6892.8   134.6 6894.01  141.16 6894.17
     150 6894.17

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    7.64    .045   134.6     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          7.64   134.6            56.63      50   49.44             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1200

INPUT
Description:
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6892.64   36.66 6892.64   38.75 6892.52   40.72 6892.49    42.5 6891.63
   42.59 6889.77   45.59 6890.58   47.79 6890.64    47.8 6890.64    48.4 6890.41
   65.51 6888.27      75 6888.47   81.47 6888.61    84.3 6888.57   85.23 6889.07
  112.76 6891.66  118.83 6891.86  129.94    6892   131.5  6892.4  142.26 6892.66
     150 6892.66

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   36.66    .045   131.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         36.66   131.5            46.46      50   82.68             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1150

INPUT
Description:
Station Elevation Data    num=      19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6894.07    2.72 6894.07    9.98 6893.64   21.21 6891.55   25.74 6891.01
   35.28 6889.26   55.82 6886.35   62.27 6885.25   67.09 6885.33   72.87 6885.38
   82.05 6885.45  123.13 6886.62  131.01 6888.31  159.52 6889.99  175.93 6890.37
   182.4  6890.4  182.62 6890.41   183.5 6890.43  186.85 6890.43
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    9.98    .045  175.93     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9.98  175.93             49.8      50   49.97             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1100

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6893.38    7.97 6893.47   11.03 6893.11   43.57 6887.14   55.97 6885.38
   59.86 6884.72   72.02 6884.92   74.21 6884.96   82.63 6885.03  105.76 6885.69
  124.96 6889.81  142.19 6890.83  178.29 6891.67  192.54 6891.73  193.02 6891.75
  194.96  6891.8  199.21  6891.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    7.97    .045  178.29     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          7.97  178.29            50.13      50   72.83             .1       .3

CROSS SECTION


RIVER: Existing Channel
REACH: East               RS: 1050

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6892.05   10.03 6892.05   13.94 6892.08   15.76 6892.37   40.21 6887.63
   40.39 6887.58   54.33 6885.03   58.63 6884.41   59.99 6884.18    73.7 6884.42
   83.82 6884.59   85.74 6884.61   91.01 6884.76  121.46  6891.3  127.47 6891.66
  171.48 6891.66
```

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	15.76	.045	127.47	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.76	127.47	72.28	50	51.48	.1	.3

CROSS SECTION

RIVER: Existing Channel
REACH: East RS: 1000

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6891.26	5.44	6891.26	11.48	6891.3	19.25	6891.2	19.5	6891.76
19.5	6891.74	19.58	6891.76	26.72	6892.42	26.75	6892.42	26.76	6892.42
31.73	6892.62	38.17	6892.85	39.06	6892.87	53.88	6890.92	62.2	6883.33
75.01	6883.38	76.97	6883.39	89.26	6887.7	96.33	6893.15	97.62	6892.7
104.25	6892.35	105.39	6892.98	105.63	6892.96	106.44	6892.9	107.05	6892.85
150.01	6892.85								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	39.06	.045	96.33	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
39.06	96.33	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Existing Channel

Reach	River Sta.	n1	n2	n3
East	5000	.05	.045	.05
East	4950	.05	.045	.05
East	4900	.05	.045	.05
East	4850	.05	.045	.05
East	4800	.05	.045	.05

East	4750	.05	.045	.05
East	4700	.05	.045	.05
East	4650	.05	.045	.05
East	4600	.05	.045	.05
East	4550	.05	.045	.05
East	4500	.05	.045	.05
East	4450	.05	.045	.05
East	4400	.05	.045	.05
East	4350	.05	.045	.05
East	4300	.05	.045	.05
East	4250	.05	.045	.05
East	4200	.05	.045	.05
East	4150	.05	.045	.05
East	4100	.05	.045	.05
East	4050	.05	.045	.05
East	4000	.05	.045	.05
East	3950	.05	.045	.05
East	3900	.05	.045	.05
East	3850	.05	.045	.05
East	3800	.05	.045	.05
East	3750	.05	.045	.05
East	3700	.05	.045	.05
East	3650	.05	.045	.05
East	3600	.05	.045	.05
East	3550	.05	.045	.05
East	3500	.05	.045	.05
East	3450	.05	.045	.05
East	3400	.05	.045	.05
East	3350	.05	.045	.05
East	3300	.05	.045	.05
East	3250	.05	.045	.05
East	3200	.05	.045	.05
East	3150	.05	.045	.05
East	3100	.05	.045	.05
East	3050	.05	.045	.05
East	3000	.05	.045	.05
East	2950	.05	.045	.05
East	2900	.05	.045	.05
East	2850	.05	.045	.05
East	2800	.05	.045	.05
East	2750	.05	.045	.05
East	2700	.05	.045	.05
East	2650	.05	.045	.05
East	2600	.05	.045	.05

East	2550	.05	.045	.05
East	2500	.05	.045	.05
East	2450	.05	.045	.05
East	2400	.05	.045	.05
East	2350	.05	.045	.05
East	2300	.05	.045	.05
East	2250	.05	.045	.05
East	2200	.05	.045	.05
East	2150	.05	.045	.05
East	2100	.05	.045	.05
East	2050	.05	.045	.05
East	2000	.05	.045	.05
East	1950	.05	.045	.05
East	1900	.05	.045	.05
East	1850	.05	.045	.05
East	1800	.05	.045	.05
East	1750	.05	.045	.05
East	1700	.05	.045	.05
East	1650	.05	.045	.05
East	1600	.05	.045	.05
East	1550	.05	.045	.05
East	1500	.05	.045	.05
East	1450	.05	.045	.05
East	1400	.05	.045	.05
East	1350	.05	.045	.05
East	1300	.05	.045	.05
East	1250	.05	.045	.05
East	1200	.05	.045	.05
East	1150	.05	.045	.05
East	1100	.05	.045	.05
East	1050	.05	.045	.05
East	1000	.05	.045	.05

SUMMARY OF REACH LENGTHS

River: Existing Channel

Reach	River Sta.	Left	Channel	Right
East	5000	53.22	50	51.12
East	4950	56.3	50	55.05

East	4900	71.1	50	38.94
East	4850	49.15	50	56.56
East	4800	61.25	50	43.37
East	4750	62.73	50	41.17
East	4700	48.59	50	53.31
East	4650	31.33	50	63.68
East	4600	31.96	50	60.47
East	4550	69.03	50	28.51
East	4500	50.62	50	52.59
East	4450	46.56	50	51.87
East	4400	61.22	50	41.17
East	4350	50.69	50	48.39
East	4300	39.47	50	60.56
East	4250	47.28	50	53.35
East	4200	34.12	50	59.42
East	4150	54.56	50	47.87
East	4100	78.87	50	30.41
East	4050	48.52	50	51.38
East	4000	53.35	50	53.9
East	3950	66.9	50	63.88
East	3900	29.56	50	67.78
East	3850	54.23	50	63.45
East	3800	51.02	50	49.21
East	3750	52.26	50	46.49
East	3700	60.14	50	33.53
East	3650	51.25	50	52.46
East	3600	62.01	50	47.9
East	3550	59.06	50	53.38
East	3500	39.9	50	66.73
East	3450	24.8	50	100.26
East	3400	54.43	50	48.43
East	3350	60.4	50	46.98
East	3300	56.3	50	33.79
East	3250	48.03	50	52.79
East	3200	50.1	50	50.13
East	3150	44.23	50	56.79
East	3100	33.1	50	68.21
East	3050	67.72	50	48.85
East	3000	64.93	50	45.01
East	2950	50.79	50	51.25
East	2900	65.91	50	45.14
East	2850	66.73	50	53.41
East	2800	67.78	50	48.95
East	2750	45.41	50	50.66

East	2700	62.4	50	52.53
East	2650	54.3	50	79.13
East	2600	60.01	50	72.05
East	2550	65.45	50	93.8
East	2500	69.23	50	85.3
East	2450	38.25	50	54.23
East	2400	62.04	50	59.15
East	2350	50.75	50	50.85
East	2300	40.98	50	54.76
East	2250	49.97	50	49.41
East	2200	53.67	50	48.88
East	2150	34.58	50	63.09
East	2100	31.66	50	64.9
East	2050	49.84	50	49.41
East	2000	47.64	50	56.5
East	1950	52.36	50	54.3
East	1900	63.75	50	36.61
East	1850	61.98	50	38.16
East	1800	50.79	50	53.54
East	1750	61.55	50	50.72
East	1700	28.94	50	59.09
East	1650	50.13	50	73.62
East	1600	77.3	50	30.02
East	1550	50.69	50	49.44
East	1500	65.39	50	50.26
East	1450	109.19	50	50.75
East	1400	51.77	50	59.74
East	1350	44.72	50	60.04
East	1300	53.12	50	50.07
East	1250	56.63	50	49.44
East	1200	46.46	50	82.68
East	1150	49.8	50	49.97
East	1100	50.13	50	72.83
East	1050	72.28	50	51.48
East	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Existing Channel

Reach	River Sta.	Contr.	Expan.

East	5000	.1	.3
East	4950	.1	.3
East	4900	.1	.3
East	4850	.1	.3
East	4800	.1	.3
East	4750	.1	.3
East	4700	.1	.3
East	4650	.1	.3
East	4600	.1	.3
East	4550	.1	.3
East	4500	.1	.3
East	4450	.1	.3
East	4400	.1	.3
East	4350	.1	.3
East	4300	.1	.3
East	4250	.1	.3
East	4200	.1	.3
East	4150	.1	.3
East	4100	.1	.3
East	4050	.1	.3
East	4000	.1	.3
East	3950	.1	.3
East	3900	.1	.3
East	3850	.1	.3
East	3800	.1	.3
East	3750	.1	.3
East	3700	.1	.3
East	3650	.1	.3
East	3600	.1	.3
East	3550	.1	.3
East	3500	.1	.3
East	3450	.1	.3
East	3400	.1	.3
East	3350	.1	.3
East	3300	.1	.3
East	3250	.1	.3
East	3200	.1	.3
East	3150	.1	.3
East	3100	.1	.3
East	3050	.1	.3
East	3000	.1	.3
East	2950	.1	.3
East	2900	.1	.3

East	2850	.1	.3
East	2800	.1	.3
East	2750	.1	.3
East	2700	.1	.3
East	2650	.1	.3
East	2600	.1	.3
East	2550	.1	.3
East	2500	.1	.3
East	2450	.1	.3
East	2400	.1	.3
East	2350	.1	.3
East	2300	.1	.3
East	2250	.1	.3
East	2200	.1	.3
East	2150	.1	.3
East	2100	.1	.3
East	2050	.1	.3
East	2000	.1	.3
East	1950	.1	.3
East	1900	.1	.3
East	1850	.1	.3
East	1800	.1	.3
East	1750	.1	.3
East	1700	.1	.3
East	1650	.1	.3
East	1600	.1	.3
East	1550	.1	.3
East	1500	.1	.3
East	1450	.1	.3
East	1400	.1	.3
East	1350	.1	.3
East	1300	.1	.3
East	1250	.1	.3
East	1200	.1	.3
East	1150	.1	.3
East	1100	.1	.3
East	1050	.1	.3
East	1000	.1	.3

HEC-RAS Plan: Existing River: Existing Channel Reach: East

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	5000	100-YR	43.00	6959.70	6960.86	6960.86	6961.15	0.036699	4.36	9.86	17.05	1.01
East	5000	5-YR	4.00	6959.70	6960.15	6960.15	6960.26	0.049278	2.69	1.49	6.62	1.00
East	4950	100-YR	43.00	6957.48	6958.53		6958.71	0.022577	3.43	12.52	21.61	0.80
East	4950	5-YR	4.00	6957.48	6957.89	6957.84	6957.95	0.030306	1.99	2.01	9.76	0.78
East	4900	100-YR	43.00	6956.08	6957.19	6957.14	6957.44	0.028870	3.98	10.80	17.92	0.90
East	4900	5-YR	4.00	6956.08	6956.53	6956.47	6956.59	0.024429	1.97	2.03	8.53	0.71
East	4850	100-YR	43.00	6954.44	6955.51	6955.51	6955.84	0.035476	4.60	9.35	14.50	1.01
East	4850	5-YR	4.00	6954.44	6954.77	6954.77	6954.88	0.050805	2.71	1.48	6.68	1.02
East	4800	100-YR	43.00	6953.12	6954.22		6954.33	0.009349	2.69	15.98	20.46	0.54
East	4800	5-YR	4.00	6953.12	6953.41		6953.44	0.015502	1.48	2.70	12.39	0.56
East	4750	100-YR	43.00	6952.24	6953.55		6953.73	0.015007	3.39	12.69	16.31	0.68
East	4750	5-YR	4.00	6952.24	6952.70		6952.74	0.012493	1.67	2.39	7.75	0.53
East	4700	100-YR	43.00	6951.54	6952.77		6952.96	0.016053	3.46	12.44	16.32	0.70
East	4700	5-YR	4.00	6951.54	6951.92		6951.97	0.019453	1.90	2.11	7.91	0.65
East	4650	100-YR	43.00	6950.54	6951.74	6951.65	6951.99	0.023552	3.95	10.87	15.56	0.83
East	4650	5-YR	4.00	6950.54	6951.00	6950.91	6951.06	0.017481	1.84	2.18	7.89	0.62
East	4600	100-YR	43.00	6949.23	6950.23	6950.23	6950.54	0.035718	4.46	9.64	15.79	1.01
East	4600	5-YR	4.00	6949.23	6949.53	6949.53	6949.64	0.052726	2.65	1.51	7.26	1.02
East	4550	100-YR	43.00	6947.88	6949.52		6949.60	0.006158	2.36	18.23	20.70	0.44
East	4550	5-YR	4.00	6947.88	6948.60		6948.62	0.004239	1.06	3.78	10.84	0.32
East	4500	100-YR	43.00	6947.90	6948.82		6949.04	0.024525	3.83	11.22	17.43	0.84
East	4500	5-YR	4.00	6947.90	6948.19		6948.23	0.018267	1.65	2.43	10.75	0.61
East	4450	100-YR	43.00	6946.40	6947.45	6947.40	6947.74	0.027957	4.27	10.06	14.54	0.91
East	4450	5-YR	4.00	6946.40	6946.71	6946.71	6946.81	0.050436	2.48	1.62	8.31	0.99
East	4400	100-YR	43.00	6944.96	6946.69		6946.85	0.011515	3.24	13.26	14.71	0.60
East	4400	5-YR	4.00	6944.96	6945.69		6945.73	0.009171	1.60	2.50	6.78	0.46
East	4350	100-YR	43.00	6944.46	6945.83		6946.08	0.020831	4.04	10.64	13.31	0.80
East	4350	5-YR	4.00	6944.46	6944.96	6944.89	6945.03	0.023999	2.15	1.86	6.76	0.72
East	4300	100-YR	43.00	6943.79	6945.06	6944.81	6945.23	0.013613	3.28	13.12	16.46	0.65
East	4300	5-YR	4.00	6943.79	6944.24		6944.27	0.010147	1.48	2.70	9.00	0.48

HEC-RAS Plan: Existing River: Existing Channel Reach: East (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	4250	100-YR	43.00	6942.82	6943.85	6943.85	6944.17	0.035008	4.55	9.45	14.74	1.00
East	4250	5-YR	4.00	6942.82	6943.19	6943.19	6943.28	0.053175	2.47	1.62	8.74	1.01
East	4200	100-YR	43.00	6941.68	6943.18		6943.25	0.004488	2.09	20.61	22.22	0.38
East	4200	5-YR	4.00	6941.68	6942.29		6942.30	0.001900	0.78	5.11	12.64	0.22
East	4150	100-YR	43.00	6941.65	6942.47	6942.47	6942.73	0.037587	4.09	10.52	20.50	1.01
East	4150	5-YR	4.00	6941.65	6941.96	6941.96	6942.03	0.046812	2.16	1.85	11.10	0.93
East	4100	100-YR	43.00	6940.48	6941.42		6941.50	0.008415	2.29	18.76	28.36	0.50
East	4100	5-YR	4.00	6940.48	6940.76		6940.78	0.010299	1.13	3.54	18.02	0.45
East	4050	100-YR	43.00	6939.60	6940.41	6940.41	6940.70	0.037059	4.31	9.97	17.56	1.01
East	4050	5-YR	4.00	6939.60	6939.81	6939.79	6939.88	0.039089	2.12	1.88	10.01	0.86
East	4000	100-YR	43.00	6938.49	6940.37		6940.39	0.001184	1.18	36.59	34.47	0.20
East	4000	5-YR	4.00	6938.49	6938.88		6938.91	0.011363	1.42	2.82	10.93	0.49
East	3950	100-YR	43.00	6937.94	6940.35		6940.36	0.000326	0.65	66.18	57.94	0.11
East	3950	5-YR	4.00	6937.94	6938.47		6938.49	0.006433	1.15	3.46	11.95	0.38
East	3900	100-YR	880.00	6937.13	6939.82		6940.07	0.007176	3.98	221.03	129.74	0.54
East	3900	5-YR	14.00	6937.13	6937.71	6937.67	6937.74	0.020669	1.37	10.21	65.67	0.61
East	3850	100-YR	880.00	6935.31	6938.98		6939.51	0.017110	5.86	150.07	94.14	0.82
East	3850	5-YR	14.00	6935.31	6936.24	6936.21	6936.44	0.033437	3.56	3.93	8.45	0.92
East	3800	100-YR	880.00	6934.35	6937.63	6937.63	6938.44	0.026291	7.21	121.99	76.87	1.01
East	3800	5-YR	14.00	6934.35	6935.18		6935.25	0.016913	2.19	6.40	17.38	0.64
East	3750	100-YR	880.00	6933.18	6935.97	6935.97	6936.69	0.026437	6.83	128.91	89.51	1.00
East	3750	5-YR	14.00	6933.18	6933.93	6933.90	6934.08	0.033448	3.10	4.51	12.14	0.90
East	3700	100-YR	880.00	6931.90	6935.52		6935.80	0.007109	4.18	210.53	113.85	0.54
East	3700	5-YR	14.00	6931.90	6932.80		6932.89	0.017452	2.47	5.67	13.17	0.66
East	3650	100-YR	880.00	6931.20	6934.83	6934.62	6935.26	0.016635	5.24	168.06	122.56	0.79
East	3650	5-YR	14.00	6931.20	6932.18		6932.24	0.010004	2.03	6.89	14.16	0.51
East	3600	100-YR	880.00	6930.58	6933.47	6933.47	6934.19	0.026631	6.81	129.30	90.30	1.00
East	3600	5-YR	14.00	6930.58	6931.22	6931.20	6931.34	0.040634	2.85	4.91	17.42	0.95
East	3550	100-YR	880.00	6929.49	6932.59		6932.98	0.011886	4.99	176.41	107.50	0.69
East	3550	5-YR	14.00	6929.49	6930.27		6930.31	0.011960	1.72	8.13	24.52	0.53

HEC-RAS Plan: Existing River: Existing Channel Reach: East (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	3500	100-YR	880.00	6928.80	6932.16		6932.50	0.007413	4.65	189.41	90.02	0.56
East	3500	5-YR	14.00	6928.80	6929.43		6929.50	0.022467	2.21	6.33	21.03	0.71
East	3450	100-YR	880.00	6928.01	6931.43		6931.99	0.013155	6.03	146.02	72.18	0.75
East	3450	5-YR	14.00	6928.01	6928.72		6928.76	0.010592	1.58	8.87	27.90	0.49
East	3400	100-YR	880.00	6927.47	6930.79	6930.47	6931.25	0.015329	5.49	160.35	102.84	0.77
East	3400	5-YR	14.00	6927.47	6928.12	6927.99	6928.17	0.013515	1.81	7.73	23.81	0.56
East	3350	100-YR	880.00	6926.42	6929.45	6929.42	6930.27	0.024029	7.29	120.78	70.80	0.98
East	3350	5-YR	14.00	6926.42	6926.87	6926.87	6927.00	0.047251	2.91	4.81	18.56	1.01
East	3300	100-YR	880.00	6924.78	6928.87		6929.39	0.011224	5.77	152.42	71.24	0.70
East	3300	5-YR	14.00	6924.78	6925.58		6925.65	0.012551	2.08	6.72	15.81	0.56
East	3250	100-YR	880.00	6923.75	6928.18		6928.79	0.012342	6.26	140.48	62.21	0.73
East	3250	5-YR	14.00	6923.75	6924.48	6924.45	6924.64	0.036210	3.22	4.34	11.70	0.93
East	3200	100-YR	880.00	6923.28	6927.07	6926.93	6927.98	0.020071	7.69	114.50	53.76	0.93
East	3200	5-YR	14.00	6923.28	6924.06		6924.10	0.004634	1.50	9.33	16.97	0.36
East	3150	100-YR	880.00	6923.15	6925.91	6925.91	6926.88	0.024117	7.91	111.27	57.61	1.00
East	3150	5-YR	14.00	6923.15	6923.67		6923.72	0.015644	1.63	8.57	34.37	0.58
East	3100	100-YR	880.00	6921.98	6925.26		6925.84	0.012334	6.11	144.02	66.41	0.73
East	3100	5-YR	14.00	6921.98	6922.62		6922.70	0.027686	2.16	6.48	26.20	0.77
East	3050	100-YR	880.00	6921.56	6925.08		6925.39	0.004921	4.50	200.36	93.77	0.48
East	3050	5-YR	14.00	6921.56	6921.92		6921.94	0.009235	1.31	10.66	39.99	0.45
East	3000	100-YR	880.00	6920.57	6924.42		6925.00	0.011987	6.08	146.34	80.22	0.72
East	3000	5-YR	14.00	6920.57	6921.05		6921.16	0.030929	2.64	5.31	17.30	0.84
East	2950	100-YR	880.00	6919.84	6923.24	6923.24	6924.20	0.019805	7.93	116.13	71.49	0.93
East	2950	5-YR	14.00	6919.84	6920.40		6920.45	0.007840	1.63	8.57	20.43	0.44
East	2900	100-YR	880.00	6919.31	6922.38	6922.27	6923.14	0.015667	7.14	135.67	90.41	0.83
East	2900	5-YR	14.00	6919.31	6919.57	6919.56	6919.67	0.043662	2.56	5.47	24.20	0.95
East	2850	100-YR	880.00	6917.96	6922.05		6922.48	0.008515	5.30	173.38	97.24	0.61
East	2850	5-YR	14.00	6917.96	6918.48		6918.54	0.013678	1.99	7.02	18.84	0.58
East	2800	100-YR	880.00	6917.16	6920.74	6920.74	6921.80	0.019517	8.27	110.09	67.16	0.93
East	2800	5-YR	14.00	6917.16	6917.66		6917.74	0.018761	2.23	6.28	18.08	0.67

HEC-RAS Plan: Existing River: Existing Channel Reach: East (Continued)

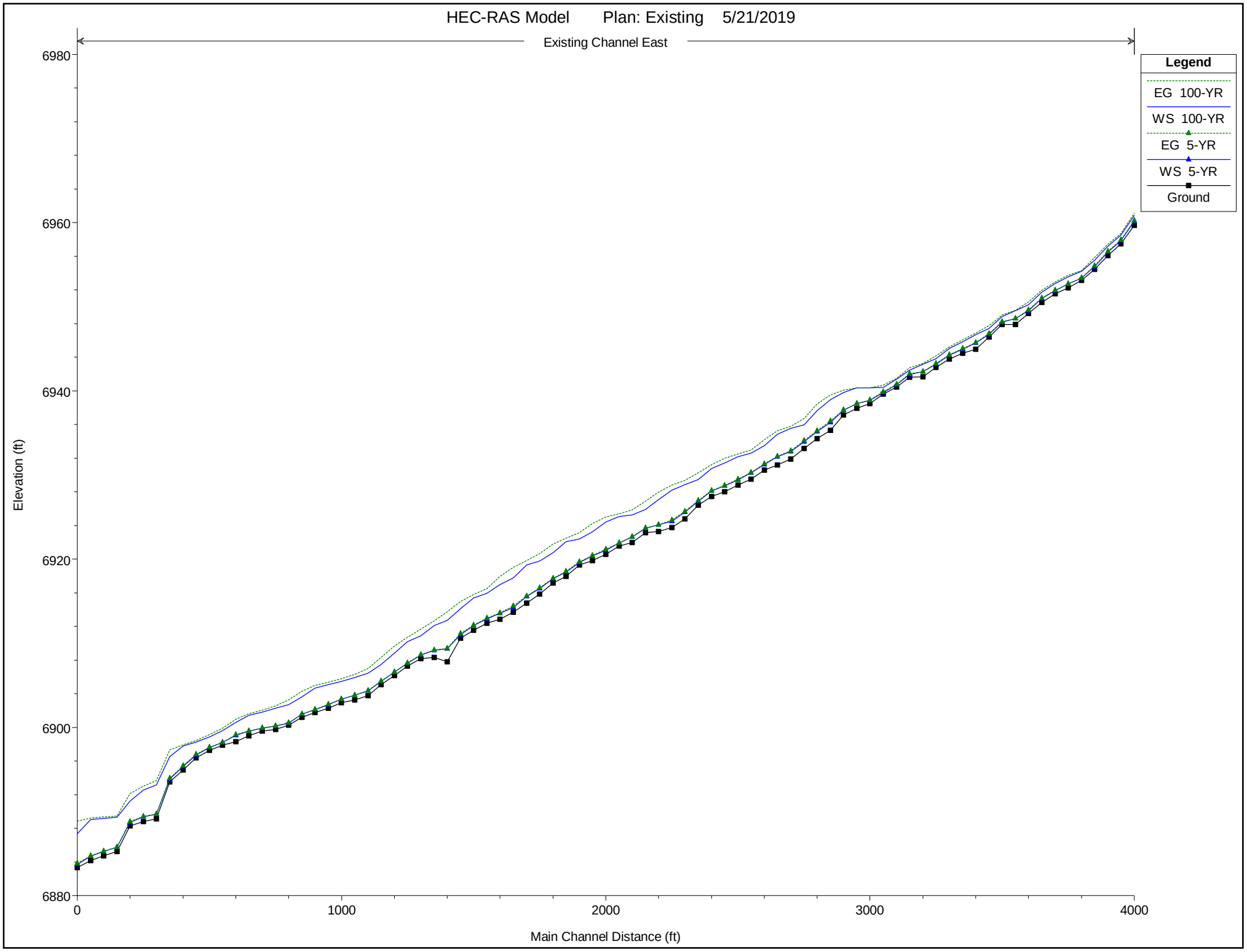
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	2750	100-YR	880.00	6915.84	6919.79	6919.67	6920.64	0.021782	7.39	119.13	63.08	0.95
East	2750	5-YR	14.00	6915.84	6916.49		6916.60	0.027695	2.72	5.14	14.61	0.81
East	2700	100-YR	880.00	6914.78	6919.33		6919.82	0.010160	5.59	158.99	85.51	0.66
East	2700	5-YR	14.00	6914.78	6915.54	6915.40	6915.62	0.014491	2.25	6.22	14.47	0.60
East	2650	100-YR	880.00	6913.71	6917.78	6917.78	6919.01	0.022953	8.88	99.38	45.63	1.01
East	2650	5-YR	14.00	6913.71	6914.27	6914.27	6914.44	0.042538	3.32	4.22	12.34	1.00
East	2600	100-YR	880.00	6912.84	6916.95	6916.95	6917.96	0.016859	8.11	114.79	86.19	0.88
East	2600	5-YR	14.00	6912.84	6913.56		6913.61	0.008222	1.83	7.63	15.76	0.46
East	2550	100-YR	880.00	6912.38	6915.93	6915.70	6916.48	0.012350	6.15	162.55	119.51	0.73
East	2550	5-YR	14.00	6912.38	6912.88	6912.81	6912.97	0.022779	2.41	5.82	17.27	0.73
East	2500	100-YR	880.00	6911.54	6915.38		6915.78	0.013164	5.04	174.57	113.18	0.72
East	2500	5-YR	14.00	6911.54	6912.11	6911.95	6912.17	0.011681	1.96	7.15	17.50	0.54
East	2450	100-YR	880.00	6910.62	6914.10	6914.10	6914.96	0.018168	7.52	125.22	92.48	0.89
East	2450	5-YR	14.00	6910.62	6911.01	6911.01	6911.15	0.044623	3.00	4.67	16.51	0.99
East	2400	100-YR	880.00	6907.81	6912.72	6912.60	6913.72	0.020181	8.06	109.65	52.89	0.94
East	2400	5-YR	14.00	6907.81	6909.36		6909.40	0.002629	1.43	9.76	12.11	0.28
East	2350	100-YR	880.00	6908.31	6912.09	6911.78	6912.65	0.017486	6.04	145.77	92.62	0.83
East	2350	5-YR	14.00	6908.31	6909.14		6909.18	0.008051	1.71	8.17	18.46	0.45
East	2300	100-YR	880.00	6908.18	6910.90	6910.90	6911.70	0.019749	7.38	130.55	88.05	0.92
East	2300	5-YR	14.00	6908.18	6908.61		6908.65	0.014289	1.67	8.37	30.31	0.56
East	2250	100-YR	880.00	6907.30	6910.18		6910.72	0.016717	5.85	150.37	93.35	0.81
East	2250	5-YR	14.00	6907.30	6907.61		6907.68	0.028653	2.04	6.85	30.99	0.77
East	2200	100-YR	880.00	6906.18	6908.81	6908.81	6909.67	0.025344	7.41	118.78	70.62	1.01
East	2200	5-YR	14.00	6906.18	6906.56		6906.60	0.016610	1.70	8.25	32.69	0.60
East	2150	100-YR	880.00	6905.09	6907.46	6907.46	6908.33	0.025269	7.47	117.75	68.96	1.01
East	2150	5-YR	14.00	6905.09	6905.45	6905.41	6905.51	0.029664	1.88	7.47	39.40	0.76
East	2100	100-YR	880.00	6903.79	6906.44		6907.02	0.017047	6.11	143.96	84.97	0.83
East	2100	5-YR	14.00	6903.79	6904.35		6904.40	0.017075	1.83	7.63	27.49	0.61
East	2050	100-YR	880.00	6903.25	6905.91		6906.31	0.010559	5.08	173.36	94.41	0.66
East	2050	5-YR	14.00	6903.25	6903.81		6903.83	0.007776	1.25	11.24	40.15	0.41

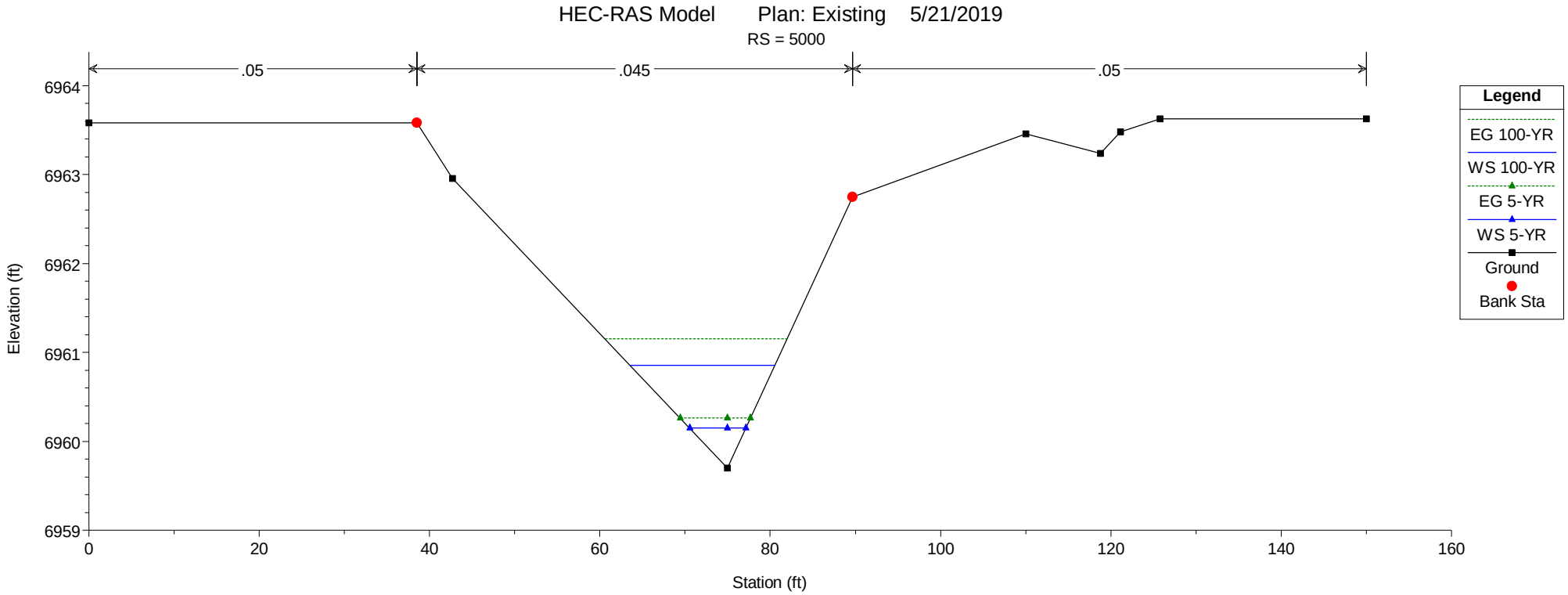
HEC-RAS Plan: Existing River: Existing Channel Reach: East (Continued)

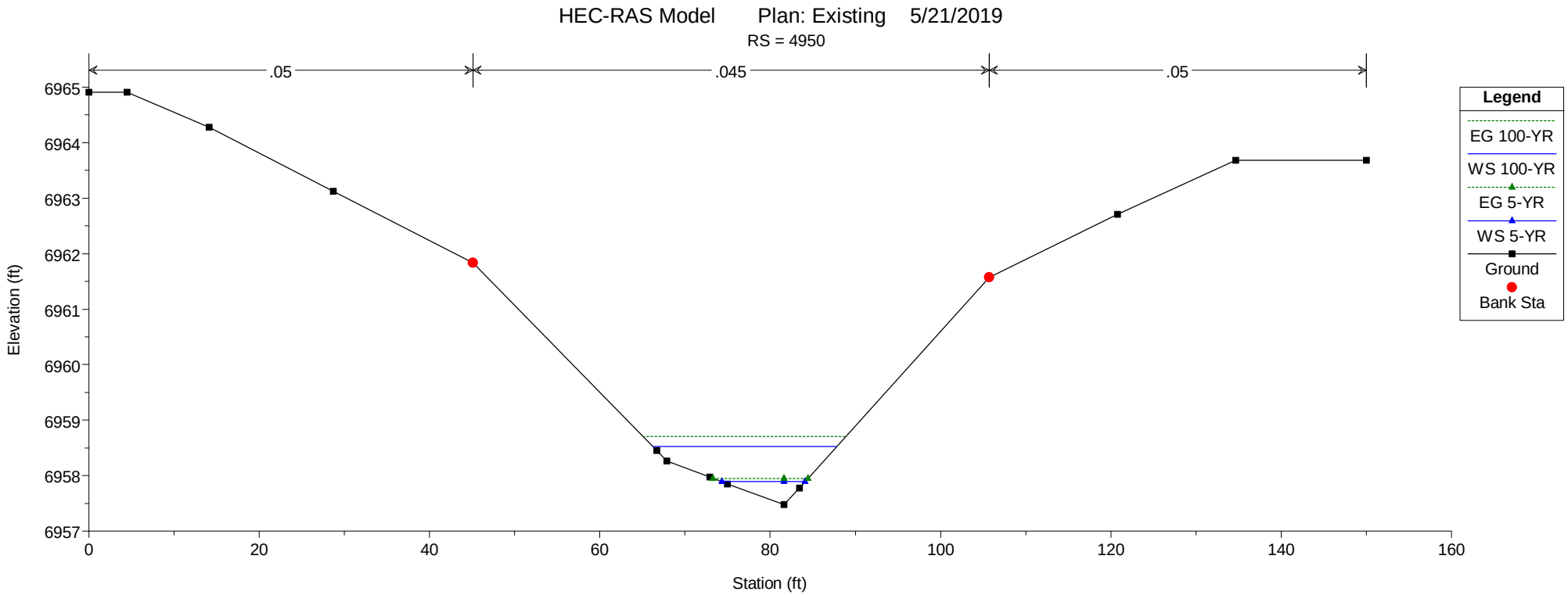
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	2000	100-YR	880.00	6902.93	6905.46		6905.81	0.008814	4.69	187.81	100.72	0.60
East	2000	5-YR	14.00	6902.93	6903.35		6903.37	0.011438	1.22	11.50	56.74	0.48
East	1950	100-YR	880.00	6902.27	6905.08		6905.38	0.007938	4.38	200.75	110.13	0.57
East	1950	5-YR	14.00	6902.27	6902.70		6902.74	0.014071	1.41	9.90	45.58	0.54
East	1900	100-YR	880.00	6901.77	6904.66		6904.97	0.008319	4.47	196.81	108.57	0.59
East	1900	5-YR	14.00	6901.77	6902.09		6902.12	0.010813	1.39	10.04	38.75	0.48
East	1850	100-YR	880.00	6901.20	6903.61	6903.53	6904.28	0.022907	6.58	133.81	88.45	0.94
East	1850	5-YR	14.00	6901.20	6901.56	6901.44	6901.59	0.010508	1.45	9.66	34.42	0.48
East	1800	100-YR	880.00	6900.25	6902.69		6903.25	0.017469	6.00	146.79	90.94	0.83
East	1800	5-YR	14.00	6900.25	6900.49	6900.49	6900.57	0.054590	2.25	6.21	39.29	1.00
East	1750	100-YR	880.00	6899.75	6902.27		6902.55	0.009309	4.22	208.72	136.86	0.60
East	1750	5-YR	14.00	6899.75	6900.16		6900.17	0.002612	0.80	17.56	54.06	0.25
East	1700	100-YR	880.00	6899.58	6901.83		6902.06	0.009474	3.91	225.10	167.64	0.59
East	1700	5-YR	14.00	6899.58	6899.89		6899.91	0.014544	1.28	10.92	59.80	0.53
East	1650	100-YR	880.00	6898.99	6901.44		6901.64	0.007234	3.55	247.56	173.70	0.52
East	1650	5-YR	14.00	6898.99	6899.54		6899.55	0.004246	0.94	14.91	51.72	0.31
East	1600	100-YR	880.00	6898.29	6900.57	6900.55	6900.97	0.029291	5.10	172.65	201.43	0.97
East	1600	5-YR	14.00	6898.29	6899.04	6898.94	6899.13	0.022796	2.39	5.85	17.54	0.73
East	1550	100-YR	880.00	6897.87	6899.60		6899.88	0.015843	4.32	203.85	192.52	0.74
East	1550	5-YR	14.00	6897.87	6898.19		6898.21	0.014518	1.14	12.29	80.18	0.51
East	1500	100-YR	880.00	6897.28	6898.85		6899.12	0.014571	4.17	210.88	196.80	0.71
East	1500	5-YR	14.00	6897.28	6897.62		6897.63	0.009372	0.89	15.66	105.95	0.41
East	1450	100-YR	880.00	6896.36	6898.24		6898.45	0.011479	3.73	243.10	234.35	0.63
East	1450	5-YR	14.00	6896.36	6896.71	6896.69	6896.78	0.039766	2.05	6.84	39.39	0.87
East	1400	100-YR	880.00	6894.94	6897.76		6897.92	0.006047	3.34	276.99	186.93	0.48
East	1400	5-YR	14.00	6894.94	6895.37	6895.29	6895.43	0.019574	1.99	7.02	24.71	0.66
East	1350	100-YR	880.00	6893.53	6896.51	6896.51	6897.30	0.026314	7.16	122.97	79.06	1.01
East	1350	5-YR	14.00	6893.53	6893.84	6893.84	6893.95	0.049736	2.64	5.30	24.69	1.00
East	1300	100-YR	880.00	6889.13	6893.14		6893.67	0.012928	5.83	150.96	76.82	0.73
East	1300	5-YR	14.00	6889.13	6889.67		6889.71	0.007983	1.54	9.07	23.82	0.44

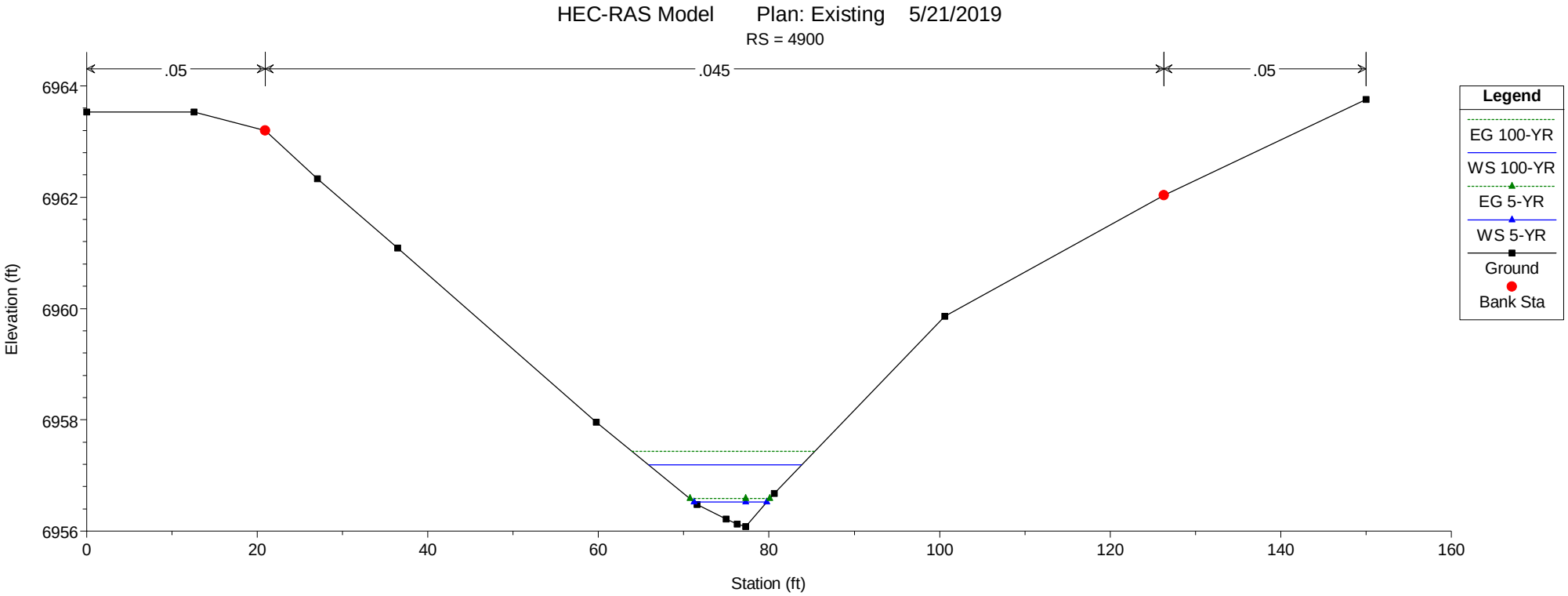
HEC-RAS Plan: Existing River: Existing Channel Reach: East (Continued)

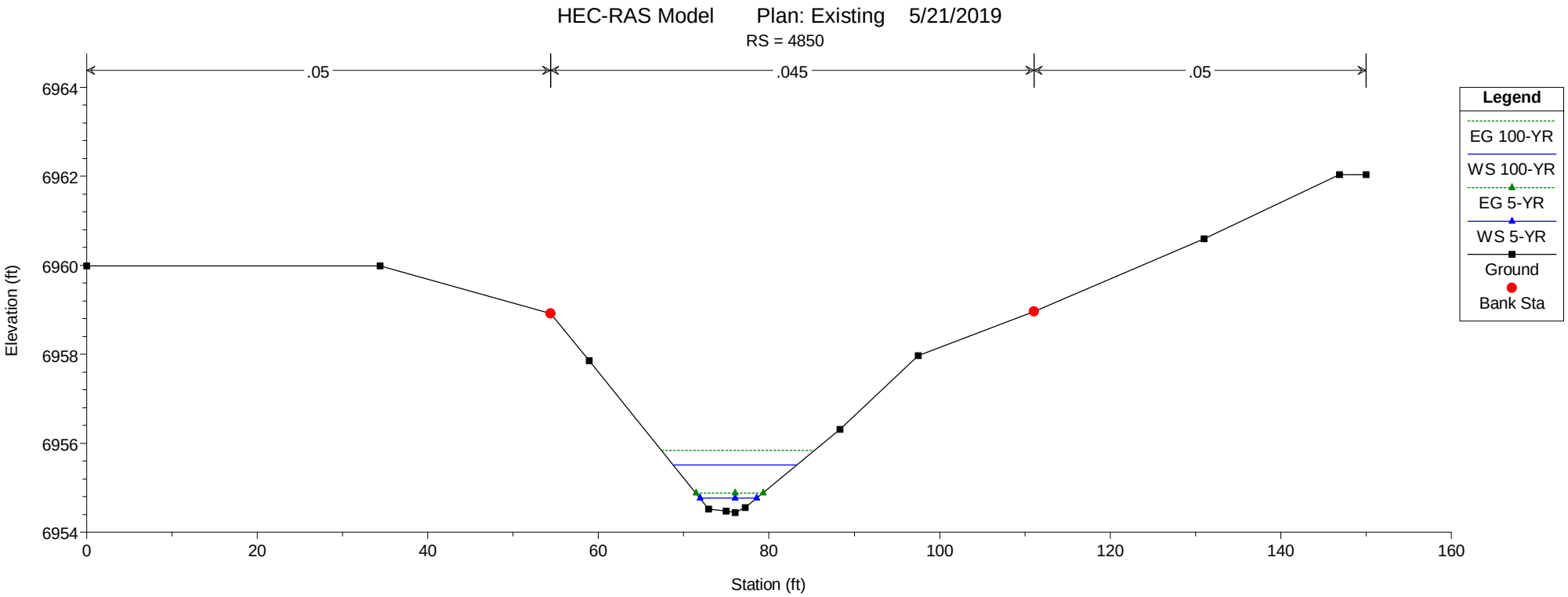
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	1250	100-YR	880.00	6888.78	6892.52	6891.92	6893.03	0.012479	5.72	153.94	78.94	0.72
East	1250	5-YR	14.00	6888.78	6889.36		6889.39	0.005136	1.33	10.54	24.88	0.36
East	1200	100-YR	880.00	6888.27	6891.21	6891.21	6892.12	0.026053	7.63	115.37	65.50	1.01
East	1200	5-YR	14.00	6888.27	6888.70	6888.70	6888.81	0.044386	2.65	5.29	22.50	0.96
East	1150	100-YR	880.00	6885.25	6889.31		6889.45	0.002445	3.04	289.00	112.95	0.34
East	1150	5-YR	14.00	6885.25	6885.74		6885.77	0.010348	1.47	9.52	32.78	0.48
East	1100	100-YR	880.00	6884.72	6889.19		6889.34	0.002046	3.16	278.35	89.62	0.32
East	1100	5-YR	14.00	6884.72	6885.26		6885.29	0.008650	1.37	10.21	34.19	0.44
East	1050	100-YR	880.00	6884.18	6889.04		6889.23	0.002327	3.47	253.67	78.02	0.34
East	1050	5-YR	14.00	6884.18	6884.70		6884.74	0.014211	1.63	8.59	32.24	0.56
East	1000	100-YR	880.00	6883.33	6887.34	6887.34	6888.83	0.022827	9.80	89.84	30.43	1.01
East	1000	5-YR	14.00	6883.33	6883.72	6883.66	6883.82	0.024726	2.53	5.54	16.13	0.76

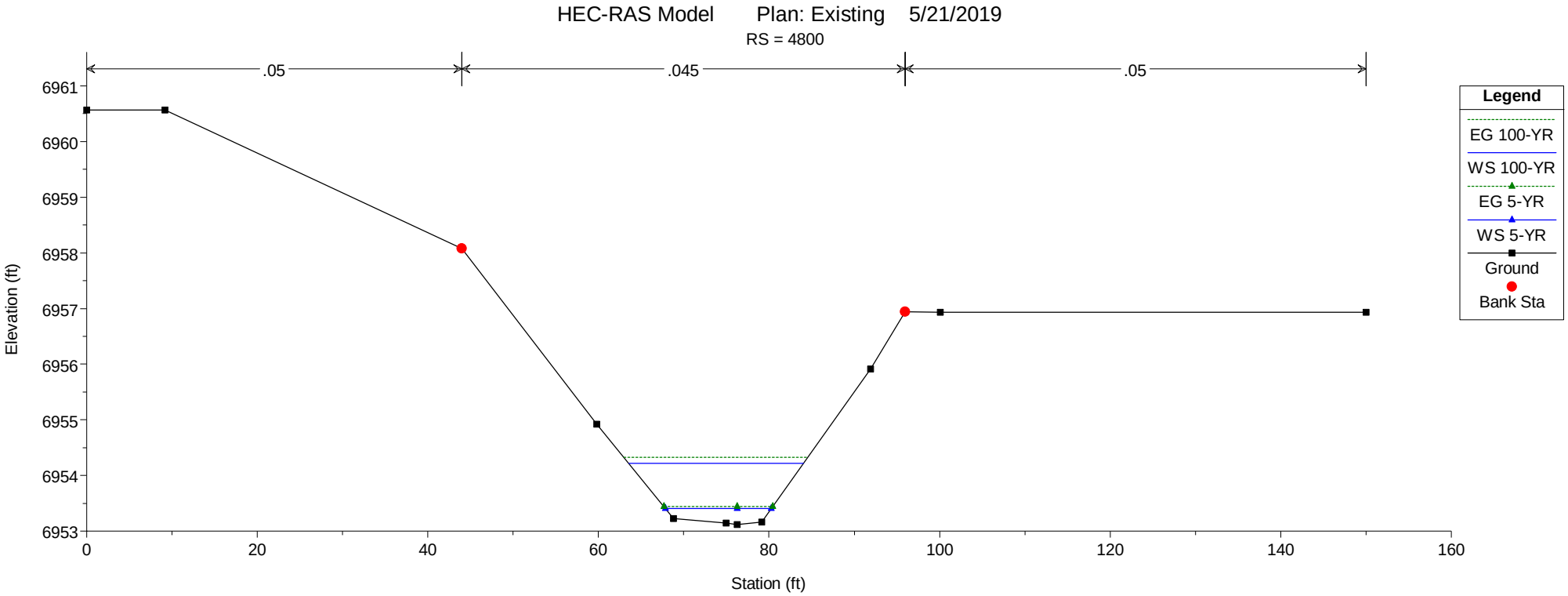

HEC-RAS Model Plan: Existing 5/21/2019
Existing Channel East
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Elevation (ft)
6980
6960
6940
6920
6900
6880
0
1000
2000
3000
4000
Main Channel Distance (ft)

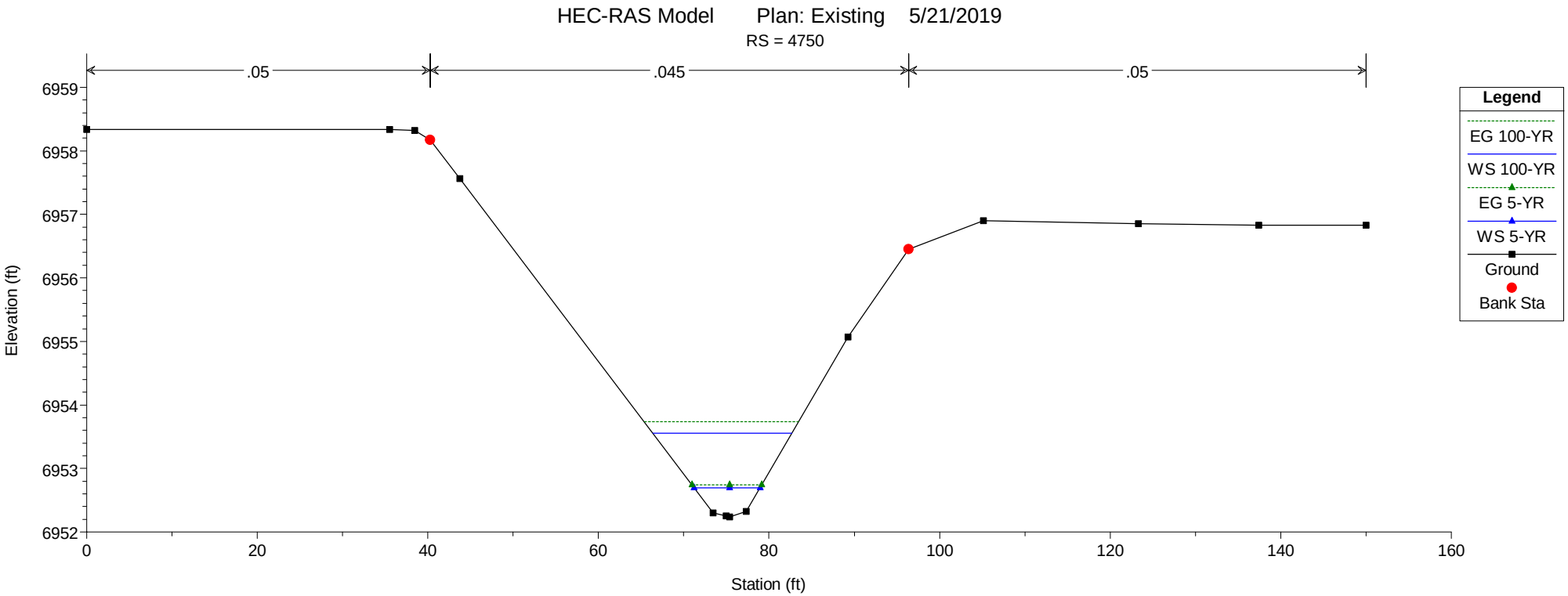

HEC-RAS Model Plan: Existing 5/21/2019
RS = 5000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

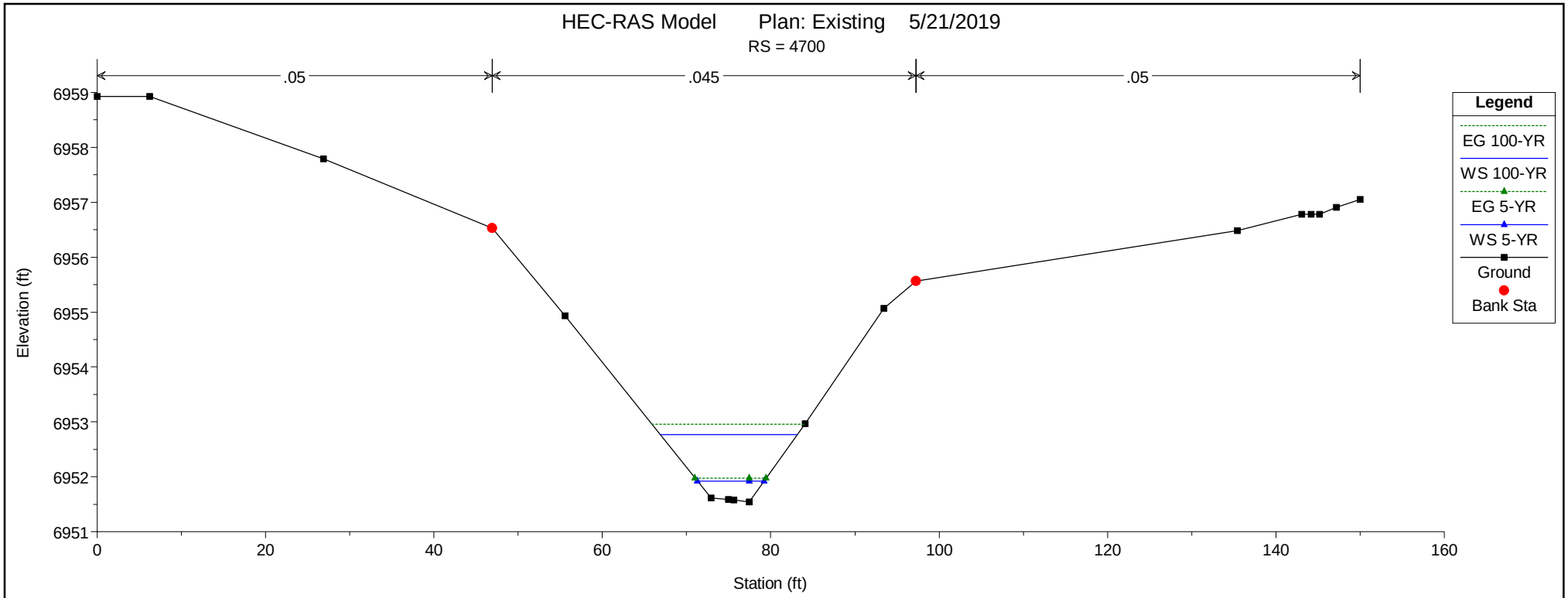

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4950
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

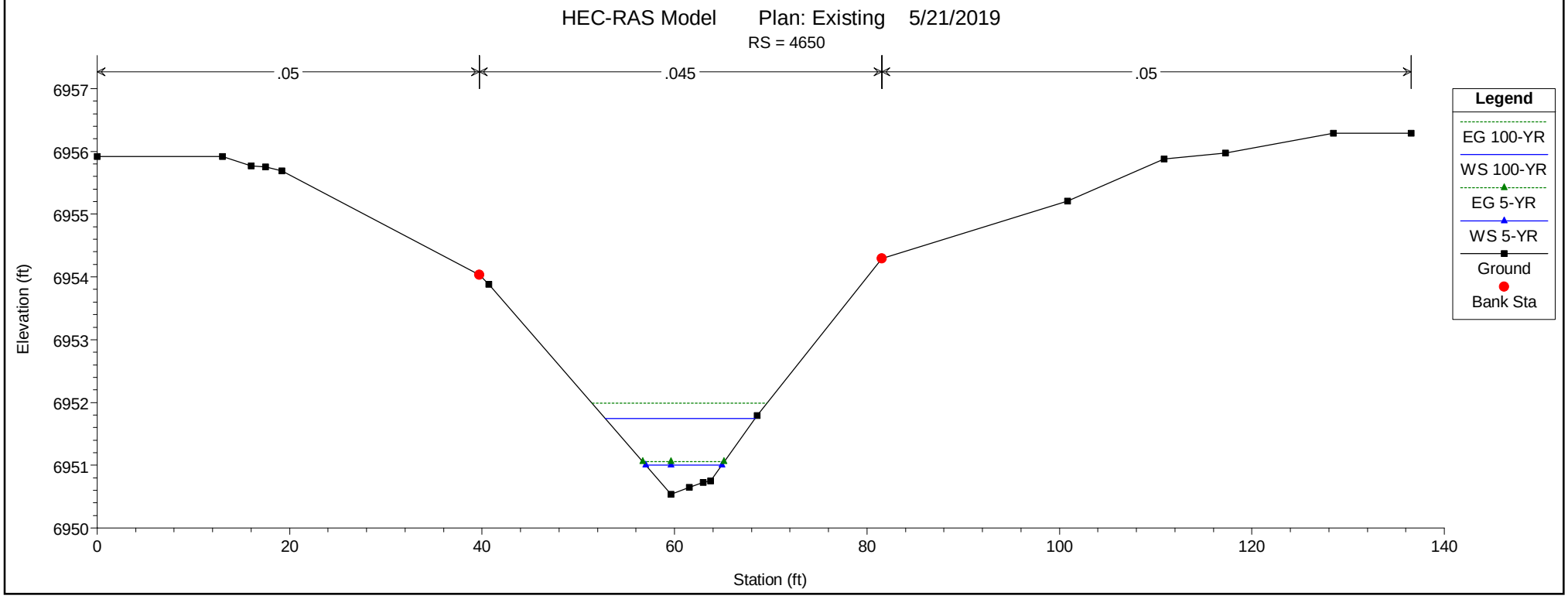

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4900
.05
.045
.05
Elevation (ft)
6964
6962
6960
6958
6956
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

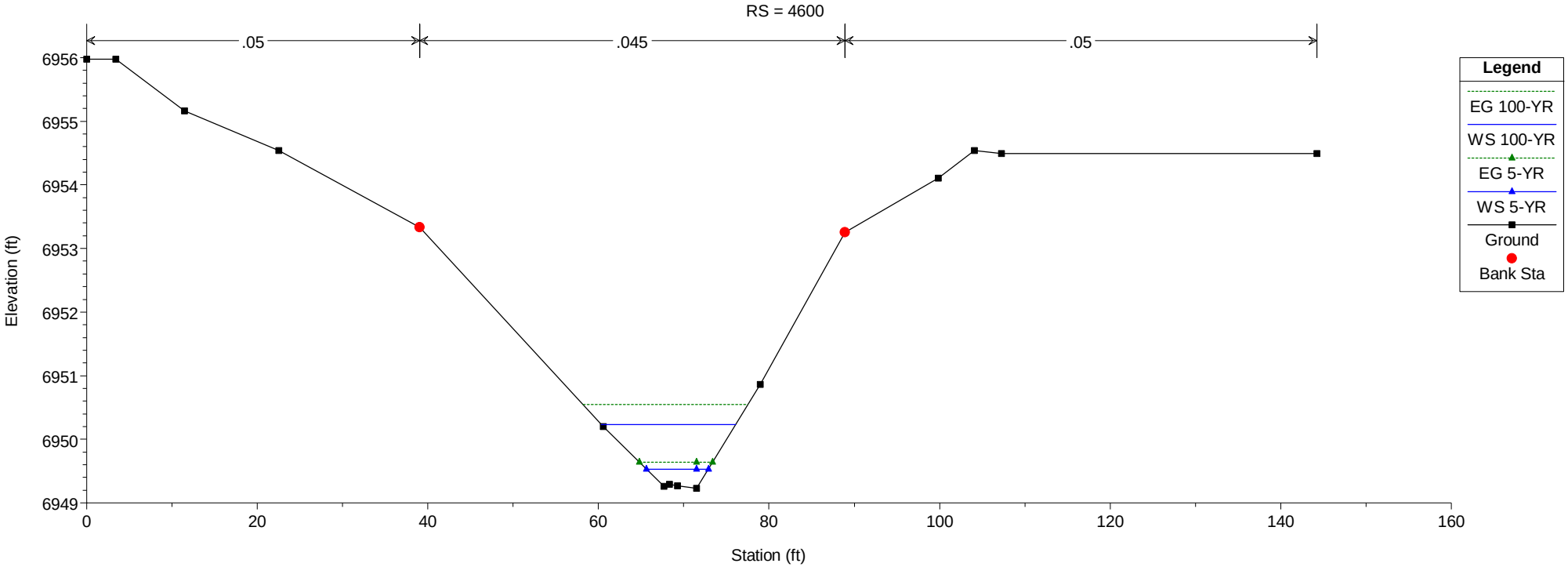

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4850
.05
.045
.05
Elevation (ft)
6964
6962
6960
6958
6956
6954
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

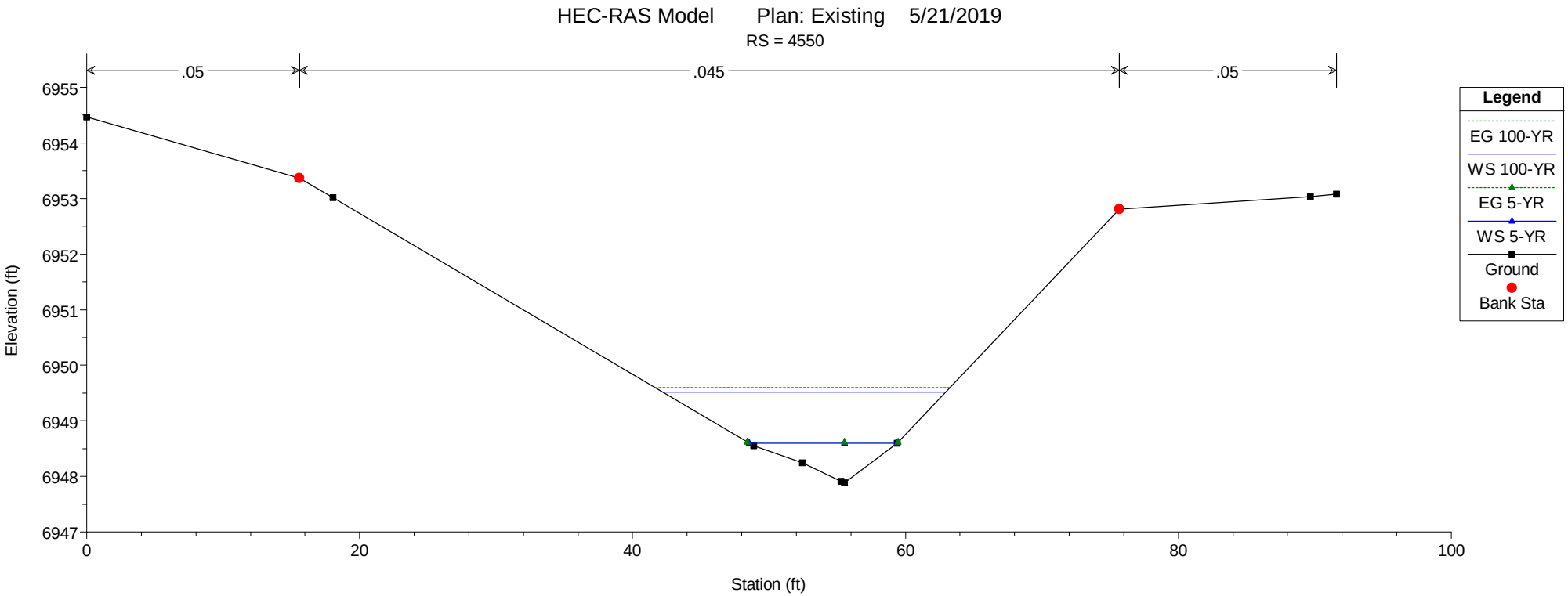

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4800
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

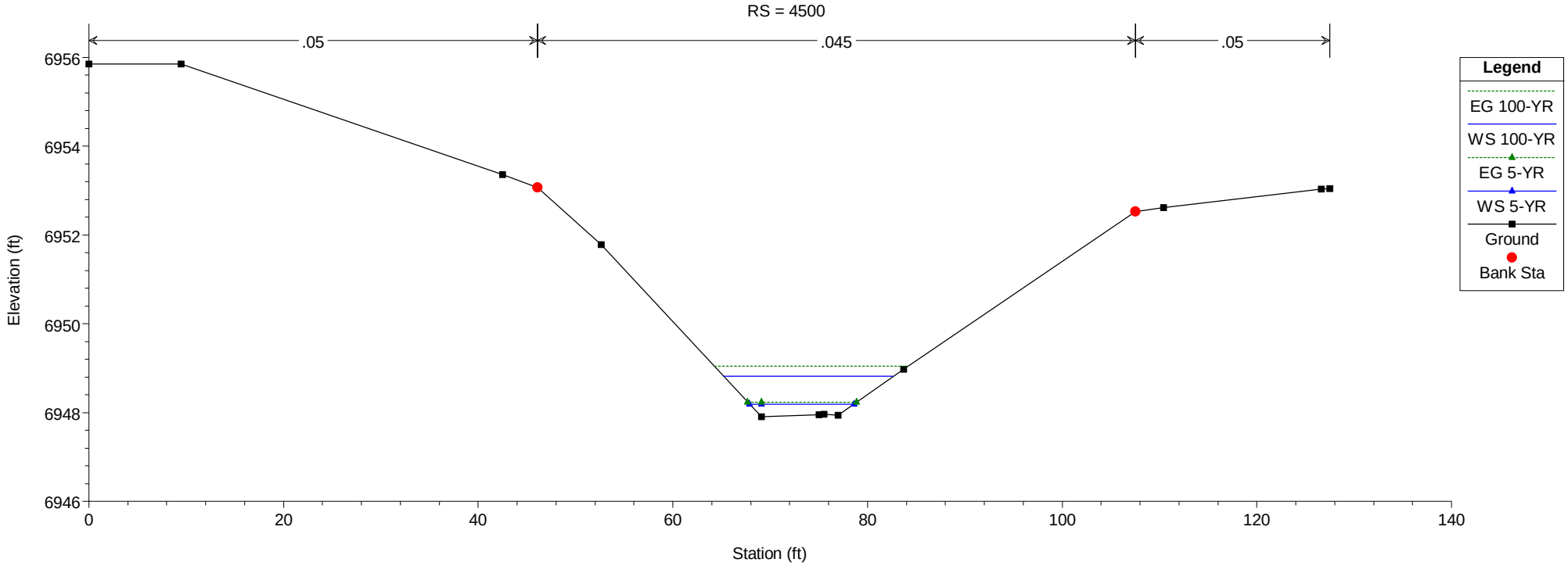

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4750
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

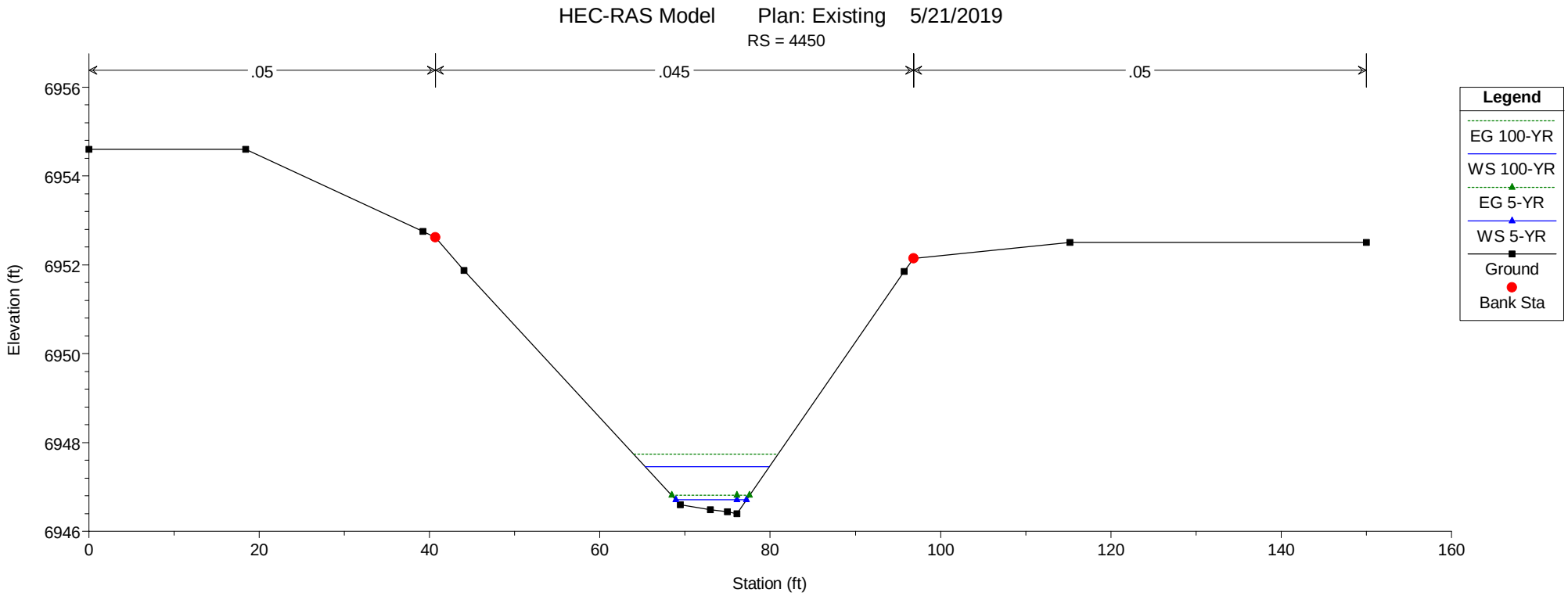

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4700
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

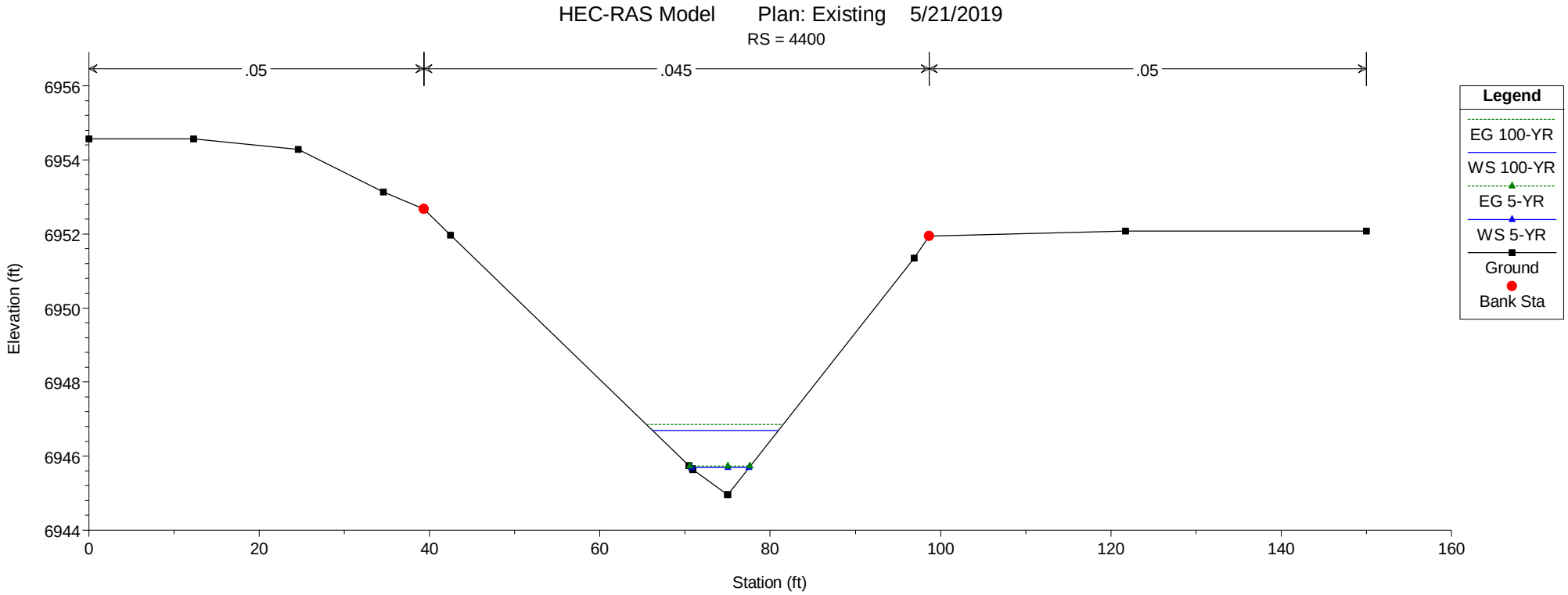

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4650
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

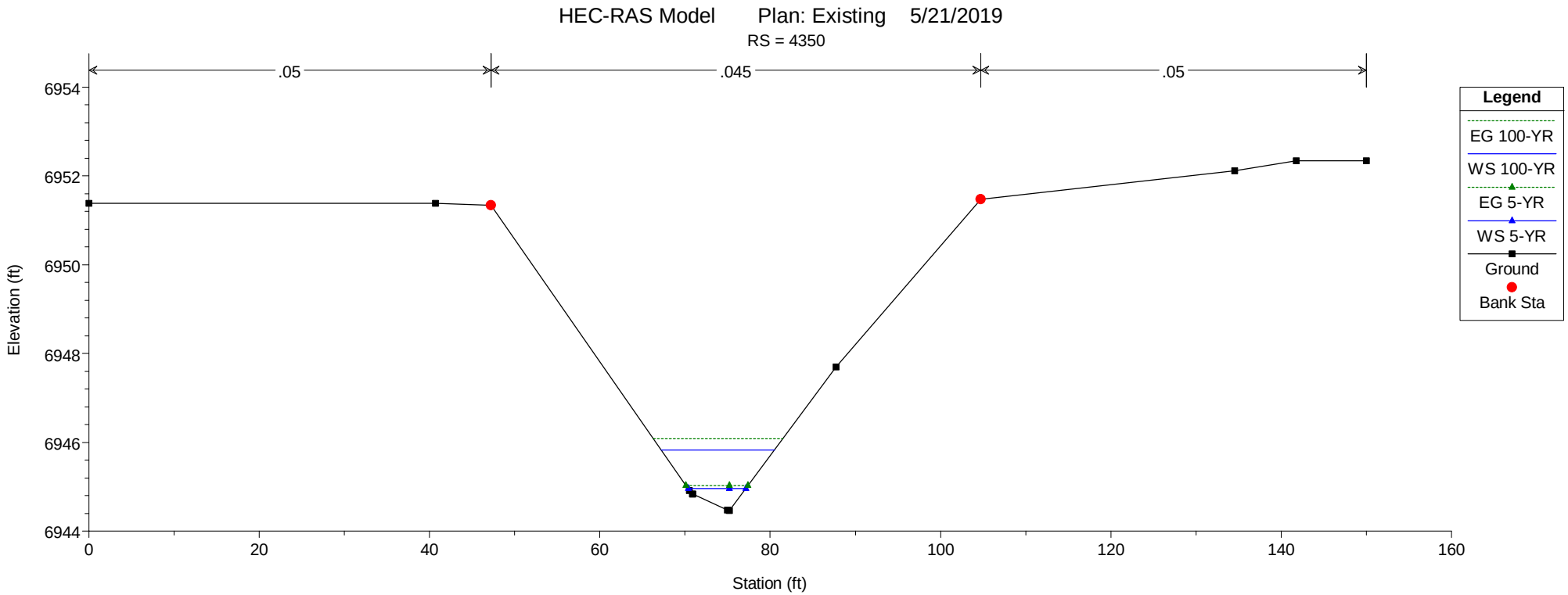

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4600
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

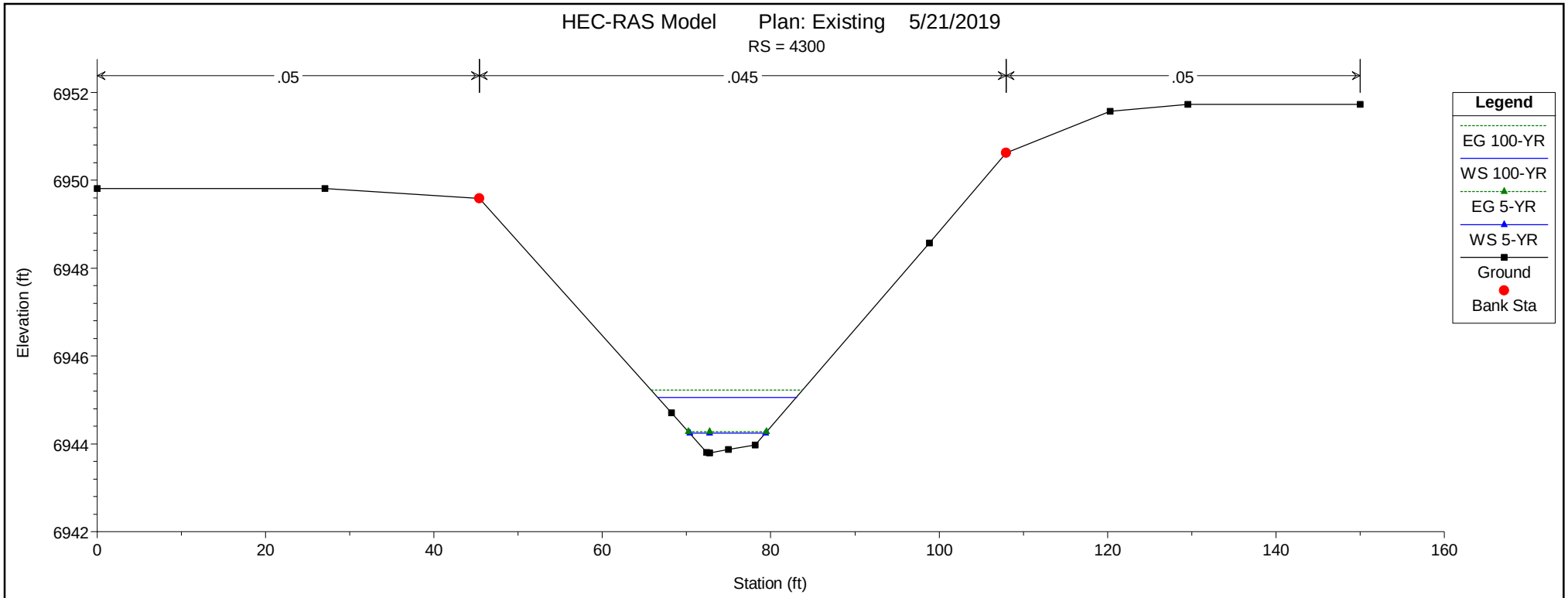

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4550
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

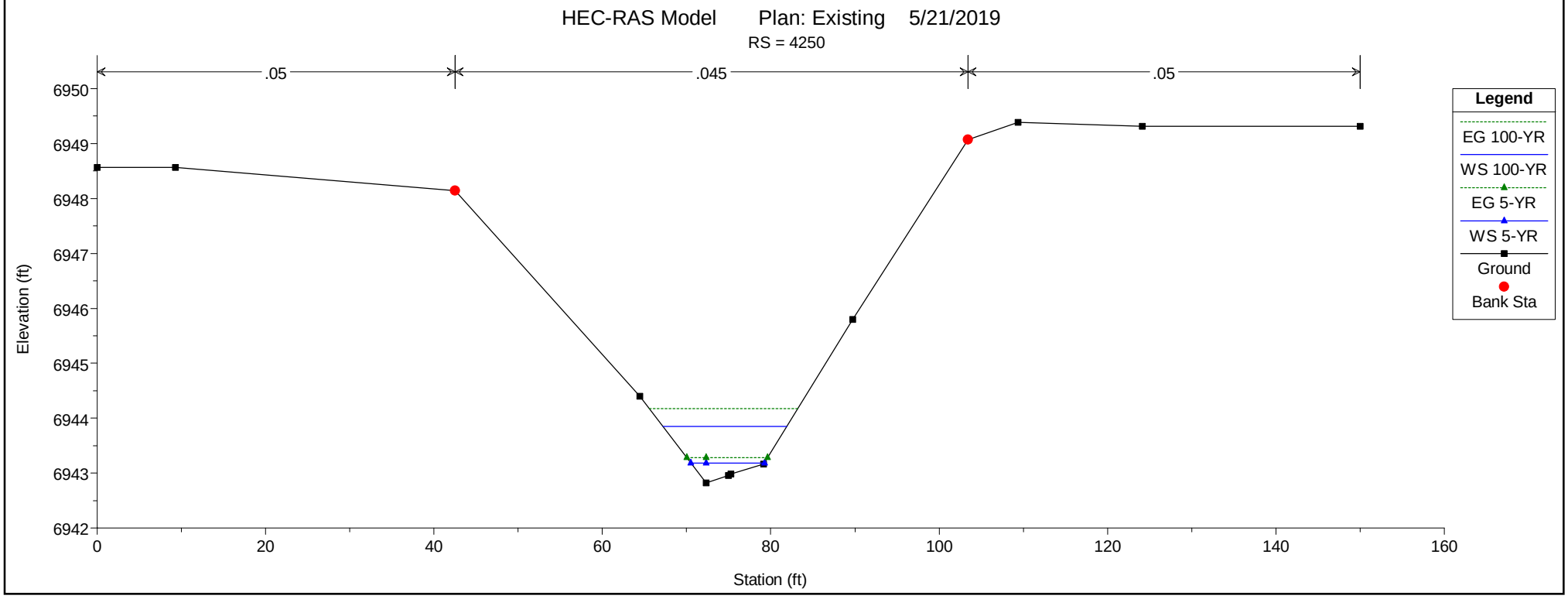

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4500
.05
.045
.05
Elevation (ft)
6956
6954
6952
6950
6948
6946
0
20
40
60
80
100
120
140
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

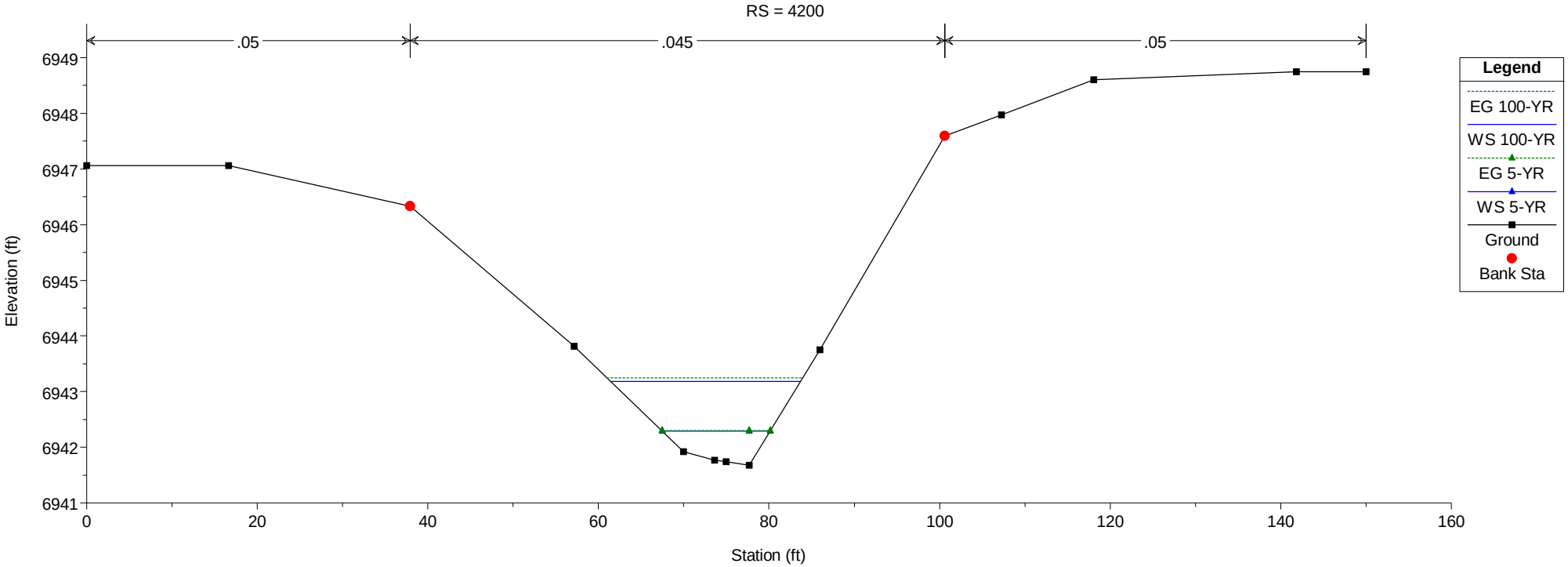

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4450
.05
.045
.05
Elevation (ft)
6956
6954
6952
6950
6948
6946
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

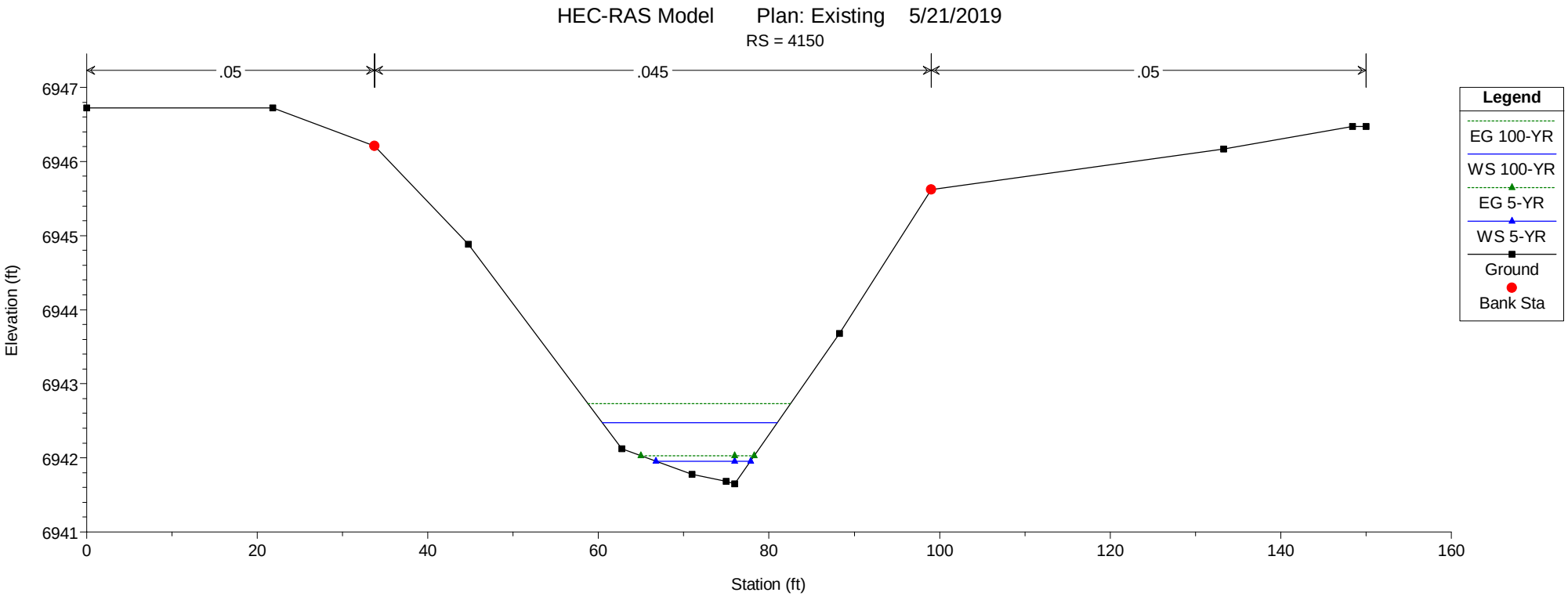

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4400
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

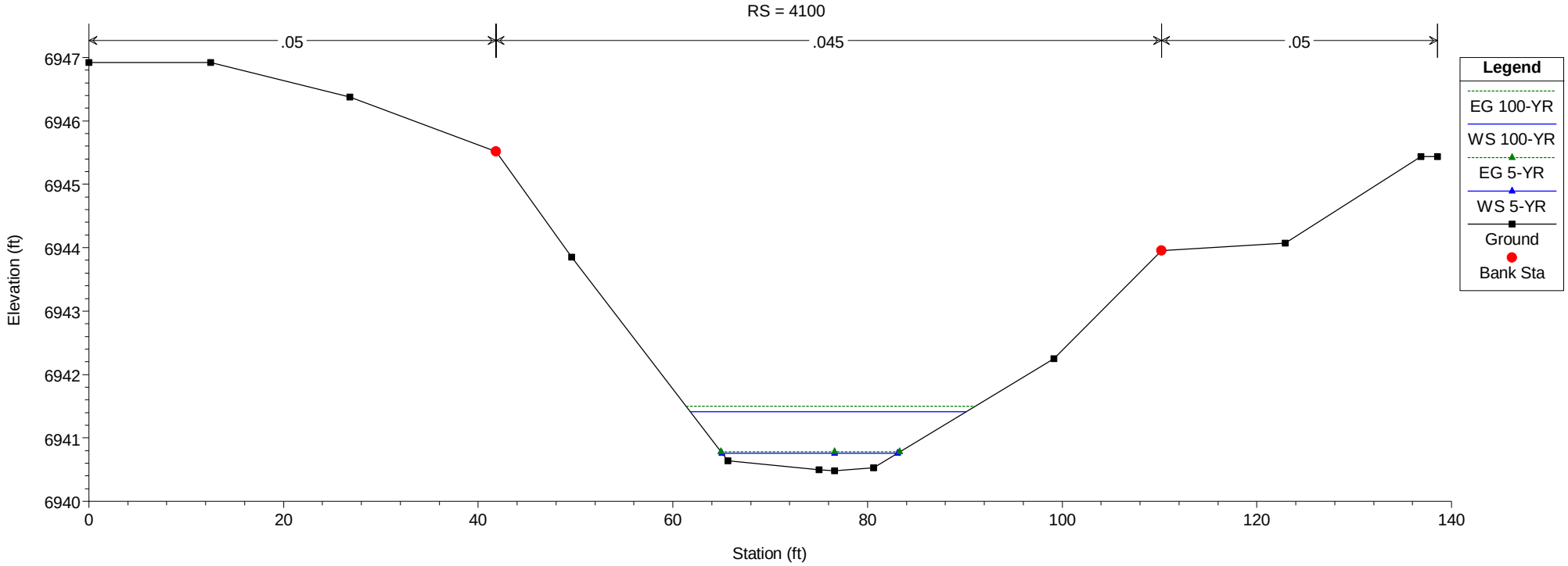

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4350
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

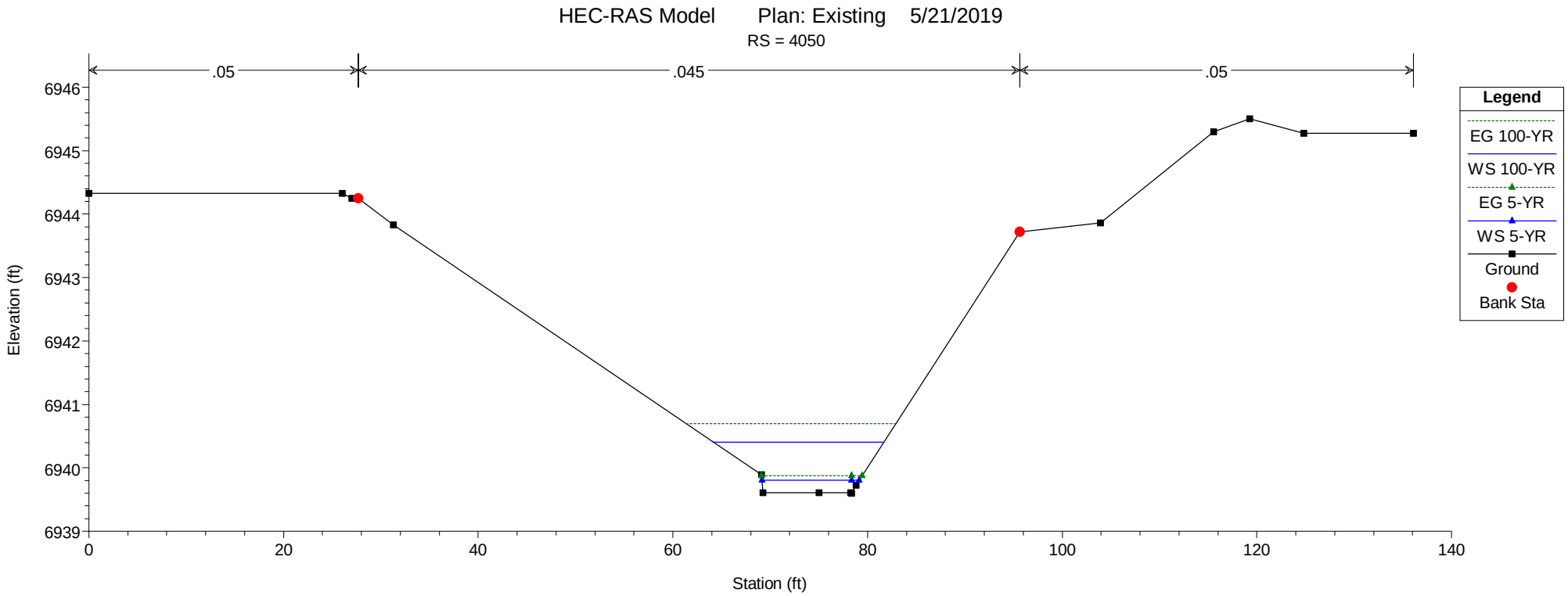

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

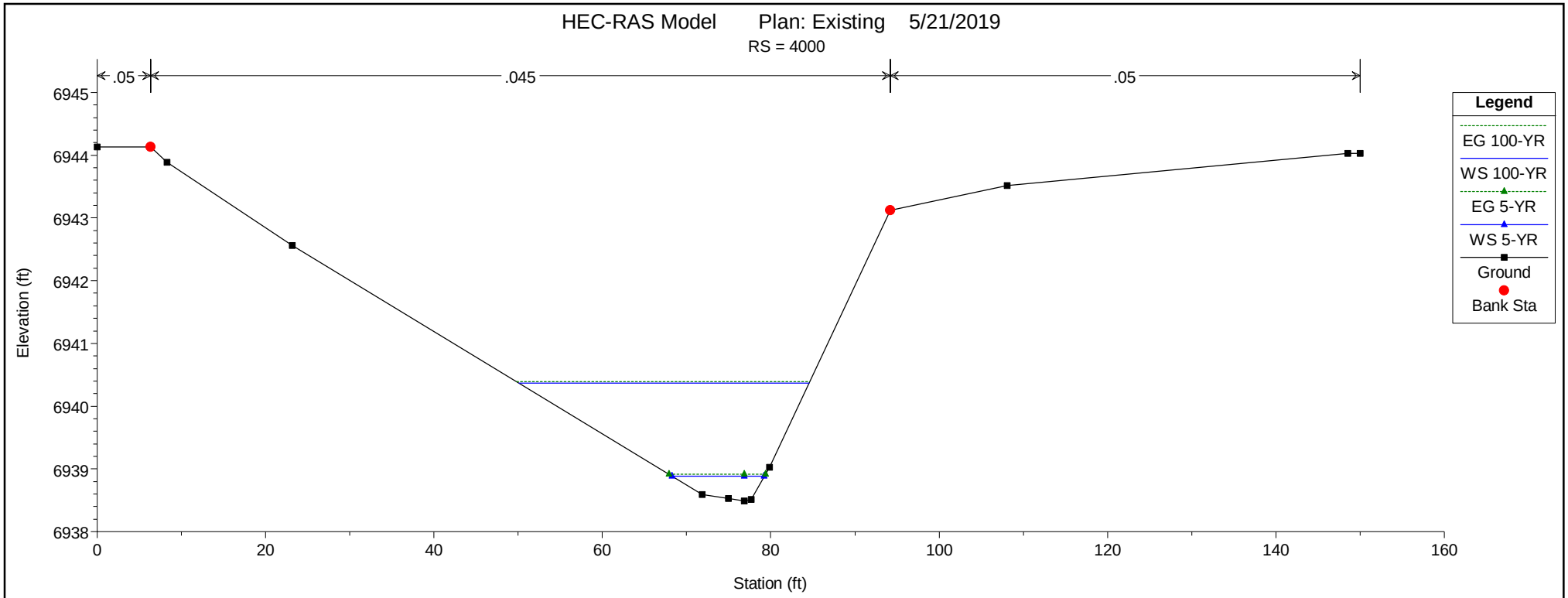

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

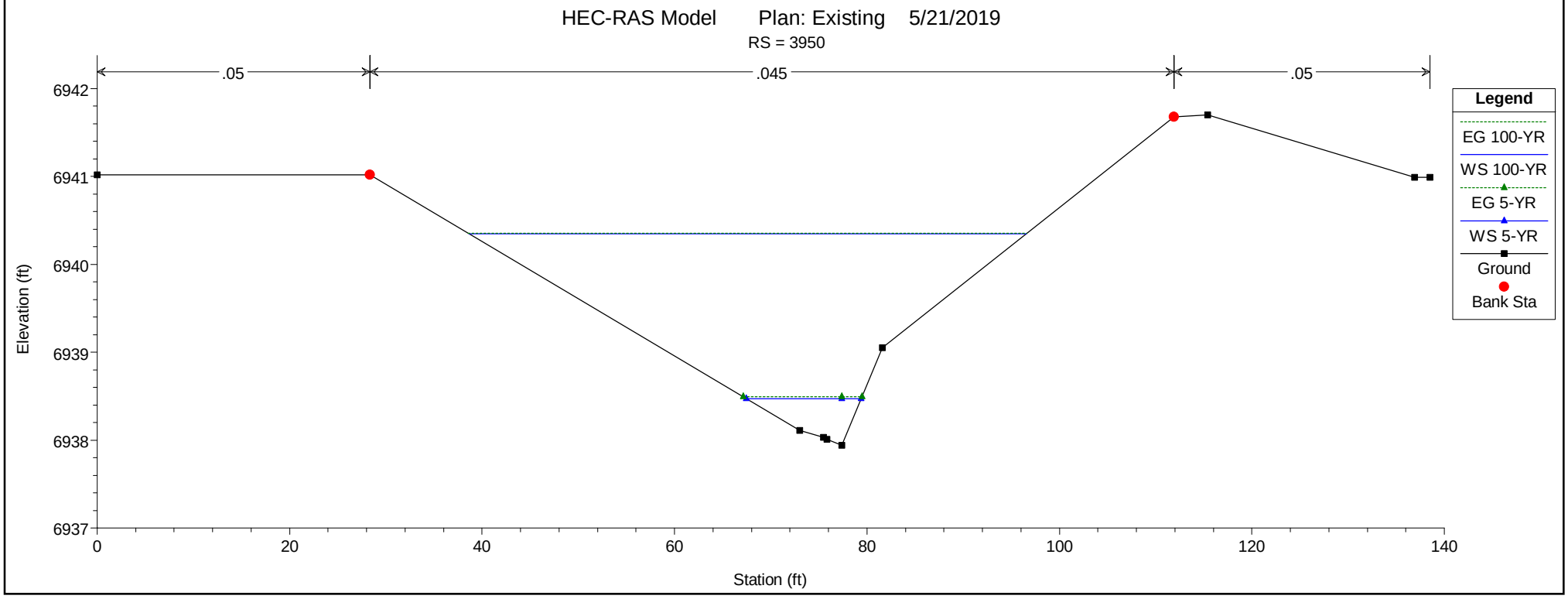

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4200
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6949
6948
6947
6946
6945
6944
6943
6942
6941
0
20
40
60
80
100
120
140
160
Station (ft)


HEC-RAS Model Plan: Existing 5/21/2019
RS = 4150
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6947
6946
6945
6944
6943
6942
6941
0
20
40
60
80
100
120
140
160
Station (ft)


HEC-RAS Model Plan: Existing 5/21/2019
RS = 4100
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

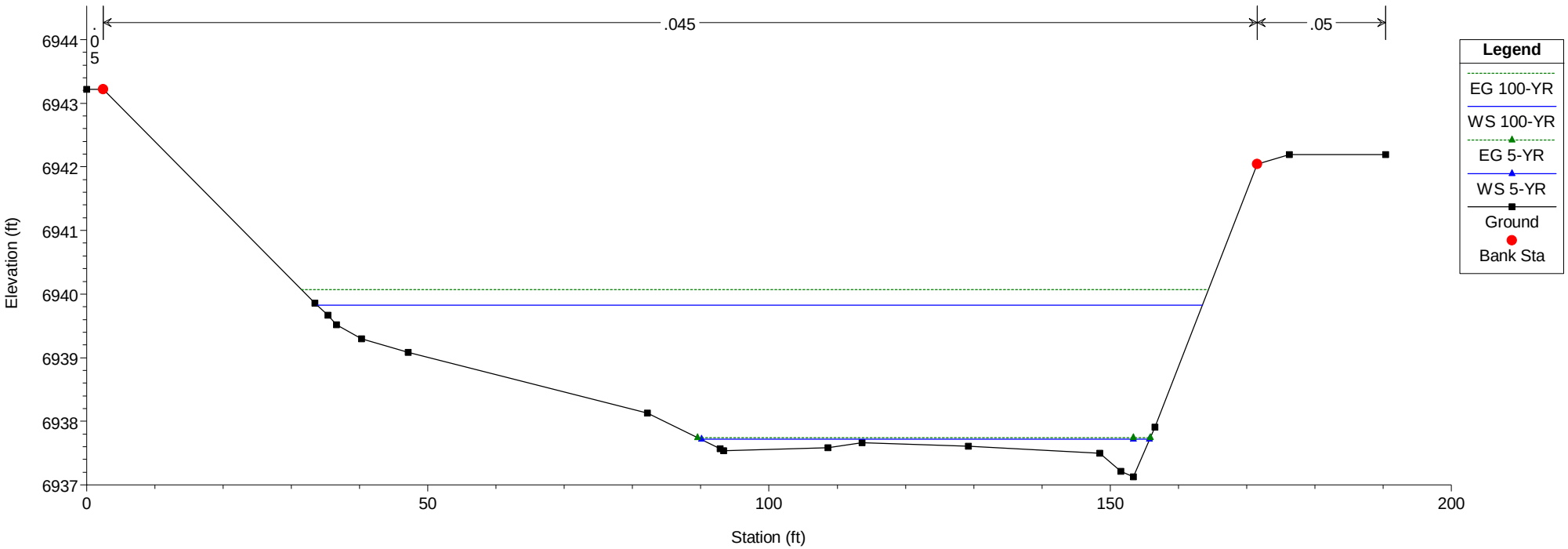

HEC-RAS Model Plan: Existing 5/21/2019
RS = 4050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 4000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 3950
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

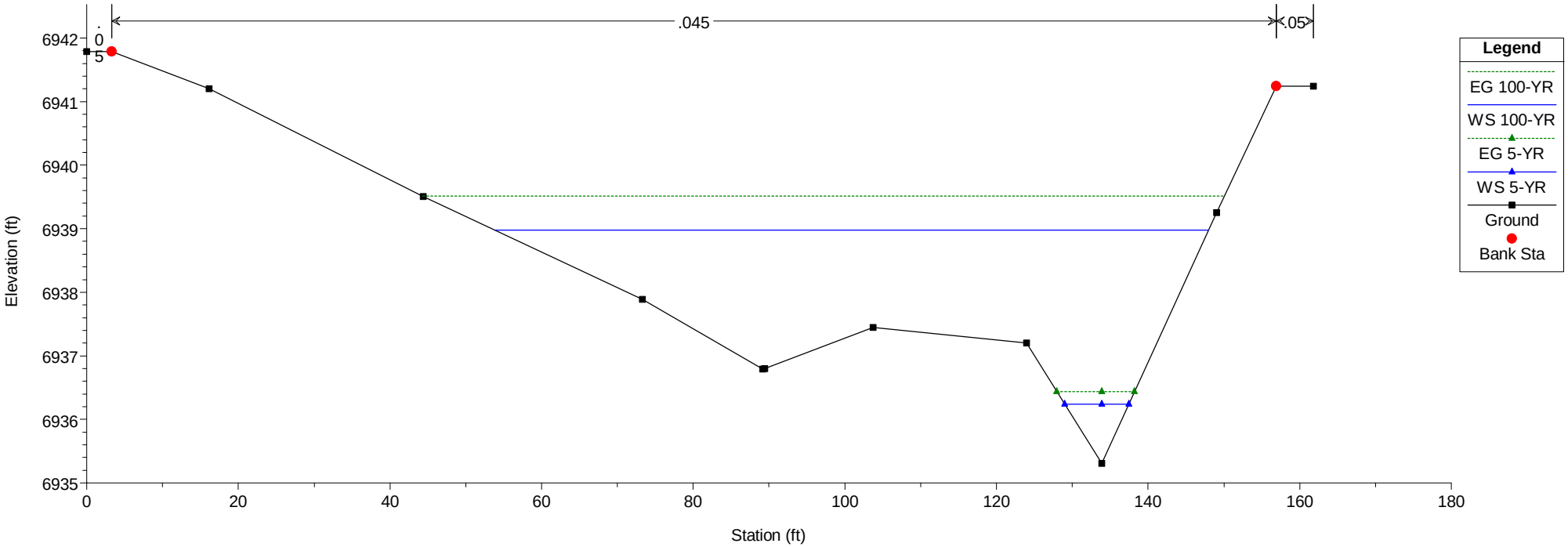
HEC-RAS Model Plan: Existing 5/21/2019

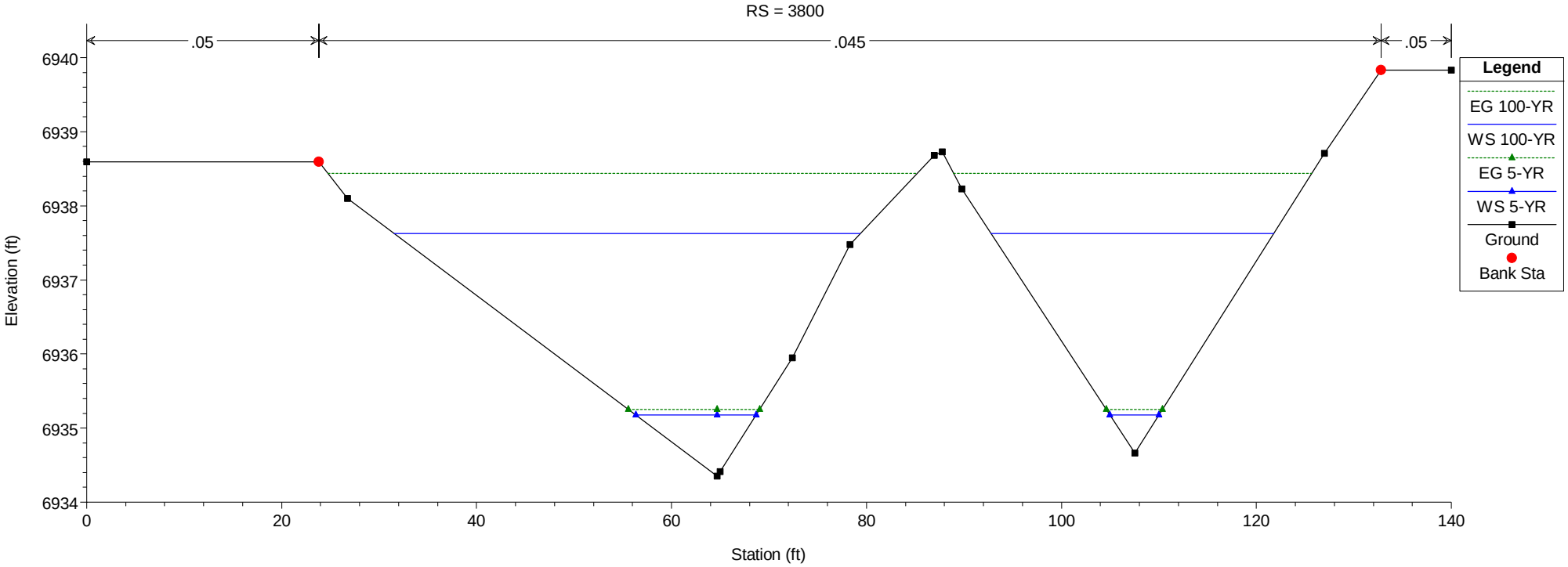
RS = 3900

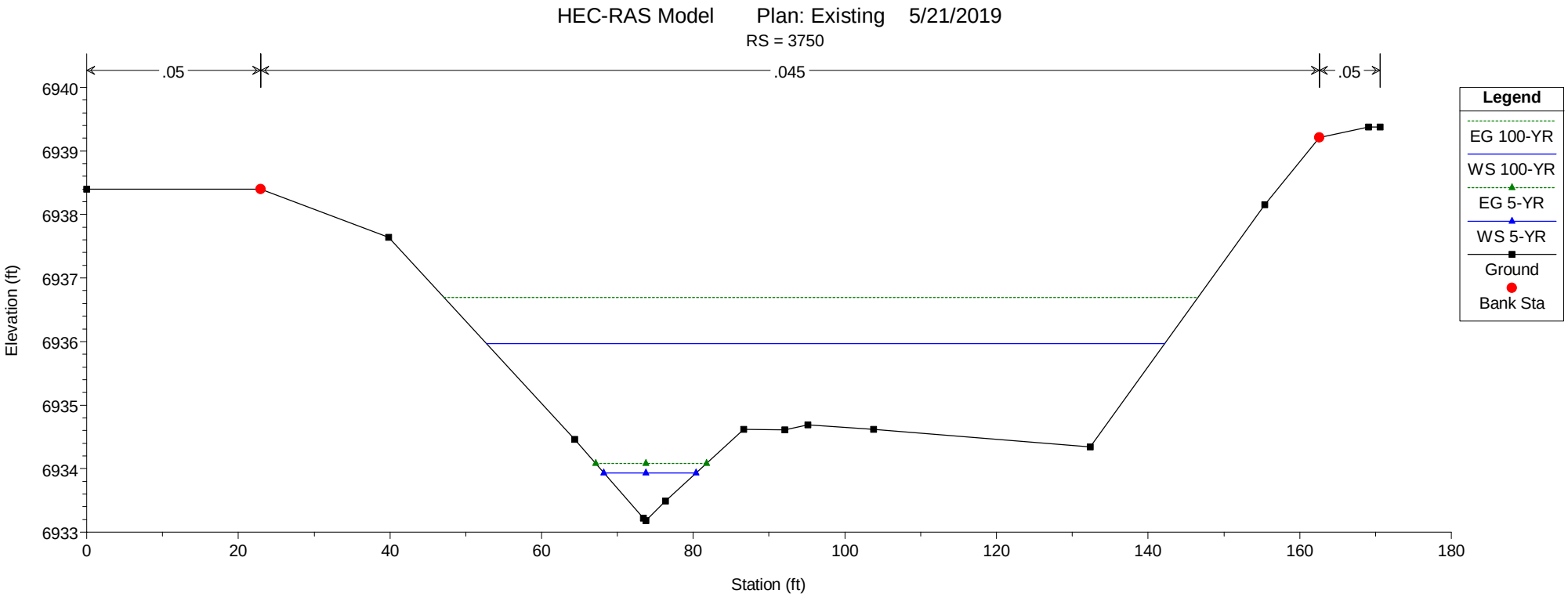


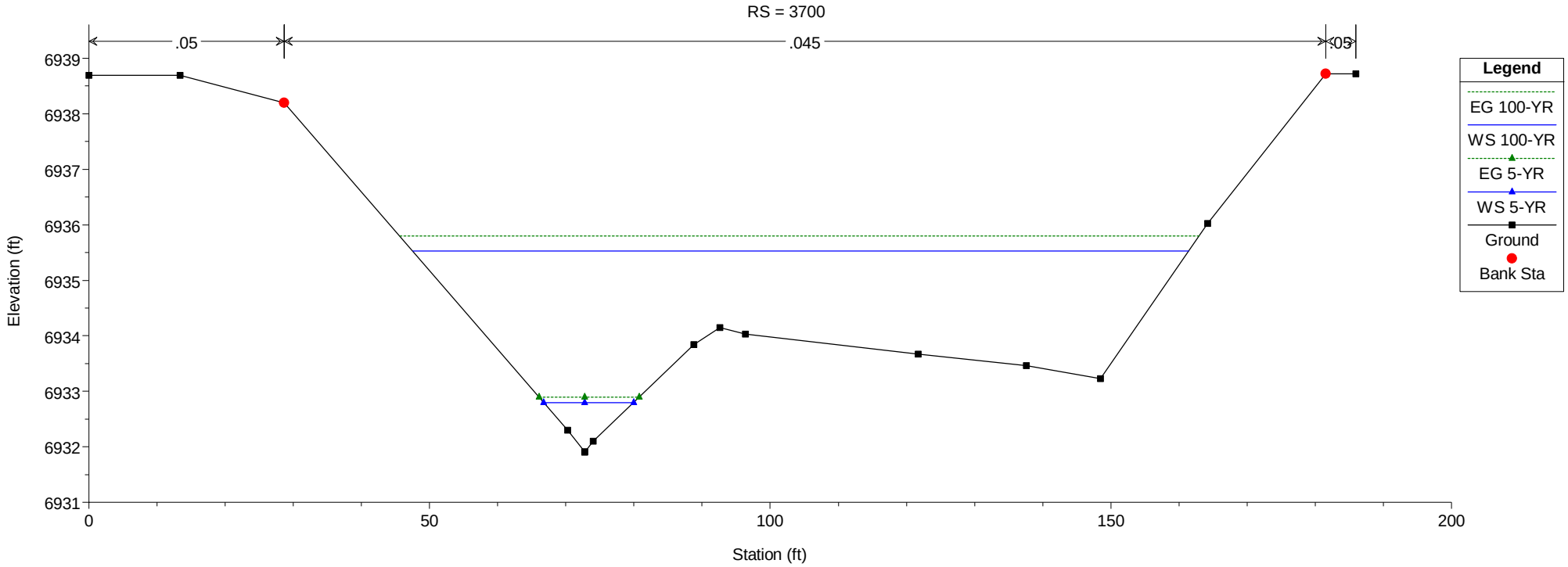
HEC-RAS Model Plan: Existing 5/21/2019

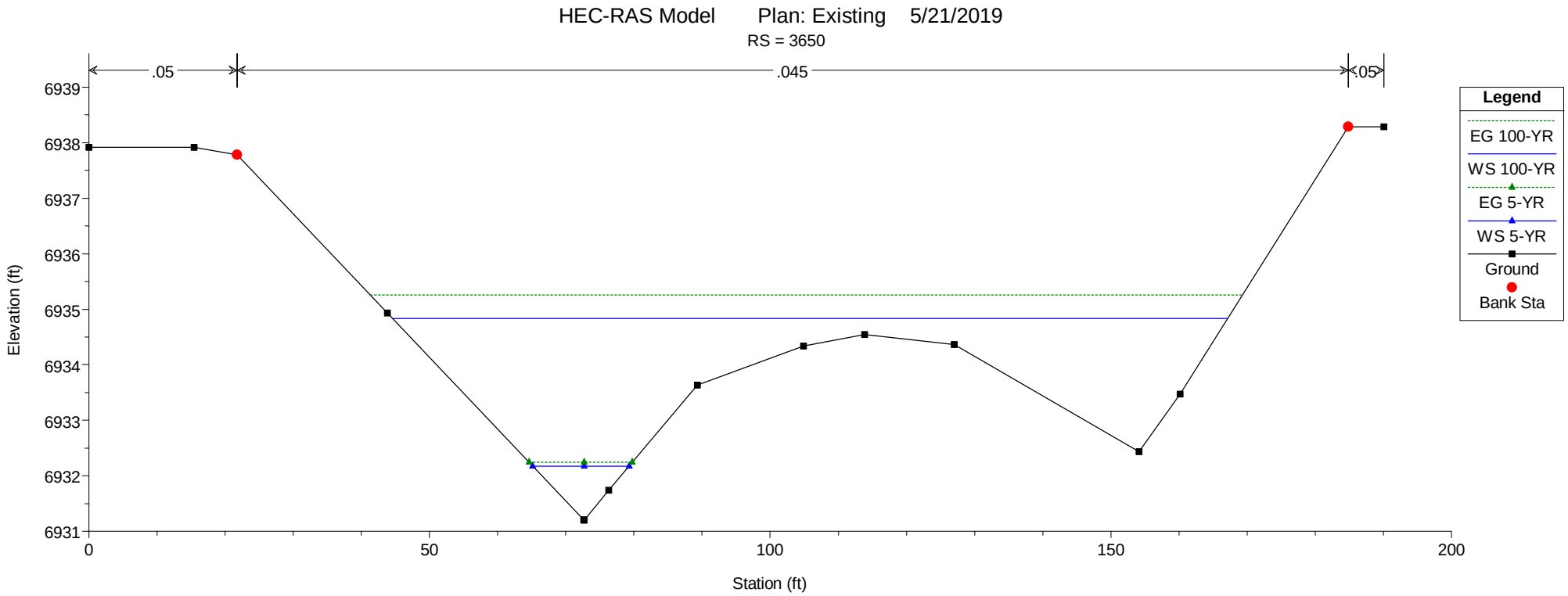
RS = 3850

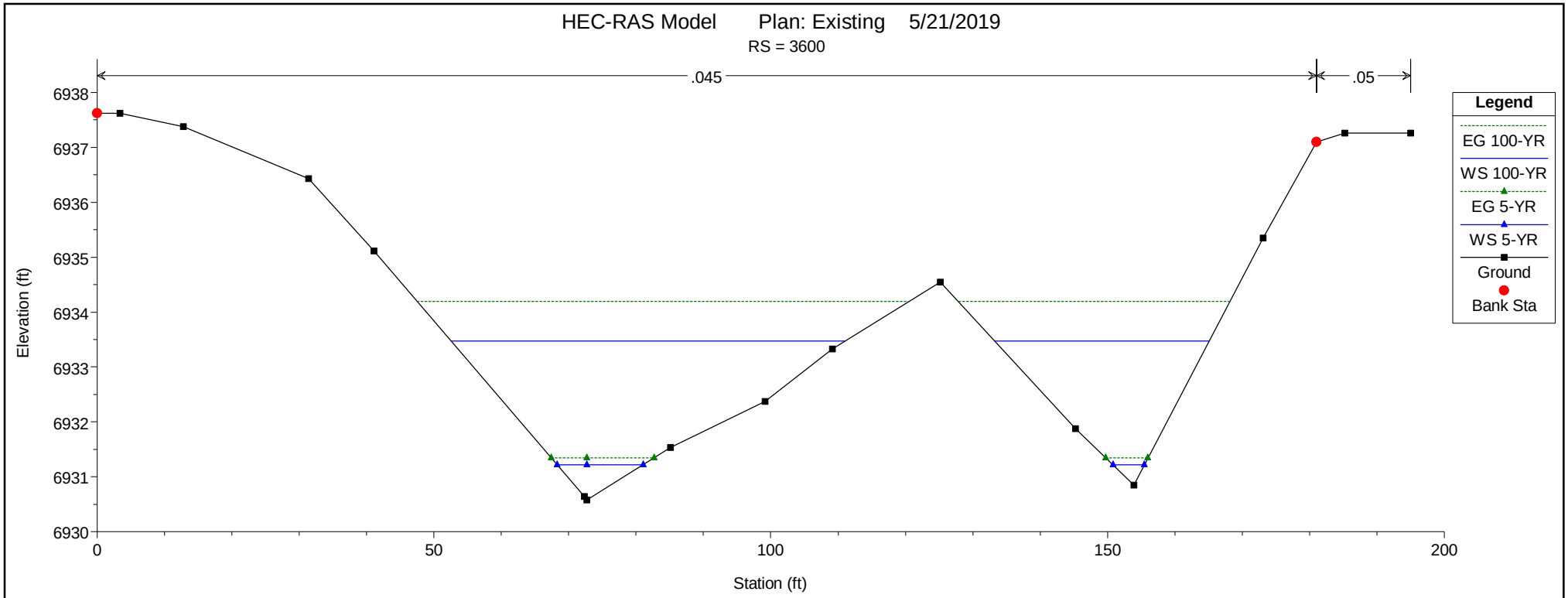


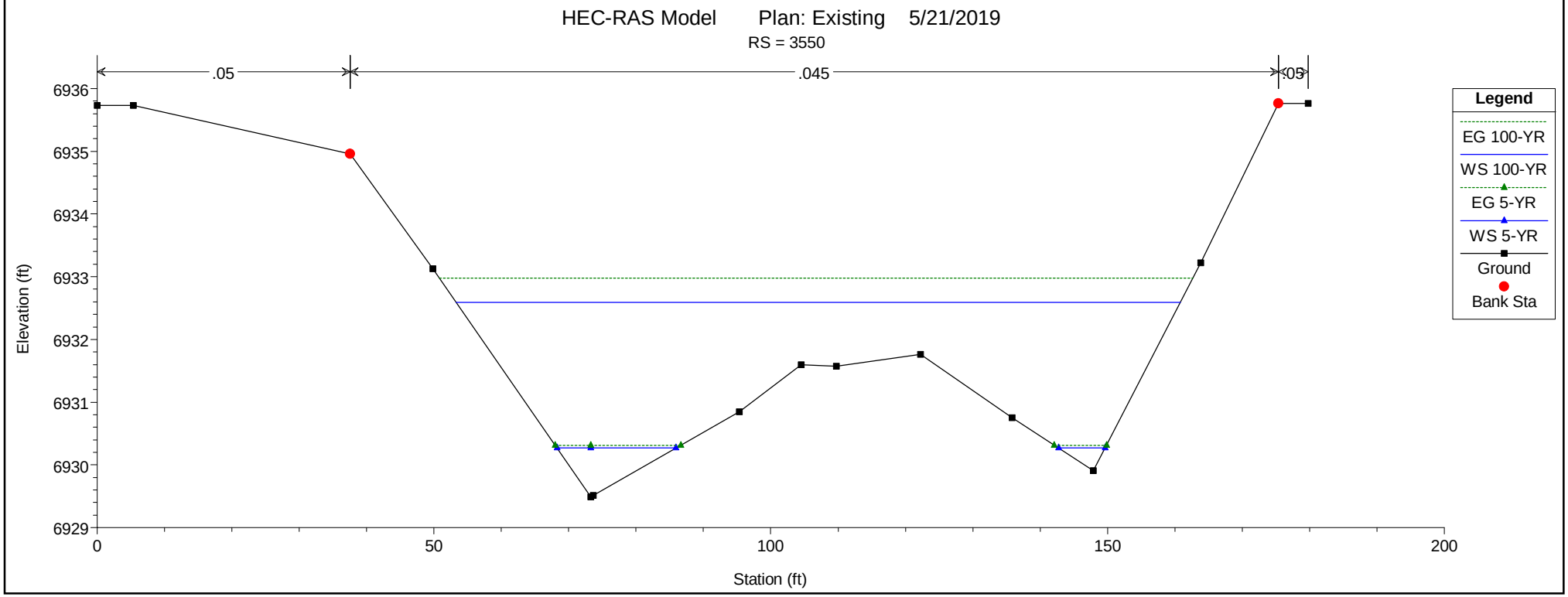

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3800
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

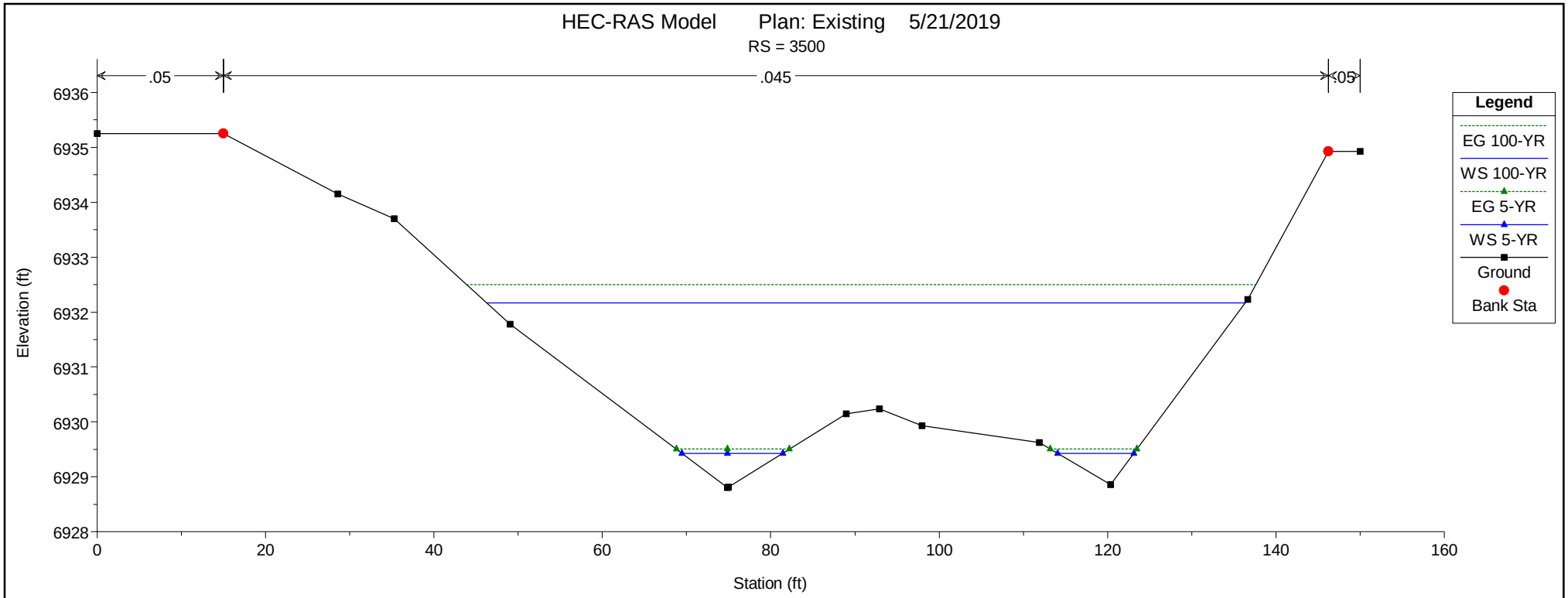

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3750
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

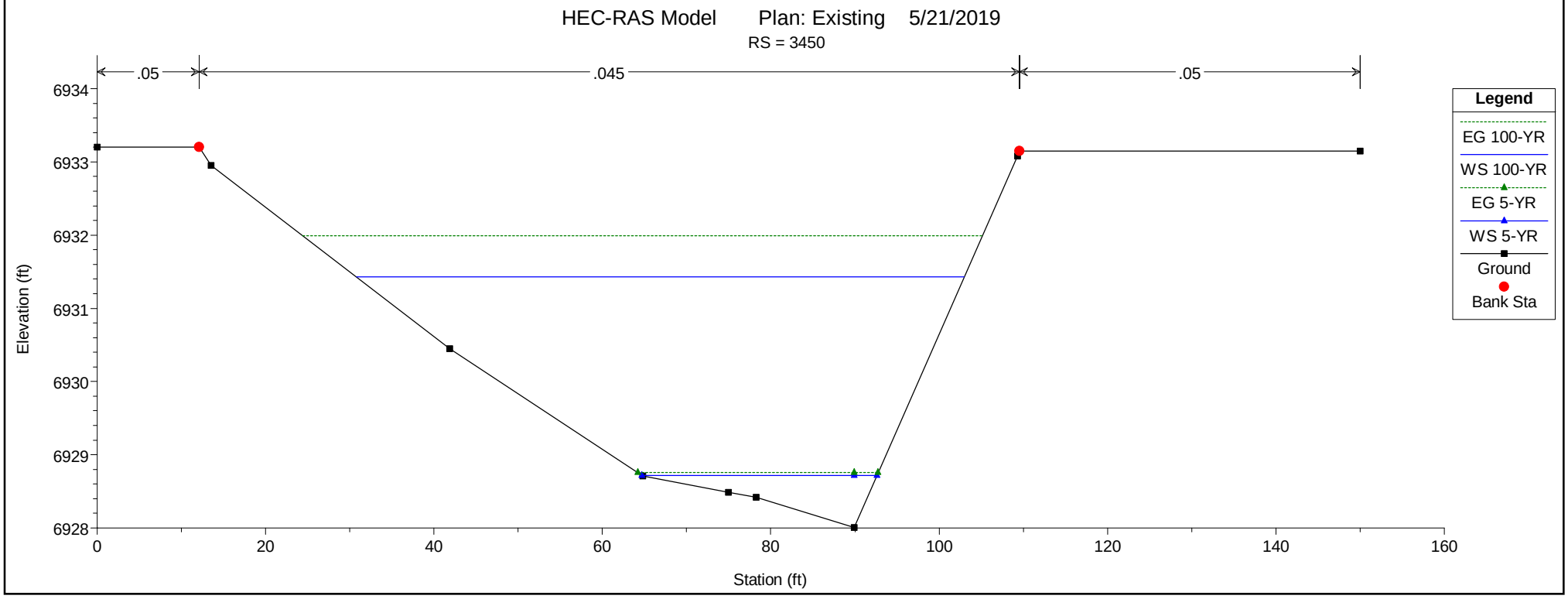

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3700
.05
.045
.05
Elevation (ft)
6939
6938
6937
6936
6935
6934
6933
6932
6931
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

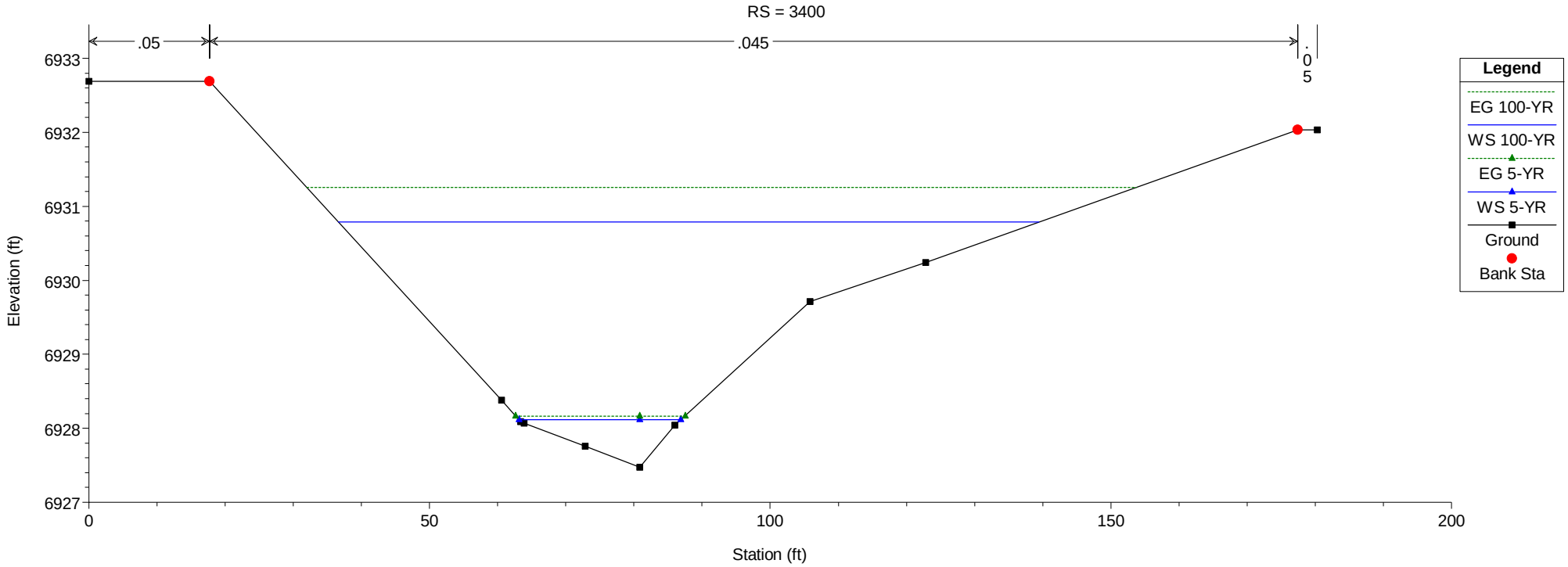

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3650
.05
.045
.05
Elevation (ft)
6939
6938
6937
6936
6935
6934
6933
6932
6931
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

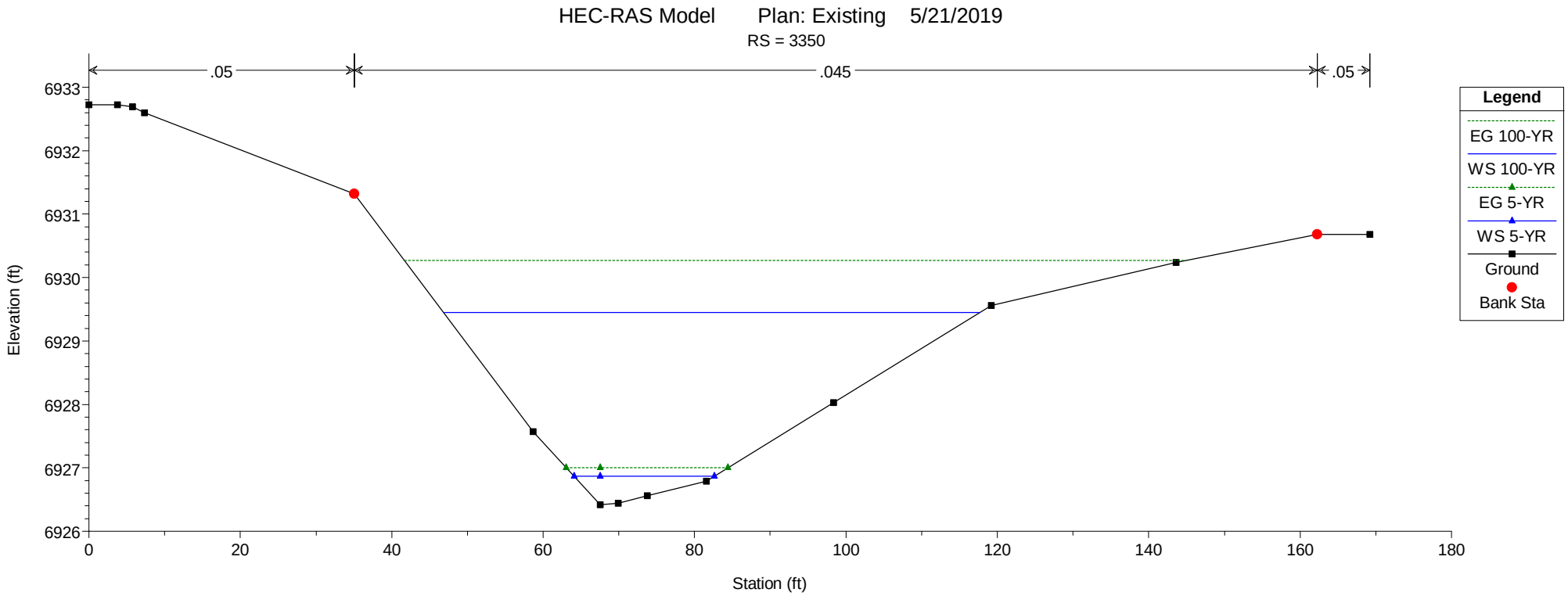

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3600
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

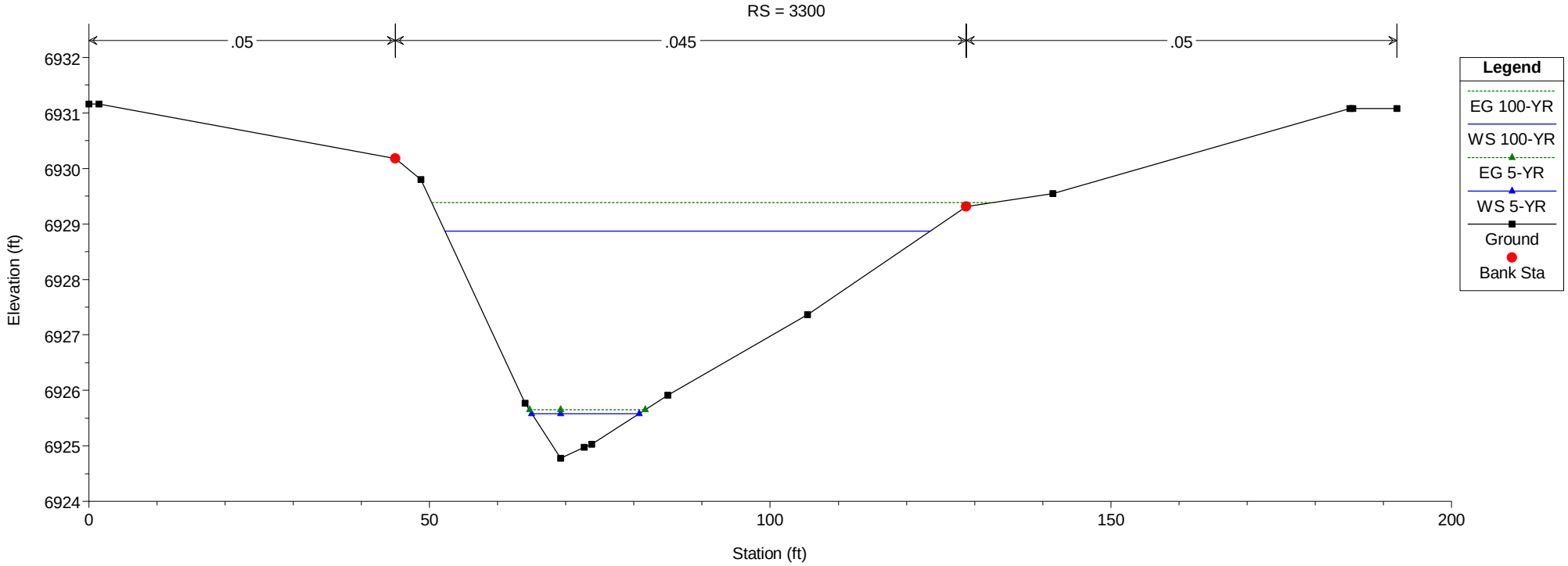

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3550
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

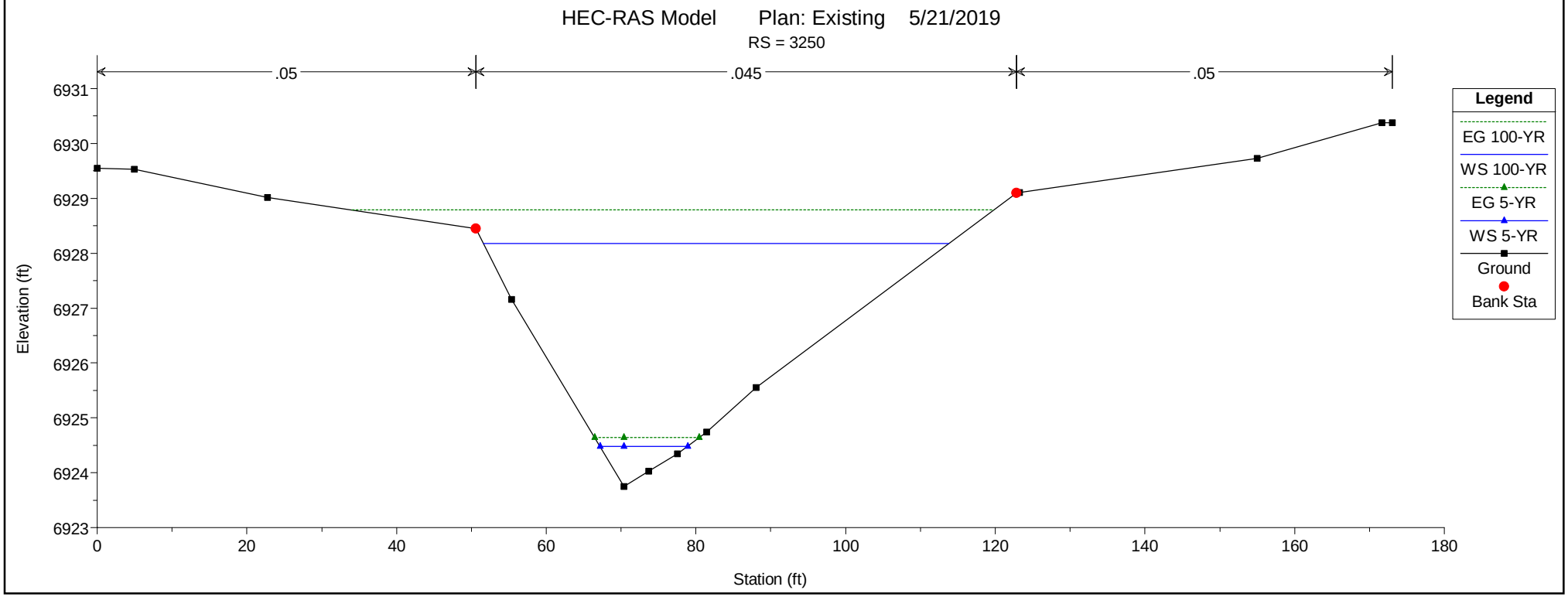

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3500
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

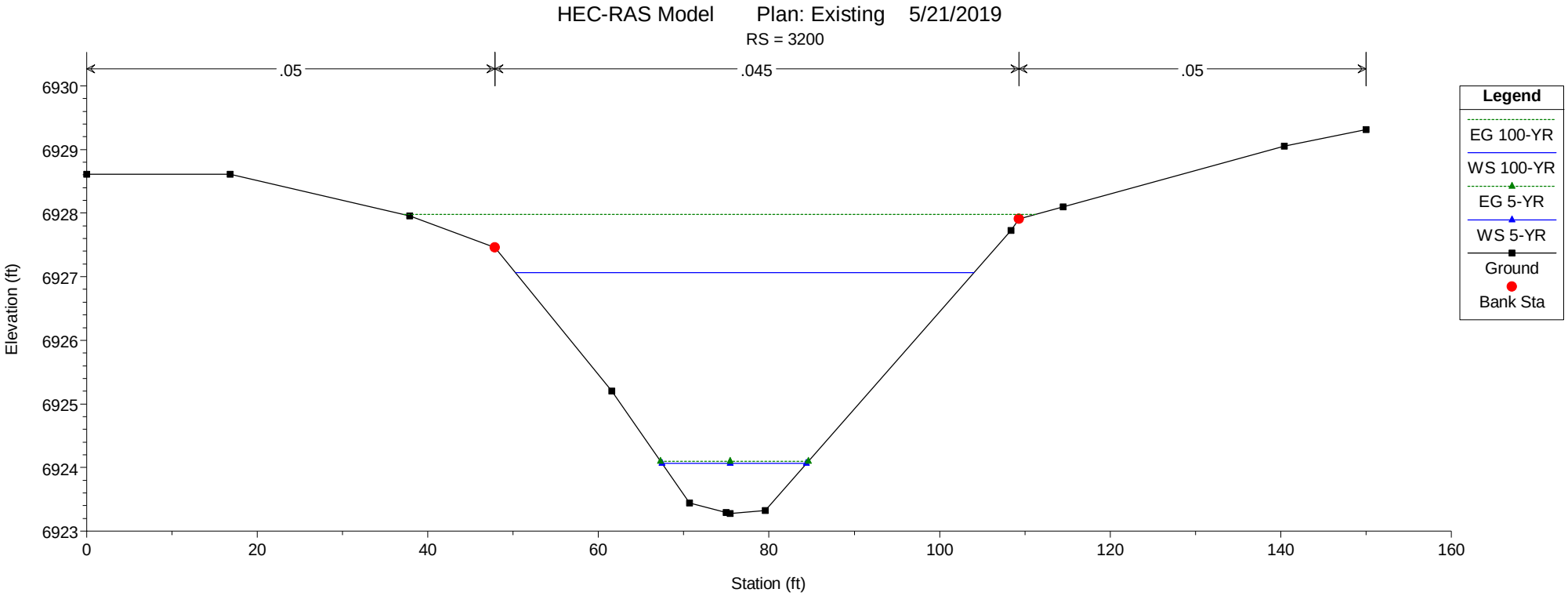

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3450
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

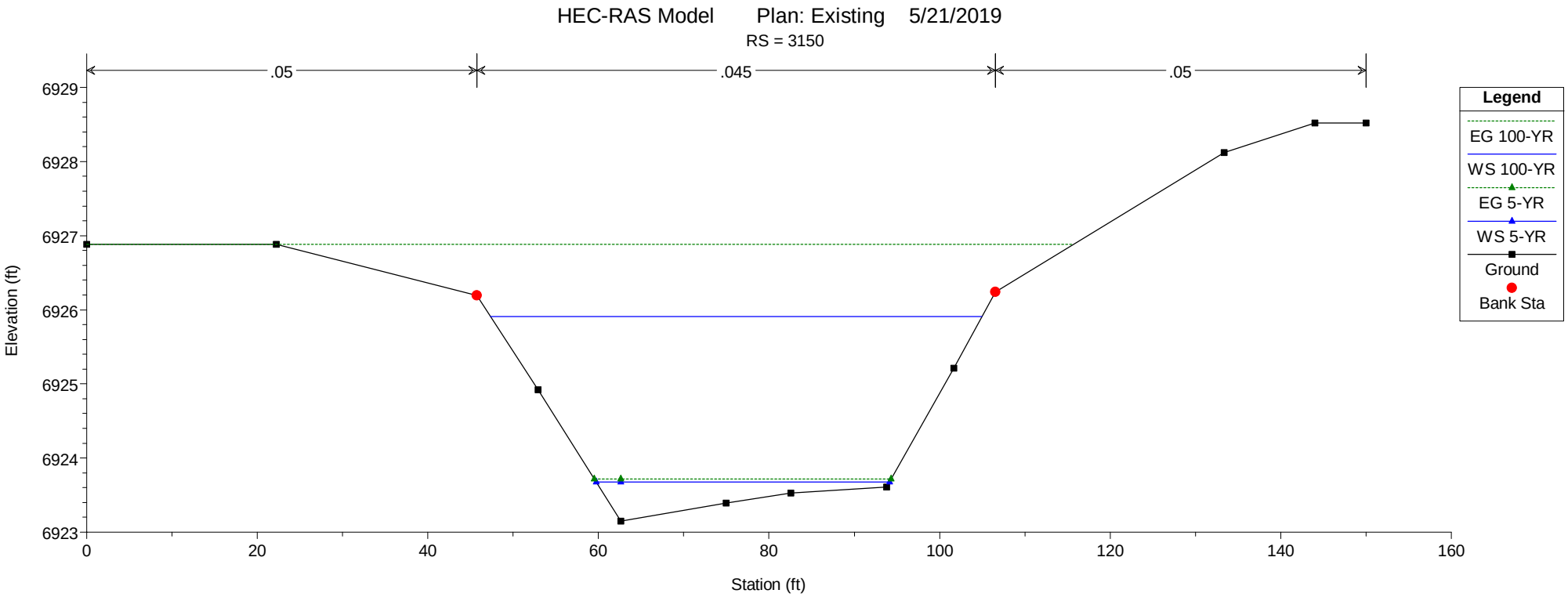

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3400
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

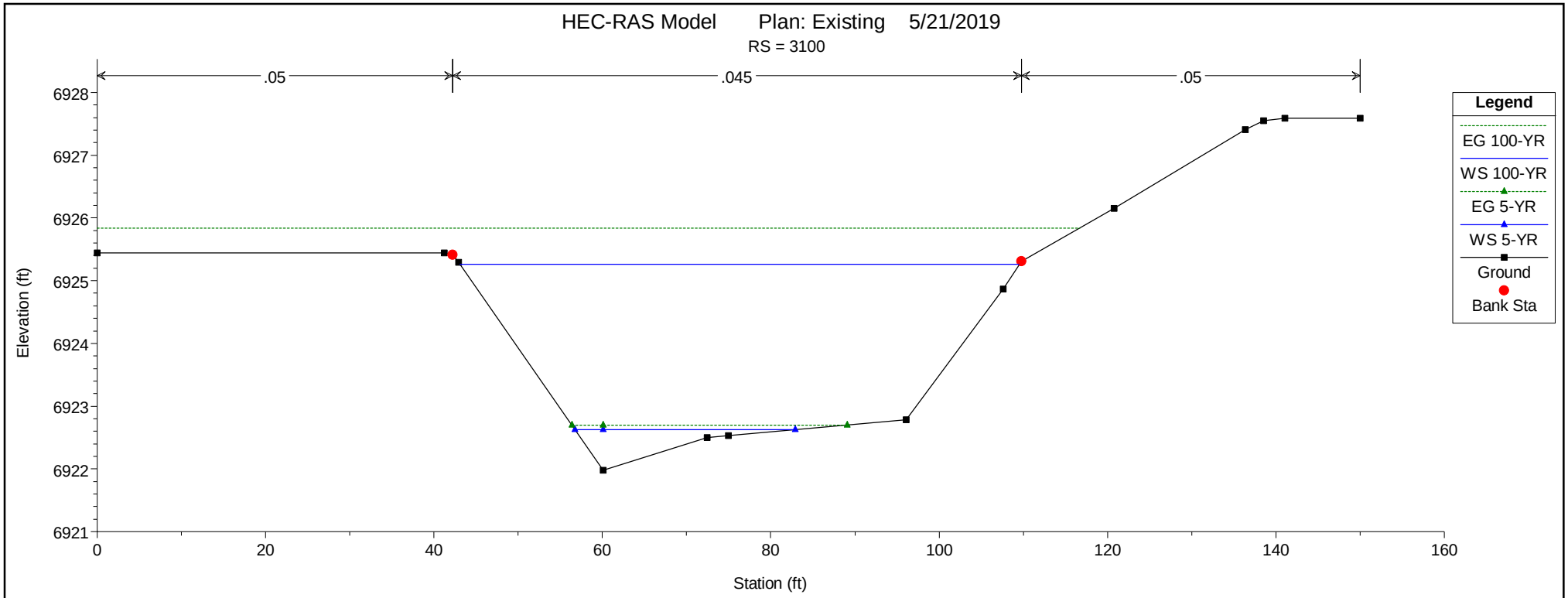

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3350
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

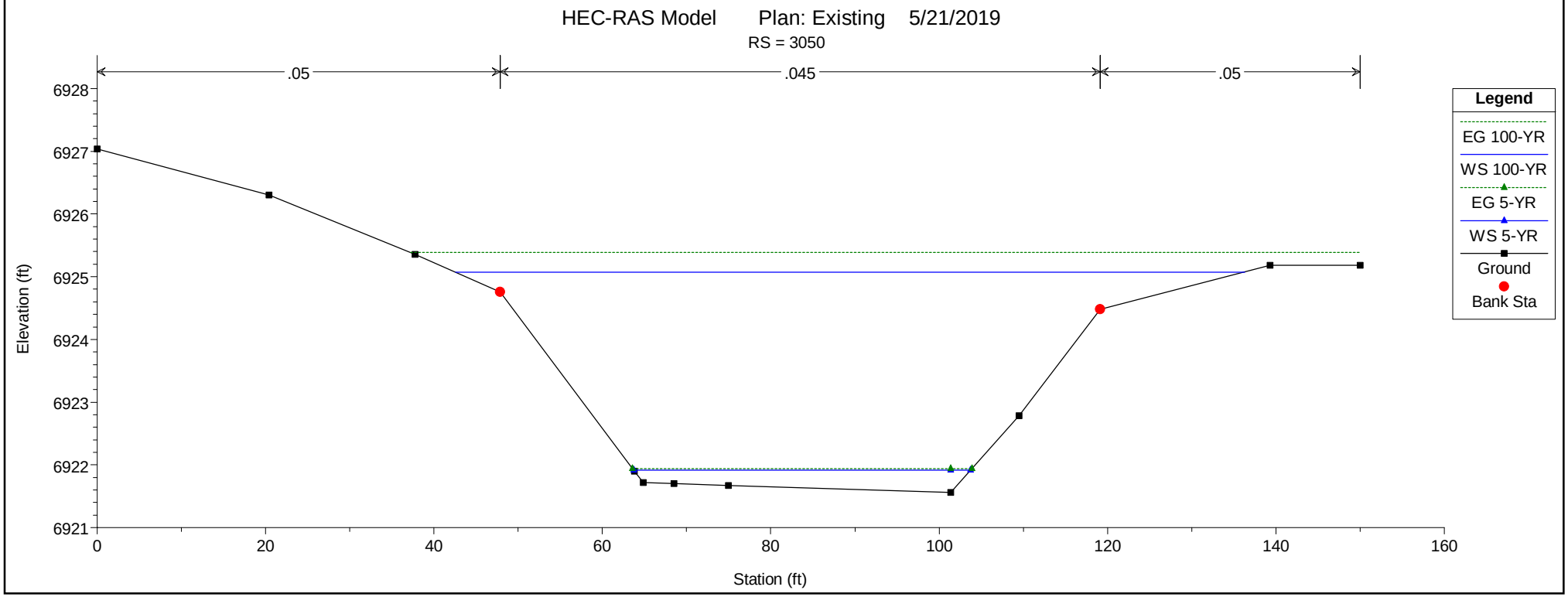

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

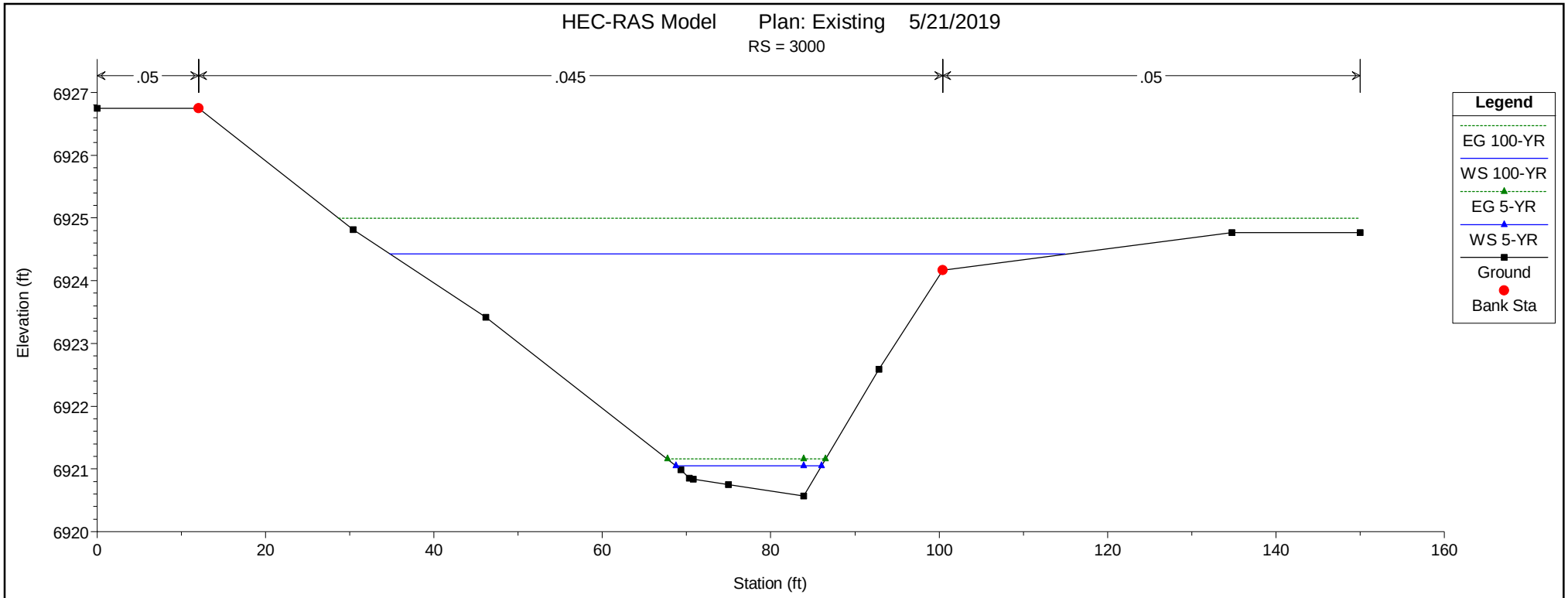

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

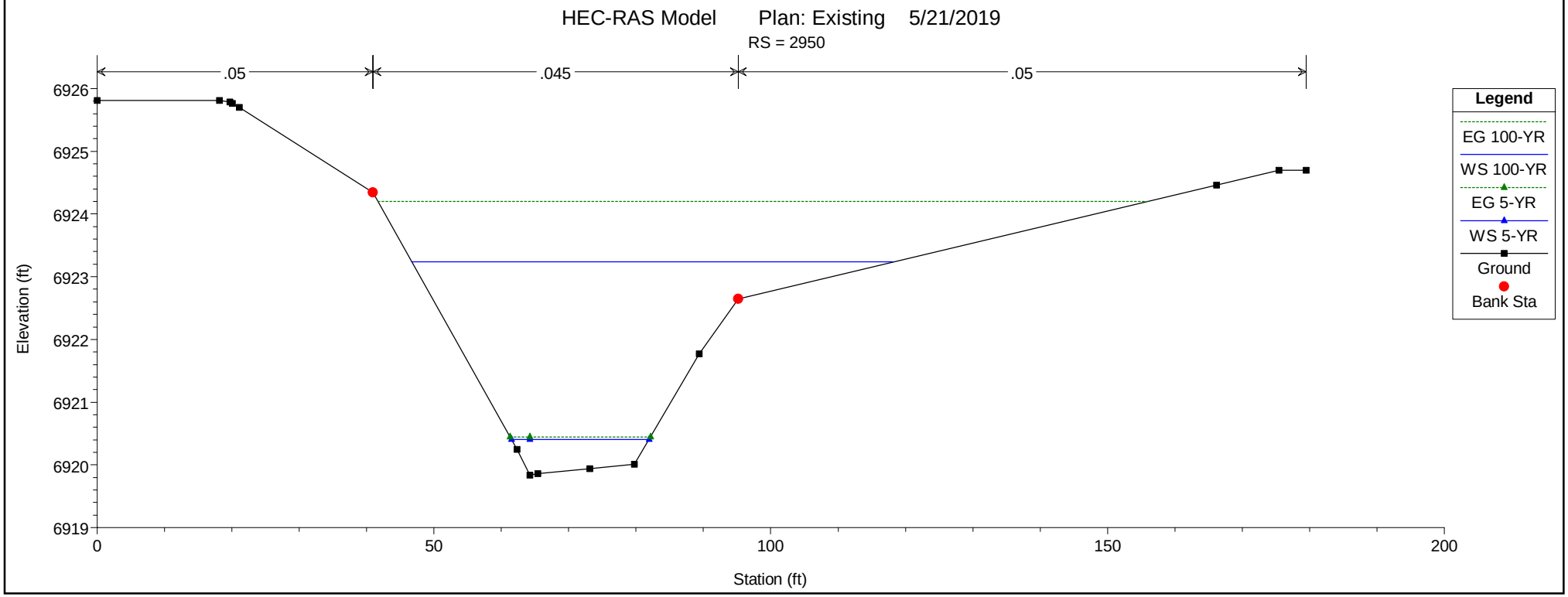

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3200
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6930
6929
6928
6927
6926
6925
6924
6923
0
20
40
60
80
100
120
140
160

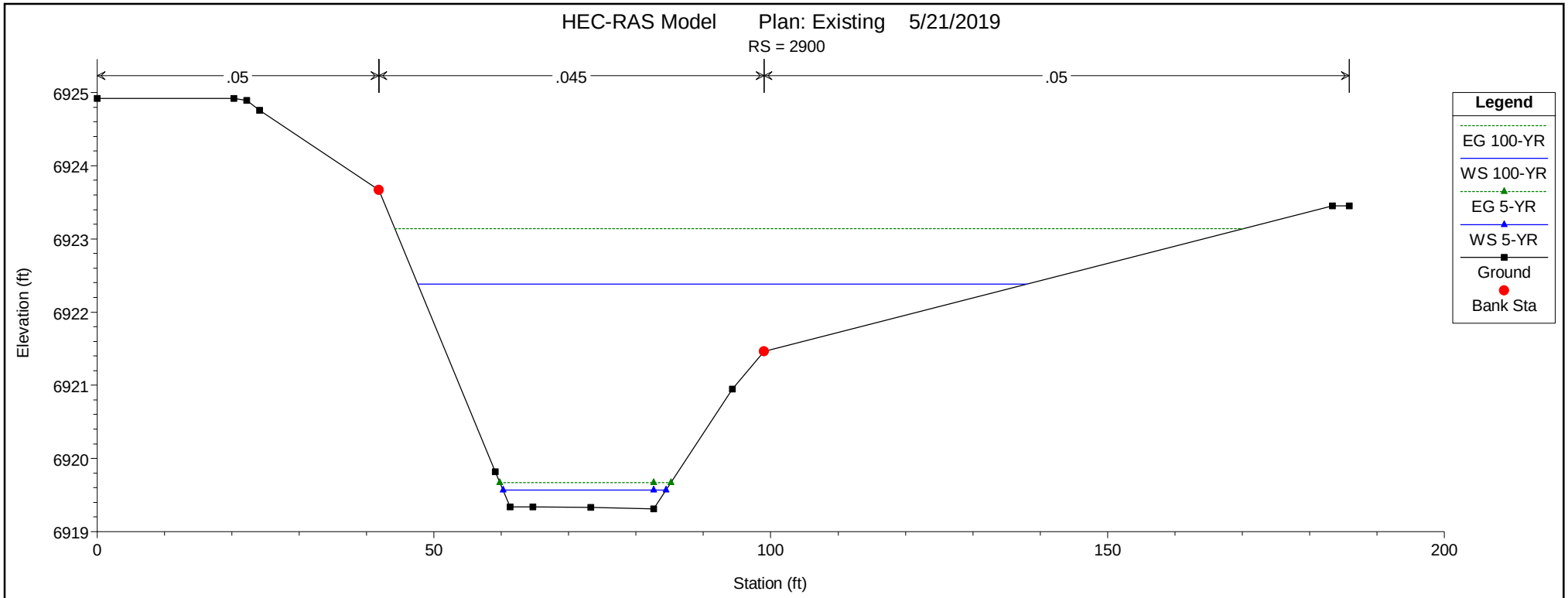

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3150
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6929
6928
6927
6926
6925
6924
6923
0
20
40
60
80
100
120
140
160

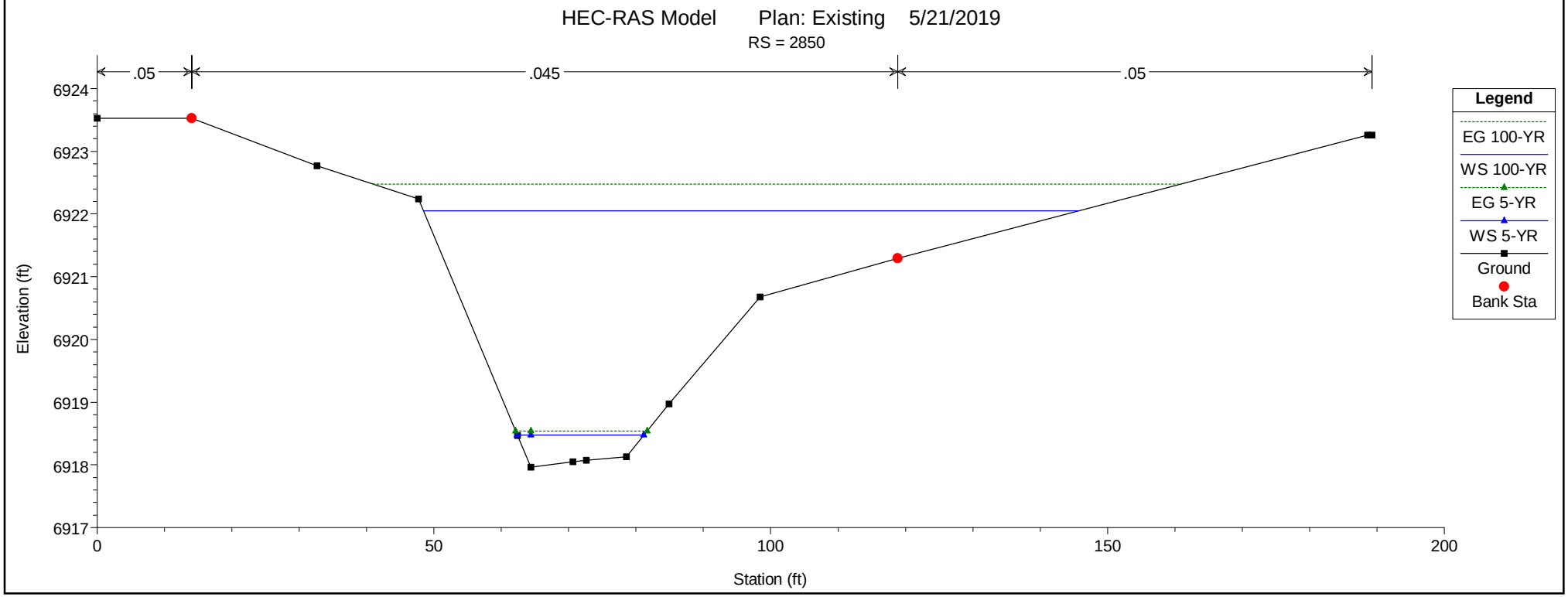

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3100
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

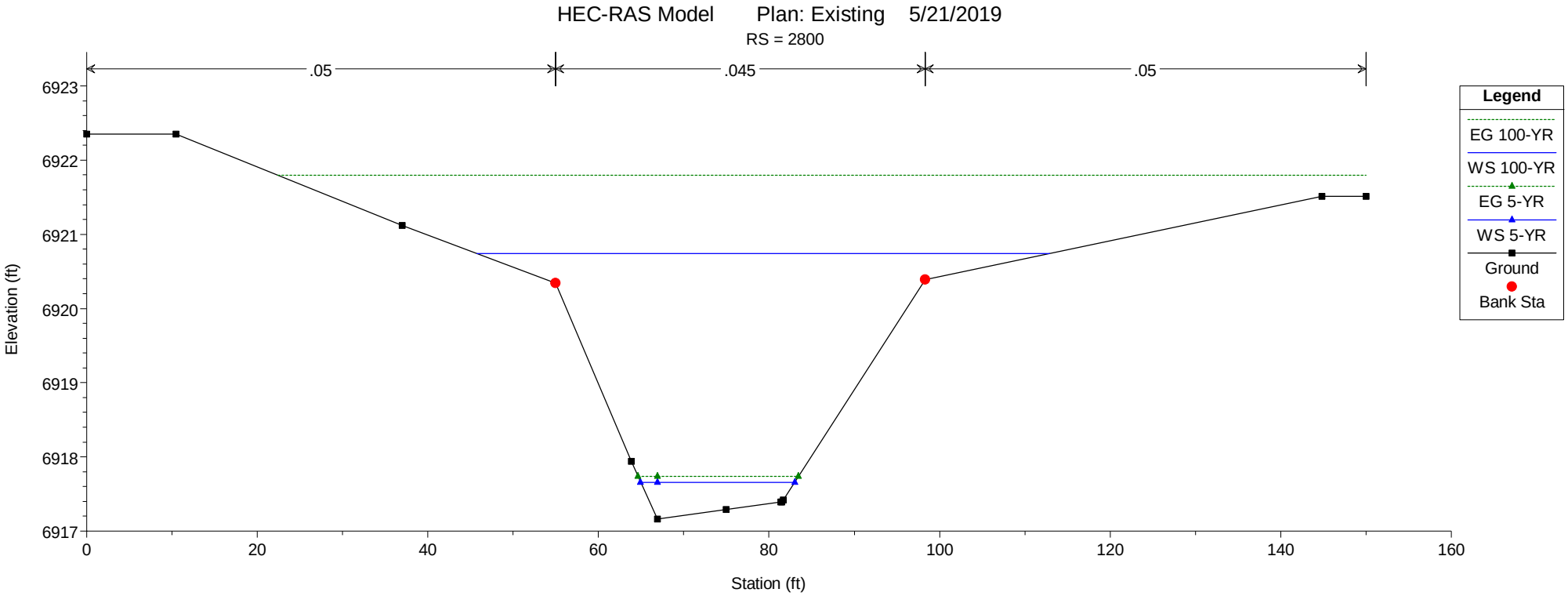

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

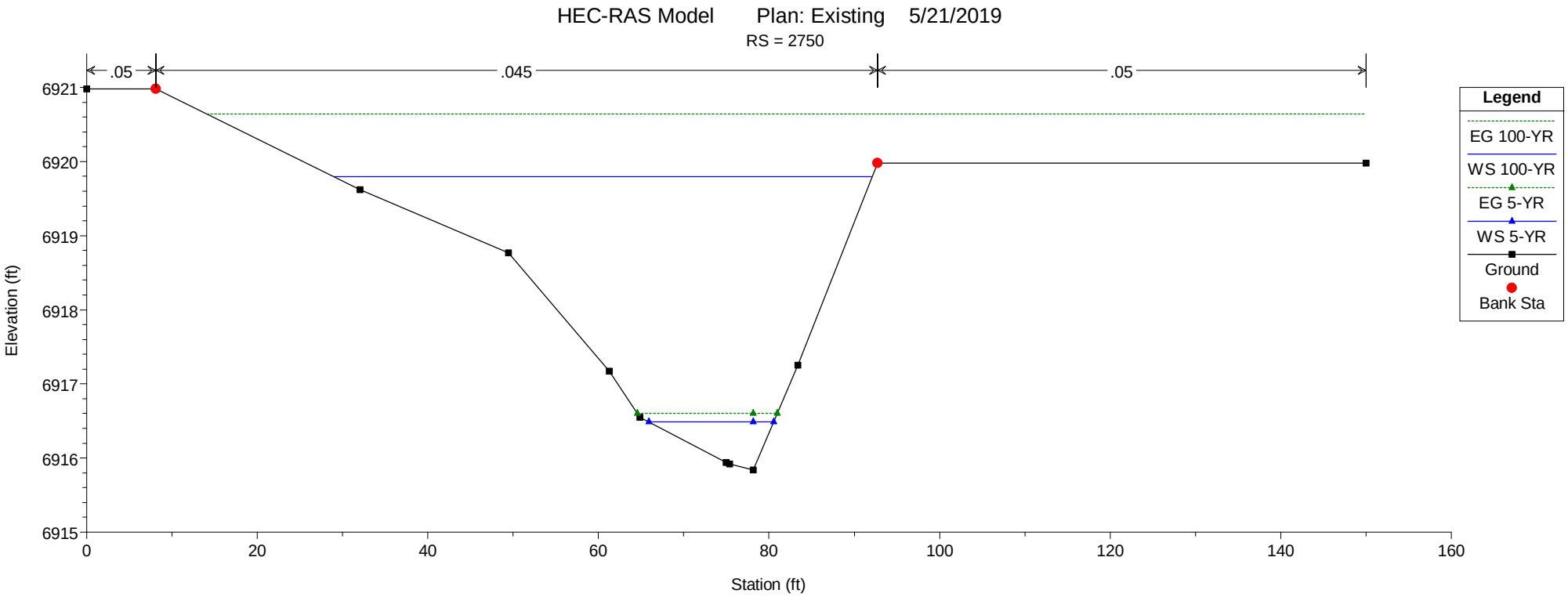

HEC-RAS Model Plan: Existing 5/21/2019
RS = 3000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

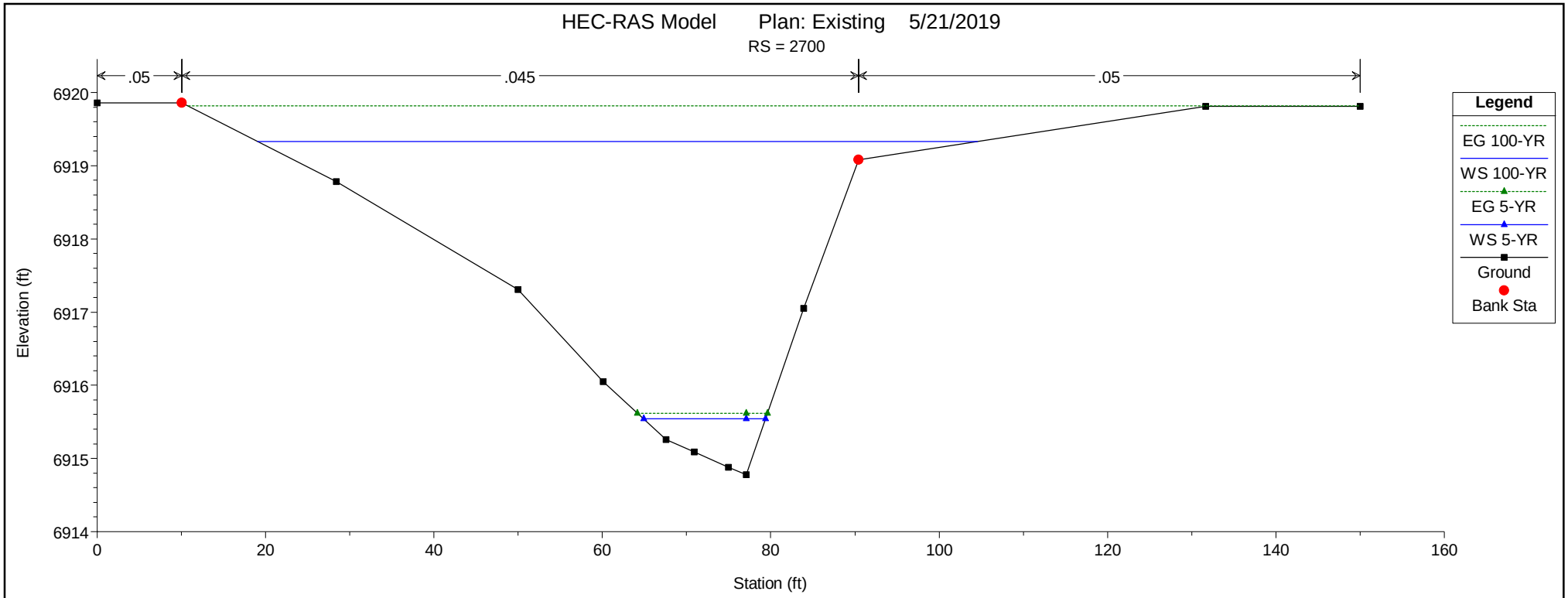

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2950
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

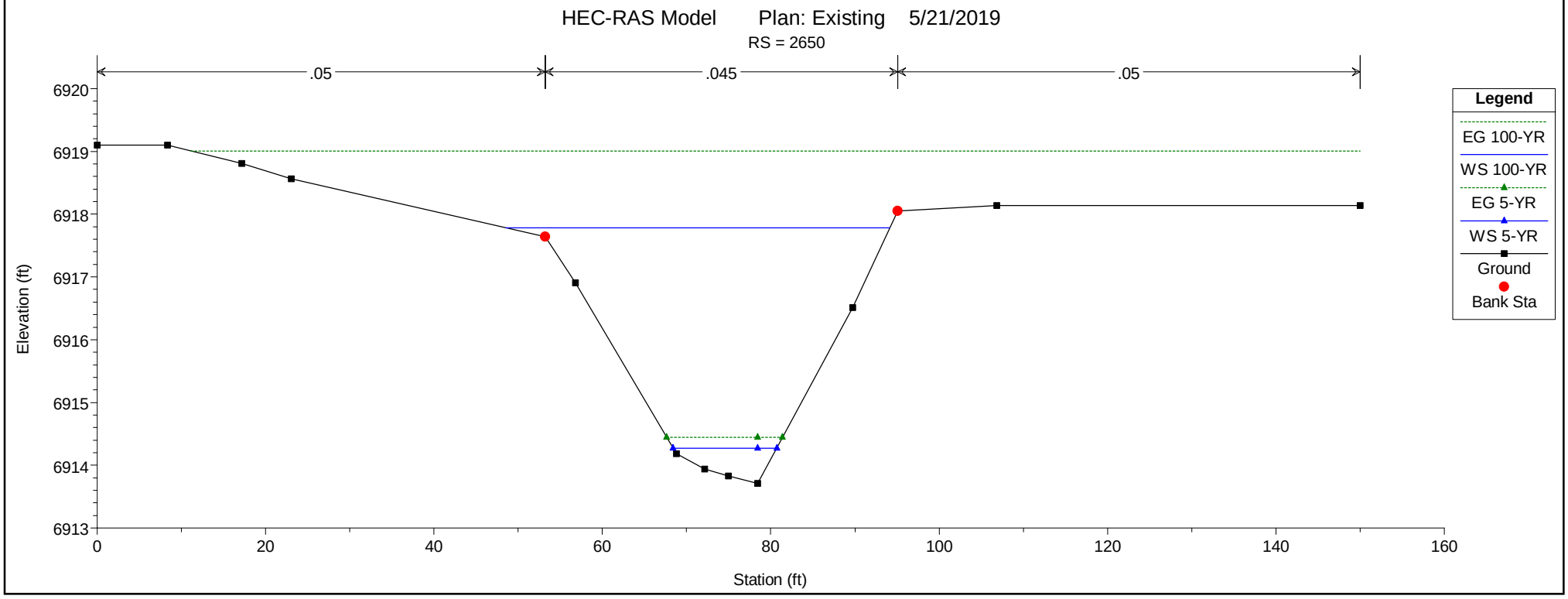

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2900
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

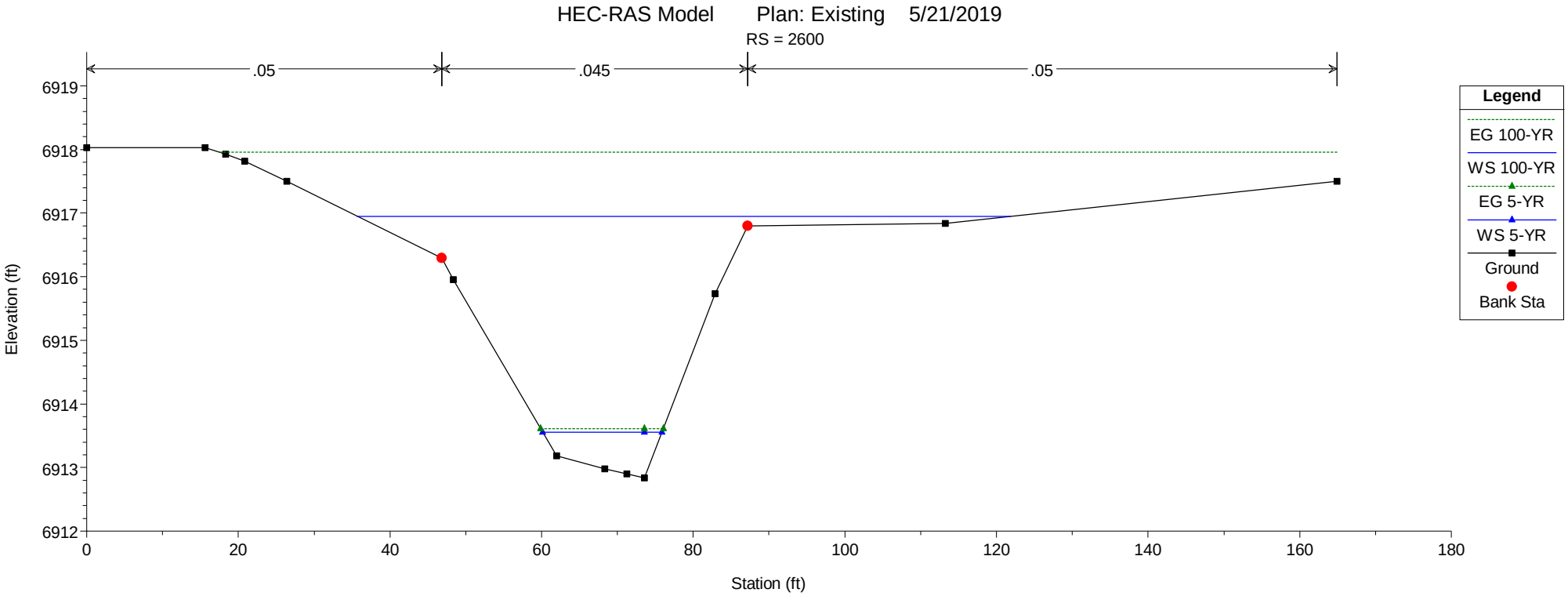

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2850
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

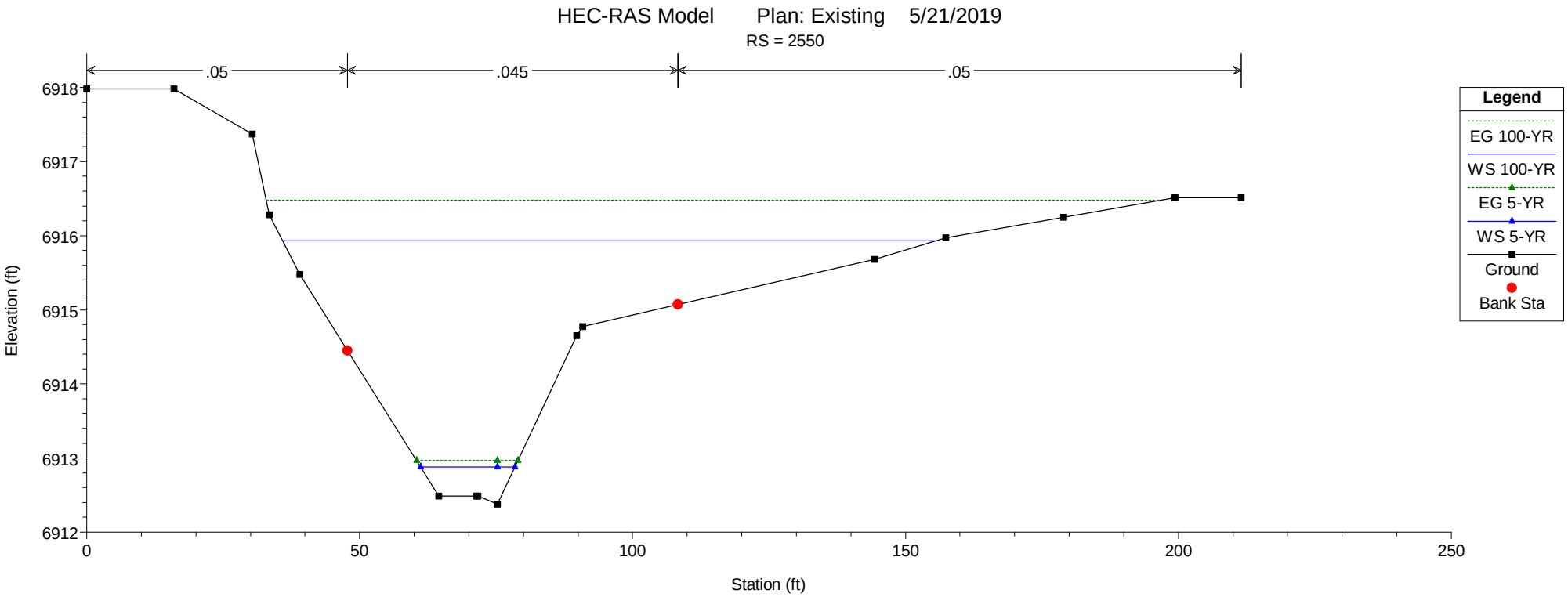

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2800
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

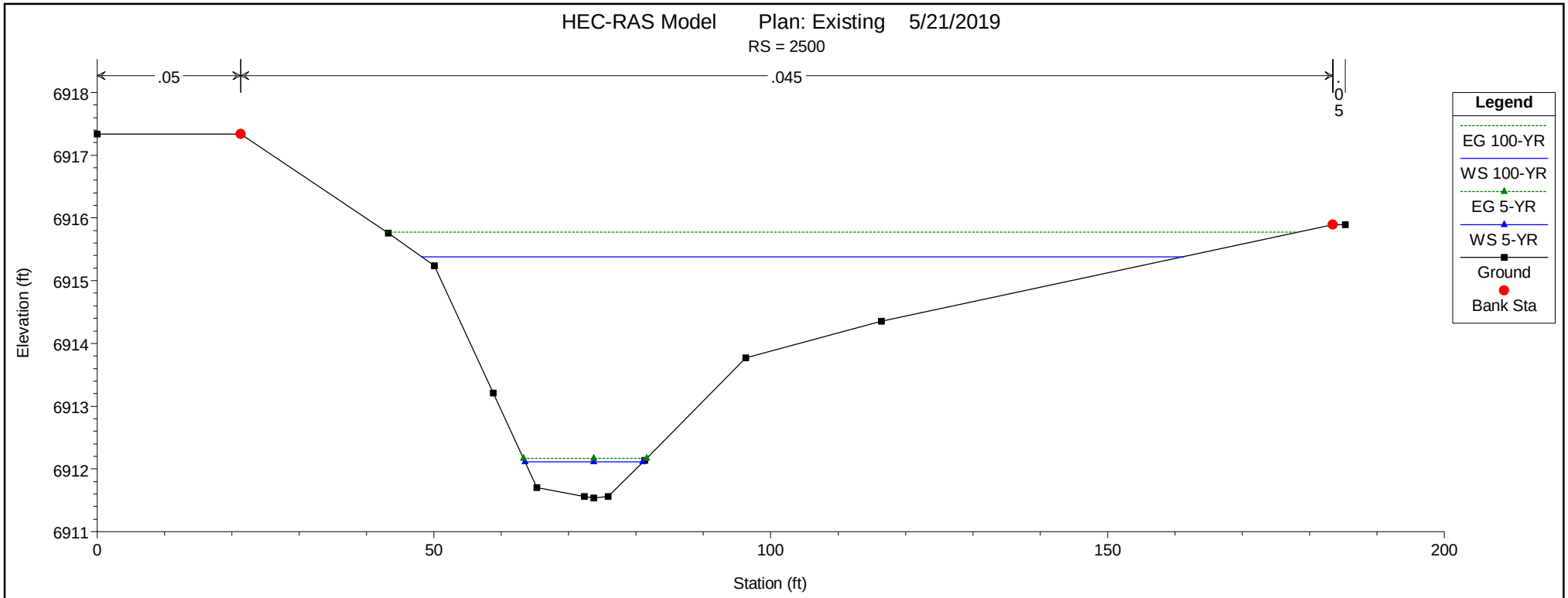

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2750
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

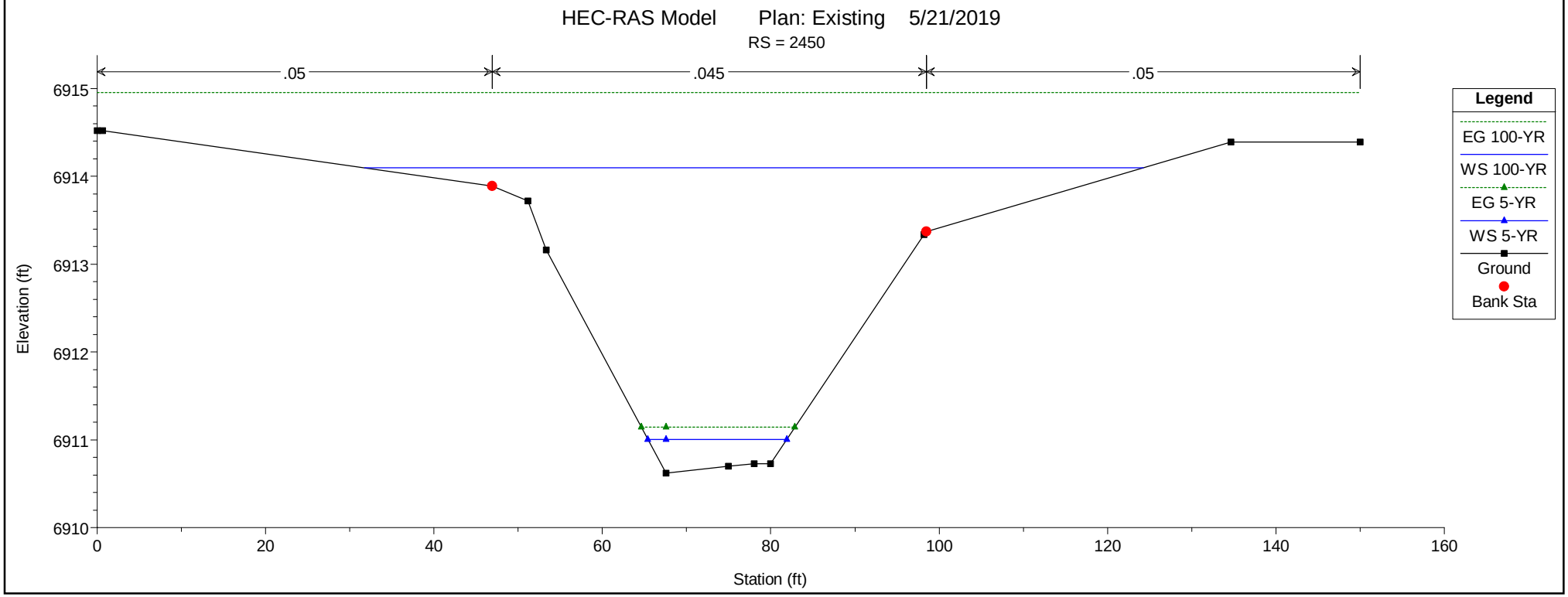

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2700
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

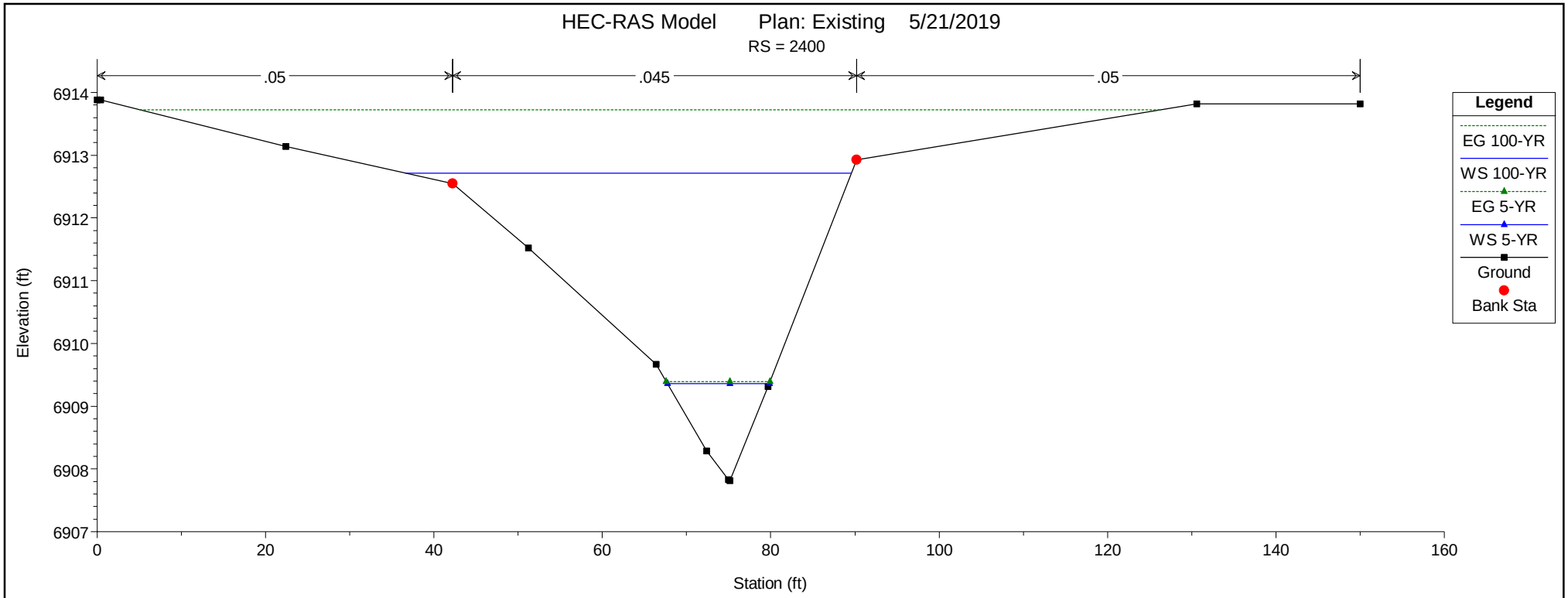

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2650
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

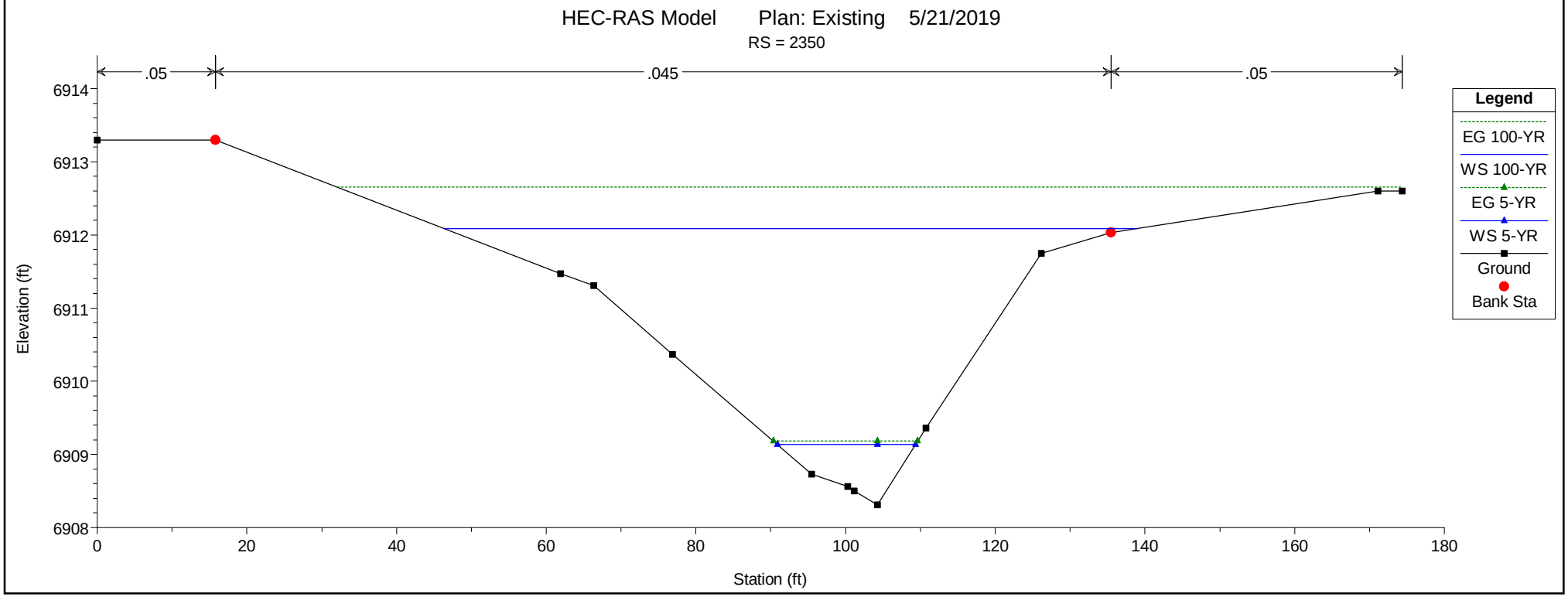

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2600
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

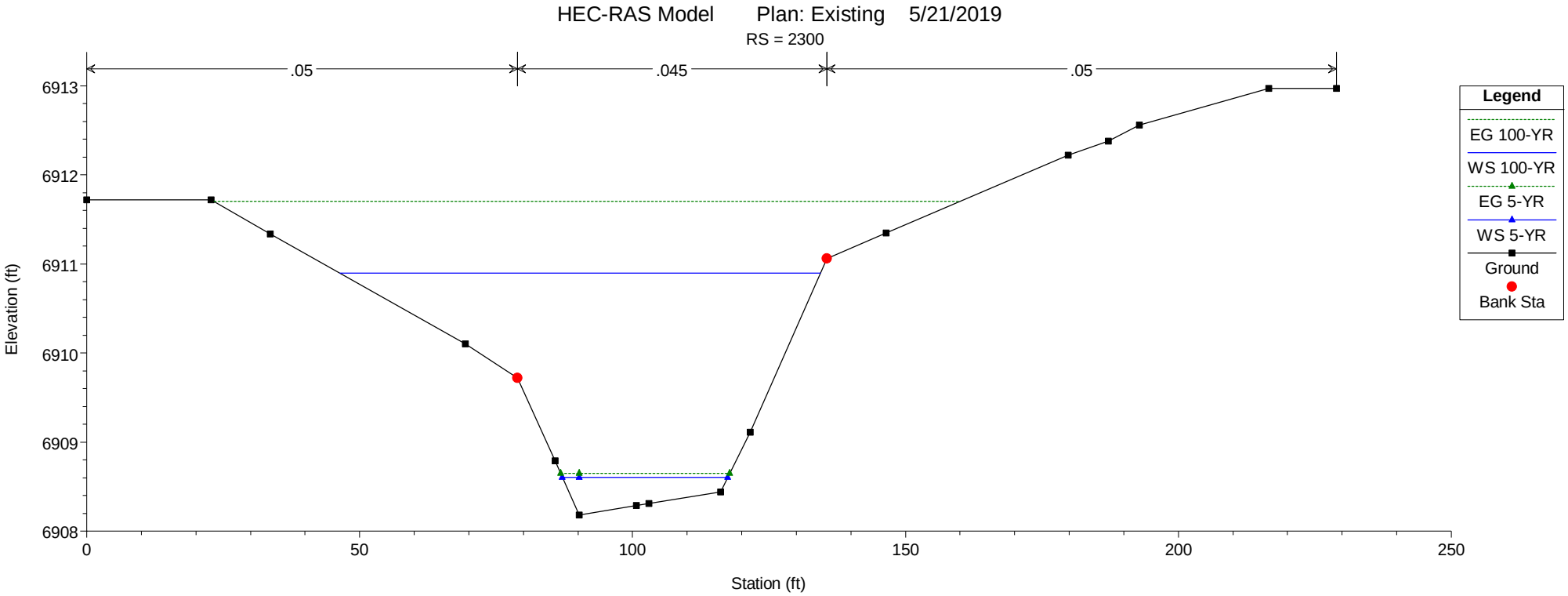

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2550
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

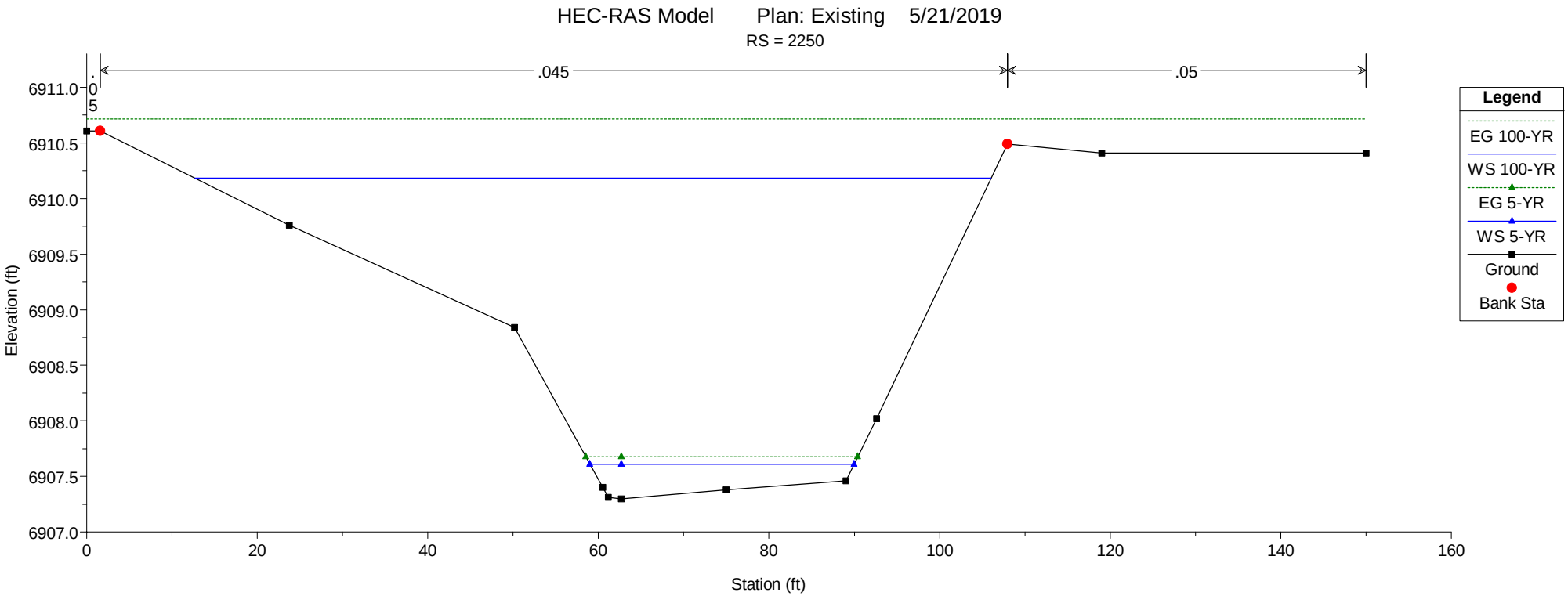

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2500
.05
.045
.05
Elevation (ft)
6918
6917
6916
6915
6914
6913
6912
6911
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

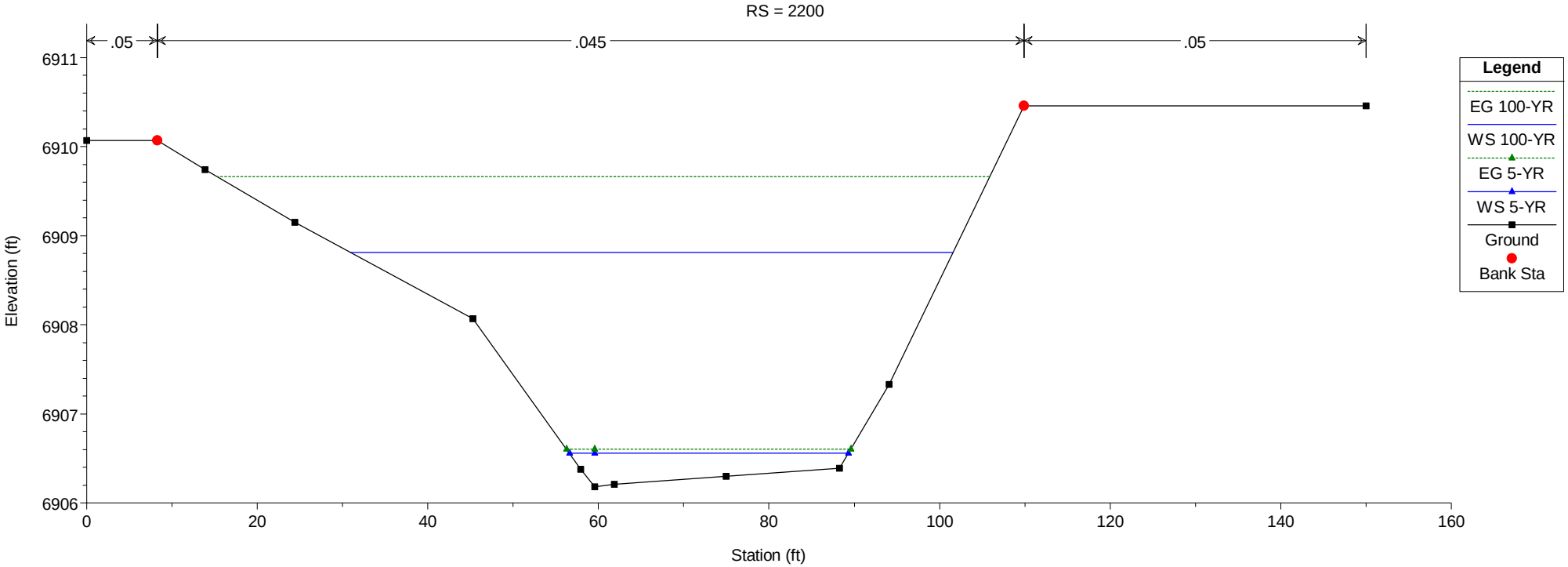

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2450
.05
.045
.05
Elevation (ft)
6915
6914
6913
6912
6911
6910
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

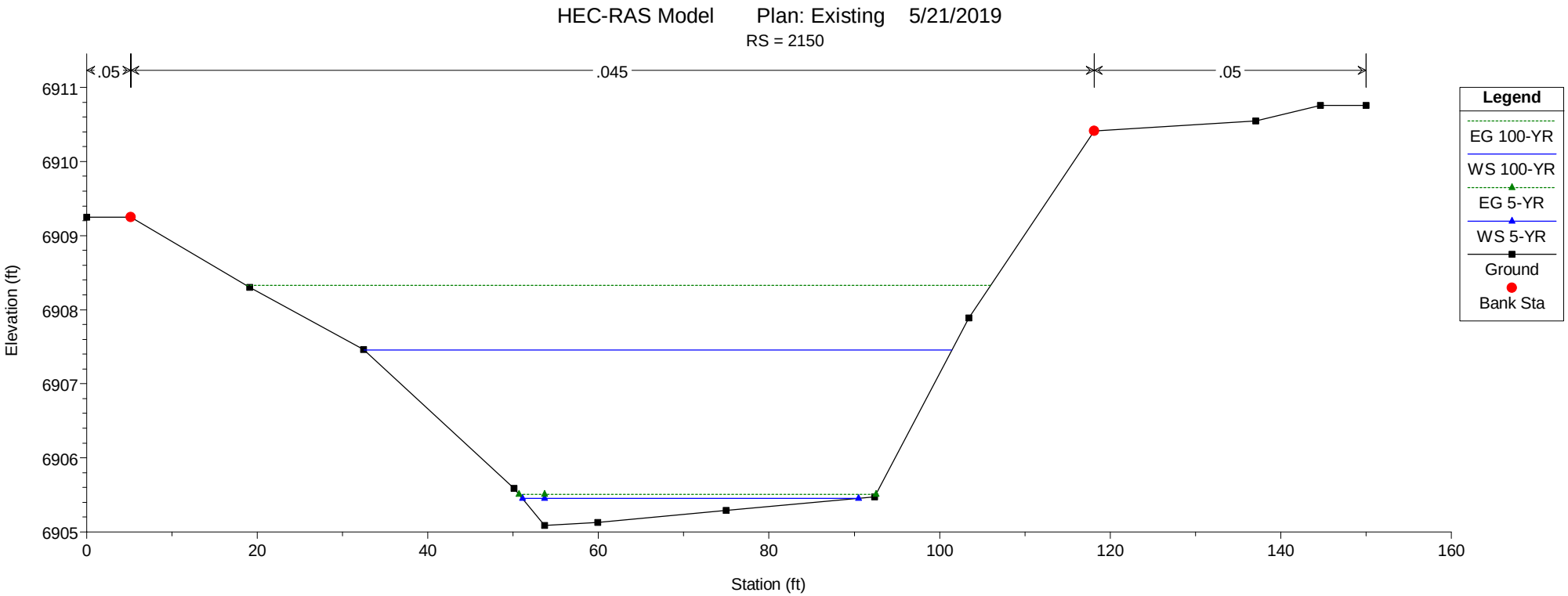

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2400
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

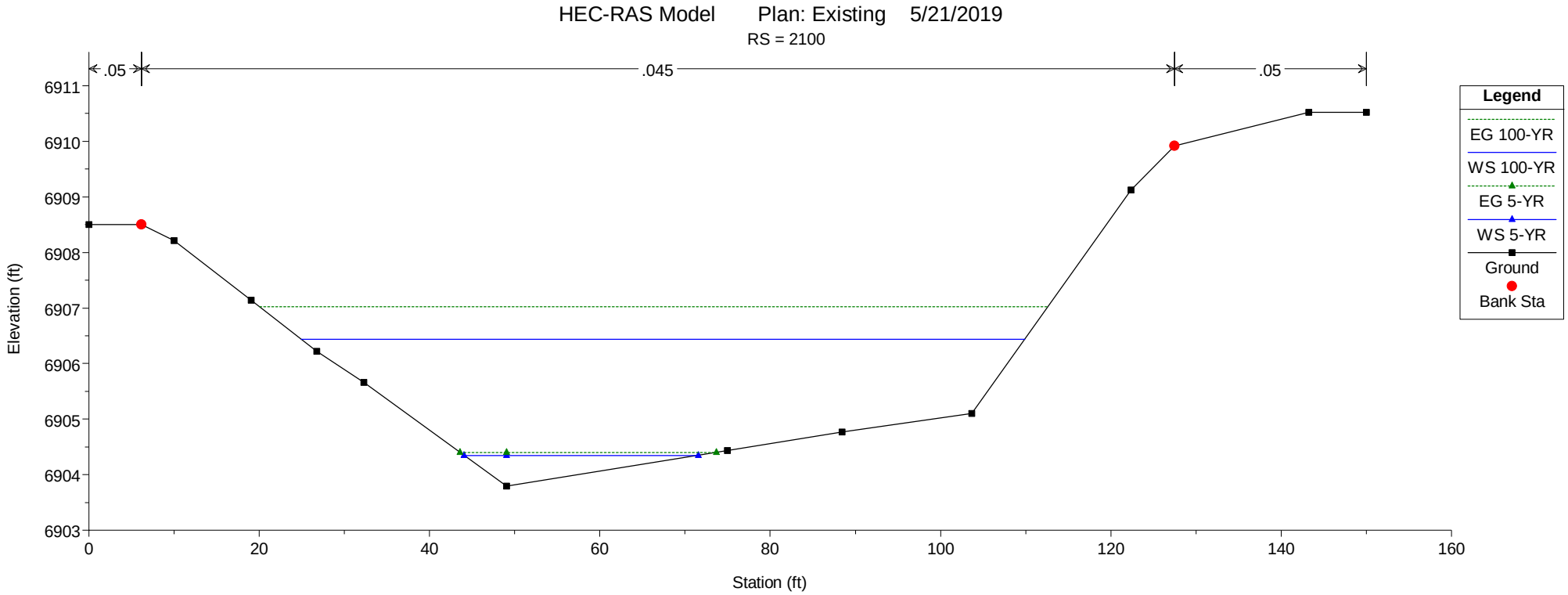

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2350
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

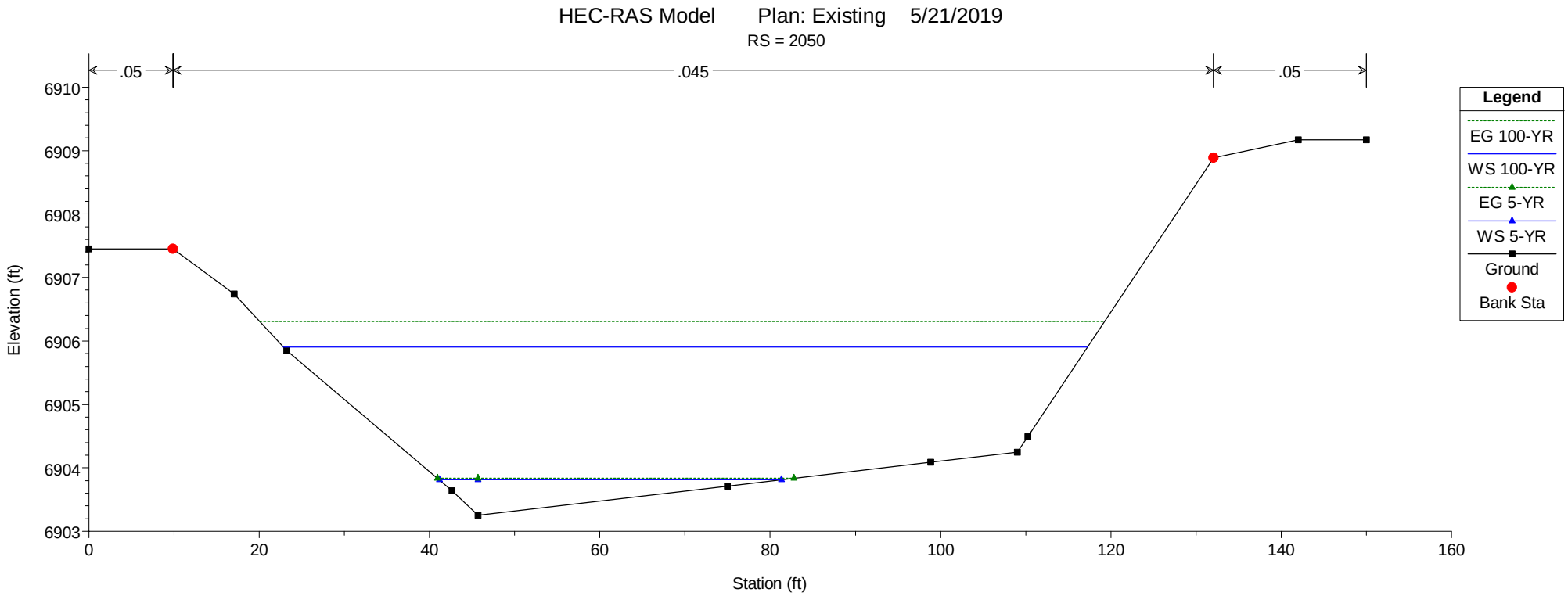

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

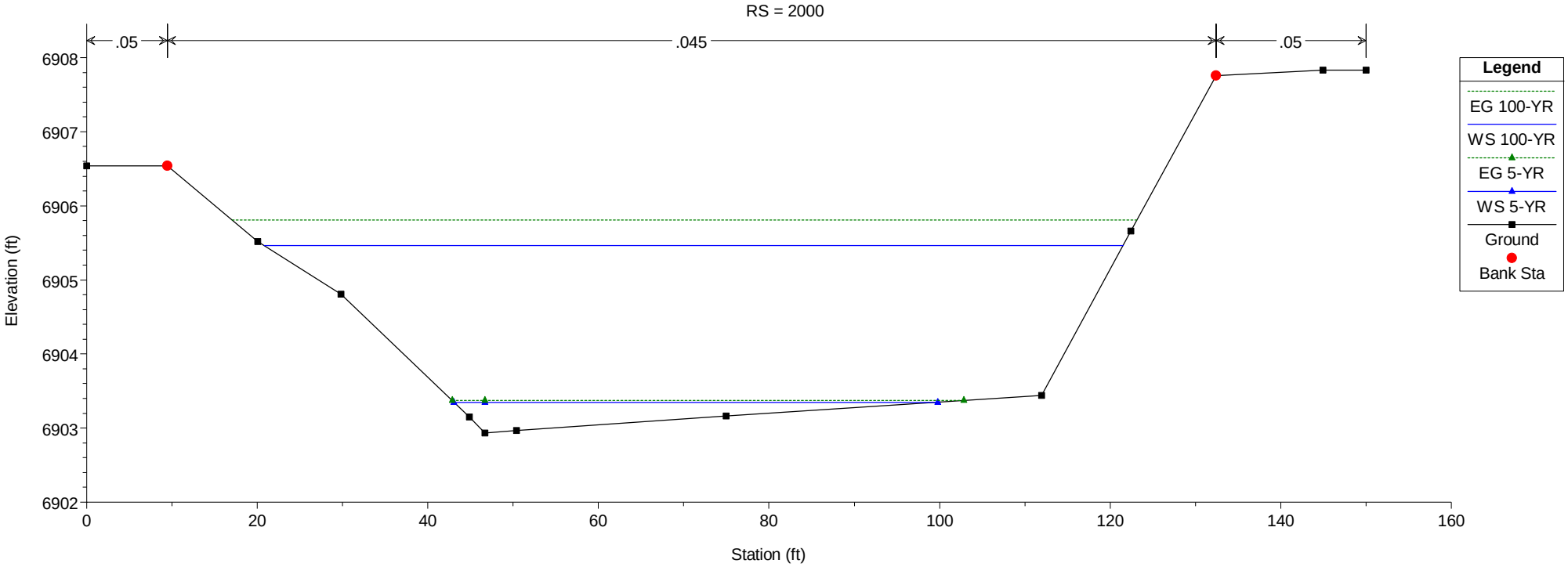

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

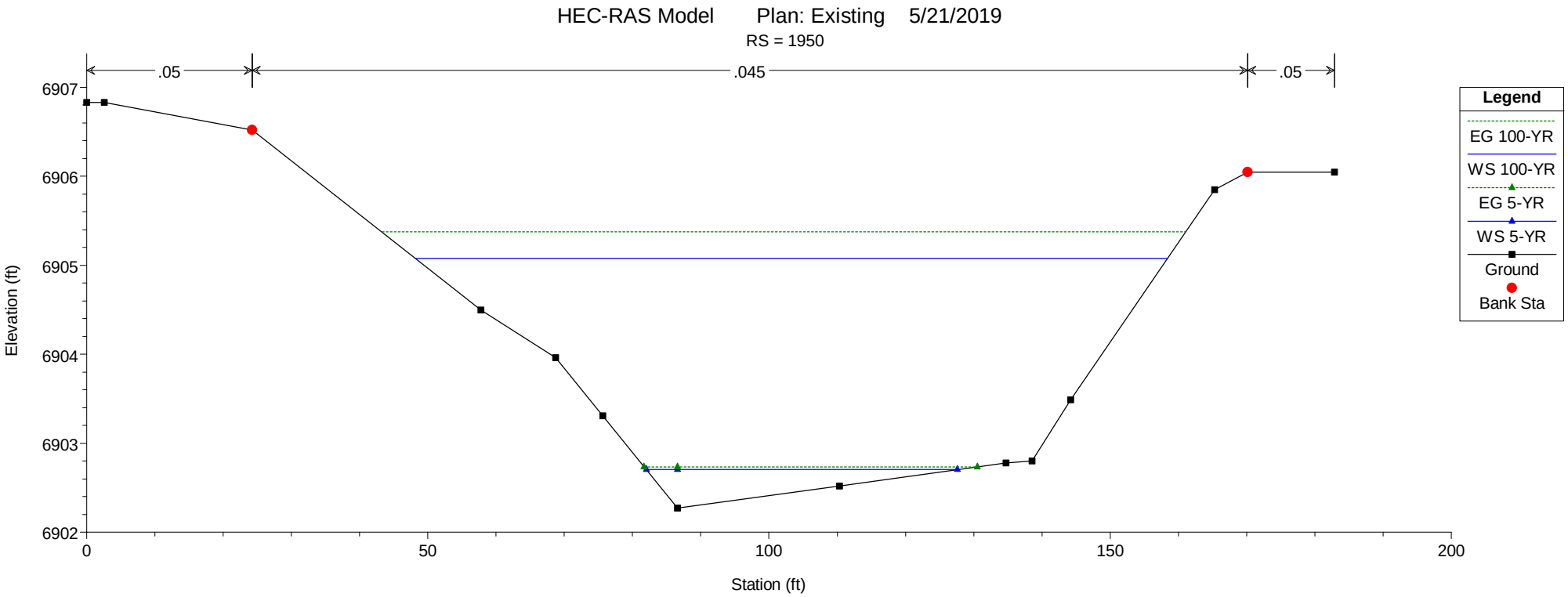

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2200
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6911
6910
6909
6908
6907
6906
0
20
40
60
80
100
120
140
160
Station (ft)

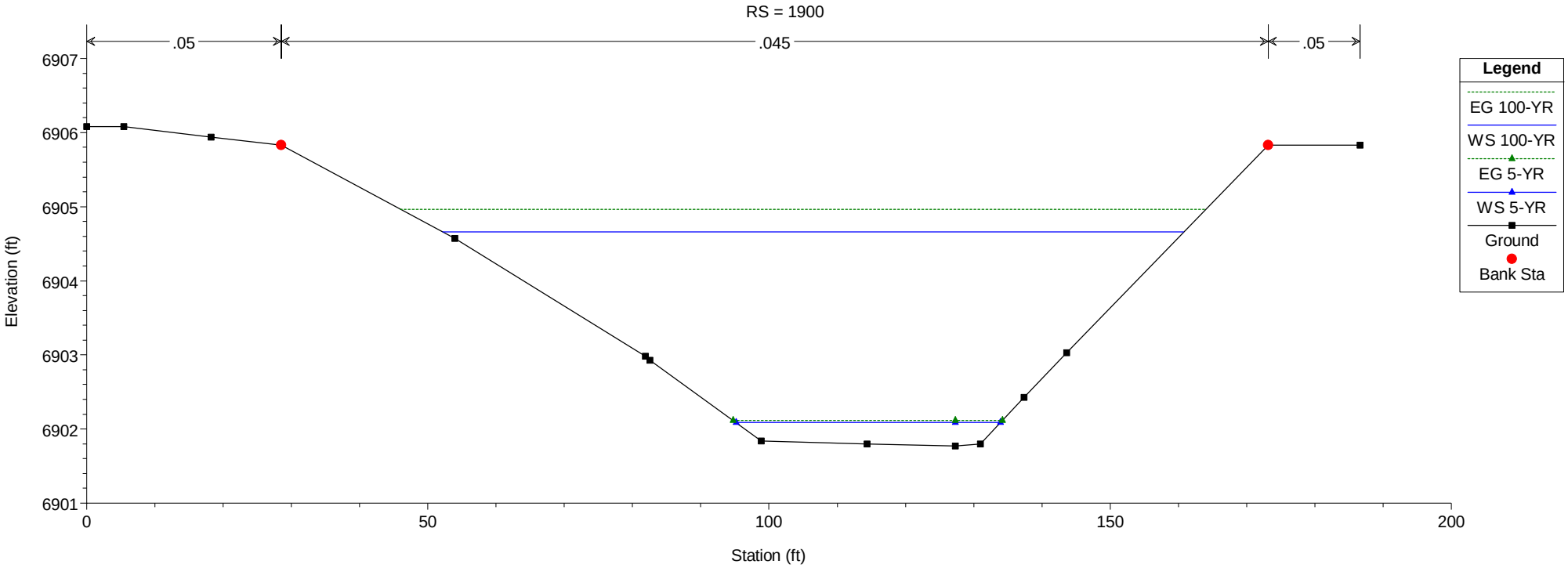

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2150
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6911
6910
6909
6908
6907
6906
6905
0
20
40
60
80
100
120
140
160
Station (ft)

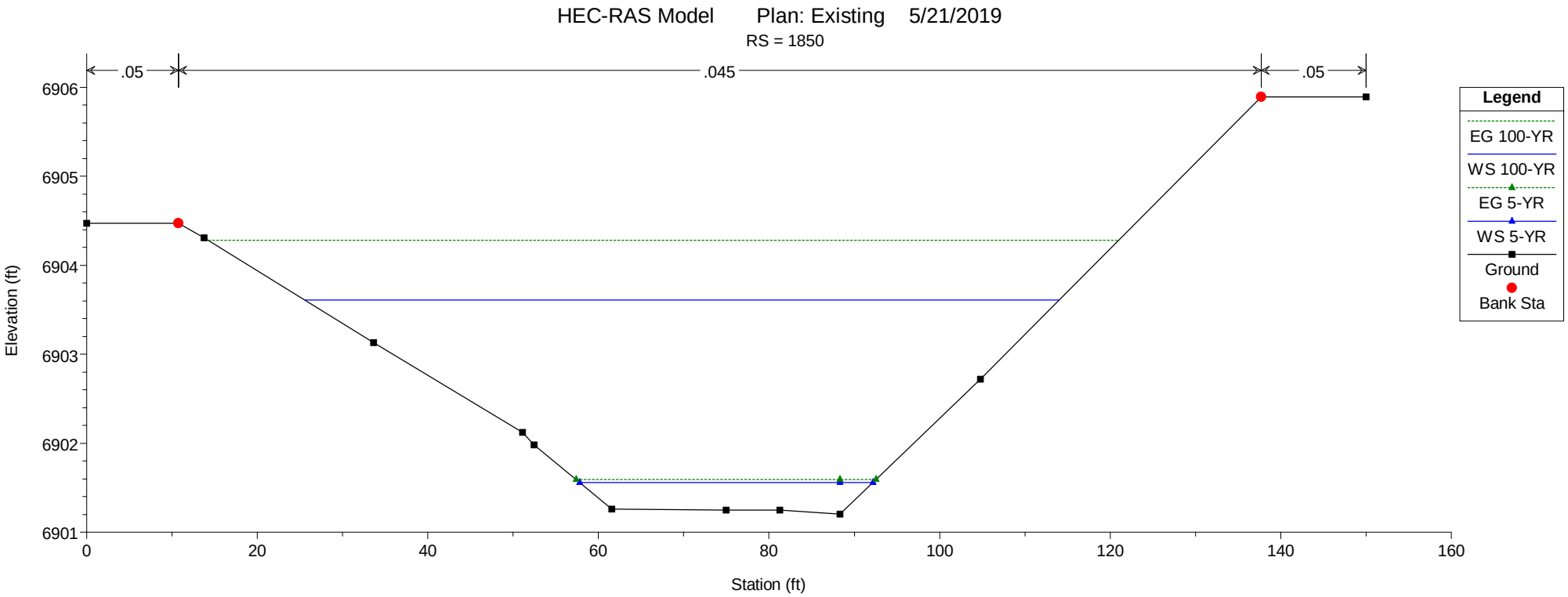

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2100
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

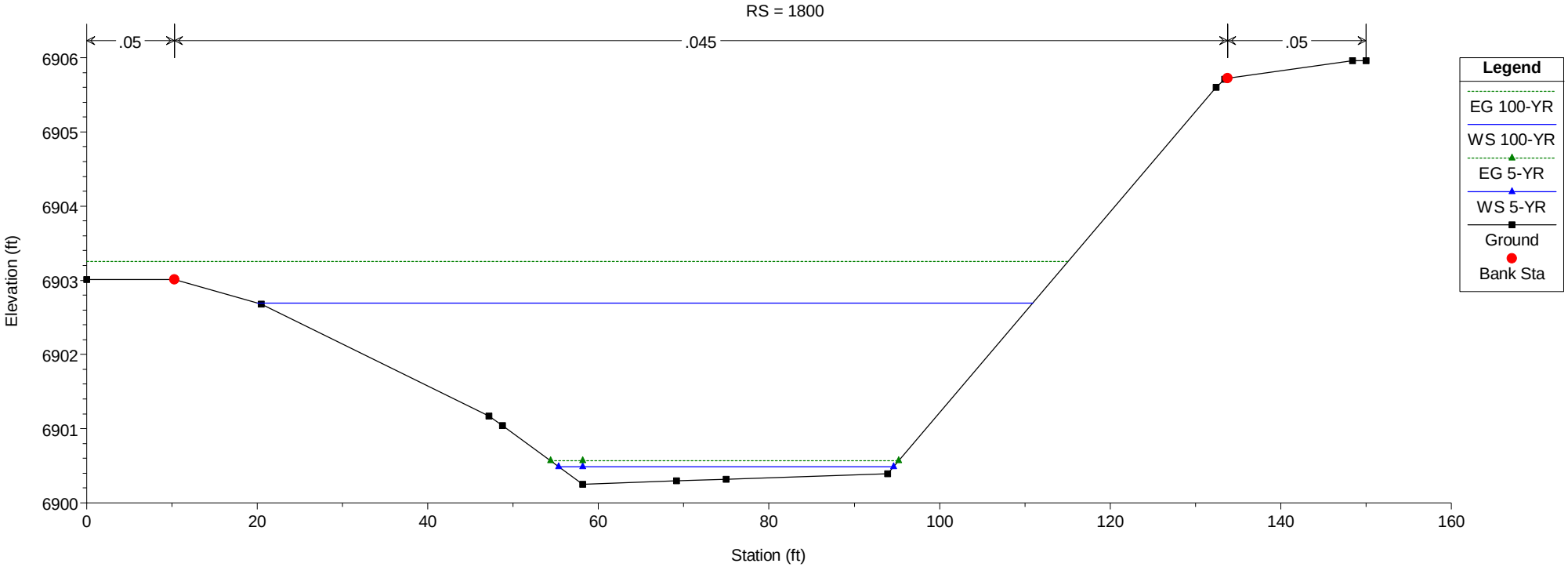

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

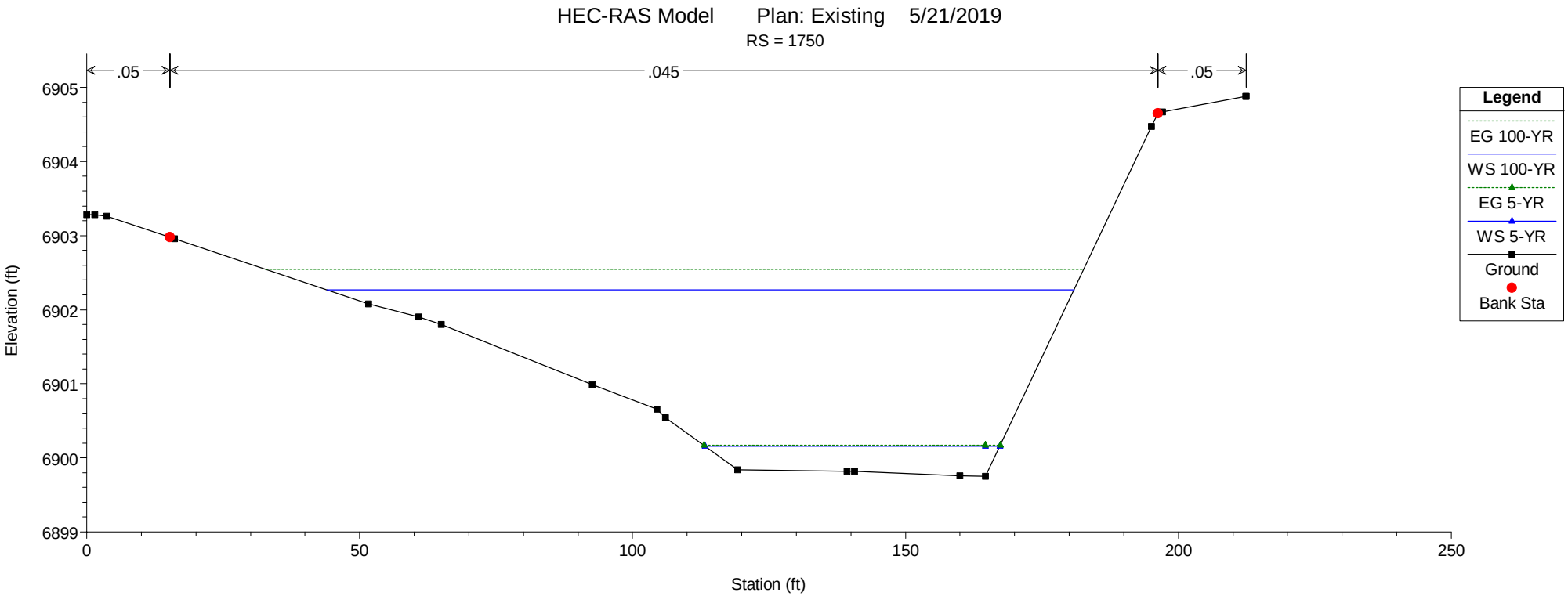

HEC-RAS Model Plan: Existing 5/21/2019
RS = 2000
.05
.045
.05
Elevation (ft)
6908
6907
6906
6905
6904
6903
6902
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

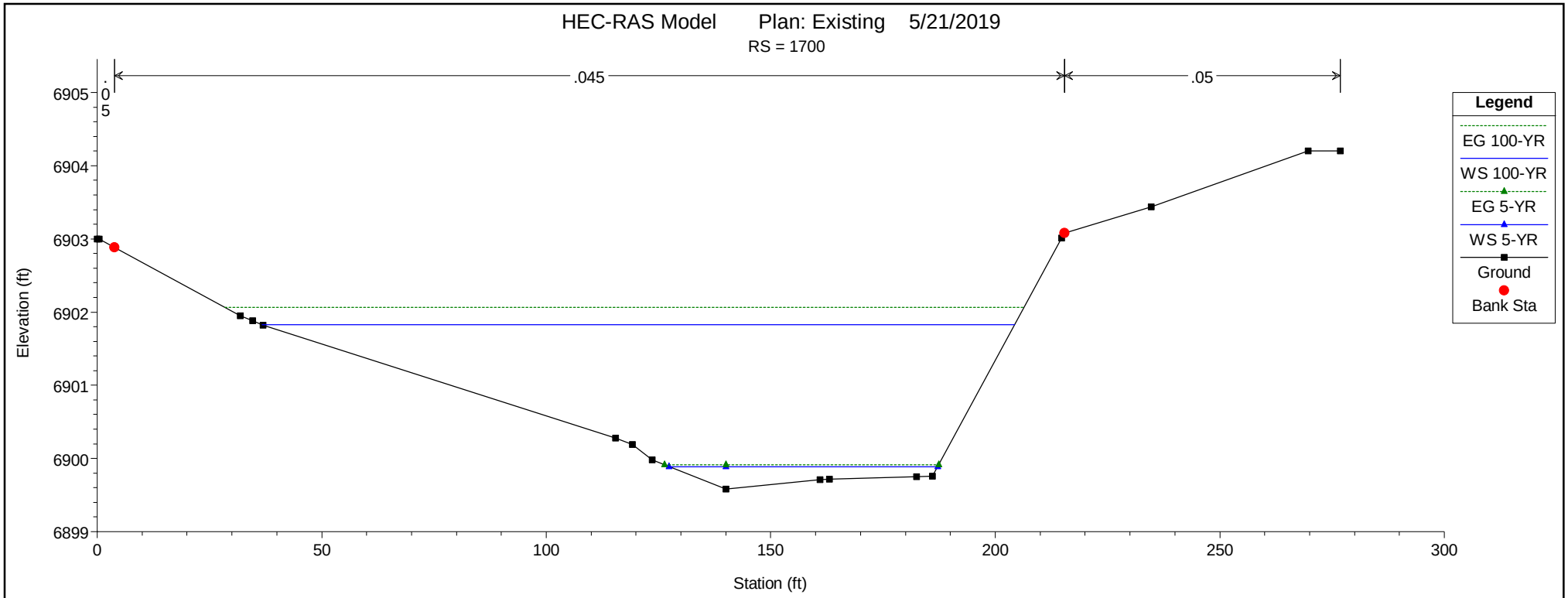

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1950
.05
.045
.05
Elevation (ft)
6907
6906
6905
6904
6903
6902
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

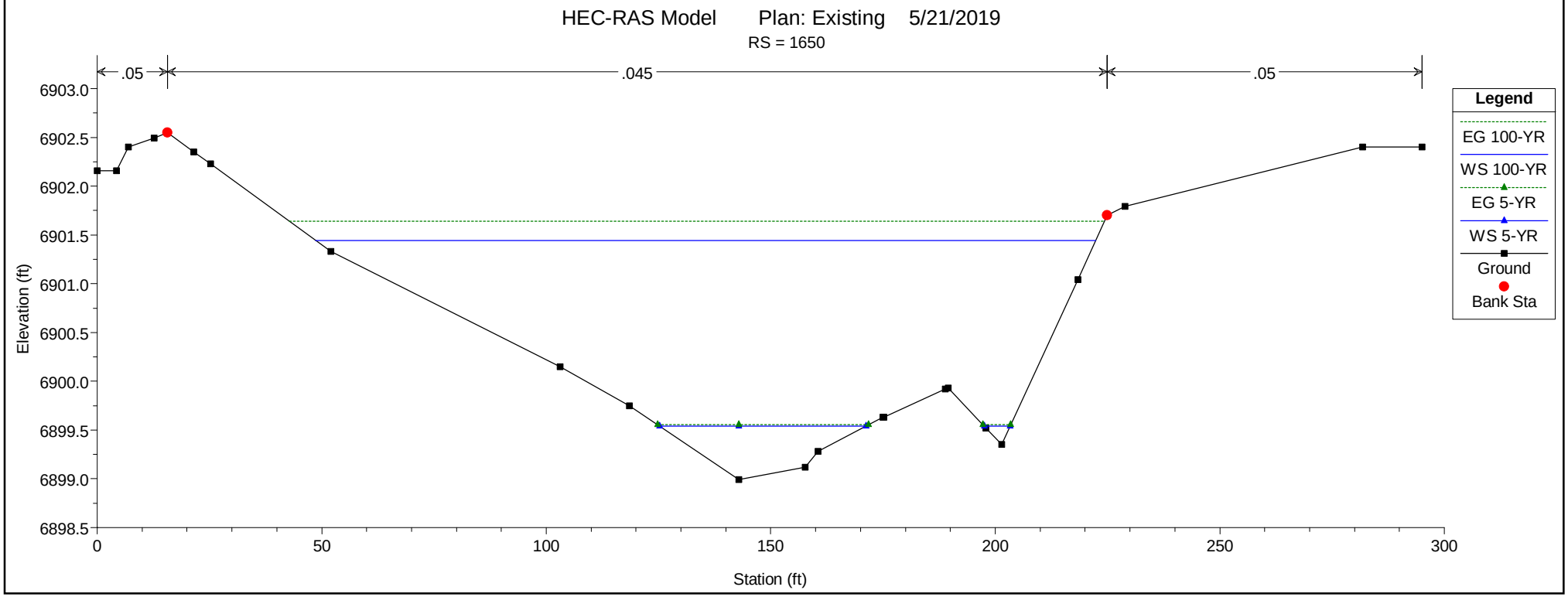

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1900
.05
.045
.05
Elevation (ft)
6907
6906
6905
6904
6903
6902
6901
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

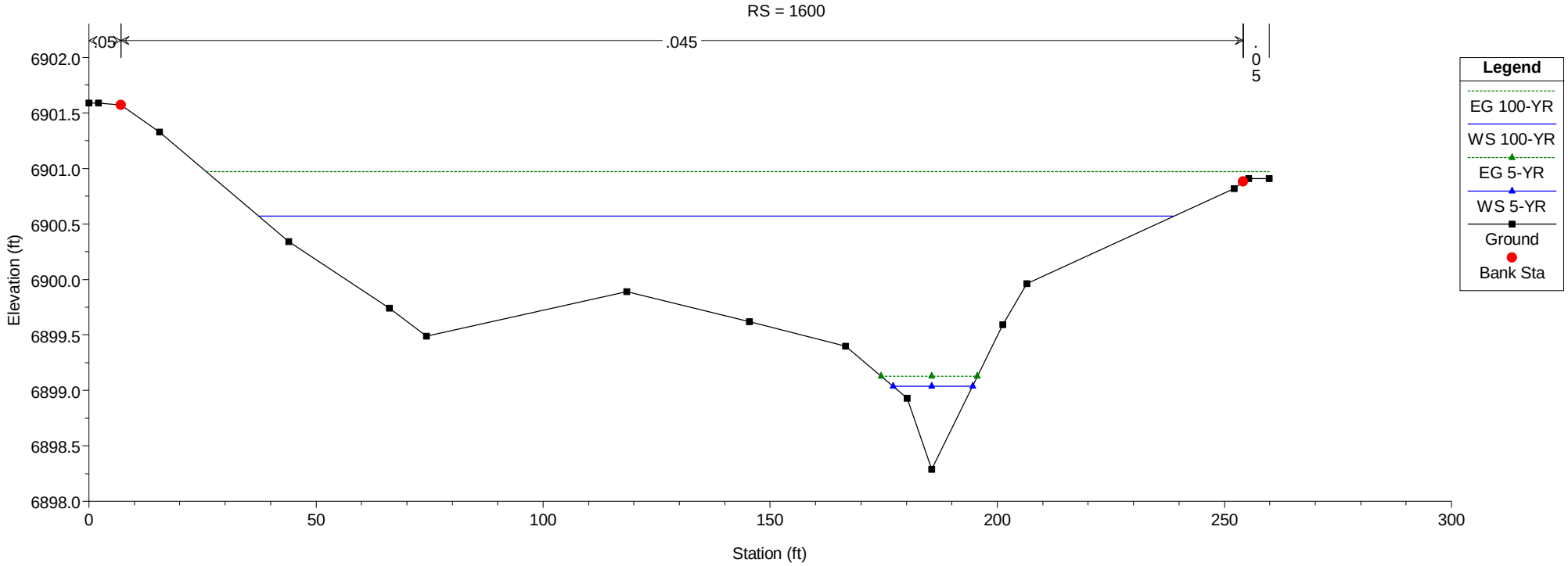

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1850
.05
.045
.05
Elevation (ft)
6906
6905
6904
6903
6902
6901
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

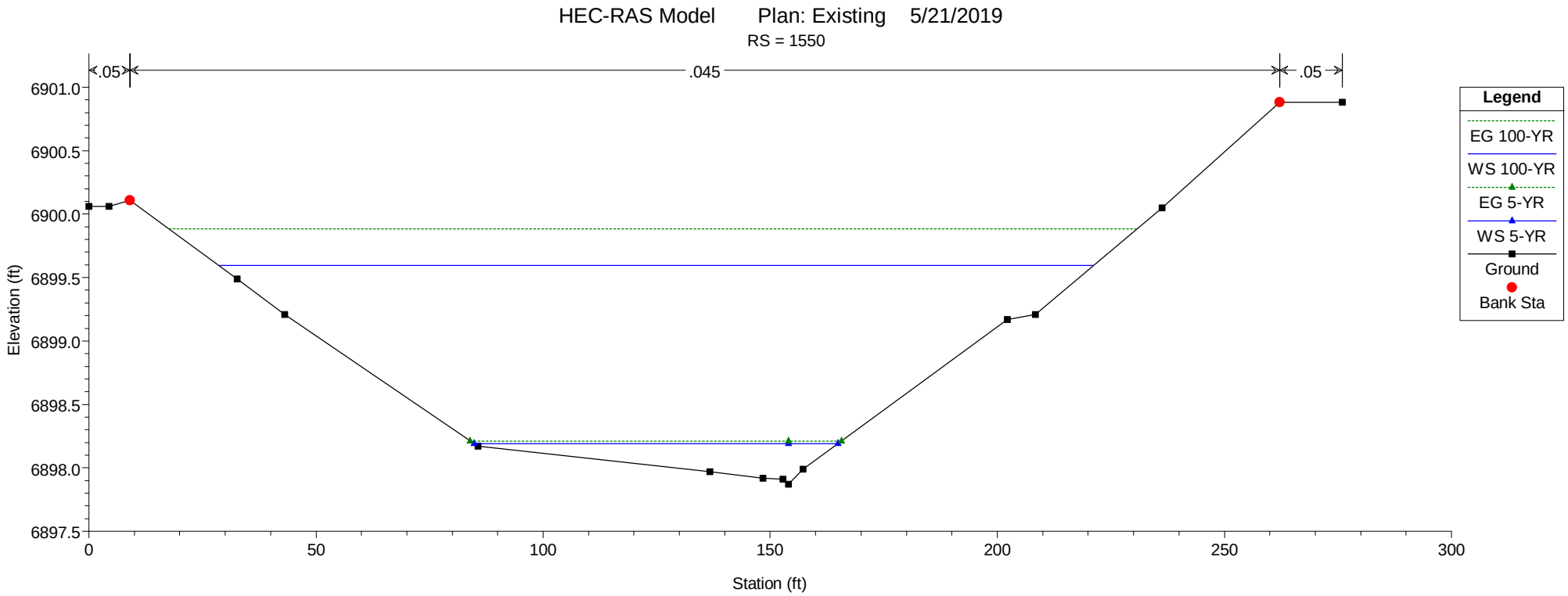

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1800
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

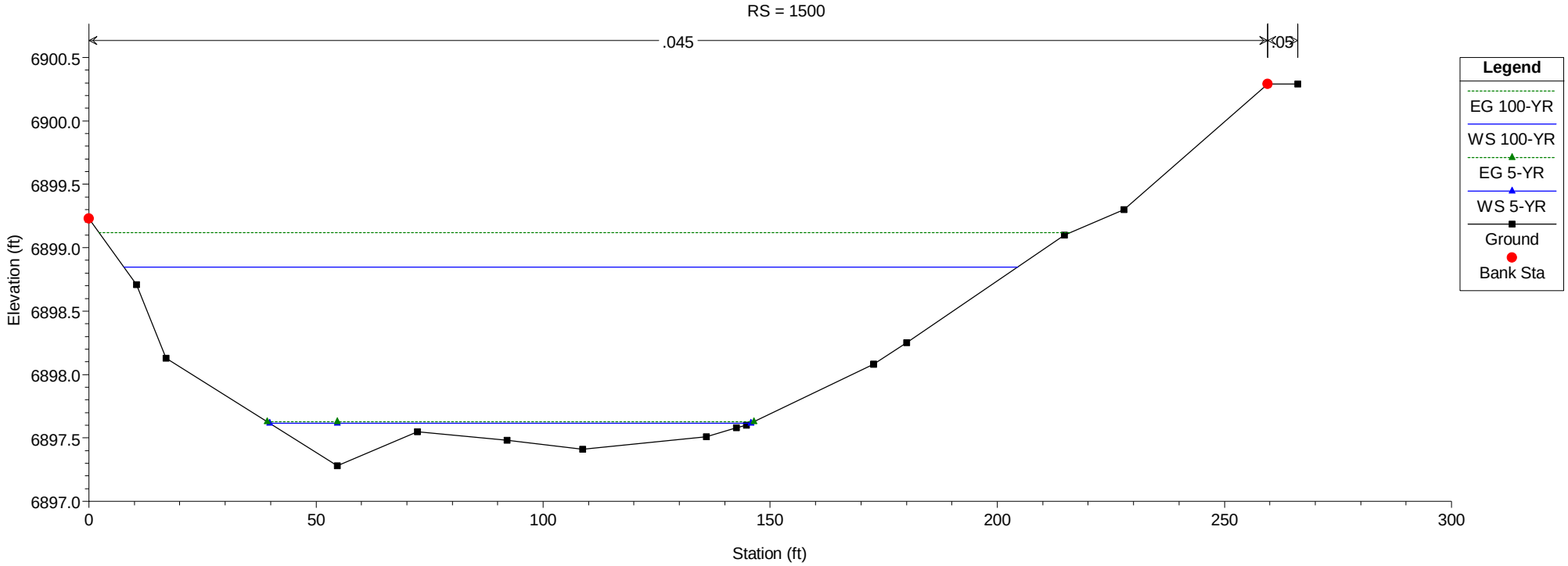

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1750
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

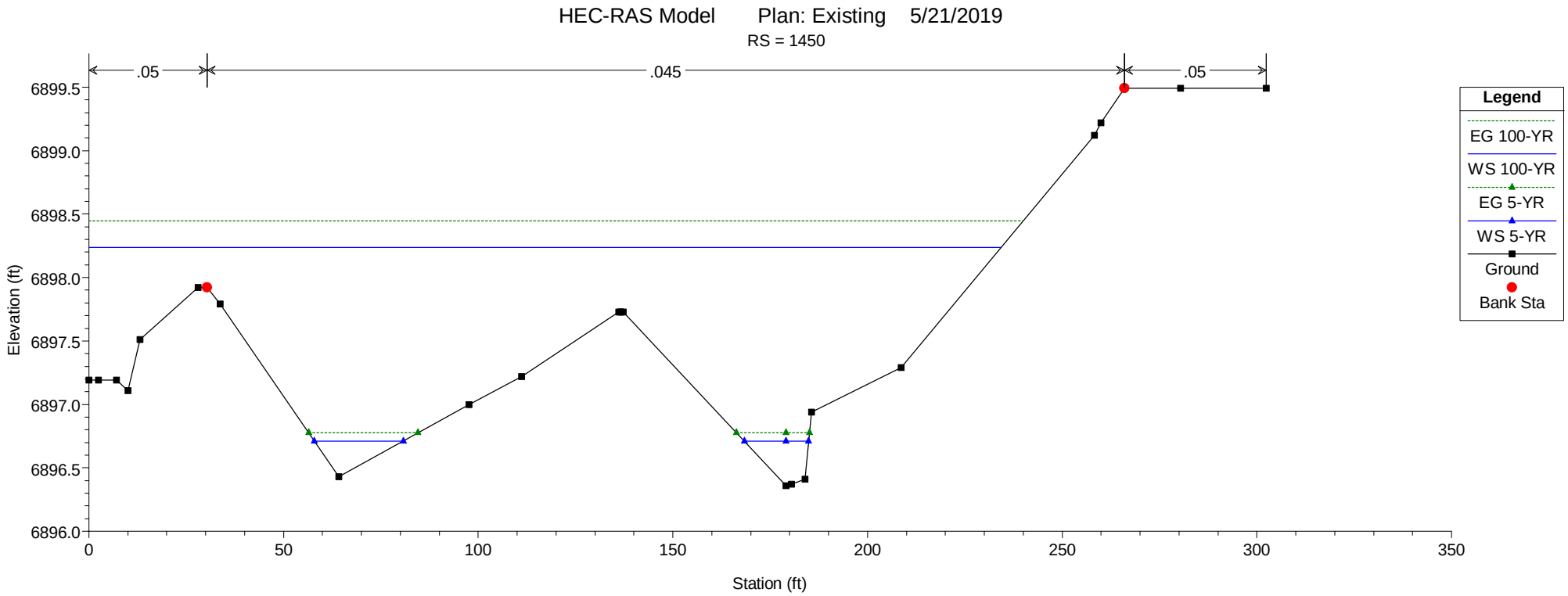

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1700
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

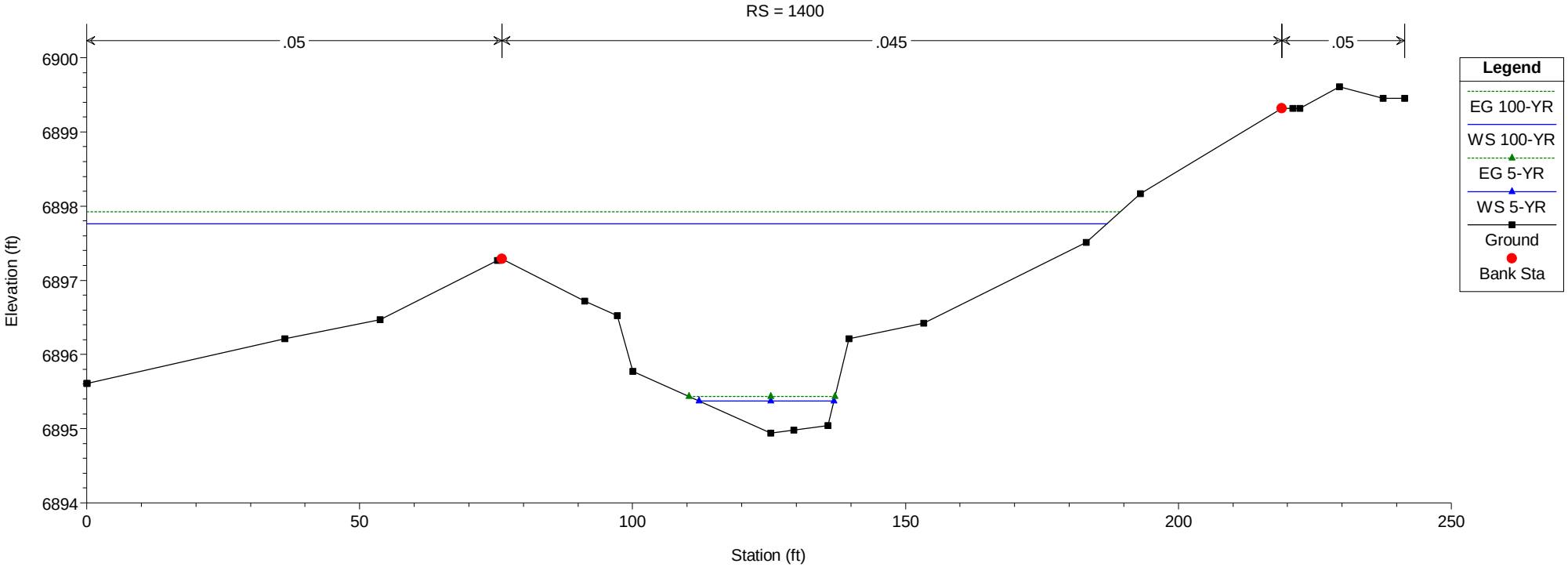

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1650
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

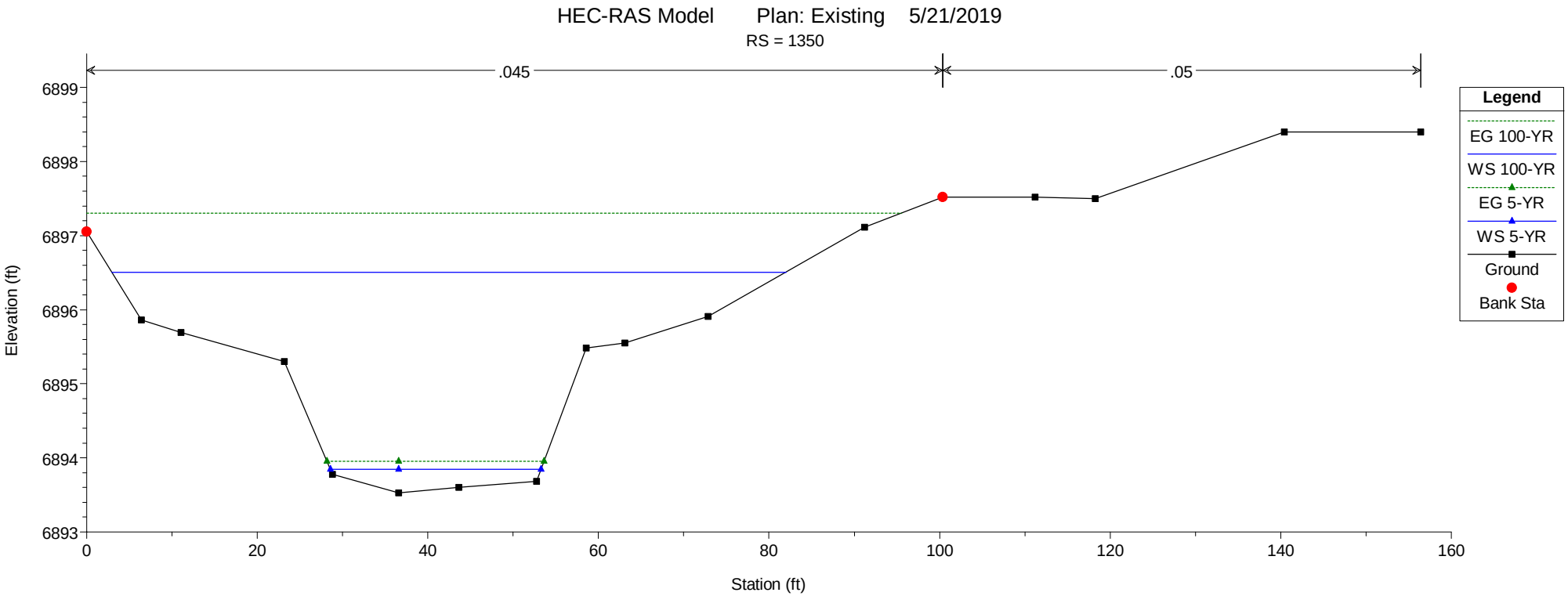

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1600
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

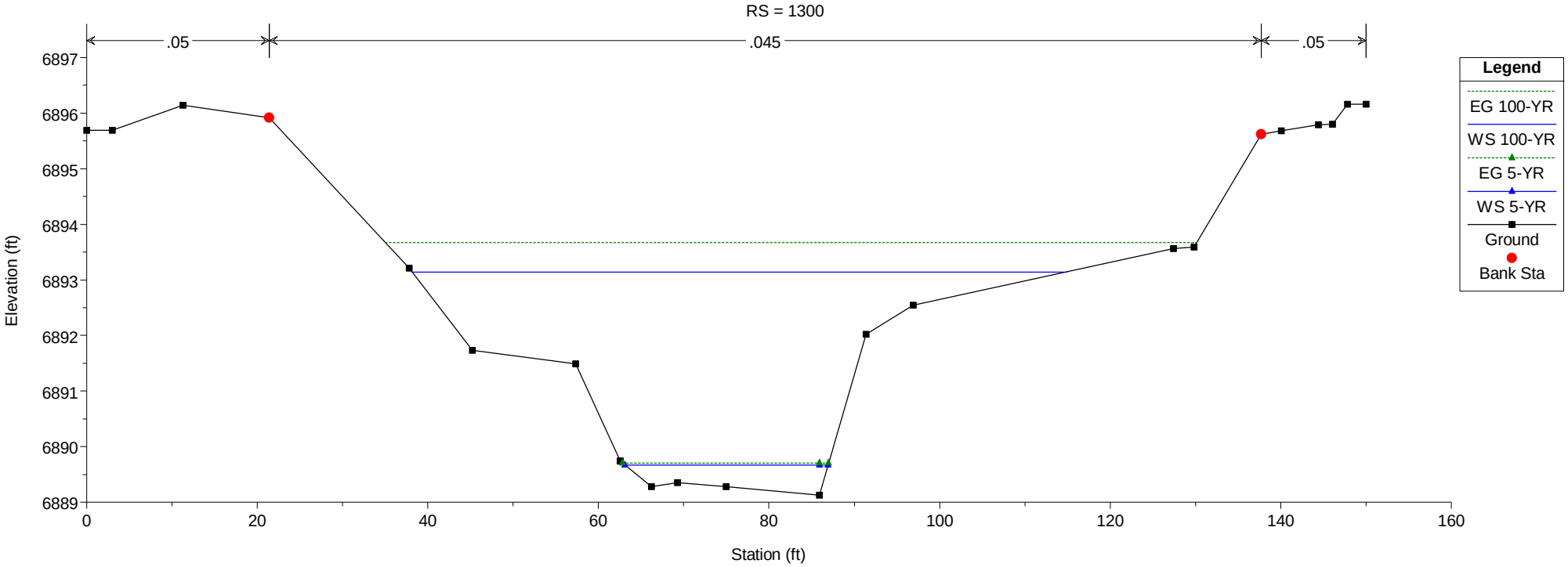

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1550
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

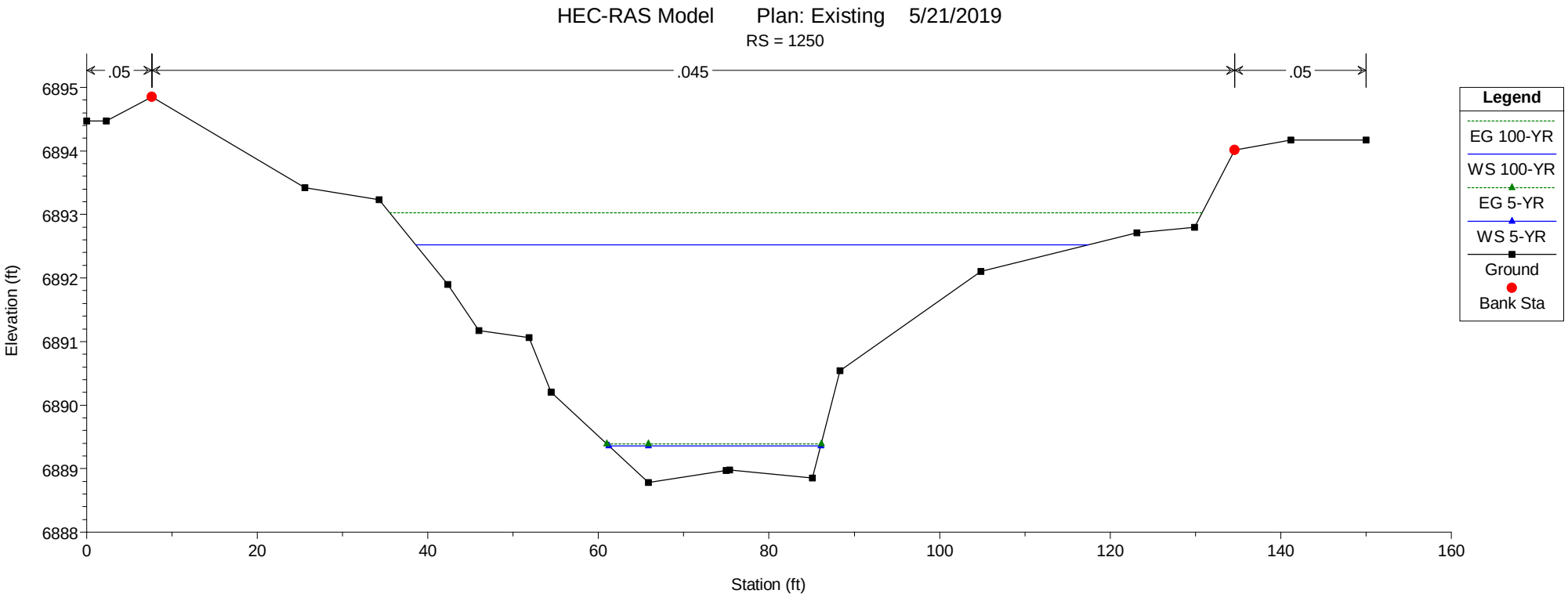

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1500
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

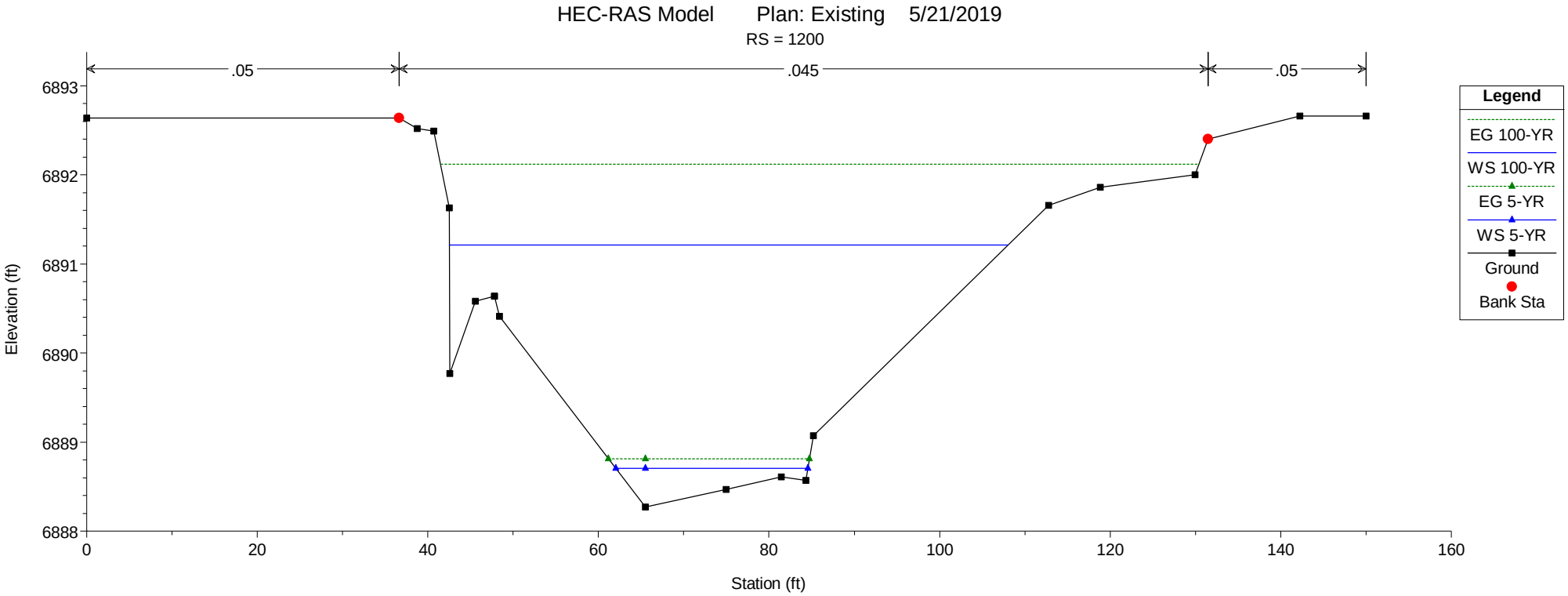

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1450
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

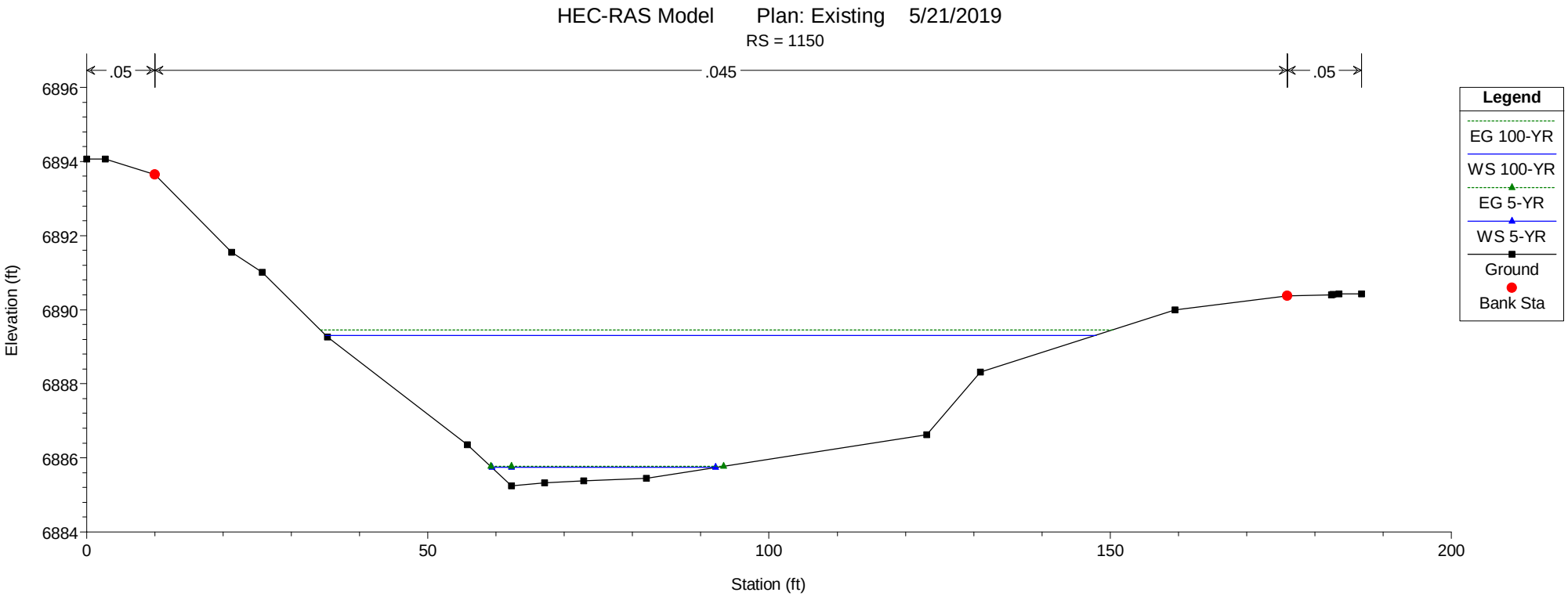

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1400
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6900
6899
6898
6897
6896
6895
6894
0
50
100
150
200
250
Station (ft)

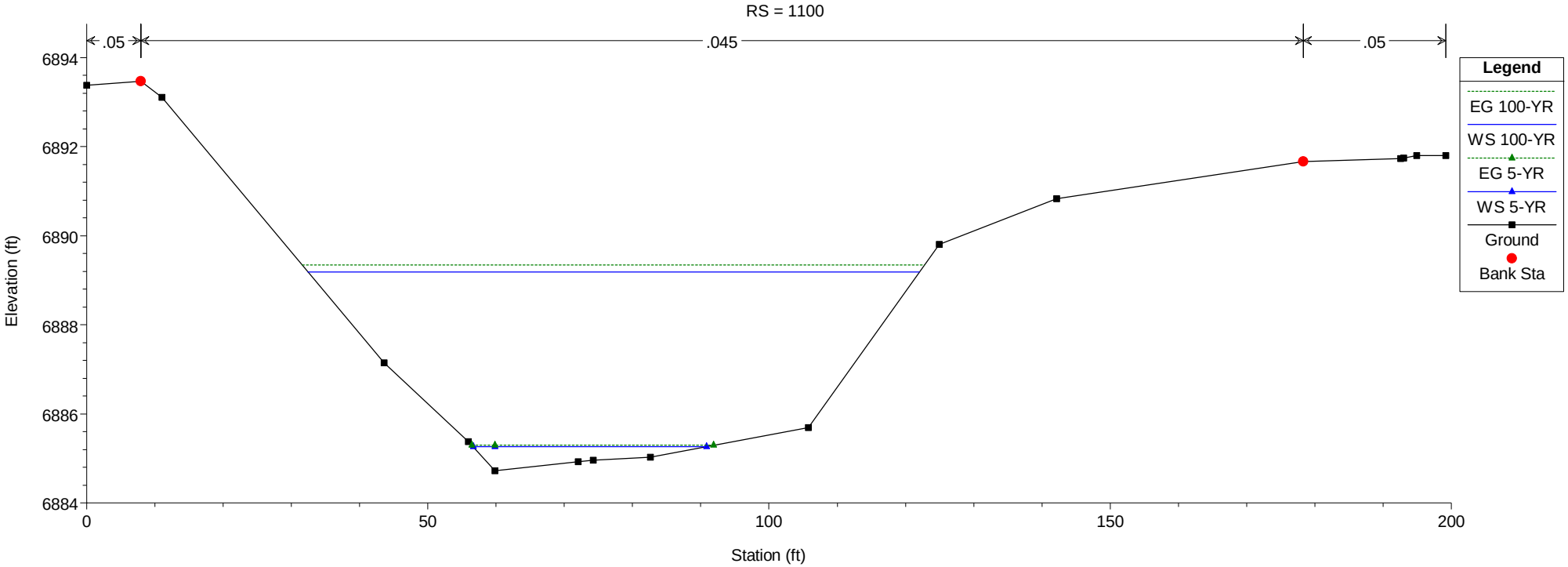

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1350
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6899
6898
6897
6896
6895
6894
6893
0
20
40
60
80
100
120
140
160
Station (ft)

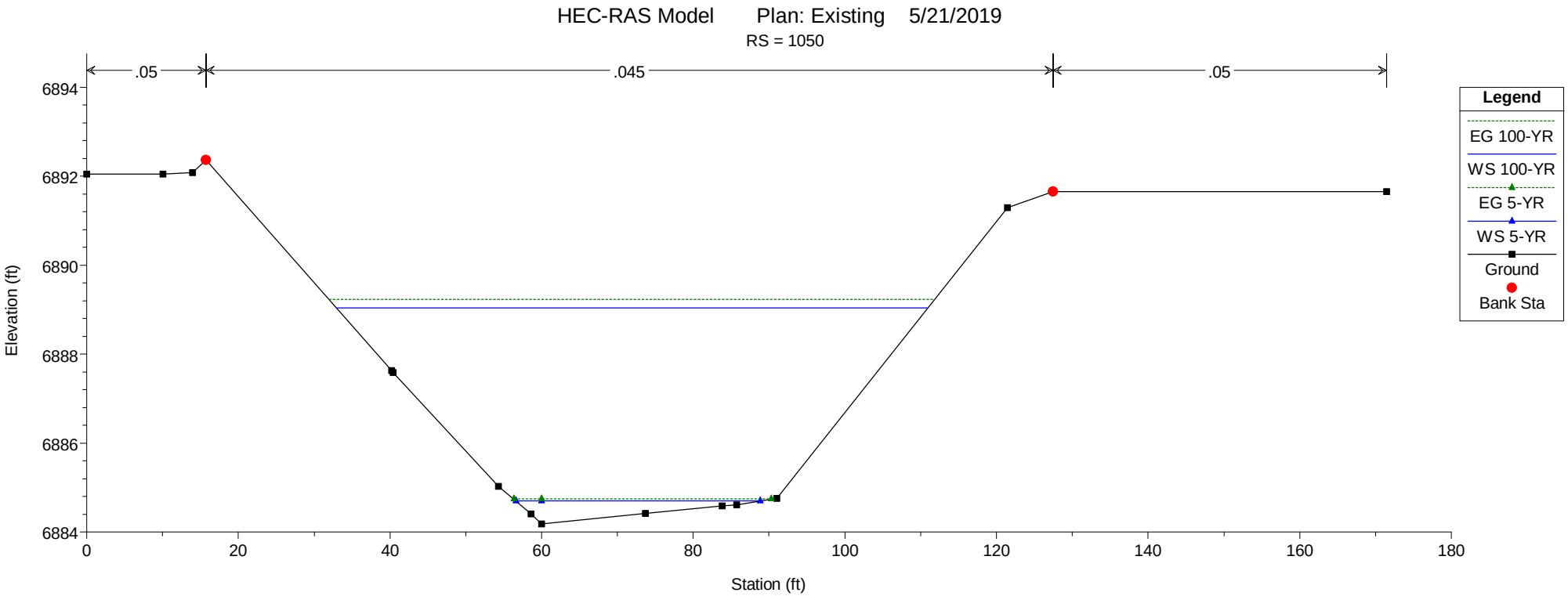

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

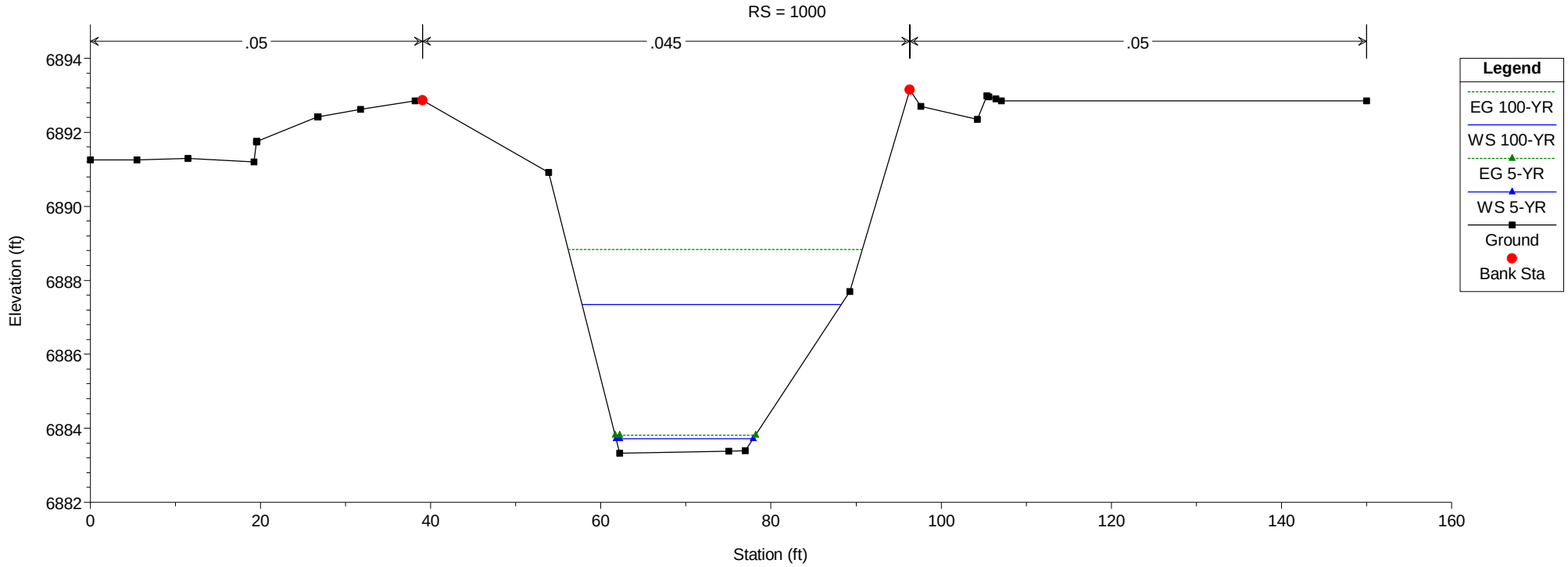

HEC-RAS Model Plan: Existing 5/21/2019
RS = 1250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 1200
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 1150
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 1100
.05
.045
.05
Elevation (ft)
6894
6892
6890
6888
6886
6884
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 1050
.05
.045
.05
Elevation (ft)
6894
6892
6890
6888
6886
6884
0
20
40
60
80
100
120
140
160
180
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Existing 5/21/2019
RS = 1000
.05
.045
.05
Elevation (ft)
6894
6892
6890
6888
6886
6884
6882
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

Proposed Conditions Model

```
                    HEC-RAS HEC-RAS 5.0.3 September 2016
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HEC-RAS Model
Project File : CLH14.20_Channel.prj
Run Date and Time: 5/21/2019 2:09:41 PM

Project in English units

Project Description:
CRS Info=<SpatialReference> <CoordinateSystem Code="3502" Unit="US_survey_Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0" ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: Phase 1
Plan File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.p03

Geometry Title: Phase 1
Geometry File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.g03

Flow Title : Phase 1
Flow File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.f03

Plan Summary Information:

Number of:	Cross Sections	= 82	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: Phase 1
Flow File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.f03

Flow Data (cfs)

River	Reach	RS	100-YR	5-YR
Phase 1 Channel	North	5007	43	4
Phase 1 Channel	South	4048	131	22.5
Phase 1 Channel	South	3900	968	32.5

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Phase 1 Channel	North	100-YR	Normal S = 0.0329	Known WS = 6941.22

Phase 1 Channel North	5-YR	Normal S = 0.0329	Known WS = 6938.44
Phase 1 Channel South	100-YR	Normal S = 0.005869	Normal S = 0.0247
Phase 1 Channel South	5-YR	Normal S = 0.005869	Normal S = 0.0247

GEOMETRY DATA

Geometry Title: Phase 1
Geometry File : H:\Challenger Homes Inc\CO, El Paso County-CLH0000014.20-Bent Grass\3. Permit Const Docs\3.04 Grad-Drain\3.04.2 Prop Drain Rpt\Channel Design\GeoHecRas\CLH14.20_Channel.g03

CROSS SECTION

RIVER: Phase 1 Channel
REACH: North RS: 5007

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6963.58	38.49	6963.58	42.67	6962.96	75	6959.7	89.7	6962.75
110.04	6963.46	118.77	6963.24	121.11	6963.48	125.8	6963.63	150	6963.63

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	38.49	.045	89.7	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
38.49	89.7	53.22	50	51.12	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: North RS: 4957

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6964.91	4.49	6964.91	14.11	6964.28	28.72	6963.12	45.08	6961.83

```
   66.68 6958.45   67.88 6958.26   72.91 6957.97      75 6957.85   81.59 6957.48
   83.44 6957.78   105.7 6961.57  120.79 6962.71  134.68 6963.68     150 6963.68

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.08    .045   105.7     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.08   105.7             56.3      50   55.05             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4907

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6963.53   12.58 6963.53   20.95  6963.2   27.05 6962.33   36.46 6961.09
   59.75 6957.96   71.58 6956.48      75 6956.22   76.29 6956.13   77.28 6956.08
    80.6 6956.68   100.6 6959.86  126.33 6962.03     150 6963.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   20.95    .045  126.33     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         20.95  126.33             71.1      50   38.94             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4857

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6959.99   34.39 6959.99   54.42 6958.91    58.9 6957.85   72.94 6954.52
      75 6954.47   76.05 6954.44   77.22 6954.55   88.32 6956.31   97.52 6957.97
  111.09 6958.96  131.03 6960.59  146.87 6962.04     150 6962.04
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   54.42    .045  111.09     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         54.42  111.09            49.15      50   56.56             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4807

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6960.57     9.2 6960.57   44.01 6958.08   59.83 6954.92   68.81 6953.23
      75 6953.14   76.25 6953.12   79.12 6953.16   91.93 6955.91   95.94 6956.94
   100.1 6956.93     150 6956.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   44.01    .045   95.94     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         44.01   95.94            61.25      50   43.37             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4757

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6958.34   35.51 6958.34   38.45 6958.32   40.25 6958.17   43.73 6957.56
   73.46  6952.3      75 6952.25   75.36 6952.24   77.32 6952.32   89.26 6955.07
   96.38 6956.45  105.11  6956.9  123.28 6956.85  137.41 6956.83     150 6956.83

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.25    .045   96.38     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.25   96.38            62.73      50   41.17              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4707

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6958.93    6.21 6958.93   26.86 6957.79   46.91 6956.53   55.57 6954.93
    72.9 6951.61      75 6951.59    75.6 6951.58   77.45 6951.54   84.09 6952.97
   93.45 6955.07   97.28 6955.56   135.4 6956.48  143.04 6956.78  144.21 6956.78
  145.18 6956.78  147.21 6956.91     150 6957.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.91    .045   97.28     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.91   97.28            48.59      50   53.31              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4657

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.92      13 6955.92   15.98 6955.77   17.47 6955.75   19.19 6955.69
    39.7 6954.03   40.71 6953.88   59.63 6950.54   61.54 6950.65   62.99 6950.73
   63.73 6950.75   68.59 6951.79   81.56 6954.29  100.82 6955.21  110.87 6955.88
  117.25 6955.97  128.49 6956.29  136.54 6956.29

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    39.7    .045   81.56     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          39.7   81.56            31.33      50   63.68              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4607

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.98    3.42 6955.98   11.44 6955.16   22.53 6954.54   39.05 6953.33
   60.56  6950.2   67.66 6949.26   68.34 6949.29   69.24 6949.27   71.52 6949.23
   78.98 6950.86   88.89 6953.25   99.87 6954.11  104.06 6954.54  107.26 6954.49
  144.24 6954.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   39.05    .045   88.89     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         39.05   88.89            31.96      50   60.47              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4557

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6954.47    15.6 6953.37   18.05 6953.02   48.88 6948.55   52.45 6948.24
   55.27 6947.91   55.52 6947.88   59.39  6948.6   75.66 6952.81   89.66 6953.03
   91.58 6953.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .05    15.6    .045   75.66     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          15.6   75.66            69.03      50   28.51             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4507

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6955.85    9.47 6955.85   42.52 6953.36   46.11 6953.07   52.65 6951.78
   69.08  6947.9      75 6947.95   75.53 6947.96   76.98 6947.94    83.7 6948.98
  107.55 6952.53  110.42 6952.62  126.61 6953.03  127.51 6953.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.11    .045  107.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.11  107.55            50.62      50   52.59             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4457

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6954.6   18.39  6954.6   39.23 6952.75   40.72 6952.62   44.07 6951.87
   69.43  6946.6      73 6946.49      75 6946.44   76.07  6946.4   95.73 6951.85
   96.83 6952.15  115.18 6952.51     150 6952.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.72    .045   96.83     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.72   96.83            46.56      50   51.87             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4407

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6954.57   12.29 6954.57   24.56 6954.28   34.56 6953.13   39.34 6952.67
   42.47 6951.97   70.43 6945.75   70.85 6945.66   70.89 6945.64   70.91 6945.64
      75 6944.96   75.01 6944.96   96.91 6951.35   98.66 6951.94  121.74 6952.08
     150 6952.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   39.34    .045   98.66     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         39.34   98.66            57.03   57.03   57.03             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4350

INPUT
Description:
Station Elevation Data    num=      32
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6952.27    8.36 6952.27   11.13  6952.2   17.56 6952.08   19.74 6952.04
   22.45 6951.99   37.33 6951.71   41.85 6950.58   52.88 6947.82   53.84 6947.58
   54.15  6947.5    54.3 6947.47   55.14 6947.26   55.71 6947.11   55.97 6947.05
   56.21 6946.99    57.5 6946.67   67.02 6944.32    67.5  6944.2   67.86  6944.2
      75 6944.02   82.05 6944.12    82.5 6944.12   83.09 6944.27    92.5  6946.6
  105.72 6947.97  116.31    6950  116.74 6950.08  122.29 6951.11  128.82 6951.49
   146.5 6951.98     150 6951.98

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   37.33    .045    92.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         37.33    92.5               50      50      50             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4300

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6951.11   14.19 6951.11    37.1 6950.47   40.32 6949.66   44.49 6948.62
   46.39 6948.15    48.1 6947.72    57.5 6945.37   63.42 6943.91    67.5 6942.89
   70.56 6942.87      75 6942.77   79.39 6942.83    82.5 6942.83   86.65 6943.87
    92.5 6945.32  118.83 6948.05  120.47 6948.16  137.97 6949.38  138.43  6949.4
  142.02 6949.73  144.59 6949.87  144.73  6949.9     150  6949.9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    37.1    .045    92.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          37.1    92.5               50      50      50             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4250

INPUT
Description:
Station Elevation Data    num=      29
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6949.41   11.03 6949.41   23.15    6949   26.97 6948.85   40.17 6948.41
   41.05 6948.19   44.12 6947.42   44.23 6947.39   53.79    6945   53.99 6944.95
    57.5 6944.07   59.82  6943.5    67.5 6941.58   73.26 6941.55      75 6941.51
   76.72 6941.53    82.5 6941.54   90.21 6943.47    92.5 6944.03  102.81 6945.11
  103.46 6945.15  110.31 6945.62  110.49 6945.63   111.9 6945.76     120 6946.21
```

```
  129.75 6947.01  142.75 6947.95  143.12 6947.98     150  6948.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.17    .045    92.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.17    92.5               50      50      50             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4200

INPUT
Description:
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6948.75    1.43 6948.72    3.38 6948.68    5.34 6948.64   25.29 6948.25
   35.21    6948   36.79 6947.69   41.05 6946.87   54.49 6943.52    57.5 6942.76
   63.01 6941.39    67.5 6940.26   70.87 6940.26      75 6940.25   79.13 6940.26
    82.5 6940.26   88.01 6941.63    92.5 6942.76  109.66 6943.67  146.32 6947.11
   146.4 6947.13  146.52 6947.15  146.66 6947.19  147.13 6947.22     150 6947.22

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   36.79    .045    92.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         36.79    92.5            16.61   16.61   16.61             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4183

INPUT
Description:
Station Elevation Data    num=      35
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6948.41    2.56 6948.41    6.68 6948.33   10.83 6948.25   20.57 6948.06
    23.4    6948   23.63    6948   26.77 6947.93   27.98 6947.91   31.26 6947.85
```

```
   35.79 6947.76   36.79 6947.51   50.09 6944.18   50.46 6944.08   50.66 6944.04
   50.84 6943.99    57.5 6942.33   57.57 6942.31    67.5 6939.83   74.94 6939.83
      75 6939.83   75.06 6939.83    82.5 6939.83   82.57 6939.85    92.5 6942.33
  130.41 6944.34  134.19  6944.7   134.2  6944.7   134.8 6944.84  134.92 6944.86
  139.01 6945.74  142.96 6946.67  143.25 6946.73  147.63 6946.98  150.02 6947.11

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   36.79    .045    92.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         36.79    92.5            16.62   16.62   16.62             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   68.35 6945.17       T
   81.67  150.02 6945.17       T

CROSS SECTION


RIVER: Phase 1 Channel
REACH: North              RS: 4167

INPUT
Description:
Station Elevation Data    num=      73
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6947.76     1.8 6947.76    4.03 6947.72    7.42 6947.65    8.06 6947.64
     9.7 6947.61   13.06 6947.54    15.4  6947.5   18.74 6947.43   22.02 6947.36
   24.44 6947.33   25.69  6947.3    27.8 6947.27   28.15 6947.27   30.67 6947.24
   33.23 6947.21   41.53 6946.96   42.44 6946.75   45.53 6945.91   48.56 6945.08
   49.02 6944.97    53.2    6944   54.21 6943.69   56.49    6943   57.57 6942.67
   59.44  6942.6    60.7 6942.67   62.24 6942.61   68.79  6942.3   69.51  6942.3
   69.63 6943.13   70.48 6943.12   70.66 6943.12   70.79 6937.67   70.81 6937.67
   71.56 6937.44   71.99 6937.44      75 6937.44   78.01 6937.44   78.44 6937.44
   79.19 6937.67   79.21 6937.67   79.34 6943.12   79.53 6943.12   80.37 6943.13
   80.49  6942.3   87.12 6942.64   88.14 6942.68   89.23 6942.61   91.36 6942.68
   93.55    6943   97.09 6943.52  100.38    6944  103.02 6944.39  107.21    6945
  108.24 6945.11  117.38  6944.9   117.5 6945.09  119.21 6945.09  121.04 6945.09
  122.42  6945.1  125.69 6945.11  129.02 6945.13  132.41 6945.15   132.9 6945.16
  132.98 6945.17  135.94 6945.19  138.47 6945.74   140.8 6946.28  140.97 6946.32
  144.49 6946.34  146.95 6946.48     150 6946.48

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   70.66    .045   79.34     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         70.66   79.34                0       0       0             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   72.49 6945.17       T
   77.52     150 6945.17       T

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 4048

INPUT
Description:
Station Elevation Data    num=      57
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6945.56   28.23 6945.56    28.6 6945.55   28.97 6945.55   29.08 6945.55
   29.33 6945.55   29.68 6945.54   30.01 6945.54   30.29 6945.54   33.22 6945.46
   33.32 6945.46   33.99 6945.45   43.03 6943.68   51.76    6942   53.91 6941.43
   58.06 6941.05   58.31 6941.02   58.97 6941.02   69.04 6941.43   69.53 6941.43
   69.63 6942.09   70.29 6942.07   70.66 6942.08   70.79 6936.57    70.8 6936.57
   71.49  6936.4   72.03  6936.4      75  6936.4   77.97  6936.4   78.51  6936.4
    79.2 6936.57   79.21 6936.57   79.34 6942.08    79.6 6942.07   79.71 6942.07
   80.37 6942.09   80.47 6941.43   80.96 6941.43    85.2 6941.59   87.13 6941.39
   97.36 6941.32   97.94 6941.33    99.8 6941.36   105.5 6941.41   109.4 6941.68
  115.17  6941.8  118.88    6942  128.94 6942.69  130.47 6942.82  132.14    6943
  132.29 6943.02  132.42 6943.04  133.32 6943.06  134.26 6943.09  145.49 6944.07
  149.49 6944.15     150 6944.15

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   70.66    .045   79.34     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         70.66   79.34                10      10      10             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   72.25 6945.17       T
   77.75     150 6945.17       T
```

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 4038

INPUT
Description:
Station Elevation Data num= 53

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6945.42	30.73	6945.42	31.66	6945.23	32.31	6945.12	32.84	6945.02
49.16	6941.26	49.98	6941.07	50.18	6941.03	50.22	6941.02	50.49	6940.94
50.92	6940.8	58.17	6938.68	58.58	6938.64	59.48	6938.73	59.63	6938.74
60.5	6938.89	60.66	6938.89	60.68	6938.16	60.8	6938.14	68.41	6936.35
74.33	6936.34	75	6936.34	75.67	6936.34	81.59	6936.35	89.2	6938.14
89.32	6938.16	89.34	6938.89	89.53	6938.88	90.37	6938.74	90.48	6938.74
91.41	6938.73	92.4	6938.84	96.39	6940	96.97	6940.09	97.26	6940.09
100.85	6940.33	106.97	6940.81	108.71	6940.88	109.88	6941	125.75	6941.92
127.58	6942	127.68	6942.01	129.13	6942.19	129.64	6942.24	129.69	6942.25
136.87	6943	137.53	6943.1	137.58	6943.11	138.2	6943.2	142.03	6943.29
145.76	6943.37	149.38	6943.46	150	6943.46				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	60.66	.045	89.34	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
60.66	89.34	56.2	38.24	31.2	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	67.23	6945.17	T
82.76	150	6945.17	T

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 4000

INPUT
Description:
Station Elevation Data num= 37

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6944.58	19.68	6944.58	20.76	6944.55	20.98	6944.54	21.63	6944.52

```
    26.5 6944.38   33.44 6944.17   35.37 6944.11   36.76 6943.78   38.58 6943.34
   58.45 6938.57   62.88 6937.45   68.49 6936.11   72.39 6936.12      75 6936.12
   75.98 6936.12   80.42 6936.12   83.42 6936.12    91.5 6938.32   92.77 6938.61
   94.25 6938.84  114.08    6941  122.96 6941.56  131.62    6942  132.01 6942.05
   136.6  6942.7  137.92 6942.84  138.04 6942.85  139.36    6943  139.52 6943.03
  139.67 6943.07  139.83 6943.09     141 6943.13  142.61 6943.18  144.99 6943.25
  148.83 6943.37     150 6943.37

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   35.37    .045   94.25     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         35.37   94.25             65.72      50   44.95             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3950

INPUT
Description:
Station Elevation Data    num=      29
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6941.82   10.52 6941.82   17.21  6941.5   25.06 6940.77   46.96 6940.28
   49.39 6940.23   49.63 6940.22   50.08 6940.11   57.22 6938.32   57.47 6938.26
    57.8 6938.18   67.47 6935.81   72.34 6935.82   74.97 6935.82      75 6935.82
    77.6 6935.83   82.47 6935.82   88.93 6937.16   92.57 6937.92  109.06 6940.49
  112.27    6941  117.56 6941.78  122.24    6942  123.34 6942.12  123.99 6942.21
  126.35 6942.75  142.91 6942.83  145.07 6942.84     150 6942.84

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   49.63    .045  117.56     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         49.63  117.56             36.58      50    66.6             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3900
```

INPUT
Description:
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6943.22	2.46	6943.22	33.41	6939.86	35.37	6939.67	36.6	6939.52
39.03	6939.37	39.55	6939.34	40.25	6939.3	40.96	6939.27	42.02	6939.24
43.74	6939.18	56.08	6938.83	71.55	6938.41	74.12	6937.79	76.8	6937.11
78.16	6936.76	79.14	6936.5	82.63	6935.55	84.37	6935.55	90.02	6935.54
90.9	6935.54	95.86	6935.53	97.84	6935.53	101.78	6936.4	103.71	6936.82
106.92	6937.57	107.03	6937.61	111.42	6937.62	112.63	6937.65	113.27	6937.66
113.66	6937.66	129.2	6937.61	148.46	6937.5	151.59	6937.21	153.38	6937.13
156.56	6937.91	171.58	6942.04	176.24	6942.19	190.37	6942.19		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	71.55	.045	107.03	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
71.55	107.03	45.57	50	83.5	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 3850

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6941.79	3.34	6941.79	16.12	6941.2	44.4	6939.51	69.85	6938.08
71.33	6938	72.91	6937.61	82.42	6935.25	83.49	6935.25	89.26	6935.24
90.02	6935.24	95.99	6935.24	97.53	6935.24	99.51	6935.72	99.78	6935.78
106.36	6937.41	109.92	6937.37	123.96	6937.2	133.88	6935.31	149.05	6939.25
156.89	6941.24	161.79	6941.24						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	71.33	.045	156.89	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
71.33	156.89	50.33	50	62.96	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 3800

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6938.59	23.83	6938.59	26.75	6938.1	64.69	6934.35	65	6934.41
72.38	6935.95	78.29	6937.48	79.36	6937.63	86.93	6938.68	87.76	6938.73
89.76	6938.23	107.51	6934.66	127	6938.71	132.8	6939.83	140	6939.83

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	23.83	.045	132.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
23.83	132.8	50.75	50	49.15	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 3750

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6938.4	22.93	6938.4	39.82	6937.64	64.36	6934.46	73.46	6933.22
73.77	6933.18	76.31	6933.49	86.66	6934.62	92.06	6934.61	95.12	6934.69
103.76	6934.62	132.38	6934.34	155.38	6938.15	162.61	6939.21	169.1	6939.38
170.59	6939.38								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	22.93	.045	162.61	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.93	162.61	52.26	50	46.49	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 3700

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6938.69	13.37	6938.69	28.67	6938.2	70.27	6932.3	72.77	6931.91
72.8	6931.9	74.04	6932.1	88.79	6933.84	92.58	6934.15	96.39	6934.03
121.74	6933.67	137.6	6933.46	148.44	6933.23	164.2	6936.02	181.52	6938.72
185.99	6938.72								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	28.67	.045	181.52	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
28.67	181.52	60.14	50	33.53	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 3650

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6937.92	15.4	6937.92	21.77	6937.78	43.82	6934.93	72.59	6931.21
72.68	6931.2	76.28	6931.74	89.29	6933.63	104.89	6934.34	113.84	6934.54
126.98	6934.36	154.1	6932.43	160.15	6933.47	184.83	6938.29	190.1	6938.29

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	21.77	.045	184.83	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
21.77	184.83	51.25	50	52.46	.1	.3

CROSS SECTION

```
RIVER: Phase 1 Channel
REACH: South              RS: 3600

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6937.62     3.4 6937.62   12.79 6937.38   31.35 6936.43    41.1 6935.11
   72.31 6930.64   72.71 6930.58   85.12 6931.53   99.12 6932.37  109.14 6933.33
  125.17 6934.55  145.22 6931.88  153.89 6930.85  173.12 6935.35  181.06  6937.1
  185.24 6937.26  194.98 6937.26

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05       0    .045  181.06     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  181.06            62.01      50    47.9             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3550

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6935.73    5.33 6935.73   37.55 6934.96   49.84 6933.13   73.26 6929.49
   73.65 6929.51   95.34 6930.85  104.54  6931.6  109.72 6931.57  122.26 6931.76
  135.86 6930.75   147.9 6929.91  163.85 6933.22  175.35 6935.76  179.76 6935.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   37.55    .045  175.35     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         37.55  175.35            59.06      50   53.38             .1       .3

CROSS SECTION
```

```
RIVER: Phase 1 Channel
REACH: South              RS: 3500

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6935.25   15.01 6935.25   28.58 6934.15   35.27  6933.7   49.03 6931.78
   74.87  6928.8      75 6928.81   88.97 6930.15   92.89 6930.24   97.98 6929.93
  111.92 6929.62  120.37 6928.86  136.63 6932.23  146.26 6934.93     150 6934.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.01    .045  146.26     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.01  146.26             39.9      50   66.73             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3450

INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6933.2   12.09  6933.2   13.53 6932.95   41.86 6930.45    64.8 6928.71
      75 6928.49   78.25 6928.42   89.89 6928.01  109.29 6933.08  109.55 6933.15
     150 6933.15

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   12.09    .045  109.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         12.09  109.55             24.8      50  100.26             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3400
```

```
INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6932.69   17.69 6932.69   60.53 6928.38   63.35 6928.09   63.87 6928.07
   72.82 6927.76   80.87 6927.47   86.02 6928.04  105.87 6929.71  122.83 6930.24
  177.44 6932.03  180.28 6932.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   17.69    .045  177.44     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         17.69  177.44            54.43      50   48.43             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3350

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6932.72     3.8 6932.72    5.77 6932.69    7.36  6932.6   35.04 6931.32
   58.71 6927.57   67.53 6926.42   69.95 6926.44   73.79 6926.56   81.57 6926.79
   98.39 6928.03  119.22 6929.56  143.64 6930.24  162.24 6930.68  169.23 6930.68

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   35.04    .045  162.24     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         35.04  162.24             60.4      50   46.98             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3300

INPUT
```

```
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6931.16    1.46 6931.16   44.98 6930.18   48.76  6929.8   64.02 6925.77
   69.23 6924.78   72.69 6924.97   73.78 6925.03   84.98 6925.91  105.49 6927.36
   128.8 6929.31  141.49 6929.55  185.07 6931.08  185.49 6931.08     192 6931.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   44.98    .045   128.8     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         44.98   128.8             56.3      50   33.79              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3250

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6929.55    4.97 6929.53   22.77 6929.02   50.59 6928.45   55.37 6927.16
    70.4 6923.75   73.72 6924.03   77.53 6924.34   81.44 6924.74   88.07 6925.55
  122.82  6929.1  123.27 6929.11  155.02 6929.73  171.66 6930.38  173.05 6930.38

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   50.59    .045  122.82     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         50.59  122.82            48.03      50   52.79              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3200

INPUT
Description:
Station Elevation Data    num=      14
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6928.61   16.79 6928.61   37.89 6927.96   47.88 6927.46   61.58  6925.2
   70.66 6923.44      75 6923.29   75.47 6923.28   79.54 6923.32  108.39 6927.73
  109.33 6927.91  114.48  6928.1  140.39 6929.05     150 6929.31

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   47.88    .045  109.33     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         47.88  109.33             50.1      50   50.13              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3150

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6926.88   22.24 6926.88   45.77 6926.19   52.94 6924.92   62.61 6923.15
      75 6923.39   82.58 6923.53    93.8 6923.61  101.67 6925.21  106.55 6926.24
  133.38 6928.12  144.02 6928.52     150 6928.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.77    .045  106.55     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.77  106.55            44.23      50   56.79              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3100

INPUT
Description:
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6927.43   38.05 6927.43    43.4 6927.16   56.47 6926.72   93.94 6925.45
```

```
   95.21 6925.41   96.15 6925.26  113.08 6921.99  124.02 6922.45  125.32 6922.51
  127.99 6922.54  149.07 6922.79  160.41 6924.83  162.73 6925.31  174.68 6926.23
  189.47 6927.42  191.56 6927.56  191.58 6927.56  193.94 6927.59  200.66 6927.59

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   95.21    .045  162.73     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         95.21  162.73             33.1      50   68.21             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3050

INPUT
Description:
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6926.3   18.49  6926.3   35.86 6925.36   45.94 6924.76   55.95 6922.97
    61.9  6921.9   62.95 6921.72   64.44 6921.71   66.81  6921.7   73.09 6921.67
   99.45 6921.56  103.57 6922.18   107.6 6922.78   107.9 6922.83  117.14 6921.62
  117.24  6921.6  117.26  6921.6  117.35 6921.59  117.52 6921.57  117.53 6921.57
  123.19 6921.62   123.5 6921.62  127.25 6921.65  128.87 6921.67  129.48 6921.68
  129.73 6921.72  136.89 6922.78  157.71 6925.89  165.78 6925.81   175.4 6925.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   45.94    .045  157.71     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         45.94  157.71            67.72      50   48.85             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 3000

INPUT
Description:
Station Elevation Data    num=      18
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6926.75   10.46 6926.75   12.07 6926.58   28.76 6924.81   44.56 6923.42
   67.71 6920.99   68.71 6920.85    69.2 6920.84   73.39 6920.75   82.31 6920.57
   91.26 6922.59   98.84 6924.17   99.59 6924.18  100.45  6924.2  133.18 6924.77
  138.48 6924.85  170.65 6925.36  171.52 6925.36

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   12.07    .045  100.45     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         12.07  100.45            64.93      50   45.01             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2950

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6925.81   18.13 6925.81   19.68 6925.79   20.08 6925.76   21.08  6925.7
   40.93 6924.34   62.31 6920.25   64.23 6919.84    65.4 6919.86   73.12 6919.94
   79.78 6920.01    89.4 6921.77   95.22 6922.65  166.18 6924.46  175.43  6924.7
  179.51  6924.7

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   40.93    .045   95.22     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         40.93   95.22            50.79      50   51.25             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2900

INPUT
Description:
Station Elevation Data    num=      14
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6924.92    20.3 6924.92   22.17 6924.89   24.13 6924.76   41.82 6923.67
   59.09 6919.82   61.33 6919.34   64.69 6919.34   73.26 6919.33   82.61 6919.31
   94.28 6920.95      99 6921.46  183.37 6923.45  185.87 6923.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   41.82    .045      99     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         41.82      99            65.91      50   45.14              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2850

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6923.53   14.01 6923.53   32.65 6922.77   47.73 6922.24   62.37 6918.47
   64.37 6917.96   70.64 6918.05   72.59 6918.07   78.56 6918.13   84.89 6918.97
   98.45 6920.68  118.89 6921.29  188.61 6923.26  189.28 6923.26

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   14.01    .045  118.89     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         14.01  118.89            66.73      50   53.41              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2800

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6922.35   10.49 6922.35   37.01 6921.12   54.97 6920.34   63.84 6917.94
```

```
   66.89 6917.16      75 6917.29   81.41 6917.39    81.5 6917.39   81.68 6917.42
    98.3 6920.39  144.82 6921.51     150 6921.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   54.97    .045    98.3     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         54.97    98.3            67.78      50   48.95             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2750

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6920.98    2.97 6920.98   11.77 6920.48   26.95 6919.62   44.36 6918.77
   56.14 6917.17   59.76 6916.55   69.88 6915.94   70.26 6915.92   73.03 6915.84
   78.27 6917.25   87.59 6919.98   96.39 6920.17  149.06 6921.29  162.54 6921.54
  175.32 6921.49  218.27 6921.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   44.36    .045   87.59     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         44.36   87.59            45.41      50   50.66             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2700

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6919.86   10.07 6919.86   28.38 6918.78   49.99 6917.31   60.09 6916.05
   67.57 6915.26   70.91 6915.09      75 6914.88   77.09 6914.78   83.92 6917.05
```

```
   90.44 6919.08  131.67 6919.81     150 6919.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   10.07    .045   90.44     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         10.07   90.44             62.4      50   52.53             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2650

INPUT
Description:
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6919.1     3.3  6919.1   12.14 6918.81   18.04 6918.56   48.18 6917.64
   51.78 6916.91   63.76 6914.18    67.1 6913.94   69.97 6913.83   73.42 6913.71
   77.01  6914.6   84.69 6916.51   90.07 6918.05  101.83 6918.14   118.9 6918.36
  152.13  6918.8  209.76  6918.3  213.27 6918.29  216.87 6917.85  217.08 6917.85

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   48.18    .045   90.07     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         48.18   90.07             54.3      50   79.13             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2600

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6917.96    6.74 6917.96    8.13 6917.91    9.41 6917.85   36.41 6916.26
   36.83 6916.17   46.06  6914.3   51.62 6913.17    57.5 6912.98   60.81  6912.9
   63.17 6912.83   71.84 6915.53   76.79 6916.76   86.44 6916.78  101.56  6916.8
```

```
  154.82  6917.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   36.41    .045   76.79     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         36.41   76.79            60.01      50   72.05             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2550

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6917.98   13.25 6917.98   27.48 6917.37   30.62 6916.28   36.17 6915.49
   59.92  6912.7    61.7 6912.49   68.61 6912.49   68.87 6912.49   72.47 6912.38
   86.97 6914.65   88.06 6914.77   120.5 6915.32  141.53 6915.68  154.56 6915.97
  176.13 6916.25  196.52 6916.51

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   27.48    .045   88.06     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         27.48   88.06            65.45      50    93.8             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2500

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6917.34   21.33 6917.34   43.19 6915.76   50.05 6915.24   58.83 6913.21
   65.27  6911.7   72.35 6911.56   73.69 6911.54   75.82 6911.56   81.29 6912.14
    96.3 6913.77  116.43 6914.35  183.46 6915.89  185.27 6915.89
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   21.33    .045  183.46     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         21.33  183.46            69.23      50    85.3             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2450

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6914.52     .64 6914.52   46.94 6913.89   51.13 6913.72   53.31 6913.16
   67.55 6910.62      75  6910.7   78.02 6910.73   79.98 6910.73   98.22 6913.34
   98.49 6913.37  134.64 6914.39     150 6914.39

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   46.94    .045   98.49     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.94   98.49            38.25      50   54.23             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2400

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6913.88     .43 6913.88    22.4 6913.14   42.22 6912.55   51.23 6911.52
   66.38 6909.67   72.38 6908.29      75 6907.83   75.12 6907.81   79.67 6909.31
   90.18 6912.93  130.62 6913.82     150 6913.82

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   42.22    .045   90.18     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         42.22   90.18            62.04      50   59.15              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2350

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6913.3   15.78  6913.3   61.91 6911.47   66.32 6911.31   76.86 6910.37
   95.48 6908.73  100.28 6908.56  101.17  6908.5  104.23 6908.31  110.73 6909.36
  126.12 6911.75   135.5 6912.03  171.12  6912.6  174.35  6912.6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.78    .045   135.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.78   135.5            50.75      50   50.85              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2300

INPUT
Description:
Station Elevation Data    num=      19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6911.72   21.63 6911.72   35.87 6911.22    68.2  6910.1   77.81 6909.72
   84.67 6908.79   89.07 6908.18   99.56 6908.29  101.84 6908.31  114.97 6908.44
  120.41 6909.11  134.47 6911.06  148.71 6911.43  178.67 6912.22  186.02 6912.38
  191.75 6912.56  215.43 6912.97  242.12 6913.43  244.08 6913.43

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .05   77.81    .045  134.47     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         77.81  134.47            40.98      50   54.76             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2250

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6910.61    1.56 6910.61   23.77 6909.76   50.13 6908.84   60.48  6907.4
   61.16 6907.31    62.7  6907.3      75 6907.38      89 6907.46    92.6 6908.02
  107.95 6910.49  119.02 6910.41     150 6910.41

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    1.56    .045  107.95     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1.56  107.95            49.97      50   49.41             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2200

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6910.07    8.28 6910.07    13.9 6909.74   24.43 6909.15   45.28 6908.07
   57.94 6906.38   59.54 6906.18   61.87 6906.21      75  6906.3   88.29 6906.39
   94.06 6907.33   109.9 6910.46     150 6910.46

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    8.28    .045   109.9     .05
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.28   109.9            53.67      50   48.88             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2150

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6909.25     5.2 6909.25   19.11  6908.3   32.48 6907.46   50.08 6905.59
   53.71 6905.09   59.94 6905.13      75 6905.29   92.37 6905.47  103.43 6907.89
  118.11 6910.41  137.07 6910.55  144.67 6910.76     150 6910.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05     5.2    .045  118.11     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           5.2  118.11            34.58      50   63.09             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 2100

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  6908.5    6.15  6908.5   10.02 6908.21   19.07 6907.14   26.74 6906.22
   32.27 6905.66   49.04 6903.79      75 6904.43   88.43 6904.77  103.66  6905.1
  122.34 6909.12   127.5 6909.92  143.26 6910.52     150 6910.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    6.15    .045   127.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          6.15   127.5            31.66      50    64.9             .1       .3
```

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 2050

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6907.45	9.89	6907.45	17.07	6906.74	23.21	6905.85	42.66	6903.64
45.68	6903.25	75	6903.71	98.82	6904.09	109.01	6904.25	110.23	6904.49
132.05	6908.89	142	6909.17	150	6909.17				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	9.89	.045	132.05	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9.89	132.05	49.84	50	49.41	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 2000

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6906.54	9.47	6906.54	20.03	6905.52	29.79	6904.81	44.84	6903.15
46.69	6902.93	50.42	6902.97	75	6903.16	111.98	6903.44	122.44	6905.66
132.44	6907.76	144.92	6907.83	150	6907.83				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	9.47	.045	132.44	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9.47	132.44	47.64	50	56.5	.1	.3

CROSS SECTION

```
RIVER: Phase 1 Channel
REACH: South              RS: 1950

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6906.83     2.6 6906.83   24.26 6906.52    57.8  6904.5   68.74 6903.96
    75.6 6903.31   86.59 6902.27   110.3 6902.52  134.76 6902.78  138.55  6902.8
  144.24 6903.49  165.28 6905.85  170.19 6906.05  182.84 6906.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   24.26    .045  170.19     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         24.26  170.19            52.36      50    54.3             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1900

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6906.08    7.45 6906.08   18.38 6905.96    30.5 6905.83   55.96 6904.57
    83.9 6902.98   84.52 6902.93  100.86 6901.84  116.33  6901.8  129.31 6901.77
  132.98  6901.8  137.59 6902.25  145.61 6903.03  175.17 6905.83  188.45 6905.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    30.5    .045  175.17     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          30.5  175.17            63.75      50   36.61             .1       .3

CROSS SECTION
```

```
RIVER: Phase 1 Channel
REACH: South              RS: 1850

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6904.47   10.75 6904.47   13.78 6904.31   33.62 6903.13   51.09 6902.12
   52.48 6901.98   61.55 6901.26      75 6901.25   81.26 6901.25    88.3  6901.2
  104.78 6902.72  137.72 6905.89     150 6905.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   10.75    .045  137.72     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         10.75  137.72            61.98      50   38.16             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1800

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6903.01   10.31 6903.01   20.44 6902.68   47.13 6901.17   48.74 6901.04
   58.16 6900.25   69.18  6900.3      75 6900.32   93.92 6900.39  132.45  6905.6
  133.42 6905.71  133.78 6905.72  148.41 6905.96     150 6905.96

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   10.31    .045  133.78     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         10.31  133.78            50.79      50   53.54             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1750
```

```
INPUT
Description:
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6903.28     .48 6903.28    2.59 6903.26   14.65 6902.96   15.17 6902.95
   50.62 6902.08   59.82  6901.9   63.99  6901.8   91.99 6900.98  103.49 6900.66
  104.95 6900.55  118.29 6899.84  138.14 6899.82  139.68 6899.82   159.9 6899.76
  163.67 6899.75   193.9 6904.45  195.26 6904.65  196.13 6904.67  211.27 6904.87

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.17    .045  196.13     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.17  196.13            61.55      50   50.72              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1700

INPUT
Description:
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6902.99    3.91 6902.99    6.93 6902.99    8.14 6903.01   39.36 6901.96
    42.3 6901.88   44.68 6901.82  123.09 6900.28  126.95 6900.19  131.45 6899.98
  147.78 6899.58  168.72 6899.71  171.02 6899.72  182.45 6899.74  193.75 6899.76
  222.18 6902.98  223.04 6903.08  223.27 6903.08  242.45 6903.45   277.3  6904.2
   284.5  6904.2

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    8.14    .045  223.04     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          8.14  223.04            28.94      50   59.09              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
```

REACH: South RS: 1650

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6902.16	3.92	6902.16	6.58	6902.39	12.3	6902.49	15.32	6902.55
21.1	6902.35	25.17	6902.21	51.67	6901.33	102.76	6900.15	118.11	6899.75
142.55	6898.99	157.36	6899.12	160.23	6899.28	174.59	6899.63	174.86	6899.64
188.52	6899.92	189.21	6899.93	197.93	6899.5	201.03	6899.35	218.05	6901.03
224.55	6901.7	228.53	6901.79	281.43	6902.4	294.65	6902.4		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	25.17	.045	197.93	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
25.17	197.93	50.13	50	73.62	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1600

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6901.59	2.06	6901.59	7.04	6901.57	15.57	6901.33	43.98	6900.34
66.12	6899.74	74.32	6899.49	118.46	6899.89	145.39	6899.62	166.55	6899.4
180.14	6898.93	185.57	6898.29	201.22	6899.59	206.55	6899.96	252.15	6900.82
254.18	6900.88	255.31	6900.91	259.84	6900.91				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	7.04	.045	254.18	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7.04	254.18	77.3	50	30.02	.1	.3

CROSS SECTION

```
RIVER: Phase 1 Channel
REACH: South              RS: 1550

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6900.06    4.45 6900.06    9.08 6900.11   32.59 6899.49   43.11 6899.21
   85.62 6898.17  136.71 6897.97  148.44 6897.92  152.79 6897.91  154.06 6897.87
  157.25 6897.99  202.23 6899.17  208.34 6899.21  236.29 6900.05  262.22 6900.88
  275.94 6900.88

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    9.08    .045  262.22     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9.08  262.22            50.69      50   49.44              .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1500

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6899.23   10.45 6898.71   16.94 6898.13   54.66 6897.28   72.38 6897.55
   92.11 6897.48  108.73 6897.41  135.95 6897.51  142.61 6897.58  144.79  6897.6
  172.75 6898.08  172.79 6898.08  180.01 6898.25  214.74  6899.1  227.93  6899.3
  259.53 6900.29  259.56 6900.29  266.11 6900.29

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05       0    .045  259.53     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  259.53            65.39      50   50.26              .1       .3

CROSS SECTION
```

RIVER: Phase 1 Channel
REACH: South RS: 1450

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6897.19	2.4	6897.19	7.1	6897.19	9.98	6897.11	13.15	6897.51
28.03	6897.92	30.39	6897.92	33.72	6897.79	64.2	6896.43	97.65	6897
111.18	6897.22	136.14	6897.73	136.58	6897.73	136.63	6897.73	137.26	6897.73
179.1	6896.36	180.44	6896.37	183.9	6896.41	185.63	6896.94	208.58	6897.29
258.32	6899.12	259.97	6899.22	265.98	6899.49	280.35	6899.49	302.4	6899.49

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	30.39	.045	265.98	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
30.39	265.98	109.19	50	50.75	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1400

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6895.61	.12	6895.61	36.32	6896.21	53.71	6896.47	75.26	6897.27
76.03	6897.29	76.07	6897.29	91.24	6896.72	97.25	6896.52	100.08	6895.77
125.33	6894.94	129.54	6894.98	135.84	6895.04	139.62	6896.21	153.34	6896.42
183.07	6897.51	193.08	6898.17	218.95	6899.32	220.94	6899.32	222.25	6899.32
229.54	6899.61	237.52	6899.45	241.42	6899.45				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	76.07	.045	218.95	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
76.07	218.95	51.77	50	59.74	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1350

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6896.76	.27	6896.77	18.93	6897.05	18.94	6897.05	25.36	6895.86
29.98	6895.69	42.08	6895.3	47.76	6893.78	55.5	6893.53	62.56	6893.6
71.69	6893.68	77.52	6895.48	82.03	6895.55	91.81	6895.91	110.15	6897.11
119.33	6897.52	130.14	6897.52	137.2	6897.5	159.37	6898.4	175.32	6898.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	18.93	.045	119.33	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
18.93	119.33	44.72	50	60.04	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1300

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6895.69	2.98	6895.69	11.3	6896.14	21.38	6895.92	37.79	6893.21
45.21	6891.73	57.32	6891.49	62.54	6889.74	62.55	6889.74	66.21	6889.28
69.25	6889.35	75	6889.28	85.9	6889.13	91.38	6892.02	96.92	6892.54
127.41	6893.56	129.81	6893.59	137.69	6895.62	140.07	6895.68	144.43	6895.79
146.08	6895.8	147.85	6896.16	150	6896.16				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	21.38	.045	137.69	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
21.38	137.69	53.12	50	50.07	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1250

INPUT
Description:
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6894.47	2.29	6894.47	7.64	6894.85	25.6	6893.42	34.28	6893.23
42.32	6891.9	45.96	6891.17	51.88	6891.06	54.44	6890.2	54.45	6890.2
65.86	6888.78	75	6888.97	75.36	6888.98	85.1	6888.85	88.31	6890.54
104.84	6892.1	123.12	6892.71	129.88	6892.8	134.6	6894.01	141.16	6894.17
150	6894.17								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	7.64	.045	134.6	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7.64	134.6	56.63	50	49.44	.1	.3

CROSS SECTION

RIVER: Phase 1 Channel
REACH: South RS: 1200

INPUT
Description:
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6892.64	36.66	6892.64	38.75	6892.52	40.72	6892.49	42.5	6891.63
42.59	6889.77	45.59	6890.58	47.79	6890.64	47.8	6890.64	48.4	6890.41
65.51	6888.27	75	6888.47	81.47	6888.61	84.3	6888.57	85.23	6889.07
112.76	6891.66	118.83	6891.86	129.94	6892	131.5	6892.4	142.26	6892.66
150	6892.66								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	36.66	.045	131.5	.05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

```
         36.66   131.5            46.46      50   82.68             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1150

INPUT
Description:
Station Elevation Data    num=      19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6894.07    2.72 6894.07    9.98 6893.64   21.21 6891.55   25.74 6891.01
   35.28 6889.26   55.82 6886.35   62.27 6885.25   67.09 6885.33   72.87 6885.38
   82.05 6885.45  123.13 6886.62  131.01 6888.31  159.52 6889.99  175.93 6890.37
   182.4  6890.4  182.62 6890.41   183.5 6890.43  186.85 6890.43

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    9.98    .045  175.93     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9.98  175.93             49.8      50   49.97             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1100

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6893.38    7.97 6893.47   11.03 6893.11   43.57 6887.14   55.97 6885.38
   59.86 6884.72   72.02 6884.92   74.21 6884.96   82.63 6885.03  105.76 6885.69
  124.96 6889.81  142.19 6890.83  178.29 6891.67  192.54 6891.73  193.02 6891.75
  194.96  6891.8  199.21  6891.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05    7.97    .045  178.29     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

```
          7.97  178.29            50.13      50   72.83             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1050

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6892.05   10.03 6892.05   13.94 6892.08   15.76 6892.37   40.21 6887.63
   40.39 6887.58   54.33 6885.03   58.63 6884.41   59.99 6884.18    73.7 6884.42
   83.82 6884.59   85.74 6884.61   91.01 6884.76  121.46  6891.3  127.47 6891.66
  171.48 6891.66

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   15.76    .045  127.47     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         15.76  127.47            72.28      50   51.48             .1       .3

CROSS SECTION


RIVER: Phase 1 Channel
REACH: South              RS: 1000

INPUT
Description:
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6891.26    5.44 6891.26   11.48  6891.3   19.25  6891.2    19.5 6891.76
    19.5 6891.74   19.58 6891.76   26.72 6892.42   26.75 6892.42   26.76 6892.42
   31.73 6892.62   38.17 6892.85   39.06 6892.87   53.88 6890.92    62.2 6883.33
   75.01 6883.38   76.97 6883.39   89.26  6887.7   96.33 6893.15   97.62  6892.7
  104.25 6892.35  105.39 6892.98  105.63 6892.96  106.44  6892.9  107.05 6892.85
  150.01 6892.85

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   39.06    .045   96.33     .05
```

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
39.06	96.33	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Phase 1 Channel

Reach	River Sta.	n1	n2	n3
North	5007	.05	.045	.05
North	4957	.05	.045	.05
North	4907	.05	.045	.05
North	4857	.05	.045	.05
North	4807	.05	.045	.05
North	4757	.05	.045	.05
North	4707	.05	.045	.05
North	4657	.05	.045	.05
North	4607	.05	.045	.05
North	4557	.05	.045	.05
North	4507	.05	.045	.05
North	4457	.05	.045	.05
North	4407	.05	.045	.05
North	4350	.05	.045	.05
North	4300	.05	.045	.05
North	4250	.05	.045	.05
North	4200	.05	.045	.05
North	4183	.05	.045	.05
North	4167	.05	.045	.05
South	4048	.05	.045	.05
South	4038	.05	.045	.05
South	4000	.05	.045	.05
South	3950	.05	.045	.05
South	3900	.05	.045	.05
South	3850	.05	.045	.05
South	3800	.05	.045	.05
South	3750	.05	.045	.05
South	3700	.05	.045	.05
South	3650	.05	.045	.05
South	3600	.05	.045	.05
South	3550	.05	.045	.05
South	3500	.05	.045	.05

South	3450	.05	.045	.05
South	3400	.05	.045	.05
South	3350	.05	.045	.05
South	3300	.05	.045	.05
South	3250	.05	.045	.05
South	3200	.05	.045	.05
South	3150	.05	.045	.05
South	3100	.05	.045	.05
South	3050	.05	.045	.05
South	3000	.05	.045	.05
South	2950	.05	.045	.05
South	2900	.05	.045	.05
South	2850	.05	.045	.05
South	2800	.05	.045	.05
South	2750	.05	.045	.05
South	2700	.05	.045	.05
South	2650	.05	.045	.05
South	2600	.05	.045	.05
South	2550	.05	.045	.05
South	2500	.05	.045	.05
South	2450	.05	.045	.05
South	2400	.05	.045	.05
South	2350	.05	.045	.05
South	2300	.05	.045	.05
South	2250	.05	.045	.05
South	2200	.05	.045	.05
South	2150	.05	.045	.05
South	2100	.05	.045	.05
South	2050	.05	.045	.05
South	2000	.05	.045	.05
South	1950	.05	.045	.05
South	1900	.05	.045	.05
South	1850	.05	.045	.05
South	1800	.05	.045	.05
South	1750	.05	.045	.05
South	1700	.05	.045	.05
South	1650	.05	.045	.05
South	1600	.05	.045	.05
South	1550	.05	.045	.05
South	1500	.05	.045	.05
South	1450	.05	.045	.05
South	1400	.05	.045	.05
South	1350	.05	.045	.05
South	1300	.05	.045	.05

South	1250	.05	.045	.05
South	1200	.05	.045	.05
South	1150	.05	.045	.05
South	1100	.05	.045	.05
South	1050	.05	.045	.05
South	1000	.05	.045	.05

SUMMARY OF REACH LENGTHS

River: Phase 1 Channel

Reach	River Sta.	Left	Channel	Right
North	5007	53.22	50	51.12
North	4957	56.3	50	55.05
North	4907	71.1	50	38.94
North	4857	49.15	50	56.56
North	4807	61.25	50	43.37
North	4757	62.73	50	41.17
North	4707	48.59	50	53.31
North	4657	31.33	50	63.68
North	4607	31.96	50	60.47
North	4557	69.03	50	28.51
North	4507	50.62	50	52.59
North	4457	46.56	50	51.87
North	4407	57.03	57.03	57.03
North	4350	50	50	50
North	4300	50	50	50
North	4250	50	50	50
North	4200	16.61	16.61	16.61
North	4183	16.62	16.62	16.62
North	4167	0	0	0
South	4048	10	10	10
South	4038	56.2	38.24	31.2
South	4000	65.72	50	44.95
South	3950	36.58	50	66.6
South	3900	45.57	50	83.5
South	3850	50.33	50	62.96
South	3800	50.75	50	49.15
South	3750	52.26	50	46.49
South	3700	60.14	50	33.53

South	3650	51.25	50	52.46
South	3600	62.01	50	47.9
South	3550	59.06	50	53.38
South	3500	39.9	50	66.73
South	3450	24.8	50	100.26
South	3400	54.43	50	48.43
South	3350	60.4	50	46.98
South	3300	56.3	50	33.79
South	3250	48.03	50	52.79
South	3200	50.1	50	50.13
South	3150	44.23	50	56.79
South	3100	33.1	50	68.21
South	3050	67.72	50	48.85
South	3000	64.93	50	45.01
South	2950	50.79	50	51.25
South	2900	65.91	50	45.14
South	2850	66.73	50	53.41
South	2800	67.78	50	48.95
South	2750	45.41	50	50.66
South	2700	62.4	50	52.53
South	2650	54.3	50	79.13
South	2600	60.01	50	72.05
South	2550	65.45	50	93.8
South	2500	69.23	50	85.3
South	2450	38.25	50	54.23
South	2400	62.04	50	59.15
South	2350	50.75	50	50.85
South	2300	40.98	50	54.76
South	2250	49.97	50	49.41
South	2200	53.67	50	48.88
South	2150	34.58	50	63.09
South	2100	31.66	50	64.9
South	2050	49.84	50	49.41
South	2000	47.64	50	56.5
South	1950	52.36	50	54.3
South	1900	63.75	50	36.61
South	1850	61.98	50	38.16
South	1800	50.79	50	53.54
South	1750	61.55	50	50.72
South	1700	28.94	50	59.09
South	1650	50.13	50	73.62
South	1600	77.3	50	30.02
South	1550	50.69	50	49.44
South	1500	65.39	50	50.26

South	1450	109.19	50	50.75
South	1400	51.77	50	59.74
South	1350	44.72	50	60.04
South	1300	53.12	50	50.07
South	1250	56.63	50	49.44
South	1200	46.46	50	82.68
South	1150	49.8	50	49.97
South	1100	50.13	50	72.83
South	1050	72.28	50	51.48
South	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Phase 1 Channel

Reach	River Sta.	Contr.	Expan.
North	5007	.1	.3
North	4957	.1	.3
North	4907	.1	.3
North	4857	.1	.3
North	4807	.1	.3
North	4757	.1	.3
North	4707	.1	.3
North	4657	.1	.3
North	4607	.1	.3
North	4557	.1	.3
North	4507	.1	.3
North	4457	.1	.3
North	4407	.1	.3
North	4350	.1	.3
North	4300	.1	.3
North	4250	.1	.3
North	4200	.1	.3
North	4183	.3	.5
North	4167	.3	.5
South	4048	.3	.5
South	4038	.1	.3
South	4000	.1	.3
South	3950	.1	.3
South	3900	.1	.3

South	3850	.1	.3
South	3800	.1	.3
South	3750	.1	.3
South	3700	.1	.3
South	3650	.1	.3
South	3600	.1	.3
South	3550	.1	.3
South	3500	.1	.3
South	3450	.1	.3
South	3400	.1	.3
South	3350	.1	.3
South	3300	.1	.3
South	3250	.1	.3
South	3200	.1	.3
South	3150	.1	.3
South	3100	.1	.3
South	3050	.1	.3
South	3000	.1	.3
South	2950	.1	.3
South	2900	.1	.3
South	2850	.1	.3
South	2800	.1	.3
South	2750	.1	.3
South	2700	.1	.3
South	2650	.1	.3
South	2600	.1	.3
South	2550	.1	.3
South	2500	.1	.3
South	2450	.1	.3
South	2400	.1	.3
South	2350	.1	.3
South	2300	.1	.3
South	2250	.1	.3
South	2200	.1	.3
South	2150	.1	.3
South	2100	.1	.3
South	2050	.1	.3
South	2000	.1	.3
South	1950	.1	.3
South	1900	.1	.3
South	1850	.1	.3
South	1800	.1	.3
South	1750	.1	.3
South	1700	.1	.3

South	1650	.1	.3
South	1600	.1	.3
South	1550	.1	.3
South	1500	.1	.3
South	1450	.1	.3
South	1400	.1	.3
South	1350	.1	.3
South	1300	.1	.3
South	1250	.1	.3
South	1200	.1	.3
South	1150	.1	.3
South	1100	.1	.3
South	1050	.1	.3
South	1000	.1	.3

HEC-RAS Plan: Phase 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South	4048	100-YR	131.00	6936.40	6939.52		6940.42	0.011778	7.64	17.14	8.56	0.76
South	4048	5-YR	22.50	6936.40	6937.20	6937.20	6937.61	0.031734	5.09	4.42	8.45	1.00
South	4038	100-YR	131.00	6936.34	6939.90		6939.99	0.000977	2.39	54.87	42.04	0.22
South	4038	5-YR	22.50	6936.34	6937.05		6937.12	0.006734	2.11	10.68	19.17	0.45
South	4000	100-YR	131.00	6936.11	6939.93		6939.95	0.000328	1.15	117.79	51.44	0.12
South	4000	5-YR	22.50	6936.11	6936.84		6936.89	0.005360	1.75	12.84	20.63	0.39
South	3950	100-YR	131.00	6935.81	6939.92		6939.93	0.000237	0.94	139.39	54.54	0.10
South	3950	5-YR	22.50	6935.81	6936.65		6936.68	0.003234	1.46	15.44	22.39	0.31
South	3900	100-YR	968.00	6935.53	6939.34		6939.73	0.006878	5.73	216.66	122.21	0.58
South	3900	5-YR	32.50	6935.53	6936.37		6936.44	0.006672	2.11	15.39	22.00	0.45
South	3850	100-YR	968.00	6935.24	6938.88		6939.31	0.008363	5.30	187.32	91.91	0.61
South	3850	5-YR	32.50	6935.24	6936.02		6936.08	0.007299	1.97	16.49	27.89	0.45
South	3800	100-YR	968.00	6934.35	6937.76	6937.76	6938.59	0.025606	7.30	132.63	80.52	1.00
South	3800	5-YR	32.50	6934.35	6935.48		6935.58	0.014645	2.54	12.78	24.84	0.62
South	3750	100-YR	968.00	6933.18	6936.07	6936.07	6936.84	0.025954	7.01	138.11	90.91	1.00
South	3750	5-YR	32.50	6933.18	6934.18	6934.18	6934.44	0.038923	4.05	8.02	16.22	1.02
South	3700	100-YR	968.00	6931.90	6935.62		6935.92	0.007329	4.36	221.88	115.11	0.55
South	3700	5-YR	32.50	6931.90	6933.16		6933.29	0.014324	2.83	11.50	18.83	0.64
South	3650	100-YR	968.00	6931.20	6934.94	6934.68	6935.38	0.015969	5.35	180.94	123.90	0.78
South	3650	5-YR	32.50	6931.20	6932.52		6932.62	0.011923	2.57	12.67	20.91	0.58
South	3600	100-YR	968.00	6930.58	6933.57	6933.57	6934.33	0.026912	7.00	138.36	93.45	1.01
South	3600	5-YR	32.50	6930.58	6931.43	6931.42	6931.62	0.039871	3.47	9.38	24.40	0.99
South	3550	100-YR	968.00	6929.49	6932.73		6933.13	0.011178	5.06	191.37	109.05	0.67
South	3550	5-YR	32.50	6929.49	6930.52		6930.59	0.011724	2.08	15.63	35.05	0.55
South	3500	100-YR	968.00	6928.80	6932.31		6932.67	0.007301	4.77	202.99	91.71	0.57
South	3500	5-YR	32.50	6928.80	6929.64		6929.76	0.024274	2.77	11.72	29.42	0.77
South	3450	100-YR	968.00	6928.01	6931.54		6932.15	0.013660	6.27	154.32	73.90	0.77
South	3450	5-YR	32.50	6928.01	6928.96		6929.02	0.009631	2.04	15.97	31.94	0.51
South	3400	100-YR	968.00	6927.47	6930.91	6930.57	6931.40	0.015105	5.57	173.94	108.05	0.77
South	3400	5-YR	32.50	6927.47	6928.33		6928.42	0.014798	2.43	13.40	28.50	0.62

HEC-RAS Plan: Phase 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South	3350	100-YR	968.00	6926.42	6929.60	6929.55	6930.44	0.023161	7.32	132.29	74.95	0.97
South	3350	5-YR	32.50	6926.42	6927.08	6927.08	6927.27	0.040106	3.57	9.12	22.97	1.00
South	3300	100-YR	968.00	6924.78	6929.04		6929.58	0.010949	5.86	165.08	73.98	0.69
South	3300	5-YR	32.50	6924.78	6925.84		6925.96	0.016757	2.88	11.28	20.25	0.68
South	3250	100-YR	968.00	6923.75	6928.37		6928.99	0.012004	6.35	152.41	64.74	0.73
South	3250	5-YR	32.50	6923.75	6924.86		6925.03	0.021104	3.31	9.81	16.91	0.77
South	3200	100-YR	968.00	6923.28	6927.19	6927.09	6928.18	0.020951	8.00	121.02	55.27	0.95
South	3200	5-YR	32.50	6923.28	6924.33		6924.41	0.007539	2.27	14.30	20.11	0.47
South	3150	100-YR	968.00	6923.15	6926.06	6926.04	6927.07	0.023566	8.07	119.91	59.15	1.00
South	3150	5-YR	32.50	6923.15	6923.88		6923.95	0.011680	2.05	15.89	36.52	0.55
South	3100	100-YR	968.00	6921.99	6925.01	6924.93	6925.91	0.021521	7.62	126.97	63.80	0.95
South	3100	5-YR	32.50	6921.99	6922.77	6922.77	6922.91	0.045754	3.03	10.72	38.03	1.01
South	3050	100-YR	968.00	6921.56	6925.28		6925.43	0.002186	3.11	312.70	116.37	0.32
South	3050	5-YR	32.50	6921.56	6922.05		6922.08	0.007135	1.45	22.41	59.63	0.42
South	3000	100-YR	968.00	6920.57	6924.56		6925.17	0.012335	6.25	158.14	89.72	0.74
South	3000	5-YR	32.50	6920.57	6921.31		6921.47	0.023776	3.16	10.29	20.93	0.79
South	2950	100-YR	968.00	6919.84	6923.42	6923.42	6924.38	0.018555	7.98	129.73	79.49	0.91
South	2950	5-YR	32.50	6919.84	6920.67		6920.75	0.009177	2.28	14.27	23.22	0.51
South	2900	100-YR	968.00	6919.31	6922.51	6922.42	6923.30	0.015622	7.34	147.57	96.39	0.84
South	2900	5-YR	32.50	6919.31	6919.74	6919.73	6919.91	0.038784	3.35	9.70	26.17	0.97
South	2850	100-YR	968.00	6917.96	6922.18		6922.64	0.008533	5.48	186.54	102.41	0.62
South	2850	5-YR	32.50	6917.96	6918.75		6918.85	0.012971	2.58	12.58	21.95	0.60
South	2800	100-YR	968.00	6917.16	6920.97	6920.97	6922.00	0.016962	8.19	127.36	82.10	0.88
South	2800	5-YR	32.50	6917.16	6917.88		6918.03	0.020972	3.09	10.53	20.19	0.75
South	2750	100-YR	968.00	6915.84	6919.87	6919.87	6920.92	0.018415	8.38	123.71	64.60	0.92
South	2750	5-YR	32.50	6915.84	6916.77		6916.94	0.022725	3.31	9.83	18.00	0.79
South	2700	100-YR	968.00	6914.78	6919.50		6920.00	0.009953	5.67	174.82	98.17	0.66
South	2700	5-YR	32.50	6914.78	6915.82	6915.66	6915.96	0.016788	3.02	10.77	17.96	0.69
South	2650	100-YR	968.00	6913.71	6918.03	6918.03	6919.24	0.020549	8.84	111.70	56.07	0.96
South	2650	5-YR	32.50	6913.71	6914.57	6914.54	6914.81	0.032383	3.97	8.18	14.80	0.94

HEC-RAS Plan: Phase 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South	2600	100-YR	968.00	6912.83	6917.23	6917.23	6918.12	0.013470	7.76	144.76	114.03	0.80
South	2600	5-YR	32.50	6912.83	6913.85		6913.95	0.009737	2.55	12.75	18.19	0.54
South	2550	100-YR	968.00	6912.38	6916.07	6915.88	6916.64	0.012316	6.44	180.03	129.94	0.74
South	2550	5-YR	32.50	6912.38	6913.14		6913.28	0.019806	2.98	10.92	21.21	0.73
South	2500	100-YR	968.00	6911.54	6915.55		6915.93	0.012493	5.00	193.72	122.41	0.70
South	2500	5-YR	32.50	6911.54	6912.39	6912.18	6912.50	0.012367	2.58	12.60	21.30	0.59
South	2450	100-YR	968.00	6910.62	6914.21	6914.21	6915.12	0.018284	7.79	136.19	104.61	0.90
South	2450	5-YR	32.50	6910.62	6911.22	6911.22	6911.45	0.040700	3.85	8.45	19.18	1.02
South	2400	100-YR	968.00	6907.81	6912.80	6912.78	6913.93	0.021747	8.54	114.30	56.01	0.98
South	2400	5-YR	32.50	6907.81	6909.75		6909.82	0.004580	2.16	15.02	15.23	0.38
South	2350	100-YR	968.00	6908.31	6912.20	6911.94	6912.80	0.017591	6.21	156.73	102.47	0.84
South	2350	5-YR	32.50	6908.31	6909.40		6909.49	0.010340	2.36	13.76	23.18	0.54
South	2300	100-YR	968.00	6908.18	6911.03	6911.03	6911.85	0.019218	7.52	142.60	92.90	0.91
South	2300	5-YR	32.50	6908.18	6908.79		6908.87	0.015293	2.31	14.08	33.08	0.62
South	2250	100-YR	968.00	6907.30	6910.31		6910.86	0.016458	5.95	162.81	97.56	0.81
South	2250	5-YR	32.50	6907.30	6907.77		6907.88	0.026327	2.71	11.98	33.17	0.80
South	2200	100-YR	968.00	6906.18	6908.95	6908.95	6909.83	0.024911	7.52	128.80	74.00	1.00
South	2200	5-YR	32.50	6906.18	6906.72		6906.81	0.017961	2.37	13.71	34.89	0.67
South	2150	100-YR	968.00	6905.09	6907.60	6907.60	6908.49	0.024780	7.60	127.44	71.78	1.00
South	2150	5-YR	32.50	6905.09	6905.58	6905.54	6905.68	0.028654	2.52	12.92	42.73	0.81
South	2100	100-YR	968.00	6903.79	6906.55		6907.17	0.017024	6.30	153.55	86.42	0.83
South	2100	5-YR	32.50	6903.79	6904.57		6904.64	0.015500	2.19	14.86	38.23	0.62
South	2050	100-YR	968.00	6903.25	6906.03		6906.45	0.010538	5.24	184.78	95.84	0.67
South	2050	5-YR	32.50	6903.25	6903.99		6904.03	0.009563	1.66	19.56	52.93	0.48
South	2000	100-YR	968.00	6902.93	6905.59		6905.95	0.008815	4.83	200.48	102.79	0.61
South	2000	5-YR	32.50	6902.93	6903.50		6903.53	0.010484	1.52	21.34	70.56	0.49
South	1950	100-YR	968.00	6902.27	6905.21		6905.52	0.007929	4.50	215.16	113.42	0.58
South	1950	5-YR	32.50	6902.27	6902.85		6902.90	0.015626	1.85	17.56	58.46	0.60
South	1900	100-YR	968.00	6901.77	6904.78		6905.11	0.008403	4.59	210.68	112.42	0.59
South	1900	5-YR	32.50	6901.77	6902.30		6902.35	0.008466	1.72	18.86	44.14	0.46

HEC-RAS Plan: Phase 1 (Continued)

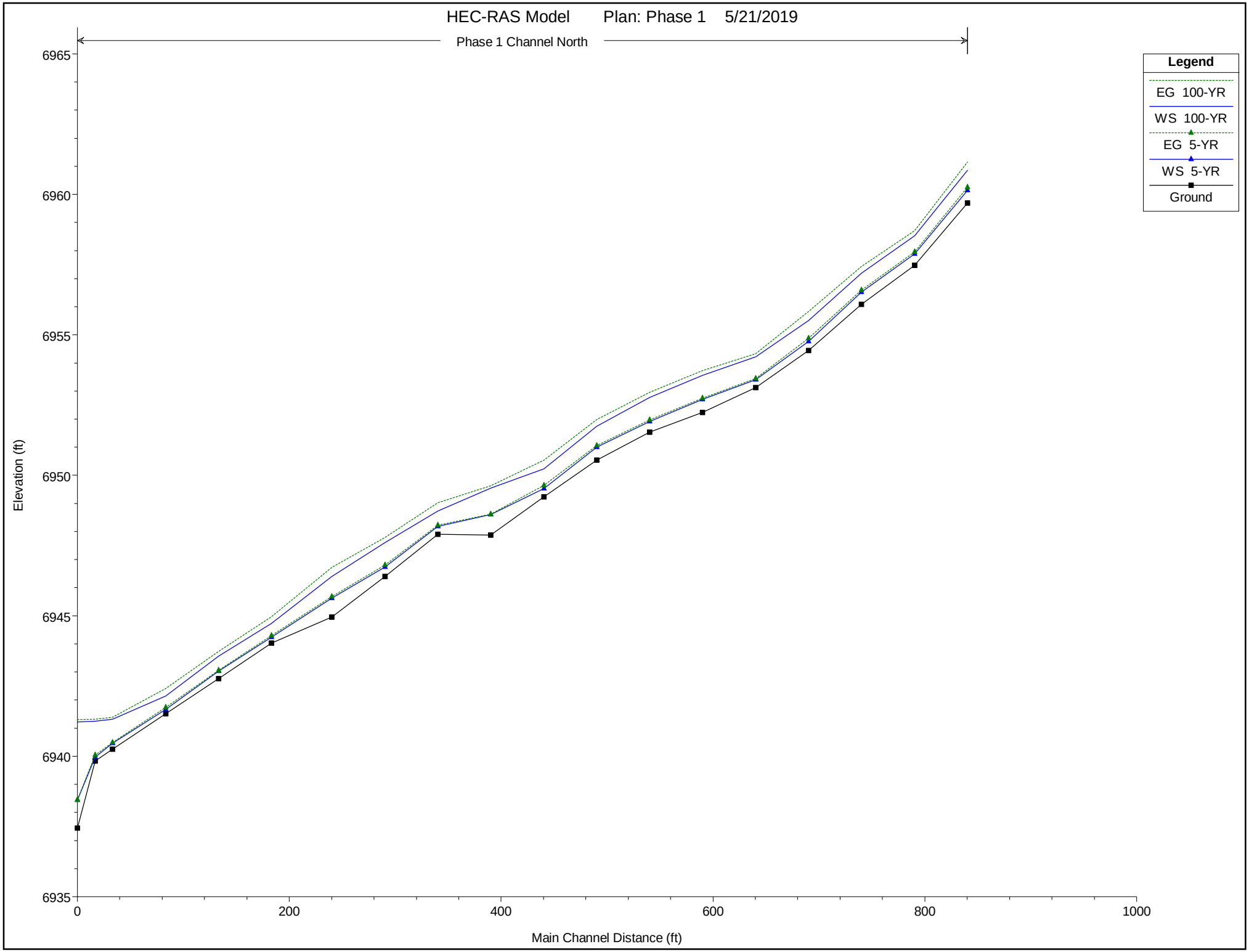
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South	1850	100-YR	968.00	6901.20	6903.73	6903.65	6904.43	0.022393	6.69	144.76	91.75	0.94
South	1850	5-YR	32.50	6901.20	6901.69		6901.77	0.016457	2.24	14.49	37.57	0.64
South	1800	100-YR	968.00	6900.25	6902.80		6903.39	0.018091	6.19	156.45	94.90	0.85
South	1800	5-YR	32.50	6900.25	6900.66		6900.75	0.025598	2.43	13.35	42.66	0.77
South	1750	100-YR	968.00	6899.75	6902.37		6902.66	0.009560	4.36	222.23	141.56	0.61
South	1750	5-YR	32.50	6899.75	6900.34		6900.36	0.003445	1.17	27.66	58.54	0.30
South	1700	100-YR	968.00	6899.58	6901.93		6902.17	0.009338	4.00	241.99	172.26	0.59
South	1700	5-YR	32.50	6899.58	6900.05		6900.09	0.010006	1.54	21.12	66.36	0.48
South	1650	100-YR	968.00	6898.99	6901.53		6901.74	0.007443	3.78	263.17	177.28	0.54
South	1650	5-YR	32.50	6898.99	6899.79		6899.81	0.003384	1.06	31.39	79.27	0.29
South	1600	100-YR	968.00	6898.29	6900.63	6900.62	6901.06	0.028809	5.22	185.60	206.62	0.97
South	1600	5-YR	32.50	6898.29	6899.24	6899.20	6899.40	0.031796	3.17	10.25	25.84	0.89
South	1550	100-YR	968.00	6897.87	6899.67		6899.98	0.015790	4.43	218.43	197.84	0.74
South	1550	5-YR	32.50	6897.87	6898.30		6898.33	0.014530	1.53	21.18	88.51	0.55
South	1500	100-YR	968.00	6897.28	6898.91		6899.20	0.014984	4.34	223.10	200.55	0.73
South	1500	5-YR	32.50	6897.28	6897.71		6897.74	0.009747	1.22	26.61	116.07	0.45
South	1450	100-YR	968.00	6896.36	6898.33		6898.54	0.010624	3.76	264.95	236.87	0.61
South	1450	5-YR	32.50	6896.36	6896.87	6896.83	6896.95	0.030042	2.27	14.31	57.18	0.80
South	1400	100-YR	968.00	6894.94	6897.89		6898.05	0.005684	3.38	300.11	188.79	0.47
South	1400	5-YR	32.50	6894.94	6895.56	6895.47	6895.67	0.022158	2.64	12.29	31.07	0.74
South	1350	100-YR	968.00	6893.53	6896.63	6896.63	6897.46	0.025645	7.28	132.90	81.62	1.01
South	1350	5-YR	32.50	6893.53	6894.01	6894.01	6894.19	0.040952	3.42	9.50	25.85	0.99
South	1300	100-YR	968.00	6889.13	6893.31		6893.85	0.013015	5.89	164.28	82.75	0.74
South	1300	5-YR	32.50	6889.13	6889.94		6890.01	0.007336	2.05	15.88	25.51	0.46
South	1250	100-YR	968.00	6888.78	6892.68	6892.07	6893.20	0.012681	5.81	166.72	84.57	0.73
South	1250	5-YR	32.50	6888.78	6889.63		6889.68	0.005750	1.85	17.60	27.56	0.41
South	1200	100-YR	968.00	6888.27	6891.35	6891.35	6892.29	0.025283	7.78	124.43	66.96	1.01
South	1200	5-YR	32.50	6888.27	6888.87	6888.87	6889.06	0.041579	3.53	9.21	24.15	1.01
South	1150	100-YR	968.00	6885.25	6889.59		6889.73	0.002237	3.01	321.07	119.15	0.32
South	1150	5-YR	32.50	6885.25	6885.95		6886.01	0.010110	1.86	17.46	41.54	0.51

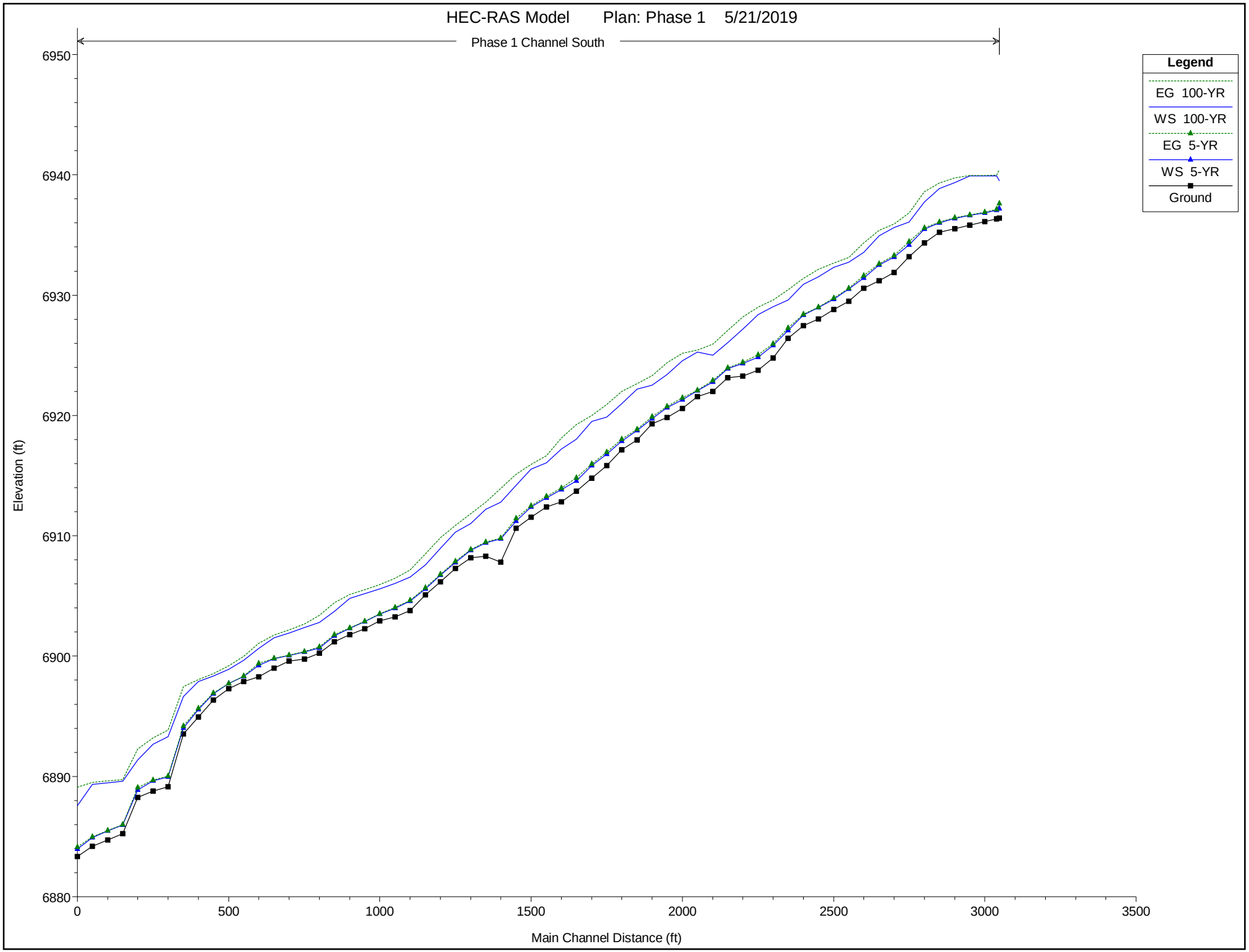
HEC-RAS Plan: Phase 1 (Continued)

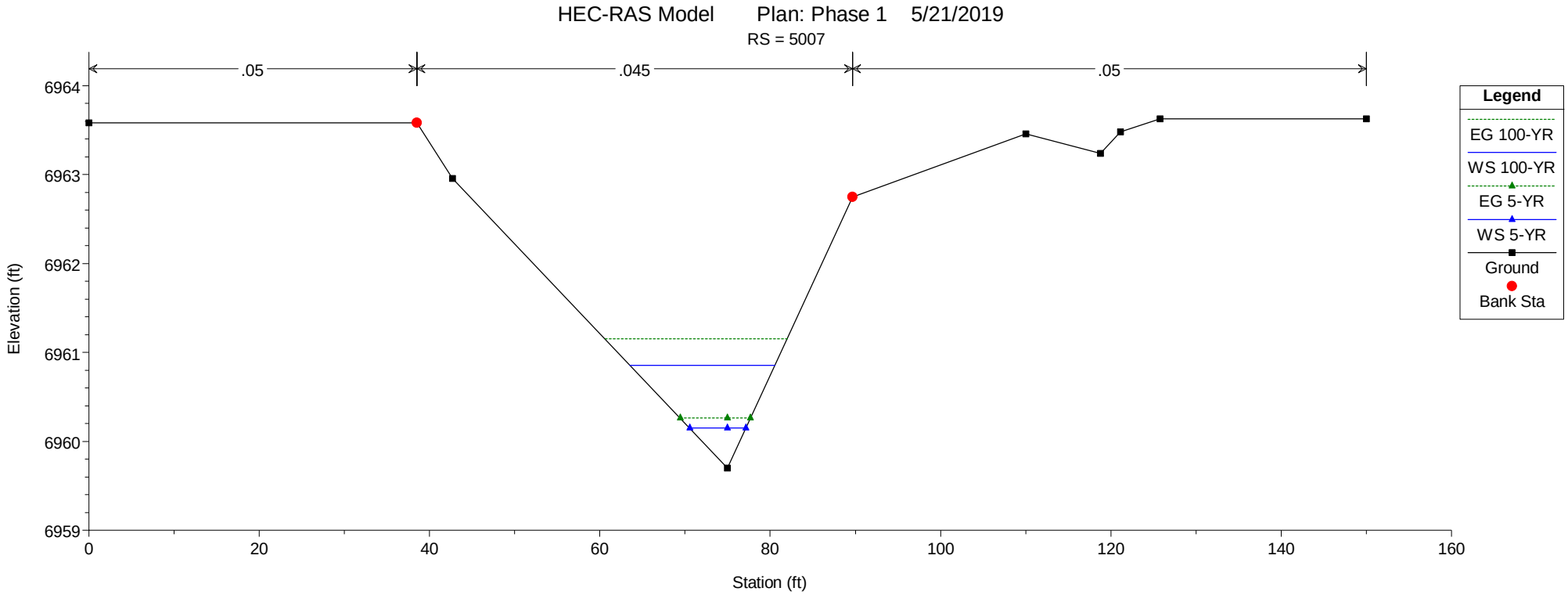
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South	1100	100-YR	968.00	6884.72	6889.46		6889.62	0.001930	3.19	303.69	92.44	0.31
South	1100	5-YR	32.50	6884.72	6885.46		6885.51	0.009910	1.84	17.69	42.30	0.50
South	1050	100-YR	968.00	6884.18	6889.32		6889.51	0.002227	3.51	276.00	80.78	0.33
South	1050	5-YR	32.50	6884.18	6884.90		6884.97	0.011896	2.06	15.79	36.48	0.55
South	1000	100-YR	968.00	6883.33	6887.56	6887.56	6889.12	0.022562	10.02	96.60	31.29	1.01
South	1000	5-YR	32.50	6883.33	6883.95	6883.88	6884.14	0.024693	3.45	9.42	17.05	0.82
North	5007	100-YR	43.00	6959.70	6960.86	6960.86	6961.15	0.036699	4.36	9.86	17.05	1.01
North	5007	5-YR	4.00	6959.70	6960.15	6960.15	6960.26	0.049278	2.69	1.49	6.62	1.00
North	4957	100-YR	43.00	6957.48	6958.53		6958.71	0.022577	3.43	12.52	21.61	0.80
North	4957	5-YR	4.00	6957.48	6957.89	6957.84	6957.95	0.030306	1.99	2.01	9.76	0.78
North	4907	100-YR	43.00	6956.08	6957.19	6957.14	6957.44	0.028870	3.98	10.80	17.92	0.90
North	4907	5-YR	4.00	6956.08	6956.53	6956.47	6956.59	0.024429	1.97	2.03	8.53	0.71
North	4857	100-YR	43.00	6954.44	6955.51	6955.51	6955.84	0.035476	4.60	9.35	14.50	1.01
North	4857	5-YR	4.00	6954.44	6954.77	6954.77	6954.88	0.050805	2.71	1.48	6.68	1.02
North	4807	100-YR	43.00	6953.12	6954.22		6954.33	0.009349	2.69	15.98	20.46	0.54
North	4807	5-YR	4.00	6953.12	6953.41		6953.44	0.015502	1.48	2.70	12.39	0.56
North	4757	100-YR	43.00	6952.24	6953.55		6953.73	0.015007	3.39	12.69	16.31	0.68
North	4757	5-YR	4.00	6952.24	6952.70		6952.74	0.012493	1.67	2.39	7.75	0.53
North	4707	100-YR	43.00	6951.54	6952.77		6952.96	0.016053	3.46	12.44	16.32	0.70
North	4707	5-YR	4.00	6951.54	6951.92		6951.97	0.019453	1.90	2.11	7.91	0.65
North	4657	100-YR	43.00	6950.54	6951.74	6951.65	6951.99	0.023552	3.95	10.87	15.56	0.83
North	4657	5-YR	4.00	6950.54	6951.00	6950.91	6951.06	0.017481	1.84	2.18	7.89	0.62
North	4607	100-YR	43.00	6949.23	6950.23	6950.23	6950.54	0.035718	4.46	9.64	15.79	1.01
North	4607	5-YR	4.00	6949.23	6949.53	6949.53	6949.64	0.052726	2.65	1.51	7.26	1.02
North	4557	100-YR	43.00	6947.88	6949.54		6949.62	0.005688	2.29	18.77	20.98	0.43
North	4557	5-YR	4.00	6947.88	6948.61		6948.62	0.004026	1.04	3.85	10.91	0.31
North	4507	100-YR	43.00	6947.90	6948.73	6948.73	6949.03	0.035594	4.37	9.83	16.55	1.00
North	4507	5-YR	4.00	6947.90	6948.18		6948.22	0.022205	1.76	2.27	10.60	0.67
North	4457	100-YR	43.00	6946.40	6947.60		6947.79	0.015943	3.49	12.31	15.79	0.70
North	4457	5-YR	4.00	6946.40	6946.73	6946.71	6946.81	0.036741	2.23	1.79	8.49	0.86

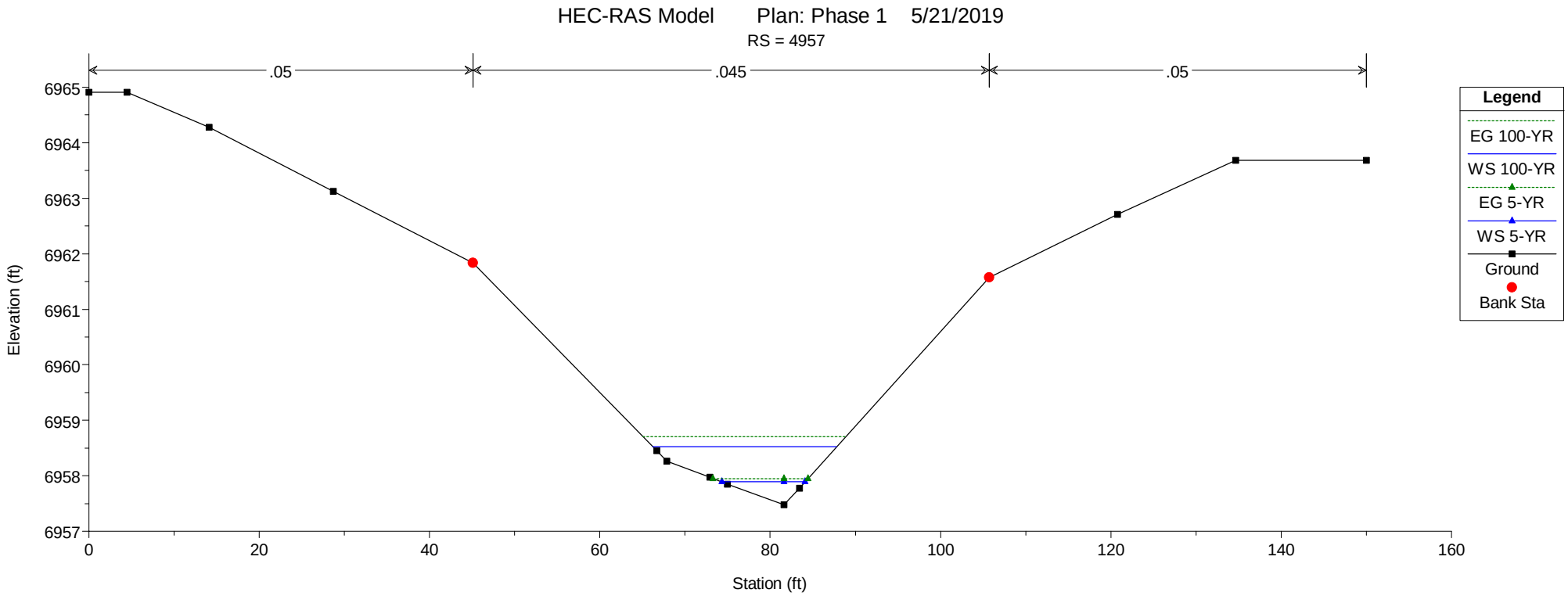
HEC-RAS Plan: Phase 1 (Continued)

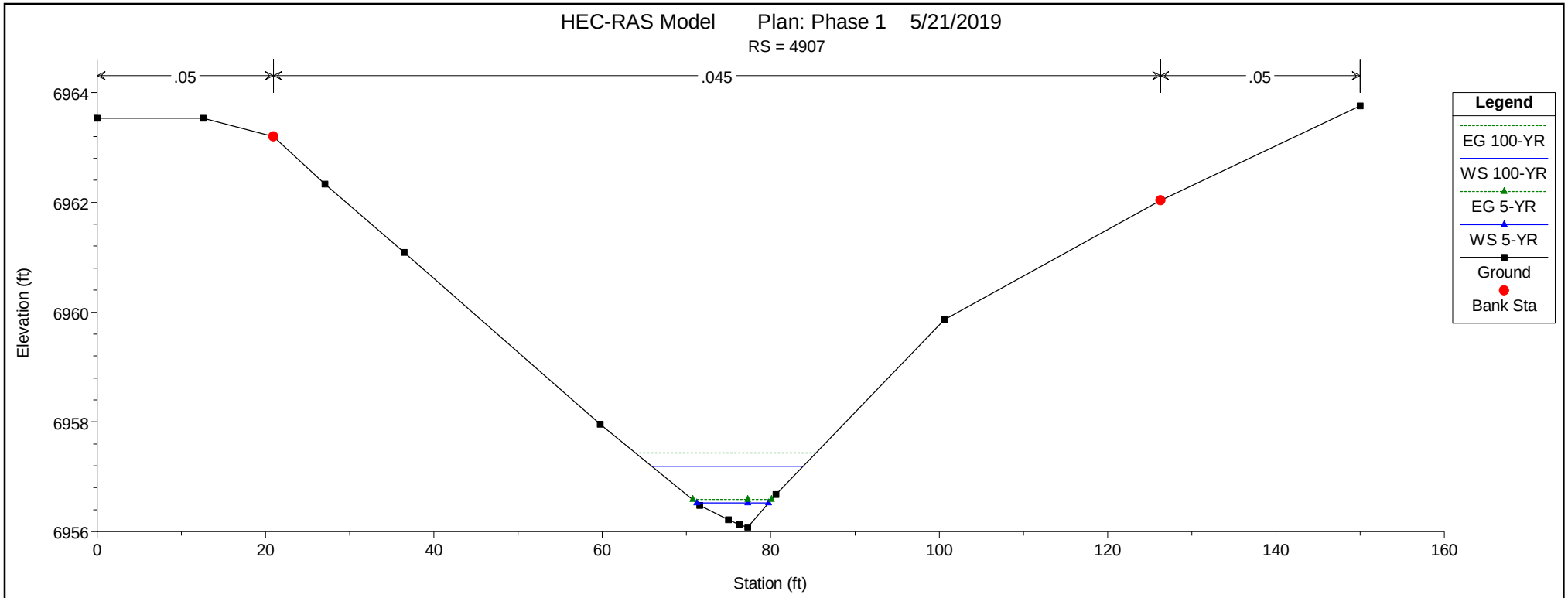
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
North	4407	100-YR	43.00	6944.96	6946.40	6946.35	6946.73	0.029057	4.58	9.39	12.46	0.93
North	4407	5-YR	4.00	6944.96	6945.62		6945.68	0.015191	1.92	2.08	6.27	0.59
North	4350	100-YR	43.00	6944.02	6944.73	6944.71	6944.97	0.031696	3.95	10.88	19.60	0.94
North	4350	5-YR	4.00	6944.02	6944.23	6944.23	6944.29	0.046036	1.88	2.13	15.58	0.90
North	4300	100-YR	43.00	6942.77	6943.56	6943.43	6943.73	0.019284	3.34	12.88	20.57	0.74
North	4300	5-YR	4.00	6942.77	6943.03	6942.96	6943.05	0.014689	1.31	3.06	16.32	0.53
North	4250	100-YR	43.00	6941.51	6942.15	6942.15	6942.41	0.037043	4.13	10.40	19.68	1.00
North	4250	5-YR	4.00	6941.51	6941.67	6941.67	6941.74	0.059230	2.01	1.99	15.91	1.00
North	4200	100-YR	43.00	6940.25	6941.32		6941.39	0.004960	2.10	20.43	23.47	0.40
North	4200	5-YR	4.00	6940.25	6940.46	6940.38	6940.48	0.013410	1.26	3.16	16.58	0.51
North	4183	100-YR	43.00	6939.83	6941.24		6941.32	0.003022	2.29	18.82	26.30	0.34
North	4183	5-YR	4.00	6939.83	6939.96	6939.96	6940.04	0.067527	2.24	1.78	16.06	1.08
North	4167	100-YR	43.00	6937.44	6941.22	6938.75	6941.30	0.000796	2.26	19.01	8.59	0.21
North	4167	5-YR	4.00	6937.44	6938.44	6937.71	6938.45	0.000580	0.80	5.03	8.46	0.14

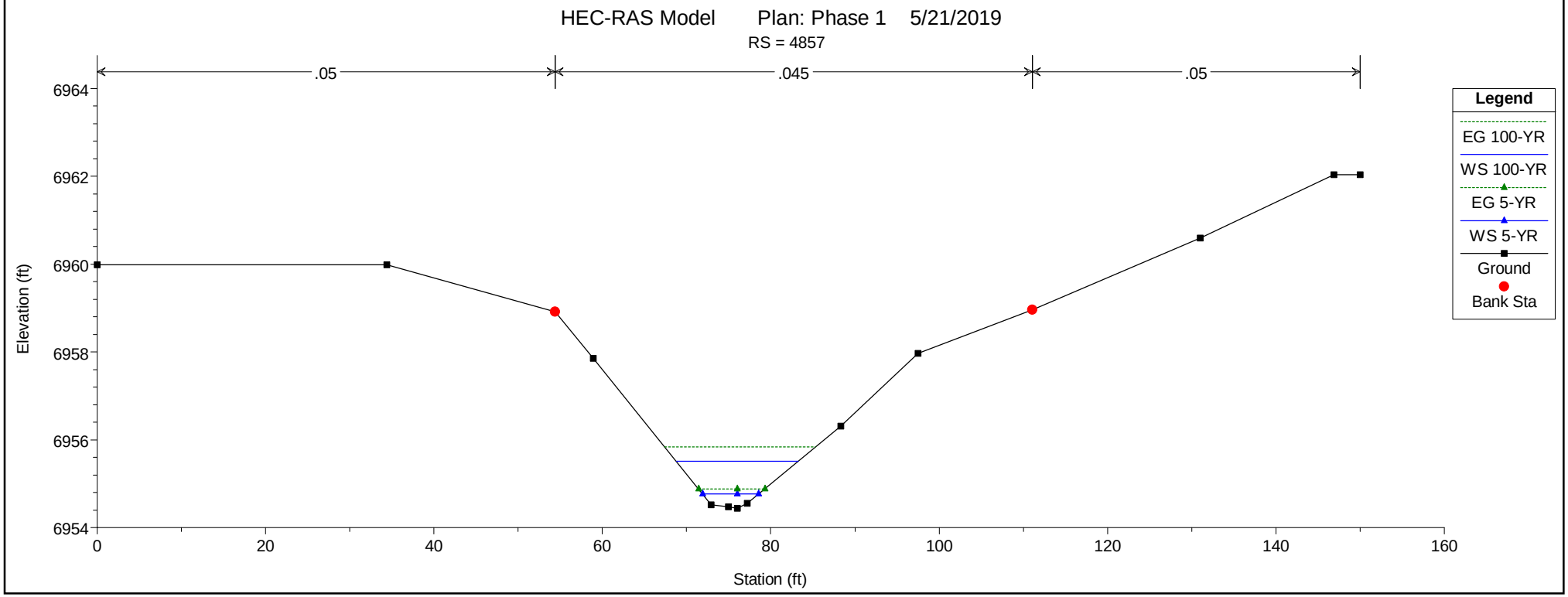

HEC-RAS Model Plan: Phase 1 5/21/2019
Phase 1 Channel North
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Elevation (ft)
6965
6960
6955
6950
6945
6940
6935
0
200
400
600
800
1000
Main Channel Distance (ft)

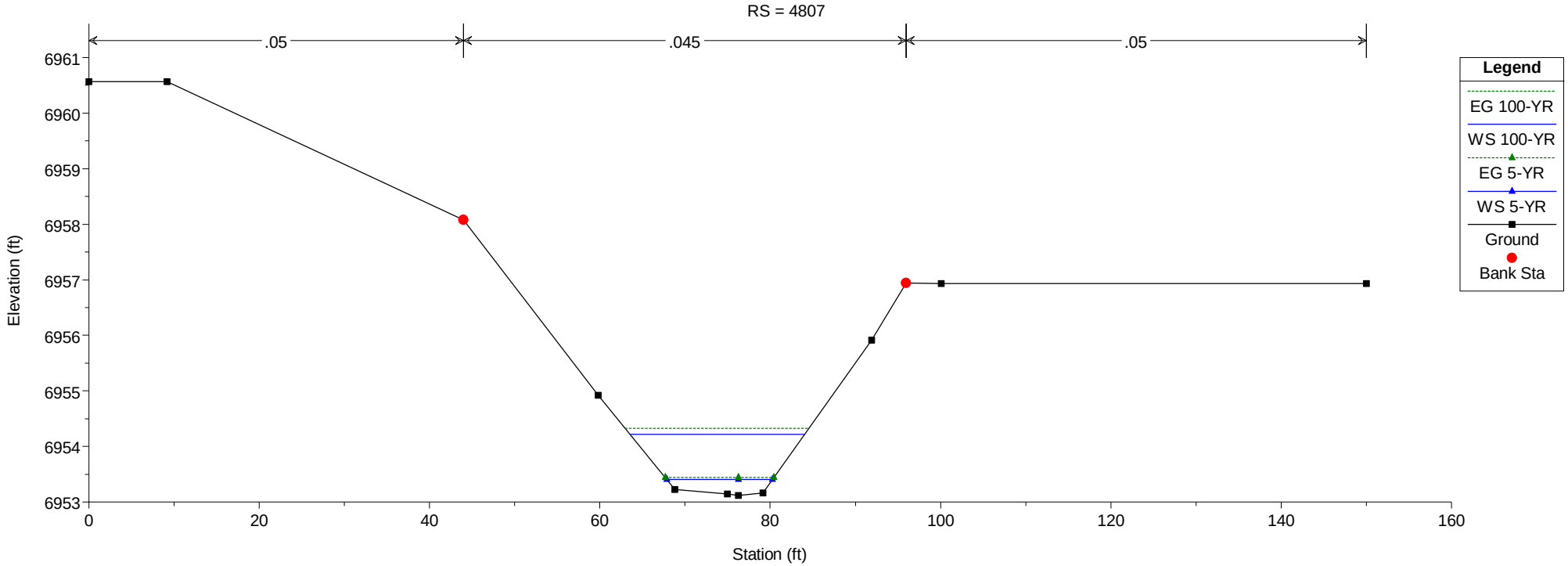

HEC-RAS Model Plan: Phase 1 5/21/2019
Phase 1 Channel South
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Elevation (ft)
6950
6940
6930
6920
6910
6900
6890
6880
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

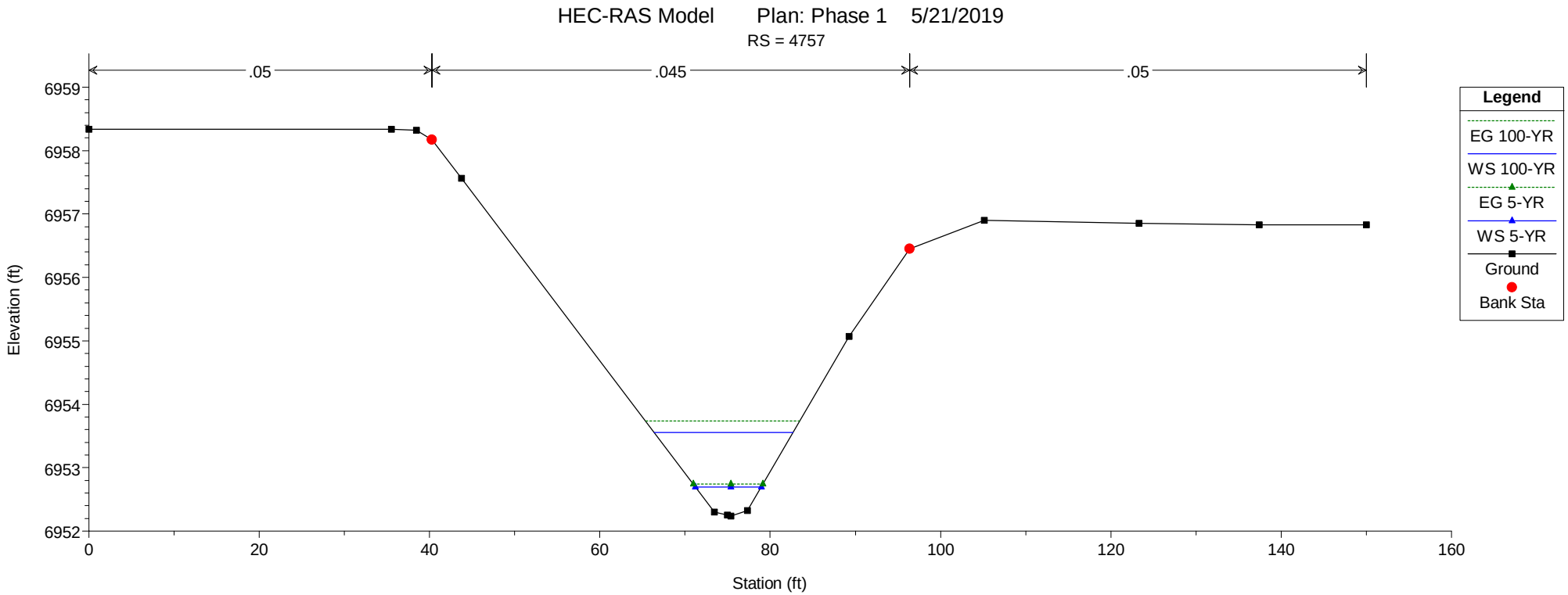

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 5007
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

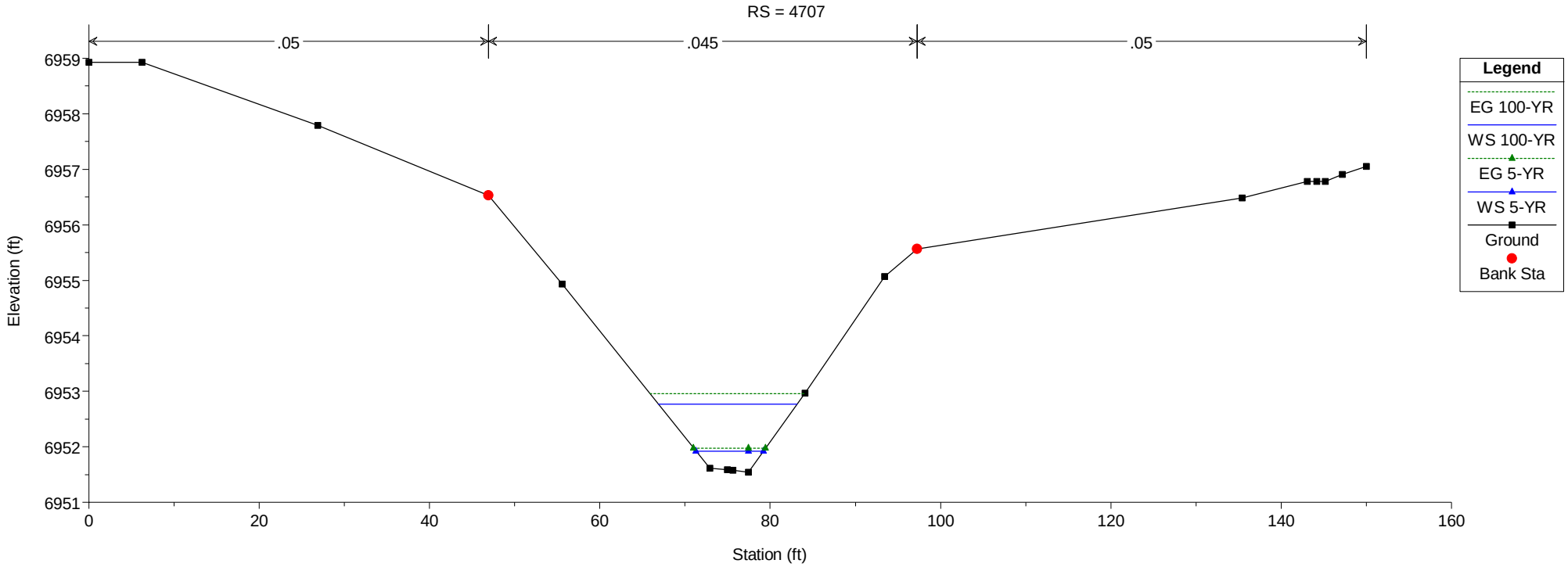

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4957
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

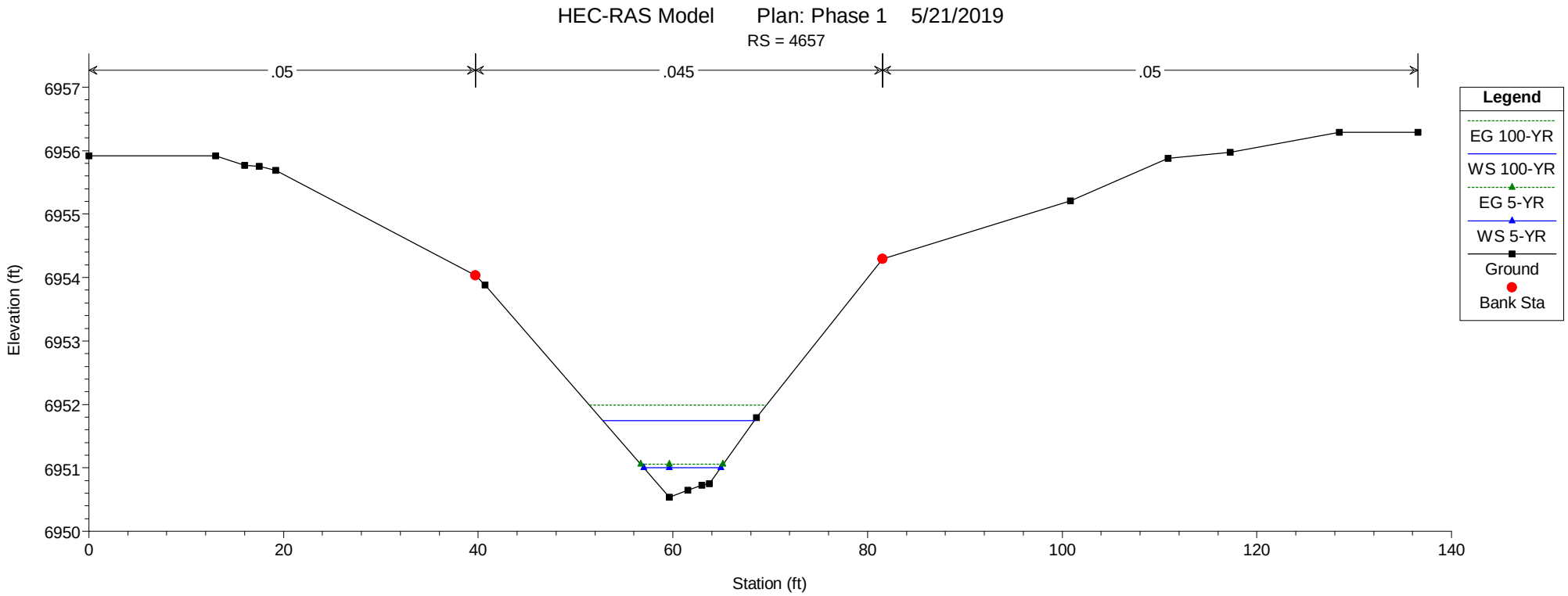

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4907
.05
.045
.05
Elevation (ft)
6964
6962
6960
6958
6956
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

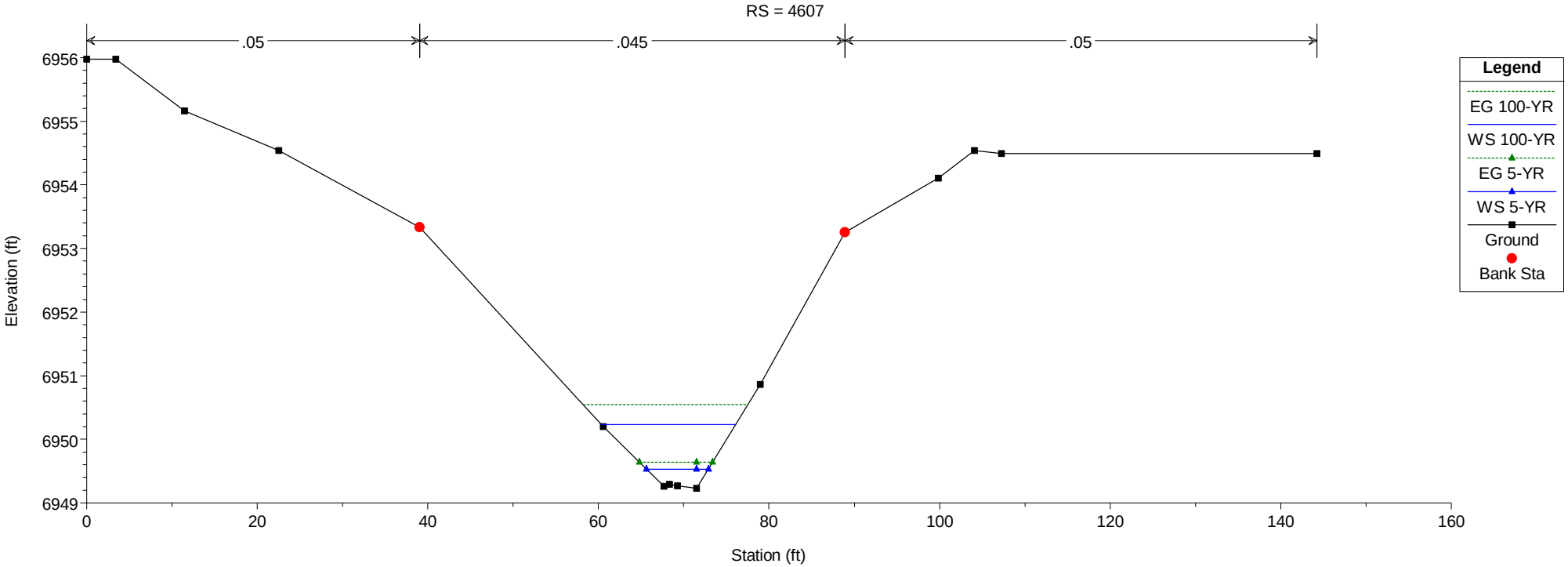

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4857
.05
.045
.05
Elevation (ft)
6964
6962
6960
6958
6956
6954
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

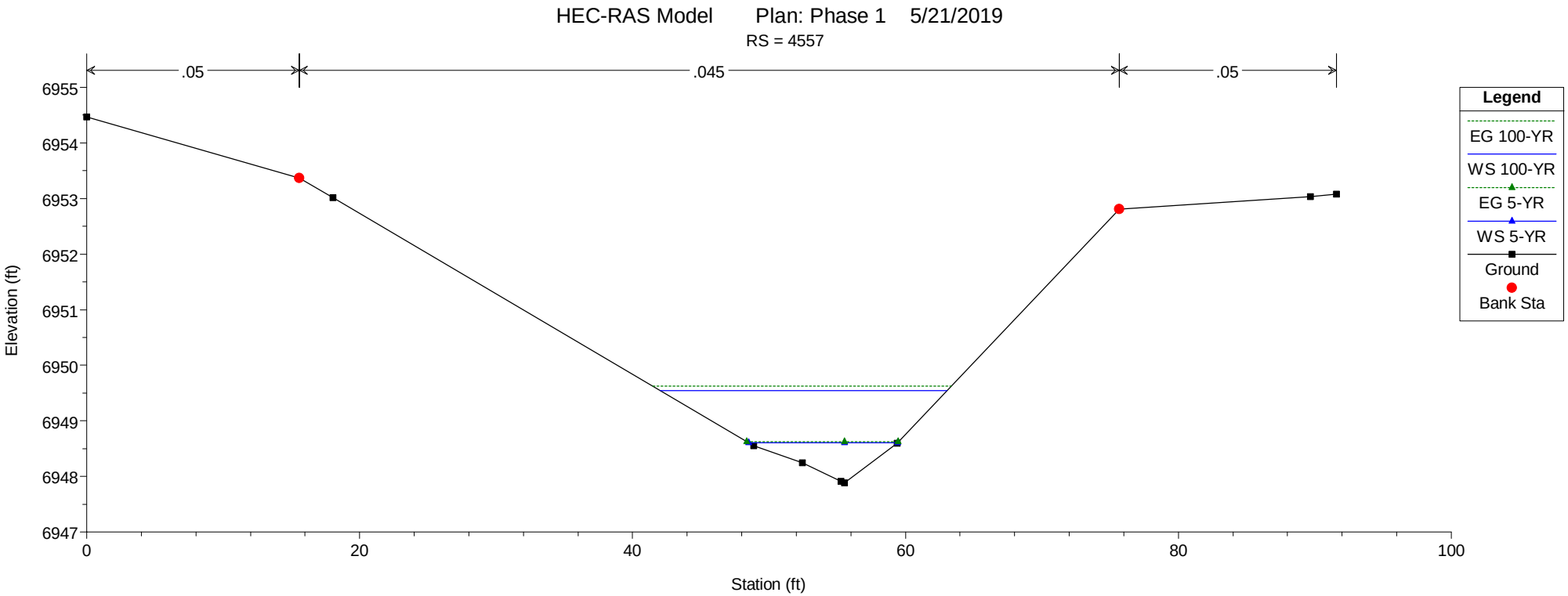

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4807
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

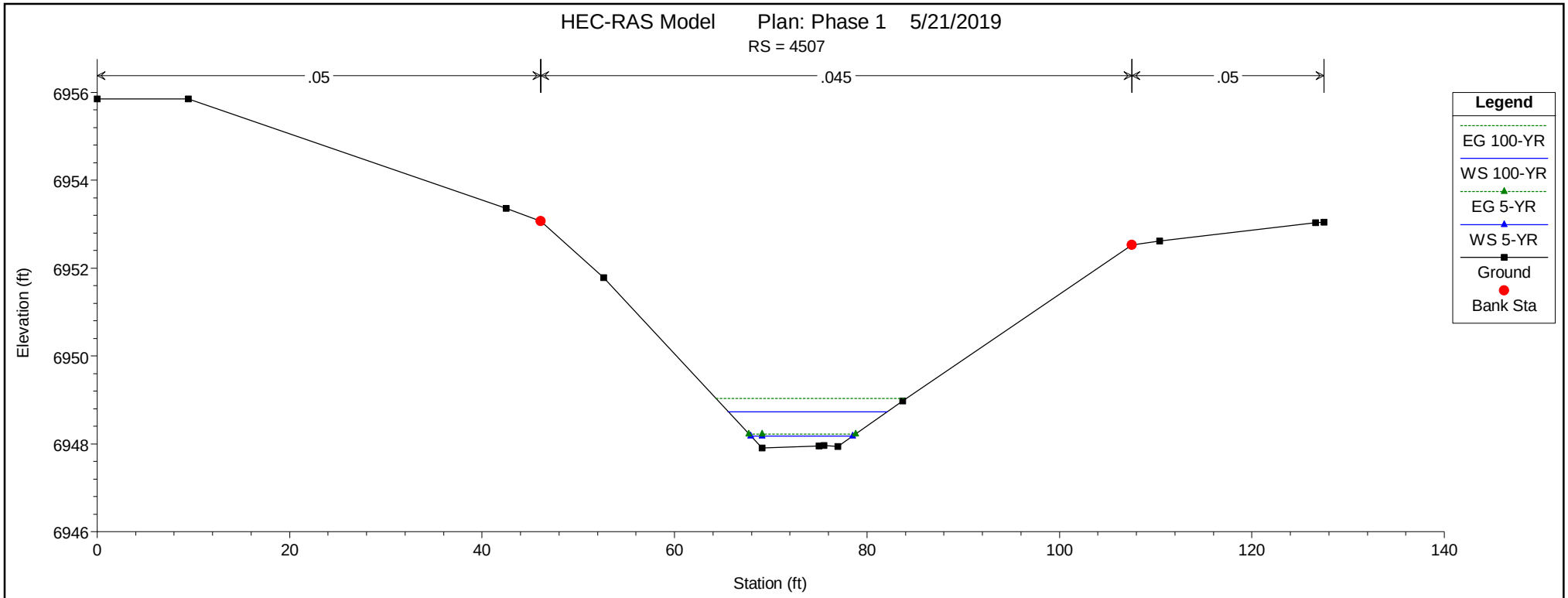

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4757
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

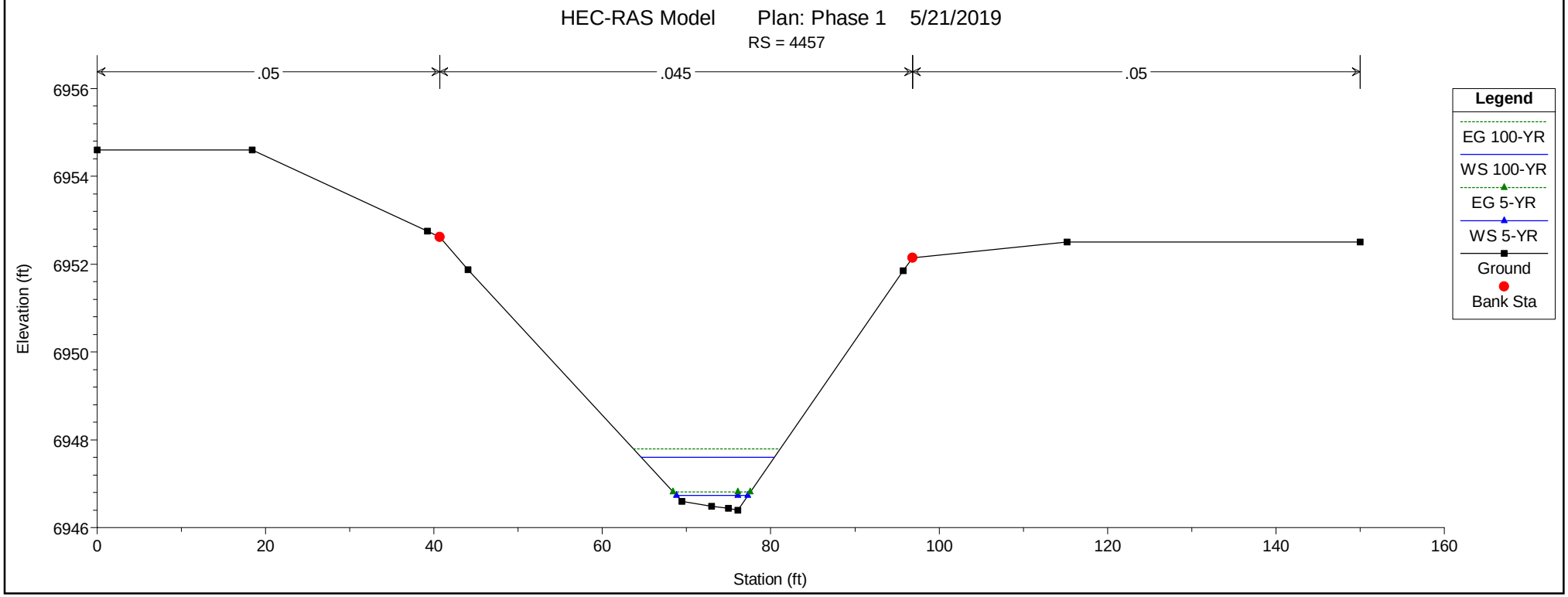

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4707
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

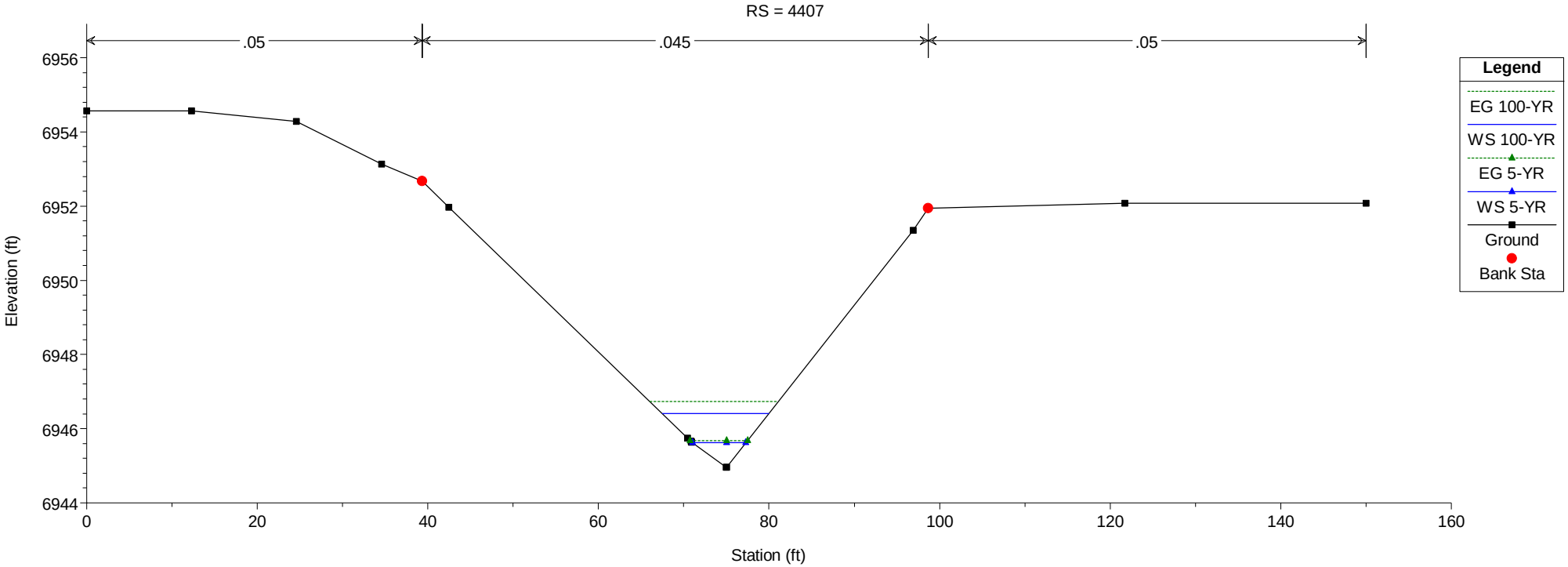

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4657
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

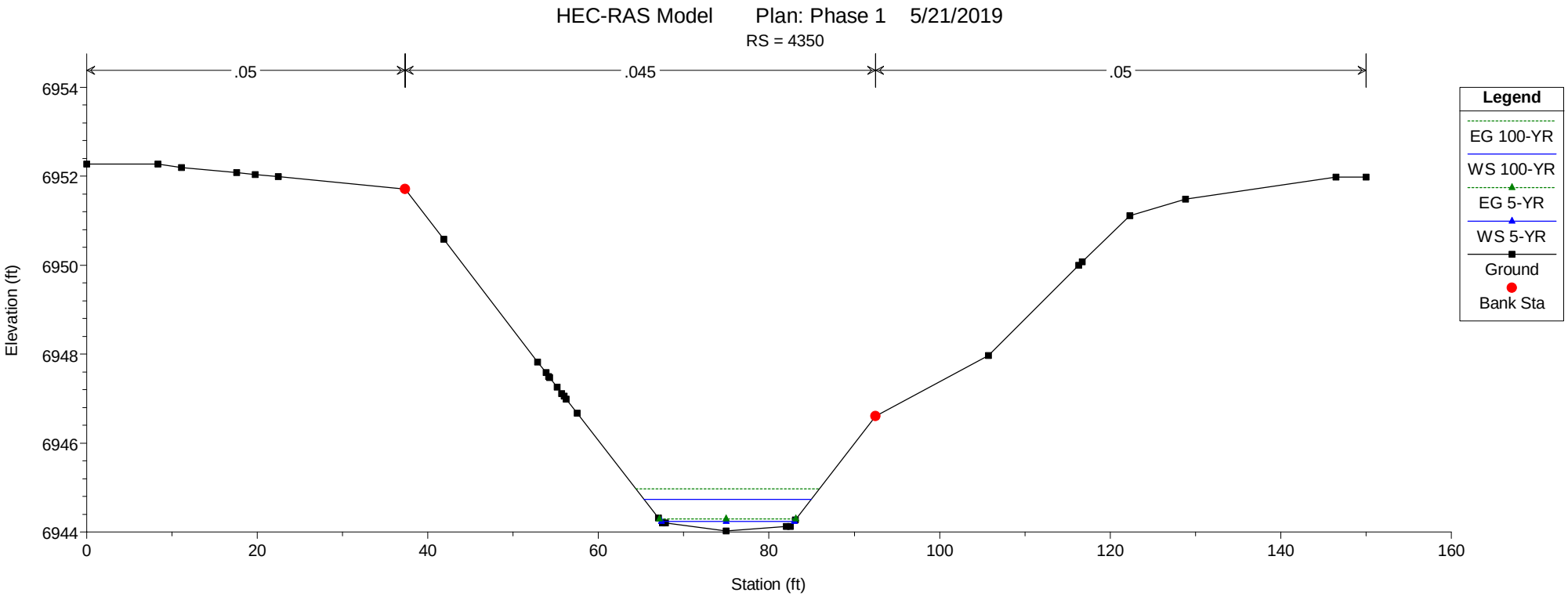

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4607
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

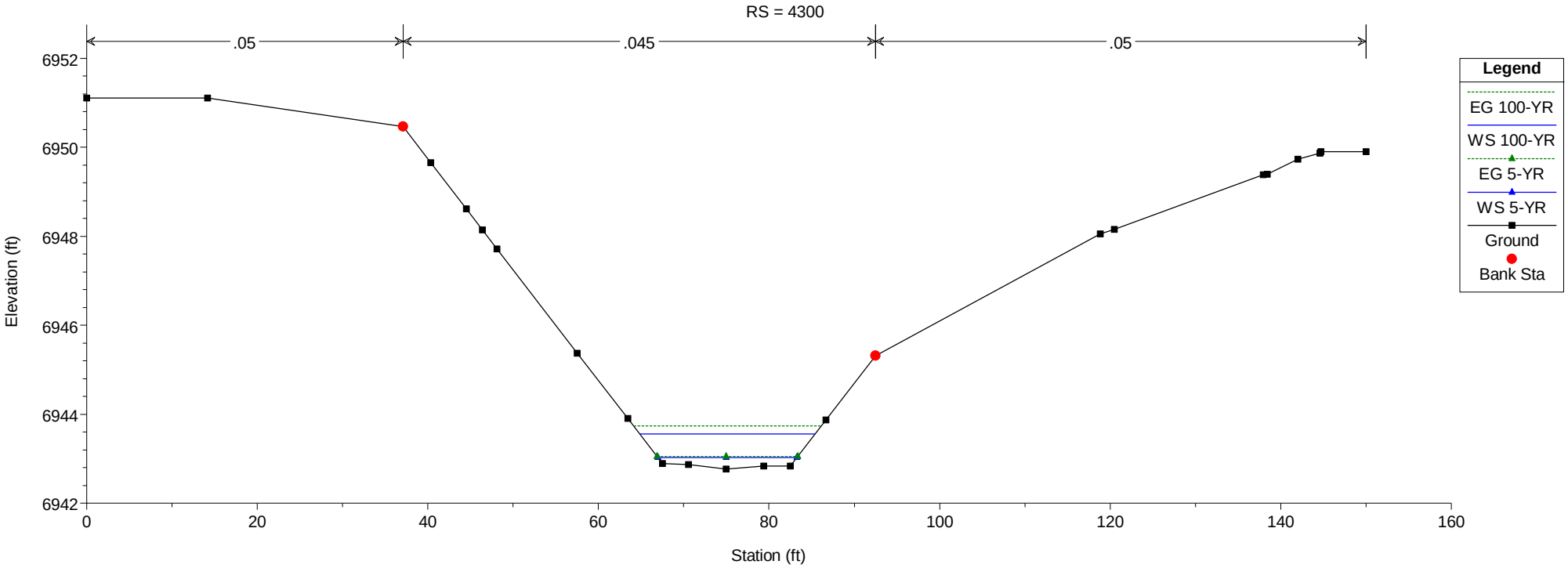

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4557
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

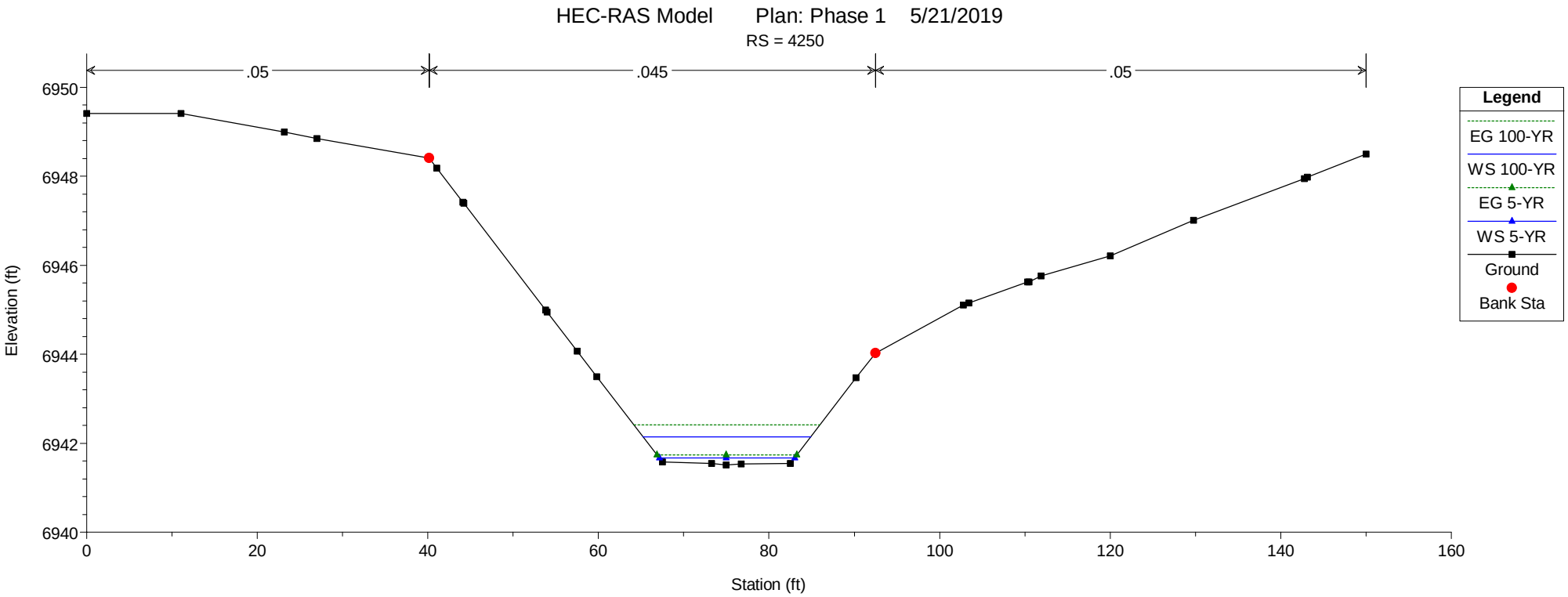

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4507
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

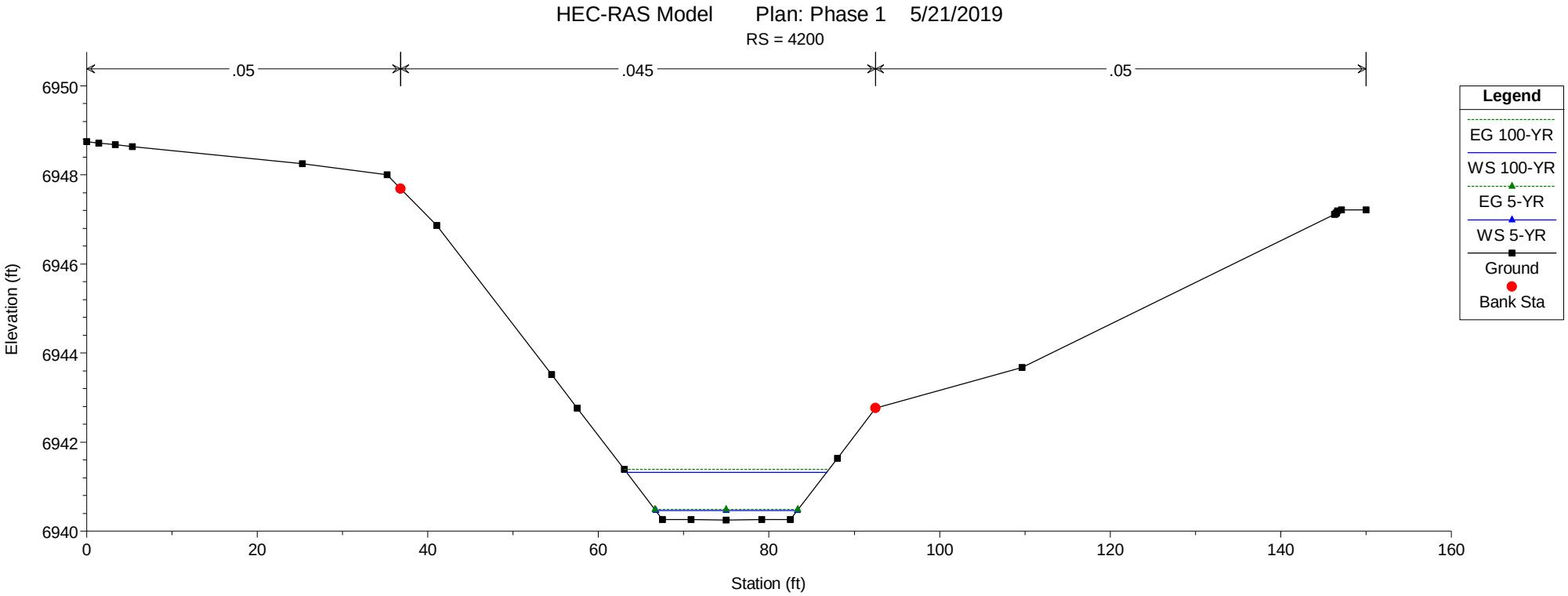

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4457
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

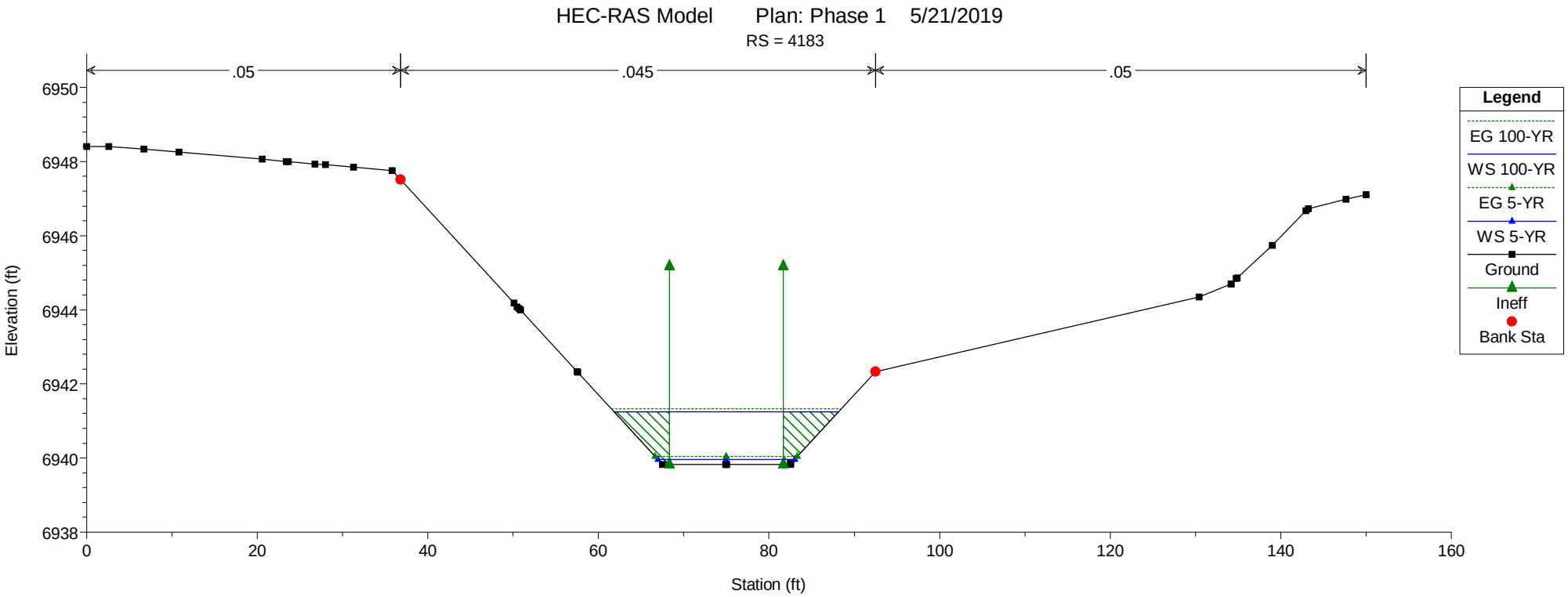

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4407
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6956
6954
6952
6950
6948
6946
6944
0
20
40
60
80
100
120
140
160
Station (ft)

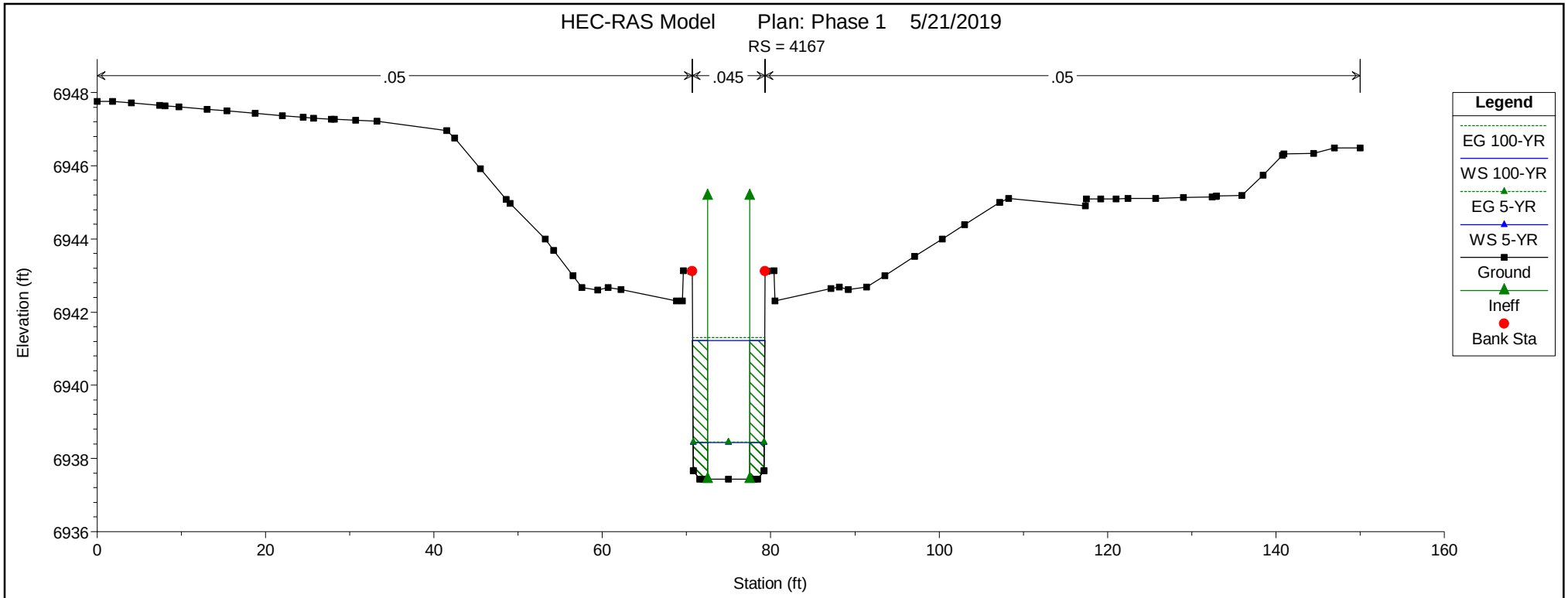

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4350
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6954
6952
6950
6948
6946
6944
0
20
40
60
80
100
120
140
160
Station (ft)

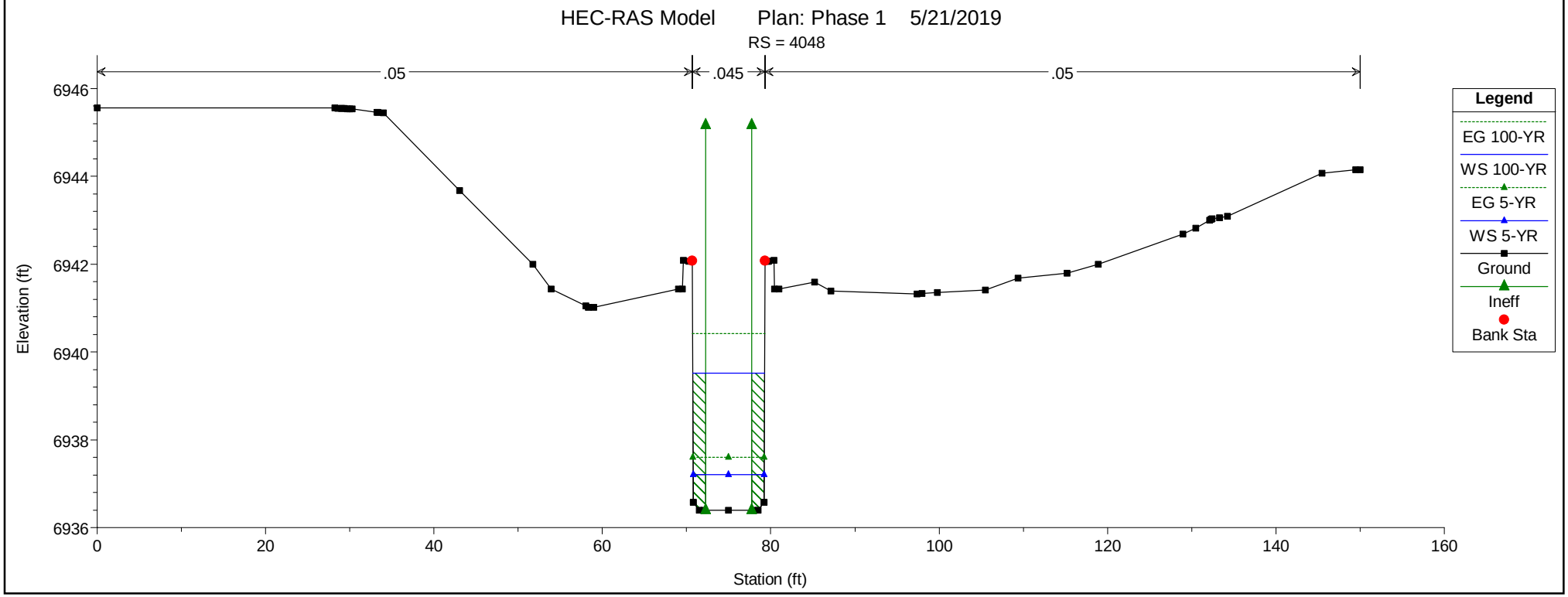

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

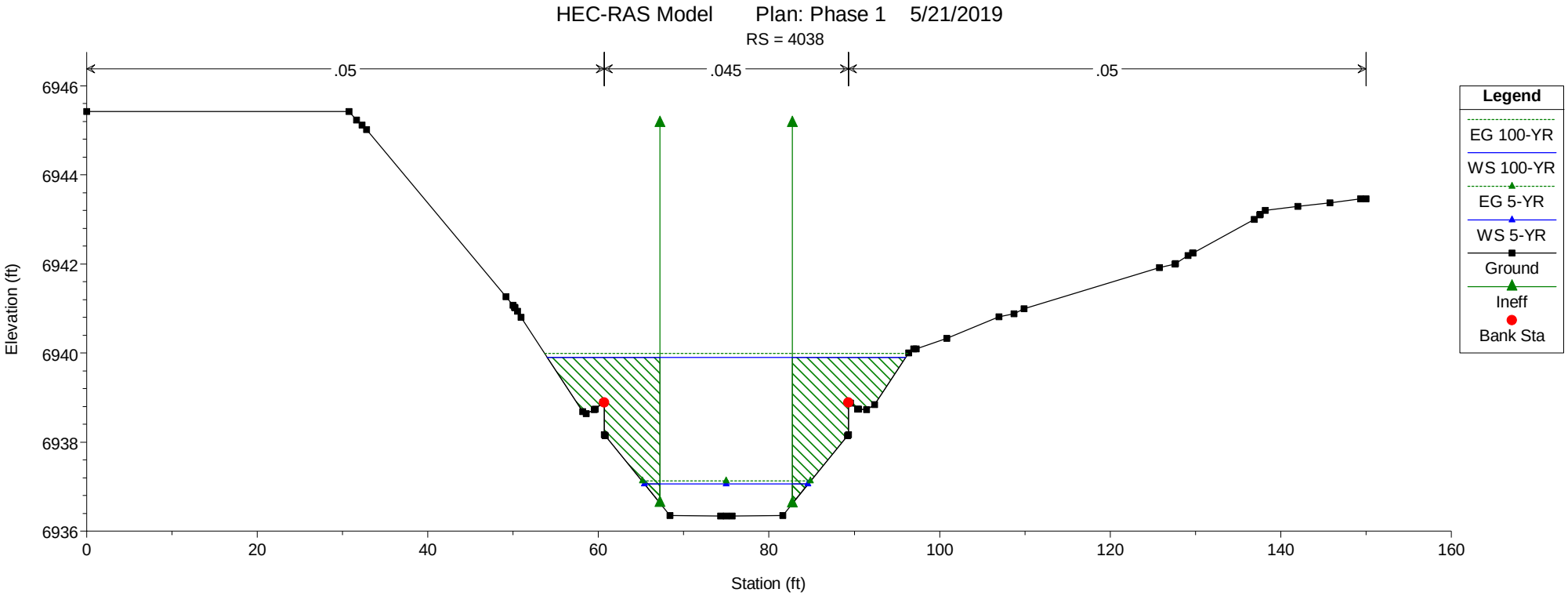

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

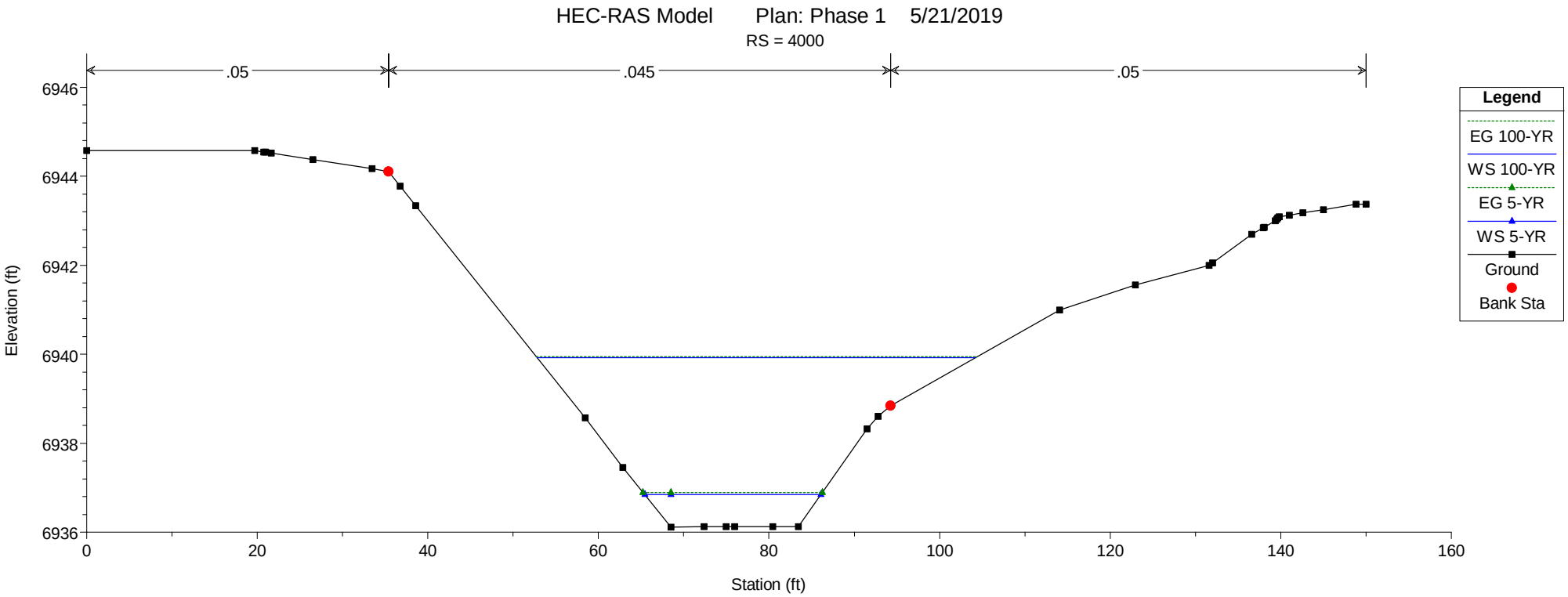

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4200
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

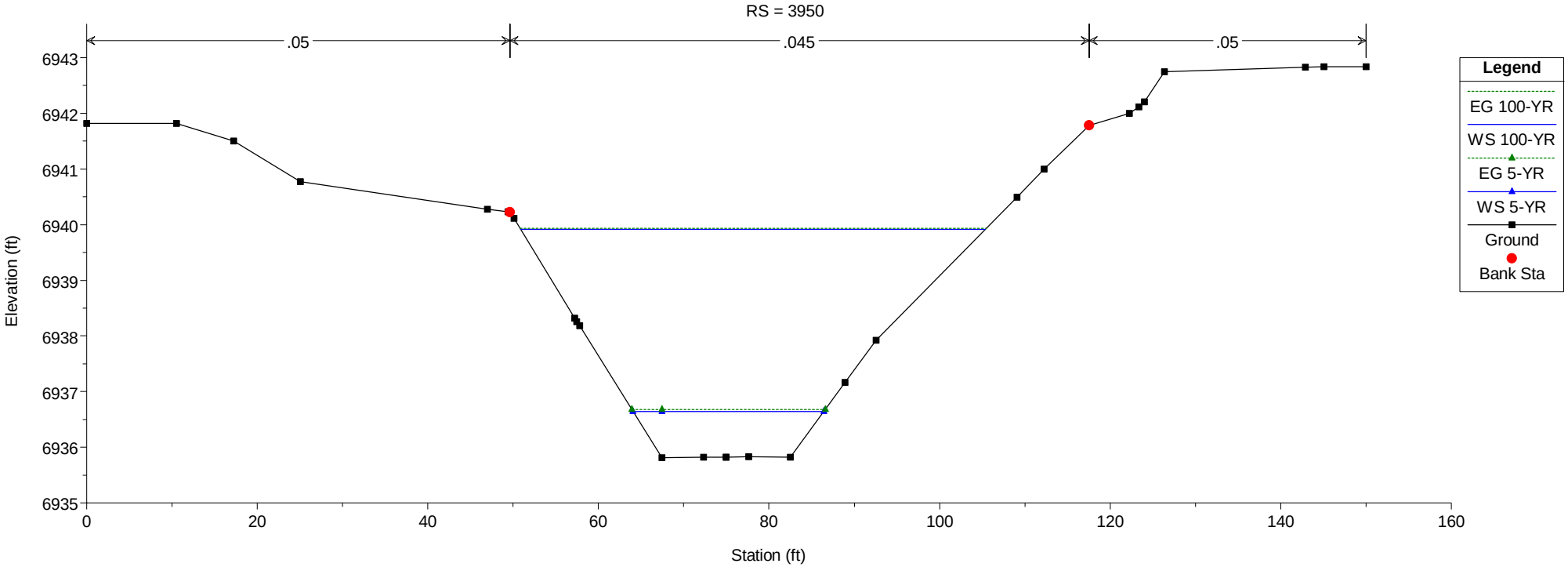

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4183
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Ineff
Bank Sta

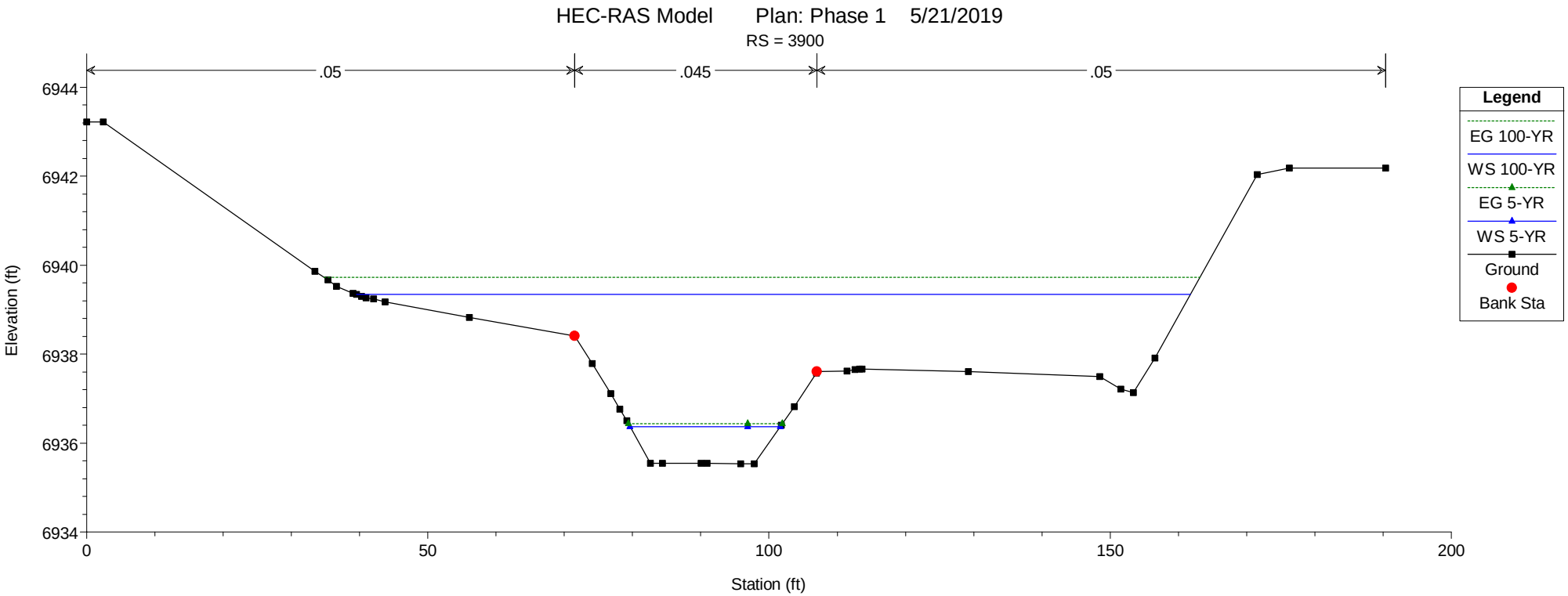

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4167
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Ineff
Bank Sta

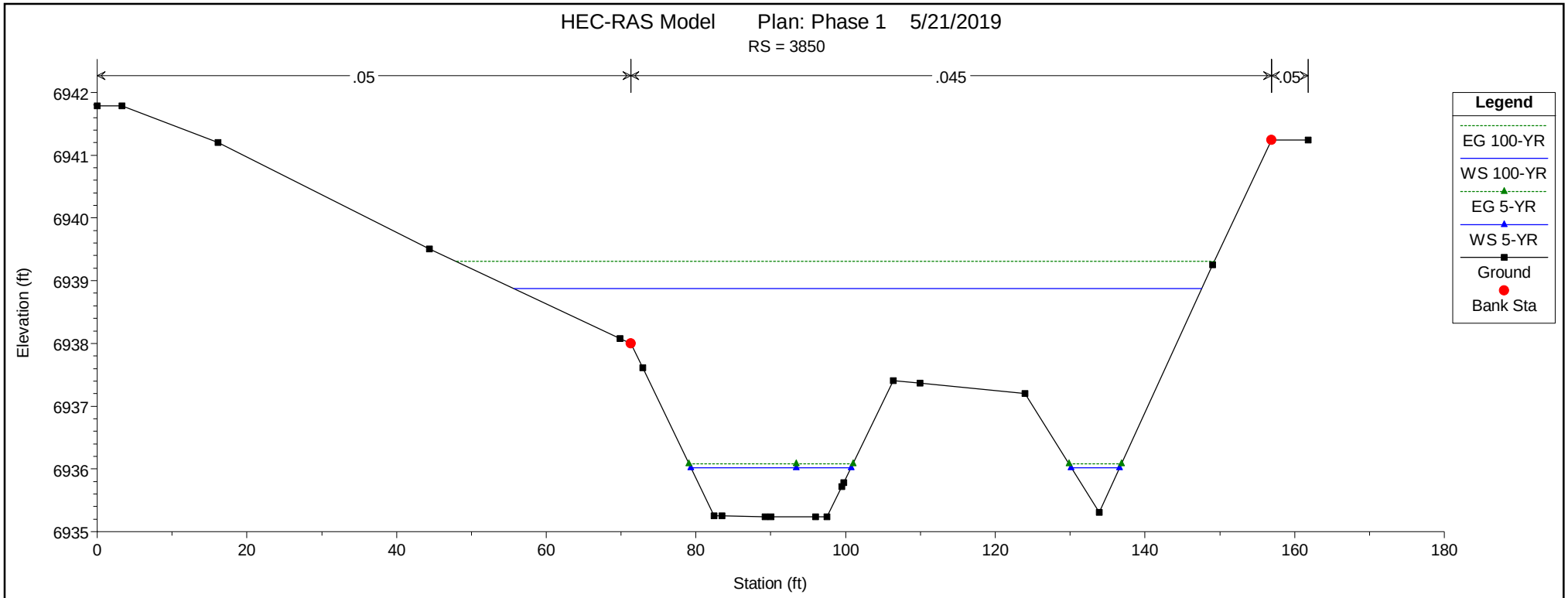

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4048
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Ineff
Bank Sta

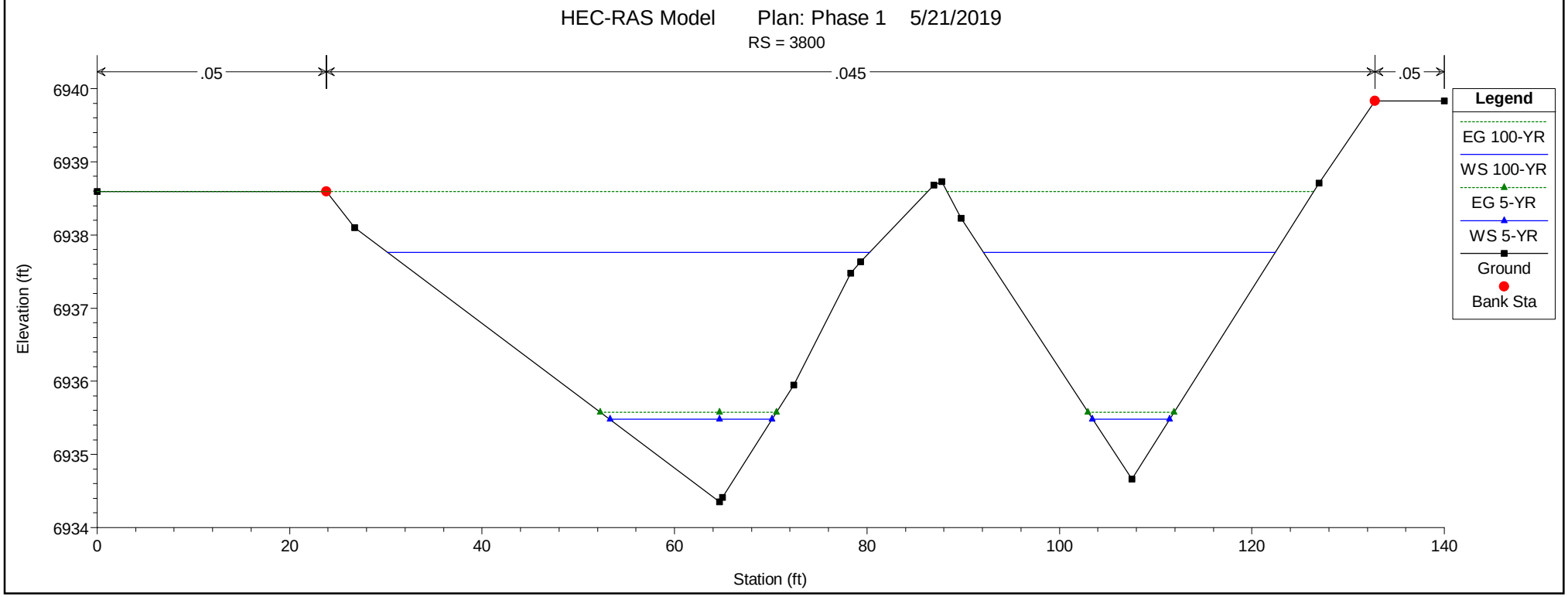

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4038
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Ineff
Bank Sta

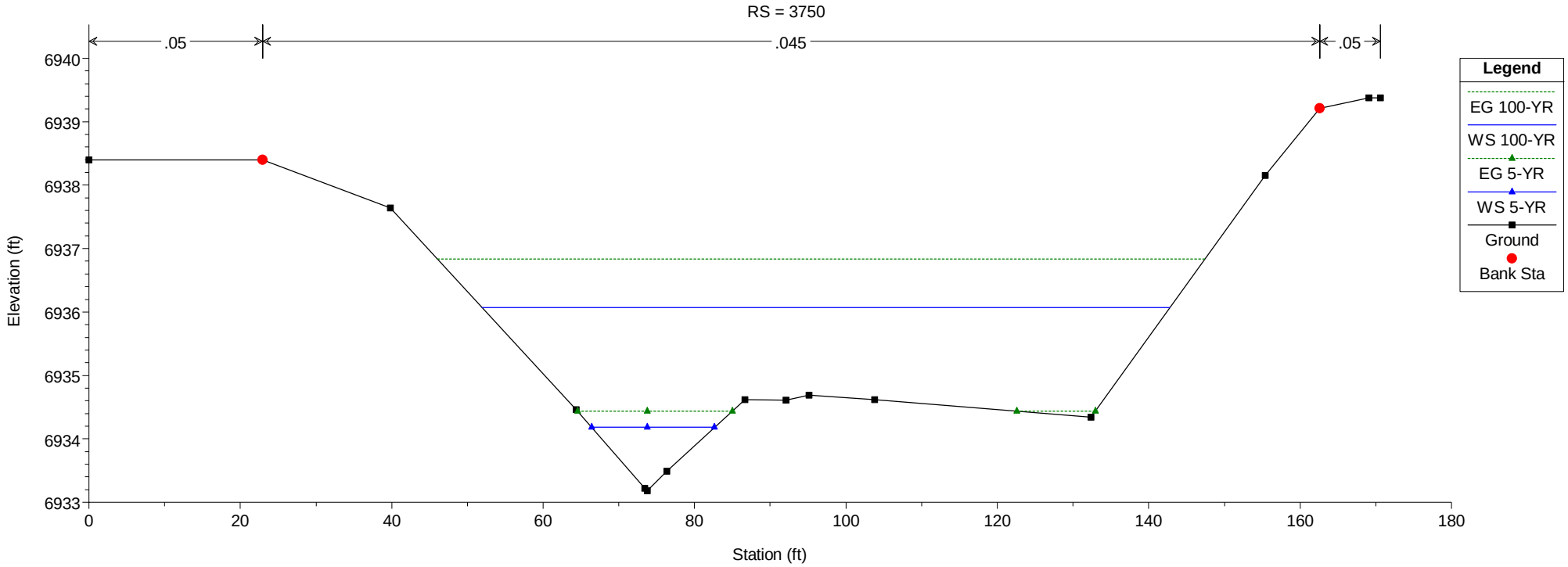

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 4000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

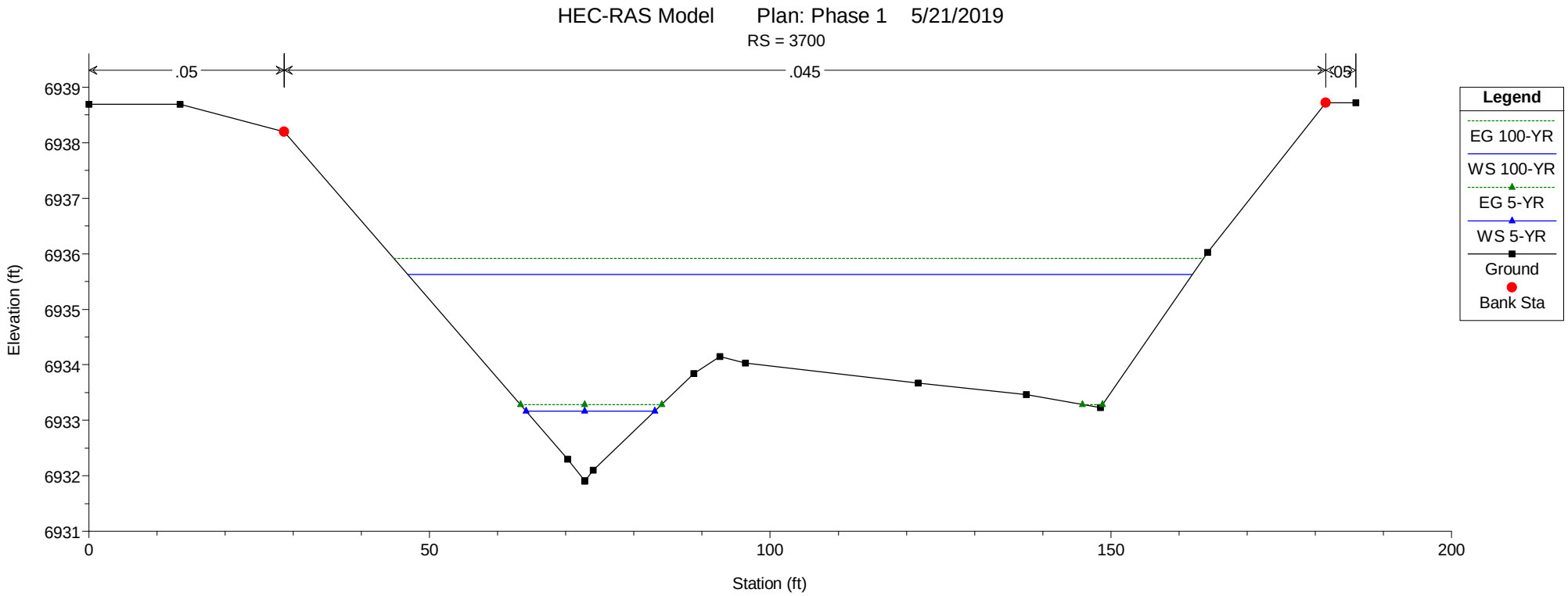

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3950
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

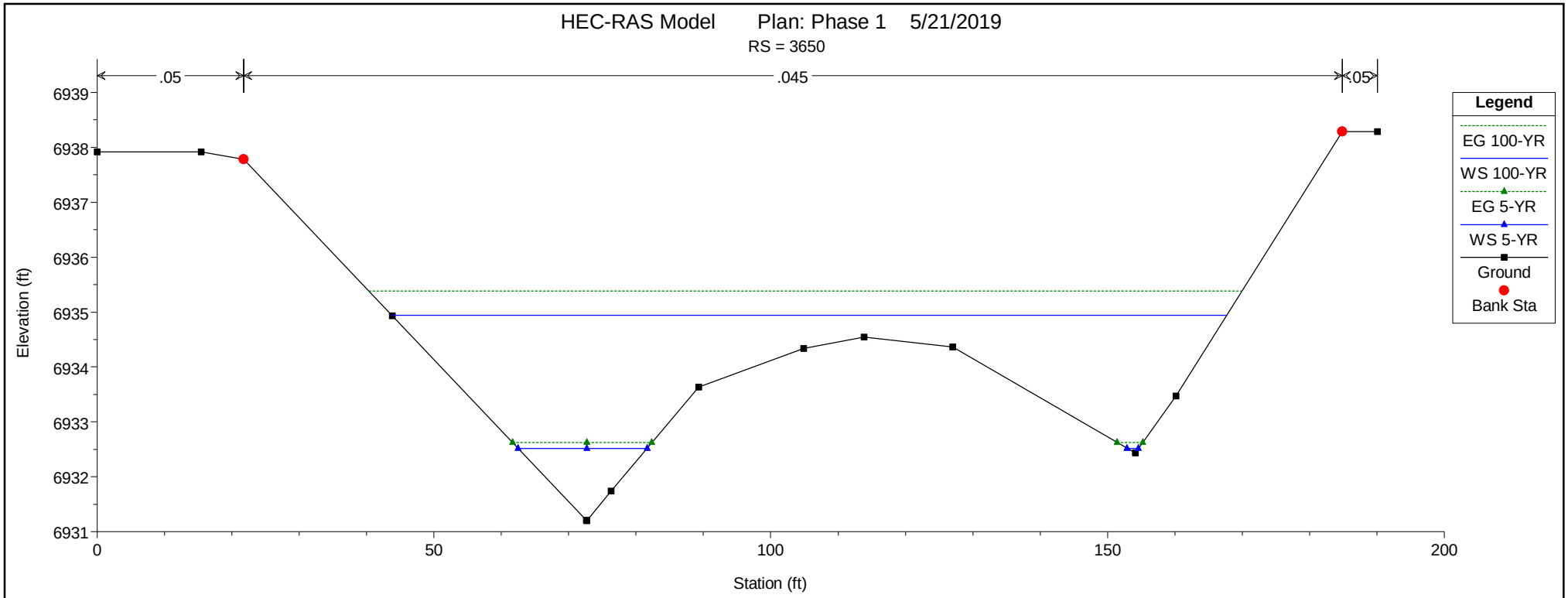

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3900
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

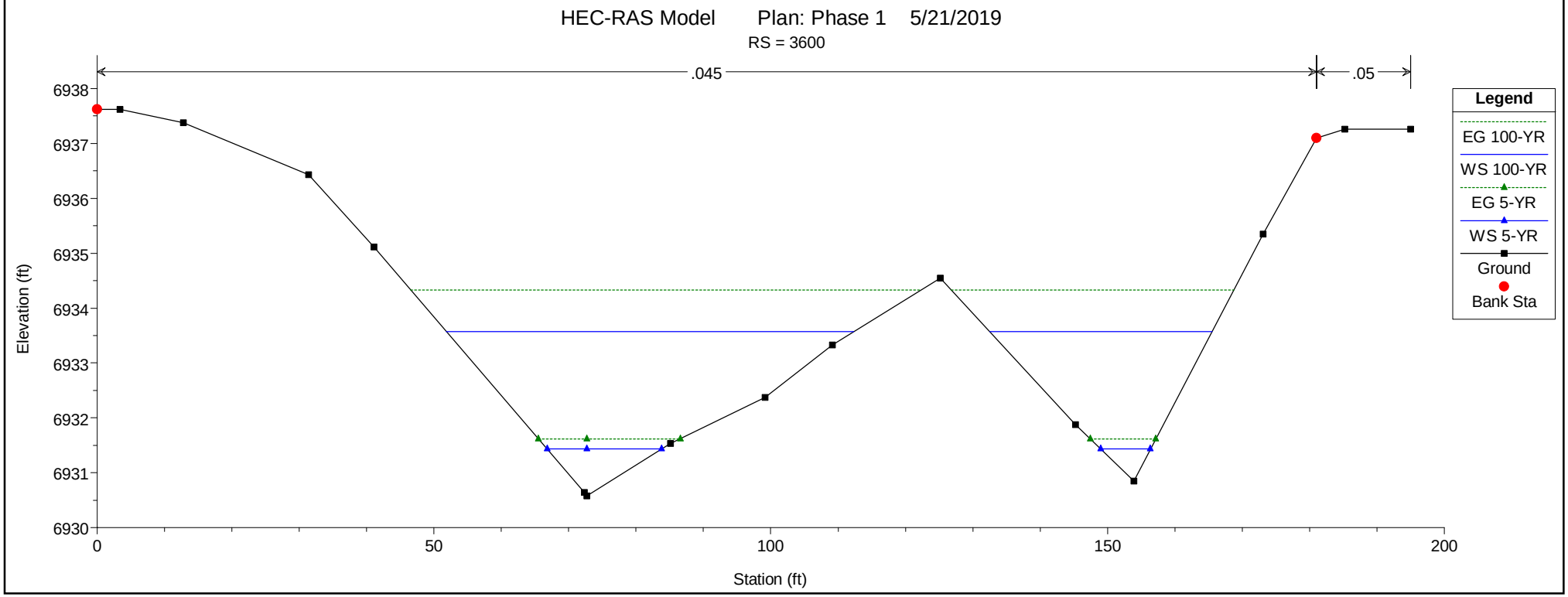

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3850
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

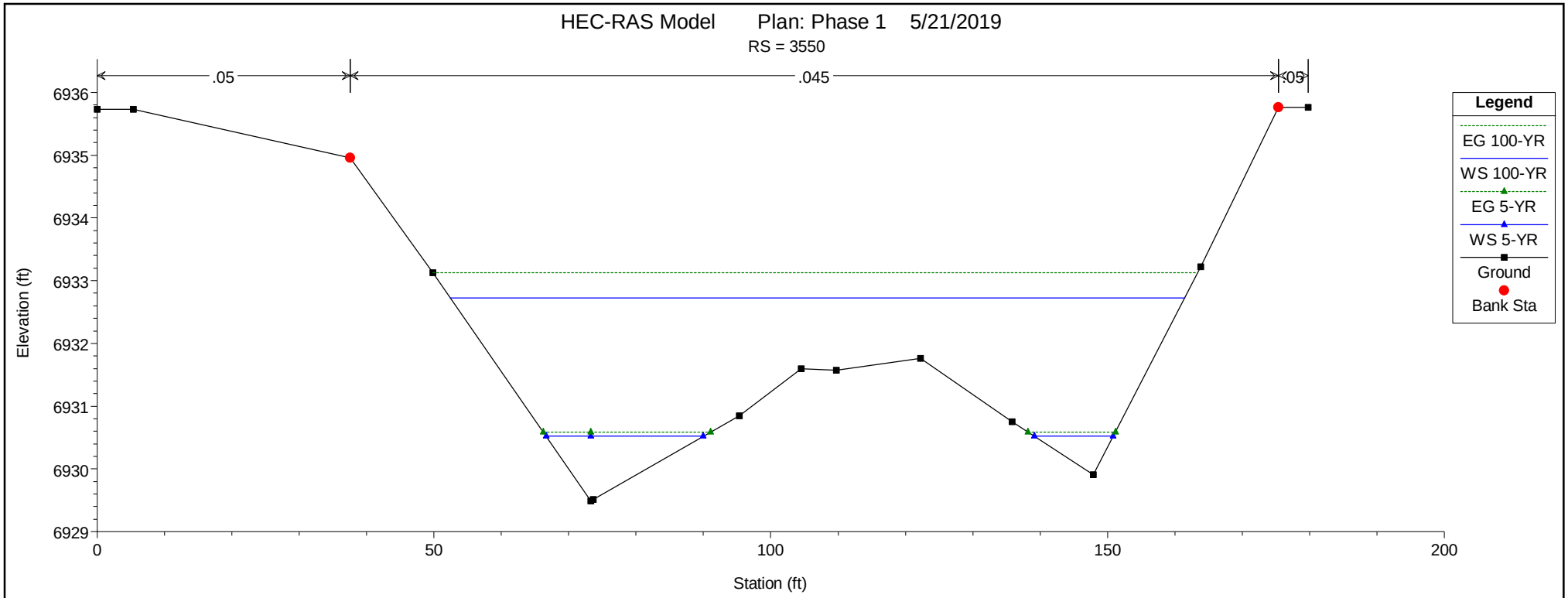

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3800
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

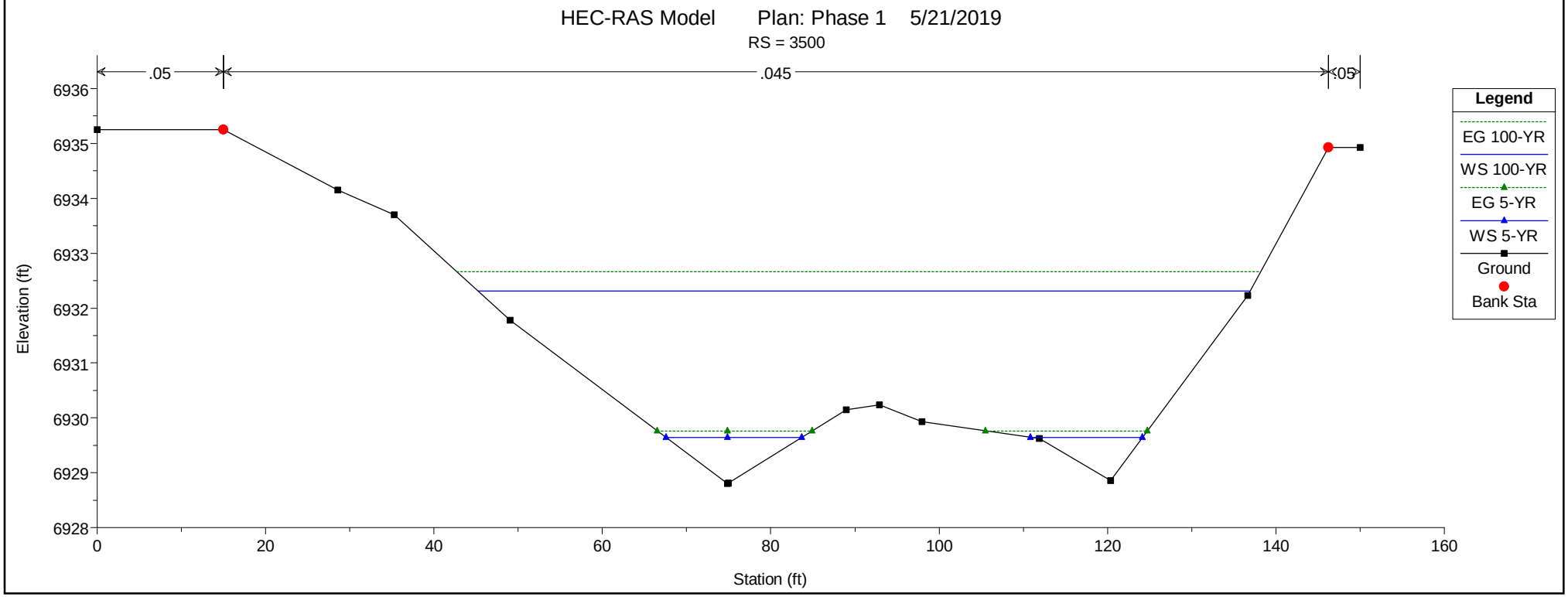

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3750
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3700
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3650
.05
.045
.05
Elevation (ft)
6939
6938
6937
6936
6935
6934
6933
6932
6931
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

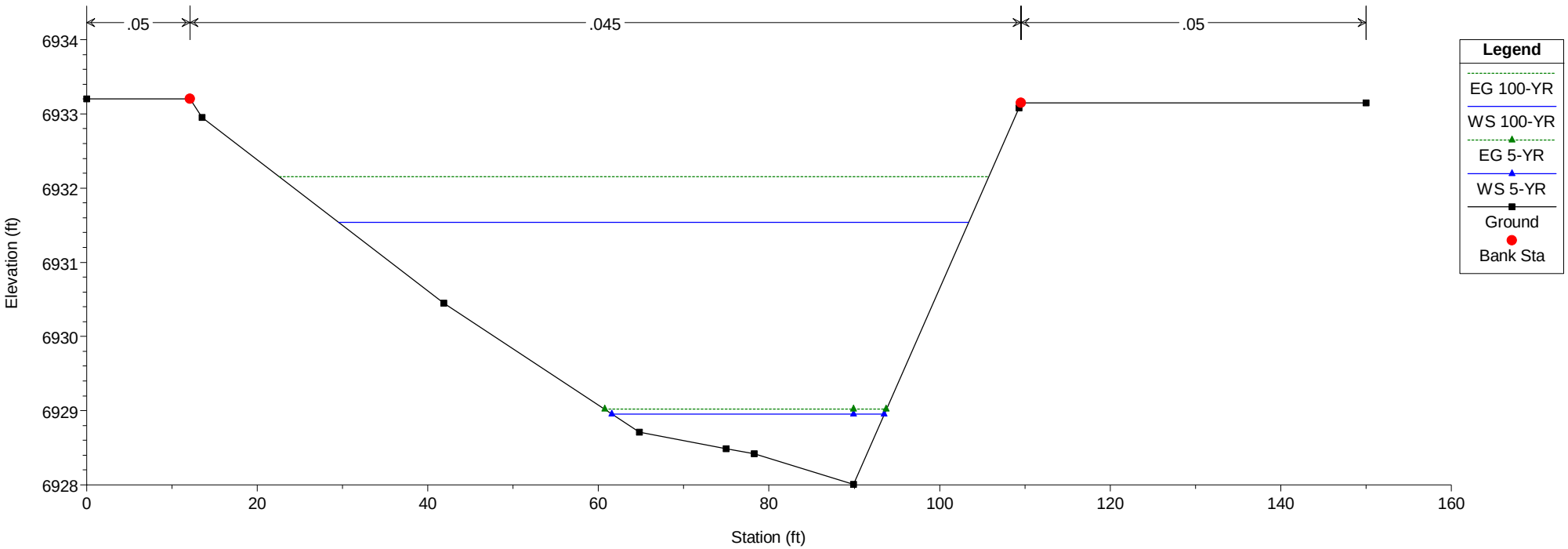

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3600
.045
.05
Elevation (ft)
6938
6937
6936
6935
6934
6933
6932
6931
6930
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3550
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3500
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

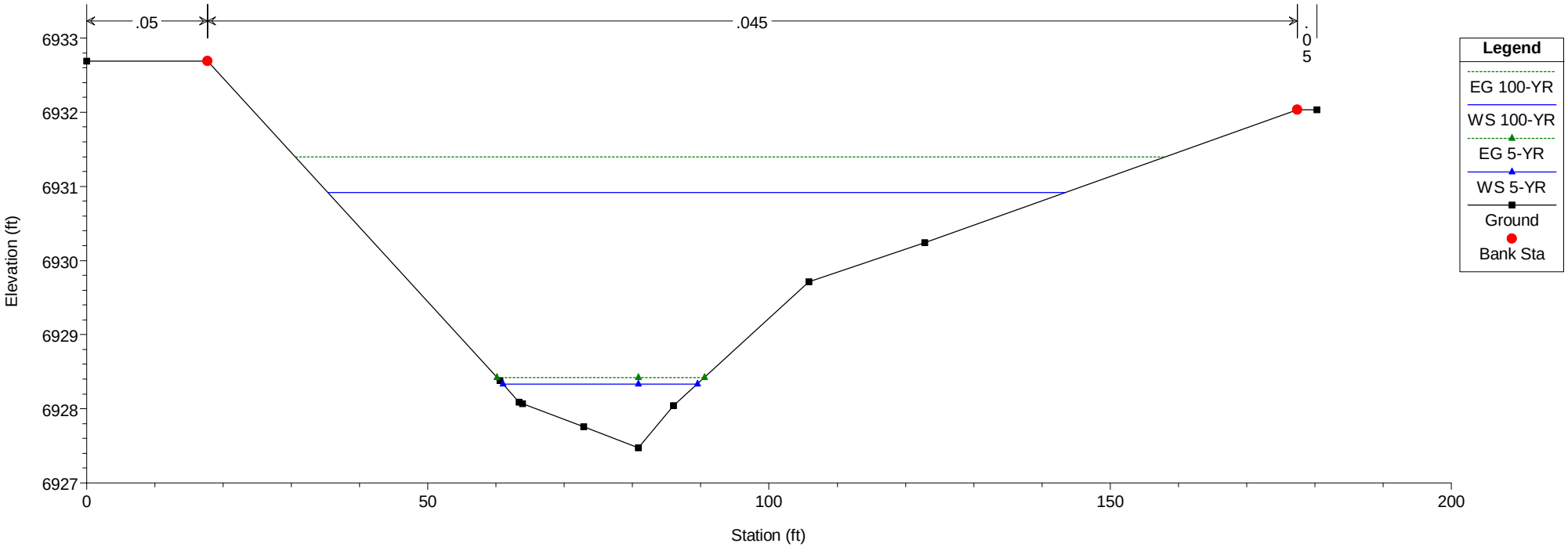
HEC-RAS Model Plan: Phase 1 5/21/2019

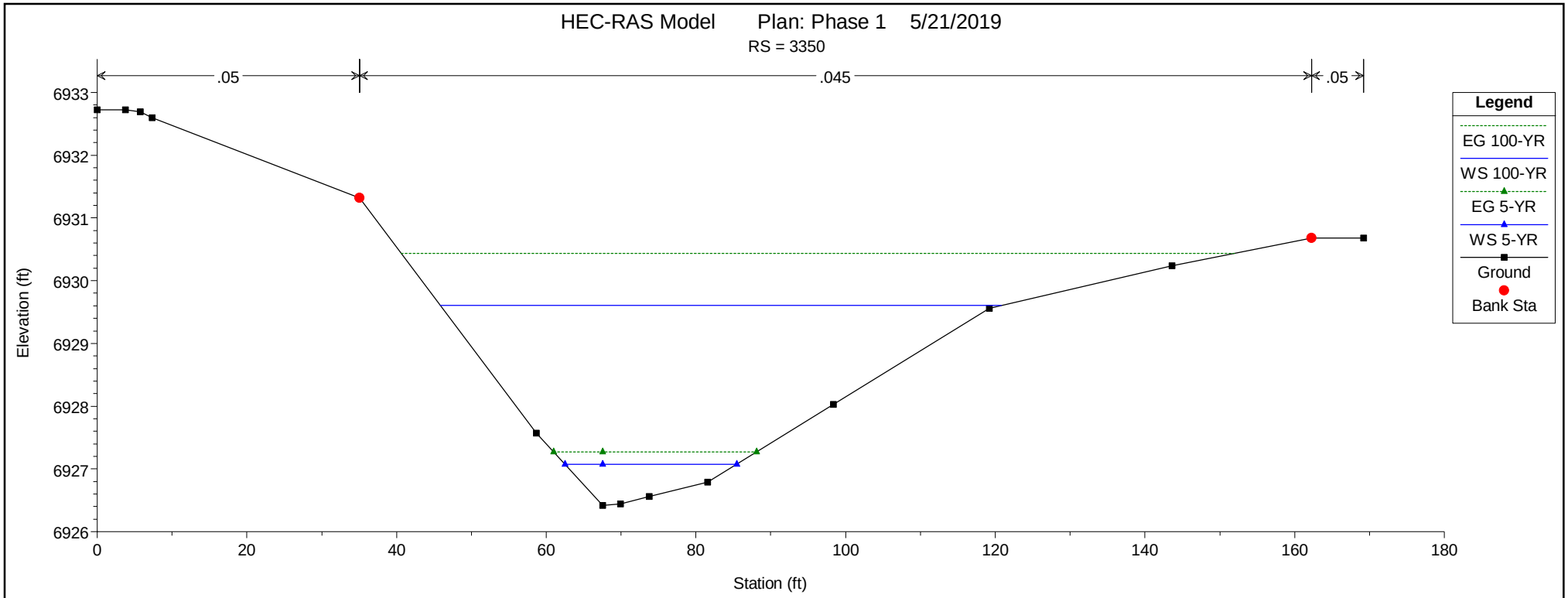
RS = 3450

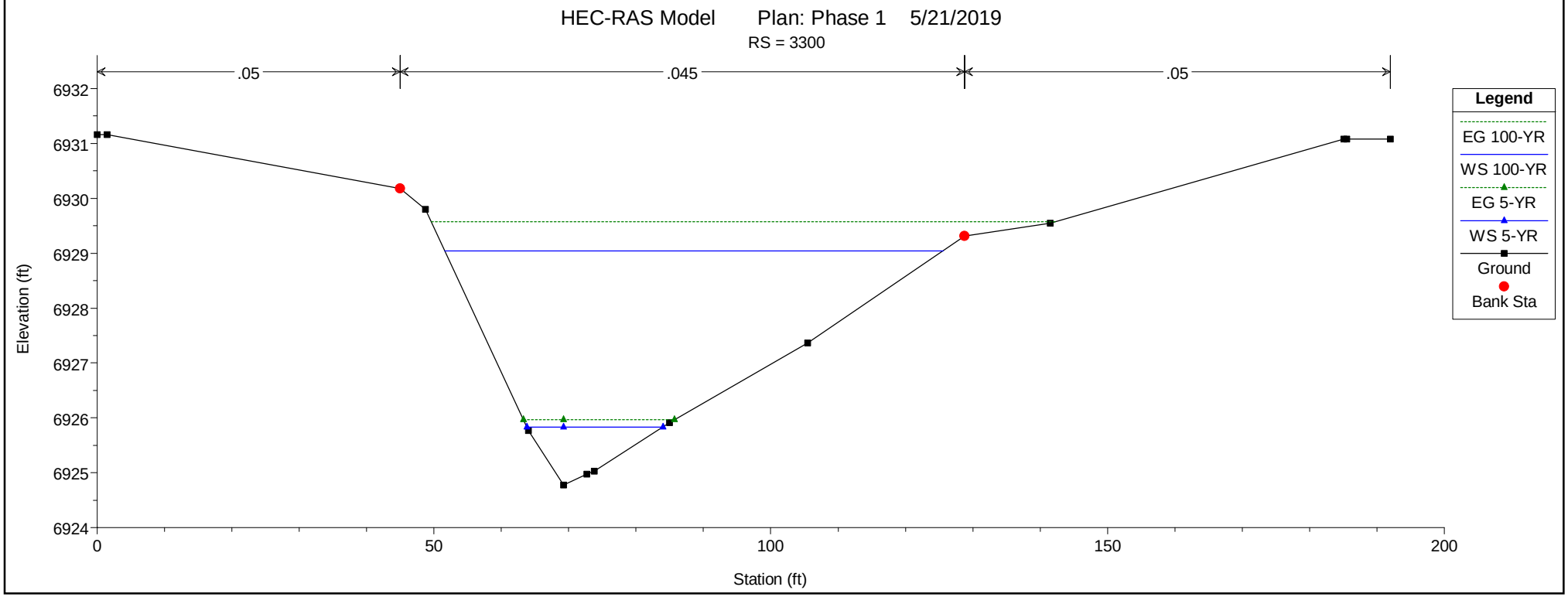


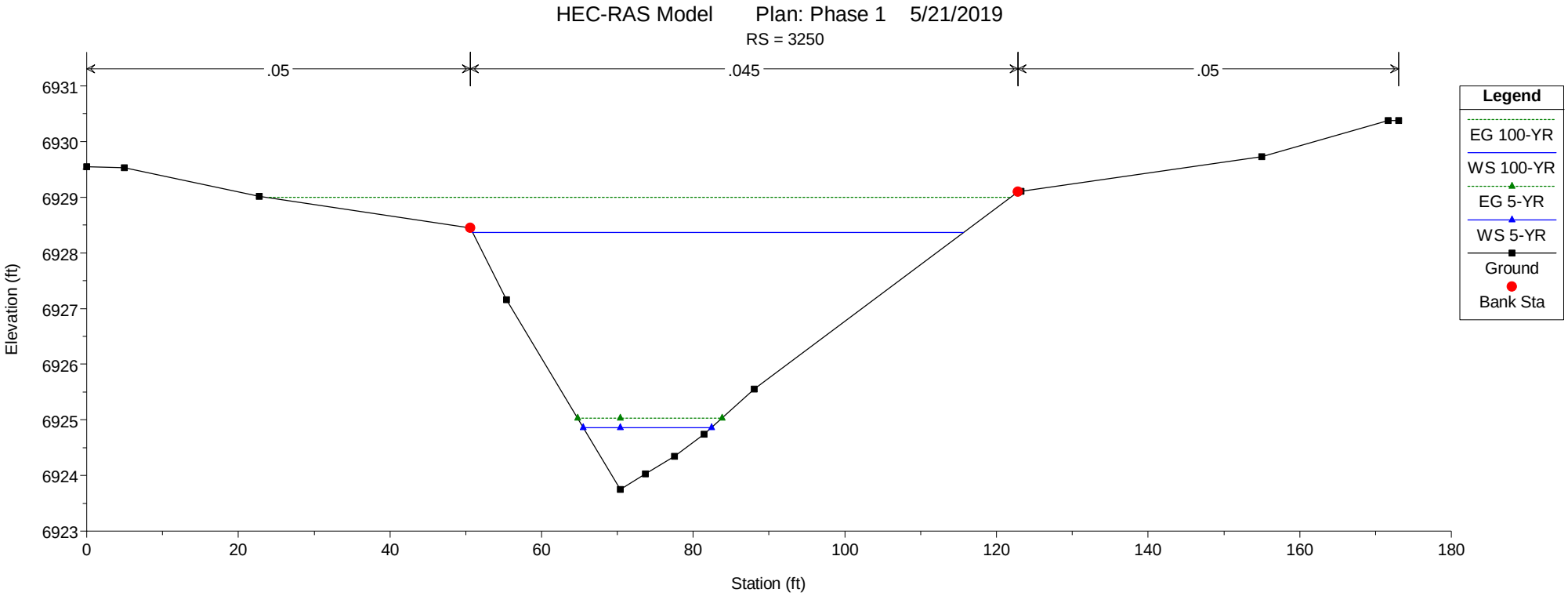
HEC-RAS Model Plan: Phase 1 5/21/2019

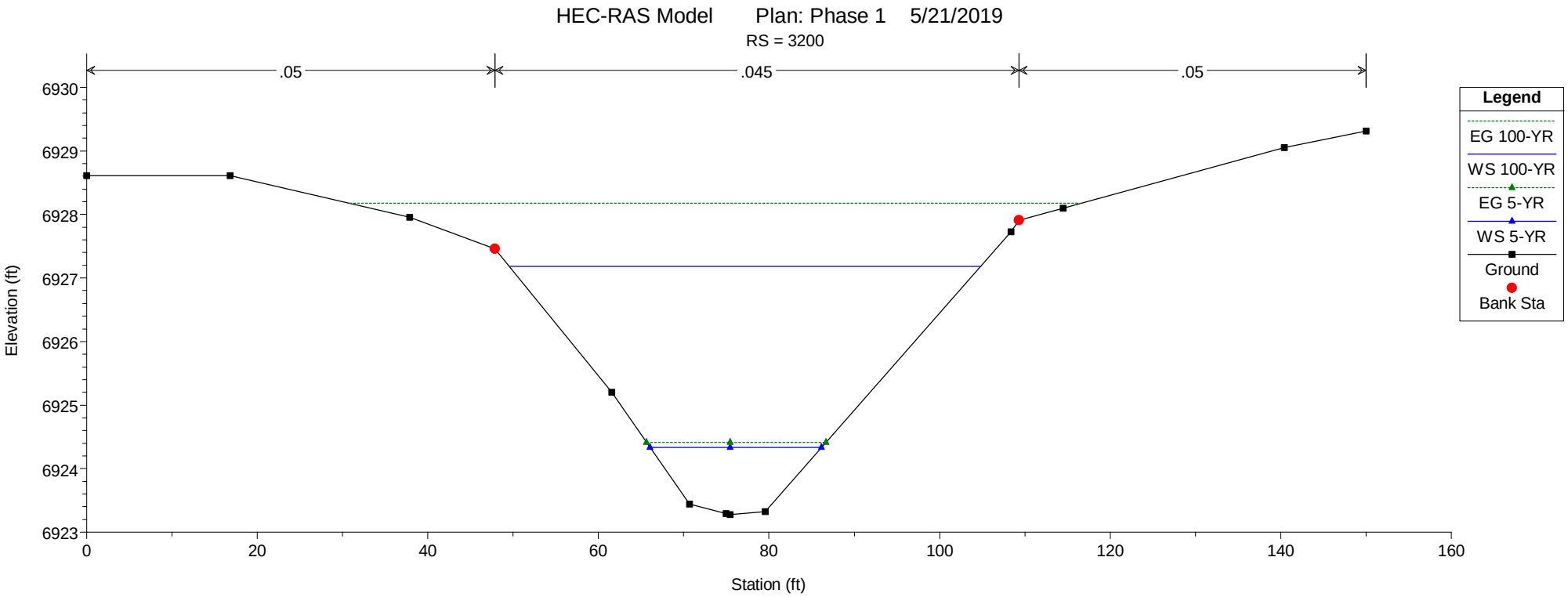
RS = 3400

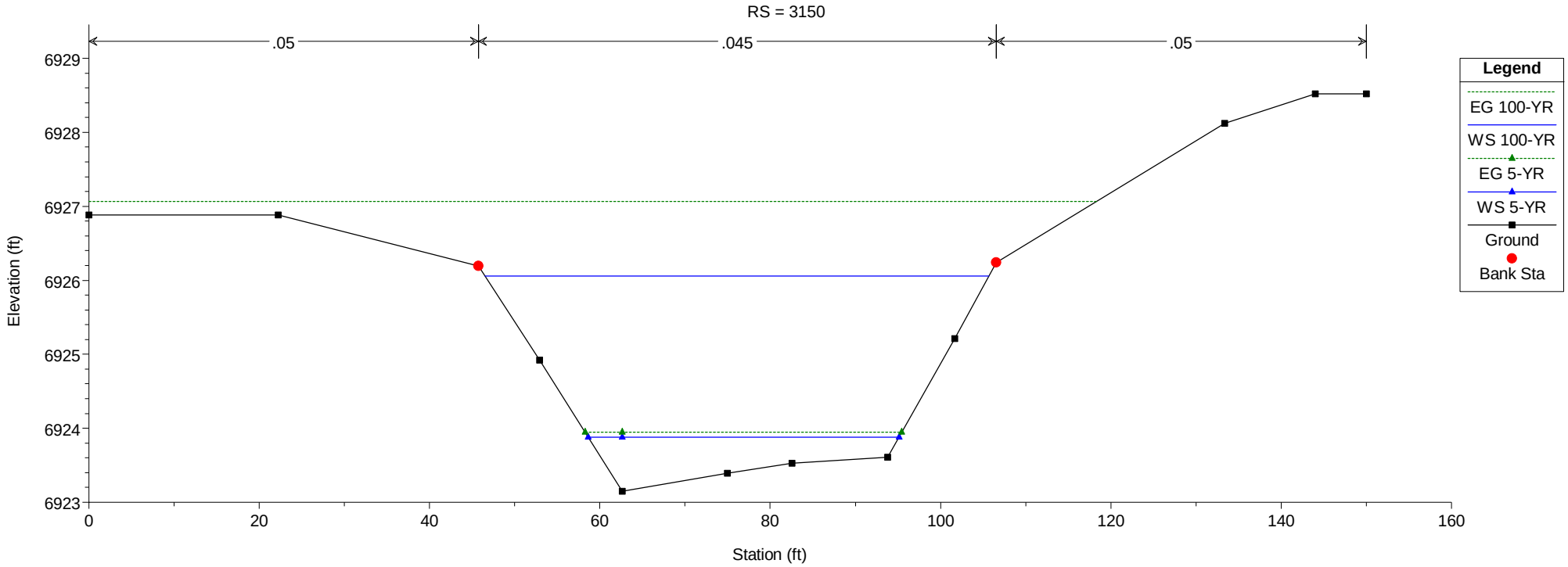


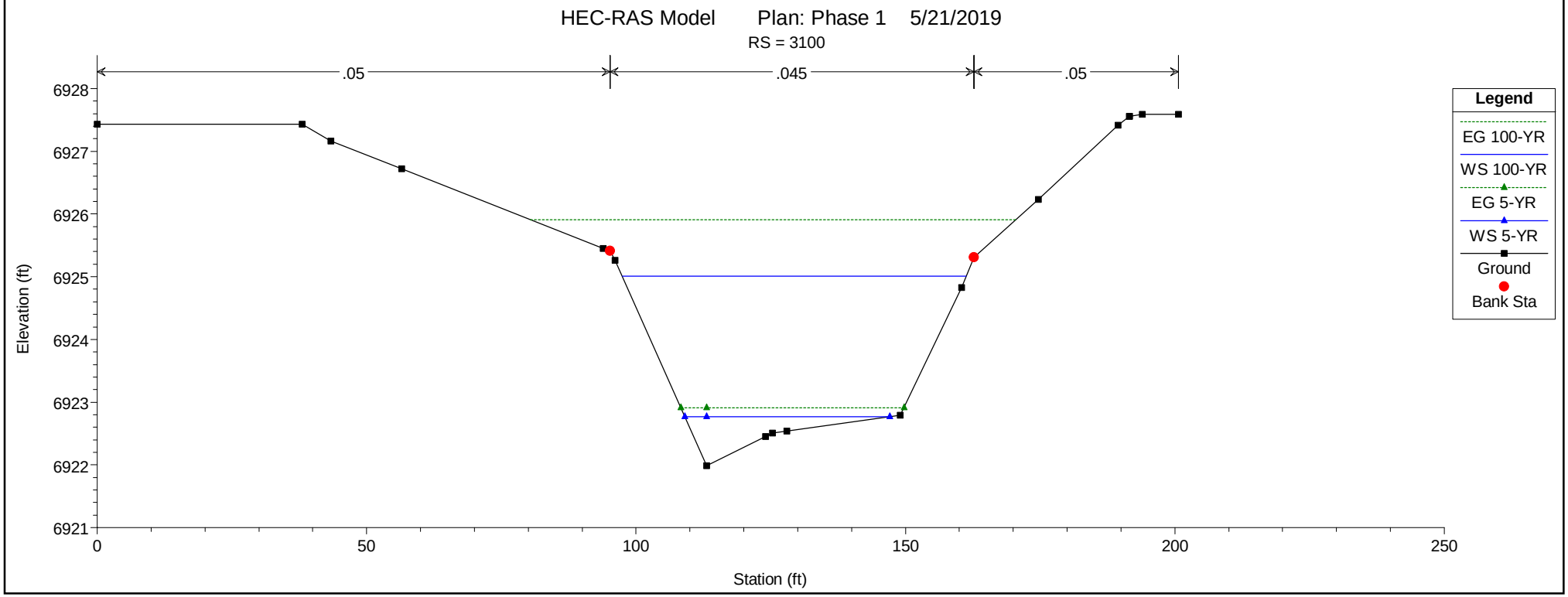

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3350
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

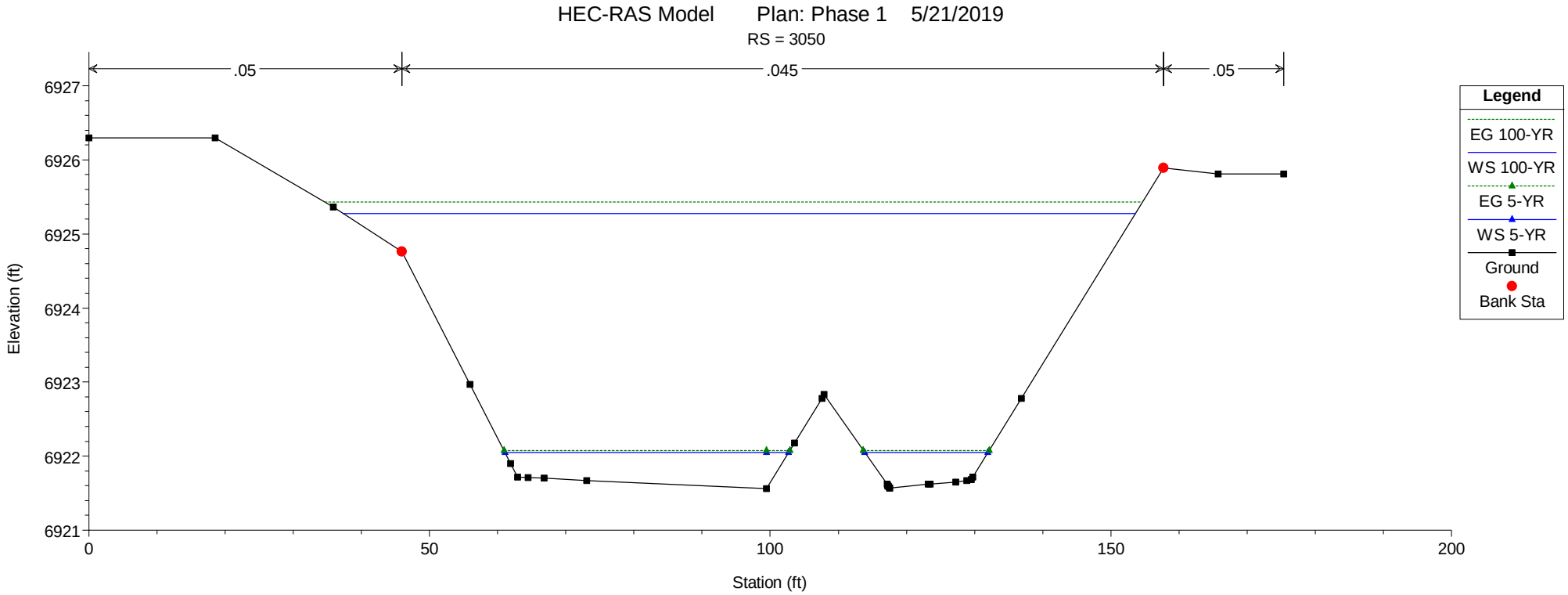

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

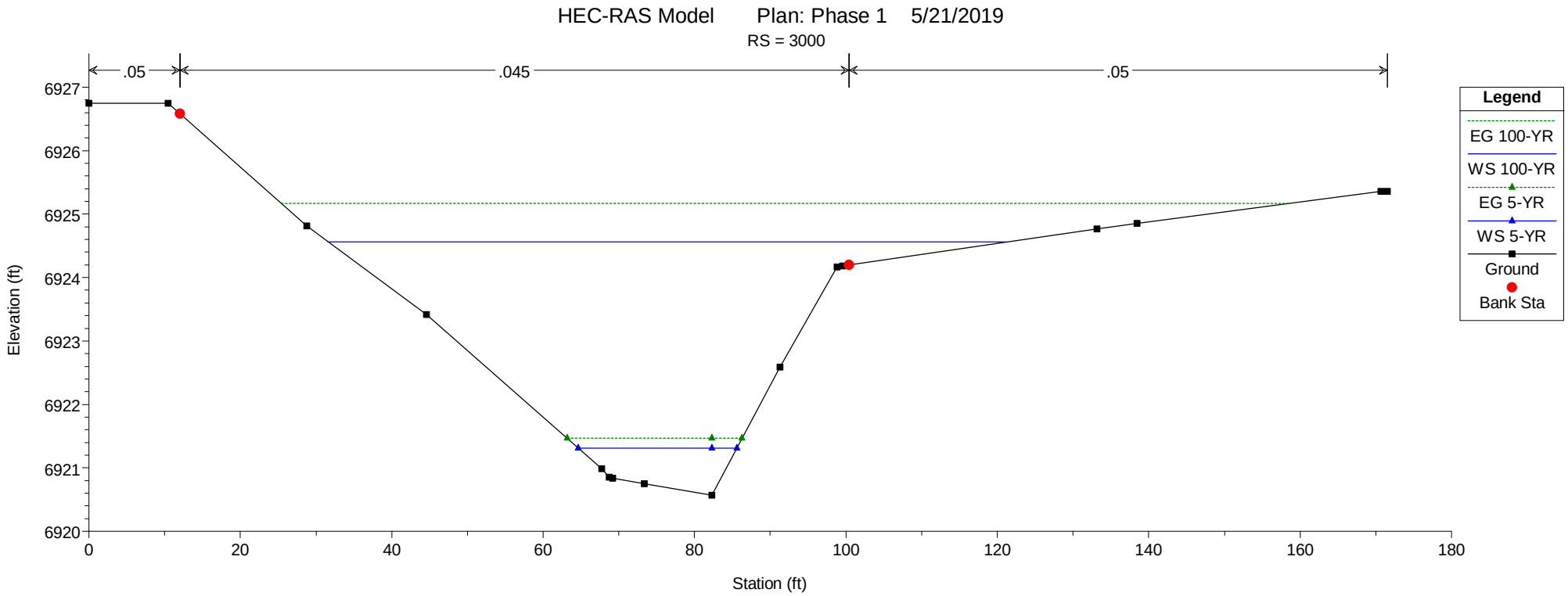

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

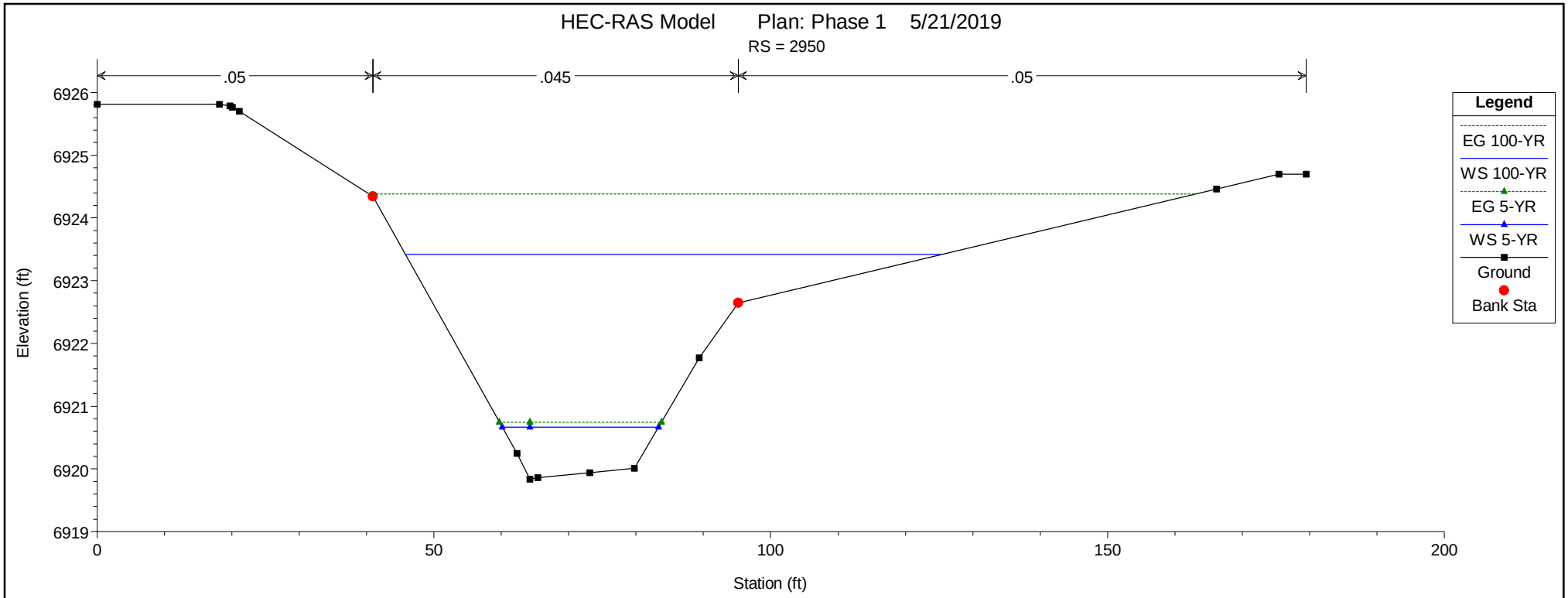

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3200
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

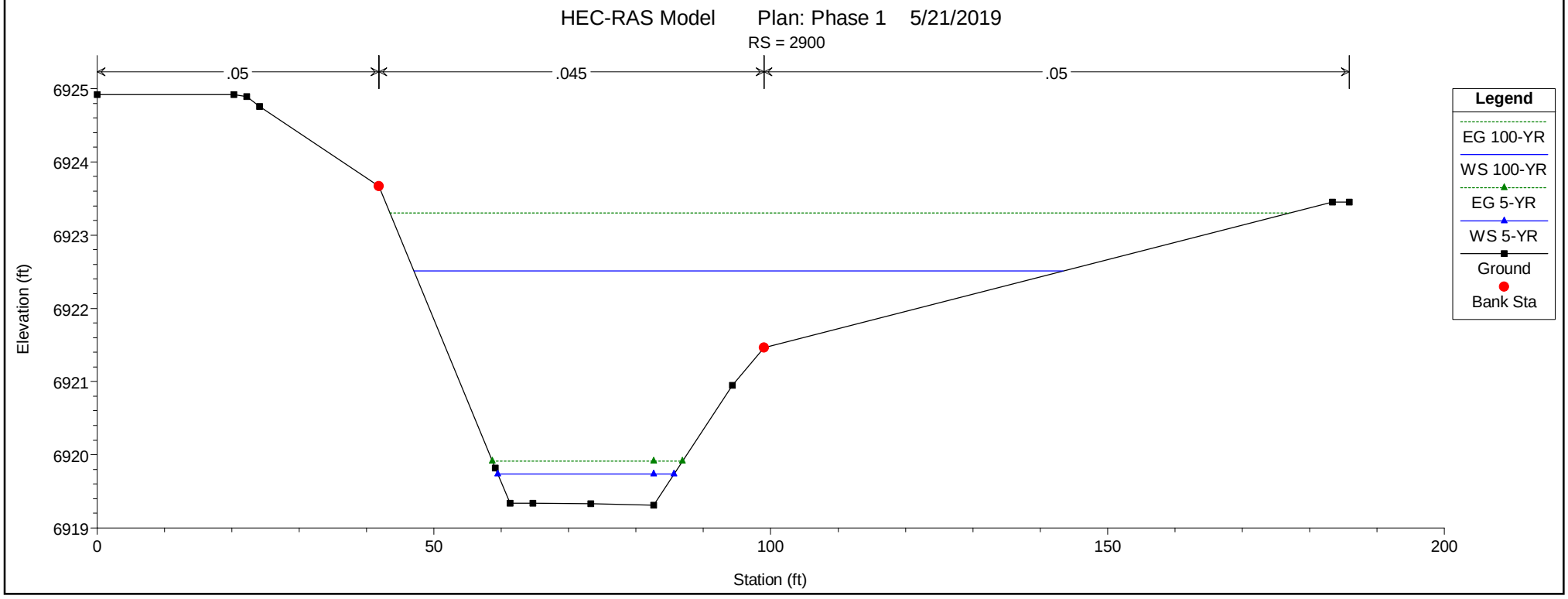

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3150
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

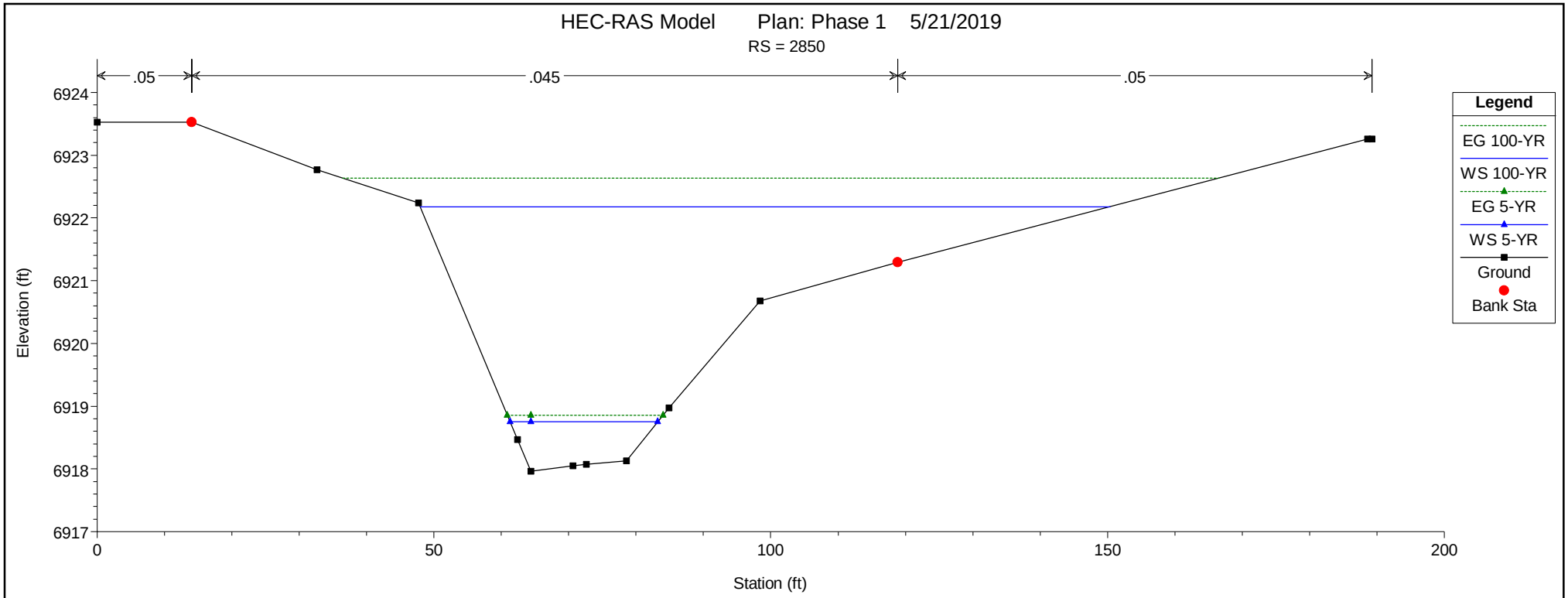

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3100
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

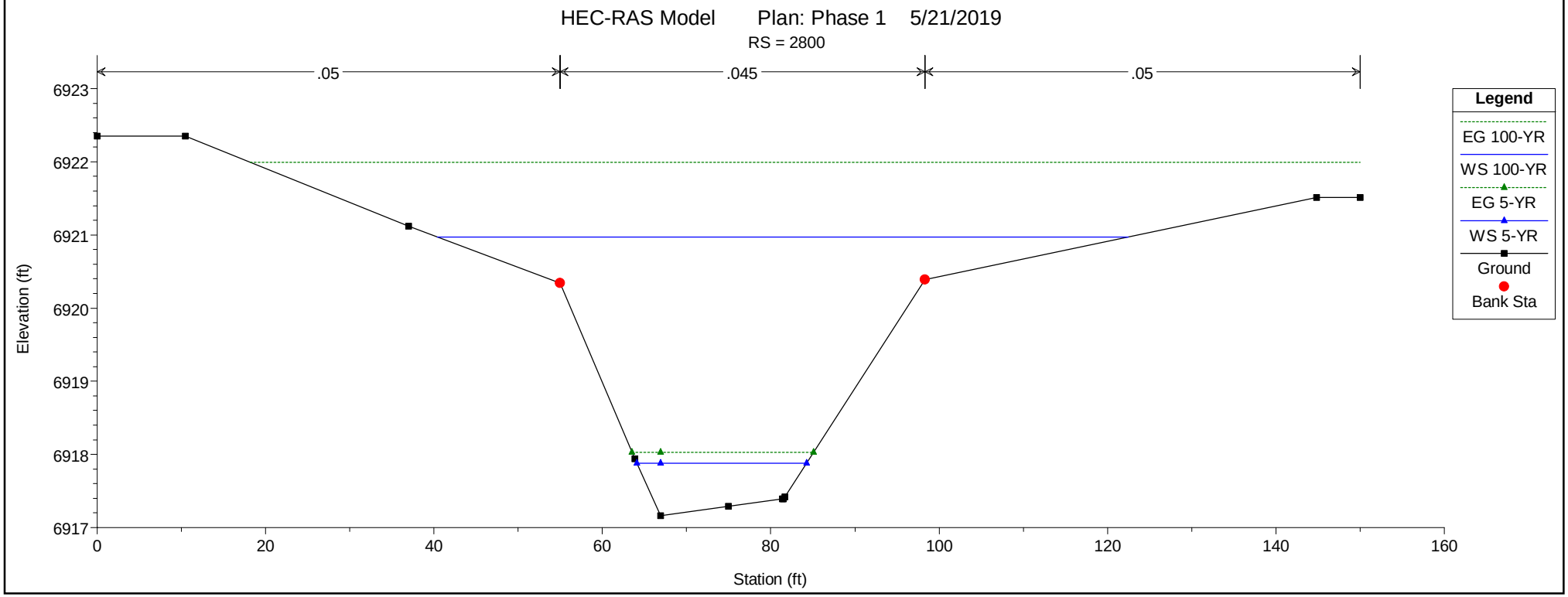

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

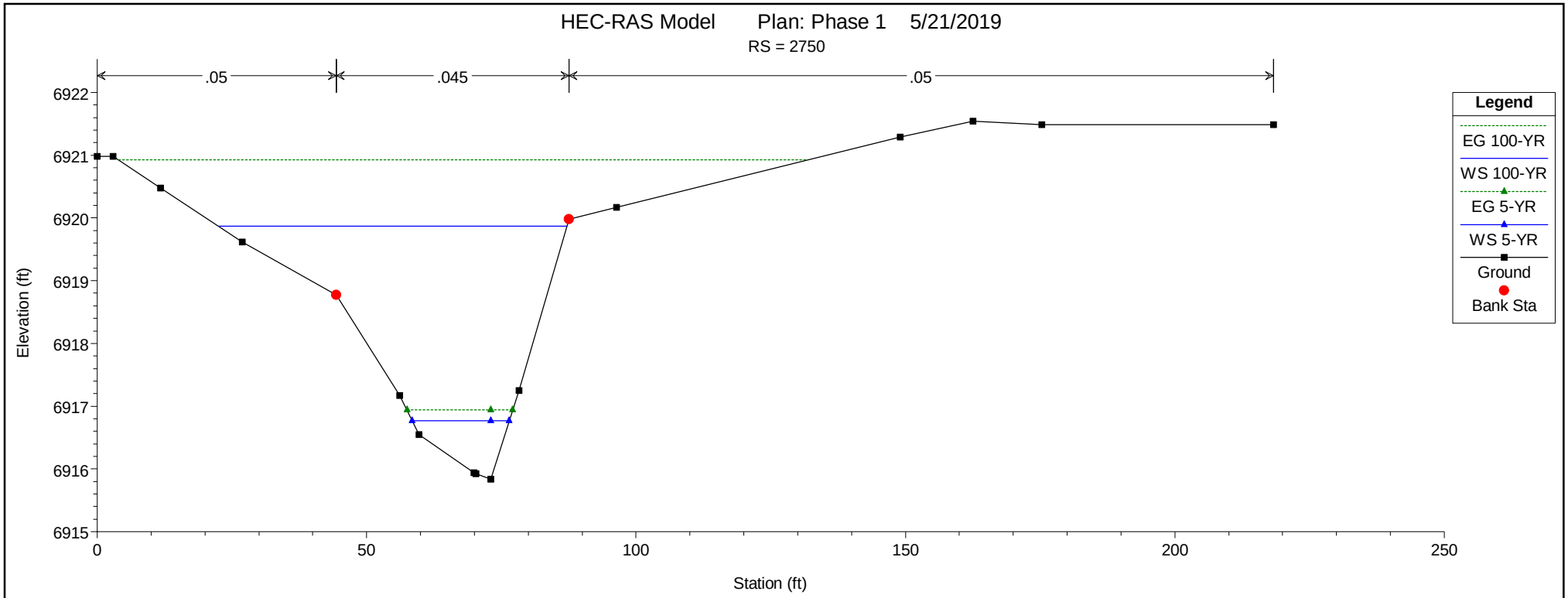

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 3000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

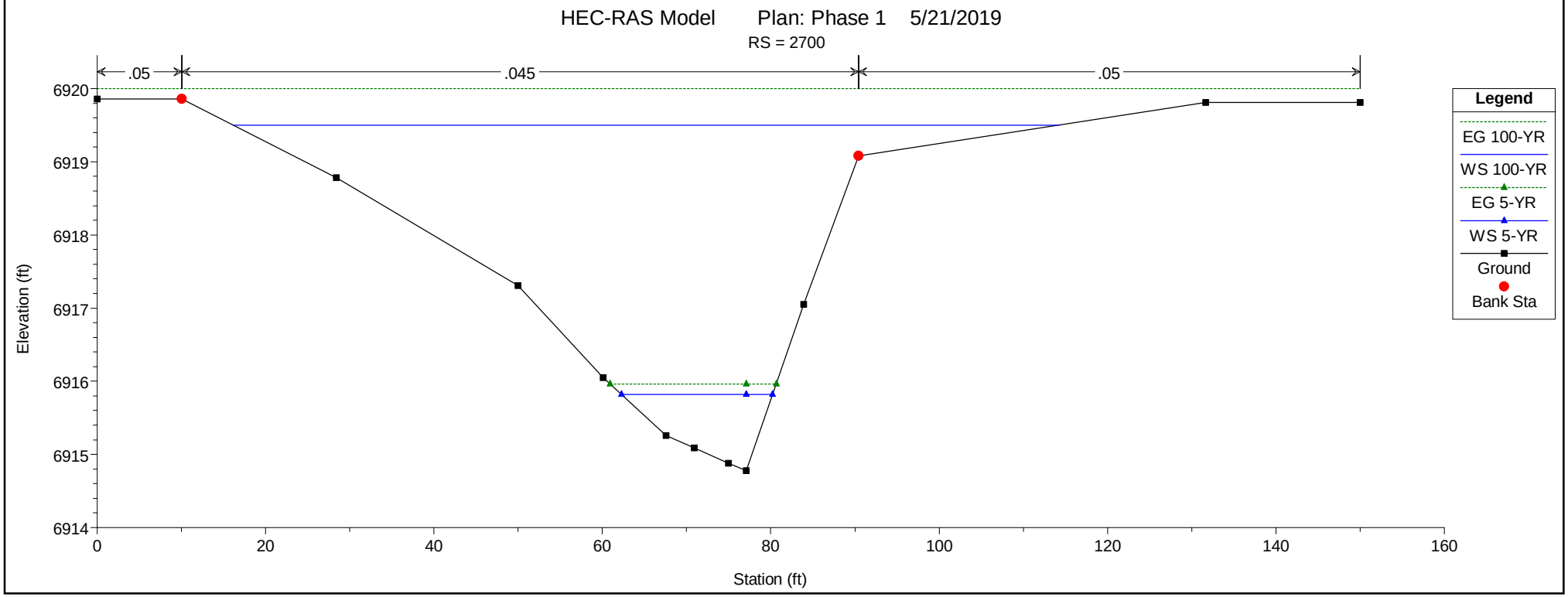

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2950
.05
.045
.05
Elevation (ft)
6926
6925
6924
6923
6922
6921
6920
6919
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

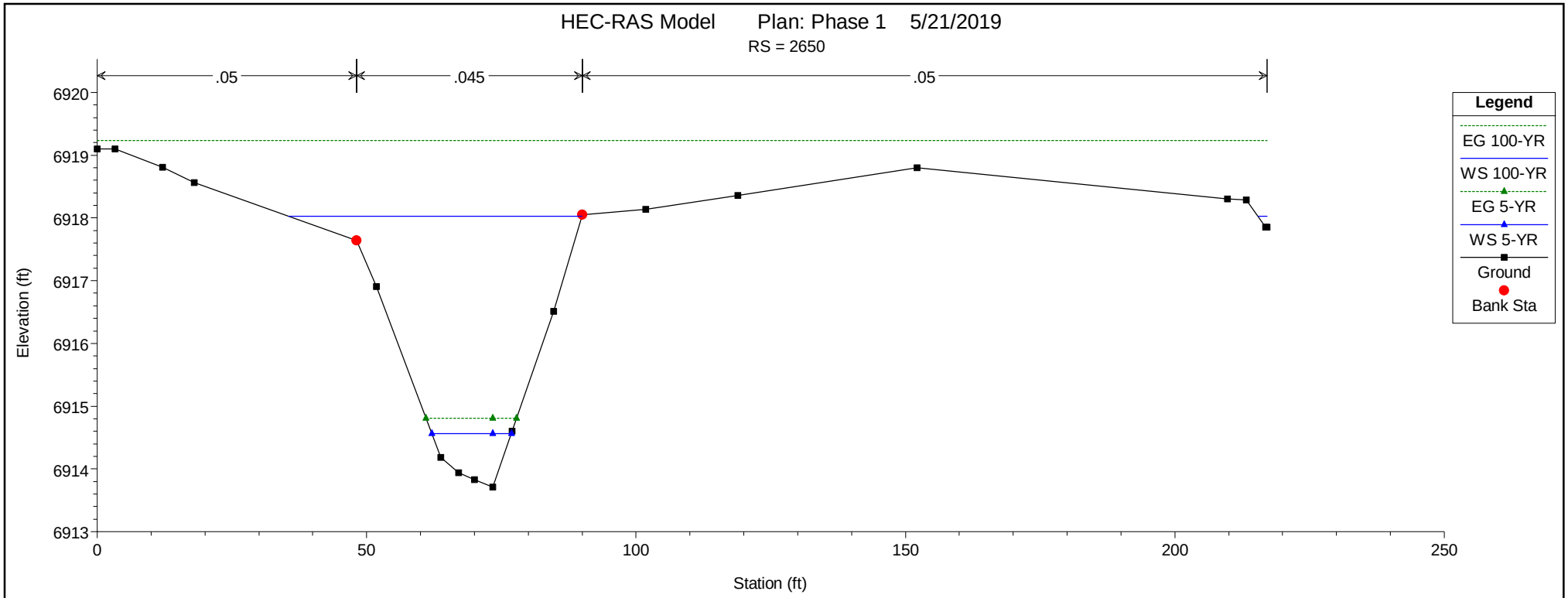

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2900
.05
.045
.05
Elevation (ft)
6925
6924
6923
6922
6921
6920
6919
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

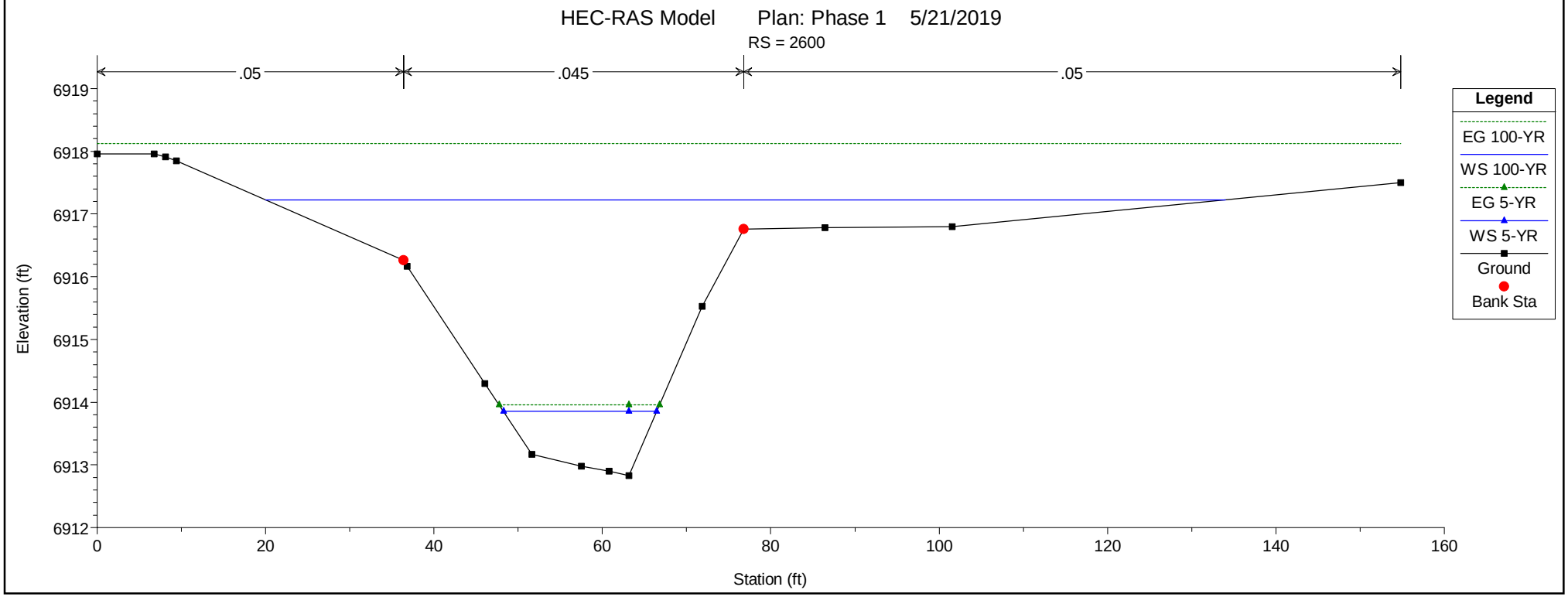

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2850
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6924
6923
6922
6921
6920
6919
6918
6917
0
50
100
150
200
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2800
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6923
6922
6921
6920
6919
6918
6917
0
20
40
60
80
100
120
140
160
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2750
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

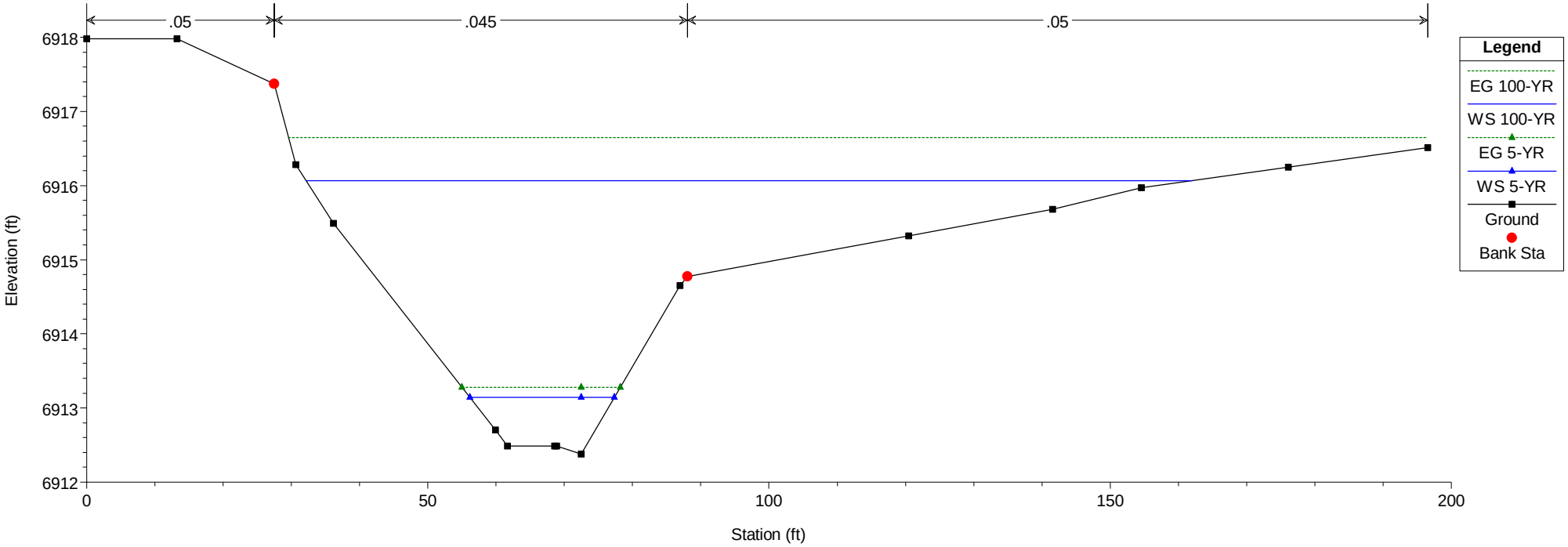

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2700
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2650
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2600
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

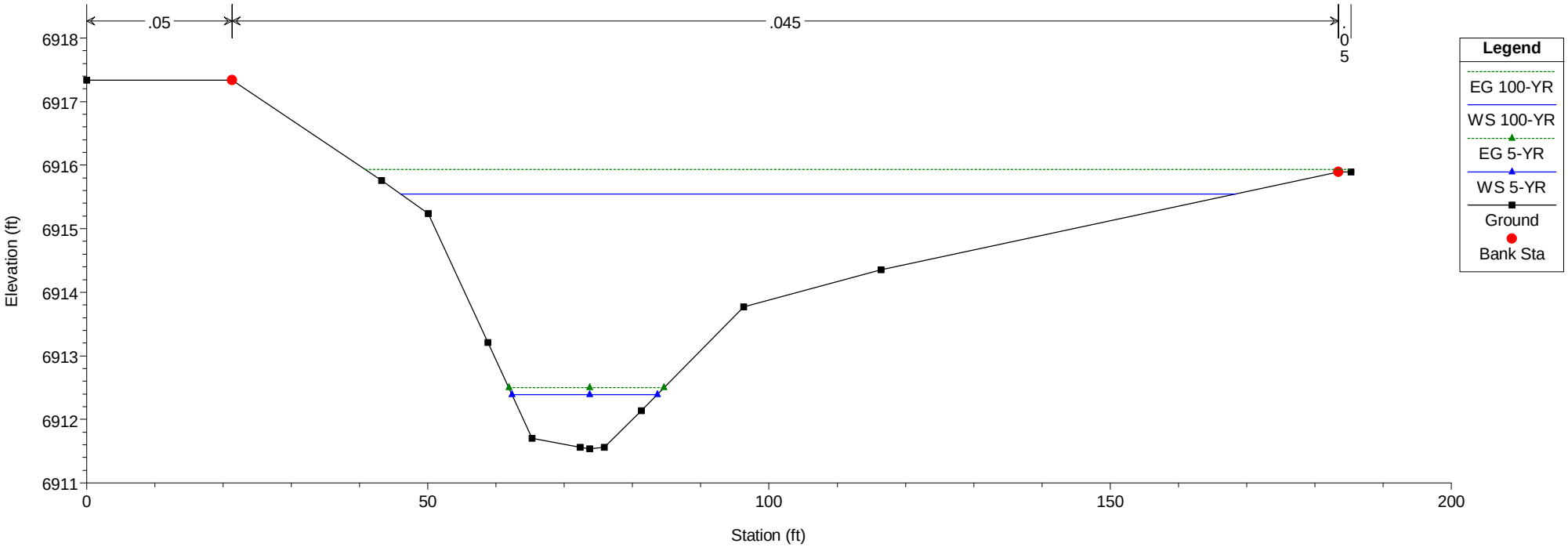
HEC-RAS Model Plan: Phase 1 5/21/2019

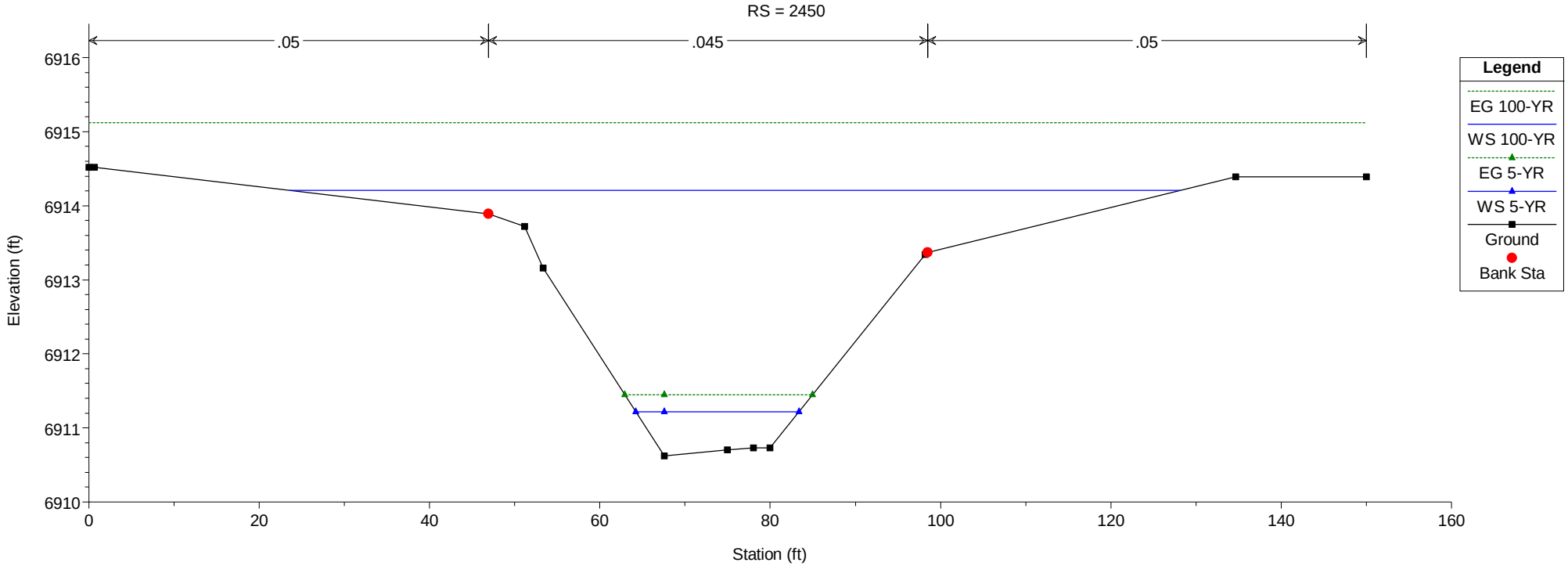
RS = 2550

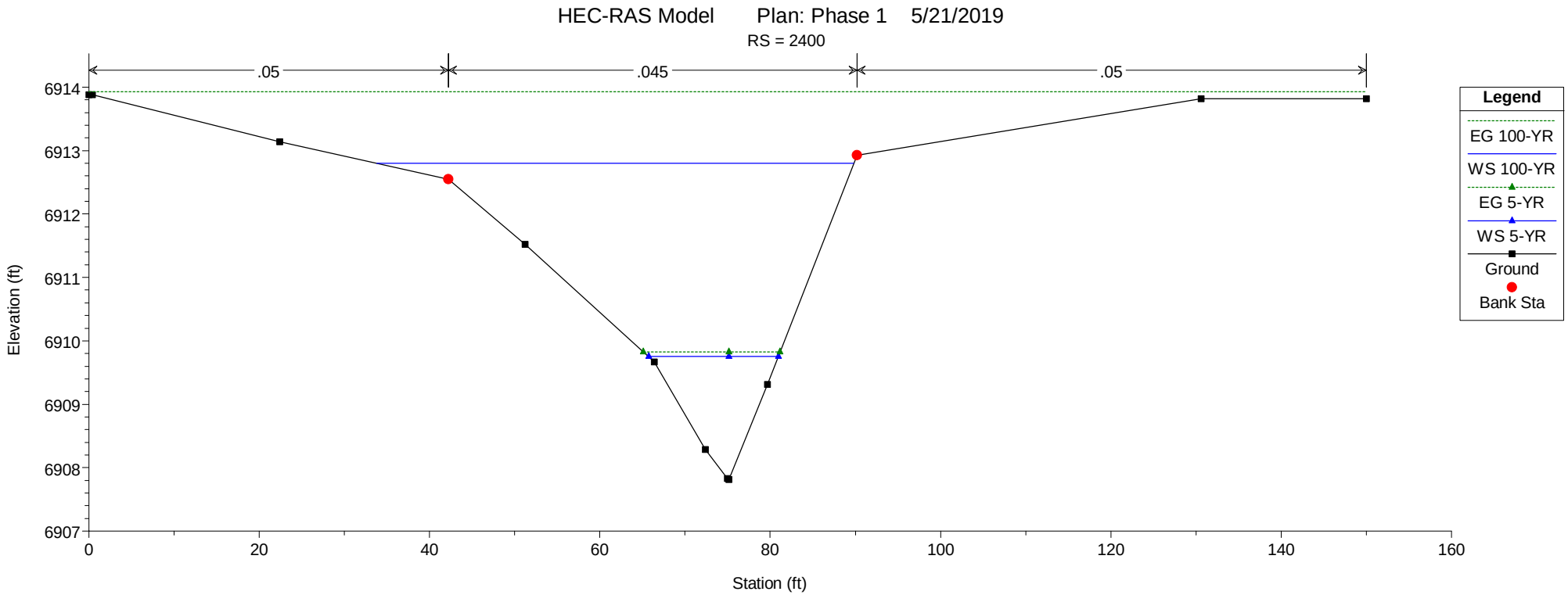


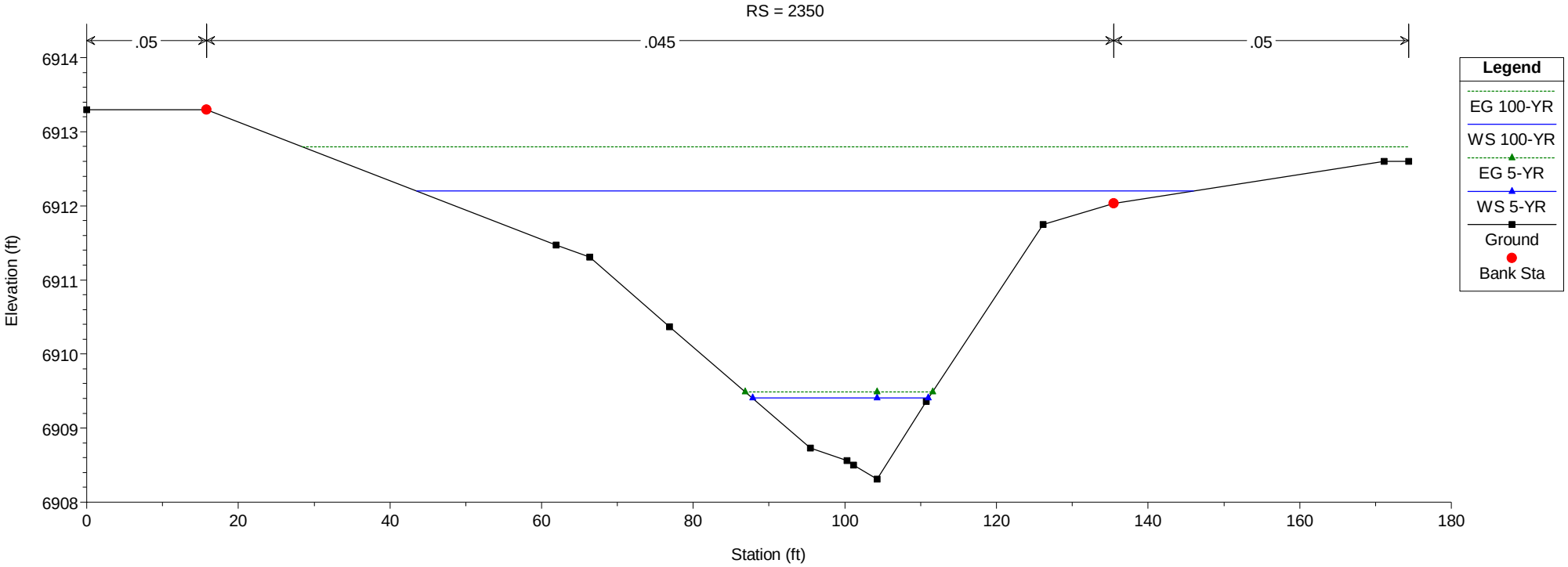
HEC-RAS Model Plan: Phase 1 5/21/2019

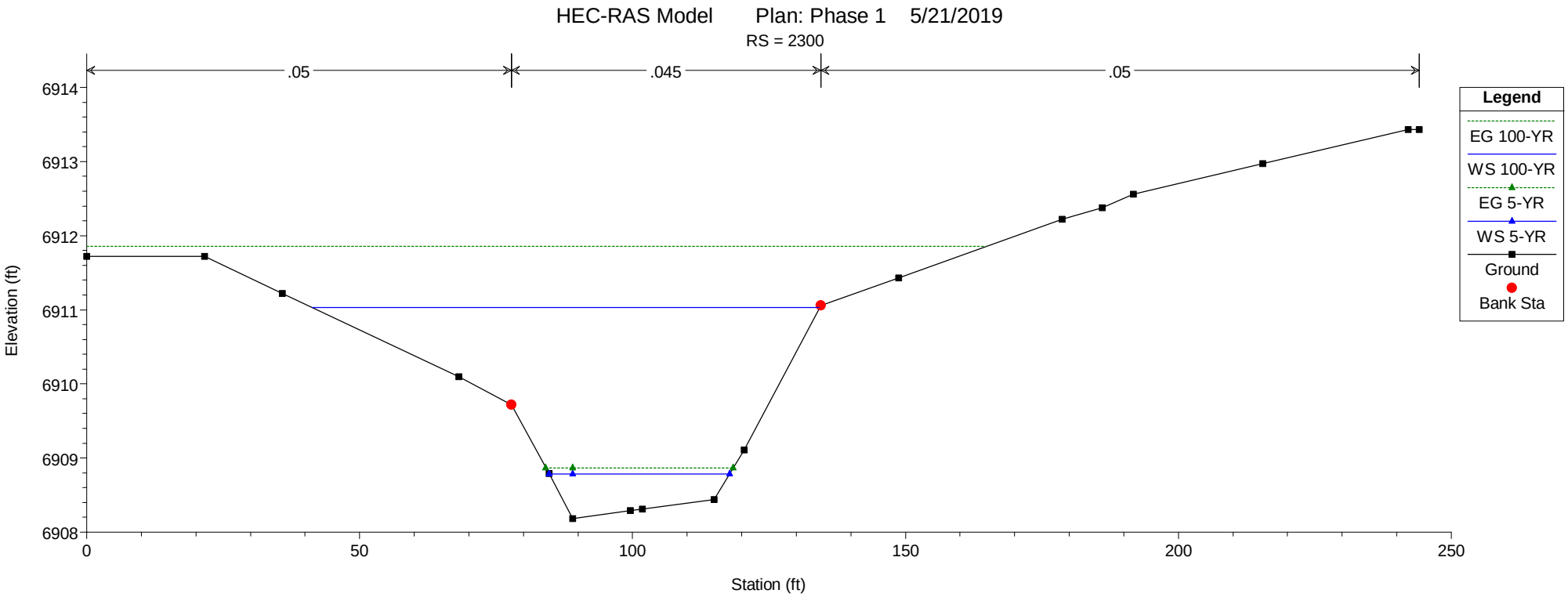
RS = 2500

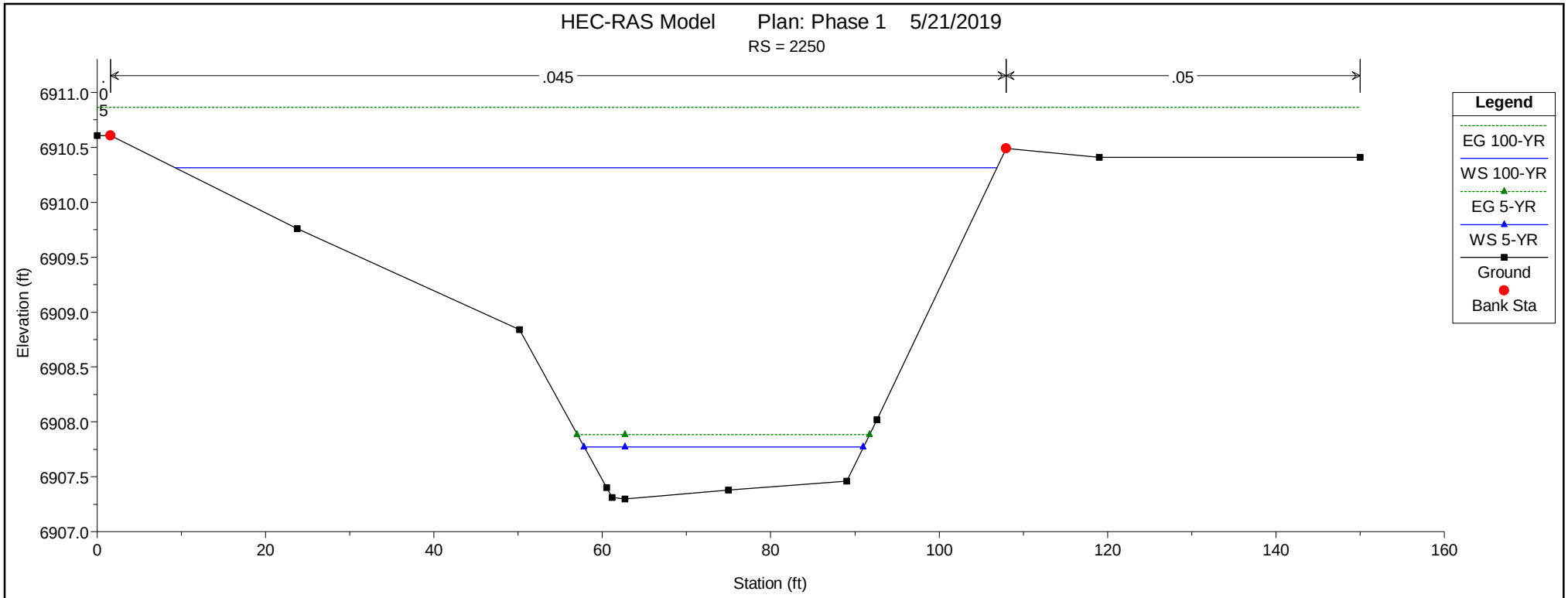


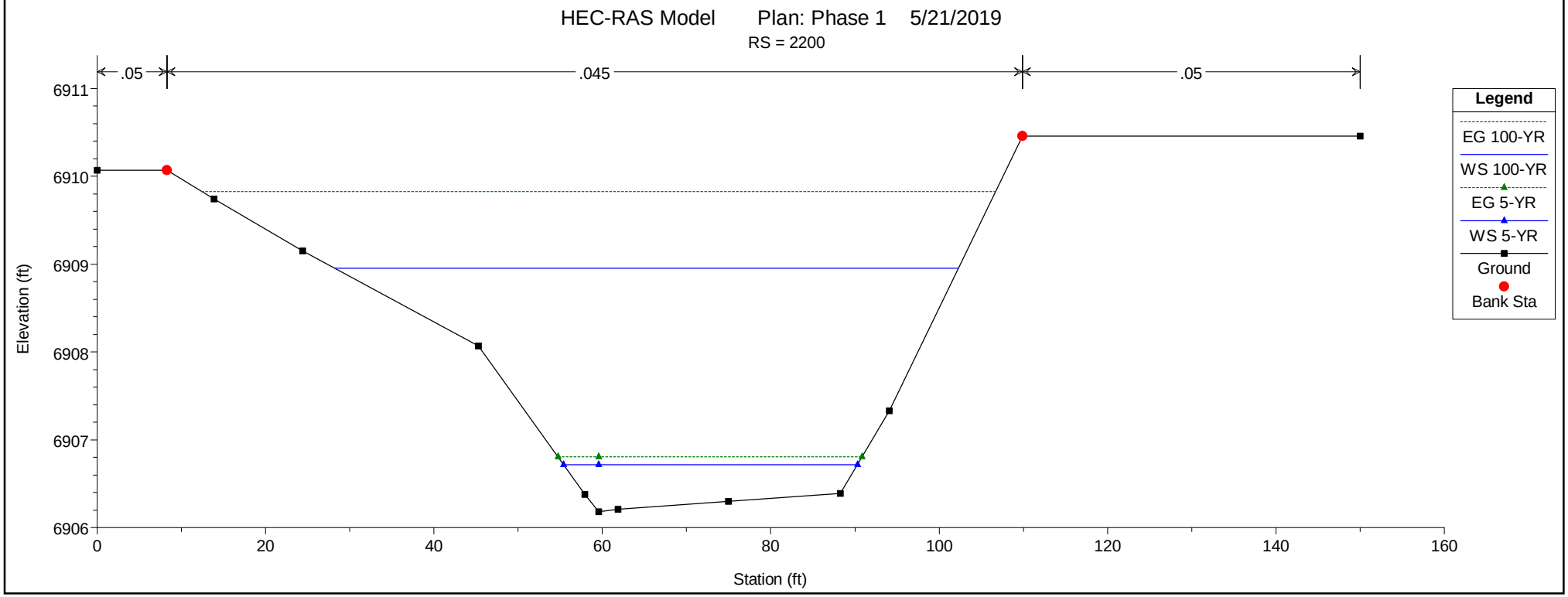

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2450
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6916
6915
6914
6913
6912
6911
6910
0
20
40
60
80
100
120
140
160
Station (ft)

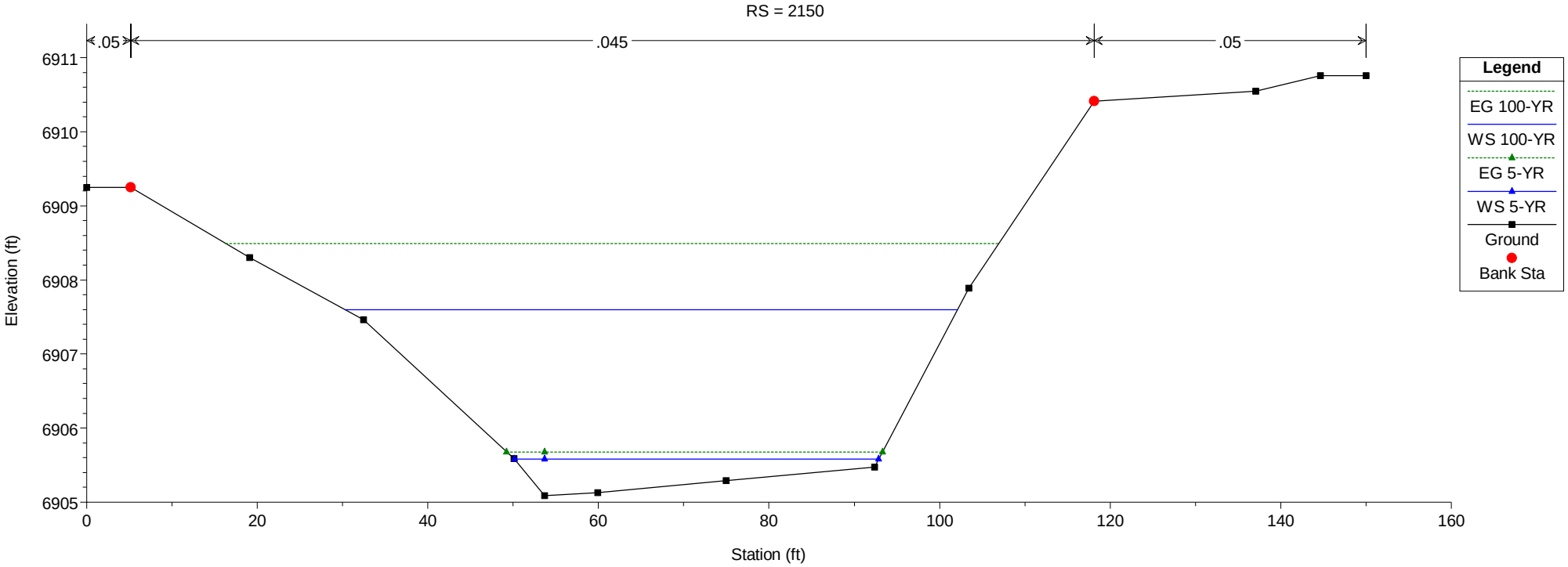

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2400
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6914
6913
6912
6911
6910
6909
6908
6907
0
20
40
60
80
100
120
140
160
Station (ft)

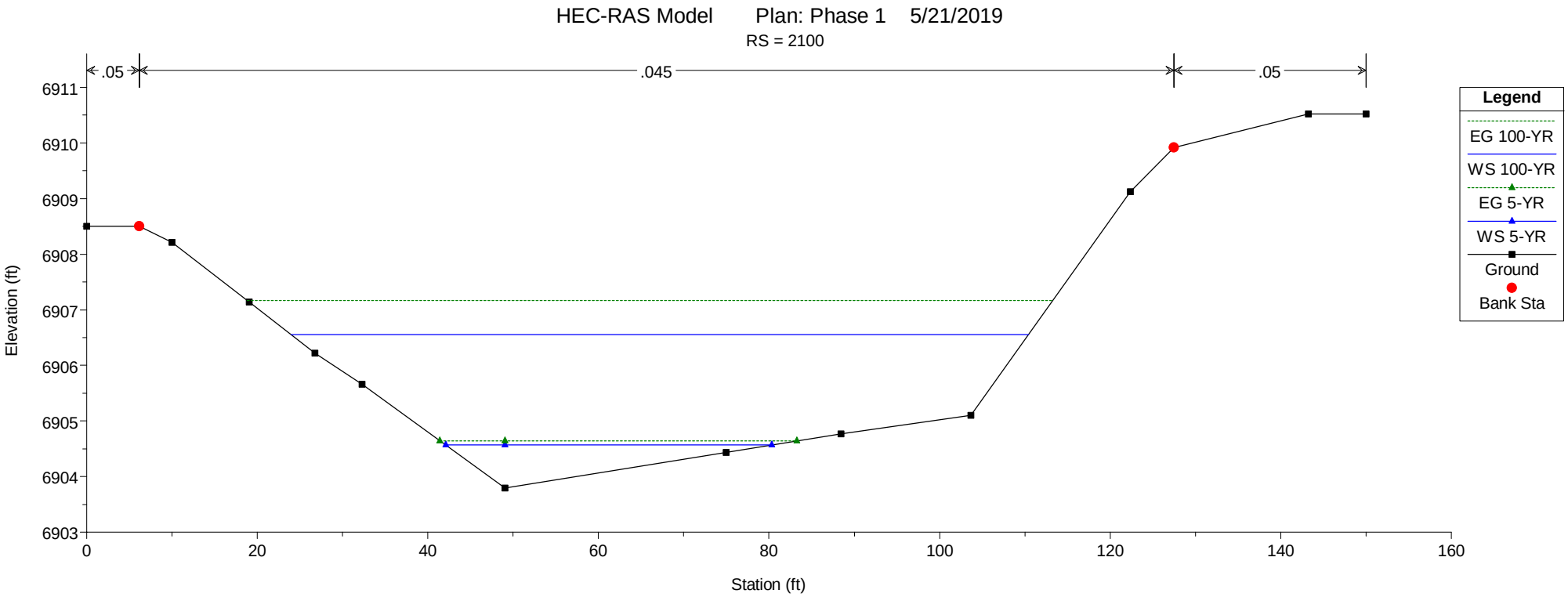

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2350
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

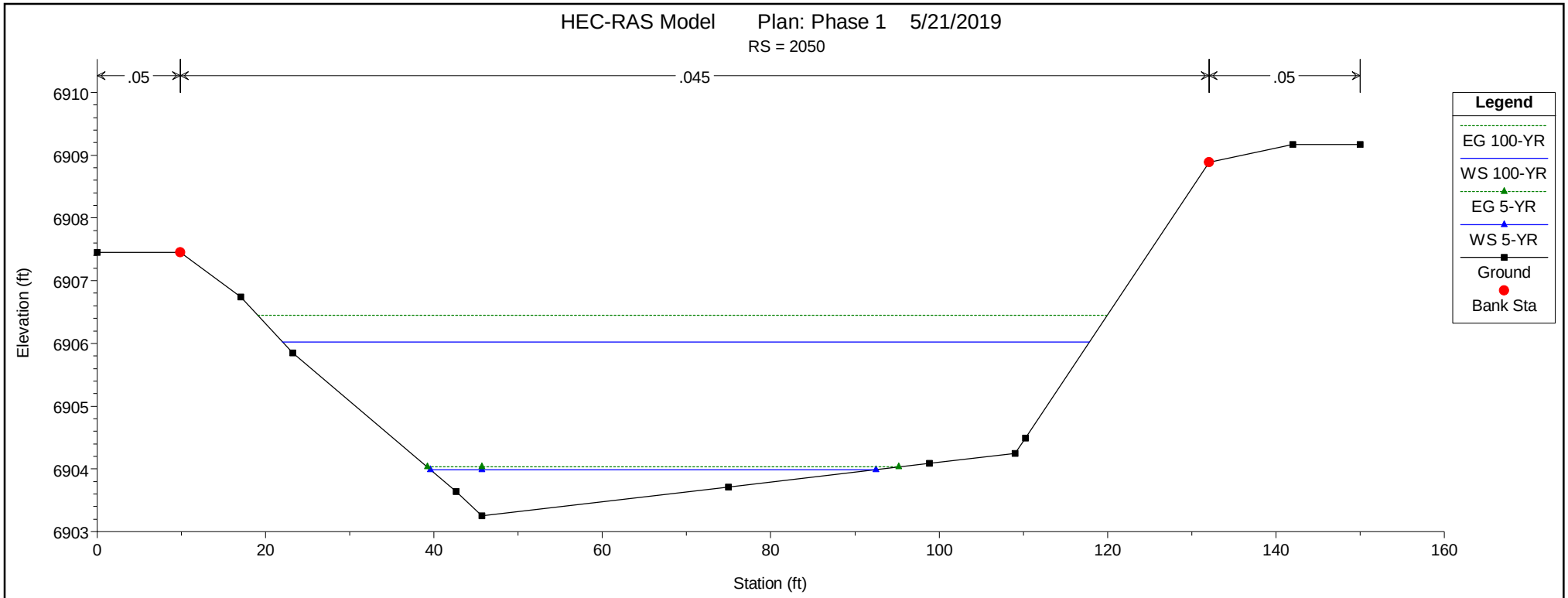

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2300
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

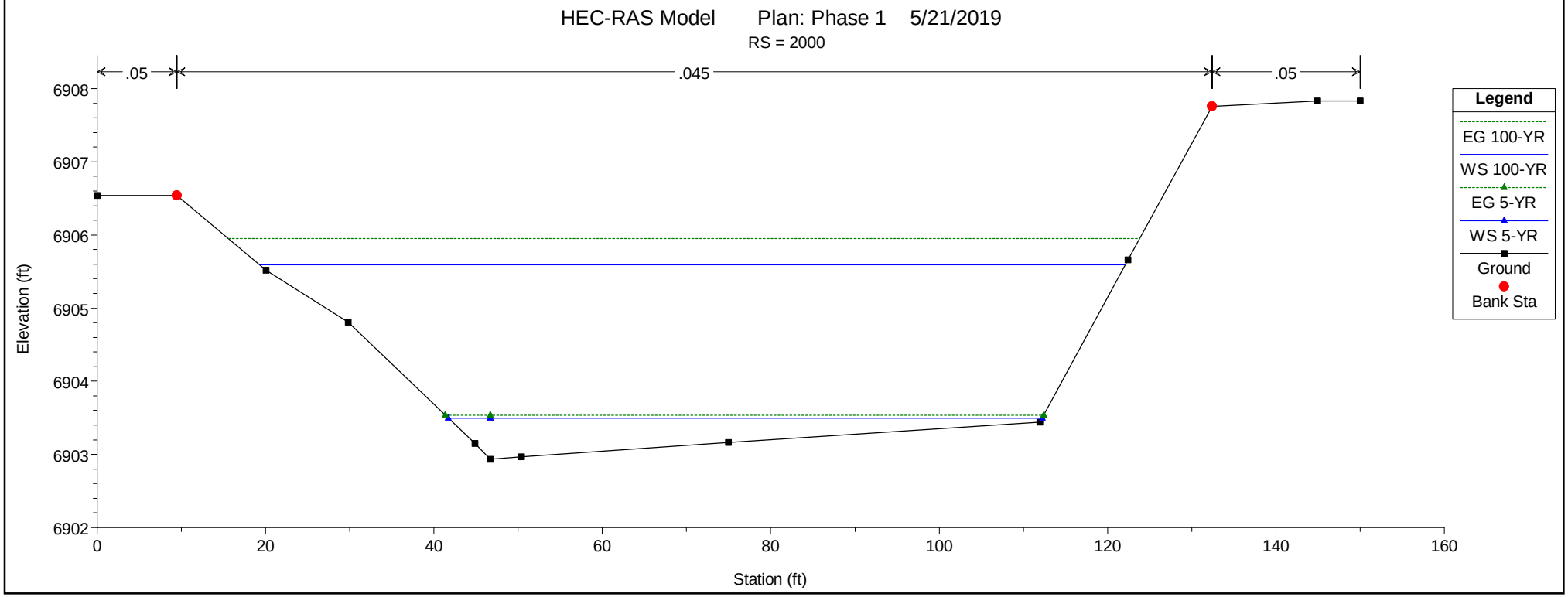

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

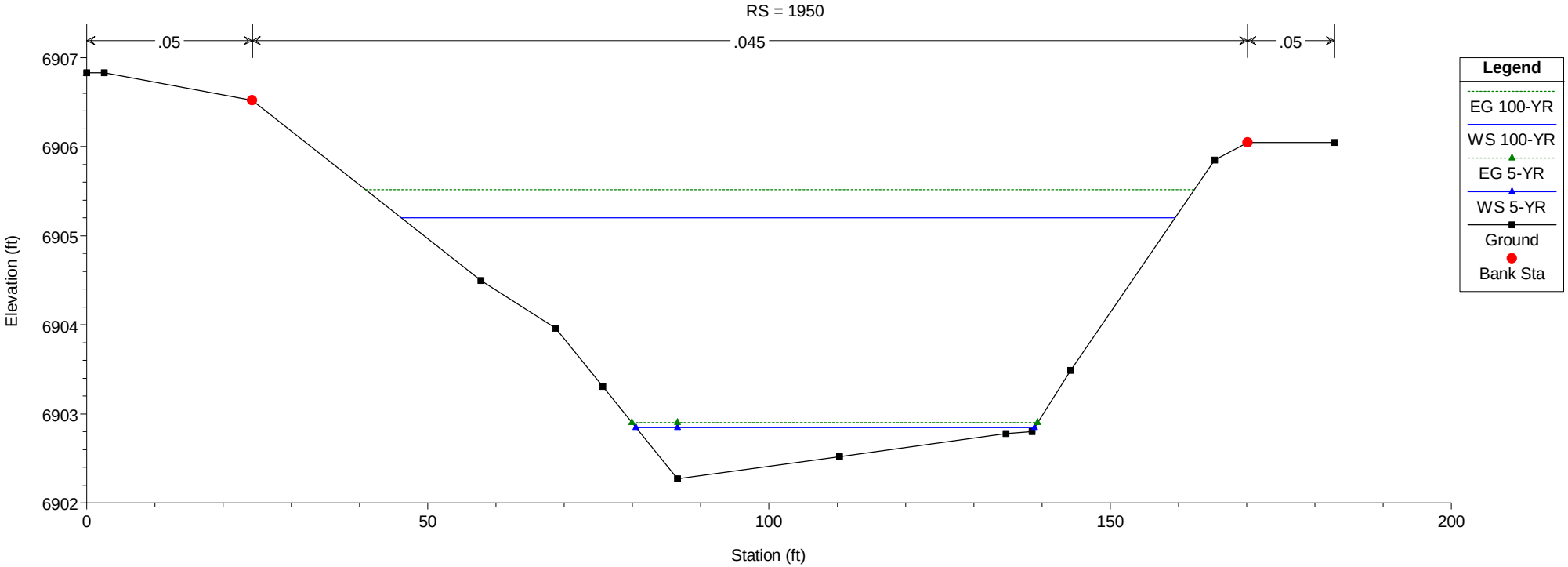

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2200
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

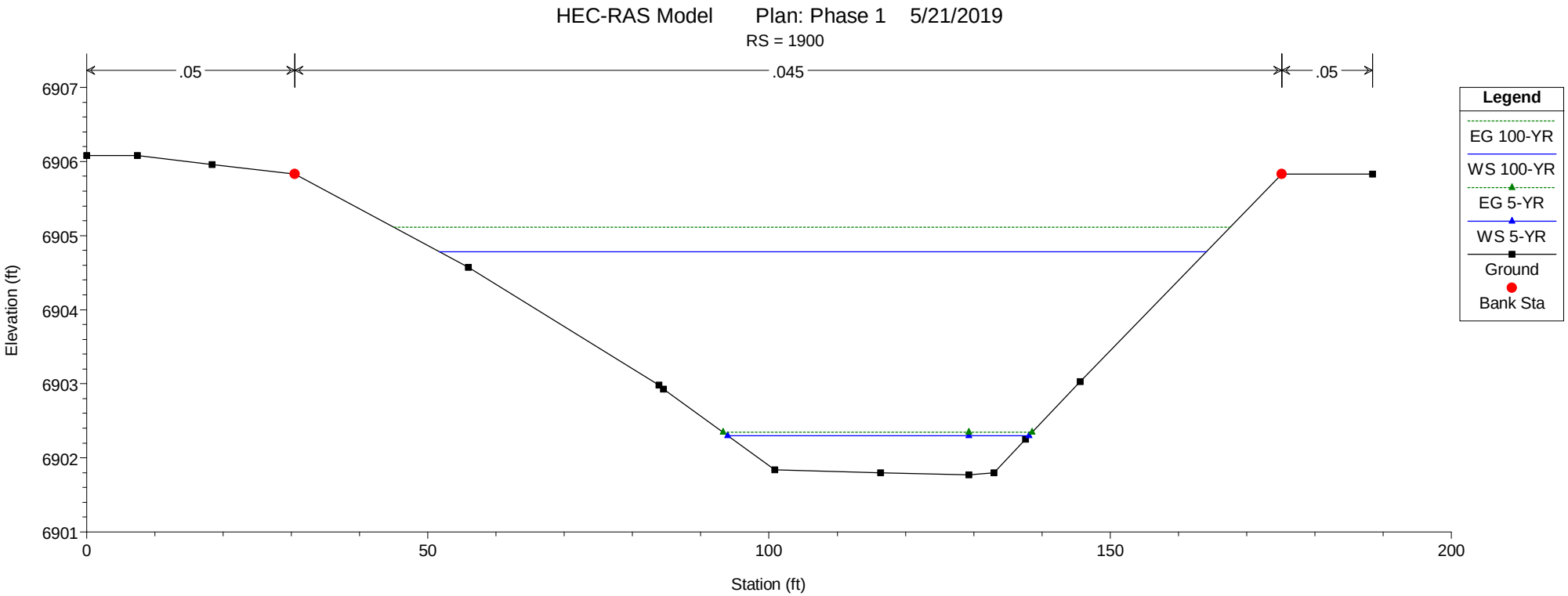

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2150
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

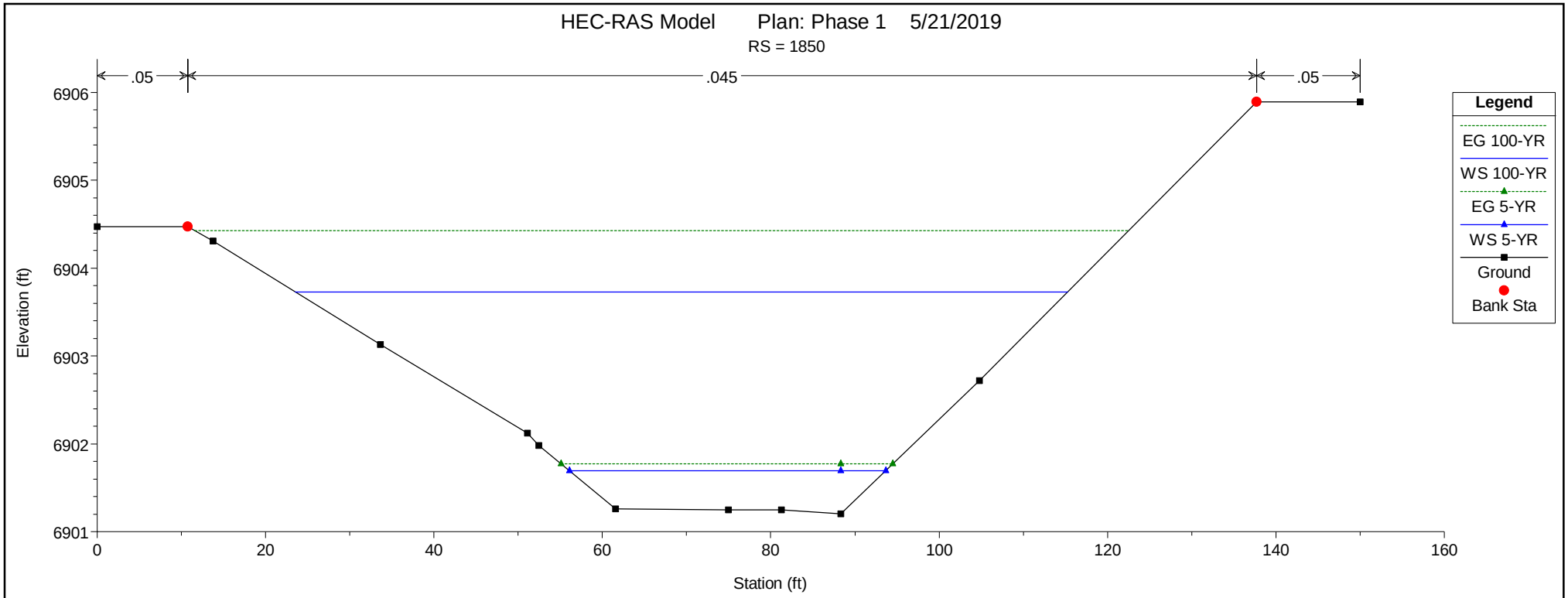

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2100
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

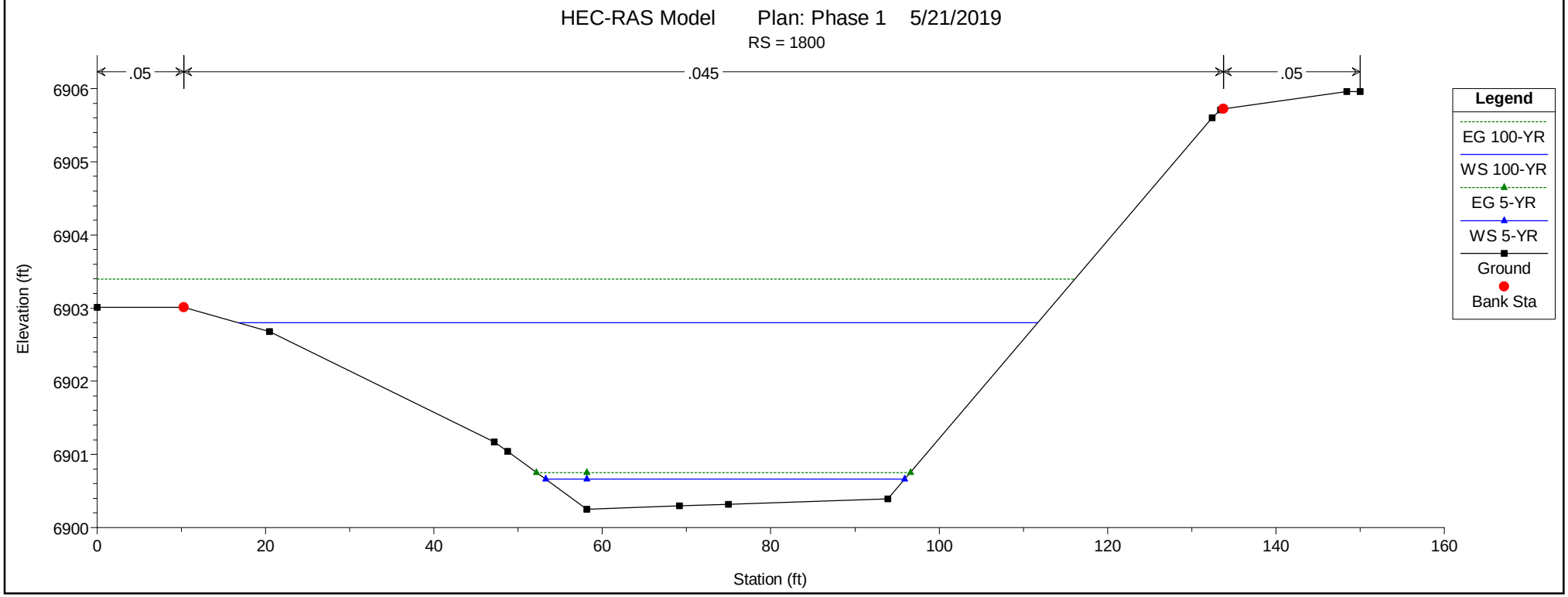

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

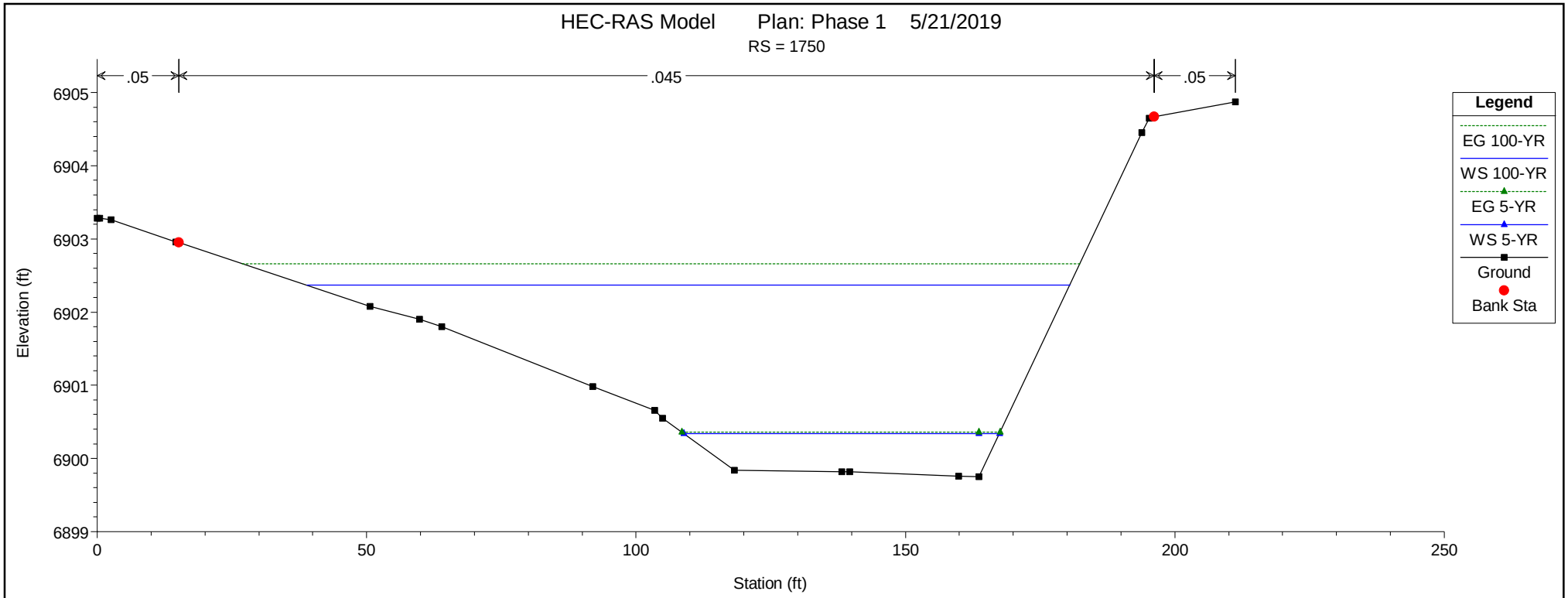

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 2000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

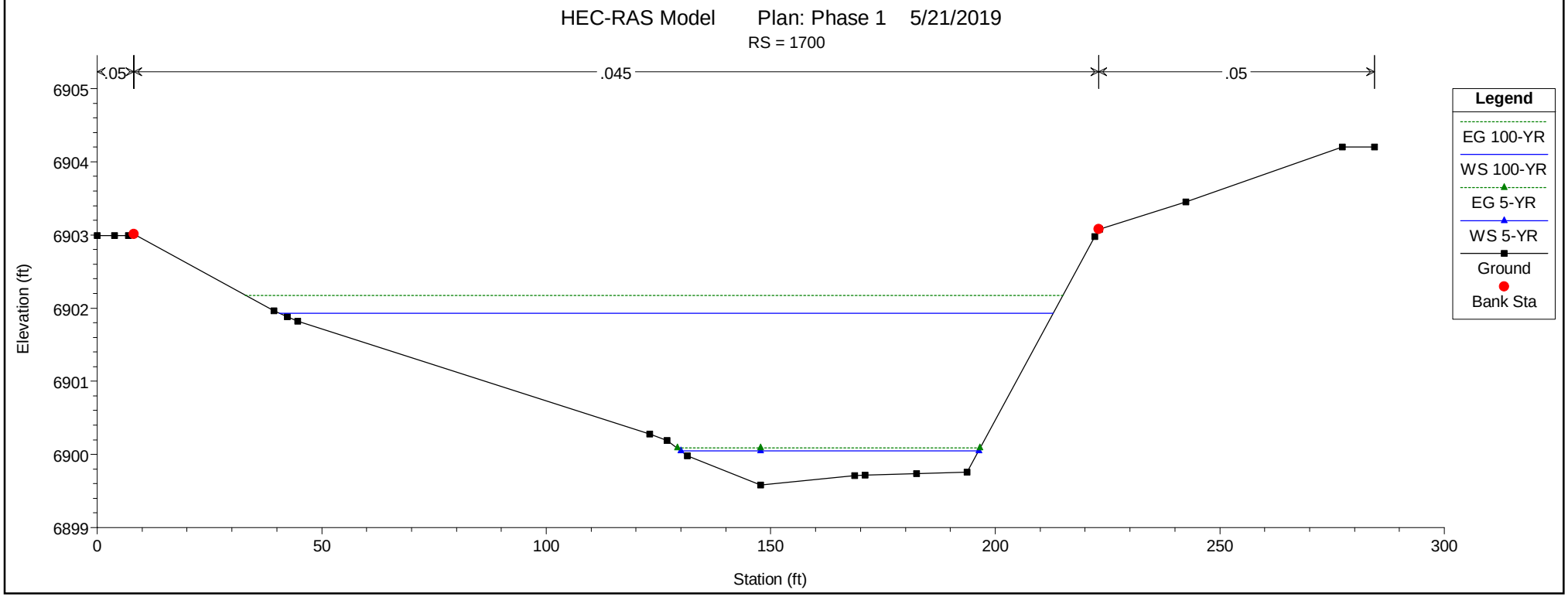

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1950
.05
.045
.05
Elevation (ft)
6907
6906
6905
6904
6903
6902
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

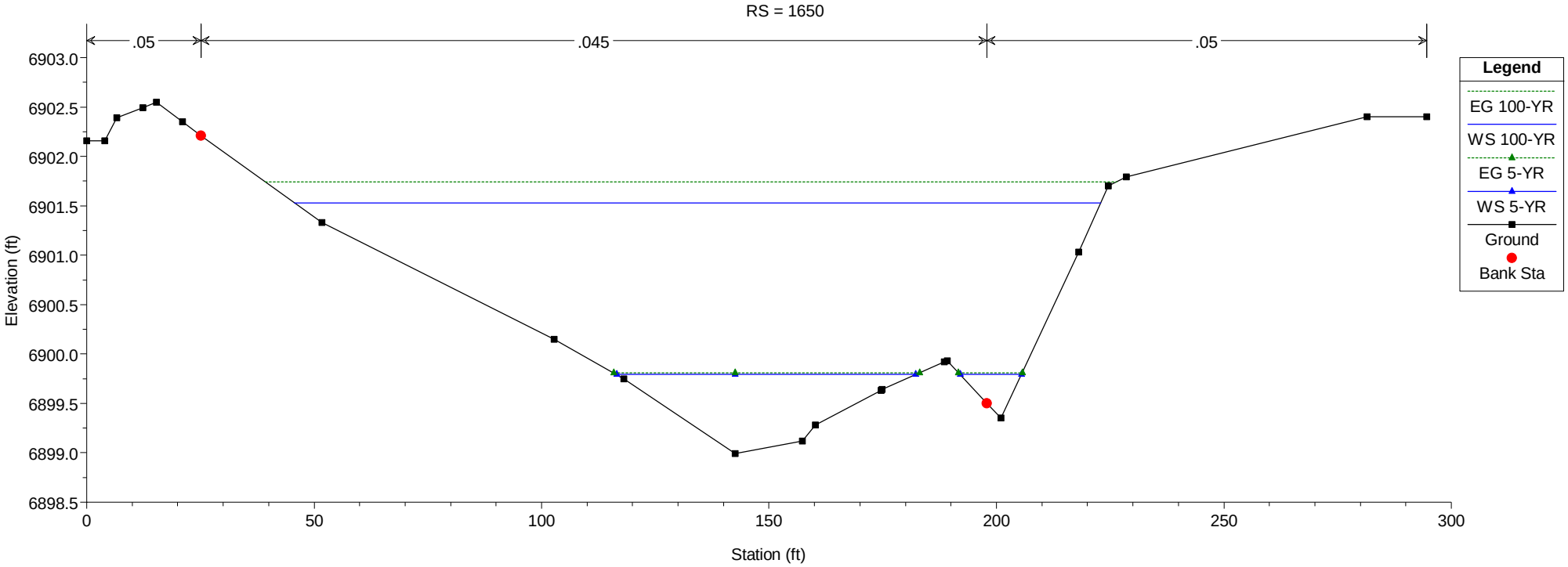

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1900
.05
.045
.05
Elevation (ft)
6907
6906
6905
6904
6903
6902
6901
0
50
100
150
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

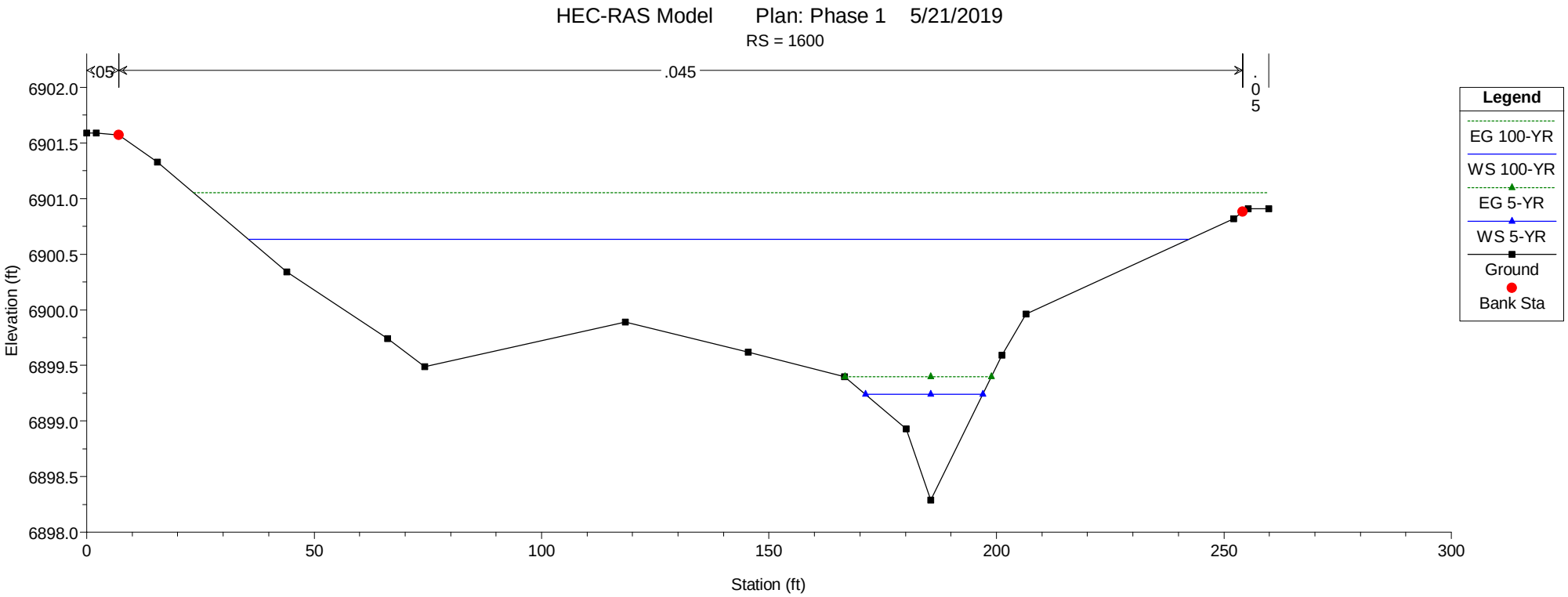

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1850
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1800
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1750
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6905
6904
6903
6902
6901
6900
6899
0
50
100
150
200
250
Station (ft)

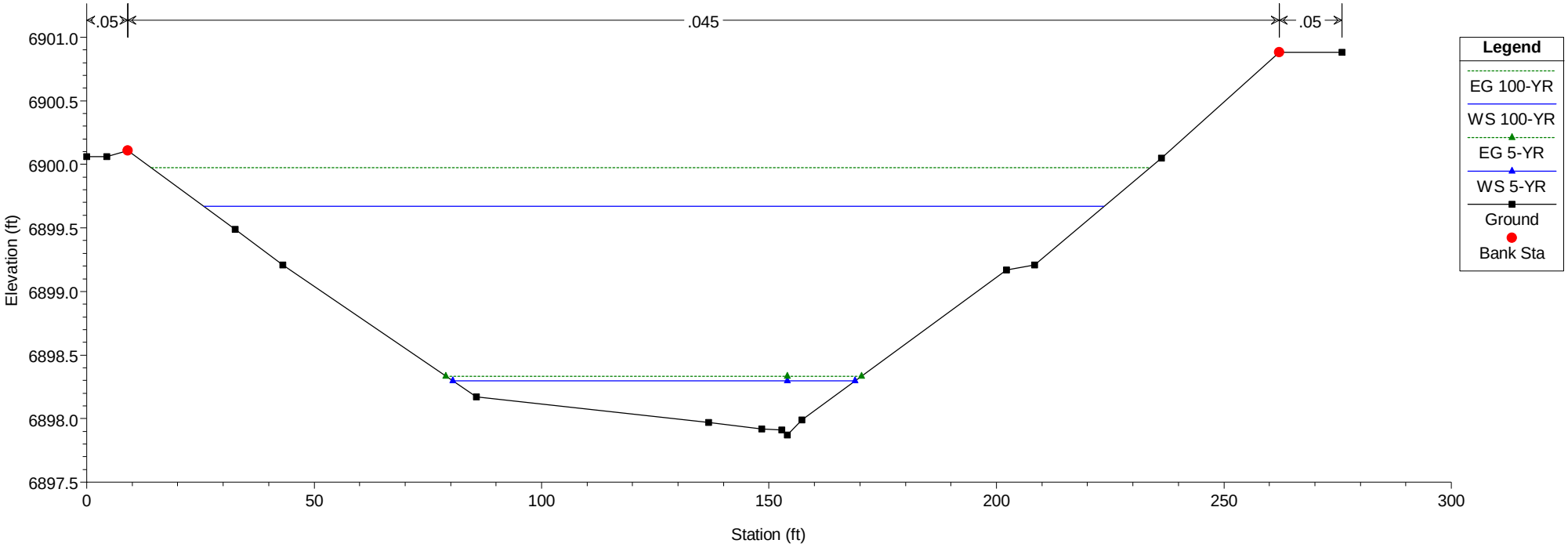

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1700
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6905
6904
6903
6902
6901
6900
6899
0
50
100
150
200
250
300
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1650
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1600
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

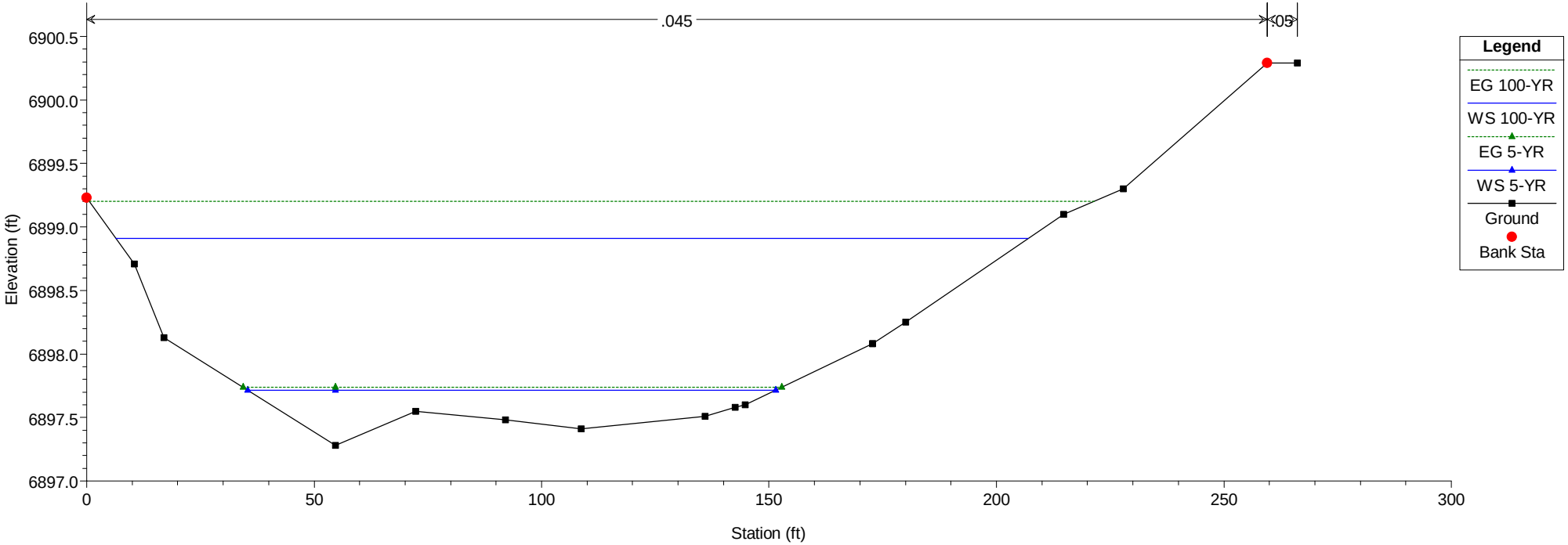
HEC-RAS Model Plan: Phase 1 5/21/2019

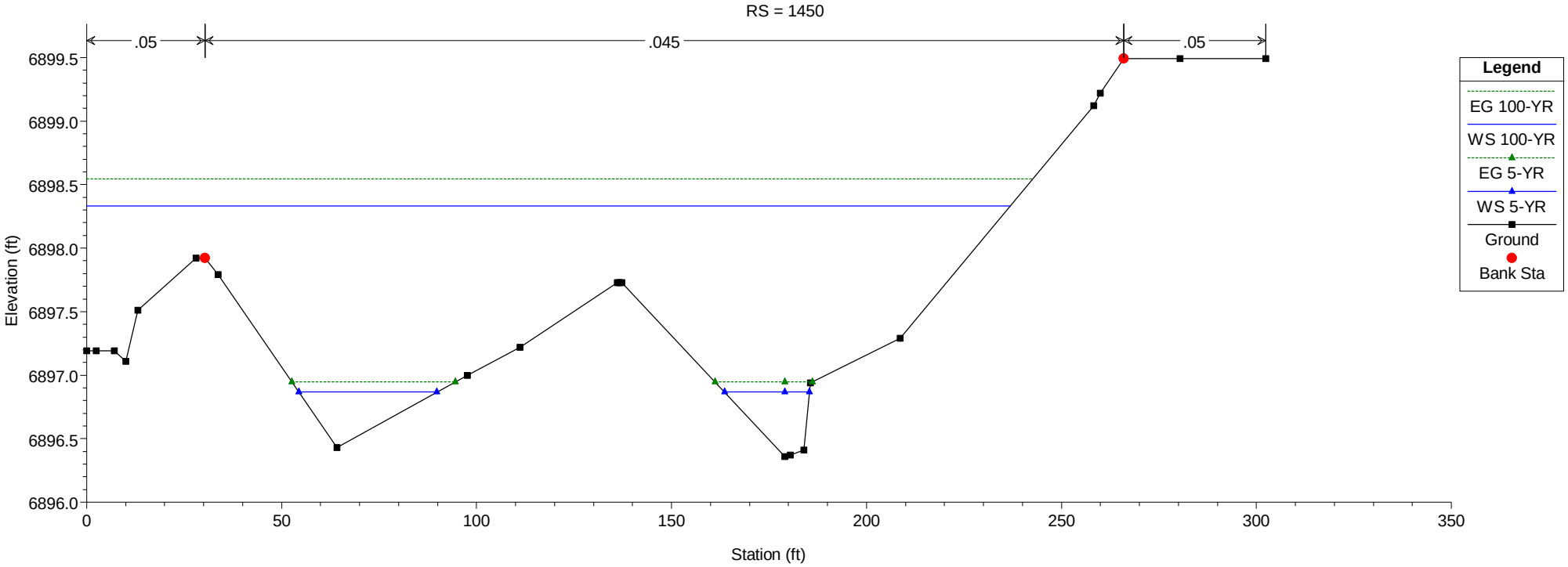
RS = 1550

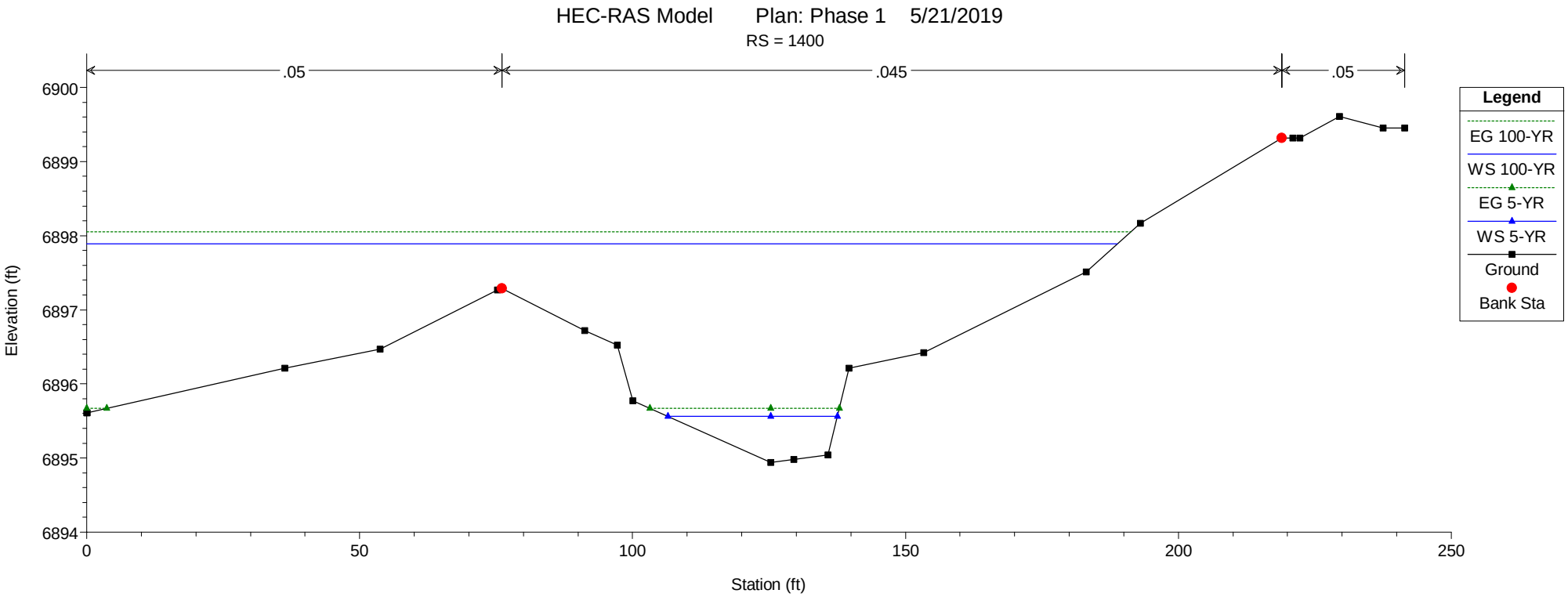


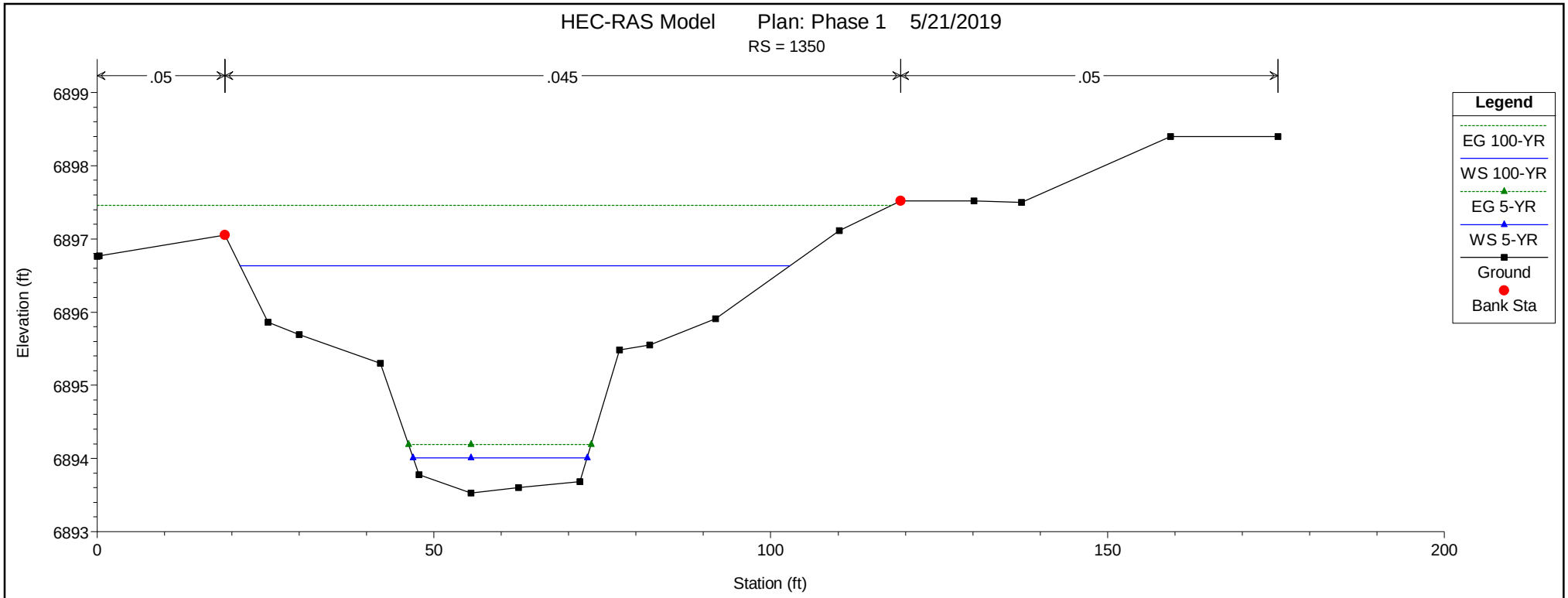
HEC-RAS Model Plan: Phase 1 5/21/2019

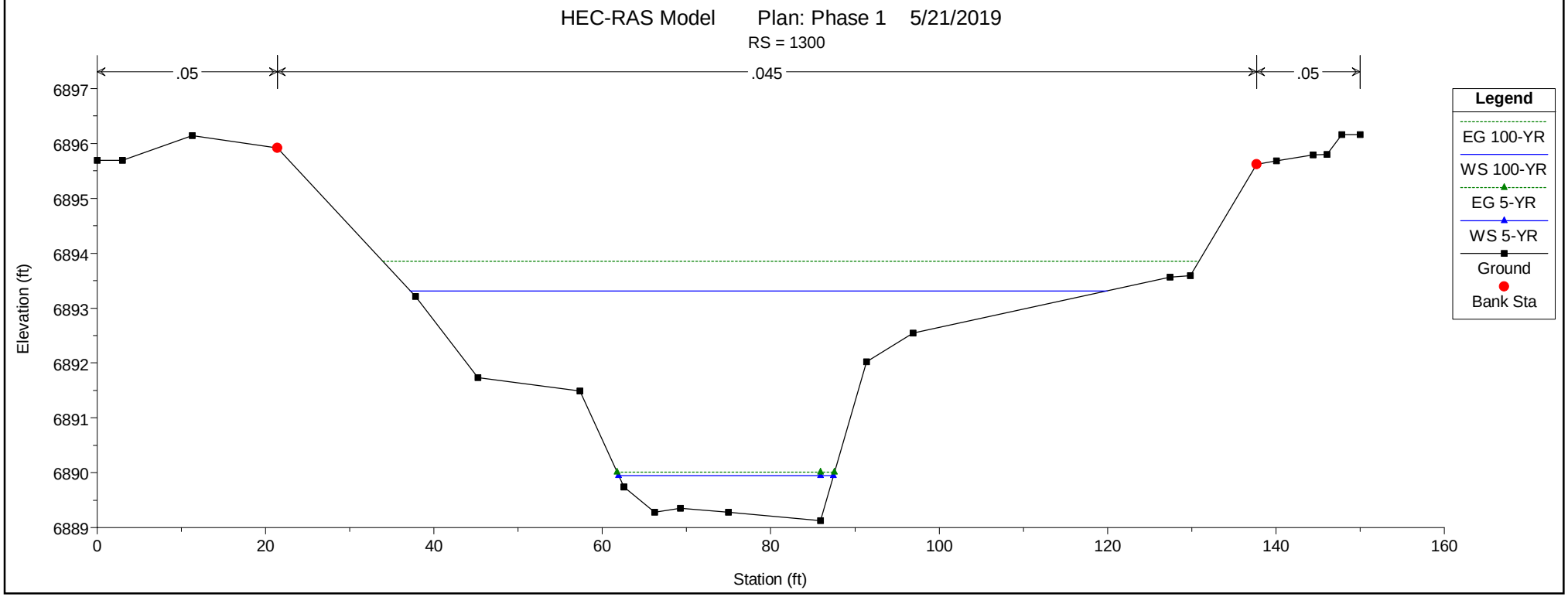
RS = 1500

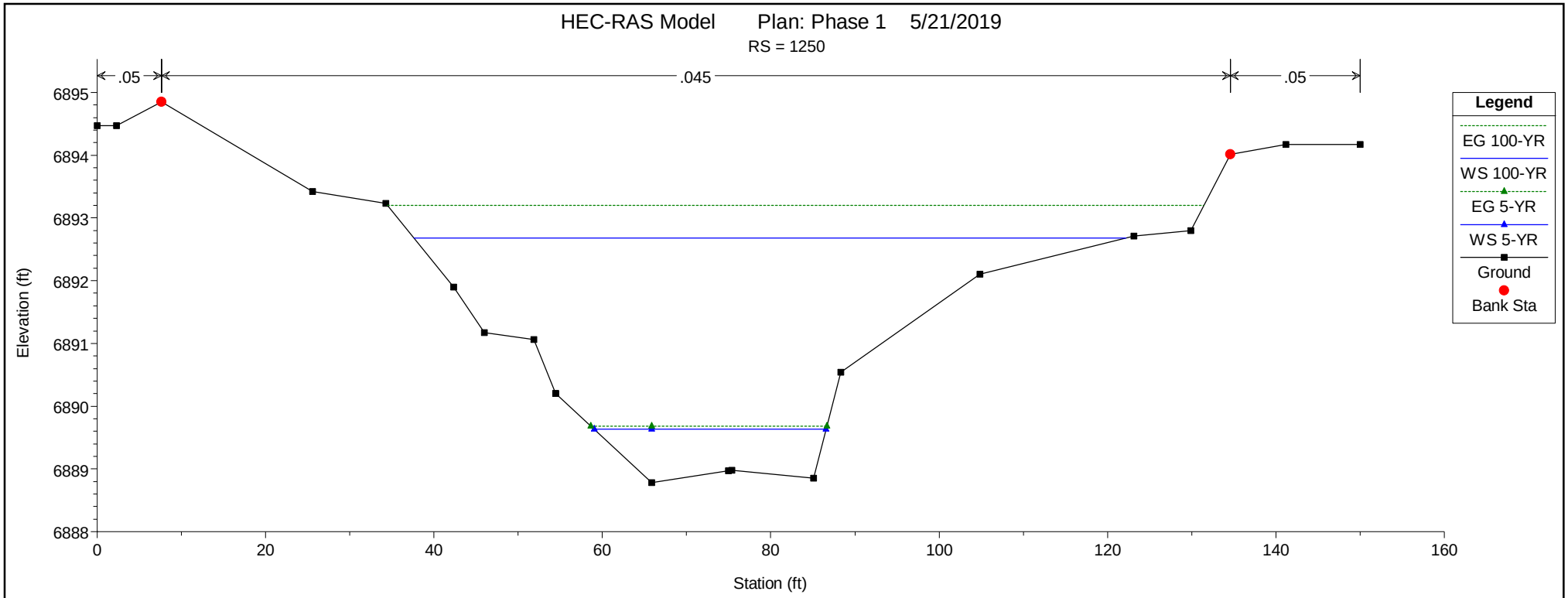


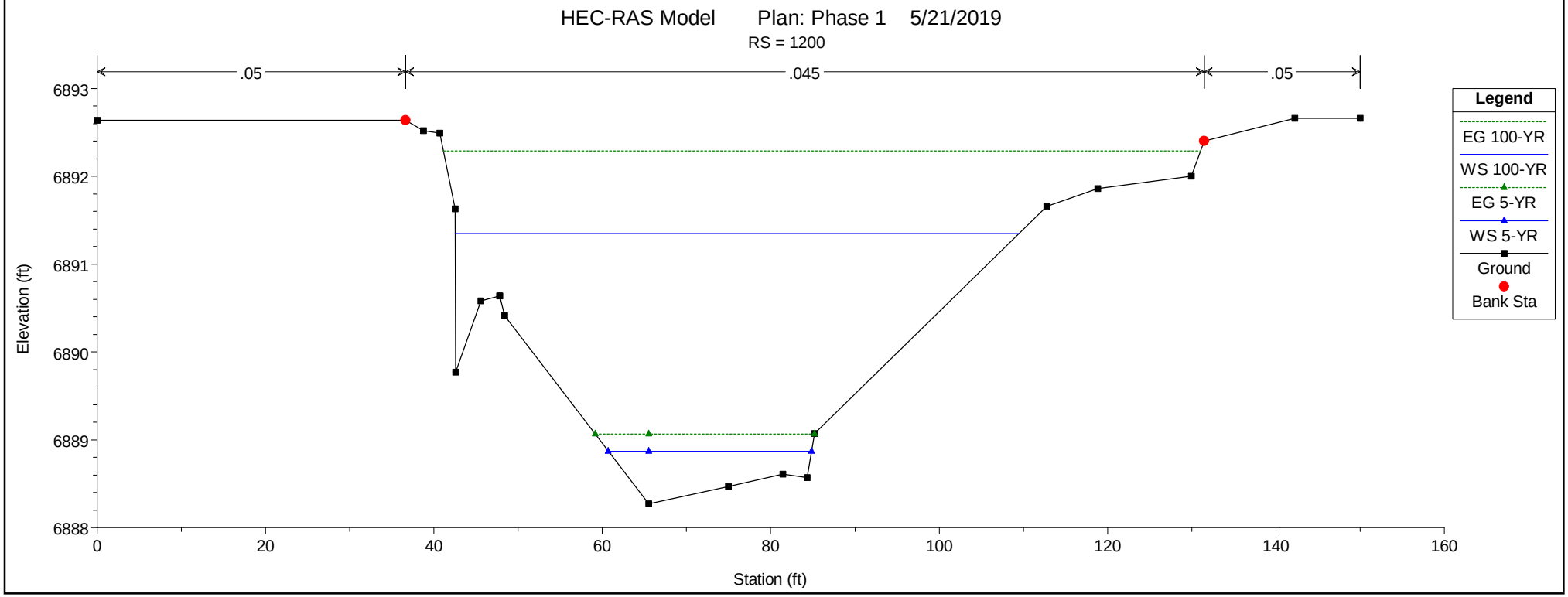

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1450
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

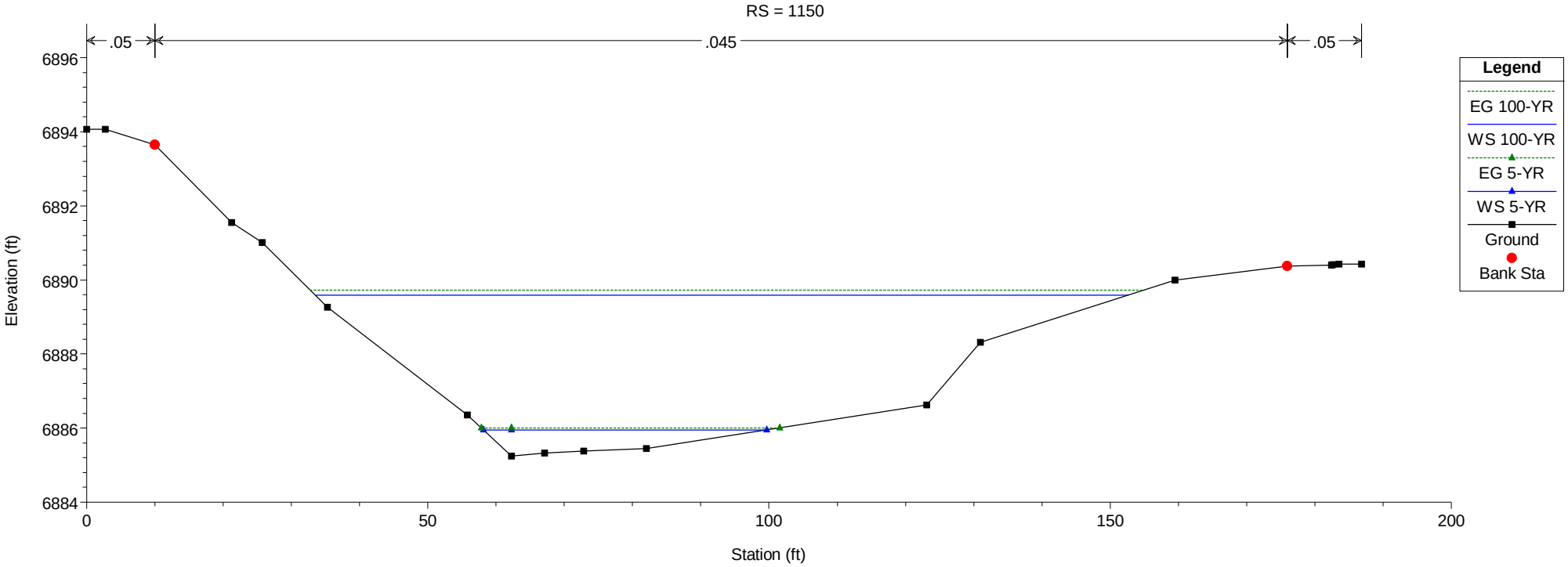

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1400
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

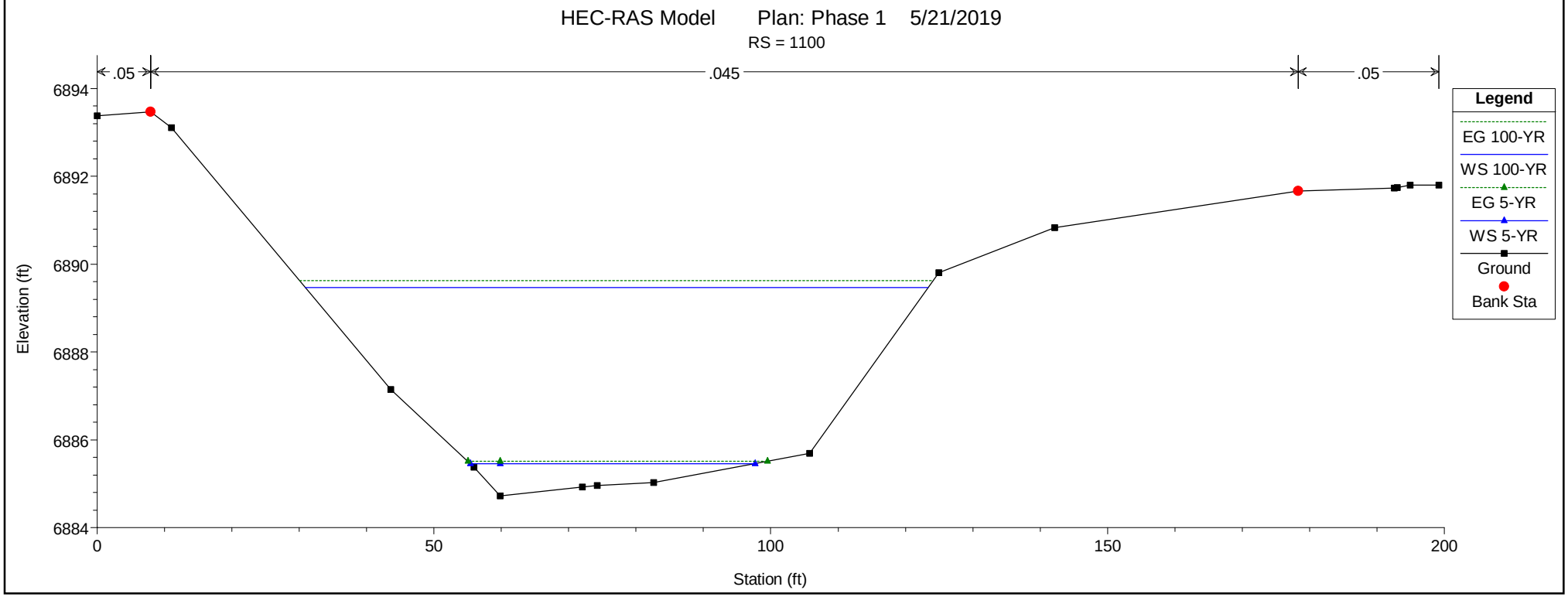

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1350
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

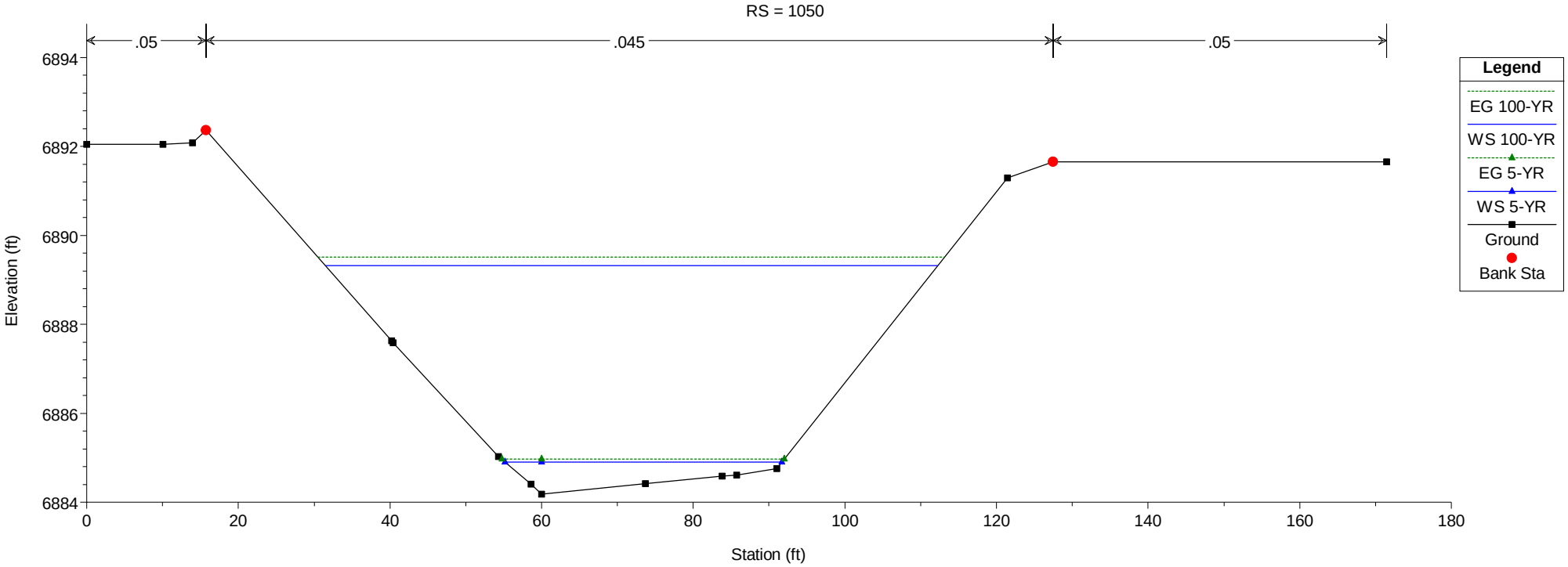

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1300
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

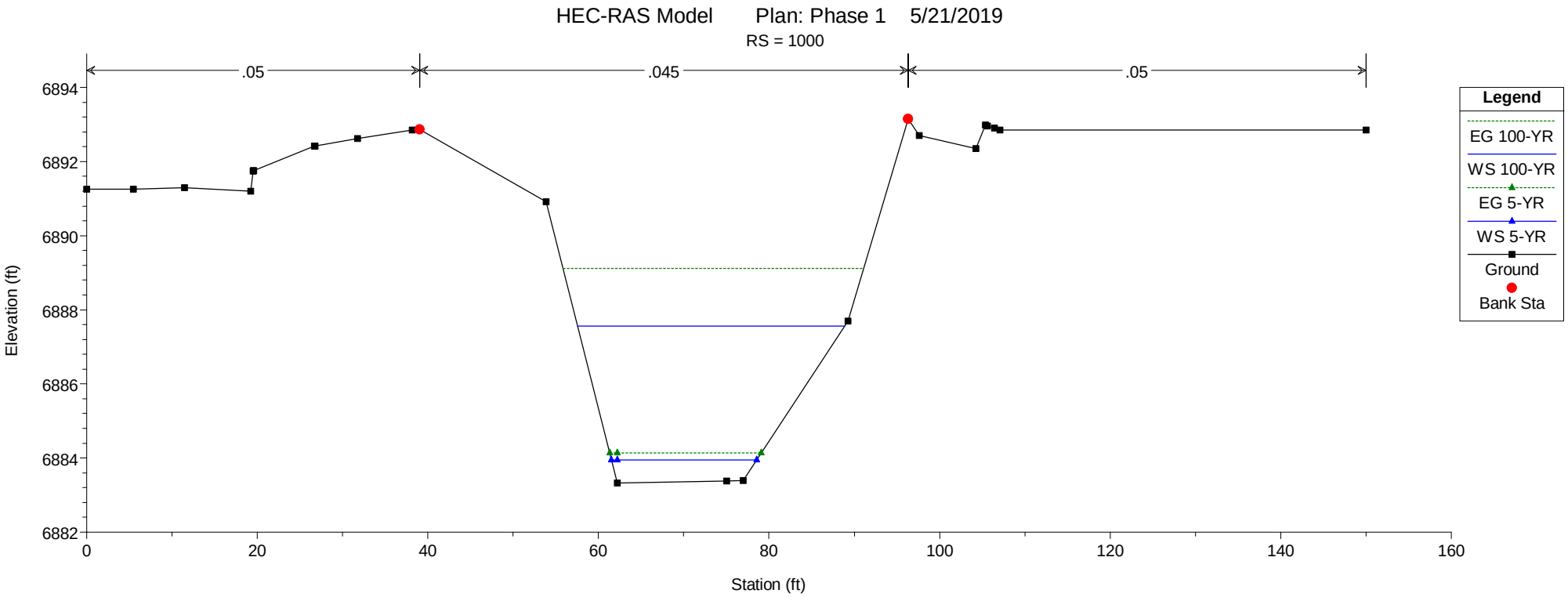

HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1250
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1200
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1150
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6896
6894
6892
6890
6888
6886
6884
0
50
100
150
200
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1100
.05
.045
.05
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta
Elevation (ft)
6894
6892
6890
6888
6886
6884
0
50
100
150
200
Station (ft)


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1050
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta


HEC-RAS Model Plan: Phase 1 5/21/2019
RS = 1000
.05
.045
.05
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
EG 5-YR
WS 5-YR
Ground
Bank Sta

APPENDIX E

Preliminary Pond Design

Tributary to Detention Pond WU

See Figures 3-2 & 3-7 of the Falcon Drainage Basin Planning Study (September 2015)

Basin	Area (sq miles)	Percent Impervious
WT10	0.14	2%
WT20	0.07	2%
WT30	0.08	4%
WT40	0.19	3%
WT50	0.19	2%
WT60	0.20	2%
WT70	0.17	1%
WT80	0.07	2%
WT90	0.15	1%
WT100	0.19	1%
WT110	0.19	2%
WT120	0.05	3%
WT130	0.10	29%
WT140	0.13	2%
WT150	0.23	10%
WT160	0.11	20%
WT170	0.12	3%
WT180	0.10	0%
WT190	0.06	8%
WT200	0.30	4%
WT210	0.27	12%
WT220	0.19	13%
WT230	0.20	27%
WT240	0.08	27%
Total	3.58	7.33%

Water Quality Capture Volume, WQCV:

WQCV = a(0.91*I* ^3 - 1.19*I* ^2 + 0.78*I*) (Equation 3-1)

Where:

a = Coefficient corresponding to WQCV drain time

I = Imperviousness (%/100)

Drain Time =	40	hrs
WQCV =	0.051	Inches

BMP Storage Volume, V:

V = (WQCV/12)A (Equation 3-3)

Where:

A = Tributary area (acres)

V =	9.764	acre-ft

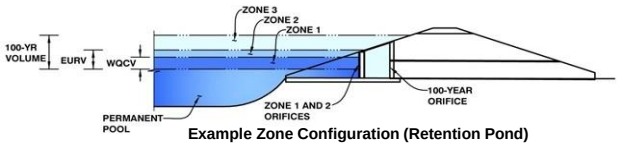
*Reference Section 3.0 of UDFCD Volume 3, August 2011

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **Challenger Homes**

Basin ID: **Detention and Water Quality Pond WU**



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	2291.20	acres		
Watershed Length =	27,984	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	7.33%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Castle Pines - City Office			
Water Quality Capture Volume (WQCV) =	9.764	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	11.312	acre-feet		
2-yr Runoff Volume (P1 = 0.84 in.) =	5.157	acre-feet		inches
5-yr Runoff Volume (P1 = 1.12 in.) =	7.503	acre-feet		inches
10-yr Runoff Volume (P1 = 1.36 in.) =	10.464	acre-feet		inches
25-yr Runoff Volume (P1 = 1.72 in.) =	17.753	acre-feet		inches
50-yr Runoff Volume (P1 = 2.01 in.) =	37.566	acre-feet		inches
100-yr Runoff Volume (P1 = 2.31 in.) =	82.799	acre-feet		inches
500-yr Runoff Volume (P1 = 3.07 in.) =	201.813	acre-feet		inches
Approximate 2-yr Detention Volume =	4.741	acre-feet		
Approximate 5-yr Detention Volume =	6.907	acre-feet		
Approximate 10-yr Detention Volume =	9.601	acre-feet		
Approximate 25-yr Detention Volume =	14.669	acre-feet		
Approximate 50-yr Detention Volume =	22.089	acre-feet		
Approximate 100-yr Detention Volume =	40.896	acre-feet		

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	15	0.000		
6818.2	--	1.90	--	--	--	21,261	0.488	20,000	0.459
6819	--	2.70	--	--	--	61,537	1.413	53,331	1.224
6820	--	3.70	--	--	--	111,883	2.568	140,041	3.215
6821	--	4.70	--	--	--	149,826	3.440	270,895	6.219
6822	--	5.70	--	--	--	184,669	4.239	438,143	10.058
6823	--	6.70	--	--	--	197,045	4.524	629,000	14.440
6824	--	7.70	--	--	--	203,805	4.679	829,425	19.041
6825	--	8.70	--	--	--	209,996	4.821	1,036,325	23.791
6826	--	9.70	--	--	--	216,045	4.960	1,249,346	28.681
6827	--	10.70	--	--	--	222,053	5.098	1,468,395	33.710
6828	--	11.70	--	--	--	228,051	5.235	1,693,447	38.876
6829	--	12.70	--	--	--	234,619	5.386	1,924,782	44.187
6830	--	13.70	--	--	--	241,328	5.540	2,162,755	49.650
6830.2	--	13.90	--	--	--	242,670	5.571	2,211,155	50.761
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
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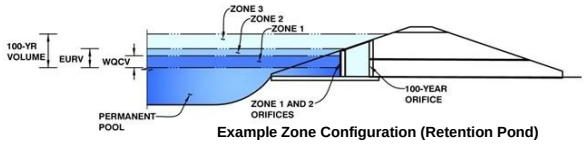
	--		--	--	--				
	--		--	--	--				

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Thompson Thrift**

Basin ID: **Detention and Water Quality Pond**



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	5.64	9.764	Orifice Plate
Zone 2			
Zone 3			
		9.764	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.102E-01	ft^2
Depth at top of Zone using Orifice Plate =	5.64	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	15.87	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00	4.00	5.00		
Orifice Area (sq. inches)	15.87	15.87	15.87	15.87	15.87	15.87		

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be $\geq$ 4
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	12.70	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	200.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.00	feet

Calculated Parameters for Spillway

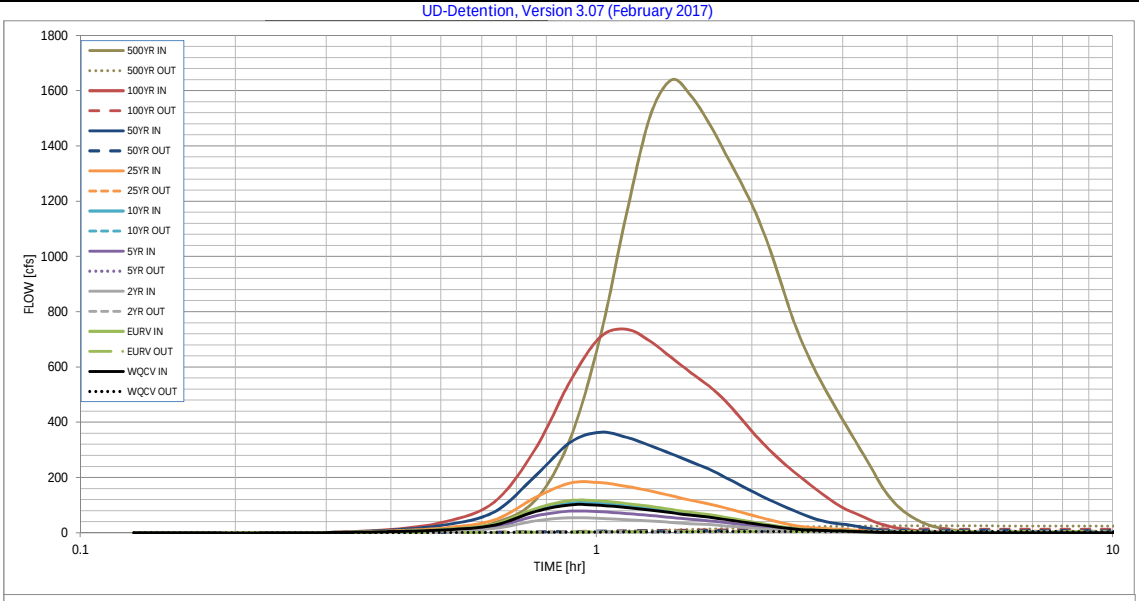
Spillway Design Flow Depth=	1.13	feet
Stage at Top of Freeboard =	13.83	feet
Basin Area at Top of Freeboard =	5.56	acres

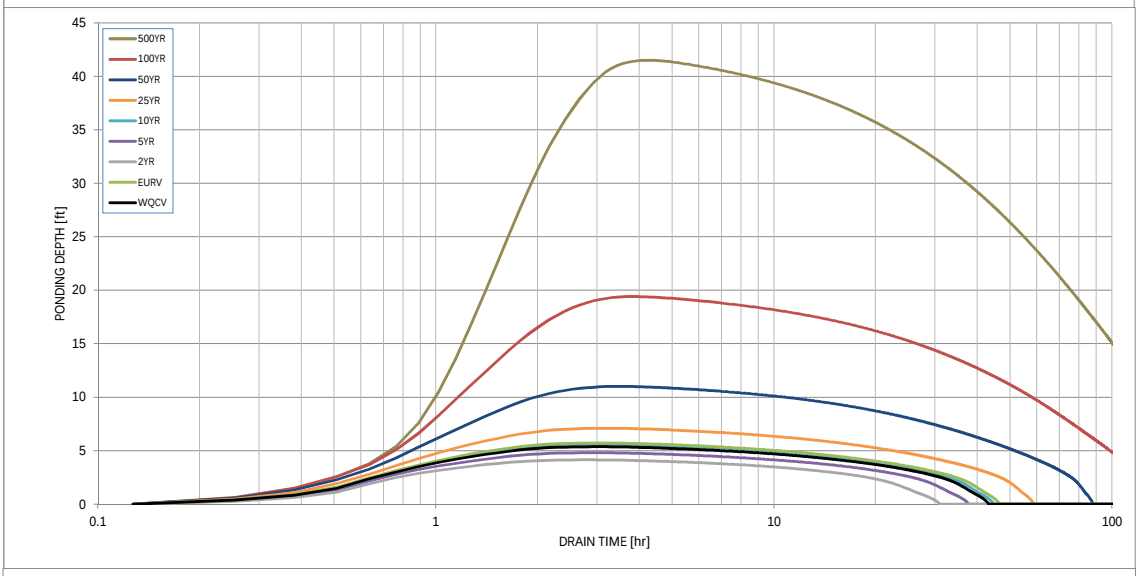
Routed Hydrograph Results

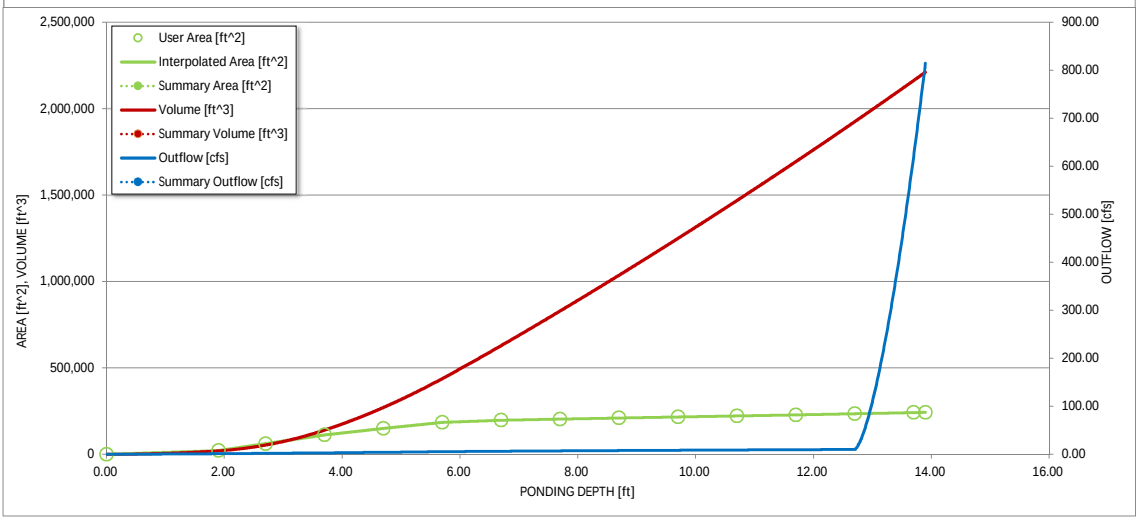
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.84	1.12	1.36	1.72	2.01	2.31	3.07
Calculated Runoff Volume (acre-ft) =	9.764	11.312	5.157	7.503	10.464	17.753	37.566	82.799	201.813
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	9.756	11.304	5.148	7.496	10.451	17.740	37.540	82.749	201.703
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.01	0.11	0.27	0.68
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	5.4	13.0	32.3	249.1	626.2	1569.1
Peak Inflow Q (cfs) =	101.5	117.0	54.5	78.6	108.5	181.6	364.4	736.9	1639.4
Peak Outflow Q (cfs) =	5.1	5.5	3.6	4.3	5.3	6.7	9.2	13.7	25.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.4	0.2	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	40	27	32	38	50	75	115	177
Time to Drain 99% of Inflow Volume (hours) =	40	43	29	35	41	54	81	124	>120
Maximum Ponding Depth (ft) =	5.37	5.72	4.14	4.81	5.53	7.10	11.01	19.41	41.50
Area at Maximum Ponding Depth (acres) =	3.98	4.25	2.95	3.53	4.10	4.59	5.14	5.57	5.57
Maximum Volume Stored (acre-ft) =	8.703	10.143	4.429	6.602	9.349	16.262	35.297	50.761	50.761

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
7.62 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:07:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:15:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:22:52	3.75	4.19	2.22	3.04	3.95	5.78	8.07	9.62	7.55
0.656	0:30:29	11.02	12.51	6.22	8.74	11.70	18.26	28.75	39.66	36.25
	0:38:06	28.31	32.16	15.96	22.44	30.05	47.01	76.51	112.76	119.21
	0:45:43	77.37	87.83	43.73	61.40	82.11	128.00	206.49	305.00	339.58
	0:53:20	101.50	117.04	54.48	78.60	108.49	180.31	327.12	548.13	706.31
	1:00:58	99.69	115.58	52.61	76.57	106.82	181.63	364.45	707.89	1152.67
	1:08:35	91.53	106.31	48.00	70.10	98.16	168.17	345.95	736.86	1507.19
	1:16:12	82.60	95.96	43.26	63.23	88.59	151.92	316.08	693.86	1639.38
	1:23:49	72.72	84.59	37.90	55.55	78.04	134.40	285.91	634.53	1582.08
	1:31:26	63.68	74.10	33.12	48.61	68.35	117.83	257.20	579.81	1484.12
	1:39:04	57.07	66.30	29.85	43.67	61.21	104.90	231.14	531.57	1371.90
	1:46:41	48.42	56.40	25.08	36.89	51.99	90.02	200.35	477.34	1267.45
	1:54:18	40.28	46.95	20.80	30.66	43.27	75.07	171.48	414.25	1160.11
	2:01:55	32.35	37.79	16.54	24.51	34.78	60.88	144.61	353.48	1035.17
	2:09:32	25.25	29.55	12.81	19.08	27.18	47.84	120.49	302.13	895.48
	2:17:10	19.12	22.42	9.61	14.40	20.60	36.62	99.24	258.47	763.51
	2:24:47	14.14	16.54	7.18	10.69	15.21	27.18	80.45	220.99	662.68
	2:32:24	11.22	13.09	5.75	8.52	12.05	21.23	63.54	187.66	578.97
	2:40:01	9.40	10.95	4.84	7.15	10.09	17.64	49.17	156.98	508.74
	2:47:38	8.13	9.46	4.20	6.19	8.73	15.17	39.88	128.85	445.41
	2:55:16	7.24	8.42	3.75	5.52	7.77	13.45	34.03	104.08	387.09
	3:02:53	6.60	7.68	3.44	5.05	7.09	12.22	30.08	84.67	331.93
	3:10:30	5.07	5.94	2.58	3.83	5.46	9.67	24.88	70.11	278.80
	3:18:07	3.65	4.27	1.86	2.76	3.93	6.98	18.88	56.07	226.05
	3:25:44	2.71	3.17	1.38	2.05	2.92	5.17	13.79	42.78	173.48
	3:33:22	2.01	2.36	1.03	1.52	2.17	3.83	10.17	32.10	133.07
	3:40:59	1.49	1.74	0.75	1.12	1.60	2.84	7.68	24.09	101.80
	3:48:36	1.08	1.26	0.54	0.81	1.16	2.07	5.79	18.05	78.28
	3:56:13	0.78	0.91	0.39	0.59	0.84	1.49	4.35	13.59	59.83
	4:03:50	0.55	0.65	0.28	0.42	0.60	1.08	3.26	10.39	45.67
	4:11:28	0.37	0.43	0.18	0.27	0.40	0.73	2.47	7.95	34.37
	4:19:05	0.22	0.26	0.10	0.16	0.24	0.45	1.79	6.21	25.80
	4:26:42	0.11	0.13	0.05	0.08	0.12	0.23	1.22	4.79	19.98
	4:34:19	0.03	0.04	0.01	0.02	0.04	0.09	0.76	3.55	15.62
	4:41:56	0.00	0.00	0.00	0.00	0.00	0.01	0.41	2.50	12.50
	4:49:34	0.00	0.00	0.00	0.00	0.00	0.00	0.16	1.63	9.73
	4:57:11	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.95	7.31
	5:04:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	5.24
	5:12:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	3.51
	5:20:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12
	5:27:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07
	5:35:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37
	5:42:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	5:50:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:13:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:28:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:36:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:43:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:51:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:59:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:06:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:14:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:21:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:29:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:37:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:44:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:52:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:00:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:07:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:15:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:22:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:30:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:38:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:45:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:53:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:01:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9:08:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, May 21 2019

5-yr Weir

Trapezoidal Weir

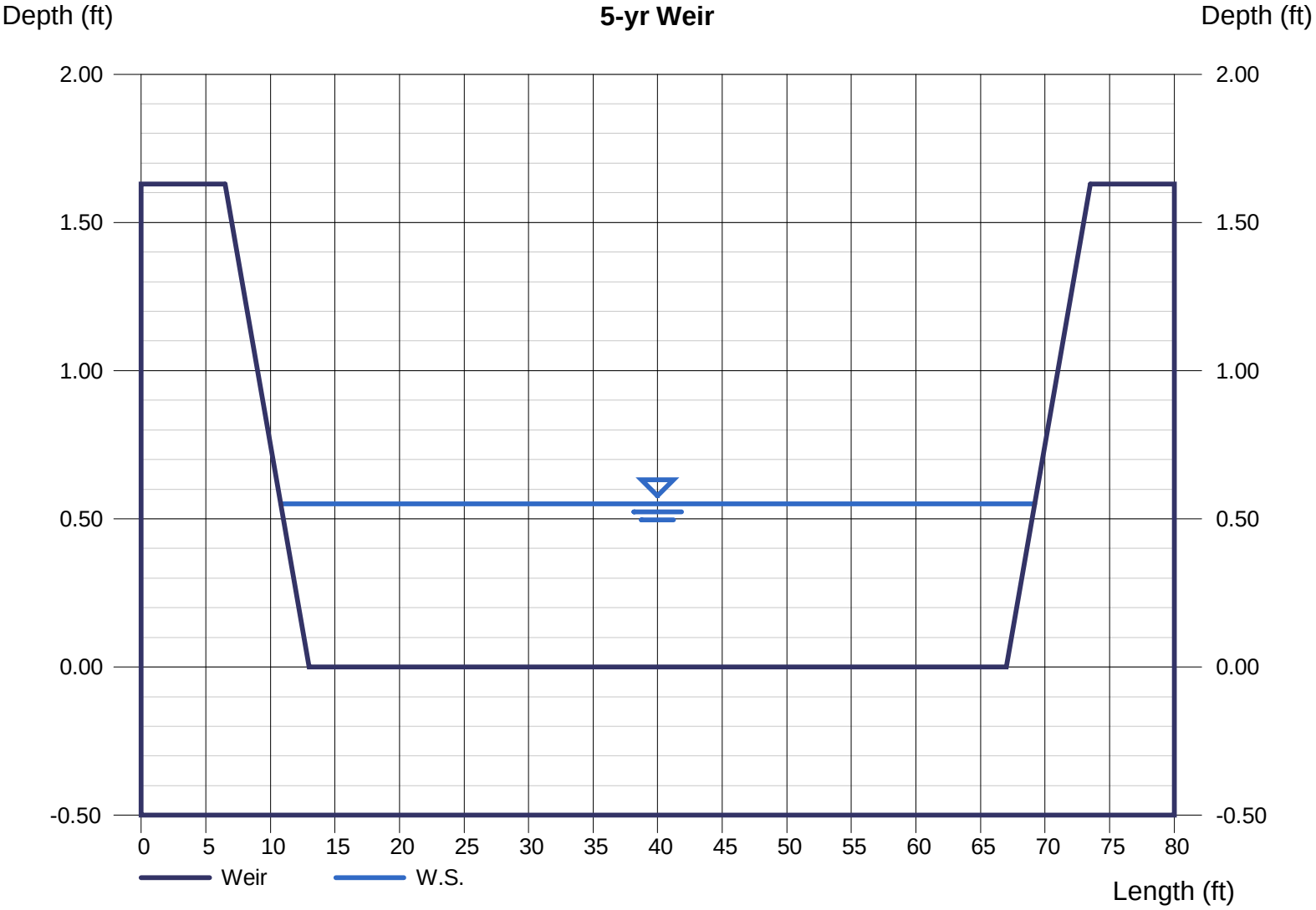
Crest	=	Sharp
Bottom Length (ft)	=	54.00
Total Depth (ft)	=	1.63
Side Slope (z:1)	=	4.00

Calculations

Weir Coeff. Cw	=	3.10
Compute by:		Known Q
Known Q (cfs)	=	70.00

Highlighted

Depth (ft)	=	0.55
Q (cfs)	=	70.00
Area (sqft)	=	30.91
Velocity (ft/s)	=	2.26
Top Width (ft)	=	58.40



Rock Chute Design - Plan Sheet

(Version 4.02 - 11/04/09, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Pond WU - Riprap Weir
Designer: Aaron Johnston
Date: 5/20/2019

County: 0.00
Checked by:
Date:

Design Values

Angular D_{50} dia. = *19.1* in.
$Rock_{chute}$ thickness = *38.3* in.
Inlet apron length = *19* ft.
Outlet apron length = *24* ft.
Radius = *53* ft.
Will bedding be used? *Yes* ---------- Depth (in.) = *6.0*

Rock Gradation Envelope

% Passing	Diameter, in. (weight, lbs.)
D_{100} ---------	29 - 38 (1714 - 4062)
D_{85} ---------	25 - 34 (1116 - 2961)
D_{50} ---------	19 - 29 (508 - 1714)
D_{10} ---------	15 - 25 (260 - 1116)

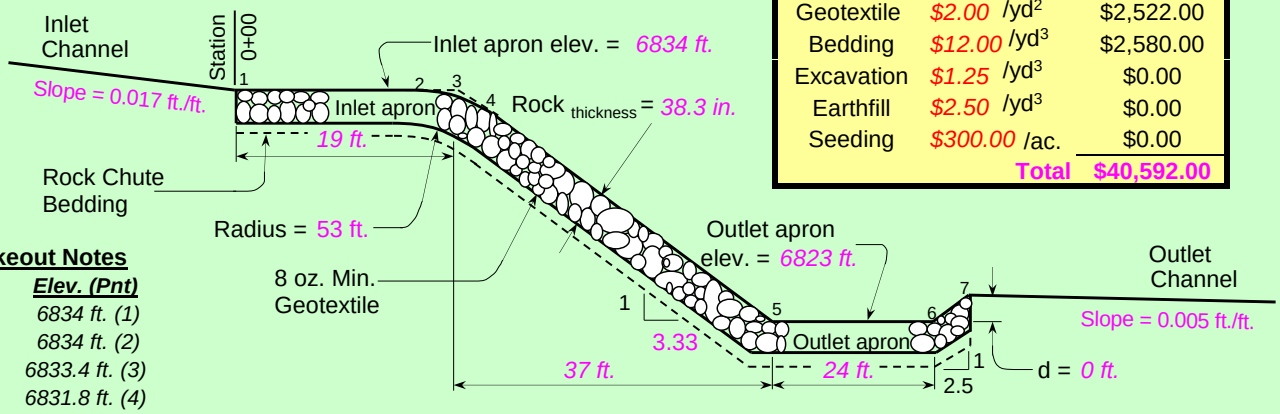
Quantities [a]

Angular Rock = 1183 yd^3
Geotextile (8 oz.)[b] = 1261 yd^2
Bedding (6 in.) = 215 yd^3
Excavation = *0* yd^3
Earthfill = *0* yd^3
Seeding = *0.0* acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).*
[b] *Geotextile shall be overlapped (18-in. min.) and anchored (18-in. min. along sides and 24-in. min. on the ends).*

Rock Chute Cost Estimate

Unit	Unit Cost	Cost
Rock	*$30.00* /$yd^3$	$35,490.00
Geotextile	*$2.00* /$yd^2$	$2,522.00
Bedding	*$12.00* /$yd^3$	$2,580.00
Excavation	*$1.25* /$yd^3$	$0.00
Earthfill	*$2.50* /$yd^3$	$0.00
Seeding	*$300.00* /ac.	$0.00
	Total	**$40,592.00**

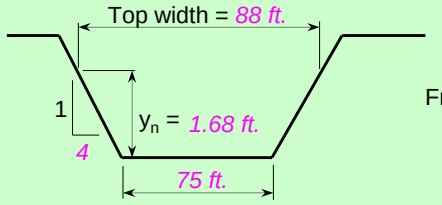


Profile Along Centerline of Rock Chute

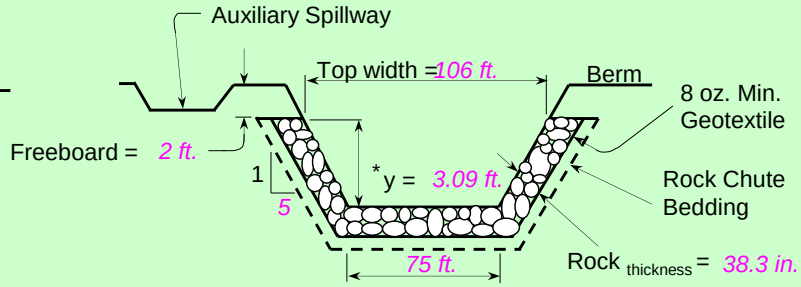
*****Note:*** ***The outlet will not function adequately***

Stakeout Notes

Sta.	Elev. (Pnt)
0+00	6834 ft. (1)
0+11.2	6834 ft. (2)
0+19	6833.4 ft. (3)
0+26.5	6831.8 ft. (4)
0+56	6823 ft. (5)
0+80	6823 ft. (6)
0+80	6823 ft. (7)

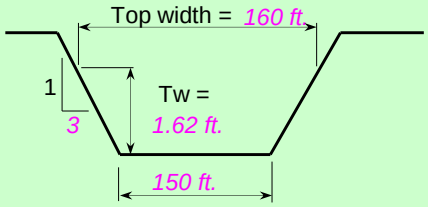


Inlet Channel Cross Section



Rock Chute Cross Section

* Use H_p throughout chute but not less than z_2.



Outlet Channel Cross Section

Profile, Cross Sections, and Quantities

Project: Pond WU - Riprap Weir
Location: County

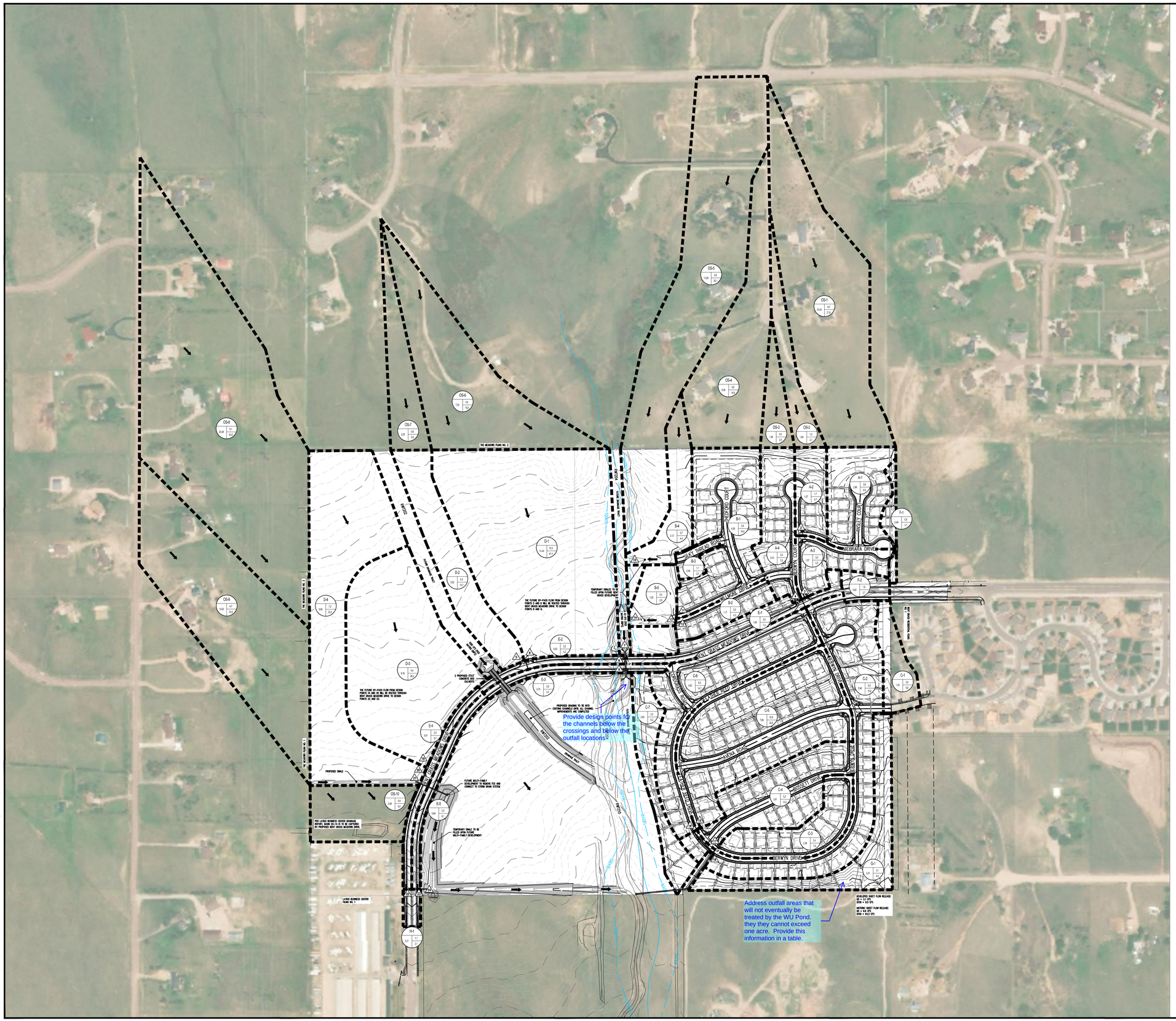
U.S. Department of Agriculture
Natural Resources Conservation Service

Designed: Aaron Johnston	Approved by:	
Drawn: NRCS Standard Dwg.	Title:	
Traced:	Sheet No.	Drawing No.
Checked:	of	

APPENDIX F

Drainage Map

Provide an existing conditions drainage plan/map.



VICINITY MAP

N

0 20 50 100
SCALE: 1"=100'

DRAINAGE LEGEND

- PROPERTY LINE
- 6485 EXISTING MAJOR CONTOUR
- 6483 EXISTING MINOR CONTOUR
- BASIN BOUNDARY LINE
- 100-YR FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

DESIGN POINT SUMMARY TABLE

Design Point	Q5 (cfs)	Q100 (cfs)
1	6.8	26.8
2	8.7	30.8
3	9.8	33.2
4	12.1	40.1
5	4.2	25.8
6	15.3	25.8
7	4.0	43.0
8	18.3	70.4
9	21.2	97.7
10	1.4	6.0
11	8.0	24.6
12	2.0	4.3
13	9.5	27.8
14	9.5	29.2
15	10.9	24.9
16	15.1	24.0
17	9.0	27.4
18	31.2	74.0
19	9.4	35.3
20	19.0	46.4
21	22.7	63.9
22	2.4	17.1
23	4.0	34.0
24	25.5	91.6

RUNOFF SUMMARY TABLE

Basin ID	Q5 (cfs)	Q100 (cfs)
A-1	3.6	9.5
A-2	1.7	4.7
A-3	2.0	5.0
A-4	3.0	7.9
B-1	5.8	14.9
B-2	2.0	4.3
B-3	1.1	2.3
B-4	0.7	4.4
B-5	0.4	2.9
C-1	2.6	5.8
C-2	6.2	15.9
C-3	3.4	7.9
C-4	5.2	12.0
C-5	10.9	24.9
C-6	6.0	14.7
C-7	2.0	6.2
D-1	15.3	41.1
D-2	4.2	10.7
D-3	9.4	26.2
D-4	7.2	23.5
E-1	3.5	7.4
E-2	2.2	4.2
E-3	2.9	5.3
E-4	3.0	5.7
E-5	3.3	6.1
F-1	0.6	1.7
F-2	1.8	3.7
G-1	3.1	9.5
H-1	1.1	2.1
OS-1	4.5	21.8
OS-2	1.2	2.1
OS-3	0.4	2.4
OS-4	3.8	14.8
OS-5	5.8	26.1
OS-6	4.6	18.5
OS-7	0.8	4.8
OS-8	9.1	43.5
OS-9	4.7	22.6
OS-10	0.9	6.0

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Colorado Springs, CO 80920
719.900.7220
GallowayUS.com

NOT FOR CONSTRUCTION

CHALLENGER HOMES

BENT GRASS RESIDENTIAL FILING NO. 2
DRAINAGE PLAN

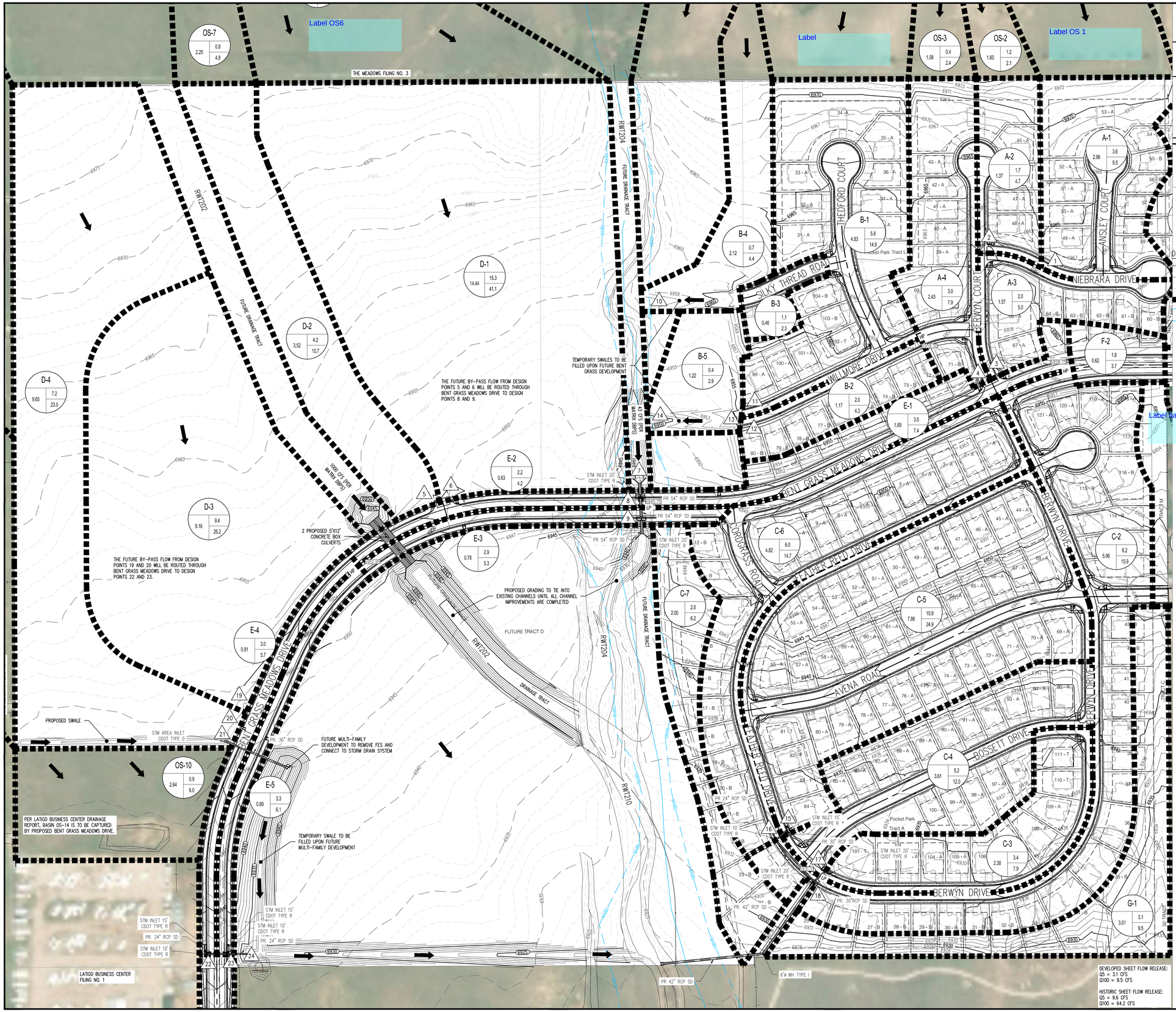
BENT GRASS MEADOWS DRIVE
COLORADO SPRINGS, COLORADO

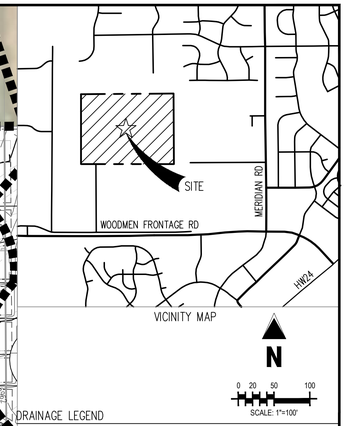
#	Date	Issue / Description	Init.

Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	SMB
Date:	JUNE 2019

OVERALL BASIN PLAN - FDR

DR-1
Sheet 1 of 2





DRAINAGE LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- BASIN BOUNDARY LINE
- FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	6.8	26.8
2	8.7	30.8
3	9.8	33.2
4	12.1	40.1
5	4.2	25.8
6	15.3	25.8
7	4.0	43.0
8	18.3	70.4
9	21.2	97.7
10	1.4	6.0
11	8.0	24.6
12	2.0	4.3
13	9.5	27.8
14	9.5	29.2
15	10.9	24.9
16	15.1	24.0
17	9.0	27.4
18	31.2	74.0
19	9.4	35.3
20	19.0	46.4
21	22.7	63.9
22	2.4	17.1
23	4.0	34.0
24	25.5	91.6

RUNOFF SUMMARY TABLE

Basin ID	Q_5 (cfs)	Q_{100} (cfs)
A-1	3.6	9.5
A-2	1.7	4.7
A-3	2.0	5.0
A-4	3.0	7.9
B-1	5.8	14.9
B-2	2.0	4.3
B-3	1.1	2.3
B-4	0.7	4.4
B-5	0.4	2.9
C-1	2.6	5.8
C-2	6.2	15.9
C-3	3.4	7.9
C-4	5.2	12.0
C-5	10.9	24.9
C-6	6.0	14.7
C-7	2.0	6.2
D-1	15.3	41.1
D-2	4.2	10.7
D-3	9.4	26.2
D-4	7.2	23.5
E-1	3.5	7.4
E-2	2.2	4.2
E-3	2.9	5.3
E-4	3.0	5.7
E-5	3.3	6.1
F-1	0.6	1.7
F-2	1.8	3.7
G-1	3.1	9.5
H-1	1.1	2.1
OS-1	4.5	21.8
OS-2	1.2	2.1
OS-3	0.4	2.4
OS-4	3.8	14.8
OS-5	5.8	26.1
OS-6	4.6	18.5
OS-7	0.8	4.8
OS-8	9.1	43.5
OS-9	4.7	22.6
OS-10	0.9	6.0

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Include a inlet and pipe routinng summary table

BENT GRASS RESIDENTIAL FILING NO. 2
DRAINAGE PLAN

BENT GRASS MEADOWS DRIVE
COLORADO SPRINGS, COLORADO

#	Date	Issue / Description	Init.

Include acreage of each basin in this table

Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	SMB
Date:	JUNE 2019

PROPOSED DRAINAGE MAP - FDR

DR-2
Sheet 2 of 2