Appendix D

Rock Creek Road
Preliminary Hydraulics Recommendations Memorandum
Mono County, California
December 2012

Rock Creek Road

CA PFH 89-1(1)

Preliminary Hydraulics Recommendations Memorandum

Mono County, California

Prepared for:

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Project No. WVXW3020

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I. PROJECT DESCRIPTION AND LOCATION

A. DESCRIPTION

This project consists of improvements to California Forest Highway (FH) 89, Rock Creek Road. The Federal Highway Administration, Central Federal Lands Highway Division (CFLHD), in cooperation with Mono County, Inyo County, and the Inyo National Forest (INF) propose to rehabilitate, restore, and resurface (3R) approximately 9.2 miles of the roadway. This project will be funded through the Federal Lands Access Program. The project limits are shown on the following page. This route is within the INF, but is maintained by the County.

This route is a two-lane paved roadway with paved widths varying from 22 to 24 feet and variable width unpaved shoulders. One goal of the project is to widen the pavement section to add a bike lane, achieving a total paved width of 28 feet. The intent is to maintain all cuts and fills within the existing bench as much as possible. The alignment for FH-89 consists of relatively gentle horizontal curvature in mountainous terrain. The route is posted at 35 mph. Based on the general design speed of the existing roadway, a 40 mph design speed was chosen for this project.

Three separate field review meetings have been held to date. A scoping review was held in November 2011; a Social, Economic, and Environmental (SEE Team) meeting and field review was held in July 2012; and a 30% design field review was conducted in November 2012. The purpose of the reviews were to review the conceptual plans, add site features, review existing culverts, document and review parking pullouts, document clear zone issues, signs, pavement markings, utilities, and discuss design requirements with the Counties and INF. Part of the site investigations was to determine existing drainage conditions within the project area and to make recommendations for improvements.

During the reviews, the team examined the major drainage crossings and visible culverts, noted size and condition of the pipes and needs for replacement of pipes, end sections, and/or headwalls. The purpose of this memorandum is to document the findings of the various field reviews, to define criteria and computational methods used for the hydrologic and hydraulic analysis, and to document the recommendations for culvert extensions or replacements for the project.

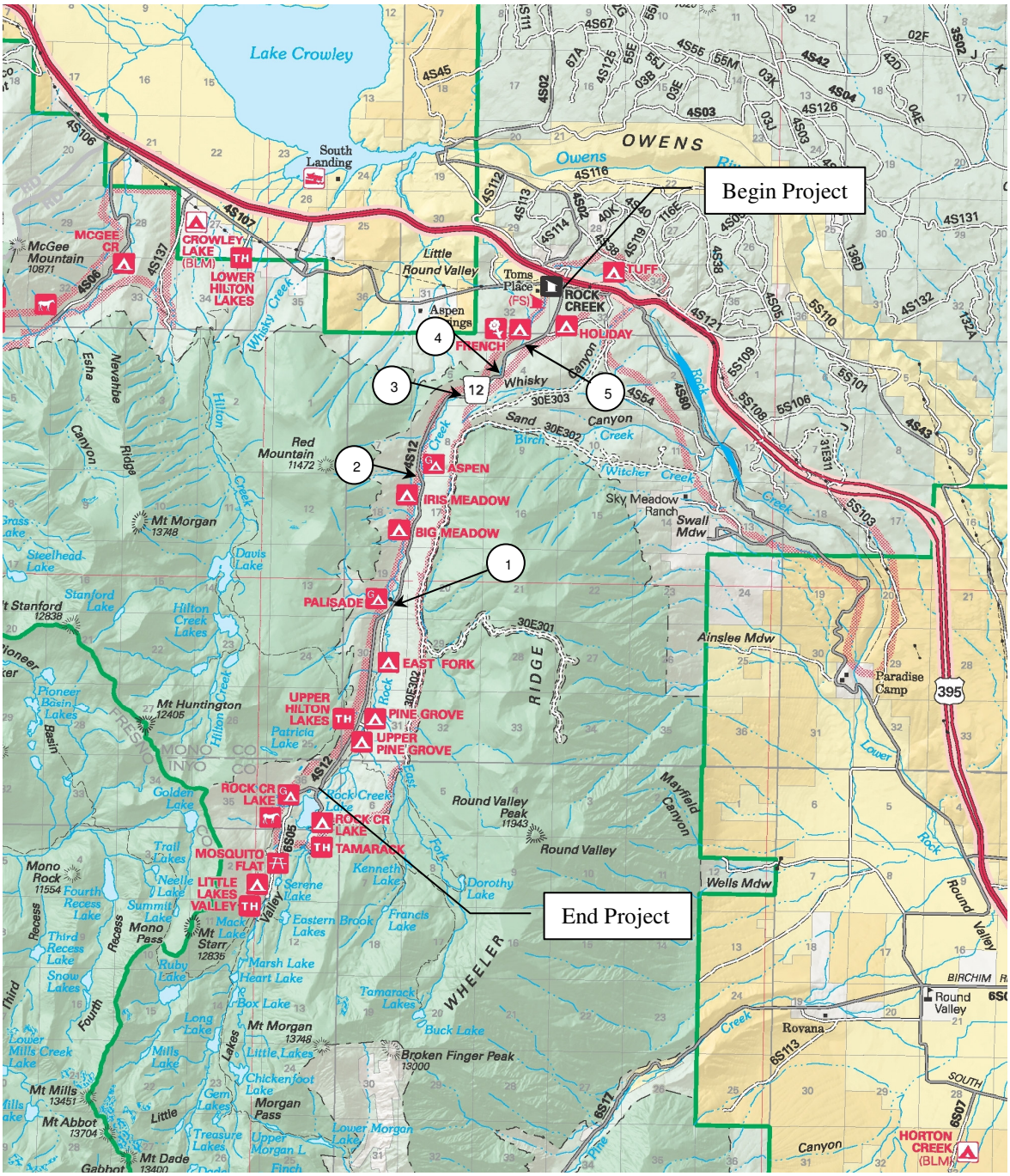


FIGURE 1: LOCATION MAP

B. LOCATION

The segment of FH-89 for this project begins at the intersection with Crowley Lake Drive, just south of Highway 395, approximately 25 miles northwest of Bishop, California. The project terminates approximately 9.2 miles to the south at Rock Creek Lake. The roadway is owned by Inyo National Forest and maintained by Mono County. The route is functionally classified as a minor collector servicing the INF. All facilities along the route are associated with the use of adjacent lands, and all of the traffic on Rock Creek Road is related to recreational use in the forest. The route serves as the only access to 11 campgrounds, two resorts, a pack station, a boat launch, and multiple trail heads.

II. DRAINAGE BASINS

A. MAJOR BASINS

Larger flow areas or major basin crossings were identified using USGS mapping or field observations of active flow or evidence of erosion at the culvert inlet or outlet. These locations required a more detailed hydrologic and hydraulic analysis. The recommendations considered several factors, such as size of culvert required to provide a 25-year crossing; available headwater depth; length of culvert required to provide a stable slope from the edge of pavement to the top of pipe; and need for end treatment, including end sections, headwalls and wingwalls, and riprap outlet protection.

FH-89 is within the Rock Creek drainage basin. Rock Creek flows northerly through the project area parallel to the roadway. Within the lower 5.8 miles of the project, Rock Creek crosses the roadway five times (See Figure 1: Location Map for crossing locations). Further south (upstream) Rock Creek stays along the east side of the roadway until the road terminates at Mosquito Flat. Several tributaries contribute to Rock Creek along the 9.2 miles of road. Six of these tributaries cross Rock Creek Road prior to joining the creek, five of which are located upstream of the first major crossing of Rock Creek, near the Palisade campground.

B. MINOR BASINS

In addition to the major drainage crossings, there are approximately 38 existing minor culvert crossings within the project area. This includes cross culverts for minor basins and ditch relief culverts. Pipe sizes for these basins range from 12 inches to 48 inches in diameter. Existing culverts were noted during the scoping review in November 2011 and were further assessed during the 30% field review in November 2012. The general approach being taken for minor culvert replacement is as follows:

- Existing 12" culverts will generally be upsized to a minimum of 18". The preferred minimum of 24" will be used where enough grade and cover exist.

- 18" and larger culverts within Mono County that appear to be hydraulically adequate and in good condition are to remain.

- Inyo County has requested that all existing culverts within their portion of the route (approximately the southernmost 1.1 miles) be replaced in kind.

III. DRAINAGE DESIGN CRITERIA

A. GENERAL CRITERIA

Hydrology and hydraulics criteria for the Rock Creek Road project is generally based on the guidelines outlined in Chapter 7 of the Federal Lands Highway Project Development and Design Manual (PDDM) (Reference 1).

B. HYDROLOGIC CRITERIA

Hydrologic analysis for the project was done only in specific locations. These locations were identified to be in larger flow areas (major basins), or areas where further analysis was required to make proper recommendations. Locations were chosen based on field observations of active flow or evidence of erosion at the inlet or outlet of the culvert. As discussed in the field, the five major open-bottom culverts would be extended on the downstream side to accommodate the widening of Rock Creek Road for the bike lane, while not raising the water surface elevation of Rock Creek.

Two different hydrologic methodologies were used for this analysis, the regional regression equations (Reference 2) and the NRCS TR-55 graphical peak method (Reference 3). Regional regression equations were used for the major Rock Creek crossings and for the six tributary crossings. TR-55 was used as a comparison for the smaller tributary crossings.

The USGS National Streamflow Statistics (NSS) program uses current statewide regression equations to estimate flood magnitude and frequency on ungaged watersheds. The NSS recently replaced the National Flood Frequency (NFF) program. A recent update of the regression equations and hydraulic regions for the state of California was released in a July 2012 report (Reference 2) where 30 years of additional flood gage data have been analyzed. The software program developed by NSS to estimate flood magnitude and frequency would normally be used in this instance, but the software does not include this latest change. Instead, the regression equations from the July 2012 report were used to calculate design flows for the project area. California is divided into six hydrologic regions, each with their own regression equations. The project area is within the Sierra Nevada Region (formerly the Sierra Region). Variables used in the equations are basin area, mean annual precipitation, and mean basin elevation. This methodology recommends a minimum basin area of 0.14 square miles (90 acres). Locations where hydrologic

analysis was performed are along major drainageways, and the specific basins chosen meet this minimum basin size requirement.

The NRCS TR-55 graphical peak method was used initially for the six tributary basins. This method relies on basin parameters such as soil cover, hydrologic soils group, runoff curve number, area, length, slope, and time of concentration. Rainfall precipitation was based on NOAA (Atlas 14) Point Precipitation Frequency Estimates for the 24-hour storm duration.

These two approaches are consistent with the recommended hydrology guidelines presented in the PDDM. However, results of the TR-55 method produced design flows much higher than anticipated and at a much higher magnitude than has been observed in this area. Mono County has stated that they are not aware of any specific drainage deficiencies or the need for significantly increased culvert capacity at any locations along the route. Therefore, for the purpose of comparison to the TR-55 method, regression analysis was also used on the six tributary basins (all larger than 90 acres), and the results produced flow rates much closer to those expected.

The overestimation of the TR-55 method is believed to be caused by the sensitivity of the curve number in an area that is not well studied and has limited soils data. The soils data collected for the Rock Creek basin showed large areas of Type D soils with high runoff potential. Since the regression analysis produced flow rates that are more consistent with observed flows and existing culvert sizes, this analysis was used to determine the design flows.

The minimum design storm frequency is based on the roadway classification. For this route, based on the design speed (< 45 mph), current and future Average Daily Traffic (< 1500), and not being designated as a critical access road; this route is classified as a low-standard road. Therefore culvert replacements are recommended to be designed for the 25-year storm event, in accordance with Table 7.1-A of the PDDM.

C. HYDRAULIC CRITERIA

Culverts

The minimum culvert size for replacements is typically 18”. Existing culverts smaller than 18” are to be replaced. In some cases where very little cover is available, this is the largest pipe that will fit. End treatments will typically consist of end sections, but headwalls will be used on the larger pipes. Culvert outlets will include rock riprap outlet protection. Culvert hydraulic design is based on the PDDM, with both capacity design and stability design considered. Headwater to depth ratios (HW/D) up to 1.5 are allowed. Object markers are to be provided at the end of each culvert (existing and proposed).

Riprap
Local scour at culvert entrances and outlets was observed in some locations, as well as the need to further stabilize the fill slopes approaching the culverts. The need for riprap protection at the culvert inlets and outlets, stream channels, and adjacent fill slopes will be evaluated and designed based on the guidance in HEC-14 (Reference 4).

Inlets
When needed, drop inlets will be used in cut sections of the roadway with narrow ditch widths and in some areas where underdrains are required. Inlets may be added to both existing and new culverts.

Ditches
Roadside ditch sections will be utilized in conjunction with the 3R roadway sections. Roadside ditches will be either grass lined or riprap lined, depending on grade and velocity, and will be designed based on the guidance in HEC-15 (Reference 5). Ditches will be protected during construction with erosion control devices. Ditch relief culvert crossings will be provided where deemed necessary.

Floodplains
According to the effective Flood Insurance Rate Maps (FIRMs), there are no mapped 100-year floodplains within the project area.

Aquatic Organism Passage
In general, culvert crossings on live (perennial) streams are to be evaluated on whether they need to be designed to accommodate aquatic organism passage. Rock Creek is a live stream within the project area, and based on field observations the existing crossings appear to have been sized and designed to accommodate aquatic organism passage. They are three-sided structures with a natural stream bottom, so the streambed through the culvert mimics the natural stream conditions. The proposed extensions of these culverts will not alter the existing streambed conditions and therefore will not impact the ability of the structures to adequately pass aquatic organisms.

INF has requested that the other perennial (“blue line”) tributaries also be evaluated, and that any culverts to be replaced with the project be considered for aquatic organism passage. Each of the tributary crossings was evaluated during the 30% field review in November 2012. In most cases the streams themselves are very steep immediately upstream and downstream of the road, and it is unlikely that the existing streams accommodate the migration of aquatic organisms. It was also observed that not all of the blue line streams are actively flowing throughout the year. Based on these observations, the current recommendation is that these six culverts do not need to accommodate aquatic organism passage. INF is to provide their concurrence to this prior to final design.

IV. RECOMMENDED DRAINAGE STRUCTURES

A. MINOR CROSSINGS

During the scoping field review in November 2011, an inventory was taken of the existing drainage culverts along the project route. The existing culverts were assessed during the subsequent field reviews and initial recommendations have been made.

In general, the minor culverts are structurally intact but some require cleaning to remove sediment and debris. Some of the culverts require end section improvements as well as regrading to repair the effects of scour. The culverts that are damaged beyond repair or did not meet the minimum size requirements are recommended to be replaced. As noted previously, Inyo County has requested that all culverts within their section of the roadway be replaced.

Some of the existing culverts are 12", so replacing them even with a minimum size of 18" will be an improvement, as far as hydraulic capacity and clogging potential. Many of the existing culverts are recommended to remain in place, since they are in good condition and appear to be hydraulically adequate. For some of the culverts to remain, other recommendations have been made, such as adding or replacing end sections, cleaning the inlet and/or outlet areas, or adding outlet protection.

During the 30% field review in November 2012 there was further assessment of many of the culverts on a location by location basis and further discussion with County staff. Existing culverts were inspected for condition, hydraulic adequacy, and erosion problems. Roadside ditches were also visually evaluated for capacity and erosion problems. In some of the narrower areas, use of a paved ditch may be an option to reduce the construction limits. Some areas where underdrain is needed were also identified.

B. MAJOR CROSSINGS

As noted previously, hydrologic and hydraulic analysis was performed at the five locations where Rock Creek crosses Rock Creek Road. Ideally the existing open-bottom arch culverts will all remain in place. The design concept discussed is to construct a clear span concrete slab structure at the downstream side of each culvert, which will act as an "extension" of the culvert and will accommodate the wider roadway section. Extending the culverts on the downstream side will also minimize any hydraulic impacts. The hydraulic function and capacity of the existing structures was checked using HEC-RAS (Reference 6). The specific locations are listed below.

Station 1069+80 (RC 5)
The existing crossing is a 13' wide x 8' high concrete arch open-bottom culvert. Proposed is to extend to the right side.

Station 1079+08 (RC 4)
The existing crossing is a 13' wide x 9' high concrete arch open-bottom culvert. Proposed is to extend to the left side.

Station 1126+56 (RC 3)
The existing crossing is a 13' wide x 8' high concrete arch open-bottom culvert. Proposed is to extend to the right side.

Station 1201+50 (RC 2)
The existing crossing is a 13' wide x 7' high concrete arch open-bottom culvert. Proposed is to extend to the left side.

Station 1301+01 (RC 1)
The existing crossing is a 12' wide x 8' high concrete arch open-bottom culvert. Proposed is to extend to the right side.

Hydraulic analysis has shown that each of these crossings is hydraulically adequate to convey the 25-year flow. Results of the hydraulic analysis are included in the Appendix.

In addition to these locations, six other tributary crossings along Rock Creek Road were identified by review of the USGS maps as being major "blue-line" crossings that warrant further analysis. The results of the analysis have determined their hydraulic adequacy, and recommendations for any required replacements and/or outlet protection are made below.

Station 1165+24 (TR 7)
The existing crossing is an 18" CMP. The upstream invert was not found and was assumed to be buried. The culvert should be replaced with a 24" pipe.

Station 1311+27 (TR 6)
The existing crossing is an 18" CMP. The culvert has been evaluated for hydraulic adequacy and is undersized. This crossing will require a 36" culvert.

Station 1351+92 (TR 5)
The existing crossing is an 18" CMP. The culvert has been evaluated for hydraulic adequacy and is undersized. The culvert should be replaced with a 30" pipe.

Station 1380+30 (TR 4)
The existing crossing is an 18" CMP. The culvert has been evaluated for hydraulic adequacy and is undersized. The culvert should be replaced with a 24" pipe.

Station 1424+72 (TR 3)
The existing crossing is a 36" CMP. The culvert was found to be hydraulically adequate and will be replaced in kind.

Station 1476+88 (RC 2)
The existing crossing is a series of two 36" CMP's. The culverts were found to be hydraulically adequate and will be replaced in kind.

Final culvert profiles will be designed using the guidelines in the Guide for Designing and Staking Culvert in the Field (Reference 7). Culvert end treatments, in the form of headwalls or end sections with rock riprap outlet protection as needed, will be provided at all new culvert installations.

V. EROSION CONTROL AND WATER QUALITY

An erosion and sediment control plan will be developed for the project during final design, which will consist of measures that serve as Best Management Practices (BMP's) for water quality during construction, as well as permanent measures. The BMP's for erosion and sediment control focus primarily toward protecting receiving waters and water sources in areas of construction activity. They include controls such as silt fence, inlet protection, and riprap outlet protection at culverts. Roadside ditches will also be protected during construction.

VI. CONCLUSION

The CFLHD Project Design and Development Manual (PDDM) was used for drainage criteria, with a 25-year recurrence interval used for the analysis of the cross culverts. The current recommendations for each minor culvert location have been assessed during the field reviews, and final recommendations for major culverts will be based on consideration of all pertinent criteria and constraints, with input and acceptance by the appropriate County, INF, and CFLHD personnel. The two hydrology methods to be analyzed, regression analysis and TR-55, are consistent with the PDDM.

VII. REFERENCES

1. *Federal Lands Highway Project Development and Design Manual (PDDM)*, prepared by the Federal Highway Administration (FHWA-USDT), February 2011.

2. *Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006,* prepared in cooperation with FEMA, 2012.

3. *WinTR-55 Computer Program, Urban Hydrology for Small Watersheds, Version 1.00.09*, developed by the Natural Resources Conservation Service, dated August 5, 2009.

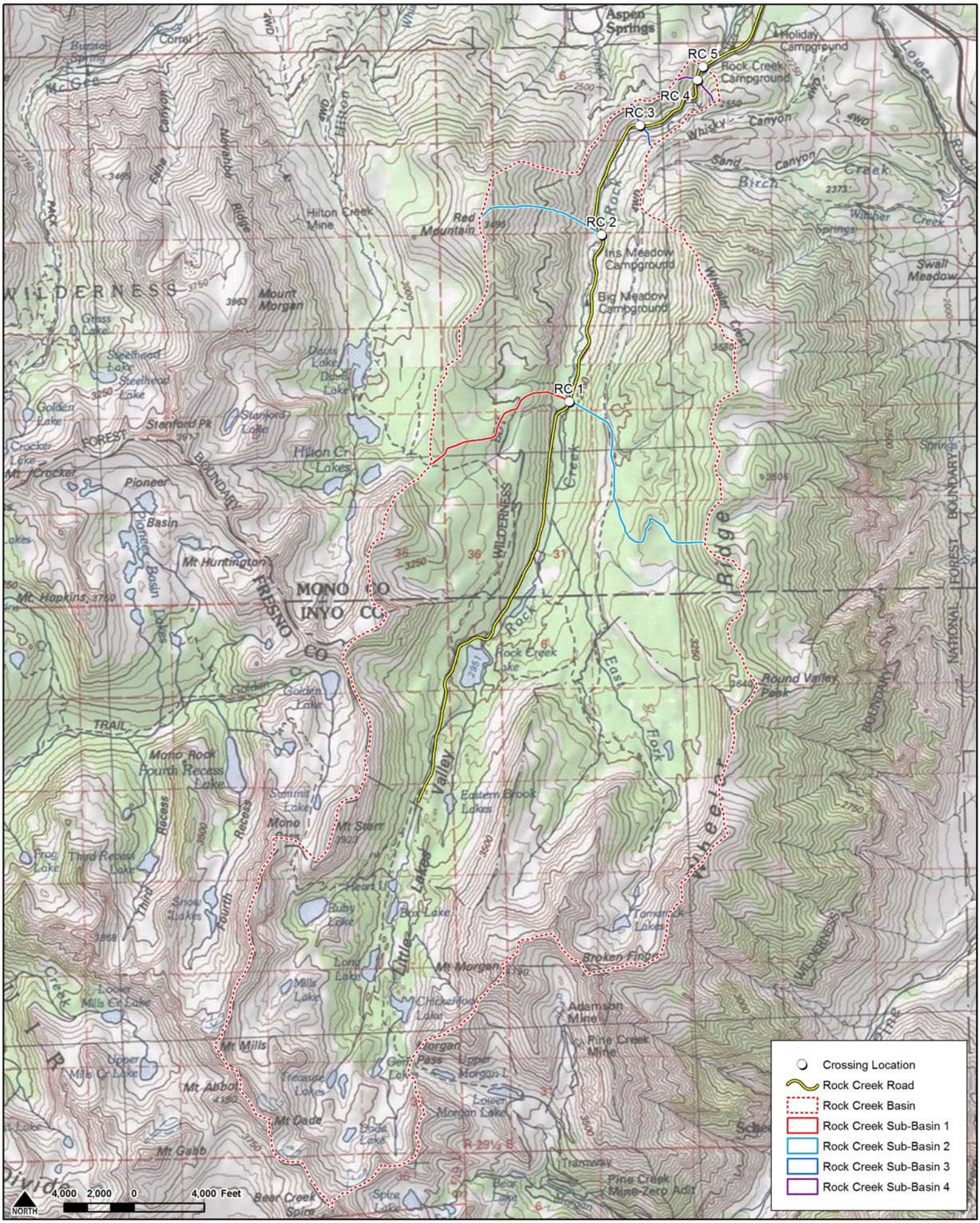
4. *FHWA HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channels,* prepared by the Federal Highway Administration (NHI-06-086), 2006.

5. *FWHA HEC-15, Design of Roadside Channels with Flexible Linings,* prepared by the Federal Highway Administration (NHI-05-114), 2005.

6. HEC-RAS, River Analysis System; Version 4.1.0; Hydraulic Engineering Center – U.S. Army Corps of Engineers; January 2010.

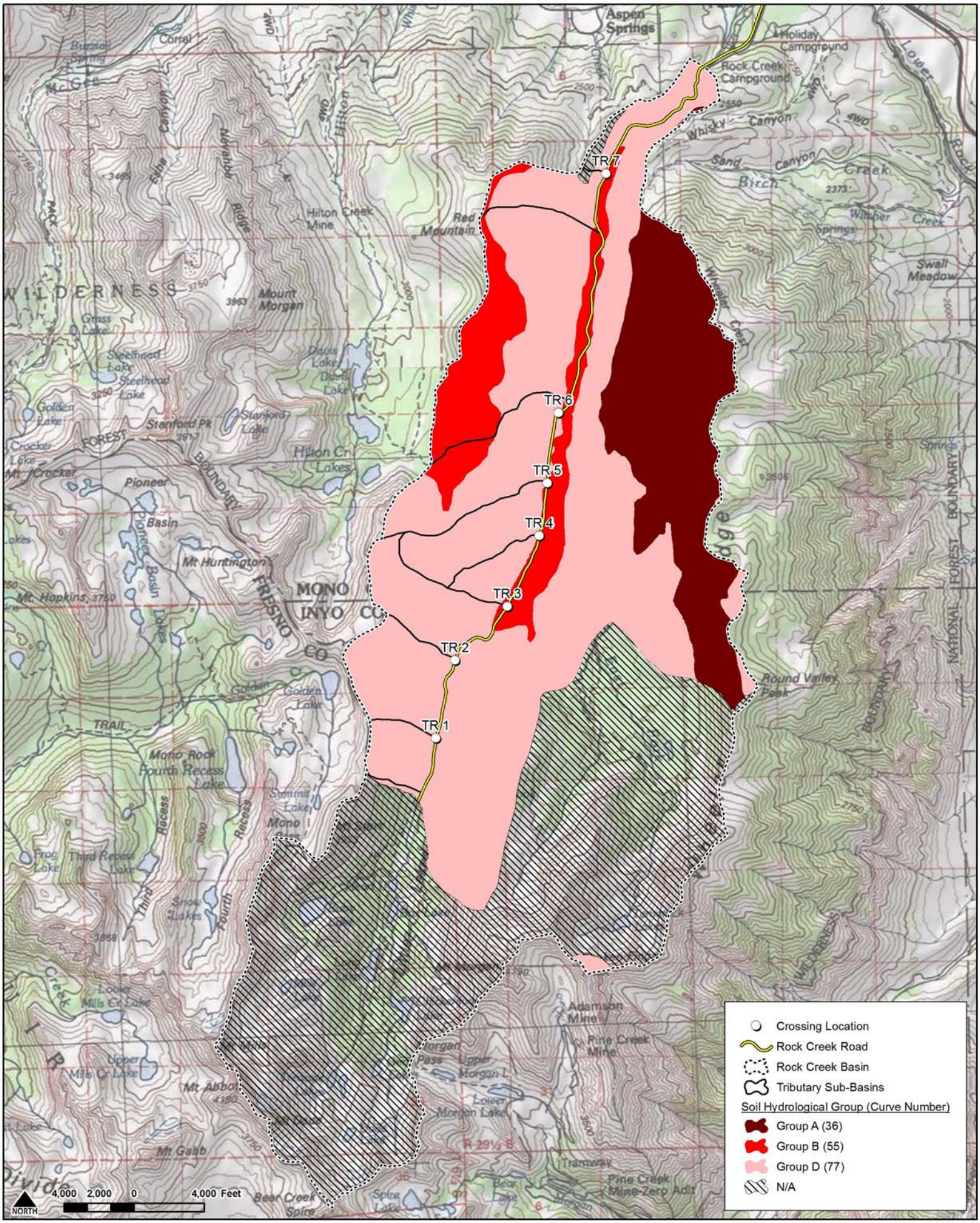
7. *Guide for Designing and Staking Culvert in the Field*, prepared by the Central Federal Lands Highway Division, dated January 9, 1996.

APPENDIX



Date: 1/2/2013

Rock Creek Road
Rock Creek Basins



Date: 1/2/2013

Rock Creek Road
Tributary Sub-Basins

Culvert Summary Table

FH-89 (Rock Creek Road)					
Culvert ID	Station	Existing Crossing	25-year Design Flow (cfs)	Proposed Crossing	Remarks
TR 2	1476+88	36" CMP	27.8	36" Pipe	Used Regression Flows and HY8 Analysis
TR 3	1424+72	36" CMP	25.9	36" Pipe	Used Regression Flows and HY8 Analysis
TR 4	1380+30	18" CMP	11.9	24" Pipe	Used Regression Flows and HY8 Analysis
TR 5	1351+92	18" CMP	24.5	30" Pipe	Used Regression Flows and HY8 Analysis
TR 6	1311+27	18" CMP	38.5	36" Pipe	Used Regression Flows and HY8 Analysis
TR 7	1165+24	18" CMP	17.8	24" Pipe	Used Regression Flows and HY8 Analysis
RC 1	1301+01	12' X 8' ARCH	511.3	Existing to Remain	To be lengthened downstream with bridge extension
RC 2	1201+50	13' X 7' ARCH	566.2	Existing to Remain	To be lengthened downstream with bridge extension
RC 3	1126+56	13' X 8' ARCH	661.2	Existing to Remain	To be lengthened downstream with bridge extension
RC 4	1079+08	13' x 9' ARCH	671.3	Existing to Remain	To be lengthened downstream with bridge extension
RC 5	1069+80	13' X 8' ARCH	673.5	Existing to Remain	To be lengthened downstream with bridge extension

Note: Each of the culverts for the Rock Creek tributary sub-basins was evaluated and considered for aquatic organism passage (AOP). Current recommendation is that these culverts do not need to accommodate AOP.

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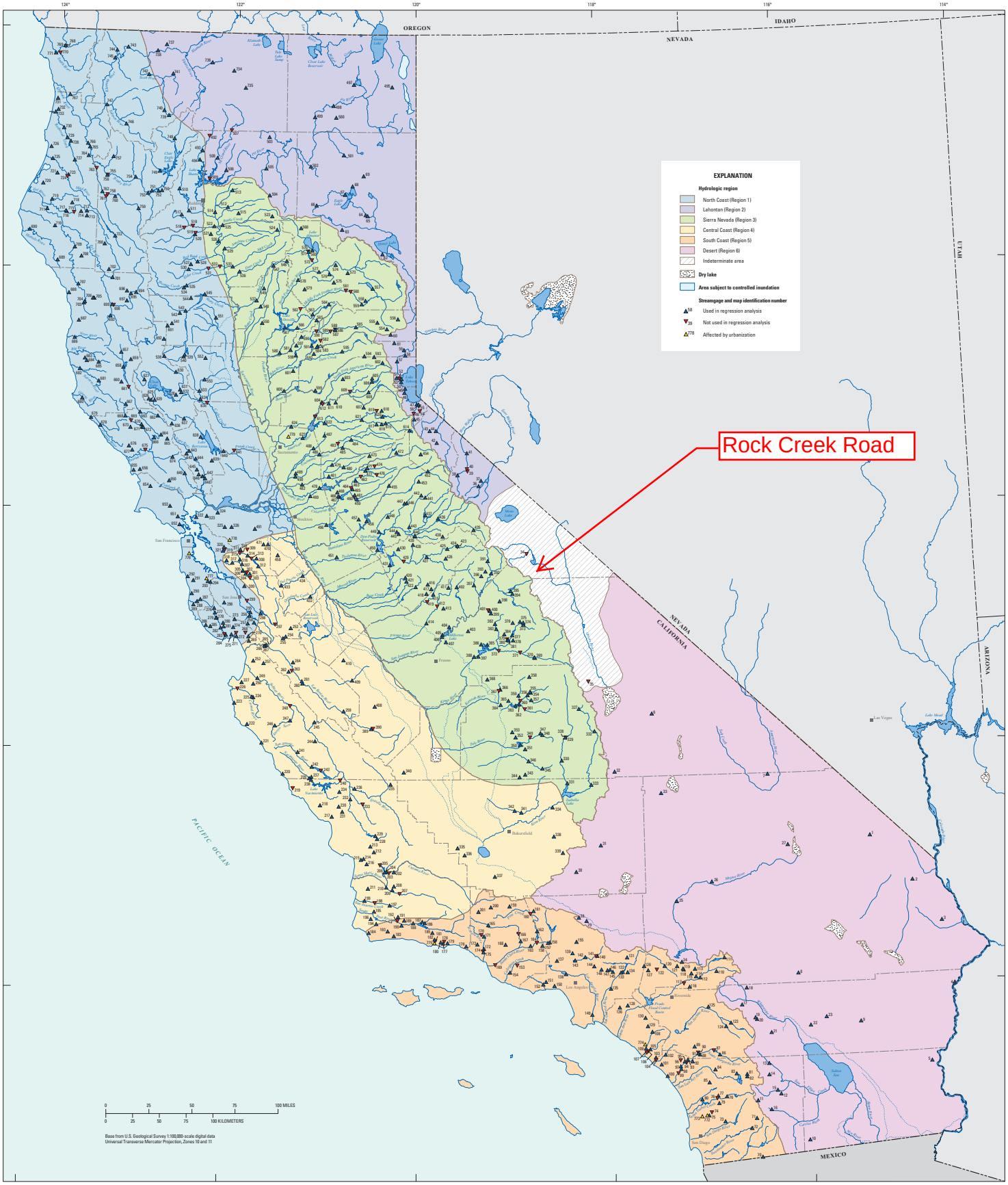
Prepared in cooperation with the
Federal Emergency Management Agency

Scientific Investigations Report 2012–5113
Locations of Hydrologic Regions and Streamgages in California—Plate 1

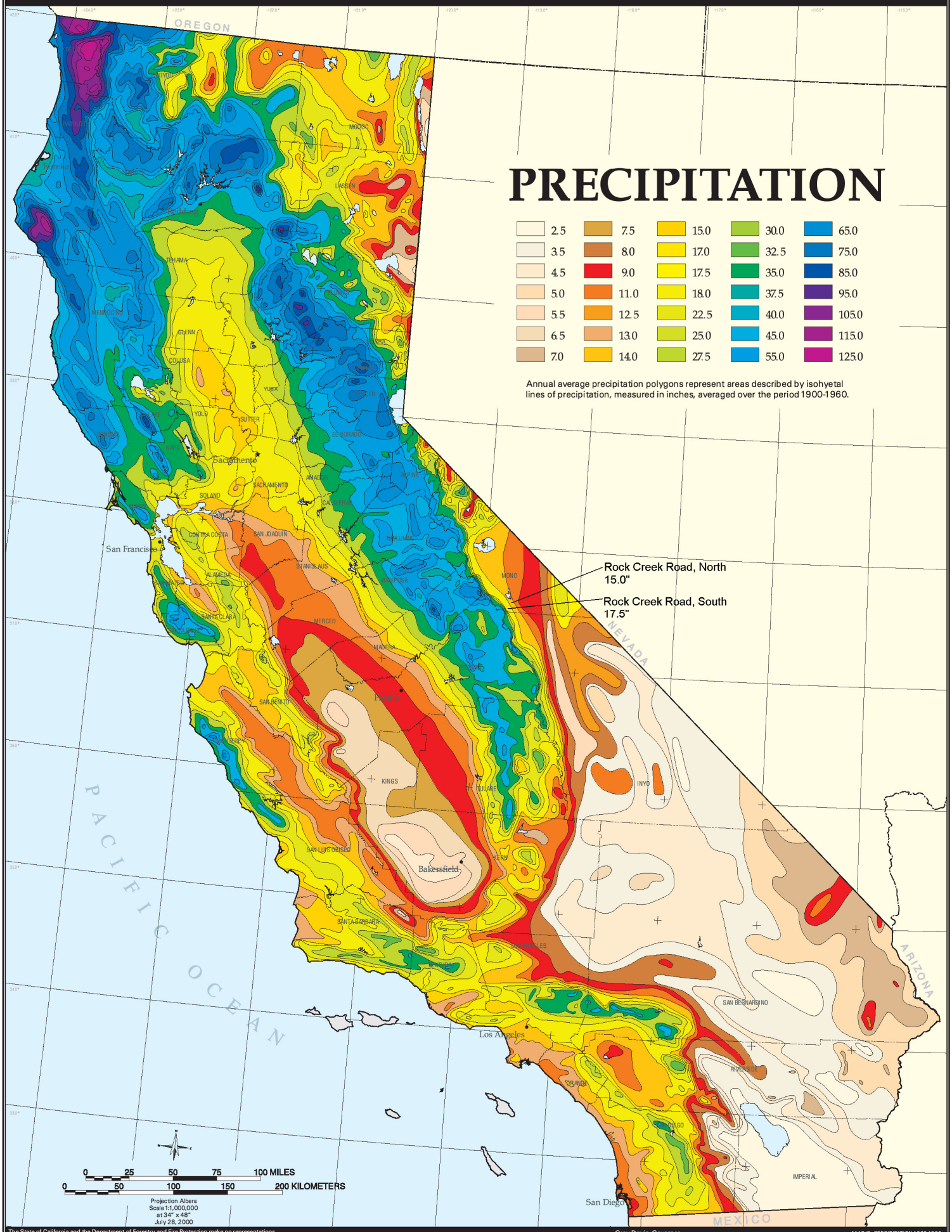


Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006

By
Anthony J. Gotvald, Nancy A. Barth, Andrea G. Veilleux, and Charles Parrett

2012

STATE OF CALIFORNIA



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Gray Davis, Governor,
State of California
Mary D. Nichols, Secretary for Resources,
The Resources Agency
Andrea E. Tuttle, Director,
Department of Forestry and Fire Protection

MAP ID: PRECIPITATION 1900-1960

DATA SOURCES
USGS; 1:100,000 DLGs
S.E. Rantz, USGS, 1969, 1972

Scientific-Investigations Report 2012–5113

Prepared in cooperation with the Federal Emergency Management Agency

Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006

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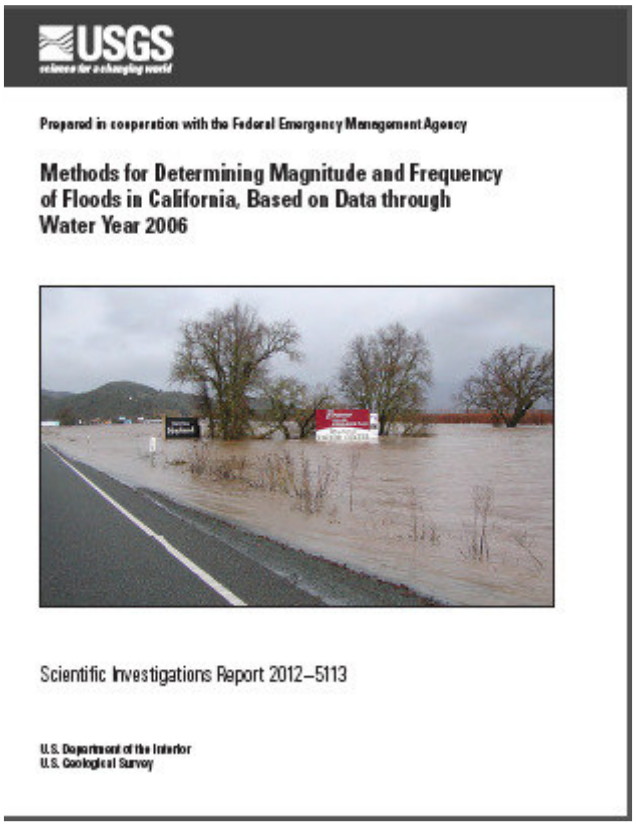
ABSTRACT



Methods for estimating the magnitude and frequency of floods in California that are not substantially affected by regulation or diversions have been updated. Annual peak-flow data through water year 2006 were analyzed for 771 streamflow-gaging stations (streamgages) in California having 10 or more years of data. Flood-frequency estimates were computed for the streamgages by using the expected moments algorithm to fit a Pearson Type III distribution to logarithms of annual peak flows for each streamgage. Low-outlier and historic information were incorporated into the flood-frequency analysis, and a generalized Grubbs-Beck test was used

First posted July 3, 2012

- **Report** PDF (2 MB)
- **Plate** PDF (0.6 Mb)
- **Table 2** XLS (0.1 Mb)
- **Table 4** XLS (0.3 Mb)
- **Table 10** XLS (0.2 Mb)

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to detect multiple potentially influential low outliers. Special methods for fitting the distribution were developed for streamgages in the desert region in southeastern California. Additionally, basin characteristics for the streamgages were computed by using a geographical information system.

Regional regression analysis, using generalized least squares regression, was used to develop a set of equations for estimating flows with 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual exceedance probabilities for ungaged basins in California that are outside of the southeastern desert region. Flood-frequency estimates and basin characteristics for 630 streamgages were combined to form the final database used in the regional regression analysis. Five hydrologic regions were developed for the area of California outside of the desert region. The final regional regression equations are functions of drainage area and mean annual precipitation for four of the five regions. In one region, the Sierra Nevada region, the final equations are functions of drainage area, mean basin elevation, and mean annual precipitation. Average standard errors of prediction for the regression equations in all five regions range from 42.7 to 161.9 percent.

For the desert region of California, an analysis of 33 streamgages was used to develop regional estimates of all three parameters (mean, standard deviation, and skew) of the log-Pearson Type III distribution. The regional estimates were then used to develop a set of equations for estimating flows with 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual exceedance probabilities for ungaged basins. The final regional regression equations are functions of drainage area. Average standard errors of prediction for these regression equations range from 214.2 to 856.2 percent.

Annual peak-flow data through water year 2006 were analyzed for eight streamgages in California having 10 or more years of data considered to be affected by urbanization. Flood-frequency estimates were computed for the urban streamgages by fitting a Pearson Type III distribution to logarithms of annual peak flows for each streamgage. Regression analysis could not be used to develop flood-frequency estimation equations for urban streams because of the limited number of sites. Flood-frequency estimates for the eight urban sites were graphically compared to flood-frequency estimates for 630 non-urban sites.

The regression equations developed from this study will be incorporated into the U.S. Geological Survey (USGS) StreamStats program. The StreamStats program is a Web-based application that provides streamflow statistics and basin characteristics for USGS streamgages and ungaged sites of interest. StreamStats can also compute basin characteristics and provide estimates of streamflow statistics for ungaged sites when users select the location of a site along any stream in California.

Suggested citation:

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles, 2012, Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl., available online only at http://pubs.usgs.gov/sir/2012/5113/.

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Combinations of independent explanatory variables that do not have multicollinearity and provide the lowest estimation error for each AEP were selected for inclusion in the final regression equations. Drainage area, mean basin elevation, and mean annual precipitation were the most appropriate basin characteristics used to estimate peak-streamflow frequency for ungaged sites in the Sierra Nevada region, and drainage area and mean annual precipitation were the basin characteristics used in the other regions outside of the desert region of California. The final regional regression equations for the 50- through 0.2-percent AEP flows for the five hydrologic regions are given in table 5. The values of drainage area, mean annual precipitation, and mean basin elevation for the 630 streamgages used in the regression analysis are given in table 2.

As previously described, regression analysis relating P-percent AEP flows to basin characteristics was not used to develop estimation equations for ungaged sites in the desert region. A WLS regression was used to determine regional models for the standard deviation and mean. The best model for the standard deviation was a constant model with a value of 0.91 log units. The best model for the mean was a linear model relating the mean to the log of drainage area. The best model for skew was previously determined by Thomas and others (1997) to be a constant value of zero. Placing these regional values of LP3 parameters into the basic LP3 equation (eq. 1) provided final equations for estimating P-percent AEP flows using drainage area (*DRNAREA*) as the only explanatory variable. Details on the development of the equations for estimating P-percent AEP flows in the desert region are given in the appendix. The final regional equations for the 50- through 0.2-percent AEP flows for the desert region are given in table 5. The values of drainage area for the 33 streamgages used in the regression analysis are given in table 2.

Table 5. Regional flood-frequency equations for rural ungaged streams in California.

[mi^2, square miles; *DRNAREA*, drainage area, in mi^2; *PRECIP*, mean annual precipitation, in inches; *ELEV*, mean basin elevation, in feet]

Percent annual exceedance probability	Hydrologic region (shown in pl. 1)		
	North Coast (Region 1)	Lahontan (Region 2)	Sierra Nevada (Region 3)
50	$1.82(DRNAREA)^{0.904}(PRECIP)^{0.983}$	$0.0865(DRNAREA)^{0.736}(PRECIP)^{1.59}$	$2.43(DRNAREA)^{0.924}(ELEV)^{-0.646}(PRECIP)^{2.06}$
20	$8.11(DRNAREA)^{0.887}(PRECIP)^{0.772}$	$0.182(DRNAREA)^{0.733}(PRECIP)^{1.58}$	$11.6(DRNAREA)^{0.907}(ELEV)^{-0.566}(PRECIP)^{1.70}$
10	$14.8(DRNAREA)^{0.880}(PRECIP)^{0.696}$	$0.260(DRNAREA)^{0.734}(PRECIP)^{1.59}$	$17.2(DRNAREA)^{0.896}(ELEV)^{-0.486}(PRECIP)^{1.54}$
4	$26.0(DRNAREA)^{0.874}(PRECIP)^{0.628}$	$0.394(DRNAREA)^{0.733}(PRECIP)^{1.58}$	$20.7(DRNAREA)^{0.885}(ELEV)^{-0.386}(PRECIP)^{1.39}$
2	$36.3(DRNAREA)^{0.870}(PRECIP)^{0.589}$	$0.532(DRNAREA)^{0.733}(PRECIP)^{1.58}$	$21.1(DRNAREA)^{0.879}(ELEV)^{-0.316}(PRECIP)^{1.31}$
1	$48.5(DRNAREA)^{0.866}(PRECIP)^{0.556}$	$0.713(DRNAREA)^{0.731}(PRECIP)^{1.56}$	$20.6(DRNAREA)^{0.874}(ELEV)^{-0.250}(PRECIP)^{1.24}$
0.5	$61.0(DRNAREA)^{0.863}(PRECIP)^{0.531}$	$0.944(DRNAREA)^{0.729}(PRECIP)^{1.55}$	$19.4(DRNAREA)^{0.870}(ELEV)^{-0.188}(PRECIP)^{1.18}$
0.2	$79.3(DRNAREA)^{0.860}(PRECIP)^{0.503}$	$1.35(DRNAREA)^{0.727}(PRECIP)^{1.52}$	$17.4(DRNAREA)^{0.865}(ELEV)^{-0.110}(PRECIP)^{1.11}$

Percent annual exceedance probability	Hydrologic region (shown in pl. 1)		
	Central Coast (Region 4)	South Coast (Region 5)	Desert (Region 6)
50	$0.00459(DRNAREA)^{0.856}(PRECIP)^{2.58}$	$3.60(DRNAREA)^{0.672}(PRECIP)^{0.753}$	$10.3(DRNAREA)^{0.506}$
20	$0.0984(DRNAREA)^{0.852}(PRECIP)^{1.97}$	$7.43(DRNAREA)^{0.739}(PRECIP)^{0.872}$	$60.0(DRNAREA)^{0.506}$
10	$0.460(DRNAREA)^{0.846}(PRECIP)^{1.66}$	$6.56(DRNAREA)^{0.783}(PRECIP)^{1.07}$	$151(DRNAREA)^{0.506}$
4	$2.13(DRNAREA)^{0.842}(PRECIP)^{1.34}$	$4.71(DRNAREA)^{0.832}(PRECIP)^{1.32}$	$403(DRNAREA)^{0.506}$
2	$5.32(DRNAREA)^{0.840}(PRECIP)^{1.15}$	$3.84(DRNAREA)^{0.864}(PRECIP)^{1.47}$	$760(DRNAREA)^{0.506}$
1	$11.0(DRNAREA)^{0.840}(PRECIP)^{0.994}$	$3.28(DRNAREA)^{0.891}(PRECIP)^{1.59}$	$1{,}350(DRNAREA)^{0.506}$
0.5	$20.3(DRNAREA)^{0.840}(PRECIP)^{0.865}$	$2.84(DRNAREA)^{0.915}(PRECIP)^{1.70}$	$2{,}270(DRNAREA)^{0.506}$
0.2	$39.0(DRNAREA)^{0.842}(PRECIP)^{0.729}$	$2.31(DRNAREA)^{0.943}(PRECIP)^{1.83}$	$4{,}280(DRNAREA)^{0.506}$

California Regression Calulations

Regression Parameters

Basin	Station	Precipitation (inches)	Area (sq.mi)	Length (ft)	Max Elev (ft)	Min Elev (ft)	Average Basin Elevation
TR 2	1476+88	16.25	0.992	9506	12251	9872	11,062
TR 3	1424+72	16.25	0.908	9559	11932	9587	10,760
TR 4	1380+30	16.25	0.362	6345	10364	9341	9,853
TR 5	1351+92	16.25	0.839	10157	11736	9170	10,453
TR 6	1311+27	16.25	1.400	12668	11969	8927	10,448
TR 7	1165+24	16.25	0.571	8089	11467	8186	9,827
RC 1	1301+01	16.25	26.933	51177	13743	8862	11,303
RC 2	1201+50	16.25	29.942	60951	13743	8379	11,061
RC 3	1126+56	16.25	35.414	68043	13743	8005	10,874
RC 4	1079+08	16.25	35.737	72422	13743	7605	10,674
RC 5	1069+80	16.25	35.820	73311	13743	7539	10,641

From FRAP Map, State of California
S.E. Rantz, USGS, 1969, 1972
Use P = 16.25" for Mean Annual Precipitation (Average of 15" and 17.5" for Project Area)

Sierra Nevada (Region 3)							
Basin	Station	$Q_{2=}$	$Q_{5=}$	$Q_{10=}$	**$Q_{25=}$**	$Q_{50=}$	$Q_{100=}$
TR 2	1476+88	1.8	6.8	13.5	**27.8**	42.6	63.3
TR 3	1424+72	1.7	6.4	12.7	**25.9**	39.8	59.0
TR 4	1380+30	0.8	2.9	5.8	**11.9**	18.2	27.0
TR 5	1351+92	1.6	6.0	12.0	**24.5**	37.4	55.4
TR 6	1311+27	2.6	9.6	19.0	**38.5**	58.7	86.8
TR 7	1165+24	1.2	4.4	8.7	**17.8**	27.2	40.2
RC 1	1301+01	38.3	133.7	258.2	**511.3**	770.8	1127.5
RC 2	1201+50	42.8	149.0	286.9	**566.2**	851.8	1243.5
RC 3	1126+56	50.6	175.2	336.2	**661.2**	992.5	1446.1
RC 4	1079+08	51.6	178.5	342.0	**671.3**	1006.3	1464.4
RC 5	1069+80	51.8	179.2	343.3	**673.5**	1009.4	1468.6

Reference: U.S. Geological Survey Water-Resources Investigations Report 2012-5113 Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006, released July 2012.

NOAA Atlas 14, Volume 6, Version 2
Location name: Mammoth Lakes, California, US*
Coordinates: 37.4883, -118.7180
Elevation: 8913ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.100** (0.082–0.123)	**0.145** (0.119–0.178)	**0.204** (0.167–0.252)	**0.254** (0.206–0.316)	**0.324** (0.254–0.416)	**0.379** (0.292–0.498)	**0.438** (0.328–0.589)	**0.500** (0.365–0.692)	**0.590** (0.413–0.850)	**0.663** (0.449–0.990)
10-min	**0.144** (0.118–0.177)	**0.208** (0.170–0.255)	**0.293** (0.240–0.361)	**0.364** (0.296–0.453)	**0.464** (0.364–0.597)	**0.544** (0.418–0.714)	**0.627** (0.471–0.844)	**0.717** (0.523–0.992)	**0.845** (0.592–1.22)	**0.951** (0.643–1.42)
15-min	**0.174** (0.143–0.214)	**0.251** (0.206–0.309)	**0.354** (0.290–0.437)	**0.441** (0.358–0.548)	**0.561** (0.441–0.722)	**0.657** (0.506–0.864)	**0.759** (0.569–1.02)	**0.867** (0.633–1.20)	**1.02** (0.716–1.47)	**1.15** (0.778–1.72)
30-min	**0.238** (0.195–0.292)	**0.344** (0.282–0.423)	**0.485** (0.397–0.598)	**0.603** (0.489–0.751)	**0.768** (0.603–0.988)	**0.900** (0.692–1.18)	**1.04** (0.779–1.40)	**1.19** (0.866–1.64)	**1.40** (0.980–2.02)	**1.57** (1.07–2.35)
60-min	**0.322** (0.265–0.396)	**0.466** (0.382–0.573)	**0.657** (0.538–0.811)	**0.818** (0.664–1.02)	**1.04** (0.818–1.34)	**1.22** (0.938–1.60)	**1.41** (1.06–1.90)	**1.61** (1.18–2.23)	**1.90** (1.33–2.74)	**2.13** (1.44–3.19)
2-hr	**0.476** (0.391–0.585)	**0.647** (0.531–0.797)	**0.881** (0.721–1.09)	**1.08** (0.877–1.35)	**1.37** (1.07–1.76)	**1.60** (1.23–2.10)	**1.85** (1.39–2.48)	**2.12** (1.54–2.93)	**2.51** (1.76–3.62)	**2.83** (1.92–4.23)
3-hr	**0.589** (0.484–0.724)	**0.783** (0.643–0.964)	**1.05** (0.860–1.30)	**1.28** (1.04–1.59)	**1.61** (1.27–2.07)	**1.88** (1.45–2.47)	**2.17** (1.63–2.92)	**2.49** (1.81–3.44)	**2.95** (2.06–4.25)	**3.33** (2.25–4.97)
6-hr	**0.839** (0.690–1.03)	**1.10** (0.898–1.35)	**1.45** (1.19–1.79)	**1.75** (1.42–2.18)	**2.20** (1.72–2.82)	**2.56** (1.97–3.36)	**2.94** (2.21–3.96)	**3.37** (2.46–4.66)	**3.98** (2.79–5.74)	**4.49** (3.04–6.71)
12-hr	**1.15** (0.942–1.41)	**1.53** (1.26–1.89)	**2.06** (1.69–2.54)	**2.51** (2.04–3.12)	**3.15** (2.47–4.05)	**3.66** (2.82–4.81)	**4.20** (3.16–5.66)	**4.79** (3.50–6.63)	**5.62** (3.94–8.11)	**6.30** (4.26–9.40)
24-hr	**1.56** (1.32–1.87)	**2.17** (1.84–2.61)	**2.99** (2.54–3.60)	**3.68** (3.10–4.46)	**4.64** (3.80–5.77)	**5.40** (4.35–6.83)	**6.19** (4.89–7.99)	**7.03** (5.43–9.27)	**8.20** (6.13–11.2)	**9.14** (6.64–12.8)
2-day	**1.97** (1.68–2.37)	**2.80** (2.38–3.37)	**3.91** (3.31–4.71)	**4.83** (4.07–5.85)	**6.11** (5.01–7.60)	**7.12** (5.74–9.01)	**8.17** (6.46–10.5)	**9.27** (7.17–12.2)	**10.8** (8.09–14.8)	**12.1** (8.77–16.9)
3-day	**2.21** (1.88–2.65)	**3.16** (2.69–3.80)	**4.43** (3.76–5.33)	**5.49** (4.62–6.65)	**6.95** (5.70–8.65)	**8.11** (6.54–10.3)	**9.32** (7.37–12.0)	**10.6** (8.19–14.0)	**12.4** (9.25–16.9)	**13.8** (10.0–19.4)
4-day	**2.39** (2.04–2.87)	**3.43** (2.91–4.12)	**4.80** (4.06–5.77)	**5.94** (5.00–7.19)	**7.52** (6.17–9.36)	**8.78** (7.08–11.1)	**10.1** (7.98–13.0)	**11.5** (8.87–15.1)	**13.4** (10.0–18.3)	**15.0** (10.9–21.0)
7-day	**2.80** (2.38–3.36)	**3.95** (3.35–4.74)	**5.47** (4.64–6.59)	**6.74** (5.68–8.17)	**8.52** (6.98–10.6)	**9.92** (8.00–12.6)	**11.4** (9.01–14.7)	**13.0** (10.0–17.1)	**15.2** (11.3–20.7)	**16.9** (12.3–23.8)
10-day	**3.05** (2.60–3.67)	**4.26** (3.62–5.12)	**5.87** (4.97–7.07)	**7.21** (6.07–8.73)	**9.08** (7.44–11.3)	**10.6** (8.52–13.4)	**12.1** (9.58–15.6)	**13.8** (10.6–18.2)	**16.1** (12.0–22.0)	**18.0** (13.1–25.3)
20-day	**3.85** (3.28–4.62)	**5.32** (4.52–6.39)	**7.24** (6.13–8.71)	**8.82** (7.42–10.7)	**11.0** (9.02–13.7)	**12.7** (10.2–16.1)	**14.5** (11.5–18.7)	**16.4** (12.7–21.6)	**19.1** (14.2–26.0)	**21.2** (15.4–29.8)
30-day	**4.58** (3.90–5.50)	**6.28** (5.34–7.55)	**8.47** (7.18–10.2)	**10.3** (8.64–12.4)	**12.7** (10.4–15.8)	**14.6** (11.7–18.4)	**16.5** (13.1–21.3)	**18.6** (14.4–24.5)	**21.5** (16.1–29.4)	**23.9** (17.4–33.6)
45-day	**5.42** (4.61–6.50)	**7.36** (6.25–8.84)	**9.82** (8.33–11.8)	**11.8** (9.94–14.3)	**14.4** (11.8–18.0)	**16.5** (13.3–20.8)	**18.6** (14.7–23.9)	**20.8** (16.1–27.4)	**23.8** (17.8–32.6)	**26.4** (19.2–37.0)
60-day	**6.43** (5.47–7.72)	**8.63** (7.33–10.4)	**11.4** (9.64–13.7)	**13.5** (11.4–16.4)	**16.4** (13.5–20.4)	**18.6** (15.0–23.5)	**20.8** (16.4–26.8)	**23.1** (17.9–30.5)	**26.4** (19.7–36.0)	**29.1** (21.1–40.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

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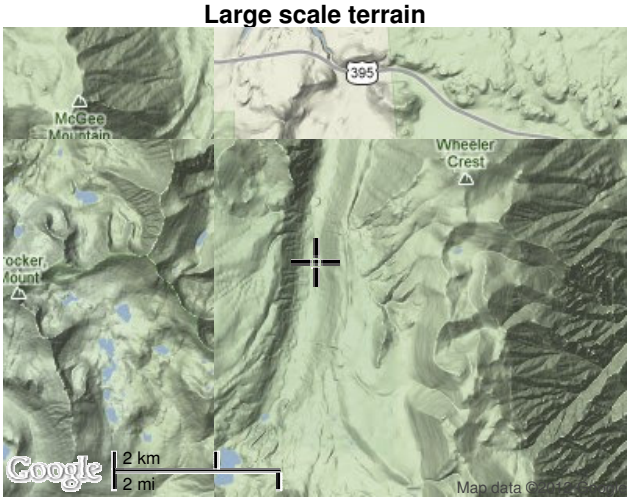
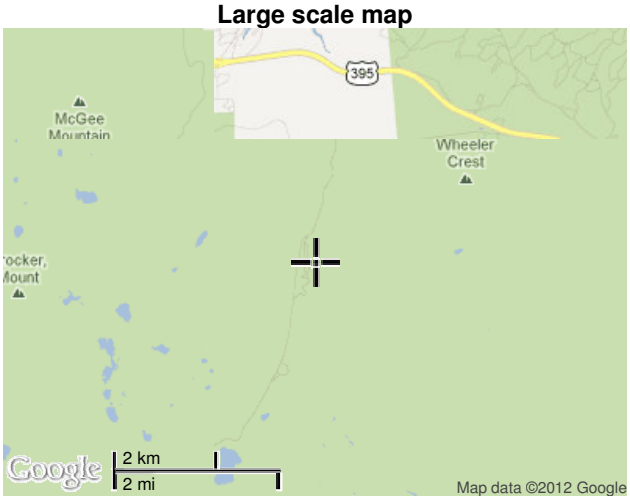
Maps & aerials

Small scale terrain

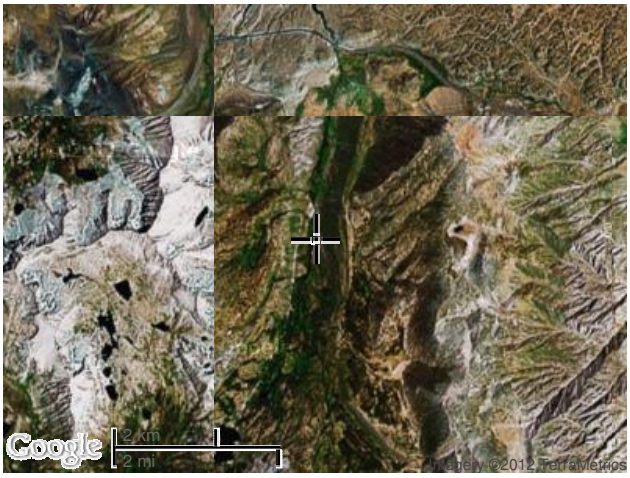
Large scale terrain



Large scale map



Large scale aerial



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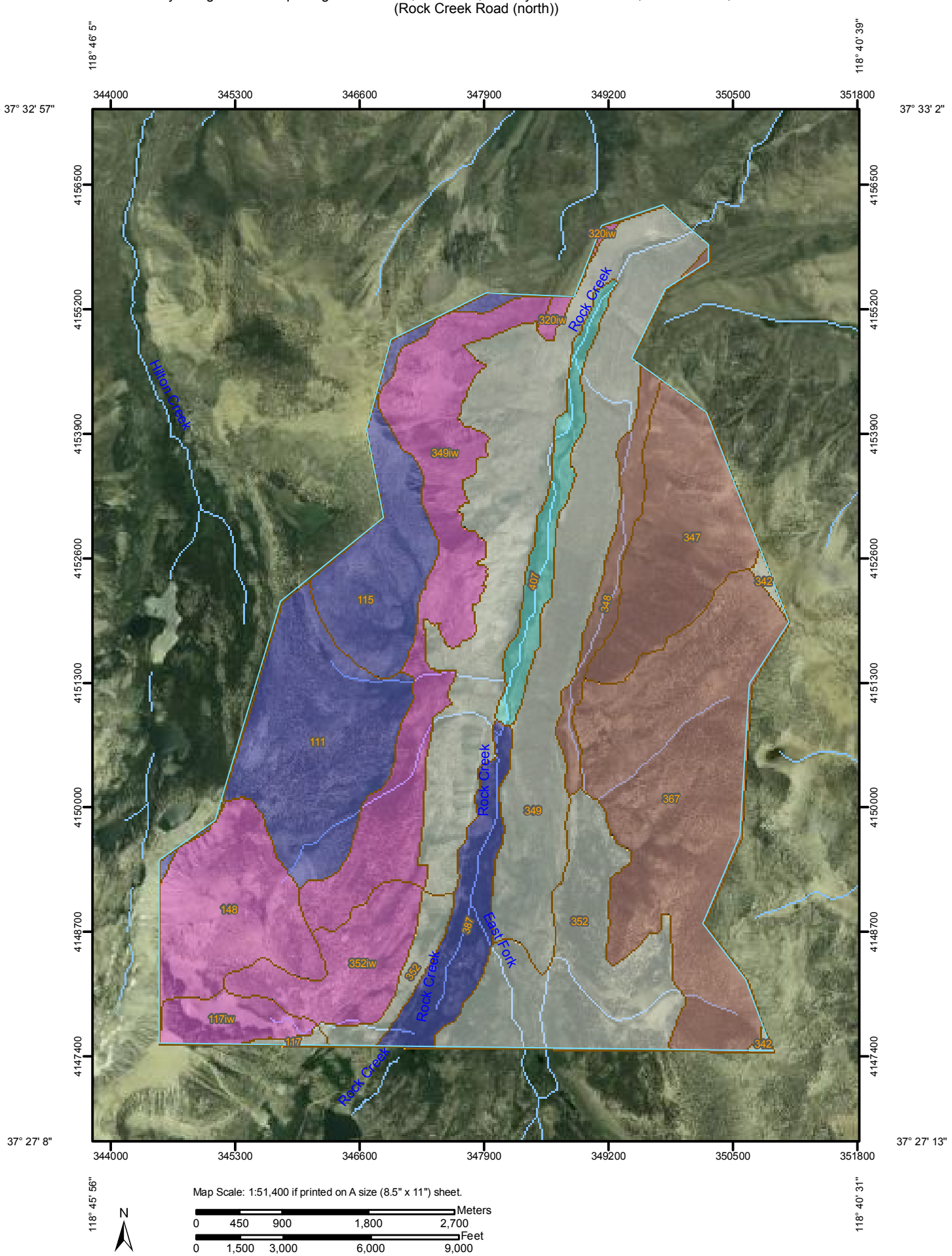
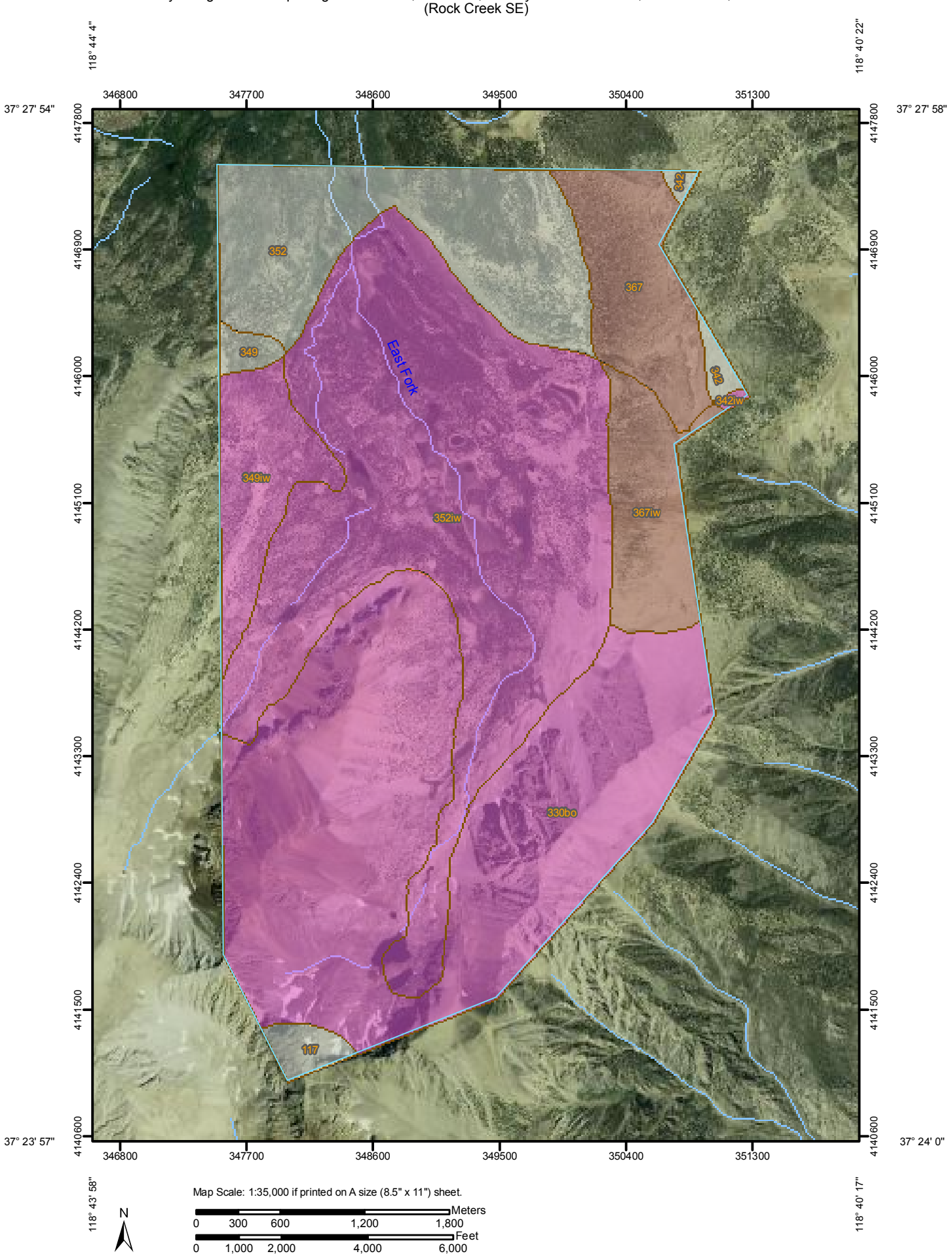
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Hydrologic Soil Group—High Sierra Area, California; and Inyo National Forest, Western Part, California
(Rock Creek Road (north))

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118° 40' 22"
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4146900
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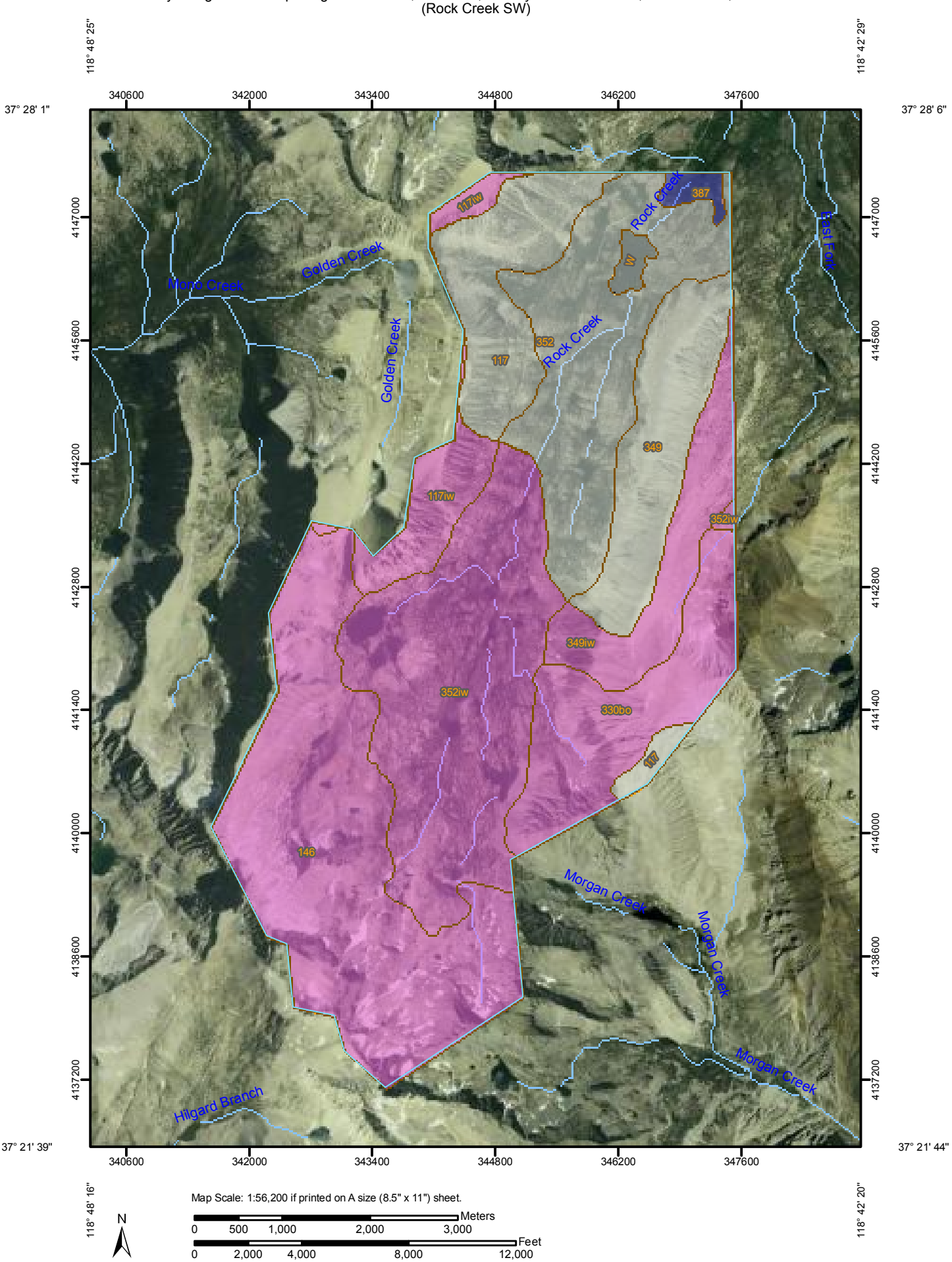
118° 40' 17"
352
342
367
349
East Fork
347
342iw
349iw
352iw
367iw
330bo
117
Map Scale: 1:35,000 if printed on A size (8.5" x 11") sheet.
N
Meters
0 300 600 1,200 1,800
Feet
0 1,000 2,000 4,000 6,000

Hydrologic Soil Group—High Sierra Area, California; and Inyo National Forest, Western Part, California
(Rock Creek SW)



Map Scale: 1:56,200 if printed on A size (8.5" x 11") sheet.

N

Meters
0 500 1,000 2,000 3,000

Feet
0 2,000 4,000 8,000 12,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

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

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:51,400 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

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

Soil Survey Area: High Sierra Area, California
Survey Area Data: Version 1, Feb 20, 2008

Soil Survey Area: Inyo National Forest, Western Part, California
Survey Area Data: Version 2, Jan 10, 2012

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/26/2005; 8/27/2005

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.

TR-55 Basins
FH-89 (Rock Creek Road)
Weighted Curve Number

									Ground Cover	Area in sq. Feet by soil "MUKEY" from SSURGO								
									Good	77	77	77				77	<--Soil Curve Number	
									Good				55	55	55		<--Soil Curve Number	
Station	**Basin**	**Area_ft2**	**Flowdist (ft)**	**MaxElev (Meters)**	**MinElev (Meters)**	**Elev300ft (Meters)**	**Elev1300ft (Meters)**	**10% Elev**	**85% Elev**	**471357**	**471462**	**471465**	**471500**	**471508**	**B**	**D**	**Total Area**	**Weighted Curve Number**
1476+88	TR 2	27,650,714	9,506	12,251	9,872	12,192	12,139	10,110	11,894	17,172,085		8,881,730				1,596,899	27,650,714	77.00
1424+72	TR 3	25,319,633	9,559	11,932	9,587	11,765	11,270	9,822	11,580	5,641,863		6,107,173	420,628			13,149,968	25,319,632	76.63
1380+30	TR 4	10,093,250	6,345	10,364	9,341	10,354	10,308	9,443	10,211			3,062,797	979,631			6,050,823	10,093,251	74.86
1351+92	TR 5	23,383,122	10,157	11,736	9,170	11,522	11,158	9,427	11,351		2,318,474	1,390,462	348,237		6,441,983	12,883,966	23,383,122	70.61
1311+27	TR 6	39,035,611	12,668	11,969	8,927	11,834	11,480	9,231	11,513		8,736,881		1,597	162,102	15,067,515	15,067,515	39,035,610	68.42
1165+24	TR 7	15,906,575	8,089	11,467	8,186	11,430	11,243	8,514	10,975		7,366,721			119,253	2,105,150	6,345,451	15,936,575	73.93

t Values from GIS
Calculated Values
Inputted Values

TR-55 Time of Concentration Summary

Project Rock Creek Road
Subject Runoff Calculations
Item TR-55 Time of Concentration (Tc) Calculation

Client FHWA - CFLHD

Sheet Flow Equation $t_c = \alpha / P_2^{0.5} (nL/S^{0.5})^{0.8}$
P_2 = 2-year, 24-hour rainfall depth, (in)
α = unit conversion constant equal to 0.42
Shallow Flow Velocity Equation $V = k S^{0.5}$
where k = 1.50 (for shallow concentrated flow)

Sheet 1 / 1
Job No. WVXW3020
Date 21-Dec-12

Basin Information				Sheet Flow (not to exceed 300 feet)							Shallow Concentrated Flow						Channel Flow											Total Tc
Drainage Basin	Station	Area (acres)	Curve No	US Elev. (feet)	DS Elev. (feet)	Length (feet)	Manning's n (1)	Slope (%)	P2	Tc (hr.) (2)	US Elev. (feet)	DS Elev. (feet)	Length (feet)	Slope (%)	Velocity (ft/s.)	Tc (hr.)	US Elev. (feet)	DS Elev. (feet)	Length (feet)	Slope (ft/ft)	Manning's n	Channel Depth (feet)	Side Slope Estimate (_:1)	Area (sq. ft.)	Wp (feet)	R (ft)	Velocity (ft/s.)	Tc (hr.)	(hr.)
TR 2	1476+88	634.8	77	12251	12192	300	1.400	19.67	2.2	1.14	12192	12139	1000	5.30	3.45	0.080	12139	9872	8206	0.276	0.035	0.50	4	1.00	4.123	0.243	8.68	0.263	1.49
TR 3	1424+72	581.3	77	11932	11765	300	2.400	55.67	2.2	1.16	11765	11270	1000	49.50	10.55	0.026	11270	9587	8259	0.204	0.035	0.50	4	1.00	4.123	0.243	7.45	0.308	1.49
TR 4	1380+30	231.7	75	10364	10354	300	3.400	3.33	2.2	4.73	10354	10308	1000	4.60	3.22	0.086	10308	9341	5045	0.192	0.035	0.50	4	1.00	4.123	0.243	7.23	0.194	5.01
TR 5	1351+92	536.8	71	11736	11522	300	4.400	71.33	2.2	1.71	11522	11158	1000	36.40	9.05	0.031	11158	9170	8857	0.224	0.035	0.50	4	1.00	4.123	0.243	7.82	0.314	2.05
TR 6	1311+27	896.1	68	11969	11834	300	5.400	45.00	2.2	2.42	11834	11480	1000	35.40	8.92	0.031	11480	8927	11368	0.225	0.035	0.50	4	1.00	4.123	0.243	7.83	0.404	2.85
TR 7	1165+24	365.2	74	11467	11430	300	6.400	12.33	2.2	4.65	11430	11243	1000	18.70	6.49	0.043	11243	8186	6789	0.450	0.035	0.50	4	1.00	4.123	0.243	11.08	0.170	4.86

Notes:
(1) HDS-2 Table 2.1: Woods, Light Underbrush
(2) HDS-2 Equation 2.6

HSchram

Inyo Nat'l Forest
Rock Creek Road
Mono County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.2	3.0	3.7	4.6	5.4	6.2	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

HSchram

Inyo Nat'l Forest
Rock Creek Road
Mono County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period ANALYSIS: (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)
SUBAREAS						
Basin TR2	30.46	76.68	126.00	197.27	265.10	336.03
Basin TR3	24.22	64.09	107.76	171.24	232.16	296.42
Basin TR4	6.45	13.73	22.66	35.91	48.97	62.77
Basin TR5	11.72	28.28	54.70	96.61	138.94	184.87
Basin TR6	16.98	35.83	67.90	122.95	179.66	242.20
Basin TR7	10.18	21.84	36.18	57.35	78.27	100.40
REACHES						
OUTLET	83.82	189.40	338.24	568.49	797.40	1043.53

HY-8 Culvert Analysis Report

Existing Conditions

Water Surface Profile Plot for Culvert: 36" PIPE

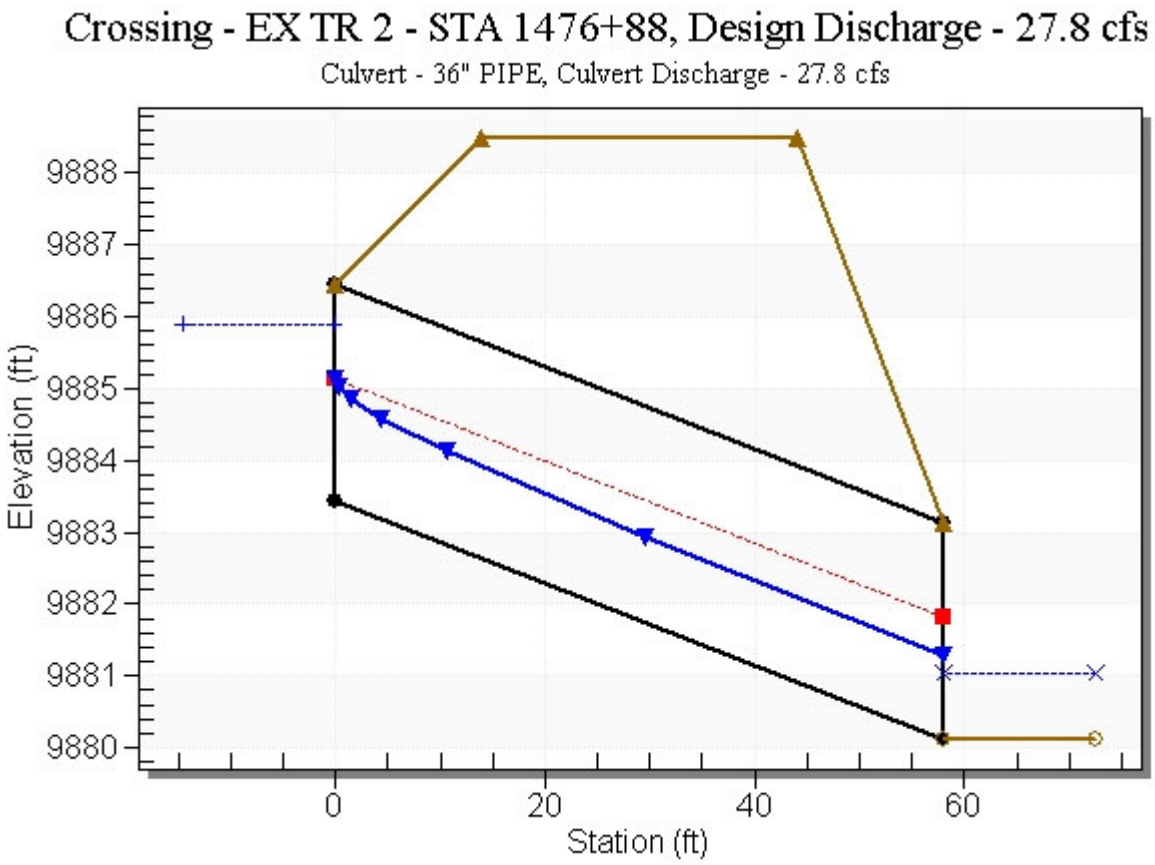


Table 1 - Culvert Summary Table: 36" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.84	1.84	9883.98	0.535	0.0*	1-S2n	0.302	0.398	0.307	0.224	5.004	2.107
7.98	7.98	9884.61	1.168	0.0*	1-S2n	0.613	0.889	0.618	0.493	7.646	3.260
14.13	14.13	9885.03	1.594	0.0*	1-S2n	0.810	1.196	0.815	0.657	9.031	3.817
20.27	20.27	9885.43	1.990	0.0*	1-S2n	0.982	1.441	0.990	0.785	9.939	4.208
26.42	26.42	9885.80	2.359	0.0*	1-S2n	1.133	1.654	1.144	0.891	10.654	4.516
27.75	27.75	9885.88	2.438	0.0*	1-S2n	1.166	1.698	1.167	0.912	10.902	4.575
38.70	38.70	9886.54	3.104	0.0*	5-S2n	1.403	2.020	1.410	1.067	11.854	4.992
44.85	44.85	9886.95	3.515	0.0*	5-S2n	1.532	2.175	1.534	1.142	12.337	5.188
50.99	50.99	9887.41	3.967	0.0*	5-S2n	1.656	2.316	1.665	1.212	12.669	5.364
57.14	57.14	9887.91	4.470	0.0*	5-S2n	1.780	2.440	1.783	1.276	13.052	5.523
63.28	63.28	9888.47	5.030	0.0*	5-S2n	1.908	2.538	1.917	1.337	13.286	5.672

Water Surface Profile Plot for Culvert: 36" PIPE

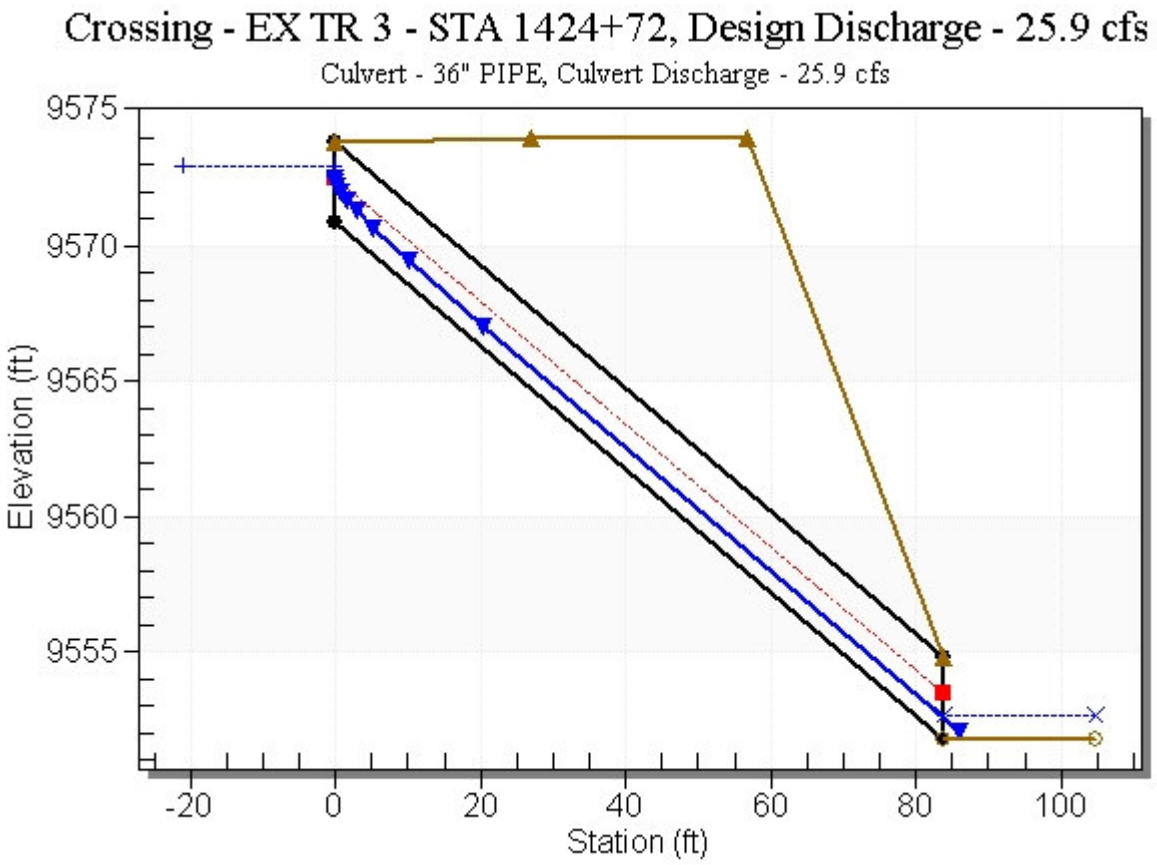


Table 2 - Culvert Summary Table: 36" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.73	1.73	9571.27	0.449	0.0*	1-S2n	0.144	0.386	0.146	0.217	6.396	2.066
7.46	7.46	9571.80	0.982	0.0*	1-S2n	0.400	0.853	0.413	0.476	12.247	3.198
13.18	13.18	9572.15	1.329	0.0*	1-S2n	0.550	1.150	0.559	0.635	14.357	3.746
18.91	18.91	9572.47	1.650	0.0*	1-S2n	0.661	1.387	0.677	0.759	15.691	4.131
24.64	24.64	9572.82	1.999	0.0*	1-S2n	0.753	1.595	0.755	0.862	17.504	4.433
25.95	25.95	9572.90	2.076	0.0*	1-S2n	0.774	1.638	0.778	0.884	17.675	4.494
36.09	36.09	9573.50	2.685	0.0*	1-S2n	0.928	1.947	0.937	1.033	19.213	4.902
41.82	41.82	9573.87	3.053	0.0*	5-S2n	0.999	2.106	1.005	1.106	20.086	5.094
47.55	44.38	9574.05	3.227	0.0*	5-S2n	1.030	2.164	1.037	1.173	20.401	5.267
53.27	45.02	9574.09	3.272	0.0*	5-S2n	1.038	2.179	1.039	1.236	20.650	5.424
59.00	45.53	9574.13	3.307	0.0*	5-S2n	1.044	2.190	1.049	1.295	20.597	5.569

Water Surface Profile Plot for Culvert: 18" PIPE

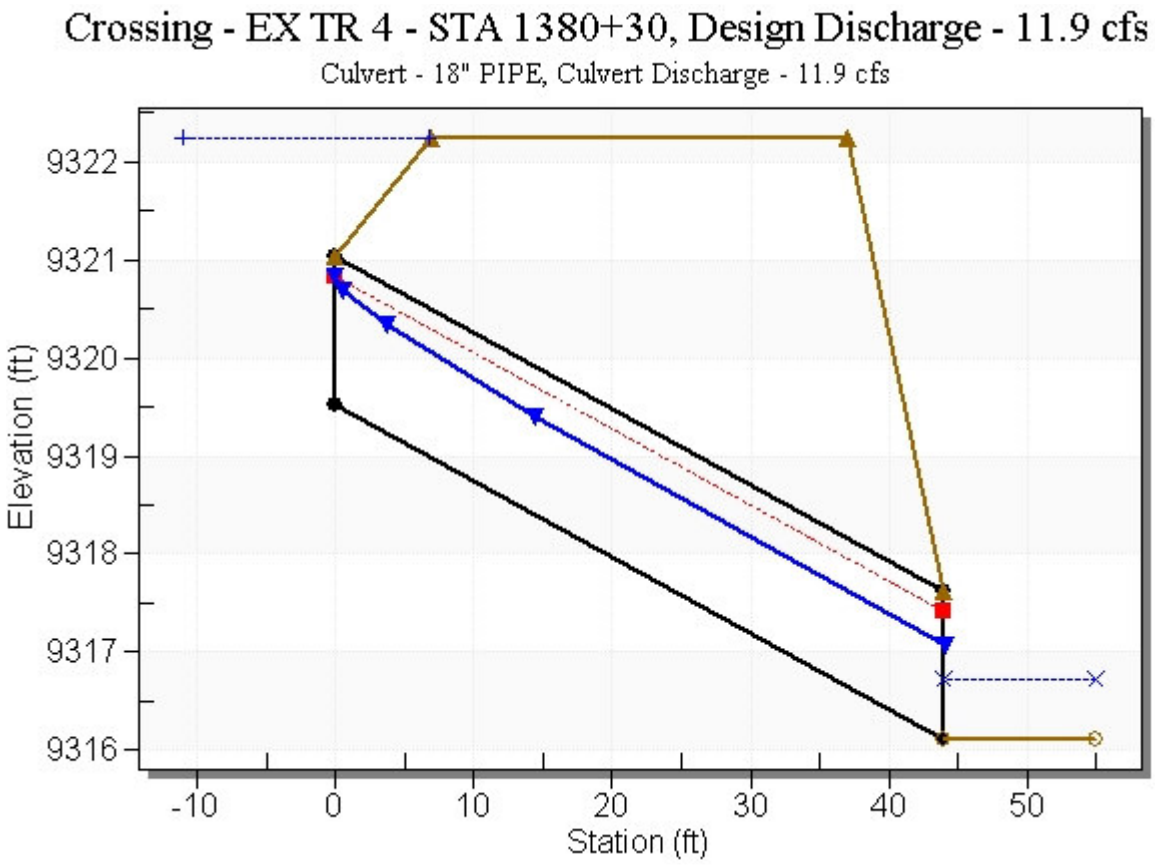


Table 3 - Culvert Summary Table: 18" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.78	0.78	9319.95	0.423	0.0*	1-S2n	0.213	0.324	0.214	0.138	4.871	1.592
3.40	3.40	9320.48	0.948	0.0*	1-S2n	0.469	0.700	0.470	0.314	7.213	2.545
6.02	6.02	9320.92	1.393	0.0*	1-S2n	0.639	0.945	0.639	0.426	8.413	3.008
8.65	8.65	9321.42	1.889	0.0*	5-S2n	0.789	1.134	0.789	0.513	9.187	3.334
11.27	11.27	9322.05	2.522	0.0*	5-S2n	0.934	1.273	0.934	0.587	9.733	3.588
11.90	11.90	9322.23	2.700	0.0*	5-S2n	0.970	1.301	0.970	0.603	9.853	3.643
16.51	12.17	9322.31	2.780	0.0*	5-S2n	0.986	1.314	0.987	0.710	9.888	3.983
19.13	12.25	9322.33	2.802	0.0*	5-S2n	0.990	1.317	0.991	0.763	9.897	4.144
21.76	12.31	9322.35	2.820	0.0*	5-S2n	0.993	1.320	0.995	0.812	9.904	4.289
24.38	12.37	9322.37	2.838	0.0*	5-S2n	0.997	1.323	0.998	0.858	9.921	4.421
27.00	12.42	9322.38	2.854	0.0*	5-S2n	1.000	1.325	1.004	0.901	9.891	4.541

Water Surface Profile Plot for Culvert: 18" PIPE

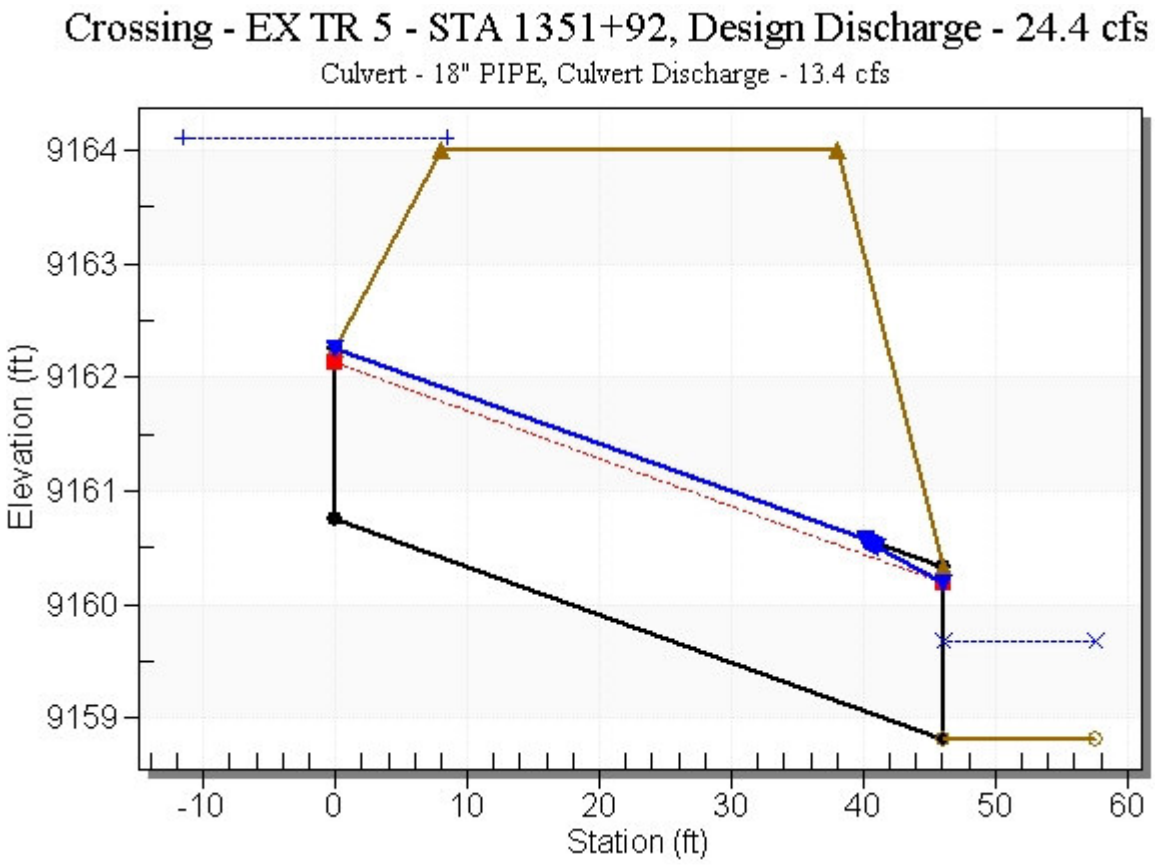


Table 4 - Culvert Summary Table: 18" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.63	1.63	9161.39	0.641	0.0*	1-S2n	0.372	0.477	0.376	0.209	4.665	2.027
7.01	7.01	9162.34	1.594	0.0*	5-S2n	0.838	1.023	0.842	0.461	6.867	3.142
12.39	12.39	9163.62	2.872	2.751	7-M2c	1.343	1.324	1.332	0.616	7.483	3.683
17.77	13.29	9164.06	3.155	3.310	7-M2c	1.500	1.365	1.358	0.736	7.900	4.062
23.15	13.36	9164.10	3.179	3.353	7-M2c	1.500	1.368	1.360	0.837	7.936	4.360
24.45	13.38	9164.11	3.184	3.361	7-M2c	1.500	1.369	1.360	0.859	7.943	4.424
33.91	13.47	9164.17	3.215	3.418	7-M2c	1.500	1.373	1.362	1.003	7.992	4.822
39.29	13.52	9164.20	3.231	3.445	7-M2c	1.500	1.375	1.371	1.074	7.985	5.012
44.67	13.56	9164.22	3.246	3.471	7-M2c	1.500	1.377	1.372	1.140	8.005	5.182
50.05	13.61	9164.25	3.259	3.496	7-M2c	1.500	1.379	1.374	1.201	8.023	5.337
55.43	13.65	9164.27	3.273	3.519	7-M2c	1.500	1.381	1.368	1.259	8.069	5.481

Water Surface Profile Plot for Culvert: 18" PIPE

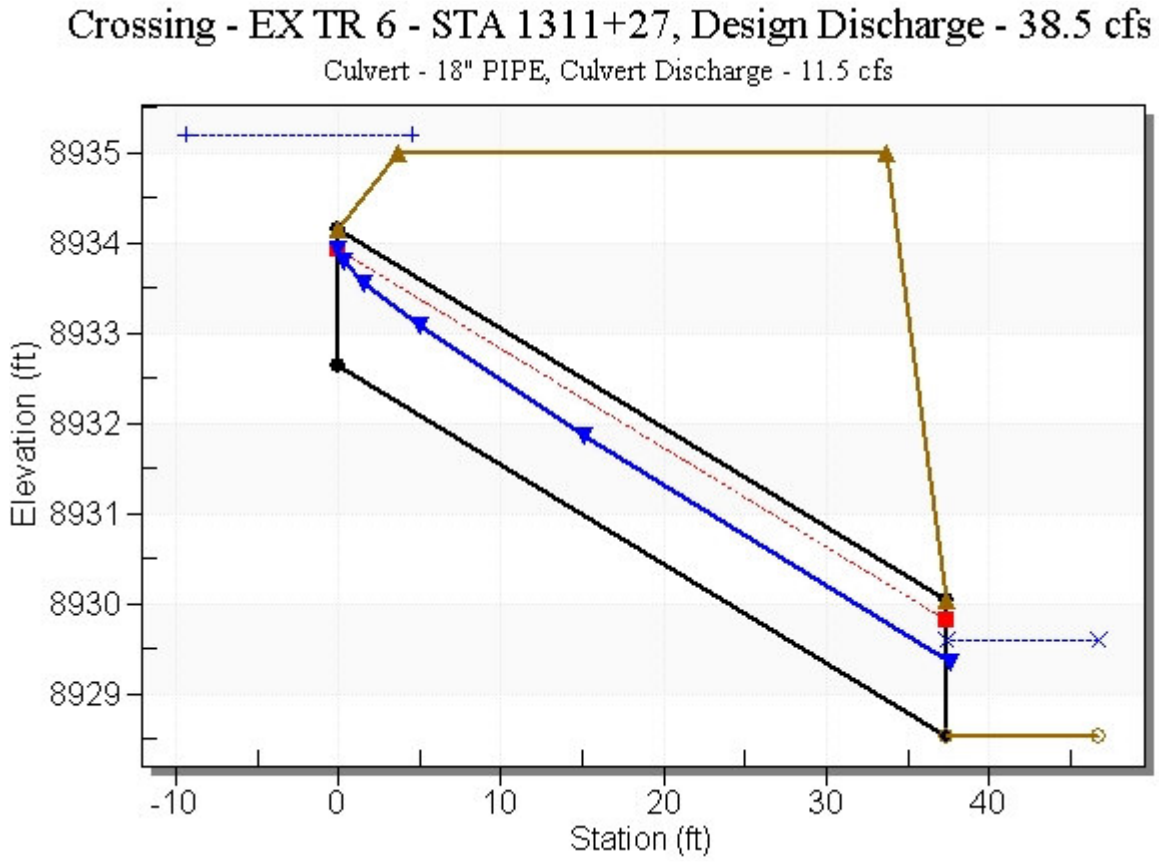


Table 5 - Culvert Summary Table: 18" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2.62	2.62	8933.42	0.781	0.0*	1-S2n	0.371	0.612	0.377	0.272	7.468	2.351
11.03	10.78	8935.01	2.366	0.0*	5-S2n	0.812	1.250	0.813	0.581	11.017	3.568
19.45	11.10	8935.09	2.452	0.0*	5-S2n	0.827	1.265	0.828	0.769	11.100	4.161
27.86	11.30	8935.15	2.506	0.0*	5-S2n	0.836	1.274	0.837	0.914	11.148	4.580
36.28	11.46	8935.19	2.550	0.0*	5-S2n	0.843	1.281	0.844	1.035	11.187	4.909
38.49	11.50	8935.20	2.561	0.0*	5-S2n	0.845	1.283	0.846	1.064	11.196	4.985
53.10	11.73	8935.27	2.628	0.0*	5-S2n	0.856	1.294	0.857	1.234	11.251	5.421
61.52	11.85	8935.30	2.662	0.0*	5-S2n	0.861	1.299	0.862	1.320	11.278	5.630
69.93	11.96	8935.33	2.694	0.0*	5-S2n	0.867	1.304	0.867	1.398	11.303	5.819
78.35	12.07	8935.37	2.725	0.0*	5-S2n	0.871	1.309	0.872	1.472	11.326	5.991
86.76	12.17	8935.39	2.753	2.753	5-S1f	0.876	1.314	1.314	1.540	7.434	6.150

Water Surface Profile Plot for Culvert: 18" PIPE

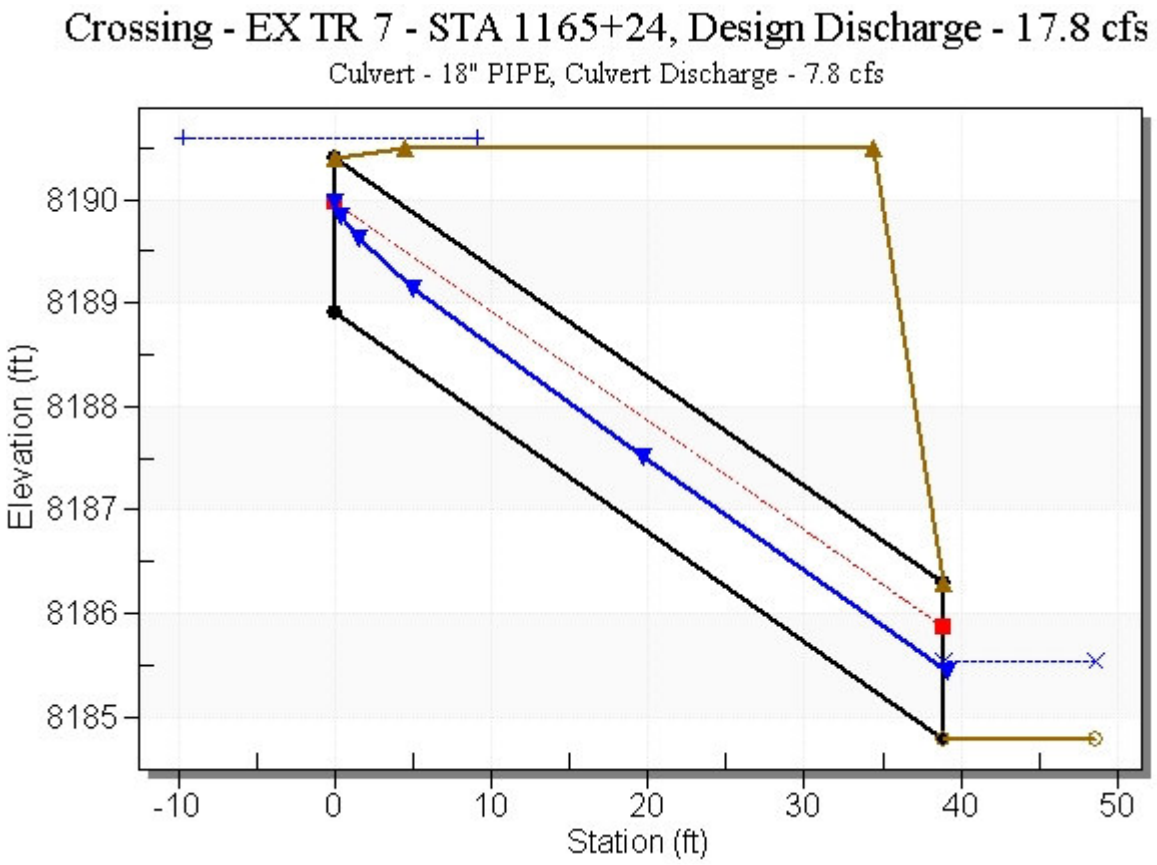


Table 6 - Culvert Summary Table: 18" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.19	1.19	8189.41	0.509	0.0*	1-S2n	0.247	0.402	0.251	0.175	5.960	1.832
5.09	5.09	8190.11	1.214	0.0*	1-S2n	0.534	0.866	0.535	0.390	8.970	2.866
8.99	7.46	8190.53	1.629	0.0*	5-S2n	0.660	1.057	0.666	0.524	9.834	3.370
12.89	7.66	8190.57	1.668	0.0*	5-S2n	0.670	1.070	0.672	0.628	9.981	3.724
16.79	7.81	8190.60	1.697	0.0*	5-S2n	0.678	1.080	0.679	0.716	10.045	4.001
17.81	7.84	8190.60	1.704	0.0*	5-S2n	0.679	1.082	0.681	0.737	10.046	4.065
24.60	8.05	8190.65	1.744	0.0*	5-S2n	0.689	1.095	0.694	0.861	10.054	4.431
28.50	8.16	8190.67	1.767	0.0*	5-S2n	0.695	1.102	0.697	0.924	10.132	4.607
32.40	8.26	8190.69	1.787	0.0*	5-S2n	0.700	1.109	0.702	0.982	10.172	4.765
36.30	8.35	8190.71	1.807	0.0*	5-S2n	0.705	1.115	0.705	1.035	10.230	4.909
40.20	8.44	8190.72	1.824	0.0*	5-S2n	0.709	1.120	0.710	1.086	10.231	5.042

HY-8 Culvert Analysis Report

Proposed Conditions

Water Surface Profile Plot for Culvert: 24" PIPE

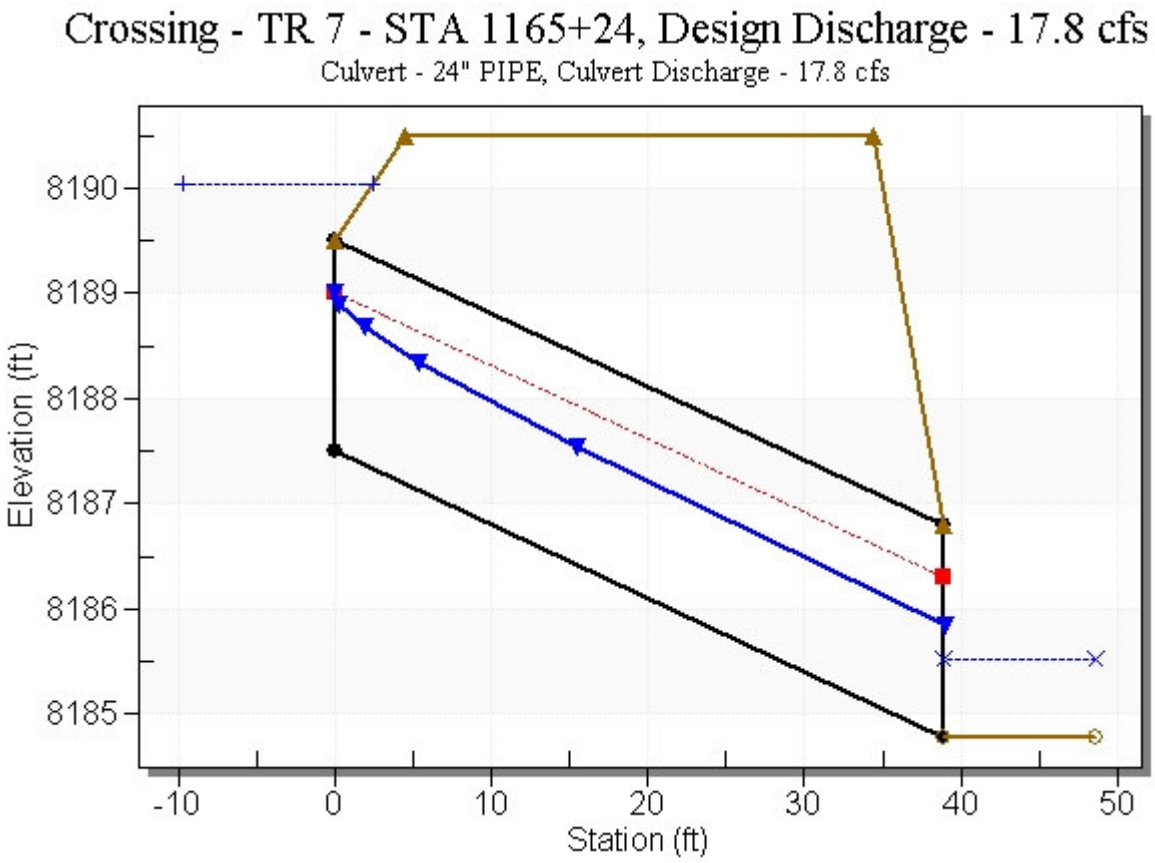


Table 1 - Culvert Summary Table: 24" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.19	1.19	8187.98	0.481	0.0*	1-S2n	0.247	0.370	0.260	0.175	4.797	1.832
5.09	5.09	8188.55	1.045	0.0*	1-S2n	0.528	0.794	0.533	0.390	7.513	2.866
8.99	8.99	8189.00	1.496	0.0*	1-S2n	0.716	1.066	0.721	0.524	8.792	3.370
12.89	12.89	8189.42	1.924	0.0*	1-S2n	0.875	1.287	0.877	0.628	9.716	3.724
16.79	16.79	8189.90	2.398	0.0*	5-S2n	1.021	1.472	1.022	0.716	10.406	4.001
17.81	17.81	8190.03	2.535	0.0*	5-S2n	1.058	1.515	1.064	0.737	10.495	4.065
24.60	21.24	8190.55	3.049	0.0*	5-S2n	1.181	1.641	1.183	0.861	10.979	4.431
28.50	21.44	8190.58	3.082	0.0*	5-S2n	1.188	1.647	1.190	0.924	11.011	4.607
32.40	21.61	8190.61	3.110	0.0*	5-S2n	1.194	1.652	1.194	0.982	11.045	4.765
36.30	21.76	8190.63	3.134	0.0*	5-S2n	1.199	1.656	1.199	1.035	11.060	4.909
40.20	21.89	8190.66	3.156	0.0*	5-S2n	1.204	1.660	1.204	1.086	11.072	5.042

Water Surface Profile Plot for Culvert: 36" PIPE

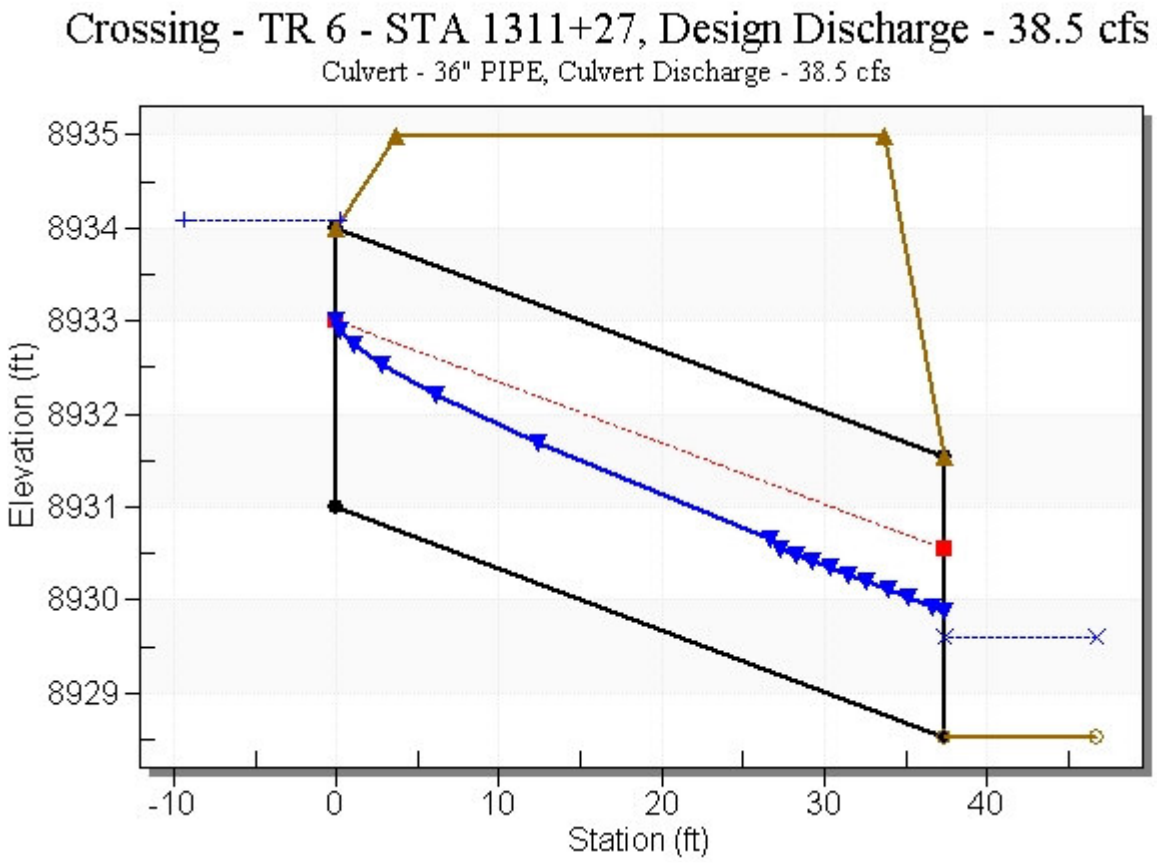


Table 2 - Culvert Summary Table: 36" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2.62	2.62	8931.64	0.639	0.0*	1-S2n	0.333	0.483	0.343	0.272	7.268	2.351
11.03	11.03	8932.37	1.373	0.0*	1-S2n	0.686	1.043	0.693	0.581	8.847	3.568
19.45	19.45	8932.93	1.926	0.0*	1-S2n	0.928	1.408	0.933	0.769	10.408	4.161
27.86	27.86	8933.43	2.431	0.0*	1-S2n	1.120	1.701	1.127	0.914	11.452	4.580
36.28	36.28	8933.94	2.938	0.0*	1-S2n	1.297	1.952	1.304	1.035	12.299	4.909
38.49	38.49	8934.08	3.077	0.0*	5-S2n	1.341	2.014	1.349	1.064	12.483	4.985
53.10	51.90	8935.02	4.025	0.0*	5-S2n	1.601	2.336	1.666	1.234	12.877	5.421
61.52	52.79	8935.10	4.095	0.0*	5-S2n	1.617	2.357	1.685	1.320	12.922	5.630
69.93	53.41	8935.15	4.145	0.0*	5-S2n	1.629	2.371	1.697	1.398	12.959	5.819
78.35	53.94	8935.19	4.189	0.0*	5-S2n	1.639	2.383	1.708	1.472	12.983	5.991
86.76	54.42	8935.23	4.227	0.0*	5-S2n	1.648	2.394	1.717	1.540	13.014	6.150

Water Surface Profile Plot for Culvert: 30" PIPE

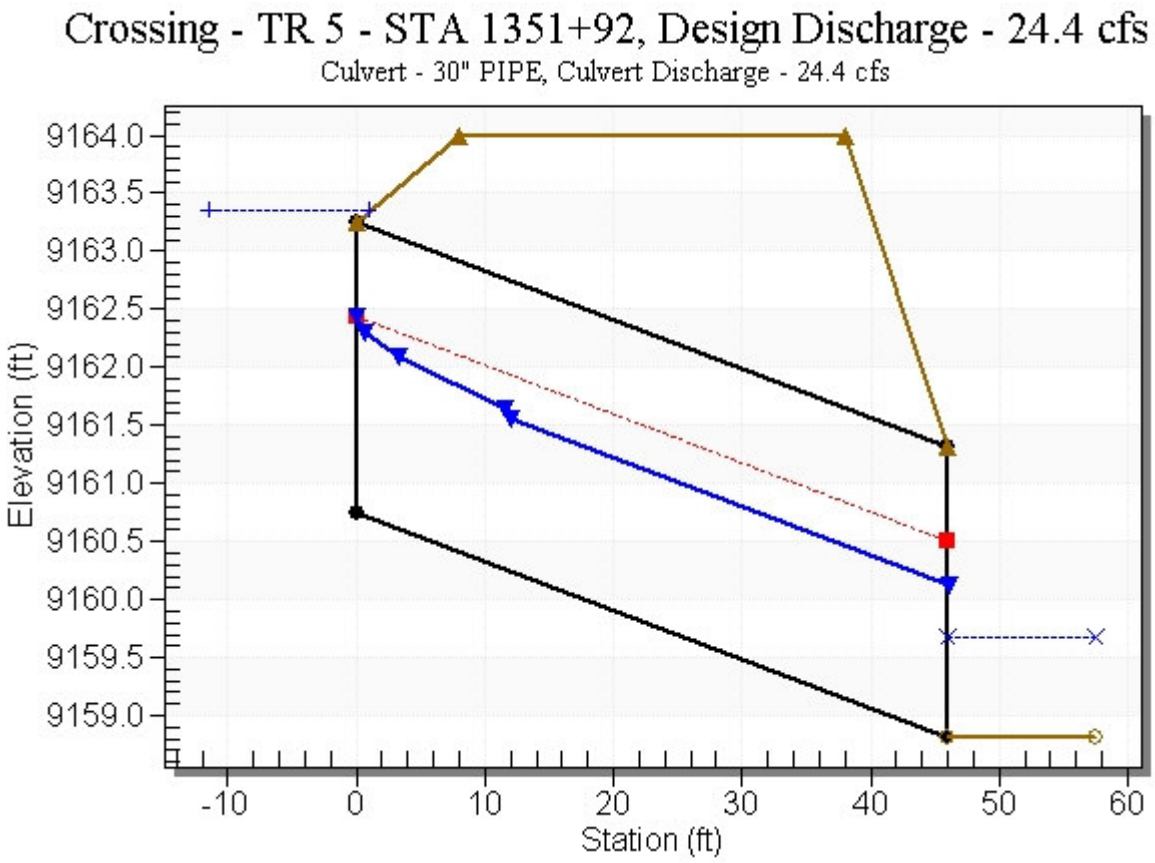


Table 3 - Culvert Summary Table: 30" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.63	1.63	9161.29	0.539	0.0*	1-S2n	0.306	0.398	0.308	0.209	4.555	2.027
7.01	7.01	9161.92	1.172	0.0*	1-S2n	0.653	0.870	0.660	0.461	6.711	3.142
12.39	12.39	9162.39	1.640	0.0*	1-S2n	0.885	1.177	0.891	0.616	7.876	3.683
17.77	17.77	9162.81	2.065	0.0*	1-S2n	1.081	1.423	1.086	0.736	8.680	4.062
23.15	23.15	9163.24	2.491	0.0*	1-S2n	1.262	1.632	1.262	0.837	9.319	4.360
24.45	24.45	9163.35	2.599	0.0*	5-S2n	1.303	1.680	1.309	0.859	9.402	4.424
33.91	31.92	9164.03	3.283	0.0*	5-S2n	1.543	1.917	1.543	1.003	10.030	4.822
39.29	32.39	9164.08	3.331	0.0*	5-S2n	1.559	1.932	1.561	1.074	10.060	5.012
44.67	32.74	9164.12	3.367	0.0*	5-S2n	1.570	1.942	1.574	1.140	10.068	5.182
50.05	33.04	9164.15	3.399	0.0*	5-S2n	1.580	1.951	1.584	1.201	10.086	5.337
55.43	33.31	9164.18	3.427	0.0*	5-S2n	1.589	1.959	1.592	1.259	10.109	5.481

Water Surface Profile Plot for Culvert: 24" PIPE

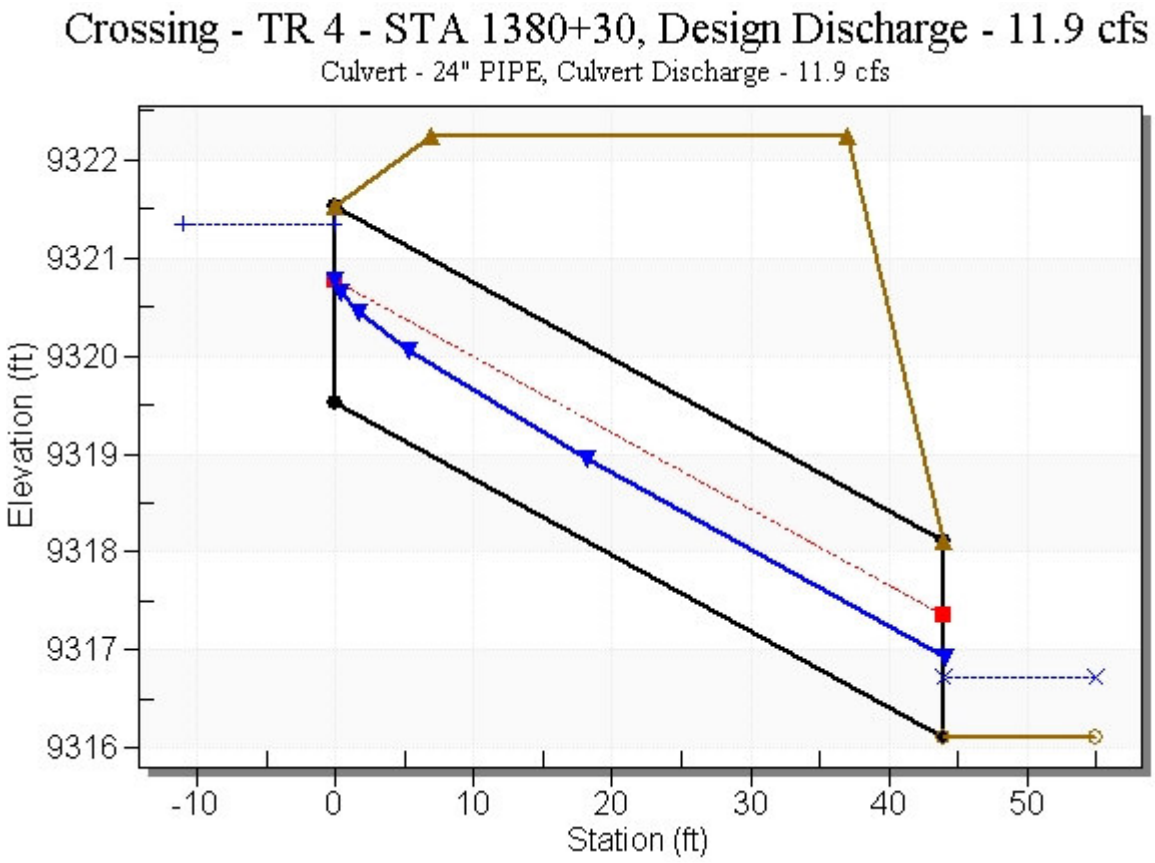


Table 4 - Culvert Summary Table: 24" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.78	0.78	9319.91	0.379	0.0*	1-S2n	0.206	0.288	0.238	0.138	4.945	1.592
3.40	3.40	9320.36	0.835	0.0*	1-S2n	0.422	0.640	0.430	0.314	6.935	2.545
6.02	6.02	9320.68	1.152	0.0*	1-S2n	0.563	0.863	0.566	0.426	8.199	3.008
8.65	8.65	9320.98	1.450	0.0*	1-S2n	0.681	1.045	0.684	0.513	9.070	3.334
11.27	11.27	9321.27	1.735	0.0*	1-S2n	0.789	1.204	0.790	0.587	9.762	3.588
11.90	11.90	9321.34	1.805	0.0*	1-S2n	0.813	1.236	0.815	0.603	9.895	3.643
16.51	16.51	9321.88	2.353	0.0*	5-S2n	0.979	1.460	0.979	0.710	10.800	3.983
19.13	19.13	9322.25	2.715	0.0*	5-S2n	1.069	1.570	1.069	0.763	11.200	4.144
21.76	19.43	9322.29	2.759	0.0*	5-S2n	1.079	1.583	1.082	0.812	11.210	4.289
24.38	19.59	9322.31	2.784	0.0*	5-S2n	1.085	1.590	1.089	0.858	11.216	4.421
27.00	19.73	9322.33	2.804	0.0*	5-S2n	1.089	1.595	1.094	0.901	11.221	4.541

Water Surface Profile Plot for Culvert: 30" PIPE

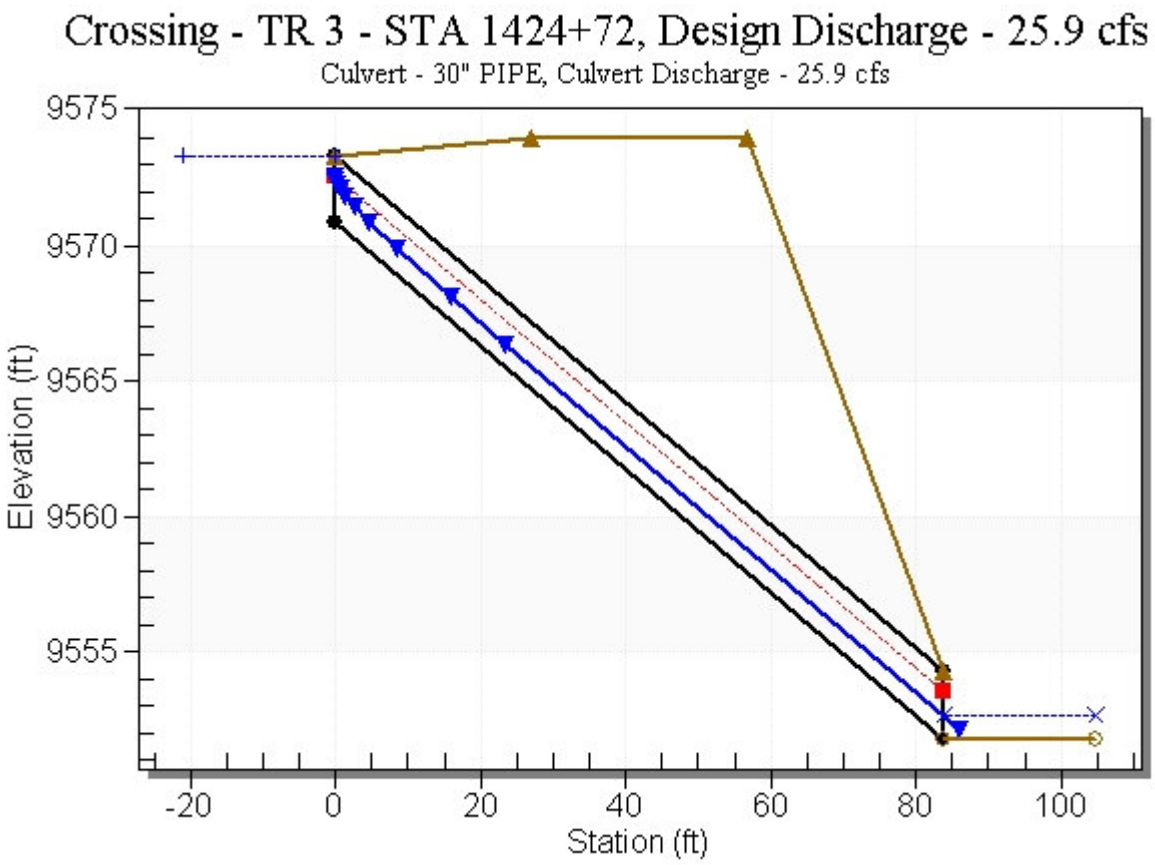


Table 5 - Culvert Summary Table: 30" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.73	1.73	9571.30	0.477	0.0*	1-S2n	0.195	0.412	0.195	0.217	7.114	2.066
7.46	7.46	9571.86	1.040	0.0*	1-S2n	0.435	0.899	0.439	0.476	12.613	3.198
13.18	13.18	9572.29	1.473	0.0*	1-S2n	0.585	1.218	0.588	0.635	14.835	3.746
18.91	18.91	9572.74	1.922	0.0*	1-S2n	0.709	1.472	0.711	0.759	16.378	4.131
24.64	24.64	9573.20	2.383	0.0*	1-S2n	0.814	1.687	0.816	0.862	17.659	4.433
25.95	25.95	9573.31	2.495	0.0*	1-S2n	0.836	1.735	0.844	0.884	17.746	4.494
36.09	33.54	9574.04	3.220	0.0*	5-S2n	0.963	1.966	0.965	1.033	19.154	4.902
41.82	34.00	9574.09	3.268	0.0*	5-S2n	0.971	1.980	0.973	1.106	19.213	5.094
47.55	34.35	9574.13	3.305	0.0*	5-S2n	0.976	1.991	0.981	1.173	19.216	5.267
53.27	34.65	9574.16	3.338	0.0*	5-S2n	0.981	2.000	0.983	1.236	19.331	5.424
59.00	34.91	9574.19	3.367	0.0*	5-S2n	0.986	2.005	0.988	1.295	19.348	5.569

Water Surface Profile Plot for Culvert: 36" PIPE

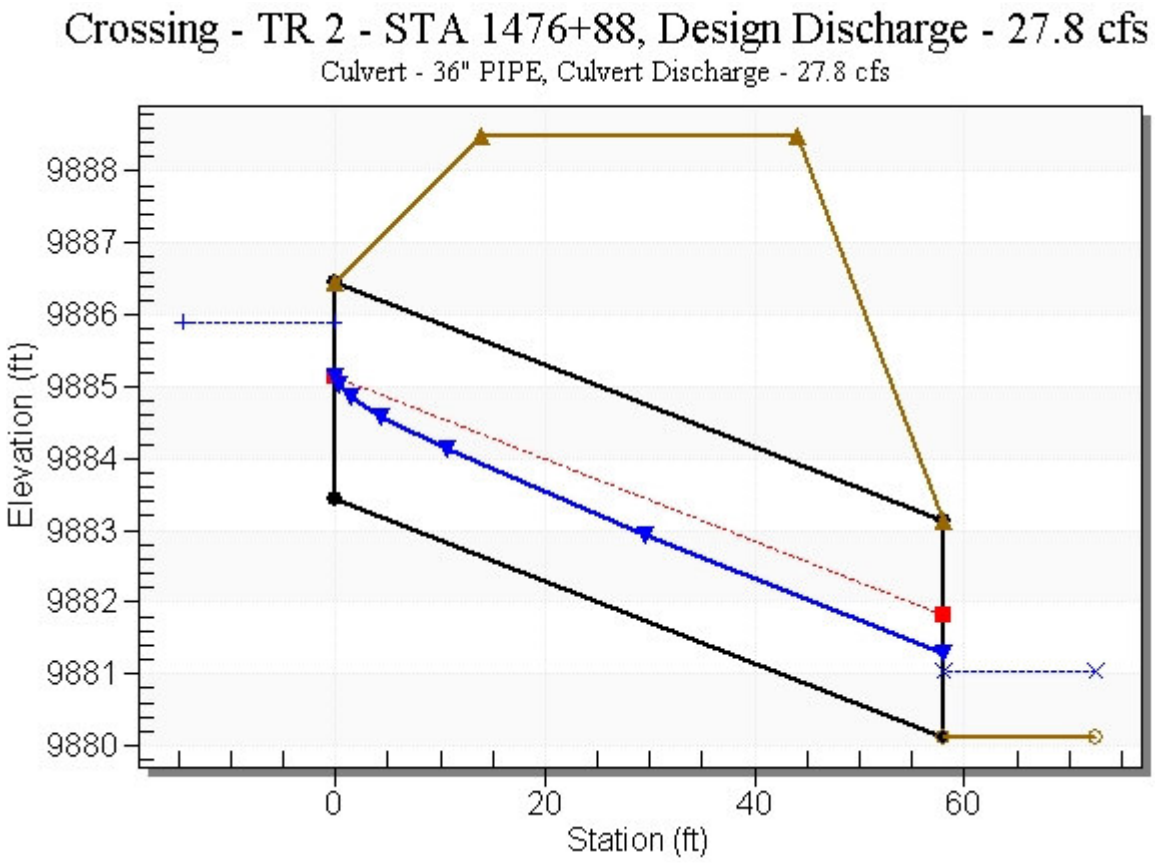
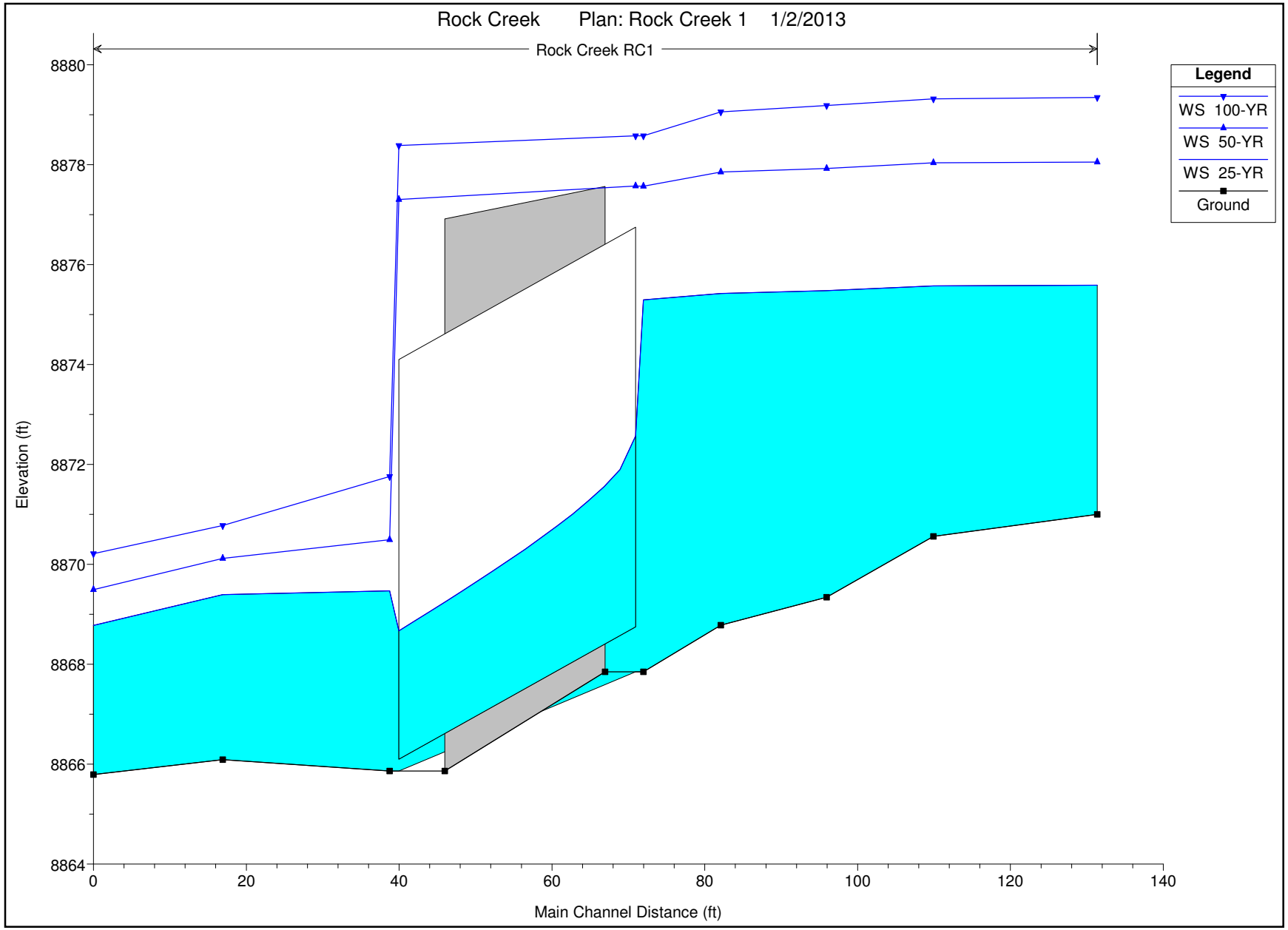


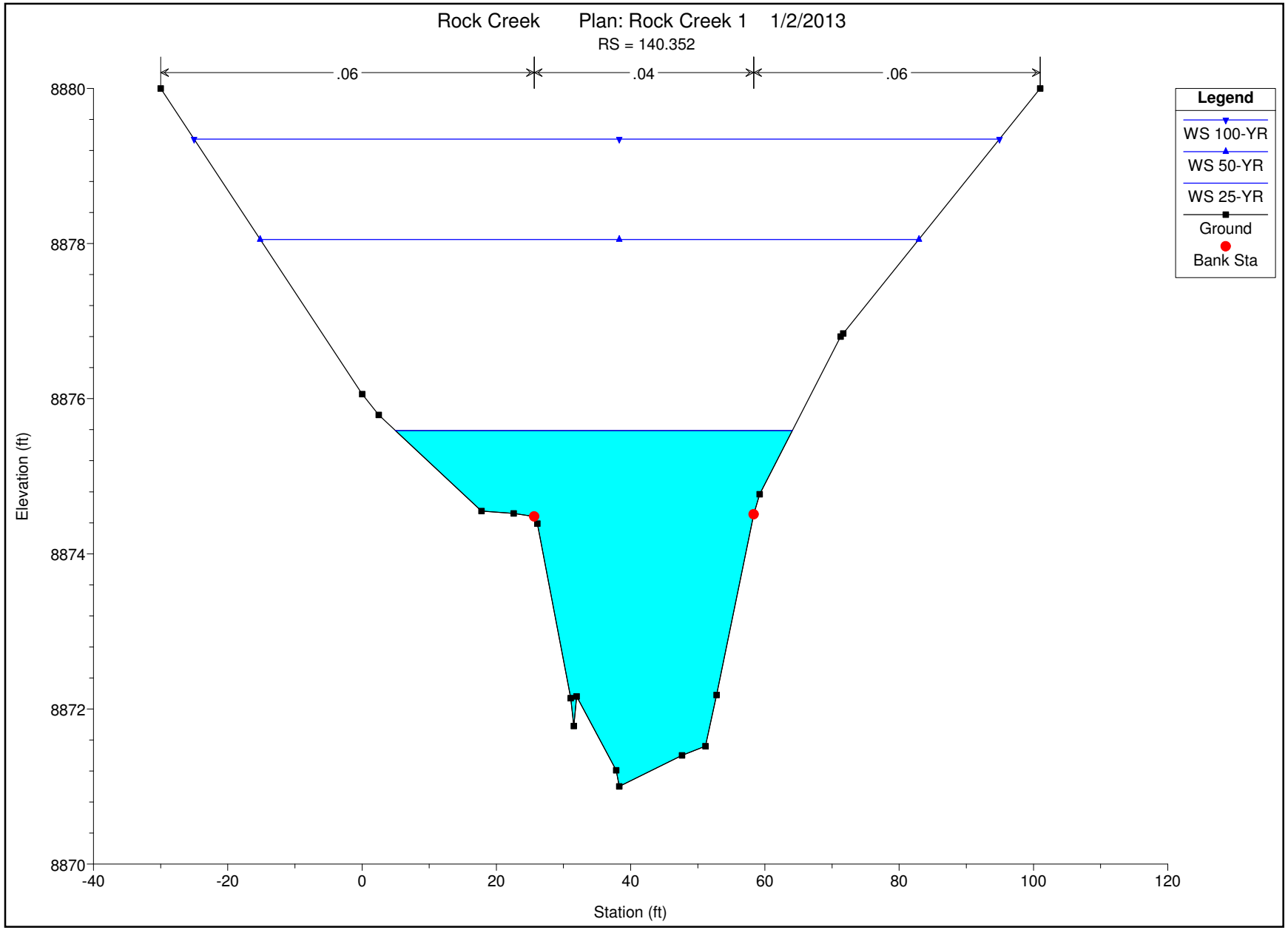
Table 6 - Culvert Summary Table: 36" PIPE

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.84	1.84	9883.98	0.535	0.0*	1-S2n	0.302	0.398	0.307	0.224	5.004	2.107
7.98	7.98	9884.61	1.168	0.0*	1-S2n	0.613	0.889	0.618	0.493	7.646	3.260
14.13	14.13	9885.03	1.594	0.0*	1-S2n	0.810	1.196	0.815	0.657	9.031	3.817
20.27	20.27	9885.43	1.990	0.0*	1-S2n	0.982	1.441	0.990	0.785	9.939	4.208
26.42	26.42	9885.80	2.359	0.0*	1-S2n	1.133	1.654	1.144	0.891	10.654	4.516
27.75	27.75	9885.88	2.438	0.0*	1-S2n	1.166	1.698	1.167	0.912	10.902	4.575
38.70	38.70	9886.54	3.104	0.0*	5-S2n	1.403	2.020	1.410	1.067	11.854	4.992
44.85	44.85	9886.95	3.515	0.0*	5-S2n	1.532	2.175	1.534	1.142	12.337	5.188
50.99	50.99	9887.41	3.967	0.0*	5-S2n	1.656	2.316	1.665	1.212	12.669	5.364
57.14	57.14	9887.91	4.470	0.0*	5-S2n	1.780	2.440	1.783	1.276	13.052	5.523
63.28	63.28	9888.47	5.030	0.0*	5-S2n	1.908	2.538	1.917	1.337	13.286	5.672

HEC-RAS Plan: RC1 River: Rock Creek Reach: RC1

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)	
RC1	140.352	25-YR	511.30	8871.00	8875.59		8875.87	0.002698	4.32	132.21	59.12	0.41
RC1	140.352	50-YR	770.80	8871.00	8878.05		8878.19	0.000744	3.23	324.91	98.11	0.23
RC1	140.352	100-YR	1127.50	8871.00	8879.35		8879.50	0.000690	3.55	465.78	119.94	0.23
RC1	118.907	25-YR	511.30	8870.56	8875.58		8875.81	0.001834	3.93	144.14	54.00	0.34
RC1	118.907	50-YR	770.80	8870.56	8878.04		8878.18	0.000651	3.21	322.73	88.77	0.22
RC1	118.907	100-YR	1127.50	8870.56	8879.32		8879.48	0.000661	3.65	450.79	112.64	0.23
RC1	104.934	25-YR	511.30	8869.34	8875.48		8875.77	0.001976	4.41	124.66	32.88	0.34
RC1	104.934	50-YR	770.80	8869.34	8877.92		8878.15	0.001018	4.09	249.40	74.02	0.26
RC1	104.934	100-YR	1127.50	8869.34	8879.18		8879.46	0.001082	4.67	355.22	94.11	0.28
RC1	91.080	25-YR	511.30	8868.78	8875.42		8875.74	0.002395	4.59	119.27	27.42	0.34
RC1	91.080	50-YR	770.80	8868.78	8877.85		8878.13	0.001425	4.47	211.01	52.16	0.28
RC1	91.080	100-YR	1127.50	8868.78	8879.06		8879.43	0.001686	5.33	293.85	84.87	0.31
RC1	80.945	25-YR	511.30	8867.85	8875.29	8871.75	8875.71	0.001743	5.19	98.51	14.31	0.35
RC1	80.945	50-YR	770.80	8867.85	8877.57	8872.85	8878.09	0.001594	5.83	140.97	43.22	0.34
RC1	80.945	100-YR	1127.50	8867.85	8878.58	8874.16	8879.37	0.002173	7.32	194.30	71.41	0.41
RC1	70		Culvert									
RC1	47.753	25-YR	511.30	8865.86	8869.47	8869.47	8871.11	0.016120	10.28	49.75	15.18	1.00
RC1	47.753	50-YR	770.80	8865.86	8870.49	8870.49	8872.65	0.015235	11.79	65.36	15.30	1.01
RC1	47.753	100-YR	1127.50	8865.86	8871.76	8871.76	8874.50	0.014218	13.29	84.82	15.45	1.00
RC1	25.895	25-YR	511.30	8866.09	8869.39	8869.39	8870.35	0.017804	7.89	66.83	41.01	0.96
RC1	25.895	50-YR	770.80	8866.09	8870.12	8870.12	8871.17	0.014539	8.38	103.37	57.84	0.91
RC1	25.895	100-YR	1127.50	8866.09	8870.78	8870.78	8872.03	0.013515	9.37	145.35	70.97	0.91
RC1	8.986	25-YR	511.30	8865.79	8868.78	8868.78	8869.70	0.014753	7.82	72.38	45.71	0.90
RC1	8.986	50-YR	770.80	8865.79	8869.49	8869.49	8870.52	0.012175	8.49	112.67	65.36	0.86
RC1	8.986	100-YR	1127.50	8865.79	8870.21	8870.21	8871.35	0.010905	9.26	164.10	77.74	0.84


Rock Creek Plan: Rock Creek 1 1/2/2013
Rock Creek RC1
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
8866
8864
0
20
40
60
80
100
120
140
Main Channel Distance (ft)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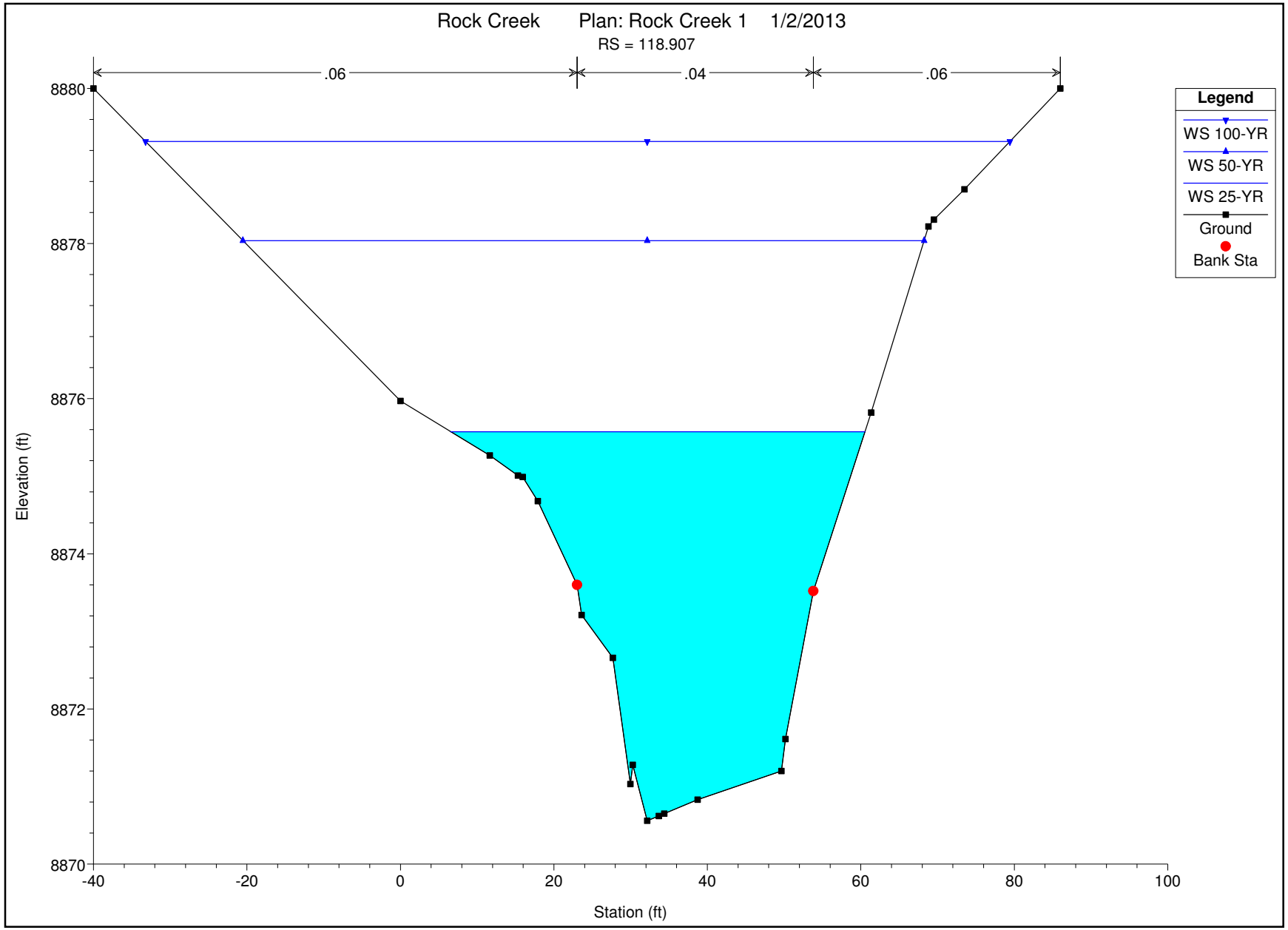
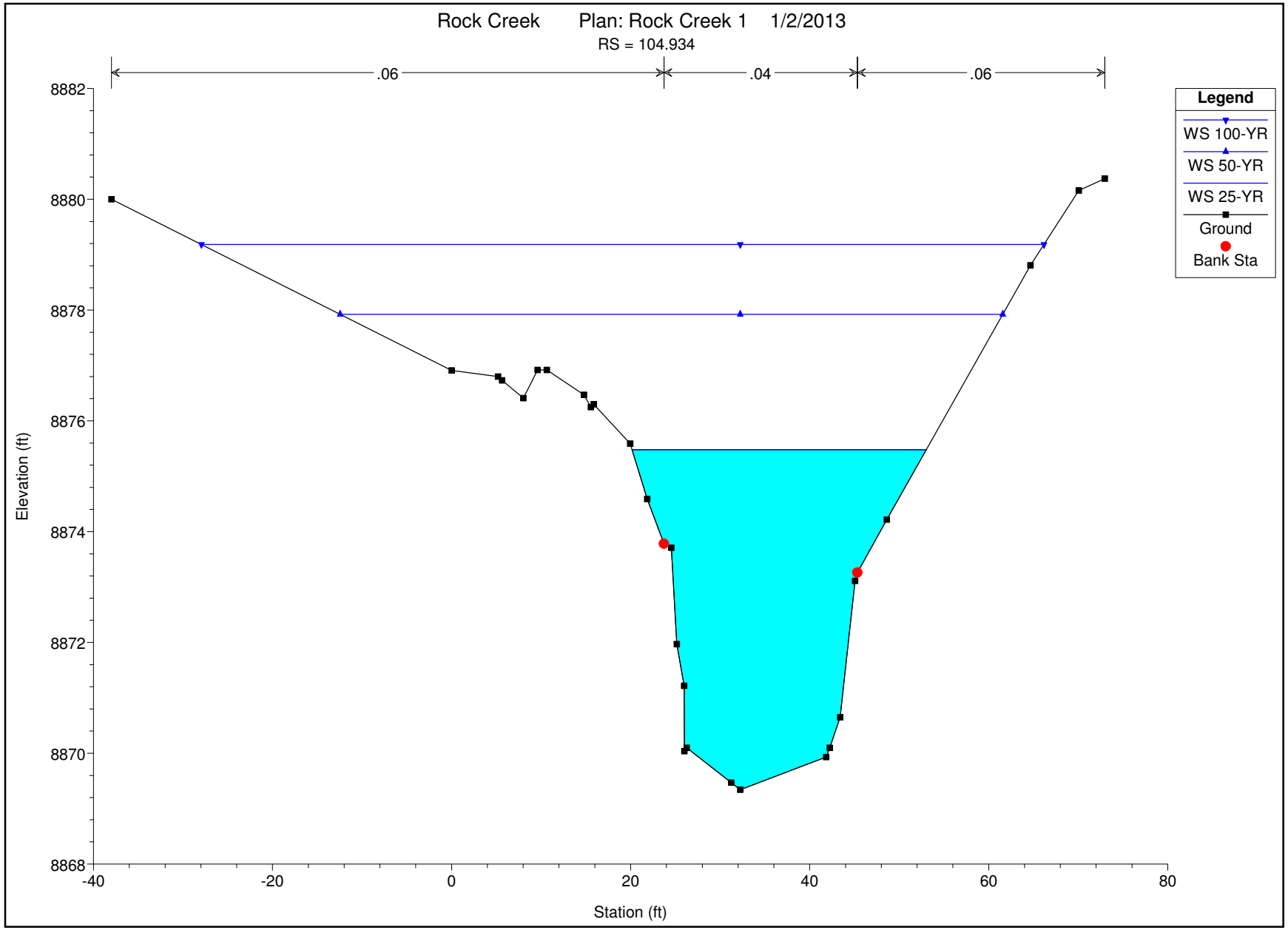
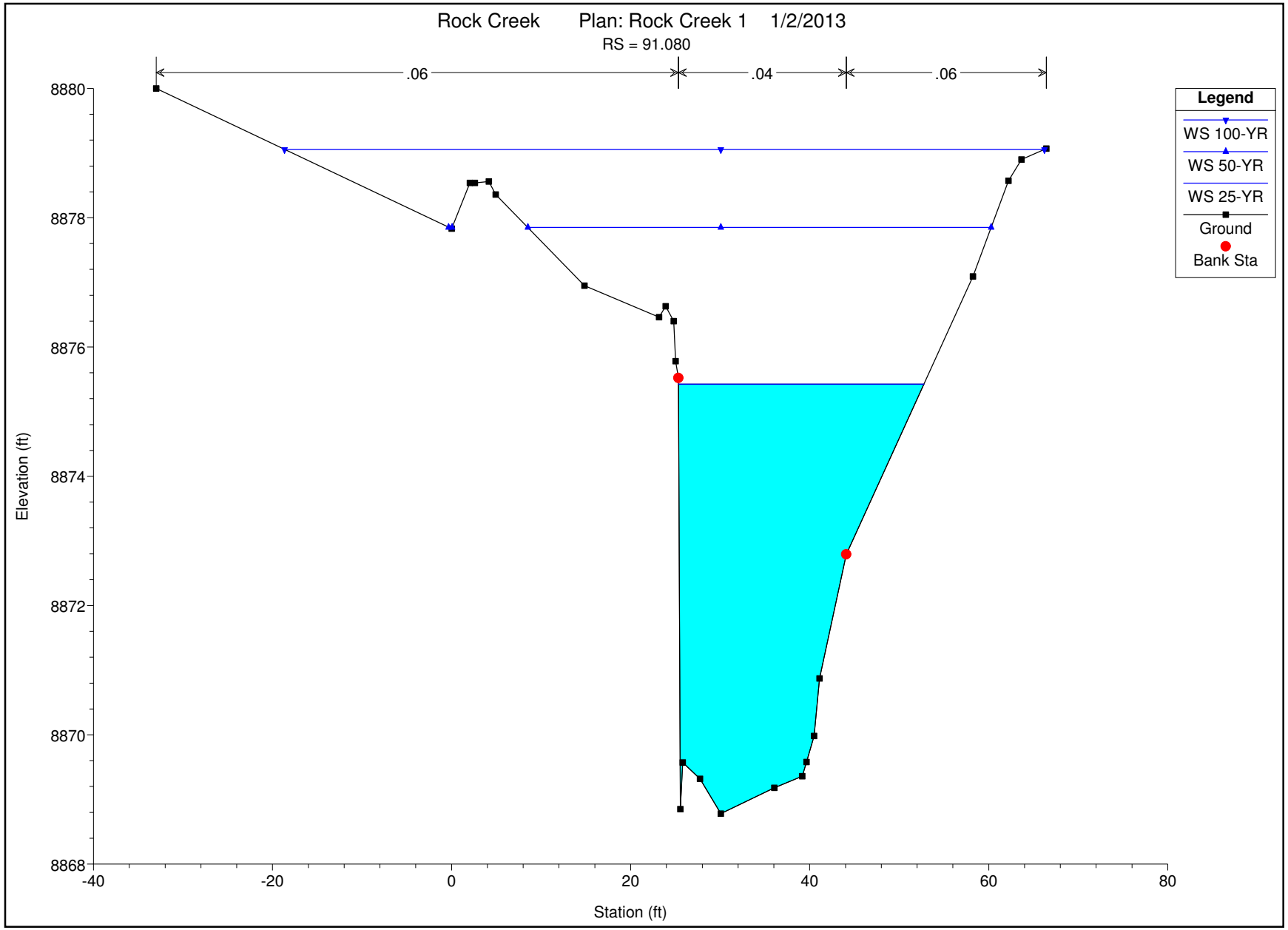
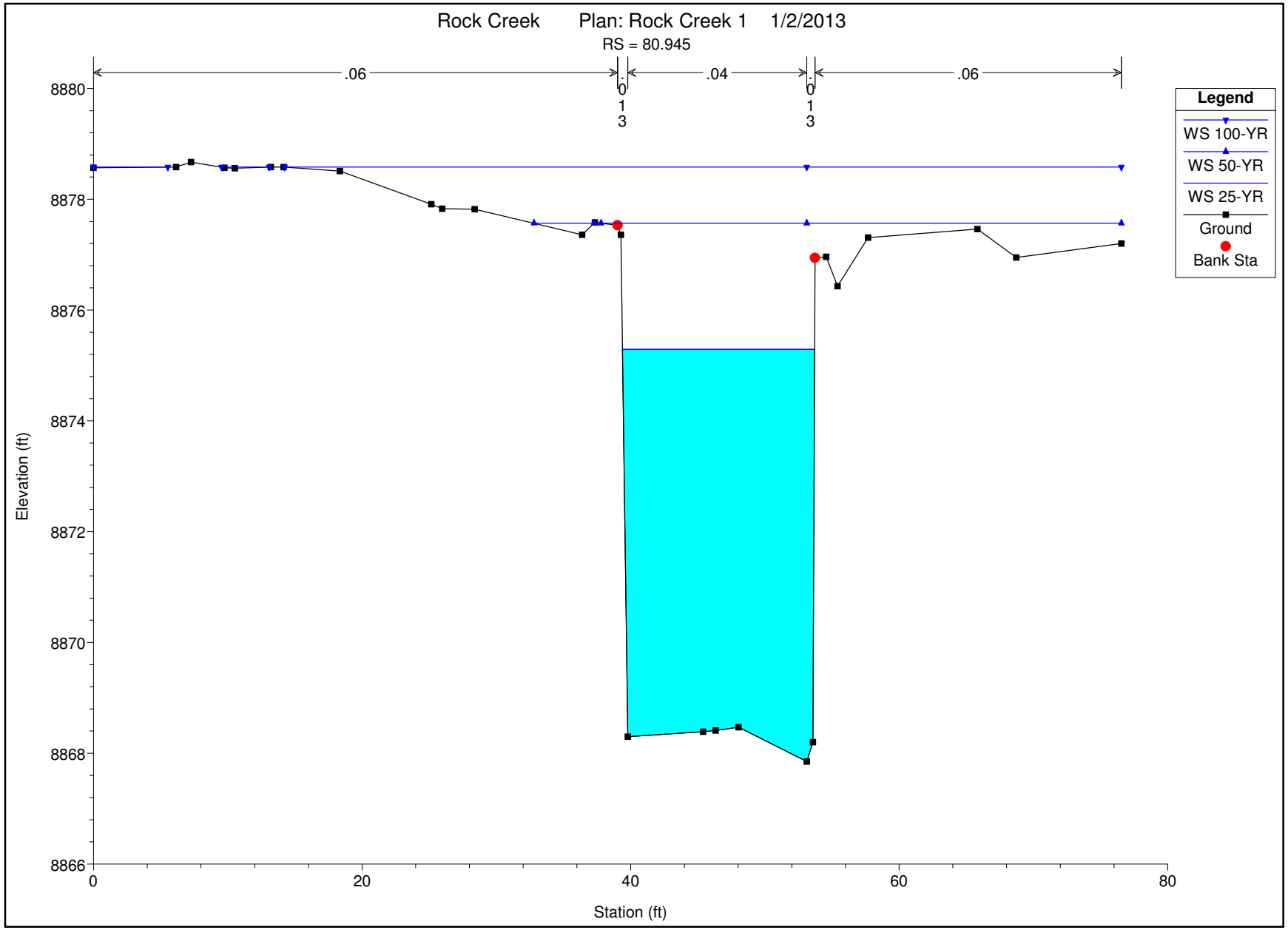
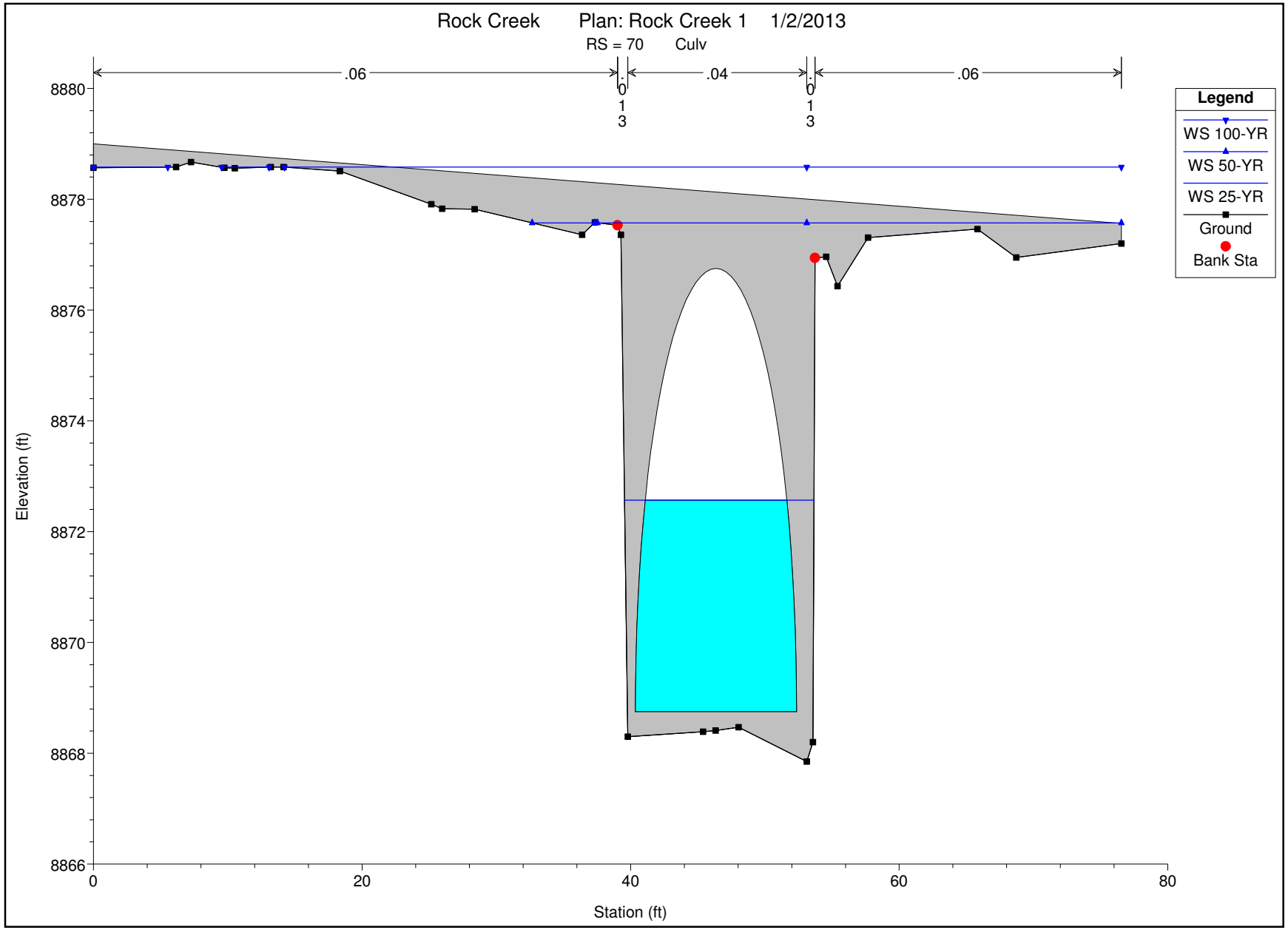
RS = 140.352
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
-40
-20
0
20
40
60
80
100
120
Station (ft)

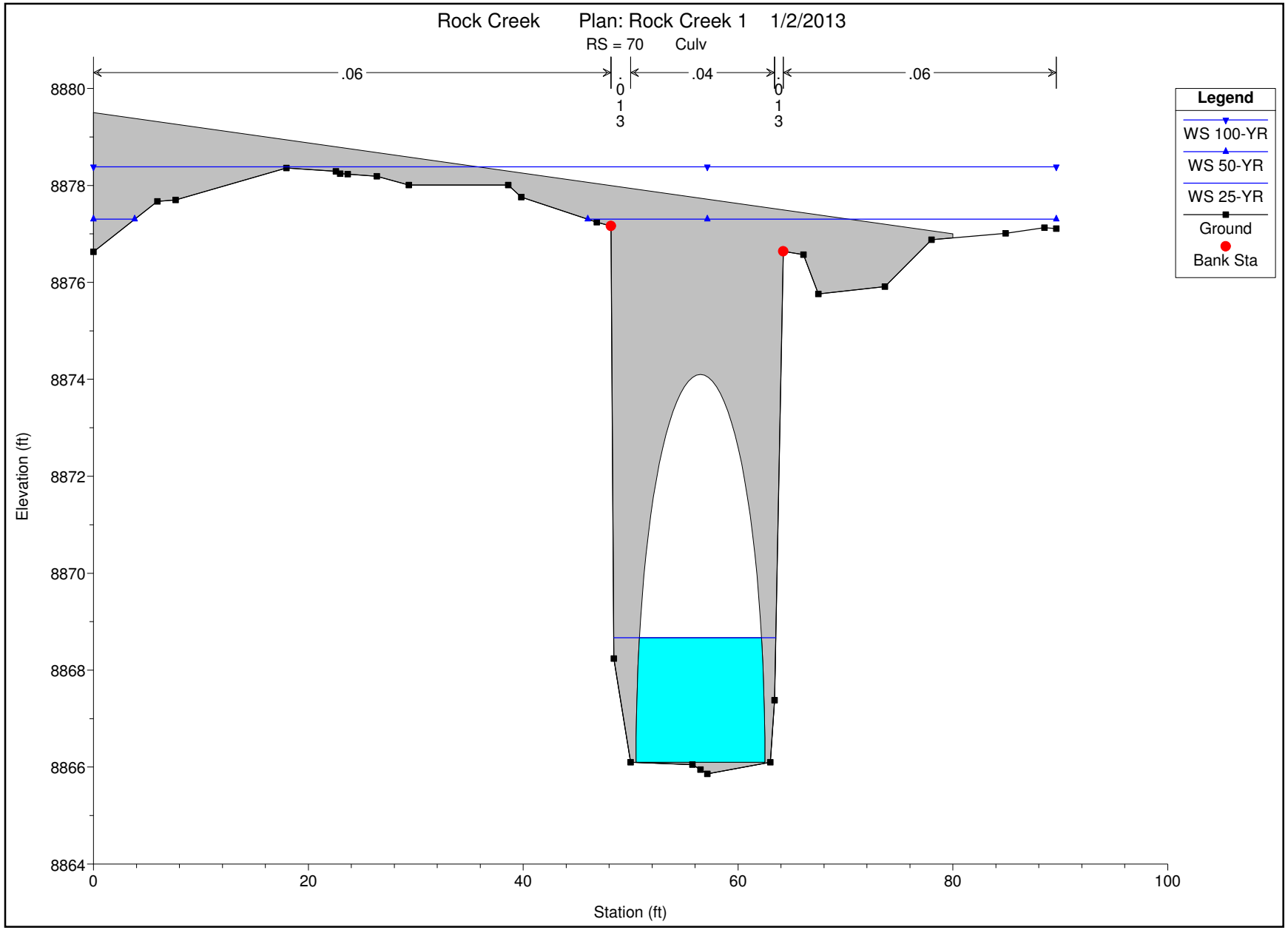

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 118.907
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
-40
-20
0
20
40
60
80
100
Station (ft)

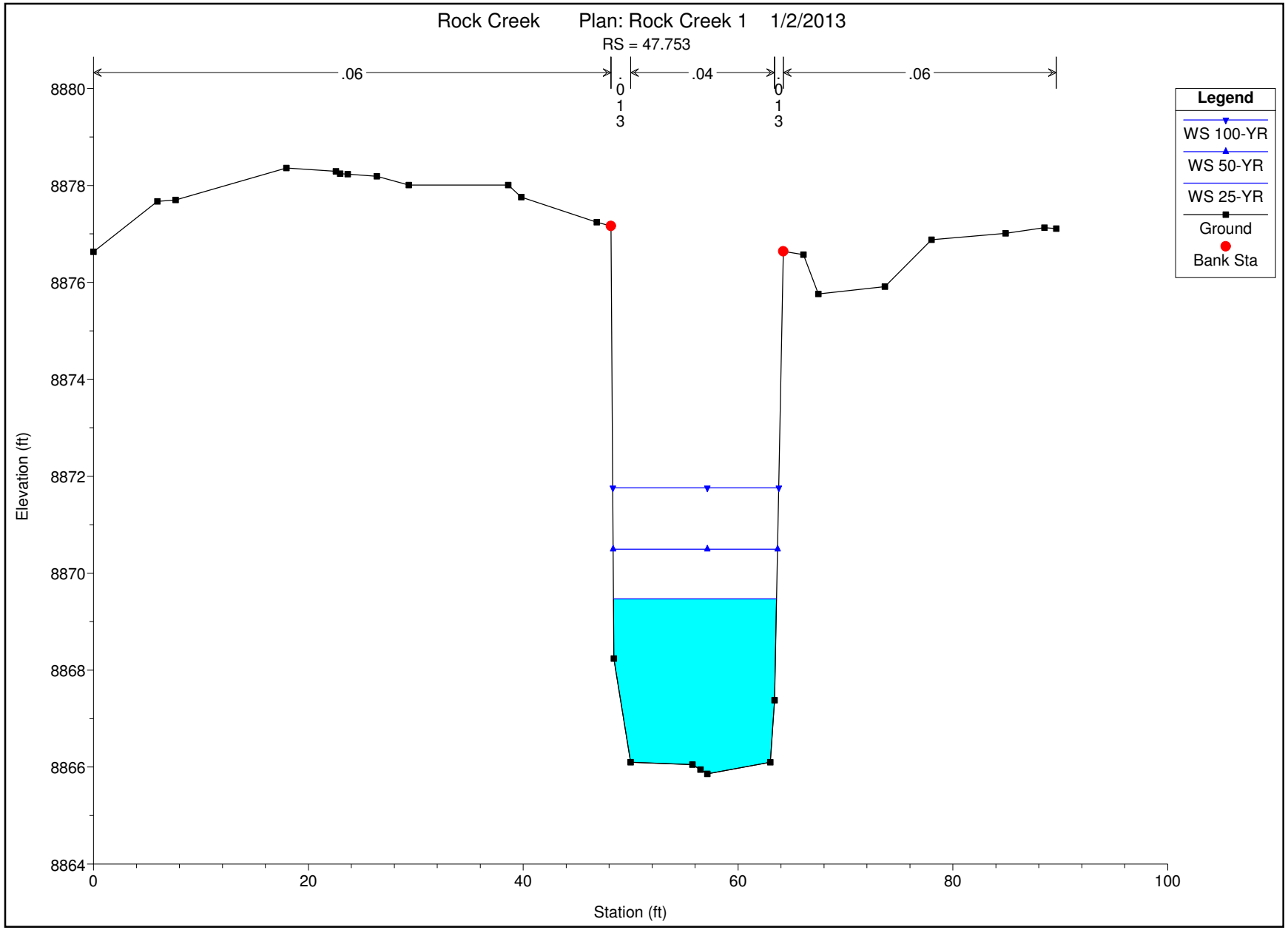

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 104.934
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8882
8880
8878
8876
8874
8872
8870
8868
-40
-20
0
20
40
60
80
Station (ft)

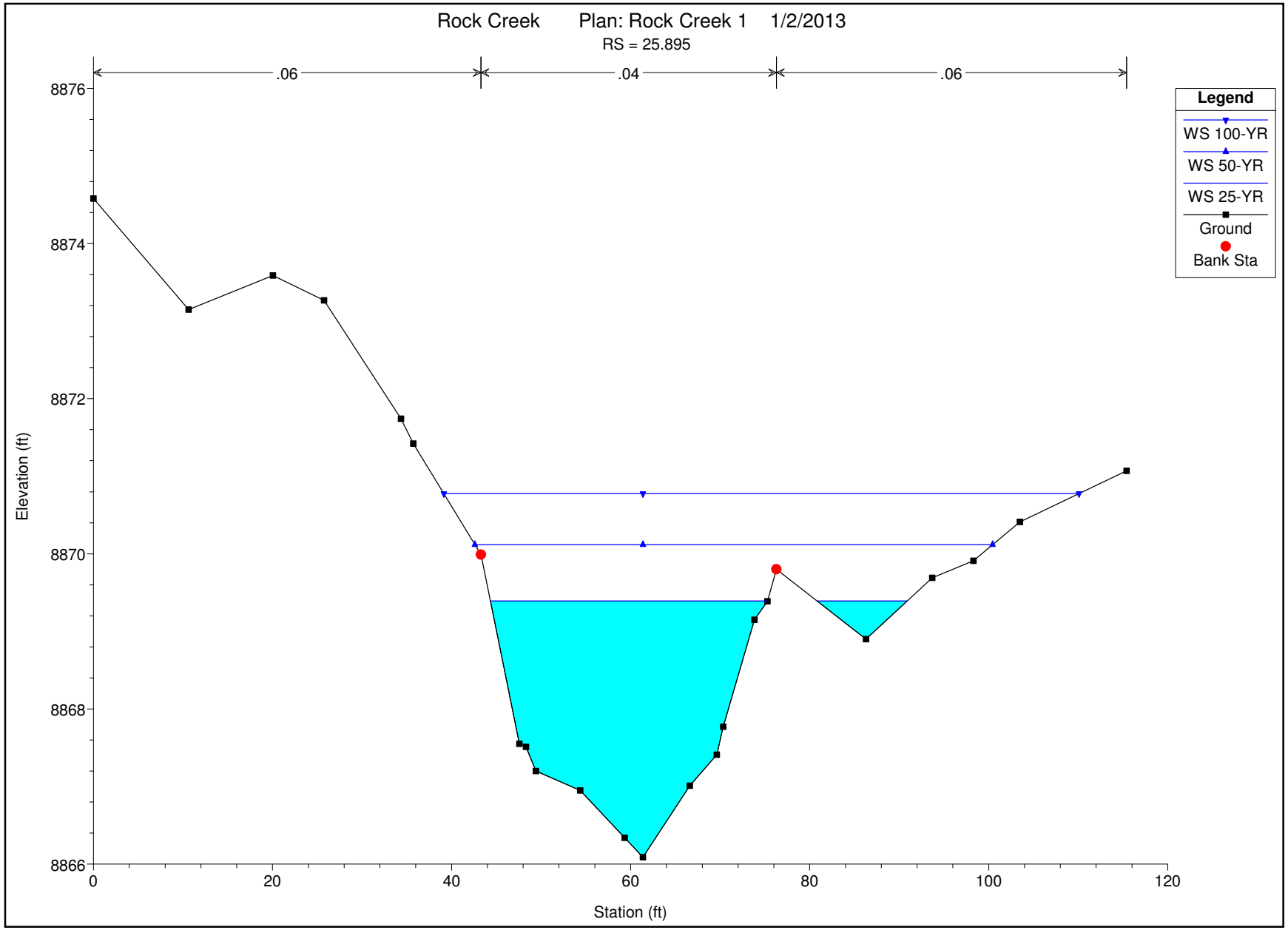

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 91.080
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
-40
-20
0
20
40
60
80
Station (ft)

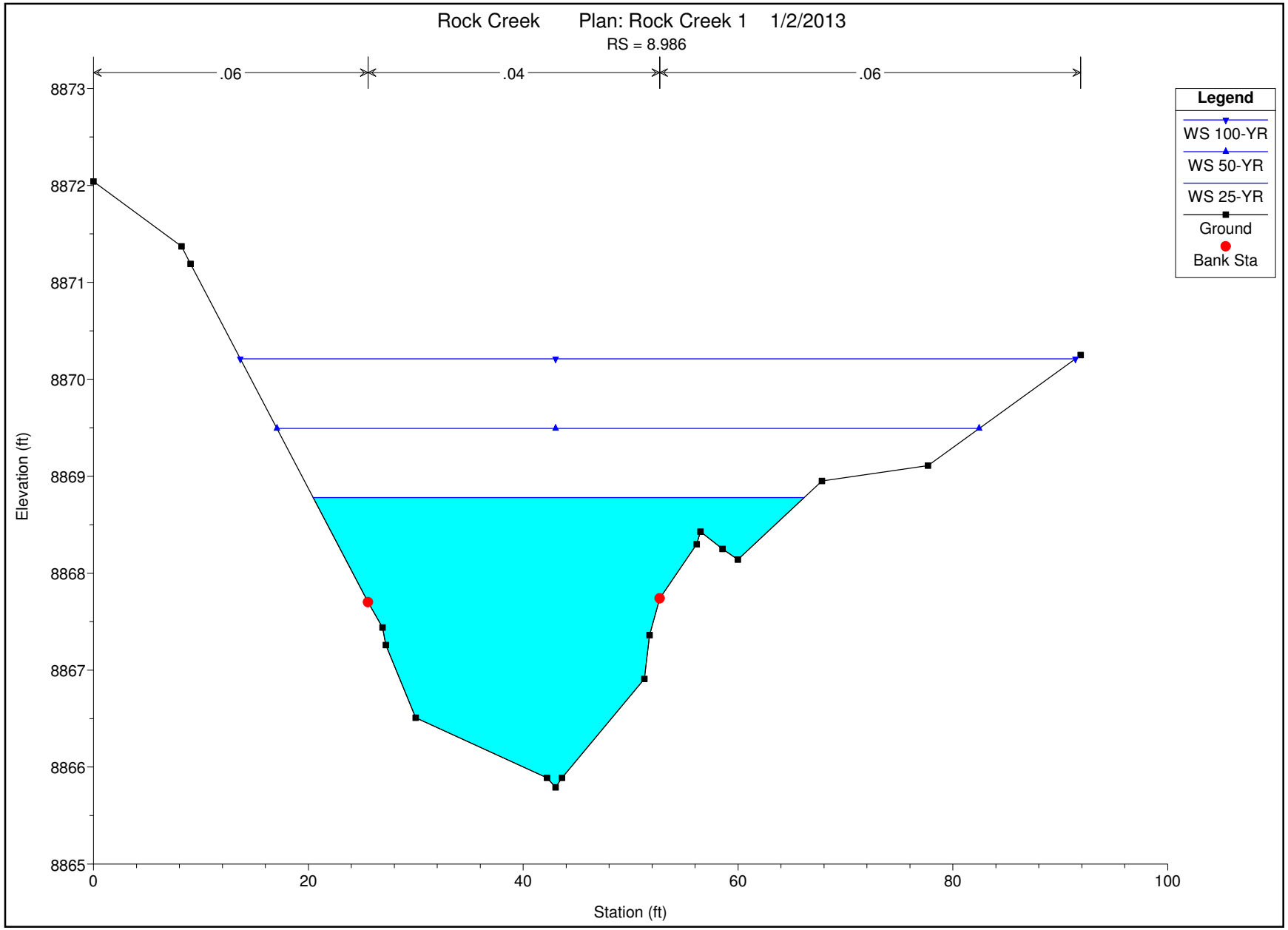

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 80.945
.06
.04
.06
.013
.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
8866
0
20
40
60
80
Station (ft)


Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 70 Culv
.06
.04
.06
.013
.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
8866
0
20
40
60
80
Station (ft)


Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 70 Culv
.06
.04
.06
.013
.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
8866
8864
0
20
40
60
80
100
Station (ft)

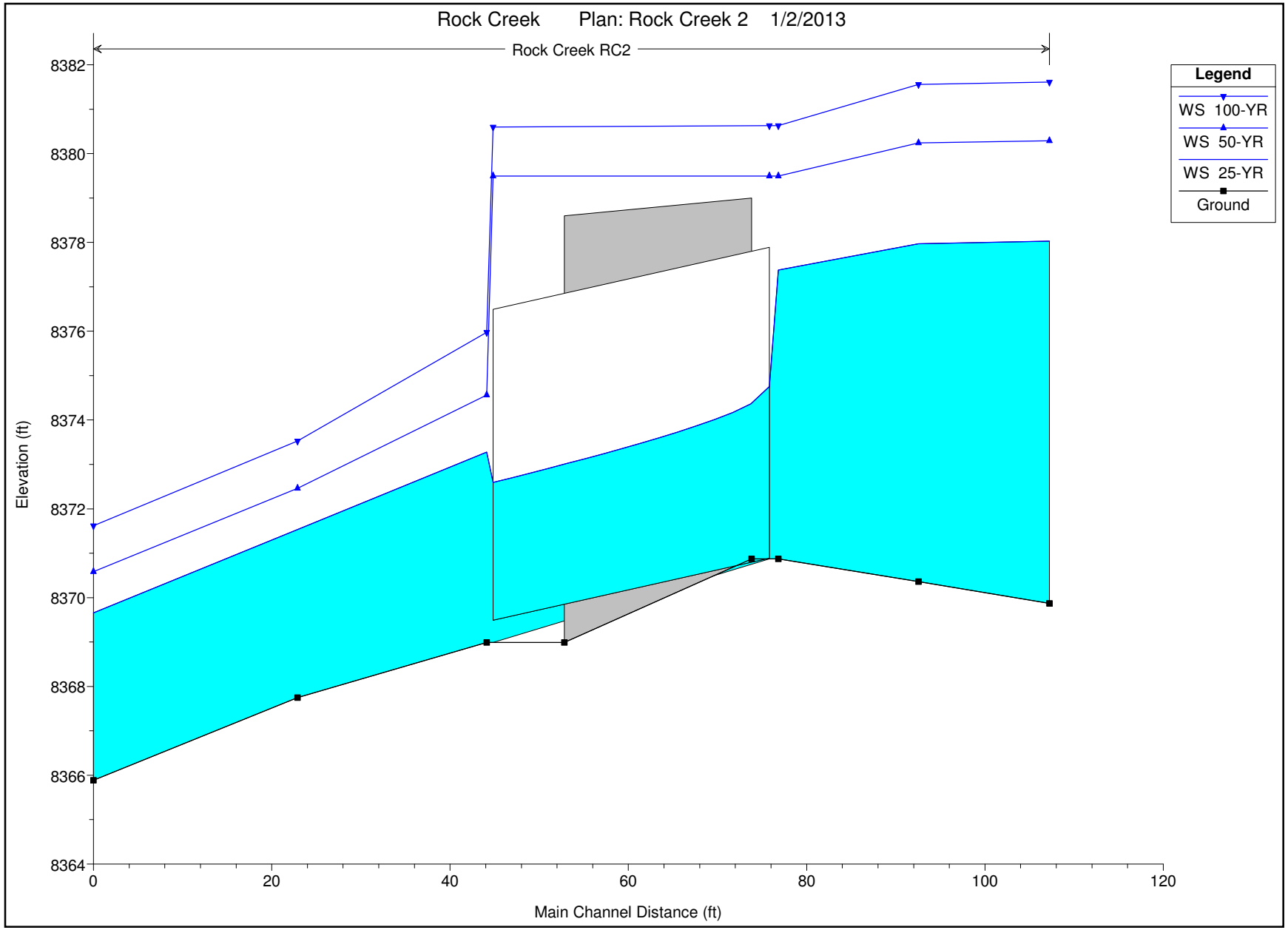

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 47.753
.06
.04
.06
0
1
3
0
1
3
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8880
8878
8876
8874
8872
8870
8868
8866
8864
0
20
40
60
80
100
Station (ft)

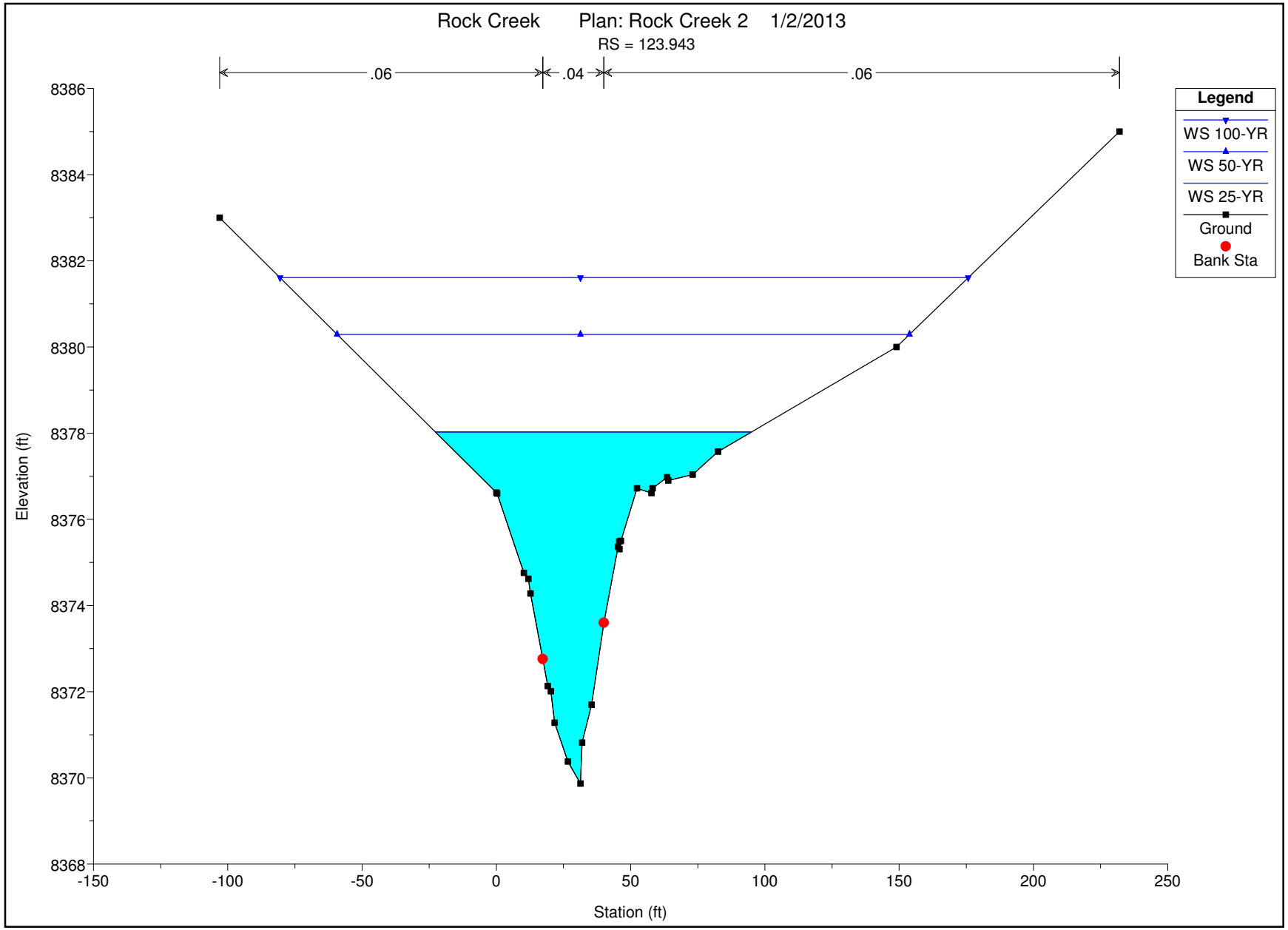

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 25.895
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8876
8874
8872
8870
8868
8866
0
20
40
60
80
100
120
Station (ft)

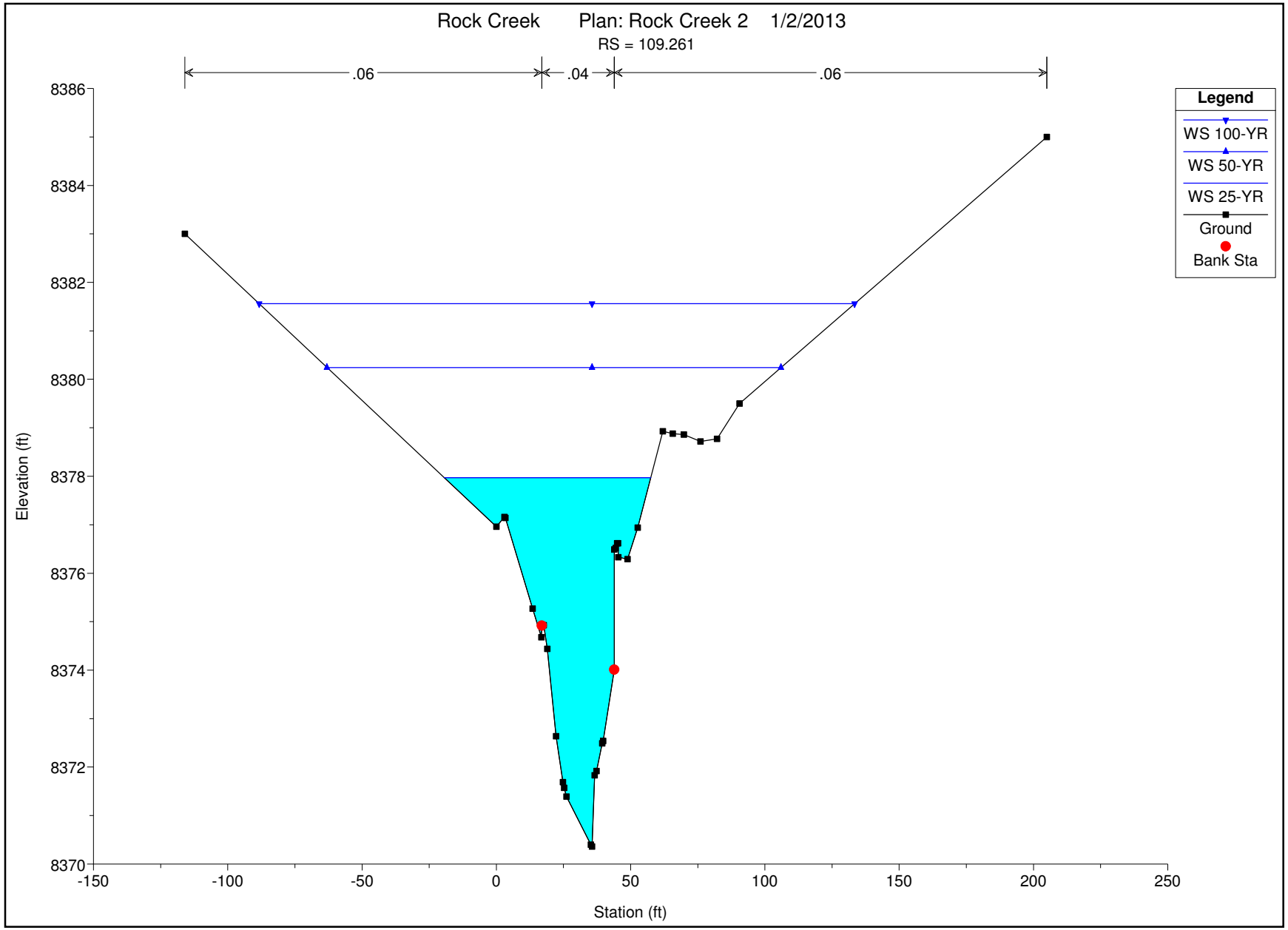

Rock Creek Plan: Rock Creek 1 1/2/2013
RS = 8.986
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8873
8872
8871
8870
8869
8868
8867
8866
8865
0
20
40
60
80
100
Station (ft)

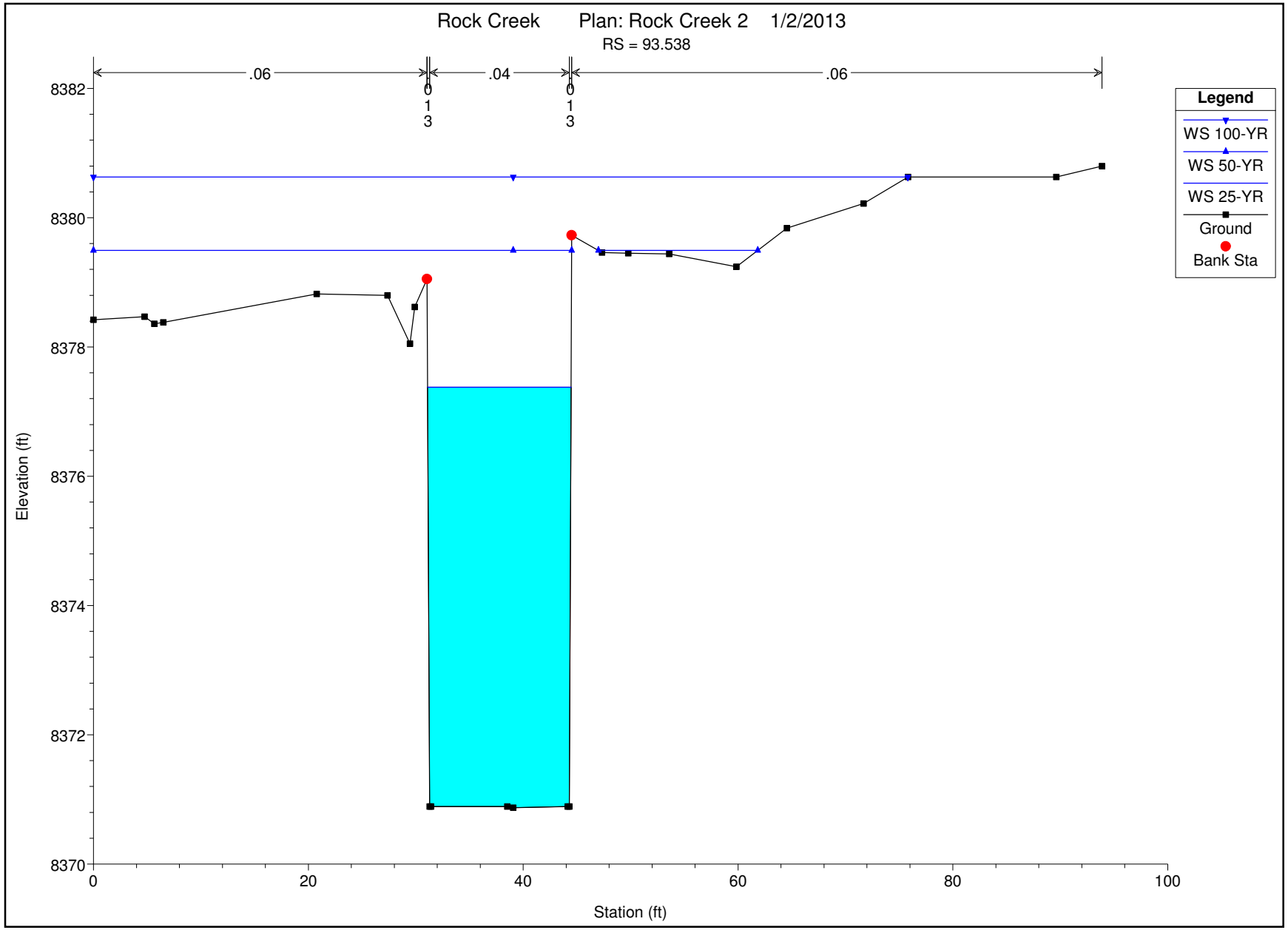
HEC-RAS Plan: RC2 River: Rock Creek Reach: RC2

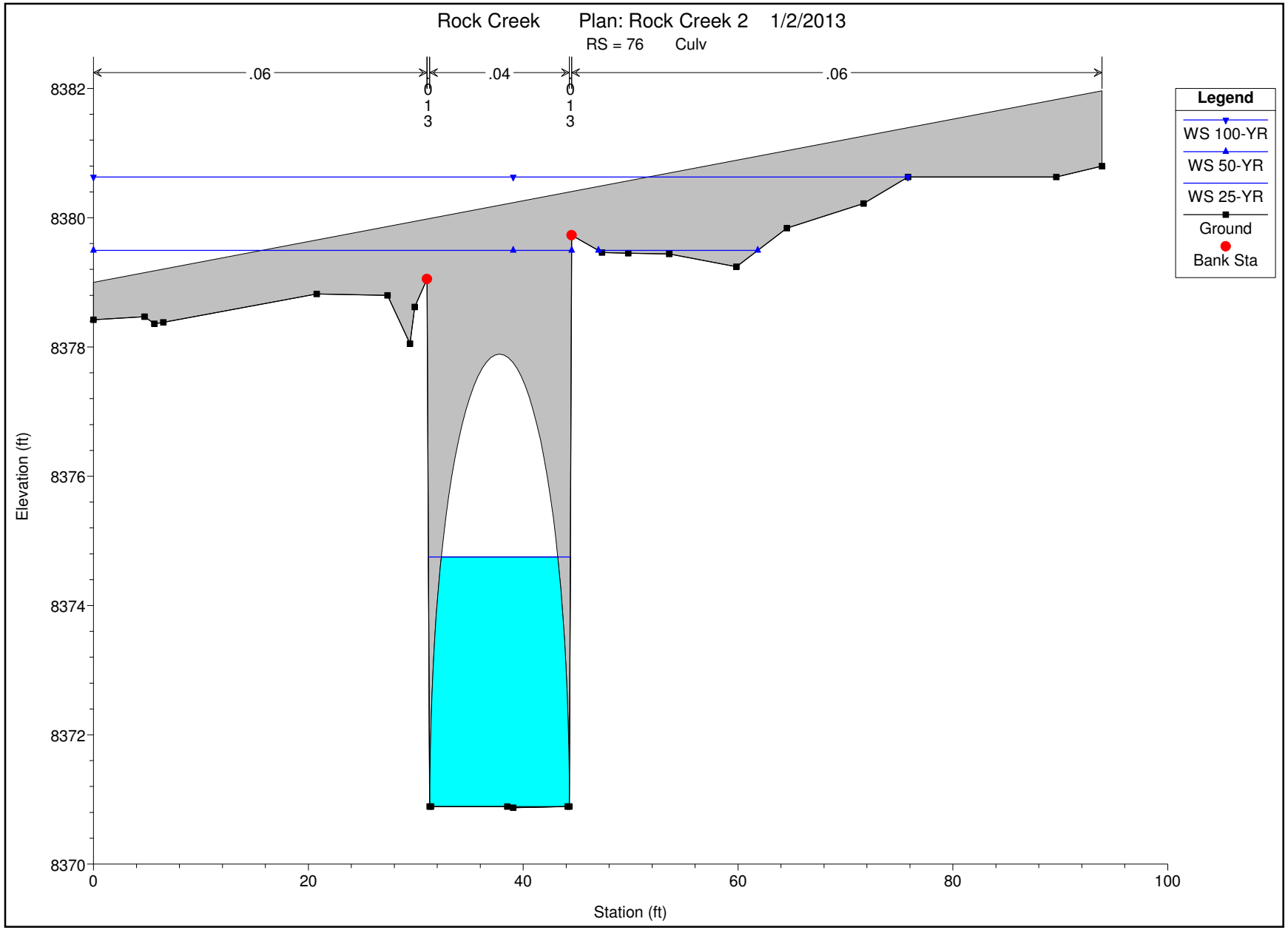
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
RC2	123.943	25-YR	566.20	8369.87	8378.03		8378.15	0.000581	3.05	287.48	117.70	0.21
RC2	123.943	50-YR	851.80	8369.87	8380.29		8380.35	0.000270	2.53	665.14	213.10	0.15
RC2	123.943	100-YR	1243.50	8369.87	8381.61		8381.67	0.000249	2.66	974.53	256.26	0.15
RC2	109.261	25-YR	566.20	8370.36	8377.97		8378.13	0.000856	3.35	212.97	76.89	0.24
RC2	109.261	50-YR	851.80	8370.36	8380.24		8380.35	0.000423	2.94	489.24	169.04	0.18
RC2	109.261	100-YR	1243.50	8370.36	8381.56		8381.66	0.000395	3.14	746.23	221.69	0.18
RC2	93.538	25-YR	566.20	8370.87	8377.38	8374.76	8378.06	0.003223	6.62	85.58	13.37	0.46
RC2	93.538	50-YR	851.80	8370.87	8379.49	8375.96	8380.27	0.002754	7.19	143.14	59.35	0.44
RC2	93.538	100-YR	1243.50	8370.87	8380.63	8377.40	8381.56	0.003124	8.31	220.80	75.81	0.47
RC2	76		Culvert									
RC2	60.825	25-YR	566.20	8368.99	8373.28	8373.28	8375.19	0.025978	11.09	51.05	13.45	1.00
RC2	60.825	50-YR	851.80	8368.99	8374.56	8374.56	8376.95	0.026216	12.39	68.72	14.47	1.00
RC2	60.825	100-YR	1243.50	8368.99	8375.98	8375.98	8378.94	0.026889	13.82	90.00	15.22	1.00
RC2	39.600	25-YR	566.20	8367.75	8371.53	8371.53	8372.93	0.019546	9.47	59.77	21.65	1.00
RC2	39.600	50-YR	851.80	8367.75	8372.46	8372.46	8374.19	0.018738	10.56	80.68	23.48	1.00
RC2	39.600	100-YR	1243.50	8367.75	8373.53	8373.53	8375.63	0.017999	11.64	107.13	27.53	1.00
RC2	16.705	25-YR	566.20	8365.89	8369.66	8369.66	8370.97	0.019551	9.20	61.56	23.90	1.01
RC2	16.705	50-YR	851.80	8365.89	8370.59	8370.59	8372.13	0.016472	10.01	88.26	33.72	0.96
RC2	16.705	100-YR	1243.50	8365.89	8371.62	8371.62	8373.33	0.014189	10.71	128.20	42.58	0.92

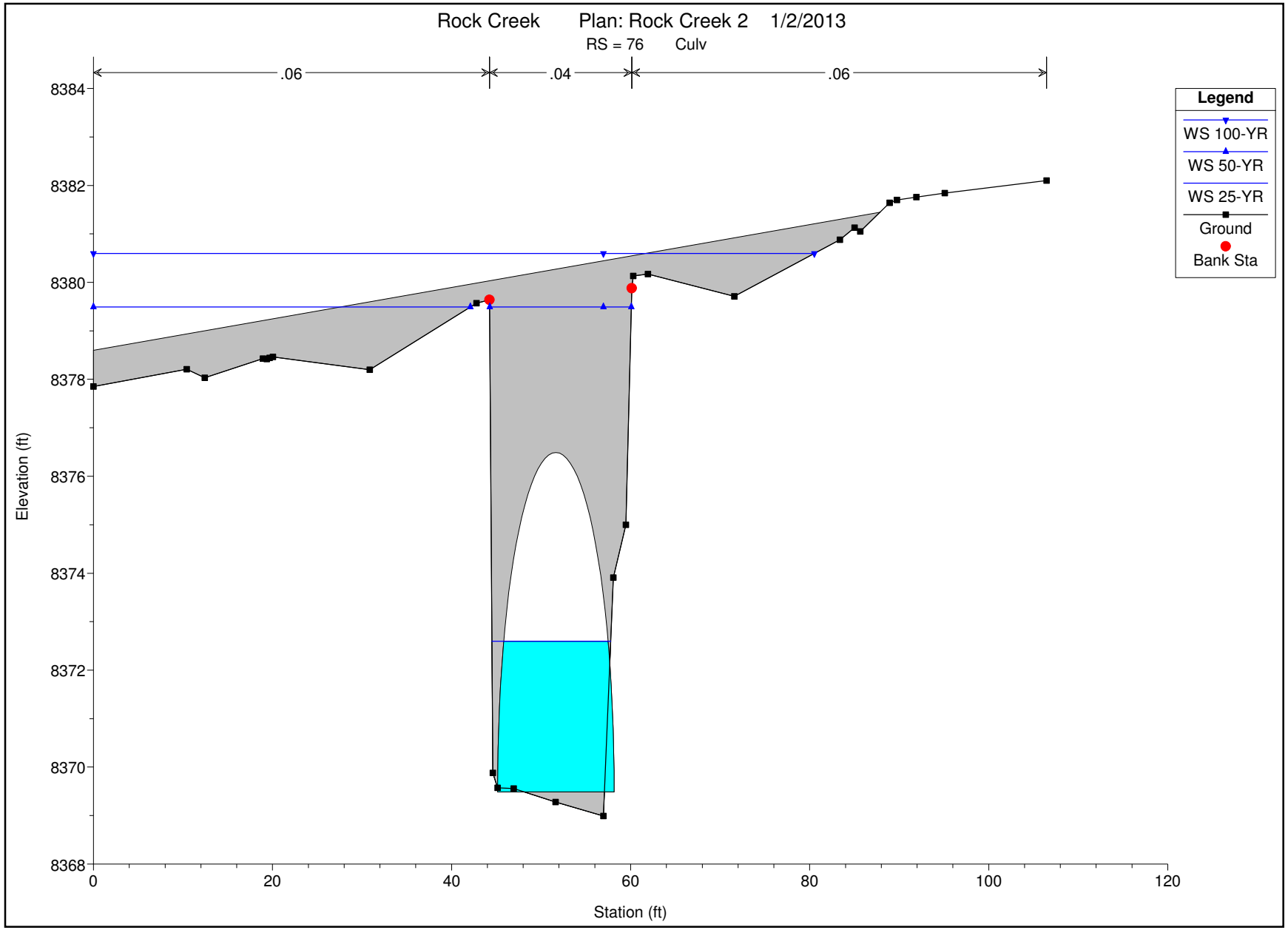

Rock Creek Plan: Rock Creek 2 1/2/2013
Rock Creek RC2
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Elevation (ft)
8382
8380
8378
8376
8374
8372
8370
8368
8366
8364
0
20
40
60
80
100
120
Main Channel Distance (ft)

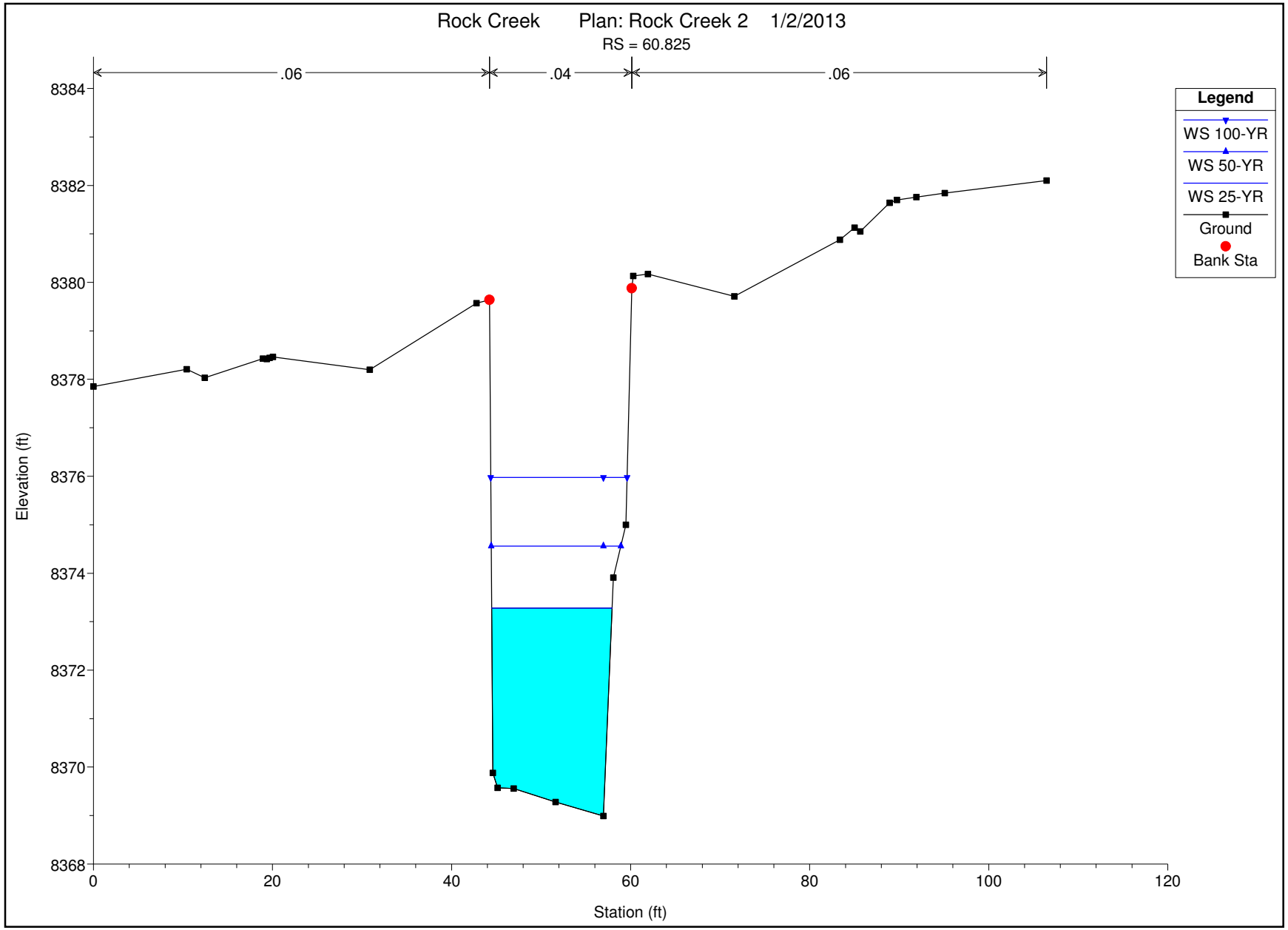

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 123.943
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8386
8384
8382
8380
8378
8376
8374
8372
8370
8368
-150
-100
-50
0
50
100
150
200
250
Station (ft)

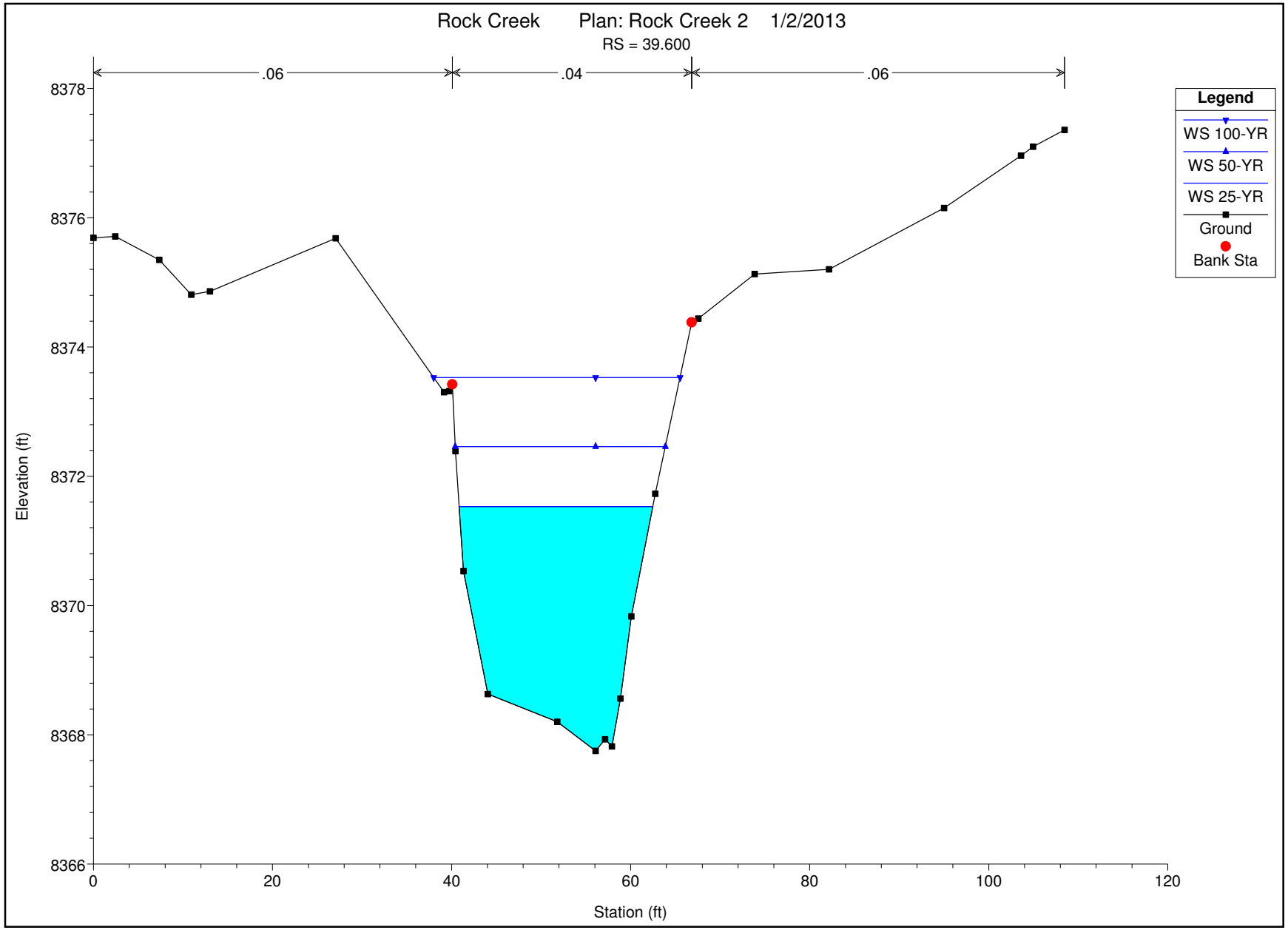

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 109.261
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8386
8384
8382
8380
8378
8376
8374
8372
8370
-150
-100
-50
0
50
100
150
200
250
Station (ft)

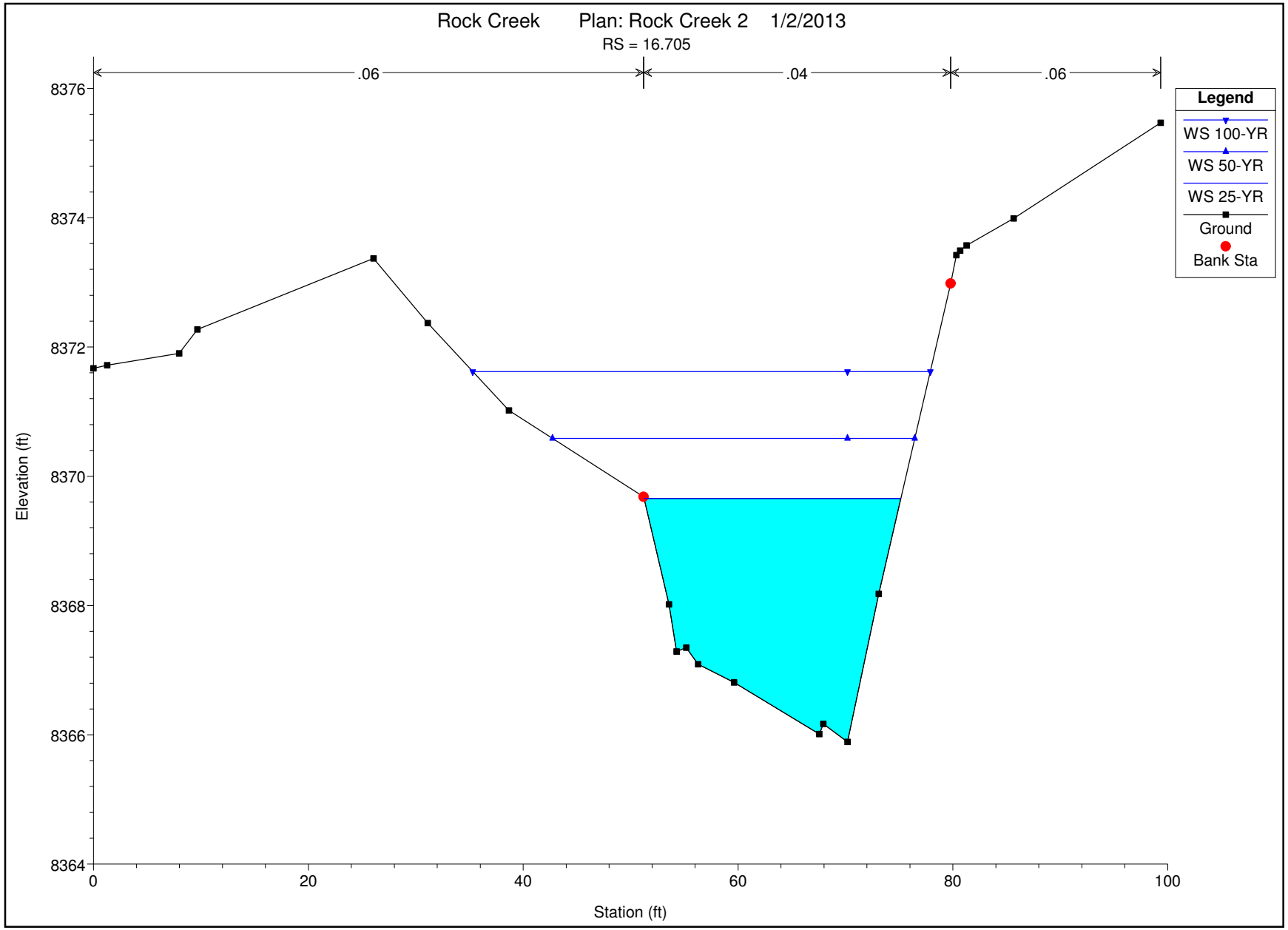

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 93.538
.06
.04
.06
0
1
3
0
1
3
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8382
8380
8378
8376
8374
8372
8370
0
20
40
60
80
100
Station (ft)


Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 76 Culv
.06
.04
.06
0
1
3
0
1
3
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8382
8380
8378
8376
8374
8372
8370
0
20
40
60
80
100
Station (ft)


Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 76 Culv
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8384
8382
8380
8378
8376
8374
8372
8370
8368
0
20
40
60
80
100
120
Station (ft)

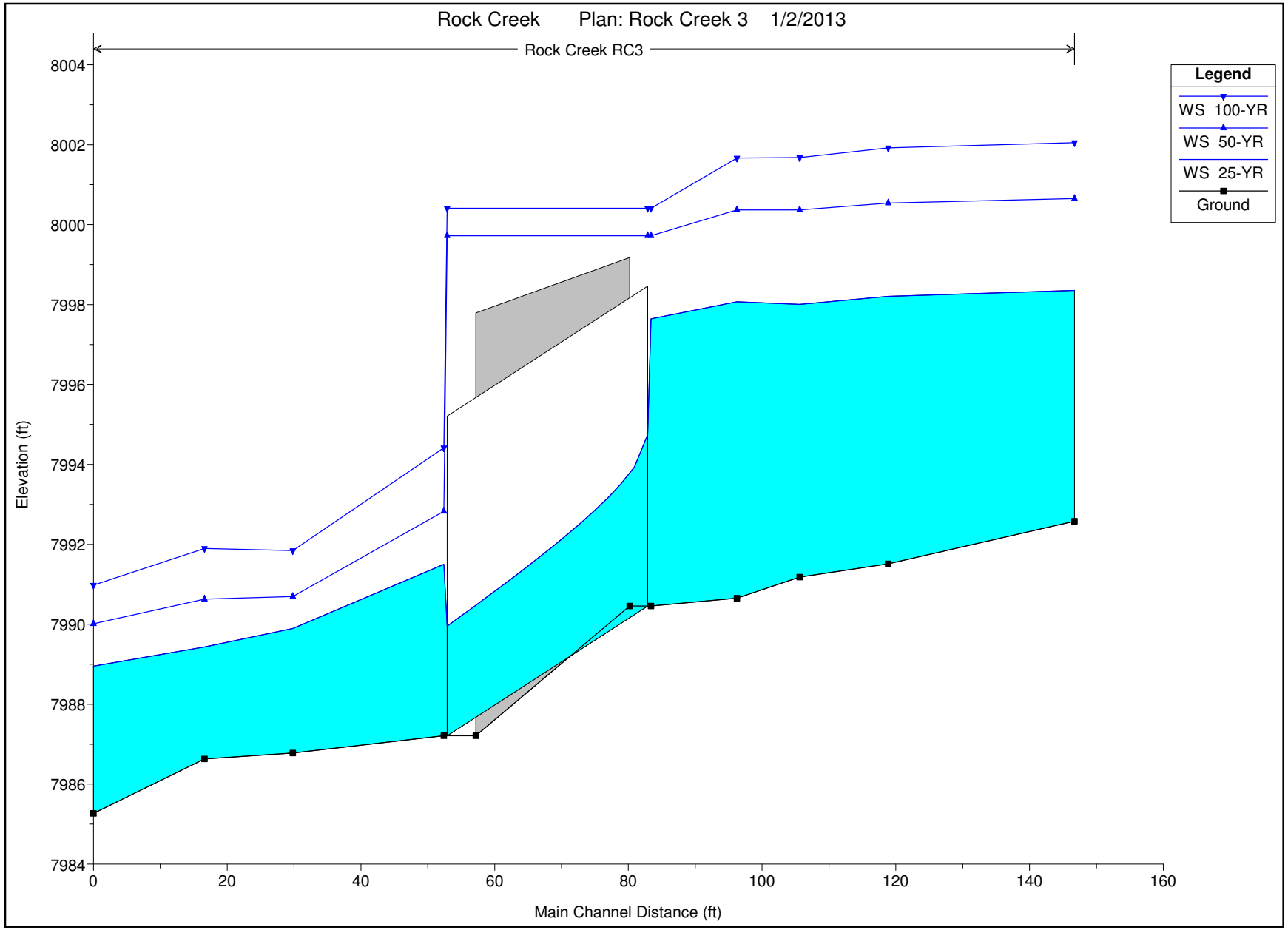

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 60.825
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8384
8382
8380
8378
8376
8374
8372
8370
8368
0
20
40
60
80
100
120
Station (ft)

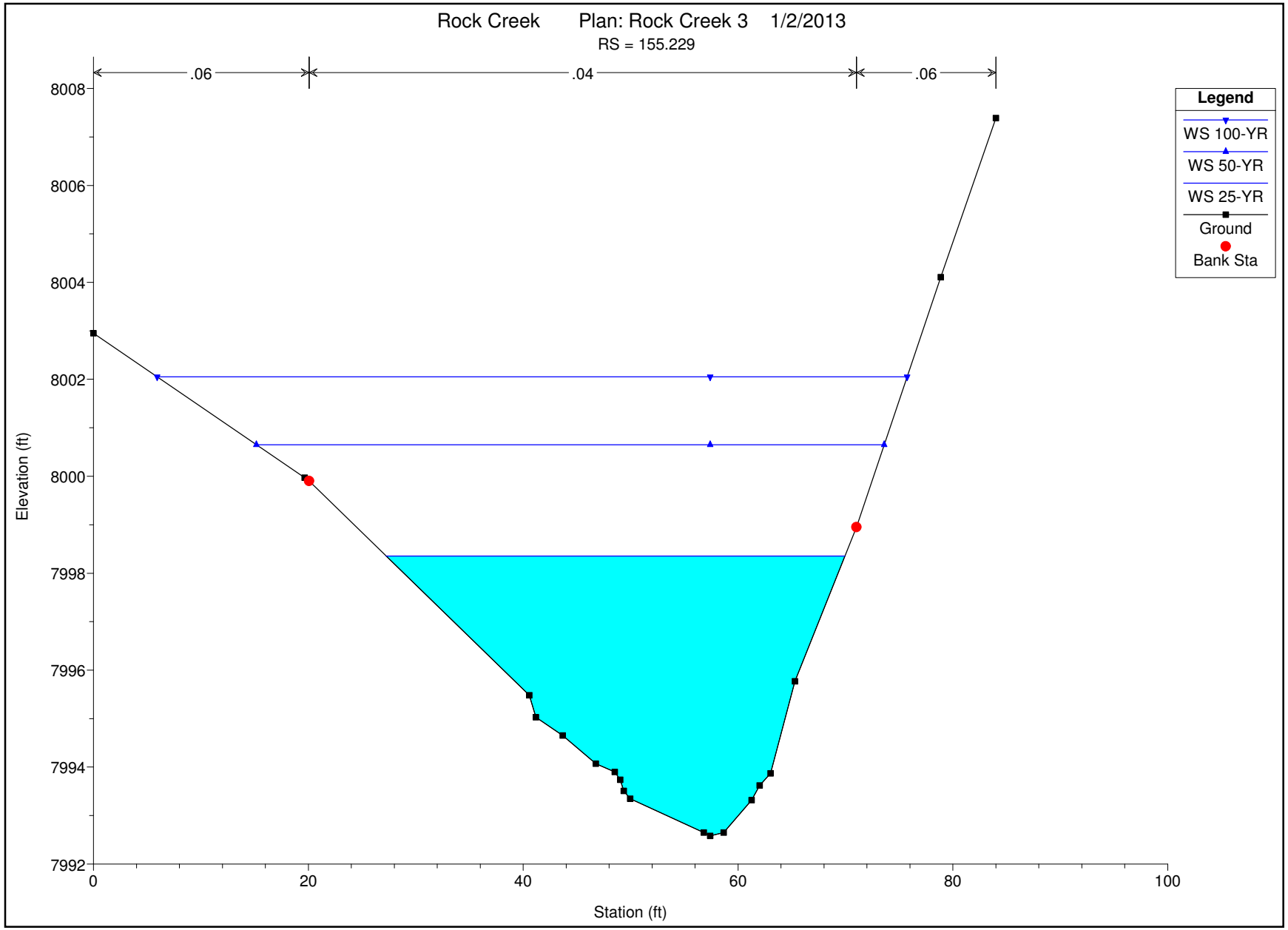

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 39.600
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8378
8376
8374
8372
8370
8368
8366
0
20
40
60
80
100
120
Station (ft)

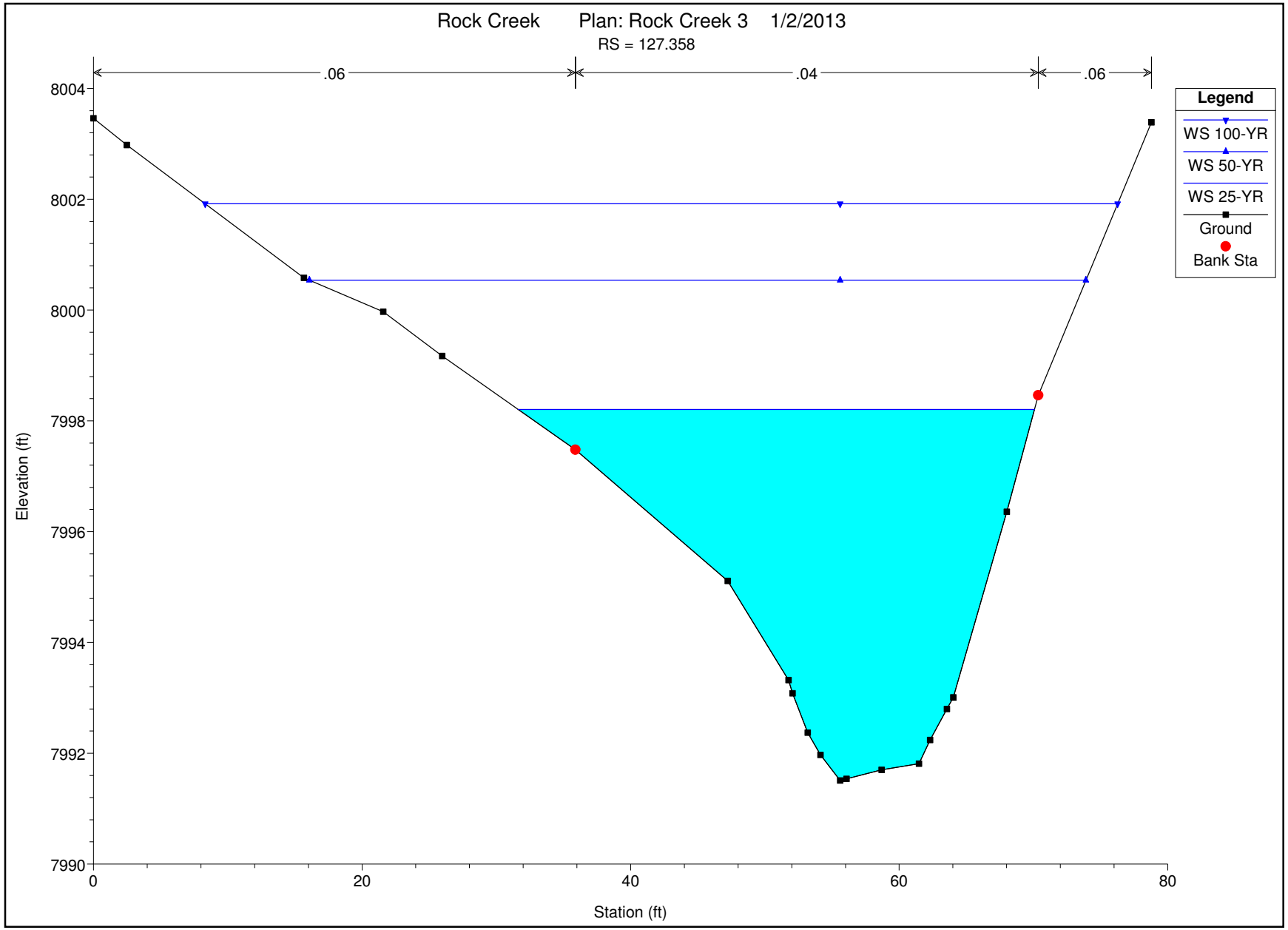

Rock Creek Plan: Rock Creek 2 1/2/2013
RS = 16.705
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8376
8374
8372
8370
8368
8366
8364
0
20
40
60
80
100
Station (ft)

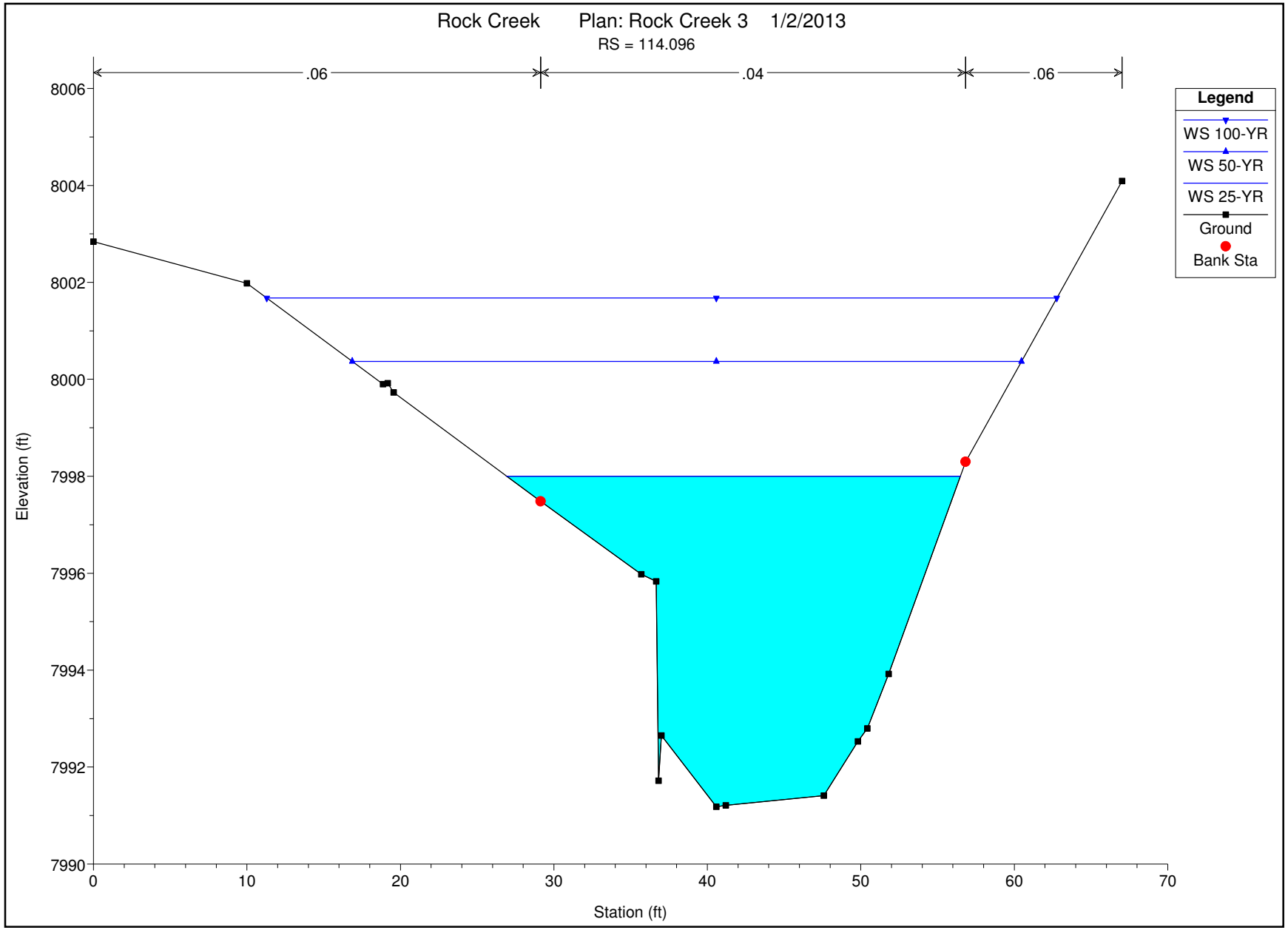
HEC-RAS Plan: RC3 River: Rock Creek Reach: RC3

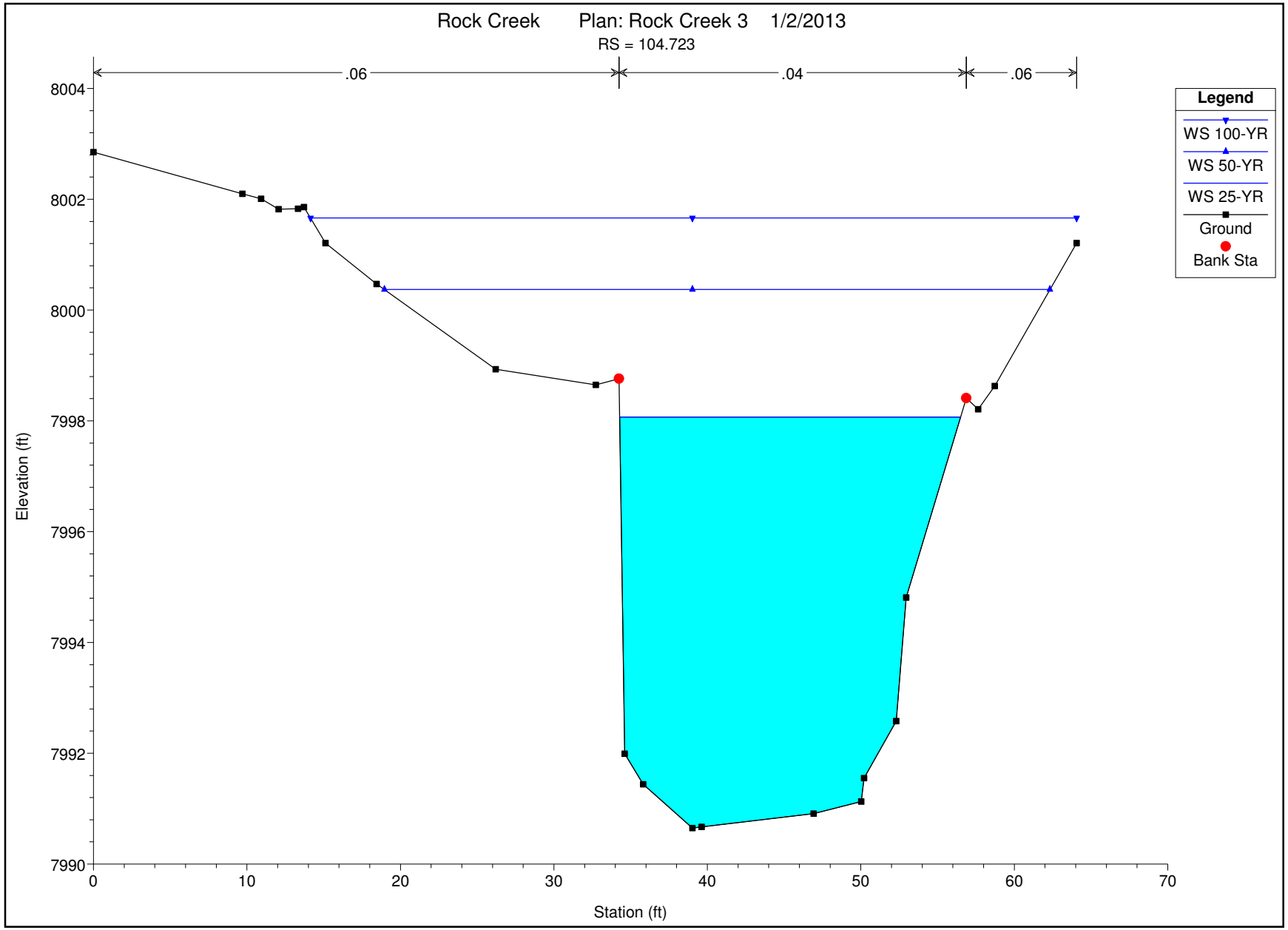
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
RC3	155.229	25-YR	661.20	7992.58	7998.35		7998.70	0.003531	4.71	140.25	42.70	0.46
RC3	155.229	50-YR	992.50	7992.58	8000.65		8000.89	0.001426	3.94	255.50	58.44	0.31
RC3	155.229	100-YR	1446.10	7992.58	8002.05		8002.35	0.001284	4.41	345.30	69.81	0.31
RC3	127.358	25-YR	661.20	7991.51	7998.21		7998.60	0.003400	5.01	133.24	38.45	0.45
RC3	127.358	50-YR	992.50	7991.51	8000.54		8000.84	0.001480	4.51	243.45	57.83	0.32
RC3	127.358	100-YR	1446.10	7991.51	8001.92		8002.30	0.001473	5.15	330.34	67.95	0.33
RC3	114.096	25-YR	661.20	7991.18	7998.00		7998.53	0.005075	5.82	114.08	29.56	0.50
RC3	114.096	50-YR	992.50	7991.18	8000.37		8000.81	0.002392	5.37	200.53	43.62	0.37
RC3	114.096	100-YR	1446.10	7991.18	8001.68		8002.26	0.002572	6.29	262.61	51.48	0.40
RC3	104.723	25-YR	661.20	7990.65	7998.07		7998.45	0.002642	4.97	133.00	22.21	0.36
RC3	104.723	50-YR	992.50	7990.65	8000.37		8000.78	0.001957	5.20	209.92	43.37	0.32
RC3	104.723	100-YR	1446.10	7990.65	8001.66		8002.23	0.002323	6.25	271.16	49.92	0.36
RC3	91.876	25-YR	661.20	7990.46	7997.65	7994.75	7998.38	0.003053	6.88	96.12	13.76	0.46
RC3	91.876	50-YR	992.50	7990.46	7999.72	7996.06	8000.69	0.003041	7.92	130.25	30.27	0.47
RC3	91.876	100-YR	1446.10	7990.46	8000.41	7997.64	8002.08	0.004901	10.49	161.40	55.12	0.60
RC3	75		Culvert									
RC3	60.895	25-YR	661.20	7987.21	7991.50	7991.50	7993.64	0.027875	11.75	56.27	13.25	1.00
RC3	60.895	50-YR	992.50	7987.21	7992.82	7992.82	7995.63	0.029571	13.43	73.89	13.32	1.01
RC3	60.895	100-YR	1446.10	7987.21	7994.41	7994.41	7998.00	0.031873	15.20	95.13	13.41	1.01
RC3	38.288	25-YR	661.20	7986.78	7989.90	7989.90	7991.16	0.019175	9.03	73.21	29.20	1.01
RC3	38.288	50-YR	992.50	7986.78	7990.70	7990.70	7992.32	0.018314	10.23	97.02	30.32	1.01
RC3	38.288	100-YR	1446.10	7986.78	7991.84	7991.84	7993.63	0.014259	10.78	141.61	51.47	0.92
RC3	25.105	25-YR	661.20	7986.63	7989.43	7989.43	7990.67	0.019075	8.92	74.28	31.98	1.01
RC3	25.105	50-YR	992.50	7986.63	7990.63	7990.28	7991.80	0.011088	8.76	121.17	46.60	0.81
RC3	25.105	100-YR	1446.10	7986.63	7991.90		7993.05	0.007684	8.92	187.20	54.98	0.71
RC3	8.484	25-YR	661.20	7985.27	7988.95	7988.95	7990.34	0.016185	9.52	73.04	30.16	0.96
RC3	8.484	50-YR	992.50	7985.27	7990.01	7990.01	7991.56	0.012565	10.24	110.83	41.82	0.89
RC3	8.484	100-YR	1446.10	7985.27	7990.98	7990.98	7992.83	0.011828	11.44	152.81	45.09	0.90

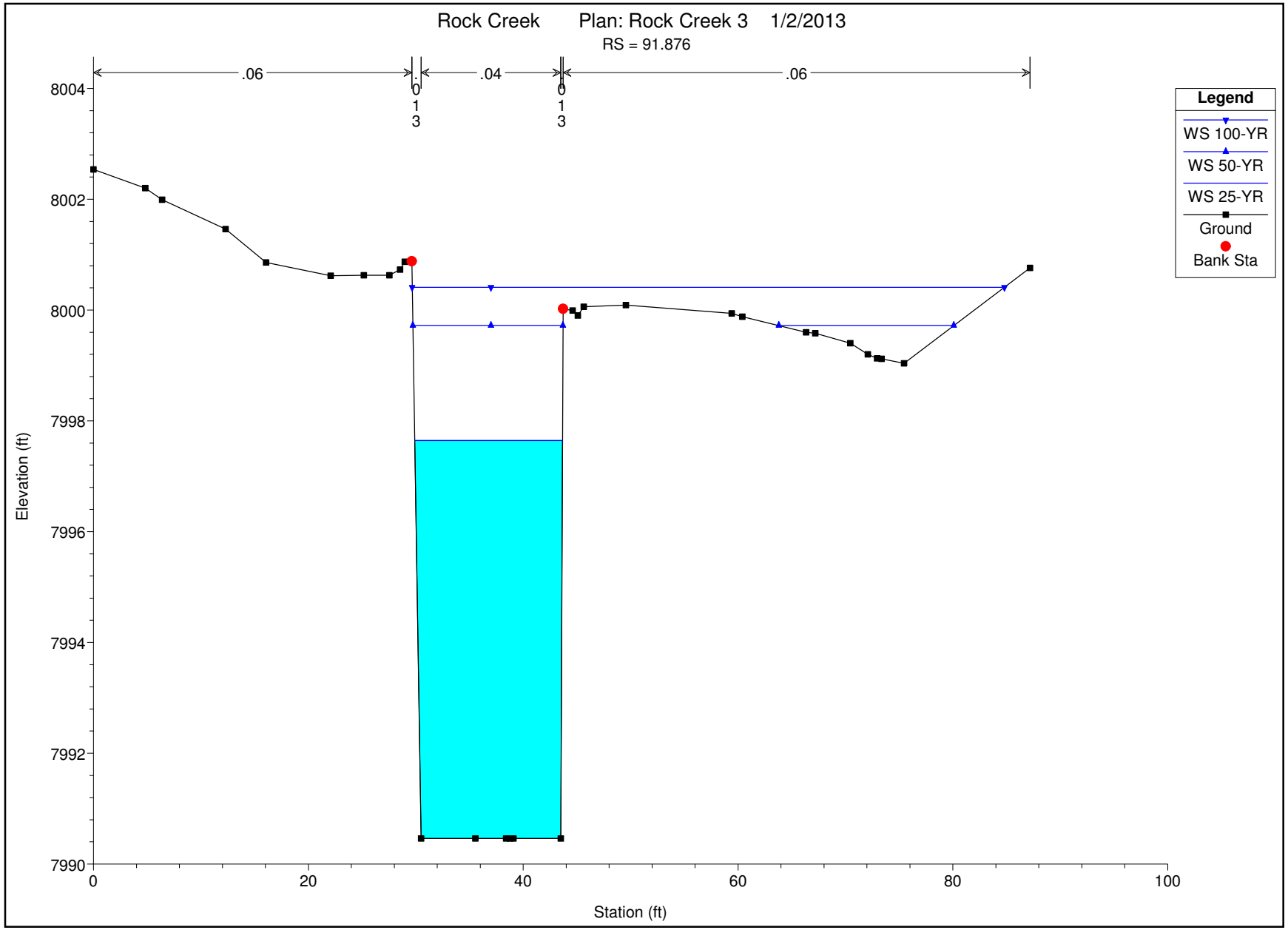

Rock Creek Plan: Rock Creek 3 1/2/2013
Rock Creek RC3
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
7988
7986
7984
0
20
40
60
80
100
120
140
160
Main Channel Distance (ft)

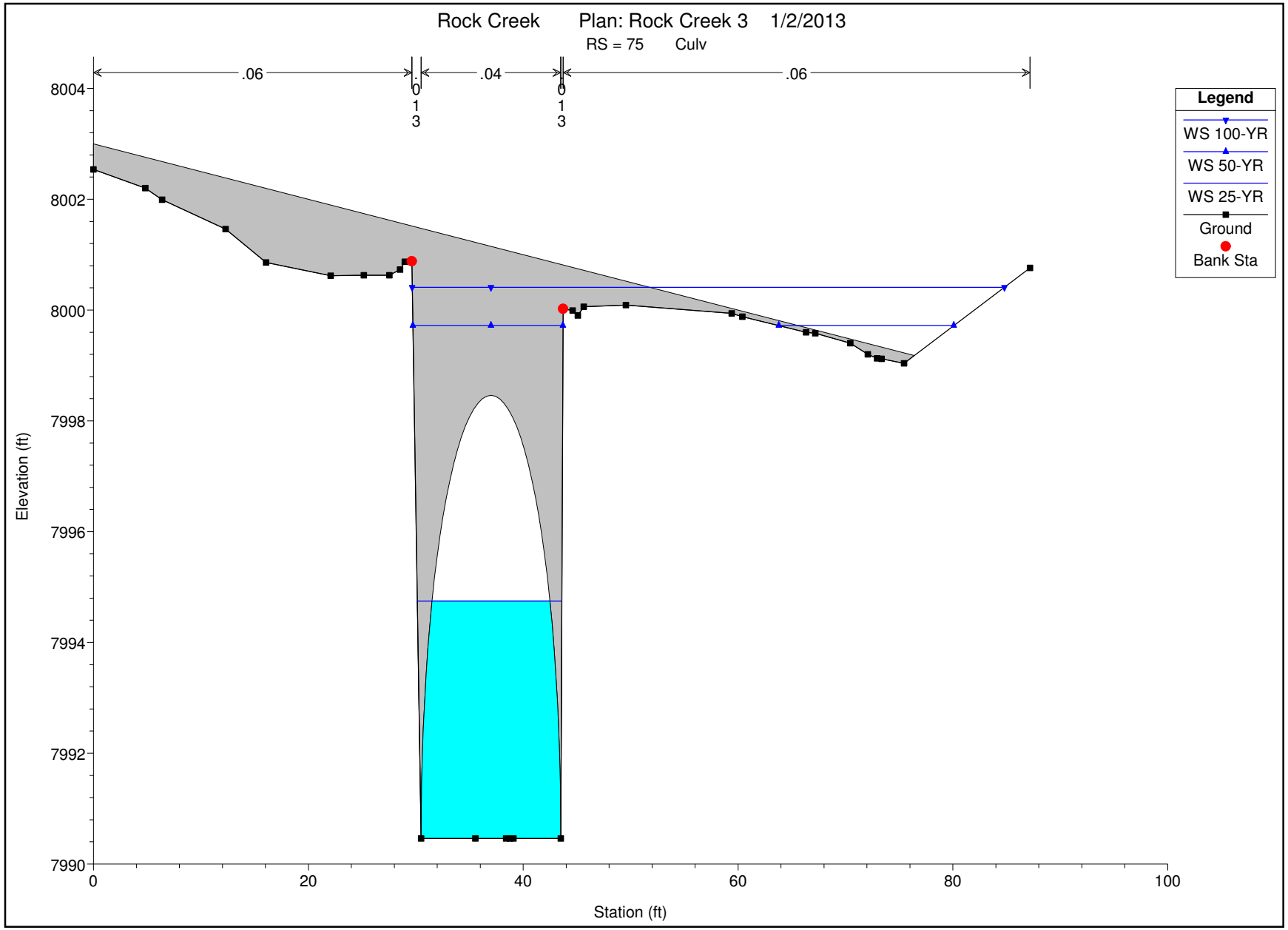

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 155.229
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8008
8006
8004
8002
8000
7998
7996
7994
7992
0
20
40
60
80
100
Station (ft)

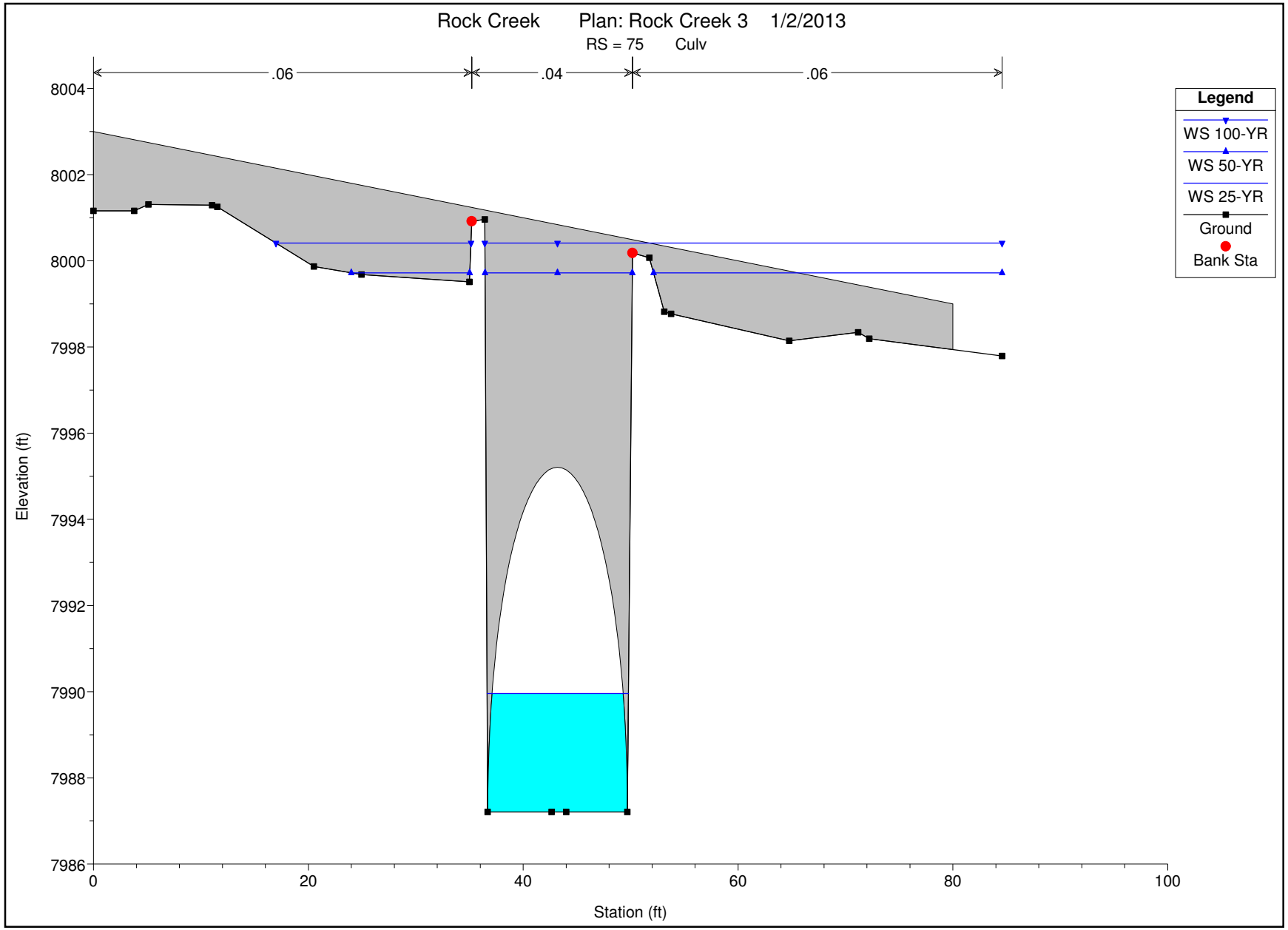

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 127.358
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
0
20
40
60
80
Station (ft)

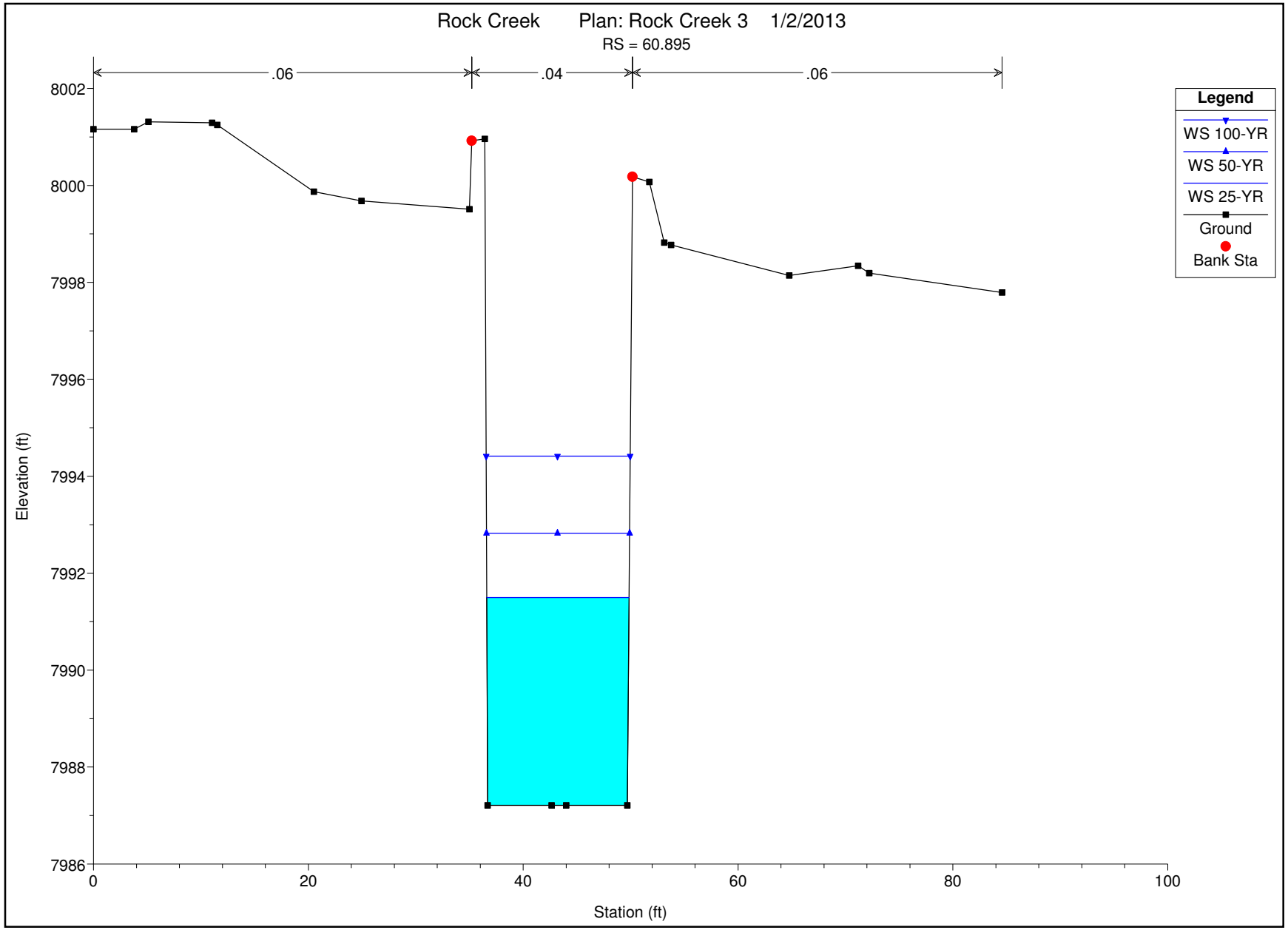

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 114.096
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8006
8004
8002
8000
7998
7996
7994
7992
7990
0
10
20
30
40
50
60
70
Station (ft)

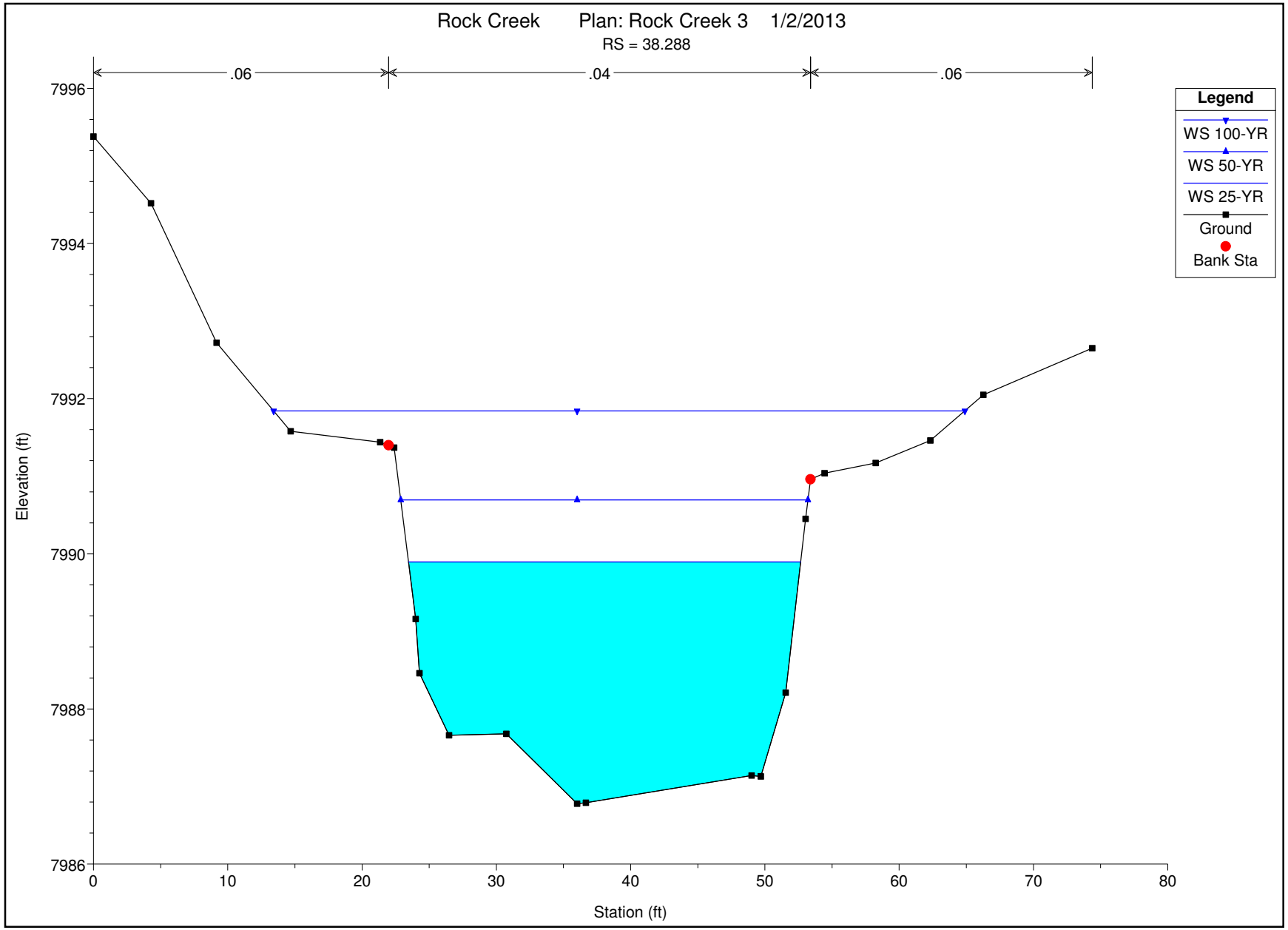

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 104.723
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
0
10
20
30
40
50
60
70
Station (ft)

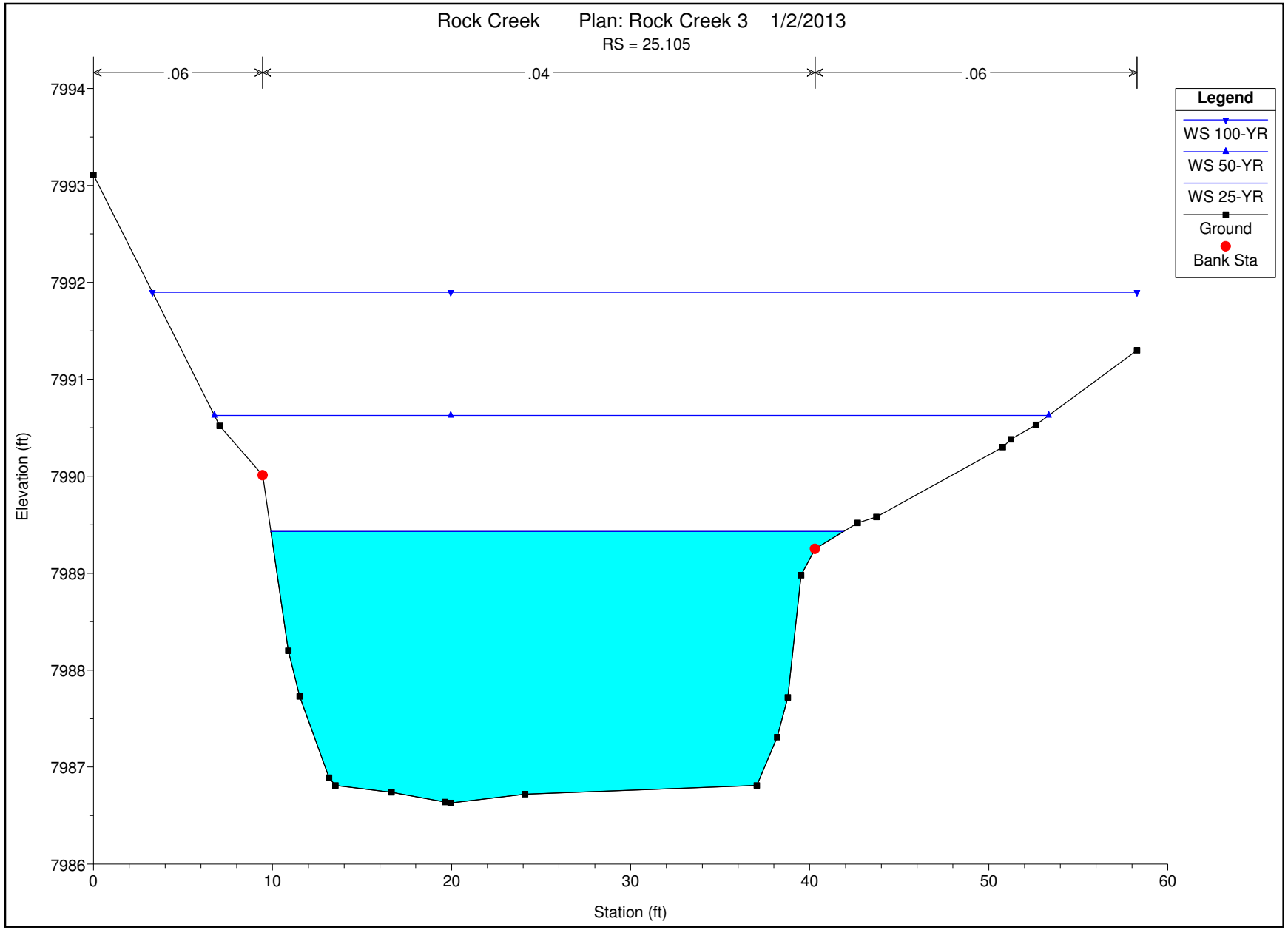

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 91.876
.06
.04
.06
0.013
0.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
0
20
40
60
80
100
Station (ft)

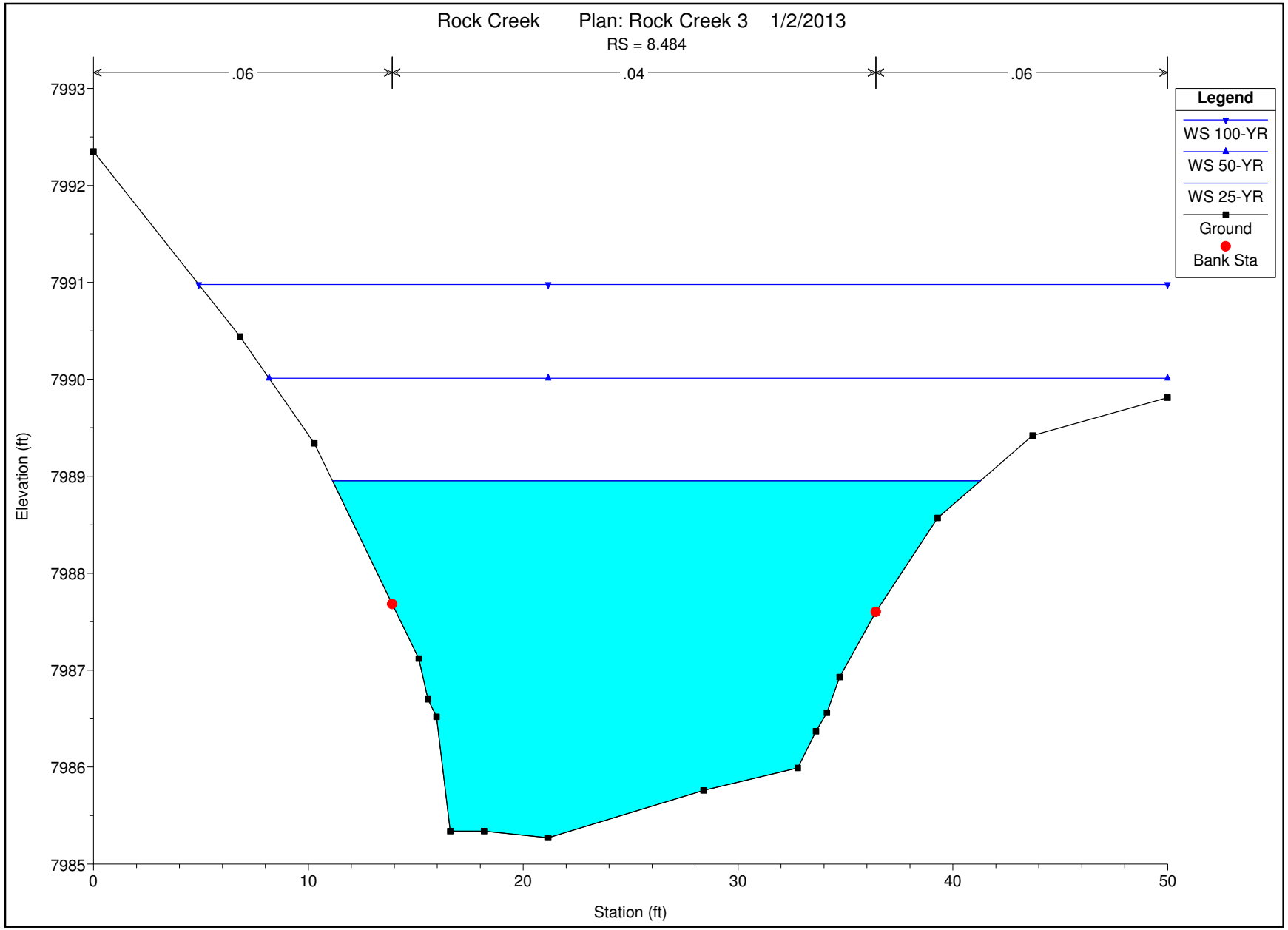

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 75 Culv
.06
.04
.06
0
1
3
0
1
3
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
0
20
40
60
80
100
Station (ft)


Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 75 Culv
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8004
8002
8000
7998
7996
7994
7992
7990
7988
7986
0
20
40
60
80
100
Station (ft)


Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 60.895
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
8002
8000
7998
7996
7994
7992
7990
7988
7986
0
20
40
60
80
100
Station (ft)

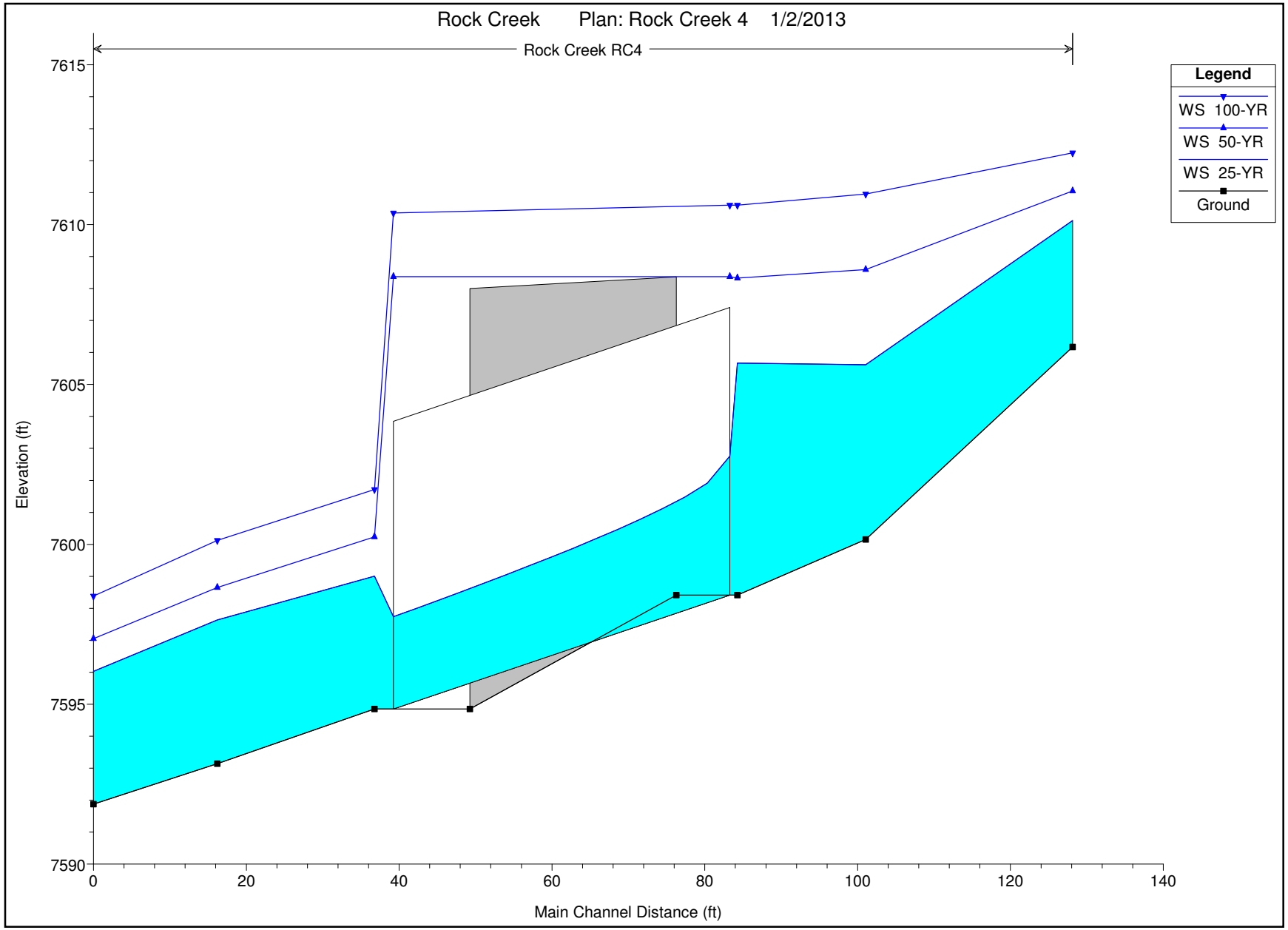

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 38.288
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7996
7994
7992
7990
7988
7986
0
10
20
30
40
50
60
70
80
Station (ft)

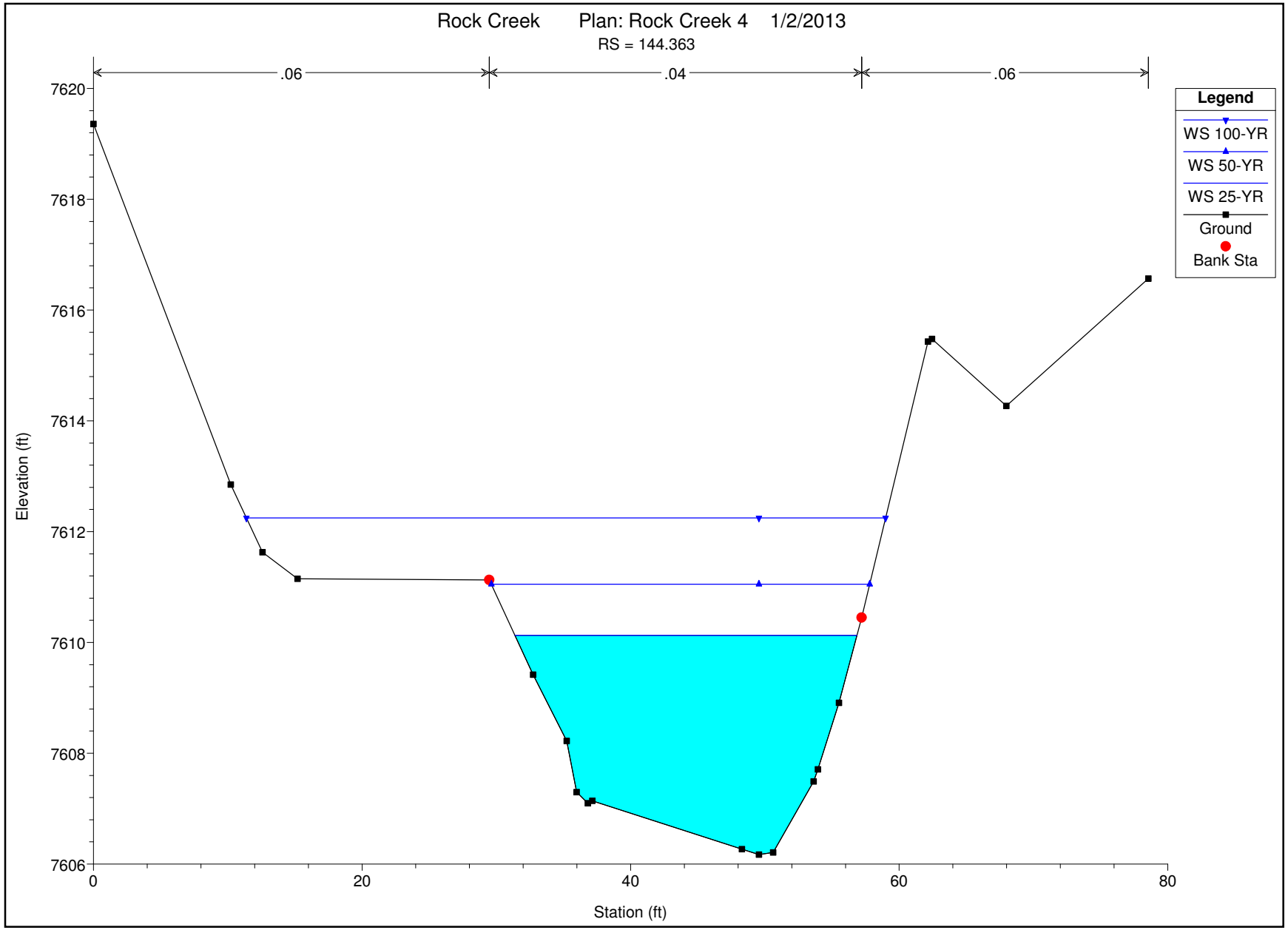

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 25.105
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7994
7993
7992
7991
7990
7989
7988
7987
7986
0
10
20
30
40
50
60
Station (ft)

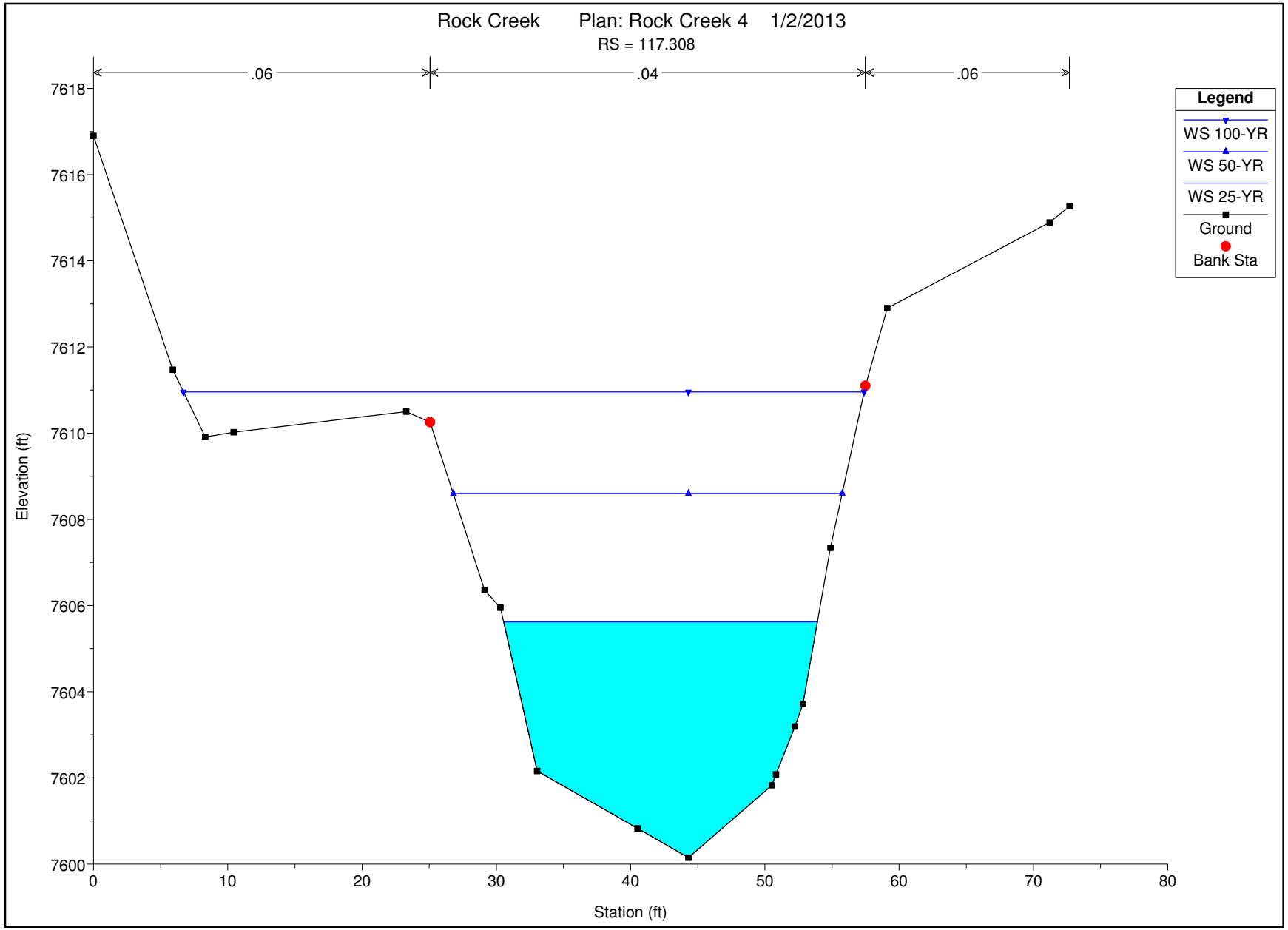

Rock Creek Plan: Rock Creek 3 1/2/2013
RS = 8.484
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7993
7992
7991
7990
7989
7988
7987
7986
7985
0
10
20
30
40
50
Station (ft)

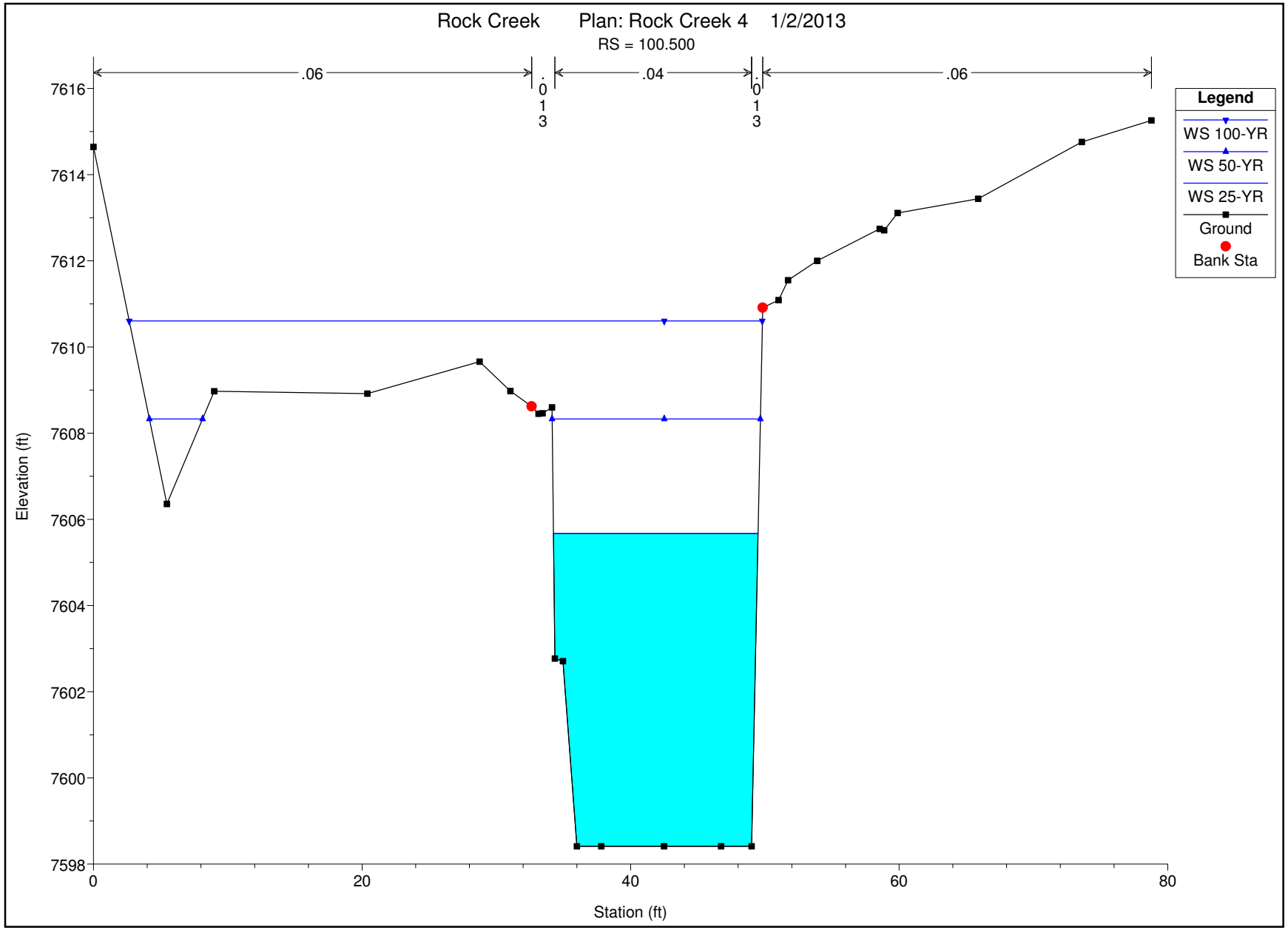
HEC-RAS Plan: RC4 River: Rock Creek Reach: RC4

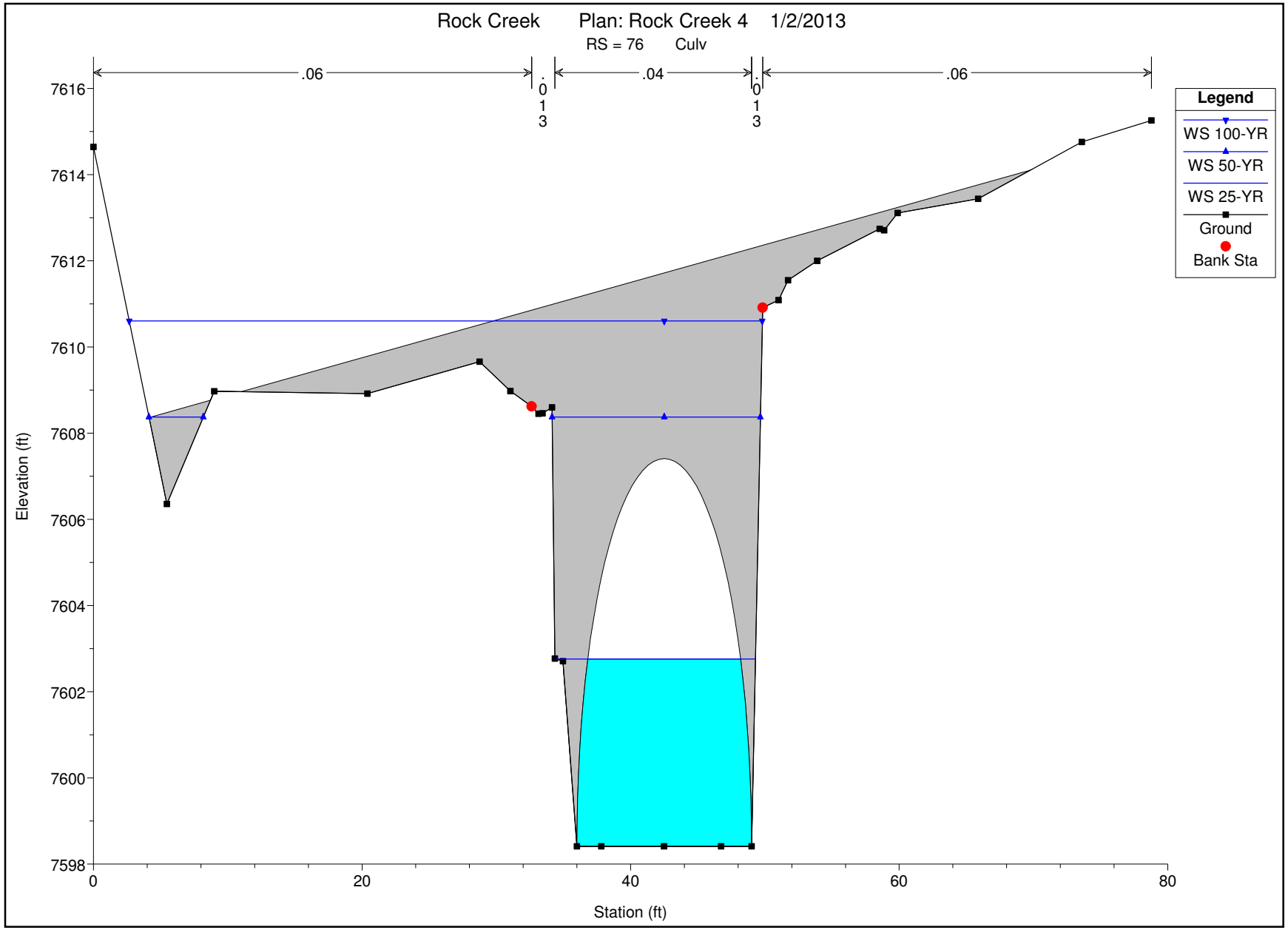
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
RC4	144.363	25-YR	671.30	7606.17	7610.13	7610.13	7611.53	0.018771	9.51	70.58	25.46	1.01
RC4	144.363	50-YR	1006.30	7606.17	7611.05	7611.05	7612.79	0.017426	10.57	95.38	28.17	1.00
RC4	144.363	100-YR	1464.40	7606.17	7612.25	7612.25	7614.06	0.012737	10.98	148.34	47.60	0.90
RC4	117.308	25-YR	671.30	7600.15	7605.62		7606.47	0.007912	7.37	91.06	23.37	0.66
RC4	117.308	50-YR	1006.30	7600.15	7608.60		7609.15	0.003211	5.94	169.37	28.96	0.43
RC4	117.308	100-YR	1464.40	7600.15	7610.96		7611.51	0.002436	5.99	255.16	50.69	0.39
RC4	100.500	25-YR	671.30	7598.41	7605.67	7602.73	7606.33	0.003402	6.50	103.35	15.23	0.44
RC4	100.500	50-YR	1006.30	7598.41	7608.33	7603.98	7609.08	0.002664	6.95	148.14	19.47	0.40
RC4	100.500	100-YR	1464.40	7598.41	7610.61	7605.46	7611.44	0.002397	7.54	234.99	47.15	0.41
RC4	76		Culvert									
RC4	52.995	25-YR	671.30	7594.85	7599.00	7599.00	7601.00	0.024690	11.34	59.22	14.95	1.00
RC4	52.995	50-YR	1006.30	7594.85	7600.24	7600.24	7602.84	0.025826	12.94	77.75	15.09	1.00
RC4	52.995	100-YR	1464.40	7594.85	7601.72	7601.72	7605.03	0.027369	14.62	100.20	15.26	1.01
RC4	32.440	25-YR	671.30	7593.14	7597.63	7597.63	7599.26	0.020731	10.23	65.68	20.79	1.00
RC4	32.440	50-YR	1006.30	7593.14	7598.65	7598.65	7600.74	0.019555	11.62	87.53	22.18	1.00
RC4	32.440	100-YR	1464.40	7593.14	7600.12	7600.12	7602.42	0.015106	12.29	128.59	35.96	0.91
RC4	16.227	25-YR	671.30	7591.87	7596.03	7596.03	7597.50	0.019545	9.73	68.97	23.53	1.00
RC4	16.227	50-YR	1006.30	7591.87	7597.05	7597.05	7598.80	0.017473	10.62	96.21	32.04	0.98
RC4	16.227	100-YR	1464.40	7591.87	7598.38	7598.38	7600.10	0.011890	10.78	157.75	57.16	0.85

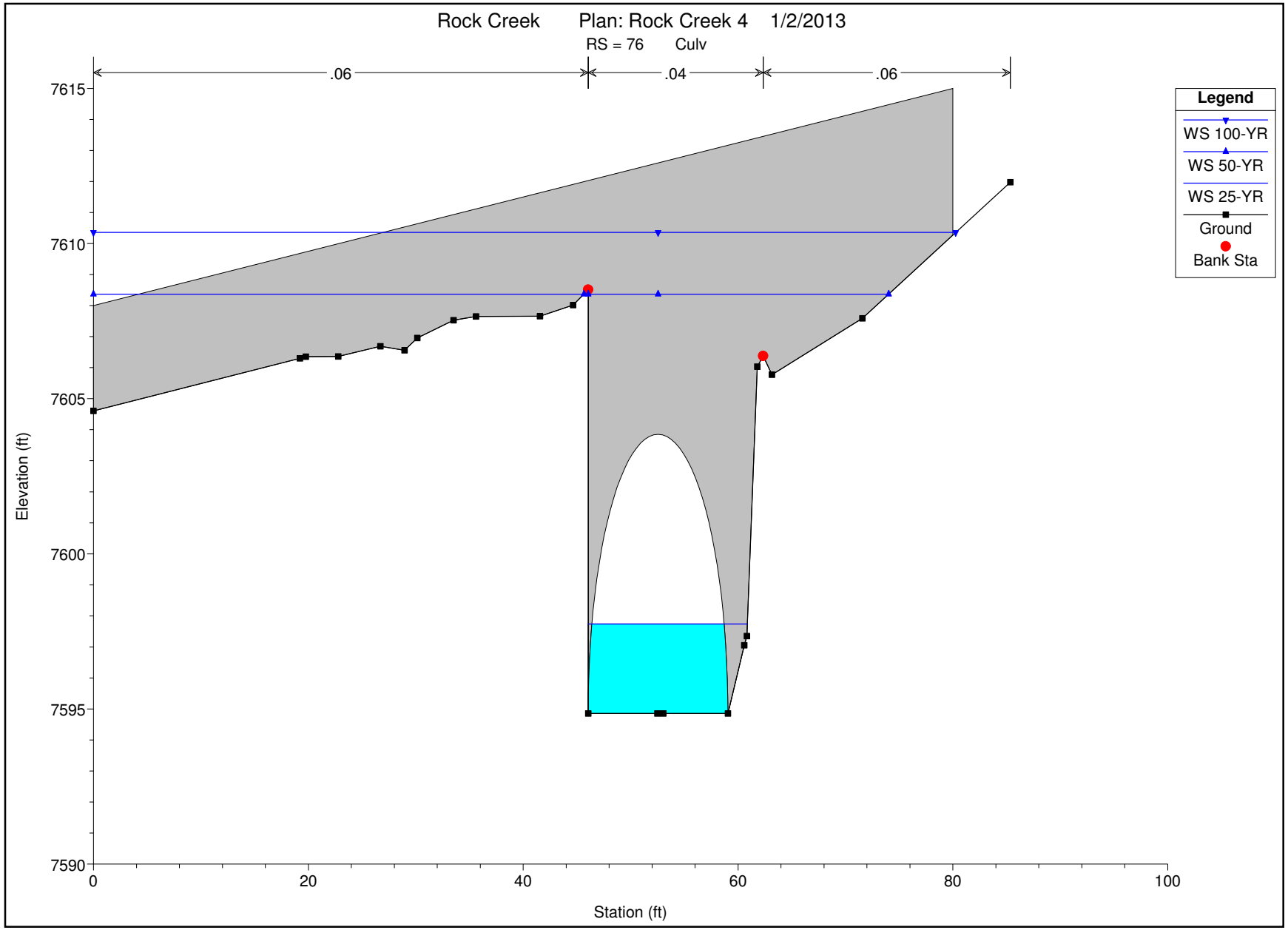

Rock Creek Plan: Rock Creek 4 1/2/2013
Rock Creek RC4
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Elevation (ft)
7615
7610
7605
7600
7595
7590
0
20
40
60
80
100
120
140
Main Channel Distance (ft)

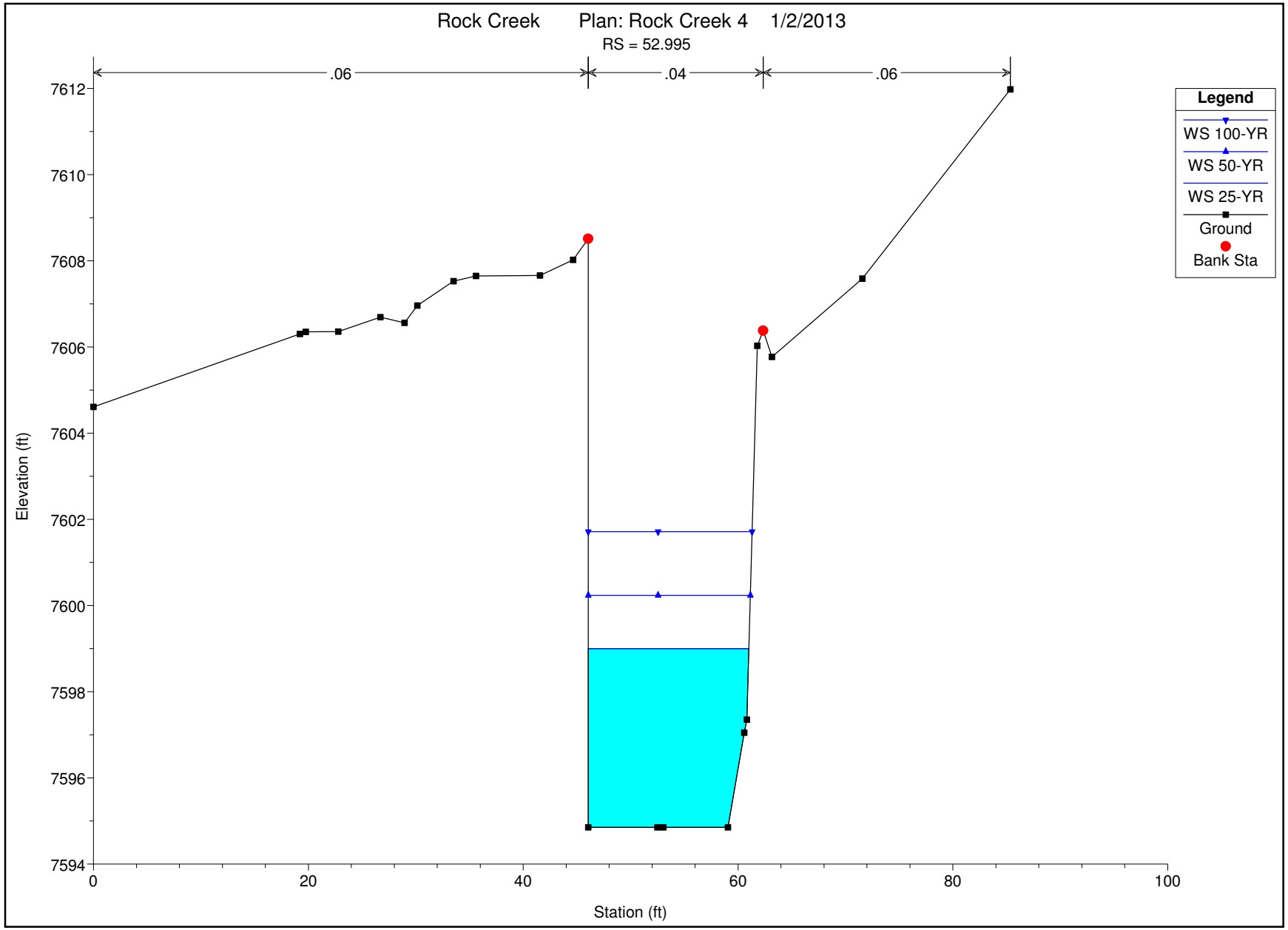

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 144.363
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7620
7618
7616
7614
7612
7610
7608
7606
0
20
40
60
80
Station (ft)

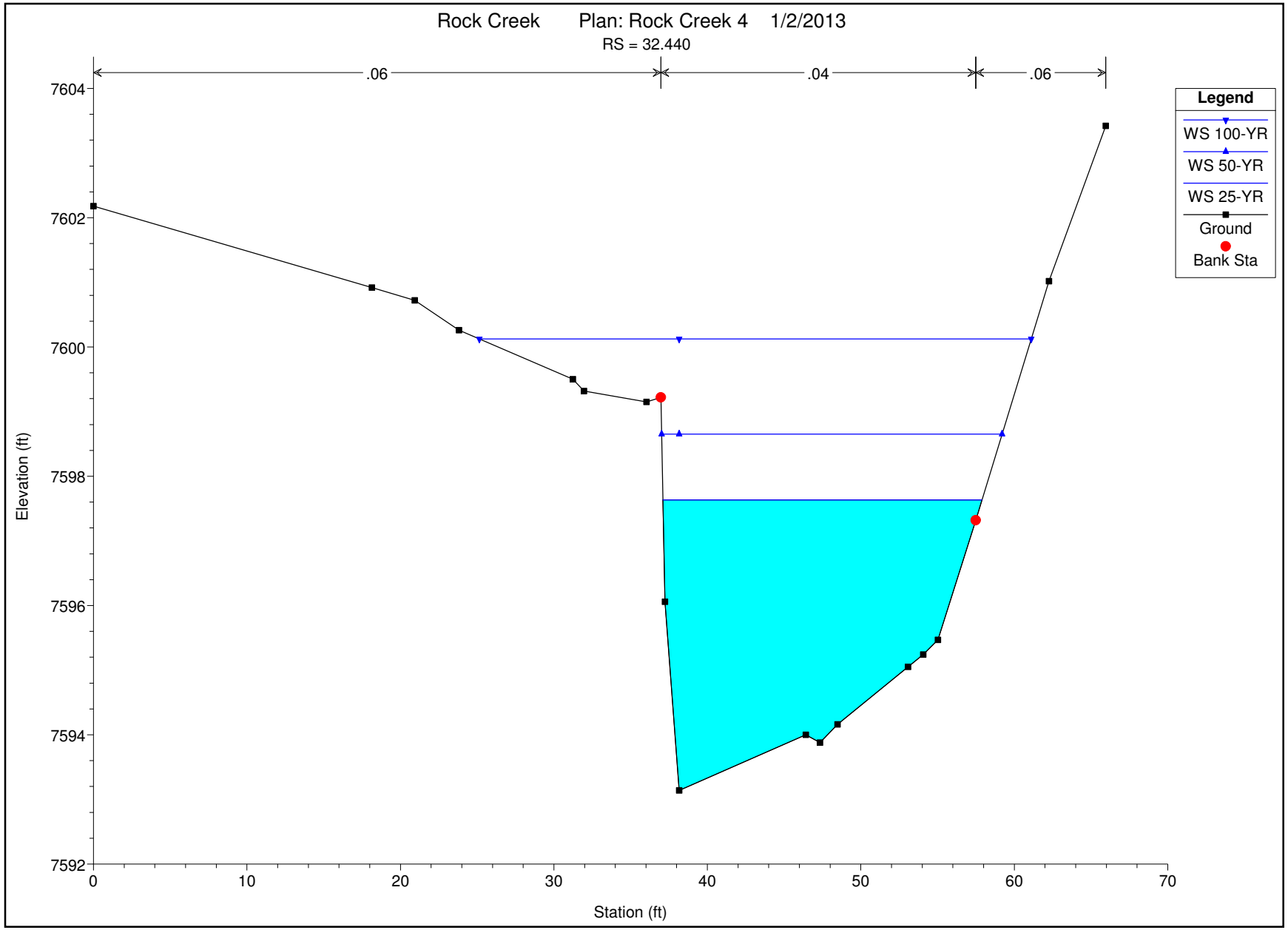

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 117.308
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7618
7616
7614
7612
7610
7608
7606
7604
7602
7600
0
10
20
30
40
50
60
70
80
Station (ft)

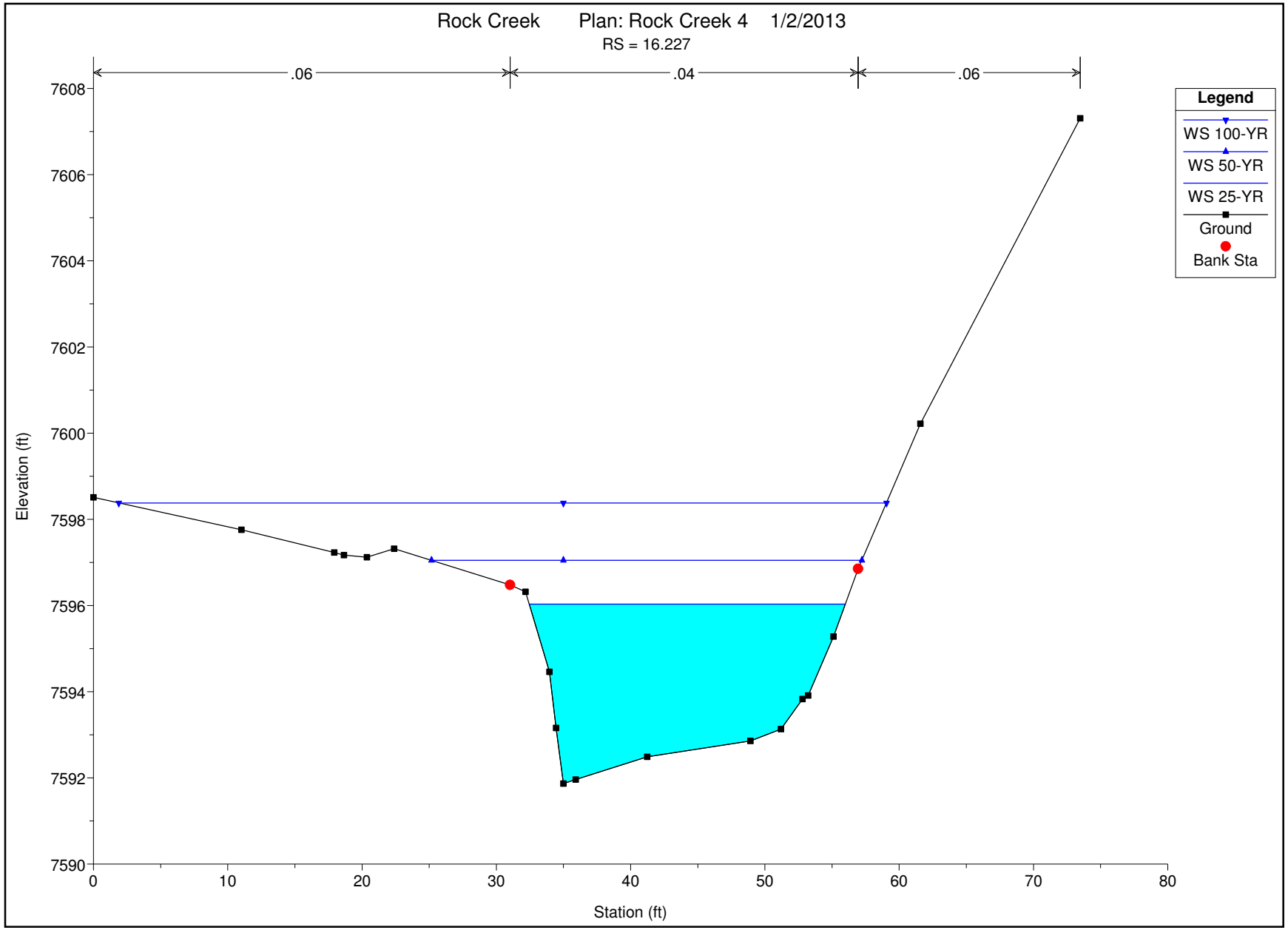

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 100.500
.06
.013
.04
.013
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7616
7614
7612
7610
7608
7606
7604
7602
7600
7598
0
20
40
60
80
Station (ft)


Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 76 Culv
.06
.013
.04
.013
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7616
7614
7612
7610
7608
7606
7604
7602
7600
7598
0
20
40
60
80
Station (ft)


Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 76 Culv
.06
.04
.06
7615
7610
7605
7600
7595
7590
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta

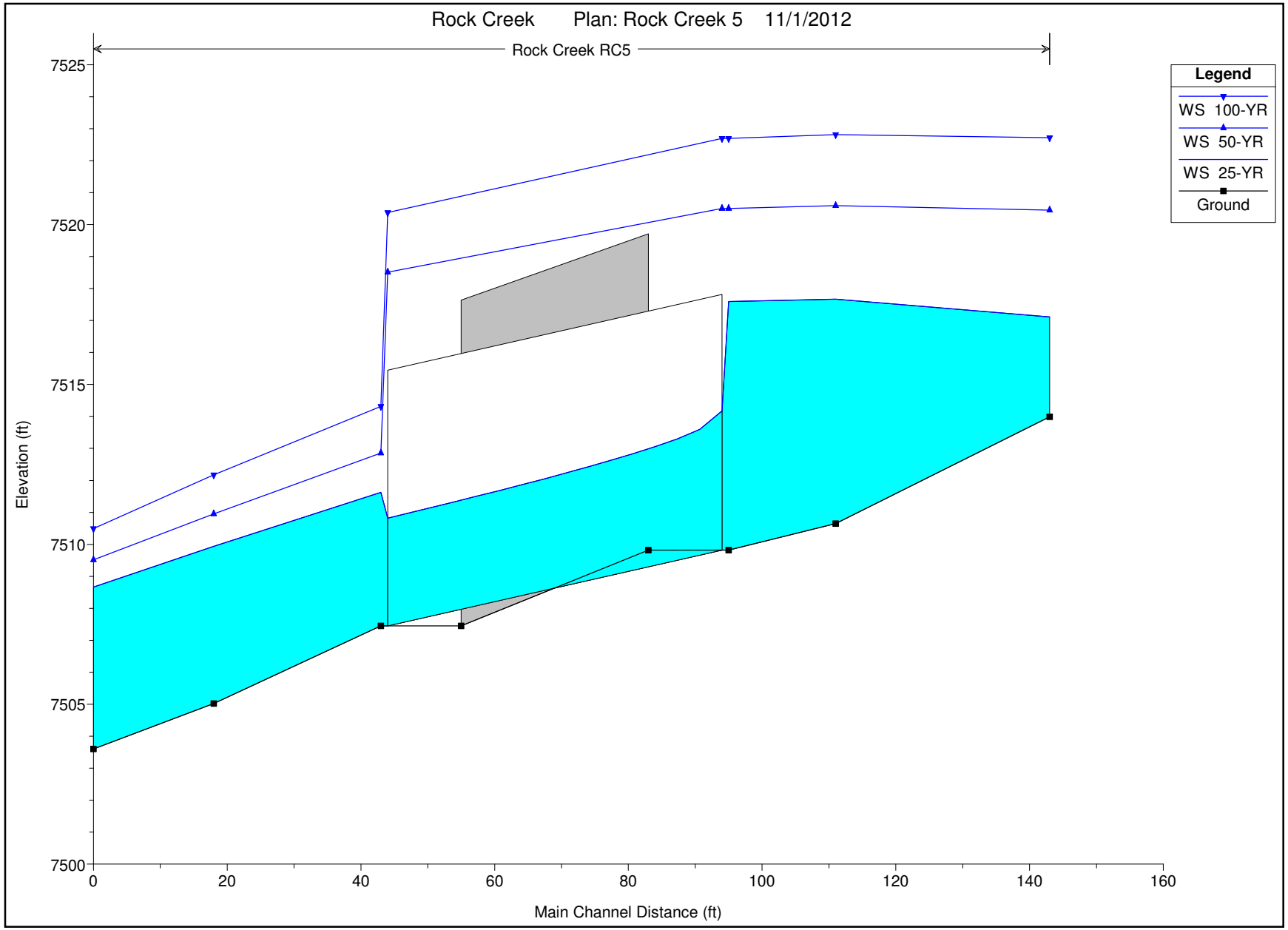

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 52.995
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7612
7610
7608
7606
7604
7602
7600
7598
7596
7594
0
20
40
60
80
100
Station (ft)

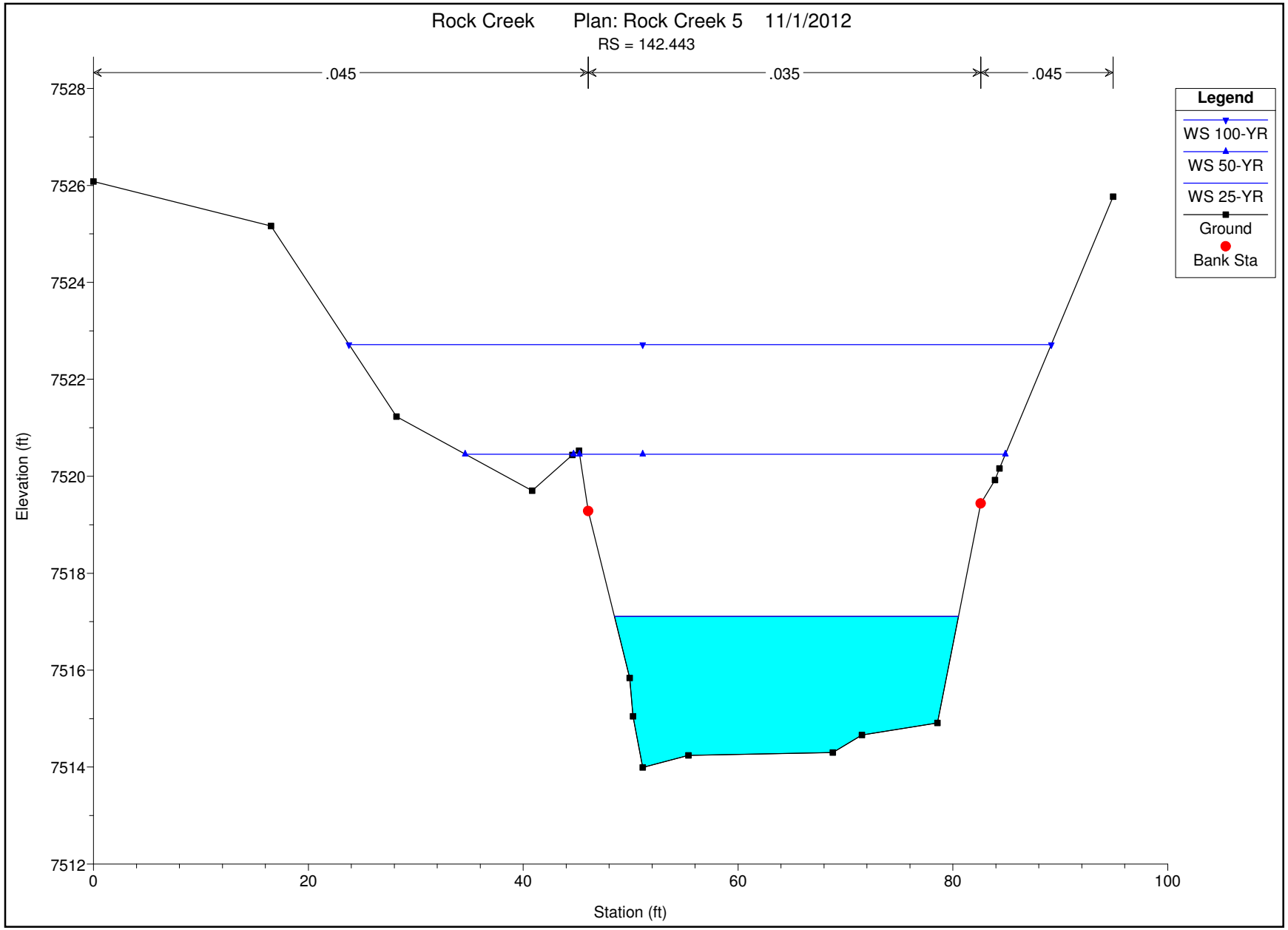

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 32.440
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7604
7602
7600
7598
7596
7594
7592
0
10
20
30
40
50
60
70
Station (ft)

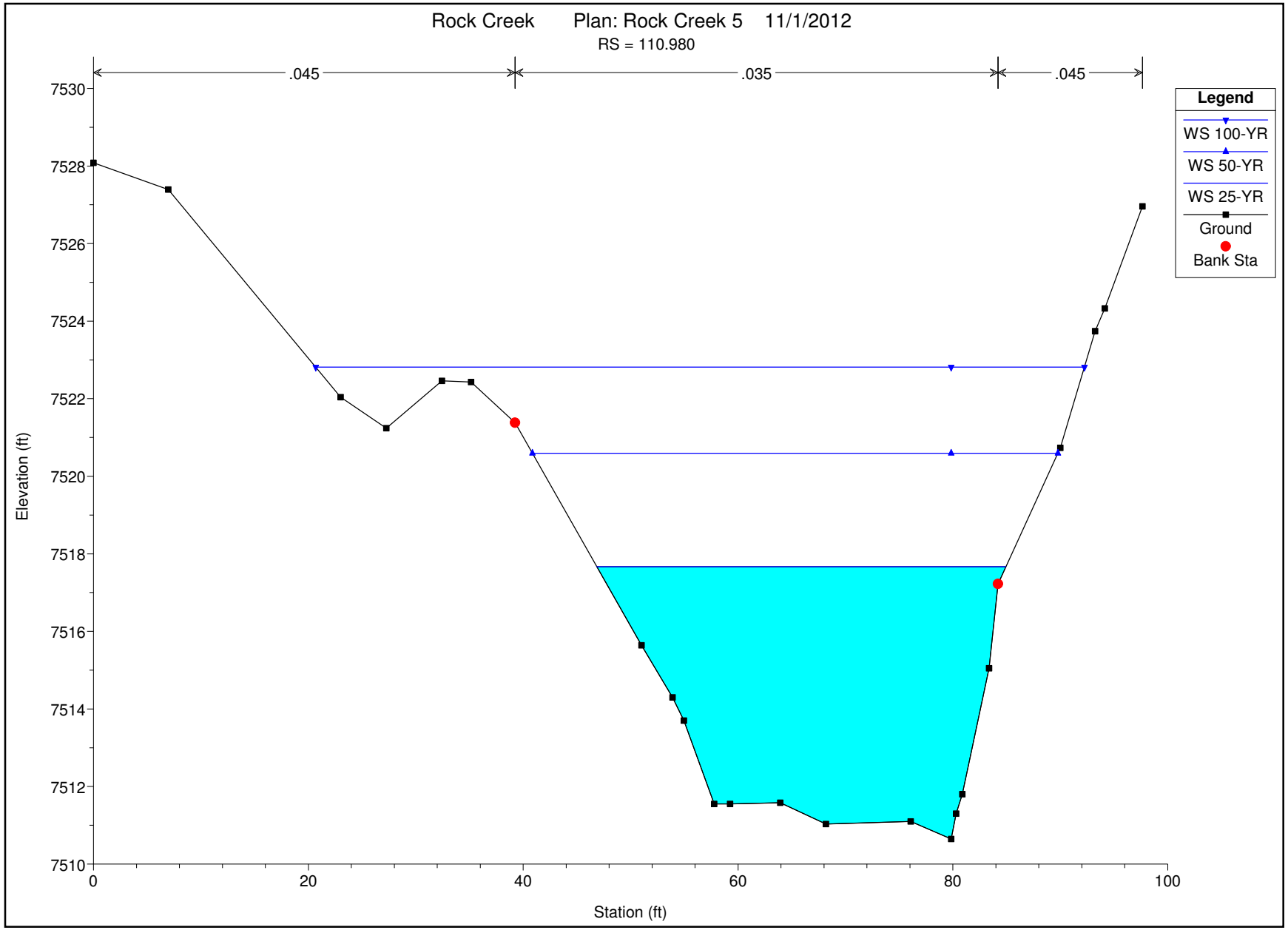

Rock Creek Plan: Rock Creek 4 1/2/2013
RS = 16.227
.06
.04
.06
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7608
7606
7604
7602
7600
7598
7596
7594
7592
7590
0
10
20
30
40
50
60
70
80
Station (ft)

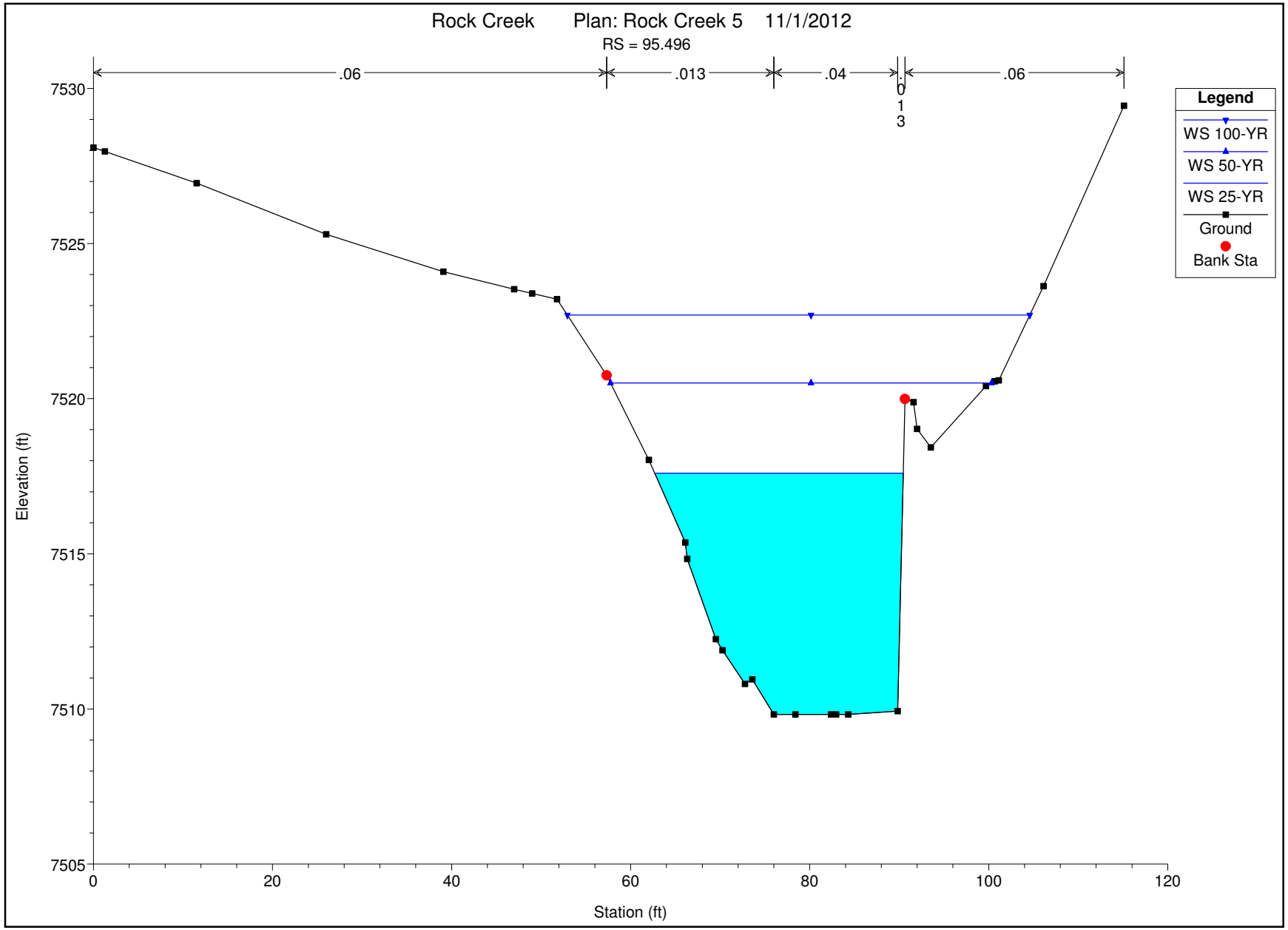
HEC-RAS Plan: RC5 River: Rock Creek Reach: RC5

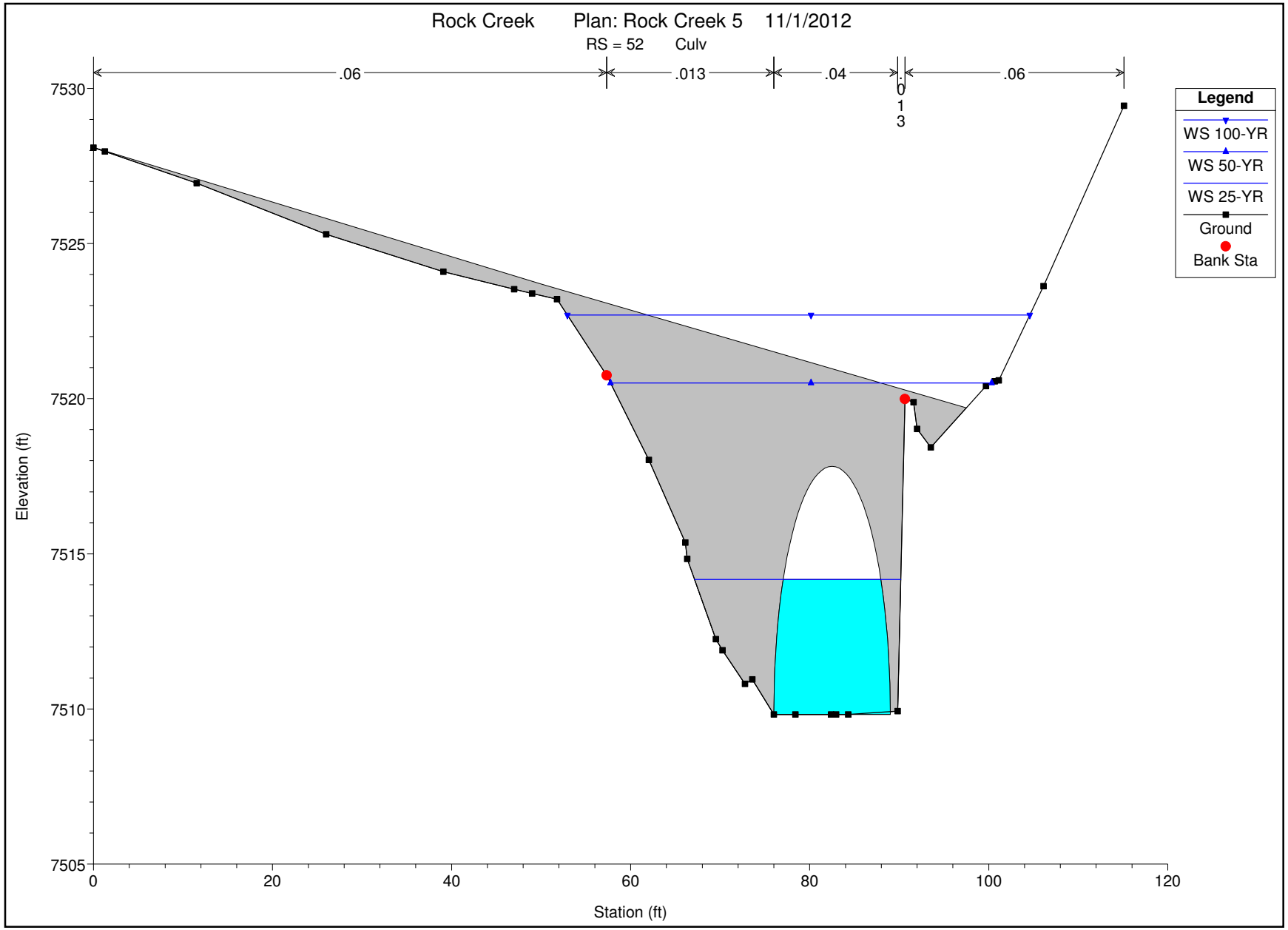
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
RC5	142.443	25-YR	674.00	7513.99	7517.11	7516.98	7518.21	0.012715	8.40	80.27	32.02	0.93
RC5	142.443	50-YR	1009.00	7513.99	7520.46		7520.86	0.001765	5.09	202.93	49.73	0.39
RC5	142.443	100-YR	1469.00	7513.99	7522.72		7523.07	0.001034	4.92	336.78	65.37	0.31
RC5	110.980	25-YR	674.00	7510.65	7517.67		7517.86	0.000939	3.53	190.98	38.08	0.28
RC5	110.980	50-YR	1009.00	7510.65	7520.59		7520.76	0.000504	3.24	318.35	48.92	0.21
RC5	110.980	100-YR	1469.00	7510.65	7522.82		7523.00	0.000426	3.50	448.35	71.55	0.20
RC5	95.496	25-YR	674.00	7509.82	7517.60	7513.48	7517.84	0.000582	3.97	169.62	27.75	0.28
RC5	95.496	50-YR	1009.00	7509.82	7520.51	7514.48	7520.74	0.000356	3.90	268.19	42.57	0.25
RC5	95.496	100-YR	1469.00	7509.82	7522.70	7515.62	7522.98	0.000320	4.35	371.95	51.66	0.24
RC5	52		Culvert									
RC5	43.664	25-YR	674.00	7507.45	7511.62	7511.62	7513.48	0.017244	10.94	61.63	16.68	1.00
RC5	43.664	50-YR	1009.00	7507.45	7512.86	7512.86	7515.14	0.017020	12.12	83.23	18.39	1.00
RC5	43.664	100-YR	1469.00	7507.45	7514.31	7514.31	7517.01	0.016415	13.17	111.72	22.61	1.00
RC5	19.765	25-YR	674.00	7505.02	7509.94	7509.94	7511.47	0.015233	9.94	67.80	22.41	1.01
RC5	19.765	50-YR	1009.00	7505.02	7510.95	7510.95	7512.84	0.013312	11.06	92.52	26.95	0.98
RC5	19.765	100-YR	1469.00	7505.02	7512.17	7512.17	7514.38	0.011031	12.05	129.94	34.32	0.93
RC5	2.159	25-YR	674.00	7503.60	7508.66	7508.66	7509.91	0.013221	9.01	76.84	33.07	0.97
RC5	2.159	50-YR	1009.00	7503.60	7509.52	7509.52	7511.00	0.012015	9.91	108.03	39.48	0.96
RC5	2.159	100-YR	1469.00	7503.60	7510.49	7510.49	7512.19	0.010943	10.74	151.78	51.22	0.94

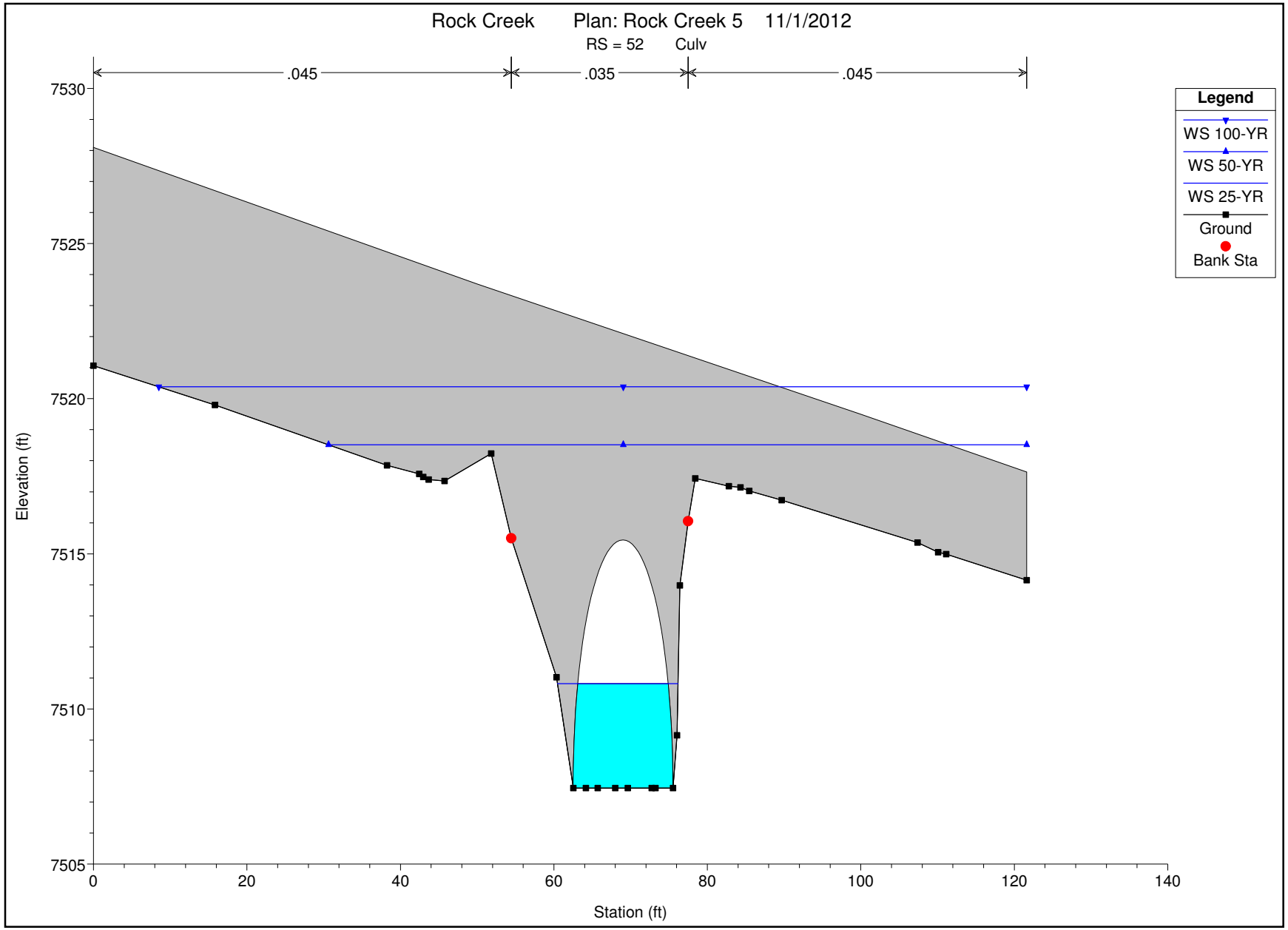

Rock Creek Plan: Rock Creek 5 11/1/2012
Rock Creek RC5
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Elevation (ft)
7525
7520
7515
7510
7505
7500
0
20
40
60
80
100
120
140
160
Main Channel Distance (ft)

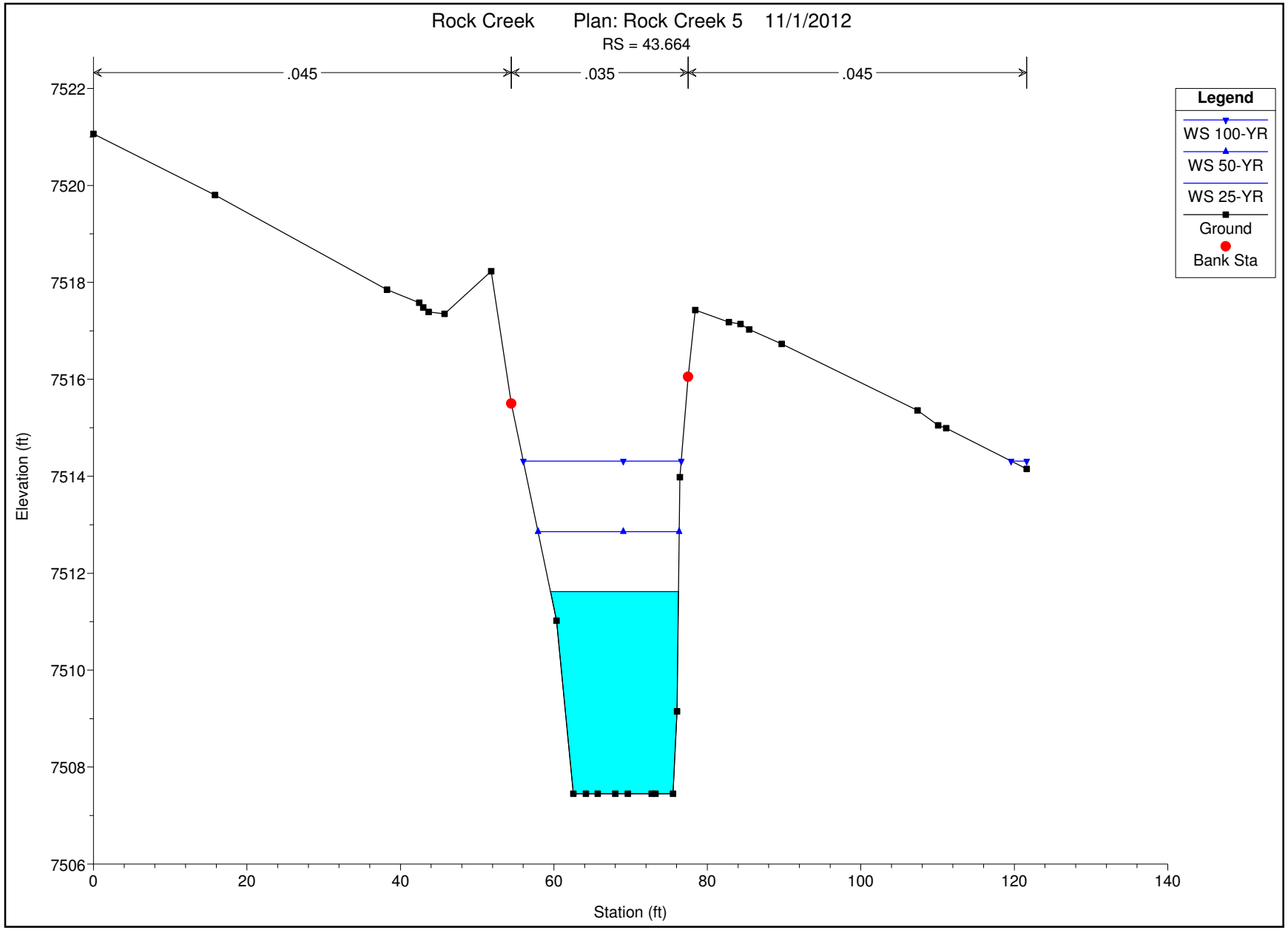

Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 142.443
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7528
7526
7524
7522
7520
7518
7516
7514
7512
0
20
40
60
80
100
Station (ft)

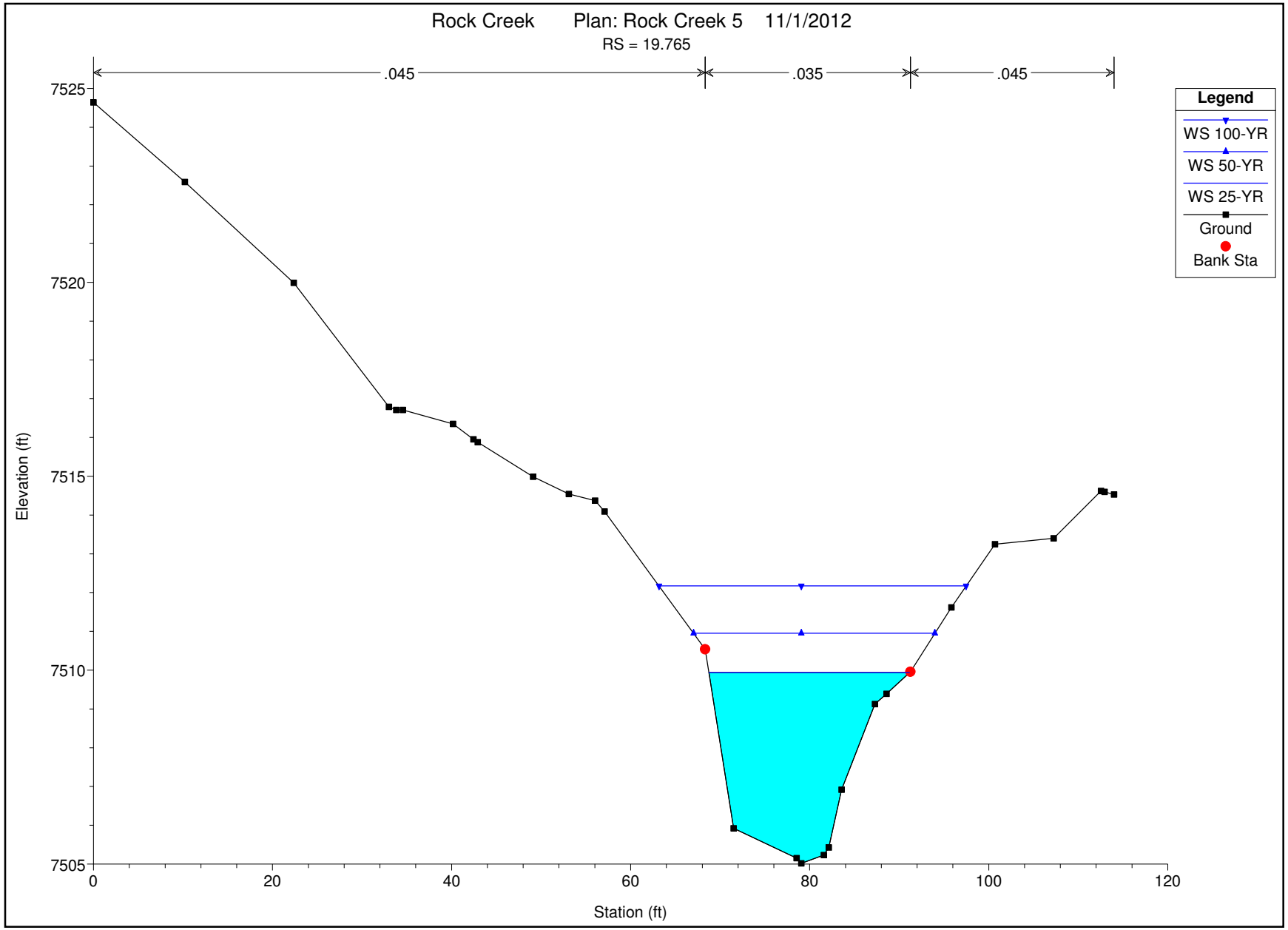

Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 110.980
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7530
7528
7526
7524
7522
7520
7518
7516
7514
7512
7510
0
20
40
60
80
100
Station (ft)

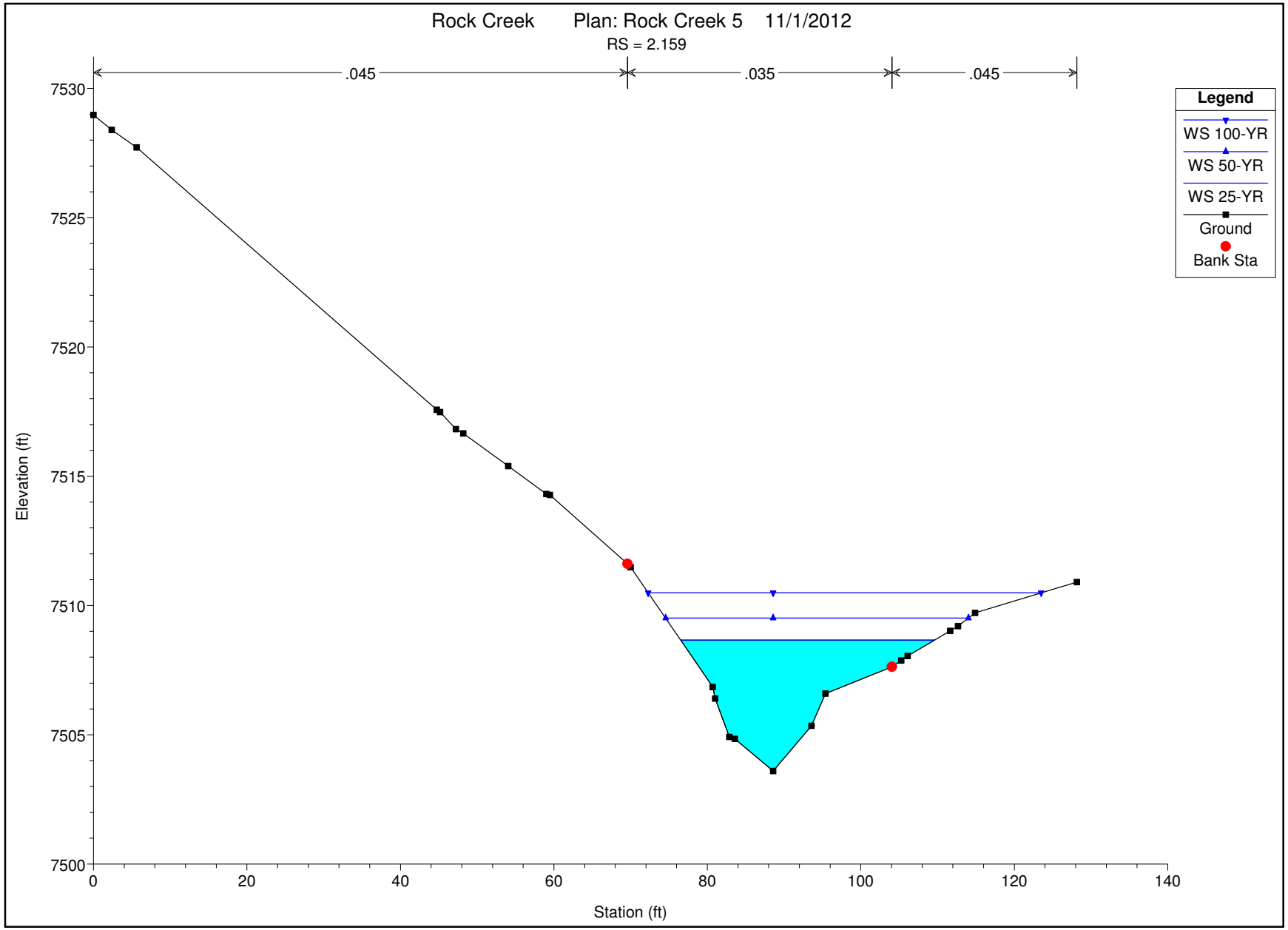

Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 95.496
.06
.013
.04
.06
.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7530
7525
7520
7515
7510
7505
0
20
40
60
80
100
120
Station (ft)


Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 52 Culv
.06
.013
.04
.06
.013
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7530
7525
7520
7515
7510
7505
0
20
40
60
80
100
120
Station (ft)


Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 52 Culv
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7530
7525
7520
7515
7510
7505
0
20
40
60
80
100
120
140
Station (ft)


Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 43.664
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7522
7520
7518
7516
7514
7512
7510
7508
7506
0
20
40
60
80
100
120
140
Station (ft)


Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 19.765
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7525
7520
7515
7510
7505
0
20
40
60
80
100
120
Station (ft)


Rock Creek Plan: Rock Creek 5 11/1/2012
RS = 2.159
.045
.035
.045
Legend
WS 100-YR
WS 50-YR
WS 25-YR
Ground
Bank Sta
Elevation (ft)
7530
7525
7520
7515
7510
7505
7500
0
20
40
60
80
100
120
140
Station (ft)